



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

# DESIGN MANUAL

March 15, 2006

Includes:      Programming Standards  
                         Design Process  
                         Design Requirements

# DFCM DESIGN MANUAL

March 15, 2006

The DFCM Design Manual is divided into three separate yet dependent sections. The sections are “Programming Standards”, “Design Process” and “Design Requirements”. Each section provides information and direction for developing programs and designs to meet the DFCM expectations.

The “**Programming Standards**” section lists the basic requirements for a complete and final program for a new building. It does not give step by step directions or process requirements for producing a final program. The selected programming firm, the using agency and DFCM are expected to determine and process what best suits the project and the participants.

The “**Design Process**” section gives direction on what is expected as an outcome of the design process. DFCM intends to select only qualified exceptional design teams. DFCM expects an effort that is not driven by minimal requirements but by good design practice. As such this is meant to be a guide and not a rigid procedural manual. This section covers issues such as quality requirements, code requirements, design process submittals and budget control.

The “**Design Requirements**” section is just that, a list of requirements that apply to DFCM projects. The basic levels of requirements are those imposed by codes. The next level of requirements are those that, due to experience, DFCM has found need to exceed code or are best design practice for normal state buildings. The next levels of requirements are those that meet individual agency needs and standards. The “Design Requirements” section encompass these requirements.



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

# **PROGRAMMING STANDARDS**

March 15, 2006

## **PROGRAMMING STANDARDS PURPOSE**

The purpose of this standard is to set forth the requirements for facility programming services for DFCM.

Programming services shall define and provide a cost estimate for the project within the constraints of the “Agreement between DFCM and the Programming Consultant.” The finished program must communicate the needs of the Users into a workable facility description.

Avoid programming requirements that may conflict with future requirements of the Design Process or the Design Requirements.

# PROGRAMMING STANDARDS

## TABLE OF CONTENTS

Programming Standards Purpose  
Table of Contents

- 1.0 General**
  - 1.1 General
    - A. Purpose and Scope
- 2.0 Facility Program**
  - 2.1 General
  - 2.2 The Completed Program Shall Include.
    - A. Signature Page
    - B. Executive Summary
    - C. Programming procedure
    - D. Space use program
    - E. Detailed space use descriptions
    - F. Detailed room descriptions
    - G. Building systems performance criteria
    - H. Cost Analysis
  - 2.3 Introductory Information
    - A. Title Sheet
    - B. Signature Sheet
  - 2.4 Executive Summary
    - A. Purpose
    - B. Organization
  - 2.5 Site analysis
    - A. Purpose
    - B. Physical Characteristics
    - C. Orientation
    - D. Site Functions and Relationships
    - E. Code
  - 2.6 Building Requirements
    - A. Purpose
  - 2.7 Individual Space Outlines
    - A. Purpose
    - B. Spaces
    - C. Detached Analysis of Each Space
    - D. Area Space summary Sheet
  - 2.8 Cost Model

# PROGRAMMING STANDARDS

## 1.0 GENERAL

### 1.1 General

- A. Purpose and Scope.
  - 1. Programs shall comply with the Design Process, the Design Requirements, and the Programming Standards.
  - 2. The intent of the Program Standards is to provide clear criteria which the Facility Program must achieve for the project to be considered successful.
    - a. The DFCM's Designated Representative may exclude portions of the Program Standards for projects where the scope of the programming needs are less, such as for feasibility studies.
  - 3. The specific performance requirements are given as minimum criteria to allow the Programming Consultant flexibility. If the needs of the Project are less stringent than the minimums identified in the Program Standards the approval of the DFCM's Designated Representative is required.

## 2.0 FACILITY PROGRAM

**2.1 General.** A "Program" is defined as a written statement setting forth design objectives, constraints, and criteria for a project, including space requirements and relationships, flexibility and expandability, special equipment and systems, and site requirements.

**2.2 The completed program shall include, but is not limited to the following:**

- A. Signature Page
- B. Executive Summary
  - 1. Programmatic analysis and conclusions.
  - 2. Programming references and site information.
  - 3. Programming team.
  - 4. Building programming committee.
  - 5. Area comparisons.
  - 6. Program spaces summary.

- C. Programming procedure
- D. Space use program
  - 1. Site considerations
  - 2. Site diagrams
  - 3. Efficiency analysis
  - 4. Stacking diagram
  - 5. Constructability
  - 6. General adjacency description
  - 7. General adjacency diagram
  - 8. Adjacency matrix
  - 9. Pre-schematic finish schedule
- E. Detailed space use descriptions
  - 1. Space adjacency descriptions
  - 2. Space adjacency diagrams
  - 3. Program spaces summary
- F. Detailed room descriptions
- G. Building systems performance criteria
  - 1. Code requirements
  - 2. Individual space requirements
  - 3. Structural overview
  - 4. Mechanical systems
    - a. Codes
    - b. Air handling
    - c. Controls
    - d. Fire sprinkling
    - e. Plumbing
  - 5. Site utility infrastructure
  - 6. Electrical systems
    - a. Codes
    - b. Lighting
    - c. Distribution
    - d. Fire and safety
    - e. Communications

- H. Cost Analysis
  - 1. Project estimate
  - 2. Project schedule
  - 3. Construction cost estimate description
    - a. Detailed estimate

## **2.3 Introductory Information**

### **A. Title Sheet**

- 1. Project Name
- 2. Name of the agency or institution
- 3. DFCM Project Number
- 4. Date of Publication
- 5. Name, address, and telephone number of the firm preparing program.

### **B. Signature Sheet**

- 1. Appropriate signatures should include the following:
  - a. Representatives of agency persons involved in the preparation of the program.
  - b. Other persons reviewing the program as required by the agency.
  - c. Director of DFCM.
  - d. DFCM's Designated Representative.
- 2. Acknowledgments
  - a. Acknowledgments Statement.
  - b. List names and titles of individual who were involved in the process.
- 3. Index
  - a. Provide a complete index with page numbers.
  - b. Index of charts, maps and illustrations.

## **2.4 Executive Summary**

- A. Purpose of the executive summary is to summarize essential information about the program for convenient reference. The summary should present the highlights and essential data of the program findings for the purpose of informing the Division of Facilities Construction and Management, the Building Board, the Governor, and the Legislature as to the most important aspects of the program.

## B. Organization

1. Project Justification: Present a brief summary of functions and a statement of need as discussed in the building analysis section.
2. Space Requirements Summary (1 or 2 pages): Present a summary of spaces which includes both net and gross square footages with individual spaces being grouped in logical divisions. Identify which spaces are assigned usable spaces and which are auxiliary or support spaces.
3. Cost Model: Facility Program Cost model requires a mixture of costs per functional space (such as office, classroom, etc.), cost per cubic foot, cost per square foot, and cost per linear foot for items where the cost is not easily forecast by a cost per square foot model such as site utilities. In some cases, design options shall be selected to reduce the range of costs for the program. These design options shall be defined as assumptions. All cost information shall be summarized into a cost model with line item totals for demolition, civil/site work, structural, electrical, mechanical, landscaping, and architectural systems.
4. Project Schedule: The executive summary is to include a brief summary of the estimated time line of the entire project, including design, construction, and date of occupancy.

## 2.5 Site Analysis

A. The purpose of this section is to identify the effects of the site on the program, project cost and schedule.

1. The main questions to be answered in this section are:
  - a. What is on the site now?
  - b. How will the site affect the project?
2. The main areas of concern:
  - a. Physical characteristics.
  - b. Orientation/views/prevaling conditions.
  - c. Site functions and relationships.
  - d. Site access and preparation issues.
  - e. Codes and easement restrictions.
  - f. Geotechnical considerations and impacts.

B. Physical Characteristics: Collect, organize and present facts about the site which are pertinent to the development of the project. This process involves two levels of investigation:

1. Visual Survey and Investigation: This first level of fact finding is performed by the programming team and contains the following:
  - a. Visually document the site with air and land based photographs keyed to a site plan and verbal descriptions as needed.
  - b. Present features, irregularities, unique qualities.
  - c. Site description.
  - d. Neighboring buildings or features.
  - e. Utility surveys and documentation.
  
2. Independent Testing and Surveying: DFCM shall be responsible for testing and surveying. DFCM shall contract for environmental assessments, geologic survey, soil investigation, surface contours and property description survey, utilities surveys, title search, and archeological surveys. Programming Consultant is responsible to interpret the results and present the impact to the project. Detailed information from the following testing and surveys shall be completed and included in the Facility Program appendix.
  - a. Hazardous Materials Assessment: If contaminants are present, DFCM's Designated Representative shall arrange for the assessment and identify the costs for removal.
  - b. Geologic Survey: Identify the seismic characteristics of the site, fault lines, and the general geologic structure.
  - c. Soils Investigation: Identify the structure of the soil. Test soil for bearing capacity, collapsibility, and other characteristics. Locate the water table. Provide a topsoil mechanical/nutrient analysis. Advise concerning needs for special footings and foundations.
  - d. Surface Contours and Property Description Survey: Identify surface contours and all visible features. Locate the property line.
  - e. Utilities Surveys: This is usually done in conjunction with the surface contours and property description survey. Identify separate utility lines and related information such as size, material, depth, etc. Document the available documents for utilities. Test water pressure for fire fighting requirements.
  - f. Title Search: Determine ownership, easements, rights of way or other information associated with the project.
  - g. Archeological Surveys: Some sites shall require archeological surveys prior to design and construction. These surveys shall be completed according to the State Archeologist prior to completion of the program document.

h. Indicate the distance to the nearest known seismic fault.

3. Test and survey analysis by Programming Consultant.

a. Utility feasibility studies to determine capacity and location for Civil Systems, Central Plant Mechanical Systems, Electrical Systems, and Communications Systems.

b. Review the Independent Testing and Surveying results.

c. Include a statement of the impact the results may have on the project and project schedule.

d. Analyze the cost impact of the results and include these costs in the cost model.

e. Prepare a list of drawings, specifications, studies, etc., which are available for the site or facility. Analyze the accuracy and deficiencies of the available documents.

C. Orientation

1. Present the orientation of the site:

a. Solar exposure

b. View into the site and out of the site

c. Climate

d. Prevailing winds and wind exposure

D. Site Functions and Relationships

1. Circulation of vehicles, pedestrians, and service needs.

a. Identify service to the facility including dumpster location, screened utility areas, and any special access areas needed.

2. Concepts of how the following types of circulation will work: Public, staff, pedestrian, student, vehicles, parking requirements, public transportation, service, ADA access, security site requirements. Use diagrams to illustrate access and circulation concepts.

a. Define areas of limited access.

b. Parking spaces required for Staff, visitors, and motor pool including any secured parking needs.

- E. Code
  - 1. Provide site consideration requirements.
    - a. How will the fire lane access requirements affect this project?
    - b. Identify by diagram access lane requirements and its effect on cost.
  - 2. Building/occupancy types and the cost impact.
  - 3. City and County zoning ordinances.
    - a. While local zoning approval is not required for State projects, this information is critical to enable the project to be a good neighbor to the intent of the local ordinances.
  - 4. Fire Marshall considerations.

## 2.6 Building Requirements

- A. The purpose of this section is to present the requirements for the following elements:
  - 1. Identification: The purpose of this section is to identify the essential nature of this project. What is the mission of this project? What are the departments and divisions that are to be housed here? What is the major grouping of spaces? What are the major elements of this design project?
  - 2. Justification: The purpose of this section is to demonstrate why the project is needed at this time, at this location, and with these occupants. DFCM and the Agency shall assist in the preparation of this portion of the Facility Program document. Some areas of concern may be:
    - a. Why is the facility needed?
    - b. Why are the listed departments housed together in this facility?
    - c. What will this project contribute to the mission of the agency?
  - 3. History and Growth: The purpose of this section is to present this project in terms of time. The needs of the user are constantly changing. Present the following information:
    - a. History of growth of the user group.
    - b. Agency's present location and number of square feet presently used.
    - c. Anticipated growth: Document the factors leading to growth projection.
    - d. What are the needs of the user group for changeability, adaptability, flexibility, expansion?

4. Master Plan Reconciliation: If this project is required to work within the context of a campus or organization master plan, indicate ways in which the project aligns with the intent of the master plan. Indicate ways in which the project does not meet the requirements of the master plan.
5. Function: The purpose of this section is to analyze the functions to be performed in this facility. The information of the individual space requirements is essential to this section and will be used extensively. The key words are people, activities and their relationships to the project design concept.
  - a. People
    - (1) Identify the people involved in this facility. Examples: Staff, students, public patients, customers, Agency.
    - (2) Number of people.
    - (3) Categories of people in the facility.
    - (4) Present the organization of the staff in the facility.
    - (5) Present user characteristics.
    - (6) It is pertinent to consider patterns of behavior, unique needs, and special needs that will impact the facility.
  - b. Activity
    - (1) Group types of activities in appropriate and applicable categories such as: departments, service, public access, private, noisy, quiet, clean, dirty, secure, controlled, dark, etc.
  - c. Relationships: The purpose of this section is to study relationships in the project.
    - (1) Study adjacencies, and present adjacency requirements.
    - (2) Positive essential relationships.
    - (3) Negative relationships. What spaces should be kept apart or in some way separated?
    - (4) Use graphical diagrams such as bubble diagrams and stacking diagrams to define the needs of relationships.
    - (5) Evaluate the scale of individual spaces and evaluate ways they could be assembled to meet relationship needs.
    - (6) Identify zones of compatibility and shared space options.
    - (7) Identify concepts pertinent to the project, for example: Hierarchy of functions, service grouping, activity grouping, people grouping, home base, accessibility, separated flow, sequential flow, flexibility, adaptability.

6. Form: The purpose of this section is to present requirements that will influence the physical shape of the project outside of function. The question here is: “What will be the massing characteristics of the facility on the site?” Several factors are:
  - a. Quality and Image: Describe the quality and durability level expected. Describe how the new building match, or contrast, with the existing materials on neighboring facilities. Communicate the goals that are appropriate to the funding and use.
  - b. Building Space Utilization Efficiency: Use this section to analyze the net-to-gross ratio. Identify and justify what ratios should be used. For our purposes net square feet means all space that is of the essence to the project. Refer to Utah Space Standards for applicable requirements. Areas not included in the net are:
    - (1) Restrooms
    - (2) Circulation
    - (3) Structure and partitions
    - (4) Columns
    - (5) Unassigned storage/maintenance areas
    - (6) Stairs
    - (7) Elevators
    - (8) Mechanical, electrical, and communication shafts and spaces.
  - c. Guidance: Programming Consultant shall recommend the net-to-gross factor most appropriate to this particular project and site.
  - d. Code Impact: Include here a Codes analysis. Before the final program is issued, review the analysis with the Building Official.
  - e. Structural Requirements: Include here an analysis of the structural requirements.
  - f. Mechanical Requirements: Include here an analysis of the mechanical requirements.
  - g. Electrical Requirements: Include here an analysis of the electrical requirements.
  - h. Communication Requirements: Include here an analysis of the communication requirements.
  - i. Energy Efficiency Requirements: Include here an analysis of the energy efficiency requirements.

- j. Hazardous Materials: Identify the project considerations related to asbestos or other hazardous materials.
- k. Existing Facilities: (If Required)
  - (1) Identify the problems related to the existing facility.
  - (2) Acquire available documentation for the facility and report any deficiencies in existing documentation.
  - (3) Present the existing facility configuration.
  - (4) Study and show ways the program requirements can work within the existing spaces.

## 2.7 Individual Space Outlines

- A. The purpose of this section is to present the individual space requirements. The information required in this section is detailed and specific.
- B. Spaces: Consider these spaces as areas within facility with certain characteristics. Do not limit definition of spaces to rooms.
- C. Detached Analysis of Each Space:
  - 1. Function and activities performed in the space.
  - 2. Desirable space dimensions.
  - 3. Desirable sample floor plan: show critical dimensions such as required equipment clearances.
  - 4. Number of assigned occupants in the space and hours of use.
  - 5. Number of occasional visitors to the space.
  - 6. Reference to the current Utah Space Standards, if applicable.
  - 7. Type of light that is required including whether natural or artificial light and lighting levels required.
  - 8. Windows required.
  - 9. Views required.
  - 10. Acoustic requirements for privacy, noise, and intelligibility.
  - 11. Security requirements.
  - 12. Temperature, ventilation, and humidity requirements.
  - 13. Finish materials requirements.
  - 14. Electrical requirements.
  - 15. Communications outlet requirements.
  - 16. Audio-visual requirements.
  - 17. Required ceiling height.
  - 18. Furnishings and equipment requirements: Indicate whether the furnishings are new or existing to be relocated.

D. Area Space Summary Sheet.

1. Identify the Total of net and gross square feet needed.
2. Identify the net to gross factor.
  - a. Identify source of the net-to-gross factor.

**2.8 Cost Model.** The purpose of this section is to present the Preliminary Facility Program Cost Model.

A. The cost model must be summarized into the following categories:

1. Civil/Site
2. Landscape
3. Structural
4. Architectural
  - a. Building skin
  - b. Interior finish
5. Mechanical
6. Electrical
7. General Conditions
8. Overhead and profit.

B. Find and present the actual costs of two projects of similar size, use, and quality that have completed construction in the past two years as a comparison to the proposed project.



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

# DESIGN PROCESS

March 15, 2006

## **PREFACE**

In order for the Division of Facilities Construction and Management (DFCM) to be one of the nation's premier facility construction and maintenance managers, it is essential that we consistently provide the best value in the facilities that serve the citizens of the State of Utah.

# DESIGN PROCESS

## TABLE OF CONTENTS

Preface  
Table of Contents

<b>1.0</b>	<b>General</b>	
1.1	General	
1.2	Related Documents	
1.3	Communication	
1.4	Conflicts, Exclusions, Omissions, and Revisions	
	A.	Conflicts
	B.	Exclusions
<b>2.0</b>	<b>Project Specific Requirements</b>	
2.1	Image to Public and Occupants	
	A.	General
	B.	Appearance and Image of the Facility
2.2	Budget	
2.3	Schedule	
2.4	Agency Related Requirements	
<b>3.0</b>	<b>Regulatory, Standards, and DFCM Requirements</b>	
3.1	General	
<b>4.0</b>	<b>Project Process</b>	
4.1	General	
	A.	Definition
	B.	Meeting Requirements
	C.	Documentation Requirements
	D.	Verification
	E.	Validation
4.2	Project Conception Stage	
4.3	Project Delivery Stage	
	A.	Delivery Method & Selection Procedures
	B.	Construction Delivery Methods
	C.	Design Delivery Methods
4.4	Design Stages	
	A.	Definitions
	B.	Expectations of Design Team
	C.	Cover Sheets
	D.	System Selection Design Phase
	E.	Schematic Design Phase
	F.	Design Development Phase
	G.	Construction Documents Phase
	H.	Contract Documents Phase
	I.	Pre-Construction Stage

- 5.0 DFCM Quality Assurance Requirements**
  - 5.1 General
- 6.0 Cost Model Requirements**
  - 6.1 General
  - 6.2 Standards
  - 6.3 Cost Model Report Table of Contents
  - 6.4 Scope of Estimate
- 7.0 Project Manual Requirements**
  - 7.1 General
  - 7.2 Preferred Source Documents
  - 7.3 Construction Guarantees and Warranties
  - 7.4 Product and Service Life cycle Requirement
  - 7.5 Materials
- 8.0 CAD Requirements**
  - 8.1 General
  - 8.2 Standards
    - A. CAD Standards
    - B. CAD Software
  - 8.3 Guidance
    - A. Assumptions
    - B. Other Design Tools
    - C. Quality of Drawings
    - D. Project CD
  - 8.4 CAD Layer Guidelines-Supplemental Requirements
  - 8.5 Uniform Drawings Standards - Supplemental Requirements
    - A. Drawing Set Organization
    - B. Sheet Organization
    - C. Schedules
    - D. Drafting Conventions
    - E. Terms and Abbreviations
    - F. Symbols
    - G. Notations
    - H. Code Conventions

# DESIGN PROCESS

## 1.0 GENERAL

### 1.1 General

- A. The Design Process applies to the capital development and capital improvement activities of DFCM. It contains specific information for the preparation of contract documents administered by the Division of Facilities Construction and Management. It delineates and supplements (either directly in the document or indirectly by reference) codes, industry recognized standards, and guide specifications. Many of the criteria are based upon the experience of DFCM and the input of professional and industry representatives.
- B. Each entity which has a contract with DFCM will be evaluated on its performance in accordance with the Design Process which includes both self-performed work and the performance of its subconsultants. As a result, it is critical that the A/E, which is in contract with DFCM, communicate to its subconsultants the requirements of the Design Process and that the subconsultants communicate to the A/E and DFCM any deviations from the Design Process.

### 1.2 Related Documents

- A. The Design Process (refer to <http://dfcm.utah.gov/>) includes the following documents which are incorporated herein by reference:
  - 1. Programming Standards documents requirements for Facility Program documents. Refer to <http://dfcm.utah.gov/>
  - 2. Design Requirements documents DFCM requirements which have resulted from DFCM's expertise and experience from previous projects. Refer to <http://dfcm.utah.gov/>
- B. DFCM incorporates by reference Codes, Standards, Rules, and Regulations in the Design Requirements document.
- C. Date of Applicable Documents
  - 1. The date of the applicable Design Process, Regulatory, and Standards documents shall be defined as follows:
    - a. For the facility program, this date is usually the scheduled end date for completion of the Facility Program;

- b. For the facility design and construction, this date is usually the date of the design contract.

### **1.3 Communication**

- A. DFCM's Designated Representative shall arrange for implementing an effective process for communicating with Agency for the purposes of determining facility requirements, Agency's inquiries, and concerns related to the project.

### **1.4 Conflicts, Exclusions, Omissions, and Revisions**

#### **A. Conflicts**

- 1. In case of conflict between any of the provisions of the Design Process and other requirements, the most stringent requirement shall govern.
- 2. In cases where references in the Design Process have changed or are otherwise incorrect, document issues to DFCM's Designated Representative.

#### **B. Exclusions**

- 1. Where any requirement cannot be applied due to project specific requirements that conflict with the Design Process, they will be considered for exclusion. A requirement may be excluded only when the exclusion may not affect DFCM's ability to deliver high quality facilities and does not absolve DFCM, or entities which contract with DFCM, from the responsibility to provide facility realization services that comply with the Design Process.
- 2. DFCM's Designated Representative is responsible for submitting exclusions from the Design Process for a specific project to the Director of DFCM. The Director has the responsibility and authority for examining whether the proposed exclusions are appropriate and for approving them.

## **2.0 PROJECT SPECIFIC REQUIREMENTS**

### **2.1 Image to Public and Occupants**

#### **A. General**

- 1. The facility shall be economically efficient considering the function to be performed and the life expectancy of the structure.

2. Provide facilities that are aesthetically compatible with the function and importance of the facility. Obtain permission from DFCM’s Designated Representative to expose facility components which detract from the aesthetic quality of the facility.
3. Review aesthetic features, which are defined as architectural elements other than finishes that are not required for the facility to function efficiently for the Agency, with the DFCM’s Designated Representative. Examples of aesthetic features are: atriums, fountains, skylights, spaces with excessive volume, and exterior free standing architectural elements.
4. Honor the context of the site.

**B. Appearance and Image of the Facility**

1. Determine, with the DFCM’s Designated Representative, the required appearance and image of the facility.

Appearance and Image of the Facility	
Facility Category	Materials, Finishes, and Entry
Prestigious Facility: highly regarded by most people and very welcoming to visitors and staff.	The materials and finishes are prestigious and the best available. The approach and entry have convenient access and many welcoming features and enhancements.
Above Average appearance: regarded as attractive, clean, and welcoming to visitors and staff.	The materials and finishes are above average quality for the community. The approach and entry are above average and have some welcoming features and enhancements.
Average appearance: basically clean with approaches and entrances that project a standard image.	The materials and finishes are of a quality usually found in the community. The approach and entry present a standard appearance of an office building.
Overall appearance of the facility and of the entrance is of minimum significance.	The materials and finishes are of a quality usually found in industrial facilities. The approach and entry present a standard appearance of an industrial building.

**2.2 Budget**

- A. Provide Design Services that do not exceed the project budget in the Agreement with DFCM.
- B. The project budget, which must not be exceeded in order to have a successful project, is established prior to the commencement of the design of the project.

1. In projects where the services of an A/E are procured, the A/E with DFCM shall develop a cost model within the budget for the construction of the project. The different portions of the cost model will be assigned to the A/E and the Design Subconsultants for identifiable elements of the project. Refer to the Cost Model Requirements for additional requirements.

C. Alternates

1. Obtain approval from DFCM's Designated Representative for any alternates prior to advertisement. Do not exceed six alternates, unless approved by DFCM's Designated Representative.
2. Describe completely all bidding alternates.
3. Do not increase the scope of the original project with alternates.
4. Specify only additive alternates and only with the intent of keeping the project within the construction budget.
5. Do not include in an alternate work which is an integral part of the project.

### 2.3 Schedule

- A. Provide Design Services that are completed on schedule as documented in the Agreement with DFCM for the specific project.
1. Written approval of any changes in the schedule is required from DFCM's Designated Representative.

### 2.4 Agency Related Requirements

- A. Provide Design Services, within the constraints of the Design Process and other DFCM specified constraints, which meet requirements specified by the Agency, requirements not stated by the Agency but which are necessary for the intended use, statutory and regulatory requirements, and additional requirements specified by the participants in the Facility Program (if one is prepared).
1. Minimize the disruption of the Agency's mission.
  2. Provide a facility that has a reasonable degree of flexibility to permit future reasonably foreseeable changes in use.

## **3.0 REGULATORY, STANDARDS, AND DFCM REQUIREMENTS**

### 3.1 General

- A. Document in the Basis of Design the assumptions utilized in the design, including codes and other regulatory requirements (including dates and amendments), consensus based standards, and DFCM requirements.

- B. Comply with all applicable laws, rules, and regulatory requirements. Regulatory requirements include (but are not limited to) the documents referenced in the Design Requirements.
  - 1. A/E shall be responsible to submit the Contract Documents and obtain approval from all Authorities Having Jurisdiction.
- C. Utilize design practices and provide facilities (including products and services incorporated into facilities) that comply with current editions of consensus based standards.
  - 1. Exceptions
    - a. If a proposed system is not designed in accordance with a consensus based standard, notify the DFCM's Designated Representative. This requirement provides DFCM the opportunity to determine whether the risk of an option that does not comply with a consensus based standard is acceptable.

## **4.0 PROJECT PROCESS**

### **4.1 General**

- A. This section defines, in general, the stages in the facility life cycle based upon the Construction Specification Institute's Project Resource Manual. The DFCM's Designated Representative has the flexibility to adapt or combine stages to the needs of the project subject to DFCM processes and procedures.
- B. Meeting Requirements
  - 1. The A/E shall be responsible for arranging for meeting agendas and meeting minutes.
  - 2. Meeting Minutes
    - a. Record attendance, document action items, and document distribution of the meeting minutes. Action items include project related direction given to any project participant during the meeting or prior to the meeting which has not been documented.
- C. Documentation Requirements
  - 1. DFCM encourages document submittals to be submitted in digital pdf format; however, provide paper copies in accordance with agreements and as required to fulfill requirements. Copies in digital format may be

transmitted by email, except for copies which shall become a permanent record which shall be submitted in DVD format.

2. Permanent Record Documents include:
  - a. System Selection
  - b. Schematic Design
  - c. Design Development
  - d. Contract Documents
3. Digital Documents in pdf, DWG, DGN, DOC, XLS, and similar formats.
  - a. Documentation of Virus Free Format: Virus Scanning Software, Version, Date; Scan Date.

D. Verification

1. DFCM expects that each project task can be completed right the first time. In order to meet this expectation, the goal is to eliminate nonconformity by concentrating the efforts of all participants necessary to contribute to proper planning. Without proper planning, rework absorbs resources that often results in compressing the schedule which can increase costs, cause additional schedule compression, and reduce quality. To avoid rework, DFCM requires that each member of the A/E team is expected to verify that their work is complete prior to submitting it for observation by DFCM or its agents. DFCM's verification process shall not be a substitute for the verification process required by the parties in contract with DFCM and shall not relieve these parties of their responsibilities.
  - a. All participants shall familiarize themselves with the existing site and facility conditions as a prerequisite prior to their participation or presentation of a proposal. If the participant does not comply with this prerequisite, changes in the participant's scope of work that could have been avoided by compliance with this prerequisite shall not be accepted.
  - b. Notwithstanding this expectation, it is understood that the planning, programming, and design services develop through an iterative process; however, it is expected that the deliverables required at each phase of the process shall be substantially complete prior to obtaining approval of DFCM's Designated Representative to proceed to the next phase of the process. The reason for this requirement is to avoid compressing the schedule which contributes to poor quality. Major changes in approved documents shall be avoided and require approval of the DFCM's Designated Representative.

- E. Validation. The A/E shall fully cooperate in providing information required to validate the design.
  - 1. DFCM may validate, or arrange to have validated, that the work process and the facility complies with the Design Process, the Facility Program (if prepared), and other Agency Design Criteria. Refer to the related documents for Design Requirements.
  - 2. DFCM may arrange for the validation of the Structural Design by a Structural Engineering Peer Review. The Structural Engineering Peer Review shall be performed by a Utah registered SE experienced in similar project types.
  - 3. DFCM may arrange for the validation of the Energy Design for conformance with DFCM's energy conservation requirements by a Utah Professional Engineer specializing in mechanical engineering.
  - 4. DFCM may arrange for the validation of the Irrigation Design for conformance with DFCM's water conservation requirements by a certified Landscape Irrigation Auditor.

#### **4.2 Project Conception Stage**

- A. All DFCM projects start off as a need statement. The need statement can be as short as a few paragraphs, or it can evolve into a full program document. During this phase the scope and budget for the project are established. The program or needs statement is the guide to follow as the design progresses.
- B. DFCM shall assemble a steering committee which includes the appropriate representation from DFCM and the Agency to provide guidance to the design team throughout the process.
- C. DFCM shall allocate the funding in accordance with its procedures and prepare a schedule documenting the major milestones for the funded portions of the project. DFCM shall define project quality by requiring compliance with the Design Process and other specific requirements necessary for project success.

#### **4.3 Project Delivery Stage**

- A. DFCM shall determine the project delivery method and selection procedures. The project delivery method gives direction to the design process. Each delivery method brings with it a different set of expectation and requirements.
- B. Construction Delivery Methods:
  - 1. Construction Management/General Contractor (CM/GC): This method of construction is the preferred construction delivery method for the

development projects. The CM/GC assists the A/E by preparing a project schedule, cost estimating the designs presented at the different stages and different systems/components as required. The CM/GC also provides input on materials selected for availability, cost and constructability. The preferred method of design in this delivery method is the Single Bid Procurement as described below. An alternate to the single bid package is Multiple Bid Procurement.

2. Design-Bid-Build: The basis of this delivery method is that design is completed prior to selection of the contractor. Design is completed using the Single Bid Procurement process.
3. Design-Build: DFCM contracts with a single-entity for the complete design and construction of a project. The selection of this delivery method requires approval of the Director. Either the Single Bid or Multiple Bid Procurement methods are acceptable in this construction delivery method.

#### C. Design Delivery Methods

1. Single Bid Procurement: Design is complete for each A/E and the contract documents are issued in a single bid package.
2. Multiple Bid Procurement: “The Building Official is authorized to issue approval for the construction of foundations or any other part of a building or structure before the construction documents for the whole building or structure have been submitted, provided that adequate information and detailed statements have been filed complying with pertinent requirements of this code.” The project is separated into two bid packages. Construction can start while the remaining design elements are completed. Design Development shall be completed for all disciplines prior to issuing contract documents for any early bid package. The two bid packages are:
  - a. Site Grading, Utilities, Footings, Foundations, Core and Shell Bid Package: Includes all documents necessary for demolition, relocation, and construction of site utilities, including site grading, overall building layout, excavation, and structural elements for the primary structural framing system, stairs, elevators, major mechanical and electrical equipment and exterior skin. The A/E documents shall include final overall building dimensions including slab edges, slab openings, and all information necessary to prepare the structural shop drawings.
  - b. Final Bid Package: Includes contract documents for all other elements to be incorporated into the project.

#### 4.4 Design Stages

Note: If the project is small and uncomplicated the different design stages may be combined with approval of the DFCM Designated Representative.

##### A. Definitions:

1. “Basis of Design” Basis of Design and Assumptions for each Design Discipline. This document conveys the essence and important features of the project along with the different options for each of the systems. The document should contain information such as square footage, space efficiency and comparisons with the program requirements. Include a description of any additional spare capacity included in any of the engineered systems. Summarize the codes that will apply and submit a code analysis.
2. “Cost Model” This document refers back to the Basis of Design document and informs the steering group about the cost implications of the different systems. The Cost Model must include appropriate contingency for undocumented design issues.

##### B Expectations of Design Team.

1. DFCM expects that the A/E, together with its subconsultants, have responsible charge of the Design. The A/E shall designate the person who is in responsible charge of a specific design service for a specific project and through a qualification’s process assure DFCM that the person is qualified legally and by experience to perform the specific design service. This designated person shall be the primary day to day contact for the discipline throughout the project.
2. The goal is a quality coordinated design that minimizes the need for RFI’s or change orders, and achieves a high value for cost. It is necessary that drawings, notes, and specifications be coordinated so as to minimize conflicting provisions. A design that relies upon a preponderance of vendor expertise and design effort, generally, will not accomplish this goal. Include the necessary expertise in your A/E team. Obtain permission from DFCM for the use of any performance specifications which do not show the extent of the work on the drawings and which are significantly a product of vendor input. Coordinate all work between disciplines.
3. DFCM may utilize the services of an independent commissioning agent. The A/E shall coordinate with the selected commissioning agent to incorporate the commissioning requirements in to the specification. The commissioning agent shall provide the information that must be included in the specification. The goal of the commissioning agent is to focus on key systems identified with DFCM that, from past experience, have been

problematic. The commissioning agent validates that the key systems will comply with the Design Process, DFCM's Project Constraints, and the Basis of Design at each phase of the project after their services have been procured.

C. DFCM has established cover sheets for the drawings for each design phase. These are available through the DFCM web site. Utilize these cover sheets for each submittal phase to DFCM.

D. System Selection Design Phase

1. In the System Selection Design phase (at approximately 50% to 75% completion of Schematic Design), the A/E shall confirm the facility program requirements defined in the facility program document or as otherwise defined by DFCM.
2. The A/E shall document its Basis of Design including any design assumptions, and confirm the assumptions with the authorities having jurisdiction, the Agency and DFCM.
3. The A/E shall provide the steering committee with system options and evaluate the impact of each. Adjust the allocation of resources within the cost model, without exceeding the budget, based upon the direction from the steering committee. Obtain mutual agreement in order to proceed.
4. System Selection Submittal Requirements:
  - a. Written Requirements:
    - (1) Basis of Design
    - (2) Cost Model with system narratives for each option.
  - b. Drawings Requirements
    - (1) Use the DFCM provided cover sheets and input the required information.
      - (a) Other Drawing Requirements
        - Plan North/True North Symbol: Show on all plans in the lower right hand corner of the drawings.
        - Plan Orientation: Orient plans consistently throughout the set of drawings.
        - Graphic Scale: Show graphic scale for all drawings or views.

- (b) Comprehensive List of Sheets
  - (c) General Sheets
- (2) Civil
- (a) Civil Drawings: should include information on such items as existing benchmarks, lot lines, distance from existing buildings, existing and new utility lines and proposed footprint of the new structure.
- (3) Landscape
- (a) Potential landscape areas.
- (4) Architecture
- (a) Architectural Drawings: should include floor plans and room names, exit pathways and exterior rough elevations to show the essence of the building material types.
- (5) Structural
- (a) Structural Drawings: should include basic information on grid lines, bay spacing and locations for lateral force resisting elements.
- (6) Mechanical
- (a) Mechanical Drawings: should include basic information on system locations, connection points and utility sizing and capacity.
- (7) Electrical
- (a) Electrical Drawings: should include basic information on system locations, connection points and utility sizing and capacity.
- (8) Communications
- (a) Communications: should include basic information on system locations, connection points and utility sizing and capacity.

E. Schematic Design Phase

1. Continue to develop and refine the system selection requirements.
2. In the Schematic Design phase, the A/E documents the general extent, scale, and relationship of the project components, the type of construction and incorporates the systems selected in the previous phase.
3. The A/E shall be responsible to communicate with the State Fire Marshall's Office to receive any direction required to move to the next phase of design.
4. Schematic Submittal Requirements:
  - a. Written Requirements.
    - (1) Updated basis of design and assumptions for each Design Discipline
    - (2) Updated Cost Model
    - (3) Project Manual (refer to CSI Project Resource Manual)
  - b. Drawing Requirements. Continue to refine the previous drawings and add the following information.
    - (1) General
      - (a) Key Plans: show key plans on all drawings where one element requires two or more drawings to delineate a level.
      - (b) Column Grid Lines: show on all views, except that they may be omitted on Civil, Landscape and Site Plans.
    - (2) Civil
      - (a) Symbol Legend and Abbreviation List
      - (b) Site Demolition Plans
      - (c) Civil Site Utilities Plans
      - (d) Civil Utility Profiles
      - (e) Civil Utility Sections
      - (f) Civil Utility Details and Notes
    - (3) Landscape
      - (a) Concept landscape areas.

- (4) Architecture
  - (a) Symbol Legend and Abbreviation Lists
  - (b) Roof Plan
  - (c) Floor Plans
  - (d) Penthouse roof plan: Show on the same drawing if possible. Skylights.
  - (e) Exterior Elevations
  - (f) Sections
  
- (5) Structural
  - (a) General Structural Notes/Design Criteria
  - (b) Foundation Plans and Slab-On-Grade Plans
  - (c) Floor and Roof Framing Plans
  
- (6) Fire Protection
  - (a) Symbol Legend and Abbreviations List
  
- (7) Mechanical
  - (a) Mechanical Plans
  - (b) Mechanical Equipment Schedules (Boiler, Chiller, Cooling Tower, Air Handlers, etc.)
  
- (8) Electrical
  - (a) Lighting (Area, Horizontal IES category, Horizontal IES task illuminance, Design Issues): Site Lighting (Area, Illuminance, Design Issues).
  - (b) Power Quality {Design (%), Design Approach}; Neutral Conductor sizing for non-linear loads (Type, Design Approach).
  - (c) Symbol Legend and Abbreviations
  - (d) Electrical Site Plan
  - (e) Electrical Power Plans
  - (f) Electrical Schedules and Diagrams
  
- (9) Communications
  - (a) Structured Cabling Plans (Tt-1nn)
  - (b) Other Submittals

F. Design Development Phase

1. Continue to Develop and Refine the Schematic Design Requirements
2. After written approval of Schematic Design has been obtained from DFCM's Designated Representative, the A/E shall proceed with the design development phase of the project upon receipt of written confirmation to initiate the next phase of design. The design development phase fixes and describes the size and character of the entire project. In order for the project design to be considered successful, only minor modifications to the location of the facility on the site, the floor plans, and facility sections should be required during the Construction Documents Stage.
3. The A/E shall be responsible to communicate with the State Fire Marshall's Office to receive any direction required to move to the next phase of design.
4. Design Development Plan Review
  - a. The design professional shall meet with the building official to review the building code requirements of the proposed project.
  - b. A dimensioned site plan with distances to property lines, grades and location of new and existing buildings on the lot.
  - c. Complete code analysis which shall include the occupancy classification, type of construction, allowable area calculations and actual building area, height allowed in feet and stories, sprinkler requirements, exit width required and exit width provided, fire assemblies, and accessibility requirements.
  - d. Elevation drawings showings grades and height of building.
  - e. Typical floor plans
5. Design Development Submittal Requirements:
  - a. Written Requirements:
    - (1) Updated basis of Design and Assumptions for each Design Discipline.
    - (2) Updated Cost Model.
    - (3) Project Manual (refer to CSI Project Resource Manual)
    - (4) Code analysis and plan review

- b. Drawing Requirements: Continue to update and refine what was previously shown and add the following information.
  - (1) General
  - (2) Landscape
    - (a) Concept Landscape Areas and Plans
  - (3) Civil
    - (a) Symbol legend and abbreviation
    - (b) Site demolition plan
    - (c) Site plan
    - (d) Grading plan
    - (e) Paving plan
    - (f) Civil site utility plan
    - (g) Civil utility profiles and sections
    - (h) Typical details
  - (4) Architecture
    - (a) Architectural Demolition Plan
    - (b) Layout of existing architectural elements identifying items to be demolished, relocated, or to remain.
    - (c) Building dimensions
    - (d) Floor Plans
    - (e) Roof elevations
    - (f) Exterior building elevations
    - (g) Wall sections
    - (h) Material selections
    - (i) Typical details
  - (5) Structural
    - (a) Classification for fire rated construction
    - (b) Special Inspection
    - (c) Lateral elements
    - (d) Typical details
    - (e) Structural Demolition Plans
  - (6) Fire Protection
    - (a) Fire Detection and Alarm Plans
    - (b) Fire Detection and Alarm Schedules and Diagrams
    - (c) Fire Suppression Details

(7) Mechanical

- (a) Symbol Legend and Abbreviations List
- (b) Mechanical Demolition Plans
- (c) Equipment schedules
- (d) Single line duct drawings
- (e) Mechanical piping plans
- (f) Plumbing general piping arrangements
- (g) Flow diagrams
- (h) Plumbing fixture schedules
- (i) Large Scale Mechanical Room Plans

(8) Electrical

- (a) Electrical Large Scale Plans
- (b) Electrical Details
- (c) Electrical Lighting Plans
- (d) Electrical Diagrams and Schedules
- (e) Electronic Security System, General
- (f) Electronic Security Sheets, Plan

(9) Communications

- (a) Communications Demolition Plans
- (b) Audio Visual Plans
- (c) Audio Visual Diagrams And Schedules
- (d) Structured Cabling Plans, Large Scale Views
- (e) Layout of communication rooms showing all components in the room. Show plan view layout of racks and equipment complying with TIA/EIA requirements.
- (f) Structured Cabling Schedules and Diagrams

(10) Interior

- (a) Interior Drawings
- (b) Interior Demolition Plans
- (c) Interior Plans

G. Construction Documents Phase

1. After written approval of the Design/Development Documents has been obtained from the DFCM's Designated Representative, the A/E shall proceed with the construction documents phase of the project. The construction documents are the written and graphic documents prepared or assembled by the A/E for communicating the project design for construction and administering the construction contract. The documents

are reviewed by the authorities having jurisdiction, members of the steering committee, and others selected by members of the steering committee.

2. Coordinate requirements for the following items with the DFCM's Designated Representative and assist DFCM as needed.
  - a. Project Identification
  - b. Description of Work
  - c. Type of Bid
  - d. Obtain list of contractors from DFCM's Designated Representative, if applicable.
  - e. Time of Completion
  - f. Liquidated Damages.
  - g. Pre-Bid Meeting
  - h. Evaluation and consideration of bids.
  
3. DFCM will initiate and prepare, with assistance as required from A/E, the following standard documents.
  - a. Notice to Contractors
  - b. Bid Form
  - c. Bid Bond (DFCM)
  - d. Bidder's Proposed Subcontractors (DFCM)
  - e. Contractor Agreement Form (DFCM)
  - f. Payment Bond (DFCM)
  - g. Performance Bond (DFCM)
  - h. Certificate of Substantial Completion (DFCM)
  - i. General Conditions (DFCM)
  - j. Supplementary Conditions
  
4. Construction Documents Submittal Requirements
  - a. Written Requirements:
    - (1) Updated basis of Design and Assumptions for each Design Discipline.
    - (2) Updated Cost Model
    - (3) Specifications: In written form on drawings or separate book, covering the following:
      - (a) Masterformat 2004; all divisions used on project.
      - (b) Material description.
      - (c) Installation description (when not shown on drawings).

- (4) Fault current calculations and coordination study.
  - (5) Project Manual: (refer to CSI Project Resource Manual)
    - (a) Energy model report
    - (b) Code analysis
    - (c) Inspection requirement
  - (6) Source of Specifications Identified. If A/E incorporates any proprietary specifications or any proprietary portion of its work from a source other than A/E, then such original source must be clearly identified in the A/E's work in order for DFCM to be aware of its identity and to be able to accept or reject such use of said proprietary source. Only those items specifically approved for "sole source" in writing by the Director of the Division of Facilities construction and management may be used as a "sole source" specification. In all specifications, the provision of Utah code, Title 63, Chapter 56, the Utah Procurement code, and all applicable rules enacted pursuant thereto, must be fully complied with the A/E.
- b. Drawing Requirements: Complete, coordinated drawings ready for final review and comment by DFCM, the Agency and Authorities having jurisdiction include the following:
- (1) Project Title Page: Template provided by DFCM.
  - (2) Seals Page
  - (3) List of Drawing Sheets
- c. The A/E will provide the following documents required for Building Official review and approval.
- (1) Site Plan.
    - (a) Property description:
      - Written "Legal Description" of property boundaries.
      - Survey information
      - Geotechnical/soils report, stamped, signed and dated by a P.E.
      - Existing hazardous materials information
    - (2) Construction Description Table
      - (a) Use or occupancy
      - (b) Type of construction

- (c) Square footage allowed.
  - (d) Actual square footage of proposed structure.
  - (e) Height of proposed structure in feet and stories.
  - (f) Area increase allowances for:
    - Yards
    - Stories
    - Fire walls
    - Automatic fire sprinkling system
  - (g) Occupancy separations
  - (h) Means of egress. Show the location, construction, size and character of all portions of the means of egress. Construction documents shall designate the number of occupants to be accommodated on every floor, and in all rooms and spaces.
  - (i) Design occupant loads
  - (j) Accessibility requirements
- (3) Structural Calculations: Stamped, signed and dated by the engineer of record.
- (4) Fire Assemblies: Detailed on the drawings for walls, floor/ceiling assemblies and roof/ceiling assemblies as per “design number” or “file number” of one of the current publications of the following:
- (a) Fire resistance tables of Chapter 7 of the International Building Code.
  - (b) “Fire Resistance Directory,” Underwriter’s Laboratory.
  - (c) “Fire Resistance Design Manual,” Gypsum Association.
  - (d) ICC evaluation reports.
- (5) Flood Control/Drainage Drawings: As required, stamped, signed and dated by a professional engineer.
- (6) Special Inspection: The registered design professional in responsible charge shall submit a statement of special inspection. The statement shall include a complete list of materials and work requiring special inspection and the inspections to be performed.
- (7) Performance Based Design: Include any performance based design which has been approved by the building official.

## H. Contract Documents Phase

1. After the construction documents have been modified to comply with requirements of the authorities having jurisdiction and requirements of the steering committee written approval by the DFCM's Designated Representative is required to issue the Contract Documents.
  - a. Provide two complete and corrected sets of drawings. Drawings shall be wet-stamped, signed and dated by a State of Utah licensed Architect or Engineer and submitted for approval by the State Building Official. One set to be retained by DFCM, the other set to be given to the General Contractor and kept at the construction site.

## I. Pre-Construction Stage

### 1. General

- a. Each system or group of systems shall be integrated with other system components prior to release of the shop drawings by the A/E team and the Contractor team for construction. Pre-installation meetings are normally required for:

- (1) Site and Infrastructure
- (2) Facility Structure and Skin, including curtain walls and masonry.
- (3) Building Systems (Mechanical, Electrical, Plumbing, Building Automation, Fire Alarm)
- (4) Life Safety and Security Systems (Fire Protection, Fire Alarm, Security Electronics, Door Hardware)
- (5) Roofing

### 2. Pre-Construction Meeting

- a. DFCM's Designated Representative shall arrange for a preconstruction meeting. Shop drawing scheduling shall be coordinated so that the information is available for each discipline and trade to review and coordinate prior to the Pre-installation conference.

### 3. Pre-Installation Conference

- a. During the pre-installation conference, the A/E team and the contractor team (all members required to coordinate a system or group of systems) shall meet and resolve any issues related to shop drawing coordination and RFIs.

- b. Within 10 working days, after the pre-installation conference, responses to RFIs and construction modifications shall be issued by the A/E.

## **5.0 DFCM QUALITY ASSURANCE REQUIREMENTS**

### **5.1 General**

- A. DFCM has determined that many of the Quality Control problems can be reduced by a structured approach to interdisciplinary coordination and integration. The A/E shall integrate the drawings and specifications of all disciplines. The A/E shall inform DFCM of the process they will implement with the design team for dimensional control and comprehensive coordination of all elements of each of the following:
  - 1. Site Plan
  - 2. Floor Plan
  - 3. Reflected Ceiling Plan
  - 4. Exterior Elevations
  - 5. Selected Interior Elevations with cabinets or other types of complexity in the elevations.
  - 6. Sections at locations where above ceiling systems are congested shall delineate all building systems (e.g. Structural elements, Mechanical piping and ductwork, Electrical conduit and cable trays, and Fire Protection piping).
  - 7. Division 1 sections of the specifications.
  
- B. DFCM has determined that the functionality of systems can be improved and the costs reduced by the integration and convergence of building systems. The A/E shall implement a process with the design team for the comprehensive coordination of all elements. Elements that are typically a concern include:
  - 1. Communication Systems (structured cabling, audio-visual systems, other similar systems, and structured cabling connections to other electronic systems).
  - 2. Integrated Automation Systems (HVAC control, lighting control, electrical monitoring, monitoring of equipment, fire alarm).
  - 3. Security and Life Safety Systems (security systems, fire alarm systems, fire protection systems, door hardware, and similar systems).
  - 4. Equipment Connections (HVAC, electrical, plumbing).

## **6.0 COST MODEL REQUIREMENTS**

### **6.1 General**

- A. The goal of the Cost Model Requirements is to provide clear criteria which the cost models and bids for a facility must meet to achieve DFCM's requirements for the project to be considered successful.
- B. The DFCM's Designated Representative shall define in the "Agreement between the DFCM and A/E" the Cost Model submittals required by the A/E. Unless otherwise indicated in the "Agreement Between DFCM and A/E," Cost Models are submitted at the following phases:
  - 1. Programming
  - 2. System Selection
  - 3. Schematic Design
  - 4. Design Development
  - 5. Construction Documents
- C. The A/E shall prepare a Cost Model at each phase of the Design which identifies a sub-cost model for each discipline. Based upon this Cost Model, the A/E with each of the Design Subconsultants shall summarize in the Cost Model narrative what can be constructed in accordance with the Cost Model. Document any variances that do not comply with the Design Process, Facility Program, or Agency Requirements. Prepare design document submittals that comply with the Cost Model.

On projects where a CM/GC has been selected the CM firm will be responsible for providing an additional cost estimate. The CM/GC and the design team must work together to reconcile any differences between the two cost estimates. The project may only proceed once the cost estimate is agreed upon.
- D. If the Steering Committee determines that the design for an element of the project does not comply with the project requirements, the cost model shall be adjusted and documented; however, the project budget shall not be exceeded.
- E. At each cost model submittal, the Cost Consultant (member of the A/E team) and/or Contractor shall independently review that the cost model for the A/E team shall not be exceeded based upon the narrative and supporting documents provided at each phase of the design.
- F. DFCM defines Construction Contingency as funds for unforeseeable conditions and design errors and omissions after the time of contract award. Reasonable allowance for all foreseeable work items must be made in the cost model.

## 6.2 Standards

- A. The Cost Model shall be prepared according to the Construction Specification Institute's uniform classification of construction systems and assemblies.
  - 1. RS Means is an acceptable source of cost information as long as it is adjusted to local market conditions and project requirements.
  - 2. Exception: a proprietary Cost Estimating data base may be utilized when validated by objective evidence and approved by DFCM's Designated Representative.

## 6.3 Cost Model Report Table of Contents

- A. Executive Summary
  - 1. Project Summary: Brief summary of overall project, including total square footage (current vs. program), net square footage (current vs. program), and space efficiency (current vs. program);
  - 2. Funding
  - 3. Total Construction Cost Model: Facility Cost (Lump Sum, Cost/gross sf), On-site Cost (Lump Sum, Cost/gross sf), and Off-site Cost (Lump Sum, Cost/gross sf);
  - 4. DFCM Furnished Cost Model (Lump Sum, Cost/gross sf);
  - 5. Delivery Method
- B. Project Narrative
  - 1. Site Narrative
  - 2. Facility Narrative
- C. Construction Cost Model summarizing costs in the following categories.
  - 1. Footing and Foundation
  - 2. Structural Core and Shell
  - 3. Exterior Cladding
  - 4. Interiors
  - 5. Mechanical
  - 6. Electrical
  - 7. Fire Protection
  - 8. Special Demolition
  - 9. Civil/Site Work
  - 10. General: General Conditions, Fee, Design Contingency, Escalation Contingency, Construction Contingency

- D. Assumptions and Qualifications
  - 1. Market Conditions
  - 2. Project Assumptions

#### **6.4 Scope of Estimate**

- A. Facility Program preliminary cost model requires a mixture of costs per functional space (such as office, classroom, etc.), cost per cubic foot, cost per square foot, and cost per linear foot (for items where the cost is not easily forecast by a cost per square foot model such as site utilities). In some cases, design options shall be selected to reduce the range of costs for the program. These design options shall be defined as assumptions.
- B. Schematic Design Cost model requires a mixture of cost per cubic foot, cost per square foot, and cost per linear foot (for items where the cost is not easily forecast by a cost per square foot model such as site utilities). The cost model shall be based upon the design options selected and other assumptions identified in the narrative.
- C. Design/Development Cost model shall be developed based upon unit costs for approximate quantities of materials and installation shown on the design development documents or identified in the assumptions.
- D. Construction Documents Cost model shall be developed based upon unit costs for actual quantities of materials and installation shown on the construction documents or identified in the assumptions.

## **7.0 PROJECT MANUAL REQUIREMENTS**

### **7.1 General**

- A. The Project Resource Manual published by The Construction Specifications Institute serves as a reference document covering a wide range of information required by those involved in the Facility Development Process. As a generic standard, it informs the A/E about industry-wide expectations which must be adapted to the constraints of the Design Process and to specific project requirements.
- B. Apply CSI MasterFormat 2004 for organizing the numbering of sections, the SectionFormat for the organizing individual sections and the PageFormat for each individual page. (Note: MasterFormat 1995 may be utilized for projects with A/E agreements dated before January 1, 2006.)

- C. The only parties to the construction contract are the DFCM and Contractor. The A/E shall therefore address all instructions to the Contractor. Do not address individual subcontractors or trades.
- D. Provide an orderly and logical arrangement by complying with the CSI requirements that establishes a standard location for specific information and to state that information only in that location.
  - 1. Index all documents in the Project Manual.
- E. Edit guide specifications carefully to convey the necessary requirements for each project discipline. Avoid elaborate and expensive requirements for items that are not critical to the success of the project. Delete from guide specifications irrelevant items. Modify guide specifications to add clarity and special requirements to conform to project requirements.
  - 1. Coordinate Project Manual with Drawings.
  - 2. Carefully coordinate Structural General Notes with the specifications.
  - 3. Do not use lump sum allowances in any specification sections.

## **7.2 Preferred Source Documents**

- A. DFCM requires written disclosure and project manager approval if specifications are prepared by a manufacturer. Manufacturer written specifications generally should not be used in order to avoid unfair influence by a manufacturer in the procurement process.
- B. DFCM requires that specifications be prepared in compliance with CSI requirements and that the specification masters be prepared using a documented quality process.
- C. DFCM does not require, but accepts the Full Language version of ARCOM Masterspec or BSD SpecLink Construction Specifications as the specification template. They are derived independently from the manufacturers and because they follow a quality and tested process.

## **7.3 Construction guarantees and warranties shall:**

- A. Protect DFCM against faults, defects, or failure, in spite of technical compliance with the terms of the contract.
- B. Extend the manufacturer's responsibility beyond the end of the one year guarantee period on selected items as approved by DFCM.
- C. The one year guarantee period shall not limit the effect of warranties provided in or required by the contract. The Contractor shall correct failures during the one year guarantee period after substantial completion.

#### **7.4 Product and Service Life Cycle Requirement:**

- A. Assure there is a high value for the cost by:
  - 1. Maximize competition consistent with the purpose. In addition, minimize sole source procurements (Refer to <http://www.rules.utah.gov/publicat/code/r023/r023-001.htm>). Provide a minimum of three manufacturers for each material or installation, except where authorization from the Director of DFCM has been obtained for sole source procurements. The use of an “or equal” clause in the specifications shall define a process for determining “equal products or services” which requires approval by the A/E and shall not leave it to the vendor to make this determination.
  - 2. In order to avoid excessive addition and replacement costs, use open source and open protocol systems when possible.
    - a. Where proprietary software and service organizations are required to service a component, obtain price information for DFCM and the Agency identifying the long term cost (10 years) in order to include this in the evaluation.
  - 3. Provide facility components which are durable, with low failure rates, and low cost to maintain.
  - 4. New Technologies: Reduce life cycle costs by incorporating proven technologies in facilities, and by performing “due diligence” prior to procuring new technologies.

#### **7.5 Materials**

- A. Specify materials which are new, unless approved by DFCM’s Designated Representative. Provide certification or label with the name of the manufacturer or supplier and the approved testing laboratory where consensus based standards have been developed.

### **8.0 CAD REQUIREMENTS**

#### **8.1 General**

- A. The goal of the CAD Standards is to provide clear criteria which the Drawings for a facility must meet to achieve DFCM’s requirements. Comply with the requirements of the National Cad Standard as supplemented by this standard.

- B. Coordinate with DFCM's Designated Representative to determine the drawing format.
- C. The performance requirements are given as appropriate as minimum criteria to allow flexibility within the constraints of the CAD Standards. If a variance from the standard is desired, the approval of the DFCM's Designated Representative is required.

## **8.2 Standards**

- A. CAD Standards
  - 1. National CAD Standard, current version.
- B. CAD Software
  - 1. AutoCAD, current version
  - 2. Microstation, current version

## **8.3 Guidance**

- A. Assumptions
  - 1. Any CAD information that will be shared between multiple sheets, such as floor plans, should be contained in a separate CAD file. For AutoCAD the file would be an XREF.
  - 2. All disciplines shall use the same title block for all drawings submitted for the same project. For AutoCAD, create the title block as an X-ref.
- B. Other Design Tools
  - 1. Isometric and perspective views may be used to supplement and explain the design.
  - 2. Models and renderings may be used to supplement and explain the drawings.
- C. Quality of Drawings
  - 1. These documents shall convey to all participants the graphic information necessary for the required work. It is essential that the documents be accurate and explicit.
  - 2. All elements of the Contract Documents shall be properly coordinated to minimize conflicts between drawings and specifications.
  - 3. Include the extent, size shape and generic types of materials, and the relationship to other materials.
  - 4. Avoid duplication of items in Contract Documents. If items are duplicated, the A/E and Subconsultants shall carefully coordinate to prevent conflicts.

5. List all drawings in the index, including the cover sheet as the first sheet of the set.
- D. Project CD: A/E shall prepare Project CD that establishes the project setup for the other members of the A/E Team. Distribute Project CD at the kickoff meeting to all members of the project team. Include:
1. Title Block
  2. Common CAD Layers
  3. Common Fonts
  4. Model Files, such as floor plans
  5. Sheet files including title block information that varies with each sheet.
  6. Initial sheet index

#### **8.4 CAD Layer Guidelines - Supplemental Requirements**

- A. Layer Name: Use Mandatory Level 1 Discipline Designator, Mandatory Major Group, Optional Minor Group.
- B. Identify user-defined layers using standard alphanumeric format.

#### **8.5 Uniform Drawing Standards - Supplemental Requirements**

- A. Drawing Set Organization
  1. Reference the border/title block and model files into a sheet file.
  2. Include a “ready-to-plot” sheet tab for both full size plotting and reduced size plotting.
  3. File Naming Convention: DFCM’s preference is to use two character discipline designators. One character discipline designators may be used for sheets that apply to all the drawings in a discipline or if the project is small. For small projects, the use of one character discipline designators must be approved by DFCM’s Designated Representative for the project.
- B. Sheet Organization
  1. Use a common sheet size for all sheets for a specific project to facilitate filing hard copy documents, plotting capabilities, and to maintain a consistency for Facility Management users. Use Architectural Standard “D size” (24” X 36”) or “F size” (30” X 42”).
  2. Obtain written approval, prior to submitting sheets that vary from this standard, from the DFCM’s Designated Representative. Request shall be in writing and include a justification for the variance.

3. Sheet Margins:

Sheet Margins	
Top and Bottom Margin	1/2"
Left Margin	1-1/2"
Right Margin	3/4"

C. Schedules: Comply with National Cad Standards Module 03.

D. Drafting Conventions: Comply with Drafting Conventions Module 04

1. AutoCAD users should choose either the architectural (feet and inches) or engineering (feet and tenths).
2. Global Origin: The origin of a drawing file is important because it serves as the point of reference from which all other elements are located. Origins are typically defined (located) in a drawing file by the Cartesian coordinate system of x, y, and z or for AutoCAD users 0, 0, 0.
3. Title Block: For DFCM projects the title block area will be placed on each sheet in the NCS horizontal text format with the title block placed in the right hand margin of the border sheet. DFCM requires additional information in the standard blocks of the NCS format using a horizontal layout. Utilize the DFCM provided cover sheet template.
4. All revisions to the Contract Documents shall be accomplished using the delta symbol placed adjacent to the revised element with the most current revision number. The portion revised shall be clouded on the drawings encompassing the delta symbol. Only the current revisions shall have the clouded area depicted. Previous revision delta symbols shall remain, but the clouded line shall be erased or frozen. If an entire drawing is revised or a new drawing is added to the set, place the revision delta in the issue block. Include revision block with change order numbers, dates and descriptions.
5. Text/Fonts: For drawing content, use standard fonts provided with the CAD software. If specialty fonts are used in the title block, provide specialty font to DFCM.
6. Scale: Scale shall be expressed both numerically and graphically. For building project plans, use 1/8" or 1/4" scale, unless approved otherwise by DFCM's Designated Representative. Large scale views may use standard scales larger than 1/4". For Site plans, use 1/1, 1/10, 1/20, 1/30, 1/40, 1/50, 1/60, or 1/100 scale, unless approved otherwise by DFCM's Designated Representative.

7. Sheet Types: Comply with the requirements of the sheet types section of this module. Comply with the descriptions of requirements for plans generated by each discipline.
- E. Terms and Abbreviations: Comply with Terms and Abbreviations National Cad Standards Module 05.
  - F. Symbols: Comply with the Symbols Module 06. Standard symbols ensure clear and concise communication.
    1. Exception No. 1: Lighting fixture symbols may be added to the symbol list which more graphically describe the lighting fixture, if identified on the symbol schedule.
    2. Exception No. 2: Fire alarm symbols that comply with NFPA 170 are preferred.
  - G. Notations: Comply with Module 07.
  - H. Code Conventions. Provide the code information as required in the design process and in the DFCM cover sheet templates.



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

# **DESIGN REQUIREMENTS**

June 30, 2008

## **PREFACE**

In order for the Division of Facilities Construction and Management (DFCM) to be one of the nation's premier facility managers, it is essential that we consistently improve our performance. In order to do this, the Design Requirements provides a document and review process for consistently improving our processes and standards.

Updates to this standard will be added with highlighted backgrounds and dated at time of occurrence, until such time that a new version may be adopted for use. (02/06/2008)

# TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL .....</b>	<b>1</b>
1.1	General .....	1
1.2	Procedure .....	1
1.3	Hierarchy of Requirements .....	1
1.4	Changes and Additions to Design Requirements .....	2
<b>2.0</b>	<b>CODES / LAWS/ RULES AND REGULATORY REQUIREMENTS .....</b>	<b>4</b>
2.1	General .....	4
2.2	DFCM requirements include (but are not limited to): .....	4
2.3	Building Code Commission .....	4
2.4	Fire Prevention Board .....	4
2.5	Accessibility Code .....	4
2.6	Labor-Industrial Commission .....	4
2.7	Department of Health .....	5
2.8	Department of Environmental Quality .....	5
2.9	County Health Department (for the county where the facility is located) .....	6
2.10	Department of Commerce .....	6
<b>3.0</b>	<b>DFCM REQUIREMENTS .....</b>	<b>7</b>
3.1	General .....	7
3.2	Civil .....	11
3.3	Architectural .....	13
3.4	Structural .....	16
3.5	Mechanical .....	17
3.6	Electrical .....	26
<b>4.0</b>	<b>LANDSCAPE AND IRRIGATION STANDARDS .....</b>	<b>38</b>
4.1	Purpose .....	38
4.2	Principles and General Guidelines .....	38
4.3	Water Allowances .....	40
4.4	Definitions .....	40
4.5	Landscape Design Standards .....	44
4.6	Irrigation Design Standards .....	45
4.7	Contract Documents .....	47
4.8	Irrigation Record Drawings and Operations and Maintenance Manuals .....	50
4.9	Plan Review, Construction Inspection and Post-Construction Monitoring .....	51
4.10	Soils Definitions & Guidelines .....	52
4.11	Plant List .....	54
4.12	Irrigation Schedule Form Instructions .....	68
4.13	Resources .....	74
<b>5.0</b>	<b>HIGH PERFORMANCE BUILDING RATING SYSTEM .....</b>	<b>76</b>
5.1	General .....	76
5.2	Definitions .....	76
5.3	Referenced Standards and Codes .....	76
5.4	Design and Technology Charrette .....	77
5.5	Prerequisites .....	77
5.6	Energy Efficiency Requirements: .....	78
5.7	Sustainability Credits .....	81
5.8	Submittals .....	85



## **1.0 GENERAL**

### 1.1 General

- A. These Design Requirements apply to all plans, processes, and procedures required for compliance with the Design Process.

### 1.2 Procedure

- A. Complete the Design Requirement/Variance Form to make recommendations for additions, deletions, and changes to the Design Requirements.
- B. Complete the Design Requirement/Variance Form to request approval by the Director to vary from these Design Requirements based upon the specific project needs.
- C. All Design Requirement modifications require approval by the Director.
  - (1) If the Design Requirement is approved by the Director, then the DFCM's Designated Representative shall distribute the Design Requirements Procedure document to the appropriate project participants and shall file it in the project file.
  - (2) If the Design Requirement is approved by the Director and has general applicability to other projects, the Director shall arrange for the Design Requirement modification to be added to the appropriate document.
    - a. Verify with the DFCM person responsible for the specific professional discipline and the appropriate DFCM maintenance person that the proposed Design Requirement meets their requirements.

### 1.3 Hierarchy of Requirements

- A. The hierarchy of requirements is as follows:
  - (1) Comply with the minimum requirements of all applicable laws, rules, and regulatory requirements.
    - a. Exceptions: Wherever there are practical difficulties involved in carrying out these provisions, the State Building Official with the approval of the Director of DFCM and/or the State Fire Marshall shall have authority to grant modifications. The modifications granted by the State Building Official shall be documented in this standard under the heading "Design Requirements."
  - (2) Comply with the consensus based ANSI standards for design, products, installation, and services unless the applicable laws, rules, and regulatory requirements are more stringent.

- (3) Comply with the “Performance Requirements: Design Requirements” unless the ANSI standards or the applicable laws, rules, and regulatory requirements are more stringent.
- (4) Comply with the Contract Documents, unless the “Performance Requirements: Design Requirements”, the ANSI standards, or the applicable laws, rules, and regulatory requirements are more stringent.

#### 1.4 Changes and Additions to Design Requirements

- (1) Complete the following document and submit it to the person to whom you are responsible to for ultimate decision by the Director, for requested changes/additions to the Design Requirements.

<b>Design Requirement/Variance Change Request</b>	
<b>Project Name</b>	<b>Date</b>
	<b>DFCM Project Number</b>
	<b>Risk Management Number</b>
<b>Requested by</b>	<b>Entity</b>
<b>Brief Description of the Problem</b>	
<b>Design Requirements</b>	
<b>Justification</b>	
<b>Director Approval</b>	<b>Date</b>
<b>Action to Include This Design Requirements in the Design Requirements</b>	
<b>Professional Reviewer</b>	<b>Position</b>
<b>Maintenance Reviewer</b>	<b>Position</b>
<b>Director Approval</b>	<b>Date</b>

## **2.0 CODES / LAWS/ RULES AND REGULATORY REQUIREMENTS**

### 2.1 General

- A. Comply with adopted State Codes and all other applicable Standards and Codes at the time submitted to the State Building Official, including but not limited to Section 2.2 through Section 2.10:

### 2.2 DFCM requirements include (but are not limited to):

- A. Administrative Services: Comply with Title R23: Administrative Services, Facilities Construction and Management. Refer to <http://www.rules.utah.gov/publicat/code/r023/r023.htm>.
- B. DFCM Services: Comply with Services requirements. Refer to <http://dfcm.utah.gov>. Services requirements include:
  - (1) Inspections and Testing, refer to [http://dfcm.utah.gov/bldg\\_official.php](http://dfcm.utah.gov/bldg_official.php).
  - (2) Standards and Standard Project Documents, refer to [http://dfcm.utah.gov/standard\\_docs.php](http://dfcm.utah.gov/standard_docs.php).
  - (3) Roofing, Paving, and Hazardous Materials, refer to [http://dfcm.utah.gov/const\\_roofing.php](http://dfcm.utah.gov/const_roofing.php).
  - (4) Other requirements which may be added after this document is published.

### 2.3 Building Code Commission

- A. Comply with Utah Uniform Building Standards Act. Refer to [http://www.dopl.utah.gov/licensing/statutes\\_and\\_rules/R156-56.pdf](http://www.dopl.utah.gov/licensing/statutes_and_rules/R156-56.pdf). Enforcement of these codes is the responsibility of the State Building Official.

### 2.4 Fire Prevention Board

- A. Comply with Fire Codes in accordance with “Laws, Rules” of the State Fire Marshall. Refer to [http://firemarshal.utah.gov/Laws\\_Rules/laws\\_rules.html](http://firemarshal.utah.gov/Laws_Rules/laws_rules.html). Enforcement of these codes is the responsibility of the Utah Fire Marshall.

### 2.5 Accessibility Code

- A. Comply with the US Department of Justice Federal Registers – Americans with Disabilities Act. Refer to <http://www.usdoj.gov/crt/ada/adahom1.htm>.

### 2.6 Labor-Industrial Commission

- A. Comply with requirements of the Labor-Industrial Commission. Refer to <http://www.labor.state.ut.us>.

- (1) Boiler and Pressure Vessel Compliance Manual, Refer to [http://laborcommission.utah.gov/Safety\\_Division/BLRCompManRev8-306.pdf](http://laborcommission.utah.gov/Safety_Division/BLRCompManRev8-306.pdf).
- (2) Utah Occupational Safety and Health, refer to <http://www.rules.utah.gov/publicat/code/r614/r614.htm>.
- (3) Elevator Rules: American National Standard Safety Code for Elevators and Escalators, ANSI/ASME A17.1 with amendments administered by Labor-Industrial Commission of Utah, Department of Occupational Safety and Health Elevator Division. Refer to <http://www.rules.utah.gov/publicat/code/r616/r616-003.htm>.

## 2.7 Department of Health

- A. Comply with requirements of Department of Health. Refer to <http://www.health.utah.gov>.
  - (1) Health Care Rules, refer to <http://health.utah.gov/hflcra>.
  - (2) Utah Indoor Clean Air Act, refer to <http://www.tobaccofreeutah.org/r392-510.htm>.

## 2.8 Department of Environmental Quality

- A. Comply with requirements of Department of Environmental Quality. Refer to <http://www.deq.utah.gov>.
  - (1) Public Drinking Water Rules, refer to <http://drinkingwater.utah.gov/rules.htm>.
  - (2) Utah Division of Air Quality: R307-801, Asbestos, refer to <http://airquality.utah.gov/HAPS/ASBESTOS/rules/newrules.pdf>; Environmental Protection Agency (EPA): Regulations for Asbestos – Code of Federal Regulations Title 40, Part 61 Subpart M; and Toxic Substances Control Act PART 763 (Updated 1997) – ASBESTOS: OSHA Standards 1910.1001, 1915.1001, and 1926.1101
  - (3) Underground Storage Tank Act, refer to <http://www.undergroundtanks.utah.gov/>.
  - (4) Air Conservation Act, refer to <http://www.rules.utah.gov/publicat/code/r307/r307-008.htm>.
  - (5) Fugitive Dust Plan, Refer to <http://www.rules.utah.gov/publicat/code/r307/r307-309.htm>.
  - (6) Utah Pollutant Discharge Elimination System, Refer to <http://www.rules.utah.gov/publicat/code/r317/r317.htm>.

- (7) Operating Permits of the Division of Air Quality, refer to <http://www.rules.utah.gov/publicat/code/r307/r307-415.htm>.
- 2.9 County Health Department (for the county where the facility is located)
  - A. Food Service Sanitation Rules
- 2.10 Department of Commerce
  - A. Pipeline Safety, refer <http://www.rules.utah.gov/publicat/code/r746/r746-409.htm>.
  - B. Qualifications: Refer to the Project Participants heading of this document.

## 3.0 DFCM REQUIREMENTS

These requirements are enhancements of code requirements that DFCM has initiated for best practices for State owned facilities.

### 3.1 General

#### A. Distributed Live Loads

- (1) Modify IBC Table 1607.1 “Minimum Uniformly Distributed Live Loads and Minimum Concentrated Live Loads” by the following:
  - a. Increase the Uniformly Distributed Live Loads to 80 psf for: Office use in Access floor systems; Operating room, laboratories, private rooms, wards in Hospitals; Reading rooms in Libraries; Offices in Office buildings; Classrooms in schools.
  - b. Increase the Minimum Concentrated Live Loads to 2500 lbs for: Office use and Computer use for Access floor systems; Operating rooms, laboratories, corridors above the first floor for Hospitals; Reading rooms, Stack rooms, Corridors above first floor in Libraries; Lobbies and first-floor corridors, offices, corridors above first floor in Office Buildings; Classrooms, Corridors above first floor, First floor corridors in Schools.

#### B. Enhanced Accessibility

- (1) “It is the policy of the Utah State Building Board that, when appropriate for the intended use of the building and achievable within the project budget, the following accessibility enhancements beyond those required by the Americans with Disabilities Act be provided for in state owned buildings and buildings leased by DFCM: (1) powered door openers for the primary entrance designated for use by people with disabilities, and (2) powered door openers for one uni-sex restroom or for one male and one female restroom in the building unless restrooms with a door-less entry are provided. This policy is not intended to limit the use of powered door openers to the standard set forth herein. This policy applies to the construction or major renovation of state-owned facilities and new leases where the entire building is being leased by DFCM. This policy is not intended to create any rights to any third parties.
- (2) Determinations that one or both of these enhancements are not appropriate for the intended use of the building or not possible within the project or lease budget shall be made by the Director or his designee. Determinations of whether this enhancement to accessibility is appropriate should consider the potential of access by people with disabilities. The Director may determine that powered door openers are appropriate for the primary entrance while not warranted or not possible within the budget for access to restrooms. The Director may also determine that one or both of these enhancements are not feasible in (a) the renovation of an existing

building due to its design or configuration or (b) in a leased facility due to the nature and circumstances of the lease.”

C. Energy Efficient Products:

- (1) Select, where life-cycle cost-effective, products that are in the upper 25 percent range of the energy efficiency rating. Energy efficient products include:
  - a. Heating and cooling equipment;
  - b. Motors;
  - c. Lighting fixtures, compact fluorescent light bulbs, exit signs;
  - d. Windows, doors and skylights;
  - e. Roof products;
  - f. Food service equipment;
  - g. Transformers;
  - h. Office equipment;
  - i. Electronics; and
  - j. Appliances.
- (2) Exceptions:
  - a. Energy efficient products that have been stipulated as life-cycle cost-effective by DFCM.
  - b. ENERGY STAR® products that are certified and labeled through the US Environmental Protection Agency.
  - c. Energy Efficient Products listed items on General Service Administration, GSA Advantage website. “Energy Efficient Products” mean items that meet Federal Energy Management Program (FEMP) energy efficiency levels as required by the Federal Acquisition Regulation (FAR) Subpart 23.203, Executive Order 13123, and Executive Order 13221.

D. Energy Design Standards:

- (1) Buildings except Low-Rise Residential Buildings. Design facilities according to the applicable ANSI/ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, (Standard 90.1) at the time submitted to the State Building Official for mandatory

requirements and either the prescriptive, simplified, or energy-cost-budget methods:

- a. **Building Envelope Prescriptive Method.** Design an integrated system of building envelope components to reduce the envelope performance factor by 10 percent or more to what is required by Standard 90.1. Submit the Envelope Compliance Certificate declaring the building envelope meets Standard 90.1 requirements using DOE Comcheck software or Appendix C of Standard 90.1. The certificate shall show the envelope is 10 percent better than Code.
  - b. **Interior Lighting System Prescriptive Method.** Design the interior lighting system to reduce the interior lighting power density by 10 percent or more to what is required by Standard 90.1 using either the whole-building or space-by-space methods of Standard 90.1. Submit the Lighting and Power Certificate declaring the lighting and power system meet Standard 90.1 requirements using DOE Comcheck software. The certificate shall show the lighting power is 10 percent better than Code.
  - c. **Mechanical Systems Simplified Method.** Design the HVAC system type to meet Standard 90.1 requirements. Submit the Mechanical Certificate declaring the mechanical systems meet Standard 90.1 requirements using DOE Comcheck software.
  - d. **Energy-Cost-Budget Method (Optional).** Design the building to save 20 percent or more of the annual energy cost using the energy-cost-budget method. The energy-cost-budget method is an optional method to the prescriptive or simplified methods. Submit the Energy-Cost-Budget report from the Standard 90.1 User Manual. The form shall show annual energy cost is 20 percent better than Code.
- (2) **Low-Rise Residential Buildings.** Design facilities according to International Energy Conservation Code for mandatory requirements and either the component or system analysis methods:
- a. **Building Envelope.** Design the building envelope to meet the envelope performance factor by 10 percent or more using the building envelope component performance approach. Submit the Envelope Compliance Certificate declaring the building envelope meets IECC requirements using DOE Rescheck software. The certificate shall show the envelope is 10 percent or more than Code.
  - b. **System Analysis (Optional).** Design the building to save 20 percent or more of the annual energy use according to system analysis method.

- (3) Industrial, Laboratory, Research, and Other Energy-Intensive Facilities. Design industrial, laboratory, research, and other energy-intensive facilities or processes to reduce energy use by 10 percent or more over standard practice.

E. Hazardous Materials

- (1) DFCM shall procure a qualified abatement consultant during the Schematic Design phase of the Design stage. The abatement consultant shall survey all renovation and demolition projects for hazardous materials such as asbestos-containing building materials, lead-based paint, mold, universal wastes such as PCBs, CFCs, mercury, household/janitorial cleaning products, identified/unidentified containers of chemicals or products, or any other materials or waste that may be environmentally unsafe.
- (2) Prior to the start of a survey by the abatement consultant, the A/E shall provide drawings at the design development phase of the design stage to the abatement consultant with sufficient information to define the building or facility areas affected by the renovation or demolition. The abatement consultant shall coordinate abatement documents with the updated Contract Documents prior to final preparation. The abatement consultant shall prepare a complying and comprehensive hazardous materials survey report identifying and quantifying all hazardous and non-hazardous building materials to include asbestos-containing building materials, lead-based paint, mold and universal wastes that affect the areas of renovation or demolition.
- (3) DFCM shall procure a qualified abatement contractor to remove all hazardous materials prior to the beginning of any building demolition or renovation.

F. Vibration

- (1) Design structure in accordance with the following minimum requirements for vibration:

Space Category	Vibration Sensitivity
Laboratories with equipment sensitive to vibration	Comply with manufacturer’s requirements for vibration.
Offices, classrooms, and other similar spaces.	There are no vibrations from machines or traffic which are detectable by people.
Common Area spaces.	There is occasional movement in the floor when heavy equipment are moved nearby.
Storage spaces.	There is obvious and annoying movement when people walk by or equipment is being moved nearby.

G. Utah Space Standards

- (1) Comply with the “Utah Space Standards,” August 1994. Refer to [http://www.dfc.state.ut.us/downloads/3pubs/1994\\_08\\_space\\_standards.pdf](http://www.dfc.state.ut.us/downloads/3pubs/1994_08_space_standards.pdf).

## H. Infrastructure Flexibility

- (1) Interior Shear Walls: Minimize interior shear walls, bearing walls and braced frames which may disrupt future additions or modifications to the facility.
- (2) Spare Mechanical Space: Provide 25% spare space in pipe chases and for mechanical equipment (except air handlers).
- (3) Main Electrical Room: Locate main electrical room close to transformer and near the center of the load (which is usually located near where central mechanical equipment is located). Locate panelboards in satellite electrical rooms dedicated for electrical equipment and which stack vertically in the facility.
- (4) Spare Electrical Capacity: Provide 25% future space for additional overcurrent protection devices in panelboards and switchboards. Provide 25% additional load capacity in addition to the capacity required for continuous loads in panelboards and switchboards.
- (5) Communication Rooms: Locate communications rooms so they stack vertically and comply with TIA/EIA standards.
- (6) Spare Communication System Capacities: Provide 100% future space (this is not necessarily horizontal space, but may be vertical space in racks for future equipment) for cabling, data, and communications electronic equipment.
- (7) Equipment Access: In new facilities, provide access for replacement of equipment which does not require demolition.
- (8) Storage Space: Provide a minimum 6' X 6' space for storage of janitorial supplies or .2% of the gross square footage, whichever is greater.

## I. Standard Building Plaque

- (1) For development projects, provide a design for a building plaque to be mounted on a prominent wall near the entrance to the building in compliance with the DFCM plaque standard. Refer to [http://dfcm.utah.gov/downloads/plaque\\_policy.pdf](http://dfcm.utah.gov/downloads/plaque_policy.pdf) . (02/06/2008)

## 3.2 Civil

### A. Paving

- (1) Use untreated base course under all curbs and gutters. Use untreated base course material under all sidewalks exterior flatwork and paved areas.
- (2) Untreated base course under asphalt paving: Asphalt - 8" minimum compacted base (96%)

- (3) Concrete – curbs, gutters, sidewalks, exterior flatwork – Minimum 6” compacted base (96%) or minimum 4-3/4” crushed gravel.

<b>Untreated Base Course</b>	
<b>Size</b>	<b>% by Weight Paving Sieve</b>
1”	100
1/2”	70 to 100
#4	41 to 68
#16	21 to 41
#50	10 to 27
#200	4 to 13

- (4) Surface course (asphalt) aggregate:

<b>Surface Course (asphalt)</b>	
<b>Size</b>	<b>% by Weight Paving Sieve</b>
1/2”	100
3/8”	70 to 100
#4	50 to 78
#16	30 to 48
#50	18 to 31
#200	7 to 13

- (5) Base course (lower lift) can be 3/4” asphalt if placed in more than 1 lift.
- (6) Construct asphalt paving only when atmospheric temperature is above 50 degree F and underlying base is from moisture. Permit no vehicular traffic for at least 24 hours after laying asphalt pavements.
- (7) Striping paint: State of Utah #780. Spread at the rate of 103-113 sf/gal. Minimum thickness shall be 7 dry mil.
- (8) Tack coat all adjoining materials, i.e. previously constructed asphalt, concrete, etc. except untreated base course.
- (9) Surface smoothness: variation in the finished surface must not exceed 1/8” in 10 ft. in any direction.
- (10) Asphalt shall comply with Marshall Design with voids 1.5% to 3.0%
- (11) Drainage: Slope all asphalt concrete paving surfaces for positive drainage a minimum of 1.5% and preferable 2%.
- (12) Minimum thickness for parking areas: 3”. Minimum thickness for road areas and truck traffic is 3” including dumpster access.
- (13) Maximum thickness for lifts: 3”

### 3.3 Architectural

#### A. Suspended Ceiling Systems

- (1) Brief Description of the Problem. In as much as the IBC requires that suspended ceiling comply with the requirements of section 9.6.2.6 of ASCE 7 for installation in high seismic areas, the code section has 3 requirements which have been problematic in application:
  - a. The width of the perimeter supporting closure angle must be not less than 2 inches and the grid must have a  $\frac{3}{4}$ " clearance from the wall. This requirement has created an aesthetic nightmare for architects and contractors since the 2" angle brings out all irregularities on the plane of the wall and requires increased inspection time to ensure a  $\frac{3}{4}$ " clearance.
  - b. Except where rigid braces are used to limit lateral deflection, sprinkler heads and other penetrations shall have a 2 inch oversize ring, sleeve, or adapter through the ceiling tile to allow for free movement of at least one inch in all horizontal directions. Alternately, a swing joint is permitted to accomplish the same movement. The issues with this requirement is that the Fire Marshall and the fire protection community will not approve any oversize rings, sleeves or adapters which are not listed for this use and currently there are not listed systems on the market. The use of the swing joint is not defined in the code and no one has been able to establish how many joints are necessary to accomplish the horizontal movement of one inch in all directions.
  - c. Special inspection is required for suspended ceilings. This requirement is once again a problem since the ICC does not have a certification system for a ceiling inspector and we end up using a regular code inspector.
- (2) IBC section 104.11 allows the Building Official to approve alternate designs or methods of construction which he feels are equivalent or meet the intent of the current code. Uniform Building code Standard 25-2 for metal suspension systems for acoustical tile and for lay-in panel ceilings that can be found in the 1997 edition of the UBC is an equivalent standard that has been used in the codes for many years. This standard offers protection in all the seismic areas in the state and does eliminate all three of the issues identified above.
- (3) The State of Utah will allow the use of the 1997 UBC Standard 25-2 as an alternate means for the installation of suspended ceilings. This standard should remain available until all the issues identified above have been addressed by ICC and the listed materials are available in the market place. The designers may still use the current code requirements found in the 2003 IBC if they can show that they have met the intent of the current code.

B. Daylight and Outside Views

- (1) Daylight and outside views are desirable for all occupied spaces. The needs of some occupied spaces may require special consideration for light control.

C. New Roofing Requirements

- (1) Comply with Contractor Roofing Warranty: Include DFCM requirements. Refer to [http://dfcm.utah.gov/downloads/Roofing/Contractor%20Roofing%20Warranty%20\(final\).pdf](http://dfcm.utah.gov/downloads/Roofing/Contractor%20Roofing%20Warranty%20(final).pdf).
- (2) Comply with Guaranty for Bituminous Roofing: Include DFCM requirements. Refer to [http://dfcm.utah.gov/downloads/Roofing/Warranty%20for%20Bituminous%20Roofing%20\(final\).pdf](http://dfcm.utah.gov/downloads/Roofing/Warranty%20for%20Bituminous%20Roofing%20(final).pdf).
- (3) Comply with Guaranty for Single-Ply Roofing: Include DFCM requirements. Refer to [http://dfcm.utah.gov/downloads/Roofing/Warranty%20for%20Single%20Ply%20Roofing%20\(final\).pdf](http://dfcm.utah.gov/downloads/Roofing/Warranty%20for%20Single%20Ply%20Roofing%20(final).pdf).
- (4) Comply with the list of DFCM approved manufacturers and approved installers.
- (5) Where manufacturer's standards show one or more possible approach for compliance to the standard, provide their most stringent approach.
- (6) Eliminate conflict between roof penetrations (i.e. vents, exhausts) and roof crickets, flashing, and valleys. Consider relocating penetrations to less visible areas. Provide 18" access for replacing roofing components.
- (7) In new facilities, build slope into roof structure in lieu of built-up insulation to solve roof drainage issues.
- (8) Minimum slope for all roofing and waterproofing systems shall be a ¼" per foot along the longest drainage path.
- (9) Do not provide the following components, unless approved by the Director: Other Roofing Components: ballasted roofs.
- (10) All roofing systems and components should meet or exceed all ASTM, UL and FM requirements.
- (11) Minimum 60 mil thickness required for all single ply roofs.
- (12) Minimum 4-ply, type VI felts with type III asphalt for all built-up roofs.
- (13) All metal associated with the roof should be color clad, use standing seam joints where possible. Follow SMACNA guidelines for all metal work.

- (14) Provide reasonable access to all roof levels for maintenance personnel.
- (15) Steep slope roofing should be designed as directed by the DCM Program Manager.
- (16) Comply with all other minimum standards as published by the DFCM roofing group.

D. Replacement Roofing Requirements

- (1) Comply with Design Requirements Record Roofing Requirements.
- (2) Existing Roof System Components: For existing roofs, evaluate the feasibility of using existing insulation, sheet metal and other existing roof system components if they are in like new condition and will not have a deleterious effect on the new roof system.
- (3) Roof Slope: Each existing facility project shall be evaluated to determine existing roof slope and if additional slope is required to eliminate ponding.
- (4) Roof Diaphragm: Evaluate the existing roof to determine whether the diaphragm needs to be upgraded to meet current seismic requirements. Report shall include: 1) Existing conditions related to current requirements; 2) Recommendations for upgrading the diaphragm relative to an upgrade of the facility; 3) Estimated costs for upgrading the diaphragm.
- (5) Roof Load Evaluation: Evaluate the existing roof deck structure to determine the existing dead and live load capacity. The weight of the entire roof system shall not exceed an amount that would reduce the live load capacity of the roof structure below the current requirements. Report shall include: The existing conditions relative to current requirements; 2) Recommendations for upgrading the load capacity, relative to an upgrade of the facility; 3) Estimated costs for upgrading the structure.
- (6) Vapor Retarder: Determine the need for vapor retarder based on dew point calculations, facility use, and existing facility and roofing system conditions.

E. Waterproofing and Sealants

- (1) Warranty: For sealant systems, guarantee both labor and materials for a minimum of two years. For waterproofing project, guarantee both labor and materials for a minimum five years.
- (2) Qualifications: For Dampproofing and Waterproofing, select products that have performed successfully for a minimum 15 years and select manufacturers that have been producing materials for 15 years.

F. Acoustical Quality

- (1) When possible, design spaces in accordance with following minimum requirements for “Privacy.”

<b>Privacy</b>	
<b>Space Category</b>	<b>Measured NIC Rating</b>
Confidential with high voice levels	58-60+
Confidential with slightly raised voice levels	52-58
Confidential with normal voice levels	50-52
Confidential with lowered voice levels	45-50

- (2) Design spaces in accordance with the following minimum requirements for “Ambient Background Noise.

<b>Ambient Background Noise</b>	
<b>Space Category</b>	<b>Measured NC Rating</b>
Critical Performing Spaces	<20
Performing Spaces, Courtrooms, Executive Offices	20-30
Sleeping, testing, or relaxing spaces	25-35
Private offices, small conference rooms, classrooms, libraries	30 -35
Open offices, reception areas, cafeterias, gymnasiums	35-40
Lobbies, laboratories, maintenance shops	40 -45
Kitchens, industrial shops, equipment rooms	45-55

G. Guardrails

- (1) Comply with code requirements for opening size but orient the members so that a ladder effect does not occur.

3.4 Structural

A. Concrete

- (1) Warranty: Provide additional two-year written guarantee commencing on the date of substantial completion to promptly remove and/or repair defective concrete (pitting, spalling, cracking, honeycombing, etc.).
- (2) Concrete Strengths & Testing: Provide minimum compressive strength measured at 28 days of 3000 psi for foundations, stem walls, piers, miscellaneous interior walls, etc., and 4000 psi minimum for all exterior flatwork, ramps, curbs, gutters catch basins, concrete pavements, interior floor slabs, elevated slabs, shear walls and columns. DFCM allows shear wall and columns to be specified in excess of 4000 psi. Specify pre-cast concrete with a minimum strength of 5000 psi.
- (3) Cement Types: Comply with the recommendations of the Geotechnical report. DFCM requires one of these types: Type I or Type II (both low alkali) and Type V. In southern Utah, usually select Type V. In other parts of the state select Type I or Type II (low alkali).

- (4) Concrete Mix: Provide low alkali cement for all concrete in direct contact with earth. Specify water/cement ratios in accordance with ACI 318. Specify number of bags of cement per/yard in accordance with C150. Provide admixtures complying with the requirements of ASTM C260 for air entrained concrete. Do not use “IA”, “IIA”, etc. For frost resistant concrete, the following minimum air contents are required for concrete in direct contact with soils or exposed to severe salting: for ¾” maximum aggregate size per C33, provide air content per ASTM C260 of 6-1/2%+ 1-1/2%; for 1”, provide 6%+ 1-1/2%; for 1-1/2”, provide 5-1/2”+1%. Water cement ratios shall be limited to 0.50. (excluding grout mixes) The slump of all concrete shall be limited to 4” unless plasticizers are used. A maximum of 10% fly ash is allowed.
- (5) Testing: DFCM shall pay for testing, unless other procedures are specified. The frequency and minimum numbers of test cylinders shall be as outlined in the IBC, however at least three test cylinders must be taken from each pour related to a structural member. The intent is to not to do testing on concrete for items such as curb, gutter, sidewalk, mow strips, light pole bases, etc.
- (6) Reinforcement: Reinforce all concrete with conventional rebar or welded wire fabric. Slabs on grade supporting less than 400 psf uniform loads and no rack loads may be un-reinforced. The sub-base for all un-reinforced slabs must be uniformly compacted with on-site observation and per requirements specified in the project specifications.

### 3.5 Mechanical

#### A. Controllability of Systems

- (1) Maintaining space comfort temperature is an important consideration in the design of the mechanical system along with the proper ventilation within each space. This is accomplished best by the proper zoning of the space with regards to the mechanical system installed and the ability to control the temperature within each zone. The zoning for control of the space temperature shall be such that corner spaces having multiple exposures, office spaces for directors, managers, or other such individuals, and conference rooms larger than 200 square feet, shall have individual space control. Other multiple spaces shall be zoned with these spaces of like size, occupancy, and exposures are one zone and do not exceed more than four spaces per zone. Open spaces, such as open offices, shall not exceed one zone per every 750 square feet. Individual classroom spaces may be zone as a single zone even if the space exceeds 750 square feet with consideration for noise and air distribution (some large classroom spaces may need more than one zone for temperature control). Laboratory space zoning will be matched to the exhaust requirements for the labs and size of the laboratory space.

B. Indoor Air Quality

- (1) Comply with ASHRAE 62.1-2004 and all approved addenda for Indoor Air Quality performance.
- (2) Comply with the carbon dioxide differentials for all types of occupancy are accordance with ASHRAE 62-2001, Appendix D.

C. Plumbing General Requirements

- (1) Insulation: Completely insulate the following systems: all domestic cold water piping above ceiling; all domestic hot water piping and recirculation lines; roof drain and overflow piping including horizontal piping above ceilings, vertical piping below roof drain bowl, and roof drain bowls. Provide protective covering for exposed insulation in areas subjected to damage.
- (2) Exterior piping insulation: Cover all insulation with aluminum jackets secured with aluminum bands 12 inches o.c. Seal joints watertight.
- (3) Main plumbing connections: Locate main water, and sewer connections and mechanical rooms on the same side of site as service, preferably close to maximum demand points such as core toilet stack, kitchens, boiler room, and fire protection systems.
- (4) Piping installation: Install piping overhead wherever possible. Avoid installing piping below or in concrete slab floors. Install piping on warm side of building insulation. Provide water-tight sleeve and caulking around pipe for all piping passing through floors.
- (5) Exposed pipe: comply with ASTM 53.
- (6) Underground pipe: comply with ASTM A106.
- (7) Roof drains: provide minimum 3 inch roof drains.
- (8) Equipment Pads: Provide minimum 4" high concrete bases for all pumps, air compressors, boilers, chillers, and other equipment.
- (9) Valves: Install valves with bonnets at least 45 degrees above the horizontal to ensure debris does not collect in bonnet.

D. Water System

- (1) Municipal Water Meter: Each facility shall have a compound water meter installed in the water line serving the facility in accordance with local water authority.
- (2) Campus Water Meters. Install meter in the main mechanical room or within easy access of mechanical spaces. If conditions do not permit inside installation, provide meter box outside. Where fire sprinklers are

installed, the fire main shall be connected ahead of the meter. Where outside meters are used, the meter box shall be 52" x 81" x 71" high with a concrete base under the meter, but the rest of the floor shall be gravel. Top shall have recessed eyes. Top to be poured separate so it can be moved off with a crane and the eyes shall be left large enough to insert a chain by which can be lifted. Cover to have a 24 inch locking meter lid in center. Position meter so it can be read without personnel entering the vault. Water meter indicator shall be the totalize type reading directly in gallons of water. Water meter shall be installed with valves on both sides so meter can be removed and a bypass line installed. Sleeve around pipes passing through walls of meter box.

- (3) Domestic Water Pressure shall be maintained at a reasonable operating pressure, i.e., 50 – 80 psig.
- (4) Valves: Provide valves near the main with a union for all branch lines of water which supply more than one outlet or unit so areas of the building may be shut down for repair without having to shut down large areas. Provide isolation valves as necessary and provide, as a minimum, valves for each toilet group outside of the toilet room, each floor, and each branch line that is 2" or greater. Provide a shutoff valve on all water supply lines on the room side of the fixture. Valves shall have a gasket seat, not a ground joint. Supply lines from the valve shall be 3/8" brass, chrome plated. Provide chases or access panels to access valves. In lieu of oversized globe valves, ball valves with full opening ports and adequate pressure and temperature rating may be provided up to two inches in size. For valves greater than two inches in size, butterfly valves with wheel and gear operator may be used.
- (5) Water relief valves: Connect water relief valve exhaust or discharge to nearby floor drain. Provide sump in pipe tunnels at each cleanout. Provide floor drains in toilet and utility rooms.
- (6) Faucets and hose bibs: Provide non-freeze type hose bibs with shut-off valves for the lines serving the hose bib located inside facility. Provide faucet with hose attachment and vacuum breaker in each restroom so floor can be washed with clean water. Provide hose bib with vacuum breaker in mechanical rooms and chiller rooms. Provide non-freeze hose bib with vacuum breaker near cooling tower. Provide hose bibs outside building for window washing, walk and area way washdown (generally not more than 150' on center).
- (7) Inaccessible Water Piping: Provide Duiiron cast iron pipe, PVC "Blue Brute", or copper up to 2 inches in size, for water lines under building slab or other inaccessible locations.
- (8) Soil cover for outside services greater than 6000 HDD: Provide minimum cover of 48" or preferred cover of 60" for water. In no instance shall the minimum depth be less than the frost line.

- (9) Soil cover for outside services less than 6000 HDD: Provide minimum cover of 36" or preferred cover of 48" for water.

E. Waste System

- (1) Pipe Tunnel Sumps: Provide sump in pipe tunnels at each cleanout. Sump shall be three foot square and four feet deep with grating cover and porous walls. Floor drains may be used in lieu of sump if depth of waste line is such that drains may be tied in.
- (2) Drains: Provide drains indirectly connected to building drainage system for walk-in refrigerators and other places where food is stored. Provide floor drains in toilet and utility rooms. Provide deep seal P-traps on all floor drains.
- (3) Equipment Room Floor Drains: Trenches with grating covers with bottoms sloped to drain are preferred over multi-floor drains in mechanical equipment rooms and some laboratories.
- (4) Water still drains: Provide Kimax glass to nearest main drain from water still drains or provide glass pipe for the first 20 feet horizontally or to the floor below. Provide cleanout at water still and at main drain line before glass is connected with soil piping
- (5) Waterproofing pans: Provide membrane waterproofing pans for shower stalls and custodial floor sinks so they are 100% water tight. Provide clamping device which clamps drain to pans. Provide a mastic seal between floor drain bottom and lead or membrane so when clamping device is tightened there is a complete seal so no water can get through. Do not clog weep holes. Test pans by placing test plug in drain and filling with water overnight.
- (6) Dishwasher connections: Provide indirect connection for waste on automatic dishwashing machines. Install minimum 3" drain so that it is accessible under conveyor table.
- (7) Cleanouts: Provide cleanouts at base of each vertical rise, each turn in excess of 45 degrees and on straight runs every 50 feet.
- (8) Horizontal Waste lines: Provide dedicated minimum 3" horizontal waste lines with adequate cleanouts for garbage disposals and dishwashers.
- (9) Roof drains: Roof drain piping shall not be less than 3 inches.
- (10) Flush valves: Provide screwdriver stop valves on flush valves for water closets and urinals. Provide exposed type flush valves.

F. Plumbing Fixtures and Equipment

- (1) Water Heaters: Coordinate installation so that nothing will interfere with the removal of water heaters or for heating coils in heat exchangers to

allow for periodic cleaning. Provide unions for all connecting piping to facilitate the removal of piping. Provide combination temperature and pressure relief valve piped to adequate drain. Where feasible install flexible connections and tie-down straps to accommodate movement during seismic events.

- (2) Toilet Room Fixtures: Provide exposed type flush valves with lever operator (no push buttons or floor operators), diaphragm type only. In restrooms subject to vandalism, provide concealed flush valves. If space and budget allows, flush valves may be concealed in other applications. Hands free sensor actuated valves are acceptable, if acceptable by the Agency. Provide fixtures manufactured by one manufacturer.
- (3) Showers: Provide non-scald type shower valve with integral stops. Provide institutional type shower heads with flow adjustment and adjustable head and spray. Extend head out from wall so water does not run down wall when valve is turned off. Heads shall be vandal proof. Provide watertight shower escutcheon with weep hole in bottom.
- (4) Waterproofing pans: Provide membrane or lead waterproofing pans for shower stalls and custodial floor sinks so they are 100% water tight. Provide clamping device which clamps drain to pans. Provide a mastic seal between floor drain bottom and lead or membrane so when clamping device is tightened there is a complete seal so no water can get through. Do not clog weep holes. Test pans by placing test plug in drain and filling with water overnight.
- (5) Drinking Fountains: Provide refrigerated type, wall hung drinking fountains with stainless basins. Provide removable grid strainer to enable cable-style cleaning without having to dismantle the fountain.
- (6) Do not specify the following components, unless approved by the Director: Toilet Room Fixtures: Tank type

#### G. HVAC General

- (1) Heating systems: Hot water systems are the preferred heating systems. Provide air separators and expansion tanks for all hot water heating systems regardless of piping arrangement. Tie air separators into piping system on suction side of circulating pump. If campus system hot water system is turned off during the summer, provide alternate heating system for equipment requiring a heating source.
- (2) HVAC: Locate mechanical rooms to take advantage of ductwork and piping proximities to major loads. Provide continuous cooling for telecommunication and main telecommunication room. Carefully coordinate the location of any exhaust or relief air with mechanical air intake systems to avoid short cycling. Provide dedicated relief air path for all systems which introduce outside air. Exfiltration through the building envelope does not comply with this requirement.

- (3) Redundancy: Provide for continuous operation through redundancy and/or modularization for facilities greater than 30,000 sf or which have critical functions or critical care residents. The loss of one half or less of the design cooling or heating system for the entire facility shall be tolerated temporarily in the event of equipment failure for: heat pumps, boilers, refrigeration machinery (excluding cooling towers), and condensate pumps.
- (4) Access: Provide stair access to equipment. Provide disassembly access for all valves, piping, and equipment.
- (5) Water Treatment: Provide water treatment for heating water systems, chilled water systems, condenser water systems, and steam systems. Provide for one year on site service by water treatment company including supply of chemicals. Provide treated water in the heating system until facility is accepted by DFCM.

#### H. Air Distribution

- (1) Filtration: Air handling equipment shall be fitted with filters in the medium efficiency category having an average efficiency of 25% to 35% based on MERV rating criteria. Specify that the Contractor replace all filters prior to building occupancy and provide one replacement set of filters for the entire facility. For air handlers exceeding 10,000 cfm, provide pressure differential instrumentation across the filter bank to facilitate maintenance.
- (2) Ductwork Materials: Provide rectangular and round ductwork from galvanized steel, stainless steel or aluminum. Leakage requirements shall meet or exceed SMACNA standards.
- (3) Volume Adjusting Devices: Provide devices that can be securely locking in place and that are accessible for adjustment after construction.
- (4) Do not provide the following components, unless approved by the Director:
  - a. Duct Lining: lining of outside air ducts, lining of ductwork within 10 feet downstream of any device that adds moisture to the air stream, lining of ductwork exposed to humid air stream above 70% RH such as swimming pool applications.
  - b. Ductwork: Fiberboard ductwork.

#### I. Piping System

- (1) Design Requirements
- (2) Piping Systems: Piping system shall be provided with manual air vent valves at system high points and drain valves at system low points. Suitable provisions, such as access panels, shall be furnished in building

construction to permit full access to these valves. Manual air vents shall be 3/8" globe valves with 1/4" copper tubing to near floor or to locations where water may be caught in bucket. Drain valves shall be threaded for 3/4" hose connections. Provide water-tight sleeve and caulking around pipe for all piping passing through floors.

- (3) Pumps: Provide pressure gauge with gauge cocks as close to pump suction and discharge as possible and avoid pressure drops across valves, strainer, flexible connectors, etc. Provide suitable throttling valves on discharge side of all pumps, such as globe valves, or balancing cocks. Throttling valve shall have set point position indicator and shall not be used for shut-off valve.
- (4) Exposed pipe: comply with ASTM 53.
- (5) Underground pipe: comply with ASTM A106.
- (6) Air Vents: Provide suitable air vents for all heat producing equipment (converters, unit heaters, coils, etc.).
- (7) Valves: Provide valves near the main with a union for all branch lines of water or steam which supply more than one outlet or unit so areas of the building may be shut down for repair without having to shut down large areas. For valves 2" and larger on systems greater than 200 degrees F shall be flanged or grooved.

#### J. Steam

- (1) Motor Operated Steam Valve: If the existing central plant serving the campus is a steam system, provide a motor operated steam valve for each new building. Coordinate location with the Agency. If equipment requires steam when the valve may be closed, connect equipment ahead of motor operated steam valve. Design for gravity flow of condensate in lieu of providing vacuum pumps. Provide tunnels, chases, access doors, or crawl spaces for accessing steam piping. Do not install underground or in split tile. Provide properly dripped steam mains. Provide drip legs ahead of all steam pressure reducing valves and steam coils to ensure clean, dry steam at the valve.
- (2) Valves: Low pressure steam valves shall have a 200 psi rating and allow renewable seats and discs. For 100 psi steam line use 25 psi flanges and 300 psi screwed valves. Provide valves near the main with a union for all branch lines of steam which supply more than one outlet or unit so areas of the building may be shut down for repair without having to shut down large areas.
- (3) Steam piping: For steam piping 2" and smaller, provide schedule 80 black steel. For sizes 2-1/2" or larger, provide schedule 40 black steel for low pressure steam (15 psig or less) and schedule 80 black steel for high pressure steam (higher than 15 psig). Provide low pressure steam valves

with a 200 psi rating and allow renewable seats and discs. Provide 250 psi flanges and 300 psi screwed valves for 100 psi steam lines.

- (4) Condensate piping: Provide schedule 80 black steel pipe, including underground return lines.
- (5) Underground steam lines: Provide Gilsulate, Ric-wil, Portage and Durrant insulated underground pipe for underground steam lines. If pre-insulated piping is used, provide separate insulated conduits for steam and condensate return piping.
- (6) Expansion Provisions: Provide expansion loops, swing joints, offsets, etc., for expansion of piping. Do not use expansion joints except when expansion loops, offsets, swing joints, etc., are possible due to space constraints. If expansion joints are provided, provide adequate internal or external guides that are properly supported anchored. Do not provide swing joints on main runs; however, swing joints may be installed on risers off the main.
- (7) Pressure reducing stations: Provide pilot-operated valve for pressure reducing stations. Provide a three-valve by-pass at all reducing stations with ample clearance to permit normal maintenance and inspection. Recommend parallel pressure reducing stations when low demand is expected. Provide safety relief valves on the low pressure side of regulator stations. Provide discharge piping to facility exterior in a safe location. For pipes discharging near grade, install pipes into an eight inch concrete tie set upright in the ground (buried) over a gravel base twelve inches deep. Provide pressure gauges on both the high pressure and low pressure sides of all regulator stations. Locate gauges so they will function when bypass is used.
- (8) Steam Meter: Provide totalizing type meter which reads directly in pounds of steam.
- (9) Miscellaneous Requirements: Provide eccentric reducers when steam piping changes pipe sizes. Provide water-tight sleeve and caulking around pipe for all piping passing through floors.

#### K. Natural Gas

- (1) Seismic gas shut off valve: Provide a seismic gas shut off valve installed per manufacturer's instructions for each natural gas system.
- (2) Natural Gas Piping: Weld all concealed natural gas piping if larger than 4". Where feasible install flexible connections and tie-down straps to accommodate movement during seismic events.
- (3) Soil cover for outside services greater than 6000 HDD: Provide minimum cover of 24" or preferred cover of 36" for gas.

- (4) Soil cover for outside services less than 6000 HDD: Provide minimum cover of 24” or preferred cover of 36” for gas.

L. HVAC Equipment

- (1) Boilers: Provide boiler backup by redundancy or modularization. If a power burner is specified, the A/E shall determine the maximum allowable length of positive pressure flue.
- (2) Unit Heaters: If a unit heater is higher than 10’ AFF, a centrifugal blower shall be provided and not a propeller fan. Provide all gas or oil unit heater with a 2-stage thermostat. On call for heat, the stage cycles the fan. The second stage fires the burner. For shop applications with heavy duty or corrosive atmospheres, provide sealed combustion units that bring combustion air from outside the space.
- (3) Water Chillers: Specify appropriate ARI Standards and certification.
- (4) Cooling Towers: Specify certification by the Cooling Technology Institute.
- (5) Converters: Provide side inlets and side outlets for all converters. Provide pressure gauges with snubbers on the primary and secondary side of each converter. Install thermometers on the inlet and outlet of the secondary side of each converter.
- (6) Do not provide the following components, unless approved by the Director: HVAC Equipment: electric resistance heat, furnaces.

M. Integrated Automation

- (1) Direct Digital Control: Provide direct digital control in all facilities, except where operations personnel require pneumatic control as an extension of an existing system. Provide digital metering of electrical, hot water, steam, and chilled water sources to each facility. Provide flow metering devices hot water heating systems. Provide straightforward DDC control systems. Avoid locating thermostats on outside walls or on partitions between offices. For perimeter radiant systems, provide Hydronic piping subcircuits to match the cooling zones.
- (2) Control valves: Provide visual position indicators. Provide control valves with stem in the vertical position. If possible, provide packless valves. Do not provide “self-contained” valves.
- (3) Dampers: Provide low leakage design of felt or neoprene edges for fresh air and exhaust air dampers. Provide opposed blade type modulating dampers with maximum blade width of eight inches. Provide fresh air dampers that close in fan shutdown or power failure. Provide steel trunnions mounted in bronze sleeve bearing or ball bearings for damper blades. Do not exceed 48 inches in length between damper bearings. Provide dampers that close substantially tight and provide substantially the

full area of the opening when open. Provide substantial bar or channel frames for dampers. For rectangular dampers larger than four square feet in area, provide additional corner bracing.

- (4) Thermostats: If system supports DDC monitoring, provide solid state thermostats. Thermostats in corridors, halls, restrooms and other similar unsupervised areas shall be flush mounted aspirating type with stainless steel cover. Thermostats in public, but supervised areas shall have locking covers with concealed adjustment. Thermostats in private offices may have exposed adjustments.
- (5) Panels: Provide control devices, relays, piping, wiring and terminals in cabinets, except that switches, pilot lights, and push buttons mounted on the door. Provide minimum 14 gauge steel or 12 gauge aluminum. Equip doors with hinges, latches, and locks. Secure panels to walls, columns or floors with clearances required by NEC. Provide two (2) keys for each panel.
- (6) Wall Mounted Control Diagrams: Provide plastic laminated copies of all applicable controls diagrams mounted on the wall in each equipment room.
- (7) Control wiring: Provide control wiring in raceway complying with the requirements of DIV 16, ~~except that 1/2" C may be installed for control wiring of less than 50 volts which complies with NEC conduit fill requirements.~~ Section 3.6 Electrical.

#### N. Automatic Sprinkler Systems

- (1) Provide an automatic sprinkler system in buildings when required by ~~the building codes adopted by the State of Utah.~~ State Fire Marshals Rules R710. The Installation shall conform to Sate Fire Marshals Rule R710 and NFPA 13.
- (2) It is desirable that all buildings constructed by the State of Utah be equipped with an automatic sprinkler system to provide added life safety for the occupants and to protect the building from fire loss.
- (3) Fire sprinklers shall be considered as an integral component of building design when the availability of water supply and the cost do not make the installation prohibitive.
- (4) Secondary structures and small buildings or buildings with low occupant loads may be excluded from this requirement with the approval of the Director.

### 3.6 Electrical (06/30/2008)

- A. The following Codes and Standards are to be considered a minimum requirement for section 3.6. Where items contained in this section are in conflict with any of the following codes or standards the more stringent requirement shall apply.

- (1) National Electrical Code- NEC “2005”
- (2) International Building Code- IBC “2006”
- (3) International Energy Conservation Code- IECC “2007”
- (4) Illuminating Engineering Society of North America- IESNA Handbook 9<sup>th</sup> Edition
- (5) UL 96A
- (6) NFPA 780
- (7) Utah State Fire Marshals rules R710
- (8) National Fire Alarm Code- NFPA 72 “2007”

B. Emergency Electrical Requirements

- (1) ~~Modify paragraph 700.12 General Requirements of the NEC “Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, emergency lighting, emergency power, or both shall be available within the time required for the application but not to exceed 10 seconds. The supply system for emergency purposes for buildings totaling less than 5000 sf, in addition to the normal services to the building and meeting the general requirements of this section, shall be one or more of the types of systems described in 700.12 (A) through 700.12 (E). Unit equipment in accordance with 700.12(F) shall satisfy the applicable requirements of this article for buildings totaling less than 5000 sf. The supply system for emergency purposes for buildings totaling 5000 sf or greater, in addition to the normal services to the building and meeting the general requirements of this section, shall be the type of system described by 700.12 (B). This requirement shall not prohibit the use of the supply systems 700.12 (A), or 700.12 (C) through (F), for buildings totaling 5000 sf or greater, if these systems are required for safety purposes and if these systems are automatically connected to a Generator Set as described in 700.12 (B).”~~ [The balance of section 700 is unchanged.]
- (2) ~~Modify paragraph 701.11 Legally Required Standby Systems of the NEC~~
- (3) ~~“Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, legally required standby power will be available within the time required for the application but not to exceed 20 seconds. The supply system for legally required standby purposes for buildings totaling less than 5000 sf, in addition to the normal services to the building shall be permitted to comprise one or more of the types of systems described in 701.11(A) through 701.11 (F). Unit equipment in accordance with 701.11(G) shall satisfy the applicable requirements of this article for buildings totaling less than 5000 sf. The supply system for legally required standby purposes for~~

~~buildings totaling 5000 sf or greater, in addition to the normal services to the building shall be required to be the type of system described by 701.11 (B). This requirement shall not prohibit the use of the supply systems 701.11 (A), or 701.11 (C) through (G), for buildings totaling 5000 sf or greater if these systems are required for safety purposes and if these systems are automatically connected to a Generator Set as described in 701.11 (B).” [The balance of this section is unchanged.]~~

- (4) ~~The Director of DFCM may authorize battery packs in suitable applications when the standard is not achievable due to the unique circumstances of a particular project or the constraints of the project budget.~~

C. Lighting

- (1) Occupants within an enclosed space shall have the capability to adjust the lighting within the enclosed space.
- (2) All lighting shall meet or exceed the current energy code for watts per square foot, control requirements and other requirements. All lighting shall utilize the most efficient lamps and ballasts available for the application. All incandescent lighting must be approved by the DFCM representative.
- (3) Light Pollution Reduction: Comply with Light Pollution Reduction requirements, unless otherwise directed by the DFCM’s Designated Representative.
- (4) Comply with the Illuminating Engineering Society of North America (IESNA) Recommended Practice Manual: “Lighting for Exterior Environments (RP-33-99).” Provide exterior luminaires which are shielded. For luminaires with more than 3000 initial lamp lumens, provide Full Cutoff (IESNA Classification) luminaires. Interior lighting shall be positioned so that the maximum candela value does not fall outside the interior space, such as out through a window. Exterior lighting shall be located so that the maximum candela value of all exterior lighting shall fall within the property. Provide shielding for any luminaires within a distance of 2.25 times its mounting height from the property boundary so that no light from the luminaire illuminates past the property boundary.
- (5) Lighting Fixtures. Provide lenses that will not yellow due to exposure to sunlight or to the light sources in the fixture. When acrylic diffusers are specified, provide 100% virgin acrylic. Provide electronic ballast suitable for the load type, energy savings, and starting temperatures required ~~except that magnetic ballasts may be used in outdoor applications.~~ Provide program start ballasts if available for the lamp type. Connect equipment grounding conductor to fixture housing. Provide 10% spare lamps, diffusers or glass for each light fixture type with not less than one for less than 10.
- (6) Interior Lighting: Provide T-8 lamps in fixtures, except for areas requiring special lighting. Provide independent safety-wires attached to structure at

two diagonal corners of lighting fixtures in compliance with seismic requirements. For recessed fluorescent fixtures that are removable, locate outlet box with 3' of steel flexible conduit to the fixture to aid in removing and relocating fixture.

- (7) Exterior Lighting: Provide -10 degree F. ballasts, either constant wattage or pulse start. Provide break-away fuses for all phase conductors for all outside pole mounted lighting fixtures. Provide a shorting fuse insert for neutral fuse holder. Do not use common neutral multi-wire circuits for this type of lighting.
- (8) Reflected Ceiling Plan Coordination: Coordinate the lighting fixture with the reflected ceiling plan for **suspended** lay-in, and surface mounted fixtures. Recessed lighting fixtures in acoustical tile ceiling shall be located centered on a single tile. ~~or at the intersection of four tiles.~~
- (9) Lighting Fixture Supports: Provide swivel bases for stems supporting lighting fixture which exceed 12" in length.
- (10) **HID Sources: Provide Constant Wattage ballasts. Use metal halide sources,** provide Pulse Start Metal Halide lamps and **electronic** ballasts. ~~For indoor, provide pulse start electronic ballasts. For outdoor up to 200 watts, provide pulse start electronic ballasts. For outdoor above 200 watts, provide magnetic ballasts if control, noise, and flicker requirements are satisfied. Where High Pressure Sodium sources are approved, use auto-regulating ballasts.~~

D. Raceways to 600 V

- (+) Raceways, Fittings, and Boxes. Provide steel raceway, fitting, and box system for all wiring, except that plastic conduit (minimum schedule 40) may be installed underground and aluminum cable trays may be installed for communications cabling. For steel raceway **when** installed in contact with soil, provide rigid or IMC PVC coated or wrapped raceways, fittings, etc. Provide steel raceways for penetrating structural elements (minimum 40° **6"** each side) and rigid steel conduit (PVC coated or wrapped) for bends greater than ~~22~~ **30** degrees. Provide minimum ~~3/4"~~ **1/2"** raceways **except Communications raceways shall be 3/4" minimum.** ~~except 1/2" may be provided for HVAC Instrumentation and Control. For Communications raceway, the bend must be a minimum 6 times the diameter for sizes 2" or less and 10 times the diameter for larger than 2".~~ Provide flexible steel conduit (minimum 1/2") in short lengths where movement, vibration, misalignment or cramped quarters exist. Provide insulated throat or equal type plastic bushings for box connections. ~~1" or larger. Provide double lock nuts and plastic bushings for IMC and rigid conduit.~~ Provide liquid-tight flexible conduit with approved moisture-tight fittings for wet, humid, corrosive or oily locations. Provide a minimum 18" liquid-tight flexible conduit at each motor. ~~Provide minimum 4/s box 1-1/2" deep with plaster rings, except provide 3-1/2" deep masonry boxes for masonry. For boxes with 3 or more raceway entrances, provide minimum 2-1/8" box. For boxes with 4 or more raceway entrances, provide~~

- (2) ~~4-11/16" boxes (except for masonry boxes). Provide gang boxes for multiple gang installations. Provide accessible junction boxes in interior raceway runs at minimum 100-foot intervals. Provide minimum 12" clearance from hot water and steam lines measured from outside of insulation.~~
- (3) Electrical Supports. All raceways, boxes, and conductors shall be supported independently from all other electrical or mechanical systems, directly from building structure by a listed supporting device. ~~Provide bracing parallel to trusses, beams, joist, bridging, etc. Provide anchors capable of supporting 4 times the weight of the unit supported, but not less than 100 lbs. For ceiling fixture outlet boxes, provide minimum supporting capacity of 200 lbs and a standard 3/8" stud. Provide outlet boxes with rigid support using metal bar hangers between studs. Provide concrete pads 6 inches beyond the largest dimension of the equipment. Extend equipment pad a minimum of 4" above finished floor or grade.~~
- (4) Equipment Pads. Provide concrete pads a minimum of 6" beyond the dimensions of the equipment. Extend equipment pad a minimum of 4" above finished floor or grade.
- (5) ~~Steel Raceway Supports. Provide minimum of 2 supports per ten foot length; Support within 12 inches of bends, couplings, fittings and boxes, minimum of two straps per ten foot length. For 2 runs or less of 3/4" to 1-1/4" raceways, provide supports with full straps, clamps or hangers. For individual run 1-1/2" or larger raceways, provide supports with hangers. All other raceways, support with trapeze mounting channels.~~
- (6) Future Raceways: Provide five capped spare 3/4" conduits from each section of a flush mounted branch panel board into the ceiling and floor space. If the floor space is not accessible, provide an additional 3/4" conduit from each section of a branch panel board into the ceiling. Provide 200-lb nylon pull cord in all empty conduit, then cap raceway using a blank cover similar to adjacent wiring device covers.
- (7) Underground Raceway Identification and Installation: Provide direct buried conduit in an area outside a building not less 24" deep, with magnetic "yellow warning" ribbon 12" directly above and 6" below finished grade measured from the top of the conduit or duct bank.
- (8) Do not provide the following, unless approved by the Director:
- (9) Exposed cable wiring.
- (10) Other raceway systems: Electrical Non-metallic Tubing, aluminum conduit, die cast fittings, steel cable trays.

E. Conductors

- (1) ~~Conductors. Provide minimum #12 copper conductors with 600 V insulation (THW, THWN, THWN-2, XHHW, or XHHW-2) for all phase~~

~~conductors; unless ambient conditions require an increased insulation rating. Do not parallel less than #1/0 conductors. Do not feed conductors through one section of panelboard to connect to an overcurrent device in another section of panelboard. Provide separate neutrals for all GFI circuit breakers and for the load side of feed thru GFCI outlets. Provide minimum 12" clearance from hotwater and steam lines measured from outside of insulation.~~

- (2) Metal Clad Cable. Type MC Cable is allowed only when concealed in ceilings or walls. MC Cable must be protected from physical damage and supported directly from the building or structure by use of a listed support. MC Cable home runs are not allowed. Home runs must be in conduit from the electrical panel or cabinet to the first junction or pull box. MC Cable Used for Fire Alarm System Signaling or Initiation Circuits must have an overall outer coating of red.
- (3) Non-metallic sheathed cable may be used only for residential single or multi-family housing unless approved by DFCM Director.
- (4) Do not provide the following, unless approved by the Director: Exposed cable wiring. Splices in panel board, switchboard enclosures, or in conduit bodies.  
Other cabling methods: ~~Non-metallic sheathed cables (Romex), Metal Clad Cables,~~ Aluminum conductors.

#### F. Grounding

- (1) ~~Grounding. Ground all medium voltage equipment and exposed metals in the immediate area with the neutral conductor of the primary cable and with a minimum 5/8" X 10' ground rod. Provide grounding electrode system at the service entrance with, at a minimum, two of the following electrodes as defined in the NEC: metal underground water pipe, concrete-encased electrode, or ground ring. In addition, bond to other available electrodes. Provide a separate green grounding conductor enclosed with phase conductors in all raceways on the load side of the service entrance. Provide grounding bushings for all service raceways and for raceways installed in concentric/eccentric knockouts. All grounding systems shall be interconnected and/or bonded to the grounding electrode system. Upgrade as necessary existing electrical systems to comply with the NEC and these requirements.~~

#### G. Medium Voltage

- (1) Medium Voltage Conductors: Provide copper conductors with copper tape shields and EPR insulation and 100% copper neutral in Medium Voltage Duct banks; or, in utility tunnels or other areas without public access, provide armored cable or rigid conduit. Comply, as a minimum, with the installation requirements for Medium-Voltage Cable standard NECA 600-2003. Perform Hi-Pot test after terminations have been made, but before connections have been made to buses or apparatus. Perform continuity tests of all cables after entire installation and terminations have been

completed. If a cable fails to perform, replace faulty cable and retest. All tests will be recorded and submitted with M & O O&M manuals at project conclusion.

- (2) Medium Voltage Duct Banks. For interior of buildings in non-public areas, provide rigid galvanized conduit or armored cable marked with red HIGH VOLTAGE. For exterior applications or public areas, provide concrete encased duct-banks (red dye) with raceways in multiples of two and a minimum of one spare conduit (with polypropylene pull wire) per feeder. Provide rigid metal conduit for the first 10 feet of duct bank from a facility or manhole. Provide minimum 4" raceway.
- (3) ~~Medium Voltage Transformer: A/E shall design harmonic mitigation to reduce current total harmonic distortion (based upon full load capacity of the transformer) below 5%. Provide copper or aluminum windings. Provide transformer taps and adjust voltage output to obtain the proper value. Provide primary and secondary terminations at medium voltage transformers, cable, splices, etc. necessary to complete installation. Do not use Askarel transformers.~~
- (4) Lightning Protection: Provide lightning (surge) arresters for medium voltage transformers and switchgear located above ground outside.

#### H. Controller

- (1) ~~Motor controllers: Provide NEMA rated magnetic motor controllers with thermal overload relays for each phase. Provide auxiliary contacts, HOA switches or start-stop pushbuttons as appropriate, stop and run pilot lights, and reset pushbuttons. Provide fused control transformer in the starter for 120 V control. Provide safety interlock to prevent opening enclosure with equipment or control energized.~~
- (2) Variable Frequency ~~Controllers~~ **Drives: Provide variable frequency drives** suitable for the application, factory pre-wired with integral disconnect, input filter, and integral ventilation. ~~Coordinate approved manufacturers with the Agency. Provide interface to HVAC or Building Automation System for control.~~ For interior **location VFD's**, size ventilation for ambient temperature of 32 degrees F. to 90 degrees F. Avoid ~~exterior~~ **outdoor location** mounted **VFD's**; but, if required, provide ventilation for ambient temperatures from -30 degrees F. to 120 degrees F. Fault current rating shall be sized based upon the fault current analysis of the nearest upstream overcurrent device. Include factory startup and tune to optimize life of motor. ~~Provide VFCs which operate within the following normal ranges of inputs: +/- 10% input voltage; +/- 5% input frequency; less than 7% voltage THD. Provide VFCs which operate through voltage sags of 0% voltage for 1 cycle and 60% voltage for 10 cycles. For Motors 7.5 hp and larger, provide a minimum power quality performance of 12% current THD and 3% voltage THD at filter or VFC input by providing a broadband type filter or minimum 12 pulse VFC complying with the power quality performance requirements demonstrated by standard factory published data. For Motors less than 7.5 hp, provide AC Line Reactor or~~

~~DC Link Reactor. For VFC output filtering, provide output filter if drive output at motor termination exceeds pulse withstand capability. Provide 95% efficiency minimum including filter and 95% power factor. Provide local speed control, HOA switch, remote start/stop, external safeties, run annunciation, fault annunciation, and speed reference input connection. For maintenance purposes, provide stable operation including starting, stopping and running with the motor completely disconnected; provide auto-restart after a power failure; provide capability for starting into a rotating motor at any speed.~~

- (3) Provide a manual bypass of ~~UFC~~ the VFD as part of controller.
- (4) ~~Do not provide the following components, unless approved by the Director.~~
- (5) ~~Other Electrical Components: IEC motor controllers.~~

#### I. Electrical Distribution

- (1) Overcurrent and Ground Fault Protection: Set overcurrent and ground fault protection based upon Fault Current Protection and Coordination Study prepared by the A/E.
- (2) Submit study with ~~M & O~~ O&M manuals.
- (3) Transformers: Provide transformers with copper conductors. Provide transformer taps of 4 taps – 2.5% above normal and 2 taps – 2.5% below normal. Adjust voltage output to obtain the proper value at the main disconnect.
- (4) Metering: Provide secondary digital metering (including demand monitoring) at the main distribution panel(s) in each facility. ~~For secondary digital metering of services of 800 Amps or greater, include Harmonic monitoring and an option for building automation or remote monitoring. Indicate multiplying factor on meter face where current transformers are used.~~
- (5) Utility Metering: Comply with serving utility's regulations, if applicable. Comply with utility's metering requirements. Include cost assessed by serving utility.
- (6) Switchboards and Panel boards: Provide bus hardware installed on the bus for future over-current devices of not less than 25% minimum. Provide over-current devices in the same sequence as shown on the panel schedules or one-line diagrams. ~~Coordinate that the height of the operating handle of the over-current device does not exceed 6'6" above the floor. Identify main over-current protection devices.~~

- (7) Panel boards: Provide listed panel board construction for all branch panels and circuit breaker distribution panels. ~~For 3-phase 4-wire delta systems, connect Hi-Leg to center bus. Provide ground bus bonded to enclosure to terminate all equipment ground conductors. Include insulated ground bus for insulated ground circuits.~~ Load Centers and plug in circuit breakers may be used only in Residential Single and Multi-family residences unless approved by the DFCM Director. Key all panel boards alike and provide 3 keys.
- (8) Circuit Breakers: Provide one, two or three-pole over-current devices with common handle (not field modifiable). ~~Provide bolted connections.~~
- (9) ~~Do not use the following components, unless approved by the Director:~~  
~~Other Electrical Components: load centers, plug in circuit breakers.~~

#### J. Power Quality

- (1) The A/E shall include as a basis of design an evaluation of potential Harmonic Risks to the Electrical Distribution System and provide a plan to mitigate these risks. The Power Quality Plan shall be approved by the DFCM representative. Power Quality Testing may be performed by the DFCM after the facility is occupied to determine the effectiveness of the Power Quality Mitigation approach.
- (2) Electrical Services.
  - a. Services of 300 KVA or larger shall be 277/480 volt at the Service Main Disconnecting means except for those proven to be unnecessary and approved by the DFCM Director.
  - b. Harmonic producing (non linear) loads such as Lighting, VFD's, UPS's and Computer rooms shall be separated or grouped as far as reasonably cost effective.
  - c. All Panels fed from a Step Down transformer shall have 200% Neutral feeders.
  - d. All multi-wire branch circuits with shared neutrals shall have an oversized neutral. This neutral shall be at least one trade size larger than the phase conductors.
  - e. Provide 277 volt lighting wherever there is a 277/480 volt wye service available.
- (3) Existing Electrical Services. Power Quality Testing should be performed prior to the Upgrade, Addition or Alteration of any of the following Electrical Components or Systems, VFD's, UPS's, Step Down Transformers and Generators. It shall be determined from this testing the proper equipment and method to be used that will insure that the existing system will not be adversely affected by the work to be performed. Power

Quality Testing should be performed after completion to determine the effectiveness of the material and methods used.

- (4) Power Factor. All new Construction or Upgrade of existing Electrical Services shall meet the minimum requirement of 95% and Maximum of 98% Power Factor. The DFCM Representative shall approve the method and layout of Power Factor Correction Capacitors prior to installation.
- (5) Step Down Transformers.
  - a. All Step Down transformers shall be Energy Star Nema TPI K-rated or HMT with 200% Neutral capability, unless proven unnecessary and approved by the DFCM Representative. The K-Rating shall be as determined by Manufacture recommendations for the equipment they serve.
  - b. All Step Down transformers feeding Computer rooms or areas subject to high Non Linear loads shall be fed from a Harmonic Mitigating Transformer with 200 % Neutral.
- (6) Variable Frequency Drives. For motors 10 HP and larger, provide a minimum power quality performance of 12% current THD and 3% voltage THD measured at the VFD input terminals. This shall be accomplished by using Harmonic filters or a minimum of 12 pulse drive that will comply with the power quality performance requirements. For motors less than 10 hp provide AC Line Reactors with a minimum of 3% Impedance. Provide output filtering if the motor is located more than 50 feet from the drive.
- (7) Lighting. Electronic Ballasts shall have <20% THD for 277 volt lighting systems and <10% THD for 120 Volt Lighting Systems. In Existing Buildings where high Harmonic Currents are present provide <10% THD Ballasts.
- (8) Generators. For new construction a service that is to be backed up by a Generator shall be designed to have no more than 12% Current THD or 3% Voltage THD. For Existing Services to be backed up by a Generator Power Quality Testing shall be performed to determined that there is not more than 12% Current THD or 3% Voltage THD and that there is not a leading Power Factor. If there is it shall be corrected prior to bringing the Generator online.
- (9) Uninterruptible Power Supplies. Provide a minimum Power Quality performance of 12% current THD and 3% voltage THD measured at the UPS input terminals. Provide filtering if necessary.
- (10) Transient Voltage Suppression System. TVSS Shall be provided for the main service of each facility with services greater than 200 Amps. A second level of TVSS shall be provided for panels serving primarily computer or non linear loads.

#### K. Miscellaneous Electrical

- (1) ~~Lighting Contactors: Provide NEMA-rated lighting contactors with HOA.~~
- (2) ~~Wiring Devices: Locate switches so as not to exceed 48" to the bottom above finished floor. Except for floor boxes, locate convenience outlets so that outlet is not less than 18" to the bottom and not greater than 48" to the top above finished floor. Coordinate heights with cabinetry and finishes. Use feed-through GFCI outlets only if the outlet served is located in the same room. Convenience outlets (120 V) and switches (120/277V) shall be minimum 20A self-grounding with nylon faces and cover plates. Coordinate device colors and plates with the finishes. Provide industrial raised covers for surface switches and outlets. Arrange devices in gangs if multiple devices are located at the same location. Provide mounting strips and blank cover plates for outlet boxes without devices. Do not connect more than eight (8) convenience outlets on each 20A circuit.~~
- (3) Lightning Protection: If the risk analysis performed per NFPA 780 or UL 96A exceeds moderate risk, provide a lightning protection system. Minimum qualifications required: LPI-certified installer, designer, and inspector. Obtain a UL Master Label for the facility.
- (4) Generator Fuel Tank Size. Size fuel tank to comply with the needs of the facility or a minimum of 24 hours of operation at full load capacity.
- (5) Hazardous Classifications. Coordinate with the State Fire Marshall hazardous classifications and requirements, including class, division and group requirements.
- (6) Power Quality:
  - a. ~~A/E shall include in the Basis of Design an evaluation of the potential harmonic risks to the electrical distribution system and the approach to mitigate the risks to transformers, neutral conductors, and other equipment.~~
  - b. ~~Design TVSS for the main service of each facility with services greater than 200 A. Include a second level of TVSS for panelboards serving primarily computer or other electronic equipment.~~
  - c. ~~Specify harmonic testing of each transformer (voltage and current THD) after the facility is occupied to determine effectiveness of the Power Quality approach.~~
  - d. ~~Hazardous Classifications: Coordinate with Fire Marshall hazardous classifications and requirements, including class, division, and group requirements.~~
  - e. ~~Generator Fuel Tank Size: Size fuel tank to comply with Code requirements and facility needs. Allowance shall be made in the capacity so that there is adequate fuel to comply with these requirements when the tank indicates that it needs to be refilled.~~

~~Provide a minimum tank capacity for 24 hour continuous operation.~~

L. Structured Cabling

- (1) Test all structured cabling systems to demonstrate compliance with TIA/EIA standards for the category of system selected. Include warranty and the test results in the Project Resource Manual.

M. Fire Alarm

- (1) Provide addressable fire alarm systems as required by State Fire Marshals Rules R710. The Installation shall comply with Sate Fire Marshals Rules R710 and NFPA 72.
- (2) Install class "A" looped systems or as approved by Fire Marshal.
- (3) Do not use the following components, unless approved by the Director. Other Fire Alarm Components: Zoned Fire Alarm panels, ionization smoke detectors.

N. Misc. Systems

- (1) Determine requirements for other systems such as security, cctv, etc.

## **4.0 LANDSCAPE AND IRRIGATION STANDARDS**

### 4.1 Purpose

- A. The Division of Facilities Construction and Management (DFCM) has found that for state owned or developed properties:
  - (1) Water is an increasingly scarce resource.
  - (2) Nearly two thirds of the culinary water resources are used for outdoor use, including watering landscapes.
  - (3) The DFCM desires to promote the design, installation and maintenance of landscapes that are both attractive and water efficient.
  - (4) All state facilities are to be landscaped and the site developed to the project limit lines or natural boundaries. If a facility is in a natural setting, all construction damaged areas are to be restored to the extent practicable.
  - (5) The Landscape design for DFCM projects should recognize the Geological and Historic nature or context of the site.
  
- B. Applicability. The provisions of this section shall apply to all projects on state property that involve the development or major modification of landscaping regardless of funding source, and all other projects under the jurisdiction of the DFCM or under state mandates. This section does not apply to:
  - (1) Registered Historical Sites
  - (2) Sites submitted for variance to these guide lines due to unique context.
  - (3) Institutional or other sites with unique context.
  
- C. Documentation for Plan Approval. A Landscape Development Package shall be submitted to DFCM and the appropriate institution, agency or site manager for approval. Both the Landscape Plan and the Irrigation Plan in the Development Package shall be prepared by a Landscape Architect or another licensed professional as recognized by the State of Utah to perform Landscape Architectural services. Soils reports and other necessary documentation for plan approval must be submitted by the appropriate licensed professionals as stipulated by the State of Utah. The Landscape Development Package shall consist of all documents as listed in Section 3.3.7.

### 4.2 Principles and General Guidelines

- A. Soil Analysis: Quality topsoil is the foundation of quality landscapes. The growth rate, health and visual appearance of landscape plants are directly related to soil quality. Several chemical and physical characteristics influence topsoil quality: soluble salts, pH, texture, organic matter, coarse fragments, and nutrient content. The sodium adsorption ratio (SAR) is an additional property to consider if salinity

and/ or soil pH approach unacceptable levels. It is imperative that topsoil meet acceptable standards for these properties. If soil falls outside of acceptable standards for any one of these properties, reject the material or realize that amendments will need to be made in order to bring the top soil within the acceptable ranges. This will promote healthy plant growth. Soil types will vary from site to site. Soil type will affect irrigation scheduling. Soils may be improved if needed with organic matter to enhance drainage and moisture retention. Soil qualities to be tested but not limited to:

- (1) Soluble Salts
- (2) pH
- (3) Texture
- (4) Organic Matter
- (5) Course Fragments
- (6) Sodium Adsorption Ratio (SAR)
- (7) Nutrient Concentrations
- (8) % Sand
- (9) % Silt
- (10) % Clay

B. Appropriate Plant Selection and Zoning the Landscape: All plants shall conform to USDA zone requirements and be suitable to the local soils. Plants shall be selected according to appropriate solar aspect, exposure, and micro climates. Trees and shrubs should be placed to reduce solar gain in the summer and allow solar gain in the winter. Use healthy, well-adapted plants and zone the landscape by grouping plants together according to their water requirements. It is important to place the right plant in the right place. Avoid planting a high water-use plant next to a low water-use plant. Place plants in areas that will accommodate their mature size. Many beautiful trees, shrubs, perennials and groundcovers are available for use in a water-wise landscape. Select plants for their low water-use, drought tolerance, pest and disease resistance, size, color, form, texture, leaves, flowers, fruit and maintenance needs. Choose plants to provide year-round interest. Many plants have exceptional winter form, habit color, and texture. (Plant list is a comprehensive list of acceptable plants for DFCM projects. Some plants do not as of this time have a Water Zone or Plant Factor value. It is the designer's responsibility to understand the water requirements of these plants and to group the plants into the appropriate Hydra Zones. Any plants proposed to be used that are not on the list must be submitted to the DFCM for approval prior to being shown on the planting plan.)

C. Practical Turf Areas: Plant turf only in areas of manageable sizes and shapes. Limit turf to areas where it provides a functional benefit. Selection of appropriate

turf varieties should be determined by site location, functionality and climate. Excess turf may be replaced with a variety of other low water-use plants.

- D. **Efficient Irrigation:** Irrigation systems are to be designed for minimal maintenance and maximum water conservation. Irrigate efficiently – not excessively. Use properly designed systems and apply the right amount of water at the right time. Irrigate turf areas separately from other plantings. Turf is best watered with overhead sprinklers. Trees, shrubs, flowers and ground covers are watered most efficiently with low-volume drip, spray or bubbler emitters. Do not rely solely on an automatic timer. ET based controllers and soil sensors are encouraged. All irrigations systems shall have “rain delay or rain shut-off” capabilities. Water efficiently and only when needed.
- E. **Mulching:** Use mulches in tree, shrub and perennial borders to conserve soil moisture and increase soil nutrients. Mulch applied at the right depth will reduce weed growth and slow erosion. Organic mulches such as bark improve soil over time.
- F. **Appropriate Maintenance:** Water-wise landscaping will reduce maintenance; however, it will not eliminate it. Low water-use landscapes are simply maintained differently than the average lawn. Maintain the landscape by pruning, fertilizing, watering, weeding mowing and proper deadheading of perennials and flowering plant material.

#### 4.3 Water Allowances

- A. The use of water allowance or water budgeting will greatly encourage the design of water-wise landscape design. The amount of water required is dependent on the site context, but should generally follow the allowable use indicated below as a minimum. The Landscape water allowance shown below is for each project’s total landscape area per project.

Type of Facility		Water Allowance (% of allowable water used)
A.	Office type buildings	50%
B.	Existing campus/institution	70%
C.	New campus/institution	60%
D.	Recreational areas (ball fields etc.)	70%
E.	State Parks (natural areas)	10%

#### 4.4 Definitions

“Administrative Standards” shall mean the set of rules, procedures and requirements set forth in a landscape ordinance associated with making permit application, assembling materials for public review, meeting the requirements of the landscape ordinance, seeking approvals, enforcement, conducting site inspections, and filing reports.

“Bubbler” shall mean an irrigation head that delivers water to the root zone by “flooding” the planted area, usually measured in gallons per minute. Bubblers exhibit a trickle, umbrella or short stream pattern.

“Central Control” shall mean a control system which can operate multiple controllers, sensors, and other irrigation devices from one central location. The Central Controller can monitor conditions in the system and surrounding areas then control the site controller to properly respond to the conditions. The system can make adjustments and operate without personal intervention. The monitor function of a central control system may consist of but not limited to the following: Flow sensors, soil moisture sensors, wind sensors, weather stations and rain sensors. These sensors monitor and report current conditions. The central control system can respond if any of the conditions are outside pre-defined limits.

“Drip Emitter” shall mean a drip irrigation fitting that delivers water slowly at the root zone of the plant, usually measured in gallons per hour. Drip emitters shall be a threaded emitter onto a 1/2” flex pipe, which shall be liquid welded to a lateral supply line.

“Evapotranspiration (ET)” shall mean the quantity of water evaporated from adjacent soil surfaces transpired by plants during a specific time, expressed in inches per day, month or year (see also Reference Evapotranspiration Rate).

“Extra-Drought Tolerant Plant” shall mean a plant that can survive without irrigation throughout the year once established, although supplemental water may be desirable during drought periods for improved appearance and disease resistance.

“Ground Cover” shall mean material planted in such a way as to form a continuous cover over the ground that can be maintained at a height not more than twelve (12) inches.

“Hardscape” shall mean patios, decks and paths. Does not include driveways, parking lots, and sidewalks.

“Hydra Zone” (or “Water Zone”) shall mean grouping plants together according to similar water requirements. (Plant List for Hydra Zone values). Each zone is based on the amount of water required for vegetation to flourish. Each plant in these zones should have a plant factor that correlates to the Hydra Zone. The Plant factor is used in the Water Allowance Formula. Correlating values are as follows:

Hydra zone (or water zone)	Plant Factor
3+	1
2-4	.75
1-3	.50
0-1	.25
0	0

“Irrigated Landscape Area” shall mean all portions of a development site to be improved with planting and irrigation. Natural open space areas shall not be included in the Irrigated Landscaped Area.

“Irrigation Efficiency” shall mean the measurement of the amount of water beneficially applied, divided by the total amount of water applied. Irrigation

efficiency is derived from measurements and estimates of irrigation system hardware characteristics and management practices.

“Irrigation Contractor” shall mean a person who has been certified by The Irrigation Association to install irrigation systems or as otherwise noted.

“Irrigation Designer” shall mean a person who has been certified by The Irrigation Association to prepare irrigation system designs.

“Irrigation Plan” shall mean the plan which shows the components of the irrigation system with water meter size, backflow prevention, rain shut-off device, precipitation rates, flow rate and operating pressure for each irrigation zone, and identification of all irrigation equipment.

“Irrigation Water Auditor” shall mean a person who has been certified by The Irrigation Association to conduct a landscape irrigation audit.

“Landscape Architect” shall mean a person who holds a license to practice Landscape Architecture in the State of Utah.

“Landscape Designer” shall mean a person who has been certified by the Utah Nursery and Landscape Association to prepare Landscape Plans.

“Landscape Development Package” shall mean the preparation of graphic and written criteria, specifications and detailed plans to arrange and modify the effects of natural features such as plantings, ground and water forms, circulation, walks and other features to comply with the provisions of this ordinance. The Landscape Development Package shall include a project data sheet, a Planting Plan, and Irrigation Plan, a Grading Plan, a Soils Report, a Landscape Water Allowance Schedule and an Irrigation Schedule.

“Landscape Water Allowance” shall mean for design purposes, the upper limit of annual applied water for the established landscaped area. It is based upon the local Reference Evapotranspiration Rate, the ET adjustment factor and the size of the landscaped area.

“Landscaped Zone” shall mean a portion of the landscaped area having plants with similar water needs, areas with similar microclimate (i.e., slope, exposure, wind, etc.) and soil conditions, and areas that will be similarly irrigated. A landscape zone can be served by one irrigation valve or a set of valves with the same schedule.

“Landscaping” shall mean any combination of living plants, such as trees, shrubs, vines, ground covers, flowers, turf or ornamental grass; natural features such as rock, stone or bark chips.

“Mulch” shall mean any material such as bark, wood chips, rocks/stones or other similar materials left loose and applied to the soil.

“Non-Drought Tolerant Plant” shall mean a plant that will require regular irrigation for adequate appearance, growth and disease resistance.

“Plant Factor Shall” mean using a value associated to a group of plant material that has similar requirements for water consumption. This value is used in the calculation for the landscape water allowance. Example: Turf = 1, Non-drought tolerant trees, shrubs and ground cover = 0.75, Water-conserving trees, shrubs and ground cover = 0.50, Extra drought tolerant trees, shrubs and ground cover = 0.25, Mulch areas not irrigated = 0.0. The Plant Factor correlates to the Hydra Zone. The Plant factor is used in the Water Allowance Formula. Correlating values are as follows:

Hydra zone (or water zone)	Plant Factor
3+	1
2-4	.75
1-3	.50
0-1	.25
0	0

“Plant Hydra Zone” (or water zone) shall mean the grouping of plants together according to similar water requirements.

“Planting Plan” shall mean a plan which clearly and accurately identifies and locates new and existing trees, shrubs, ground covers, turf areas, driveways, sidewalks, hardscape features and fences.

“Precipitation Rate” shall mean the rate at which water is applied per unit of time, usually measured in inches per hour.

“Rain Shut-Off Device” shall mean a device wired to an automatic controller that shuts off the irrigation system when it rains.

“Reference Evapotranspiration Rate” or ET shall mean a standard measurement of environmental parameters which affect the water use of plants. ET is expressed in inches per day, month or year and is an estimate of the evapotranspiration of a large field of four to five inches tall, cool season grass that is well watered. See also Evapotranspiration.

“Runoff” shall mean irrigation water that is not absorbed by the soil or landscape area to which it is applied and which flows onto other areas.

“Soils Report” shall mean a report by a soils laboratory indicating soil type(s), soil depth, soluble salts, texture, organic matter, coarse fragments, sodium adsorption ratio (SAR), nutrient concentrations, uniformity, composition, bulk density, infiltration rates, and pH for the top soil and subsoil for a given site. The soils report also includes recommendations for soil amendments.

“Spray Sprinkler” shall mean an irrigation head that sprays water through a nozzle.

“Stream Sprinkler” shall mean an irrigation head that projects water through a gear rotor in single or multiple streams.

“Turf” shall mean a surface layer of earth containing mowed grass with its roots.

“Waste of Water” shall mean and include, but not be limited to:

- The use of water for any purpose, including landscape irrigation, which consumes or for which is applied substantial amounts of excess water beyond the reasonable amount required by the use, whether such excess water remains on the site, evaporates, percolates underground, goes into the sewer system or is allowed to run into the gutter or street. Every water consumer is deemed to have under his control at all times the water lines and facilities, through which water is being supplied and used to his premises and to know the manner and extent of his water use and excess runoff.
- The excessive use, loss or escape of water through breaks, leaks or malfunctions in the water user’s plumbing for any period of time after such escape of water should reasonably have been discovered and corrected. It shall be presumed that a period of 8 hours after the water user discovers such break, leak or malfunction or receives notice of such condition, whichever occurs first, is a reasonable time to correct such condition.
- Washing sidewalks, driveways, parking areas, tennis courts, patios or other paved areas except to alleviate immediate fire, health or safety hazards.

“Water Use Efficiency Review” (audit) shall mean an on-site survey and measurement of irrigation equipment and management efficiency and the generation of recommendations to improve efficiency.

“Water Conserving Plant” shall mean a plant that can generally survive with available rainfall once established, although supplemental irrigation may be needed or desirable during the growing season.

“Water Zone” See Hydra Zone

#### 4.5 Landscape Design Standards

- A. Creating Plant Hydra Zones or Water Zones: There are guidelines that should be used when creating the four water use zones that may occur in a water-wise landscape. Each zone is based on the amount of water required for vegetation to flourish. Grouping plants together according to similar water requirements avoids wasteful over watering and encourages proper growth. Avoid high plant hydrazones being adjacent to low hydrazones. Without transition zones, water from the wet zones will be wasted on the adjacent dry zones. For many water efficient plants, there is such a thing as too much water. Water needs are dependent on the soil type, weather conditions, plant material, and amount of competition with weeds or desirable plants. Careful selection of a “low-volume” irrigation system will conserve large amounts of water.
- (1) Plant Hydra Zone 0: No supplemental water is required after plants are established. This is the lowest water zone in a water-wise landscape and will provide the greatest savings when compared to conventional landscaping.

- (2) Plant Hydra Zone 1: At least 1-inch of supplemental water per month may be required after plants are established. Plants growing in this zone need more water than natural precipitation.
  - (3) Plant Hydra Zone 2: At least 1-inch of supplemental water every 2 weeks may be required after plants are established. This is still less than most conventional landscapes.
  - (4) Plant Hydra Zone 3: At least 1-inch of supplemental water each week may be required after plants are established. This zone should be kept small and functional in size. It could be considered a mini-oasis and is best used when incorporated carefully into the landscape design. Turf/Lawn is generally the primary plant used in this zone.
- B. Plant Selection. Plants selected for landscape areas shall consist of plants that are well-suited to the microclimate and soil conditions at the project site. Plants with similar water needs shall be grouped together as much as possible.
  - C. For projects located at the interface between urban areas and natural open space (non-irrigated), Extra-Drought Tolerant Plants shall be selected that will blend with the native vegetation and are fire resistant or fire retardant. Plants with low fuel volume or high moisture content shall be emphasized. Plants that tend to accumulate excessive amounts of dead wood or debris shall be avoided.
  - D. Areas with slopes greater than 33% shall be landscaped with deep-rooting, Water Conserving Plants for erosion control and soil stabilization.
  - E. Park strips and other landscaped areas less than 8 feet wide shall be landscaped with Water Conserving Plants and/or grass. Areas less than 5 feet wide shall not be planted in turf.
  - F. Planting material should be used as a screening device for parking areas, service yards, transformers, and other site utilities etc. Trees in parking areas shall be selected based on reducing leaf litter and be “sap-drip” free.
  - G. Mulch. After completion of all planting, all irrigated non-turf areas shall be covered with a minimum layer of 3” of Mulch to retain water, inhibit weed growth and moderate soil temperature. Non-porous material shall not be placed under the mulch.
  - H. Soil Preparation. Soil preparation shall be suitable to provide healthy growing conditions for the plants and to encourage water infiltration and penetration. Soil preparation shall include scarifying the soil to a minimum depth of six (6) inches and amending the soil with organic materials as per specific recommendations of the Landscape Architect based on the Soils Report.
  - I. All plant material shall be installed according to the ANLA (American Nursery & Landscape Association) guidelines.

#### 4.6 Irrigation Design Standards

- A. Recommended Point of Connection (POC) component installation order: 1-connection to source, 2-stop and waste valve/ or shut off, 3-filtration device, 4-pressure regulator, 5-backflow preventer, 6-quick coupler blowout, 7-master valve, and 8-flow meter – (if required).
- B. In situations of secondary water supply, provide filtration system necessary to clean water supply and protect irrigation system components. Provide accessible pressure gauges immediately upstream and downstream of the filtration device. (Non self cleaning units)
- C. Landscape Water Meter. A separate irrigation system water meter and backflow prevention assembly that are in compliance with state code shall be installed for all new landscape irrigation systems. The landscape water meter and backflow prevention assembly shall be separate from the water meter and backflow prevention assembly installed for indoor uses. The size of the meter shall be determined based on irrigation demand.
- D. Pressure Regulation. A pressure regulating valve shall be installed and maintained by the consumer if the static service pressure exceeds 80 pounds per square inch (psi). The pressure-regulating valve shall be located between the landscape water meter and the first point of water use or first point of division in the pipe and shall be set at the manufacture’s recommended pressure for sprinklers and or drip/micro systems. Pressure regulation devices may include one or all of the following: 1- pressure regulation valve at the main line POC, 2-pressure regulation device on individual sprinkler heads, 3-regulation of low volume drip/micro systems.
- E. Irrigation systems with 1” POC or 10,000 square feet and larger of landscaped area shall have a flow sensor and master valve installed. Systems with irrigated area of 1 acre and larger shall have a normally closed master valve. Where necessary, the master valve shall be capable of manual operation to allow manual use of the irrigation system. A normally open master valve is acceptable if the controller is capable to shut the valve off in event of unscheduled flow.
- F. Automatic Controller. All irrigation systems shall include an electric automatic controller with multiple programs and multiple repeat cycle capabilities and a flexible calendar program. Controller shall be programmable for multiple start times for repeat and rest periods, and shall be capable of water budget adjustment. Controller shall be able to provide separate programs for turf zones, shrub zones, and drip zones. All controllers shall be capable of temporarily shutting down the system by utilizing internal/external options (such as rain, wind, and freeze devices) and the ability to adjust run times based on a percentage of maximum ET or by use of a soil sensor. Power wire and control wire shall not be contained in the same conduit.
- G. On slopes exceeding 33%, the irrigation system shall consist of Drip Emitters, Bubblers or sprinklers with a maximum Precipitation Rate of 0.85 inches per hour and adjusted sprinkler cycle to eliminate Runoff. Lateral lines are to run parallel to slope when possible.
- H. Each valve shall irrigate a landscape with similar site, slope and soil conditions and plant materials with similar watering needs. Turf and non-turf areas shall be

irrigated on separate valves. No single zone shall be designed or installed with sprinklers of differing pressure requirements or precipitation rates. (Rotors, spray heads, drip emitters, micro sprays, etc. may not be mixed within a zone.

- I. Drip Emitters or Bubblers shall be provided for each tree where practicable. Bubblers shall not exceed 1.5 gallons per minute per device. Bubblers for trees shall be placed on a separate valve unless specifically exempted by the DFCM.
- J. Sprinklers shall have matched Precipitation Rates with each control valve circuit. All sprinkler heads shall be spaced at a maximum of 50% of design performance diameter of the sprinkler. In known windy areas sprinklers are to be designed with reduced head spacing or low angle nozzles. Spacing shall be reduced below 50% of design performance diameter when conditions demand.
- K. Check valves shall be required where elevation differences will cause low-head drainage. Pressure compensating valves and sprinklers shall be required where a significant variation in water pressure will occur within the irrigation system due to elevation differences.
- L. Drip Irrigation lines shall be placed underground or otherwise permanently covered, except for Drip Emitters and where approved as a temporary installation. Filters and end flush valves shall be provided as necessary and as per industry standards.
- M. Irrigation zones with overhead spray or stream sprinklers shall be designed to operate between 6:00 pm and 10:00 am to reduce water loss from wind and evaporation. Drip or bubbler zones are excluded from this requirement.
- N. Program valves for multiple repeat cycles where necessary to reduce runoff, particularly slopes and soils with slow infiltration rates.

#### 4.7 Contract Documents

- A. Project Data Sheet. The Project Data Form shall contain the following:
  - (1) Project name and address;
  - (2) Type of project
  - (3) Landscape Architect's name, address, phone and fax number; and
  - (4) Landscape Contractor's name, address, phone and fax number.
- B. Planting Plan. A detailed Planting Plan shall be drawn at a scale that clearly identifies the following:
  - (1) Location of all plant materials, a legend with botanical and common names, and size of plant materials;
  - (2) Property lines and street names;

- (3) Existing and proposed buildings, walls, fences, light poles, utilities, paved areas and other site improvements;
- (4) Existing trees and plant materials to be removed or retained; and
- (5) Designation of Landscape Zones.
- (6) Details and specifications for tree staking, soil preparation, and other planting work.

C. Irrigation Plan. A detailed Irrigation Plan shall be drawn at the same scale as the planting plan and shall contain the following information:

- (1) Layout of the irrigation system and a legend summarizing the type and size of all components of the system, including manufacturer name and model numbers;
- (2) Static water pressure in pounds per square inch (psi) at the point of connection to the public water supply ; and
- (3) Flow rate in gallons per minute and design operating pressure in psi for each valve and precipitation rate in inches per hour for each valve with sprinklers.
- (4) Installation details for irrigation components.

D. Grading Plan. A Grading Plan shall be drawn at the same scale as the Planting Plan and shall contain the following information:

- (1) Property lines and street names, existing and proposed buildings, walls, fences, utilities, paved areas and other site improvements; and
- (2) Existing and finished contour lines and spot elevations as necessary for the proposed site improvements.

E. Soils Report. A Soils Report will be required where irrigated landscaped areas consisting of grass or similar turf exceed 33% of the overall landscaped area or where the total landscaped area exceeds 2,500 square feet. The Soils Report shall describe the depth, composition and bulk density of the top soil and subsoil at the site and shall include recommendations for soil amendments. The Planting Plan shall incorporate the recommendations of the Soils Report into the planting specifications.

F. Landscape Water Allowance. The annual Landscape Water Allowance shall be calculated using the following equation:

$$\text{Landscape Water Allowance (gallons)} = \text{ET} \times \text{PF} \times \text{AREA} / \text{IE} \times .62$$

Where Landscape Water Allowance is in gallons per growing season,

$$\text{ET} = \text{Reference Evapotranspiration in inches per growing season}$$

PF = Plant factor (see chart below)

AREA = Total Irrigated Landscape Area in square feet

IE = Irrigation efficiency (see chart below)

.62 = Conversion to gallons

Estimated Landscape Water use = ET x PF x AREA/IE x .62

G. Plant Factor (PF) shall be the following for each type of plant material:

Plant Type	Plant Hydra Zone	Plant Factor (PF)
Turf	3+	1.0
Non-drought tolerant trees, shrubs and ground cover	2-3	0.75
Water-conserving trees, shrubs and ground cover	1-2	0.50
Extra drought-tolerant trees, shrubs and ground cover	0-1	0.25
Mulch areas not irrigated, or plants not needing additional water after being established	0	0.0

H. Irrigation Efficiency (IE) shall be the following for each type of irrigation:

Irrigation Type	Irrigation Efficiency (IE)
Bubblers	0.85
Drip Emitters	0.85
Stream Sprinklers in planter strips 8 feet or wider	0.75
Spray Sprinklers in planter strips 8 feet or wider	0.625
Spray Sprinklers in planter strips less than 8 feet wide	0.4

I. Irrigation Schedule. A monthly Irrigation Schedule shall be prepared that covers the initial 120-day plant establishment period and the typical long-term use period. This schedule shall consist of a table with the following information for each valve:

- (1) Plant type (for example, turf, trees, low water use plants);
- (2) Irrigation type (for example, sprinklers, drip, bubblers);
- (3) Flow rate in gallons per minute;
- (4) Precipitation rate in inches per hour (sprinklers only);
- (5) Run times in minutes per day;
- (6) Number of water days per week; and
- (7) Cycle time to avoid runoff.

- J. The irrigation schedule shall rely on the estimated landscape water use calculations and shall be adjusted as necessary for irrigation efficiency, soil conditions, slope, and microclimate conditions. (See Irrigation Schedule Form)

#### 4.8 Irrigation Record Drawings and Operations and Maintenance Manuals

- A. Irrigation record drawings and operations and maintenance manuals are to be turned over to the DFCM at project completion prior to final acceptance.
- B. The following shall be included on Irrigation Record Drawings. In addition, provide a reduced color-coded drawing(s) showing all zones and assigned valves.
- C. Note all points of connection (P.O.C.) include tap size, line size and static water pressure (P.S.I.) of service.
- D. Provide name and phone number of the servicing water purveyor. Include the name and date the installation was completed and the date the as-build drawing was approved.
- E. Accurately locate all the following major components by dimension and their size as installed on the project: (But not limited to the Following)
  - (1) Water Meters
  - (2) Backflow Preventers
  - (3) Pressure Reducing Valves (note pressure settings)
  - (4) Filters
  - (5) Stop and Waste
  - (6) Master Control Valves
  - (7) Isolation and Gate Valves
  - (8) Control wire junction boxes
  - (9) Pumps
  - (10) Flow Sensors
  - (11) Remote Control Valves (note station assignment, size, flow rate, pressure setting. D.U. and actual flow rates, if available from water audit)
  - (12) Drip System Pressure Regulators and Filters
  - (13) Quick Couplers and Hose Bibs
  - (14) Pressure Main Lines and Sizes

- (15) Main Line Sleeves and Sizes
- (16) Capped main Lines and Future P.O.C.'s
- (17) Manual Drain Valves and Sumps
- (18) Remote Control Wire (label both ends and in junction box)
- (19) Controller Location(s) (Note manufacturer, model, size and number of stations used)
- (20) Central Control
- (21) Rain Sensors
- (22) Moisture Sensors
- (23) Note and identify location(s) of existing utility systems as encountered during installation, i.e.; gas, phone, sewer, etc.
- (24) Air Release Valves

F. Indicate and show the following additional components installed on the project:

- (1) All Sprinkler Heads
- (2) Lateral Lines and sizes
- (3) Lateral Line Sleeves and sizes
- (4) Manual or Automatic Flush Valves

G. Operations and Maintenance Manual

- (1) A signed and dated written description of the contractor's warranty and warrantee period. Include name, address, phone number and license number.
- (2) A description of system start up and winterization process.
- (3) All product literature and customer service information for products used/installed on project.

#### 4.9 Plan Review, Construction Inspection and Post-Construction Monitoring

A. As part of the Site Plan and Building Approval Process, a copy of the Landscape Development Package shall be submitted to the DFCM for review and approval before construction begins. With the Landscape Development Package, a copy of the Landscape Water Allowance Worksheet shall be completed by a Landscape

Architect or another licensed professional as recognized by the State of Utah to perform Landscape Architectural services and submitted to the DFCM.

- B. All Landscape Plan Documentation Packages submitted must be prepared by a licensed Landscape Architect, or another licensed professional as recognized by the State of Utah to perform Landscape Architectural services
- C. The Irrigation Plan must be prepared by a Landscape Architect, or another licensed professional as recognized by the State of Utah to perform Landscape Architectural services.
- D. All landscape irrigation systems shall be installed by an Irrigation Contractor. The person representing the contracting firm shall be a full-time employee of the firm and shall be directly involved with the project including at least weekly site visits during construction.
- E. All installers, designers and auditors shall meet state and local license, insurance and bonding requirements and be able to show proof of such upon demand.
- F. During construction, site inspection of the landscaping may be performed by the DFCM, the local institution or agency.
- G. During construction a mainline pressure and leak test will be conducted.
- H. Following construction an inspection shall be scheduled with the DFCM to verify compliance with the approved landscape and irrigation plans. A Certificate of Substantial Completion Form shall be completed by the Contractor or Landscape Architect and submitted to the DFCM.
- I. Following construction a Water Use Efficiency Review (Audit) will be conducted by a certified Landscape Irrigation Auditor. The auditor shall be independent of the contractor, design firm and owner/developer of the project. The water performance audit will verify that the irrigation system complies with the minimum standards required by this ordinance. The auditor shall furnish a certificate to the DFCM, Landscape Architect, and installer certifying compliance with the minimum distribution requirements and an irrigation schedule.
- J. The DFCM reserves the right to perform site inspections at any time before, during or after the irrigation system and landscape installation, and to require corrective measures if requirements of this guideline are not satisfied.

#### 4.10 Soils Definitions & Guidelines

- A. Soluble salts. High levels of soluble salts make it difficult for plants to absorb water and can have direct toxic effects on many landscape plants. Electrical conductivity of the extracted soil solution (ECe) is the measure of soluble salts. Soluble salts are removed (leached) relatively easily by applying excess, low salt water to a well drained soil. This must be done before seeding or transplanting, since plants are most sensitive to salts at these times. See the related Utah State University Extension Bulletins Salinity and Plant Tolerance and Selection and Planting of Landscape Trees for more information about salinity tolerance.

- B. pH. pH is an indication of the acidity or alkalinity (basic nature) of soil. A pH of 7.0 is neutral, while values below 7.0 are acidic and values above 7.0 are alkaline or basic. Most Utah soils have pH values in the mid-7.0 to low 8.0 range. Many plants grow well over a broad range of soil pH; however, some acid-loving plants such as blueberry, rhododendron and azalea will not grow well above pH7. Other sensitive plants are susceptible to iron deficiency (iron chlorosis) above pH 7.5. See the related Utah State Extension Bulletins Control of Iron Chlorosis in Ornamental and Crop Plants and Managing Soil pH in Utah for more information about iron chlorosis and soil pH.
- C. Texture. Texture refers to the proportion (%) of sand-, silt, and clay-sized particles in the soil. The percentages by weight of sand, silt and clay are used to assign soil to a specific texture class (e.g., silt loam). Texture influences the water holding capacity, aeration (gas exchange), drainage, tilth and compaction and nutrient retention of soil. A mixture of sand, silt and clay is desirable. Soils are unacceptable if they are dominated by one particle size. It is not practical to change soil texture on a large scale. Large amounts of sand, silt or clay would be required to change soil texture and it is difficult to incorporate this material thoroughly. Large amounts of organic matter will improve the physical characteristics of soil composed of too much sand, silt or clay.
- D. Organic matter. Organic matter is essential in the formation of soil structure, reducing soil compaction and retaining essential plant nutrients. Generally, the higher the level of organic matter, the better the soil quality. In Utah, native soil organic matter levels are low, often less than 1% by weight. Soil organic matter content can be increased by adding compost, peat moss or other organic amendments.
- E. Coarse fragments. Coarse fragments (gravel, rocks, etc.) can, if present in large amounts, make it difficult to till, seed, aerate and generally manage soil in a landscape. Construction wastes such as concrete can also contribute unacceptable coarse fragments to soil. If percentage of coarse fragments is high, the soil should be screened before use.
- F. Sodium adsorption ratio (SAR). The sodium adsorption ratio is a measure of the amount of sodium (an undesirable element) relative to calcium and magnesium (desirable elements) in soil. Soils with high SAR values tend to have poor structure and low water infiltration and percolation rates. Soils with a high SAR also have a high pH and/or ECe. If pH and ECe are within acceptable ranges, SAR should also be acceptable.
- G. Nutrient concentrations. Nutrients are essential for plant growth. High quality topsoils normally have adequate phosphorus (P), potassium (K) and iron (Fe). Additional nitrogen (N) is usually required on an annual basis. If the topsoil meets these nutrient guidelines, then no additional fertilizer is needed until further soil tests indicate a deficiency.

**Summary of Topsoil Quality Guidelines**

Category	Soluble salts (dS/m or mmho/cm)	pH	Sand (%)	Silt (%)	Clay (%)	Texture class*	Organic Matter (%)	% Coarse fragments (>2 mm in diameter)**	Sodium Adsorption Ratio (SAR)*
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Ideal	< 2	5.5 to 7.5	< 70	< 70	< 30	L, SiL	≥ 2.0	≤ 2	< 3 for any texture
Acceptable	< 4	5.0 to 8.2	< 70	< 70	< 30	SCL, SL, CL, SiCL	≥ 1.0	2.1 to 5.0	3 to 7 (SiL, SiCL, CL) 3 to 10 (SCL, SL, L)
Unacceptable	> 4	< 5.0 or > 8.2	> 70	> 70	> 30	LS, SC, SiC, S, Si, C	< 1.0	> 5.0	> 10 for any texture

\* L = loam; SiL = Silt loam; SCL = sandy clay loam; SL = sandy loam; CL = clay loam; SiCL = silty clay loam; LS = loamy sand; SC = sandy clay; SiC = silty clay; S = sand; C = clay

\*\* This guideline also includes no fragments larger than 1 ½ inch in diameter.

#### Nutrient Guidelines for Landscaping

Category	Nitrate-nitrogen (ppm or mg N/kg soil)	Phosphorus (ppm or mg P/kg soil)	Potassium (ppm or mg K/kg soil)	Iron (ppm or mg Fe/kg soil)
Acceptable	> 20	> 15	> 150	> 10

#### Course Fragment Guidelines

Category	% Course fragments (Rocks) > 2mm	≥ 1.5" in diameter
Ideal	≤ 2.0	None
Acceptable	2.1 – 5.0	None
Unacceptable	> 5.0	Present

#### Compost Quality Guidelines for Landscaping

Category	pH	Soluble Salts dS/m or mmho/cm	Sodium Absorption Ratio (SAR)	Carbon:Nitrogen Ratio (C:O)	% Moisture	% Rocks (Coarse Fragments) > 2mm
Ideal	6 to 8	≤ 5	< 10	≤ 30:1	25 to 35	0
Acceptable	5-6, 8-9	≤ 20	≤ 20	31:1 to 50:1	< 25, > 35	≤ 5
Unacceptable	< 5, > 9	> 20	> 20	< 12:1, > 50:1	< 20, > 50	> 5

#### 4.11 Plant List

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
<b>DECIDUOUS TREES</b>				
5 - 9			Acer buergeranum	Trident Maple
4 - 8	1 - 2	.50	Acer campestre	Hedge Maple
2 - 8	1 - 2	.50	Acer ginnala	Amur Maple
2 - 8	1	.25	Acer glabrum	Rocky Mountain Maple
4 - 7	1	.25	Acer grandidentatum	Bigtooth Maple
4 - 8			Acer griseum	Paperbark Maple
2 - 9	1	.25	Acer negundo	Boxelder, Ash-leaved or Manitoba Maple
4 - 8	1	.25	Acer nigrum	Black Maple
5 - 8			Acer palmatum	Japanese Maple
3 - 7	3	1	Acer platanoides	Norway Maple
5 - 7	2	.50	Acer pseudoplatanus	Sycamore Maple
3 - 9			Acer rubrum	Red Maple

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
3 - 9			<i>Acer saccharinum</i>	Silver Maple
4 - 8			<i>Acer saccharum</i>	Sugar Maple
3 - 8	1 - 2	.50	<i>Acer tataricum</i>	Tatarian Maple
4 - 8	2	.50	<i>Acer truncatum</i>	Shantung Maple or Purpleblow
7 - 8			<i>Aesculus californica</i>	California Buckeye
3 - 7			<i>Aesculus glabra</i>	Ohio Buckeye
3 - 8	2	.50	<i>Aesculus hippocastanum</i>	Horsechestnut
	2	.50	<i>Aesculus sp.</i>	Horsechestnut
3 - 8			<i>Aesculus X carnea</i>	Red Horsechestnut
4 - 8	0	0	<i>Ailanthus altissima</i>	Tree of Heaven
6 - 9			<i>Albizia julibrissin</i>	Mimosa, Silk Tree, Albizia
3 - 7	3	1	<i>Alnus glutinosa</i>	European or Common Alder
1-6	3	1	<i>Alnus incana</i>	Mountain Alder
1 - 7			<i>Alnus tenuifolia</i>	Thinleaf Alder or Mountain Alder
2 - 7			<i>Amelanchier alnifolia</i>	Saskatoon, Western Serviceberry
4 - 9			<i>Amelanchier arborea</i>	Downy Serviceberry
4	1	.25	<i>Amelanchier laevis</i>	Princess Diane Serviceberry, Cole's Select Serviceberry, Laevis Serviceberry
4 - 8			<i>Amerlancier uthahensis</i>	Utah Serviceberry
2 - 7			<i>Betula papyrifera</i>	Paper Birch
4 - 9			<i>Betula nigra</i>	River Birch
3 - 7	3	1	<i>Betula occidentalis</i>	Western Water Birch
2 - 7			<i>Betula pendula</i>	European White Birch
4 - 8			<i>Carpinus betulus</i>	European Hornbeam
3 - 9			<i>Carpinus caroliniana</i>	American Hornbeam, Muscledwood
4 - 9			<i>Castanea mollissima</i>	Chinese Chestnut
5 - 9			<i>Catalpa bignonioides</i>	Southern Catalpa
5 - 9			<i>Catalpa bignonioides 'Nana'</i>	Umbrella Catalpa
4 - 9	1	.25	<i>Catalpa speciosa</i>	Western Catalpa
4 - 8	1	.25	<i>Catalpa speciosa</i>	Northern Catalpa
2 - 9	0 - 1	.25	<i>Celtis occidentalis</i>	Common Hackberry
5 - 9	0	0	<i>Celtis reticulata</i>	Netleaf Hackberry
4 - 8			<i>Cercidiphyllum japonicum</i>	Katsuratree
3 - 9	2	.50	<i>Cercis canadensis</i>	Eastern Redbud or Judas Tree
7 - 9			<i>Cercis occidentalis</i>	California or Western Red Bud
3 - 8			<i>Cercocarpus ledifolius</i>	Curleaf Mountain Mahogany
			<i>Cercocarpus montanus</i>	Mountain Mahogany
8 - 10			<i>Chilopsis linearis</i>	Desert Willow
3 - 9			<i>Chionanthus virginicus</i>	Fringetree, White Fringetree
4 - 8			<i>Cladrastis lutea</i>	Yellowwood
4 - 9			<i>Corylus americana</i>	American Hazelnut
3 - 7			<i>Cornus alternifolia</i>	Pagoda or Alternate-Leaf Dogwood
5 - 9			<i>Cornus florida</i>	Flowering Dogwood
3 - 7			<i>Cornus kousa</i>	Kousa Dogwood
4 - 8			<i>Cornus mas</i>	Corneliancherry Dogwood
2 - 8			<i>Cornus sericea</i>	Red-osier or Red-Stemmed Dogwood
4 - 7			<i>Corylus columna</i>	Turkish Filbert, Turkish Hazel

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4 - 8			<i>Corylus cornuta</i>	Beaked Hazelnut
4 - 9			<i>Cotinus coggyria</i>	Common Smoketree, Smokebush
3 - 8			<i>Cotinus obovatus</i>	American Smoketree, Chittamwood
5 - 9			<i>Cowania mexicana</i>	Cliffrose, Quininebush
3 - 8	1	.25	<i>Crataegus crusgalli</i>	Cockspur Hawthorn
2 - 8			<i>Crataegus douglasii</i>	River Hawthorn, Black or Douglas Hawthorn
4 - 8			<i>Crataegus laevigata</i>	English Hawthorn
3 - 8	2	.50	<i>Crataegus phaenopyrum</i>	Washington Hawthorn
3 - 8	1 - 2	.50	<i>Crataegus sp.</i>	Hawthorn
4 - 8			<i>Crataegus viridis</i>	Green Hawthorn
4 - 8			<i>Crataegus X lavalleyi</i>	Lavalle Hawthorn
2 - 7	0 - 1	.25	<i>Eleagnus angustifolia</i>	Russian Olive
8 - 10			<i>Eriobotrya japonica</i>	Loquat
3 - 9			<i>Fagus grandifolia</i>	American Beech
4 - 7			<i>Fagus sylvatica</i>	European Beech
3 - 9	2	.50	<i>Fraxinus pennsylvanica</i>	Green Ash
3 - 9			<i>Fraxinus americana</i>	White Ash
6 - 9			<i>Fraxinus anomala</i>	Singleleaf Ash
3 - 9			<i>Fraxinus excelsior</i>	European Ash
4 - 7			<i>Fraxinus quadrangulata</i>	Blue Ash
7 - 9	0	0	<i>Fraxinus velutina</i>	Velvet or Modesto Ash
3 - 8	2	.50	<i>Ginkgo biloba</i>	Ginkgo, Maidenhair Tree
3 - 9	1	.25	<i>Gleditsia triacanthos inermis</i>	Thornless Honey Locust
3 - 8	1	.25	<i>Gymnocladus dioicus</i>	Kentucky Coffee Tree
5 - 9			<i>Ilex opaca</i>	American Holly
3 - 7			<i>Juglans cinerea</i>	Butternut
7 - 9			<i>Juglans major</i>	Arizona Walnut
4 - 9	2	.50	<i>Juglans nigra</i>	Black Walnut
4 - 8			<i>Juglans regia</i>	English or Persian Walnut
5 - 9	1	.25	<i>Koelreuteria paniculata</i>	Goldenraintree
5 - 7			<i>Laburnum X watereri</i>	Goldenchain tree, Waterer Laburnum
7 - 9			<i>Lagerstroemia indica</i>	Crapemyrtle
2 - 6	3	1	<i>Larix decidua</i>	European Larch
5 - 9			<i>Liquidambar styraciflua</i>	Sweetgum, American Sweetgum
4 - 9			<i>Liriodendron tulipifera</i>	Yellow-Poplar, Tuliptree, Tulip Poplar
4 - 9	1	.25	<i>Maclura pomerifera</i>	Osage Orange
3 - 8			<i>Magnolia acuminata</i>	Cucumber Tree, Cucumber Magnolia
6 - 9			<i>Magnolia grandiflora</i>	Southern Magnolia
6 - 9			<i>Magnolia kobus</i>	Kobus Magnolia
3 - 8			<i>Magnolia X loebneri</i>	Loebner Magnolia
4 - 9			<i>Magnolia x soulangiana</i>	Saucer Magnolia
3 - 9			<i>Malus pumila</i>	Apple
2 - 8	1 - 2	.50	<i>Malus sp.</i>	Apple including crabapples (many varieties)
8 - 10			<i>Melia azedarach</i>	Chinaberry
4 - 8	1 - 2	.50	<i>Morus alba</i>	Fruitless Mulberry
5 - 9			<i>Morus rubra</i>	Red Mulberry
6 - 9			<i>Ostrya knowltonii</i>	Knowlton Hophornbeam
3 - 9			<i>Ostrya virginiana</i>	Eastern Hophornbeam, Iron Wood
3 - 8			<i>Phellodendron amurense</i>	Amur Corktree

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6 - 9			<i>Pistacia chinensis</i>	Chinese Pistache
4 - 9			<i>Pistacia vera</i>	Pistachio
4 - 9			<i>Platanus occidentalis</i>	American Sycamore or Plane Tree
4 - 8	2	.50	<i>Platanus x acerifolia</i>	London Plane Tree, Sycamore
3 - 9			<i>Populus alba</i>	White Poplar
3 - 8	1 - 2	.50	<i>Populus alba</i> 'Pyramidalis' or 'bolleana'	Bolleana Poplar
3 - 9			<i>Populus angustifolia</i>	Narrowleaf Cottonwood
2 - 5			<i>Populus balsamifera</i>	Balsam Poplar
2 - 8			<i>Populus candicans</i>	Balm of Gilead
2 - 9	2	.50	<i>Populus deltoides</i>	Eastern Cottonwood
5 - 9			<i>Populus fremontii</i>	Freemont Cottonwood
3 - 9			<i>Populus nigra</i> 'Italica'	Lombardy Poplar
	2	.50	<i>Populus</i> sp.	Cottonwood, improved "cottonless" varieties
3 - 7	3	1	<i>Populus tremuloides</i>	Quaking Aspen
3 - 8			<i>Populus trichocarpa</i>	Black Cottonwood
3 - 9			<i>Populus X canadensis</i>	Carolina Poplar
7 - 10			<i>Prosopis juliflora</i>	Honey Mesquite
4 - 9			<i>Prunus armeniaca</i>	Apricot
3 - 8			<i>Prunus avium</i>	Sweet Cherry, Mazzard
5 - 8			<i>Prunus cerasifera</i>	Purpleleaf, Cherry or Myrobalan Plum
3 - 9			<i>Prunus cerasus</i>	Sour Cherry
4 - 9			<i>Prunus domestica</i>	Common Plum
3 - 6			<i>Prunus padus</i>	European Birdcherry, May Day Tree
5 - 9			<i>Prunus persica</i>	Peach
4 - 7			<i>Prunus sargentii</i>	Sargent Cherry
5 - 9			<i>Prunus serrulata</i>	Japanese Flowering or Oriental Cherry
4 - 9			<i>Prunus subhirtella</i>	Higan Cherry
2 - 9	0	0	<i>Prunus virginiana</i>	Common Chokecherry
2 - 9	1	.25	<i>Prunus virginiana</i> "Canada Red"	Canada Red Chokecherry
5 - 8			<i>Prunus X yedoensis</i>	Yoshino Cherry
3 - 9			<i>Ptelea angustifolia</i>	Common or Western Hoptree, Wafer-Ash
5 - 8	2	.50	<i>Pyrus Calleryana</i>	Callery Flowering Pear
4 - 9			<i>Pyrus communis</i>	Common Pear
3 - 7			<i>Pyrus ussuriensis</i>	Ussurian Pear
5 - 9			<i>Quercus acutissima</i>	Sawtooth Oak
3 - 9			<i>Quercus alba</i>	White Oak
3 - 8			<i>Quercus bicolor</i>	Swamp White Oak
4 - 8			<i>Quercus cerris</i>	Turkey Oak
4 - 8	0	0	<i>Quercus gambelii</i>	Gambel Oak / Scrub Oak
2	0	0	<i>Quercus gambelii</i>	Gambel's Oak
4 - 8			<i>Quercus imbricaria</i>	Shingle or Laurel Oak
2 - 8	1	.25	<i>Quercus macrocarpa</i>	Bur Oak
4 - 7			<i>Quercus muehlenbergii</i>	Chinkapin Oak
4 - 8			<i>Quercus palustris</i>	Pin Oak
4 - 8	2	.50	<i>Quercus robur</i>	English Oak
4 - 8	2	.50	<i>Quercus rubra</i>	Northern Red Oak
5 - 9			<i>Quercus shumardii</i>	Shumard Oak
7 - 9			<i>Quercus trubinella</i>	Shrub Live Oak
7 - 9			<i>Quercus undulata</i>	Wavyleaf Oak

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6 -9			Robinia neomexicana	New Mexico Locust
3 - 9			Robinia pseudoacacia	Black Locust
	0	0	Robinia pseudoacacia 'Purple Robe'	Purple Robe Locust
3 - 8	0 - 1	.25	Robinia x ambigua 'Idaho'	Idaho Flowering Locust
2 - 8			Salix amygdaloides	Peachleaf Willow
5 -8			Salix babylonica	Weeping Willow
			Salix exigua	Cotyote Willow
4 -9			Salix fragilis	Crack Willow
4 - 9			Salix matsudana	Hankow Willow 'Globe Navajo'
4 - 9			Salix nigra	Black Willow
5 - 9			Sambucus cerulea	Blue Elder
5 - 8	2	.50	Sophora japonica	Japanese Pagoda Tree
3 - 7			Sorbus alnifolia	Korean Mountain Ash
2 - 7			Sorbus americana	American Mountain Ash
3 - 7			Sorbus aucuparia	European Mountain-Ash or Rowan
2 - 6			Sorbus scopulina	Green Mountain Ash
	2	.50	Sorbus sp.	Mountain Ash
3 - 7	2	.50	Syringa reticulata	Japanese Tree Lilac
5 - 8			Tamarix ramosissima	Tamarisk, Salt-Cedar
	1	.25	Taxodium distichum	Bald Cypress
2 - 9	2	.50	Tilia americana	American Basswood, American Linden
3 - 7	3		Tilia cordata	Littleleaf Linden
4 - 7	2	.50	Tilia tomentosa	Silver Linden
3 - 7			Tilia X euchlora	Crimean Linden
4 -9			Ulmus parvifolia	Lacebark or Chinese Elm
3 - 9			Ulmus pumila	Siberian Elm
6 - 9			Yucca brevifolia	Joshua Tree
5 - 8	2	.50	Zelkova serrata	Japanese Zelkova
6 - 9			Zizyphus jujuba	Chinese Date
<b>EVERGREEN TREES</b>				
3 - 7	2 - 3	.75	Abies concolor	White Fir
1 - 5	3	1	Abies lasiocarpa	Subalpine or Alpine Fir
5 - 8	0	0	Calocedrus decurrens	Incense Cedar
6 - 9			Cedrus atlantica	Atlas Cedar
7 - 9			Cedrus deodara	Deodar Cedar
5 - 7			Cedrus libani	Cedar of Lebanon
5 - 9	1	.25	Cedrus sp.	Cedar
4 - 8			Chamaecyparis obtusa	Hinoki falsecypress
7 - 9			Cupressus arizonica	Arizona Cypress
7 - 9			Cupressus sempervirens	Italian Cypress
			Juniperis osteosperma	Utah Juniper
3 - 9			Juniperus chinensis	Chinese Juniper
3 - 7	0	0	Juniperus scopulorum	Rocky Mountain Juniper
4 - 7	0	0	Juniperus sp.	Juniper
2 - 9	0	0	Juniperus virginiana	Eastern Red Cedar
2 - 6	3	1	Larix decidua	European Larch
4 - 7			Larix kaempferi	Japanese Larch
4 -8			Metasequoia glyptostroboides	Dawn Redwood
2 - 7	2	.50	Picea abies	Norway Spruce
2 - 5	1	.25	Picea engelmannii	Engelmann spruce
2 - 6	2	.50	Picea glauca	White or Blackhills Spruce
4 - 7			Picea omorika	Serbian Spruce
2 - 7	2	.50	Picea pungens	Blue Spruce
5 - 7	1	.25	Pinus aristata	Bristlecone Pine

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4 - 8			<i>Pinus bungeana</i>	Lacebark Pine
2 - 6			<i>Pinus contorta</i> var. <i>latifolia</i>	Lodge Pole Pine
3 - 7	1	.25	<i>Pinus densiflora</i>	Japanese Red Pine
4 - 8	0	0	<i>Pinus edulis</i>	Pinyon Pine
4 - 7	1	.25	<i>Pinus flexilis</i>	Limber Pine
8 - 10			<i>Pinus halepensis</i>	Aleppo Pine
	1	.25	<i>Pinus heldreichii leucodermis</i>	Bosnian Red Cone Pine
	1	.25	<i>Pinus jeffreyi</i>	Jeffrey Pine
4 - 7	1	.25	<i>Pinus longaeva</i>	Bristlecone Pine
5 - 9	1	.25	<i>Pinus monophylla</i>	Singleleaf Pinyon Pine
5 - 8			<i>Pinus monticola</i>	Western White Pine
2 - 8	1	.25	<i>Pinus mugo</i>	Mugo Pine
4 - 7	1	.25	<i>Pinus nigra</i>	Austrian Pine
4 - 7			<i>Pinus parviflora</i>	Japanese White Pine
3 - 7	1	.25	<i>Pinus ponderosa</i>	Ponderosa Pine
5 - 9			<i>Pinus strobiformis</i>	Southwestern White Pine
3 - 8			<i>Pinus strobus</i>	Eastern White Pine
2 - 8	1	.25	<i>Pinus sylvestris</i>	Scotch Pine
5 - 9	1	.25	<i>Pinus thunbergiana</i>	Japanese Black Pine
5 - 7	1	.25	<i>Pinus wallichiana</i>	Himalayan White Pine
4 - 6	2	.50	<i>Pseudotsuga menzeisii</i> 'Glauca'	Rocky Mountain Fir
4 - 6			<i>Pseudotsuga menziesii</i>	Douglas Fir
6 - 8	2	.50	<i>Sequoiadendron giganteum</i>	Giant Sequoia
4 - 9			<i>Taxodium distichum</i>	Baldcypress
6 - 9			<i>Thuja (Platycladus) orientalis</i>	Oriental Arborvitae
2 - 8	2	.50	<i>Thuja occidentalis</i>	American Arborvitae or Northern White Cedar
5 - 7			<i>Thuja plicata</i>	Western Red Cedar
<b>SHRUBS</b>				
3 - 5	2	.50	<i>Abies balsamea</i> 'Nana'	Dwarf Balsam Fir
4 - 9			<i>Amelanchier utahensis</i>	Utah Serviceberry
4 - 5	0 - 1	.25	<i>Amerlancier alnifolia</i>	Saskatoon Serviceberry
2	0 - 1	.25	<i>Amorpha canescens</i>	Lead Plant
2	1	.25	<i>Amorpha fruticosa</i>	False Indigo
2 - 6	0		<i>Arctostaphylos patula</i>	Greenleaf manzanita
3 - 8	1 - 2	.50	<i>Aronia melanocarpa</i>	Black Chokeberry
	0	0	<i>Artemisia tridentata</i>	Big Sage, Sagebrush
3	0	0	<i>Artemisia cana</i>	Silver Sagebrush
			<i>Artemisia filifolia</i>	Sand Sagebrush
2	0	0	<i>Artemisia frigida</i>	Fringed Sagebrush
			<i>Artemisia ludoviciana</i>	Prairie Sagebrush
			<i>Artemisia nova</i>	Black Sagebrush
	0	0	<i>Atriplex canescens</i>	Fourwing Salt Bush
			<i>Atriplex confertifolia</i>	Shade Scale
	0	0	<i>Atriplex gardneri</i>	Gardner Salt Bush
	1 - 2	.50	<i>Berberis</i> sp.	William Penn Barberry, Crimson Pygmy Barberry
5 - 8	1 - 2	.50	<i>Berberis</i> sp. (screening varieties)	Mentor Barberry, Red Leaf Barberry, Rose Glow Barberry
5 - 9	2	.50	<i>Buddleia</i> sp.	Butterfly Bush
	2	.50	<i>Buxus Microphylla</i> 'Winter Gem'	Winter Gem Boxwood
5 - 6	2	.50	<i>Buxus Sempervirens</i>	Common Boxwood
2 - 7	0 - 1	.25	<i>Caragana arborecens</i>	Siberian Peashrub
3 - 7	1	.25	<i>Caragana pygmaea</i>	Pygmy Peashrub
	1	.25	<i>Caryopteris clandonensis</i>	Blue Mist Spirea

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			Ceanothus intergerrimus	Deer Brush
			Ceanothus martinii	Utah Mountain Lilac
			Ceratoideus lanata	Winterfat
2	0	0	Cercocarpus ledifolius	Curl-leaf Mountain Mahogany
2	0	0	Cercocarpus montanus	True Mountain Mahogany
4 - 8	1	.25	Chaenomeles japonica	Flowering Quince
4	0 - 1	.25	Chamaebatiaria millifolium	Fernbush
			Chilopsis linearis	Desert Willow
			Chrysothamnus ssp.	Rabbit Brush
	0	0	Chrysothamnus nauseosus	Rubber Rabbitbrush
			Clematis ligusticifolia	White Virgin's Bower
5 - 7	0	0	Collutea arborescens	Bladdersenna
5 - 9	2	.50	Continus coggygria	Smoke Tree or Smokebush
2 - 8	2	.50	Cornus Sericea	Redstem Dogwood
	2	.50	Cornus Sericea 'Kelseyi'	Dwarf Kelsey Dogwood
2 - 8	2	.50	Cornus sp.	Red Twig Dogwood, Yellow Twig Dogwood, Tartarian Dogwood
4 - 7	1	.25	Cotoneaster acutifolius	Peking Cotoneaster
5 - 7	1	.25	Cotoneaster apiculatus	Cranberry Cotoneaster
5 - 7	1	.25	Cotoneaster divaricatus	Spreading Cotoneaster
4 - 7			Cotoneaster horizontalis	Rock Cotoneaster
4 - 7	1	.25	Cotoneaster lucidus	Hedge Cotoneaster
	0	0	Cowania mexicana	Cliff Rose
5 - 8	1	.25	Cytisus sp.	Broom
4 - 8	2	.50	Daphne burkwoodii	Daphne
3 - 6	0	0	Ephedra viridis	Mormon Tea or Brigham Tea
			Eriogonum corymbosum	Freemont's Buckwheat
3 - 8	2	.50	Euonymus alata	Winged Euonymous
5 - 8	2	.50	Euonymus alatus 'Compacta'	Dwarf Winged Euonymous or Dwarf Frebush
7 - 9	2	.50	Euonymus japonica	Evergreen Euonymous
7 - 9	2	.50	Euonymus japonica 'Microphylla'	Box Leaf Euonymous
5 - 8	2	.50	Euonymus kiatschovica 'Manhattan'	Manhattan Euonymous
5	0	0	Fallugia paradoxa	Apache Plume
6	0	0	Forestiera neomexicana	New Mexico Privet or Desert Olive
	1	.25	Forsythia sp.	Forsythia
5 - 8	2	.50	Forsythia x intermedia	Forsythia
	1	.25	Genista Lydia	Lydia Broom
			Grayia spinosa	Snakebrush/Hop Sage
5 - 8	1	.25	Hibiscus syriacus	Confederate Rose, Rose of Sharon
	1	.25	Holodiscus discolor	Ocean Spray
3	0 - 1	.25	Holodiscus dumosus	Rockspray Spirea
			Jamesia americana	Waxflower, Cliff Jamesia
3 - 9	0 - 1	.25	Juniperus chinesis	Phitzer Juniper, Blue Point Juniper and other upright varieties
2 - 6	0 - 1	.25	Juniperus communis	Common Juniper
3 - 9	1	.25	Juniperus horizontalis	Creeping Juniper
3 - 9	0 - 1	.25	Juniperus Sabina	Tam Juniper or Savin Juniper (many varieties)
	1	.25	Kolkwitzia amabilis	Beauty Bush

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5 - 7	2	.50	Ligustrum vulgare	Common Privet (several varieties for screening)
	1	.25	Lonicera sp.	Zabelli Honeysuckle, Tatarian Honeysuckle
5 - 8	1 - 2	.50	Mahonia aquifolium	Oregon Grapeholly
3	0	0	Mahonia fremontii	Fremont Barberry
3	1	.25	Mahonia repens	Creeping Mahonia
	2	.50	Pachistma myrsinites (may also be listed as "Paxistima")	Mountain Lover
	2	.50	Paeonia Suffruticosa	Tree Peony
	0	0	Peraphyllum ramosissimum	Squaw Apple
			Petrophytum caespitosum	Rock Spirea, Tufted Rock Mat
7 - 8			Philadelphus microphyllus	Littleleaf Mockorange
4 - 8	1	.25	Philadelphus sp.	Mockorange, Sweet Mockorange (dwarf varieties also available)
			Physocarpus malvaceus	Mountain Ninebark
2 - 7	1	.25	Physocarpus sp.	Ninebark
2 - 6	2	.50	Picea glauca 'Conica'	Dwarf Alberta Spruce
2 - 7	1	.25	Pinus mugo	Mugo Pine
	1	.25	Pinus mugo pumilo	Dwarf Mugo Pine
2 - 7	1	.25	Potentilla fruticosa	Shrubby Cinquefoil
3 - 6	0 - 1	.25	Prunus besseyi	Western Sand Cherry
4 - 8	2	.50	Prunus glandulosa	Dwarf Flowering Almond
2	0	0	Prunus tomentosa	Nanking Cherry
2 - 6	1	.25	Prunus virginiana	Chokecherry
	2	.50	Prunus x cistena	Purple Sand Cherry
3 - 6	0	0	Purshia mexicana var. stansburiana	Cliff Rose
	0	0	Purshia tridentata	Antelope Bitterbrush
	2	.50	Pyracantha angustifolia	Dwarf Pyracantha
5 - 9	2	.50	Pyracantha coccinea	Pyracantha, Firethorn
2 - 7	1	.25	Rhamnus cathartica	Tallhedge Buckthorn
2 - 9	0 - 1	.25	Rhus glabra	Smooth Sumac
2 - 9	1	.25	Rhus glabra 'Cismontana'	Dwarf Mountain Sumac
2	0	0	Rhus trilobata	Oakbrush Sumac, Oakleaf Sumac, Skunkbrush
3 - 8	1	.25	Rhus typhina	Staghorn Sumac
2 - 7	1	.25	Ribes sp.	Alpine Currant, Golden Currant
3 - 6	2	.50	Ribes aureau	Golden Current
4	0 - 1	.25	Rosa foetida	Copper Rose
5 - 8	1	.25	Rosa foetida bicolor	Austrian Brier Rose
5 - 8	1	.25	Rosa foetida 'Persiana'	Persian Yellow Rose
	2	.50	Rosa meideland	Meideland Rose and Others
2 - 8	1	.25	Rosa rubrifolia	Redleaf Rose
2 - 7	0 - 1	.25	Rosa rugosa	Rugosa Rose
2	1	.25	Rosa woodsii	Woods Rose
	1	.25	Rubus deliciosus	Colorado Thimbleberry
3	2	.50	Salix purpurea	Dwarf Blue Arctic Willow
3 - 6	0	0	Salvia dorrii	Dorr's Sage
			Sambucus caerulea	Blue Elderberry
	1	.25	Sambucus sp.	Elderberry
2 - 6	0	0	Shepherdia argentea	Silver Buffaloberry
3 - 6	0	0	Shepherdia rotundifolia	Roundleaf Buffaloberry
2 - 6	0	0	Shepherdia sp.	Buffaloberry
			Sorbus scopulina	Rocky Mountain Ash

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
3 - 8	2 - 3	.75	<i>Spiraea x bumalda</i>	Bumald Spiraea
3 - 8	2	.50	<i>Spiraea x vanhouttei</i>	Bridal Wreath Spiraea
3 - 7	1 - 2	.50	<i>Symphoricarpos albus</i>	Common Snowberry
			<i>Symphoricarpos occidentalis</i>	Mountain Snowberry
2	2	.50	<i>Symphoricarpos oreophilus</i>	Mountain Snowberry
3 - 7	2	.50	<i>Syringa meyeri 'Palibin'</i>	Dwarf Korean Lilac
3 - 7	1 - 2	.50	<i>Syringa patula 'Miss Kim'</i>	Dwarf Korean Lilac or Miss Kim Lilac
3 - 7	1	.25	<i>Syringa vulgaris</i>	Common Lilac (many varieties)
6 - 7	3	1	<i>Taxus baccata</i>	English Yew
4 - 7	3	1	<i>Taxus cuspidata</i>	Japanese Yew
4 - 7	3	1	<i>Taxus x media</i>	Anglojap Yew
6	2	.50	<i>Taxus sp. (low, spreading)</i>	Spreading English Yew, Dwarf Japanese Yew and Others
4 - 7	2	.50	<i>Taxus sp. (screening)</i>	Hick's Yew, Japanese Yew, Upright Yew, Brown's Yew and Others
			<i>Tetradymia</i>	Horsebrush
5	2	.50	<i>Thuja sp. (low, spreading)</i>	Woodward Globe Arborvitae, Little Giant Arborvitae and Others
	2	.50	<i>Thuja sp. (screening)</i>	Emerald Arborvitae, Blue Cone Arborvitae and Others
3 - 8	2	.50	<i>Viburnum rhytidophyllum</i>	Leatherleaf Viburnum
3 - 8	2	.50	<i>Viburnum sp.</i>	Arrowwood Viburnum, Burkwood Viburnum, Cranberry Bush
5 - 8	2	.50	<i>Weigela florida</i>	Weigela
			<i>Yucca angustissima</i>	Narrow Leaved Yucca
			<i>Yucca elata</i>	Soaptree Yucca
4 - 6	0	0	<i>Yucca filamentosa</i>	Yucca
4			<i>Yucca glauca</i>	Great Plains Yucca
	0	0	<i>Yucca sp.</i>	Yucca
<b>VINES AND GROUND COVERS</b>				
	2	.50	<i>Aegopodium podagraria</i>	Bishop's Weed
	2	.50	<i>Arabis caucasica</i>	Rock Cress
	2	.50	<i>Arctostaphylos uva-ursi</i>	Kinnikinnick
4 - 9	1	.25	<i>Campsis radicans</i>	Trumpet Vine
	1	.25	<i>Cerastium tomentosum</i>	Snow In Summer
	1 - 2	.50	<i>Clematis 'Hybrids'</i>	Clematis
	1	.25	<i>Convallaria majalis</i>	Lilly-of-the-Valley
5 - 7	1 - 2	.50	<i>Cotoneaster sp.</i>	Cotoneaster
	2	.50	<i>Delosperma cooperi</i>	Delosperma, Ice Plant
	2	.50	<i>Delosperma nubigenum</i>	Yellow Ice Plant
4 - 8	2	.50	<i>Euonymus fortunei</i>	Winter Creeper
	0	0	<i>Euphorbia myrsinites</i>	Spurge
	1	.25	<i>Fragaria sp.</i>	Wild Strawberry
	2	.50	<i>Galium odoratum</i>	Sweet Woodruff
5	1	.25	<i>Genista pilosa</i>	Vancouver Gold Genista
	2	.50	<i>Hedera helix</i>	English Ivy
	1	.25	<i>Helianthemum nummularium</i>	Sunrose, Rockrose
5	2	.50	<i>Hypericum calycinum</i>	Aaron's Beard, St. John's Wort
3 - 9	0 - 1	.25	<i>Juniperus sp.</i>	Juniper (many species and varieties)
4	1	.25	<i>Lonicera japonica</i>	Japanese Honeysuckle

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
5	0	0	Mahonia repens	Creeping Oregon Grape
	2	.50	Pachistima canbyi	Mountain Lover
	2	.50	Pachysandra terminalis	Pachysandra
	0 – 1	.25	Parthenocisisis sp.	Virginia Creeper, Boston Ivy
4 - 7	1	.25	Polygonum aubertii	Silverlace Vine
3 - 9	1	.25	Rhus aromatica	Grow Low Sumac
5 - 7	1	.25	Rosa sp.	Spreading Rose
	1	.25	Sedum sp.	Utah Green Sedum, Goldmoss Sedum, Green Stonecrop, Dragon's Blood Sedum
	1	.25	Sempervivum tectorum	Hens And Chicks
4	2	.50	Thymus sp.	Woolly Thyme, Pink Creeping Thyme
	1	.25	Vinca major	Periwinkle
	2	.50	Vinca minor	Dwarf Periwinkle
	1 – 2	.50	Vitis sp.	Grapes
4 - 9	2	.50	Wisteria	Wisteria
<b>ORNAMENTAL GRASSES</b>				
			Achantherum lettermanii	Needlegrass
			Achnatherum hymenoides	Indian Rice Grass
			Aristida purpurea	Purple Threeawn "No Eat-Um"
			Bouteloa curtipendula	Sideoats Grama
	1	.25	Bouteloa gracilis	Blue Grama
			Bromus anomalus	Nodding Brome
			Bromus carinatus/marginatus	California, Mountain Brome
	0	0	Buchloe dactyloides	Buffalograss
	1	.25	Calamagrostis x acutiflora 'Stricta'	Feather Reed Grass
			Danthonia intermedia	Oat Grass
			Deschampsia caespitosa	Tufted hairgrass, Salt & Pepper
			Elymus elymoides	Bottlebrush Squirrel Tail
	0	0	Elymus glaucus	Blue Oat Grass
			Elymus lanceolatus	Thickspike Wheatgrass
			Elymus trachycaulus	Slender Wheatgrass
CS	2	.50	Festuca arundinacea	Tall Fescue
			Festuca idahoensis	Idaho Fescue
CS	0	0	Festuca ovina	Sheep Fescue
	1	.25	Festuca ovina glauca	Blue Sheep Fescue
CS	3	1	Festuca rubra	Red Fescue
			Festuca subulata	Bearded Fescue
			Hesperostipa comata	Needle and Thread Grass
			Hilaria jamesii	Galleta Curly Grass
			Koeleria macrantha	June Grass
			Leymus cinereus	Great Basin Wild Rye
CS	3	1	Lolium perenne	Perennial Rye
			Melica bulbosa	Onion Grass
			Melica spectabilis	Purple Onion Grass
	1	.25	Miscanthus sinensis 'Gracillimus'	Maidenhair Grass
			Muhlenbergia montana	Scratch Grass
			Muhlenbergia richardsonis	Mat Muhly
CS	0	0	Oryzopsis hymenoides	Indian Ricegrass
			Pascopyrum smithii	Western Wheatgrass
	0	0	Pennisetum ruppelii	Fountain Grass
			Poa ampla	Big Bluegrass

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
			Poa curta	Wasatch Bluegrass
			Poa fendleriana	Mutton Bluegrass
CS	3	1	Poa pratensis	Kentucky Bluegrass
			Poa secunda	Sandbergs Bluegrass
			Pseudoregneria spicatum	Bluebunch Wheatgrass
			Schizachyrium scoparium	Little Bluestem
			Sporobolus airoides	Alkali Sacaton
			Sporobolus cryptandrus	Sand Dropseed
	1	.25	Stipa sp.	Needlegrass, Needle and Thread Grass
			Stipa speciosa	Desert Needlegrass
			Stipa viridula	Green Needlegrass
<b>HERBACIOUS PERENNIALS</b>				
3	0	0	Achillea millifolium	Milfoil Yarrow
	0	0	Achillea sp.	Yarrow (many varieties)
			Actaea rubra	Baneberry
4 - 8	3	1	Aegopodium podagraria 'Variegatum'	Bishop's Weed
	1	.25	Aesclepias tuberosa	Butterfly flower
<b>HERBACIOUS PERENNIALS</b>				
3	0	0	Achillea millifolium	Milfoil Yarrow
	0	0	Achillea sp.	Yarrow (many varieties)
			Actaea rubra	Baneberry
4 - 8	3	1	Aegopodium podagraria 'Variegatum'	Bishop's Weed
	1	.25	Aesclepias tuberosa	Butterfly flower
			Agastache ssp.	Wild Hyssop
	2	.50	Alcea rosea	Hollyhock
			Allium ssp.	Wild Onion
	2	.50	Alyssum saxatilis	Basket of Gold
	2	.50	Anacyclus depressus	Mount Atlas Daisy
4	1	.25	Anaphalis margaritacea	Pearly Everlasting
			Anemone patens	Wind Flower
	1	.25	Anemone pulsatilla	Pasque Flower
			Antennaria dimorpha	Pussy Toes
			Antennaria microphylla	Pearly Pussy Toes
4	2	.50	Antennaria rosea	Pink Pussy Toes
			Apocynum	Spreading Dogbane
	2	.50	Aquilegia sp.	Columbine
5	2	.50	Arabis caucasica	Rock Cress
			Arabis ssp.	Rockcress
			Arenaria ssp.	Sandwort
			Argemone munita	Armed Prickly Poppy
4	2	.50	Armeria maritima	Common Thrift or Sea Pink
			Arnica cordifolia	Heart Leaf Arnica
3	0	0	Artemisia frigida	Fringed Sage
			Artemisia ludoviciana	Prairie Sagebrush
3	0	0	Artemisia schmidtiana	Silver Mound
	0 - 2	.25	Artemisia sp.	Wormwood, Sagebrush
			Asclepias asperula	Spider Milkweed
3	1	.25	Asclepias tuberosa	Butterfly Milkweed or Butterfly Weed
	0 - 2	.25	Aster sp.	Alpine Aster, Hardy Aster, Michaelmas Daisy, Pacific Aster
			Astragalus ssp.	Milkvetch
4	1	.25	Aubrieta deltoidea	Purple Rock Cress
4	2	.50	Aurinia saxatile campactum	Dwarf Basket of Gold

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
			Balsamorhiza ssp.	Balsamroot
4	2	.50	Baptisia australis	Blue False Indigo
			Berberis fendlerii	Freemont Barberry
	2	.50	Bergenia cordifolia	Bergenia, Saxifrage
			Brickellia grandiflora	Tasselflower
	1	.25	Bulbs	Spring Flowering Bulbs
3	0 - 1	.25	Callirhoe involucrata	Poppy Mallow
			Calochortus nuttallii	Sego Lilly
			Calylophus lavandulifolia	Evening Primrose
			Camassia quamash	Blue Camas
3	3		Campanula rotundifolia	Bell Flower or Bluebells of Scotland
	2	.50	Campanula sp.	Carpathian Harebell, Serbian Bellflower, Bluebells of Scotland and others
			Castilleja ssp.	Indian Paint Brush
3	1	.25	Centaurea montana	Bachelor Button
4	1	.25	Centranthus ruber	Keys Of Heaven, Jupiter's Beard, Red Valerian
3	2	.50	Cerastium tomentosum	Snow-in-Summer
			Chaenactis douglasii	Dusty Maidens
	2	.50	Cheiranthus cheiri	Wallflower
	2	.50	Chrysanthemum maximum	Shasta Daisy
4	2	.50	Chrysanthemum x superbum	Shasta Daisy
			Clemantis hirsutissima	Lionsbeard, Sugarbowls
	2	.50	Coreopsis grandiflora	Coreopsis, Pot of Gold
4	2	.50	Coreopsis verticillata	Threadleaf Coreopsis
	1	.25	Corydalis lutea	Yellow Corydalis
			Crepis acuminata	Hawksbeard
			Crypthantha flava	Yellow Forget-Me-Not
			Crypthantha humilis	Dwarf Forget-Me-Not
			Dephinium nuttalianum	Perennial Larkspur
2	2	.50	Dianthus "Zing Rose"	Zing Rose Dianthus
2	2	.50	Dianthus barbatus	Sweet William
2	2	.50	Dianthus sp.	Hardy Carnation, Sweet William, Maiden Pinks
3	3	1	Dicentra eximia	Fringed Bleeding Heart
2	3	1	Dicentra spectabilis	Bleeding Heart
3	0 - 1	.25	Echinacea purpurea	Purple Coneflower
			Epilobium angustiolium	Fireweed
	2	.50	Epimedium x rubrum	Barrenwort
			Erigeron ssp.	Yellow Daisy, Fleabane
	0	0	Eriogonum umbellatum	Sulphur Flower
			Eriophyllum lanatum	Woolyleaf, Oregon Sunshine
			Erogonum ssp.	Buckwheat
	2	.50	Eryngium alpinum	Blue Sea Holly
			Erysimum asperum	Pretty Wallflower
			Erythronium grandiflorum	Glacier Lily, Dogtooth Violet
	2	.50	Euphorbia epithymoides	Cushion Flower, Spurge
4	0	0	Euphorbia polychroma	Cushion Spurge
			Fragaria vesca	Woodland Strawberry
			Fritillara pudica	Yellow Bell
3	0	0	Gaillardia aristata	Blanketflower
3	0	0	Gaillardia aristata	Indian Blanket Flower
3	0 - 1	.25	Gaillardia sp.	Blanket Flower, Firewheel
			Gaura coccinea	Scarlot Guara
	2	.50	Gaura lindheimeri	Gaura, Whirling Butterflies

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
	0 – 2	.25	Geranium sp.	Cranesbill, Wild Geranium
			Geranium viscosissimum	Sticky Purple Geranium
	0 – 2	.25	Geum sp.	Geum, Grecian Rose
			Geum Triflorum	Prairie Smoke, Old Man's Beard
			Gilia aggregata	Scarlet Gilia
	2	.50	Gypsophila paniculata	Baby's Breath
			Haplopappus acaulis	Goldenweed, Jimmyweed
			Hedysarum boreale	Sweetvetch
			Helenium hoopesii	Orange Sneezeweed
			Helianthella uniflora	Little Sunflower
3	1 -2	.50	Hemerocallis hybrid	Daylily
	1	.25	Herniaria glabra	Green Carpet, Rupture Wort
			Heterotheca villosa	Golden Hoary Aster
			Heuchera rubescens	Coralbells, Alumroot
	2	.50	Heuchera sanguinea	Coral Bells
	2	.50	Hibiscus moscheutos	Perennial Hibiscus
	2	.50	Hosta sp.	Plantain Lily
			Hydrophyllum capitatum	Ballhead Waterleaf
			Hymenoxys acaulis	Stemless Woollybase
3	2	.50	Iberis Sempervirens	Candytuft
			Iliamna rivularis	Wild Hollyhock
3	1	.25	Iris Hybrids	Iris
	1	.25	Iris missouriensis	Missouri Iris
	2		Iris sibirica	Siberian Iris
	1	.25	Iris x germanica	German Bearded Iris
5	1	.25	Kniphofia uvaria	Red Hot Poker
			Lathyrus pauciflorus	Utah Sweet Pea, Wild Sweet Pea
	1	.25	Lavandula angustifolia	English Lavender
			Lesquerella multiceps	Bladderpod
			Lewisia rediviva	Bitterroot
	2	.50	Liatriis spicata	Gayfeather
	2	.50	Limonium latifolium	Statice, Sea Lavender
			Linanthastrum nuttallii	Flaxflower
	1	.25	Linaria purpurea	Toad Flax
3	0	0	Linum perenne	Flax
	0 – 1	.25	Linum sp.	Golden Flax, Perennial Flax, Native Blue Flax
			Lomatium ssp.	Biscuitroot
			Lonicera involucrata	Utah Twinberry
3	3		Lupinus 'Russel Hybrid'	Lupine
3	2	.50	Lychnis sp.	Maltese Cross, Rose Campion
			Mentzelia laevicaulis	Blazing Star
			Mertensia brevistyla	Wasatch Bluebell
			Mertensia ciliata	Mountain Bluebell
			Mertensia oblongifolia	Western Bluebell
			Mirabilis multiflora	Showy Four-O-Clock
3	1	.25	Monarda didyma	Bee Balm
			Mondardella odoratissima	Cloverhead Horsemint
3	2	.50	Narcissus species	Daffodil
2	2	.50	Oenothera elata	Showy Primrose
3	1	.25	Oenothera missourensis	Missouri Primrose
2	0 – 1	.25	Oenothera sp.	Evening Primrose
			Osmohiza occidentalis	Western Sweet Cicely
			Oxytropis lambertii	Crazyweed, Locoweed
			Oxytropis sericea	Silky Crazyweed

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
	2	.50	<i>Paeonia hybrida</i>	Peony
3	2	.50	<i>Papaver orientale</i>	Oriental Poppy
	1	.25	<i>Papaver sp.</i>	Poppy, Oriental Poppy
2	0 – 1	.25	<i>Penstemon sp.</i>	Firecracker Penstemon, Palmer Penstemon, Shrublet Penstemon, Wasatch Penstemon
			<i>Perideria gairdneri</i>	False Yarrow
3	1 - 2	.50	<i>Perovskia atriplicifolia</i>	Russian Sage
			<i>Phacelia sericea</i>	Silky Phacelia
			<i>Phlox hoodii</i>	Carpet Phlox
			<i>Phlox longifolia</i>	Longleaf Phlox
3	1 - 2	.50	<i>Phlox subulata</i>	Creeping Phlox
3	3		<i>Physostegia virginiana</i>	Obedient Plant
	2	.50	<i>Platycodon grandiflorus</i>	Balloon Flower
	1	.25	<i>Polemonium caeruleum</i>	Jacob's Ladder
			<i>Polemonium foliosissimum</i>	Leafy Jacobs ladder
			<i>Potentilla gracilis</i>	Showy Cinquefoil
5	1	.25	<i>Pulsatilla vulgaris</i>	Pasque Flower
4	0 - 1	.25	<i>Ratibida columnaris</i>	Prairie Coneflower, Mexican Hat
3	1	.25	<i>Rudbeckia hirta</i>	Gloriosa Daisy
	0 – 2	.25	<i>Rudbeckia sp.</i>	Black Eyed Susan, Dwarf Rustic Coneflower
	2	.50	<i>Salvia sp.</i>	Salvia
	1	.25	<i>Santolina sp.</i>	Lavender Cotton
3	2	.50	<i>Saponaria ocymoides</i>	Rock Soap Wort
			<i>Sedum lanceolatum</i>	Stonecrop
4	0 - 1	.25	<i>Sedum sp.</i>	Sedum (many species and varieties)
			<i>Sidlacea oregana</i>	Oregon Checkermallow
			<i>Silene acaulis</i>	Douglas Campion
			<i>Sisyrinchium ssp. Idahoensis</i>	Purple-eyed Grass
	2	.50	<i>Solidago Canadensis</i>	Goldenrod
2	2	.50	<i>Solidago hybrids</i>	Goldenrod
			<i>Solidago sparsiflora</i>	Goldenrod
			<i>Sphaeralcea ssp.</i>	Globemallow
4	1 - 2	.50	<i>Stachys bysantina</i>	Lambs Ears
			<i>Stanleya pinnata</i>	Prince's Plume
	2	.50	<i>Teucrium chamaedrys</i>	Germander
3	2 - 3	.75	<i>Thymus sp.</i>	Thyme (many varieties)
			<i>Townsendia incana</i>	Easter Daisy
	2	.50	<i>Tradescantia virginiana</i>	Spiderwort
			<i>Trifolium maci lentrum</i>	Leanclover
2	3	1	<i>Tulipa hybrids</i>	Tulip
	2	.50	<i>Verbena sp.</i>	Verbena
	2	.50	<i>Veronica sp.</i>	Speedwell
3	1	.25	<i>Veronica spicata</i>	Spike Speedwell
	0	0	<i>Viguiera multiflora</i>	Showy Godeneye
4	3	1	<i>Vinca minor</i>	Periwinkle
			<i>Viola adunca</i>	Blue Violet
			<i>Viola nuttallii</i>	Yellow Prairie Violet
	0 – 2	.25	<i>Viola sp.</i>	Violet Pansy
			<i>Wyethia amplexicaulis</i>	Mule's Ears
	1	.25	<i>Zauschneria californica</i>	Hummingbird Fuchsia
			<i>Zauschneria latifolia</i>	Hummingbird Flower

4.12 Irrigation Schedule Form Instructions

- A. A monthly irrigation schedule shall be prepared to cover the initial 120-day plant establishment period and the following one-year period. The irrigation schedule shall be prepared by a Landscape Architect or another licensed professional as recognized by the State of Utah. Attached is a suggested form for the irrigation schedule. The preparer may use this form or follow another appropriate format.
- B. The schedule should rely on monthly Reference Evapotranspiration (ET<sub>o</sub>) data for the Salt Lake County area. Once established, turf can be maintained in an attractive manner at approximately 100 percent of the ET<sub>o</sub> rate under normal weather conditions. Water-Conserving Plants typically need 50 percent or less of the ET<sub>o</sub> under normal weather conditions. The amount of water applied for each valve should also be adjusted for Irrigation Efficiency, local rainfall, specific site conditions (e.g., water holding capacity and infiltration rate). Ultimately, the amount and frequency of irrigation will need to be monitored regularly to adjust for plant growth, climatic changes and site conditions.
- C. For valves with overhead Spray or Stream Sprinklers, set valves to operate between 6:00 pm and 10:00 am to reduce water loss from wind and evaporation. Early morning irrigation is recommended for turf and ground cover. On slopes and soils with slow infiltration rates, program valves for multiple repeat cycles to reduce runoff.
- D. The following chart is an example for the Salt Lake Count Area. For the water allowance formula the relative ET<sub>o</sub> is to be used in accordance to the location of the project.

Estimated Monthly ET <sub>o</sub> for Salt Lake (Airport)												
											Annual	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ET <sub>o</sub>
--	--	0.31	1.89	3.39	4.64	5.39	4.53	2.72	1.38	--	--	24.26



Note: This irrigation schedule should be used as a guide. The landscaping should be monitored regularly and the schedule adjusted as needed for plant growth, local rainfall, and climate conditions. Check irrigation system frequently to minimize run off and over-spray. Schedule valves with sprinklers to irrigate between 6 PM and 10:00 AM to reduce water loss from wind and evaporation.

Jul	Month
15	Run time (minutes per day)
3	Run time (Days per week)



**SUBSTANTIAL COMPLETION FORM**

Project Name: \_\_\_\_\_

Project Address: \_\_\_\_\_

I/We hereby certify the following:

- 1. The landscaping work for the above project has been completed in substantial conformance to the DFCM Landscape and Irrigation Standards (Guidelines)
- 2. The automatic controller has been set according to the approved irrigation schedule for the plant establishment period.
- 3. A Water Use Efficiency Review (audit) has been conducted on the completed landscape. The irrigation system has been adjusted to meet the minimum Irrigation Efficiency required by the DFCM and minimize overspray and runoff.
- 4. A copy of the irrigation schedule has been give to the property owner, and the DFCM.
- 5. A completed set of record drawings have been given to the DFCM.

Comments: \_\_\_\_\_  
\_\_\_\_\_

Substantial Completion Form prepared by:

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_ License No.: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

Telephone: \_\_\_\_\_

Water Use Efficiency Review (Audit) Certified by:

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_ License No.: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

Telephone: \_\_\_\_\_

## PROJECT DATA FORM

Project Name: \_\_\_\_\_

Project Address: \_\_\_\_\_

Type of Facility:

Type of Facility	Water Allowance (% of allowable water used)	
A.	Office type buildings	50%
B.	Existing campus/institution	70%
C.	New campus/institution	60%
D.	Recreational areas (ball fields etc.)	70%
E.	State Parks (natural areas)	10%

Landscape Architect:

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_ License No.: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_

Landscape Contractor:

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_ License No.: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_

#### 4.13 Resources

Larry A. Rupp, William A. Varga, Teresa A. Cerny, Chad R. Reid, Mike Kuhns, *Selection and Culture of Landscape Plants in Utah. A Guide for High Mountain Valleys (Rich, Morgan, Summit, Daggett, and Wasatch Counties)*. Utah State University Extension, December 2002

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## 5.0 HIGH PERFORMANCE BUILDING RATING SYSTEM

### 5.1 General

- A. This section defines a High Performance Building Rating System for Buildings except Low-Rise Residential Buildings.
- B. If required by contract, a building shall comply with the Prerequisites (Section 5.5) and Energy Requirements (Section 5.6), and scores with 20 points or more with the Sustainability Credits (Section 5.7).

### 5.2 Definitions

“Agency” is any state agency, board, commission, department, or division.

“Designer” is the architect(s), engineer(s), and other professionals responsible for the building design.

“Institution” means the University of Utah, Utah State University, Southern Utah University, Weber State University, Snow College, Dixie State College of Utah, College of Eastern Utah, Utah Valley State College, Salt Lake Community College, Utah College of Applied Technology, and any other university or college which may be established and maintained by the state.

“Low-Rise Residential Buildings” means single-family houses, multi-family buildings of three stories or less above grade, and manufactured houses.

“Life-cycle costs” means the sum of the present values of investment costs, capital costs, installation costs, energy costs, operating costs, maintenance costs, and disposal costs, over the lifetime of the project, product, or measure.

“Life-cycle cost-effective” means the life-cycle costs of a product, project, or measure are estimated to be equal to or less than the base case (i.e., current or standard practice or product).

### 5.3 Referenced Standards and Codes.

The design shall comply with all applicable Standards and Codes at the time submitted to the State Building Official, including but not limited to:

ANSI/ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

ANSI/ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy

ANSI/ASHRAE Standard 62, Ventilation for Acceptable Indoor Air Quality.

ANSI/ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, including Appendix G.

Illuminating Engineering Society of North America, *IESNA Lighting Handbook*.

U.S. Green Building Council, *Leadership in Energy & Environmental Design for New & Major Renovations (LEED-NC)*.

#### 5.4 Design and Technology Charrette

- A. DFCM may conduct a Design and Technology Charrette with the designers to review the requirements of the standard and strive for an integrated design of energy efficiency and environmental measures. In addition, the charrette shall also consider sustainable site design including:
- (1) Natural shade to reduce heat island effect from parking lots and landscaping areas;
  - (2) Shielded or reduced parking and façade lighting to reduce night sky pollution;
  - (3) Reuse of existing building to conserve our resources;
  - (4) Avoiding sewer and waterway contamination;
  - (5) Use local building materials and products to support local economy and reduce the environmental impacts from transportation;
  - (6) Encourage the use of public transportation;
  - (7) Protect wet-lands and green spaces; and
  - (8) Provide recycling center.

#### 5.5 Prerequisites

- A. **Fundamental Building Systems Commissioning.** DFCM may engage a Commissioning Agent that is not an individual directly responsible for project design or employed by one of the designers. Commissioning Agent shall ensure that fundamental building components are installed and calibrated to operate as intended.
- B. **Life-Cycle Cost Analysis.** Designer shall use life-cycle cost analysis in making decisions about their investments in products, services, construction, and other projects to lower the State Government's costs and to reduce energy and water consumption.
- C. **CFC Reduction in HVAC and Refrigeration Equipment.** Designer shall select HVAC and refrigeration equipment without chlorofluorocarbons (CFC) based refrigerants.
- D. **Ventilation Systems.** Designer shall provide mechanical ventilation system according to Standard 62. Mechanical ventilation system shall have the capability

to operate continuously during occupancy and designed not to be easily shut-down or otherwise defeated, such as blocked registers.

- E. Drainage Systems. Designer shall design surface grades, storm drainage system, HVAC system, and other systems to avoid accumulation of standing water around or in the building.
- F. Landscape and Irrigation Systems. Designer shall design landscape and irrigation systems according to DFCM Guidelines for Landscape & Irrigation Standard.
- G. Fundamental Lighting Design. Designer shall design the lighting system according to IESNA Lighting Handbook.
- H. Mold Prevention during Construction. Contractor shall ensure porous type building materials, such as wood, insulation, paper, and fabric, is kept dry to prevent the growth of mold and bacteria. Materials that have been affected by mold shall be abated or replaced. Building insulation that is damp or wet for 72 hours shall be replaced.
- I. Filtration Media Replacement before Occupancy. Contractor shall ensure that filtration media is replaced before occupancy.
- J. Thermal Comfort. Designer shall ensure that thermal comfort requirements are meet according to Standard 55. Exceptions:
  - (1) Winter humidification is not required;
  - (2) Summer dehumidification is not required; and
  - (3) Upper temperature limit in natural ventilated buildings is not required.

#### 5.6 Energy Efficiency Requirements:

- A. Energy Performance. DFCM may select an integrated system of components to reduce source energy use what is required by Standard 90.1.
  - (1) DFCM shall engage an Energy Specialist with 3 years of experience with hourly energy modeling. Energy Specialist is not an individual directly responsible for project design or employed by one of the designers. Energy specialist shall perform the energy analysis according to Appendix G of Standard 90.1. Energy Specialist shall prepare report according to DFCM template and shall specify which energy efficiency measure should be commissioned. Energy Specialist shall consider reducing energy use in each major categories: 1) lighting, 2) cooling, 3) heating, 4) pumps/cooling tower, 5) internal loads, and 6) external loads. Energy specialist should also consider the following technologies:
    - a. Daylighting;
    - b. Natural ventilation;

- c. Evaporative cooling;
- d. Demand-controlled ventilation using CO2 or occupancy sensors;
- e. Green roof;
- f. Ground source heat pumps;
- g. Spectrally selective glazings;
- h. Underfloor air distribution;
- i. Radiant cold beam system; and
- j. Displacement ventilation system.

(2) Commissioning Agent shall ensure the selected energy efficiency measures are installed and calibrated to operate as intended.

B. Small Buildings Prescriptive Energy (Optional). For nonresidential buildings with 3 floors or less and 75,000 square feet or less, Designer may substantially design the Building Envelope, Lighting System, HVAC system, and Service Water Heating system according to the recommended performance levels shown in Tables 1 through 4 in compliance with Standard 90.1.

Table 1 – Small Buildings Prescription Energy Option: Building Envelope<sup>(4)</sup>

Category	Component	Recommendation
Roof	Insulation entirely above deck	R-20 continuous insulation and Energy-Star® rated surface
	Metal building	R-13 + R-19
	Attic and other	R-38
	Single rafter (insulated flat or vaulted ceilings)	R-38 + R-5 continuous insulation
Walls	Mass (HC > 7 Btu/ft2) <sup>(1)</sup>	R-11.4 continuous insulation
	Metal building	R-13+R-13
	Steel framed	R-13+ R-7.5 continuous insulation
	Wood frame and other	R-13 + R-3.8 continuous insulation
	Below-grade walls	R-7.5 continuous insulation
Floors	Mass	R-10.4 continuous insulation
	Steel framed:	R-30
	Wood framed and other	R-30
Slab	Unheated	None <sup>(2)</sup>
	Heated	R-10 for 36 in.
Doors	Swinging	U-0.70
	Non-swinging	U-0.50
Vertical Glazing	Window-to-wall ratio (WWR)	40% maximum
	Overall thermal transmittance	U-0.42
	Shading Coefficient	SC-0.40 <sup>(3)</sup>
	Exterior sun control (S, E, W only)	Projection Factor-0.5 <sup>(5)</sup>
	Low-e coating	Emittance < 0.05
Orientation	$(A_{north} * SC_{north} + A_{south} * SC_{south}) > (A_{east} * SC_{east} + A_{west} * SC_{west})$	Area (A) and Shading Coefficient (SC) of the Window
Skylight	Percent of roof area	3% maximum
	Overall thermal transmittance	U-0.69
	Overall solar heat gain coefficient	SC-0.42

<sup>(1)</sup> Fully grouted CMU walls or 6 inch concrete walls qualify for a mass wall.

<sup>(2)</sup> R-10 for 24 in. located in counties of Box Elder, Cache, Carbon, Daggett, Duchesne, Morgan, Rich, Summit, Uintah, and Wasatch.

<sup>(3)</sup> SC-0.44 for glazing located on the street side of the street level with continuous overhang with projection factor of 0.5 (S, E, W only).

<sup>(4)</sup> Reference documents: ASHRAE *Advanced Energy Design Guide for Small Office Buildings* and Standard 90.1.

<sup>(5)</sup> Projection Factor = (Horizontal Projection) / (Height Above Sill)

Table 2 – Small Buildings Prescription Energy Option: Lighting

Category	Component	Recommendation
Interior Lighting	Lighting power density (LPD)	10% Savings over Standard 90.1
	Premium T8 lamps	≥ 3100 Lumens
	Premium T8 ballasts	BF ≤ 0.8
	Window daylighting controls	Dim within 12 ft of windows
	Skylight daylighting controls	Dim within 8 ft of skylight
	Occupancy sensors	Auto-off in non-24 hour rooms
	Ceiling reflectance	80%
	Wall and partitions reflectance	70%
	High or low bay lighting	High or low bay T5 <sup>(1)</sup> fixtures

<sup>(1)</sup> In semi-heated or unheated spaces, use pulse start metal halide.

Table 3 – Small Buildings Prescription Energy Option: HVAC

Category	Component	Recommendation
HVAC	Air Conditioner (< 65,000 Btu/hr)	15 SEER
	Air Conditioner (≥ 65,000 Btu/hr and < 135,000 Btu/hr)	11.0 EER and 11.4 IPLV
	Air Conditioner (≥ 135,000 Btu/hr and < 240,000 Btu/hr)	10.8 EER and 11.2 IPLV
	Air Conditioner (> 240,000 Btu/hr)	10.0 EER and 10.4 IPLV
	Air Conditioner Water or Evaporatively Cooled	14.0 EER
	Heat Pumps (< 65,000 Btu/hr)	13 SEER (Cooling) 8.0 HSPF (Heating, Split System) 7.5 HSPF (Heating, Single System)
	Heat Pumps (≥ 65,000 Btu/hr and < 135,000 Btu/hr)	11.0 EER and 11.4 IPLV (Cooling) 3.4 COP (Heating, 47° OSA) 2.4 COP (Heating, 17° OSA)
	Heat Pumps (≥ 135,000 Btu/hr and < 240,000 Btu/hr)	10.8 EER and 11.2 IPLV
	Heat Pumps (> 240,000 Btu/hr)	10.0 EER and 10.4 IPLV
	Air Conditioner Water or Evaporative Cooled	14.0 EER
	Water-source heat pump	14.0 EER (Cooling) 4.6 COP (Heating)
	Semi-cooled spaces	Direct or Indirect Evaporative Cooling (< 25,000 cfm)
	Gas furnace (≤ 225,000 Btu)	80% AFUE or Et (Single Package AC) 90% AFUE or Et (Split AC)
	Gas furnace (> 225,000 Btu)	80% Ec
Boiler	Hot Water Boiler (≤ 300,000 Btu)	90% AFUE
Motors	All pump and fan motors (≥ 1 hp)	NEMA Premium Efficiency Motors
Economizer	Air conditioners and heat pumps (single package)	Cooling capacity > 54,000 Btu
Ventilation	Outdoor air dampers	Motorized control
Duct	Friction rate	0.08 in. w.c. per 100 feet
	Sealing	Sealing class B
	Insulation level	R-6

Table 4 – Small Buildings Prescription Energy Option: Service Water Heating

Category	Component	Recommendation
Service Water Heating	Gas storage	90% Et
	Gas instantaneous	0.81 EF or 81% Et
	Electric storage 12 kW	$EF > 0.99 - 0.0012 \times \text{Volume}$
	Pipe insulation	1 in. (diameter < 1.5 in.) 1.5 in. (diameter > 1.5 in.)

5.7 Sustainability Credits

A. Daylighting Credits

(1) Daylighting. Designer shall use daylight as the primary lighting system for 40 to 90 percent of the space, excluding copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas. Daylight zones shall have a minimum Daylight Factor of 2 percent and a maximum illumination of 200 footcandles. “Daylight Factor” means the ratio of interior to exterior illumination. Design shall lower peak and annual cooling loads compared to a building meeting Standard 90.1.

a. The Commissioning Agent shall ensure the daylighting control system is installed and calibrated to operate as intended.

- 2 points Daylighting in 40 percent of the space.
- 3 points Daylighting in 52 percent of the space.
- 4 points Daylighting in 62 percent of the space.
- 5 points Daylighting in 74 percent of the space.
- 6 points Daylighting in 90 percent of the space.

B. Energy Credits

(1) Evaporative Cooling. Designer shall select the evaporative cooling system to reduce mechanical cooling by 15 percent based on calculation method of Appendix G, Standard 90.1. Design the HVAC controls to turn off the evaporative cooling system whenever the indoor humidity level exceeds 60 percent. It should be integrated with the air economizer system and mechanical cooling system:

a. The Commissioning Agent shall ensure the evaporative cooling system is installed and calibrated to operate as intended.

- 2 points Evaporative cooling system.

(2) Demand-Controlled Ventilation using CO2 Sensors. Designer shall select the ventilation system to have a means to automatically reduce outside air intake using CO2 Sensors according to Standard 62.

a. The Commissioning Agent shall ensure the Demand-Controlled Ventilation system is installed and calibrated to operate as intended.

1 points Demand-controlled ventilation system.

- (3) Underfloor Air Distribution. Designer shall provide an underfloor air distribution system with ceiling return or equivalent air displacement system, excluding copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas.

2 points Underfloor air distribution system.

C. Renewable Energy Credits

- (1) Renewable Energy. Designer shall select on-site renewable energy such as photovoltaic, wind, geothermal, and fuel cells utilizing biogas to reduce source energy use.

2 point 5 percent reduction in source energy use.  
3 points 12 percent reduction in source energy use.  
4 points 22 percent reduction in source energy use.  
5 points 34 percent reduction in source energy use.  
6 points 50 percent reduction in source energy use.

D. Indoor Air Quality Credits

- (1) Low-Emitting Materials. Designer shall select adhesives and sealants, paints and coatings, carpet, and composite woods with low-emitting materials.

1 point Select adhesives and sealants that meet USGBC LEED™ - NC, Credit 4.1, requirements.  
1 point Select paints and coatings that meet USGBC LEED™ - NC, Credit 4.2, requirements.  
1 point Select carpets that meet USGBC LEED™ - NC, Credit 4.3, requirements.  
1 point Select composite woods that meet USGBC LEED™ - NC, Credit 4.4, requirements.

- (2) Pollutant Source Control. Designer shall design the HVAC system to vent pollution sources, minimize cross-contamination of chemical pollutants, avoid dust and microbial growth, and install rated filtration media.

1 point Install source ventilation system to vent pollution sources such as copy rooms, chemical storage rooms, janitorial rooms, food preparation spaces, and other polluting activities. Install separation walls that extend to the structure to prevent cross-contamination.  
1 point Design HVAC system to avoid areas where mold and dust can accumulate, such as return plenums and fibrous ductwork.  
1 point Select MERV rated filters of 11 or greater according to Standard 52.2.

(3) Construction Indoor Air Quality Management Plan. Contractor shall ensure that Volatile Organic Compounds (VOC), dust, oils, and odors have been contained and removed before occupancy.

- a. Prior to installation of materials and products that emits VOC or odors, allow materials and products to off-gas in a well ventilated staging area. Remove any oil films and dust.
- b. During installation of materials and products that emits VOC or odors, use HVAC fans, open windows, or temporary fans to continuously ventilate the area until emissions dissipate, and protect porous materials with polyethylene vapor retarders.
- c. During dust producing activities (such as drywall installation and finishing), protect HVAC fans and ductwork from accumulating dust by turning off the fans and cover air grilles, registers, and other duct openings. Use temporary fans to ventilate the space.
- d. Prior to operating HVAC system, vacuum dust that has accumulated in HVAC fans, plenums, and ductwork with HEPA vacuum and remove any oil films from metal surfaces.
- e. Prior to substantial completion, vacuum carpet and other soft surface with HEPA vacuum.

1 point

Construction Indoor Air Quality Management Plan

1 point

Prior to occupancy and after Substantial Completion, flush building for 15 days with 100 percent outside air.

E. Commissioning and Training Credits

(1) Additional Commissioning. Commissioning Agent shall ensure the building is designed, constructed, and calibrated to operate as intended. Implement the following additional commissioning tasks beyond the Prerequisites Fundamental Commissioning requirements:

- a. Review and provide recommendations on the design document prior to issuing the construction documents.
- b. Review the contractor submittals relative to the systems being commissioned.
- c. Develop Recommissioning Plan to schedule commissioning activities to assure the building is continuously tuned to optimize performance.

2 points

Additional commissioning.

F. Acoustics Credits

- (1) Improve Acoustical Performance. Designer shall design work spaces to provide acoustic levels that limit excess noise from exterior sources, HVAC systems, and other sources.

1 point Acoustical level of 36 to 40 dBA background, and 0.6 second reverberating times or less.  
2 points Acoustical level of 35 dBA background or less, and 0.6 second reverberating times or less.

G. Sustainable Material Credits

- (1) Recycled Content. Designer shall select building products that have incorporated recycled-content in major materials from the Construction Products category of the US Environmental Protection Agency (EPA) Comprehensive Procurement Guidelines. Major materials include parking areas, floor, roof, partition, walls, or serving a structural function throughout the building.

1 point Four to seven major materials with recycled-content.  
2 points Eight or more major materials with recycled-content.

H. Waste Reduction Credits

- (1) Site Waste Reduction. Contractor shall ensure that construction waste, demolition, and land clearing waste are recycled, composted, and salvaged. "Recycle Rate" is the ratio of recycled waste (by weight) to total waste (by weight).

1 point Recycle Rate of 50 to 74 percent.  
2 points Recycle Rate of 75 percent or greater.

I. Water Reduction Credits

- (1) Water Efficient Fixtures and Appliances. Designer shall select water-efficient, fixtures and appliances with maximum flow shown below:

- a. Sensor faucet, 0.5 gpm
- b. Showerhead, 1.5 gpm
- c. Sensored flushometer toilet, 1.1-1.3 gpf, or dual flush valve
- d. Waterless or ultra-low flow urinal, 0.5 lpf

2 points Water efficient fixtures and appliances.

J. Performance Measurement and Verification Credits

- (1) Building Performance Monitoring on Multi-Building Campus. On a multi-building campus, agencies and institutions shall meter each energy type for each building. Energy type includes electricity, natural gas, central chilled

water, central heating water, and central steam. The energy management system shall have the capability to monitor and log sub-metering energy use and electrical demand. Provide sub-meter water use on landscaping and other irrigation strategies.

1 point            Building performance monitoring on multi-building campus.

(2)    System Performance Monitoring. Designer shall provide continuous metering equipment for the following equipment performance shall have the capability to monitor and log equipment performance:

- a.     Lighting system (kWh and kW)
- b.     Motor loads >20 hp (kWh and kW)
- c.     Variable speed drive operation
- d.     Chiller efficiency or chiller plant efficiency (i.e. chiller, cooling tower and pumps)
- e.     Air and water economizer operation
- f.     On variable volume system, supply air static pressure and volume
- g.     Boiler efficiency or boiler plant efficiency (i.e. boiler and pumps)
- h.     Process loads (kWh and kW)

1 point            System performance monitoring.

K.    Innovation in Design

(1)    The Director of DFCM, based on justified recommendations by the Energy Manager, may award up to 4 additional points for exceptional energy or environmental measures not specifically addressed in the rating system.

1 to 4 points    Exceptional energy or environmental measures.

5.8    Submittals

A.    DFCM shall establish letter templates to document compliance with the High Performance Building Rating System used by the designers, contractors, agencies, institutions, commissioning agents, and energy specialists.



STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

**Division of Facilities Construction and Management**

**DFCM**

# **DESIGN REQUIREMENTS**

December 4, 2008

## **PREFACE**

In order for the Division of Facilities Construction and Management (DFCM) to be one of the nation's premier facility managers, it is essential that we consistently improve our performance. In order to do this, the Design Requirements provides a document and review process for consistently improving our processes and standards.

Updates to this standard will be added with highlighted backgrounds and dated at time of occurrence, until such time that a new version may be adopted for use. (02/06/2008)

# TABLE OF CONTENTS

<b>1.0</b>	<b>GENERAL .....</b>	<b>1</b>
1.1	General .....	1
1.2	Procedure .....	1
1.3	Hierarchy of Requirements .....	1
1.4	Changes and Additions to Design Requirements .....	2
<b>2.0</b>	<b>CODES / LAWS/ RULES AND REGULATORY REQUIREMENTS .....</b>	<b>4</b>
2.1	General .....	4
2.2	DFCM requirements include (but are not limited to): .....	4
2.3	Building Code Commission .....	4
2.4	Fire Prevention Board .....	4
2.5	Accessibility Code .....	4
2.6	Labor-Industrial Commission .....	4
2.7	Department of Health .....	5
2.8	Department of Environmental Quality .....	5
2.9	County Health Department (for the county where the facility is located) .....	6
2.10	Department of Commerce .....	6
<b>3.0</b>	<b>DFCM REQUIREMENTS .....</b>	<b>7</b>
3.1	General .....	7
3.2	Civil .....	11
3.3	Architectural .....	13
3.4	Structural .....	16
3.5	Mechanical .....	17
3.6	Electrical .....	26
<b>4.0</b>	<b>LANDSCAPE AND IRRIGATION STANDARDS .....</b>	<b>38</b>
4.1	Purpose .....	38
4.2	Principles and General Guidelines .....	38
4.3	Water Allowances .....	40
4.4	Definitions .....	40
4.5	Landscape Design Standards .....	44
4.6	Irrigation Design Standards .....	45
4.7	Contract Documents .....	47
4.8	Irrigation Record Drawings and Operations and Maintenance Manuals .....	50
4.9	Plan Review, Construction Inspection and Post-Construction Monitoring .....	51
4.10	Soils Definitions & Guidelines .....	52
4.11	Plant List .....	54
4.12	Irrigation Schedule Form Instructions .....	68
4.13	Resources .....	74
<b>5.0</b>	<b>HIGH PERFORMANCE BUILDING RATING SYSTEM .....</b>	<b>76</b>
5.1	General .....	76
5.2	Definitions .....	76
5.3	Referenced Standards and Codes .....	76
5.4	Design and Technology Charrette .....	77
5.5	Prerequisites .....	77
5.6	Energy Efficiency Requirements: .....	78
5.7	Sustainability Credits .....	81
5.8	Submittals .....	85



## 1.0 GENERAL

### 1.1 General

- A. These Design Requirements apply to all plans, processes, and procedures required for compliance with the Design Process.

### 1.2 Procedure

- A. Complete the Design Requirement/Variance Form to make recommendations for additions, deletions, and changes to the Design Requirements.
- B. Complete the Design Requirement/Variance Form to request approval by the Director to vary from these Design Requirements based upon the specific project needs.
- C. All Design Requirement modifications require approval by the Director.
  - (1) If the Design Requirement is approved by the Director, then the DFCM's Designated Representative shall distribute the Design Requirements Procedure document to the appropriate project participants and shall file it in the project file.
  - (2) If the Design Requirement is approved by the Director and has general applicability to other projects, the Director shall arrange for the Design Requirement modification to be added to the appropriate document.
    - a. Verify with the DFCM person responsible for the specific professional discipline and the appropriate DFCM maintenance person that the proposed Design Requirement meets their requirements.

### 1.3 Hierarchy of Requirements

- A. The hierarchy of requirements is as follows:
  - (1) Comply with the minimum requirements of all applicable laws, rules, and regulatory requirements.
    - a. Exceptions: Wherever there are practical difficulties involved in carrying out these provisions, the State Building Official with the approval of the Director of DFCM and/or the State Fire Marshall shall have authority to grant modifications. The modifications granted by the State Building Official shall be documented in this standard under the heading "Design Requirements."
  - (2) Comply with the consensus based ANSI standards for design, products, installation, and services unless the applicable laws, rules, and regulatory requirements are more stringent.

- (3) Comply with the “Performance Requirements: Design Requirements” unless the ANSI standards or the applicable laws, rules, and regulatory requirements are more stringent.
- (4) Comply with the Contract Documents, unless the “Performance Requirements: Design Requirements”, the ANSI standards, or the applicable laws, rules, and regulatory requirements are more stringent.

#### 1.4 Changes and Additions to Design Requirements

- (1) Complete the following document and submit it to the person to whom you are responsible to for ultimate decision by the Director, for requested changes/additions to the Design Requirements.

<b>Design Requirement/Variance Change Request</b>	
<b>Project Name</b>	<b>Date</b>
	<b>DFCM Project Number</b>
	<b>Risk Management Number</b>
<b>Requested by</b>	<b>Entity</b>
<b>Brief Description of the Problem</b>	
<b>Design Requirements</b>	
<b>Justification</b>	
<b>Director Approval</b>	<b>Date</b>
<b>Action to Include This Design Requirements in the Design Requirements</b>	
<b>Professional Reviewer</b>	<b>Position</b>
<b>Maintenance Reviewer</b>	<b>Position</b>
<b>Director Approval</b>	<b>Date</b>

## **2.0 CODES / LAWS/ RULES AND REGULATORY REQUIREMENTS**

### 2.1 General

- A. Comply with adopted State Codes and all other applicable Standards and Codes at the time submitted to the State Building Official, including but not limited to Section 2.2 through Section 2.10:

### 2.2 DFCM requirements include (but are not limited to):

- A. Administrative Services: Comply with Title R23: Administrative Services, Facilities Construction and Management. Refer to <http://www.rules.utah.gov/publicat/code/r023/r023.htm>.
- B. DFCM Services: Comply with Services requirements. Refer to <http://dfcm.utah.gov>. Services requirements include:
  - (1) Inspections and Testing, refer to [http://dfcm.utah.gov/bldg\\_official.php](http://dfcm.utah.gov/bldg_official.php).
  - (2) Standards and Standard Project Documents, refer to [http://dfcm.utah.gov/standard\\_docs.php](http://dfcm.utah.gov/standard_docs.php).
  - (3) Roofing, Paving, and Hazardous Materials, refer to [http://dfcm.utah.gov/const\\_roofing.php](http://dfcm.utah.gov/const_roofing.php).
  - (4) Other requirements which may be added after this document is published.

### 2.3 Building Code Commission

- A. Comply with Utah Uniform Building Standards Act. Refer to [http://www.dopl.utah.gov/licensing/statutes\\_and\\_rules/R156-56.pdf](http://www.dopl.utah.gov/licensing/statutes_and_rules/R156-56.pdf). Enforcement of these codes is the responsibility of the State Building Official.

### 2.4 Fire Prevention Board

- A. Comply with Fire Codes in accordance with “Laws, Rules” of the State Fire Marshall. Refer to [http://firemarshal.utah.gov/Laws\\_Rules/laws\\_rules.html](http://firemarshal.utah.gov/Laws_Rules/laws_rules.html). Enforcement of these codes is the responsibility of the Utah Fire Marshall.

### 2.5 Accessibility Code

- A. Comply with the US Department of Justice Federal Registers – Americans with Disabilities Act. Refer to <http://www.usdoj.gov/crt/ada/adahom1.htm>.

### 2.6 Labor-Industrial Commission

- A. Comply with requirements of the Labor-Industrial Commission. Refer to <http://www.labor.state.ut.us>.

- (1) Boiler and Pressure Vessel Compliance Manual, Refer to [http://laborcommission.utah.gov/Safety\\_Division/BLRCompManRev8-306.pdf](http://laborcommission.utah.gov/Safety_Division/BLRCompManRev8-306.pdf).
- (2) Utah Occupational Safety and Health, refer to <http://www.rules.utah.gov/publicat/code/r614/r614.htm>.
- (3) Elevator Rules: American National Standard Safety Code for Elevators and Escalators, ANSI/ASME A17.1 with amendments administered by Labor-Industrial Commission of Utah, Department of Occupational Safety and Health Elevator Division. Refer to <http://www.rules.utah.gov/publicat/code/r616/r616-003.htm>.

## 2.7 Department of Health

- A. Comply with requirements of Department of Health. Refer to <http://www.health.utah.gov>.
  - (1) Health Care Rules, refer to <http://health.utah.gov/hflcra>.
  - (2) Utah Indoor Clean Air Act, refer to <http://www.tobaccofreeutah.org/r392-510.htm>.

## 2.8 Department of Environmental Quality

- A. Comply with requirements of Department of Environmental Quality. Refer to <http://www.deq.utah.gov>.
  - (1) Public Drinking Water Rules, refer to <http://drinkingwater.utah.gov/rules.htm>.
  - (2) Utah Division of Air Quality: R307-801, Asbestos, refer to <http://airquality.utah.gov/HAPS/ASBESTOS/rules/newrules.pdf>; Environmental Protection Agency (EPA): Regulations for Asbestos – Code of Federal Regulations Title 40, Part 61 Subpart M; and Toxic Substances Control Act PART 763 (Updated 1997) – ASBESTOS: OSHA Standards 1910.1001, 1915.1001, and 1926.1101
  - (3) Underground Storage Tank Act, refer to <http://www.undergroundtanks.utah.gov/>.
  - (4) Air Conservation Act, refer to <http://www.rules.utah.gov/publicat/code/r307/r307-008.htm>.
  - (5) Fugitive Dust Plan, Refer to <http://www.rules.utah.gov/publicat/code/r307/r307-309.htm>.
  - (6) Utah Pollutant Discharge Elimination System, Refer to <http://www.rules.utah.gov/publicat/code/r317/r317.htm>.

- (7) Operating Permits of the Division of Air Quality, refer to <http://www.rules.utah.gov/publicat/code/r307/r307-415.htm>.
- 2.9 County Health Department (for the county where the facility is located)
  - A. Food Service Sanitation Rules
- 2.10 Department of Commerce
  - A. Pipeline Safety, refer <http://www.rules.utah.gov/publicat/code/r746/r746-409.htm>.
  - B. Qualifications: Refer to the Project Participants heading of this document.

## 3.0 DFCM REQUIREMENTS

These requirements are enhancements of code requirements that DFCM has initiated for best practices for State owned facilities.

### 3.1 General

#### A. Distributed Live Loads

- (1) Modify IBC Table 1607.1 “Minimum Uniformly Distributed Live Loads and Minimum Concentrated Live Loads” by the following:
  - a. Increase the Uniformly Distributed Live Loads to 80 psf for: Office use in Access floor systems; Operating room, laboratories, private rooms, wards in Hospitals; Reading rooms in Libraries; Offices in Office buildings; Classrooms in schools.
  - b. Increase the Minimum Concentrated Live Loads to 2500 lbs for: Office use and Computer use for Access floor systems; Operating rooms, laboratories, corridors above the first floor for Hospitals; Reading rooms, Stack rooms, Corridors above first floor in Libraries; Lobbies and first-floor corridors, offices, corridors above first floor in Office Buildings; Classrooms, Corridors above first floor, First floor corridors in Schools.

#### B. Enhanced Accessibility

- (1) “It is the policy of the Utah State Building Board that, when appropriate for the intended use of the building and achievable within the project budget, the following accessibility enhancements beyond those required by the Americans with Disabilities Act be provided for in state owned buildings and buildings leased by DFCM: (1) powered door openers for the primary entrance designated for use by people with disabilities, and (2) powered door openers for one uni-sex restroom or for one male and one female restroom in the building unless restrooms with a door-less entry are provided. This policy is not intended to limit the use of powered door openers to the standard set forth herein. This policy applies to the construction or major renovation of state-owned facilities and new leases where the entire building is being leased by DFCM. This policy is not intended to create any rights to any third parties.
- (2) Determinations that one or both of these enhancements are not appropriate for the intended use of the building or not possible within the project or lease budget shall be made by the Director or his designee. Determinations of whether this enhancement to accessibility is appropriate should consider the potential of access by people with disabilities. The Director may determine that powered door openers are appropriate for the primary entrance while not warranted or not possible within the budget for access to restrooms. The Director may also determine that one or both of these enhancements are not feasible in (a) the renovation of an existing

building due to its design or configuration or (b) in a leased facility due to the nature and circumstances of the lease.”

C. Energy Efficient Products:

- (1) Select, where life-cycle cost-effective, products that are in the upper 25 percent range of the energy efficiency rating. Energy efficient products include:
  - a. Heating and cooling equipment;
  - b. Motors;
  - c. Lighting fixtures, compact fluorescent light bulbs, exit signs;
  - d. Windows, doors and skylights;
  - e. Roof products;
  - f. Food service equipment;
  - g. Transformers;
  - h. Office equipment;
  - i. Electronics; and
  - j. Appliances.
- (2) Exceptions:
  - a. Energy efficient products that have been stipulated as life-cycle cost-effective by DFCM.
  - b. ENERGY STAR® products that are certified and labeled through the US Environmental Protection Agency.
  - c. Energy Efficient Products listed items on General Service Administration, GSA Advantage website. “Energy Efficient Products” mean items that meet Federal Energy Management Program (FEMP) energy efficiency levels as required by the Federal Acquisition Regulation (FAR) Subpart 23.203, Executive Order 13123, and Executive Order 13221.

D. Energy Design Standards:

- (1) Buildings except Low-Rise Residential Buildings. Design facilities according to the applicable ANSI/ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, (Standard 90.1) at the time submitted to the State Building Official for mandatory

requirements and either the prescriptive, simplified, or energy-cost-budget methods:

- a. **Building Envelope Prescriptive Method.** Design an integrated system of building envelope components to reduce the envelope performance factor by 10 percent or more to what is required by Standard 90.1. Submit the Envelope Compliance Certificate declaring the building envelope meets Standard 90.1 requirements using DOE Comcheck software or Appendix C of Standard 90.1. The certificate shall show the envelope is 10 percent better than Code.
  - b. **Interior Lighting System Prescriptive Method.** Design the interior lighting system to reduce the interior lighting power density by 10 percent or more to what is required by Standard 90.1 using either the whole-building or space-by-space methods of Standard 90.1. Submit the Lighting and Power Certificate declaring the lighting and power system meet Standard 90.1 requirements using DOE Comcheck software. The certificate shall show the lighting power is 10 percent better than Code.
  - c. **Mechanical Systems Simplified Method.** Design the HVAC system type to meet Standard 90.1 requirements. Submit the Mechanical Certificate declaring the mechanical systems meet Standard 90.1 requirements using DOE Comcheck software.
  - d. **Energy-Cost-Budget Method (Optional).** Design the building to save 20 percent or more of the annual energy cost using the energy-cost-budget method. The energy-cost-budget method is an optional method to the prescriptive or simplified methods. Submit the Energy-Cost-Budget report from the Standard 90.1 User Manual. The form shall show annual energy cost is 20 percent better than Code.
- (2) **Low-Rise Residential Buildings.** Design facilities according to International Energy Conservation Code for mandatory requirements and either the component or system analysis methods:
- a. **Building Envelope.** Design the building envelope to meet the envelope performance factor by 10 percent or more using the building envelope component performance approach. Submit the Envelope Compliance Certificate declaring the building envelope meets IECC requirements using DOE Rescheck software. The certificate shall show the envelope is 10 percent or more than Code.
  - b. **System Analysis (Optional).** Design the building to save 20 percent or more of the annual energy use according to system analysis method.

- (3) Industrial, Laboratory, Research, and Other Energy-Intensive Facilities. Design industrial, laboratory, research, and other energy-intensive facilities or processes to reduce energy use by 10 percent or more over standard practice.

E. Hazardous Materials

- (1) DFCM shall procure a qualified abatement consultant during the Schematic Design phase of the Design stage. The abatement consultant shall survey all renovation and demolition projects for hazardous materials such as asbestos-containing building materials, lead-based paint, mold, universal wastes such as PCBs, CFCs, mercury, household/janitorial cleaning products, identified/unidentified containers of chemicals or products, or any other materials or waste that may be environmentally unsafe.
- (2) Prior to the start of a survey by the abatement consultant, the A/E shall provide drawings at the design development phase of the design stage to the abatement consultant with sufficient information to define the building or facility areas affected by the renovation or demolition. The abatement consultant shall coordinate abatement documents with the updated Contract Documents prior to final preparation. The abatement consultant shall prepare a complying and comprehensive hazardous materials survey report identifying and quantifying all hazardous and non-hazardous building materials to include asbestos-containing building materials, lead-based paint, mold and universal wastes that affect the areas of renovation or demolition.
- (3) DFCM shall procure a qualified abatement contractor to remove all hazardous materials prior to the beginning of any building demolition or renovation.

F. Vibration

- (1) Design structure in accordance with the following minimum requirements for vibration:

Space Category	Vibration Sensitivity
Laboratories with equipment sensitive to vibration	Comply with manufacturer’s requirements for vibration.
Offices, classrooms, and other similar spaces.	There are no vibrations from machines or traffic which are detectable by people.
Common Area spaces.	There is occasional movement in the floor when heavy equipment are moved nearby.
Storage spaces.	There is obvious and annoying movement when people walk by or equipment is being moved nearby.

G. Utah Space Standards

- (1) Comply with the “Utah Space Standards,” August 1994. Refer to [http://www.dfc.state.ut.us/downloads/3pubs/1994\\_08\\_space\\_standards.pdf](http://www.dfc.state.ut.us/downloads/3pubs/1994_08_space_standards.pdf).

## H. Infrastructure Flexibility

- (1) Interior Shear Walls: Minimize interior shear walls, bearing walls and braced frames which may disrupt future additions or modifications to the facility.
- (2) Spare Mechanical Space: Provide 25% spare space in pipe chases and for mechanical equipment (except air handlers).
- (3) Main Electrical Room: Locate main electrical room close to transformer and near the center of the load (which is usually located near where central mechanical equipment is located). Locate panelboards in satellite electrical rooms dedicated for electrical equipment and which stack vertically in the facility.
- (4) Spare Electrical Capacity: Provide 25% future space for additional overcurrent protection devices in panelboards and switchboards. Provide 25% additional load capacity in addition to the capacity required for continuous loads in panelboards and switchboards.
- (5) Communication Rooms: Locate communications rooms so they stack vertically and comply with TIA/EIA standards.
- (6) Spare Communication System Capacities: Provide 100% future space (this is not necessarily horizontal space, but may be vertical space in racks for future equipment) for cabling, data, and communications electronic equipment.
- (7) Equipment Access: In new facilities, provide access for replacement of equipment which does not require demolition.
- (8) Storage Space: Provide a minimum 6' X 6' space for storage of janitorial supplies or .2% of the gross square footage, whichever is greater.

## I. Standard Building Plaque

- (1) For development projects, provide a design for a building plaque to be mounted on a prominent wall near the entrance to the building in compliance with the DFCM plaque standard. Refer to [http://dfcm.utah.gov/downloads/plaque\\_policy.pdf](http://dfcm.utah.gov/downloads/plaque_policy.pdf) . (02/06/2008)

## 3.2 Civil

### A. Paving

- (1) Use untreated base course under all curbs and gutters. Use untreated base course material under all sidewalks exterior flatwork and paved areas.
- (2) Untreated base course under asphalt paving: Asphalt - 8" minimum compacted base (96%)

- (3) Concrete – curbs, gutters, sidewalks, exterior flatwork – Minimum 6” compacted base (96%) or minimum 4-3/4” crushed gravel.

<b>Untreated Base Course</b>	
<b>Size</b>	<b>% by Weight Paving Sieve</b>
1”	100
1/2”	70 to 100
#4	41 to 68
#16	21 to 41
#50	10 to 27
#200	4 to 13

- (4) Surface course (asphalt) aggregate:

<b>Surface Course (asphalt)</b>	
<b>Size</b>	<b>% by Weight Paving Sieve</b>
1/2”	100
3/8”	70 to 100
#4	50 to 78
#16	30 to 48
#50	18 to 31
#200	7 to 13

- (5) Base course (lower lift) can be 3/4” asphalt if placed in more than 1 lift.
- (6) Construct asphalt paving only when atmospheric temperature is above 50 degree F and underlying base is from moisture. Permit no vehicular traffic for at least 24 hours after laying asphalt pavements.
- (7) Striping paint: State of Utah #780. Spread at the rate of 103-113 sf/gal. Minimum thickness shall be 7 dry mil.
- (8) Tack coat all adjoining materials, i.e. previously constructed asphalt, concrete, etc. except untreated base course.
- (9) Surface smoothness: variation in the finished surface must not exceed 1/8” in 10 ft. in any direction.
- (10) Asphalt shall comply with Marshall Design with voids 1.5% to 3.0%
- (11) Drainage: Slope all asphalt concrete paving surfaces for positive drainage a minimum of 1.5% and preferable 2%.
- (12) Minimum thickness for parking areas: 3”. Minimum thickness for road areas and truck traffic is 3” including dumpster access.
- (13) Maximum thickness for lifts: 3”

### 3.3 Architectural

#### A. Suspended Ceiling Systems

- (1) Brief Description of the Problem. In as much as the IBC requires that suspended ceiling comply with the requirements of section 9.6.2.6 of ASCE 7 for installation in high seismic areas, the code section has 3 requirements which have been problematic in application:
  - a. The width of the perimeter supporting closure angle must be not less than 2 inches and the grid must have a  $\frac{3}{4}$ " clearance from the wall. This requirement has created an aesthetic nightmare for architects and contractors since the 2" angle brings out all irregularities on the plane of the wall and requires increased inspection time to ensure a  $\frac{3}{4}$ " clearance.
  - b. Except where rigid braces are used to limit lateral deflection, sprinkler heads and other penetrations shall have a 2 inch oversize ring, sleeve, or adapter through the ceiling tile to allow for free movement of at least one inch in all horizontal directions. Alternately, a swing joint is permitted to accomplish the same movement. The issues with this requirement is that the Fire Marshall and the fire protection community will not approve any oversize rings, sleeves or adapters which are not listed for this use and currently there are not listed systems on the market. The use of the swing joint is not defined in the code and no one has been able to establish how many joints are necessary to accomplish the horizontal movement of one inch in all directions.
  - c. Special inspection is required for suspended ceilings. This requirement is once again a problem since the ICC does not have a certification system for a ceiling inspector and we end up using a regular code inspector.
- (2) IBC section 104.11 allows the Building Official to approve alternate designs or methods of construction which he feels are equivalent or meet the intent of the current code. Uniform Building code Standard 25-2 for metal suspension systems for acoustical tile and for lay-in panel ceilings that can be found in the 1997 edition of the UBC is an equivalent standard that has been used in the codes for many years. This standard offers protection in all the seismic areas in the state and does eliminate all three of the issues identified above.
- (3) The State of Utah will allow the use of the 1997 UBC Standard 25-2 as an alternate means for the installation of suspended ceilings. This standard should remain available until all the issues identified above have been addressed by ICC and the listed materials are available in the market place. The designers may still use the current code requirements found in the 2003 IBC if they can show that they have met the intent of the current code.

B. Daylight and Outside Views

- (1) Daylight and outside views are desirable for all occupied spaces. The needs of some occupied spaces may require special consideration for light control.

C. New Roofing Requirements

- (1) Comply with Contractor Roofing Warranty: Include DFCM requirements. Refer to [http://dfcm.utah.gov/downloads/Roofing/Contractor%20Roofing%20Warranty%20\(final\).pdf](http://dfcm.utah.gov/downloads/Roofing/Contractor%20Roofing%20Warranty%20(final).pdf).
- (2) Comply with Guaranty for Bituminous Roofing: Include DFCM requirements. Refer to [http://dfcm.utah.gov/downloads/Roofing/Warranty%20for%20Bituminous%20Roofing%20\(final\).pdf](http://dfcm.utah.gov/downloads/Roofing/Warranty%20for%20Bituminous%20Roofing%20(final).pdf).
- (3) Comply with Guaranty for Single-Ply Roofing: Include DFCM requirements. Refer to [http://dfcm.utah.gov/downloads/Roofing/Warranty%20for%20Single%20Ply%20Roofing%20\(final\).pdf](http://dfcm.utah.gov/downloads/Roofing/Warranty%20for%20Single%20Ply%20Roofing%20(final).pdf).
- (4) Comply with the list of DFCM approved manufacturers and approved installers.
- (5) Where manufacturer's standards show one or more possible approach for compliance to the standard, provide their most stringent approach.
- (6) Eliminate conflict between roof penetrations (i.e. vents, exhausts) and roof crickets, flashing, and valleys. Consider relocating penetrations to less visible areas. Provide 18" access for replacing roofing components.
- (7) In new facilities, build slope into roof structure in lieu of built-up insulation to solve roof drainage issues.
- (8) Minimum slope for all roofing and waterproofing systems shall be a ¼" per foot along the longest drainage path.
- (9) Do not provide the following components, unless approved by the Director: Other Roofing Components: ballasted roofs.
- (10) All roofing systems and components should meet or exceed all ASTM, UL and FM requirements.
- (11) Minimum 60 mil thickness required for all single ply roofs.
- (12) Minimum 4-ply, type VI felts with type III asphalt for all built-up roofs.
- (13) All metal associated with the roof should be color clad, use standing seam joints where possible. Follow SMACNA guidelines for all metal work.

- (14) Provide reasonable access to all roof levels for maintenance personnel.
- (15) Steep slope roofing should be designed as directed by the DCM Program Manager.
- (16) Comply with all other minimum standards as published by the DFCM roofing group.

D. Replacement Roofing Requirements

- (1) Comply with Design Requirements Record Roofing Requirements.
- (2) Existing Roof System Components: For existing roofs, evaluate the feasibility of using existing insulation, sheet metal and other existing roof system components if they are in like new condition and will not have a deleterious effect on the new roof system.
- (3) Roof Slope: Each existing facility project shall be evaluated to determine existing roof slope and if additional slope is required to eliminate ponding.
- (4) Roof Diaphragm: Evaluate the existing roof to determine whether the diaphragm needs to be upgraded to meet current seismic requirements. Report shall include: 1) Existing conditions related to current requirements; 2) Recommendations for upgrading the diaphragm relative to an upgrade of the facility; 3) Estimated costs for upgrading the diaphragm.
- (5) Roof Load Evaluation: Evaluate the existing roof deck structure to determine the existing dead and live load capacity. The weight of the entire roof system shall not exceed an amount that would reduce the live load capacity of the roof structure below the current requirements. Report shall include: 1) The existing conditions relative to current requirements; 2) Recommendations for upgrading the load capacity, relative to an upgrade of the facility; 3) Estimated costs for upgrading the structure.
- (6) Vapor Retarder: Determine the need for vapor retarder based on dew point calculations, facility use, and existing facility and roofing system conditions.

E. Waterproofing and Sealants

- (1) Warranty: For sealant systems, guarantee both labor and materials for a minimum of two years. For waterproofing project, guarantee both labor and materials for a minimum five years.
- (2) Qualifications: For Dampproofing and Waterproofing, select products that have performed successfully for a minimum 15 years and select manufacturers that have been producing materials for 15 years.

F. Acoustical Quality

- (1) When possible, design spaces in accordance with following minimum requirements for “Privacy.”

Privacy	
Space Category	Measured NIC Rating
Confidential with high voice levels	58-60+
Confidential with slightly raised voice levels	52-58
Confidential with normal voice levels	50-52
Confidential with lowered voice levels	45-50

- (2) Design spaces in accordance with the following minimum requirements for “Ambient Background Noise.”

Ambient Background Noise	
Space Category	Measured NC Rating
Critical Performing Spaces	<20
Performing Spaces, Courtrooms, Executive Offices	20-30
Sleeping, testing, or relaxing spaces	25-35
Private offices, small conference rooms, classrooms, libraries	30 -35
Open offices, reception areas, cafeterias, gymnasiums	35-40
Lobbies, laboratories, maintenance shops	40 -45
Kitchens, industrial shops, equipment rooms	45-55

G. Guardrails

- (1) Comply with code requirements for opening size but orient the members so that a ladder effect does not occur.

3.4 Structural

A. Concrete

- (1) Warranty: Provide additional two-year written guarantee commencing on the date of substantial completion to promptly remove and/or repair defective concrete (pitting, spalling, cracking, honeycombing, etc.).
- (2) Concrete Strengths & Testing: Provide minimum compressive strength measured at 28 days of 3000 psi for foundations, stem walls, piers, miscellaneous interior walls, etc., and 4000 psi minimum for all exterior flatwork, ramps, curbs, gutters catch basins, concrete pavements, interior floor slabs, elevated slabs, shear walls and columns. DFCM allows shear wall and columns to be specified in excess of 4000 psi. Specify pre-cast concrete with a minimum strength of 5000 psi.
- (3) Cement Types: Comply with the recommendations of the Geotechnical report. DFCM requires one of these types: Type I or Type II (both low alkali) and Type V. In southern Utah, usually select Type V. In other parts of the state select Type I or Type II (low alkali).

- (4) Concrete Mix: Provide low alkali cement for all concrete in direct contact with earth. Specify water/cement ratios in accordance with ACI 318. Specify number of bags of cement per/yard in accordance with C150. Provide admixtures complying with the requirements of ASTM C260 for air entrained concrete. Do not use “IA”, “IIA”, etc. For frost resistant concrete, the following minimum air contents are required for concrete in direct contact with soils or exposed to severe salting: for ¾” maximum aggregate size per C33, provide air content per ASTM C260 of 6-1/2%+ 1-1/2%; for 1”, provide 6%+ 1-1/2%; for 1-1/2”, provide 5-1/2”+1%. Water cement ratios shall be limited to 0.50. (excluding grout mixes) The slump of all concrete shall be limited to 4” unless plasticizers are used. A maximum of 10% fly ash is allowed.
- (5) Testing: DFCM shall pay for testing, unless other procedures are specified. The frequency and minimum numbers of test cylinders shall be as outlined in the IBC, however at least three test cylinders must be taken from each pour related to a structural member. The intent is to not to do testing on concrete for items such as curb, gutter, sidewalk, mow strips, light pole bases, etc. **Concrete testing shall not be required where allowed by the currently adopted building code. (12/04/2008)**
- (6) Reinforcement: Reinforce all concrete with conventional rebar or welded wire fabric. Slabs on grade supporting less than 400 psf uniform loads and no rack loads may be un-reinforced. The sub-base for all un-reinforced slabs must be uniformly compacted with on-site observation and per requirements specified in the project specifications.

### 3.5 Mechanical

#### A. Controllability of Systems

- (1) Maintaining space comfort temperature is an important consideration in the design of the mechanical system along with the proper ventilation within each space. This is accomplished best by the proper zoning of the space with regards to the mechanical system installed and the ability to control the temperature within each zone. The zoning for control of the space temperature shall be such that corner spaces having multiple exposures, office spaces for directors, managers, or other such individuals, and conference rooms larger than 200 square feet, shall have individual space control. Other multiple spaces shall be zoned with these spaces of like size, occupancy, and exposures are one zone and do not exceed more than four spaces per zone. Open spaces, such as open offices, shall not exceed one zone per every 750 square feet. Individual classroom spaces may be zone as a single zone even if the space exceeds 750 square feet with consideration for noise and air distribution (some large classroom spaces may need more than one zone for temperature control). Laboratory space zoning will be matched to the exhaust requirements for the labs and size of the laboratory space.

B. Indoor Air Quality

- (1) Comply with ASHRAE 62.1-2004 and all approved addenda for Indoor Air Quality performance.
- (2) Comply with the carbon dioxide differentials for all types of occupancy are accordance with ASHRAE 62-2001, Appendix D.

C. Plumbing General Requirements

- (1) Insulation: Completely insulate the following systems: all domestic cold water piping above ceiling; all domestic hot water piping and recirculation lines; roof drain and overflow piping including horizontal piping above ceilings, vertical piping below roof drain bowl, and roof drain bowls. Provide protective covering for exposed insulation in areas subjected to damage.
- (2) Exterior piping insulation: Cover all insulation with aluminum jackets secured with aluminum bands 12 inches o.c. Seal joints watertight.
- (3) Main plumbing connections: Locate main water, and sewer connections and mechanical rooms on the same side of site as service, preferably close to maximum demand points such as core toilet stack, kitchens, boiler room, and fire protection systems.
- (4) Piping installation: Install piping overhead wherever possible. Avoid installing piping below or in concrete slab floors. Install piping on warm side of building insulation. Provide water-tight sleeve and caulking around pipe for all piping passing through floors.
- (5) Exposed pipe: comply with ASTM 53.
- (6) Underground pipe: comply with ASTM A106.
- (7) Roof drains: provide minimum 3 inch roof drains.
- (8) Equipment Pads: Provide minimum 4" high concrete bases for all pumps, air compressors, boilers, chillers, and other equipment.
- (9) Valves: Install valves with bonnets at least 45 degrees above the horizontal to ensure debris does not collect in bonnet.

D. Water System

- (1) Municipal Water Meter: Each facility shall have a compound water meter installed in the water line serving the facility in accordance with local water authority.

- (2) Campus Water Meters. Install meter in the main mechanical room or within easy access of mechanical spaces. If conditions do not permit inside installation, provide meter box outside. Where fire sprinklers are installed, the fire main shall be connected ahead of the meter. Where outside meters are used, the meter box shall be 52" x 81" x 71" high with a concrete base under the meter, but the rest of the floor shall be gravel. Top shall have recessed eyes. Top to be poured separate so it can be moved off with a crane and the eyes shall be left large enough to insert a chain by which can be lifted. Cover to have a 24 inch locking meter lid in center. Position meter so it can be read without personnel entering the vault. Water meter indicator shall be the totalize type reading directly in gallons of water. Water meter shall be installed with valves on both sides so meter can be removed and a bypass line installed. Sleeve around pipes passing through walls of meter box.
- (3) Domestic Water Pressure shall be maintained at a reasonable operating pressure, i.e., 50 – 80 psig.
- (4) Valves: Provide valves near the main with a union for all branch lines of water which supply more than one outlet or unit so areas of the building may be shut down for repair without having to shut down large areas. Provide isolation valves as necessary and provide, as a minimum, valves for each toilet group outside of the toilet room, each floor, and each branch line that is 2" or greater. Provide a shutoff valve on all water supply lines on the room side of the fixture. Valves shall have a gasket seat, not a ground joint. Supply lines from the valve shall be 3/8" brass, chrome plated. Provide chases or access panels to access valves. In lieu of oversized globe valves, ball valves with full opening ports and adequate pressure and temperature rating may be provided up to two inches in size. For valves greater than two inches in size, butterfly valves with wheel and gear operator may be used.
- (5) Water relief valves: Connect water relief valve exhaust or discharge to nearby floor drain. Provide sump in pipe tunnels at each cleanout. Provide floor drains in toilet and utility rooms.
- (6) Faucets and hose bibs: Provide non-freeze type hose bibs with shut-off valves for the lines serving the hose bib located inside facility. Provide faucet with hose attachment and vacuum breaker in each restroom so floor can be washed with clean water. Provide hose bib with vacuum breaker in mechanical rooms and chiller rooms. Provide non-freeze hose bib with vacuum breaker near cooling tower. Provide hose bibs outside building for window washing, walk and area way washdown (generally not more than 150' on center).
- (7) Inaccessible Water Piping: Provide Duirom cast iron pipe, PVC "Blue Brute", or copper up to 2 inches in size, for water lines under building slab or other inaccessible locations.

- (8) Soil cover for outside services greater than 6000 HDD: Provide minimum cover of 48" or preferred cover of 60" for water. In no instance shall the minimum depth be less than the frost line.
- (9) Soil cover for outside services less than 6000 HDD: Provide minimum cover of 36" or preferred cover of 48" for water.

E. Waste System

- (1) Pipe Tunnel Sumps: Provide sump in pipe tunnels at each cleanout. Sump shall be three foot square and four feet deep with grating cover and porous walls. Floor drains may be used in lieu of sump if depth of waste line is such that drains may be tied in.
- (2) Drains: Provide drains indirectly connected to building drainage system for walk-in refrigerators and other places where food is stored. Provide floor drains in toilet and utility rooms. Provide deep seal P-traps on all floor drains.
- (3) Equipment Room Floor Drains: Trenches with grating covers with bottoms sloped to drain are preferred over multi-floor drains in mechanical equipment rooms and some laboratories.
- (4) Water still drains: Provide Kimax glass to nearest main drain from water still drains or provide glass pipe for the first 20 feet horizontally or to the floor below. Provide cleanout at water still and at main drain line before glass is connected with soil piping
- (5) Waterproofing pans: Provide membrane waterproofing pans for shower stalls and custodial floor sinks so they are 100% water tight. Provide clamping device which clamps drain to pans. Provide a mastic seal between floor drain bottom and lead or membrane so when clamping device is tightened there is a complete seal so no water can get through. Do not clog weep holes. Test pans by placing test plug in drain and filling with water overnight.
- (6) Dishwasher connections: Provide indirect connection for waste on automatic dishwashing machines. Install minimum 3" drain so that it is accessible under conveyor table.
- (7) Cleanouts: Provide cleanouts at base of each vertical rise, each turn in excess of 45 degrees and on straight runs every 50 feet.
- (8) Horizontal Waste lines: Provide dedicated minimum 3" horizontal waste lines with adequate cleanouts for garbage disposals and dishwashers.
- (9) Roof drains: Roof drain piping shall not be less than 3 inches.
- (10) Flush valves: Provide screwdriver stop valves on flush valves for water closets and urinals. Provide exposed type flush valves.

F. Plumbing Fixtures and Equipment

- (1) Water Heaters: Coordinate installation so that nothing will interfere with the removal of water heaters or for heating coils in heat exchangers to allow for periodic cleaning. Provide unions for all connecting piping to facilitate the removal of piping. Provide combination temperature and pressure relief valve piped to adequate drain. Where feasible install flexible connections and tie-down straps to accommodate movement during seismic events.
- (2) Toilet Room Fixtures: Provide exposed type flush valves with lever operator (no push buttons or floor operators), diaphragm type only. In restrooms subject to vandalism, provide concealed flush valves. If space and budget allows, flush valves may be concealed in other applications. Hands free sensor actuated valves are acceptable, if acceptable by the Agency. Provide fixtures manufactured by one manufacturer.
- (3) Showers: Provide non-scald type shower valve with integral stops. Provide institutional type shower heads with flow adjustment and adjustable head and spray. Extend head out from wall so water does not run down wall when valve is turned off. Heads shall be vandal proof. Provide watertight shower escutcheon with weep hole in bottom.
- (4) Waterproofing pans: Provide membrane or lead waterproofing pans for shower stalls and custodial floor sinks so they are 100% water tight. Provide clamping device which clamps drain to pans. Provide a mastic seal between floor drain bottom and lead or membrane so when clamping device is tightened there is a complete seal so no water can get through. Do not clog weep holes. Test pans by placing test plug in drain and filling with water overnight.
- (5) Drinking Fountains: Provide refrigerated type, wall hung drinking fountains with stainless basins. Provide removable grid strainer to enable cable-style cleaning without having to dismantle the fountain.
- (6) Do not specify the following components, unless approved by the Director: Toilet Room Fixtures: Tank type

G. HVAC General

- (1) Heating systems: Hot water systems are the preferred heating systems. Provide air separators and expansion tanks for all hot water heating systems regardless of piping arrangement. Tie air separators into piping system on suction side of circulating pump. If campus system hot water system is turned off during the summer, provide alternate heating system for equipment requiring a heating source.
- (2) HVAC: Locate mechanical rooms to take advantage of ductwork and piping proximities to major loads. Provide continuous cooling for telecommunication and main telecommunication room. Carefully coordinate the location of any exhaust or relief air with mechanical air

intake systems to avoid short cycling. Provide dedicated relief air path for all systems which introduce outside air. Exfiltration through the building envelope does not comply with this requirement.

- (3) Redundancy: Provide for continuous operation through redundancy and/or modularization for facilities greater than 30,000 sf or which have critical functions or critical care residents. The loss of one half or less of the design cooling or heating system for the entire facility shall be tolerated temporarily in the event of equipment failure for: heat pumps, boilers, refrigeration machinery (excluding cooling towers), and condensate pumps.
- (4) Access: Provide stair access to equipment. Provide disassembly access for all valves, piping, and equipment.
- (5) Water Treatment: Provide water treatment for heating water systems, chilled water systems, condenser water systems, and steam systems. Provide for one year on site service by water treatment company including supply of chemicals. Provide treated water in the heating system until facility is accepted by DFCM.

#### H. Air Distribution

- (1) Filtration: Air handling equipment shall be fitted with filters in the medium efficiency category having an average efficiency of 25% to 35% based on MERV rating criteria. Specify that the Contractor replace all filters prior to building occupancy and provide one replacement set of filters for the entire facility. For air handlers exceeding 10,000 cfm, provide pressure differential instrumentation across the filter bank to facilitate maintenance.
- (2) Ductwork Materials: Provide rectangular and round ductwork from galvanized steel, stainless steel or aluminum. Leakage requirements shall meet or exceed SMACNA standards.
- (3) Volume Adjusting Devices: Provide devices that can be securely locking in place and that are accessible for adjustment after construction.
- (4) Do not provide the following components, unless approved by the Director:
  - a. Duct Lining: lining of outside air ducts, lining of ductwork within 10 feet downstream of any device that adds moisture to the air stream, line of ductwork exposed to humid air stream above 70% RH such as swimming pool applications.
  - b. Ductwork: Fiberboard ductwork.

#### I. Piping System

- (1) Design Requirements

- (2) Piping Systems: Piping system shall be provided with manual air vent valves at system high points and drain valves at system low points. Suitable provisions, such as access panels, shall be furnished in building construction to permit full access to these valves. Manual air vents shall be 3/8" globe valves with 1/4" copper tubing to near floor or to locations where water may be caught in bucket. Drain valves shall be threaded for 3/4" hose connections. Provide water-tight sleeve and caulking around pipe for all piping passing through floors.
- (3) Pumps: Provide pressure gauge with gauge cocks as close to pump suction and discharge as possible and avoid pressure drops across valves, strainer, flexible connectors, etc. Provide suitable throttling valves on discharge side of all pumps, such as globe valves, or balancing cocks. Throttling valve shall have set point position indicator and shall not be used for shut-off valve.
- (4) Exposed pipe: comply with ASTM 53.
- (5) Underground pipe: comply with ASTM A106.
- (6) Air Vents: Provide suitable air vents for all heat producing equipment (converters, unit heaters, coils, etc.).
- (7) Valves: Provide valves near the main with a union for all branch lines of water or steam which supply more than one outlet or unit so areas of the building may be shut down for repair without having to shut down large areas. For valves 2" and larger on systems greater than 200 degrees F shall be flanged or grooved.

#### J. Steam

- (1) Motor Operated Steam Valve: If the existing central plant serving the campus is a steam system, provide a motor operated steam valve for each new building. Coordinate location with the Agency. If equipment requires steam when the valve may be closed, connect equipment ahead of motor operated steam valve. Design for gravity flow of condensate in lieu of providing vacuum pumps. Provide tunnels, chases, access doors, or crawl spaces for accessing steam piping. Do not install underground or in split tile. Provide properly dripped steam mains. Provide drip legs ahead of all steam pressure reducing valves and steam coils to ensure clean, dry steam at the valve.
- (2) Valves: Low pressure steam valves shall have a 200 psi rating and allow renewable seats and discs. For 100 psi steam line use 25 psi flanges and 300 psi screwed valves. Provide valves near the main with a union for all branch lines of steam which supply more than one outlet or unit so areas of the building may be shut down for repair without having to shut down large areas.
- (3) Steam piping: For steam piping 2" and smaller, provide schedule 80 black steel. For sizes 2-1/2" or larger, provide schedule 40 black steel for low

pressure steam (15 psig or less) and schedule 80 black steel for high pressure steam (higher than 15 psig). Provide low pressure steam valves with a 200 psi rating and allow renewable seats and discs. Provide 250 psi flanges and 300 psi screwed valves for 100 psi steam lines.

- (4) Condensate piping: Provide schedule 80 black steel pipe, including underground return lines.
- (5) Underground steam lines: Provide Gilsulate, Ric-wil, Portage and Durrant insulated underground pipe for underground steam lines. If pre-insulated piping is used, provide separate insulated conduits for steam and condensate return piping.
- (6) Expansion Provisions: Provide expansion loops, swing joints, offsets, etc., for expansion of piping. Do not use expansion joints except when expansion loops, offsets, swing joints, etc., are possible due to space constraints. If expansion joints are provided, provide adequate internal or external guides that are properly supported anchored. Do not provide swing joints on main runs; however, swing joints may be installed on risers off the main.
- (7) Pressure reducing stations: Provide pilot-operated valve for pressure reducing stations. Provide a three-valve by-pass at all reducing stations with ample clearance to permit normal maintenance and inspection. Recommend parallel pressure reducing stations when low demand is expected. Provide safety relief valves on the low pressure side of regulator stations. Provide discharge piping to facility exterior in a safe location. For pipes discharging near grade, install pipes into an eight inch concrete tie set upright in the ground (buried) over a gravel base twelve inches deep. Provide pressure gauges on both the high pressure and low pressure sides of all regulator stations. Locate gauges so they will function when bypass is used.
- (8) Steam Meter: Provide totalizing type meter which reads directly in pounds of steam.
- (9) Miscellaneous Requirements: Provide eccentric reducers when steam piping changes pipe sizes. Provide water-tight sleeve and caulking around pipe for all piping passing through floors.

#### K. Natural Gas

- (1) Seismic gas shut off valve: Provide a seismic gas shut off valve installed per manufacturer's instructions for each natural gas system.
- (2) Natural Gas Piping: Weld all concealed natural gas piping if larger than 4". Where feasible install flexible connections and tie-down straps to accommodate movement during seismic events.
- (3) Soil cover for outside services greater than 6000 HDD: Provide minimum cover of 24" or preferred cover of 36" for gas.

- (4) Soil cover for outside services less than 6000 HDD: Provide minimum cover of 24” or preferred cover of 36” for gas.

L. HVAC Equipment

- (1) Boilers: Provide boiler backup by redundancy or modularization. If a power burner is specified, the A/E shall determine the maximum allowable length of positive pressure flue.
- (2) Unit Heaters: If a unit heater is higher than 10’ AFF, a centrifugal blower shall be provided and not a propeller fan. Provide all gas or oil unit heater with a 2-stage thermostat. On call for heat, the stage cycles the fan. The second stage fires the burner. For shop applications with heavy duty or corrosive atmospheres, provide sealed combustion units that bring combustion air from outside the space.
- (3) Water Chillers: Specify appropriate ARI Standards and certification.
- (4) Cooling Towers: Specify certification by the Cooling Technology Institute.
- (5) Converters: Provide side inlets and side outlets for all converters. Provide pressure gauges with snubbers on the primary and secondary side of each converter. Install thermometers on the inlet and outlet of the secondary side of each converter.
- (6) Do not provide the following components, unless approved by the Director: HVAC Equipment: electric resistance heat, furnaces.

M. Integrated Automation

- (1) Direct Digital Control: Provide direct digital control in all facilities, except where operations personnel require pneumatic control as an extension of an existing system. Provide digital metering of electrical, hot water, steam, and chilled water sources to each facility. Provide flow metering devices hot water heating systems. Provide straightforward DDC control systems. Avoid locating thermostats on outside walls or on partitions between offices. For perimeter radiant systems, provide Hydronic piping subcircuits to match the cooling zones.
- (2) Control valves: Provide visual position indicators. Provide control valves with stem in the vertical position. If possible, provide packless valves. Do not provide “self-contained” valves.
- (3) Dampers: Provide low leakage design of felt or neoprene edges for fresh air and exhaust air dampers. Provide opposed blade type modulating dampers with maximum blade width of eight inches. Provide fresh air dampers that close in fan shutdown or power failure. Provide steel trunnions mounted in bronze sleeve bearing or ball bearings for damper blades. Do not exceed 48 inches in length between damper bearings. Provide dampers that close substantially tight and provide substantially the

full area of the opening when open. Provide substantial bar or channel frames for dampers. For rectangular dampers larger than four square feet in area, provide additional corner bracing.

- (4) Thermostats: If system supports DDC monitoring, provide solid state thermostats. Thermostats in corridors, halls, restrooms and other similar unsupervised areas shall be flush mounted aspirating type with stainless steel cover. Thermostats in public, but supervised areas shall have locking covers with concealed adjustment. Thermostats in private offices may have exposed adjustments.
- (5) Panels: Provide control devices, relays, piping, wiring and terminals in cabinets, except that switches, pilot lights, and push buttons mounted on the door. Provide minimum 14 gauge steel or 12 gauge aluminum. Equip doors with hinges, latches, and locks. Secure panels to walls, columns or floors with clearances required by NEC. Provide two (2) keys for each panel.
- (6) Wall Mounted Control Diagrams: Provide plastic laminated copies of all applicable controls diagrams mounted on the wall in each equipment room.
- (7) Control wiring: Provide control wiring in raceway complying with the requirements of DIV 16, ~~except that 1/2" C may be installed for control wiring of less than 50 volts which complies with NEC conduit fill requirements.~~ Section 3.6 Electrical.

#### N. Automatic Sprinkler Systems

- (1) Provide an automatic sprinkler system in buildings when required by ~~the building codes adopted by the State of Utah.~~ State Fire Marshals Rules R710. The Installation shall conform to Sate Fire Marshals Rule R710 and NFPA 13.
- (2) It is desirable that all buildings constructed by the State of Utah be equipped with an automatic sprinkler system to provide added life safety for the occupants and to protect the building from fire loss.
- (3) Fire sprinklers shall be considered as an integral component of building design when the availability of water supply and the cost do not make the installation prohibitive.
- (4) Secondary structures and small buildings or buildings with low occupant loads may be excluded from this requirement with the approval of the Director.

### 3.6 Electrical (06/30/2008)

- A. The following Codes and Standards are to be considered a minimum requirement for section 3.6. Where items contained in this section are in conflict with any of the following codes or standards the more stringent requirement shall apply.

- (1) National Electrical Code- NEC “2005”
- (2) International Building Code- IBC “2006”
- (3) International Energy Conservation Code- IECC “2007”
- (4) Illuminating Engineering Society of North America- IESNA Handbook 9<sup>th</sup> Edition
- (5) UL 96A
- (6) NFPA 780
- (7) Utah State Fire Marshals rules R710
- (8) National Fire Alarm Code- NFPA 72 “2007”

B. Emergency Electrical Requirements

- (1) ~~Modify paragraph 700.12 General Requirements of the NEC “Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, emergency lighting, emergency power, or both shall be available within the time required for the application but not to exceed 10 seconds. The supply system for emergency purposes for buildings totaling less than 5000 sf, in addition to the normal services to the building and meeting the general requirements of this section, shall be one or more of the types of systems described in 700.12 (A) through 700.12 (E). Unit equipment in accordance with 700.12(F) shall satisfy the applicable requirements of this article for buildings totaling less than 5000 sf. The supply system for emergency purposes for buildings totaling 5000 sf or greater, in addition to the normal services to the building and meeting the general requirements of this section, shall be the type of system described by 700.12 (B). This requirement shall not prohibit the use of the supply systems 700.12 (A), or 700.12 (C) through (F), for buildings totaling 5000 sf or greater, if these systems are required for safety purposes and if these systems are automatically connected to a Generator Set as described in 700.12 (B).”~~ [The balance of section 700 is unchanged.]
- (2) ~~Modify paragraph 701.11 Legally Required Standby Systems of the NEC~~
- (3) ~~“Current supply shall be such that, in the event of failure of the normal supply to, or within, the building or group of buildings concerned, legally required standby power will be available within the time required for the application but not to exceed 20 seconds. The supply system for legally required standby purposes for buildings totaling less than 5000 sf, in addition to the normal services to the building shall be permitted to comprise one or more of the types of systems described in 701.11(A) through 701.11 (F). Unit equipment in accordance with 701.11(G) shall satisfy the applicable requirements of this article for buildings totaling less than 5000 sf. The supply system for legally required standby purposes for~~

~~buildings totaling 5000 sf or greater, in addition to the normal services to the building shall be required to be the type of system described by 701.11 (B). This requirement shall not prohibit the use of the supply systems 701.11 (A), or 701.11 (C) through (G), for buildings totaling 5000 sf or greater if these systems are required for safety purposes and if these systems are automatically connected to a Generator Set as described in 701.11 (B).” [The balance of this section is unchanged.]~~

- (4) ~~The Director of DFCM may authorize battery packs in suitable applications when the standard is not achievable due to the unique circumstances of a particular project or the constraints of the project budget.~~

C. Lighting

- (1) Occupants within an enclosed space shall have the capability to adjust the lighting within the enclosed space.
- (2) All lighting shall meet or exceed the current energy code for watts per square foot, control requirements and other requirements. All lighting shall utilize the most efficient lamps and ballasts available for the application. All incandescent lighting must be approved by the DFCM representative.
- (3) Light Pollution Reduction: Comply with Light Pollution Reduction requirements, unless otherwise directed by the DFCM’s Designated Representative.
- (4) Comply with the Illuminating Engineering Society of North America (IESNA) Recommended Practice Manual: “Lighting for Exterior Environments (RP-33-99).” Provide exterior luminaires which are shielded. For luminaires with more than 3000 initial lamp lumens, provide Full Cutoff (IESNA Classification) luminaires. Interior lighting shall be positioned so that the maximum candela value does not fall outside the interior space, such as out through a window. Exterior lighting shall be located so that the maximum candela value of all exterior lighting shall fall within the property. Provide shielding for any luminaires within a distance of 2.25 times its mounting height from the property boundary so that no light from the luminaire illuminates past the property boundary.
- (5) Lighting Fixtures. Provide lenses that will not yellow due to exposure to sunlight or to the light sources in the fixture. When acrylic diffusers are specified, provide 100% virgin acrylic. Provide electronic ballast suitable for the load type, energy savings, and starting temperatures required ~~except that magnetic ballasts may be used in outdoor applications.~~ Provide program start ballasts if available for the lamp type. Connect equipment grounding conductor to fixture housing. Provide 10% spare lamps, diffusers or glass for each light fixture type with not less than one for less than 10.
- (6) Interior Lighting: Provide T-8 lamps in fixtures, except for areas requiring special lighting. Provide independent safety-wires attached to structure at

two diagonal corners of lighting fixtures in compliance with seismic requirements. For recessed fluorescent fixtures that are removable, locate outlet box with 3' of steel flexible conduit to the fixture to aid in removing and relocating fixture.

- (7) Exterior Lighting: Provide -10 degree F. ballasts, either constant wattage or pulse start. Provide break-away fuses for all phase conductors for all outside pole mounted lighting fixtures. Provide a shorting fuse insert for neutral fuse holder. Do not use common neutral multi-wire circuits for this type of lighting.
- (8) Reflected Ceiling Plan Coordination: Coordinate the lighting fixture with the reflected ceiling plan for **suspended** lay-in, and surface mounted fixtures. Recessed lighting fixtures in acoustical tile ceiling shall be located centered on a single tile. ~~or at the intersection of four tiles.~~
- (9) Lighting Fixture Supports: Provide swivel bases for stems supporting lighting fixture which exceed 12" in length.
- (10) HID Sources: ~~Provide Constant Wattage ballasts. Use~~ metal halide **sources**, provide Pulse Start Metal Halide lamps and **electronic** ballasts. ~~For indoor, provide pulse start electronic ballasts. For outdoor up to 200 watts, provide pulse start electronic ballasts. For outdoor above 200 watts, provide magnetic ballasts if control, noise, and flicker requirements are satisfied. Where High Pressure Sodium sources are approved, use auto-regulating ballasts.~~

D. Raceways to 600 V

- (+) Raceways, Fittings, and Boxes. Provide steel raceway, fitting, and box system for all wiring, except that plastic conduit (minimum schedule 40) may be installed underground and aluminum cable trays may be installed for communications cabling. For steel raceway **when** installed in contact with soil, provide rigid or IMC PVC coated or wrapped raceways, fittings, etc. Provide steel raceways for penetrating structural elements (minimum 40° **6"** each side) and rigid steel conduit (PVC coated or wrapped) for bends greater than ~~22~~ **30** degrees. Provide minimum ~~3/4"~~ **1/2"** raceways **except Communications raceways shall be 3/4" minimum.** ~~except 1/2" may be provided for HVAC Instrumentation and Control. For Communications raceway, the bend must be a minimum 6 times the diameter for sizes 2" or less and 10 times the diameter for larger than 2".~~ Provide flexible steel conduit (minimum 1/2") in short lengths where movement, vibration, misalignment or cramped quarters exist. Provide insulated throat or equal type plastic bushings for box connections. ~~1" or larger. Provide double lock nuts and plastic bushings for IMC and rigid conduit.~~ Provide liquid-tight flexible conduit with approved moisture-tight fittings for wet, humid, corrosive or oily locations. Provide a minimum 18" liquid-tight flexible conduit at each motor. ~~Provide minimum 4/s box 1-1/2" deep with plaster rings, except provide 3-1/2" deep masonry boxes for masonry. For boxes with 3 or more raceway entrances, provide minimum 2-1/8" box. For boxes with 4 or more raceway entrances, provide~~

- (2) ~~4-11/16" boxes (except for masonry boxes). Provide gang boxes for multiple gang installations. Provide accessible junction boxes in interior raceway runs at minimum 100 foot intervals. Provide minimum 12" clearance from hot water and steam lines measured from outside of insulation.~~
- (3) Electrical Supports. All raceways, boxes, and conductors shall be supported independently from all other electrical or mechanical systems, directly from building structure by a listed supporting device. ~~Provide bracing parallel to trusses, beams, joist, bridging, etc. Provide anchors capable of supporting 4 times the weight of the unit supported, but not less than 100 lbs. For ceiling fixture outlet boxes, provide minimum supporting capacity of 200 lbs and a standard 3/8" stud. Provide outlet boxes with rigid support using metal bar hangers between studs. Provide concrete pads 6 inches beyond the largest dimension of the equipment. Extend equipment pad a minimum of 4" above finished floor or grade.~~
- (4) Equipment Pads. Provide concrete pads a minimum of 6" beyond the dimensions of the equipment. Extend equipment pad a minimum of 4" above finished floor or grade.
- (5) ~~Steel Raceway Supports. Provide minimum of 2 supports per ten foot length; Support within 12 inches of bends, couplings, fittings and boxes, minimum of two straps per ten foot length. For 2 runs or less of 3/4" to 1-1/4" raceways, provide supports with full straps, clamps or hangers. For individual run 1-1/2" or larger raceways, provide supports with hangers. All other raceways, support with trapeze mounting channels.~~
- (6) Future Raceways: Provide five capped spare 3/4" conduits from each section of a flush mounted branch panel board into the ceiling and floor space. If the floor space is not accessible, provide an additional 3/4" conduit from each section of a branch panel board into the ceiling. Provide 200-lb nylon pull cord in all empty conduit, then cap raceway using a blank cover similar to adjacent wiring device covers.
- (7) Underground Raceway Identification and Installation: Provide direct buried conduit in an area outside a building not less 24" deep, with magnetic "yellow warning" ribbon 12" directly above and 6" below finished grade measured from the top of the conduit or duct bank.
- (8) Do not provide the following, unless approved by the Director:
- (9) Exposed cable wiring.
- (10) Other raceway systems: Electrical Non-metallic Tubing, aluminum conduit, die cast fittings, steel cable trays.

E. Conductors

- (1) ~~Conductors. Provide minimum #12 copper conductors with 600 V insulation (THW, THWN, THWN-2, XHHW, or XHHW-2) for all phase~~

~~conductors; unless ambient conditions require an increased insulation rating. Do not parallel less than #1/0 conductors. Do not feed conductors through one section of panelboard to connect to an overcurrent device in another section of panelboard. Provide separate neutrals for all GFI circuit breakers and for the load side of feed thru GFCI outlets. Provide minimum 12" clearance from hotwater and steam lines measured from outside of insulation.~~

- (2) Metal Clad Cable. Type MC Cable is allowed only when concealed in ceilings or walls. MC Cable must be protected from physical damage and supported directly from the building or structure by use of a listed support. MC Cable home runs are not allowed. Home runs must be in conduit from the electrical panel or cabinet to the first junction or pull box. MC Cable Used for Fire Alarm System Signaling or Initiation Circuits must have an overall outer coating of red.
- (3) Non-metallic sheathed cable may be used only for residential single or multi-family housing unless approved by DFCM Director.
- (4) Do not provide the following, unless approved by the Director: Exposed cable wiring. Splices in panel board, switchboard enclosures, or in conduit bodies. Other cabling methods: ~~Non-metallic sheathed cables (Romex), Metal Clad Cables,~~ Aluminum conductors.

#### F. Grounding

- (1) ~~Grounding. Ground all medium voltage equipment and exposed metals in the immediate area with the neutral conductor of the primary cable and with a minimum 5/8" X 10' ground rod. Provide grounding electrode system at the service entrance with, at a minimum, two of the following electrodes as defined in the NEC: metal underground water pipe, concrete-encased electrode, or ground ring. In addition, bond to other available electrodes. Provide a separate green grounding conductor enclosed with phase conductors in all raceways on the load side of the service entrance. Provide grounding bushings for all service raceways and for raceways installed in concentric/eccentric knockouts. All grounding systems shall be interconnected and/or bonded to the grounding electrode system. Upgrade as necessary existing electrical systems to comply with the NEC and these requirements.~~

#### G. Medium Voltage

- (1) Medium Voltage Conductors: Provide copper conductors with copper tape shields and EPR insulation and 100% copper neutral in Medium Voltage Duct banks; or, in utility tunnels or other areas without public access, provide armored cable or rigid conduit. Comply, as a minimum, with the installation requirements for Medium-Voltage Cable standard NECA 600-2003. Perform Hi-Pot test after terminations have been made, but before connections have been made to buses or apparatus. Perform continuity tests of all cables after entire installation and terminations have been

completed. If a cable fails to perform, replace faulty cable and retest. All tests will be recorded and submitted with M & O O&M manuals at project conclusion.

- (2) Medium Voltage Duct Banks. For interior of buildings in non-public areas, provide rigid galvanized conduit or armored cable marked with red HIGH VOLTAGE. For exterior applications or public areas, provide concrete encased duct-banks (red dye) with raceways in multiples of two and a minimum of one spare conduit (with polypropylene pull wire) per feeder. Provide rigid metal conduit for the first 10 feet of duct bank from a facility or manhole. Provide minimum 4" raceway.
- (3) ~~Medium Voltage Transformer: A/E shall design harmonic mitigation to reduce current total harmonic distortion (based upon full load capacity of the transformer) below 5%. Provide copper or aluminum windings. Provide transformer taps and adjust voltage output to obtain the proper value. Provide primary and secondary terminations at medium voltage transformers, cable, splices, etc. necessary to complete installation. Do not use Askarel transformers.~~
- (4) Lightning Protection: Provide lightning (surge) arresters for medium voltage transformers and switchgear located above ground outside.

#### H. Controller

- (1) ~~Motor controllers: Provide NEMA rated magnetic motor controllers with thermal overload relays for each phase. Provide auxiliary contacts, HOA switches or start-stop pushbuttons as appropriate, stop and run pilot lights, and reset pushbuttons. Provide fused control transformer in the starter for 120 V control. Provide safety interlock to prevent opening enclosure with equipment or control energized.~~
- (2) ~~Variable Frequency Controllers~~ **Drives: Provide variable frequency drives** suitable for the application, factory pre-wired with integral disconnect, input filter, and integral ventilation. ~~Coordinate approved manufacturers with the Agency. Provide interface to HVAC or Building Automation System for control.~~ For interior **location VFD's**, size ventilation for ambient temperature of 32 degrees F. to 90 degrees F. Avoid ~~exterior outdoor location~~ mounted **VFD's**; but, if required, provide ventilation for ambient temperatures from -30 degrees F. to 120 degrees F. Fault current rating shall be sized based upon the fault current analysis of the nearest upstream overcurrent device. Include factory startup and tune to optimize life of motor. ~~Provide VFCs which operate within the following normal ranges of inputs: +/- 10% input voltage; +/- 5% input frequency; less than 7% voltage THD. Provide VFCs which operate through voltage sags of 0% voltage for 1 cycle and 60% voltage for 10 cycles. For Motors 7.5 hp and larger, provide a minimum power quality performance of 12% current THD and 3% voltage THD at filter or VFC input by providing a broadband type filter or minimum 12 pulse VFC complying with the power quality performance requirements demonstrated by standard factory published data. For Motors less than 7.5 hp, provide AC Line Reactor or~~

~~DC Link Reactor. For VFC output filtering, provide output filter if drive output at motor termination exceeds pulse withstand capability. Provide 95% efficiency minimum including filter and 95% power factor. Provide local speed control, HOA switch, remote start/stop, external safeties, run annunciation, fault annunciation, and speed reference input connection. For maintenance purposes, provide stable operation including starting, stopping and running with the motor completely disconnected; provide auto-restart after a power failure; provide capability for starting into a rotating motor at any speed.~~

- (3) Provide a manual bypass of ~~UFC~~ the VFD as part of controller.
- (4) ~~Do not provide the following components, unless approved by the Director.~~
- (5) ~~Other Electrical Components: IEC motor controllers.~~

#### I. Electrical Distribution

- (1) Overcurrent and Ground Fault Protection: Set overcurrent and ground fault protection based upon Fault Current Protection and Coordination Study prepared by the A/E.
- (2) Submit study with ~~M & O~~ O&M manuals.
- (3) Transformers: Provide transformers with copper conductors. Provide transformer taps of 4 taps – 2.5% above normal and 2 taps – 2.5% below normal. Adjust voltage output to obtain the proper value at the main disconnect.
- (4) Metering: Provide secondary digital metering (including demand monitoring) at the main distribution panel(s) in each facility. ~~For secondary digital metering of services of 800 Amps or greater, include Harmonic monitoring and an option for building automation or remote monitoring. Indicate multiplying factor on meter face where current transformers are used.~~
- (5) Utility Metering: Comply with serving utility's regulations, if applicable. Comply with utility's metering requirements. Include cost assessed by serving utility.
- (6) Switchboards and Panel boards: Provide bus hardware installed on the bus for future over-current devices of not less than 25% minimum. Provide over-current devices in the same sequence as shown on the panel schedules or one-line diagrams. ~~Coordinate that the height of the operating handle of the over-current device does not exceed 6'6" above the floor. Identify main over-current protection devices.~~

- (7) Panel boards: Provide listed panel board construction for all branch panels and circuit breaker distribution panels. ~~For 3-phase 4-wire delta systems, connect Hi-Leg to center bus. Provide ground bus bonded to enclosure to terminate all equipment ground conductors. Include insulated ground bus for insulated ground circuits.~~ Load Centers and plug in circuit breakers may be used only in Residential Single and Multi-family residences unless approved by the DFCM Director. Key all panel boards alike and provide 3 keys.
- (8) Circuit Breakers: Provide one, two or three-pole over-current devices with common handle (not field modifiable). ~~Provide bolted connections.~~
- (9) ~~Do not use the following components, unless approved by the Director:~~  
~~Other Electrical Components: load centers, plug in circuit breakers.~~

#### J. Power Quality

- (1) The A/E shall include as a basis of design an evaluation of potential Harmonic Risks to the Electrical Distribution System and provide a plan to mitigate these risks. The Power Quality Plan shall be approved by the DFCM representative. Power Quality Testing may be performed by the DFCM after the facility is occupied to determine the effectiveness of the Power Quality Mitigation approach.
- (2) Electrical Services.
  - a. Services of 300 KVA or larger shall be 277/480 volt at the Service Main Disconnecting means except for those proven to be unnecessary and approved by the DFCM Director.
  - b. Harmonic producing (non linear) loads such as Lighting, VFD's, UPS's and Computer rooms shall be separated or grouped as far as reasonably cost effective.
  - c. All Panels fed from a Step Down transformer shall have 200% Neutral feeders.
  - d. All multi-wire branch circuits with shared neutrals shall have an oversized neutral. This neutral shall be at least one trade size larger than the phase conductors.
  - e. Provide 277 volt lighting wherever there is a 277/480 volt wye service available.
- (3) Existing Electrical Services. Power Quality Testing should be performed prior to the Upgrade, Addition or Alteration of any of the following Electrical Components or Systems, VFD's, UPS's, Step Down Transformers and Generators. It shall be determined from this testing the proper equipment and method to be used that will insure that the existing system will not be adversely affected by the work to be performed. Power

Quality Testing should be performed after completion to determine the effectiveness of the material and methods used.

- (4) Power Factor. All new Construction or Upgrade of existing Electrical Services shall meet the minimum requirement of 95% and Maximum of 98% Power Factor. The DFCM Representative shall approve the method and layout of Power Factor Correction Capacitors prior to installation.
- (5) Step Down Transformers.
  - a. All Step Down transformers shall be Energy Star Nema TPI K-rated or HMT with 200% Neutral capability, unless proven unnecessary and approved by the DFCM Representative. The K-Rating shall be as determined by Manufacture recommendations for the equipment they serve.
  - b. All Step Down transformers feeding Computer rooms or areas subject to high Non Linear loads shall be fed from a Harmonic Mitigating Transformer with 200 % Neutral.
- (6) Variable Frequency Drives. For motors 10 HP and larger, provide a minimum power quality performance of 12% current THD and 3% voltage THD measured at the VFD input terminals. This shall be accomplished by using Harmonic filters or a minimum of 12 pulse drive that will comply with the power quality performance requirements. For motors less than 10 hp provide AC Line Reactors with a minimum of 3% Impedance. Provide output filtering if the motor is located more than 50 feet from the drive.
- (7) Lighting. Electronic Ballasts shall have <20% THD for 277 volt lighting systems and <10% THD for 120 Volt Lighting Systems. In Existing Buildings where high Harmonic Currents are present provide <10% THD Ballasts.
- (8) Generators. For new construction a service that is to be backed up by a Generator shall be designed to have no more than 12% Current THD or 3% Voltage THD. For Existing Services to be backed up by a Generator Power Quality Testing shall be performed to determined that there is not more than 12% Current THD or 3% Voltage THD and that there is not a leading Power Factor. If there is it shall be corrected prior to bringing the Generator online.
- (9) Uninterruptible Power Supplies. Provide a minimum Power Quality performance of 12% current THD and 3% voltage THD measured at the UPS input terminals. Provide filtering if necessary.
- (10) Transient Voltage Suppression System. TVSS Shall be provided for the main service of each facility with services greater than 200 Amps. A second level of TVSS shall be provided for panels serving primarily computer or non linear loads.

#### K. Miscellaneous Electrical

- (1) ~~Lighting Contactors: Provide NEMA-rated lighting contactors with HOA.~~
- (2) ~~Wiring Devices: Locate switches so as not to exceed 48" to the bottom above finished floor. Except for floor boxes, locate convenience outlets so that outlet is not less than 18" to the bottom and not greater than 48" to the top above finished floor. Coordinate heights with cabinetry and finishes. Use feed-through GFCI outlets only if the outlet served is located in the same room. Convenience outlets (120 V) and switches (120/277V) shall be minimum 20A self-grounding with nylon faces and cover plates. Coordinate device colors and plates with the finishes. Provide industrial raised covers for surface switches and outlets. Arrange devices in gangs if multiple devices are located at the same location. Provide mounting strips and blank cover plates for outlet boxes without devices. Do not connect more than eight (8) convenience outlets on each 20A circuit.~~
- (3) Lightning Protection: If the risk analysis performed per NFPA 780 or UL 96A exceeds moderate risk, provide a lightning protection system. Minimum qualifications required: LPI-certified installer, designer, and inspector. Obtain a UL Master Label for the facility.
- (4) Generator Fuel Tank Size. Size fuel tank to comply with the needs of the facility or a minimum of 24 hours of operation at full load capacity.
- (5) Hazardous Classifications. Coordinate with the State Fire Marshall hazardous classifications and requirements, including class, division and group requirements.
- (6) Power Quality:
- a. ~~A/E shall include in the Basis of Design an evaluation of the potential harmonic risks to the electrical distribution system and the approach to mitigate the risks to transformers, neutral conductors, and other equipment.~~
  - b. ~~Design TVSS for the main service of each facility with services greater than 200 A. Include a second level of TVSS for panelboards serving primarily computer or other electronic equipment.~~
  - e. ~~Specify harmonic testing of each transformer (voltage and current THD) after the facility is occupied to determine effectiveness of the Power Quality approach.~~
  - d. ~~Hazardous Classifications: Coordinate with Fire Marshall hazardous classifications and requirements, including class, division, and group requirements.~~
  - e. ~~Generator Fuel Tank Size: Size fuel tank to comply with Code requirements and facility needs. Allowance shall be made in the capacity so that there is adequate fuel to comply with these requirements when the tank indicates that it needs to be refilled.~~

~~Provide a minimum tank capacity for 24 hour continuous operation.~~

L. Structured Cabling

- (1) Test all structured cabling systems to demonstrate compliance with TIA/EIA standards for the category of system selected. Include warranty and the test results in the Project Resource Manual.

M. Fire Alarm

- (1) Provide addressable fire alarm systems as required by State Fire Marshals Rules R710. The Installation shall comply with Sate Fire Marshals Rules R710 and NFPA 72.
- (2) Install class “A” looped systems or as approved by Fire Marshal.
- (3) Do not use the following components, unless approved by the Director. Other Fire Alarm Components: Zoned Fire Alarm panels, ionization smoke detectors.

N. Misc. Systems

- (1) Determine requirements for other systems such as security, cctv, etc.

## **4.0 LANDSCAPE AND IRRIGATION STANDARDS**

### 4.1 Purpose

- A. The Division of Facilities Construction and Management (DFCM) has found that for state owned or developed properties:
- (1) Water is an increasingly scarce resource.
  - (2) Nearly two thirds of the culinary water resources are used for outdoor use, including watering landscapes.
  - (3) The DFCM desires to promote the design, installation and maintenance of landscapes that are both attractive and water efficient.
  - (4) All state facilities are to be landscaped and the site developed to the project limit lines or natural boundaries. If a facility is in a natural setting, all construction damaged areas are to be restored to the extent practicable.
  - (5) The Landscape design for DFCM projects should recognize the Geological and Historic nature or context of the site.
- B. Applicability. The provisions of this section shall apply to all projects on state property that involve the development or major modification of landscaping regardless of funding source, and all other projects under the jurisdiction of the DFCM or under state mandates. This section does not apply to:
- (1) Registered Historical Sites
  - (2) Sites submitted for variance to these guide lines due to unique context.
  - (3) Institutional or other sites with unique context.
- C. Documentation for Plan Approval. A Landscape Development Package shall be submitted to DFCM and the appropriate institution, agency or site manager for approval. Both the Landscape Plan and the Irrigation Plan in the Development Package shall be prepared by a Landscape Architect or another licensed professional as recognized by the State of Utah to perform Landscape Architectural services. Soils reports and other necessary documentation for plan approval must be submitted by the appropriate licensed professionals as stipulated by the State of Utah. The Landscape Development Package shall consist of all documents as listed in Section 3.3.7.

### 4.2 Principles and General Guidelines

- A. Soil Analysis: Quality topsoil is the foundation of quality landscapes. The growth rate, health and visual appearance of landscape plants are directly related to soil quality. Several chemical and physical characteristics influence topsoil quality: soluble salts, pH, texture, organic matter, coarse fragments, and nutrient content. The sodium adsorption ratio (SAR) is an additional property to consider if salinity

and/ or soil pH approach unacceptable levels. It is imperative that topsoil meet acceptable standards for these properties. If soil falls outside of acceptable standards for any one of these properties, reject the material or realize that amendments will need to be made in order to bring the top soil within the acceptable ranges. This will promote healthy plant growth. Soil types will vary from site to site. Soil type will affect irrigation scheduling. Soils may be improved if needed with organic matter to enhance drainage and moisture retention. Soil qualities to be tested but not limited to:

- (1) Soluble Salts
- (2) pH
- (3) Texture
- (4) Organic Matter
- (5) Course Fragments
- (6) Sodium Adsorption Ratio (SAR)
- (7) Nutrient Concentrations
- (8) % Sand
- (9) % Silt
- (10) % Clay

B. Appropriate Plant Selection and Zoning the Landscape: All plants shall conform to USDA zone requirements and be suitable to the local soils. Plants shall be selected according to appropriate solar aspect, exposure, and micro climates. Trees and shrubs should be placed to reduce solar gain in the summer and allow solar gain in the winter. Use healthy, well-adapted plants and zone the landscape by grouping plants together according to their water requirements. It is important to place the right plant in the right place. Avoid planting a high water-use plant next to a low water-use plant. Place plants in areas that will accommodate their mature size. Many beautiful trees, shrubs, perennials and groundcovers are available for use in a water-wise landscape. Select plants for their low water-use, drought tolerance, pest and disease resistance, size, color, form, texture, leaves, flowers, fruit and maintenance needs. Choose plants to provide year-round interest. Many plants have exceptional winter form, habit color, and texture. (Plant list is a comprehensive list of acceptable plants for DFCM projects. Some plants do not as of this time have a Water Zone or Plant Factor value. It is the designer's responsibility to understand the water requirements of these plants and to group the plants into the appropriate Hydra Zones. Any plants proposed to be used that are not on the list must be submitted to the DFCM for approval prior to being shown on the planting plan.)

C. Practical Turf Areas: Plant turf only in areas of manageable sizes and shapes. Limit turf to areas where it provides a functional benefit. Selection of appropriate

turf varieties should be determined by site location, functionality and climate. Excess turf may be replaced with a variety of other low water-use plants.

- D. **Efficient Irrigation:** Irrigation systems are to be designed for minimal maintenance and maximum water conservation. Irrigate efficiently – not excessively. Use properly designed systems and apply the right amount of water at the right time. Irrigate turf areas separately from other plantings. Turf is best watered with overhead sprinklers. Trees, shrubs, flowers and ground covers are watered most efficiently with low-volume drip, spray or bubbler emitters. Do not rely solely on an automatic timer. ET based controllers and soil sensors are encouraged. All irrigations systems shall have “rain delay or rain shut-off” capabilities. Water efficiently and only when needed.
- E. **Mulching:** Use mulches in tree, shrub and perennial borders to conserve soil moisture and increase soil nutrients. Mulch applied at the right depth will reduce weed growth and slow erosion. Organic mulches such as bark improve soil over time.
- F. **Appropriate Maintenance:** Water-wise landscaping will reduce maintenance; however, it will not eliminate it. Low water-use landscapes are simply maintained differently than the average lawn. Maintain the landscape by pruning, fertilizing, watering, weeding mowing and proper deadheading of perennials and flowering plant material.

#### 4.3 Water Allowances

- A. The use of water allowance or water budgeting will greatly encourage the design of water-wise landscape design. The amount of water required is dependent on the site context, but should generally follow the allowable use indicated below as a minimum. The Landscape water allowance shown below is for each project’s total landscape area per project.

<b>Type of Facility</b>		<b>Water Allowance (% of allowable water used)</b>
A.	Office type buildings	50%
B.	Existing campus/institution	70%
C.	New campus/institution	60%
D.	Recreational areas (ball fields etc.)	70%
E.	State Parks (natural areas)	10%

#### 4.4 Definitions

“Administrative Standards” shall mean the set of rules, procedures and requirements set forth in a landscape ordinance associated with making permit application, assembling materials for public review, meeting the requirements of the landscape ordinance, seeking approvals, enforcement, conducting site inspections, and filing reports.

“Bubbler” shall mean an irrigation head that delivers water to the root zone by “flooding” the planted area, usually measured in gallons per minute. Bubblers exhibit a trickle, umbrella or short stream pattern.

“Central Control” shall mean a control system which can operate multiple controllers, sensors, and other irrigation devices from one central location. The Central Controller can monitor conditions in the system and surrounding areas then control the site controller to properly respond to the conditions. The system can make adjustments and operate without personal intervention. The monitor function of a central control system may consist of but not limited to the following: Flow sensors, soil moisture sensors, wind sensors, weather stations and rain sensors. These sensors monitor and report current conditions. The central control system can respond if any of the conditions are outside pre-defined limits.

“Drip Emitter” shall mean a drip irrigation fitting that delivers water slowly at the root zone of the plant, usually measured in gallons per hour. Drip emitters shall be a threaded emitter onto a 1/2” flex pipe, which shall be liquid welded to a lateral supply line.

“Evapotranspiration (ET)” shall mean the quantity of water evaporated from adjacent soil surfaces transpired by plants during a specific time, expressed in inches per day, month or year (see also Reference Evapotranspiration Rate).

“Extra-Drought Tolerant Plant” shall mean a plant that can survive without irrigation throughout the year once established, although supplemental water may be desirable during drought periods for improved appearance and disease resistance.

“Ground Cover” shall mean material planted in such a way as to form a continuous cover over the ground that can be maintained at a height not more than twelve (12) inches.

“Hardscape” shall mean patios, decks and paths. Does not include driveways, parking lots, and sidewalks.

“Hydra Zone” (or “Water Zone”) shall mean grouping plants together according to similar water requirements. (Plant List for Hydra Zone values). Each zone is based on the amount of water required for vegetation to flourish. Each plant in these zones should have a plant factor that correlates to the Hydra Zone. The Plant factor is used in the Water Allowance Formula. Correlating values are as follows:

Hydra zone (or water zone)	Plant Factor
3+	1
2-4	.75
1-3	.50
0-1	.25
0	0

“Irrigated Landscape Area” shall mean all portions of a development site to be improved with planting and irrigation. Natural open space areas shall not be included in the Irrigated Landscaped Area.

“Irrigation Efficiency” shall mean the measurement of the amount of water beneficially applied, divided by the total amount of water applied. Irrigation

efficiency is derived from measurements and estimates of irrigation system hardware characteristics and management practices.

“Irrigation Contractor” shall mean a person who has been certified by The Irrigation Association to install irrigation systems or as otherwise noted.

“Irrigation Designer” shall mean a person who has been certified by The Irrigation Association to prepare irrigation system designs.

“Irrigation Plan” shall mean the plan which shows the components of the irrigation system with water meter size, backflow prevention, rain shut-off device, precipitation rates, flow rate and operating pressure for each irrigation zone, and identification of all irrigation equipment.

“Irrigation Water Auditor” shall mean a person who has been certified by The Irrigation Association to conduct a landscape irrigation audit.

“Landscape Architect” shall mean a person who holds a license to practice Landscape Architecture in the State of Utah.

“Landscape Designer” shall mean a person who has been certified by the Utah Nursery and Landscape Association to prepare Landscape Plans.

“Landscape Development Package” shall mean the preparation of graphic and written criteria, specifications and detailed plans to arrange and modify the effects of natural features such as plantings, ground and water forms, circulation, walks and other features to comply with the provisions of this ordinance. The Landscape Development Package shall include a project data sheet, a Planting Plan, and Irrigation Plan, a Grading Plan, a Soils Report, a Landscape Water Allowance Schedule and an Irrigation Schedule.

“Landscape Water Allowance” shall mean for design purposes, the upper limit of annual applied water for the established landscaped area. It is based upon the local Reference Evapotranspiration Rate, the ET adjustment factor and the size of the landscaped area.

“Landscaped Zone” shall mean a portion of the landscaped area having plants with similar water needs, areas with similar microclimate (i.e., slope, exposure, wind, etc.) and soil conditions, and areas that will be similarly irrigated. A landscape zone can be served by one irrigation valve or a set of valves with the same schedule.

“Landscaping” shall mean any combination of living plants, such as trees, shrubs, vines, ground covers, flowers, turf or ornamental grass; natural features such as rock, stone or bark chips.

“Mulch” shall mean any material such as bark, wood chips, rocks/stones or other similar materials left loose and applied to the soil.

“Non-Drought Tolerant Plant” shall mean a plant that will require regular irrigation for adequate appearance, growth and disease resistance.

“Plant Factor Shall” mean using a value associated to a group of plant material that has similar requirements for water consumption. This value is used in the calculation for the landscape water allowance. Example: Turf = 1, Non-drought tolerant trees, shrubs and ground cover = 0.75, Water-conserving trees, shrubs and ground cover = 0.50, Extra drought tolerant trees, shrubs and ground cover = 0.25, Mulch areas not irrigated = 0.0. The Plant Factor correlates to the Hydra Zone. The Plant factor is used in the Water Allowance Formula. Correlating values are as follows:

Hydra zone (or water zone)	Plant Factor
3+	1
2-4	.75
1-3	.50
0-1	.25
0	0

“Plant Hydra Zone” (or water zone) shall mean the grouping of plants together according to similar water requirements.

“Planting Plan” shall mean a plan which clearly and accurately identifies and locates new and existing trees, shrubs, ground covers, turf areas, driveways, sidewalks, hardscape features and fences.

“Precipitation Rate” shall mean the rate at which water is applied per unit of time, usually measured in inches per hour.

“Rain Shut-Off Device” shall mean a device wired to an automatic controller that shuts off the irrigation system when it rains.

“Reference Evapotranspiration Rate” or ET shall mean a standard measurement of environmental parameters which affect the water use of plants. ET is expressed in inches per day, month or year and is an estimate of the evapotranspiration of a large field of four to five inches tall, cool season grass that is well watered. See also Evapotranspiration.

“Runoff” shall mean irrigation water that is not absorbed by the soil or landscape area to which it is applied and which flows onto other areas.

“Soils Report” shall mean a report by a soils laboratory indicating soil type(s), soil depth, soluble salts, texture, organic matter, coarse fragments, sodium adsorption ratio (SAR), nutrient concentrations, uniformity, composition, bulk density, infiltration rates, and pH for the top soil and subsoil for a given site. The soils report also includes recommendations for soil amendments.

“Spray Sprinkler” shall mean an irrigation head that sprays water through a nozzle.

“Stream Sprinkler” shall mean an irrigation head that projects water through a gear rotor in single or multiple streams.

“Turf” shall mean a surface layer of earth containing mowed grass with its roots.

“Waste of Water” shall mean and include, but not be limited to:

- The use of water for any purpose, including landscape irrigation, which consumes or for which is applied substantial amounts of excess water beyond the reasonable amount required by the use, whether such excess water remains on the site, evaporates, percolates underground, goes into the sewer system or is allowed to run into the gutter or street. Every water consumer is deemed to have under his control at all times the water lines and facilities, through which water is being supplied and used to his premises and to know the manner and extent of his water use and excess runoff.
- The excessive use, loss or escape of water through breaks, leaks or malfunctions in the water user’s plumbing for any period of time after such escape of water should reasonably have been discovered and corrected. It shall be presumed that a period of 8 hours after the water user discovers such break, leak or malfunction or receives notice of such condition, whichever occurs first, is a reasonable time to correct such condition.
- Washing sidewalks, driveways, parking areas, tennis courts, patios or other paved areas except to alleviate immediate fire, health or safety hazards.

“Water Use Efficiency Review” (audit) shall mean an on-site survey and measurement of irrigation equipment and management efficiency and the generation of recommendations to improve efficiency.

“Water Conserving Plant” shall mean a plant that can generally survive with available rainfall once established, although supplemental irrigation may be needed or desirable during the growing season.

“Water Zone” See Hydra Zone

#### 4.5 Landscape Design Standards

- A. Creating Plant Hydra Zones or Water Zones: There are guidelines that should be used when creating the four water use zones that may occur in a water-wise landscape. Each zone is based on the amount of water required for vegetation to flourish. Grouping plants together according to similar water requirements avoids wasteful over watering and encourages proper growth. Avoid high plant hydrazones being adjacent to low hydrazones. Without transition zones, water from the wet zones will be wasted on the adjacent dry zones. For many water efficient plants, there is such a thing as too much water. Water needs are dependent on the soil type, weather conditions, plant material, and amount of competition with weeds or desirable plants. Careful selection of a “low-volume” irrigation system will conserve large amounts of water.
- (1) Plant Hydra Zone 0: No supplemental water is required after plants are established. This is the lowest water zone in a water-wise landscape and will provide the greatest savings when compared to conventional landscaping.

- (2) Plant Hydra Zone 1: At least 1-inch of supplemental water per month may be required after plants are established. Plants growing in this zone need more water than natural precipitation.
  - (3) Plant Hydra Zone 2: At least 1-inch of supplemental water every 2 weeks may be required after plants are established. This is still less than most conventional landscapes.
  - (4) Plant Hydra Zone 3: At least 1-inch of supplemental water each week may be required after plants are established. This zone should be kept small and functional in size. It could be considered a mini-oasis and is best used when incorporated carefully into the landscape design. Turf/Lawn is generally the primary plant used in this zone.
- B. Plant Selection. Plants selected for landscape areas shall consist of plants that are well-suited to the microclimate and soil conditions at the project site. Plants with similar water needs shall be grouped together as much as possible.
  - C. For projects located at the interface between urban areas and natural open space (non-irrigated), Extra-Drought Tolerant Plants shall be selected that will blend with the native vegetation and are fire resistant or fire retardant. Plants with low fuel volume or high moisture content shall be emphasized. Plants that tend to accumulate excessive amounts of dead wood or debris shall be avoided.
  - D. Areas with slopes greater than 33% shall be landscaped with deep-rooting, Water Conserving Plants for erosion control and soil stabilization.
  - E. Park strips and other landscaped areas less than 8 feet wide shall be landscaped with Water Conserving Plants and/or grass. Areas less than 5 feet wide shall not be planted in turf.
  - F. Planting material should be used as a screening device for parking areas, service yards, transformers, and other site utilities etc. Trees in parking areas shall be selected based on reducing leaf litter and be “sap-drip” free.
  - G. Mulch. After completion of all planting, all irrigated non-turf areas shall be covered with a minimum layer of 3” of Mulch to retain water, inhibit weed growth and moderate soil temperature. Non-porous material shall not be placed under the mulch.
  - H. Soil Preparation. Soil preparation shall be suitable to provide healthy growing conditions for the plants and to encourage water infiltration and penetration. Soil preparation shall include scarifying the soil to a minimum depth of six (6) inches and amending the soil with organic materials as per specific recommendations of the Landscape Architect based on the Soils Report.
  - I. All plant material shall be installed according to the ANLA (American Nursery & Landscape Association) guidelines.

#### 4.6 Irrigation Design Standards

- A. Recommended Point of Connection (POC) component installation order: 1-connection to source, 2-stop and waste valve/ or shut off, 3-filtration device, 4-pressure regulator, 5-backflow preventer, 6-quick coupler blowout, 7-master valve, and 8-flow meter – (if required).
- B. In situations of secondary water supply, provide filtration system necessary to clean water supply and protect irrigation system components. Provide accessible pressure gauges immediately upstream and downstream of the filtration device. (Non self cleaning units)
- C. Landscape Water Meter. A separate irrigation system water meter and backflow prevention assembly that are in compliance with state code shall be installed for all new landscape irrigation systems. The landscape water meter and backflow prevention assembly shall be separate from the water meter and backflow prevention assembly installed for indoor uses. The size of the meter shall be determined based on irrigation demand.
- D. Pressure Regulation. A pressure regulating valve shall be installed and maintained by the consumer if the static service pressure exceeds 80 pounds per square inch (psi). The pressure-regulating valve shall be located between the landscape water meter and the first point of water use or first point of division in the pipe and shall be set at the manufacture’s recommended pressure for sprinklers and or drip/micro systems. Pressure regulation devices may include one or all of the following: 1- pressure regulation valve at the main line POC, 2-pressure regulation device on individual sprinkler heads, 3-regulation of low volume drip/micro systems.
- E. Irrigation systems with 1” POC or 10,000 square feet and larger of landscaped area shall have a flow sensor and master valve installed. Systems with irrigated area of 1 acre and larger shall have a normally closed master valve. Where necessary, the master valve shall be capable of manual operation to allow manual use of the irrigation system. A normally open master valve is acceptable if the controller is capable to shut the valve off in event of unscheduled flow.
- F. Automatic Controller. All irrigation systems shall include an electric automatic controller with multiple programs and multiple repeat cycle capabilities and a flexible calendar program. Controller shall be programmable for multiple start times for repeat and rest periods, and shall be capable of water budget adjustment. Controller shall be able to provide separate programs for turf zones, shrub zones, and drip zones. All controllers shall be capable of temporarily shutting down the system by utilizing internal/external options (such as rain, wind, and freeze devices) and the ability to adjust run times based on a percentage of maximum ET or by use of a soil sensor. Power wire and control wire shall not be contained in the same conduit.
- G. On slopes exceeding 33%, the irrigation system shall consist of Drip Emitters, Bubblers or sprinklers with a maximum Precipitation Rate of 0.85 inches per hour and adjusted sprinkler cycle to eliminate Runoff. Lateral lines are to run parallel to slope when possible.
- H. Each valve shall irrigate a landscape with similar site, slope and soil conditions and plant materials with similar watering needs. Turf and non-turf areas shall be

irrigated on separate valves. No single zone shall be designed or installed with sprinklers of differing pressure requirements or precipitation rates. (Rotors, spray heads, drip emitters, micro sprays, etc. may not be mixed within a zone.

- I. Drip Emitters or Bubblers shall be provided for each tree where practicable. Bubblers shall not exceed 1.5 gallons per minute per device. Bubblers for trees shall be placed on a separate valve unless specifically exempted by the DFCM.
- J. Sprinklers shall have matched Precipitation Rates with each control valve circuit. All sprinkler heads shall be spaced at a maximum of 50% of design performance diameter of the sprinkler. In known windy areas sprinklers are to be designed with reduced head spacing or low angle nozzles. Spacing shall be reduced below 50% of design performance diameter when conditions demand.
- K. Check valves shall be required where elevation differences will cause low-head drainage. Pressure compensating valves and sprinklers shall be required where a significant variation in water pressure will occur within the irrigation system due to elevation differences.
- L. Drip Irrigation lines shall be placed underground or otherwise permanently covered, except for Drip Emitters and where approved as a temporary installation. Filters and end flush valves shall be provided as necessary and as per industry standards.
- M. Irrigation zones with overhead spray or stream sprinklers shall be designed to operate between 6:00 pm and 10:00 am to reduce water loss from wind and evaporation. Drip or bubbler zones are excluded from this requirement.
- N. Program valves for multiple repeat cycles where necessary to reduce runoff, particularly slopes and soils with slow infiltration rates.

#### 4.7 Contract Documents

- A. Project Data Sheet. The Project Data Form shall contain the following:
  - (1) Project name and address;
  - (2) Type of project
  - (3) Landscape Architect's name, address, phone and fax number; and
  - (4) Landscape Contractor's name, address, phone and fax number.
- B. Planting Plan. A detailed Planting Plan shall be drawn at a scale that clearly identifies the following:
  - (1) Location of all plant materials, a legend with botanical and common names, and size of plant materials;
  - (2) Property lines and street names;

- (3) Existing and proposed buildings, walls, fences, light poles, utilities, paved areas and other site improvements;
- (4) Existing trees and plant materials to be removed or retained; and
- (5) Designation of Landscape Zones.
- (6) Details and specifications for tree staking, soil preparation, and other planting work.

C. Irrigation Plan. A detailed Irrigation Plan shall be drawn at the same scale as the planting plan and shall contain the following information:

- (1) Layout of the irrigation system and a legend summarizing the type and size of all components of the system, including manufacturer name and model numbers;
- (2) Static water pressure in pounds per square inch (psi) at the point of connection to the public water supply ; and
- (3) Flow rate in gallons per minute and design operating pressure in psi for each valve and precipitation rate in inches per hour for each valve with sprinklers.
- (4) Installation details for irrigation components.

D. Grading Plan. A Grading Plan shall be drawn at the same scale as the Planting Plan and shall contain the following information:

- (1) Property lines and street names, existing and proposed buildings, walls, fences, utilities, paved areas and other site improvements; and
- (2) Existing and finished contour lines and spot elevations as necessary for the proposed site improvements.

E. Soils Report. A Soils Report will be required where irrigated landscaped areas consisting of grass or similar turf exceed 33% of the overall landscaped area or where the total landscaped area exceeds 2,500 square feet. The Soils Report shall describe the depth, composition and bulk density of the top soil and subsoil at the site and shall include recommendations for soil amendments. The Planting Plan shall incorporate the recommendations of the Soils Report into the planting specifications.

F. Landscape Water Allowance. The annual Landscape Water Allowance shall be calculated using the following equation:

$$\text{Landscape Water Allowance (gallons)} = \text{ET} \times \text{PF} \times \text{AREA} / \text{IE} \times .62$$

Where Landscape Water Allowance is in gallons per growing season,

$$\text{ET} = \text{Reference Evapotranspiration in inches per growing season}$$

PF = Plant factor (see chart below)

AREA = Total Irrigated Landscape Area in square feet

IE = Irrigation efficiency (see chart below)

.62 = Conversion to gallons

Estimated Landscape Water use = ET x PF x AREA/IE x .62

G. Plant Factor (PF) shall be the following for each type of plant material:

Plant Type	Plant Hydra Zone	Plant Factor (PF)
Turf	3+	1.0
Non-drought tolerant trees, shrubs and ground cover	2-3	0.75
Water-conserving trees, shrubs and ground cover	1-2	0.50
Extra drought-tolerant trees, shrubs and ground cover	0-1	0.25
Mulch areas not irrigated, or plants not needing additional water after being established	0	0.0

H. Irrigation Efficiency (IE) shall be the following for each type of irrigation:

Irrigation Type	Irrigation Efficiency (IE)
Bubblers	0.85
Drip Emitters	0.85
Stream Sprinklers in planter strips 8 feet or wider	0.75
Spray Sprinklers in planter strips 8 feet or wider	0.625
Spray Sprinklers in planter strips less than 8 feet wide	0.4

I. Irrigation Schedule. A monthly Irrigation Schedule shall be prepared that covers the initial 120-day plant establishment period and the typical long-term use period. This schedule shall consist of a table with the following information for each valve:

- (1) Plant type (for example, turf, trees, low water use plants);
- (2) Irrigation type (for example, sprinklers, drip, bubblers);
- (3) Flow rate in gallons per minute;
- (4) Precipitation rate in inches per hour (sprinklers only);
- (5) Run times in minutes per day;
- (6) Number of water days per week; and
- (7) Cycle time to avoid runoff.

- J. The irrigation schedule shall rely on the estimated landscape water use calculations and shall be adjusted as necessary for irrigation efficiency, soil conditions, slope, and microclimate conditions. (See Irrigation Schedule Form)

#### 4.8 Irrigation Record Drawings and Operations and Maintenance Manuals

- A. Irrigation record drawings and operations and maintenance manuals are to be turned over to the DFCM at project completion prior to final acceptance.
- B. The following shall be included on Irrigation Record Drawings. In addition, provide a reduced color-coded drawing(s) showing all zones and assigned valves.
- C. Note all points of connection (P.O.C.) include tap size, line size and static water pressure (P.S.I.) of service.
- D. Provide name and phone number of the servicing water purveyor. Include the name and date the installation was completed and the date the as-build drawing was approved.
- E. Accurately locate all the following major components by dimension and their size as installed on the project: (But not limited to the Following)
  - (1) Water Meters
  - (2) Backflow Preventers
  - (3) Pressure Reducing Valves (note pressure settings)
  - (4) Filters
  - (5) Stop and Waste
  - (6) Master Control Valves
  - (7) Isolation and Gate Valves
  - (8) Control wire junction boxes
  - (9) Pumps
  - (10) Flow Sensors
  - (11) Remote Control Valves (note station assignment, size, flow rate, pressure setting. D.U. and actual flow rates, if available from water audit)
  - (12) Drip System Pressure Regulators and Filters
  - (13) Quick Couplers and Hose Bibs
  - (14) Pressure Main Lines and Sizes

- (15) Main Line Sleeves and Sizes
- (16) Capped main Lines and Future P.O.C.'s
- (17) Manual Drain Valves and Sumps
- (18) Remote Control Wire (label both ends and in junction box)
- (19) Controller Location(s) (Note manufacturer, model, size and number of stations used)
- (20) Central Control
- (21) Rain Sensors
- (22) Moisture Sensors
- (23) Note and identify location(s) of existing utility systems as encountered during installation, i.e.; gas, phone, sewer, etc.
- (24) Air Release Valves

F. Indicate and show the following additional components installed on the project:

- (1) All Sprinkler Heads
- (2) Lateral Lines and sizes
- (3) Lateral Line Sleeves and sizes
- (4) Manual or Automatic Flush Valves

G. Operations and Maintenance Manual

- (1) A signed and dated written description of the contractor's warranty and warrantee period. Include name, address, phone number and license number.
- (2) A description of system start up and winterization process.
- (3) All product literature and customer service information for products used/installed on project.

#### 4.9 Plan Review, Construction Inspection and Post-Construction Monitoring

A. As part of the Site Plan and Building Approval Process, a copy of the Landscape Development Package shall be submitted to the DFCM for review and approval before construction begins. With the Landscape Development Package, a copy of the Landscape Water Allowance Worksheet shall be completed by a Landscape

Architect or another licensed professional as recognized by the State of Utah to perform Landscape Architectural services and submitted to the DFCM.

- B. All Landscape Plan Documentation Packages submitted must be prepared by a licensed Landscape Architect, or another licensed professional as recognized by the State of Utah to perform Landscape Architectural services
- C. The Irrigation Plan must be prepared by a Landscape Architect, or another licensed professional as recognized by the State of Utah to perform Landscape Architectural services.
- D. All landscape irrigation systems shall be installed by an Irrigation Contractor. The person representing the contracting firm shall be a full-time employee of the firm and shall be directly involved with the project including at least weekly site visits during construction.
- E. All installers, designers and auditors shall meet state and local license, insurance and bonding requirements and be able to show proof of such upon demand.
- F. During construction, site inspection of the landscaping may be performed by the DFCM, the local institution or agency.
- G. During construction a mainline pressure and leak test will be conducted.
- H. Following construction an inspection shall be scheduled with the DFCM to verify compliance with the approved landscape and irrigation plans. A Certificate of Substantial Completion Form shall be completed by the Contractor or Landscape Architect and submitted to the DFCM.
- I. Following construction a Water Use Efficiency Review (Audit) will be conducted by a certified Landscape Irrigation Auditor. The auditor shall be independent of the contractor, design firm and owner/developer of the project. The water performance audit will verify that the irrigation system complies with the minimum standards required by this ordinance. The auditor shall furnish a certificate to the DFCM, Landscape Architect, and installer certifying compliance with the minimum distribution requirements and an irrigation schedule.
- J. The DFCM reserves the right to perform site inspections at any time before, during or after the irrigation system and landscape installation, and to require corrective measures if requirements of this guideline are not satisfied.

#### 4.10 Soils Definitions & Guidelines

- A. Soluble salts. High levels of soluble salts make it difficult for plants to absorb water and can have direct toxic effects on many landscape plants. Electrical conductivity of the extracted soil solution (ECe) is the measure of soluble salts. Soluble salts are removed (leached) relatively easily by applying excess, low salt water to a well drained soil. This must be done before seeding or transplanting, since plants are most sensitive to salts at these times. See the related Utah State University Extension Bulletins Salinity and Plant Tolerance and Selection and Planting of Landscape Trees for more information about salinity tolerance.

- B. pH. pH is an indication of the acidity or alkalinity (basic nature) of soil. A pH of 7.0 is neutral, while values below 7.0 are acidic and values above 7.0 are alkaline or basic. Most Utah soils have pH values in the mid-7.0 to low 8.0 range. Many plants grow well over a broad range of soil pH; however, some acid-loving plants such as blueberry, rhododendron and azalea will not grow well above pH7. Other sensitive plants are susceptible to iron deficiency (iron chlorosis) above pH 7.5. See the related Utah State Extension Bulletins Control of Iron Chlorosis in Ornamental and Crop Plants and Managing Soil pH in Utah for more information about iron chlorosis and soil pH.
- C. Texture. Texture refers to the proportion (%) of sand-, silt, and clay-sized particles in the soil. The percentages by weight of sand, silt and clay are used to assign soil to a specific texture class (e.g., silt loam). Texture influences the water holding capacity, aeration (gas exchange), drainage, tilth and compaction and nutrient retention of soil. A mixture of sand, silt and clay is desirable. Soils are unacceptable if they are dominated by one particle size. It is not practical to change soil texture on a large scale. Large amounts of sand, silt or clay would be required to change soil texture and it is difficult to incorporate this material thoroughly. Large amounts of organic matter will improve the physical characteristics of soil composed of too much sand, silt or clay.
- D. Organic matter. Organic matter is essential in the formation of soil structure, reducing soil compaction and retaining essential plant nutrients. Generally, the higher the level of organic matter, the better the soil quality. In Utah, native soil organic matter levels are low, often less than 1% by weight. Soil organic matter content can be increased by adding compost, peat moss or other organic amendments.
- E. Coarse fragments. Coarse fragments (gravel, rocks, etc.) can, if present in large amounts, make it difficult to till, seed, aerate and generally manage soil in a landscape. Construction wastes such as concrete can also contribute unacceptable coarse fragments to soil. If percentage of coarse fragments is high, the soil should be screened before use.
- F. Sodium adsorption ratio (SAR). The sodium adsorption ratio is a measure of the amount of sodium (an undesirable element) relative to calcium and magnesium (desirable elements) in soil. Soils with high SAR values tend to have poor structure and low water infiltration and percolation rates. Soils with a high SAR also have a high pH and/or ECe. If pH and ECe are within acceptable ranges, SAR should also be acceptable.
- G. Nutrient concentrations. Nutrients are essential for plant growth. High quality topsoils normally have adequate phosphorus (P), potassium (K) and iron (Fe). Additional nitrogen (N) is usually required on an annual basis. If the topsoil meets these nutrient guidelines, then no additional fertilizer is needed until further soil tests indicate a deficiency.

**Summary of Topsoil Quality Guidelines**

Category	Soluble salts (dS/m or mmho/cm)	pH	Sand (%)	Silt (%)	Clay (%)	Texture class*	Organic Matter (%)	% Coarse fragments (>2 mm in diameter)**	Sodium Adsorption Ratio (SAR)*
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Ideal	< 2	5.5 to 7.5	< 70	< 70	< 30	L, SiL	≥ 2.0	≤ 2	< 3 for any texture
Acceptable	< 4	5.0 to 8.2	< 70	< 70	< 30	SCL, SL, CL, SiCL	≥ 1.0	2.1 to 5.0	3 to 7 (SiL, SiCL, CL) 3 to 10 (SCL, SL, L)
Unacceptable	> 4	< 5.0 or > 8.2	> 70	> 70	> 30	LS, SC, SiC, S, Si, C	< 1.0	> 5.0	> 10 for any texture

\* L = loam; SiL = Silt loam; SCL = sandy clay loam; SL = sandy loam; CL = clay loam; SiCL = silty clay loam; LS = loamy sand; SC = sandy clay; SiC = silty clay; S = sand; C = clay

\*\* This guideline also includes no fragments larger than 1 ½ inch in diameter.

#### Nutrient Guidelines for Landscaping

Category	Nitrate-nitrogen (ppm or mg N/kg soil)	Phosphorus (ppm or mg P/kg soil)	Potassium (ppm or mg K/kg soil)	Iron (ppm or mg Fe/kg soil)
Acceptable	> 20	> 15	> 150	> 10

#### Course Fragment Guidelines

Category	% Course fragments (Rocks) > 2mm	≥ 1.5" in diameter
Ideal	≤ 2.0	None
Acceptable	2.1 – 5.0	None
Unacceptable	> 5.0	Present

#### Compost Quality Guidelines for Landscaping

Category	pH	Soluble Salts dS/m or mmho/cm	Sodium Absorption Ratio (SAR)	Carbon:Nitrogen Ratio (C:O)	% Moisture	% Rocks (Coarse Fragments) > 2mm
Ideal	6 to 8	≤ 5	< 10	≤ 30:1	25 to 35	0
Acceptable	5-6, 8-9	≤ 20	≤ 20	31:1 to 50:1	< 25, > 35	≤ 5
Unacceptable	< 5, > 9	> 20	> 20	< 12:1, > 50:1	< 20, > 50	> 5

#### 4.11 Plant List

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
<b>DECIDUOUS TREES</b>				
5 - 9			Acer buergeranum	Trident Maple
4 - 8	1 - 2	.50	Acer campestre	Hedge Maple
2 - 8	1 - 2	.50	Acer ginnala	Amur Maple
2 - 8	1	.25	Acer glabrum	Rocky Mountain Maple
4 - 7	1	.25	Acer grandidentatum	Bigtooth Maple
4 - 8			Acer griseum	Paperbark Maple
2 - 9	1	.25	Acer negundo	Boxelder, Ash-leaved or Manitoba Maple
4 - 8	1	.25	Acer nigrum	Black Maple
5 - 8			Acer palmatum	Japanese Maple
3 - 7	3	1	Acer platanoides	Norway Maple
5 - 7	2	.50	Acer pseudoplatanus	Sycamore Maple
3 - 9			Acer rubrum	Red Maple

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
3 - 9			<i>Acer saccharinum</i>	Silver Maple
4 - 8			<i>Acer saccharum</i>	Sugar Maple
3 - 8	1 - 2	.50	<i>Acer tataricum</i>	Tatarian Maple
4 - 8	2	.50	<i>Acer truncatum</i>	Shantung Maple or Purpleblow
7 - 8			<i>Aesculus californica</i>	California Buckeye
3 - 7			<i>Aesculus glabra</i>	Ohio Buckeye
3 - 8	2	.50	<i>Aesculus hippocastanum</i>	Horsechestnut
	2	.50	<i>Aesculus sp.</i>	Horsechestnut
3 - 8			<i>Aesculus X carnea</i>	Red Horsechestnut
4 - 8	0	0	<i>Ailanthus altissima</i>	Tree of Heaven
6 - 9			<i>Albizia julibrissin</i>	Mimosa, Silk Tree, Albizia
3 - 7	3	1	<i>Alnus glutinosa</i>	European or Common Alder
1-6	3	1	<i>Alnus incana</i>	Mountain Alder
1 - 7			<i>Alnus tenuifolia</i>	Thinleaf Alder or Mountain Alder
2 - 7			<i>Amelanchier alnifolia</i>	Saskatoon, Western Serviceberry
4 - 9			<i>Amelanchier arborea</i>	Downy Serviceberry
4	1	.25	<i>Amelanchier laevis</i>	Princess Diane Serviceberry, Cole's Select Serviceberry, Laevis Serviceberry
4 - 8			<i>Amerlancier uthahensis</i>	Utah Serviceberry
2 - 7			<i>Betula papyrifera</i>	Paper Birch
4 - 9			<i>Betula nigra</i>	River Birch
3 - 7	3	1	<i>Betula occidentalis</i>	Western Water Birch
2 - 7			<i>Betula pendula</i>	European White Birch
4 - 8			<i>Carpinus betulus</i>	European Hornbeam
3 - 9			<i>Carpinus caroliniana</i>	American Hornbeam, Muscledwood
4 - 9			<i>Castanea mollissima</i>	Chinese Chestnut
5 - 9			<i>Catalpa bignonioides</i>	Southern Catalpa
5 - 9			<i>Catalpa bignonioides 'Nana'</i>	Umbrella Catalpa
4 - 9	1	.25	<i>Catalpa speciosa</i>	Western Catalpa
4 - 8	1	.25	<i>Catalpa speciosa</i>	Northern Catalpa
2 - 9	0 - 1	.25	<i>Celtis occidentalis</i>	Common Hackberry
5 - 9	0	0	<i>Celtis reticulata</i>	Netleaf Hackberry
4 - 8			<i>Cercidiphyllum japonicum</i>	Katsuratree
3 - 9	2	.50	<i>Cercis canadensis</i>	Eastern Redbud or Judas Tree
7 - 9			<i>Cercis occidentalis</i>	California or Western Red Bud
3 - 8			<i>Cercocarpus ledifolius</i>	Curleaf Mountain Mahogany
			<i>Cercocarpus montanus</i>	Mountain Mahogany
8 - 10			<i>Chilopsis linearis</i>	Desert Willow
3 - 9			<i>Chionanthus virginicus</i>	Fringetree, White Fringetree
4 - 8			<i>Cladrastis lutea</i>	Yellowwood
4 - 9			<i>Corylus americana</i>	American Hazelnut
3 - 7			<i>Cornus alternifolia</i>	Pagoda or Alternate-Leaf Dogwood
5 - 9			<i>Cornus florida</i>	Flowering Dogwood
3 - 7			<i>Cornus kousa</i>	Kousa Dogwood
4 - 8			<i>Cornus mas</i>	Corneliancherry Dogwood
2 - 8			<i>Cornus sericea</i>	Red-osier or Red-Stemmed Dogwood
4 - 7			<i>Corylus columna</i>	Turkish Filbert, Turkish Hazel

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
4 - 8			<i>Corylus cornuta</i>	Beaked Hazelnut
4 - 9			<i>Cotinus coggyria</i>	Common Smoketree, Smokebush
3 - 8			<i>Cotinus obovatus</i>	American Smoketree, Chittamwood
5 - 9			<i>Cowania mexicana</i>	Cliffrose, Quininebush
3 - 8	1	.25	<i>Crataegus crusgalli</i>	Cockspur Hawthorn
2 - 8			<i>Crataegus douglasii</i>	River Hawthorn, Black or Douglas Hawthorn
4 - 8			<i>Crataegus laevigata</i>	English Hawthorn
3 - 8	2	.50	<i>Crataegus phaenopyrum</i>	Washington Hawthorn
3 - 8	1 - 2	.50	<i>Crataegus sp.</i>	Hawthorn
4 - 8			<i>Crataegus viridis</i>	Green Hawthorn
4 - 8			<i>Crataegus X lavalleyi</i>	Lavalle Hawthorn
2 - 7	0 - 1	.25	<i>Eleagnus angustifolia</i>	Russian Olive
8 - 10			<i>Eriobotrya japonica</i>	Loquat
3 - 9			<i>Fagus grandifolia</i>	American Beech
4 - 7			<i>Fagus sylvatica</i>	European Beech
3 - 9	2	.50	<i>Fraxinus pennsylvanica</i>	Green Ash
3 - 9			<i>Fraxinus americana</i>	White Ash
6 - 9			<i>Fraxinus anomala</i>	Singleleaf Ash
3 - 9			<i>Fraxinus excelsior</i>	European Ash
4 - 7			<i>Fraxinus quadrangulata</i>	Blue Ash
7 - 9	0	0	<i>Fraxinus velutina</i>	Velvet or Modesto Ash
3 - 8	2	.50	<i>Ginkgo biloba</i>	Ginkgo, Maidenhair Tree
3 - 9	1	.25	<i>Gleditsia triacanthos inermis</i>	Thornless Honey Locust
3 - 8	1	.25	<i>Gymnocladus dioicus</i>	Kentucky Coffee Tree
5 - 9			<i>Ilex opaca</i>	American Holly
3 - 7			<i>Juglans cinerea</i>	Butternut
7 - 9			<i>Juglans major</i>	Arizona Walnut
4 - 9	2	.50	<i>Juglans nigra</i>	Black Walnut
4 - 8			<i>Juglans regia</i>	English or Persian Walnut
5 - 9	1	.25	<i>Koelreuteria paniculata</i>	Goldenrain tree
5 - 7			<i>Laburnum X watereri</i>	Goldenchain tree, Waterer Laburnum
7 - 9			<i>Lagerstroemia indica</i>	Crapemyrtle
2 - 6	3	1	<i>Larix decidua</i>	European Larch
5 - 9			<i>Liquidambar styraciflua</i>	Sweetgum, American Sweetgum
4 - 9			<i>Liriodendron tulipifera</i>	Yellow-Poplar, Tuliptree, Tulip Poplar
4 - 9	1	.25	<i>Maclura pomerifera</i>	Osage Orange
3 - 8			<i>Magnolia acuminata</i>	Cucumber Tree, Cucumber Magnolia
6 - 9			<i>Magnolia grandiflora</i>	Southern Magnolia
6 - 9			<i>Magnolia kobus</i>	Kobus Magnolia
3 - 8			<i>Magnolia X loebneri</i>	Loebner Magnolia
4 - 9			<i>Magnolia x soulangiana</i>	Saucer Magnolia
3 - 9			<i>Malus pumila</i>	Apple
2 - 8	1 - 2	.50	<i>Malus sp.</i>	Apple including crabapples (many varieties)
8 - 10			<i>Melia azedarach</i>	Chinaberry
4 - 8	1 - 2	.50	<i>Morus alba</i>	Fruitless Mulberry
5 - 9			<i>Morus rubra</i>	Red Mulberry
6 - 9			<i>Ostrya knowltonii</i>	Knowlton Hophornbeam
3 - 9			<i>Ostrya virginiana</i>	Eastern Hophornbeam, Iron Wood
3 - 8			<i>Phellodendron amurense</i>	Amur Corktree

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
6 - 9			<i>Pistacia chinensis</i>	Chinese Pistache
4 - 9			<i>Pistacia vera</i>	Pistachio
4 - 9			<i>Platanus occidentalis</i>	American Sycamore or Plane Tree
4 - 8	2	.50	<i>Platanus x acerifolia</i>	London Plane Tree, Sycamore
3 - 9			<i>Populus alba</i>	White Poplar
3 - 8	1 - 2	.50	<i>Populus alba</i> 'Pyramidalis' or 'bolleana'	Bolleana Poplar
3 - 9			<i>Populus angustifolia</i>	Narrowleaf Cottonwood
2 - 5			<i>Populus balsamifera</i>	Balsam Poplar
2 - 8			<i>Populus candicans</i>	Balm of Gilead
2 - 9	2	.50	<i>Populus deltoides</i>	Eastern Cottonwood
5 - 9			<i>Populus fremontii</i>	Freemont Cottonwood
3 - 9			<i>Populus nigra</i> 'Italica'	Lombardy Poplar
	2	.50	<i>Populus</i> sp.	Cottonwood, improved "cottonless" varieties
3 - 7	3	1	<i>Populus tremuloides</i>	Quaking Aspen
3 - 8			<i>Populus trichocarpa</i>	Black Cottonwood
3 - 9			<i>Populus X canadensis</i>	Carolina Poplar
7 - 10			<i>Prosopis juliflora</i>	Honey Mesquite
4 - 9			<i>Prunus armeniaca</i>	Apricot
3 - 8			<i>Prunus avium</i>	Sweet Cherry, Mazzard
5 - 8			<i>Prunus cerasifera</i>	Purpleleaf, Cherry or Myrobalan Plum
3 - 9			<i>Prunus cerasus</i>	Sour Cherry
4 - 9			<i>Prunus domestica</i>	Common Plum
3 - 6			<i>Prunus padus</i>	European Birdcherry, May Day Tree
5 - 9			<i>Prunus persica</i>	Peach
4 - 7			<i>Prunus sargentii</i>	Sargent Cherry
5 - 9			<i>Prunus serrulata</i>	Japanese Flowering or Oriental Cherry
4 - 9			<i>Prunus subhirtella</i>	Higan Cherry
2 - 9	0	0	<i>Prunus virginiana</i>	Common Chokecherry
2 - 9	1	.25	<i>Prunus virginiana</i> "Canada Red"	Canada Red Chokecherry
5 - 8			<i>Prunus X yedoensis</i>	Yoshino Cherry
3 - 9			<i>Ptelea angustifolia</i>	Common or Western Hoptree, Wafer-Ash
5 - 8	2	.50	<i>Pyrus Calleryana</i>	Callery Flowering Pear
4 - 9			<i>Pyrus communis</i>	Common Pear
3 - 7			<i>Pyrus ussuriensis</i>	Ussurian Pear
5 - 9			<i>Quercus acutissima</i>	Sawtooth Oak
3 - 9			<i>Quercus alba</i>	White Oak
3 - 8			<i>Quercus bicolor</i>	Swamp White Oak
4 - 8			<i>Quercus cerris</i>	Turkey Oak
4 - 8	0	0	<i>Quercus gambelii</i>	Gambel Oak / Scrub Oak
2	0	0	<i>Quercus gambelii</i>	Gambel's Oak
4 - 8			<i>Quercus imbricaria</i>	Shingle or Laurel Oak
2 - 8	1	.25	<i>Quercus macrocarpa</i>	Bur Oak
4 - 7			<i>Quercus muehlenbergii</i>	Chinkapin Oak
4 - 8			<i>Quercus palustris</i>	Pin Oak
4 - 8	2	.50	<i>Quercus robur</i>	English Oak
4 - 8	2	.50	<i>Quercus rubra</i>	Northern Red Oak
5 - 9			<i>Quercus shumardii</i>	Shumard Oak
7 - 9			<i>Quercus trubinella</i>	Shrub Live Oak
7 - 9			<i>Quercus undulata</i>	Wavyleaf Oak

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
6 -9			Robinia neomexicana	New Mexico Locust
3 -9			Robinia pseudoacacia	Black Locust
	0	0	Robinia pseudoacacia 'Purple Robe'	Purple Robe Locust
3 -8	0 -1	.25	Robinia x ambigua 'Idaho'	Idaho Flowering Locust
2 -8			Salix amygdaloides	Peachleaf Willow
5 -8			Salix babylonica	Weeping Willow
			Salix exigua	Cotyote Willow
4 -9			Salix fragilis	Crack Willow
4 -9			Salix matsudana	Hankow Willow 'Globe Navajo'
4 -9			Salix nigra	Black Willow
5 -9			Sambucus cerulea	Blue Elder
5 -8	2	.50	Sophora japonica	Japanese Pagoda Tree
3 -7			Sorbus alnifolia	Korean Mountain Ash
2 -7			Sorbus americana	American Mountain Ash
3 -7			Sorbus aucuparia	European Mountain-Ash or Rowan
2 -6			Sorbus scopulina	Green Mountain Ash
	2	.50	Sorbus sp.	Mountain Ash
3 -7	2	.50	Syringa reticulata	Japanese Tree Lilac
5 -8			Tamarix ramosissima	Tamarisk, Salt-Cedar
	1	.25	Taxodium distichum	Bald Cypress
2 -9	2	.50	Tilia americana	American Basswood, American Linden
3 -7	3		Tilia cordata	Littleleaf Linden
4 -7	2	.50	Tilia tomentosa	Silver Linden
3 -7			Tilia X euchlora	Crimean Linden
4 -9			Ulmus parvifolia	Lacebark or Chinese Elm
3 -9			Ulmus pumila	Siberian Elm
6 -9			Yucca brevifolia	Joshua Tree
5 -8	2	.50	Zelkova serrata	Japanese Zelkova
6 -9			Zizyphus jujuba	Chinese Date
<b>EVERGREEN TREES</b>				
3 -7	2 -3	.75	Abies concolor	White Fir
1 -5	3	1	Abies lasiocarpa	Subalpine or Alpine Fir
5 -8	0	0	Calocedrus decurrens	Incense Cedar
6 -9			Cedrus atlantica	Atlas Cedar
7 -9			Cedrus deodara	Deodar Cedar
5 -7			Cedrus libani	Cedar of Lebanon
5 -9	1	.25	Cedrus sp.	Cedar
4 -8			Chamaecyparis obtusa	Hinoki falsecypress
7 -9			Cupressus arizonica	Arizona Cypress
7 -9			Cupressus sempervirens	Italian Cypress
			Juniperis osteosperma	Utah Juniper
3 -9			Juniperus chinensis	Chinese Juniper
3 -7	0	0	Juniperus scopulorum	Rocky Mountain Juniper
4 -7	0	0	Juniperus sp.	Juniper
2 -9	0	0	Juniperus virginiana	Eastern Red Cedar
2 -6	3	1	Larix decidua	European Larch
4 -7			Larix kaempferi	Japanese Larch
4 -8			Metasequoia glyptostroboides	Dawn Redwood
2 -7	2	.50	Picea abies	Norway Spruce
2 -5	1	.25	Picea engelmannii	Engelmann spruce
2 -6	2	.50	Picea glauca	White or Blackhills Spruce
4 -7			Picea omorika	Serbian Spruce
2 -7	2	.50	Picea pungens	Blue Spruce
5 -7	1	.25	Pinus aristata	Bristlecone Pine

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4 - 8			<i>Pinus bungeana</i>	Lacebark Pine
2 - 6			<i>Pinus contorta</i> var. <i>latifolia</i>	Lodge Pole Pine
3 - 7	1	.25	<i>Pinus densiflora</i>	Japanese Red Pine
4 - 8	0	0	<i>Pinus edulis</i>	Pinyon Pine
4 - 7	1	.25	<i>Pinus flexilis</i>	Limber Pine
8 - 10			<i>Pinus halepensis</i>	Aleppo Pine
	1	.25	<i>Pinus heldreichii leucodermis</i>	Bosnian Red Cone Pine
	1	.25	<i>Pinus jeffreyi</i>	Jeffrey Pine
4 - 7	1	.25	<i>Pinus longaeva</i>	Bristlecone Pine
5 - 9	1	.25	<i>Pinus monophylla</i>	Singleleaf Pinyon Pine
5 - 8			<i>Pinus monticola</i>	Western White Pine
2 - 8	1	.25	<i>Pinus mugo</i>	Mugo Pine
4 - 7	1	.25	<i>Pinus nigra</i>	Austrian Pine
4 - 7			<i>Pinus parviflora</i>	Japanese White Pine
3 - 7	1	.25	<i>Pinus ponderosa</i>	Ponderosa Pine
5 - 9			<i>Pinus strobiformis</i>	Southwestern White Pine
3 - 8			<i>Pinus strobus</i>	Eastern White Pine
2 - 8	1	.25	<i>Pinus sylvestris</i>	Scotch Pine
5 - 9	1	.25	<i>Pinus thunbergiana</i>	Japanese Black Pine
5 - 7	1	.25	<i>Pinus wallichiana</i>	Himalayan White Pine
4 - 6	2	.50	<i>Pseudotsuga menzeisii</i> 'Glauca'	Rocky Mountain Fir
4 - 6			<i>Pseudotsuga menziesii</i>	Douglas Fir
6 - 8	2	.50	<i>Sequoiadendron giganteum</i>	Giant Sequoia
4 - 9			<i>Taxodium distichum</i>	Baldcypress
6 - 9			<i>Thuja (Platycladus) orientalis</i>	Oriental Arborvitae
2 - 8	2	.50	<i>Thuja occidentalis</i>	American Arborvitae or Northern White Cedar
5 - 7			<i>Thuja plicata</i>	Western Red Cedar
<b>SHRUBS</b>				
3 - 5	2	.50	<i>Abies balsamea</i> 'Nana'	Dwarf Balsam Fir
4 - 9			<i>Amelanchier utahensis</i>	Utah Serviceberry
4 - 5	0 - 1	.25	<i>Amerlancier alnifolia</i>	Saskatoon Serviceberry
2	0 - 1	.25	<i>Amorpha canescens</i>	Lead Plant
2	1	.25	<i>Amorpha fruticosa</i>	False Indigo
2 - 6	0		<i>Arctostaphylos patula</i>	Greenleaf manzanita
3 - 8	1 - 2	.50	<i>Aronia melanocarpa</i>	Black Chokeberry
	0	0	<i>Artemisia tridentata</i>	Big Sage, Sagebrush
3	0	0	<i>Artemisia cana</i>	Silver Sagebrush
			<i>Artemisia filifolia</i>	Sand Sagebrush
2	0	0	<i>Artemisia frigida</i>	Fringed Sagebrush
			<i>Artemisia ludoviciana</i>	Prairie Sagebrush
			<i>Artemisia nova</i>	Black Sagebrush
	0	0	<i>Atriplex canescens</i>	Fourwing Salt Bush
			<i>Atriplex confertifolia</i>	Shade Scale
	0	0	<i>Atriplex gardneri</i>	Gardner Salt Bush
	1 - 2	.50	<i>Berberis</i> sp.	William Penn Barberry, Crimson Pygmy Barberry
5 - 8	1 - 2	.50	<i>Berberis</i> sp. (screening varieties)	Mentor Barberry, Red Leaf Barberry, Rose Glow Barberry
5 - 9	2	.50	<i>Buddleia</i> sp.	Butterfly Bush
	2	.50	<i>Buxus Microphylla</i> 'Winter Gem'	Winter Gem Boxwood
5 - 6	2	.50	<i>Buxus Sempervirens</i>	Common Boxwood
2 - 7	0 - 1	.25	<i>Caragana arborescens</i>	Siberian Peashrub
3 - 7	1	.25	<i>Caragana pygmaea</i>	Pygmy Peashrub
	1	.25	<i>Caryopteris clandonensis</i>	Blue Mist Spirea

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			Ceanothus intergerrimus	Deer Brush
			Ceanothus martinii	Utah Mountain Lilac
			Ceratoidees lanata	Winterfat
2	0	0	Cercocarpus ledifolius	Curl-leaf Mountain Mahogany
2	0	0	Cercocarpus montanus	True Mountain Mahogany
4 - 8	1	.25	Chaenomeles japonica	Flowering Quince
4	0 - 1	.25	Chamaebatiaria millifolium	Fernbush
			Chilopsis linearis	Desert Willow
			Chrysothamnus ssp.	Rabbit Brush
	0	0	Chrysothamnus nauseosus	Rubber Rabbitbrush
			Clematis ligusticifolia	White Virgin's Bower
5 - 7	0	0	Collutea arborescens	Bladdersenna
5 - 9	2	.50	Continus coggygria	Smoke Tree or Smokebush
2 - 8	2	.50	Cornus Sericea	Redstem Dogwood
	2	.50	Cornus Sericea 'Kelseyi'	Dwarf Kelsey Dogwood
2 - 8	2	.50	Cornus sp.	Red Twig Dogwood, Yellow Twig Dogwood, Tartarian Dogwood
4 - 7	1	.25	Cotoneaster acutifolius	Peking Cotoneaster
5 - 7	1	.25	Cotoneaster apiculatus	Cranberry Cotoneaster
5 - 7	1	.25	Cotoneaster divaricatus	Spreading Cotoneaster
4 - 7			Cotoneaster horizontalis	Rock Cotoneaster
4 - 7	1	.25	Cotoneaster lucidus	Hedge Cotoneaster
	0	0	Cowania mexicana	Cliff Rose
5 - 8	1	.25	Cytisus sp.	Broom
4 - 8	2	.50	Daphne burkwoodii	Daphne
3 - 6	0	0	Ephedra viridis	Mormon Tea or Brigham Tea
			Eriogonum corymbosum	Freemont's Buckwheat
3 - 8	2	.50	Euonymous alata	Winged Euonymous
5 - 8	2	.50	Euonymous alatus 'Compacta'	Dwarf Winged Euonymous or Dwarf Frebush
7 - 9	2	.50	Euonymus japonica	Evergreen Euonymous
7 - 9	2	.50	Euonymus japonica 'Microphylla'	Box Leaf Euonymous
5 - 8	2	.50	Euonymus kiatschovica 'Manhattan'	Manhattan Euonymous
5	0	0	Fallugia paradoxa	Apache Plume
6	0	0	Forestiera neomexicana	New Mexico Privet or Desert Olive
	1	.25	Forsythia sp.	Forsythia
5 - 8	2	.50	Forsythia x intermedia	Forsythia
	1	.25	Genista Lydia	Lydia Broom
			Grayia spinosa	Snakebrush/Hop Sage
5 - 8	1	.25	Hibiscus syriacus	Confederate Rose, Rose of Sharon
	1	.25	Holodiscus discolor	Ocean Spray
3	0 - 1	.25	Holodiscus dumosus	Rockspray Spirea
			Jamesia americana	Waxflower, Cliff Jamesia
3 - 9	0 - 1	.25	Juniperus chinesis	Phitzer Juniper, Blue Point Juniper and other upright varieties
2 - 6	0 - 1	.25	Juniperus communis	Common Juniper
3 - 9	1	.25	Juniperus horizontalis	Creeping Juniper
3 - 9	0 - 1	.25	Juniperus Sabina	Tam Juniper or Savin Juniper (many varieties)
	1	.25	Kolkwitzia amabilis	Beauty Bush

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5 - 7	2	.50	Ligustrum vulgare	Common Privet (several varieties for screening)
	1	.25	Lonicera sp.	Zabelli Honeysuckle, Tatarian Honeysuckle
5 - 8	1 - 2	.50	Mahonia aquifolium	Oregon Grapeholly
3	0	0	Mahonia fremontii	Fremont Barberry
3	1	.25	Mahonia repens	Creeping Mahonia
	2	.50	Pachistma myrsinites (may also be listed as "Paxistima")	Mountain Lover
	2	.50	Paeonia Suffruticosa	Tree Peony
	0	0	Peraphyllum ramosissimum	Squaw Apple
			Petrophytum caespitosum	Rock Spirea, Tufted Rock Mat
7 - 8			Philadelphus microphyllus	Littleleaf Mockorange
4 - 8	1	.25	Philadelphus sp.	Mockorange, Sweet Mockorange (dwarf varieties also available)
			Physocarpus malvaceus	Mountain Ninebark
2 - 7	1	.25	Physocarpus sp.	Ninebark
2 - 6	2	.50	Picea glauca 'Conica'	Dwarf Alberta Spruce
2 - 7	1	.25	Pinus mugo	Mugo Pine
	1	.25	Pinus mugo pumilo	Dwarf Mugo Pine
2 - 7	1	.25	Potentilla fruticosa	Shrubby Cinquefoil
3 - 6	0 - 1	.25	Prunus besseyi	Western Sand Cherry
4 - 8	2	.50	Prunus glandulosa	Dwarf Flowering Almond
2	0	0	Prunus tomentosa	Nanking Cherry
2 - 6	1	.25	Prunus virginiana	Chokecherry
	2	.50	Prunus x cistena	Purple Sand Cherry
3 - 6	0	0	Purshia mexicana var. stansburiana	Cliff Rose
	0	0	Purshia tridentata	Antelope Bitterbrush
	2	.50	Pyracantha angustifolia	Dwarf Pyracantha
5 - 9	2	.50	Pyracantha coccinea	Pyracantha, Firethorn
2 - 7	1	.25	Rhamnus cathartica	Tallhedge Buckthorn
2 - 9	0 - 1	.25	Rhus glabra	Smooth Sumac
2 - 9	1	.25	Rhus glabra 'Cismontana'	Dwarf Mountain Sumac
2	0	0	Rhus trilobata	Oakbrush Sumac, Oakleaf Sumac, Skunkbrush
3 - 8	1	.25	Rhus typhina	Staghorn Sumac
2 - 7	1	.25	Ribes sp.	Alpine Currant, Golden Currant
3 - 6	2	.50	Ribes aureau	Golden Current
4	0 - 1	.25	Rosa foetida	Copper Rose
5 - 8	1	.25	Rosa foetida bicolor	Austrian Brier Rose
5 - 8	1	.25	Rosa foetida 'Persiana'	Persian Yellow Rose
	2	.50	Rosa meideland	Meideland Rose and Others
2 - 8	1	.25	Rosa rubrifolia	Redleaf Rose
2 - 7	0 - 1	.25	Rosa rugosa	Rugosa Rose
2	1	.25	Rosa woodsii	Woods Rose
	1	.25	Rubus deliciosus	Colorado Thimbleberry
3	2	.50	Salix purpurea	Dwarf Blue Arctic Willow
3 - 6	0	0	Salvia dorrii	Dorr's Sage
			Sambucus caerulea	Blue Elderberry
	1	.25	Sambucus sp.	Elderberry
2 - 6	0	0	Shepherdia argentea	Silver Buffaloberry
3 - 6	0	0	Shepherdia rotundifolia	Roundleaf Buffaloberry
2 - 6	0	0	Shepherdia sp.	Buffaloberry
			Sorbus scopulina	Rocky Mountain Ash

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3 - 8	2 - 3	.75	<i>Spiraea x bumalda</i>	Bumald Spiraea
3 - 8	2	.50	<i>Spiraea x vanhouttei</i>	Bridal Wreath Spiraea
3 - 7	1 - 2	.50	<i>Symphoricarpos albus</i>	Common Snowberry
			<i>Symphoricarpos occidentalis</i>	Mountain Snowberry
2	2	.50	<i>Symphoricarpos oreophilus</i>	Mountain Snowberry
3 - 7	2	.50	<i>Syringa meyeri</i> 'Palibin'	Dwarf Korean Lilac
3 - 7	1 - 2	.50	<i>Syringa patula</i> 'Miss Kim'	Dwarf Korean Lilac or Miss Kim Lilac
3 - 7	1	.25	<i>Syringa vulgaris</i>	Common Lilac (many varieties)
6 - 7	3	1	<i>Taxus baccata</i>	English Yew
4 - 7	3	1	<i>Taxus cuspidata</i>	Japanese Yew
4 - 7	3	1	<i>Taxus x media</i>	Anglojap Yew
6	2	.50	<i>Taxus</i> sp. (low, spreading)	Spreading English Yew, Dwarf Japanese Yew and Others
4 - 7	2	.50	<i>Taxus</i> sp. (screening)	Hick's Yew, Japanese Yew, Upright Yew, Brown's Yew and Others
			<i>Tetradymia</i>	Horsebrush
5	2	.50	<i>Thuja</i> sp. (low, spreading)	Woodward Globe Arborvitae, Little Giant Arborvitae and Others
	2	.50	<i>Thuja</i> sp. (screening)	Emerald Arborvitae, Blue Cone Arborvitae and Others
3 - 8	2	.50	<i>Viburnum rhytidophyllum</i>	Leatherleaf Viburnum
3 - 8	2	.50	<i>Viburnum</i> sp.	Arrowwood Viburnum, Burkwood Viburnum, Cranberry Bush
5 - 8	2	.50	<i>Weigela florida</i>	Weigela
			<i>Yucca angustissima</i>	Narrow Leaved Yucca
			<i>Yucca elata</i>	Soaptree Yucca
4 - 6	0	0	<i>Yucca filamentosa</i>	Yucca
4			<i>Yucca glauca</i>	Great Plains Yucca
	0	0	<i>Yucca</i> sp.	Yucca
<b>VINES AND GROUND COVERS</b>				
	2	.50	<i>Aegopodium podagraria</i>	Bishop's Weed
	2	.50	<i>Arabis caucasica</i>	Rock Cress
	2	.50	<i>Arctostaphylos uva-ursi</i>	Kinnikinnick
4 - 9	1	.25	<i>Campsis radicans</i>	Trumpet Vine
	1	.25	<i>Cerastium tomentosum</i>	Snow In Summer
	1 - 2	.50	<i>Clematis</i> 'Hybrids'	Clematis
	1	.25	<i>Convallaria majalis</i>	Lilly-of-the-Valley
5 - 7	1 - 2	.50	<i>Cotoneaster</i> sp.	Cotoneaster
	2	.50	<i>Delosperma cooperi</i>	Delosperma, Ice Plant
	2	.50	<i>Delosperma nubigenum</i>	Yellow Ice Plant
4 - 8	2	.50	<i>Euonymus fortunei</i>	Winter Creeper
	0	0	<i>Euphorbia myrsinites</i>	Spurge
	1	.25	<i>Fragaria</i> sp.	Wild Strawberry
	2	.50	<i>Galium odoratum</i>	Sweet Woodruff
5	1	.25	<i>Genista pilosa</i>	Vancouver Gold Genista
	2	.50	<i>Hedera helix</i>	English Ivy
	1	.25	<i>Helianthemum nummularium</i>	Sunrose, Rockrose
5	2	.50	<i>Hypericum calycinum</i>	Aaron's Beard, St. John's Wort
3 - 9	0 - 1	.25	<i>Juniperus</i> sp.	Juniper (many species and varieties)
4	1	.25	<i>Lonicera japonica</i>	Japanese Honeysuckle

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5	0	0	Mahonia repens	Creeping Oregon Grape
	2	.50	Pachistima canbyi	Mountain Lover
	2	.50	Pachysandra terminalis	Pachysandra
	0 – 1	.25	Parthenocisisis sp.	Virginia Creeper, Boston Ivy
4 - 7	1	.25	Polygonum aubertii	Silverlace Vine
3 - 9	1	.25	Rhus aromatica	Grow Low Sumac
5 - 7	1	.25	Rosa sp.	Spreading Rose
	1	.25	Sedum sp.	Utah Green Sedum, Goldmoss Sedum, Green Stonecrop, Dragon's Blood Sedum
	1	.25	Sempervivum tectorum	Hens And Chicks
4	2	.50	Thymus sp.	Woolly Thyme, Pink Creeping Thyme
	1	.25	Vinca major	Periwinkle
	2	.50	Vinca minor	Dwarf Periwinkle
	1 – 2	.50	Vitis sp.	Grapes
4 - 9	2	.50	Wisteria	Wisteria
<b>ORNAMENTAL GRASSES</b>				
			Achantherum lettermanii	Needlegrass
			Achnatherum hymenoides	Indian Rice Grass
			Aristida purpurea	Purple Threeawn "No Eat-Um"
			Bouteloa curtipendula	Sideoats Grama
	1	.25	Bouteloa gracilis	Blue Grama
			Bromus anomalus	Nodding Brome
			Bromus carinatus/marginatus	California, Mountain Brome
	0	0	Buchloe dactyloides	Buffalograss
	1	.25	Calamagrostis x acutiflora 'Stricta'	Feather Reed Grass
			Danthonia intermedia	Oat Grass
			Deschampsia caespitosa	Tufted hairgrass, Salt & Pepper
			Elymus elymoides	Bottlebrush Squirrel Tail
	0	0	Elymus glaucus	Blue Oat Grass
			Elymus lanceolatus	Thickspike Wheatgrass
			Elymus trachycaulus	Slender Wheatgrass
CS	2	.50	Festuca arundinacea	Tall Fescue
			Festuca idahoensis	Idaho Fescue
CS	0	0	Festuca ovina	Sheep Fescue
	1	.25	Festuca ovina glauca	Blue Sheep Fescue
CS	3	1	Festuca rubra	Red Fescue
			Festuca subulata	Bearded Fescue
			Hesperostipa comata	Needle and Thread Grass
			Hilaria jamesii	Galleta Curly Grass
			Koeleria macrantha	June Grass
			Leymus cinereus	Great Basin Wild Rye
CS	3	1	Lolium perenne	Perennial Rye
			Melica bulbosa	Onion Grass
			Melica spectabilis	Purple Onion Grass
	1	.25	Miscanthus sinensis 'Gracillimus'	Maidenhair Grass
			Muhlenbergia montana	Scratch Grass
			Muhlenbergia richardsonis	Mat Muhly
CS	0	0	Oryzopsis hymenoides	Indian Ricegrass
			Pascopyrum smithii	Western Wheatgrass
	0	0	Pennisetum ruppelii	Fountain Grass
			Poa ampla	Big Bluegrass

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			Poa curta	Wasatch Bluegrass
			Poa fendleriana	Mutton Bluegrass
CS	3	1	Poa pratensis	Kentucky Bluegrass
			Poa secunda	Sandbergs Bluegrass
			Pseudoregneria spicatum	Bluebunch Wheatgrass
			Schizachyrium scoparium	Little Bluestem
			Sporobolus airoides	Alkali Sacaton
			Sporobolus cryptandrus	Sand Dropseed
	1	.25	Stipa sp.	Needlegrass, Needle and Thread Grass
			Stipa speciosa	Desert Needlegrass
			Stipa viridula	Green Needlegrass
<b>HERBACIOUS PERENNIALS</b>				
3	0	0	Achillea millifolium	Milfoil Yarrow
	0	0	Achillea sp.	Yarrow (many varieties)
			Actaea rubra	Baneberry
4 - 8	3	1	Aegopodium podagraria 'Variegatum'	Bishop's Weed
	1	.25	Aesclepias tuberosa	Butterfly flower
<b>HERBACIOUS PERENNIALS</b>				
3	0	0	Achillea millifolium	Milfoil Yarrow
	0	0	Achillea sp.	Yarrow (many varieties)
			Actaea rubra	Baneberry
4 - 8	3	1	Aegopodium podagraria 'Variegatum'	Bishop's Weed
	1	.25	Aesclepias tuberosa	Butterfly flower
			Agastache ssp.	Wild Hyssop
	2	.50	Alcea rosea	Hollyhock
			Allium ssp.	Wild Onion
	2	.50	Alyssum saxatilis	Basket of Gold
	2	.50	Anacyclus depressus	Mount Atlas Daisy
4	1	.25	Anaphalis margaritacea	Pearly Everlasting
			Anemone patens	Wind Flower
	1	.25	Anemone pulsatilla	Pasque Flower
			Antennaria dimorpha	Pussy Toes
			Antennaria microphylla	Pearly Pussy Toes
4	2	.50	Antennaria rosea	Pink Pussy Toes
			Apocynum	Spreading Dogbane
	2	.50	Aquilegia sp.	Columbine
5	2	.50	Arabis caucasica	Rock Cress
			Arabis ssp.	Rockcress
			Arenaria ssp.	Sandwort
			Argemone munita	Armed Prickly Poppy
4	2	.50	Armeria maritima	Common Thrift or Sea Pink
			Arnica cordifolia	Heart Leaf Arnica
3	0	0	Artemisia frigida	Fringed Sage
			Artemisia ludoviciana	Prairie Sagebrush
3	0	0	Artemisia schmidtiana	Silver Mound
	0 - 2	.25	Artemisia sp.	Wormwood, Sagebrush
			Asclepias asperula	Spider Milkweed
3	1	.25	Asclepias tuberosa	Butterfly Milkweed or Butterfly Weed
	0 - 2	.25	Aster sp.	Alpine Aster, Hardy Aster, Michaelmas Daisy, Pacific Aster
			Astragalus ssp.	Milkvetch
4	1	.25	Aubrieta deltoidea	Purple Rock Cress
4	2	.50	Aurinia saxatile campactum	Dwarf Basket of Gold

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			Balsamorhiza ssp.	Balsamroot
4	2	.50	Baptisia australis	Blue False Indigo
			Berberis fendlerii	Freemont Barberry
	2	.50	Bergenia cordifolia	Bergenia, Saxifrage
			Brickellia grandiflora	Tasselflower
	1	.25	Bulbs	Spring Flowering Bulbs
3	0 - 1	.25	Callirhoe involucrata	Poppy Mallow
			Calochortus nuttallii	Sego Lilly
			Calylophus lavandulifolia	Evening Primrose
			Camassia quamash	Blue Camas
3	3		Campanula rotundifolia	Bell Flower or Bluebells of Scotland
	2	.50	Campanula sp.	Carpathian Harebell, Serbian Bellflower, Bluebells of Scotland and others
			Castilleja ssp.	Indian Paint Brush
3	1	.25	Centaurea montana	Bachelor Button
4	1	.25	Centranthus ruber	Keys Of Heaven, Jupiter's Beard, Red Valerian
3	2	.50	Cerastium tomentosum	Snow-in-Summer
			Chaenactis douglasii	Dusty Maidens
	2	.50	Cheiranthus cheiri	Wallflower
	2	.50	Chrysanthemum maximum	Shasta Daisy
4	2	.50	Chrysanthemum x superbum	Shasta Daisy
			Clemantis hirsutissima	Lionsbeard, Sugarbowls
	2	.50	Coreopsis grandiflora	Coreopsis, Pot of Gold
4	2	.50	Coreopsis verticillata	Threadleaf Coreopsis
	1	.25	Corydalis lutea	Yellow Corydalis
			Crepis acuminata	Hawksbeard
			Crypthantha flava	Yellow Forget-Me-Not
			Crypthantha humilis	Dwarf Forget-Me-Not
			Dephinium nuttalianum	Perennial Larkspur
2	2	.50	Dianthus "Zing Rose"	Zing Rose Dianthus
2	2	.50	Dianthus barbatus	Sweet William
2	2	.50	Dianthus sp.	Hardy Carnation, Sweet William, Maiden Pinks
3	3	1	Dicentra eximia	Fringed Bleeding Heart
2	3	1	Dicentra spectabilis	Bleeding Heart
3	0 - 1	.25	Echinacea purpurea	Purple Coneflower
			Epilobium angustiolium	Fireweed
	2	.50	Epimedium x rubrum	Barrenwort
			Erigeron ssp.	Yellow Daisy, Fleabane
	0	0	Eriogonum umbellatum	Sulphur Flower
			Eriophyllum lanatum	Woolyleaf, Oregon Sunshine
			Erogonum ssp.	Buckwheat
	2	.50	Eryngium alpinum	Blue Sea Holly
			Erysimum asperum	Pretty Wallflower
			Erythronium grandiflorum	Glacier Lily, Dogtooth Violet
	2	.50	Euphorbia epithymoides	Cushion Flower, Spurge
4	0	0	Euphorbia polychroma	Cushion Spurge
			Fragaria vesca	Woodland Strawberry
			Fritillara pudica	Yellow Bell
3	0	0	Gaillardia aristata	Blanketflower
3	0	0	Gaillardia aristata	Indian Blanket Flower
3	0 - 1	.25	Gaillardia sp.	Blanket Flower, Firewheel
			Gaura coccinea	Scarlot Guara
	2	.50	Gaura lindheimeri	Gaura, Whirling Butterflies

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
	0 – 2	.25	Geranium sp.	Cranesbill, Wild Geranium
			Geranium viscosissimum	Sticky Purple Geranium
	0 – 2	.25	Geum sp.	Geum, Grecian Rose
			Geum Triflorum	Prairie Smoke, Old Man's Beard
			Gilia aggregata	Scarlet Gilia
	2	.50	Gypsophila paniculata	Baby's Breath
			Haplopappus acaulis	Goldenweed, Jimmyweed
			Hedysarum boreale	Sweetvetch
			Helenium hoopesii	Orange Sneezeweed
			Helianthella uniflora	Little Sunflower
3	1 -2	.50	Hemerocallis hybrid	Daylily
	1	.25	Herniaria glabra	Green Carpet, Rupture Wort
			Heterotheca villosa	Golden Hoary Aster
			Heuchera rubescens	Coralbells, Alumroot
	2	.50	Heuchera sanguinea	Coral Bells
	2	.50	Hibiscus moscheutos	Perennial Hibiscus
	2	.50	Hosta sp.	Plantain Lily
			Hydrophyllum capitatum	Ballhead Waterleaf
			Hymenoxys acaulis	Stemless Woollybase
3	2	.50	Iberis Sempervirens	Candytuft
			Iliamna rivularis	Wild Hollyhock
3	1	.25	Iris Hybrids	Iris
	1	.25	Iris missouriensis	Missouri Iris
	2		Iris sibirica	Siberian Iris
	1	.25	Iris x germanica	German Bearded Iris
5	1	.25	Kniphofia uvaria	Red Hot Poker
			Lathryus pauciflorus	Utah Sweet Pea, Wild Sweet Pea
	1	.25	Lavandula angustifolia	English Lavender
			Lesquerella multiceps	Bladderpod
			Lewisia rediviva	Bitterroot
	2	.50	Liatis spicata	Gayfeather
	2	.50	Limonium latifolium	Statice, Sea Lavender
			Linanthastrum nuttallii	Flaxflower
	1	.25	Linaria purpurea	Toad Flax
3	0	0	Linum perenne	Flax
	0 – 1	.25	Linum sp.	Golden Flax, Perennial Flax, Native Blue Flax
			Lomatium ssp.	Biscuitroot
			Lonicera involucrata	Utah Twinberry
3	3		Lupinus 'Russel Hybrid'	Lupine
3	2	.50	Lychnis sp.	Maltese Cross, Rose Campion
			Mentzelia laevicaulis	Blazing Star
			Mertensia brevistyla	Wasatch Bluebell
			Mertensia ciliata	Mountain Bluebell
			Mertensia oblongifolia	Western Bluebell
			Mirabilis multiflora	Showy Four-O-Clock
3	1	.25	Monarda didyma	Bee Balm
			Mondardella odoratissima	Cloverhead Horsemint
3	2	.50	Narcissus species	Daffodil
2	2	.50	Oenothera elata	Showy Primrose
3	1	.25	Oenothera missourensis	Missouri Primrose
2	0 – 1	.25	Oenothera sp.	Evening Primrose
			Osmohiza occidentalis	Western Sweet Cicely
			Oxytropis lambertii	Crazyweed, Locoweed
			Oxytropis sericea	Silky Crazyweed

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
	2	.50	<i>Paeonia hybrida</i>	Peony
3	2	.50	<i>Papaver orientale</i>	Oriental Poppy
	1	.25	<i>Papaver sp.</i>	Poppy, Oriental Poppy
2	0 – 1	.25	<i>Penstemon sp.</i>	Firecracker Penstemon, Palmer Penstemon, Shrublet Penstemon, Wasatch Penstemon
			<i>Perideria gairdneri</i>	False Yarrow
3	1 - 2	.50	<i>Perovskia atriplicifolia</i>	Russian Sage
			<i>Phacelia sericea</i>	Silky Phacelia
			<i>Phlox hoodii</i>	Carpet Phlox
			<i>Phlox longifolia</i>	Longleaf Phlox
3	1 - 2	.50	<i>Phlox subulata</i>	Creeping Phlox
3	3		<i>Physostegia virginiana</i>	Obedient Plant
	2	.50	<i>Platycodon grandiflorus</i>	Balloon Flower
	1	.25	<i>Polemonium caeruleum</i>	Jacob's Ladder
			<i>Polemonium foliosissimum</i>	Leafy Jacobs ladder
			<i>Potentilla gracilis</i>	Showy Cinquefoil
5	1	.25	<i>Pulsatilla vulgaris</i>	Pasque Flower
4	0 - 1	.25	<i>Ratibida columnaris</i>	Prairie Coneflower, Mexican Hat
3	1	.25	<i>Rudbeckia hirta</i>	Gloriosa Daisy
	0 – 2	.25	<i>Rudbeckia sp.</i>	Black Eyed Susan, Dwarf Rustic Coneflower
	2	.50	<i>Salvia sp.</i>	Salvia
	1	.25	<i>Santolina sp.</i>	Lavender Cotton
3	2	.50	<i>Saponaria ocymoides</i>	Rock Soap Wort
			<i>Sedum lanceolatum</i>	Stonecrop
4	0 - 1	.25	<i>Sedum sp.</i>	Sedum (many species and varieties)
			<i>Sidlacea oregana</i>	Oregon Checkermallow
			<i>Silene acaulis</i>	Douglas Campion
			<i>Sisyrinchium ssp. Idahoensis</i>	Purple-eyed Grass
	2	.50	<i>Solidago Canadensis</i>	Goldenrod
2	2	.50	<i>Solidago hybrids</i>	Goldenrod
			<i>Solidago sparsiflora</i>	Goldenrod
			<i>Sphaeralcea ssp.</i>	Globemallow
4	1 - 2	.50	<i>Stachys bysantina</i>	Lambs Ears
			<i>Stanleya pinnata</i>	Prince's Plume
	2	.50	<i>Teucrium chamaedrys</i>	Germander
3	2 - 3	.75	<i>Thymus sp.</i>	Thyme (many varieties)
			<i>Townsendia incana</i>	Easter Daisy
	2	.50	<i>Tradescantia virginiana</i>	Spiderwort
			<i>Trifolium maci lentrum</i>	Leanclover
2	3	1	<i>Tulipa hybrids</i>	Tulip
	2	.50	<i>Verbena sp.</i>	Verbena
	2	.50	<i>Veronica sp.</i>	Speedwell
3	1	.25	<i>Veronica spicata</i>	Spike Speedwell
	0	0	<i>Viguiera multiflora</i>	Showy Godeneye
4	3	1	<i>Vinca minor</i>	Periwinkle
			<i>Viola adunca</i>	Blue Violet
			<i>Viola nuttallii</i>	Yellow Prairie Violet
	0 – 2	.25	<i>Viola sp.</i>	Violet Pansy
			<i>Wyethia amplexicaulis</i>	Mule's Ears
	1	.25	<i>Zauschneria californica</i>	Hummingbird Fuchsia
			<i>Zauschneria latifolia</i>	Hummingbird Flower

4.12 Irrigation Schedule Form Instructions

- A. A monthly irrigation schedule shall be prepared to cover the initial 120-day plant establishment period and the following one-year period. The irrigation schedule shall be prepared by a Landscape Architect or another licensed professional as recognized by the State of Utah. Attached is a suggested form for the irrigation schedule. The preparer may use this form or follow another appropriate format.
- B. The schedule should rely on monthly Reference Evapotranspiration (ET<sub>o</sub>) data for the Salt Lake County area. Once established, turf can be maintained in an attractive manner at approximately 100 percent of the ET<sub>o</sub> rate under normal weather conditions. Water-Conserving Plants typically need 50 percent or less of the ET<sub>o</sub> under normal weather conditions. The amount of water applied for each valve should also be adjusted for Irrigation Efficiency, local rainfall, specific site conditions (e.g., water holding capacity and infiltration rate). Ultimately, the amount and frequency of irrigation will need to be monitored regularly to adjust for plant growth, climatic changes and site conditions.
- C. For valves with overhead Spray or Stream Sprinklers, set valves to operate between 6:00 pm and 10:00 am to reduce water loss from wind and evaporation. Early morning irrigation is recommended for turf and ground cover. On slopes and soils with slow infiltration rates, program valves for multiple repeat cycles to reduce runoff.
- D. The following chart is an example for the Salt Lake Count Area. For the water allowance formula the relative ET<sub>o</sub> is to be used in accordance to the location of the project.

Estimated Monthly ET <sub>o</sub> for Salt Lake (Airport)												
											Annual	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ET <sub>o</sub>
--	--	0.31	1.89	3.39	4.64	5.39	4.53	2.72	1.38	--	--	24.26



Note: This irrigation schedule should be used as a guide. The landscaping should be monitored regularly and the schedule adjusted as needed for plant growth, local rainfall, and climate conditions. Check irrigation system frequently to minimize run off and over-spray. Schedule valves with sprinklers to irrigate between 6 PM and 10:00 AM to reduce water loss from wind and evaporation.

Jul	Month
15	Run time (minutes per day)
3	Run time (Days per week)



**SUBSTANTIAL COMPLETION FORM**

Project Name: \_\_\_\_\_

Project Address: \_\_\_\_\_

I/We hereby certify the following:

- 1. The landscaping work for the above project has been completed in substantial conformance to the DFCM Landscape and Irrigation Standards (Guidelines)
- 2. The automatic controller has been set according to the approved irrigation schedule for the plant establishment period.
- 3. A Water Use Efficiency Review (audit) has been conducted on the completed landscape. The irrigation system has been adjusted to meet the minimum Irrigation Efficiency required by the DFCM and minimize overspray and runoff.
- 4. A copy of the irrigation schedule has been give to the property owner, and the DFCM.
- 5. A completed set of record drawings have been given to the DFCM.

Comments: \_\_\_\_\_  
\_\_\_\_\_

Substantial Completion Form prepared by:

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_ License No.: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

Telephone: \_\_\_\_\_

Water Use Efficiency Review (Audit) Certified by:

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_ License No.: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

Telephone: \_\_\_\_\_

## PROJECT DATA FORM

Project Name: \_\_\_\_\_

Project Address: \_\_\_\_\_

Type of Facility:

Type of Facility	Water Allowance (% of allowable water used)	
A.	Office type buildings	50%
B.	Existing campus/institution	70%
C.	New campus/institution	60%
D.	Recreational areas (ball fields etc.)	70%
E.	State Parks (natural areas)	10%

Landscape Architect:

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_ License No.: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_

Landscape Contractor:

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_ License No.: \_\_\_\_\_

Address: \_\_\_\_\_

Telephone: \_\_\_\_\_

#### 4.13 Resources

Larry A. Rupp, William A. Varga, Teresa A. Cerny, Chad R. Reid, Mike Kuhns, *Selection and Culture of Landscape Plants in Utah. A Guide for High Mountain Valleys (Rich, Morgan, Summit, Daggett, and Wasatch Counties)*. Utah State University Extension, December 2002

Larry A. Rupp, Dana Libbey, *Selection and Culture of Landscape Plants in Utah. A Guide for Castleland RC&D Carbon, Emery, Grand, and San Juan Counties*. Utah State Extension, April 1996

Teresa A. Cerny, Larry A. Rupp, Chad R. Reid, Mike Kuhns, *Selection and Culture of Landscape Plants in Utah. A Guide for Southwestern and Central Utah (Iron, Beaver, Kane, Millard, Juab, Sanpete, Sevier, Piute, Wayne, Garfield, and parts of Washington Counties)*. Utah State University Extension, December 2002

Mike Kuhns, Larry Rupp, *Selecting and Planting Landscape Trees*. Utah State University Extension, Second Edition July 2000

The Planning Division of the Salt Lake City Community & Economic Development Department, *Water Conserving Plants for Salt Lake City*. Salt Lake City, Utah, September 1995

Lone Peak Conservation Nursery State of Utah, Utah State University, Natural Resource and Environmental Policy Program, Department of Landscape Architecture and Environmental Planning, *Utah Native Plant List*. April 2002

Rich Koenig, Von Isaman, *Top Soil Quality Guidelines for Landscaping*. Utah State University Extension, June 2002

Utah Irrigation Association, *Water Efficient Landscape Ordinance for Commercial Business Number*. Draft, Aug. 26, 2000

Utah Irrigation Association, *Water Efficient Landscape Ordinance for Commercial Business Number*. Draft, May 22, 2001

Utah Irrigation Association, *Water Efficient Landscape Ordinance for Commercial Business Number*. Draft, June 7, 2001

Irrigation Standards Committee of The Utah Irrigation Association, *Minimum Standards for Efficient Landscape Irrigation System Design and Installation*. Version 2002

Utah Irrigation Association, *Best Management Practices of Landscape Irrigation*. Draft, 4/25/02

Utah Irrigation Association, *Glossary of Terms*. Version 2002

Jim Knopf, *Water Wise Landscaping with Trees Shrubs & Vines, A Xeriscape Guide for the Rocky Mountain Region California & the Desert Southwest*. Chamisa Books 1999

Jim Knopf, *The Xeriscape Flower Gardener, A Waterwise Guide for the Rocky Mountain Region*. Johnson Books: Boulder 1991

Dr. Rich Koenig, Utah State University Cooperative Extension Soil Specialist, and Von Isaman, President of QA Consulting and Testing, LLC. *Topsoil Quality Guidelines for Landscaping*, June 2002, AG/SO-02

Von Isaman, President of QA Consulting and Testing LLC., Dr. Rich Koenig, USU Cooperative Extension Soils Specialist, and Teresa Cerny, USU Cooperative Extension Horticulturist, March 7, 2002. Draft Guidelines

## 5.0 HIGH PERFORMANCE BUILDING RATING SYSTEM

### 5.1 General

- A. This section defines a High Performance Building Rating System for Buildings except Low-Rise Residential Buildings.
- B. If required by contract, a building shall comply with the Prerequisites (Section 5.5) and Energy Requirements (Section 5.6), and scores with 20 points or more with the Sustainability Credits (Section 5.7).

### 5.2 Definitions

“Agency” is any state agency, board, commission, department, or division.

“Designer” is the architect(s), engineer(s), and other professionals responsible for the building design.

“Institution” means the University of Utah, Utah State University, Southern Utah University, Weber State University, Snow College, Dixie State College of Utah, College of Eastern Utah, Utah Valley State College, Salt Lake Community College, Utah College of Applied Technology, and any other university or college which may be established and maintained by the state.

“Low-Rise Residential Buildings” means single-family houses, multi-family buildings of three stories or less above grade, and manufactured houses.

“Life-cycle costs” means the sum of the present values of investment costs, capital costs, installation costs, energy costs, operating costs, maintenance costs, and disposal costs, over the lifetime of the project, product, or measure.

“Life-cycle cost-effective” means the life-cycle costs of a product, project, or measure are estimated to be equal to or less than the base case (i.e., current or standard practice or product).

### 5.3 Referenced Standards and Codes.

The design shall comply with all applicable Standards and Codes at the time submitted to the State Building Official, including but not limited to:

ANSI/ASHRAE Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

ANSI/ASHRAE Standard 55, Thermal Environmental Conditions for Human Occupancy

ANSI/ASHRAE Standard 62, Ventilation for Acceptable Indoor Air Quality.

ANSI/ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, including Appendix G.

Illuminating Engineering Society of North America, *IESNA Lighting Handbook*.

U.S. Green Building Council, *Leadership in Energy & Environmental Design for New & Major Renovations (LEED-NC)*.

#### 5.4 Design and Technology Charrette

- A. DFCM may conduct a Design and Technology Charrette with the designers to review the requirements of the standard and strive for an integrated design of energy efficiency and environmental measures. In addition, the charrette shall also consider sustainable site design including:
- (1) Natural shade to reduce heat island effect from parking lots and landscaping areas;
  - (2) Shielded or reduced parking and façade lighting to reduce night sky pollution;
  - (3) Reuse of existing building to conserve our resources;
  - (4) Avoiding sewer and waterway contamination;
  - (5) Use local building materials and products to support local economy and reduce the environmental impacts from transportation;
  - (6) Encourage the use of public transportation;
  - (7) Protect wet-lands and green spaces; and
  - (8) Provide recycling center.

#### 5.5 Prerequisites

- A. **Fundamental Building Systems Commissioning.** DFCM may engage a Commissioning Agent that is not an individual directly responsible for project design or employed by one of the designers. Commissioning Agent shall ensure that fundamental building components are installed and calibrated to operate as intended.
- B. **Life-Cycle Cost Analysis.** Designer shall use life-cycle cost analysis in making decisions about their investments in products, services, construction, and other projects to lower the State Government's costs and to reduce energy and water consumption.
- C. **CFC Reduction in HVAC and Refrigeration Equipment.** Designer shall select HVAC and refrigeration equipment without chlorofluorocarbons (CFC) based refrigerants.
- D. **Ventilation Systems.** Designer shall provide mechanical ventilation system according to Standard 62. Mechanical ventilation system shall have the capability

to operate continuously during occupancy and designed not to be easily shut-down or otherwise defeated, such as blocked registers.

- E. Drainage Systems. Designer shall design surface grades, storm drainage system, HVAC system, and other systems to avoid accumulation of standing water around or in the building.
- F. Landscape and Irrigation Systems. Designer shall design landscape and irrigation systems according to DFCM Guidelines for Landscape & Irrigation Standard.
- G. Fundamental Lighting Design. Designer shall design the lighting system according to IESNA Lighting Handbook.
- H. Mold Prevention during Construction. Contractor shall ensure porous type building materials, such as wood, insulation, paper, and fabric, is kept dry to prevent the growth of mold and bacteria. Materials that have been affected by mold shall be abated or replaced. Building insulation that is damp or wet for 72 hours shall be replaced.
- I. Filtration Media Replacement before Occupancy. Contractor shall ensure that filtration media is replaced before occupancy.
- J. Thermal Comfort. Designer shall ensure that thermal comfort requirements are meet according to Standard 55. Exceptions:
  - (1) Winter humidification is not required;
  - (2) Summer dehumidification is not required; and
  - (3) Upper temperature limit in natural ventilated buildings is not required.

#### 5.6 Energy Efficiency Requirements:

- A. Energy Performance. DFCM may select an integrated system of components to reduce source energy use what is required by Standard 90.1.
  - (1) DFCM shall engage an Energy Specialist with 3 years of experience with hourly energy modeling. Energy Specialist is not an individual directly responsible for project design or employed by one of the designers. Energy specialist shall perform the energy analysis according to Appendix G of Standard 90.1. Energy Specialist shall prepare report according to DFCM template and shall specify which energy efficiency measure should be commissioned. Energy Specialist shall consider reducing energy use in each major categories: 1) lighting, 2) cooling, 3) heating, 4) pumps/cooling tower, 5) internal loads, and 6) external loads. Energy specialist should also consider the following technologies:
    - a. Daylighting;
    - b. Natural ventilation;

- c. Evaporative cooling;
- d. Demand-controlled ventilation using CO2 or occupancy sensors;
- e. Green roof;
- f. Ground source heat pumps;
- g. Spectrally selective glazings;
- h. Underfloor air distribution;
- i. Radiant cold beam system; and
- j. Displacement ventilation system.

(2) Commissioning Agent shall ensure the selected energy efficiency measures are installed and calibrated to operate as intended.

B. Small Buildings Prescriptive Energy (Optional). For nonresidential buildings with 3 floors or less and 75,000 square feet or less, Designer may substantially design the Building Envelope, Lighting System, HVAC system, and Service Water Heating system according to the recommended performance levels shown in Tables 1 through 4 in compliance with Standard 90.1.

Table 1 – Small Buildings Prescription Energy Option: Building Envelope<sup>(4)</sup>

Category	Component	Recommendation
Roof	Insulation entirely above deck	R-20 continuous insulation and Energy-Star® rated surface
	Metal building	R-13 + R-19
	Attic and other	R-38
	Single rafter (insulated flat or vaulted ceilings)	R-38 + R-5 continuous insulation
Walls	Mass (HC > 7 Btu/ft2) <sup>(1)</sup>	R-11.4 continuous insulation
	Metal building	R-13+R-13
	Steel framed	R-13+ R-7.5 continuous insulation
	Wood frame and other	R-13 + R-3.8 continuous insulation
	Below-grade walls	R-7.5 continuous insulation
Floors	Mass	R-10.4 continuous insulation
	Steel framed:	R-30
	Wood framed and other	R-30
Slab	Unheated	None <sup>(2)</sup>
	Heated	R-10 for 36 in.
Doors	Swinging	U-0.70
	Non-swinging	U-0.50
Vertical Glazing	Window-to-wall ratio (WWR)	40% maximum
	Overall thermal transmittance	U-0.42
	Shading Coefficient	SC-0.40 <sup>(3)</sup>
	Exterior sun control (S, E, W only)	Projection Factor-0.5 <sup>(5)</sup>
	Low-e coating	Emittance < 0.05
Orientation	$(A_{north} * SC_{north} + A_{south} * SC_{south}) > (A_{east} * SC_{east} + A_{west} * SC_{west})$	Area (A) and Shading Coefficient (SC) of the Window
Skylight	Percent of roof area	3% maximum
	Overall thermal transmittance	U-0.69
	Overall solar heat gain coefficient	SC-0.42

<sup>(1)</sup> Fully grouted CMU walls or 6 inch concrete walls qualify for a mass wall.

<sup>(2)</sup> R-10 for 24 in. located in counties of Box Elder, Cache, Carbon, Daggett, Duchesne, Morgan, Rich, Summit, Uintah, and Wasatch.

<sup>(3)</sup> SC-0.44 for glazing located on the street side of the street level with continuous overhang with projection factor of 0.5 (S, E, W only).

<sup>(4)</sup> Reference documents: ASHRAE *Advanced Energy Design Guide for Small Office Buildings* and Standard 90.1.

<sup>(5)</sup> Projection Factor = (Horizontal Projection) / (Height Above Sill)

Table 2 – Small Buildings Prescription Energy Option: Lighting

Category	Component	Recommendation
Interior Lighting	Lighting power density (LPD)	10% Savings over Standard 90.1
	Premium T8 lamps	≥ 3100 Lumens
	Premium T8 ballasts	BF ≤ 0.8
	Window daylighting controls	Dim within 12 ft of windows
	Skylight daylighting controls	Dim within 8 ft of skylight
	Occupancy sensors	Auto-off in non-24 hour rooms
	Ceiling reflectance	80%
	Wall and partitions reflectance	70%
	High or low bay lighting	High or low bay T5 <sup>(1)</sup> fixtures

<sup>(1)</sup> In semi-heated or unheated spaces, use pulse start metal halide.

Table 3 – Small Buildings Prescription Energy Option: HVAC

Category	Component	Recommendation
HVAC	Air Conditioner (< 65,000 Btu/hr)	15 SEER
	Air Conditioner (≥ 65,000 Btu/hr and < 135,000 Btu/hr)	11.0 EER and 11.4 IPLV
	Air Conditioner (≥ 135,000 Btu/hr and < 240,000 Btu/hr)	10.8 EER and 11.2 IPLV
	Air Conditioner (> 240,000 Btu/hr)	10.0 EER and 10.4 IPLV
	Air Conditioner Water or Evaporatively Cooled	14.0 EER
	Heat Pumps (< 65,000 Btu/hr)	13 SEER (Cooling) 8.0 HSPF (Heating, Split System) 7.5 HSPF (Heating, Single System)
	Heat Pumps (≥ 65,000 Btu/hr and < 135,000 Btu/hr)	11.0 EER and 11.4 IPLV (Cooling) 3.4 COP (Heating, 47° OSA) 2.4 COP (Heating, 17° OSA)
	Heat Pumps (≥ 135,000 Btu/hr and < 240,000 Btu/hr)	10.8 EER and 11.2 IPLV
	Heat Pumps (> 240,000 Btu/hr)	10.0 EER and 10.4 IPLV
	Air Conditioner Water or Evaporative Cooled	14.0 EER
	Water-source heat pump	14.0 EER (Cooling) 4.6 COP (Heating)
	Semi-cooled spaces	Direct or Indirect Evaporative Cooling (< 25,000 cfm)
	Gas furnace (≤ 225,000 Btu)	80% AFUE or Et (Single Package AC) 90% AFUE or Et (Split AC)
	Gas furnace (> 225,000 Btu)	80% Ec
Boiler	Hot Water Boiler (≤ 300,000 Btu)	90% AFUE
Motors	All pump and fan motors (≥ 1 hp)	NEMA Premium Efficiency Motors
Economizer	Air conditioners and heat pumps (single package)	Cooling capacity > 54,000 Btu
Ventilation	Outdoor air dampers	Motorized control
Duct	Friction rate	0.08 in. w.c. per 100 feet
	Sealing	Sealing class B
	Insulation level	R-6

Table 4 – Small Buildings Prescription Energy Option: Service Water Heating

Category	Component	Recommendation
Service Water Heating	Gas storage	90% Et
	Gas instantaneous	0.81 EF or 81% Et
	Electric storage 12 kW	$EF > 0.99 - 0.0012 \times \text{Volume}$
	Pipe insulation	1 in. (diameter < 1.5 in.) 1.5 in. (diameter > 1.5 in.)

5.7 Sustainability Credits

A. Daylighting Credits

(1) Daylighting. Designer shall use daylight as the primary lighting system for 40 to 90 percent of the space, excluding copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas. Daylight zones shall have a minimum Daylight Factor of 2 percent and a maximum illumination of 200 footcandles. “Daylight Factor” means the ratio of interior to exterior illumination. Design shall lower peak and annual cooling loads compared to a building meeting Standard 90.1.

a. The Commissioning Agent shall ensure the daylighting control system is installed and calibrated to operate as intended.

- 2 points Daylighting in 40 percent of the space.
- 3 points Daylighting in 52 percent of the space.
- 4 points Daylighting in 62 percent of the space.
- 5 points Daylighting in 74 percent of the space.
- 6 points Daylighting in 90 percent of the space.

B. Energy Credits

(1) Evaporative Cooling. Designer shall select the evaporative cooling system to reduce mechanical cooling by 15 percent based on calculation method of Appendix G, Standard 90.1. Design the HVAC controls to turn off the evaporative cooling system whenever the indoor humidity level exceeds 60 percent. It should be integrated with the air economizer system and mechanical cooling system:

a. The Commissioning Agent shall ensure the evaporative cooling system is installed and calibrated to operate as intended.

- 2 points Evaporative cooling system.

(2) Demand-Controlled Ventilation using CO2 Sensors. Designer shall select the ventilation system to have a means to automatically reduce outside air intake using CO2 Sensors according to Standard 62.

a. The Commissioning Agent shall ensure the Demand-Controlled Ventilation system is installed and calibrated to operate as intended.

1 points Demand-controlled ventilation system.

- (3) Underfloor Air Distribution. Designer shall provide an underfloor air distribution system with ceiling return or equivalent air displacement system, excluding copy rooms, storage areas, mechanical, laundry, and other low occupancy support areas.

2 points Underfloor air distribution system.

C. Renewable Energy Credits

- (1) Renewable Energy. Designer shall select on-site renewable energy such as photovoltaic, wind, geothermal, and fuel cells utilizing biogas to reduce source energy use.

2 point 5 percent reduction in source energy use.  
3 points 12 percent reduction in source energy use.  
4 points 22 percent reduction in source energy use.  
5 points 34 percent reduction in source energy use.  
6 points 50 percent reduction in source energy use.

D. Indoor Air Quality Credits

- (1) Low-Emitting Materials. Designer shall select adhesives and sealants, paints and coatings, carpet, and composite woods with low-emitting materials.

1 point Select adhesives and sealants that meet USGBC LEED™ - NC, Credit 4.1, requirements.  
1 point Select paints and coatings that meet USGBC LEED™ - NC, Credit 4.2, requirements.  
1 point Select carpets that meet USGBC LEED™ - NC, Credit 4.3, requirements.  
1 point Select composite woods that meet USGBC LEED™ - NC, Credit 4.4, requirements.

- (2) Pollutant Source Control. Designer shall design the HVAC system to vent pollution sources, minimize cross-contamination of chemical pollutants, avoid dust and microbial growth, and install rated filtration media.

1 point Install source ventilation system to vent pollution sources such as copy rooms, chemical storage rooms, janitorial rooms, food preparation spaces, and other polluting activities. Install separation walls that extend to the structure to prevent cross-contamination.  
1 point Design HVAC system to avoid areas where mold and dust can accumulate, such as return plenums and fibrous ductwork.  
1 point Select MERV rated filters of 11 or greater according to Standard 52.2.

(3) Construction Indoor Air Quality Management Plan. Contractor shall ensure that Volatile Organic Compounds (VOC), dust, oils, and odors have been contained and removed before occupancy.

- a. Prior to installation of materials and products that emits VOC or odors, allow materials and products to off-gas in a well ventilated staging area. Remove any oil films and dust.
- b. During installation of materials and products that emits VOC or odors, use HVAC fans, open windows, or temporary fans to continuously ventilate the area until emissions dissipate, and protect porous materials with polyethylene vapor retarders.
- c. During dust producing activities (such as drywall installation and finishing), protect HVAC fans and ductwork from accumulating dust by turning off the fans and cover air grilles, registers, and other duct openings. Use temporary fans to ventilate the space.
- d. Prior to operating HVAC system, vacuum dust that has accumulated in HVAC fans, plenums, and ductwork with HEPA vacuum and remove any oil films from metal surfaces.
- e. Prior to substantial completion, vacuum carpet and other soft surface with HEPA vacuum.

1 point

Construction Indoor Air Quality Management Plan

1 point

Prior to occupancy and after Substantial Completion, flush building for 15 days with 100 percent outside air.

E. Commissioning and Training Credits

(1) Additional Commissioning. Commissioning Agent shall ensure the building is designed, constructed, and calibrated to operate as intended. Implement the following additional commissioning tasks beyond the Prerequisites Fundamental Commissioning requirements:

- a. Review and provide recommendations on the design document prior to issuing the construction documents.
- b. Review the contractor submittals relative to the systems being commissioned.
- c. Develop Recommissioning Plan to schedule commissioning activities to assure the building is continuously tuned to optimize performance.

2 points

Additional commissioning.

F. Acoustics Credits

- (1) Improve Acoustical Performance. Designer shall design work spaces to provide acoustic levels that limit excess noise from exterior sources, HVAC systems, and other sources.

1 point Acoustical level of 36 to 40 dBA background, and 0.6 second reverberating times or less.  
2 points Acoustical level of 35 dBA background or less, and 0.6 second reverberating times or less.

G. Sustainable Material Credits

- (1) Recycled Content. Designer shall select building products that have incorporated recycled-content in major materials from the Construction Products category of the US Environmental Protection Agency (EPA) Comprehensive Procurement Guidelines. Major materials include parking areas, floor, roof, partition, walls, or serving a structural function throughout the building.

1 point Four to seven major materials with recycled-content.  
2 points Eight or more major materials with recycled-content.

H. Waste Reduction Credits

- (1) Site Waste Reduction. Contractor shall ensure that construction waste, demolition, and land clearing waste are recycled, composted, and salvaged. "Recycle Rate" is the ratio of recycled waste (by weight) to total waste (by weight).

1 point Recycle Rate of 50 to 74 percent.  
2 points Recycle Rate of 75 percent or greater.

I. Water Reduction Credits

- (1) Water Efficient Fixtures and Appliances. Designer shall select water-efficient, fixtures and appliances with maximum flow shown below:

- a. Sensor faucet, 0.5 gpm
- b. Showerhead, 1.5 gpm
- c. Sensored flushometer toilet, 1.1-1.3 gpf, or dual flush valve
- d. Waterless or ultra-low flow urinal, 0.5 lpf

2 points Water efficient fixtures and appliances.

J. Performance Measurement and Verification Credits

- (1) Building Performance Monitoring on Multi-Building Campus. On a multi-building campus, agencies and institutions shall meter each energy type for each building. Energy type includes electricity, natural gas, central chilled

water, central heating water, and central steam. The energy management system shall have the capability to monitor and log sub-metering energy use and electrical demand. Provide sub-meter water use on landscaping and other irrigation strategies.

1 point            Building performance monitoring on multi-building campus.

(2)    System Performance Monitoring. Designer shall provide continuous metering equipment for the following equipment performance shall have the capability to monitor and log equipment performance:

- a.     Lighting system (kWh and kW)
- b.     Motor loads >20 hp (kWh and kW)
- c.     Variable speed drive operation
- d.     Chiller efficiency or chiller plant efficiency (i.e. chiller, cooling tower and pumps)
- e.     Air and water economizer operation
- f.     On variable volume system, supply air static pressure and volume
- g.     Boiler efficiency or boiler plant efficiency (i.e. boiler and pumps)
- h.     Process loads (kWh and kW)

1 point            System performance monitoring.

K.    Innovation in Design

(1)    The Director of DFCM, based on justified recommendations by the Energy Manager, may award up to 4 additional points for exceptional energy or environmental measures not specifically addressed in the rating system.

1 to 4 points    Exceptional energy or environmental measures.

5.8    Submittals

A.    DFCM shall establish letter templates to document compliance with the High Performance Building Rating System used by the designers, contractors, agencies, institutions, commissioning agents, and energy specialists.