

**Western Oregon University**

**Facilities**

**Operations & Maintenance**

**Guidelines Handbook**

**Priorities and Guidelines for Operations and  
Maintenance of Existing Western Oregon University  
Buildings and Facilities**

These operations and maintenance (O & M) guidelines were developed to help WOU operations and maintenance staff develop and update their own enhanced O & M plans and manuals with the best management and sustainability practices. The primary goal of these guidelines is to maximize the use of sustainable O & M practices in all WOU facilities while facilitating compliance with the Energy Plan. In addition, building operations and maintenance practices are directly tied to ongoing building costs and the internal occupant comfort and external building environment. Campus-wide implementation of these O & M guidelines can therefore lead to substantial economic, social, and environmental benefits.

## **Maintenance Practices & Approaches**

There are four distinct maintenance approaches:

**Reactive Maintenance** is sometimes referred to as breakdown maintenance or “replace on failure.” It is not a desirable approach as it guarantees interruption of service. Equipment life may be significantly shortened due to the lack of regular maintenance, and costs end up higher in the long run.

**Preventive Maintenance** refers to performing regularly scheduled tasks and equipment replacements to avoid problems before they occur. Examples of preventive maintenance include replacing fan belts annually or replacing air conditioning units every ten years. It is possible that the replaced equipment could operate longer, but the odds of a failure and the frequency of repairs increase as the equipment gets older. Replacement decisions must balance with the resource efficiency of utilizing a material or system for longer.

**Predictive Maintenance** relies on monitoring or testing to predict problems and deal with them before they become too big. Predictive maintenance tasks can include measuring vibration, temperatures, efficiency or other characteristics and comparing them to engineering limits. Equipment is repaired or replaced when results exceed limits.

**Reliability-Centered Maintenance (RCM)** is the optimum mix of reactive, time-or interval-based, condition-based, and proactive maintenance practices. This offers a better approach to preventive maintenance.

These principal maintenance strategies, rather than being applied independently, are integrated to take advantage of their respective strengths in order to maximize facility and equipment reliability while minimizing life-cycle costs.

RCM is an advanced maintenance approach that WOU would like to investigate further and it is recommended that all facility managers investigate, develop and begin implementing the RCM approach on campus. Another overarching strategy that should drive O & M decisions is the 80/20 rule. This rule suggests that O & M staff allocate 80% of their time maintaining the top 20% of most critical equipment to achieve the most benefit from maintenance and operations practices.

The combined approaches of RCM produce and integrated maintenance system that maximizes facility and equipment reliability. However, this approach only provides guidance at the preventative and predictive levels.

A user should understand system boundaries and facility envelope, system/equipment functions, functional failures, and failure modes, all of which are critical components of the RCM program.

### **Leadership in Energy and Environmental Design for Existing Buildings: Operations & Maintenance (LEED EB: O & M)**

LEED-EB: O & M is a green building rating system developed by the US Green Building Council. It is intended to help building operators reduce the environmental impact of their practices and achieve recognition for their efforts. The six categories of the rating system are site, water, energy, materials (purchasing and solid waste), indoor environment quality, and innovation.

This standard provides useful guidelines to help WOU facilities achieve a number of goals that include: reducing the amount of energy, water, and other resources used, reducing operating costs; and improving the health of occupants and facilities staff. LEED-EB O & M requires 11 plans and policies in the following areas: building exterior and site maintenance programs; energy system and policies; water fixtures; irrigation systems and process use; purchasing of environmentally-preferred products and food; waste stream management; and, cleaners and other products that affect the quality of the indoor environment. It also requires meeting the minimum energy performance using the Energy Star Portfolio.

WOU has already required that new building construction achieve LEED New Construction (NC) Silver. Thinking about LEED-EB: O & M requirements and including the recommended components in WOU facility O & M plans may help the facility prepare for potential future WOU requirements related to LEED-EB.

Followed at a minimum, the guidelines set forth by the State of Oregon and Oregon University System in regards to LEED requirements along with sustainable operation practices, all of the buildings and properties that are owned or leased by Western Oregon University shall be operated and maintained in accordance with sustainable operation and maintenance guidelines and policies. These guidelines and policies as in LEED projects cover the impacts on the surrounding properties, rivers, streams, energy consumption, and usage of environmentally friendly materials, indoor environmental quality and water consumption.

## **How to Use This Document**

The intent of this document is to provide guidance on O & M procedures applied in all WOU facilities, to achieve high performance and sustainable practices in our existing buildings. The guidelines herein are meant to work alongside or in place of already existing practices, and facility staff can identify and select to implement any or all of the guidelines as they apply, if they augment practices already in place. Exactly how this document is to be used is up to the discretion of facility staff and depends on practices and requirements already in place. There are references to frequencies of actions that may not be applicable or possible for certain buildings, facilities, or assets. Consider the frequency that is most appropriate for the conditions of such.

This is a “working” document that will be updated frequently. Future versions will likely include additional chapters, including minor remodel strategies and additional tools such as a WOU Life Cycle Cost Analysis tool.

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# Operations & Maintenance Guidelines

## Retro-commissioning-Guidelines

Establish key performance indicators for the building equipment and systems identified in the operation manual. Routinely track the indicators to ensure performance is being met.

Augment the building systems operations manual to include information that documents operating schedules, set points and sequences of operation for the building's water, waste, and Indoor Air Quality (IAQ) performance

Augment the performance indicators established for energy use to include the building's water, waste, and IAQ performance. Performance indicators might include one or more of the following: tracking water and waste bills; water and waste benchmarking; trend logging; and/or air quality monitoring. Routinely track the indicators to ensure performance goals are being met.

Follow guidelines set forth by the State of Oregon Energy Code/ASHRE as a minimum.

Conduct an investigation of the building's energy-using systems, such as:

- HVAC Equipment and Systems-Packaged Air Conditioning Systems: Fan coils and unit ventilator, VAVs, chilled water systems, hot water systems, air filters, ducts and economizers
- Lighting equipment and systems: Lamps, luminaires, exit and emergency lighting and controls including occupancy and motion sensors, timers, time clocks and day lighting controls.
- Controls Equipment and systems: Computerized Maintenance Management system; energy management control system, building management control system and all of their components.
- Conduct a building scoping walk-through to identify maintenance and operational improvements for landscape management and irrigation, waste collection and management, and air quality condition. Prepare a scoping report that identifies needed repairs, basic maintenance problems and operations improvements such as scheduling and optimization.

# Landscaping

## Landscaping O & M Plan

The first influential step toward green landscaping is creating a green landscaping O & M plan. A green landscaping O & M plan helps to fully realize the intended state of a building's landscaping while also protecting the local and regional ecosystem and human health. Landscaping should be maintained to maximize the health of plants and people, while also reducing impacts on the planet and budget. Additionally, a well-executed O&M plan will improve the beauty and life of the plantings. The ultimate goal in developing this plan is to create an effective maintenance program that keeps plants healthy while reducing needed resources.

Prepare or update the landscape O&M plan of our facility. Include strategies to reduce the need for pesticides, fertilizers, water, and maintenance, and to preserve natural resources. The plan should cover all aspects of grounds maintenance including plant care, turf management, irrigation, integrated pest management (IPM), and hardscapes. The plan should include the following sections:

- Landscaping maintenance goals
- Responsibilities
- Landscape documentation
- Maintenance task list and schedule
- Evaluation task list and schedule
- Recordkeeping process
- Maintenance system audit

Implement plan in conjunction with staff training and goal-setting.

## General Landscaping O & M Guidelines

The goal of routine maintenance in natural areas is to protect, conserve and enhance native plants, water quality, soil, sensitive areas, and wildlife (including fish). The goal of design and routine maintenance in formal landscapes is to promote the health, safety, and longevity of landscapes that enhance the aesthetic beauty of WOU facilities with a minimum of resources used.

General Landscape Operation and Maintenance Guidelines include:

- Increase the use of native plants, increase irrigation efficiency to reduce water use, give better plant care in order to reduce pests and diseases and thereby minimize pesticide use.
- Follow the best management practices (BMP) related to IPM, turf placement and maintenance, species selection and care, irrigation systems and schedules, and maintenance guidelines.
- Identify and assess the components and layout of the landscape, assess the geographic location and microclimates, inventory the plants, and identify soil types.

## **Integrated Pest Management (IPM)**

### **Action Thresholds:**

- Pests – the recommended insects per square foot, or per plant, will be used to establish the need for treatment
- Monitoring – monitor for pests, disease and general health on a regular basis.
- Prevention – proper and frequent inspections are needed for the overall health of the plant.
- Control – proper cultural practices are used as well as disease resistant landscape material, biological controls and the use of the least toxic yet most effective material.
- Environmental conditions - moisture, temperature, wind speed and other related conditions will be considered before a decision is made to determine the best course of action.

Well chosen plants and a well maintained landscape dramatically reduce the need for pest control. Appropriate selection of plants, irrigation, application of mulch and/or fertilizer, mowing and other practices all help landscapes withstand pest pressures and support natural predators.

Training of staff how to identify pests and work with an IPM Program. All staff associated with the design, construction and maintenance of the grounds, landscaped building, faculties and other areas where pests must be controlled, or vegetation managed, receive an orientation/training to the IPM policy and its guidelines.

Use pesticides only as a last resort. When they are used, select the least-toxic product.

Collect and maintain pest management records. Include date, specific location, name, reference used for identification, corroborating expert (as needed), stage of lifecycle, extent of pest presence and other pertinent information. Include any control methods implemented, details about pesticide application and on-going monitoring.

### **Native and Drought-Tolerant Plants vs. Invasive Plants**

The key to reducing maintenance needs is to choose the proper plant for the site. Select native plants and/or drought-tolerant plants that have proven their toughness and ability to thrive with minimal care.

Do not plant any species listed as noxious weeds on WOU properties.

Select plants on the basis of their function and adaptability to the site, resistance to diseases and pests and the amount of care required.

Integrate native and/or drought tolerant plants into existing landscapes as appropriate for the area and landscape design.

Determine if noxious or invasive species should be removed from the site.

### **Turf**

Turf areas vary widely in grass type and function from highly maintained athletic fields to courtyards and each type of turf requires distinct maintenance.



Manage turf pests, including weeds, through good practices.

Do not seed turf grass within one foot of a fence line or structure. Replacing turf with a properly installed gravel/concrete strip or equivalent minimizes landscaping maintenance by simplifying the mowing process. Avoid using pesticides and opt for manual removing any weeds from this strip.

Write and follow a section in the O & M plan to include turf mowing, edging, and fertilizing, reseeding, irrigation and, based on use, top dressing, dethatching and aerification.

### **Trees**

Selecting healthy trees, planting them in appropriate sites, and nurturing them when young will prolong their life and reduce the maintenance needed to keep them safe and healthy for humans to enjoy.

Review landscape designs to insure that the selected trees can achieve the design goal with minimum care, before the design is approved.

Promote training of tree care specialists with proper training/certification.

Tree management priorities should emerge from the establishment of a WOU tree inventory and regular monitoring of trees on the inventory.

Maintenance schedules and procedures shall be based upon priorities established in the landscape O & M plan for the University.

### **Plant Beds**

Plant beds are generally designed as focal points or visual frames in more formal areas around the buildings. As such, require a high level of maintenance and can include both native and ornamental species. These beds contain trees, woody shrubs, and herbaceous perennials that die down in the winter. Maintenance should focus on ensuring the right plant is the right place and enhancing existing soils by mulching for water retention and weed control. Actual maintenance given to a plant bed will vary depending on location, type of site, design goals, and species.

Shrub bed designs should be reviewed by a professional familiar with the site, soils, and species selected before the designs are approved. The goal is to install a shrub bed that can achieve the design goal with a minimum of care.

### **Irrigation**

Drought resistant landscaping should be utilized as much as possible: However, inevitably some landscaping will require irrigation. A wide variety of WOU properties use automatic irrigation systems to maintain their turf, shrub beds, annuals and plantings. The goal of landscape management must be to provide suitable water to plants, but not enough to provide runoff and waste.

The irrigation system is a management tool and cannot replace the sound judgment of trained professionals. The best designed irrigation system will fail without regular maintenance.

Update and retrofit existing irrigation systems and equipment to take advantage of new water saving technology, such as rain shut off devices and drip irrigation.

In order to conserve water, move toward using reclaimed water to operate irrigation systems.

Report irrigation leaks and shut off the water as soon as possible to prevent water waste. Make repairs as soon as feasible to maintain plant health.

Include the following features with irrigation controller and systems:

- Use a flow sensor to monitor how much water is being used
- Use a rain sensor to shut off the controller due to rain
- Use a remote hand controller as a tool for sprinkler head and maintenance inspections
- Use a central control irrigation controller and insure the maintenance staffs are properly trained in its use

Periodically verify that plant material is healthy and that the soil moisture is adequate. Use a soil probe to visually inspect root dept, soil structure and moisture.

During the dry season, water deeply but infrequently. Do not exceed one inch per week (including rainfall).

Perform regular inspection to optimize irrigation equipment.

Equipment maintenance should be performed on a weekly basis, which includes checking equipment for damage, leaks, or adjustments and then performing the adjustment or repair necessary.

Prioritize future irrigation system improvements by maintaining a record of repairs that are needed.

Sub meter landscape if possible for water budgeting and leak detection.

Adjust water pressure as needed. Set water pressure to minimize wind effects. Make sure supply and pressure meet design specifications.

### **Bio-swales/Rain gardens**

Rain gardens are shallow depressions that can hold and soak up water runoff from roof tops, driveways, patios and other impervious surfaces. Rain gardens have deep, compost amended high infiltration rate soils and are landscaped with native or adapted plants. By holding and naturally infiltrating runoff, rain gardens filter oil and grease from driveways, pesticides and fertilizers from lawns as well as other pollutants before they reach the storm drain and eventually streams, wetlands, lake and other marine waters.

Mulch as much as needed to prevent erosion and weeds.

Regularly inspect and keep inlet and outlet well protected with rock and clear of debris.

Water as needed until native or adapted plants are established.

## **Snow and Ice Removal – Inclement Weather**

All Physical Plant essential personnel will be involved in snow and ice removal. All mechanical equipment will be used to clear sidewalks, ADA ramps and parking lots in order to reduce the need for de-icers. Our goal is to have clear access to all buildings and events while campus remains open. If de-icers are used, only the most non-toxic/corrosive and minimum amounts are to be used.

# Building Envelope

## **Wall Maintenance**

Identify and schedule regular inspections and maintenance for each exterior wall type. Create a detailed annual schedule that includes inspection, painting and refinishing vertical wall surfaces.

## **Roof Maintenance**

Identify and schedule regular inspections and maintenance based on roofing type and weather conditions. Utilize outside qualified contractor to check for leaks or damage through advanced techniques.

Perform both preventive and regular maintenance on all building roofs to ensure the safety of occupants, the durability of the structure and efficient use of heating and cooling.

Keep detailed record of all roof work completed as well as an inspection checklist.

Checklist will include the following information: worn spots, holes, deteriorated sections. Adequate drainage, flashings, fasteners, cracking or weather again of sealants, open joints, penetrations and exhaust flashings.

## **Roof cleaning**

Cool roofs should be cleaned at least once a year with a medium pressure spray and following the manufactures recommendations. Clean all debris from the surface of the roof including anything gathered behind HVAC units, pipes and pitch pans and any other roof penetrations. Debris has tendency to hold water, and water will expedite roof deterioration especially if the roof is asphalt based such as built up or asphalt shingles.

## **Roof Retrofit Opportunities**

If the existing roofing is determined to be beyond repair, or it is not economical feasible to continue maintenance activity, the roofing will need to be replaced.

TPO/PVC single ply roofing is an excellent choice for re-roofing depending on the type of building and equipment to be worked around. Cool roofs are recommended for low-sloped roofs. Cool roofs will not only lower cooling loads, but will also reduce thermal stresses due to daily temperature cycles. Roof retrofits provide an opportunity to add considerable R-value to the roof, which can drastically reduce energy use in all seasons. Calculate the energy benefits when considering roof retrofits.

## **Windows and Doors**

Create an inventory of all existing windows and doors and identify the most appropriate inspection and maintenance schedule for each window and door.

Cleaning and maintenance would include the following:

- Clean with environmentally preferable cleaning products
- Keep sill and track areas clean and free of dirt and other debris
- Keep weep holes clear

- Clean frame surfaces avoiding petroleum based cleaner and solvents
- Check for air infiltration through the doors and windows
- Make sure corners of mechanically joined frames are caulked to prevent water penetration
- Check weather stripping around doors and windows and replace as needed

### **Window and Door Retrofit Opportunities**

Window replacement with double-paned windows and low-e coatings will lower both the cooling and heating costs and should be evaluated as part of a renovation. New windows provide better weatherization and energy saving for the facility. Evaluate the possibility of improving the envelope through careful and limited use of glazing and increased wall insulation values.

# HVAC Systems and Indoor Air Quality

Heating, ventilating and air conditioning (HVAC) systems account for approximately 39% of the energy used in commercial buildings in the United States. Significant energy savings can be realized by improving control of the HVAC operations and improving the efficiency of the individual system components. Improvement in controls can also remedy indoor air quality concerns. Achieving the best results in energy efficiency, effectiveness, and indoor air quality demands overall systems approach that consider interactions between all building systems.

Western Oregon University goals include a net reduction in energy use in campus buildings. These goals should drive both development of new, and update of existing, operation and maintenance plans that are developed for all WOU facilities.

The challenge is to optimize occupant productivity with energy savings; two forces that occasionally are in direct conflict with each other. It is important to remember that most buildings exist solely to enable humans to complete tasks. The financial benefits of improvements in productivity can sometime far outweigh the energy impacts necessary to achieve productive work spaces. The O & M staff is tasked with finding the precious balance by optimizing HVAC systems and education occupants.

## **Indoor Air Quality**

HVAC O & M staff can influence indoor air quality (IAQ) in several ways, but their most important task is ensuring proper ventilation. Proper ventilation consists of a continuous supply of outside air at a rate that varies based on the space type and occupancy conditions. IAQ is a constantly changing interaction of a complex set of factors. The indoor environment in any building results from the interaction between the site, climate, building system, construction techniques, contaminate sources and building occupants. The following elements may contribute to indoor air quality problems. All must be considered to prevent, investigate, and resolve indoor air quality problems:

- Source: a source of contamination of discomfort indoors, outdoor, or with the mechanical systems of the building.
- Pathways: one or more pollutant pathways connect the pollutant source to the occupants and driving force exists to move pollutants along the pathway(s).
- Occupants: building occupants are present.

Optimizing the ventilation can be equally challenging with regard to providing for human productivity and comfort and managing energy use and it should be closely monitored.

The guidelines provided should help develop a combination of building O & M practices and schedules that best serve occupant needs and productivity, reduce energy consumption and environmental impacts, and maintain good IAQ.

## **HVAC O & M Plan**

HVAC operation and maintenance practices vary depending on the type of equipment, building types, and the existing envelope conditions, as well as building location, size, use pattern, and purpose. A dedicated O & M plan helps to fully realize the intended reliable,

effective and efficient and health operation state of a buildings HVAC system, as well as lengthen system life.

### **HVAC O & M Goals**

One goal is compliance with regulations. Another maintenance goal is making sure that the HVAC system does not become a source of indoor air contaminants. Inspection and periodic cleaning of the system, as well as the environments around outside air intakes, are important tasks to avoid potential problems. Conditions to avoid include: standing water and idling vehicles around outside air intakes and entryways.

### **Responsibilities**

Appoint an Energy Manager or assign the function of energy-use.

Provide staff with diagnostic tools.

Provide training in energy-efficient and indoor air quality O & M strategies.

Indicate the responsible staff position for each maintenance task. Provide training as needed for task.

### **System Documentation**

Develop and maintain a documentation and performance tracking system for continuity.

Utilize the WOU energy account system to locate savings opportunities and to track and measure the success of energy-efficient strategies.

### **HVAC O & M task list/ schedule**

Prioritize operation and maintenance tasks and adjust schedules to fit available staff time. When setting priorities, keep in mind the goals of indoor air quality, comfort, and energy efficiency to make sure they are not overlooked. Then create a list with specific maintenance tasks for the following system components, and indicate how often they need to be carried out:

- Air delivery systems
- Outside air delivery
- Ducts
- Hydronics
- Controls

### **The type of information to be included for each task includes:**

- Task description
- Detailed instruction or reference to location of instructions
- Appropriate corrective action for typical problems (clean lubricate, replace, adjust, tighten, program, schedule)
- Tools required
- Notes about why the task is important or how it helps meet the goals
- Location of related system documentation
- Shutdown/start up issues

- A description of what, where, and how the records resulting from the task will be stored.

### **Evaluation Task list and schedule**

Investigate opportunities for automatic controls.

Develop a space use based operations schedule and adhere to it.

In addition to regular inspection, include performance monitoring and system testing in the HVAC O & M plan, to ensure that the HVAC systems are meeting the performance goals. This part of the plan should include the following performance characteristics:

- Air quality
- Thermal comfort
- Energy efficiency
- Noise

### **O & M Audit Approach**

Include an audit process to periodically review how well the HVAC plan is working the audit should include the following:

- Completeness of procedures and checklists
- Availability of procedures and checklists to the O & M staff
- Training for staff

Stay current of routine maintenance practices.

### **Additional Factors: Uncontrolled Appliances**

Additional factors can impact HVAC performance in buildings, such as devices brought in by building occupants and fluctuating building conditions during the day. Occupant devices range from desk lamps, electric fans, and space heaters, to other devices. At best, these devices help provide occupants with the additional environmental controls that modern buildings have taken away. At worst, they are a nuisance, if not a fire hazard.

Address ways of dealing with devices brought by employees/staff/students in the plan. External factors would include:

- Conduct a building survey to identify heating or cooling devices brought by building occupants, which may indicate the occupants have additional heating or cooling needs.
- Use a program to identify individual devices that work and are efficient.
- Set guidelines for employees regarding personal plug-in devices.

### **HVAC Systems**

General Guidelines for HVAC Systems includes:

- When possible, provide temperature for zones/spaces according to their function to reduce HVAC loads (e.g., hallway can be cooler in the winter and warmer in the summer than office areas).



- Install blinds, window shades, and other devices to control HVAC loads in areas with load factors not considered in the HVAC control loop (e.g., leaky windows, heat gain in east, south, and west facing offices, poorly insulated walls).
- Look for low cost or not cost system modifications, such as changing operation procedures or automating system settings.

An example of this is so called “night-flush” where maximum cool outside air is brought into buildings late at night and early morning in hot seasons, to pre-cool buildings and maximize fresh air, when it is energy efficient and comfortable to do so.

## **Air Delivery Systems**

### **Packaged Air Conditioning Systems**

Replacement of packaged air conditioning units is not usually cost effective based on energy efficiency alone. When units are to be replaced, it is important to seal and insulate ducts and check for airflow constrictions. It is also critical to perform cooling load calculations to check whether a different capacity is appropriate as is might cost less and perform better.

Regular maintenance to this equipment would include the following: replace air filters, inspect and test economizer dampers, check fan, belts, and bearings, check coils and condensate drain pan, control settings, compressor maintenance, cabinet and ductwork for air leaks, inspect piping insulation, inspect electrical connections, measure supply air flow if needed. Refer to the manufactures recommendations for each piece of equipment and modify the maintenance tasks as necessary.

### **Fan Coils and Unit Ventilators**

Confirm appropriate set points and control points.

Implement supply air pressure reset controls to save fan energy.

Reduce the supply fan minimum speed set point. Often this is set higher than necessary due to the default setting of the variable speed drive.

Analyze space use to determine best setting or strategy for conditioning (i.e., shade glazing to reduce loads on unit)

Maintenance of fan coils and unit ventilators (notably filter changing and cleaning) is similar to Package Air Conditioning systems.

### **Variable Air Volume Systems**

The appropriate list of maintenance tasks varies depending on the type of cooling and heating and on the type of control system. Older systems often have pneumatic controls, which use the pressure in a compressed air line to control dampers and valves. Newer systems typically have direct digital control (DDC) systems that use electrical connections between sensors and actuators and a digital controller. Valves and dampers are moved by electric motors.

Good practice control measures for these units include the following:

- Reduce minimum airflow settings for VAV boxes to the minimum required for ventilation

- Retrofit pneumatic VAV box controls with a DDC system including zone temperature sensors and electric damper actuators.
- Implement supply and pressure reset controls to save fan energy.
- Identify “rogue” zones that have either excessive cooling loads, undersized VAV boxes or other control problems that prevent the system from resetting either the supply air temperature or supply air pressure. These zones may not be meeting their temperature set points, requiring the supply air temperature to remain low, even though all of the other zones could be satisfied with a higher supply air temperature.

Malfunctioning VAV boxes can result in thermal discomfort and fail to prevent buildup of indoor air contaminants. It is important to insure that VAV box minimum setting combined with the outdoor air fraction provides enough supply air so that sufficient outdoor air enters the space at partial loads.

Maintenance tasks should include those listed for Packaged A /C systems as well as:

- Determine the appropriate control sequences: and,
- Verify VAV box operation, fan start/stop controls, supply air static pressure control, supply air temperature control.

## **Outside Air Delivery**

### **Filters**

Select filters that provide up to 85% or MERV 13 efficiencies if the system is compatible. Check with the equipment manufactures or HVAC designers to determine the proper filter system to maximize for filtration and energy efficiency.

Inspect and replace filter regularly, as described in the maintenance recommendations for specific systems used. Generally, a change of filters should be from 2 to 4 times a year.

Select and use pleated panel filters whenever possible.

Make sure that filters are properly fitted to prevent air from bypassing the filter and check filter seals.

### **Economizers**

WOU's climate is ideal for economizers. It's often cool enough outside for an economizer to be used frequently. The saving from this “free cooling” can be big. They usually do require maintenance to work over the long term. An outside air economizer can be part of any air handler.

### **Duct Work**

Duct leakage can cause or exacerbate air quality problems and waste energy. The following are considered best practices procedures when working on these:

- Isolate HVAC during construction or remodeling of specific areas. Enclose work area and tape over or seal all return diffusers within area. Change air filters after completion of work.
- Ensure each section is pressure balanced to ensure adequate flow.
- Provide flush out period after installing new flooring or painting.

- Check the spread and throw of diffusers to ensure effective air mixing at point of use, and ensure comfort of occupants that are located near diffusers.
- Periodically perform a complete duct inspection. Identify if ducts need sealing and whether cleaning is required.
- Minimize dust and dirt build-up.
- Routinely clean system components such as coils and drip pans.

### **Chilled Water Systems**

Replace standard efficiency with premium efficiency motors for pumps with long run hours.

Wherever practical, replace single-pass water cooling schemes in chiller systems with other methods of heat rejections.

Trim the pump impeller rather than using a balancing valve to reduce flow in constant pump speed applications; this may reduce pump power significantly.

Replace 3 way valves with 2 way valves on cooling coils and implement variable flow control on the chilled water loop if feasible.

Install variable speed fan controls on cooling tower to reduce fan energy consumption.

Review chiller sequencing controls for optima strategy for efficiency.

Address tasks for chiller, cooling towers, pumps, chilled water piping and valves including the following typical maintenance tasks for these systems.

Chiller maintenance, cooling tower maintenance, pump maintenance, piping maintenance and air release valve/strainer maintenance. Refer to the manufacturers' recommendations.

### **Hot Water Systems**

Possible approaches to increase boiler/exchanger efficiency include:

- Reduce "on" time
- Reduce load
- Just meet loads-Lower steam pressure or water temperature to meet the actual load conditions.

Replace standard efficiency with premium efficiency motors for pumps with long run hours.

Perform boiler tune ups once per year using combustion efficiency and emissions monitoring equipment.

Replace three way valves with two way valves on cooling coils and implement variable flow control on the hot water loop.

Pressure or temperature setting should be set no higher than required to avoid short cycling or rapid on and off of the equipment.

### **Controls**

Controls are a retrofit option. The most basic function is connection to an Energy Management Control Systems (EMCS) for Start/stop control. Energy savings will vary depending on how the existing system is being operated. It is also used for monitoring of the different systems.

Check set point versus control point. Verify that minimum condensing pressures are being implemented.

Check controls periodically, as they often drift out of calibration.

Ensure controls adequately reflect the actual building conditions and needs.

# Electrical and Lighting Systems

Creation and implementation of an Electrical and Lighting O & M plan is fundamental to achieving energy efficiencies in existing buildings. A successful and effective O & M plan schedules regular audits, encourages feedback from maintenance staff and occupants and identifies any area that does not provide intended results.

Prepare or update the Electrical and Lighting O & M plan for the University, including the following elements:

- Assess the scheduling of lighting systems-does the scheduling match the occupancy?
- If a digital scheduling system is not used, assigning responsibility to appropriate parties.
- Are cleaning staff responsible for turning off lighting?

Inspection, repair, and recalibration should be conducted at regular intervals.

Re-lamping schedules and specific procedures, discussing both group and spot re-lamping for each luminary type present in a facility.

Procedure for identifying and dealing with unexpected light inhibitors (such as a tree or shrub that has grown to block the light.)

Recycling and disposal plans for used lamps and ballasts, including toxic waste procedures.

Scheduled audits and feedback of the implementation and effectiveness of the maintenance plan, to identify any additional areas which need periodic or special lighting system corrections, repair, or upgrades.

Upgrade electrical systems and lights plans as lighting systems are upgraded or changed, and consider Energy Star Equipment whenever possible. Inform all maintenance personnel of changes.

## **Scheduling Group Re-lamping and Cleaning**

Proper planning of a group re-lamping schedule is critical. Waiting too long could result in higher number of burnouts and increased maintenance costs. Setting the schedule requires a review of manufacture information and coordination with the maintenance staff. Building O & M staff should work together to estimate optimal group re-lamping and then adjust schedules as actual operating conditions dictate actual bulb bur out rates.

Inform maintenance staff of the ballast type during replacement in order to determine the proper disposal method. Maintenance staff should never disassemble ballasts for disposal. Old ballasts must be properly disposed, due to heavy metals and toxin concerns.

Determine appropriate locations for posting group re-lamping schedule and include lighting O & M plan.

Maintain good re-lamping records to trigger the next scheduled group re-lamping.

Clean luminaries at the time of re-lamping. Use best practices procedures to accomplish this task.

### **Exit and Emergency Lighting**

Exit signs typically operate at all times, representing a significant cost and energy savings opportunity. LED's should be the first option at retrofitting and purchasing of new units for replacement.

Create a regular schedule for emergency lighting routine maintenance, including periodic testing and replacing failed components.

Perform a life cycle cost benefit analysis to determine if group battery replacement is cost effective.

### **Lighting Controls**

Lighting controls exist in many forms. The following options should be explored to help reduce the total energy load on campus.

- Occupancy and Motions Sensors-Infrared, Ultrasonic and Dual Technology sensors.
- Timers and Time clocks
- Daylight controls

# Plumbing Fixtures and Mechanical Systems

## **General Plumbing Fixtures and System Guidelines**

Water systems should be reviewed for retro-fit opportunities.

Periodically check safety and shutoff valves for proper operation. For faucets, clean aerators if the flow appears restricted or irregular. Inspect showerhead for deposits, debris, or build-up.

Test pressure relief valves and checks for trapped air.

Check manual or automatic bleeder devices for operability.

Check pumps and motors for circulation pumps for leaks, noise or vibrations. Test for proper pressure.

In areas where water quality is a problem, perform routine testing of water quality. Water quality testing is important for both public health and for the maintenance of the piping system.

Check domestic water circulator pumps for proper operation. Periodically check the flow rate through domestic water lines.

## **Fixtures**

### Toilet and Urinals

- When replacing tank-type toilets, specify toilet with the Water Sense label. (1.28 gallons or less)
- When replacing urinals, replace with high efficiency models designed to use 0.5 gpm or less.

Evaluate and, when possible, update systems to use non-potable water for toilet and urinal flushing. Package gray water treatment systems can provide water filtered and treated sufficiently for these uses.

Replace worn part and adjust mechanisms to ensure that the water consumed per flush meets manufacturer's original equipment specifications.

Correctly adjust and maintain automatic sensors to ensure proper operation.

### **Facets and Showerheads**

Install low flow aerators on lavatory faucets to reduce water use, or replace with code-compliant low-flow sensor faucet.

Encourage users to take shorter showers.

Replace all showerheads with high-efficiency fixtures or install flow restrictors in existing fixtures.

## **Water Heaters**

Evaluate each point of use in the facilities for hot water needs and determine if a tank-less water heating system can be employed to reduce stand-by heat losses from existing tank heaters.

Perform routine flushing to remove mineral deposits and extend the life of water tanks.

When possible, look at Solar Thermal Systems and compare the efficiencies and over all life costs.

## **Steam and Gas Lines**

Proper operation and maintenance of boiler and furnaces by trained staff is essential for occupant safety and efficiency.

Provide proper training for all staff that operate or maintain boiler and furnaces.

Establish written checklists for startup and shutdown of boilers.

Replace older inefficient boiler(s) when possible.

Check piping and periodically test pressure relief valve.

Check temperature and pressure controls.

Inspect, clean and adjust boiler according to manufacturer's specifications. Inspect the combustion chamber for cracks, deterioration or sign of incomplete combustion. Clean soot or condensate off of the exterior heat exchanger surface according to procedures recommended by the manufacturer.

After cleaning or maintenance of any repairs, check all connections for leaks after initial firing.

Check steam traps as scheduled

Check all gas appliances for possible leaks.



# Green Cleaning Practices, Equipment and Products

Green cleaning is a holistic approach to janitorial/housekeeping services. It takes into account the health, safety and the environmental risks of product and processes associated with cleaning, and balances this with need of the facility. Green cleaning involves the use of alternative products, application of the product in different ways, and evaluation and/or behavior shifts associated with how buildings are used to reduce risks, while maintaining a satisfactory level of cleanliness and disinfection.

## General Green Cleaning Best Practices

All effective green cleaning programs are built on using best green cleaning practices along with effective product, equipment and green cleaning methods. The following best practice applies for general green cleaning purposes across a variety of WOU facilities:

- **Reduce the need to clean** Use effective entrance matting systems to prevent soil, moisture and other contaminants from entering the facility. This reduces the need to clean, eases cleaning, protects floor from damage, and makes floor safer by reducing slipping.
- **Follow instruction and precautions provided by the manufacturer:**All products should be used following instructions or precautions provided by the manufacturer. Follow the instructions for diluting and mixing products before use, to avoid damage to surfaces being cleaned and/or leaving residues or hazardous gases.
- **Clean first, and only use a disinfectant or germicide if needed:** Surfaces must be cleaned thoroughly, whether or not disinfectants are used. If any product claims to be a disinfectant or sanitizer, then it must be listed as a WOU approved antimicrobial product. If the decision is made, then personnel must be trained in the proper use of these products and label direction must be followed.
- **Minimize the use of products that leave a scent in the room:** Fragrance formulations often are a complex mixture of chemical ingredients and often added purely for aesthetic reasons. Avoid using these products unless it is a natural fragrance used to improve cleaning performance or counter-act objectionable odor from the product or the environment being cleaned.
- **Purchase quality floor finishes:** A quality product finish handles wear and tear, requires minimal burnishing, is long lasting and facilitates easier removal of soil by dust mopping and daily cleaning. Floor should reach 5 to 10 years without needing to be stripped. Consider the impact and Life Cycle Cost of maintenance in choosing floor products.

- **Use Cold Water:** Experiment with green cleaning products that work with cold water. Products certified by Green Seal, Inc. are designed to work with cold water. This save money and eliminates the risk of burns from cleaning with hot water.
- **Vacuum carpets frequently prior to considering the use of any carpet cleaning products:** This helps maintain indoor environmental quality and extends the life of the carpet along with reducing the use of chemical and water based shampoo extraction products.
- Properly train all custodial and maintenance personnel. Conduct periodic monitoring to ensure personnel are properly following established procedures.
- Investigate the use of new cleaning technologies and equipment. New products often offer opportunity to conserve energy, improve safety, and reduce resource use and waste, and eliminate toxics.
- Purchase universal mounted dispersing/proportioning systems. These dispense chemical concentrate diluted with the right amount of water, to provide a ready to use mixture to spray bottles, mop bucket, auto scrubbers or any other receptacle.

### **Green Cleaning Plan**

Develop a green cleaning plan for the campus and train custodial staff on use of new products and practices.

Evaluate current cleaning products, methods, and equipment. Evaluation checklists are available at the US Department of Interior's website

<http://greeninginterior.doi.gov/buildings/index.html>

Refer to the" Green Seal "Products standard for all cleaning supplies used for Western Oregon University buildings.

<http://www.greenseal.org/GreenBusiness/Standards.aspx>

Identify which products contain hazardous substances that can be replaced by healthier alternatives. Phase in the selected new green cleaning products after current products are depleted.

Monitor progress and continually improve the program.

Keep a log of all cleaning chemicals used or stored on campus and attach MSDS and technical bulletins from the suppliers.

### **Green Cleaning Product Selection**

The following green cleaning product characteristics were developed and adapted from Green Seal, Inc. and should be referred to as guidelines for product selection:

- The undiluted compound shall not be hazardous to humans.
- The undiluted product shall not contain any ingredients that are known carcinogens or known to cause reproductive toxicity.
- The undiluted product shall not be a skin sensitizer.
- The undiluted product shall not contain substances that contribute significantly to the production of photochemical smog, tropospheric, ozone, or poor indoor air quality.
- The product used shall not be toxic to aquatic life.

- All organic ingredients in the product as used shall exhibit ready biodegradability.
- The product as used shall not contain more than 0.5% weight of total phosphorus.
- The primary packaging shall be recyclable.
- The product manufacture shall identify any fragrances on their MSDS.
- The manufacture's label must clearly and prominently state recommended dilution levels with cold water.
- The manufacture must also include detailed instruction for proper use and disposal, and for the use of personal protective equipment.

### **All purpose cleaners-**

- Use cleaners with a neutral pH instead of those with extreme pH factors.
- Use cleaners that are readily biodegradable.
- Use product with no or low levels of dyes and fragrances.
- Use products that have no or low VOS's.

### **General Degreasers/Disinfectants**

Degreasers: Choose products with D-Limonene (derived from citrus fruits) and methyl esters from soy and corn when possible.

Disinfectants: Choose products containing hydrogen peroxide when possible.

### **Bathroom Cleaners/ Disinfectants/ Urinal Deodorizer**

Prefer products with a more neutral pH (green bathroom cleaners may fall more in the range of pH 4 as compared to a pH below 1)

Use products that readily biodegrade and have no or low levels of dyes and fragrances.

Bathroom cleaners: surfactants, contains terms such as lauryl, amides, glycosides, citric or acetic acid.

Prefer antimicrobial ingredients that have a lower potential for persistence in the environment and to accumulate in living tissue compared to those with greater potential.

### **Lime and Scale Remover**

Choose environmentally preferable lime and scale remover with a pH in the range of pH 4 as compared to traditional products that may have a pH below 1.

Preferred ingredients: citric or acetic acid.

### **General Carpet Cleaning**

- Do not allow carpets to become too wet.
- Use general purpose cleaner whenever possible and reduce water use.
- Use equipment that provides maximum extraction of moisture from carpets.
- Use blower/dehumidifiers when needed.
- Waste, Energy and Water Reduction
- The green cleaning program should focus on the 3 R's: reduce, reuse, and recycle.

# Recycling and Waste Management

## **Reuse Expansion**

Work with Business office/Oregon State University/Non-profits/local community for reuse of reusable building materials/products. Try to eliminate the use of fuel and other costs for disposal or reuse of products with minimal recycle content.

Expand collection of polystyrene peanuts for reuse.

## **Recycling Collection**

Increase paper recycling each year.

Work directly with the vendor for paper recycling and other basic recyclables to resolve any contamination problems.

Increase the amount of scrap metal recycled each year.

Increase the collection of yard waste for composting every year.

## **Buying Recycled Products**

Increase the overall purchases of environmentally preferable products.

Increase the purchase of environmentally preferable products for University construction projects. Use the LEED standard to define environmentally preferable products.

## **Greenhouse Gas Emissions**

Show an increase in the reduction of greenhouse gas emission from recycling and waste prevention.

Western Oregon University goals are to target Zero-Waste.

Reduction of consumable goods including office supplies, fuels, and mechanical/electronic equipment is the primary strategy for preserving natural resources and keeping material out of the landfill. Reducing overall consumption offers the most benefit for lowering carbon emissions at WOU when compared with other waste management strategies, and therefore a priority area of focus for all WOU facilities.

## **Residence Hall move in and move out waste reduction program.**

Encourage students and staff to reduce waste by being proactive.

Educate staff and students in recycling opportunities along with waste management shall be ongoing with a zero waste goal along with reducing our carbon footprint.

During move in and move out for beginning and end of terms, proper recycling containers along with staff to monitor the flow of materials going into these containers is paramount. Work with nonprofit groups to assist with this duty as they can also take items that might have reuse to fill a need elsewhere.