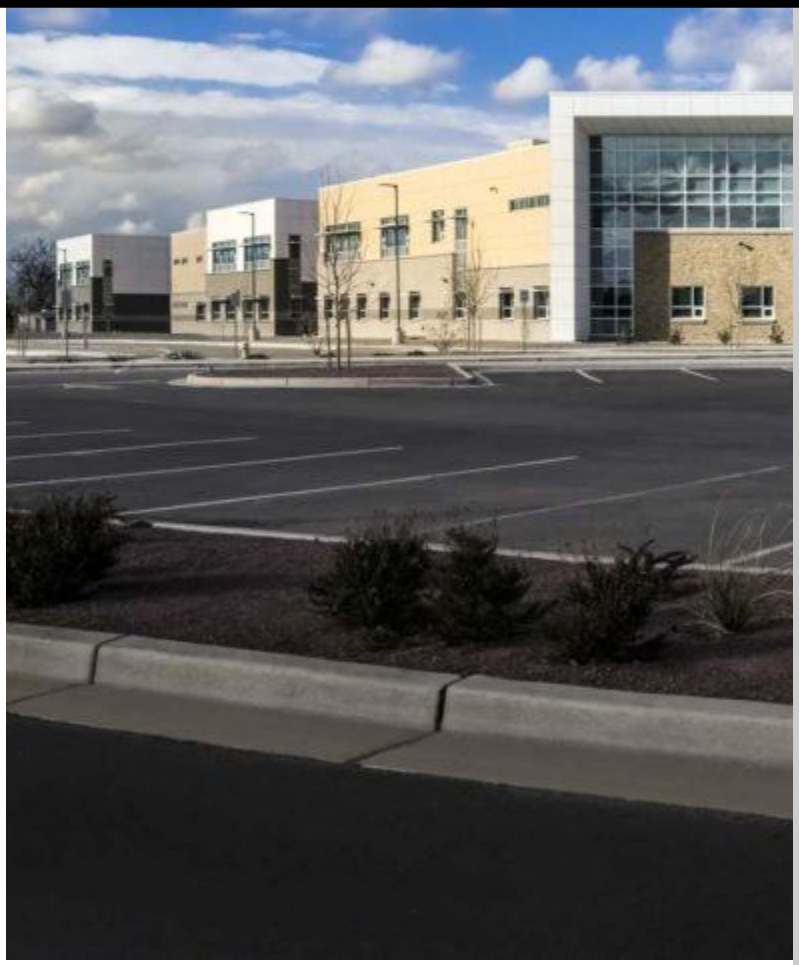
# Bernalillo Public School District



# PREVENTIVE MAINTENANCE PLAN

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# TABLE OF CONTENTS


| | |
|---|---|
| Executive Summary | 2 |
| Introduction | 4 |
| Purpose | 4 |
| Goal | 5 |
| Staffing Levels | 5 |
| Maintenance Approach | 4 |
| Maintenance Workflow | 4 |
| Maintenance Categories | |
| A. Building Envelope | 6 |
| B. Interior Doors | 8 |
| C. Walls, Floors, Acoustical Ceilings, and Stairs | 9 |
| D. Heating, Ventilation, and Air Conditioning (HVAC) | 10 |
| E. Lighting Systems | 12 |
| F. Plumbing Systems | 13 |
| G. Life and Fire Safety | 17 |
| H. Kitchen and Refrigeration Equipment | 23 |
| I. Custodial Services | 24 |
| J. Grounds-Landscaping, Parking Lots, Sidewalks, and Site Drainage | 25 |
| K. Playgrounds, Courts, and Athletic Fields | 28 |
| L. Site Utilities | 30 |
| Maintenance Priorities | 31 |
| Maintenance Key Performance Indicators | 31 |
| Life Cycle Cost Analysis for Facilities | 32 |

## EXECUTIVE SUMMARY

The Bernalillo Public School District (BPSD) is located within Sandoval County, with its administrative location within the Town of Bernalillo. BPSD provides quality education for communities ranging from Sandia Pueblo to the Pueblo of Cochiti, with various locations in between.

BPSD is led by a Board of Education and Superintendent who have set out to provide high-quality, culturally sustainable learning experiences, strong school leadership and quality education.

BPSD has nine (9) educational facilities with approximately 596,428 gross square feet and four (4) administrative/support facilities with approximately 40,980 gross square feet within its' facility inventory.

BPSD understands that although preventive maintenance seems like a simple practice, in theory it can become a daunting task when considering core business operations such as budget-cost control, scheduling, organizing priorities, keeping up to date with system data, and ensuring that productivity of facilities and equipment stays in compliance with manufacturers warranties and in keeping with best practices.

Effective facility Preventive Maintenance Plans (PMP) protect capital investments, ensure the health and safety of our children, and support educational performance. Without a PMP "preventative" maintenance quickly devolves into actual maintenance and staying ahead of the maintenance curve requires a formal PMP. In addition. An effective PMP can also provide BPSD with a proactive effort to reduce energy consumption and decrease costs.

Utilizing the New Mexico Public Schools Facility Authority's Facility Maintenance Assessment Report Strategy and the School Facilities Maintenance Task Force National Forum on Education Statistics and the Association of School Business Officials International (ASBO®) "Planning Guide for Maintaining School Facilities", BPSD has developed its PMP to ensure regularly scheduled maintenance activities are undertaken to help prevent unexpected failures in the future and also to establish benchmark key performance indicators in evaluating the effectiveness of PMP activities.

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## INTRODUCTION

Learning does not occur in a vacuum, students and staff thrive in an orderly, clean, and safe environment. Classrooms that are well ventilated, suitably lighted, and properly maintained, facilitate learning. Moreover, appropriate facilities maintenance extends the life span of older facilities and maximizes the useful life of newer facilities.

*"Nationally, the average age of a school building is from 49 to 50 years – the highest in memory. Some schools date back to World War II. But as schools get older and more desperate for repairs, the funding gap for public schools keeps getting worse. The American Society of Civil Engineers gives the condition of America's 100,000 public school buildings an overall grade of D+"*

*Christina Zdanowicz and Holly Yan, CNN*
*September 18, 2022*

To put this in context, the oldest BPSD school in use today, was originally constructed in 1957. While it has undergone many additions and renovations, the fact is that some of the existing infrastructure has been in place for over 66 years.

Preventative maintenance is defined as the necessary and scheduled maintenance performed on a piece of plant, equipment, or asset (buildings etc.) to lessen the likelihood of it failing. Unlike regular maintenance, preventative maintenance is the **proactive,** not corrective, or reactive maintenance performed while the equipment or asset is working. Put simply, it's about addressing things before they break.

Coupled together with the BPSD Facility Master Plan (FMP), the Preventive Maintenance Plan (PMP) has been developed to include the process for building a comprehensive picture of the physical conditions, the functional performance of BPSD facilities and infrastructure and those systems and their preventive maintenance standards which provide energy efficiency elements and reduces energy consumption and annual costs.

The PMP is built on the following steps:

1. A database of BPSD current facilities, assets, and equipment.
    a. BPSD currently utilizes Brightly (formerly FacilityDude) as its Facility Management software.
2. A business process for preventative maintenance schedules, tasks, and activities.
    a. BPSD shall develop maintenance category checklists.
3. Outline and implement the procedures, processes, and documentation behind the PMP.
4. Tracking and measuring the quality and outcomes of the PMP.

## PURPOSE

The purpose of this PMP is to establish guidelines for managing BPSD facilities and infrastructure systems, which includes building maintenance, custodial services, building occupancy, asset management, inspections, and energy conservation programs.

## GOAL

This PMP is designed to maximize the **efficiency** of each building system, minimize the need for major repairs and replacements, and to promote productivity, and maximize the maintenance budget.

In addition, each BPSD facility shall remain safe, accessible, and conform to all current code and safety requirements.

## STAFFING LEVELS

Maintenance staff includes maintenance managers, custodial specialists, and maintenance technicians. It is recommended that to adequately maintain facilities, BPSD staffing levels should not be less than two (2) maintenance technicians per 10,000 square feet of facilities.

## MAINTENANCE APPROACH

Utilizing the PMP will increase the useful life of equipment, reduce breakdowns, and provide a comfortable and safe environment for students and employees.

Preventive maintenance tasks associated with equipment and building systems should be scheduled as indicated for each building system.

Corrective maintenance activities should be generated from regular facility maintenance inspections, routine maintenance procedures, or routine technical operations. The goal is to have facility technicians or staff members noticing potential issues before they need an emergency response. Corrective maintenance should avoid most reactive maintenance work.

Reactive maintenance should be performed when there are unexpected problems with equipment operation. These activities are emergency or urgent responses to facility needs and activities.

All facility systems shall be documented including but not limited to model type and number, year of installation/replacement, physical location within facility, work order history, annual cost of operating and repairs, warranties, and manufacturer's maintenance schedules.

## MAINTENANCE WORKFLOW

All maintenance activities, including inspections shall be listed on the facility maintenance calendar. All details about materials needed for each work order, as well as spare parts needed, should be outlined in the work request description.

# MAINTENANCE CATEGORIES

## A. BUILDING ENVELOPE

It is important to create systematic processes to account for the steps necessary to maintain exterior building components such as windows and caulking, exterior walls and finishes, entry and Exterior doors, and roof, flashing and gutter systems, collectively the **Building Envelope**.

- **Windows and Caulking**: beyond routine window washing to keep glass looking clean, it's also imperative to ***inspect*** the indoor and outdoor framework of all windows. With seasonal changes and weather elements a window's frame can start to decay, damage frame assemblies, and create gaps in the foundation – perfect pathways for cold drafts, dust, water, and pests to enter the building.

  Inspection Point of Emphasis: Window systems should be inspected for proper working condition, especially if windows are deemed a secondary emergency exit, further supporting a secure facility. Investigate any water damage in or around windows and frames and follow up with minor repairs. Check the caulking around window frames, fill in the gaps and replace any caulking that has dried out. Deteriorated finishes and rust should also be repaired/recoated to prevent further damage. Repair or replace broken or cracked windows and graffiti should be removed in a timely manner.

  Inspection Schedule: Quarterly inspections are required of all facility window systems.

- **Exterior Walls and Finishes**: Building exterior finish (brick, stucco, CMU, paint, transition joints etc.) may appear firm and sturdy, however, over time and constant exposure to environmental elements, extreme temperature fluctuations, changes in weather, these systems are not immune to erosion.

  Inspection Point of Emphasis: If building cracks are not addressed in a timely manner, they can lead to more severe problems such as issues with the foundation, window and door frames and internal water seepage. Areas where utilities enter the building envelope should also be sealed to prevent any unwanted elements from getting in and damaging other systems.

  Inspection Schedule: Quarterly inspections are required of all building walls and finishes.

- **Entry/Exterior Doors**: Door systems are in constant use causing the finish to fade and paint to chip. Door systems will last longer and look their best when properly maintained. Although doors have great strength and durability, they are not immune to damage and require routine cleaning and maintenance to maintain working reliability, security, and a quality appearance.

  Inspection Point of Emphasis: Inspect exterior doors for any damage either to the door itself, the weather seals, and other components such as the hardware (closures, handles, hinges, latches etc.).

  Inspections should include but are not limited to:

- Cracks, splits, or signs of moisture in the frame or glass.
- Faded, cracked, chipped or peeling finish – simply refinish to refresh the look.
- Moisture and fog between glass panels. The presence of fog or moisture indicates that the seal between the glass is no longer intact.
- Damage to the weather strip and seal, which may include cracks, tears, gaps, or discoloration.

Exterior doors made of steel or aluminum are built for extreme durability, however exterior door hardware and hinges may need to be cleaned once a year with increased cleaning frequencies and maintenance on higher use doors. Maintaining entrance doors can also keep energy bills down by ensuring that your doors are sealed tightly supporting a well-insulated building. Weather-strip is a resilient material designed to act as a barrier in the space between the sash and frame to reduce air and water infiltration. Make sure it is still effective.

Inspection Schedule: Quarterly inspections are required of all entry and exterior doors.

- **Roofs, Flashing and Gutter Systems**: the most exposed part of the building envelope and probably the first to undergo damage from daily weather conditions and natural disasters.

  Inspection Point of Emphasis: Visual inspections after every rain or snowfall (light or heavy) to determine and repair small issues before they become large ones.

  Inspections should include the following:

  - Roofs: check for evidence of ponding, erosion and for debris build-up in the drains (and on roof) physical damage, vandalism or other problems. Ensure covers are on the drains & draining properly. Check the condition of parapets and for debris or equipment that needs to be removed.
  - Flashing: inspect flashing to ensure it is intact and in good condition around devices, drains, pitch pans etc. Check for wear & tear, deterioration, or physical damage.
  - Gutters: review gutters, downspouts and drains ensuring they are clean and free of debris and work as designed. Check splash blocks & canals for proper function, alignment & obstructions.
  - Skylights: inspect for evidence of leaks or broken lenses, glasses and seal integrity. Check that perimeter flashing is intact.

  Inspection Schedule: In addition to the manufacturer's warranty requirements, quarterly inspections are required of roof, flashing and gutter systems.

## B. INTERIOR DOORS

Interior doors are an important investment, and consequently it's important to maintain them to ensure that they provide: quality appeal, working reliability, energy efficiency and security for the occupants.

Interior doors get a lot of use and abuse day in and day out and constant use leads to wear and tear. Proper care and maintenance for interior door systems can save money on costly replacements. To ensure interior doors and their related hardware delivers effective use and long life, maintenance staff are required to perform inspections and testing and conduct repairs as required.

Inspection Point of Emphasis: Inspect all interior doors for any damage, either to the door itself, the weather seals, and/or other components such as the hardware (closures, handles, hinges, latches etc.).

Inspect door hardware and clean or replace any parts when needed.

- Examine the doors window interior and exterior finishes. Occasional repair to a damaged finish may be necessary.
- Inspect the exterior caulking around the outer edges of the door frame. Trim off any old, loose caulking and seal any gaps with a good quality new caulk.
- Check that all hardware (locks, opening mechanisms, etc.) operates smoothly.
- Make sure any exposed hardware screws are tightened securely.
- Clean any sand, dirt or dust from door and window hinges, sills, and tracks.
- Check any energy panels and storm and screen combinations to make sure screws in turn buttons are securely fastened.
- Check doors for smooth operation. Wood doors require a stabilization period after installation, sometimes taking up to a year to adjust to humidity levels and other environmental factors.

Inspection Schedule: In addition to the manufacturer recommended maintenance schedule, semi-annual inspections are required of all interior doors.

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## C. WALLS, FLOORS, ACOUSTIC CEILINGS, AND STAIRS

Walls, Floors, Acoustic Ceilings and Ceiling Grid and Hard Lid Ceilings, and Stair Systems undergo extensive wear and tear over their life span. As such, these systems require routine cleaning and maintenance.

- **Walls**: Under normal conditions, walls require repair and repaint on a bi-annual basis. However, if there are changes in the wall system that require repair and painting, this should be done as soon as possible.

  Inspection Point of Emphasis: Walls should be free from holes or missing pieces. Cracking or separation should be inspected to determine the reason for the cracking or separation. Conduct repairs as necessary

  Inspection Schedule: Semi-annual inspections are required of all wall systems.

- **Floors**: Routinely check for overall condition and cleanliness, physical damage, and trip hazards.

  Inspection Point of Emphasis: Flooring and baseboards should be intact and undamaged. Carpets should have no tearing or have severely worn areas that can be trip hazards. Thresholds should be intact and installed well with no loose areas. Conduct repairs as necessary.

  Inspection Schedule: Quarterly inspections are required of all floor systems.

- **Acoustic Ceilings and Ceiling Grid and Hard Lid Ceiling**: Routinely check for general conditions, physical or structural damage.

  Inspection Point of Emphasis: Stained, broken, or missing ceiling tiles, ceiling grids and hard ceilings (lids) should be inspected for damage. Conduct repairs as necessary.

  Follow up on identified stained ceiling tiles to determine the cause of the stain. .

  Inspection Schedule: Quarterly inspections are required of all ceiling systems.

- **Stairs**: Routinely check for the general condition of stairs, stair landings, and railings.

  Inspection Point of Emphasis: Stairs and stair landings should be intact and surfaces clean with no physical damage. Installed handrails should be in good physical condition with no trip hazards. Conduct prioritized repairs as soon as possible.

  Inspection Schedule: Quarterly inspections are required of all ceiling systems.

## D. HEATING, VENTILATION AND COOLING (HVAC)

HVAC systems are critical and without working systems a facility would be uninhabitable. A strong HVAC preventive maintenance program is a must have in any facility maintenance program to protect the assets and support the life of the facility, not to mention providing a comfortable internal environment for occupants.

Generally, the better an HVAC system is maintained the more likely the system will meet its estimated life-cycle.

All HVAC systems require manufacturer recommended cleaning and maintenance through both preventive and reactive maintenance efforts. Systems require this attention because high use and stresses producing minor defects are constantly at work. Regardless of the cause, the result is the same -- without routine scheduled maintenance the systems ultimately deteriorate before it is time.

Inspection Point of Emphasis: HVAC systems should be routinely reviewed for proper operations, minor repairs efforts and proper upkeep of sub-components supporting a safe and functional asset.

Two important areas at the core of any HVAC maintenance program are:

1. The manufacturers recommended performance and maintenance tasks for each piece of equipment.

   Maintenance and operations (M&O) manuals provided by the manufacturer shall be maintained and followed. These items are invaluable in providing a blueprint for the steps necessary to maintain roof top units, swamp coolers, chillers, boilers, motors, air handling units etc. - every piece of equipment in a building's HVAC system.

   These manuals must be readily available and are designed to assist with creating proper preventive maintenance strategies to support the life cycle and working reliability of the systems.

2. The overall operation of the system in relation to the school building in which it's installed.

Some aspects of an HVAC maintenance plan are simple - change the oil, check/change the belts, change the filters routinely (just like your car) and keep it clean. For example:

- Air-handler coils need to be cleaned periodically to maintain heat transfer efficiencies.
- Boilers need to be cleaned annually as even 1/16 inch of soot and ash on heat-exchange surfaces in an oil-firing boiler can reduce efficiency by 10 percent.
- Measured fire testing and flame adjustments on boilers should be considered every three years.

Maintenance Recommendations:

- Proper operations and maintenance of HVAC systems and components is critical to the environmental comfort of the occupants and a properly balanced energy efficient reliable building.
- Detailed preventive maintenance tasks should be created based on manufacturer recommendations and best practices to assist in maintaining a quality working system.
- Accurate inventories should be maintained. Systems should be reviewed on a scheduled basis for unusual noises / vibrations or leaks / filters & belt changes / loose or exposed wires, cleanliness of coils, rust or premature deterioration of system components.
- Heating & cooling systems should work as designed & operate properly.
- Ventilation – return air vents (combustion air) should be unobstructed & no damage is present.
- Boiler inspection/certifications and maintenance tasks should be developed.
- Pressure gauges, motors and pumps should be functional.

Best Practices:

- Maintaining historical records of service being performed and when it was performed is also important to be able to see trends and better predict what should be done or adjustments in maintenance to continue to optimize performance and system reliability.
- Placing basic maintenance stickers on your equipment is another way to keep maintenance staff apprised of the work that has been done on a system's many sub-components. A simple decal placed on the equipment that lists the last time the equipment was serviced, what was done (filter change, cleaning), and who serviced it is invaluable and easily identified through a quick visual check.
- Proper skillset and training - The most finely crafted preventive maintenance program is only as good as the people who manage the process. The more you and your staff know about your facilities HVAC systems, the better it will be maintained.
- Hiring qualified staff who can be taught and who want to learn is important.
- Have all system M&O manuals readily available.
- Develop formal training process and provide refresher sessions at periodic intervals to keep up with industry trends and process changes.
- Prepare a life-cycle cost analysis when determining if either to repair or replace an aging HVAC system component.
- Report damaged system elements and coordinate repair immediately.

Inspection Schedule: In addition to the manufacturer's maintenance schedule, monthly inspections shall be conducted. In addition, trend log reviews to monitor equipment operation should be done quarterly. Annual detailed review for Physical conditions (to include equipment inventory updates) to ensure system are working properly and as designed.

## E. LIGHTING SYSTEMS

Education facility lighting systems are an important facet to the overall safety and security of exterior areas and critical to the learning environment. The lighting system should provide adequate light for the task at hand (interior vs. exterior, classroom vs. gymnasium) at an effective cost, and performance should continue over time.

When lighting fixtures are cleaned and re-lamped regularly through an effective preventive maintenance program, light output can be increased by as much as 25 to 30 percent, and when energy-reduction steps are taken that would otherwise lower light output, group re-lamping and cleaning often, more than compensate for the planned reduction.

Inspection Points of Emphasis: Lighting systems shall be inspected to ensure and address any issues that may be present to include but not limited to:

- Are lighting systems to include reflectors, covers, lenses, louvers, sockets ... clean of dirt?
- Do any of the lighting systems have signs of rust or other damage?
- Are correct replacement lamps being used?
- Are light fixtures clean?
- Do ballasts, transformers and drivers have the same performance characteristics?
- Do all ballasts have a published ballast factor?
- Are lighting controls operable?
- Are exterior lighting systems clean free of graffiti … and operable?

Inspection Schedule: Bi-weekly inspections are required.



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## F. PLUMBING SYSTEMS

An efficient operating plumbing system enables the delivery of clean, fresh water to keep buildings clean and properly sanitized. Taking care of the wide range of a facilities plumbing systems is essential to keeping clean water flowing and flushing waste.

Properly functioning plumbing systems have other benefits as well:

- Essential to good health, hygiene, and well-being of facility occupants and visitors.
- Maintenance of exterior landscaping systems.

The best way to avoid plumbing problems, keep energy costs down, and conserve is to make sure the many facets of a facility's plumbing system is working properly through a quality preventive maintenance program.

Inspection Points of Emphasis: Maintaining a building's plumbing system means checking for small leaks, efficient operation of fixtures, performing seasonal maintenance (which can reduce energy costs), and addressing issues before they become larger ones.

Areas that should be inspecting include but are not limited to the following:

- Hallway water fountains
- Backflow preventer assemblies
- Water faucet handles and valves for proper operation - water should not be coming out of the handles or valves.
- Water heaters
- Water softening systems.
- Toilets including drains, worn toiler flappers, and water inlets.
- Sinks including drains for speed of drainage.
- Showers including drains for speed of drainage and shower heads.
- Dishwashing machines.
- Washers.
- Boiler systems.
- Swamp cooling systems.
- Cooling towers.
- Building fire sprinkler systems.
- Grounds sprinkler systems.
- Shut off valves – any rusted or corroded shutoff valves should be considered for repair and replacement if necessary.
- Water leaks.
- Water line/pipes, valves and fittings

Best Practices: Any issues identified shall be addressed immediately, encourage custodial teams to report any issues and follow up and know where all shutoff valves are located. In addition, preventive maintenance is required to maintain the warranties and provide reliable working systems.

Change of seasons preventive maintenance:

Fall Maintenance:

- Review and prepare building pipes for the cold.
- Cover all outdoor spigots using a styrofoam insulation cover.
- Disconnect water hoses from the outdoor spigot.
- Shut off the water valves for outdoor spigots and drain water from outdoor water lines.
- Inspect outdoor faucets for drips and leaks.
- Insulate pipes in unheated areas of the buildings.
- Water Heaters work harder to keep water hot in colder months:
    - Review all manufacturer recommendations for information on seasonal maintenance.
    - Maintain water heater temperature settings at manufacturer's recommended temperature.
    - Flush out water heaters to remove sediment which can cause corrosion, reduces efficiency, and shortens a water heater's life span.
    - Maintain clear and unobstructed access to water heaters and surrounding inlets and outlets.
- Gutter Maintenance:
    - Clean debris from building gutters and drain systems.
    - Gutters must remain free of debris so that water can drain easily as it freezes and thaws throughout the fall and winter.

Winter Maintenance: Frozen pipes are one of the biggest concerns for building maintenance during the winter season. When water inside pipes freezes, it expands, causing pipes to burst under the pressure. A main goal in winter is preventing pipes from freezing.

- Insulate both warm and cold-water pipes, especially those located in areas vulnerable to freezing such exterior mechanical rooms.
- Eliminate building drafts.
- Check areas near waters supplies, such as in kitchens and bathrooms, exterior mechanical rooms etc. that house pipes which may be at risk for freezing.
- Indoor pipes prone to freezing or located in extremely cold weather areas need additional precautionary steps to reduce the risk of freezing.
- Maintain effective unoccupied building heating levels allowing warm air to circulate to keep pipes warm.
- Ensure the building envelope is effectively sealed (doors/window seals).
- Repair damaged seals to support BPSD's energy management plan.
- Ensure the building's heating system is working properly.
- Maintain proper building heating set points at unoccupied times to prevent pipes from freezing.

Spring Maintenance: Weather warms in spring, making building operators anxious to start spring cleaning, inside and outside.

- Indoors, check all drains and make sure they are working properly.
- Exterior, check for slow leaks around buildings.
- Check all pipes for signs of leaks, such as puddles or watermarks.
- Check drains that are not used often by pouring a gallon of water down them to fill the trap and prevent odors from entering buildings. Any drains that are slow should be snaked.
- Check water-using appliances, such as washing machines, dish washers, water softening, swamp coolers, and other systems for cracked, bulging, or otherwise worn hoses. Replace any worn hoses to prevent future leaks.
- Inspect toilet bowls and tanks for leaks.
- Clear gutters and downspouts of any bird nests, leaves or other debris that may have accumulated.
- Check for bird nests built in plumbing vents and remove.
- Turn on outdoor spigots to make sure they do not leak. If leaks or drips are detected, coordinate repairs immediately.

Summer Maintenance: Summers are the time to have outdoor plumbing systems inspected and preventative performed on the following:

- Grounds sprinkler systems will need routine maintenance to ensure systems are working optimally,
- Landscaping damage,
- Tree root damage,
- Irrigation systems.

Inspection Schedule: in addition to manufacturer recommended schedules, all plumbing systems should be inspected weekly.



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## G. LIFE AND FIRE SAFETY

It is critical that a proactive approach be developed to minimize damage and maximize response times.

Fire system components from fire extinguishers and emergency lighting to code compliant fire alarms and sprinkler systems all require scheduled preventive maintenance to ensure equipment reliability and proper operation. Generally, these systems require a qualified external service vendor to provide routine scheduled maintenance tasks to meet or exceed regulated and logistical requirements. However, it is a best practice to include the inspections of each component as outlined below.

As a part of a regularly scheduled maintenance program systems should be:

- Tested in accordance with NFPA Life Safety Code Standards.
- Broken or damaged equipment or systems should be replaced and/or repaired when required.
- A record of all work performed should be documented in your facilities database.

All fire systems require routine cleaning and maintenance and shall be routinely reviewed for proper operations to include cleaning to remove routine trash and debris affecting accessibility and proper operations, conducting minor repairs to subcomponents and proper upkeep supporting a safe and functional asset providing for a safe environment.

Regulations require fire equipment and systems to comply with a standard of performance and to be regularly tested, serviced, and maintained to provide occupant safety and equipment reliability. The benefits of this include:

- Increased equipment and systems life expectancy.
- Reduced operating costs.
- Reduced insurance premiums.
- Extended equipment.

**Accumulation of debris**: debris (trash, rubbish, wood pallets, large amounts of paper products etc.) shall not be allowed to accumulate in an unsafe or inappropriate manner. Storage closets shall be maintained in an organized fashion that allows clear, safe, and unobstructed access to stored supplies.

Inspection Point of Emphasis: visually inspect all areas around and within facilities.

Inspection Schedule: Monthly inspections are required of all facilities. In addition, during maintenance or service repairs, all areas around and within facilities shall be inspected. These type of inspections do not take the place of the required monthly visual inspections.

**Combustible decorations**: Combustible decorations shall be maintained at no more than 20% of the wall area in any department and UL Listed. Combustible decorations in egress corridors are prohibited. Combustible decorations should be kept away from heat producing devices and exit ways.

All approved exit doors shall be maintained free of all debris and combustible materials.

Inspection Point of Emphasis: visually inspect all areas within a facility.

Inspection Schedule: Monthly inspections are required of all facilities. In addition, during maintenance or service repairs, all areas within facilities shall be inspected. These type of inspections do not take the place of the required monthly visual inspections.

**Combustible Materials**: Rubbish or waste material in buildings shall be stored in containers or in rooms/vaults constructed of non-combustible materials. Metal containers with tight fitting covers shall be used for oily rags and similar materials. Combustible rubbish or waste material shall be removed from the building at least once each working day.

Inspection Point of Emphasis: visually inspect all areas around or within a facility.

Inspection Schedule: Monthly inspections are required of all facilities. In addition, during maintenance or service repairs, all areas within facilities shall be inspected. These type of inspections do not take the place of the required monthly visual inspections.

**Egress Exits**: all exits and means of access to those exits shall be maintained clear, operable from the inside, without the use of a key or special knowledge or effort and unobstructed at all times.

Inspection Point of Emphasis: visually inspect all egress exits within a facility. Exit doors shall not be locked, padlocked, chained, bolted, barred, latched, or otherwise rendered unusable.

Inspection Schedule: Monthly inspections are required of all facilities. In addition, during maintenance or service repairs, all areas within facilities shall be inspected. These type of inspections do not take the place of the required monthly visual inspections.

**Electrical Panels**: a clear and unobstructed means of access with a minimum width of 36" and a minimum height of 78"shall be maintained from the operating face of electrical breaker boxes, switchboards, and panel boards.

A minimum 36" unobstructed clearance shall be maintained and includes fire panels, electrical panels, transformers, and interior and exterior electrical utility boxes. Panels should have schedules available.

Inspection Point of Emphasis: visually inspect all electrical panels within a facility and all transformers and exterior utility box locations externally located.

Inspection Schedule: Quarterly inspections are required of all electrical panels. In addition, during maintenance or service repairs, all electrical panels shall be inspected. These type of inspections do not take the place of the required quarterly inspections.

**Exit and Emergency Lights**: installed emergency lighting in all buildings, suites or areas with exits or exit pathways is designed to illuminate the path of travel for the exit served. As such all exit and emergency lighting shall be operational and lit

Inspection Point of Emphasis: visually inspect exit and emergency lighting to ensure all lighting is operable and lit. in addition, a minimum of 36" clearance shall be maintained on all fire exit and emergency lighting.

Inspection Schedule: Exit and emergency lights shall be inspected weekly.

**Extension cords**: Extension cords shall not be used as a substitute for permanent wiring. Extension cords shall not be used for fixed or stationary appliances, such as vending machines, refrigerators, etc.

Extension cords shall be plugged directly into an approved receptacle, power tap, or multi-plug adapter and shall, except for approved multiplug extension cords, serve only one portable appliance. The condition of the extension cords shall be maintained in good condition without splices, deterioration, or damage. Extension cords and flexible cords shall not be affixed to structures, extend through walls, ceilings, floor, under doors, or floor coverings. The use of multi-plug adapters/surge suppression devices is prohibited unless UL approved. Unapproved multi-plug adaptors such as multi-plug extension cords, cube adaptors and strip plugs are prohibited. The exception is for power strips with circuit breaker or fuse overload protection.

Inspection Point of Emphasis: visually inspect buildings, suites, or areas for use of extension cords.

Inspection Schedule: Extension cords shall be inspected on a quarterly basis with an emphasis during fall and winter months.

**Fire Extinguishers**: fire extinguishers shall be maintained clean and clear of debris and trash with a 36" inch clearance. All extinguishers should be labeled, monitored daily and physically checked on a monthly basis. Types of Fire Extinguishers: Class of Fire Types of Extinguishers to Use Class A: Ordinary combustible materials, such as wood, cloth, paper etc. "A-B-C" - Pressurized Water Class B: Flammable liquids, such as oil, gasoline, kerosene, etc. "A-B-C", "B-C" dry chemical, Carbon dioxide Class C: Presence of energized electrical circuits (e.g.., electronic motors, electrical wiring and devices etc.) "A-B-C", "B-C" dry chemical, Carbon dioxide Class D: Reactive Metals "D" extinguishers only Class K: Oils and Fats "K" (for kitchens)

Inspection Point of Emphasis: visually inspect all facility fire extinguishers.

Inspection Schedule: In addition to the required Life Safety external inspections, monthly inspections are required.

**Fire Protection Equipment**: fire protection equipment, such as, fire panels, fire pull stations, fire extinguishers, fire exits, fire sprinklers, fire blankets etc. shall remain easily accessible and free from all obstructions to 36".

Inspection Point of Emphasis: visually inspect all facility fire protection equipment.

Inspection Schedule: In addition to the required Life Safety external inspections, monthly inspections are required.

**Flammable Liquids**: flammable liquids shall be stored in an approved metal storage cabinet (gasoline, acetone, thinners, alcohol-based hand sanitizers etc.). Material Safety Data Sheets (MSDS) shall be made available on all chemicals in use within the confines of the district facilities. A master list of chemicals (in-use) will be maintained at the district office.

Inspection Point of Emphasis: visually inspect all storage cabinets and binders.

Inspection Schedule: Monthly inspections are required.

**Hazardous Chemical Storage**: Hazardous Chemicals shall be stored in accordance with local, state, and federal regulatory guidelines and standards.

Inspection Point of Emphasis: visually inspect all hazardous chemical storage areas and MSDS binders.

Inspection Schedule: Monthly inspections are required.

**Overcrowding of Classrooms**: general occupancy standards, established by local fire code, will be followed to maintain a safe environment and prevent injuries.

Overcrowding of rooms with physical occupants or storage is strictly prohibited.

Clean aisles shall be provided for unobstructed and safe access to all exits and exit devices.

Equipment/debris should not be placed in such a manner to obstruct a means of exit or other fire safety device.

Inspection Point of Emphasis: visually inspect all classrooms to ensure aisle space is clear and unobstructed.

Inspection Schedule: Quarterly inspections are required.

**Portable Space Heaters**: portable heating devices are permitted only under emergency situations of nonoperating or failed heating systems and should not be used as a permanent source of heating. Portable space heaters pose an increased risk to all occupants and increase the risk of fires and injuries and they are allowable in student areas and classrooms, offices, conference rooms etc., provided they are always monitored by someone.

The heating elements of such devices are limited to not more than 212 F. All applicable fire codes and the manufacturer's instructions and/or user guidelines should be followed to ensure maximum protection against loss incurred using an electrical device.

**The use of portable propane, kerosene, or other fossil fuel heaters is prohibited within any school building.**

Inspection Point of Emphasis: visually inspect all classrooms to ensure no use of portable space heaters is occurring.

Inspection Schedule: At a minimum quarterly inspections are required, however during the fall and winter months, weekly inspections should be conducted.

**Storage**: Storage should always be kept a minimum 18" below sprinkler heads and 12" below ceiling level if the area is non-sprinklered. Storage areas should be maintained in a clean and well-organized manner to prevent items from falling and aisles should be free from debris or stored items. Floors should be kept clean and clear of stored items. Organized and unobstructed access to stored items should be maintained.

Inspection Point of Emphasis: visually inspect all classrooms to ensure aisle space is clear and unobstructed.

Inspection Schedule: Monthly inspections are required.

**Upholstery, drapes, and carpeting**: upholstered furniture, drapes and carpeting in general locations must be flame retardant as verified by the manufacturer. Upholstered furniture is not allowed in corridors as permanent furniture.

Inspection Point of Emphasis: visually inspect all classrooms to ensure aisle space is clear and unobstructed.

Inspection Schedule: Quarterly inspections are required.

**Mechanical / Electrical/ Boiler Rooms**: the inherent dangers and potential hazards associated with various types of complex equipment inside such spaces dictate that only authorized construction and maintenance personnel, and/or authorized contractors hired by the district, shall have access to, or shall enter, these rooms.

- Mechanical Rooms: Are designed to house mechanical equipment, and storage should not obstruct access to the mechanical equipment. The mechanical room must not contain any open flame or fossil-fuel fired heating equipment. The items stored in the mechanical room must be organized in an orderly and safe manner.

  Storage cannot obstruct access to electrical panels, fire extinguishers, fire alarm pull stations, and must be clear of all sprinklers located on a horizontal plane 18 inches below the sprinkler deflector.

  - If the items stored in the mechanical room are combustible (cardboard boxes, paper or plastic wrapping, linens, etc.) then the mechanical room must meet normal hazardous room requirements:

Inspection Point of Emphasis: visually inspect all mechanical/electrical/boiler rooms to ensure no obstructions exist. If they do, correct immediately.

Inspection Schedule: Monthly inspections are required.

- Ventilation: Boiler room ventilation (combustion air) should be unobstructed to ensure an adequate supply of oxygen. Proper ventilation is necessary to discharge the buildup of carbon dioxide.

Inspection Point of Emphasis: visually inspect all boiler rooms to ensure there are no obstructions and an adequate supply of oxygen is present.

Inspection Schedule: Quarterly inspections are required.

- Signage: All mechanical rooms should bear the name of the room at its entrance way. Doorways and interior sections of the mechanical rooms must be free from obstruction and clean. No storage of any type is permitted in any mechanical room. A valid fire extinguisher should be present and in reliable working order and the areas secured from unauthorized access.

Inspection Point of Emphasis: visually inspect all mechanical rooms are clearly labeled and there are no obstructions present.

Inspection Schedule: Semi-annual inspections are required.

- Fire Extinguisher Inspection:
    - Know the locations of all fire extinguishers through inventory and develop a floor plan of all locations for each facility.
    - Confirm extinguishers are visible, unobstructed, and properly installed/mounted in its designated location. Verify the locking pin is intact and the tamper seal is unbroken.
    - Examine the extinguisher for obvious physical damage, corrosion, defects, leakage, or obstructed/clogged nozzle.
    - Confirm the pressure gauge or indicator is in the operable range or position and lift the extinguisher to ensure that it is full.
    - Check the last professional service date on the tag. (A licensed fire extinguisher maintenance contractor/vendor must have inspected the device within the last 12 months).
    - Wipe down dust and debris from the device and/or clean out trash inside the storage container. Initial and date the back/front of the tag.

Inspection Point of Emphasis: visually inspect all mechanical/electrical and boiler rooms and each fire extinguisher.

Inspection Schedule: Monthly inspections are required.

## H. KITCHEN AND REFRIGERATION EQUIPMENT

Establishing a consistent preventive maintenance plan from cleaning to general maintenance for an educational facility's kitchens and refrigeration equipment is key to extending the life of important systems and preventing issues. Preventive Maintenance on key systems from refrigerators to freezers, and life safety systems to general cleaning, is necessary to support a quality, safe and consistent program.

Preventative maintenance ensures your equipment is performing at peak efficiency, supports lower energy costs, results in better tasting foods, and lengthens equipment lifespan.

Inspection Points of Emphasis: In addition to manufacturer maintenance requirements, requirements of the New Mexico Environment Department, inspection and corrective action/repairs shall be conducted of the following key operating systems:

- Refrigerators
- Freezers
- Hood systems
- Water softeners
- Ice machines
- Burners and electrical wiring
- Water heaters and proper temperature settings
- Gasket replacement
- Thermostat calibration and adjustments
- Lighting system repairs
- Descaling of water lines and boilers of equipment such as steamers, ovens, dish machines, etc.
- Pest control/management
- Gas burner/gas line inspections
- Routine and prioritized cleaning and disinfection of walls, floors, ceilings, and food preparation surfaces

Any issues identified shall be repaired as necessary. In addition, all repairs shall be documented in the BPSD facility management software system. BPSD shall also include systems in their annual capital improvement planning document.

Best Practices: It's important to keep students and staff in mind when planning preventive maintenance work in school kitchens. Academic breaks are the most ideal time to perform extensive maintenance, repairs or replacements. This allows maintenance staff to perform duties efficiently and won't get in the way of critical time frames for breakfast, lunches, and other meal preparations.

Inspection Schedule: In addition to manufacturers maintenance schedules, monthly inspections are required.

## I. CUSTODIAL SERVICES

Cleanliness is one of the most important considerations to ensuring a healthy and safe educational environment for building occupants. As such, it is highly important to maintain a clean and sanitized environment.

Environmental conditions such as salt, sand, dirt, moisture, and mud can build up over time leaving long-lasting, unappealing conditions and damage if not maintained properly. From daily cleaning routines and spring cleaning to summertime detailed cleaning, maintaining a healthy and clean environment is critical to reducing health issues and reducing absences.

Schools for a long time were considered hotspots for germs even in the best of times. With COVID-19 and flu factors now a daily part of our learning environments, parents and school employees are more concerned than ever before about cleaning educational facilities well enough to curb the spread of viruses and bacteria.

Inspection Points of Emphasis:

- Evidence of routine environmental cleaning occurring both interior and exterior.
- Inspection of cleanliness of restrooms, offices, classrooms, return air vents, high dusting, light fixtures, trash removal, duct diffusers, window sills, vacuuming and window washing.
- Organization of custodial closets.
- Evidence of Material Safety Data Sheets.
- Trash receptacles and recycle bins should be available and routinely emptied.

Inspection Schedule: Weekly inspections are required.



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## J. GROUNDS-LANDSCAPING, PARKING LOTS, SIDEWALKS AND SITE DRAINAGE

All BPSD educational facilities have their own unique identity, which provides parents, students, staff, and visitors with an understanding of what the facility is and does.

Exterior areas such as landscaping, parking lots, sidewalks, and site drainage systems all undergo constant environmental exposures, growth, use, wear and tear from vehicles and other environmental conditions such as water drainage, wind, and sunlight. These constant elements combined, over time, work to wear and break-down the systems.

**Grounds-Landscaping**: As the elements of the landscaping surfaces grow and expand they require constant maintenance and upkeep to ensure a safe and functional environment. From xeriscaping to sprinkler systems, grass to large trees, all facility grounds require routine cleaning and maintenance.

Inspection Points of Emphasis:

- Review for weed control, landscape materials management, xeriscape installed effectively/properly.
- Tree/shrub/branch management (grooming).
- Sprinkler damage or water leaks,
- Identify vandalism or graffiti and remove it immediately.
- Check for trash or debris.
- Fencing and gates should be operational with no evidence of damage/vandalism.
- Safety, risk hazards or physical property damage should be mitigated to prevent additional damage or risks.

Inspection Schedule: Daily inspections for problems including vandalism etc. Weekly for cleaning and general maintenance. However, this may be reduced in colder months and replaced with a snow removal processes. Monthly review for damaged category elements, vandalism and coordination of repair.

In addition, an annual detailed review for physical conditions to ensure category elements and conditions are intact and working as designed shall be undertaken.

**Parking Lots**: As asphalt surfaces undergo the process of constant use, conditions begin to wear and breakdown due to exposure to environmental elements such as water, sunlight, drain run-off, sand, gravel and chemical (oil) spills.

Concrete and asphalt deteriorates and can create hazardous conditions for drivers, pedestrians, students, and staff. Parking areas should be both functionally and aesthetically pleasing. The overall goals of implementing these requirements are to enhance, beautify, provide aesthetic curb appeal with the rest of the campus environment, while providing efficient parking, vehicular flow, and safe pedestrian access.

As imperfections in concrete or asphalt are one of the biggest causes of accidents in parking areas, paying attention to these conditions through proactive maintenance efforts will reduce risks and hazards.

Inspection Points of Emphasis:

- Parking lots are clean and are free from trash and debris.
- All signage is clearly marked and readable.
- All landscaping islands are groomed and free from trash and debris.
- Parking lots are free of sand, gravel, oil, and other types of debris.
- ADA parking and markings are clearly delineated.
- All parking blocks are marked with highly visible paint and securely anchored to the pavement.
- All parking lot striping and crosswalks clearly visible?
- All cracks and potholes are repaired as necessary.
- All parking lots are free from standing water and moisture.
- Is the parking lot showing signs of raveling?
- Is the parking lot showing signs of alligator cracks?
- Is the parking lot showing signs of upheaval?
- Does the parking lot have any signs of grade depression?
- Does the parking lot have any tree root intrusion?

Inspection Schedule: Quarterly inspections area required.

**Sidewalks**: Sidewalks and wayfinding path systems should be in good physical condition with visual evidence and characteristics that components are routinely cleaned and maintained including routine reviews for weeds in transitions, trip hazards, holes, spalling, excessive pitting, sidewalk cracks, lifting or uneven transitions.

Inspection Points of Emphasis:

- Vertical displacement greater than ½ inch (¼ inch if on an accessible route).
- Cracks or gaps greater than ¾ inch wide and ½ inch deep.
- Three or more cracks in a single sidewalk section.
- If 50% or more of a sidewalk section has spalling or chipping ½ inch deep.
- Divots or potholes greater than 3 inches in diameter and ½ inch deep.
- Chunks of loose concrete or slabs that move or wobble.
- Benches, signs or other objects that reduce usable width to less than 36 inches.
- Hoses or cords routed across walkways.
- Utility plugs, valves or other objects that protrude ½ inch or more above the walkway surface.
- Unsecured utility covers or grates.
- Tree limbs, bushes or other plants posing an obstruction.

- Rocks, sand, dirt, or other debris accumulating on the sidewalks.

Inspection Schedule: Monthly inspections are required.

**Drainage**: A system of landscape and plumbing systems designed to direct the flow of excess water (rain, snow) from the site away from the site/building. Some common components may include:

- Culverts.
- Catch basins.
- Manholes.
- Storm drains.
- Underground structures.
- Natural drainage features.
- Level spreaders.
- Splash blocks.
- Downspouts.
- Drain swales.
- Ditches.
- Retention and detention basins.

All are designed to maintain the conveyance of storm water, and urban runoff; protect property from flooding during storm events and control erosion. As systems undergo the process of constant use, conditions begin to wear and breakdown due to exposure and environmental conditions such as water, snow, drain run-off, sand, and other environmental elements, things can get unbalanced.

Inspection Points of Emphasis:

- Routine cleaning and maintenance.
- Water flow to minor adjustments in drain covers and adjustment in splash blocks.
- Review site drainage locations and identify signs of displaced soil and stone resulting from ineffective site drainage.
- Is erosion affecting any adjacent structures or hardscape such as foundations, sidewalks or retaining walls.
- Are there tirp hazards that shall be addressed?
- Are there any signs of structural damage that needs further review?
- Are drainage areas free of trash and debris?
- Are any landscaping areas affecting drainage areas?
- Are drainage areas free of sand or other elements?
- Is there proper slop for the conveyance of water to drainage areas?

Inspection Schedule: Monthly inspections shall be conducted.

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## K. PLAYGROUNDS, COURTS, AND ATHLETIC FIELDS

Playgrounds, courts, and athletic fields provide children and adults opportunities to run around outdoors, interact with others of the same age groups to improve physical fitness, explore and extend their physical abilities while having fun.

The manufacturer/designer/installer shall provide BPSD with completed inspection and maintenance procedures necessary to maintain the play equipment and surfacing systems. BPSD is responsible for performing the inspections and maintenance as recommended by the playground equipment manufacturers to assure the safety of the users and the function of the playground equipment and surfacing system and these records must be maintained.

Inspection Point of Emphasis: In addition to the required manufacturer's required inspection and maintenance procedures, the BPSD inspection and maintenance process begins with a thorough visual review of the entire playground environment down to each component. This process should be documented in the BPSD facilities management systems to assure its completeness and to provide insight into the maintenance history.

All equipment requires routine cleaning maintenance which includes general cleaning to minor nuts and bolt repair, they need this attention because high use and stresses producing minor defects are constantly at work. These stresses may be caused by constant and heavy uses, misuse, neglect, vandalism, temperature fluctuations etc.

Other inspections areas to be evaluated include:

- Clean and Debris Free: All systems shall be cleaned and free of trash and debris.
- Pest Control: Proper pest control is required to support safe environments. Pests such as ants can take harbor in sandy areas, larger pests such as groundhogs or prairie dogs can dig holes and cause damage to the sub structure creating unsafe holes leading to sprained ankles or falls.
- Surfaces: Surfaces shall be thoroughly inspected for surface condition, structural strength, and proper drainage.
- Tripping or physical hazards: Equipment hardware should be intact & in good working condition; no splintering/no paint surface splitting and no tripping hazard areas.
- Fencing: Shall be in good condition and secure.
- Graffiti should be managed.

In all cases with playground equipment issues, it is important to determine the cause(s) as this will facilitate repairs that will both correct the defect and prevent its recurrence.

When equipment is damaged, it should be repaired or replaced immediately. If this is not possible it should be removed from service until proper repairs can be made. To avoid playground injuries there should be no loose, damaged or missing supports, anchors or footings; no loose or missing nuts, bolts or protective caps; no broken or missing rails, steps, rungs or seats; no deformed hooks, shackles, rings hangars or chains; no exposed mechanisms that could pinch or crush fingers, no splinters or deteriorated wood, no cracks or holes in the surfacing material; no trash in the area; and no environmental hazards such as roots, rocks or puddles.

Inspection Schedule: Monthly inspections are required.



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## L. SITE UTILITIES

While each educational facilities' site differs in make-up, size and structure they all share in the commonality of having various site utility systems that interface with the facility. These may include water supply systems, sanitary waste, electrical systems, communication, security, and storm water systems.

Like other components, these systems require general maintenance up to advanced maintenance including electrical panel heat maintenance as systems age and sprinkler manhole cover replacements as examples. As systems age more maintenance may be required to ensure equipment reliability, safety, security, and proper accessibility. As such, it is important to ensure they are protected from tampering or exposure to potential injury.

Site utility systems should be in good physical condition, secure, locked, physically protected, well kept, clean, and labeled with evidence of routine maintenance/cleaning occurring. Utility manhole covers and sprinkler boxes should be intact, secure and locked. Areas should be equipped with proper signage placards identifying hazards and secure from inappropriate or unauthorized accessibility. Safety, risk hazards or physical property damage should be mitigated to prevent additional damage or risks.

Inspection Point of Emphasis: Site utility components and areas should be both functionally and aesthetically pleasing. Weed growth and other obstructions need to be removed and areas maintained properly. The goals of implementing these requirements are to provide safety and security, enhance, beautify, and provide aesthetic curb appeal with the rest of the campus environment, while providing proper and safe unobstructed accessibility to qualified staff.

- All electrical panels should be secured from unauthorized access, signage should be clear and legible, and components securely anchored.
- Wiring should not be exposed to the elements.
- Utility piping should be intact, joints and other exposed areas should be sealed and secure Manhole or access covers should be in place and in good working order.
- Utility piping should be securely attached to walls.

Inspection Schedule: Site utilities should be thoroughly inspected at least twice a year (or per manufacturer recommendations) for surface condition, structural issues, security, and safety. Any conditions that require repair or correction shall be immediately completed.

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## MAINTENANCE PRIORITIES

The Facility Manager is responsible for establishing an order of priority for all repairs. The highest priority should always be given to assets, pieces of equipment, or systems that affect the health and safety of individuals in the building.

The following levels were also adopted and should be prioritized by the facility manager according to the nature of the problem, as follows:

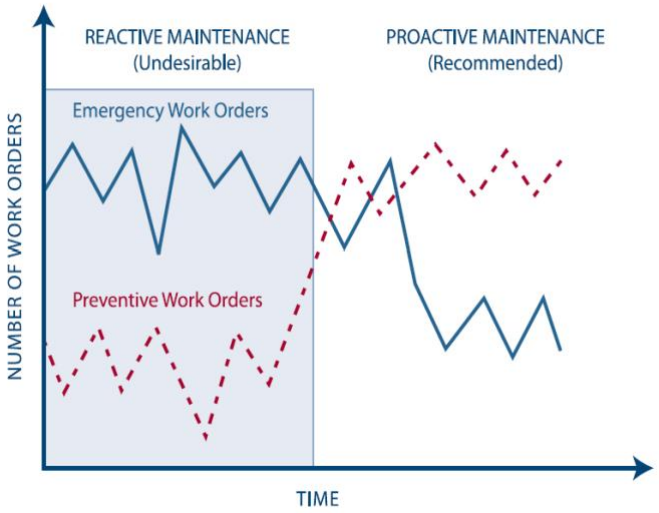
- Priority I: Emergency work orders that present an imminent or immediate danger to health, safety, security, or operational damage to buildings, equipment, or property should be taken as priority.
- Priority II: Urgent work orders that are considered to pose a threat of personal injury, equipment damage, or serious disruption of workflow, but are not considered emergencies hold a second-level priority.
- Priority III: Work orders associated with routine maintenance that do not pose a threat to employees' safety or serious disruption to the operation are not required immediate corrective action and should be taken as a third-level priority.

All other work order requests, that don't present risk, should be organized into the maintenance program to ensure project is scoped, budget identified and schedule developed.

## MAINTENANCE KEY PERFORMANCE INDICATORS

Once a base line is established, BPSD will utilize the following maintenance Key Performance Indicators:

1. Frequency of Inspections vs. Required frequency of Inspections.
2. Required Inspections vs. Actual Inspections performed.
3. Number of Preventive/Proactive Workorders vs. Reactive Workorders.
4. Cost avoidance of building systems rather than direct savings.
5. Reduced disruptions due to system failures.
6. Actual energy costs savings year 1 of implementation target of 2% reduction.




7. Annual Facility Condition Assessment of identified needs from previous annual Facility Condition Assessment.

## LIFE CYCLE COST ANALYSIS FOR FACILITIES

Life Cycle Cost (LCC) is the total discounted dollar cost of owning, operating, maintaining, and disposing of a building or a building system over a period of time.

BPSD is developing a Life Cycle Cost Analysis (LCCA) to be implemented during the design process for controlling the initial and the future cost of building ownership.

Although LCCA can be implemented at any level of the design process it can also be an effective tool for evaluation of existing building systems and LCCA can be used to evaluate the cost of a full range of projects, from an entire site complex to a specific building system component.

The effective use of LCCA is vital in demonstrating that a BPSD project request is not only the best solution for the BPSD, but also for the State of New Mexico.

The LCC contains three variables:

- Pertinent costs of ownership.
- Period of time over which these costs are incurred.
- Discount rate that is applied to future costs to equate them with present day costs.

Pertinent costs of Ownership: The first component in a LCC equation is cost which contains two cost categories by which projects are to be evaluated in a LCCA.

- Initial Expenses and Future Expenses. Initial Expenses are all costs incurred prior to occupation of the facility. Future Expenses are all costs incurred after occupation of the facility. Through the use of reasonable, consistent, and well-documented assumptions, a credible LCCA can be prepared. If costs in a particular cost category are equal in all project alternatives, they can be documented as such and removed from consideration in the LCC comparison.
- Residual Value: One future expense that warrants further explanation is that of residual value. Residual value is the net worth of a building at the end of the LCCA study period. Unlike other future expenses, an alternative's residual value can be positive or negative, a cost or a value.

Since a LCC is a summation of costs, a negative residual value indicates that there is value associated with the building at the end of the study period. Perhaps, the value is a roof that was recently replaced or it is the building's superstructure that could function for another thirty years.

Whatever the reason for the remaining value, it is a tangible asset of building ownership and should be included in the LCCA. A positive residual value indicates that there are disposal costs associated with the building at the end of the study period.

Perhaps, the costs are related to abatement of hazardous material or demolition of the structure. Whatever the cause, these are costs of building ownership and should be included in the LCCA.

Zero residual value indicates that there is no value or cost associated with the building at the end of the study period.

This rare instance occurs if the intended use of the building terminates concurrent to the end of the study period, the owner is unable to sell the building, and the owner can abandon the building at no expense.

Period of time over which these costs are incurred: The second component of the LCC equation is time. The study period is the period of time over which ownership and operations expenses are to be evaluated.

Typically, the study period can range from twenty to forty years, depending on owner's preferences, the stability of the user's program, and the intended overall life of the facility. While the length of the study period is often a reflection of the intended life of a facility, the study period is usually shorter than the intended life of the facility.

The study period is broken into two phases: the planning/construction period and the maintenance period.

- The planning/construction period is the time period from the start of the study to the date the building becomes operational (the service date).
- The maintenance period is the time period from date the building becomes operational to the end of the study.

Due to the uncertainty of construction funding and the short construction season, the planning/construction period can take several years to complete. To remove the uncertainty regarding the appropriate length of the planning/construction period and to simplify the LCC calculation, the department approves of the assumption that all initial costs will be incurred in the base year of the study. Thus, all initial costs will be entered into the LCCA at their full value. The BPSD recommended study period for LCCA is twenty years. This is due to population fluctuations within communities, the ever-changing nature of educational programs, the relative life span of individual building systems, and the reduced economic impact of costs incurred after twenty years.

The department's LCCA Spreadsheet is designed for a twenty-year study period. It can be used to evaluate project options for complete school facilities (new construction and renovation projects), as well as evaluate project options related to individual building systems (roof replacement projects, mechanical upgrade projects, etc.).

Discount rate that is applied to future costs to equate them with present day costs: The third component in the LCC equation is the discount rate. The discount rate, as defined by Life Cycle Costing as "the rate of interest reflecting the investor's time value of money."

Basically, it is the interest rate that would make an investor indifferent as to whether he received a payment now or a greater payment at some time in the future. BPSD takes the definition of discount rates a step further by separating them into two types, real discount rates and nominal discount rates.

The difference between the two is that the real discount rate excludes the rate of inflation and the nominal discount rate includes the rate of inflation. This is not to say that real discount rates ignore inflation, their use simply eliminates the complexity of accounting for inflation within the present value equation. The use of either discount rate in its corresponding present value calculation derives the same result. For simplicity, this handbook will focus on the use of real discount rates in the calculation of LCC for project alternatives.

As the economics change, so does the discount rate. To establish a standard discount rate to be used by BPSD, the department has adopted the U.S. Department of Energy's real discount rate. This rate is updated and published annually in the Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis – Annual Supplement to National Institute of Standards and Technology (NIST).

- Constant-Dollars: Discount rates can be defined as either real or nominal, and so can costs. The NIST, defines constant dollars as "dollars of uniform purchasing power tied to a reference year and exclusive of general price inflation or deflation."

  The NIST defines current dollars as "dollars of nonuniform purchasing power, including general price inflation or deflation, in which actual prices are stated."

  When using the real discount rate in present value calculations, costs must be expressed in constant dollars. Likewise, when using the nominal discount rate in present value calculations, costs must be expressed in current dollars. In the rare case that the inflation rate is zero, constant-dollars are equal to current-dollars and the real discount rate is equal to the nominal discount rate. In practice, the use of constant dollars simplifies LCCA.

- Present Value: To accurately combine initial expenses with future expenses, the present value of all expenses must first be determined. The NIST defines present value as "the time-equivalent value of past, present or future cash flows as of the beginning of the base year."

  The present value calculation uses the discount rate and the time a cost was or will be incurred to establish the present value of the cost in the base year of the study period. Since most initial expenses occur at about the same time, initial expenses are considered to occur during the base year of the study period.

  There is no need to calculate the present value of these initial expenses because their present value is equal to their actual cost. The determination of the present value of future costs is time dependent. The time period is the difference between the time of initial costs and the time of future costs. Initial costs are incurred at the beginning of the study period at Year 0, the base year.

- Future costs can be incurred anytime between Year 1 and Year 20. The present value calculation is the equalizer that allows the summation of initial and future costs. Along with time, the discount rate also dictates the present value of future costs.

  Because the current discount rate is a positive value (inflation), future expenses will have a present value less than their cost at the time they are incurred. Future costs can be broken down into two categories: one-time costs and recurring costs. Recurring costs are costs that occur every year over the span of the study period. Most operating and maintenance costs are recurring costs. One-time costs are costs that do not occur every year over the span of the study period.

Most replacement costs are one-time costs. To simplify the LCCA, all recurring costs are expressed as annual expenses incurred at the end of each year and one-time costs are incurred at the end of the year in which they occur.

To determine the present value of future one-time costs the following formula is used:

$$PV = A_t \times \frac{1}{(1+d)^t}$$

Where:

$PV$ = Present Value
$A_t$ = Amount of one-time cost at a time "t"
$d$ = Real Discount Rate
$t$ = Time (expressed as number of years)

To determine the present value of future recurring costs the following formula is used:

$$PV = A_0 \times \frac{(1+d)^t - 1}{d \times (1+d)^t}$$

Where:

$PV$ = Present Value
$A_0$ = Amount of recurring cost
$d$ = Real Discount Rate
$t$ = Time (expressed as number of years)

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