STATE OF UTAH - DEPARTMENT OF ADMINISTRATIVE SERVICES

Division of Facilities Construction and Management

DFCM

DESIGN REQUIREMENTS

June 11, 2009

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)

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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.

Design Requirement/Variance Change Request

Project Name	**Date**
	DFCM Project Number
	Risk Management Number
Requested by	**Entity**
Brief Description of the Problem	
Design Requirements	
Justification	
Director Approval	**Date**
Action to Include This Design Requirements in the Design Requirements	
Professional Reviewer	**Position**
Maintenance Reviewer	**Position**
Director Approval	**Date**

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.

(2) Standards and Standard Project Documents, refer to http://dfcm.utah.gov/standard_docs.php.

(3) Roofing, Paving, and Hazardous Materials, refer to 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. 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. 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.

(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.dfcm.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 . (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.

Untreated Base Course	
Size	**% by Weight Paving Sieve**
1"	100
½"	70 to 100
#4	41 to 68
#16	21 to 41
#50	10 to 27
#200	4 to 13

(4) Surface course (asphalt) aggregate:

Surface Course (asphalt)	
Size	**% by Weight Paving Sieve**
½%	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 ¾" 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 ¾" 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 ¾" 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.

(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.

(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.

(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."

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 rations 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 Duiron 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 and 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 ¼" copper tubing to near floor or to locations where water may be caught in bucket. Drain valves shall be threaded for ¾" 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 ½" 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 9th 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 7001.12 (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 luminares which are shielded. For luminares with more than 3000 initial lamp lumens, provide Full Cutoff (IESNA Classification) luminares. 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 luminares 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

~~(1)~~ 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 ~~10'~~ 6" each side) and rigid steel conduit (PVC coated or wrapped) for bends greater than ~~22~~ 30 degrees. Provide minimum ~~¾"~~ ½" raceways except Communications raceways shall be ¾" minimum. ~~except ½" 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 then 2".~~ Provide flexible steel conduit (minimum ½") 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 ¾" 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 ¾" 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 ¾" 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 cablings 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, course 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, course 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 proved 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:

Landscape Water Allowance (gallons) = ET x PF x AREA / IE x .62

Where Landscape Water Allowance is in gallons per growing season,

ET = 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 ire (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)*

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

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

USDA Zone	Water Zone	Plant Factor	Botanical Name	Common Name
6 - 9			Pistacia chinesis	Chinese Pistache
4 - 9			Pistacia vera	Pistachio
4 - 9			Platanus occidentalis	American Sycamore or Plane Tree
4 - 8	2	.50	Platanus x acerifolia	London Plane Tree, Sycamore
3 - 9			Populus alba	White Poplar
3 - 8	1 - 2	.50	Populus alba 'Pyramidalis' or 'bolleana'	Bolleana Poplar
3 - 9			Populus angustifolia	Narrowleaf Cottonwood
2 - 5			Populus balsamifera	Balsam Poplar
2 - 8			Populus candicans	Balm of Gilead
2 - 9	2	.50	Populus deltoides	Eastern Cottonwood
5 - 9			Populus fremontii	Freemont Cottonwood
3 - 9			Populus nigra 'Italica'	Lombardy Poplar
	2	.50	Populus sp.	Cottonwood, improved "cottonless" varieties
3 - 7	3	1	Populus tremuloides	Quaking Aspen
3 - 8			Populus trichocarpa	Black Cottonwood
3 - 9			Populus X canadensis	Carolina Poplar
7 - 10			Prosopis juliflora	Honey Mesquite
4 - 9			Prunus armeniaca	Apricot
3 - 8			Prunus avium	Sweet Cherry, Mazzard
5 - 8			Prunus cerasifera	Purpleleaf, Cherry or Myrobalan Plum
3 - 9			Prunus cerasus	Sour Cherry
4 - 9			Prunus domestica	Common Plum
3 - 6			Prunus padus	European Birdcherry, May Day Tree
5 - 9			Prunus persica	Peach
4 - 7			Prunus sargentii	Sargent Cherry
5 - 9			Prunus serrulata	Japanese Flowering or Oriental Cherry
4 - 9			Prunus subhirtella	Higan Cherry
2 - 9	0	0	Prunus virginiana	Common Chokecherry
2 - 9	1	.25	Prunus virginiana "Canada Red"	Cananda Red Chokecherry
5 - 8			Prunus X yedoensis	Yoshino Cherry
3 - 9			Ptelea angustifolia	Common or Western Hoptree, Wafer-Ash
5 - 8	2	.50	Pyrus Calleryana	Callery Flowering Pear
4 - 9			Pyrus communis	Common Pear
3 - 7			Pyrus ussuriensis	Ussurian Pear
5 - 9			Quercus acutissima	Sawtooth Oak
3 - 9			Quercus alba	White Oak
3 - 8			Quercus bicolor	Swamp White Oak
4 - 8			Quercus cerris	Turkey Oak
4 - 8	0	0	Quercus gambelii	Gambel Oak / Scrub Oak
2	0	0	Quercus gambelii	Gambel's Oak
4 - 8			Quercus imbricaria	Shingle or Laureal Oak
2 - 8	1	.25	Quercus macrocarpa	Bur Oak
4 - 7			Quercus muehlenbergii	Chinkapin Oak
4 - 8			Quercus palustris	Pin Oak
4 - 8	2	.50	Quercus robur	English Oak
4 - 8	2	.50	Quercus rubra	Northern Red Oak
5 - 9			Quercus shumardii	Shumard Oak
7 - 9			Quercus trubinella	Shrub Live Oak
7 -9			Quercus undulata	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 retuculata	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
EVERGREEN TREES				
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			Pinus bungeana	Lacebark Pine
2 - 6			Pinus contorta var. latifolia	Lodge Pole Pine
3 - 7	1	.25	Pinus densiflora	Japanese Red Pine
4 - 8	0	0	Pinus edulis	Pinyon Pine
4 - 7	1	.25	Pinus flexilis	Limber Pine
8 - 10			Pinus halepensis	Aleppo Pine
	1	.25	Pinus heldreichii leucodermis	Bosnian Red Cone Pine
	1	.25	Pinus jeffreyi	Jeffrey Pine
4 - 7	1	.25	Pinus longaeva	Bristlecone Pine
5 - 9	1	.25	Pinus monophylla	Singleleaf Pinyon Pine
5 - 8			Pinus monticola	Western White Pine
2 - 8	1	.25	Pinus mugo	Mugo Pine
4 - 7	1	.25	Pinus nigra	Austrian Pine
4 - 7			Pinus parviflora	Japanese White Pine
3 - 7	1	.25	Pinus ponderosa	Ponderosa Pine
5 - 9			Pinus strobiformis	Southwestern White Pine
3 - 8			Pinus strobus	Eastern White Pine
2 - 8	1	.25	Pinus sylvestris	Scotch Pine
5 - 9	1	.25	Pinus thunbergiana	Japanese Black Pine
5 - 7	1	.25	Pinus wallichiana	Himalayan White Pine
4 - 6	2	.50	Pseudotsuga menzeisii 'Glauca'	Rocky Mountain Fir
4 - 6			Pseudotsuga menziesii	Douglas Fir
6 - 8	2	.50	Sequoiadendron giganteum	Giant Sequoia
4 - 9			Taxodium distichum	Baldcypress
6 - 9			Thuja (Platycladus) orientalis	Oriental Arborvitae
2 - 8	2	.50	Thuja occidentalis	American Aborvitae or Northern White Cedar
5 - 7			Thuja plicata	Western Red Cedar
SHRUBS				
3 - 5	2	.50	Abies balsamea 'Nana'	Dwarf Balsam Fir
4 - 9			Amelanchier utahensis	Utah Serviceberry
4 - 5	0 – 1	.25	Amerlancier alnifolia	Saskatoon Serviceberry
2	0 - 1	.25	Amorpha canescens	Lead Plant
2	1	.25	Amorpha fruticosa	False Indigo
2 - 6	0		Arctostaphylos patula	Greenleaf manzanita
3 - 8	1 - 2	.50	Aronia melanocarpa	Black Chokeberry
	0	0	Artemisia tridentata	Big Sage, Sagebrush
3	0	0	Artemsia cana	Silver Sagebrush
			Artemsia filifolia	Sand Sagebrush
2	0	0	Artemsia frigida	Fringed Sagebrush
			Artemsia ludoviciana	Prairie Sagebrush
			Artemsia nova	Black Sagebrush
	0	0	Atriplex canescens	Fourwing Salt Bush
			Atriplex confertifolia	Shade Scale
	0	0	Atriplex gardneri	Gardner Salt Bush
	1 – 2	.50	Berberis sp.	William Penn Barberry, Crimson Pygmy Barberry
5 - 8	1 – 2	.50	Berberis sp. (screening varieties)	Mentor Barberry, Red Leaf Barberry, Rose Glow Barberry
5 - 9	2	.50	Buddleia sp.	Butterfly Bush
	2	.50	Buxus Microphylla 'Winter Gem'	Winter Gem Boxwood
5 - 6	2	.50	Buxus Sempervirens	Common Boxwood
2 - 7	0 - 1	.25	Caragana arborsecens	Siberian Peashrub
3 - 7	1	.25	Caragana pygmaea	Pygmy Peashrub
	1	.25	Caryopteris clandonensis	Blue Mist Spirea

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			Ceanothus intergerrimus	Deer Brush
			Ceanothus martinii	Utah Mountain Lilac
			Ceratoides 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
			Chrysothammnus 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 Euonymus 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 'Manhatten'	Manhatten 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	Pyrancantha, 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	Spiraea x bumalda	Bumald Spiraea
3 - 8	2	.50	Spiraea x vanhouttei	Bridal Wreath Spiraea
3 - 7	1 - 2	.50	Symphoricarpos albus	Common Snowberry
			Symphoricarpos occidentalis	Mountain Snowberry
2	2	.50	Symphoricarpos oreophilus	Mountain Snowberry
3 - 7	2	.50	Syringa meyeri 'Palibin'	Dwarf Korean Lilac
3 - 7	1 - 2	.50	Syringa patula 'Miss Kim'	Dwarf Korean Lilac or Miss Kim Lilac
3 - 7	1	.25	Syringa vulgaris	Common Lilac (many varieties)
6 -7	3	1	Taxus baccata	English Yew
4 - 7	3	1	Taxus cuspidata	Japanese Yew
4 - 7	3	1	Taxus x media	Anglojap Yew
6	2	.50	Taxus sp. (low, spreading)	Spreading English Yew, Dwarf Japanese Yew and Others
4 - 7	2	.50	Taxus sp. (screening)	Hick's Yew, Japanese Yew, Upright Yew, Brown's Yew and Others
			Tetradymia	Horsebrush
5	2	.50	Thuja sp. (low, spreading)	Woodward Globe Arborvitae, Little Giant Arborvitae and Others
	2	.50	Thuja sp. (screening)	Emerald Arborvitae, Blue Cone Arborvitae and Others
3 - 8	2	.50	Viburnum rhytidophyllum	Leatherleaf Viburnum
3 - 8	2	.50	Viburnum sp.	Arrowwood Viburnum, Burkwood Viburnum, Cranberry Bush
5 - 8	2	.50	Weigela florida	Weigela
			Yucca angustissima	Narrow Leaved Yucca
			Yucca elata	Soaptree Yucca
4 - 6	0	0	Yucca filamentosa	Yucca
4			Yucca glauca	Great Plains Yucca
	0	0	Yucca sp.	Yucca
VINES AND GROUND COVERS				
	2	.50	Aegopodium podagraria	Bishop's Weed
	2	.50	Arabis caucasica	Rock Cress
	2	.50	Arctostaphylos uva-ursi	Kinnikinnick
4 - 9	1	.25	Campsis radicans	Trumpet Vine
	1	.25	Cerastium tomentosum	Snow In Summer
	1 – 2	.50	Clematis 'Hybrids'	Clematis
	1	.25	Convallaria majalis	Lilly-of-the-Valley
5 - 7	1 – 2	.50	Cotoneaster sp.	Cotoneaster
	2	.50	Delosperma cooperi	Delosperma, Ice Plant
	2	.50	Delosperma nubigenum	Yellow Ice Plant
4 - 8	2	.50	Euonymus fortunei	Winter Creeper
	0	0	Euphorbia myrsinites	Spurge
	1	.25	Fragaria sp.	Wild Strawberry
	2	.50	Galium odoratum	Sweet Woodruff
5	1	.25	Genista pilosa	Vancouver Gold Genista
	2	.50	Hedera helix	English Ivy
	1	.25	Helianthemum nummularium	Sunrose, Rockrose
5	2	.50	Hypericum calcinum	Aaron's Beard, St. John's Wort
3 - 9	0 – 1	.25	Juniperus sp.	Juniper (many species and varieties)
4	1	.25	Lonicera japonica	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
ORNAMENTAL GRASSES				
			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	Pernnial 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 speciousa	Desert Needlegrass
			Stipa viridula	Green Needlegrass
HERBACIOUS PERENNIALS				
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
HERBACIOUS PERENNIALS				
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 saxatalis	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
			Argenone munita	Armed Prickly Poppy
4	2	.50	Armeria maritima	Common Thrift or Sea Pink
			Arnica cordifolia	Heart Leaf Arnicea
3	0	0	Artemesia frigida	Fringed Sage
			Artemesia 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
			Astragulas 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
			Castelleja 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	Perrenial 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

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	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 Woolybase
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	Liatris 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	Paeonia hybrida	Peony
3	2	.50	Papaver orientale	Oriental Poppy
	1	.25	Papaver sp.	Poppy, Oriental Poppy
2	0 – 1	.25	Penstemon sp.	Firecracker Penstemon, Palmer Penstemon, Shrublet Penstemon, Wasatch Penstemon
			Perideria gairdneri	False Yarrow
3	1 - 2	.50	Perovskia atriplicifolia	Russian Sage
			Phacelia sericea	Silky Phacelia
			Phlox hoodii	Carpet Phlox
			Phlox longifolia	Longleaf Phlox
3	1 - 2	.50	Phlox subulata	Creeping Phlox
3	3		Physostegia virginiana	Obedient Plant
	2	.50	Platycodon grandiflorus	Balloon Flower
	1	.25	Polemonium caeruleum	Jacob's Ladder
			Polemonium foliosissimum	Leafy Jacobsladder
			Potentilla gracilis	Showy Cinquefoil
5	1	.25	Pulsatilla vulgaris	Pasque Flower
4	0 - 1	.25	Ratibida columnaris	Prairie Coneflower, Mexican Hat
3	1	.25	Rudbeckia hirta	Gloriosa Daisy
	0 – 2	.25	Rudbeckia sp.	Black Eyed Susan, Dwarf Rustic Coneflower
	2	.50	Salvia sp.	Salvia
	1	.25	Santolina sp.	Lavender Cotton
3	2	.50	Saponaira ocymoides	Rock Soap Wort
			Sedum lanceolatum	Stonecrop
4	0 - 1	.25	Sedum sp.	Sedum (many species and varieties)
			Sidlacea oregana	Oregon Checkermallow
			Silene acaulis	Douglas Campion
			Sisyrinchium ssp. Idahoensis	Purple-eyed Grass
	2	.50	Solidago Canadensis	Goldenrod
2	2	.50	Solidago hybrids	Goldenrod
			Solidago sparsiflora	Goldenrod
			Sphaeralcea ssp.	Globemallow
4	1 - 2	.50	Stachys bysantina	Lambs Ears
			Stanleya pinnata	Prince's Plume
	2	.50	Teucrium chamaedrys	Germander
3	2 - 3	.75	Thymus sp.	Thyme (many varieties)
			Townsendia incana	Easter Daisy
	2	.50	Tradescantial virginiana	Spiderwort
			Trifolium maci lentrun	Leanclover
2	3	1	Tulipa hybrids	Tulip
	2	.50	Verbena sp.	Verbena
	2	.50	Veronica sp.	Speedwell
3	1	.25	Veronica spicata	Spike Speedwell
	0	0	Viguiera multiflora	Showy Godeneye
4	3	1	Vinca minor	Periwinkle
			Viola adunca	Blue Violet
			Viola nuttallii	Yellow Prairie Violet
	0 – 2	.25	Viola sp.	Violet Pansy
			Wyethia amplexicaulis	Mule's Ears
	1	.25	Zauschneria californica	Hummingbird Fuchsia
			Zauschneria latifolia	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_o) data for the Salt Lake County area. Once established, turf can be maintained in an attractive manner at approximately 100 percent of the ET_o rate under normal weather conditions. Water-Conserving Plants typically need 50 percent or less of the ET_o 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 or 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_o is to be used in accordance to the location of the project.

Estimated Monthly ET_o for Salt Lake (Airport)												
												Annual
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**ET_o**
--	--	0.31	1.89	3.39	4.64	5.39	4.53	2.72	1.38	--	--	24.26

IRRIGATION SCHEDULE FORM

Project Name:	
Project Address:	
Prepared By:	
Company	
Telephone #	
Fax #	

Valve Station Number (A)	**Plant Type (B)**	**Irrigation Type (C)**	**Flow Rate (D)**	**Precip-itation Rate (E)**	**Initial Plant Establishment Period (4 Months)**				**Following One-Year Period (12 Months)**											

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

WATER ALLOWANCE WORK SHEET

Project Name: ____

Project Location:______________________________________

ET Rate: ____

Water Use (gallons) = ET x PF x Area / IE x .62

Where:
- ET = Reference Evapotranspiration in inches per growing season
- PF = Plant Factor
- Area = Total irrigated landscape area in square feet
- IE = Irrigation Efficiency
- .62 = Conversion to gallons

Total Gallons Allowed

Hydro Zone		ET*	PF	Total Area	IE	conv.	Gallons
Bench Mark			1.00		1.0	0.62	

* 24.26 is the ET rate for the Salt Lake Airport

Total Gallons Needed

Hydro Zone	Plant Description	ET	PF	Area	IE	conv.	Gal's per zone
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						0.62	
						Total	

Total gallons needed divided by total gallons allowed = % of allowable water: __________

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, Summmit, 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 (2009)

5.1 General

A. This section defines a High Performance Building Rating System for Buildings.

B. If required by contract, a building shall comply with the High Performance Requirements in this section.

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.

"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 Requirements

A. The project must meet all DFCM Design Standards.

B. The project must achieve a LEED Silver certification.

C. The project must specifically achieve the following credits in the LEED rating system unless otherwise excepted by the Director:

(1) WE Credit 1.1: Water Efficient Landscaping: Reduce by 50%

(2) EA Credit 3 Enhanced Commissioning

(3) EQ Credit 3.1 Construction IAQ Management Plan: During Construction

(4) EQ Credit 4.1: Low-Emitting Materials: Adhesives and Sealants

(5) EQ Credit 4.2: Low-Emitting Materials: Paints and Coatings

D. The project team must hold a sustainability charrette that is at minimum approximately 3 hours of dedicated time. The charrette shall be completed during the Schematic Document Phase if the project is a CMGC or Design/Bid/Build delivery. The charrette shall be completed during the programming phase and incorporated into the program documents if there is any chance that it shall be a Design-Build delivery. The charrette must attended by the following team members at minimum:

(1) DFCM Project Manger

(2) DFCM Energy Program Director

(3) Architect team

(4) Mechanical and Electrical Engineering team

(5) Energy Consultant team

(6) User Group Member or Building Occupants

(7) General Contractor (if hired)

(8) Commissioning Agent (if hired)

(9) Facility Management Personnel

E. The Charrette shall cover the following topics at minimum:

(1) Targets and strategies for reducing energy consumption via building orientation and envelope, and via occupant behavior, and building systems

(2) Site analysis as it relates to ecological impact to surrounding areas

(3) Target for an overall building EUI (Energy Use Index)

(4) Strategies for reducing water consumption

(5) Spaces and activities most benefited from daylighting and daylighting controls

(6) Methods for reducing single occupant car commuting to the building

(7) Methods for building processes to reduce consumption and waste of resources during and after construction.

F. The project must model the building systems to analyze and make selections based on life-cycle cost. High Performance Buildings are to be built to a 50 year life-cycle. Analysis should include the following costs:

(1) Initial Costs—Purchase, Acquisition,

(2) Construction Costs

(3) Fuel Costs and Energy costs

(4) Operation, Maintenance, and Repair Costs

(5) Replacement Costs

(6) Residual Values—Resale or Salvage Values or Disposal Cost

(7) Finance Charges—Loan Interest Payments if applicable

(8) Non-Monetary Benefits or Cost

Life Cycle cost can be calculated by using the Building Life-Cycle Cost Program that is available for download from the Federal Energy Management Program (http://www1.eere.energy.gov/femp/information/download_blcc.html) or by following equation: LCC = I + Repl — Res + E + W + OM&R + O

Where:
LCC = Total LCC in present-value (PV) dollars of a given alternative
I = PV investment costs (if incurred at base date, they need not be discounted)
Repl = PV capital replacement costs
Res = PV residual value (resale value, salvage value) less disposal costs
E = PV of energy costs
W = PV of water costs
OM&R = PV of non-fuel operating, maintenance and repair costs
O = PV of other costs (e.g., contract costs for ESPCs or UESCs)

G. An energy model shall be completed to demonstrate the building design performance relative to a code compliant building. Methods for modeling shall follow those outlined by the LEED reference guide. Unless otherwise approved by the Director, the energy model must include an analysis of evaporative cooling technology and the model must include an analysis of daylighting control technology. It must also give the modeled EUI in Kbtu/sf.

H. The facility must be equipped with meters or submeters to measure the individual facility's energy consumption on an ongoing basis in a format that allows the consumption data to be entered into the Energy Star Portfolio Manager Program.

5.5 Submittals

A. Design team shall submit the Charrette Summary, Life Cycle Cost Analysis, LEED submittals and Submittal Comments, Commissioning Report, and the Energy Analysis to document compliance with these High Performance Building Requirements.