Appendix C

National Park Service
U.S. Department of the Interior

1201 Eye Street, NW, 10th Floor
Washington, DC 20005

Inspection Guidance: 2100 Trails

National Park Service
U.S. Department of the Interior

1201 Eye Street, NW, 10th Floor
Washington, DC 20005

TABLE OF CONTENTS

INTRODUCTION **1**

COMMON COMPONENTS AND CRITICAL SYSTEMS **3**

COMPREHENSIVE CONDITION ASSESSMENTS **4**

Tips for Inspections 4

Component Inspection Guidance 5

Barrier & Fencing 5

Fence/Gate 5

Generic Barrier 8

Cattle Guards 8

Furnishing ..... 8~~9~~

Exterior Furnishings ..... 8~~9~~

Benches ..... 8~~9~~

Signage & Marking 9

Sign 9

Structure ..... 12~~13~~

Base and Sub-Base ..... 12~~13~~

Stairs ..... 13~~14~~

Walkable Structure 15

Raised Trail Structures 15

Minor Trail Bridges ..... 18~~19~~

Wall ..... 24~~25~~

Retaining Walls ..... 24~~25~~

Surface ..... 26~~27~~

Land Surface ..... 26~~27~~

Paved and Unpaved Surfaces – Tread ..... 26~~27~~

Rock Excavation & Disposal ..... 27~~28~~

Plant or Vegetation ..... 27~~29~~

Social Trails ..... 27~~29~~

Clearing ..... 28~~29~~

Tree Removal ..... 28~~29~~

Stump Removal ..... 28~~30~~
Selective Thinning ..... 29~~30~~
Water Control ..... 29~~30~~
Culvert ..... 29~~30~~
Drain/Drainage Systems ..... 30~~32~~
Waterbars and Retainer Bars ..... 30~~32~~
RESOURCES ..... **34~~35~~**
REFERENCES ..... **34~~36~~**
RELATED DOCUMENTS ..... **34~~36~~**

National Park Service
U.S. Department of the Interior

1201 Eye Street, NW, 10th Floor
Washington, DC 20005

INTRODUCTION

This document contains the inspection guidance for trails. The asset records associated with a trail should be inspected using the guidelines in this document. In some cases, major electrical systems (e.g., lighting) or storage facilities will be present along a trail. When these assets are present, they should be inspected using the guidelines in the appropriate inspection guidance (e.g., Inspection Guidance – Buildings).

Trails have many different bridge types ranging from footbridges and footlogs to sophisticated, engineered bridges. As a general rule, any "major" trail bridge should be classified as a trail bridge location record (2200 asset category) separate from the trail location record (2100 asset category) in the Facility Management Software System (FMSS). A trail bridge should be considered a location record (2200 asset category) in the FMSS if: (a) it has a span greater than 20 feet or a vertical distance greater than 5 feet in height (excluding footlogs, boardwalks, and similar trail structures); or (b) it is determined to have user safety concerns. Otherwise, a trail bridge should be classified as an asset record of the trail location record (2100 asset category) in the FMSS. Trail bridge assets should be inspected and assessed using the guidelines in the document, "Inspection Guidance –Trail Bridges." Trail bridges that do not fall into these categories could be considered components of a trail and should be inspected using this document.

Any trail condition inspection should include a complete visual inspection of all constructed architectural, civil/structural, and mechanical components. A field inspection should be performed using both a system and component inspection method to identify all maintenance and repair deficiencies that need correction. The inspector should determine if there is sufficient evidence to warrant complete replacement of a system versus repairing only specific components of that system (e.g., replacing minor bridge decking as opposed to replacing the entire bridge).

A systematic approach to visual inspections must be employed to document all problems with a given trail. Some deficiencies announce themselves, such as washed out trail sections or boulder blockage. However, many deficiencies are more subtle and may require further examination (e.g., sloughing retaining wall).

During an inspection, the inspector should thoroughly document the information that will be needed in the preparation of cost estimates and inspection reports. At a minimum, the following should be recorded for each deficiency:

- The trail deficiency should be defined (e.g., trail location, trail grading, drainage, erosion, blowdown, encroaching vegetation).
- The corrective action should be specified with the appropriate verb (e.g., build/add, repair, replace, realign, adjust, relocate, remove, reopen, maintain, monitor).

- Location data should be provided with global positioning system (GPS) reading coordinates and/or a wheeled distance from a recognizable trail component, and, if possible, the geographical location should be marked on a map (e.g., 300 feet north, east, south, or west of a sign or crossing).
- Data should be quantified in sufficient detail to permit later development of budget-level cost estimates using the appropriate unit of measure (e.g., 3 rock water bars, each 8 linear feet). It may also be useful to note whether on-site or imported materials will be used.
- The relative priority of the deficiency should be noted as high, medium, or low.
- Additional comments or notes should be included that will help to define the project needs or special circumstances to consider.
- Immediate actions should be taken on safety issues found in a remote location during an inspection to mitigate identified safety issues.

While this document lays out universal inspection guidance, it does not establish one standard for all trails. Trails are constructed and maintained to different standards, as defined by a park unit's trail management plan and/or by the standard Trail Classification Standards. For example, a typical Class II trail will likely have more obstacles and more exposed rock and roots than a typical Class IV trail. These park-level standards must be considered when completing trail assessments and should guide the corrective action (and costs) to address identified deficiencies.

Trails should be assessed to identify the standard industry cost estimates of materials, supplies, and labor required to repair the deferred maintenance (DM) to a sustainable/maintainable standard in accordance with the design and use parameters assigned to that trail asset, such as its functional class. Work on a trail that alters an existing trail or new construction that helps an asset better meet its intended purpose should be classified as capital improvement (CI). Trail assessments should identify those repairs required to preserve a trail to a maintainable standard within its current functional class, move it to a sustainable design to reduce future maintenance, or establish it back to an appropriate identified historical context. Examples of trail issues to consider when conducting an inspection include the following:

- Tread that is restored or stabilized to an acceptable level according to local management policies
- Drainage systems that are completely working
- Corridor that is brushed to appropriate standard
- Cultural and natural resources that are stabilized/protected
- All constructed components (e.g., walls, steps) are operational and safe
- Trail that is able to withstand its current level of use
    - **Note:** Alterations made to trails to withstand future anticipated levels of use should be captured as CI – Alterations. In addition, alterations may trigger the need to evaluate the trail for accessibility compliance.
- Sustainable design and construction methodologies.

Trail assessments should document the work activities and repairs necessary to keep the trail operational within its existing functional class while mitigating the loss of cultural and natural resources and ensuring visitor safety. Major reroutes that significantly alter the trail alignment may be categorized as CI. The addition of features that would alter the level of functional classification should also be categorized as CI, such as adding pavement to an unpaved trail or allowing for new uses (modifications for stock use on former pedestrian-only trails).

Short or minor reroutes that do not significantly alter the trail corridor alignment or trail classification can be considered DM or component renewal (CR). Trail managers should note that it is not mandatory for trail repairs identified during an assessment to require restoration of a trail tread to its original design grade relative to the surrounding landscape. In some circumstances, it is not necessary, practical, or feasible to return tread to its original grade. Repair decisions should be made with consideration to park priorities, trail management plans, local trail management best practices, and identified historic standards. Recommended solutions to trail repairs should also follow a common sense approach, comply with local management policies, and acknowledge the limitations of work solutions in remote or wilderness areas.

When creating work orders based on the output of an assessment, please refer to the *Life-Cycle Business Practices, Volume 3* for lumping and splitting guidance.

COMMON COMPONENTS AND CRITICAL SYSTEMS

Table 1 lists typical classifications used for the trail asset category. Any classification in the FMSS can be used to categorize components of a trail, but the table contains those most likely to be used.

Table 1. Trail Component List

Top-Level Classification	Classification	Critical System
Barrier/	Fence/Gate	No
Barrier/	Railing	No
Electrical/	Lighting	No
Furnishing/	Exterior Furnishing	No
Marking/	Sign	No
Marking/	Pavement Marking	No
Structure/	Abutment	Yes
Structure/	Deck Structure	No
Structure/	Piling	Yes
Structure/	Platform	No
Structure/	Superstructure	Yes
Structure/	Wall	Yes
Structure/	Walkable Structure	Yes

Top-Level Classification	Classification	Critical System
Structure/Access/	Stairs	No
Structure/Base & Foundation/	Base and Sub-Base	Yes
Surface/	Land Surface	No
Surface/	Traffic Surface	Yes
Water Control/	Culvert	Yes
Water Control/	Drain	Yes

COMPREHENSIVE CONDITION ASSESSMENTS

TIPS FOR INSPECTIONS

For trail assets, an annual and comprehensive condition assessment requires the same diligence, accuracy, and time. Conducting annual assessments is not feasible and so parks should only complete comprehensive condition assessments. Comprehensive condition assessments must be completed every five years. There are two approaches parks can take to complete these comprehensive assessments:

- Conduct assessments on all assets once every five years. This approach requires parks to dedicate many resources during one year to completing the work.
- Complete comprehensive assessments on 20 percent of trail assets ever year. By assessing 20 percent of trails each year over a five-year timeframe, all trails in a park will receive a comprehensive assessment every five years.

It is recommended that assessors become familiar with one or more of the resources available (see References below) to understand different trail design, construction, and maintenance techniques. There are many methods for conducting a trail assessment. This inspection guidance only provides the basic information specific to the FMSS, but does not prescribe a specific methodology to complete the inspection. Assessors can use paper and pen, a Toughbook, or other handheld device to capture assessment information. Contact the FMP Help Desk to ask about available tools for conducting assessments.

Structures that make up the trail asset are integral to the integrity of the overall trail. Structures should be inspected in relation to how they impact other structures. In other words, structures should not be viewed as standalone, but rather should be inspected with an eye toward how they integrate with all the structures that make up a trail.

Below is a short list of items that may be useful during a field inspection:

- Fully charged GPS unit for collecting point and line data
- Digital camera with a fully charged battery and spares
- Sufficient storage space on the GPS unit and camera memory cards
- Paper maps, paper, and a pencil/pen for field notes

- Compass and measuring tape and/or measuring wheel
- Previous inspection information or a list of current work orders for that section of trail
- Necessary hiking gear.

COMPONENT INSPECTION GUIDANCE

Barrier & Fencing

Fence/Gate

Fencing and gates commonly found on trails include barbed wire, board, buck and rail, chain link, drift, open rail, picket, post and chain, privacy, riprap, split-rail, split-rail worm, stake and wire, and stockade. A more comprehensive list of fences (e.g., concrete, masonry or metal panels, security fences) is available in the document titled "Inspection Guidance – Roads."

A fence consists of a line of posts secured to the ground and connected with railings, pickets, planks, braces, and other fence members secured in place. Posts out of plumb may be checked by eyesight, string line, or transit. Wood gates are constructed with wood rails, pickets, planks, braces, and other members securely fastened into a single unit. Metal gates are fabricated with pipe/tube framing covered with metal chain link or other woven wire mesh, preformed panel, or metal laced fabric, and kept in shape with wires, rods, or turn buckles.

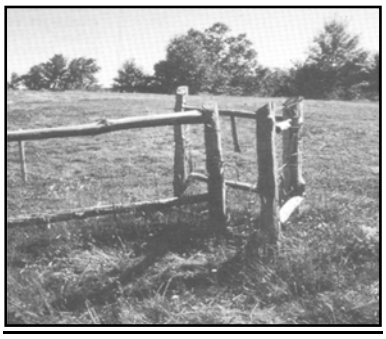

Figure 1. Dodgeway (© Appalachian Trail Conservancy)

Checks to be made:

1. Fence panels and railings (wood):
   - Splits/cracking/broken:
     - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
     - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
     - Physically damaged and broken

- Rot, fungus, or decay:
    - Moist stained area
    - Discolored, soft, or crushed area
- Parasite damage:
    - Holes less than ⅛ inch diameter, surface sag, and frass observed
    - Large holes greater than ⅛ inch diameter, surface channels, punctures, and crushing
- Out of plumb: more than 3 inches in 8 feet
- Erosion/vegetation:
    - Soil erosion under fence wall
    - Vines, trees, or shrubs climbing over or growing into fence

2. Fence posts (wood):
    - Splits/cracking/broken:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Physically damaged and broken
    - Rot, fungus, or decay:
        - Moist stained area
        - Discolored, soft, or crushed area
    - Parasite damage:
        - Holes less than ⅛ inch diameter, surface sag, and frass observed
        - Large holes greater than ⅛ inch diameter, surface channels, punctures, and crushing
    - Out of plumb: more than 3 inches in 8 feet
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vines, trees, or shrubs climbing over or around posts
3. Fence posts (metal):
    - Loose connections/anchorage:
        - Loose bolts or wire fasteners
        - Loose or bent pipe posts or railing
        - Missing or broken components
    - Out of plumb: more than 3 inches in 8 feet
    - Corrosion:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced by loss of base metal
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vines, trees, or shrubs climbing over or around posts
4. Fence posts (concrete):
    - Cracking:
        - Hairline crack

    - Wide cracks more than $^{1}/_{16}$ inch wide
    - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2 inches
- Spalling:
    - Less than 1 inch deep or 6 inches in diameter
    - More than 1 inch in depth or greater than 6 inches in diameter, or loss of more than 10 percent of surface area of a member
    - Disintegration of surface area, with corrosion of exposed reinforcing steel
- Scaling:
    - Loss of surface up to ½ inch deep, with exposure of coarse aggregates
    - Loss of surface from ½ inch to 1 inch deep with coarse aggregates clearly exposed
    - Loss of surface exceeds 1 inch, reinforcing steel usually exposed
- Reinforcing steel corrosion:
    - Rusting/discoloration evident
    - Cracks occurring parallel to reinforcement
- Out of plumb: more than 3 inches in 8 feet
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees, or shrubs climbing over or around posts

5. Fence piers (masonry/stone):
    - Deteriorated mortar joint material:
        - Cracked mortar joint material
        - Loose/missing mortar joint material
    - Out of plumb: more than 3 inches in 8 feet
    - Damaged bricks, stones or concrete masonry unit (CMU):
        - Cracked, split, damaged
        - Loose, missing
    - Erosion/vegetation:
        - Soil erosion around piers
        - Vines, trees, or shrubs climbing over or around piers
6. Gates (wood):
    - Defective gate:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Damaged or missing wood sections
    - Rot, fungus, or decay:
        - Moist stained area
        - Discolored, soft, or crushed area
    - Parasite damage:
        - Holes less than ⅛ inch diameter, surface sag, and frass observed
        - Large holes greater than ⅛ inch diameter, surface channels, punctures, and crushing

- Out of plumb: more than 3 inches in 6 feet
- Connections:
    - Loose wood at connection site
    - Broken, split, or damaged wood at connection site
- Missing fasteners or anchorage

7. Gates (metal):
    - Defective gate fabric:
        - Loose or sagging gate fabric
        - Damaged or missing gate fabric
    - Defective gate panels:
        - Loose gate panels
        - Damaged or missing gate panels
    - Loose connections:
        - Loose bolts or wire fasteners
        - Loose or bent pipe post/bracing
        - Missing or broken hinges, latches or other components
    - Out of plumb: more than ½ inch in 6 feet
    - Corrosion:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by loss of base metal

Generic Barrier

<u>Cattle Guards</u>

Trail structures not found in other sections include cattle guards.

Checks to be made:

1. Cattle guards:
    - Gaps or depressions on approaches to cattle guards that could injure animal or user

Furnishing

Exterior Furnishings

<u>Benches</u>

Typical trail “furnishings” include benches and hitch racks.

Checks to be made:

1. Benches:
    - Structural soundness of seating surface, backrest (if applicable), and base

- Gouges, wood slivers, and protruding fasteners (bolts and spikes) on seating surface and backrest (if applicable)

Signage & Marking

Sign

Signs are displayed to convey information. Four basic types of signs are common to NPS trails: identification signs, directional signs, information/education signs, and regulatory signs. Signs differ in purpose and size (e.g., small directional metal sign versus kiosk/bulletin board with a roof), and signs may be made of acrylic, aluminum, concrete, fiberglass embedment, fiberglass, glass, high-pressure laminate, laminate, masonry/stone, metal, plastic, recycled plastic, steel, timber, and wood.

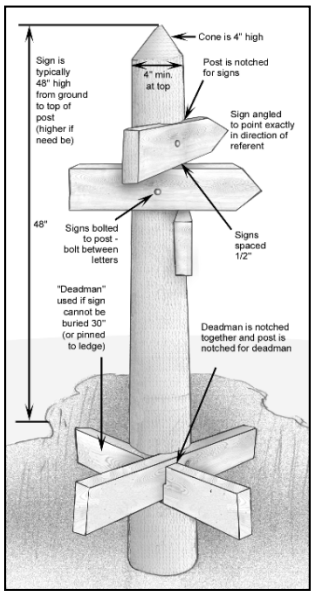

Figure 2. Timber Sign (© Acadia National Park)

Checks to be made:

1. Signage:
   - Missing sign resulting in noticeable damage, such as inappropriate social trails or resource damage
   - Signs contain incorrect information
2. Kiosk/bulletin boards:
   - Warped, rotting, or loose shingles on kiosk roof
   - Ultraviolet damage to Lexan/Plexiglas case, cracked or checked
   - Kiosk/bulletin board contains incorrect information
3. Signage (wood):
   - Loose, damaged, illegible, or missing sign face:

    - Loose sign face
    - Damaged sign face
    - Illegible sign face
    - Missing sign face
- Splits/cracks/broken posts:
    - Surface fibers separated, less than 25 percent of thickness affected
    - Surface fibers separated, greater than 25 percent of thickness affected
    - Physically damaged and broken
- Rot, fungus, or decay of posts:
    - Moist stained area
    - Discolored, soft, or crushed area
- Parasite damage of posts:
    - Holes less than ⅛ inch, surface sag, and frass observed
    - Large holes greater than ⅛ inch, surface channels, punctures, and crushing
- Out of level:
    - Less than or equal to 3 inches in 4 feet
    - More than 3 inches in 4 feet
- Out of plumb:
    - Less than or equal to 3 inches in 8 feet
    - More than 3 inches in 8 feet
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees, or shrubs climbing over or obscuring sign
- Decaying or leaning trees (if sign is mounted to tree)

4. Signage (metal):
    - Loose, damaged, illegible, or missing sign face:
        - Loose sign face
        - Damaged sign face
        - Illegible sign face
        - Missing sign face
    - Out of level:
        - Less than or equal to 3 inches in 4 feet
        - More than 3 inches in 4 feet
    - Out of plumb:
        - Less than or equal to 3 inches in 8 feet
        - More than 3 inches in 8 feet
    - Corrosion of posts:
        - Surface corrosion, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced loss of base metal
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vines, trees, or shrubs climbing over or obscuring sign
5. Signage (concrete):

- Loose, damaged, illegible, or missing sign face:
    - Loose sign face
    - Damaged sign face
    - Illegible sign face
    - Missing sign face
- Cracking:
    - Hairline crack
    - Medium cracks $^{1}/_{16}$ inch wide
    - Wide cracks more than $^{1}/_{16}$ inch wide
    - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2 inches
- Spalling:
    - Less than 1 inch deep or 6 inches in diameter
    - More than 1 inch in depth or greater than 6 inches in diameter, or loss of more than 10 percent of surface area of a member
    - Disintegration of surface area, with corrosion of exposed reinforcing steel
- Scaling:
    - Loss of surface up to ½ inch deep, with exposure of coarse aggregates
    - Loss of surface from ½ inch to 1 inch deep with coarse aggregates clearly exposed
    - Loss of surface exceeds 1 inch, reinforcing steel usually exposed
- Reinforcing steel corrosion: rusting/discoloration evident, cracks occurring parallel to reinforcement
- Out of level:
    - Less than or equal to 3 inches in 4 feet
    - More than 3 inches in 4 feet
- Out of plumb:
    - Less than or equal to 3" inches in 8 feet
    - More than 3 inches in 8 feet
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees, or shrubs climbing over or obscuring sign

6. Signage (masonry/stone):
    - Loose, damaged, illegible, or missing sign face:
        - Loose sign face
        - Damaged sign face
        - Illegible sign face
        - Missing sign face
    - Deteriorated mortar joint material:
        - Cracked mortar joint material
        - Loose/missing mortar joint material
    - Out of level:
        - Less than or equal to 2 inches in 8 feet
        - More than 2 inches in 8 feet

- Out of plumb:
    - Less than or equal to 3 inches in 8 feet
    - More than 3 inches in 8 feet
- Damaged bricks, stones, or CMU:
    - Cracked, split, damaged
    - Loose, missing
- Erosion/vegetation:
    - Soil erosion around sign footing
    - Vines, trees, or shrubs climbing over or obscuring sign

Structure

Base and Sub-Base

Base and sub-base are the compacted and prepared gravel, soil, or geosynthetic layers that are placed prior to the installation of the final surface (see Figure 3). Geosynthetics (e.g., geotextile, geonets, sheet drains, geogrids, geocells) are plastic or non-woven fabrics, sheets, nets, grids, or honeycomb-like mats usually made of polypropylene or polyethylene that can help stabilize the treadway. Inspection of base and sub-base applies primarily to unpaved, graded paths with non-native surfaces(e.g., off-road bicycle trails).

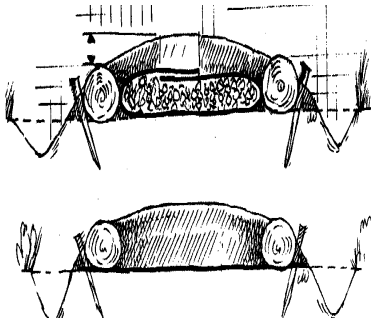

Figure 3. Geotextile Base (© ATC)

Checks to be made:

1. Exposed and/or worn out geosynthetic layer
2. Shoulders:
    - High shoulders (secondary ditches)
3. Standing water:
    - Standing water on the surface that seeps into the subgrade, causing a general softening of the entire path

4. Rutting:
   - Longitudinal depressions in the paths caused by high moisture content in the subsurface soil or base, inadequate surface course thickness, or heavy traffic loads
5. Depressions:
   - Localized low areas one or more inches below the surrounding tread surfaces caused by settlement, excessive moisture content, or improper drainage

Stairs

Stair steps may be made from stone, iron rungs, pinned steel, concrete, earth, treated timber, and/or log to armor a steep trail tread or to provide a means of ascension. Iron rungs are inserted into holes drilled in rock and provide a “step ladder” for crossing an exposed ledge.

Checks to be made:

1. Iron rungs:
   - Loose rungs
   - Corroded or cracked rungs
   - Missing rungs

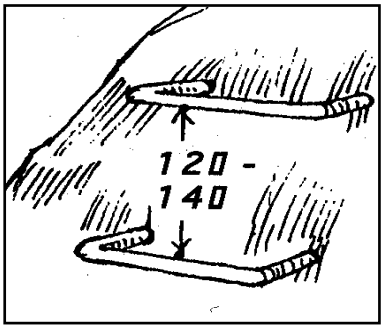

Figure 4. Steel Rungs (© ATC)

2. Log:
   - Loose or missing steps
   - Strength/sturdiness of ladder
   - Visible signs of decay

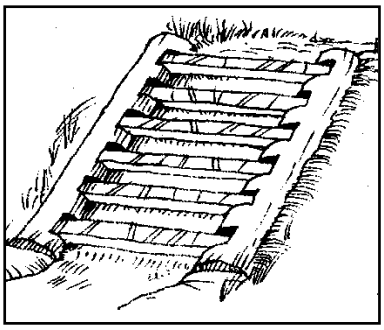

Figure 5. Step Ladder (© ATC)

3. Logs pinned to rock:
    - Loose or missing logs
    - Strength/sturdiness of logs
    - Corroded pins/loose pins
    - Visible signs of decay
4. Rocks pinned to ledge
    - Water has damaged edges of steps
    - Corroded pins
    - Loose or missing steps
5. Treated timber:
    - Water has damaged edges of steps
    - Loose or missing steps
    - Strength/Sturdiness of steps
    - Visible signs of decay
6. Stone steps
    - Continuous stone steps installed where trail grade exceeds 10 percent in order to harden the trail and prevent erosion
    - No steps are present where they should be
    - Water damage has dislodged steps or made them not level or loose
    - Steps are too small and likely to be dislodged
    - Steps are not keyed into the edge of the trail with rock
    - Steps are too high (greater than 10 inches high or evidence that hikers avoid them)
    - Stones are separated where they are intended to be congruous

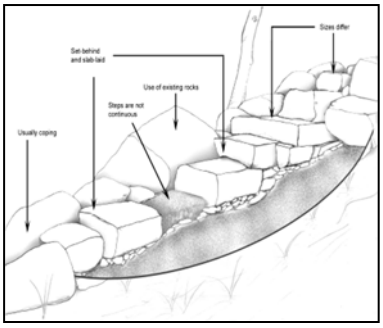

Figure 6. Rock Step (© Acadia National Park)

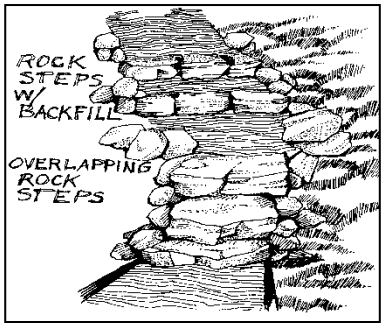

Figure 7. Rock Steps (© AMC)

Walkable Structure

<u>Raised Trail Structures</u>

Raised trails include elevated sections of trail, such as footbridges, turnpikes, and causeways, and different types of boardwalks, such as puncheons, bog bridges, and gadburies.

Turnpikes and causeways are elevated sections of trail, usually through permanently or seasonally wet areas. The terms are used largely interchangeably, although the outer walls of a turnpike are generally log and those of a causeway are rock. Both provide a dry, elevated tread through the muddied area and are constructed to allow drainage through the structure.

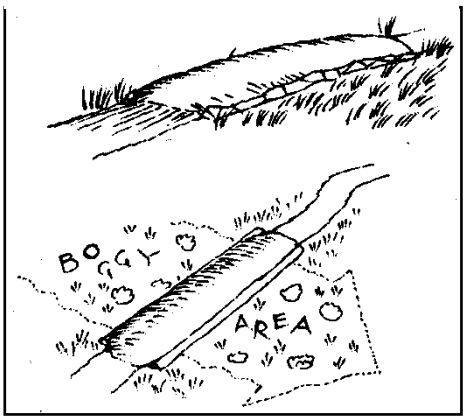

Figure 8. Turnpike (© ATC)

A puncheon is an elevated boardwalk used to cross boggy or marshy ground where uneven terrain or lack of trail tread material makes a turnpike or causeway impractical. Puncheons resemble a short version of the log footbridge. Its main components are sill logs laid perpendicular to the trail, two to three stringers laid on the sill logs parallel to

the trail, decking laid across the stringers and outer bull rails on the decking to pin the deck to the stringers and provide a degree of safety for stock and other users of the puncheon.

Gadburies also span muddy or boggy sections and allow for clear drainage. Gadbury components include sill logs, large deck logs, bull rails, and crowder rails.

Bog bridges (bogwalks) are simplified gadburies without rails of any kind and are also similar to the simplest puncheon. The difference between a bog bridge and a puncheon or gadbury may be in nomenclature only, varying from park to park or region to region. Check with local subject matter experts to confirm local naming conventions.

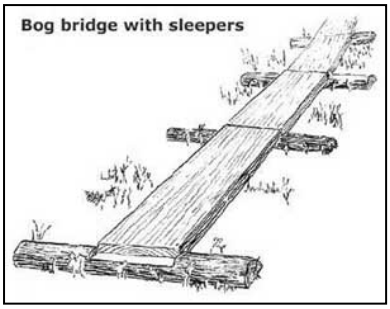

Figure 9. Bog Bridge(© Federal Highway Administration [FHWA])

Checks to be made:

1. Turnpikes (wood):
    - No turnpike structure where one is needed
    - Cross drainage – see if turnpike dams water, causing water to flow over trail
    - Depressed fill surfaces that may collect water
    - Check for washed-out tread within turnpike walls
    - Exposed fill (rocks) within turnpike walls
    - Loose joints or deteriorating log turnpike walls
    - Treadway crown is deteriorated

2. Causeways (rock):
    - No causeway structure where one is needed
    - Washed-out tread within causeway walls
    - Exposed fill (rocks) within causeway walls
    - Loose or missing rocks from causeway walls
    - Treadway crown is deteriorated

3. Bog Bridge (one or two stringers resting on sill logs):
    - No puncheon structure where one is needed
    - Broken bridge planks
    - Sloping planks, either side to side or along length of bridge

- Broken planks
- Missing sections of bridge
- Algae growth and slippery bridge surfaces
- Rusted or missing spikes

4. Puncheon (one or two stringers resting on sill logs):
    - No puncheon structure where one is needed
    - Broken bridge planks
    - Sloping planks, either side to side or along length of bridge
    - Broken planks
    - Missing sections of bridge
    - Algae growth and slippery bridge surfaces
    - Rusted or missing spikes

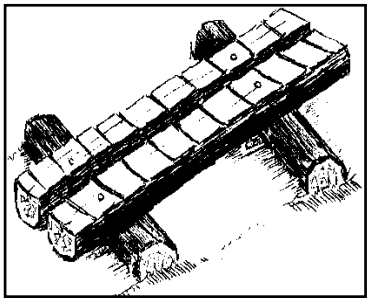

Figure 10. Puncheon (© ATC)

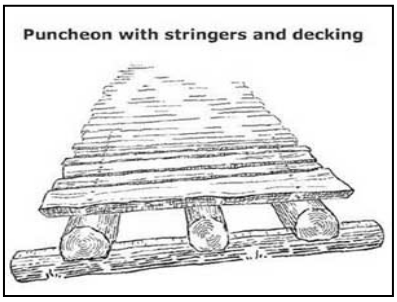

Figure 11. Puncheon (© FHWA)

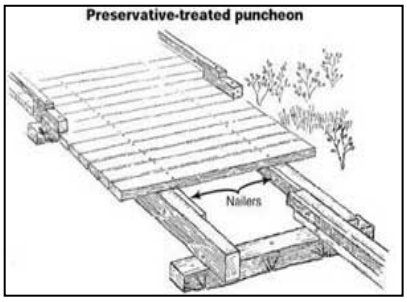

Figure 12. Puncheon (© FHWA)

5. Gadbury:
    - No gadbury structure where one is needed
    - Brush and other debris inhibiting proper drainage
    - Sinking, deteriorating, or buried sill logs
    - Splitting or decay in stringers
    - Missing, damaged, or loose decking logs
    - Missing, damaged, or loose bull rails

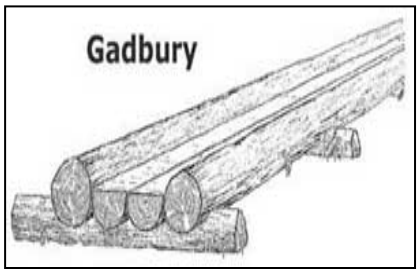

Figure 13. Gadbury (© FHWA)

6. Boardwalk:

- No boardwalk structure where one is needed
- Splitting or decay in stringers
- Missing, damaged, or loose decking logs
- Missing, damaged, or loose bull rails
- Missing or damaged railing

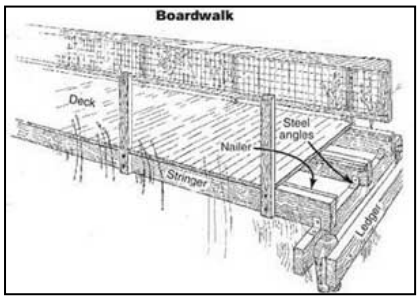

Figure 14. Boardwalk (© FHWA)

Minor Trail Bridges

This section includes trail footbridges that are not "substantial" in size. Bridges included in this category typically are small, do not carry vehicular traffic, span small bodies of water, and do not require inspection by a civil engineer. A trail bridge should be considered a location record in the FMSS (2200 asset category) if: (a) it has a span greater than 20 feet or a vertical distance greater than 5 feet in height (excluding footlogs, boardwalks, and similar trail structures); or (b) it is determined to have user safety concerns. Substantial trail bridges and those listed with the FHWA need to be classified as individual location records (Trail Bridge – 2200 asset category) in the FMSS.

Most of the non-substantial bridges to be assessed using the guidelines in this document can be broken down into the following components: substructure (e.g., abutment, footer, piling) and superstructure (e.g., girders, stringers, decking, railing, parapets).

Figure 15. Log Stringer Bridge(© FHWA)

An abutment is a substructure unit located at the end of a bridge. Its function is to provide end support for the bridge and to retain the approach embankment. The primary materials used in the construction of abutments for footbridges are stone masonry, timber, or a combination of these materials. A piling is a center structure designed to support the bridge at one or multiple midpoints.

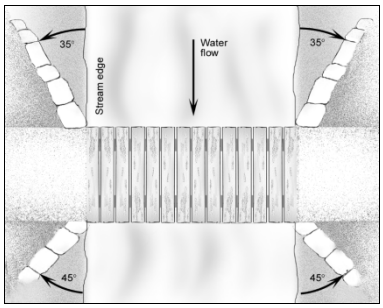

Figure 16. Abutment (© Acadia National Park)

The superstructure is designed to carry dead and live loads associated with the structural deck to the substructure (abutments/pilings). The superstructure includes primary members, a floor system with two or more main supporting members, secondary members, connections, and bearings. The main supporting members for footbridges are timber beams or timber trusses. Beams are considered single elements, while trusses have several identifiable parts: the chords (longitudinal members at the top and bottom of a truss) and the verticals and diagonals called web members. Bearings transmit and distribute the superstructure loads to the abutment and pilings, if present.

The primary function of a footbridge deck is to provide a surface over or through which pedestrian traffic can move and distribute the live and dead loads to the superstructure. Footbridges generally have noncomposite decks, which do not contribute to the structural capacity of the supporting members. A noncomposite deck only functions to span between supporting members and to provide a wearing surface for traffic.

The bridge railing is a fence-like construction built at the outer most edge of the bridge. The primary function of the bridge railing is safety—to guard and guide the movement of pedestrian and stock traffic.

Checks to be made:

1. Rock abutment or piling:
    - Cracks
        - Signs of water stain around cracks on the face of abutment
        - Visible signs of water seeping through cracks or joints in the abutment
    - Erosion or scouring at abutment or wingwalls, voids, undermining of abutment
    - Joints
        - Joint deteriorated with voids

    - Vegetation growing from joint
    - Loose stones
    - Mortar joint totally deteriorated
    - Masonry stone missing
    - Backwall and wingwall joints: joint separation or movement
- Stone deterioration:
    - Minor spalling and hairline cracks in stone
    - Spalling with cracks and chipping and loose stones
    - Masonry stone spalling with large cracks and chipping, section loss greater than 15 percent
- Rotational movement (some abutments are constructed with battered or slope front face):
    - Abutment walls rotated inward or outward
    - Wingwalls rotated inward or outward
- Breast wall bearing seat (critical where beam bears directly on the abutment wall):
    - Light spalling and chipping of concrete
    - Dirt and debris accumulated on bearing seat
    - Spalling and cracking of concrete at edge of seat
    - Severe spalling and cracking with crushing of concrete and exposed reinforcing bars
- Collision damage: member out of alignment; member cracked, crushed, or missing

2. Timber abutment or piling:

- Erosion or scouring at abutment or wingwalls, voids, undermining of abutment
- Breast/wingwall decay (decay from rot/fungus is most likely to occur at connections, splices, and support points or around bolt holes – this may be due either to the tendency of such areas to collect and retain moisture or to bolt holes or cuts being made in the surface after the preservative treatment has been applied):
    - Moist and stain or discolored area with signs of fungi although surface is solid
    - Surface spongy and member may show signs of crushing
    - Brown and white discolored area and member may show section loss and crushing
- Parasites in breast/wingwalls and pile lagging (termites, carpenter ants, powder post beetles):
    - Pinholes with dark stain area around the holes
    - Holes with surface sag and sawdust observed
    - Surface channels and crushing of the member
- Weathering:
    - Surface of wood is rough and corrugated and member may be warped
    - Surface of wood is rough and corrugated with cracks partially through the wood member, may have minor section loss
    - Member may be warped

    - Large cracks extend deeply or completely through the wood
    - Wood is crumbly and seriously deteriorated
- Rotational movement (some abutments are constructed with battered or slope front face):
    - Abutment walls rotated inward or outward
    - Wingwalls rotated inward or outward
- Bearing seat:
    - Moist and stained, surface solid
    - Dirt and debris accumulated on bearing seat
    - Moist and stained, surface soft, slight crushing
    - Area soft and crumbly and seriously deteriorated
- Collision damage: member out of alignment; member cracked, crushed, or missing

3. Concrete abutment or piling:
- Drains or weep holes:
    - Drains and weep hole clogged
    - Signs of water stain on the face of abutment around cracks
    - Visible signs of water seeping through cracks or joints in the abutment
- Erosion or scouring at abutment or wingwalls, voids, undermining of abutment
- Cracks and spalling:
    - Staining of concrete surface with signs of efflorescence deposit and spalling of cracks
    - Reinforcing bars exposed
- Scaling and popouts:
    - Loss of mortar
    - Exposed aggregate
    - Reinforcing bars exposed
- Backwall and wingwall joints: joint separation or movement
- Rotational movement (some abutments are constructed with battered or slope front face):
    - Abutment walls rotated inward or outward
    - Wingwalls rotated inward or outward
- Breast wall bearing seat (critical where beam bears directly on the abutment wall):
    - Light spalling and chipping of concrete
    - Dirt and debris accumulated on bearing seat
    - Spalling, cracking of concrete at edge of seat
    - Severe spalling and cracking with crushing of concrete and exposed reinforcing bars
- Collision damage: member out of alignment; member cracked, crushed or missing

4. Connections:
- Corrosion on gussets or connection plates:

    - Surface rust, no pitting evident
    - Corrosion evident, pitting and blistering of base material
    - Corrosion evident with loss to base section
- Corrosion on bolts:
    - Surface rust, no pitting evident
    - Corrosion evident, pitting and blistering of base material
    - Corrosion evident with loss to base section
- Connectors or fasteners:
    - Loose bolts or fasteners
    - Missing fasteners or connectors

5. Bearings:

- Expansion or fixed metal bearing:
    - Surface rust, no evidence of pitting, expansion bearing free to rotate
    - Dirt and debris accumulated around base of bearing
    - Corrosion, pitting, and blistering of base metal, expansion bearing free to rotate
    - Corrosion with loss to base section, expansion bearing frozen
    - Excess rotation of expansion bearing
    - Loss of bearing area due to lateral or longitudinal movement
- Elastomeric bearing:
    - Bulging of the bearing
    - Splitting or tearing of the bearing, including interior steel shims bond
    - Bond to the sole and/or masonry plate failed
    - Excessive longitudinal movement
- Excessive rotation movement, loss of bearing area due to lateral or longitudinal movement
- Pin and link bearing:
    - Surface rust, no pitting evident, joint free to rotate
    - Corrosion evident, pitting and blistering of base material
    - Corrosion evident with loss to base section, joint frozen
- Corrosion on sole and masonry plates:
    - Surface rust, no pitting evident
    - Corrosion evident, pitting and blistering of base material
    - Corrosion evident with loss to base section
- Anchor bolts:
    - Surface rust, no pitting evident
    - Loose anchor bolts, nuts or bearing
    - Corrosion evident, pitting and blistering of base material
    - Corrosion evident with loss to base section
    - Missing or broken anchor bolts

6. Timber deck:
   - Weathering and wear:
     - Surface of wood is rough and corrugated and member may be warped
     - Surface of wood is rough and corrugated with cracks partially through the wood member, may have minor section loss to the top surface
     - Warped members
     - Large cracks extend deeply or completely through the wood
     - Wood is crumbly and seriously deteriorated
   - Vibration per span:
     - Slight vibration in deck when users pass
     - Noticeable vibration in deck when users pass
     - Excessive vibration in deck when users pass
   - Collision damage: member out of alignment; shattered or injured timber member
   - Decay (decay from rot/fungus is most likely to occur at connections, splices, support points or around bolt holes – this may be due either to the tendency of such areas to collect and retain moisture or to bolt holes or cuts being made in the surface after the preservative treatment has been applied):
     - Moist and stained or discolored area, signs of fungi, surface is solid
     - Surface spongy, member may show signs of crushing
     - Brown and white discolored area, member may show section loss and crushing
   - Connections:
     - Loose fasteners
     - Member broken, split or damaged
     - Missing fasteners or anchorage
   - Parasites (termites, carpenter ants, powder post beetles):
     - Pinholes with dark stain area around the holes
     - Holes, surface sag, and sawdust observed
     - Surface channels, and crushing of the member
   - Deck missing: hole in deck
7. Timber railing and post:
   - Weathering:
     - Surface of wood is rough and corrugated and member may be warped
     - Surface of wood is rough and corrugated with cracks partially through the wood member, may have minor section loss
     - Warped member
     - Large cracks extend deeply or completely through the wood
     - Wood is crumbly and seriously deteriorated
   - Decay (decay from rot/fungus is most likely to occur at connections, splices, support points or around bolt holes – this may be due either to the tendency of such areas to collect and retain moisture or to bolt holes or cuts being made in the surface after the preservative treatment has been applied):
     - Moist and stained or discolored area, signs of fungi, surface is solid
     - Surface spongy, member may show signs of crushing

    - Brown and white discolored area, member may show section loss and crushing
- Parasites (termites, carpenter ants, powder post beetles):
    - Pinholes with dark stain area around the holes
    - Holes, surface sag, and sawdust observed
    - Surface channels, and crushing of the member
- Post connections:
    - Loose fasteners
    - Broken, split, or damaged
    - Missing fasteners or anchorage
- Corrosion at post anchors:
    - Surface rust, no pitting evident
    - Corrosion evident, pitting and blistering of base material
    - Corrosion evident with loss to base section
- Collision damage:
    - Railing out of alignment
    - Post out of alignment
    - Railing shattered or damaged
    - Post shattered or damaged member
- Vertical joint displacement due to substructure or bearing settlement
- Horizontal joint misalignment due to substructure or bearing settlement

Wall

Retaining Walls

These are structures used to prevent the flow or lateral movement of soil.

Trail retaining walls are typically made from wood, concrete, brick, flagstone, gabion, granite, metal, stone (drywall and mortared), or masonry/stone. The basic principles of dry laid (drywall) rockwork (utilizing the weight and the shape of the rock to create strong and long-lasting retaining walls) apply to all types of rock retaining walls.

Types of retaining walls include single-tier walls, multi-tier walls, and pinned walls. Single-tier walls are most frequently used to hold trail tread to a sloping sidehill with an outside wall. Multi-tier walls are used as outside walls holding trail tread; inside walls are used to protect the trail from slough-off, inside switchback corner walls, and in other situations, including fords, culverts, and causeways. Pinned walls are utilized over slick bedrock with few anchor points. Key rocks are pinned to the bedrock to “lock” the wall in place.

Log retaining walls (cribbing) are a stack of logs and rails tied and locked together and backfilled as with multi-tiered wall construction. Switchback corners are often a combination of these walls. Switchback corners are complex walls that may include an outside wall on the lower switchback, a nearly level landing with a waterbar or other

drainage structure, an inside-outside wall between the two switchbacks, and an inside wall above the upper trail.

Checks to be made:

1. Stone retaining walls:
    - Foundation movement indicated by changes in gradient of top tier
        - Eroding/missing layer of soil underneath foundation (footing)
        - Overhanging or loose rocks in foundation (footing)
    - Slipping joints/poor contact between rock on wall
    - Loose or missing rocks on wall
    - Missing fill between rocks on wall
    - Collapsing of wall
    - Loose or missing cap stones
2. Pinned rock retaining walls:
    - Loose or damaged pins
    - Exposed (hazardous) pins
3. Log retaining walls (cribbing):
    - Foundation movement indicated by changes in gradient of top tier
    - Eroding/missing layer of soil underneath foundation (footing)
    - Loose or deteriorating logs on wall
    - Loose or missing chinking on wall

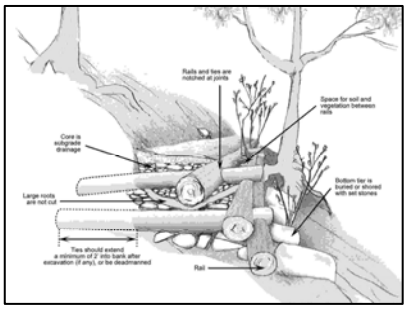

Figure 17. Log Retaining Wall (© Acadia National Park)

4. Switchback corners:
    - Signs of switchback cutting and erosion
    - Check for roots/brush
    - Waterbar blocked causing drainage to flow through switchback corner (ice buildup)
    - Check for debris; sediment should be distributed over trail under the drainage or added to backfill
    - Check if soil if too compacted/rocky

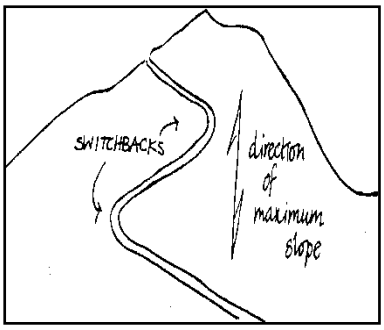

Figure 18. Switchbacks (© AMC)

Surface

Land Surface

Paved and Unpaved Surfaces – Tread

Tread is material that is placed atop the base layer to provide the walking, riding, or driving surface. Options include asphalt, concrete, gravel, native, paver block (cobble or other block stone), riprap (native rocks embedded in the ground), wood chips, or other materials (if other materials are used, these should be described in the inspection documentation).

For each trail, the management standards should define the frequency of obstacles and hazards protruding through the trail surface. As mentioned above, these standards should be based on Interagency Trail Data Standards guidelines for different classes of trails and/or the park's Trail Management Plan. For example, in general, for Class III through Class V trails, tread should be clear of loose rock, from roots protruding more than two inches, and from other obstructions that might be a hazard to trail users.

Native and gravel trails must be checked for gullies, berms, sloughing, and muddy or washed-out areas. Gullies should be repaired to prevent continued erosion and wash-outs. Gullies are natural ditches created by water rapidly eroding a section (or the entire width) of a trail. Gullies may be converted into inside (uphill) drainage channels.

Berms should be removed because they alter the natural drainage and runoff patterns across and off the trail and lead to severe erosion. Berms are accumulations of displaced soil that build up on the downhill side of a trail. They range in height from a few inches to six inches or more.

Slough is soil, rock, and silt that have accumulated on the inside of the tread at the base of the backslope, narrowing the width of the trail tread. Slough, muddy areas, and washed-out trail sections all force users to move upslope or down slope of the original trail tread and should be remedied.

Checks to be made:

1. Paved surfaces:
    - Alligator cracking: a series of interconnecting cracks resembling alligator skin or chicken wire, which usually occur in the wheel path
    - Longitudinal cracking: cracks that are parallel to the pavement centerline or asphalt lay down direction
    - Transverse cracking: cracks perpendicular to the pavement centerline
    - Potholes (or patches): a bowl-shaped hole in the pavement surface
    - Rutting: surface depressions in the wheel paths
2. Unpaved surfaces:
    - Minor surface hazards (exposed roots and loose rocks)
    - Gullies
    - Berms
    - Poor drainage, bogs, and mud holes
    - Sloughing
    - Washed-out/eroded trail sections(from heavy use or improper drainage)
    - Braids or social paths: multiple parallel trails caused by users avoiding obstacles described above
    - Trail width, either too narrow or too wide

Rock Excavation & Disposal

As with vegetation, boulder blockages force hikers and horses to move upslope or downslope of the original trail, potentially causing severe impact both to surrounding resources and to the trail itself.

Checks to be made:

1. Rock excavation and disposal:
    - Boulders blocking trails, forcing users off-trail, or creating safety hazards for stock and users

For user-specific design criteria and measurements, refer to the Forest Service Handbook and other applicable agency references.

Plant or Vegetation

Social Trails

Social trails are paths created not by the park but by trail users, often as shortcuts or as short extensions beyond the main trail. They are not maintained routes. If the park plans to leave the social trail intact, it should be listed as a trail asset and maintained as such. Otherwise, the park should block and rehabilitate the unauthorized trail. There are no specification templates for this category of trails. Instances of social paths are

deficiencies and should be noted as such. Work orders for repair of social paths can be linked to an asset record of tread or linked directly to the asset's location record.

Checks to be made:

1. Social trails:
    - Paths needing to be blocked that have been clearly established on the ground, or evidence of vegetation that has been cleared or damaged as a result of unplanned use

Clearing

Clearing is the removal of aboveground vegetation, including stumps. Cutting limbs and woody vegetation, and meeting clearance standards along the trail, should be considered cyclical maintenance. However, if needed brushing has not occurred regularly over an extended period, clearing (as required for a new trail) may be necessary.

Checks to be made:

1. Clearing:
    - Overgrowth from woody vegetation and other brush covering more than 20 percent of trail corridor

Tree Removal

Tree removal is the selective removal of trees on the site. Hazard trees are those in imminent danger of falling within the trail. "Leaner" trees are those that may interfere with the trail within 10 years. The NPS policy dictates that as much vegetation as possible should be retained. NPS staff with special training to recognize trees needing removal should participate in these assessments. When hazard trees are identified, there is a very short time frame in which they have to be removed. Any identified hazard tree deficiencies should be removed as soon as possible.

Checks to be made:

1. Tree removal:
    - Hazard and "leaner" trees that pose a danger to trail users or threaten to cause substantial damage to park resources

Stump Removal

Stump removal is the selective removal of stumps on the site. Various options exist for different sizes of stumps to be removed. Stump blockages force hikers and horses to move upslope or downslope of the original trail, potentially causing severe impact, both to surrounding resources and to the trail itself.

Checks to be made:

1. Stump removal:
    - Stumps blocking trails and forcing users off-trail

Selective Thinning

Selective thinning is the selective removal of trees and underbrush without requiring extensive clearing and/or grubbing of the site. For each trail, trail management standards should define the appropriate trail. “Corridor” or “prism” are terms relating to the width and height of the corridor that should be free from overhanging obstacles. A rule of thumb is to keep the trail corridor clear enough for the most heavily laden, large pack animal to pass through easily and safely. The corridor should be cleared on both sides and overhead. Additionally, trees that have fallen across trails need to be removed to make trails passable for users. Failure to do so results in users bypassing the trees, causing further damage to trailside soil and vegetation.

Checks to be made:

1. Selective thinning of rocks, briars, or woody vegetation:
    - Rocks, briars, or woody vegetation and limbs interfering with the trail corridor
2. Selective thinning of trees:
    - Trees that have fallen across trails and need to be removed

Water Control

Culvert

Culverts include construction and installation of culverts for storm water systems. Culverts are a type of drainage structure that allows water to flow over, across, and under trails. Such structures include stepping stones and trail fords, open culverts (either rock or wood), and closed culverts (metal, rock, or wood).

Checks to be made:

1. Open culvert (wood):
    - No culvert structure where one is needed
    - Overhanging or loose wood or logs in footing
    - Deterioration or decay of material
    - Loose or missing material
    - Open span appropriate for stock to step over (less than 16 inches) or step down and then back up onto trail (less than 24 inches)

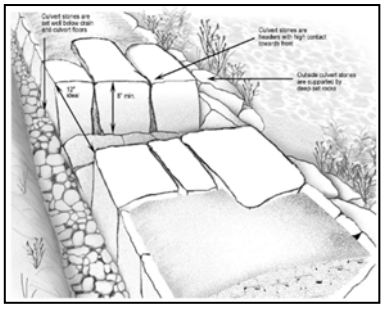

Figure 19. Open Culvert (© Acadia National Park)

2. Closed culvert (rock):
    - No culvert structure where one is needed
    - Overhanging or loose rocks in footing
    - Slipping joints/poor contact between rock on drywall
    - Loose or missing rocks on drywall and spanning rock(s)
    - Loose spanning rock, riprap, or trail tread material on spanning tread surface
3. All metal and concrete culverts:
    - No culvert structure where one is needed
    - Check for inadequate armoring of entrance and exit
    - Check for shallow gradient or culvert filled with silt
    - Check cover on culvert – see if culvert is being crushed or punctured
    - Erosion or scouring: voids, undermining of structure
    - Joints and connections to anti-seep collars should be completely watertight
    - Check for signs of physical damage, abrasions, or dents
    - Check for loss of protective coatings
    - Check for damaged connections and missing or damaged fasteners
4. Concrete culverts:
    - No culvert structure where one is needed
    - Erosion or scouring: voids, undermining of structure
    - Check for concrete deficiencies
5. Steel culverts:
    - No culvert structure where one is needed
    - Erosion or scouring: voids, undermining of structure
    - Check for signs of corrosion
    - Check for broken welds

Drain/Drainage Systems

<u>Waterbars and Retainer Bars</u>

Drainage systems for trails can be divided into three types of structures:

- Those that channel water along and off trails, such as waterbars, grade dips, and drainage ditches

- Those that protect the integrity of the tread as water flows down the trail corridor, such as checks, also known as retainer bars (the level of work required to install and maintain a check is similar in nature to that of a water bar, which is why they have been included in this section)
- Those that channel water over or below trails, such as trail fords and culverts (culverts are covered in their own section).

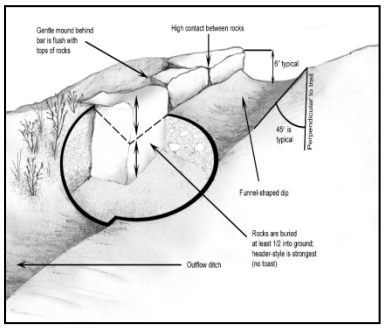

Figure 20. Drainage (© Acadia National Park)

The first type of trail drainage system seeks to maintain the “natural” flow of water on and off trails. The natural drainage pattern (the pattern which would occur most naturally without the presence of the trail) is reinforced by the presence of channeling structures, such as waterbars and dip drains (also called swales or “bleeders”). These channeling structures either force water off-trail or into drainage ditches along the trail. Waterbars turn and direct water off the treadway to the downhill side of the trail. Waterbars are made of rock, wood, or rubber. The angle of a waterbar across the trail depends on the gradient of the trail, the amount of water expected or drainage area of the waterbar, and the off-trail terrain. The ideal drainage allows the flow of the water off the trail to keep the waterbar clear of sand, soil, and debris.

Retainer bars are installed perpendicular to the trail corridor in the trail tread to reduce erosion in areas where water cannot be removed from the tread. Checks prevent the trail tread from rutting as water flows over and along the trail tread until it can be removed by a grade dip or waterbar. Checks also provide a backstop for sediments to collect and reestablish lost material on the up-slope side of the structure.

Grade dips are maintained features resembling depressions across and on the outer edge of a trail that allow water to flow off the trail freely, ideally without eroding the trail tread or creating gullies in the off-trail drainage. Maintained grade dips usually reinforce natural drainage points where waterbars have not been installed but where drainage does occur. Dip drains are often hard to see if they are full of sediment and have not been regularly maintained. Care must be taken not to overlook them during an inspection.

Checks to be made:

1. Retainer bars (wood):
    - No drainage structure where one is needed
    - High, hanging, or undercut checks (additional checks needed)
    - Loose anchoring or deteriorating logs
    - Missing fill
    - End of check exposed, users going around
2. Retainer bars (rock):
    - No drainage structure where one is needed
    - High, hanging, or undercut checks (additional checks needed)
    - Blockage of off-trail drainage by logs, rocks, or other debris
    - Loose or missing rocks
    - Missing fill between rocks
    - Loose or missing chinking
    - End of check exposed, users going around

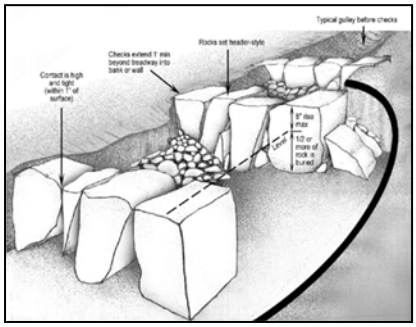

Figure 21. Stone Checks (© Acadia National Park)

3. Water Bars (wood):
    - No drainage structure where one is needed
    - Gradient of waterbar is too shallow, causing siltation
    - Water bar is built on top of the ground, diverting hikers and vulnerable to washing out
    - Earthen berm is absent below waterbar
    - Blockage of off-trail drainage by logs, rocks, or other debris
    - Width of off-trail drain: drain leading off-trail should be clear for a width of 12 to 8 inches
    - Missing fill between logs
    - Loose anchoring, deteriorating logs, or logs undercut by erosion
    - Missing fill
    - End of bar exposed, users going around
4. Water Bars (rock):
    - No drainage structure where one is needed
    - Gradient of waterbar is too shallow, causing siltation
    - Waterbar is built on top of the ground, diverting hikers and vulnerable to washing out

- Contact between rocks is minimal, allowing water to flow down trail
- Earthen berm is absent below waterbar, allowing water to flow down trail
- Blockage of off-trail drainage by logs, rocks, or other debris
- Width of off-trail drain: drain leading off-trail should be clear for a width of 12 to 8 inches
- Loose or missing rocks undercut by erosion
- Missing fill between rocks
- Loose or missing chinking
- End of bar exposed, users going around

5. Water Bars (rubber – not for pedestrian trails):
    - Blockage of off-trail drainage by logs, rocks, or other debris
    - Width of off-trail drain: drain leading off-trail should be clear for a width of 12 to 8 inches
    - Loose anchoring, deteriorating rubber, or rubber undercut by erosion
    - Missing fill
    - End of bar exposed, users going around
6. Grade dip (also called a swale, “bleeder” or dip drain):
    - Compromised/ineffective swale due to heavy use or incorrect construction or maintenance
    - Blockage of off-trail drainage by logs, rocks, and other debris
    - Width of off-trail drain: drain leading off-trail should be clear for a width of 12 to 18 inches

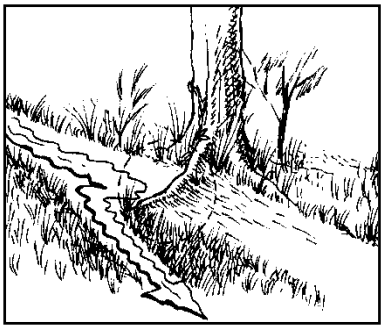

Figure 22. Bleeder (© ATC)

7. Drainage ditch:
    - Compromised/ineffective ditch due to heavy use or incorrect construction or maintenance
    - Blockage of drainage by logs, rocks, and other debris

The second type of drainage structure moves water over, across, and under trails. Such structures include stepping stones, trail fords, open culverts (either rock or wood), and closed culverts (metal, rock or wood). Culverts are covered in their own section. Stepping stones allow water to pond or flow naturally across the trail while allowing users to step on the elevated stones within the trail. An open culvert also allows water to flow across and off the trail. They are typically for intermittent water crossings and

are narrow and shallow compared to a ford. The width on a ford must be at least two feet, as anything less will present a hazard to stock stepping down into it. A closed culvert, in contrast, has a tread covering (a rock slab or wood) that allows traffic to pass over it while water flows underneath.

Checks to be made:

8. Stepping stones and fords
   - Loose or missing rocks in crossing
   - Undermining downstream
   - Blocked by sediment or debris

RESOURCES

Name	Work Group/Company Name	E-mail Address	Date Resource Added
Keith Johnston	Servicewide Trails Advisory Group	keith_johnston@nps.gov	4/12/2012
David Reus	Servicewide Trails Advisory Group	david_reus@nps.gov	4/12/2012
Shawn Wignall	Servicewide Trails Advisory Group	shawn_wignall@nps.gov	4/12/2012

REFERENCES

The following is a list of suggested references that parks may wish to use in developing their own trail standards:

- Birchard, Jr., William and Robert Proudman. *Appalachian Trail Design Construction and Maintenance.* Appalachian Trail Conservancy, 2000.
- *Trail Construction and Maintenance Notebook* (USDA FS, 9623-2833-MTDC).
- Demrow, Carl and David Salisbury. *The Complete Guide to Trail Building and Maintenance.* Appalachian Mountain Club, 1998.

RELATED DOCUMENTS

The following documents provide additional information on the asset category discussed in this business practice:

- Trail Asset Business Practice
- Trails Asset Best Management Practice
- Critical Systems List
- Life-Cycle Estimates
- Trails Toolbox on InsideNPS.

National Park Service
U.S. Department of the Interior

1201 Eye Street, NW, 10th Floor
Washington, DC 20005

Inspection Guidance: 3100 Maintained Landscapes

Version 2.1

Effective Date: January 25, 2017

End Date: Until Amended or Rescinded

Table of Contents

Introduction **1**
Roles and Responsibilities **2**
Common Components and Critical Systems **2**
Comprehensive Condition Assessments **3**
Safety 3
Tips for Inspections 3
Component Inspection Guidance 4
Barrier & Fencing 4
Fence/Gate 4
Traffic Barrier 9
Exhibit/Sculpture 10
Sculpture 10
Furnishing 11
Exterior Furnishing 11
Liquid and Gas/Plumbing 14
Fixture 14
Irrigation System 15
Marking 16
Sign 16
Structure 18
Deck Structure 18
Wall 19
Walkable Structure 20
Generic Structure 22
Structure/Access 22
Stairs 22
Structure/Base & Foundation 23
Base and Sub-Base 23
Surface 24
Land Surface 24
Plant or Vegetation 24
Traffic Surface 26
Trailer Pad 27
Turfgrass/Pasture Crop 27

Water Control 28
Culvert 28
Drain 29
Resources 29
References 30
Related Documents 30
Appendix A Inspection Guidance Change Log A-1

Introduction

This document contains the inspection guidance for maintained landscapes (ML). The critical components associated with a ML should be inspected using the guidelines found in this document. Where other asset types are collocated with a ML, these components should be inspected using the guidelines for that asset type.

All ML condition assessments should include a complete visual inspection of constructed architectural, civil/structural and mechanical components and managed vegetation. A field inspection should be performed using both a system and component inspection method to identify all maintenance and repair deficiencies that need correction. The inspector should determine if there is sufficient evidence to warrant complete replacement of a system versus repairing only specific components of that system.

A systematic approach to visual inspections must be employed to document all problems with a given ML. Some deficiencies are easily identifiable, while other deficiencies are more subtle and will require further examination to identify. Using a systematic approach reduces the likelihood that deficiencies will be missed.

During an inspection, the inspector should thoroughly document the information that will be needed in the preparation of cost estimates and inspection reports. At a minimum, the following should be recorded for each deficiency:

- The ML deficiency should be defined (e.g., hazardous tree limb, worn-out metal grate, sparse turf cover)
- The corrective action should be specified with the appropriate verb (e.g., build/add, repair, replace, realign, adjust, relocate, remove, reopen, maintain, monitor)
- Location data should be provided with global positioning system (GPS) reading coordinates and/or a wheeled distance from a recognizable ML component, and, if possible, the geographical location should be marked on a map (e.g., XYC battlefield). For landscapes, ML delineation boundary lines may need to be surveyed and mapped
- Data should be quantified in sufficient detail to permit later development of budget-level cost estimates using the appropriate unit of measure (e.g., plant 4-5 foot Bradford pear trees using a 48-inch tree space, apply 1 yard shredded bark mulch). It may also be useful to note whether on-site or imported materials will be used
- The relative priority of the deficiency should be noted as high, medium or low
- Additional comments or notes should be included that will help to define the project needs or special circumstances to consider.

Condition assessments of cultural landscapes should be conducted with an understanding of the preservation goals/objectives for individual assets and the landscape as a whole. Management goals for cultural landscapes, their associated condition, deficiencies noted and corrective actions recommended may differ from industry standard MLs. For example, contemporary ML industry standards would indicate that vines growing on wooden buildings should be removed to eliminate possible vegetative damage to the structure; in a cultural

landscape, vine coverage on a building may be necessary to meet preservation goals and should be retained.

While this document lays out universal inspection guidance, it does not establish one standard for all MLs. MLs are constructed and maintained to different goals, as defined by the park unit's management plan. These goals must be considered when completing ML assessments and should guide the corrective action (and costs) of addressing identified deficiencies.

One of the primary goals of the inspection/condition assessment is to capture the amount of deferred maintenance related to a landscape's condition. In a ML, it is important to recognize that individual features may be in good physical condition, but the historic character of the site may be compromised as a result of changes (e.g. paint color, materials, design, location). An assessment of a ML is intended to identify these deficiencies and recommend corrective actions that improve conditions while respecting and preserving landscape character.

Roles and Responsibilities

To successfully complete an inspection of a ML, it is highly recommended that maintenance staff include cultural and natural resource staff in the inspection, planning and correction of deficiencies. This will ensure that specific values of the assets/features are identified and that the cultural integrity is not compromised. In addition, park planning documents outlining management goals and objectives, such as General Management Plans, Cultural Landscape Reports and Cultural Landscapes Inventories should be consulted.

Common Components and Critical Systems

Table 1 lists typical classifications used for the ML asset category. Any classification in the Facility Management Software System (FMSS) can be used to categorize components of a ML, but Table 1 contains those most commonly used.

Table 1. Maintained Landscape Common Component List

Top-Level Classification	Classification	Critical System
Barrier/	Fence/Gate	No
Barrier/	Traffic Barrier	No
Exhibit/Sculpture	Sculpture	No
Furnishing/	Exterior Furnishing	No
Liquid and Gas/Plumbing	Fixture	No
Liquid and Gas/Plumbing	Irrigation System	No
Marking/	Sign	No
Structure/	Deck Structure	Yes
Structure/	Wall	Yes
Structure/	Walkable Structure	Yes
Structure/Access	Stairs	No
Structure/Base & Foundation	Base and Sub-Base	Yes
Surface/	Land Surface	Yes
Surface/	Plant or Vegetation	Yes
Surface/	Traffic Surface	No

Top-Level Classification	Classification	Critical System
Surface/	Trailer Pad	No
Surface/	Turfgrass/Pasture Crop	Yes
Water Control/	Culvert	Yes
Water Control/	Drain	Yes

Comprehensive Condition Assessments

Safety

All inspections should be conducted in accordance with guidance found in the National Park Service (NPS) Reference Manual 50B and related federal, state and local safety and health standards. Examples include:

- Occupational Safety & Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910
- OSHA 29 CFR 1926
- National Fire Protection Association (NFPA) Life Safety Code
- NFPA 70E: Standard for Electrical Safety in the Workplace
- U.S. Environmental Protection Agency 40 CFR.

In addition, inspectors should request current copies of all operating unit safety plans applicable to maintained landscapes before conducting the inspection. This will ensure that operating unit as well as required regulatory elements are taken into account.

Tips for Inspections

It is recommended that the park review all relevant inventory documents and the results of the most recent inspection before performing the condition assessment. Doing so will help familiarize the inspectors with the inventory and allow them to note previously reported deficiencies.

Below is a short list of additional items that may be useful during a field inspection:

- Fully charged GPS unit for collecting point and line data
- Digital camera with a fully charged battery and spares
- Sufficient storage space on the GPS unit and camera memory cards
- Blueprints, drawings, paper and a pencil/pen for field notes
- Compass
- Previous inspection information or a list of current work orders for the ML
- Necessary field gear (appropriate footwear, sun protection, clothing and rehydration equipment)
- Gloves
- Flashlight
- Magnifying glass
- Eye protection
- Binoculars
- Measuring tape/wheel
- Communication device (e.g., cell phone, radio).

While conducting ML condition assessments, digital photographs of the entire component and specific deficiencies should be taken. These digital photographs can then be loaded onto NPSFocus, and the FMSS asset number and other metadata may be added to the record in NPSFocus. Later, when developing a Project Management Information System (PMIS) project, the park can retrieve and link the photographs of the deficiencies that were uploaded to NPSFocus to the PMIS project.

Component Inspection Guidance

Barrier & Fencing

Fence/Gate

A fence consists of a line of posts secured to the ground and connected with railings, pickets, planks, braces and other fence members secured in place. Posts out of plumb may be checked by eyesight, string line or transit. Fencing and gates commonly found on MLs include those made of wood, metal, concrete and masonry/stone.

Gates are closable openings in a fence that permit people, animals and/or vehicles to move from one side of the fence to the other. Wood gates are constructed with wood rails, pickets, planks, braces and other members securely fastened into a single unit. Metal gates are fabricated with pipe/tube framing covered with metal chain link or other woven wire mesh, preformed panel or metal laced fabric and kept in shape with wires, rods or turn buckles.

Security components such as barbed, razor or concertina wire may be installed at the top of a fence or attached either directly to the posts or on a metal angle bracket attached to the top of the posts.

Checks to be made:

1. Fence panels and railings (wood):
    - Splits/cracking/broken:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Physically damaged and broken
    - Loose connections:
        - Loose bolts or wire fasteners
        - Protruding fasteners
        - Missing or broken components
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes less than 1/8" diameter, surface sag and frass observed
        - Large holes greater than 1/8" diameter, surface channels, punctures and crushing
    - Out of plumb more than 3" in 8'
    - Erosion/vegetation:

    - Soil erosion under fence wall
    - Vegetation, trees or shrubs climbing over or growing into fence in the context of cultural/historic significance

2. Fence panels (metal):
   - Fence fabric
     - Defective
     - Loose or sagging greater than 2" in diameter
     - Damaged or missing
   - Defective, loose, damaged or missing
   - Loose connections/anchorage:
     - Loose bolts or wire fasteners
     - Loose or bent pipe posts or railing
     - Missing or broken components
   - Out of plumb more than 3" in 8'
   - Corrosion:
     - Missing protective coating-galvanizing/paint, no pitting evident
     - Corrosion evidenced by pitting or blistering
     - Rust/corrosion evidenced by loss of base metal
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vegetation, trees or shrubs climbing over or around posts in the context of cultural/historic significance

Figure 1. Corrosion of Metal Railing

3. Fence panels (concrete):
   - Cracking:
     - Hairline cracks to 1/16" wide
     - Wide cracks more than 1/16" wide
     - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
   - Loose connections:
     - Loose bolts or wire fasteners
     - Protruding fasteners
     - Damaged or missing components
   - Spalling:
     - Less than 1" deep or 6" in diameter
     - More than 1"in depth or greater than 6” in diameter or loss of more than 10 percent of surface area of a member
     - Disintegration of surface area, with corrosion of exposed reinforcing steel
   - Scaling:
     - Loss of surface up to 1/2" deep, with exposure of coarse aggregates
     - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
     - Loss of surface exceeds 1" reinforcing steel usually exposed
   - Reinforcing steel corrosion:
     - Rusting/discoloration evident
     - Cracks occurring parallel to reinforcement
   - Out of plumb more than 3" in 8'

- Erosion/vegetation:
    - Soil erosion around posts
    - Vegetation, trees or shrubs climbing over or around posts in the context of cultural/historic significance

4. Fence panels (masonry/stone):
    - Deteriorated mortar joint material:
        - Cracked mortar joint material
        - Loose/missing mortar joint material
        - Eroded mortar greater than 1/2" deep
    - Damaged bricks, stones or concrete masonry unit (CMU):
        - Cracked, split, damaged
        - Loose, missing
    - Out of plumb more than 3" in 8'
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vegetation, trees or shrubs climbing over or around posts in the context of cultural/historic significance
5. Fence posts (wood):
    - Splits/cracking/broken:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Physically damaged and broken
    - Loose connections:
        - Loose bolts or wire fasteners
        - Protruding fasteners
        - Damaged or missing components
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area

Figure 2. Leaning and Rotted Fence Posts

- Parasite damage:
    - Holes less than 1/8" diameter, surface sag and frass observed

    - Large holes greater than 1/8" diameter, surface channels, punctures and crushing
- Out of plumb more than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vegetation, trees or shrubs climbing over or around posts in the context of cultural/historic significance

6. Fence posts (metal):
    - Loose connections/anchorage:
        - Loose bolts or wire fasteners
        - Loose or bent pipe posts or railing
        - Missing or broken components
    - Out of plumb more than 3" in 8'
    - Corrosion:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced by loss of base metal
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vegetation, trees or shrubs climbing over or around posts in the context of cultural/historic significance
7. Fence posts (concrete):
    - Cracking:
        - Hairline cracks to 1/16" wide
        - Wide cracks more than 1/16" wide
        - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
    - Spalling:
        - Less than 1" deep or 6" in diameter
        - More than 1” in depth or greater than 6" in diameter or loss of more than 10 percent of surface area of a member
        - Disintegration of surface area, with corrosion of exposed reinforcing steel
    - Scaling:
        - Loss of surface up to 1/2" deep, with exposure of coarse aggregates
        - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
        - Loss of surface exceeds 1", reinforcing steel usually exposed
    - Reinforcing steel corrosion:
        - Rusting/discoloration evident
        - Cracks occurring parallel to reinforcement
    - Out of plumb more than 3" in 8'
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vegetation, trees or shrubs climbing over or around posts in the context of cultural/historic significance
8. Fence posts (masonry/stone):
    - Deteriorated mortar joint material:
        - Cracked mortar joint material
        - Loose/missing mortar joint material
    - Out of plumb more than 3" in 8'

- Damaged bricks, stones or CMU:
    - Cracked, split, damaged
    - Loose, missing
- Erosion/vegetation:
    - Soil erosion around piers
    - Vegetation, trees or shrubs climbing over or around piers in the context of cultural/historic significance

9. Gates (wood):
    - Defective gate:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Damaged or missing wood sections
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Pest damage:
        - Holes less than 1/8" diameter, surface sag and frass observed
        - Large holes greater than 1/8” diameter, surface channels, punctures and crushing
    - Out of plumb more than 3" in 6'
    - Connections:
        - Loose wood at connection site
        - Broken, split or damaged wood at connection site
    - Missing fasteners or anchorage

Figure 3. Missing Sections in Wood Gate

10. Gates (metal):
    - Defective gate fabric:
        - Loose or sagging gate fabric
        - Damaged or missing gate fabric
    - Defective gate panels:
        - Loose gate panels
        - Damaged or missing gate panels
    - Loose connections:
        - Loose bolts or wire fasteners
        - Loose or bent pipe post/bracing
        - Missing or broken hinges, latches or other components
    - Out of plumb more than 1/2" in 6'
    - Corrosion:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by loss of base metal
11. Security wires:
    - Loose, broken or missing brackets or bolts

- Loose, defective, sagging, broken or missing wire
- Corroded wire:
    - Missing protective coating-galvanizing/paint, no pitting evident
    - Corrosion evidenced by pitting or blistering
    - Rust/corrosion evidenced by loss of base metal
- Corroded brackets:
    - Missing protective coating-galvanizing/paint, no pitting evident
    - Corrosion evidenced by pitting or blistering
    - Rust/corrosion evidenced by loss of base metal.

Traffic Barrier

A traffic barrier is a permanent device to keep vehicles within their roadway and prevent collision with dangerous obstacles or to prevent vehicles from accessing an area.

Guardrails & Barriers

A guardrail is a fence-like construction built at the outermost edge of the roadway or sidewalk. The primary function of the guardrail is safety, to keep errant vehicles from driving off the edge of the road and to guard and guide the movement of pedestrian traffic. The guardrail must also smoothly redirect the vehicle in such a manner that the vehicle does not overturn and the guardrail does not fail.

Inspection of proper design and placement of guardrail should be conducted by a licensed engineer. Inspectors should document any obvious safety issues (damaged or silted culverts, vegetation obstructing signs, potholes, etc.) and report them to park engineers for further review. Additional information on guardrail design can be found in *A Policy on Geometric Design of Highways and Streets* published by the American Association of State Highway and Transportation Officials (AASHTO) and state roadside design guides.

The following checks should be made in addition to the Fence/Gate checks (see page 6):

1. Vehicular damage:
    - Railing out of alignment
    - Post out of alignment
    - Railing shattered or damaged
    - Post shattered or damaged member
    - Member out of alignment, shattered member or major damage to member

Figure 4. Guardrail and Posts Out of Alignment

2. Reflective devices:
    - Missing or damaged reflective surfaces
    - Reflector misalignment that might impact visibility
    - Peeling or flaking of thermoplastic marking.

Exhibit/Sculpture

This section contains guidance on sculptures, plaques and headstones/markers that may be located on MLs. Sculptures and monuments and memorials share a number of similar features. Sculptures as features on a ML are treated as single assets. For further information on inspection of monuments and memorials, see “Inspection Guidance – Monuments and Memorials.”

Sculpture

Figure 5. Scratches and Graffiti on Metal Sculpture

Sculptures commonly associated with a ML are typically made of stone, metal or glass.

Checks to be made:

1. Stone sculpture (granite, marble, limestone, concrete, brick and tile):
    - Deteriorated surface
    - Cracking
    - Missing pieces of sculpture
    - Evidence of moisture intrusion
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Eroded or sandy mortar joints
    - Mortar cracking
    - Soft or spalling surfaces
    - Scratched surfaces
    - Vegetation/root uplifting
    - Graffiti/vandalism
2. Metal sculpture (bronze, aluminum, steel, cast/wrought iron):
    - Deteriorated surface
    - Cracking
    - Evidence of moisture intrusion
    - Rust/tarnish/corrosion
    - Exposed reinforcing
    - Out of plumb
    - Scratched surfaces
    - Vegetation/root uplifting
    - Graffiti/vandalism
3. Glass sculpture:
    - Broken or missing panes of glass
    - Scratched surfaces
    - Vegetation/root uplifting.

Plaques

A plaque is an ornamental tablet, typically of metal, porcelain or wood, which is affixed or adjacent to a

Figure 6. Cracked Headstone

sculpture. Plaques often provide descriptive information commemorating a person or event.

Checks to be made (in addition to those above for Sculpture):

- Loose or missing plaques
- Improper attachment.

Headstones/Markers

A headstone is a slab of stone set up at the head of a grave, typically inscribed with the name of the deceased. Markers are also used to denote the resting place of the deceased but may or may not be inscribed. Headstones and markers require regular inspection and maintenance, as stones may become overgrown with vegetation, settle or even fall.

Checks to be made:

- Deteriorated surface
- Cracking
- Missing pieces
- Evidence of moisture intrusion
- Spalling or broken areas
- Exposed reinforcing
- Out of plumb
- Eroded or sandy mortar joints
- Mortar cracking
- Soft or spalling surfaces
- Scratched surfaces
- Vegetation/root uplifting.

Furnishing

Exterior Furnishing

There are many different types of exterior landscape furnishings, such as pads, benches, fire rings, food lockers and picnic tables. This is a broad category encompassing most built and moveable features on a ML. Other categories, such as other exterior furnishings and miscellaneous structures, are used mainly for other asset types. Additionally if parks have an earthworks, ruins or archeological site as a feature of a ML, the park manager should consult “Inspection Guidance – Maintained Archaeological Sites.” Some common examples of exterior furnishings and checks to be made are listed below.

Checks to be made:

1. Exterior furnishings—general:
    - Vandalized and/or presence of graffiti
    - Components missing/damaged/broken
    - Potential safety hazard
    - Loose/in danger of falling
    - Deteriorated/decayed surfaces
    - Mortar failing
    - Excessive vegetation/weight

- Erosion of ground surface around base
- Blistering/peeling/bare surfaces
- Out of plumb, uplifted or settled

2. Wooden exterior furnishings:
   - Damaged or missing wood—splits, cracking or broken
   - Rot, fungus or decay—moist stained area; discolored, soft or crushed area
   - Insect/pest damage—holes, surface sag and/or frass observed; large holes, surface channels, punctures and/or crushing
   - Connections—loose wood, broken, split or damaged wood at connection site
3. Pads:
   - Damaged/deteriorated surface
   - Cracking
   - Missing components
   - Evidence of moisture intrusion
   - Spalling or broken areas
   - Exposed reinforcing
   - Vandalized and/or presence of graffiti
   - Out of plumb, uplifted or settled
   - Undermined/eroded
4. Benches—wood (log, lumber):
   - Structural soundness of seating surface (weld and metal framework, backrest, base)
   - Gouges, wood splinters and protruding fasteners (bolts and spikes) on seating surface and backrest (if applicable)
   - Loose/rusted nails and fasteners
   - Loose bases (asphalt, concrete or earth)
   - Corroded or loose bolted areas
   - Fading/peeling of painted surfaces
   - Erosion around base
   - Missing/damaged component
   - Vandalized and/or presence of graffiti
   - Insect/pest damage—holes, surface sag and/or frass observed; large holes, surface channels, punctures and/or crushing
5. Benches—granite/stone:
   - Structural soundness of seating surface (backrest and base)
   - Spalling chipping of surface
   - Excessively damp surfaces
   - Missing/damaged metal plate
   - Vandalized and/or presence of graffiti
   - Erosion around base
6. Fire rings:
   - Corrosion of grate or fire ring:
     - Surface corrosion (no pitting evident)
     - Corrosion evidenced by pitting or blistering
     - Rust/corrosion evidenced loss of base metal

Figure 7. Picnic Table with Deteriorated Wood Surface

- Broken/damaged grate or fire ring
- Missing stones (if a stone fire ring)

7. Food lockers:
   - Rusted, broken
   - Missing/damaged components
   - Vandalized and/or presence of graffiti
8. Picnic tables:
   - Structural soundness of frame, table surface, seating surface, backrest (if applicable) and base
   - Gouges, wood splinters and protruding fasteners (bolts and spikes) on table surface, seating surface and backrest (if applicable)
   - Melted or damaged surfaces
9. Chair:
   - Missing/displaced
   - Excessive paint layer buildup
10. Flag pole:
    - Foundation movement indicated by changes in gradient of top tier
    - Vandalized and/or presence of graffiti
    - Damaged, rotted pole
    - Peeling paint
    - Deteriorated base
    - Deteriorated hardware
    - Cracks (horizontal, vertical, diagonal, hairline or major)
    - Soil/debris buildup
    - Eroding/missing layer of soil underneath base
11. Grill:
    - Rusted, broken
    - Missing/displaced
    - Potential safety hazard
    - Erosion around base or cracked
    - Vandalized and/or presence of graffiti
12. Bike rack:
    - Rusted, broken
    - Missing/displaced
    - Vandalized and/or presence of graffiti.
13. Planting grate:
    - Grate damaged, sunken or missing.

Figure 8. Partially Missing Tree Grate

Recreational Equipment

Recreational equipment primarily includes playground equipment or equipment used for sporting or fitness activities.

Checks to be made:

1. General:
   - Improper surfacing (depth and material)

- Broken or rusted equipment or fencing material
- Torn nets
- Loose fill surfaces (sand, pea gravel, wood products, rubber products)
- Protruding bolts
- Vandalized and/or presence of graffiti
- Erosion around base or cracked
- Loose/missing edging
- Missing parts or components
- Loose or unstable
- Potential safety hazard
- Blistering/peeling/bare surfaces
- Inadequate clearing around individual units

2. Wood:
    - Rough surface, corrugated with cracks or seriously deteriorated
    - Vibration in deck when users pass
    - Member out of alignment; shattered or injured timber member
    - Decayed or rotting wood
    - Loose or broken fasteners
    - Insect/pest damage—holes, surface sag and/or frass observed; large holes, surface channels, punctures and/or crushing
    - Deck planks missing or hole in deck.

Refuse Container

Refuse containers may be used for waste or recycling and contain an animal proof or standard lid.

Checks to be made:

- Rusted or rotting components
- Broken or damaged containers
- Missing/damaged components/lids
- Rusted or corroded
- Vandalized and/or presence of graffiti.

Liquid and Gas/Plumbing

Fixture

A fixture is related to a plumbing system that is associated with the ML (e.g., drinking fountain).

Drinking Fountain

Drinking fountains associated with MLs are generally stand-alone devices located outside but in proximity to a building or developed area.

Checks to be made:

- Leaking fixtures
- Weak or non-existent water flow

- Non-functioning valves/buttons
- Corroded/clogged nozzle
- Clogged/non-functioning drainage
- Tainted water
- Vandalized and/or presence of graffiti
- Broken components
- Leaning or out of plumb.

Irrigation System

An irrigation system enables artificial application of water to the land or soil. Irrigation systems for MLs include backflow preventers, valves, pumps, pipe, sprinkler heads and tanks.

Checks to be made:

1. Backflow preventer:
    - Test on an annual basis for public health requirements
    - Check valves are functioning
2. Valves:
    - Leaking valve packing glands/gaskets
    - Broken/missing valve handle
    - Bent valve stem
    - Cracked valve body
    - Corrosion
3. Pumps:
    - Physical damage
    - Cracked or damaged pump housing
    - Broken pump base
    - Excessive pump noise and vibration
    - Loose, broken or missing pump assembly/mounting bolts
    - Leakage
    - Deterioration of protective covering/corrosion
    - Problems priming or engaging pump
    - Pest problems
4. Pump base and coupling:
    - Loose, broken or missing pump/motor assembly/mounting bolts
    - Loose/missing set screws
    - Defective coupling
    - Loose/missing coupling guard
    - Deterioration of protective covering/corrosion
    - Abandoned pump assemblies that require disposal
5. Pump controls:
    - Electrical arcing noise
    - Damage to control panel
    - Burned out pilot lamps
    - Access to panel blocked
    - Deterioration of protective covering/corrosion

- Pressure gauges malfunction

6. Pipe:
   - Bent/cracked pipes
   - Signs of leakage
   - Loose supports/hangers and/or broken/missing supports/hangers
   - Loose, damaged, deteriorated and/or missing insulation
   - Galvanic anode cathode protection system for reduction in thickness and/or loose fasteners or broken welds
   - Corrosion, pitting, blistering and/or loss of base metal
   - Impressed current cathode protection system
   - Not functioning due to plugging/clogging
7. Sprinkler heads:
   - Damaged or broken head (observe spray patterns while functioning)
8. Tanks:
   - Leakage
   - Vandalized and/or presence of graffiti
   - Corrosion of metal tanks
   - Wear on fiberglass tanks.

Marking

Sign

Signs are displayed to convey information. Signs differ in purpose and size, and signs may be made of acrylic, aluminum, concrete, fiberglass embedment, fiberglass, glass, high-pressure laminate, laminate, masonry/stone, metal, plastic, recycled plastic, steel, timber and wood.

Checks to be made:

1. Signage—general:
   - Missing sign resulting in noticeable damage, such as inappropriate social trails or resource damage
   - Signs contain incorrect information
2. Kiosk/bulletin boards:
   - Warped, rotting or loose shingles on kiosk roof
   - Ultraviolet damage to Lexan/Plexiglas case, cracked or checked
   - Kiosk/bulletin board contains incorrect information
3. Signage (wood):
   - Loose, damaged, illegible or missing sign face
     - Peeling paint
     - Physically damaged
   - Splits/cracks/broken posts:
     - Surface fibers separated, less than 25 percent of thickness affected

Figure 9. Wood Sign with Peeling Paint

    - Surface fibers separated, greater than 25 percent of thickness affected
    - Physically damaged and broken
- Rot, fungus or decay of posts:
    - Moist stained area
    - Discolored, soft or crushed area
- Pest damage of posts:
    - Holes less than 1/8", surface sag and frass observed
    - Large holes greater than 1/8", surface channels, punctures and crushing
- Out of level:
    - Less than or equal to 3" in 4'
    - More than 3" in 4'
- Out of plumb:
    - Less than or equal to 3" in 8'
    - More than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vegetation, trees or shrubs climbing over or obscuring sign

4. Signage (metal):
- Loose, damaged, illegible or missing sign face
- Out of level:
    - Less than or equal to 3" in 4'
    - More than 3" in 4'
- Out of plumb:
    - Less than or equal to 3" in 8'
    - More than 3" in 8'
- Corrosion of posts:
    - Surface corrosion, no pitting evident
    - Corrosion evidenced by pitting or blistering
    - Rust/corrosion evidenced loss of base metal
- Erosion/vegetation:
    - Soil erosion around posts
    - Vegetation, trees or shrubs climbing over or obscuring sign

5. Signage (concrete):
- Loose, damaged, illegible or missing sign face
- Cracking:
    - Hairline crack
    - Medium cracks 1/16" wide
    - Wide cracks more than 1/16” wide
    - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
- Spalling:
    - Less than 1" deep or 6" in diameter
    - More than 1” in depth or greater than 6" in diameter or loss of more than 10 percent of surface area of a member
    - Disintegration of surface area with corrosion of exposed reinforcing steel
- Scaling:
    - Loss of surface up to 1/2" deep with exposure of coarse aggregates
    - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
    - Loss of surface exceeds 1", reinforcing steel usually exposed

- Reinforcing steel corrosion: rusting/discoloration evident, cracks occurring parallel to reinforcement
- Out of level:
    - Less than or equal to 3” in 4'
    - More than 3" in 4'
- Out of plumb:
    - Less than or equal to 3" in 8'
    - More than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vegetation, trees or shrubs climbing over or obscuring sign

6. Signage (masonry/stone):

- Loose, damaged, illegible or missing sign face
- Deteriorated mortar joint material:
    - Cracked mortar joint material
    - Loose/missing mortar joint material
- Out of level:
    - Less than or equal to 2" in 8'
    - More than 2" in 8'
- Out of plumb:
    - Less than or equal to 3" in 8'
    - More than 3" in 8'
- Damaged bricks, stones or CMU:
    - Cracked, split, damaged
    - Loose, missing
- Erosion/vegetation:
    - Soil erosion around sign footing
    - Vegetation, trees or shrubs climbing over or obscuring sign.

Structure

Deck Structure

Deck structures include any type of outdoor platform associated with a ML.

Platforms

Typical platforms associated with MLs can include minor campground amphitheater stages and observation decks. A platform may be used for observation or presentation and consist of asphalt, concrete, earth, masonry/stone, metal, stone or wood.

Checks to be made:

- Structural soundness of stage support
- Missing stones or pavers
- Vandalism/graffiti

Figure 10. Stone Retaining Wall with Joint Cracking

- Loose footings
- Warping/twisting of stage flooring
- Loose/rusted nails and fasteners
- Deteriorated surface
- Cracking
- Evidence of moisture intrusion
- Spalling or broken areas
- Exposed reinforcing
- Out of plumb
- Eroded or sandy mortar joints
- Mortar cracking
- Soft or spalling surfaces
- Scratched surfaces.

Wall

Retaining Walls

The kinds of walls included in this section for the ML asset type are retaining and crib (walls present on MLs that enclose a boundary or landscape). Retaining walls are structures used to prevent the flow or lateral movement of soil. Retaining walls are typically constructed of rock, concrete, brick, wood or a combination of these materials. The checks are similar for each type.

Checks to be made:

1. Masonry or stone retaining walls:
    - Stains, wet spots, bulges, spalling, efflorescence and missing brick
    - Foundation movement indicated by changes in gradient of top tier
        - Eroding/missing layer of soil underneath foundation (footing)
        - Overhanging or loose rocks in foundation (footing)
    - Slipping joints/poor contact between rock on wall
    - Loose or missing rocks on wall
    - Missing fill between rocks on wall
    - Loose or missing cap stones
    - Loose or missing chinking on wall
    - Collapsing, leaning or bulging of wall
    - Cracks (horizontal, vertical, diagonal, hairline or major)

Figure 11. Retaining Wall with Stones Missing

- Vegetation causing damage (paint peeling, joint deterioration, roots causing damage, plants holding water against structure)
- Insect/termite infestation and decay on wood members
- Mechanical/chemical damage
- Improper or clogged drains or weep holes
- Poor drainage away from wall
- Soil/debris buildup
- Walls that have become separated from their peer
- Vandalized and/or presence of graffiti

2. Pinned rock retaining walls:
    - Loose or damaged pins
    - Exposed (hazardous) pins
3. Log retaining walls (cribbing):
    - Foundation movement indicated by changes in gradient of top tier
    - Eroding/missing layer of soil underneath foundation (footing)
    - Loose or deteriorating logs on wall
    - Loose or missing chinking on wall
4. Switchback corners:
    - Signs of switchback cutting and erosion
    - Check for roots/brush
    - Waterbar blocked causing drainage to flow through switchback corner (ice buildup)
    - Check for debris; sediment should be distributed over trail under the drainage or added to backfill
    - Check if soil if too compacted/rocky.

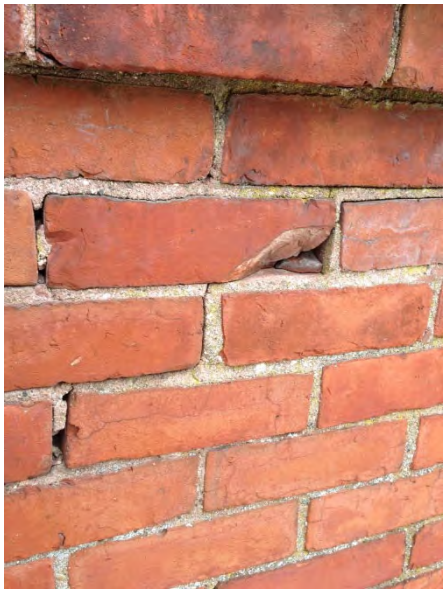

Figure 12. Brick Wall with Spalling

Walkable Structure

Decks and Patios

This section contains guidance on decks and patios that may be located on MLs. All bridges (small foot bridges) located on MLs should be captured with the trail or road with which they are typically associated.

Checks to be made:

1. Timber deck:
    - Weathering and wear:
        - Surface of wood is rough and corrugated, and member may be warped
        - Surface of wood is rough and corrugated with cracks partially through the wood member, may have minor section loss to the top surface
        - Warped members
        - Large cracks extend deeply or completely through the wood
        - Wood is crumbly and seriously deteriorated
    - Vibration per span:
        - Slight vibration in deck when users pass

    - Noticeable vibration in deck when users pass
    - Excessive vibration in deck when users pass
- Collision damage: member out of alignment; shattered or injured timber member
- Decay (decay from rot/fungus is most likely to occur at connections, splices, support points or around bolt holes—this may be due either to the tendency of such areas to collect and retain moisture or to bolt holes or cuts being made in the surface after the preservative treatment has been applied)
    - Moist and stained or discolored area with signs of fungi although surface is solid
    - Surface spongy, and member may show signs of crushing
    - Brown and white discolored area, and member may show section loss and crushing
- Connections:
    - Loose fasteners
    - Member broken, split or damaged
    - Missing fasteners or anchorage
- Parasites (termites, carpenter ants, powder post beetles):
    - Pinholes with dark stain area around the holes
    - Holes, surface sag and sawdust observed
    - Surface channels and crushing of the member
- Deck missing, hole in deck

2. Timber railing and post:
- Weathering:
    - Surface of wood is rough and corrugated, and member may be warped
    - Surface of wood is rough and corrugated with cracks partially through the wood member, may have minor section loss
    - Warped member
    - Large cracks extend deeply or completely through the wood
    - Wood is crumbly and seriously deteriorated
- Decay (decay from rot/fungus is most likely to occur at connections, splices, support points or around bolt holes—this may be due either to the tendency of such areas to collect and retain moisture or to bolt holes or cuts being made in the surface after the preservative treatment has been applied):
    - Moist and stained or discolored area with signs of fungi although surface is solid
    - Surface spongy, and member may show signs of crushing
    - Brown and white discolored area, and member may show section loss and crushing
- Pest (termites, carpenter ants, powder post beetles):
    - Pinholes with dark stain area around the holes
    - Holes, surface sag and sawdust observed
    - Surface channels and crushing of the member
- Post connections:
    - Loose fasteners, protruding fasteners
    - Broken, split or damaged
    - Missing fasteners or anchorage
- Corrosion at post anchors:
    - Surface rust, no pitting evident

    - Corrosion evident, pitting and blistering of base material
    - Corrosion evident with loss to base section
- Collision damage:
    - Railing out of alignment
    - Post out of alignment
    - Railing shattered or damaged
    - Post shattered or damaged member
- Vertical joint displacement due to substructure or bearing settlement
- Horizontal joint misalignment due to substructure or bearing settlement.

Generic Structure

Generic structures commonly found on MLs include trellises, arbors, pergolas, gazebos, colonnades and arches.

Checks to be made:

- Vandalized/graffiti
- Deteriorated/damaged supports
- Out of plumb
- Components missing/damaged/broken
- Potential safety hazard
- Loose/in danger of falling
- Deteriorated/decayed surfaces
- Mortar falling
- Excessive vegetation/weight.

Structure/Access

Stairs

Stairs in MLs would typically be associated with a cultural landscape or campground, among other uses.

Checks to be made:

1. Iron rungs:
    - Loose rungs
    - Corroded or cracked rungs
    - Missing rungs
2. Log:
    - Loose or missing steps
    - Strength/sturdiness of ladder
    - Visible signs of decay
3. Logs pinned to rock:
    - Loose or missing logs
    - Strength/sturdiness of logs
    - Corroded pins/loose pins
    - Visible signs of decay
4. Rocks pinned to ledge:

- Water has damaged edges of steps
- Corroded pins
- Loose or missing steps

5. Treated timber:
    - Water has damaged edges of steps
    - Loose or missing steps
    - Strength/sturdiness of steps
    - Visible signs of decay
6. Steps—stone:
    - Continuous stone steps installed where grade exceeds 10 percent in order to prevent erosion
    - No steps are present where there should be
    - Water damage has dislodged steps or made them not level or loose
    - Steps are too small and likely to be dislodged
    - Steps are not keyed with rock
    - Steps are too high (>10" high)
    - Stones are separated where they are intended to be congruous.
7. Steps—concrete:
    - Stains, wet spots, bulges, spalling, efflorescence or missing concrete
    - Foundation movement indicated by changes in gradient of top tier
    - Eroding/missing layer of soil underneath footing
    - Deterioration of footing
    - Deterioration of risers or treads
    - Slipping joints/cracks
    - Collapsing of steps
    - Rotation of risers or treads
    - Erosion problems
    - Vandalized and/or presence of graffiti.

Structure/Base & Foundation

Base and Sub-Base

Base and sub-base are the compacted and prepared gravel, soil, or geosynthetic layers that are placed prior to the installation of the final surface. Geosynthetics (e.g., geotextile, geonets, sheet drains, geogrids, geocells) are plastic or non-woven fabrics, sheets, nets, grids or honeycomb-like mats usually made of polypropylene or polyethylene that can help stabilize the treadway. Inspection of base and sub-base applies primarily to unpaved, graded paths with non-native surfaces (e.g., off-road bicycle trails).

Checks to be made:

1. Exposed and/or worn out geosynthetic layer
2. Shoulders:
    - High shoulders (secondary ditches)
3. Standing water:
    - Standing water on the surface that seeps into the subgrade, causing a general softening of the entire path

4. Rutting:
   - Longitudinal depressions in the paths caused by high moisture content in the subsurface soil or base, inadequate surface course thickness or heavy traffic loads
5. Depressions:
   - Localized low areas one or more inches below the surrounding tread surfaces caused by settlement, excessive moisture content or improper drainage.

Surface

Land Surface

Land surfaces could include recreational surfaces, boat ramps, mulch or tent pads.

Recreational Surface

A recreational surface is a surface used for recreational purposes. It may be either paved or unpaved.

Checks to be made:

1. Paved surfaces—concrete (poured, pavers/paving stones, blocks, etc.):
   - Cracked, pitted, damaged
   - Spalling
   - Potholes (or patches)
   - Surface materials depleted or missing
   - Erosion problems
   - Uneven, uplifted, sunken—hazardous
   - Vandalized and/or presence of graffiti
   - Joint material missing or pulled out
2. Unpaved surfaces—compacted surfaces (gravel, stone, mulch, etc.):
   - Inadequate drainage
   - Erosion problems
   - Surface material depleted or missing
   - Uneven, uplifted, sunken—hazardous
   - Exposed base material
   - Damaged/missing, uplifted, sharp or settled edging
   - Accumulation of debris.

Figure 13. Plant Bed

Figure 15. Elk Damage to Historic Apple Tree

Plant or Vegetation

This includes vegetation, such as plants, trees or shrubs, which are placed or grown on a structure or defined area.

Landscape Vegetation Features

Landscape vegetation may require different levels of inspection. Individual trees and shrubs may be important and need to be inspected separately, or it may be more important to look at groupings of trees or shrubs. Individual plants may

contribute to a larger landscape feature that should be inspected as a system. For example, a large elm tree may have historic value and be an important specimen tree on the property and require its own inspection. An orchard, on the other hand, may require inspection of individual trees and the planting of the orchard as a whole. The checks for the orchard, or groupings of fruit trees, will be different than the checks for an individual fruit tree. For example, individual tree inspections would look for dead limbs, whereas an assessment of a whole orchard would inspect for any trees missing from a planted row. If the conclusion is made that further inspection or testing is required, the note should be made as such.

Figure 16. Girdled Tree Roots

Keep in mind that because vegetation is a living organism, the time of year in which the inspection is conducted is important. It is recommended that parks conduct their inventory assessments at the best time of year for the species of vegetation in the park. For example, in certain climates, if parks inspect cool weather grass in August, the grass will appear to be stress/wilted (as is expected). If parks were to inspect cool weather grass during spring/fall, however, the grass would be in a better state to judge its overall condition. The opposite inspection cycle would apply to warm weather grass, however.

The following checks to be made apply to all landscape vegetation features as follows and range from simple plantings to more complex plant features/groupings.

Checks to be made:

1. Soil:
    - Compacted
    - Fertility/pH/moisture improper
    - Texture/structure poor
    - Erosion or buildup
    - Presence of holes, burrows, ruts or depressions
    - Further inspection/testing required
    - Inadequate mulching or fertilization

2. Vegetation:
    - Plant health/vigor problems
    - Flowers/fruit problems (insect, disease or pest damage)
    - Trunk/root problems/defects (cavities, gouges, excessive leaning, cracks, areas of bark peeling/missing, mechanical damage, root rot, girdling or exposed roots, materials embedding, etc.)
    - Plant growth excessive/irregular
    - Foliage problems (insect damage/disease, chlorotic, wilting, etc.)
    - Branch/limb problems (cavities, hanging, cracked, dead, broken, hazard/safety issues, etc.)

Figure 17. Hanging Deadwood in Tree

- Inappropriate size and shape (in the context of cultural and historical significance)
- Inappropriate pruning (dead stubs of limbs left behind, bad cuts)
- Weed/exotic species problems
- Density problems/plant mortality
- Overgrown with vegetation
- Inadequate mulching
- Damaged/improperly installed/removed components (tree staking, guy wires, cable and bracing, lightning protection)
- Vandalized
- ID tag missing/damaged
- Damaged/missing, uplifted, sharp or settled edging.

Traffic Surface

Traffic surface is the durable surface material laid down on an area that is intended to provide the capability of moving vehicular or pedestrian traffic.

Paved and Unpaved Surfaces – Tread

Tread is material that is placed atop the base layer to provide the walking, riding or driving surface. Options include asphalt, concrete, gravel, native, paver block (cobble or other block stone), riprap (native rocks embedded in the ground), wood chips or other materials (if other materials are used, these should be described in the inspection documentation).

Figure 18. Cracked and Deteriorated Walkway

Native and gravel surfaces must be checked for gullies, silting, mounding, displaced soils, sloughing and muddy or washed-out areas. Gullies should be repaired to prevent continued erosion and wash-outs. Gullies are natural ditches created by water rapidly eroding a section (or the entire width) of a ML. Gullies may be converted into inside (uphill) drainage channels.

Slough is soil, rock and silt that have accumulated on the inside of the tread at the base of the backslope, narrowing the width of the tread. Slough, muddy areas and washed-out sections force users to move upslope or downslope of the original tread and should be remedied.

Checks to be made:

1. Paved surfaces:
   - Alligator cracking: a series of interconnecting cracks resembling alligator skin or chicken wire, which usually occur in the wheel path
   - Longitudinal cracking: cracks that are parallel to the pavement centerline or asphalt lay down direction

- Transverse cracking: cracks perpendicular to the pavement centerline
- Potholes (or patches): bowl-shaped hole in the pavement surface
- Rutting: surface depressions in the wheel paths
- Eroded surface
- Deteriorated striping

2. Unpaved surfaces:
    - Minor surface hazards (exposed roots and loose rocks)
    - Gullies
    - Poor drainage, bogs and mud holes
    - Sloughing
    - Washed-out/eroded trail sections(from heavy use or improper drainage)
    - Braids or social paths: multiple parallel trails caused by users avoiding obstacles described above
    - Width either too narrow or too wide.

Trailer Pad

A trailer pad is the structure or surface on which a trailer is placed.

Checks to be made:

- Damaged/deteriorated surface/edging
- Cracking
- Missing components (e.g., bumper stop)
- Evidence of moisture intrusion
- Spalling or broken areas
- Exposed reinforcing
- Vandalized and/or presence of graffiti
- Out of plumb, uplifted or settled
- Undermined/eroded.

Turfgrass/Pasture Crop

Turfgrass/pasture crop is a section of land or turf used for growing grass or crops.

Checks to be made:

- Turf thin/spotty/poorly established
- Mowing damage/improper
- Inadequate drainage/excessive water
- Turf species improper
- Thatch layer excessive
- Turf wilted/stressed
- Presence of holes, burrows, ruts or depressions
- Edge poorly defined
- Debris/organic matter on surfaces
- Insect/disease/pest problems
- Vandalized

Figure 19. Thin, Poorly Established Turf

- Irrigation (see Irrigation System on page 18)
- Weed/exotic species problems.

Figure 20. Ponding/Poor Drainage

Water Control

Culvert

This includes construction and installation of culverts for storm water systems. Culverts are a type of drainage structure that allows the passage of water over, under or through MLs. Such structures include open culverts (either rock or wood) and closed culverts (metal, rock or wood).

Checks to be made:

1. Open culvert (wood):
    - No culvert structure where one is needed
    - Overhanging or loose wood or logs in footing
    - Deterioration or decay of material
    - Loose or missing material
2. Closed culvert (rock):
    - No culvert structure where one is needed
    - Overhanging or loose rocks in footing
    - Slipping joints/poor contact between rock on drywall
    - Loose or missing rocks on drywall and spanning rock(s)
3. All metal and concrete culverts:
    - No culvert structure where one is needed
    - Check for inadequate armoring of entrance and exit
    - Check for shallow gradient or culvert filled with silt
    - Check cover on culvert—see if culvert is being crushed or punctured
    - Erosion or scouring: voids, undermining of structure
    - Joints and connections to anti-seep collars should be completely watertight
    - Check for signs of physical damage, corrosion, abrasions or dents
    - Check for loss of protective coatings
    - Check for damaged connections and missing or damaged fasteners

4. Concrete culverts:
    - No culvert structure where one is needed
    - Erosion or scouring: voids, undermining of structure
    - Check for concrete deficiencies
5. Steel culverts:
    - No culvert structure where one is needed
    - Erosion or scouring: voids, undermining of structure
    - Check for signs of corrosion
    - Check for broken welds.

Drain

A drain is a structure that typically provides a gravity exit point or directs the movement of storm water or water that is to be re-circulated.

Waterbars and Retainer Bars

Drainage structures that channel water along and off trails, such as waterbars, checks (retainer bars or steps), dip drains (swales) and drainage ditches, should be inspected and assessed using the guidelines found in the document entitled “Inspection Guidance – Trails”.

Drainage systems channel water over or below the landscape area. Stepping stones allow water to pond or flow naturally across the landscape area while allowing users to cross the water.

Checks to be made:

- Loose, missing or overhanging rocks (in crossing, footing, etc.)
- Slipping joints/poor contact between rocks
- Uplifted or sunken
- Loose riprap
- Uneven, uplifted, sunken—hazardous.

Resources

Name	Work Group/Company Name	E-mail Address	Date Added
Susan Dolan	Program Manager, Park Cultural Landscapes Program	Susan_Dolan@nps.gov	7/24/2013
Kathleen Fitzgerald	Historical Landscape Architect, Olmsted Center for Landscape Preservation	Kathleen_Fitzgerald@nps.gov	7/24/2013
Linda Hamilton	Facility Management Systems Specialist, Harpers Ferry National Historical Park	Linda_Hamilton@nps.gov	7/24/2013
Stephanie Nelson	Cultural Landscapes Asset Preservation Coordinator	Stephanie_Nelson@nps.gov	5/20/2014
Charlie Pepper	Manager, Cultural Landscape Preservation Maintenance and Education, Olmsted Center for Landscape Preservation	Charlie_Pepper@nps.gov	7/24/2013

References

The following is a list of suggested references that parks may wish to use in developing their own ML standards:

- A Policy on Geometric Design of Highways and Streets – AASHTO
- Cultural Landscape Inventory (one for each park cultural landscape)
- Park Cultural Landscapes Program website.

Related Documents

The following documents provide additional information on the asset category discussed in this IG:

- Maintained Landscapes Asset Business Practice
- Maintained Landscapes Asset Best Management Practice
- Critical Systems List
- Life-Cycle Estimates.

Appendix A Inspection Guidance Change Log

Inspection Guidance Title:	Maintained Landscapes (3100) Asset Inspection Guidance
Responsible Group:	Comprehensive Asset Strategic Tools (CASTL) Development Group
Title of Inspection Guidance Origin White Paper:	N/A
Last Change Made On:	January 25, 2017

#	Page #	Change Description	Reason for Change	Requested By	Requested On	Change Made On	Approved By	Approved On
2.0	N/A	Initial Release	Initial Release	N/A	N/A	N/A	Mike Seibert	6/2/2014
2.1	3	Mark Plant or Vegetation as a Critical System	Correction	Leah Edwards	1/19/2017	1/25/2017	Mike Seibert	1/25/2017

National Park Service
U.S. Department of the Interior

1201 Eye Street, NW, 10th Floor
Washington, DC 20005

Condition Inspection Guidance: 4100 Buildings

Version 1.0

Effective Date: November 3, 2017

End Date: Until Amended or Rescinded

SRS Code: 4.B.1.

Table of Contents

Introduction **1**
Common Components and Critical Systems **2**
Comprehensive Condition Assessments **3**
Safety 3
Tips for Condition Inspections 3
Component Inspection Guidance 4
Electrical 4
Alternative Energy 4
Circuit Breakers 5
Electrical Panelboards 6
Electrical Transmission/Distribution 7
Lighting 16
HVAC 18
AC Package Unit 18
Air Handling Unit 18
Boiler 19
Chiller 20
Chilled Water System 22
Condenser Unit 25
Cooling Tower 26
Evaporative Cooler 28
Furnace 28
Heat Pump 29
Unit Heater 30
Liquid and Gas 31
Pump 31
Tank 32
Liquid and Gas/Plumbing 34
Fixture 34
Pipe 35
Valve 37
Safety/Alarm 39
Fire Alarm Signaling System 39
Safety/Suppression 41

Fire Extinguisher 41
Fire Sprinkler System 41
Signage & Marking 42
Sign 42
Special 44
Food Service 44
Structure 45
Wall 45
Structure/Access 48
Stairs 48
Structure/Base & Foundation 49
Foundation 49
Structure/Door 51
Exterior Door 51
Interior Door 52
Structure/Window 52
Exterior Window 52
Surface 53
Roof Surface 53
Surface/Finish 55
Exterior Finish 55
Interior Finish 55
Water Control 57
Drain 57
Resources 58
Related Documents 58
Appendix A Inspection Guidance Change Log A-1

Introduction

This document contains the condition inspection guidance (IG) for buildings. The Department of the Interior policy on deferred maintenance requires the National Park Service (NPS) to perform condition assessments on its asset portfolio at a minimum of every five years.

A complete visual inspection of all building components should be part of all building condition inspections. A field inspection should use both system and component inspection methods to identify all maintenance and repair deficiencies for correction. In other words, the inspector should determine whether there is sufficient evidence to warrant complete replacement of a system versus repairing only specific components of that system (e.g., replacing the entire floor covering versus repairing sections of the floor covering).

Visual inspections must employ a systemic approach to document all deficiencies with a given building. Some deficiencies announce themselves, such as a steam leak or ponding on a roof. Other deficiencies, however, are more subtle and may require further examination to identify. A systematic approach reduces the likelihood that an inspector will miss deficiencies.

During an inspection, the inspector should thoroughly document the information needed to prepare cost estimates and inspection reports. At a minimum, for each deficiency, the inspector should:

- Clearly define the building deficiency (e.g., cracked window, leaking steam valve packing, missing door hinge, corroded metal window frame).
- Specify the corrective action with the appropriate verb (e.g., build/add, repair, replace, realign, adjust, relocate, remove, reopen, maintain, monitor).
- Provide location data with global positioning system (GPS) reading coordinates and/or a wheeled distance from a recognizable building component and, if possible, mark the geographical location on a map (e.g., northeast corner of lower roof, in room 123 or in the main lobby at the reception desk). All building location data should include and reference the FMSS location record number and description and the Financial and Business Management System (FBMS) building ID for clarity and ease of tracking.
- Quantify data in sufficient detail to permit later development of budget-level cost estimates using the appropriate unit of measure (e.g., 120 linear feet of 4" steel conduit or 220 square feet or 7 each). It may also be useful to note approximate sizes and types of dynamic equipment, such as boilers, chillers and pumps.
- Note the relative priority of the deficiency as high (e.g., foundational deficiencies, HVAC), medium (e.g., plumbing valves) or low (e.g., paint peeling).
- Include additional comments or notes that will help to define the project needs or special circumstances to consider.

While this document lays out universal condition inspection guidance, it does not establish one standard for all buildings. Different standards guide building construction and maintenance, as defined by a park unit's management plan. Inspectors must consider park-

level standards when completing building assessments and should use them when recommending the corrective action (and costs) required to address identified deficiencies.

After performing a condition assessment, parks will obtain attribute-level facilities data as well as deficiency work orders. Parks are responsible for reviewing the data for accuracy and entering all data into the Facility Management Software System (FMSS), as appropriate.

Common Components and Critical Systems

Table 1 lists typical classifications used for the building asset category. Any classification in the FMSS can be used to categorize components of a building. Table 1 contains those most likely to be used.

Table 1. Building Component List

Top-Level Classification	Classification	Critical System
Electrical/	Alternative Energy	No
Electrical/	Circuit Breaker	Yes
Electrical/	Electrical Panel	Yes
Electrical/	Electrical Transmission/Distribution	No
Electrical/	Lighting	No
HVAC/	AC Package Unit	Yes
HVAC/	Air Handling Unit	Yes
HVAC/	Boiler	Yes
HVAC/	Chiller	Yes
HVAC/	Chilled Water System	Yes
HVAC/	Condenser Unit	Yes
HVAC/	Cooling Tower	Yes
HVAC/	Evaporative Cooler	Yes
HVAC/	Furnace	Yes
HVAC/	Heat Pump	Yes
HVAC/	Unit Heater	No
Liquid & Gas/	Pump	No
Liquid & Gas/	Tank	No
Liquid & Gas/Plumbing	Fixture	No
Liquid & Gas/Plumbing	Pipe	No
Liquid & Gas/Plumbing	Valve	No
Safety/Alarm	Fire Alarm Signaling System	No
Safety/Suppression	Fire Extinguisher	No
Safety/Suppression	Fire Sprinkler System	No
Signage & Marking/	Sign	No
Special/	Food Service	No
Structure/	Wall	Yes
Structure/Access	Stairs	No
Structure/Base & Foundation	Foundation	Yes
Structure/Door	Exterior Door	Yes
Structure/Door	Interior Door	No
Structure/Window	Exterior Window	Yes

Surface/	Roof Surface	Yes
Surface/Finish	Exterior Finish	Yes
Surface/Finish	Interior Finish	No
Water Control/	Drain	Yes

Comprehensive Condition Assessments

This section contains guidance on conducting safe and thorough field inspections of building assets.

Safety

All inspections should be conducted in accordance with guidance found in the NPS Reference Manual 50B and related federal, state and local safety and health standards, such as the following:

- Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910
- OSHA 29 CFR 1926
- National Fire Protection Association (NFPA) Life Safety Code
- NFPA 70E: Standard for Electrical Safety in the Workplace
- US Environmental Protection Agency 40 CFR.

Note: Before inspecting pneumatically actuated switches and/or breakers, be sure to turn off electricity to that area of the park.

Tips for Condition Inspections

Parks should review all relevant inventory documents and the results of the most recent inspection before performing a condition assessment. Doing so will help familiarize inspectors with the inventory and any previously reported deficiencies.

These additional items may also be useful during a field inspection:

- Fully charged GPS unit for collecting point and line data
- Digital camera with a fully charged battery and spares
- Sufficient storage space on the GPS unit and camera memory cards
- Blueprints, drawings, paper and a pencil/pen for field notes
- Compass
- Previous inspection information or a list of current work orders for the dam or levee
- Necessary field gear (appropriate footwear, sun protection, clothing and rehydration equipment)
- Gloves
- Flashlight
- Magnifying glass
- Eye protection
- Binoculars
- Measuring tape/wheel
- Communication device (e.g., cell phone, radio)
- Historic drawings, photographs and Historic Structure Report recommendations
- Infrared gun for heat and humidity assessments

- Blower door test (where feasible with building usage and availability)
- Volt meter
- Ground fault interrupter tester.

Component Inspection Guidance

The guidance in this section covers inspections of the following components:

- Electrical
- HVAC
- Liquid & Gas
- Liquid & Gas/Plumbing
- Safety/Alarm
- Fire Alarm Signaling System
- Safety/Suppression
- Fire Extinguisher
- Fire Sprinkler System
- Signage & Marking
- Structure
- Structure/Access
- Structure/Base & Foundation
- Structure/Door
- Structure/Window
- Surface
- Surface/Finish
- Water Control.

Electrical

Alternative Energy

SOLAR SYSTEMS

Solar cells are converters. They use a “fuel” that is in one form of energy (sunlight) and convert that energy into another form of energy (electricity). Solar cells do not store any electricity; they just convert energy when sunlight is available. Solar cells convert sunlight to electricity without any moving parts, noise, pollution, radiation or maintenance. The conversion of sunlight into electricity is made possible with the special properties of semiconducting materials.

Solar cells alone cannot produce usable power. They need to be interconnected to other system components that ultimately serve a specific electrical demand, or “load.” These systems can either be standalone or grid-connected. The main difference between these two basic types of systems is that, in the latter case, the system produces power in parallel with the electrical utility and can feed power back into the utility grid if the onsite load does not use all the system’s output. When the sun is shining, the direct current electricity from photovoltaic modules is converted to alternating current by the power of an electronic inverter and then fed directly into the distribution system where it supplies electric power. Any unused solar power is exported to the utility power grid or stored in battery banks.

Checks to be made:

1. Panels:
    - Output readings reported by asset manager as lower than usual or nonexistent
    - Physical damage to panels
    - Loose hardware, bolts or fasteners
2. Combiner box, inverter, switches, controls and devices:
    - Corrosion, pitting or loss of base metal
    - Signs of damage
    - Improper grounding or hot spots
    - Damaged security door or devices
    - Signs of fire or scorching
3. Transformers:
    - Corrosion, pitting or loss of base metal
    - Signs of damage
    - Damaged security door or devices
    - Loose hardware, bolts or fasteners
    - Improper ventilation
    - Blocked air intakes or exhaust ducts
    - Improper grounding or hot spots
    - Signs of oil leaks
    - Clogged filters, inoperable or damaged cooling fans
    - Bare wires or leads
4. Battery storage:
    - Physical damage—battery:
        - Corroded or loose connector
        - Loose mounting
        - Battery case not clean
        - Liquid leakage
        - Improper liquid level
        - Cracked or broken connector
        - Battery cable damaged
        - Cracked case
    - Physical damage—battery racks:
        - Corrosion
        - Rack mounting loose, broken or missing
        - Panel fasteners loose, broken or missing
        - Rack on enclosure inaccessible
        - Rack bent or broken
        - Enclosure damaged (cannot be sealed)
        - Rack or enclosure not grounded.

Circuit Breakers

Visually inspect only fuses and small circuit breakers and their enclosures in electrical circuits operating at 600 volts or below and rated at 30 amperes and below.

Checks to be made:

1. General:

- Incorrect swipe of main and arcing contacts on opening and closing
- Overheating
- Lack of continuity
- Looseness of connections on all mechanisms
- Incorrectly placed pins and cotter pins
- Improper functioning of rods and moving parts and binding occurs when breaker is operated
- No freedom of action in tripping devices and latches
- Insufficient travel of armature of overcurrent trip devices to ensure release of breaker latch
- Dirty oil in oil-film timers
- Improper functioning and unsatisfactory condition of control switch and closing relay

2. Oil tanks:
    - Leaks
    - Leak detection system
    - Cracks
    - Corrosion
    - Corrosion protection system
    - Defective gaskets
    - Improper oil levels
    - Incorrect gauge indications
    - Code compliance catchment
    - Oil for presence of dirt and sludge
3. Bushings and insulators:
    - Accumulation of dirt
    - Cracks
    - Chips
    - Lack of rigidity of supports
    - Inadequacy of connections
4. Arc chutes:
    - Moisture and other contaminants
    - Arc mufflers for loose scale
    - Runners and springs for wear or other damage
5. Indicating lamps:
    - Turn on/off as intended.

Electrical Panelboards

Checks to be made:

- Dirty
- Corroded
- Signs of overheating
- Need for touch-up painting
- Unposted or illegible instructions, identification charts, circuit diagrams and feeder schedules.

Electrical Transmission/Distribution

Boxes

Checks to be made:

- Loose mounting/attachment
- Missing mounting hardware or fasteners
- Loose cover
- Missing cover
- Open conduit or cable entry knockouts
- Corrosion with pitting or blistering
- Corrosion with loss of base material
- Evidence of overheating, grounds and short circuits, overheated splices or damaged or defective insulation
- Other physical damage, such as impact, breaks or deformation
- Missing identification markers/labels printed or in ink (no pencil), such as labels or color indicators
- Conduit connection separated or loose
- Ground fault circuit interrupter (GFCI) and arc fault circuit interrupter outlets.

Cables

Checks to be made:

- Dirty, poor ventilation, presence of moisture, greases, oil, chemical fumes
- Improper or unauthorized connections and dangerous temporary connections
- Damaged wiring devices, defective insulators, cleats and cable supports; broken or missing parts or exposed live parts
- Excessive cable sag, crowded cable spacing, excessive number of conductors in conduit and raceways
- Evidence of overheating, grounds and short circuits, overheated splices, damaged or defective insulation
- Need for painting of noncurrent-carrying parts subject to corrosion
- Unsafe, unreliable cable and wire to lighting and power panels
- Fuses, switches and other sources of discontinuity in the neutral wire of grounded alternating current systems.

Conduit

Checks to be made:

- Loose or missing fasteners or fittings, such as straps, couplings or connectors causing lack of support
- Physical damage, such as breaks or abnormal deformation or bends
- Corrosion with loss of base metal
- Evidence of overheating or burning, such as charred, flash over, carbon tracking or other heat-related deformation
- Abandoned conduits with no identified or intended use.

Cords, Cord Extensions, Portable and Appliance Cords and Plugs

Checks to be made:

- Inadequate, unsafe, unreliable or incorrect types being used
- Lengths too long, poor insulation, twisted, spliced, exposed to damage underfoot, laying on floor or across heated surfaces or lamps; lamp types used for portable extensions that are subject to moisture, oil and grease
- Plugs: cracks, breaks, loose connections, wires improperly attached and in danger of pulling away from plug when removing from outlet, missing protective cover on male ends, no grounding terminal or ground wire with clamp
- Power plugs: cable clamps loose or missing
- Improper or unauthorized flexible cords and cable run through holes in walls, ceiling or floor
- Certified Underwriters Laboratories (UL) male and female receptacles (non-UL certified are not acceptable)
- Excessive load.

Fuses

Checks to be made:

1. Bypassing:
   - Report apparent bypassing of fuses or circuit breakers for further investigation
2. Housekeeping:
   - Dust, dirt, oil, grease, corrosion, foreign matter within enclosure
   - Inadequate identification of circuits
3. Enclosures:
   - Deterioration of enclosures or connecting conduit or cable from rust or corrosion
   - Loose, corroded or missing covers
4. Connections (if visible without removing covers):
   - Loose, corroded, inadequate
   - Deteriorated insulation
5. Fuses (if visible without removing covers):
   - Overheating, indicated by discoloration of brass or copper at contact points
   - Distortion, charring, deterioration of fiber cases of cartridge-type cases
6. Grounding:
   - Loose corroded connections
   - Deteriorated or abraded insulation
   - Frayed or broken cables.

Grounding

Checks to be made:

1. Instrumentation grounding system—grounding conductor insulation:
   - Physical damage, such as cut or broken
2. Interconnection between plumbing system and electrical grounding systems
   - Physical damage, such as cut or broken
3. Instrumentation grounding system—grounding rod:
   - Bent, broken or missing

4. Instrumentation grounding system—grounding conductor termination:
    - Loose, corroded, cracked, missing, improper material (dissimilar or incompatible metals)
    - Signs of arcing, carbon tracking, burning or overheating
5. Lightning protection—rods, points, air terminals:
    - Bent, damaged or missing
6. Lightning protection—rod mounting bases:
    - Improperly anchored to structure
    - Damaged
    - Cable connectors loose or missing
7. Lightning protection—main conductor cable and downloads:
    - Loose, missing or broken
    - Signs of burning
    - Corrosion
    - Frayed cable strands
    - Not anchored to structure
8. Lightning protection—ground rod:
    - Download connection loose or damaged
    - Disconnected.

Motor Starters/Motor Control Center

Checks to be made:

1. Instrumentation grounding system—grounding conductor insulation:
    - Dirty or corroded, signs of overheating
    - Missing or illegible instructions, identification charts, circuit diagrams and feeder schedules
    - Loose or inadequate connections
    - Switches need lubrication, operate improperly; knife switches and fuse clips improperly aligned
    - Fuse ratings and ground connections
    - Removed fuse jumpers and dangerous temporary connections
    - Grounding conductor insulation physical damage, such as cut or broken
    - Grounding conductor termination is loose, corroded, cracked, missing, improper material (dislike or incompatible metals)
    - Signs of arcing, carbon tracking, burning or overheating
    - Instrumentation indicators, such as lights or gauges broken or inoperative
    - Interior not clean or moisture free
    - Enclosure damaged and cannot be sealed; openings are unused, exposing interior live surfaces or connections.

Overhead Services

Checks to be made:

- Aerial drop cable is too tight (no sag), causing excessive force/pressure on the mast
- Aerial drop cable has too much sag
- Aerial drop cable is less than 10' above highest point of grade

- Aerial drop cable is less than 2' away from surrounding surfaces or appurtenances, such as roof surfaces, windows, doors, walls, columns or trees and other buildings
- Aerial drop cable is rubbing against surrounding surfaces or appurtenances
- Cable insulation is frayed, cracked, cut, burned, shows signs of overheating or is missing
- Cable to cable connections are missing, loose, shows signs of overheating, have no insulation or are missing the drip loop
- Cable to mast connections and fasteners are missing, loose, corroded with loss of base metal, improper material used or is made less than 2' away from surrounding surfaces or appurtenances
- Mast conduit is less than 2" in diameter, is not rigid galvanized steel; shows signs of physical damage, such as bent or broken
- Fasteners are missing, loose, improper material type or are corroded with loss of base metal
- Roof seal and flashing is missing where the mast conduit penetrates a roof
- Mast conduit connections are loose, missing, corroded with loss of base metal or shows signs of burning or overheating
- Mast conduit head is loose, missing, broken, corroded with loss of base metal, shows signs of burning or overheating, is installed less than 2' away from surrounding surfaces or appurtenances or is missing internal parts, such as insulation and fasteners.

Safety Switches

Checks to be made:

- Dirty
- Corroded
- Signs of overheating
- Need for touch-up painting
- Unposted or illegible instructions, identification charts, circuit diagrams and feeder schedules
- Loose or inadequate connections
- Switches need lubrication, operate improperly
- Knife switches and fuse clips improperly aligned
- Fuse ratings and ground connections
- Removed fuse jumpers and dangerous temporary connections.

Service and Distribution

In general, the service and distribution systems consist of the service transformer(s), the overhead or lateral service feeders, the main switchgear or main distribution panelboard(s). The system also includes any subfeeders from the switchgear or main distribution panelboard to step down transformers or other panelboards and the subfeed equipment, such as the step down transformers and other panelboards. Additional components of the service and distribution system include motor control centers.

The decision to replace the entire service and distribution system can only be made after the condition of the inherent components and the equipment of the system have been evaluated and the findings of that evaluation determined. Thus, the decision to replace an

entire system should only be made after weighing the findings on the condition of the inherent components.

Checks to be made:

- Reliability and availability of spare parts for the system equipment and components
- Maintainability of the system equipment and components
- Layout and modernization of the system equipment and components
- Cost of replacement of the entire system versus the total cost for replacement or repair of individual components or equipment
- Physical condition of individual components or equipment and maintenance history
- Age of the components and equipment
- Capacity of the system and determination of overloading or available capacity for expansion.

Wireways

Checks to be made:

- Dirty, poor ventilation, detrimental ambient conditions, presence of moisture, greases, oil, chemical fumes
- Improper or unauthorized connections and dangerous temporary connections
- Damaged wiring devices, defective insulators, cleats and cable supports; broken or missing parts or exposed live parts
- Excessive cable sag and vibration, crowded cable spacing, excessive number of conductors in conduit and raceways
- Evidence of overheating, grounds and short circuits, overheated splices, damaged or defective insulation
- Need for painting of noncurrent-carrying parts subject to corrosion
- Loose mounting/attachment
- Missing mounting hardware or fasteners
- Loose or missing cover
- Open conduit or cable entry knockouts
- Corrosion with pitting or blistering
- Corrosion with loss of base material
- Evidence of overheating, grounds and short circuits, overheated splices, damaged or defective insulation
- Other physical damage, such as impact, breaks or deformation
- Missing identification markers, such as labels or color indicators
- Conduit connection separated or loose.

Generator Sets

Checks to be made:

- Corrosion evidenced by pitting or blistering
- Corrosion with loss of base metal
- Panel fasteners loose, broken or missing
- Unit not grounded
- Indicator or gauges broken or inoperative

- Fuel or coolant leaks
- Damaged or missing battery
- Missing parts or components
- Missing identification, wiring diagram or specification tags
- Loose, missing, corroded or damaged conduit or cable connections
- Broken or disconnected fuel lines
- Unit mounting loose, broken or missing
- Dirty or clogged radiator
- Worn or loose belts
- Inspect maintenance records and test logs for recurring problems and testing frequency
- General housekeeping of the equipment for maintenance and upkeep
- Evidence of overheating or carbon tracking
- Type and size of the generator, including capacity, fuel type, voltage, phase and power factor
- Estimated connected load and comparison to unit specifications
- Alarms and warning systems of the generator
- Day tanks for fuel (if present)
- Alarms, sight gauges, overflow containment, seals, gaskets and fuel caps.

SWITCHGEAR

Inspect electrical switchgear, associated apparatus and equipment connected to distribution circuits in buildings, 600 volts and under and not located in vaults or fire-resistant rooms. It includes primarily switchgear known as “metal clad,” “drawout,” “cubicle” or “truck” type.

Checks to be made:

1. Housing:
    - Poor appearance, dampness, dirty, inaccessibility or surrounding areas
    - Detrimental conditions:
        - Ambient temperatures in excess of 100°F
        - Humidity causing sweating of metal enclosures
        - Rodents, insects
        - Stored combustibles
        - Trash, dirt, dust accumulation
        - Poor location, inaccessibility
        - Poor ventilation
        - Gas, steam or water leakage
2. Exterior housing and enclosure ground:
    - Rust, corrosion, need for painting, signs of abuse, unauthorized or improper signs, scribbling, calendars, storage of materials or dust accumulations on top of enclosures, missing parts, schedules or other items
    - Poor condition
    - Presence of enclosure ground
3. Interior of compartments, cubicles and drawers:
    - Dirty, condensation, symptoms of overheating, burns from ground and short circuits, defective insulation, defective operation of locks, doors and drawers
4. Pneumatic systems:

- Poor general condition and unsatisfactory operation of all components serving breakers, including air pressure, valves, pistons and associated equipment
- Poor speed of air pressure recovery
- Air leaks
- Moisture and dirt in air lines

5. Enclosed switches:
    - Unsatisfactory operation of handle and mechanism
    - Blade latch functions improperly
    - Blades are insecure when closed
    - Blade, clips or tongue for lack of cleanliness
    - Signs of oxidation, arcing, overheating and poor contact
6. Switchgear relays:
    - Visible evidence of accumulations of dust and dirt
    - Broken glass
    - Loose or missing nuts
    - Loose mounting
    - Noisy operation
    - Signs of arcs
    - Loose connections
7. Instrument transformers:
    - Lack of cleanliness
    - Inadequate connections
    - Inadequate insulation
    - Improper ventilation
    - Unsatisfactory grounding
8. Small wiring:
    - Physical damage
    - Defective insulation
    - Poorly soldered connections
    - Damage to other connections
9. Buses and buswork:
    - Lack of cleanliness
    - Defective insulation
    - Overheating
    - Signs of flashovers
10. Rheostats/associated mechanisms:
    - Inadequate operation
    - Lack of cleanliness
    - Overheating
    - Dirty contacts
    - Over-travel
11. Mechanical devices: de-energized:
    - Unsatisfactory operation and inadequacy of mechanical devices for elevating and lowering or drawing out switchgear
    - Improper operation of interlocks, gang switches and contact safety shutters
12. Switchgear foundations:

- Settling or movement of floors, pedestals and other foundations resulting in possible misalignment of operating parts in switchgear
- Dirty, corroded, signs of overheating and need for touch-up painting
- Unposted or illegible instructions, identification charts, circuit diagrams and feeder schedules
- Loose or inadequate connections
- Switches need lubrication, operate improperly; knife switches and fuse clips improperly aligned
- Check fuse ratings and ground connections
- Remove fuse jumpers and dangerous temporary connections.

Transfer Switch

Checks to be made:

- Corrosion evidenced by pitting or blistering
- Corrosion with loss of base metal
- Enclosure mounting loose or broken
- Panel fastener loose, broken or missing
- Indicators or gauges damaged or inoperative
- Enclosure damaged and cannot be sealed or closed
- Unused opening not sealed
- Handle bent or inoperative
- Security devices missing or inoperative
- Carbon tracking from flash over
- Discoloration or deformity from overheating
- Unit is not grounded
- Switch or push buttons missing or damaged
- Missing identification, wiring diagrams or operation instruction
- Free space and clearance around the switch from debris or stored material
- Housekeeping and maintenance of the equipment.

Transformers

Checks to be made:

1. Bushings and insulators:
    - Insulators and porcelain parts: indications of cracks, checks, chips breaks; where flashover streaks are visible, reexamine for injury to glaze or for presence of cracks
    - Chipped glaze exceeding ½" in depth or an area exceeding 1" on any insulator or insulator unit, report for investigation by a qualified electrical engineer
    - Severe cracks, chipped cement or indications of leakage around bases of joints of metal to porcelain parts at terminal and transformer ends
2. Terminal ends:
    - Mechanical deficiencies, looseness, corrosion, damage to cable clamps
    - Improper oil level in oil-filled bushings
    - Heating evidenced by discoloration and corrosion indicated by blue, green, white or brown corrosion products on metallic portions of all main and ground terminals, including terminal board and grounding connections inside transformer case

3. Coils and cores:
    - When cover is open, examine interior for deficiencies, dirt and sludge. If feasible, probe down sides with glass rod and if dirt and sludge exceeds approximately ½"
4. Enclosures and cases:
    - If case is opened for any reason, examine for signs of moisture inside cover and where present for plugged breathers, inactive desiccant, enclosure leakage, etc.
5. Gauges and alarms:
    - Liquid-level gauge and alarm system: dirty, not legible, improper frequency of calibration.

Dry-Type

Checks to be made:

- Accumulation of dust on core, coils and leads
- Evidence of moisture, oil or other contaminants
- Evidence of overloads and burned insulation
- Poor contacts and connections
- Signs of corrosion
- Poorly painted surfaces, nameplates, guards and warning sings
- Inadequate ventilation, detrimental ambient temperatures and defective ground connections
- Operating temperature loads and voltage during critical operating periods from log data.

Energized

Checks to be made:

1. Concrete foundations and supporting pads:
    - Settling and movement, surface cracks exceeding 1/16" in width, breaking or crumbling within 2" of anchor bolts
    - Anchor bolts: loose or missing parts, corrosion, particularly at points closest to metal base plates and concrete foundation resulting from moisture or foreign matter and exceeding 1/8" in depth
2. Mounting platforms—wooden:
    - Cracks; breaks, signs of weakening around supporting members; rot, particularly at bolts and other fastening, holes through which bolts pass, wood contacting metal
    - Burning charring and burning at contact points, indicating grounding deficiency
    - Inadequate wood preservation treatment
3. Mounting platforms—metallic:
    - Deep pits from rust, corrosion, other signs of deterioration likely to weaken structure
4. Hangers/brackets/braces/connectors:
    - Rust, corrosion, bent, distorted, loose, missing, broken, split, other damage; burning or charring at wood contact points resulting from grounding deficiency
5. Enclosures, cases and attached appurtenances:
    - Collections of dirt or other debris close to enclosure that may interfere with radiation of heat from transformer or flashover
    - Dirt, particularly around insulators, bushings or cable entrance boxes
    - Leaks of liquid-filled transformers

- Deteriorated paint, scaling, rust; corrosion, particularly at all attached appurtenances, such as lifting lugs, bracket connections and metallic parts in contact with each other

6. Nameplates and warning signs:
   - Dirty, chipped, worn, corroded, illegible, improperly placed
7. Grounding:
   - Visual connections: loose, missing, broken connections; signs of burning or overheating, corrosion, rust, frayed cable strands, more than 1 strand broken in 7-strand cable, more than 3 strands broken in 19-strand cable
8. Bushings and insulators:
   - Cracked, chipped or broken porcelain, indication of carbon deposits, streaks from flashovers, dirt, dust, grease, soot or other foreign material on porcelain parts, signs of oil or moisture at point of insulator entrance
9. Grounding and phase terminals:
   - Overheating evidenced by excessive discoloration of copper, loose connection bolts, defective cable insulation, no mechanical tension during temperature changes, leads appear improperly trained and create danger of flashovers from unsafe phase-to-phase or phase-to-ground clearances caused by deterioration of leads or expansions during temperature changes
10. Breathers:
    - Holes plugged with debris, desiccant-type breathers need servicing or replacement
11. Grills and louvers for ventilation of air-cooled transformers:
    - Plugged with debris or foreign matter, interfering with free passage of air.

Other Electrical Systems

Checks to be made:

1. Connections and termination (visual):
   - Poor condition of contacts, contact misalignment, signs of overheating, signs of oxidation and inadequate capacity
   - Group-operated switches: rust, corrosion, loose brackets
2. Control stations and other devices:
   - Visual signs of defective operation, broken or missing parts, arcing noises
   - Insecure, loose, damaged, missing plate or switch cover
   - Not grounded
3. Enclosures and cabinets:
   - Broken or missing parts
   - Loose mounting fasteners
   - Corrosion
   - Physical damage prohibiting normal function
   - Missing identification tags
   - Missing or outdated maintenance logs.

Lighting

Checks to be made:

1. Switches and breakers:

- Poor condition of contacts, contact misalignment, signs of overheating, signs of oxidation and inadequate capacity
- Group-operated switches: rust, corrosion, loose brackets

2. Receptacles and other devices:
   - Defective operation, broken or missing parts, arcing noises
   - Insecure, loose, damaged, missing plate or switch cover
   - Not grounded
   - Excessive use of extension cords.

Devices

Checks to be made:

- Dirty, inadequate, defective contacts, difficult plugging, overheating, evidence of overloading on multiple sockets, servicing lamps or appliances, lack of grounding terminal
- Adequate number, proper type, convenient location, loose or damaged plate covers, lock outs
- Receptacles without GFCI protection in dwelling unit kitchens and bathroom
- Outdoor receptacles not weatherproof or GFCI
- Lockouts for the public.

Lighting Fixtures and Components

Checks to be made:

- Interior emergency building lighting, including exit lighting, wall-mounted lights and wall-hanging battery pack
- Emergency lighting located in auditorium, corridors, lobbies, passageways, stairways and fire escapes.

Checks to be made:

1. Lighting fixtures:
   - Broken or missing parts, such as diffusers, enclosures or covers
   - Loose or missing mounting hardware and fasteners
   - Inoperative
   - Loud humming of ballast
   - Evidence of burning or overheating, such as carbon tracking, flash over or deformation
   - Inadequately supported, insecure and improperly located, evidence of unauthorized removal and relocation
   - Incorrect types installed in hazardous locations; change in facility class requires replacement
   - Improperly located in clothes closets (should be above door or in ceiling and not serviced with cord pendants)
   - Cracked or broken luminaries and fixture parts, missing pullcords, metal pullchains not provided with insulating links
   - Indications of objects being supported from, hung on or stored in fixtures
   - Evidence of overheating, undersized or other damage to sockets, exposed or damaged connecting wiring

2. Lamps:
   - Oversized, blistering, loose base, thermal cracks from contact with fixture, bare lamps in hazardous locations, poor socket lamp connections and proper types for special applications
   - Operation of fluorescent fixtures shows poor burning and starting characteristics and loud, humming ballasts
3. Lighting voltage:
   - Excessive load
   - Interference with branch circuits for power and lighting from motor starting or stopping, such as excessive light flicker or excessive voltage dips, causing fluorescent/mercury lamps to drop out
4. Illumination levels:
   - Ambient conditions, such as dirty walls and ceilings.

HVAC

AC Package Unit

Checks to be made:

1. Air cooled:
   - Tension, condition and alignment of belts; adjust as necessary
   - Lubricate shaft and motor bearings
   - Replace air filters
   - Clean electrical wiring and connections; tighten loose connections
   - Clean coils, evaporator drain pan, blowers, fans, motors and drain piping, as required
   - Perform operational check of unit; make adjustments on controls and other components as required
   - During operation of unit, check refrigerant pressure; add refrigerant as necessary
   - Compressor oil level; add oil as required
2. Water cooled:
   - Tension, condition and alignment of belts; adjust as necessary
   - Lubricate shaft and motor bearings
   - Replace air filters
   - Clean electrical wiring and connections; tighten loose connections
   - Clean coils, evaporator drain pan, blowers, fans, motors and drain piping, as required
   - Perform operational check of unit; make adjustments on controls and other components as required
   - During operation of unit, check refrigerant pressure; add refrigerant as necessary
   - Compressor oil level; add oil as required.

Air Handling Unit

Checks to be made:

1. Air handling unit, up to 25 tons:
   - Controls and unit for proper operation
   - Unusual noise or vibration

- Tension, condition and alignment of belts, adjust as necessary
- Clean coils, evaporator drain pan, blower, motor and drain piping, as required
- Lubricate shaft and motor bearings
- Replace air filters
- Inspect exterior piping and valves for leaks; tighten connections as required
- Clean area around equipment

2. Air handling unit, 25 through 50 tons:
   - Controls and unit for proper operation
   - Unusual noise or vibration
   - Clean coils, evaporator drain pan, blower, motor and condensate drain piping, as required
   - Lubricate shaft and motor bearings
   - Belts for wear, proper tension and alignment; adjust as necessary
   - Inspect exterior piping and valves for leaks; tighten connections as required
   - Operation and clean dampers, louvers and shutters; lubricate all pivot points and linkages
   - Replace air filters.

Boiler

STEAM AND HOT WATER BOILERS

Checks to be made:

1. Heat-generating systems—maintenance:
   - Rust damage
   - Fuel and water leaks
   - Excessive noise and vibration
   - Loose, disconnected, missing or damaged parts
2. Heat-generating systems—boilers, gas/oil/electric:
   - Shell and chamber:
     - Defective or damaged
     - Excessive corrosion
     - Fuel and water leaks
     - Excessive noise and vibration
     - Loose, disconnected, missing or damaged parts
     - Missing insulation
     - Corrosion
   - Exhaust flues:
     - Defective or damaged sections
     - Loose or broken hangers, guides or supports
     - Corrosion
   - Burners/blowers:
     - Fuel leakage
     - Damaged blower motor
     - Damaged blower
     - Excessive noise or vibration
     - Defective mounting hardware or supports
     - Defective or loose electrical connectors

    - Corrosion
- Controls:
    - Damaged control panel
    - Excessive noise
    - Defective sensors
    - Defective or loose electrical connectors
    - Corrosion
- Boiler trim:
    - Defective water column
    - Damaged safety/relief valve
    - Damaged fuel oil pump
    - Defective mounting hardware or supports
    - Defective gauges
    - Damaged valves
    - Damaged blow-off piping
    - Corrosion
- Air separator/air vent:
    - Corrosion
    - Leakage
    - Cracks, laminations and distortion of shell, heads or connection
    - Proper operation of air vent, flush cock and drain valves
    - Remove sand, dirt or other system debris

3. Heat-generating systems—chemical water treatment:
    - Defective storage tanks, mixers, pumps, pipes, fittings and valves
    - Control system:
        - Defective sensors
        - Defective or loose electrical connectors.

Chiller

Checks to be made:

1. Chiller, reciprocating, air cooled:
    - Unit for proper operation, excessive noise or vibration
    - Run system diagnostics test
    - Oil level in sight glass of lead compressor only; add oil as necessary
    - Superheat and subcooling temperatures
    - Liquid line sight glass, oil and refrigerant pressures
    - Contactors, sensors and mechanical safety limits
    - Electrical wiring and connections; tighten loose connections
    - Clean intake side of condenser coils, fans and intake screens
    - Inspect fan(s) or blower(s) for bent blades of imbalance
    - Lubricate shaft bearings and motor bearings as required
    - Inspect plumbing and valves for leaks, adjust as necessary
    - Evaporator and condenser for corrosion
2. Chiller, reciprocating, water cooled:
    - Unit for proper operation, excessive noise or vibration
    - Run system diagnostics test
    - Oil level in sight glass of lead compressor only; add oil as necessary

- Superheat and sub-cooling temperatures
- Liquid line sight glass, oil and refrigerant pressures
- Contactors, sensors and mechanical limits, adjust as necessary
- Inspect plumbing and valves for leaks, tighten connections as necessary
- Check condenser and evaporator for corrosion

3. Chiller, centrifugal water cooled:
    - Unit for proper operation
    - Oil level; add oil as necessary
    - Oil temperature
    - Dehydrator or purge system; remove water if observed in sight glass
    - Run system control tests
    - Refrigerant charge/level, add as necessary
    - Compressor for excessive noise/vibration
    - Sensor and mechanical safety limits; replace as necessary
    - Clean dehydrator float valve
    - Perform spectrochemical analysis of compressor oil; replace oil as necessary
    - Replace oil filters and add oil as necessary
    - Inspect cooler and condenser tubes for leaks; clean screens as necessary
    - Inspect utility vessel vent piping and safety relief valve; replace as necessary
    - Inspect/clean the economizer (vane), gas line damper valve and actuator arm
    - Run an insulation test on the centrifugal motor
4. Chiller, absorption unit:
    - Operating log sheets for indications of increased temperature trends
    - Unit for proper operation, excessive noise or vibration
    - Clean strainers in all lines, as required
    - Pulley alignment and belts for condition, proper tension and misalignment on external purge pump system, if applicable; adjust for proper tension and/or alignment
    - Purge pump vacuum oil level, as required; add/change oil as necessary
    - Lubricate pump shaft bearings and motor bearings
    - Service system controls, wirings and connections; tighten loose connections
    - Inspect cooling and system water piping circuits for leakage
5. Chiller, screw, water cooled:
    - Unit for proper operation, excessive noise or vibration
    - Run system diagnostics test
    - Oil level and oil temperature; add oil as necessary
    - Refrigerant pressures; add as necessary
    - Replace oil filters and oil, if applicable
    - Contactors, sensors and mechanical safety limits
    - Perform spectrochemical analysis of compressor oil
    - Electrical wiring and connections; tighten loose connections
    - Inspect cooler and condenser tubes for leaks
    - Evaporator and condenser for corrosion.
6. Chiller, scroll:
    - Unit for proper operation
    - Run systems diagnostic test
    - Oil level and oil temperature; add oil as necessary

- Refrigerant pressures; add as necessary
- Replace oil filters and oil, if applicable
- Contactors, sensors and mechanical safety limits
- Electrical wiring and connections; tighten loose connections
- Inspect cooler and condenser tubes for leaks
- Evaporator and condenser for corrosion.

Chilled Water System

CHILLED WATER EQUIPMENT

Checks to be made:

1. Cooling-generating systems—maintenance:
    - Rust damage
    - Air or water leaks
    - Loose, missing or damaged mounts, hangers or fittings
    - Deteriorated surfaces
    - Missing identifier
    - Blocked access
2. Cooling-generating systems—chiller, absorption:
    - Excessive noise and vibration
    - Leakage:
        - Water
        - Absorbent
        - Fuel
    - Defective electrical connectors
    - Defective assembly or mounting hardware
    - Loose, missing or damaged insulation
    - Corrosion
    - Pumps:
        - Leaking or damaged
        - Excessive noise or vibration
        - Defective motor
        - Defective electrical connectors
    - Purge units:
        - Absorbent leakage
        - Defective electrical connectors
        - Defective mounting hardware
    - Piping, fittings and valves:
        - Leakage
        - Loose, missing or damaged insulation
        - Corrosion
    - Controls and instrumentation:
        - Damaged panel
        - Defective control or instrument
        - Damaged or missing mounting hardware
    - Air separator/air vent:
        - Corrosion

    - Leakage
    - Cracks, laminations and distortion of shell, heads or connection
    - Proper operation of air vent, flush cock and drain valves
    - Remove sand, dirt or other system debris

3. Cooling-generating systems—chiller, centrifugal:
   - Excessive noise or vibration at compressor or motor
   - Leakage:
     - Water
     - Refrigerant
   - Defective electrical connectors
   - Defective assembly and mounting hardware
   - Missing or loose insulation
   - Corrosion at compressor, motor, condenser or evaporator
   - Purge units:
     - Refrigerant leakage
     - Defective electrical connectors
     - Defective mounting hardware
   - Piping, fittings and valves:
     - Leakage
     - Loose, missing or damaged insulation
     - Corrosion
   - Controls and instrumentation:
     - Damaged panel
     - Defective control or instrument
     - Damaged or missing mounting hardware
   - Type of refrigerant used
   - Air separator/air vent:
     - Corrosion
     - Leakage
     - Cracks, laminations and distortion of shell, heads or connection
     - Proper operation of air vent, flush cock and drain valves
     - Remove sand, dirt or other system debris
4. Cooling-generating systems—chiller, reciprocating:
   - Enclosure and supports:
     - Damaged panels
     - Defective mounting hardware or supports
     - Corrosion
   - Compressor:
     - Refrigerant leakage
     - Excessive noise or vibration
     - Defective electrical connectors
     - Missing or loose mounting hardware
     - Corrosion
   - Condenser and evaporator:
     - Refrigerant or water leakage
     - Deteriorated or clogged air cooled condenser coils
     - Excessive noise or vibration
     - Corrosion

    - Loose, missing or damaged insulation
- Piping, fittings and valves:
    - Leakage
    - Loose or missing insulation
    - Corrosion
- Controls and instrumentation:
    - Damaged panel
    - Defective control or instrument
    - Damaged or missing mounting hardware
- Type of refrigerant used
- Air separator/air vent:
    - Corrosion
    - Leakage
    - Cracks, laminations and distortion of shell, heads or connection
    - Proper operation of air vent, flush cock and drain valves
    - Remove sand, dirt or other system debris

5. Cooling-generating systems—chiller, screw:
    - Excessive noise and vibration
    - Refrigerant or water leakage
    - Defective electrical connectors
    - Defective assembly or mounting hardware
    - Loose, missing or damaged insulation
    - Corrosion
    - Piping, fittings and valves:
        - Leakage
        - Loose or missing insulation
        - Corrosion
    - Controls and instrumentation:
        - Damaged panel
        - Defective control or instrument
        - Damaged or missing mounting hardware
    - Type of refrigerant used
    - Air separator/air vent:
        - Corrosion
        - Leakage
        - Cracks, laminations and distortion of shell, heads or connection
        - Proper operation of air vent, flush cock and drain valves
        - Remove sand, dirt or other system debris
6. Cooling-generating systems—condenser:
    - Air cooled:
        - Excessive noise or vibration
        - Refrigerant leakage
        - Deteriorated or clogged coils
        - Defective electrical connectors
        - Corrosion
    - Water cooled:
        - Excessive noise or vibration
        - Refrigerant or water leakage

    - Defective mounting or support hardware
    - Corrosion
- Refrigerant piping:
    - Damaged or leaking piping
    - Loose or missing supports
    - Damage, loose or missing insulation
- Type of refrigerant used
- Air separator/air vent:
    - Corrosion
    - Leakage
    - Cracks, laminations and distortion of shell, heads or connection
    - Proper operation of air vent, flush cock and drain valves
    - Remove sand, dirt or other system debris

7. Cooling-generating systems—chiller, centrifugal:
    - Enclosure, supports and reservoir:
        - Defective enclosure panels
        - Clogged reservoir drain
        - Corrosion
    - Blowers:
        - Excessive noise or vibration
        - Defective mounting hardware or support
        - Defective blower
        - Corrosion
    - Motors:
        - Excessive noise or vibration
        - Damaged motor
        - Defective electrical connectors
    - Filters/pads:
        - Defective filter/pad racks and mechanisms
        - Defective filter/pad
        - Corrosion
    - Water circulating pumps:
        - Defective pump
    - Float valves:
        - Defective float valve
    - Air separator/air vent:
        - Corrosion
        - Leakage
        - Cracks, laminations and distortion of shell, heads or connection
        - Proper operation of air vent, flush cock and drain valves
        - Remove sand, dirt or other system debris
8. Cooling generating systems—chemical water treatment system:
    - Condition of controller, sensors, pumps, pipes, fittings and valves
    - Aged, deteriorated, inoperative or abandoned water treatment system.

Condenser Unit

Checks to be made:

1. Air cooled, up to 100 tons:
    - Unit for proper operation, excessive noise or vibration
    - Pressure wash coils and fans with coil cleaning solution
    - Electrical wiring and connections; tighten loose connections
    - Lubricate shaft bearings and motor bearings
    - Inspect fan(s) or blower(s) for bent blades or imbalance; adjust as necessary
    - Belt(s) for condition, proper tension and misalignment; adjust for proper tension and/or alignment, if applicable
    - Inspect piping and valves for leaks; tighten connections as necessary
    - Refrigerant pressure; add refrigerant, if necessary
2. Air cooled, over 100 tons:
    - Pressure wash coils and fans with coil-cleaning solution
    - Clean intake side of condenser coils, fans and intake screens
    - Electrical wiring and connections; tighten loose connections
    - Lubricate shaft bearings and motor bearings
    - Inspect fan(s) or blower(s) for bent blades or imbalance; adjust as necessary
    - Belt(s) for condition, proper tension and misalignment; adjust for proper tension and/or alignment, if applicable
    - Inspect piping and valves for leaks; tighten connections as necessary
    - Refrigerant pressure; add refrigerant, if necessary
3. Water cooled, up to 25 tons:
    - Unit for proper operation, excessive noise or vibration
    - Electrical wiring and connections; tighten loose connections
    - Inspect piping and valves for leaks; tighten connections as necessary
    - Refrigerant pressure; add refrigerant, if necessary
4. Water cooled, over 25 tons
    - Unit for proper operation, excessive noise or vibration
    - Run system diagnostics test
    - Electrical wiring and connections; tighten loose connections
    - Oil level in sight glass of lead compressor only; add oil as necessary
    - Contactors, sensors and mechanical limits, adjust as necessary
    - Corrosion
    - Inspect piping and valves for leaks; tighten connections as necessary
    - Refrigerant pressure; add refrigerant, if necessary.

Cooling Tower

Checks to be made:

- Operation of unit for water leaks, noise or vibration
- Clean and inspect hot water basin
- Remove access panel
- Electrical wiring and connections; make appropriate adjustments
- Lubricate all motor and fan bearings
- Fan blades or blowers for imbalance and tip clearance
- Belt for wear, tension and alignment; adjust as required
- Drain and flush cold water sump and clean strainer

- Clean inside of water tower using water hose; scrape, brush and wipe as required; heavy deposits of scale should be removed with scale-removing compound
- Refill with water; adjust float if necessary
- Replace access panel
- Remove, clean and reinstall conductivity and ph electrodes in chemical water treatment system
- Enclosures, supports, fill and reservoirs:
  - Defective supports
  - Defective support connections or anchorage
  - Defective enclosure panel
  - Defective air intake screens
  - Defective panel or screen fasteners
  - Defective reservoir
  - Defective wood members
  - Defective fill
  - Biological fouling or scaling
  - Corrosion
- Fan assemblies:
  - Excessive noise or vibration
  - Defective fan/blower
  - Defective intake dampers
  - Defective mounting hardware or support
  - Damaged motor
  - Defective electrical connectors
  - Defective coupling
  - Defective belt or coupling guard
  - Defective belt
  - Corrosion
  - Verify operation of variable frequency drives
- Circulating pumps:
  - Excessive noise or vibration
  - Leakage
  - Damaged motor or pump
  - Defective mounting hardware
  - Defective electrical connectors
  - Corrosion
- Piping, fittings and valves:
  - Leakage
  - Loose or missing insulation
  - Corrosion
- Dampers:
  - Damper binding or hanging up
  - Corrosion
- Float valve:
  - Defective float valve
- Sump heater:
  - Defective heating element
  - Defective steam modulating valve

    - Defective electrical connectors
- Accessibility devices:
    - Defective connections, anchorage or support
    - Cracking or buckling of metal frame
    - Split, cracked or broken wood members
    - Rot, fungus or decay of wood
    - Corrosion of metal
- Leakage
- Damaged water or pump
- Defective mounting hardware.

Evaporative Cooler

Checks to be made:

1. Evaporative cooler:
    - Unit for proper operation, noise and vibration
    - Clean evaporation louver panels
    - Lubricate fan, bearings and motor
    - Belt(s) for excessive wear and deterioration
    - Visually inspect wiring for damage or loose connections; tighten loose connections
    - Clean sump
    - Clean and adjust float
    - Interior surfaces and components for loose paint/lime deposits
    - Clean, adjust nozzles
    - Remove/clean and reinstall evaporative pads
    - Start unit and check for proper operation
2. Evaporative cooler, rotating drum:
    - Unit for proper operation, noise and vibration
    - Clean evaporation louver panels
    - Lubricate rotary and fan, bearings and motor
    - Belt(s) for excessive wear and deterioration
    - Visually inspect wiring for damage or loose connections; tighten loose connections
    - Clean sump and pump intake
    - Clean and adjust float
    - Interior surfaces and components for loose paint/lime deposits
    - Clean, adjust nozzles
    - Remove/clean and reinstall evaporative pads.

Furnace

Checks to be made:

- Inspect heat exchanger for cracks and deterioration
- Inspect condensate neutralizer tank
- Remove burners and clean if necessary
- Adjust fan switch
- Clean and adjust pilot and pilot assembly
- Inspect safety controls

- Gas line leaks from the furnace shutoff valve to the burners
- Combustion air openings
- Flue pipe
- Record temperatures and performance
- Secure all panels
- Inspect and test controls and safeties
- Lubricate motors and bearings
- Inspect and adjust belts and pulleys
- Replace air filters
- Record voltage and amplifier of the blower motor, compressor and condenser fan motors
- Calibrate thermostat.

Heat Pump

Checks to be made:

1. Heat pump, air cooled, up to 5 tons:
    - Unit for proper operation, excessive noise or vibration
    - Clean intake side of condenser coils, fans and intake screens
    - Electrical wiring and connections; tighten loose connections
    - Inspect fan(s) for bent blades or unbalance; adjust and clean as necessary
    - Belts for condition, proper tension and misalignment; adjust as required
    - Lubricate shaft bearings and motor bearings
    - Inspect piping and valves for leaks; tighten connections as necessary
    - Replace air filters
    - Refrigerant pressure; add refrigerant as necessary
    - Clean evaporative drain pan and drain piping, as required
    - Cycle the reverse cycle valve to ensure proper operation
2. Heat pump, air cooled, over 5 tons:
    - Unit for proper operation, excessive noise or vibration
    - Clean intake side of condenser coils, fans and intake screens
    - Electrical wiring and connections; tighten loose connections
    - Inspect fan(s) for bent blades or unbalance; adjust and clean as necessary
    - Belts for condition, proper tension and misalignment; adjust as required
    - Lubricate shaft bearings and motor bearings
    - Inspect piping and valves for leaks; tighten connections as necessary
    - Replace air filters
    - Refrigerant pressure; add refrigerant as necessary
    - Lubricate and check operation of dampers, if applicable
    - Compressor oil level and add oil, if required
    - Cycle the reverse cycle valve to ensure proper operation
    - Clean evaporative drain pan and drain piping as required
3. Heat pump, water cooled, up to 5 tons:
    - Unit for proper operation, excessive noise or vibration
    - Clean intake side of evaporator coil, fans and intake screens
    - Electrical wiring and connections; tighten loose connections
    - Inspect fan(s) for bent blades or unbalance; adjust and clean as necessary

- Belts for condition, proper tension and misalignment; adjust as required
- Lubricate shaft bearings and motor bearings
- Inspect piping and valves for leaks; tighten connections as necessary
- Replace air filters
- Refrigerant pressure; add refrigerant as necessary
- Lubricate and check operation of dampers, if applicable
- Clean evaporator drain pan and drain line with solvent
- Cycle reverse cycle valve to ensure proper operation
- Backwash condenser coil to remove sediment

4. Heat pump, water cooled, over 5 tons:
    - Unit for proper operation, excessive noise or vibration
    - Clean intake side of evaporator coil, fans and intake screens
    - Electrical wiring and connections; tighten loose connections
    - Inspect fan(s) for bent blades or unbalance; adjust and clean as necessary
    - Belts for condition, proper tension and misalignment; adjust as required
    - Lubricate shaft bearings and motor bearings
    - Inspect piping and valves for leaks; tighten connections as necessary
    - Replace air filters
    - Refrigerant pressure; add refrigerant as necessary
    - Lubricate and check operation of dampers, if applicable
    - Clean evaporator drain pan and drain line with solvent
    - Cycle reverse cycle valve to ensure proper operation
    - Backwash condenser coil to remove sediment.

Unit Heater

Checks to be made:

1. Unit heater, gas radiant:
    - Inspect, clean and adjust control valves and thermo-sensing bulbs on gas burners
    - Inspect fuel system for leaks
    - Proper operation of burner controls; adjust thermostat
    - Fan and motor for vibration and noise; lubricate bearings
    - Electrical wiring to blower motor
    - Condition of flue pipe, damper and stack
    - Unit heater operation through complete cycle or up to 10 minutes
2. Unit heater, gas infrared:
    - Inspect fuel system for leaks around unit
    - Replace primary air intake filter
    - Blow out burner
    - Clean spark electrode and reset gap, replace if necessary
    - Clean pilot and thermo-sensor bulb, replace if necessary
    - Alignment of thermo-sensor bulb
    - Wiring and connections; tighten any loose connections
    - Clean pilot sight glass
    - Vacuum pump (fan):
        - Motor bearings for overheating; adjust or repair as required
        - Lubricate motor bearings

    - Motor mounting; adjust as required
    - Fan blade clearance; adjust as required
    - Wiring, connections, switches, etc.; tighten any loose connections
  - Operate unit to ensure that it is in proper working condition

3. Unit heater, steam:
   - Inspect, clean and adjust control valves and thermostat
   - Inspect coils, connections, trap and steam piping for leaks; repair as necessary
   - Fan and motor for vibration and noise; lubricate bearings
   - Electrical wiring to motor
   - Unit heater operation through complete cycle or up to 10 minutes.

Liquid and Gas

Pump

PUMPING STATION

The primary purpose of the pumping station is to provide an immediate and continuous flow of water to protect large or high-hazard areas. The secondary function is to provide a means for pressurizing the distribution system. The pressure is derived from the difference in elevation between the water level in the storage tank and the elevation of the water mains.

Checks to be made:

1. Pump base and coupling:
   - Loose, broken or missing pump/motor assembly/mounting bolts
   - Defects, loose/missing set screws, defective coupling and/or loose/missing coupling guard
   - Deterioration of protective covering/corrosion
   - Abandoned pump assemblies that require disposal
2. Pumps:
   - Damaged or cracked pump housing and/or broken pump base
   - Excessive noise and vibration
   - Loose, broken or missing pump assembly/mounting bolts
   - Leakage
   - Deterioration of protective covering/corrosion
3. Motors:
   - Damaged or cracked housing, end belts and/or motor base
   - Broken/loose motor hardware for loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
   - Excessive noise and vibration
   - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
4. Controls:
   - Electrical arcing noise
   - Damage to panel, burned out pilot lamps and/or access to panel blocked
   - Deterioration of protective covering/corrosion
5. Piping and fittings:

- Bent/cracked fittings and/or signs of leakage
- Bent/cracked pipes and/or signs of leakage
- Loose supports/hangers and/or broken/missing supports/hangers
- Loose, damaged, deteriorated and/or missing insulation
- Galvanic anode cathodic protection system reduction in thickness and/or loose fasteners or broken welds
- Corrosion, pitting, blistering and/or loss of base metal
- Check impressed current cathodic protection system

6. Valves:
   - Leaking packing glands/gaskets, broken/missing handle, bent stem and/or cracked body
   - Corrosion
7. Metering devices:
   - Damaged, inoperable and/or missing devices
   - Corrosion, pitting, blistering and/or loss of base metal
8. Hydrants:
   - Damaged, missing hydrant caps, gaskets or chains and/or broken/cracked hydrant
   - Leakage, seepage, drips and steady leaks with main valve closed
   - Corrosion, pitting, blister and/or loss of base metal
9. Engines:
   - Physical damage to exterior, leaking fuel or coolant, broken/loose/missing hardware, corroded terminals and wires, loose wires/connections and/or loose/broken belts
   - Corrosion, pitting, blistering and/or loss of base material.

Tank

Potable Water Storage

Potable water storage serves several major functions. The primary purpose is to provide a ready supply of water to meet the consumption needs of various users. The secondary function is to provide a means for pressurizing the water distribution system. The pressure is derived from the difference in elevation between the water level in the storage tank and the elevation of the water mains. Elevated water storage towers typically fall within two basic types of construction. The first is the “Tower Supported” type, which includes several legs to support and stabilize the tank section. The other type is the “Pedestal” type, which is characterized by its lack of support legs with only a main central support shaft between the ground and the tank section. Because of the height to which the towers are constructed, many are fitted with obstruction lights to alert aircraft to their presence. Many also serve as support platforms for rotating airfield beacons, as well as minor communication antennas. Construction materials may be steel or concrete.

Elevated Storage Tanks

Checks to be made:

1. Concrete foundations:
   - Cracks, spalling, efflorescence or exposed reinforcing
2. Structural steel supports:
   - Damaged or fatigued connections
   - Surface corrosion

- Pitting
- Holes or loss of base material
- Loss of protective coatings
- Damaged connections, missing or damaged fasteners or broken welds

3. Steel ladders/platforms:
    - Damaged or fatigued connections
    - Surface corrosion
    - Pitting
    - Holes or loss of base material
    - Loss of protective coatings
    - Damaged connections, missing or damaged fasteners or broken welds
4. Steel riser pipe:
    - Leakage in pipe joints
    - Corrosion
    - Damage, abrasions, dents
    - Loss of insulation, split seams or missing insulation
    - Loss of protective coatings
    - Damaged connections, missing or damaged, fasteners or broken welds
5. Steel tank shell plates:
    - Damage, dents, abrasions and/or signs of leakage
    - Defective connections/anchorage, loose bolts, rivets, mechanical fasteners and/or broken welds
    - Deterioration of protective covering/corrosion
    - Leakage at joints
6. Overflow piping/vents:
    - Blockage, debris in pipe/vents
7. Concrete tanks and pedestals:
    - Surface weathering, staining, chipping, spalling or cracks
    - Deterioration, leaks, crumbly expansion joints
    - Damaged
8. Altitude valves:
    - Signs of improper operation
9. Cathodic protection system:
    - Adequate operational records.

Underground and Above Ground Tanks

Checks to be made:

1. Concrete foundations:
    - Cracks
    - Spalling
    - Efflorescence
    - Exposed reinforcing
2. Structural steel supports:
    - Connections for signs of damage or fatigue
    - Evidence of surface corrosion
    - Evidence of pitting

- Holes or loss of base material
- Loss of protective coatings
- Damaged connections, missing or damaged fasteners or broken welds

3. Steel ladders/platforms:
   - Connections for signs of damage or fatigue
   - Evidence of surface corrosion
   - Evidence of pitting
   - Holes or loss of base material
   - Loss of protective coatings
   - Damaged connections, missing or damaged fasteners or broken welds
4. Steel riser, vent and overflow pipe:
   - Leakage in pipe joints
   - Corrosion
   - Signs of physical damage, abrasions or dents
   - Loss of insulation, split seams or missing insulation
   - Loss of protective coatings
   - Damaged connections, missing or damaged fasteners or broken welds
5. Steel tank shell plates:
   - Shell for physical damage, dents, abrasions and/or signs of leakage
   - Defective connections/anchorage, loose bolts, rivets, mechanical fasteners and/or broken welds
   - Deterioration of protective covering/corrosion
   - Signs of leakage at joints
6. Concrete tanks and pedestals:
   - Tank for surface weathering, staining, chipping, spalling or cracks
   - Surface deterioration, cracking or spalling
   - Deterioration, leaks, crumbly expansion joints
   - Physical damage.

Liquid and Gas/Plumbing

Fixture

Checks to be made:

1. Maintenance:
   - Loose fixtures, water leaks, loose, missing, deteriorated or damaged components, hangers or fittings
   - Inadequate or excessive water flow
   - Slow or clogged drains
2. Lavatories/sinks (includes wash fountains, utility sinks and laundry sinks):
   - Aged, deteriorated or damaged fixture and/or accessories
   - Sensors working properly
3. Bathtubs/showers:
   - Aged, deteriorated or damaged fixture and/or accessories
4. Water coolers:
   - Aged, deteriorated or damaged fixture and/or components
5. Water closets/urinals/bidets:

- Aged, deteriorated or damaged fixture and/or accessories

6. Miscellaneous partitions:
   - Wood: missing, cracking; splintered; broken; warping; rot; abrasion; scuff marks; deteriorated paint/finish; evidence of mechanical damage or personal abuse; missing/damaged hardware
   - Metal: missing; loose; indentations; bent; corrosion; deteriorated paint/finish; evidence of mechanical damage or personal abuse; missing/damaged hardware
   - Marble: missing; cracked; loose; holes; etched; pitted or dull surfaces caused by use of acidulous or abrasive cleaners; missing/damaged hardware
   - Plastic: missing; cracked; loose; holes; etched; evidence of damage or abuse; missing/damaged hardware
7. Water closet partitions:
   - Wood: missing, cracking; splintered; broken; warping; rot; abrasion; scuff marks; deteriorated paint/finish; evidence of mechanical damage or personal abuse; missing/damaged hardware
   - Metal: missing; loose; indentations; bent; corrosion; deteriorated paint/finish; evidence of mechanical damage or personal abuse; missing/damaged hardware.
   - Marble: missing; cracked; loose; holes; etched; pitted or dull surfaces caused by use of acidulous or abrasive cleaners; missing/damaged hardware
   - Phenolic: missing; cracked; loose; etched; pitted or dull surfaces caused by use of acidulous or abrasive cleaners; missing/damaged hardware
8. Toilet/shower/tub doors and hardware:
   - Wood: splitting; rotting; cracking; loose; poor fit; binding; missing; scratches; indentations; loose/damaged hardware; inoperative hardware; mechanical damage; personal abuse; delamination
   - Metal: corrosion; warping; binding; poor fit; bent; loose/damaged hardware; mechanical damage; personal abuse
   - Marble: missing; cracked; loose; holes; etched; pitted or dull surfaces caused by use of acidulous or abrasive cleaners; missing/damaged hardware
   - Phenolic: missing; cracked; loose; etched; pitted or dull surfaces caused by use of acidulous or abrasive cleaners; missing/damaged hardware; personal abuse
9. Cabinets/counters:
   - Wood: missing, cracking; splintered; broken; warping; rot; abrasion; scuff marks; deteriorated paint/finish; evidence of mechanical damage or personal abuse; missing/damaged hardware
   - Metal: missing; loose; indentations; bent; corrosion; deteriorated paint/finish; evidence of mechanical damage or personal abuse; missing/damaged hardware
   - Solid surface: cracking; indentations; discoloration; evidence of personal abuse; missing/damaged hardware
   - Laminate surface: cracking; indentations; discoloration; evidence of personal abuse; missing/damaged hardware.

Pipe

NON-POTABLE WATER DISTRIBUTION

The non-potable water distribution system is the network of pumps, piping and auxiliary equipment required to carry non-potable water from its source to the using facilities. It serves to distribute and regulate the water supply.

Checks to be made:

1. Pump base and coupling:
    - Loose, broken or missing pump/motor assembly/mounting bolts
    - Defects, loose/missing set screws, defective coupling and/or loose/missing coupling guard
    - Deterioration of protective covering/corrosion
    - Abandoned pump assemblies that require disposal
2. Pumps:
    - Damaged or cracked pump housing and/or broken pump base
    - Excessive noise and vibration
    - Loose, broken or missing pump assembly/mounting bolts
    - Leakage
    - Deterioration of protective covering/corrosion
3. Motors:
    - Damaged or cracked housing, end belts and/or motor base
    - Broken/loose motor hardware for loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
    - Excessive noise and vibration
    - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
4. Controls:
    - Electrical arcing noise
    - Damage to panel, burned out pilot lamps and/or access to panel blocked
    - Deterioration of protective covering/corrosion
5. Piping and fittings:
    - Bent/cracked fittings and/or signs of leakage
    - Bent/cracked pipes and/or signs of leakage
    - Loose supports/hangers and/or broken/missing supports/hangers
    - Loose, damaged, deteriorated and/or missing insulation
    - Galvanic anode cathodic protection system reduction in thickness and/or loose fasteners or broken welds
    - Corrosion, pitting, blistering and/or loss of base metal
    - Check impressed current cathodic protection system
6. Valves:
    - Leaking packing glands/gaskets, broken/missing handle, bent stem and/or cracked body
    - Corrosion
7. Metering devices:
    - Damaged, inoperable and/or missing devices
    - Corrosion, pitting, blistering and/or loss of base metal
8. Hydrants:
    - Damaged, missing hydrant caps, gaskets or chains and/or broken/cracked hydrant
    - Leakage, seepage, drips and steady leaks with main valve closed
    - Corrosion, pitting, blister and/or loss of base metal
9. Manholes:

- Deterioration, cracks/spalling concrete, exposed reinforcing, eroded joints (concrete masonry unit [CMU]) and/or loose/broken/displaced bricks
- Damaged/bent frame/manhole cover, damaged/broken ladder, missing rungs, missing cover and/or offset manhole frame/entrance
- Debris

10. Engines:
    - Physical damage to exterior, leaking fuel or coolant, broken/loose/missing hardware, corroded terminals and wires, loose wires/connections and/or loose/broken belts
    - Corrosion, pitting, blistering and/or loss of base material.

Valve

Checks to be made:

1. Annual contracted backflow inspection data
2. Valve body:
    - Surface corrosion, excessive rust, protective coating (paint, galvanizing) worn or missing, corrosion evidenced by pitting or blistering, deep corrosion evidenced by holes or loss of base metal
    - Body is cracked
    - Components are worn, broken or missing
3. Leakage:
    - Valve shows signs of exterior leakage at seals, glands, gaskets, packing or pipe connections
    - Shut off valve shows evidence of incomplete closure, internal leakage
4. Blockage:
    - Valve is blocked
    - Reduced flow
5. Installation:
    - Valve connections are misaligned, flange missing fasteners
    - Supports are inadequate, broken or missing
    - Excessive vibration
6. Operator (mechanical or automatic):
    - Broken, corroded, rusted
    - Missing components
    - Inoperable
    - Lever or shaft bent
    - Valve is stuck, inoperable or blocked
    - Electronic/pneumatic/Direct Digital Control (DDC)/electric control mechanism is inoperable.

Other Plumbing Systems

Checks to be made:

1. Compressed air—maintenance:
    - Rust damage, air leaks, loose, missing, deteriorated or damaged components, mounts, hangers or fittings
    - Deteriorated surfaces, missing identifier or blocked access
2. Compressed air—air compressors:

- Rust damage, oil leaks, air leaks, loose, missing, deteriorated or damaged components
- Condition of tank, motors, belts, compressors and condensate drain system
- Air compressor runs continuously or cycles too frequently
- Aged, deteriorated or inoperative air compressor

3. Compressed air—dryers:
   - Rust damage; oil/refrigerant leaks; water leaks; excessive noise and vibration; loose, missing or damaged parts
   - Debris collected on intake side of condenser coils
   - Condition motor and fan
   - Damaged or loose electrical connections
   - Aged, deteriorated or inoperative air dryer
4. Compressed air—piping, fittings, valves:
   - Rust damage, air leaks, loose, missing, deteriorated or damaged components, filters and oil separators
   - Condition of pipes, fittings, valves, hangers and supports
5. Vacuum system—maintenance:
   - Rust damage, air leaks, loose, missing, deteriorated or damaged components, mounts, hangers or fittings
   - Deteriorated surfaces, missing identifier or blocked access
6. Vacuum system—vacuum pumps:
   - Rust damage, oil leaks, air leaks, loose, missing, deteriorated or damaged components
   - Condition of tank, motors, belts and air compressors
   - Vacuum pump runs continuously or cycles too frequently
   - Aged, deteriorated or inoperative vacuum pump
7. Vacuum system—piping, fittings, valves:
   - Rust damage, air leaks, loose, missing, deteriorated or damaged components
   - Condition of pipes, fittings, valves, hangers and supports

8. Industrial/medical gas—maintenance:
   - Rust damage, leaks, loose, missing, deteriorated or damaged components, mounts, hangers or fittings
   - Deteriorated surfaces, missing identifier or blocked access
9. Industrial/medical gas—storage vessels:
   - Rust damage, air leaks, loose, missing, deteriorated or damaged components
   - Deteriorated or missing insulation
10. Industrial/medical gas—piping, fittings, valves:
    - Rust damage, air leaks, loose, missing, deteriorated or damaged components
    - Condition of pipes, fittings, valves and pipe insulation.

Sanitary Waste Treatment

Checks to be made:

1. Maintenance:
   - Rust damage, water leaks, clogged drain, loose, missing or damaged parts, hangers, supports or fittings
   - Deteriorated surfaces, missing identifier or blocked access

2. Ejectors and pumps:
   - Rust damage, leaks, excessive noise and vibration, loose, missing or damaged parts
   - Condition of motor and pump
   - Condition of floats and controllers
   - Damaged or loose electrical connections
   - Aged, deteriorated or inoperative pump
3. Piping, fittings, valves:
   - Condition of pipes, fittings and valves
   - Aged or abandoned piping.

WELL/WELL SYSTEMS

Checks to be made:

1. Maintenance:
   - Rust damage, water leaks, loose, missing or damaged parts, mounts, hangers or fittings
   - Deteriorated surfaces, missing identifier or blocked access
2. Hot water generators (includes heaters, shell and tube hot water generators, hot water storage tanks and swimming pool heaters):
   - Rust damage, fuel leaks, water leaks, excessive noise and vibration, loose, disconnected, missing or damaged parts
   - Damaged or loose electrical connections
   - Damaged or missing insulation
   - Aged, deteriorated, damaged or inoperative hot water generator
3. Piping fittings, valves:
   - Condition of pipes, fittings, valves, hangers, supports, backflow preventers, master water temperature control valve and pipe insulation

4. Pumps:
   - Rust damage, water leaks, excessive noise and vibration, loose, missing or damaged parts
   - Condition of motor, coupling and pump
   - Damaged or missing pump insulation
   - Damaged or loose electrical connections
   - Aged, deteriorated or inoperative pump.

Safety/Alarm

Fire Alarm Signaling System

Checks to be made:

1. Alarm systems—fire/theft:
   - Wire terminal connections in panel and pull-boxes; tightness or possible corrosion
   - Pull-boxes and mechanisms: proper lubrication
   - Actuate interior heat or smoke detector system by applying heat to a selected heat/smoke detector in the building in order to determine that the local building alarm operates properly and that a proper signal is transmitted over the site's fire alarm system by checking with the fire department's operator

- Interior heat or smoke detector system to determine that the local building alarm operates properly and that a proper signal is transmitted over the site's fire alarm system by checking with the fire department's operator
- In building where individual heat or smoke detectors are installed (not connected to local fire alarm system), inspect detector to ensure that unit operates properly
- Inspect automatic sprinkler system fire department connections

2. Termination board, cabinet, pedestal or outlet:
   - Missing identification or wiring diagram
   - Loose or missing fasteners and supports, missing parts and physical damage, such as broken or cracked termination strips, enclosure covers, cut wiring or cable, abandoned wiring or cable and the presence of moisture of corrosion inside the equipment
3. Boxes:
   - Loose mounting/attachment
   - Missing mounting hardware or fasteners
   - Loose cover
   - Missing cover
   - Open conduit or cable entry knockouts
   - Corrosion with pitting or blistering
   - Corrosion with loss of base material
   - Evidence of overheating, grounds and short circuits, overheated splices, damaged or defective insulation
   - Other physical damage, such as impact, breaks or deformation
   - Missing identification markers, such as labels or color indicators
   - Conduit connection separated or loose
4. Cable:
   - Dirty, poor ventilation, detrimental ambient conditions, presence of moisture, greases, oil, chemical fumes
   - Improper or unauthorized connections and dangerous temporary connections
   - Damaged wiring devices, defective insulators, cleats and cable supports; broken or missing parts or exposed live parts
   - Excessive cable sag and vibration, crowded cable spacing, excessive number of conductors in conduit and raceways
   - Evidence of overheating, grounds and short circuits, overheated splices, damaged or defective insulation
   - Need for painting of noncurrent-carrying parts subject to corrosion
   - Unsafe, unreliable cable and wire to lighting and power panels
   - Fuses, switches and other sources of discontinuity in the neutral wire of grounded alternating current systems
   - Circuits for operation of switches, receptacles, wiring for overloaded circuits and missing cover plates
5. Conduit:
   - Loose or missing fasteners or fittings, such as straps, couplings or connectors causing lack of support
   - Physical damage, such as breaks or abnormal deformation or bends
   - Corrosion with loss of base metal

- Evidence of overheating or burning, such as charred, flash over, carbon tracking or other heat-related deformation
- Abandoned conduits with no identified or intended use
- Open conduit penetrations of fire barrier walls or floors.

Safety/Suppression

Fire Extinguisher

FIRE PROTECTION SPECIALTIES

Checks to be made:

1. Fire extinguishing devices:
    - Rust damage, condition of nozzles, loose, disconnected, missing or damaged parts
    - Verify adequate charge and inspection information
    - Verify annual fire extinguisher inspection and monthly inspection records.

OTHER FIRE PROTECTION SYSTEMS

Checks to be made:

1. Chemical extinguishing systems:
    - Rust damage, condition of nozzles, loose, disconnected, missing or damaged parts
    - Damaged or loose electrical connections
    - Condition of chemical cylinder or tank and gas pressure level
2. Piping, fittings, valves:
    - Rust damage, water leaks, air leak, loose, missing or damaged parts, mounts, hangers or fittings
    - Condition of sprinkler heads
    - Verify that valves are locked in open position
    - Verify annual contracted backflow inspection on fire suppression system
3. Air compressors:
    - Rust damage, air leak, loose, missing or damaged parts, mounting, hangers or fittings
    - Condition of air compressor and whether it runs continuously or cycles too frequently
    - Aged, deteriorated or damaged air compressor.

Fire Sprinkler System

SPRINKLERS

Checks to be made:

1. Maintenance:
    - Rust damage, water leaks, loose, missing or damaged parts, hangers or fittings
    - Condition of jockey pump and whether it runs continuously or cycles too frequently
    - Deteriorated surfaces, missing identifier or blocked access
2. Sprinkler system alarm valves:
    - Rust damage, air leaks, water leaks, loose, disconnected, missing or damaged parts
    - Damaged or loose electrical connections

- Aged, deteriorated or damaged alarm valve

3. Piping, fittings, valves:
   - Rust damage, water leaks, air leak, loose, missing or damaged parts, mounts, hangers or fittings
   - Condition of sprinkler heads
   - Verify that valves are locked in open position
4. Water—pumps:
   - Rust damage, water leaks, excessive noise and vibration, loose, missing or damaged parts
   - Condition of motor, coupling and pump
   - Damaged or missing pump insulation
   - Damaged or loose electrical connections
   - Aged, deteriorated or inoperative pump.

STANDPIPE

Checks to be made:

1. Piping, fittings and valves:
   - Rust damage, water leaks, air leak, loose, missing or damaged parts, mounts, hangers or fittings
   - Condition of sprinkler heads
   - Verify that valves are locked in open position
2. Hoses:
   - Rotted or damaged hose; damaged connectors or fittings.

Signage & Marking

Sign

Signs are displayed to convey information. Four basic types of signs are common to the NPS: identification signs, directional signs, information/education signs and regulatory signs. Signs differ in purpose and size (e.g., small directional metal sign versus kiosk/bulletin board with a roof). Signs may be made of acrylic, aluminum, concrete, fiberglass embedment, fiberglass, glass, high-pressure laminate, laminate, masonry/stone, metal, plastic, recycled plastic, steel, timber and wood.

Checks to be made:

1. Signage:
   - Missing sign resulting in noticeable damage, such as inappropriate social trails or resource damage
   - Signs contain incorrect information
2. Kiosk/bulletin boards:
   - Warped, rotting or loose shingles on kiosk roof
   - Ultraviolet damage to Lexan/Plexiglas case, cracked or checked
   - Kiosk/bulletin board contains incorrect information
3. Signage (wood):
   - Loose, damaged, illegible or missing sign face:
     - Loose sign face

    - Damaged sign face
    - Illegible sign face
    - Missing sign face
- Splits/cracks/broken posts:
    - Surface fibers separated, less than 25 percent of thickness affected
    - Surface fibers separated, greater than 25 percent of thickness affected
    - Physically damaged and broken
- Rot, fungus or decay of posts:
    - Moist stained area
    - Discolored, soft or crushed area
- Parasite damage of posts:
    - Holes less than ⅛", surface sag and frass observed
    - Large holes greater than ⅛", surface channels, punctures and crushing
- Out of level:
    - Less than or equal to 3" in 4'
    - More than 3" in 4'
- Out of plumb:
    - Less than or equal to 3" in 8'
    - More than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or obscuring sign
- Decaying or leaning trees (if sign is mounted to tree)

4. Signage (metal):
    - Loose, damaged, illegible or missing sign face
    - Out of level:
        - Less than or equal to 3" in 4'
        - More than 3" in 4'
    - Out of plumb:
        - Less than or equal to 3" in 8'
        - More than 3" in 8'
    - Corrosion of posts:
        - Surface corrosion, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced loss of base metal
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vines, trees or shrubs climbing over or obscuring sign
5. Signage (concrete):
    - Loose, damaged, illegible or missing sign face
    - Cracking:
        - Hairline crack
        - Medium cracks $^{1}/_{16}$" wide
        - Wide cracks more than $^{1}/_{16}$" wide
        - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
    - Spalling:
        - Less than 1" deep or 6" in diameter

  - More than 1" in depth or greater than 6" in diameter or loss of more than 10 percent of surface area of a member
  - Disintegration of surface area, with corrosion of exposed reinforcing steel
- Scaling:
  - Loss of surface up to ½" deep, with exposure of coarse aggregates
  - Loss of surface from ½" to 1" deep with coarse aggregates clearly exposed
  - Loss of surface exceeds 1", reinforcing steel usually exposed
- Reinforcing steel corrosion: rusting/discoloration evident, cracks occurring parallel to reinforcement
- Out of level:
  - Less than or equal to 3" in 4'
  - More than 3" in 4'
- Out of plumb:
  - Less than or equal to 3" in 8'
  - More than 3" in 8'
- Erosion/vegetation:
  - Soil erosion around posts
  - Vines, trees or shrubs climbing over or obscuring sign

6. Signage (masonry/stone):
- Loose, damaged, illegible or missing sign face
- Deteriorated, cracked, loose/missing mortar joint material
- Out of level:
  - Less than or equal to 2" in 8'
  - More than 2" in 8'
- Out of plumb:
  - Less than or equal to 3" in 8'
  - More than 3" in 8'
- Damaged bricks, stones or CMU:
  - Cracked, split, damaged
  - Loose, missing
- Erosion/vegetation:
  - Soil erosion around sign footing
- Vines, trees or shrubs climbing over or obscuring sign.

Special

Food Service

KITCHEN EQUIPMENT

Checks to be made:

- Rust damage, refrigerant leaks, oil leaks, steam leaks, water leaks, excessive noise and vibration, loose, missing or damaged parts or components
- Condition of equipment cabinet, doors, door glass, gaskets and hardware
- Grease and food particle buildup on equipment
- Debris collected on intake side of condenser coils
- Condition of refrigeration unit, motors and fans
- Damaged or loose electrical controls or connections

- Type of refrigerant used in system
- Aged, deteriorated or inoperative equipment.

REFRIGERATION EQUIPMENT

Checks to be made:

- Rust damage; oil/refrigerant leaks; water leaks; excessive noise and vibration; loose, missing or damaged parts or components
- Condition of equipment cabinet, doors, gaskets and hardware
- Debris collected on intake side of condenser coils
- Condition of refrigeration unit, motors and fans
- Damaged or loose electrical controls or connections
- Damaged refrigerant piping or missing pipe insulation
- Type of refrigerant used in system
- Aged, deteriorated or inoperative equipment
- Health department food safety and inspection service certificate is up to date.

Structure

Wall

EXTERIOR WALLS

Checks to be made:

1. Weather tightness:
   - Lack of weather tightness, where butting dissimilar surfaces, between joints
   - Perform a blower door test where access can be restricted and document results
2. Parapet walls and copings:
   - Cracks, spalling, defective joints and other damage
3. Concrete:
   - Cracks; spalling; broken areas; settlement; exposed reinforcing, infestation (rats, termites, ants, etc.)
4. Masonry:
   - Eroded or sandy mortar joints; mortar cracking and pulling away from brick or concrete masonry units; efflorescence, soft, spalling or cracked bricks or concrete masonry units; settlement or expansion cracks; infestation (e.g., rats, termites, ants)
5. Wood:
   - Rotted ends, areas within the log walls and other damage
6. Weather stripping:
   - Lack of weather tightness around framed openings, where butting dissimilar surfaces, between joints
   - Blower door test
   - Identify whether a vapor barrier has been installed in the wall, attic and foundation construction and if it was installed properly
7. Trim/flashing—wood:
   - Looseness; warping; surface cracking, checking; swelling of joints; loose or missing knots; rotting; infestation (e.g., rats, termites, ants; stains); evidence of continued dampness

8. Wall insulation:
    - Missing or insufficient insulation, loose, torn, damaged facing material
9. Vents/cleanouts and chimney screen:
    - Clogged with fly ash; rust, tears and other damage; bolts and screws for rust, corrosion, loose, broken or missing parts
10. Deflection:
    - Rotting or fungus growth
    - Evidence of dampness of long duration
    - Damage or possible damage to wooden parts due to closeness or direct contact with soil
11. Columns—concrete:
    - Cracks; spalling; broken areas; settlement; exposed reinforcing
12. Columns—wood/timber:
    - Warping, checking, splitting, bowing, sagging or broken members
13. Columns—steel:
    - Corrosion, cracking, bowing, settlement
    - Missing fire proofing
    - Asbestos fire proofing
14. Columns—masonry/stone:
    - Eroded or sandy mortar joints
    - Mortar cracking and pulling away from brick or CMUs
    - Efflorescence, soft, spalling or cracked bricks or CMUs
    - Settlement or expansion cracks
15. Beams/girders/joists/rafters/trusses/studs/sills:
    - Warping, checking, splitting, bowing, sagging or broken members
    - Deflection
    - Rotting or fungus growth
    - Evidence of dampness of long duration
    - Damage or possible damage to wooden parts due to closeness or direct contact with soil
    - Insect damage
16. Sheathing:
    - Warping, sagging
    - Rotting or fungus growth
    - Evidence of dampness of long duration
    - Damage or possible damage to wooden parts due to closeness or direct contact with soil
    - Insect damage.

Basement Walls

Checks to be made:

1. Interior surface:
    - Evidence of moisture intrusion
2. Concrete:
    - Spalling or broken areas
    - Leaks or dampness

- Exposed reinforcing
- Out of plumb
- Differential settlement or frost heave indicated by cracks, binding of doors and windows and/or separation of wall or slab from footing

3. Masonry:
   - Eroded or sandy mortar joints
   - Mortar cracking and pulling away from brick
   - Soft or spalling brick
   - Leaks or dampness
   - Out of plumb
   - Differential settlement or frost heave indicated by cracks, binding of doors and windows and/or separation of wall or slab from footing
4. Infestation:
   - Rats, termites, ants, etc.
   - Form boards, scrap wood or other cellulose material under buildings and/or near foundation or structural wood.

PARTITIONS

Checks to be made:

1. Drywall/plaster/paneling:
   - Wallboard, plasterboard, hard-pressed fiberboard and cement-asbestos board: open joints; cracking; buckling; sagging; support failure; loose; failure of nailing or adhesive; abrasions; breaks; holes; discoloration from weather or utility leaks
   - Plaster: cracking, buckling, sagging, support failure; spalling, crumbling or falling from moisture absorption; efflorescence, peeling or flaking from moisture or sealer failure; discoloration from weather or utility leaks
   - Wood: checking, cracking; splintered; broken; warping; sagging; support failure; rot; infestation (e.g., rats, termites, ants); abrasion; scuff marks; mechanical damage; personal abuse
   - Soft fiberboard (acoustical and insulation): open joints; buckling; sagging; support failure; loose; missing; failure of fastenings or adhesive; abrasions; breaks; holes
   - Metal: corrosion, rust abrasions, indentations, punctures, deterioration of protective coating
2. Ceramic tile/masonry/glass block:
   - Chipped, cracked, loose, missing, holes, defective mortar joints; etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners
3. Trim:
   - Wood: missing, cracking; splintered; broken; warping; rot; infestation (e.g., rats, termites, ants); abrasion; scuff marks; personal abuse
   - Resilient (linoleum, vinyl plastic): curling, loose, adhesive failure, abrasions, indentations, punctures, tears; etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaner, evidence of mechanical damage or personal abuse
   - Ceramic/porcelain/marble: chipped, cracked, loose, missing, holes, defective mortar joints; etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners
4. Mirrors/fixtures:

- Mirrors: missing, cracking; broken; abrasion; deteriorated backing; missing/damaged mounting hardware
- Fixtures: missing; loose; inoperative, bent or other damage

5. Corner guards/rub rails:
   - Wood: missing; loose; cracked; warped; damaged/missing hardware; worn finish
   - Metal: missing; bent; damaged/missing hardware; worn finish
   - Resilient (vinyl plastic): curling, loose, adhesive failure, abrasions, indentations, punctures, tears; etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaner, evidence of mechanical damage or personal abuse.

WALL FINISHES

Checks to be made:

1. Maintenance:
   - Painting: alligatoring; checking; blistering; crawling; cracking; scaling; peeling; wrinkling; flaking; fading; loss of gloss; efflorescence; excessive chalking; mildew; bleeding; staining caused by insect screens or splashing; discoloration; complete absence of paint. Paint film is less than 3 mm in thickness on metal surfaces.
2. Wall coverings:
   - Wood paneling: dust, dirt or debris; grease or crayon stains; small scratches, nicks, nail holes or screw holes
   - Canvas and paper covering: breaks, wrinkling, fading, adhesive failure, evidence of mechanical damage or personal abuse
   - Resilient covering (plastic laminate, linoleum, vinyl plastic): curling, loose, adhesive failure, abrasions, indentations, punctures, tears; etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaner, evidence of mechanical damage or personal abuse.

Structure/Access

Stairs

Stair steps may be made from stone, iron rungs, pinned steel, concrete, earth, treated timber and/or log to armor a steep trail tread or to provide a means of ascension. Iron rungs are inserted into holes drilled in rock and provide a “step ladder” for crossing an exposed ledge.

Checks to be made:

1. Treads:
   - Risers and treads: wear, splintered, split, cracked, chipped, loose, broken, sagging, rotted or damaged to supporting structure or damage caused by settlement
   - Finished treads: absence of protective coatings, evidence of rat or insect infestation in finish and supporting members, inadequate exposure of abrasive necessary for nonslip finish surfaces; loose, missing, broken or other damage to abrasive stair nosings or treads, loose, missing, broken or other damage to abrasive stair nosings or treads, lack of nonslip finish or other types of stair covering
   - Steel: wear, rusted, loose, bent or other damage to surfaces, risers, treads and structural supports
2. Stairs/landings:

- Concrete: cracks; spalling; broken areas; settlement; exposed reinforcing
- Masonry/stone: eroded or sandy mortar joints; mortar cracking and pulling away from brick or concrete masonry units; efflorescence, soft, spalling or cracked bricks or concrete masonry units; settlement or expansion cracks
- Wood: missing; loose; cracked; warped; damaged/missing hardware; worn finish

3. Railing balustrade:
    - Hand railing and supports: lack of rigidity of supporting members, loose, splintered, missing or other damage to handrails, lattices and supports, absence of protective coatings
    - Metal railings: rust, loose, bent or other damage to surfaces and structural supports; broken welds; loose, missing or damaged bolts, nuts, rivets and screws.

Structure/Base & Foundation

Foundation

Slab on Grade

Slab on grade is a slab poured on earth, whether on undisturbed or fill soil. Concrete bases may be nonreinforced or reinforced, depending on the load to be supported. Nonreinforced concrete slabs-on-grade are cast in place and thick enough to provide required strength. Reinforced concrete slabs-on-grade use welded wire mesh or reinforcing rods embedded in the concrete to increase resistance to tensile and shear stresses.

Nonreinforced base units may be used as pads under light weight equipment, such as transformers or heat units, while reinforced bases may be used to support building components or heavy equipment.

Reinforced concrete pit walls and flooring are poured in place; the thickness depends on the angle of repose and the weight of supported structures.

Checks to be made:

1. Concrete damage:
    - Cracking, extensive disintegration of surface
    - Scaling, spalling, popouts and/or vertical displacement
2. Reinforcing steel:
    - Rusting/discoloration evident, cracks occurring parallel to reinforcement
    - Exposure of reinforcing steel
3. Sealant damage:
    - Deterioration evidenced by hardening of sealant/caulking
    - Deterioration evidenced by shrinking, cracking or missing sealant/caulking.

Special Foundations

These checks refer to all work associated with special foundations, including piles, caissons and any other special foundation situation.

Checks to be made:

1. Concrete:
    - Spalling or broken areas

- Leaks or dampness
- Exposed reinforcing
- Out of plumb
- Differential settlement or frost heave indicated by cracks, binding of doors and windows and/or separation of wall or slab from footing

2. Masonry:
    - Eroded or sandy mortar joints
    - Mortar cracking and pulling away from brick
    - Soft or spalling brick
    - Leaks or dampness
    - Out of plumb
    - Differential settlement or frost heave indicated by cracks, binding of doors and windows and/or separation of wall or slab from footing
3. Wood:
    - Soft rot
    - Out of plumb
    - Infestations (e.g., rats, termites, ants).

STANDARD FOUNDATIONS

Checks to be made:

1. Exterior surface:
    - Deteriorated paint/waterproofing
    - Deteriorated/missing caulking
    - Loose vents
2. Interior surface:
    - Evidence of moisture intrusion
3. Vent screen:
    - Frames—binding, jamming or poor fit
    - Hardware or connections—loose, broken or missing
    - Metal parts—rusting or corroding
    - Fabric—holes or rotting
    - Wooden parts—rotting and other damage
    - Vent openings—clogged, blocked, covered or inadequacy of ventilated area resulting in under floor condensation
4. Concrete:
    - Spalling or broken areas
    - Leaks or dampness
    - Exposed reinforcing
    - Out of plumb
    - Differential settlement or frost heave indicated by cracks, binding of doors and windows and/or separation of wall or slab from footing
5. Masonry:
    - Eroded or sandy mortar joints
    - Mortar cracking and pulling away from brick
    - Soft or spalling brick
    - Leaks or dampness

- Out of plumb
- Differential settlement or frost heave indicated by cracks, binding of doors and windows and/or separation of wall or slab from footing

6. Infestation:
   - Rats, termites, ants, etc.
7. Drainage:
   - Trash, debris or improper surface grading around structure resulting in water ponding or surface runoffs draining back toward building.

Structure/Door

Exterior Door

Checks to be made:

1. General:
   - Wood and trim: splitting, rotting, cracking, loose, poor fit, binding, missing, loose or missing caulking, lack of weather tightness
   - Glass: missing or broken panes, disintegration of putty
   - Trim: looseness, scratches, indentations mechanical damage, personal abuse
2. Maintenance:
   - Paint/caulk: worn/peeling paint; missing/deteriorated caulking; corrosion, abrasion, loss of finish coating; broken seals/weather stripping
   - Adjust/secure/lubricate: loose, broken or missing hardware; binding, jamming, poor fit
3. Components/hardware:
   - Loose, missing, broken parts; binding, misalignment, improper installation or adjustment, lack of lubrication; corrosion, abrasion, loss of finish coating
   - Door operator pull (meets Americans with Disabilities Act [ADA] guidelines for the size and weight of the door)
   - ADA mechanical operators functioning
   - Weather seals in tack and functioning
4. Exterior doors and frames:
   - Wood: splitting; rotting; cracking; loose; poor fit; binding; missing; scratches; indentations; loose/damaged hardware; inoperative hardware; mechanical damage; personal abuse; delimitation; loose or missing caulking; lack of weather tightness
   - Metal: corrosion; warping; binding; poor fit; bent; loose/damaged hardware; mechanical damage; personal abuse; loose/missing caulking; lack of weather tightness
   - Fiberglass: warping; binding; cracked; poor fit; loose/damaged hardware; mechanical damage; personal abuse; loose/missing caulking; lack of weather tightness
   - Swings open in appropriate direction for peak occupancy load
   - Automated accessible door openers work properly
5. Access panels/locks:
   - Corrosion; warping; binding; poor fit; bent; loose/damaged hardware; mechanical damage; vandalism.

Interior Door

Checks to be made:

1. General:
    - Wood and trim: splitting, rotting, cracking, loose, poor fit, binding, missing
    - Glass: missing or broken panes, disintegration of putty
    - Trim: looseness, scratches, indentations mechanical damage, personal abuse
2. Maintenance:
    - Paint/caulk: worn/peeling paint; missing/deteriorated caulking; corrosion, abrasion, loss of finish coating
    - Adjust/secure/lubricate: loose, broken or missing hardware; binding, jamming, poor fit
3. Components/hardware:
    - Loose, missing, broken parts; binding, misalignment, improper installation or adjustment, lack of lubrication; corrosion, abrasion, loss of finish coating
    - Door operators functioning
    - Weight of door pull meets ADA standards
    - Lock sets operating
    - Wear and tear damage and vandalism
4. Doors and frames:
    - Wood: splitting; rotting; cracking; loose; poor fit; binding; missing; scratches; indentations; loose/damaged hardware; inoperative hardware; mechanical damage; personal abuse; delimitation
    - Metal: corrosion; warping; binding; poor fit; bent; loose/damaged hardware; mechanical damage; personal abuse.

Structure/Window

Exterior Window

Checks to be made:

1. Paint/caulk/glaze:
    - Worn/peeling paint; missing/deteriorated caulking; missing/loose glazing compound, corrosion, abrasion, loss of finish coating; broken seals/weather stripping; fogging/moisture between panes
2. Glass:
    - Missing or broken panes, disintegration of putty
3. Trim:
    - Looseness, scratches, indentations, mechanical damage, personal abuse
4. Adjust/secure:
    - Loose, broken or missing hardware; binding, jamming, poor fit of frames
    - Test operational capability (if more than 30 windows, test 10 percent of the windows)
5. Hardware:
    - Loose, missing, broken parts; binding, misalignment, improper installation or adjustment, lack of lubrication; corrosion, abrasion, loss of finish coating
6. Screens:
    - Loose, broken or missing hardware; binding, jamming, poor fit of frames; metal parts for rust, corrosion, holes in fabric; wooden parts for rotting, stain, other damage

7. Shutters:
    - Splitting, rotting, cracking, loose, missing, misalignment and freedom of swing or little or no free motion as required
8. Venetian blinds, window shades:
    - Insecure or broken fasteners; poor operation; frayed or broken cords or tapes; broken or damaged slats; worn or torn material; cleanliness
9. Wood sash, frame, casing and trim:
    - Splitting, rotting, cracking, loose, poor fit, binding, missing, scratches, indentations, mechanical damage, personal abuse, loose or missing caulking, lack of weather tightness
10. Metal sash and trim:
    - Rust, corrosion, warping, binding, poor fit, lack of weather tightness
11. Storm sash:
    - Binding, jamming, poor fit of frames; metal parts for rust and corrosion; wood parts for rotting and other damage
12. Wood sash, frame, casing and trim:
    - Splitting, rotting, cracking, loose, poor fit, binding, missing, loose or missing caulking, lack of weather tightness
13. Metal sash and trim or metal storm sash:
    - Rust, corrosion, warping, binding, poor fit, nonweather tightness.

Surface

Roof Surface

Checks to be made:

1. Maintenance:
    - Painting: alligatoring; checking; blistering; crawling; cracking; scaling; peeling; wrinkling; flaking; fading; loss of gloss; excessive chalking; mildew; bleeding; staining caused by insect screens or splashing; discoloration; complete absence of paint
    - Exposed metal surfaces: need for rust removal and painting or protective coating
2. General:
    - Roof surface and drains: trash and debris
3. Single-ply membrane (elastomeric):
    - Membrane surface: deterioration, cracking, splitting and cuts
    - Side and end lap seams: separation and failure
    - Ballasted roof system: loss of stone cover
    - Roof edge flashing: pulled loose or missing
    - Adhered membrane system: separated from fasteners
4. Wood shingles:
    - Shingles:
        - Weathering, warped, broken, loose, split, curling, missing, flashing failures
        - Where possible, without damaging roof covering, use screwdriver to probe under edge of roof covering at overhang to check for rotted decking or dampness
    - Wall, vent, valley and edge flashing: open joints, loose, proper fastenings and other damage
5. Build-up:

- Cracking, alligatoring, low spots and water ponding; failure or lack of gravel stops; cracks in membrane; exposed bituminous coating; exposed, disintegrated, blistered, curled or buckled felts
- Fastenings: improper materials, loose, missing, broken, defective, exposure
- Pitch pockets/pans: replenishment of pitch

6. Other materials:
   - Clay tile: weathering, broken, missing cracked, loose, flashing failures, deterioration of expansion joint material or tile raising from improper placing or inadequate expansion joints
   - Slate: weathering, broken, cracked, loose missing; flashing failures
   - Metal: holes, looseness, punctures, broken seams, inadequate side and end laps, inadequate expansion joints, rust or corrosion and damage resulting from contact of dissimilar metals
   - Cement—asbestos: wear from weathering, broken, cracked, loose, missing, insufficient side or end lap
   - Asphalt—roll: Weathering, cracking, alligatoring, buckling, blistering, insufficient or uncemented laps, tearing from nails too close to edge, other damage to coatings
   - Asphalt—shingle: weathering, lifting, cracking, curling, buckling, blistering, loss of granules, excessive exposure
   - Asbestos shingles: weathering, broken, cracked, loose, missing, sufficient side or end lap
   - Concrete slabs: cracks, sapling, expansion joint deterioration, low spots, improper drainage
7. Flashing—general:
   - Metal base flashing: rust, open vertical joints, loose flanges, inadequate or exposed nailing, improper fastening, improper sealing with felt strips, deteriorated or missing cant strip
   - Other base flashing: sagging, deteriorating, separation, adequate coverage or embedment, vertical joints, proper fastening, buckling, cracking, surface coat, cant strip
   - Metal cap flashing: Rust, corrosion, open joints, loose, improper fastenings
8. Flashing—other cap flashings:
   - Open joints, buckling, cracking; surface coat disintegration; improper fastenings
9. Expansion joints/ballast material/debris:
   - Expansion joints: holes, deteriorated/missing caulking, missing/loose fasteners, deteriorated membrane
   - Missing ballast material
   - Debris on roof surface
10. Drainage—gutters and downspouts:
    - Misalignment, rust, corrosion, material accumulations and clogging, breaks, leaks, missing wire guards, loose or missing hangars or other fastenings
    - Failure to connect downspouts to available storm sewers or terminate on properly installed splash blocks.

Roof Openings

Checks to be made:

1. Hatches/smoke hatches/skylights:

- Splitting, cracking, improperly installed, weather tightness, rusting or inoperative hardware.

Surface/Finish

Exterior Finish

Checks to be made:

1. Painting:
   - Alligatoring; checking; blistering; crawling; cracking; scaling; peeling; wrinkling; flaking; fading; loss of gloss; efflorescence; excessive chalking; mildew; bleeding; staining caused by insect screens or splashing; discoloration; complete absence of paint. Paint film is less than 3 mm in thickness on metal surfaces.
2. Stucco:
   - Corrosion, disintegration; alligator cracks; water stains; broken areas
3. Siding—cement/asbestos:
   - Stains; loose fastenings; broken sheets
4. Siding—aluminum:
   - Corrosion from corrosive atmosphere; loose fastenings; other damage
5. Siding—ferrous and other metal:
   - Scars; scuffs; rust; corrosion; breaks in protective coatings; puncture of metal; loose, missing or broken fastenings; sagging, buckling, support failure
6. Siding—wood:
   - Looseness; warping; surface cracking, checking; swelling of joints; loose or missing knots; rotting; fungus or infestation; stains; evidence of continued dampness; skirting and other wooden parts for interference with ventilation and condensation control, damage or rot from closeness to soil levels and need for corrective or preventive treatment
7. Siding—vinyl:
   - Looseness; warping; surface cracking, missing sections, other damage.

Interior Finish

Ceiling Finishes

Checks to be made:

1. Maintenance:
   - Painting: alligatoring; checking; blistering; crawling; cracking; scaling; peeling; wrinkling; flaking; fading; loss of gloss; efflorescence; excessive chalking; mildew; bleeding; staining caused by insect screens or splashing; discoloration; complete absence of paint. Paint film is less than 3 mm in thickness on metal surfaces.
   - Metal: corrosion, rust, abrasions, indentations, punctures, deterioration of protective coating
2. Tile:
   - Ceramic tile: chipped, cracked, loose, missing, holes, defective mortar joints; etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners
3. Sheetrock/plaster:

- Plaster: cracking, buckling, sagging, support failure; spalling, crumbling or falling from moisture absorption; efflorescence, peeling or flaking from moisture or sealer failure; discoloration from weather or utility leaks
- Wallboard, plasterboard, hard pressed fiberboard and cement-asbestos board: open joints; cracking; buckling; sagging; support failure; loose; failure of nailing or adhesive; abrasions; breaks; holes; discoloration from weather or utility leaks
- Soft fiberboard (acoustical and insulation): open joints; buckling; sagging; support failure; loose; missing; failure of fastenings or adhesive; abrasions; breaks; holes; stains from weather or utility leaks

4. Sprayed material and insulation:
    - Insulation: loose/missing sections, damaged facing material and insufficient thickness or R value
    - Sprayed material: loose/missing/flaking sections, damaged areas insufficient thickness
5. Concrete:
    - Cracks; spalling; broken areas; settlement; exposed reinforcing
6. Wood:
    - Checking, cracking; splintered; broken; warping; sagging; support failure; rot; infestation (e.g., rats, termites, ants); abrasion; scuff marks; mechanical damage; personal abuse.

Floor Finishes

Checks to be made:

1. General:
    - All finished flooring: overloading; absence of protective coatings, evidence of rat or insect infestation in finish and subflooring indicated by presence of sawdust, wood pellets or small round emergence holes, check damp areas of long duration for infestation and fungus growth
2. Maintenance
    - Painting: alligatoring; checking; blistering; crawling; cracking; scaling; peeling; wrinkling; flaking; fading; loss of gloss; excessive chalking; mildew; bleeding; staining caused by insect screens or splashing; discoloration; complete absence of paint. Paint film is less than 3 mm in thickness on metal surfaces.
3. Terrazzo:
    - Wear, pitting, roughness, discoloration, settlement cracks
4. Wood floors:
    - Wood: sagging, wear, splintered, loose, warped, scratched, shrinkage cracks, rotted, stains, discoloration, moisture penetration, indentations; absence of protective coatings; evidence of rat or insect infestation in finish and subflooring indicated by presence of sawdust, wood pellets or small round emergence holes, check damp areas of long duration for infestation and fungus growth
    - Strip and plank: sagging, wear, splintered, loose, warped, scratched, shrinkage cracks, rotted, stains, discoloration, moisture penetration, indentations
    - End-gain block: loose, missing, rotted or otherwise damaged individual blocks that form uneven surfaces
5. Masonry/stone:

- Clay, quarry tile, brick: sandy and eroded mortar joints; individually stained or broken, chipped or loose, resulting in uneven surfaces

6. Access flooring—tiles, carpet or vinyl:
   - Panels fit properly in frame
   - Pedestals have proper height and are securely anchored
7. Carpet and rugs:
   - Wear, tear, cuts, raveling, discoloration, fading; binding or anchoring strips for wear, damage, poor anchorage; worn or missing tractive substance on backing of small rugs or carpets where placed over polished floor; beetle or moth damage
8. Tile, soft:
   - Resilient floor coverings (linoleum, vinyl plastic, vinyl asbestos, cork, rubber and asphalt tiles): wear, cracking, shipping, breaking, scratches, tears, indentations; lack of bonding and unevenness underlayment; evidence of damage resulting from use of solvents or excessive use of water for cleaning; absence of protective wax coatings
9. Tile, hard:
   - Ceramic, porcelain, marble, clay: cracking, chipping, breaking, scratches; lack of bonding and unevenness underlayment; evidence of damage resulting from use of solvents or excessive use of water for cleaning; absence of protective sealant
10. Sheet covering/abrasive strips/mats:
    - Resilient floor coverings (linoleum, vinyl plastic, vinyl asbestos, cork, rubber): wear, cracking, chipping, breaking, scratches, tears, indentations; lack of bonding and unevenness underlayment; evidence of damage resulting from use of solvents or excessive use of water for cleaning; absence of protective wax coatings.

Other Finishes

Checks to be made:

1. Maintenance:
   - Painting: alligatoring; checking; blistering; crawling; cracking; scaling; peeling; wrinkling; flaking; fading; loss of gloss; excessive chalking; mildew; bleeding; staining caused by insect screens or splashing; discoloration; complete absence of paint. Paint film is less than 3 mm in thickness on metal surfaces.
2. Tread inserts/covering/antislip treatment:
   - Abrasive tape: missing; loose; worn/torn
   - Metal: missing; bent; damaged/missing hardware; worn surface, worn finish/paint
   - Linoleum, vinyl plastic: curling, loose, adhesive failure, abrasions, indentations, punctures, tears; etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaner, evidence of mechanical damage or personal abuse
   - Canvas and paper covering: breaks, wrinkling, fading, adhesive failure, evidence of mechanical damage or personal abuse.

Water Control

Drain

Rain Water Drainage

Checks to be made:

1. Maintenance:
    - Loose fixtures, water leaks, loose, missing, deteriorated or damaged components, hangers or fittings
    - Inadequate or excessive water flow
    - Slow or clogged drains
2. Ejectors and pumps:
    - Rust damage, leaks, excessive noise and vibration, loose, missing or damaged parts
    - Condition of motor and pump
    - Condition of floats and controllers
    - Damaged or loose electrical connections
    - Aged, deteriorated or inoperative pump
3. Piping and fittings:
    - Condition of pipes, fittings and valves
    - Aged or abandoned piping.

Resources

Name	Affiliation	E-mail Address	Date Resource Added
Natalya Karamyshev	WASO	natalya_karamyshev@nps.gov	8/13/2015
Rick Maestas	WASO	rick_maestas@nps.gov	8/13/2015
Laura Stresemann	MWRO	laura_stresemann@nps.gov	2/22/2016
Mary Tidlow	WASO	mary_tidlow@nps.gov	8/13/2015

Related Documents

The following documents provide additional information on the asset category discussed in this IG:

- Buildings Asset Business Practice
- Critical Systems List
- Life-Cycle Estimates.

Appendix A Inspection Guidance Change Log

Business Practice Title:	Buildings (4100) Asset Inspection Guidance
Responsible Group:	Comprehensive Asset Strategic Tools (CASTL) Development Group
Title of Business Practice Origin White Paper:	N/A
Last Change Made On:	November 3, 2017

#	Page #	Change Description	Reason for Change	Requested By	Requested On	Change Made On	Approved By	Approved On
1.0	N/A	Initial Release	Initial Release	N/A	N/A	N/A	N/A	11/3/2017

National Park Service
U.S. Department of the Interior

1201 Eye Street, NW, 10th Floor
Washington, DC 20005

Inspection Guidance: 5100 Water System

Version 2.0

Effective Date: June 2, 2014

End Date: Until Amended or Rescinded

SRS Code: 4.B.1.

Table of Contents

Introduction **1**
Common Components and Critical Systems **2**
Comprehensive Condition Assessments **2**
Safety 2
Tips for Inspections 3
Water Treatment 3
Screening Systems 3
Rapid Mix Systems 5
Flocculator Systems 7
Settling Tank Systems 8
Filter Systems 10
Reverse Osmosis Systems 12
Disinfection Systems 12
Chlorine Contact Tanks 13
Component Inspection Guidance 13
Barrier & Fencing 13
Fence/Gate 13
Control & Instrumentation 18
Control 18
Electrical 19
Generator 19
Motor 20
Liquid & Gas 20
Pump 20
Tank 21
Well 23
Liquid & Gas/Plumbing 24
Pipe 25
Valve 26
Liquid & Gas/Treatment & Processing 26
Chemical Handling 27
Disinfection Equipment 27
Mechanical Handling Equipment 28
Solids Handling/Treatment 29

Treatment Equipment 33
Treatment Process Drive 35
Water Filter Packaged 36
Structure 37
Access Vault (Dry) 37
Resources 41
References 41
Related Documents 41
Appendix A Inspection Guidance Change Log A-1

Introduction

This document contains the inspection guidance for water systems. The critical components associated with a water system should be inspected using the guidelines found in this document. Other asset types can be collocated with a water system, however. Where this exists, these components should be inspected using the guidelines for that asset type.

All water system condition assessments should include a complete visual inspection of all constructed architectural, civil/structural and mechanical components. A field inspection should be performed using both a system and component inspection method to identify all maintenance and repair deficiencies that need correction. In other words, the inspector should determine if there is sufficient evidence to warrant complete replacement of a system versus repairing only specific components of that system (e.g., replacing the entire water distribution system as opposed to replacing tanks/valves).

A systematic approach to visual inspections must be employed to document all problems with a given water system. Some deficiencies are easily identifiable, such as leaking valves or corroded tanks. However, many deficiencies are more subtle (e.g., depression around wellhead) and may require further examination to identify. Using a systematic approach reduces the likelihood that deficiencies will be missed.

During an inspection, the inspector should thoroughly document the information that will be needed in the preparation of cost estimates and inspection reports. At a minimum, the following should be recorded for each deficiency:

- The water system deficiency should be defined (e.g., leaking valves, corroded tanks, missing fasteners or supports)
- The corrective action should be specified with the appropriate verb (e.g., build/add, repair, replace, realign, adjust, relocate, remove, reopen, maintain, monitor)
- Location data should be provided with global positioning system (GPS) reading coordinates and/or a wheeled distance from a recognizable component, and, if possible, the geographical location should be marked on a map (e.g., 50 feet northeast of pump house on main distribution line)
- Data should be quantified in sufficient detail to permit later development of budget-level cost estimates using the appropriate unit of measure (e.g., 120 linear feet of steel piping, 220 square feet or 7 each). It may also be useful to note whether on-site or imported materials will be used
- The relative priority of the deficiency should be noted as high, medium or low
- Additional comments or notes should be included that will help to define the project needs or special circumstances to consider.

While this document lays out universal inspection guidance, it does not establish one standard for all water systems. Water systems are constructed and maintained to different standards, as defined by a park unit's management plan. Park-level standards must be considered when completing water system assessments and should guide the corrective action (and costs) to address identified deficiencies.

Common Components and Critical Systems

Table 1 lists classifications used for the water system asset category. Any classification in the Facility Management Software System (FMSS) can be used to categorize components of a water system, but Table 1 contains those most commonly used.

Table 1. Water System Common Component List

Top-Level Classification	Classification	Critical System
Barrier/	Fence/Gate	No
Control & Instrumentation/	Control	Yes
Electrical/	Generator	No
Electrical/	Motor	No
Liquid & Gas/	Pump	Yes
Liquid & Gas/	Tank	No
Liquid & Gas/	Well	Yes
Liquid & Gas/Plumbing/	Pipe	Yes
Liquid & Gas/Plumbing/	Valve	No
Liquid & Gas/Treatment & Processing/	Chemical Handling	Yes
Liquid & Gas/Treatment & Processing/	Disinfection Equipment	Yes
Liquid & Gas/Treatment & Processing/	Mechanical Handling	Yes
Liquid & Gas/Treatment & Processing/	Physical Treatment	Yes
Liquid & Gas/Treatment & Processing/	Solids Handling/Treatment	Yes
Liquid & Gas/Treatment & Processing/	Treatment Equipment	Yes
Liquid & Gas/Treatment & Processing/	Treatment Process Drive	Yes
Liquid & Gas/Treatment & Processing/	Water Filter Packaged	No
Structure/Access/	Access Vault (Dry)	No

Comprehensive Condition Assessments

Safety

All inspections should be conducted in accordance with guidance found in the National Park Service (NPS) Reference Manual 50B and related federal, state and local safety and health standards. Examples include:

- Occupational Safety & Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910
- OSHA 29 CFR 1926
- National Fire Protection Association (NFPA) Life Safety Code
- NFPA 70E: Standard for Electrical Safety in the Workplace
- U.S. Environmental Protection Agency 40 CFR.

In addition, inspectors should request current copies of all operating unit safety plans applicable to water systems before conducting the inspection. This will ensure that operating unit as well as required regulatory elements are taken into account.

Tips for Inspections

It is recommended that the park review all relevant inventory documents and the results of the most recent inspection before performing the condition assessment. Doing so will help familiarize the inspectors with the inventory and allow them to note previously reported deficiencies.

Below is a short list of items that may be useful during a field inspection:

- Fully charged GPS unit for collecting point and line data
- Digital camera with a fully charged battery and spares
- Sufficient storage space on the GPS unit and camera memory cards
- Paper maps, paper and a pencil/pen for field notes
- Compass
- Measuring tape and/or measuring wheel:
    - Hand tape measure, 10 foot–25 foot
    - Reel tape measure, 50 foot–100 foot
- Previous inspection information or a list of current work orders for that water system
- Necessary field gear (appropriate footwear, sun protection, clothing and rehydration equipment)
- Gloves
- Flashlight
- Magnifying glass
- Eye protection
- Communication device (e.g., cell phone, radio).

When conducting an inspection of a water system, it is easier to inspect each type of water system as a whole unit, rather than breaking it down into the component classifications listed in Table 1. In order to facilitate the inspection of water systems, inspection guidance is presented below for a variety of water system types. Inspection guidance is also provided for each of the component classifications listed in Table 1 for ease of reference.

Water Treatment

Water treatment systems provide a means for removing debris, vegetation, fish, solid matter and suspended particles from the intake water. This is done by filtering through racks, screens, and other equipment. Further treatment includes removing bacteria and unpleasant tastes and odors, improving clarity and chemically enhancing for purification. Systems include tanks, pipes, pumps, collectors, screens, launders and other purification equipment.

Checks to be made:

Screening Systems

- Screening tanks:
    - Foundation settlement, cracks and/or exposed reinforcing
    - Concrete tank damage: cracks, spalling, scaling, reinforcing steel corrosion, pop outs and/or signs of leakage
    - Metal shell tanks: dents, abrasions and/or signs of leakage
    - Defective connections/anchorage or loose bolts, rivets, mechanical fasteners and broken welds

    - Deterioration of protective covering/corrosion
    - Excessive vegetation
- Bars and screens:
    - Physical damage to bar racks
    - Physical damage to screens
    - Severity of torn or elongated mesh coarse screens
    - Missing screens
- Pump assemblies:
    - Physical damage
    - Excessive pump noise and vibration
    - Pump hardware: loose, broken or missing pump assembly/mounting bolts
    - Leakage: leaking pump housing and/or leaking or damaged pump seals
    - Motor physical damage: cracked or damaged housing, end belts and/or motor base
    - Broken/loose motor hardware: loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
    - Excessive motor noise and vibration: excessive rattling, grinding noise indicating metal to metal contact and/or electrical arcing noise
    - Defective electrical connectors: loose conduit or connectors, exposed wires and/or missing cover plates
    - Pump drive defects: loose coupling fasteners, damaged coupling or drive shaft, torn/damaged coupling shock absorbers and/or missing coupling or belt guard
    - Float control hardware: loose, deformed or binding linkage and/or inoperable float control mechanism
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
- Piping, fittings and valves:
    - Bent or cracked fittings and/or signs of leakage
    - Bent/cracked pipes and/or signs of leakage
    - Supports/hangers: loose supports/hangers and/or broken/missing supports/hangers
    - Valves: leaking valve packing glands/gaskets, broken/missing valve handle, bent valve stem and/or cracked valve body
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
    - Insulation: loose, damaged, deteriorated and/or missing insulation
- Gauges, recording meters and sight glasses:
    - Moisture behind gauge lens, dial face not readable, broken lens and/or gauge inoperable
    - Recording meter for corrosion on housing, broken lens, damaged/missing pen holders and/or recording device inoperable
    - Sight glass for rush inside lens, sight glass graduations not readable and/or broken sight glass
- Tank access structures (wood):
    - Structural deformation: broken/missing members and/or missing rungs
    - Rot
    - Parasite damage

    - Loose, broken, split and/or damaged connections/anchorage
- Tank access structures (metal):
    - Structural deformation: broken/missing members and/or missing rungs
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion.

Rapid Mix Systems

- Concrete:
    - Foundation for settlement
    - Tank for cracks, spalling, scaling, reinforcing steel corrosion, pop outs, and/or signs of leakage
    - Excessive vegetation
- Rapid mix tanks (metal):
    - Foundation for settlement
    - Shell for physical damage: dents, abrasions and/or signs of leakage
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion
    - Excessive vegetation
- Pump assemblies:
    - Physical damage
    - Excessive pump noise and vibration
    - Pump hardware: loose, broken or missing pump assembly/mounting bolts
    - Leakage: leaking pump housing and/or leaking or damaged pump seals
    - Motor physical damage: cracked or damaged housing, end belts and/or motor base
    - Broken/loose motor hardware: loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
    - Excessive motor noise and vibration: excessive rattling, grinding noise indicating metal to metal contact and/or electrical arcing noise
    - Defective electrical connectors: loose conduit or connectors, exposed wires and/or missing cover plates
    - Pump drive defects: loose coupling fasteners, damaged coupling or drive shaft, torn/damaged coupling shock absorbers and/or missing coupling or belt guard
    - Float control hardware: loose, deformed or binding linkage and/or inoperable float control mechanism
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
- Chemical feeder equipment:
    - Hopper for bent/deformed hopper, damaged/missing cover, loose/missing mounting hardware and/or cracked/open/leaking shell
    - Slaker for damaged/missing covers, damaged/missing/spray nozzles, loose/missing mounting hardware, noisy slaker bearings and/or noisy slaker motor/drive
    - Mixing vat for damaged/missing cover, loose/missing mounting hardware and/or noisy agitator motor/drive

    - Cylinder storage for loose/missing cylinder connectors/chains/straps, missing cylinder label, chlorine odor and/or damaged/improper fusible plugin for cylinder device
    - Instrumentation/controls for corroded flow control device, damaged/missing/inoperable flow control device and/or chlorine odor
- Mechanical stirrer/mixer:
    - Motor/gear box for cracked/damaged housing or end bells and/or broken base
    - Motor/gear box hardware for loose bolts, broken/missing inspection covers and/or broken/missing assembly bolts
    - Excessive noise and vibration
    - Coupling or shaft for loose/missing set screws, defective coupling and/or loose/missing coupling guard
    - Paddles for defects, chemical build-up on paddles and/or broken/eroded paddles
    - Deterioration of protective covering/corrosion
- Air compressor/blower:
    - Excessive noise and vibration
    - Mounting hardware/supports
    - Air tank for defects or leaks
    - Compressor/blower assembly for loose, broken and/or missing bolts
    - Pressure gauge for defects or damage
    - Motor hardware for loose/broken/missing motor assembly bolts and/or broken/missing motor inspection cover
    - Compressor drive for loose coupling fasteners, damaged/missing coupling, damaged drive shaft and/or torn/damaged coupling shock absorber
    - Deterioration of protective covering/corrosion
    - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
- Piping, fittings and valves:
    - Fittings for bent/cracked fittings and/or signs of leakage
    - Pipes for bent/cracked pipes and/or signs of leakage
    - Supports/hangers: loose supports/hangers and/or broken/missing valve handle, bent valve stem and/or cracked valve body
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
    - Insulation: loose, damaged, deteriorated and/or missing insulation
- Gauges, recording meters and sight glasses:
    - Moisture behind gauge lens, dial face not readable, broken lens and/or gauge inoperable
    - Recording meter for corrosion on housing, broken lens, damaged/missing pen holders and/or recording device inoperable
    - Sight glass for rush inside lens, sight glass graduations not readable and/or broken sight glass
- Tank access structures (wood):
    - Structural deformation: broken/missing members and/or missing rungs
    - Rot
    - Parasite damage

    - Loose, broken, split and/or damaged connections/anchorage
- Tank access structures (metal):
    - Structural deformation: broken/missing members and/or missing rungs
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion.

Flocculator Systems

- Tanks (concrete):
    - Foundation for settlement
    - Cracks, spalling, scaling, reinforcing steel corrosion, pop outs and/or signs of leakage
    - Excessive vegetation
- Tanks (metal):
    - Foundation for settlement
    - Shell for physical damage: dents, abrasions and/or signs of leakage
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion
    - Excessive vegetation
- Pump assemblies:
    - Physical damage
    - Excessive pump noise and vibration
    - Pump hardware: loose, broken or missing pump assembly/mounting bolts
    - Leakage: leaking pump housing and/or leaking or damaged pump seals
    - Motor physical damage: cracked or damaged housing, end belts and/or motor base
    - Broken/loose motor hardware: loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
    - Excessive motor noise and vibration: excessive rattling, grinding noise indicating metal to metal contact and/or electrical arcing noise
    - Defective electrical connectors: loose conduit or connectors, exposed wires and/or missing cover plates
    - Pump drive defects: loose coupling fasteners, damaged coupling or drive shaft, torn/damaged coupling shock absorbers and/or missing coupling or belt guard
    - Float control hardware: loose, deformed or binding linkage and/or inoperable float control mechanism
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
- Mechanical stirrer/mixer:
    - Motor/gear box for cracked/damaged housing or end bells and/or broken base
    - Motor/gear box hardware for loose bolts, broken/missing inspection covers and/or broken/missing assembly bolts
    - Excessive noise and vibration
    - Coupling or shaft for loose/missing set screws, defective coupling and/or loose/missing coupling guard
    - Paddles for defects, chemical build-up on paddles and/or broken/eroded paddles

    - Deterioration of protective covering/corrosion
- Piping, fittings and valves:
    - Fittings for bent/cracked fittings and/or signs of leakage
    - Pipes for bent/cracked pipes and/or signs of leakage
    - Supports/hangers: loose supports/hangers and/or broken/missing valve handle, bent valve stem and/or cracked valve body
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
    - Insulation: loose, damaged, deteriorated and/or missing insulation
- Gauges, meters and sight glasses:
    - Moisture behind gauge lens, dial face not readable, broken lens and/or gauge inoperable
    - Recording meter for corrosion on housing, broken lens, damaged/missing pen holders and/or recording device inoperable
    - Sight glass for rush inside lens, sight glass graduations not readable and/or broken sight glass
- Tank access structures (wood):
    - Structural deformation: broken/missing members and/or missing rungs
    - Rot
    - Parasite damage
    - Loose, broken, split and/or damaged connections/anchorage
- Tank access structures (metal):
    - Structural deformation: broken/missing members and/or missing rungs
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion.

Settling Tank Systems

- Tanks (concrete):
    - Foundation for settlement
    - Cracks, spalling, scaling, reinforcing steel corrosion, pop outs and/or signs of leakage
    - Excessive vegetation
- Tanks (metal):
    - Foundation for settlement
    - Shell for physical damage: dents, abrasions and/or signs of leakage
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion
    - Excessive vegetation
- Pump assemblies:
    - Physical damage
    - Excessive pump noise and vibration
    - Pump hardware: loose, broken or missing pump assembly/mounting bolts
    - Leakage: leaking pump housing and/or leaking or damaged pump seals
    - Motor physical damage: cracked or damaged housing, end belts and/or motor base
    - Broken/loose motor hardware: loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts

    - Excessive motor noise and vibration: excessive rattling, grinding noise indicating metal to metal contact and/or electrical arcing noise
    - Defective electrical connectors: loose conduit or connectors, exposed wires and/or missing cover plates
    - Pump drive defects: loose coupling fasteners, damaged coupling or drive shaft, torn/damaged coupling shock absorbers and/or missing coupling or belt guard
    - Float control hardware: loose, deformed or binding linkage and/or inoperable float control mechanism
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
- Sludge collector:
    - Excessive noise and vibration
    - Motor/gear reducer for cracked/damaged housing or end bells and/or broken base
    - Motor/gear reducer hardware for loose bolts, broken/missing inspection covers and/or broken/missing assembly bolts
    - Chain and sprocket for loose or worn chains/sprockets/rollers, misaligned sprockets/rollers and/or rattling/grinding noise indicating defective bearing mechanism
    - Defective electrical connectors for loose conduit or connectors, exposed wires and/or missing cover plates
    - Chain guards for loose, damaged and/or missing chain guard
    - Deterioration of protective covering/corrosion
- Launders:
    - Damage, bent or deformed launder
    - Deterioration of protective covering/corrosion
- Piping, fittings and valves:
    - Fittings for bent/cracked fittings and/or signs of leakage
    - Pipes for bent/cracked pipes and/or signs of leakage
    - Supports/hangers: loose supports/hangers and/or broken/missing valve handle, bent valve stem and/or cracked valve body
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
    - Insulation: loose, damaged, deteriorated and/or missing insulation
- Gauges, recording meters, sight glasses:
    - Moisture behind gauge lens, dial face not readable, broken lens and/or gauge inoperable
    - Recording meter for corrosion on housing, broken lens, damaged/missing pen holders and/or recording device inoperable
    - Sight glass for rush inside lens, sight glass graduations not readable and/or broken sight glass
- Tank access structures (wood):
    - Structural deformation, broken/missing members and/or missing rungs
    - Rot
    - Parasite damage
    - Loose, broken, split and/or damaged connections/anchorage
- Tank access structures (metal:

    - Structural deformation, broken/missing members and/or missing rungs
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion.

Filter Systems

- Filter tanks (concrete):
    - Foundation for settlement
    - Cracks, spalling, scaling, reinforcing steel corrosion, pop outs and/or signs of leakage
    - Excessive vegetation
- Filter tanks (metal):
    - Foundation for settlement
    - Shell for physical damage: dents, abrasions and/or signs of leakage
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion
    - Excessive vegetation
- Piping, fittings and valves:
    - Fittings for bent/cracked fittings and/or signs of leakage
    - Pipes for bent/cracked pipes and/or signs of leakage
    - Supports/hangers: loose supports/hangers and/or broken/missing valve handle, bent valve stem and/or cracked valve body
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
    - Insulation: loose, damaged, deteriorated and/or missing insulation
- Gauges, recording devices and sight glasses:
    - Moisture behind gauge lens, dial face not readable, broken lens and/or gauge inoperable
    - Recording meter for corrosion on housing, broken lens, damaged/missing pen holders and/or recording device inoperable
    - Sight glass for rush inside lens, sight glass graduations not readable and/or broken sight glass
- Tank access structures (wood):
    - Structural deformation, broken/missing members and/or missing rungs
    - Rot
    - Parasite damage
    - Loose, broken, split and/or damaged connections/anchorage
- Tank access structures (metal):
    - Structural deformation, broken/missing members and/or missing rungs
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion
- Filtration media:
    - Slow sand
        - Maintain records (cleaning dates, water levels, filtration rates, raw water quality, finished water quality, etc.)
        - Hypogeal layer (Schmutzdecke) intact and undisturbed
        - Head loss within acceptable limits
        - Flow rate within acceptable range
    - Rapid sand

        - Maintain records (raw water quality, finished water quality, production chemicals inventory, turbidity, filtration rates, etc.)
        - Head loss within acceptable limits
        - Turbidity of filtered water within acceptable limits
- Backwash systems
    - Backwash pump
        - Physical damage
        - Excessive pump noise and vibration
        - Pump hardware: loose, broken or missing pump assembly/mounting bolts
        - Leakage: leaking pump housing and/or leaking or damaged pump seals
        - Motor physical damage: cracked or damaged housing, end belts and/or motor base
        - Broken/loose motor hardware: loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
        - Excessive motor noise and vibration: excessive rattling, grinding noise indicating metal to metal contact and/or electrical arcing noise
        - Defective electrical connectors: loose conduit or connectors, exposed wires and/or missing cover plates
        - Pump drive defects: loose coupling fasteners, damaged coupling or drive shaft, torn/damaged coupling shock absorbers and/or missing coupling or belt guard
        - Float control hardware: loose, deformed or binding linkage and/or inoperable float control mechanism
        - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
    - Backwash valves
        - Check for leaking valve packing glands/gaskets, broken/missing valve handle, bent valve stem and/or cracked valve body
        - Check valves for corrosion
        - Check for proper and easy operation/actuation
        - Check operating mechanism for operation under correct conditions; free and full travel of actuator arm/coupling
    - Backwash rate within acceptable limits (8 gallons per minute (gpm) per square foot [with air scour system] to 15 gpm per square foot [without air scour])
    - Air compressor
        - Excessive noise and vibration
        - Mounting hardware/supports
        - Air tank for defects or leaks
        - Compressor/blower assembly for loose, broken and/or missing bolts
        - Pressure gauge for defects or damage
        - Motor hardware for loose/broken/missing motor assembly bolts and/or broken/missing motor inspection cover
        - Compressor drive for loose coupling fasteners, damaged/missing coupling, damaged drive shaft and/or torn/damaged coupling shock absorber

        - Deterioration of protective covering/corrosion
        - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates.

Reverse Osmosis Systems

- Piping, fittings and valves:
    - Fittings for bent/cracked fittings and/or signs of leakage
    - Pipes for bent/cracked pipes and/or signs of leakage
    - Supports/hangers: loose supports/hangers and/or broken/missing valve handle, bent valve stem and/or cracked valve body
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
    - Insulation: loose, damaged, deteriorated and/or missing insulation
- Valves
    - Check for leaking valve packing glands/gaskets, broken/missing valve handle, bent valve stem and/or cracked valve body
    - Check valves for corrosion
    - Check for proper and easy operation/actuation
    - Check operating mechanism for operation under correct conditions; free and full travel of actuator arm/coupling
- Gauges, recording devices and sight glasses:
    - Moisture behind gauge lens, dial face not readable, broken lens and/or gauge inoperable
    - Recording meter for corrosion on housing, broken lens, damaged/missing pen holders and/or recording device inoperable
    - Sight glass for rush inside lens, sight glass graduations not readable and/or broken sight glass
- Controls:
    - Process function indicators (lights, gauges)—normal function indicators displayed, correct pressures displayed, abnormal function indicators NOT displayed
- Filters:
    - Replace according to manufacturer's recommendations
- Membrane:
    - Inspect and clean according to manufacturer's recommendations
    - Replace according to manufacturer's recommendations.

Disinfection Systems

- General
    - Maintain process records correctly (dosage, feeder pump operation, residuals, chemical usage, calibration, etc.)
    - Maintain material safety data sheets
    - Personnel protective equipment present and functioning
    - Monitor mechanical and electrical equipment
- Chlorine gas
    - Adequate safety precautions followed
    - Check for leaks
    - (If necessary) adjust disinfectant feed rate

- Chlorine solid
    - Includes: hypochlorite, calcium hypochlorite, chloramine, chlorine dioxide
    - Check for leaks
    - (If necessary) adjust disinfectant feed rate
    - Adequate safety precautions followed
- Ozonation
    - Check for leaks
    - Secondary disinfection process operating correctly
- Ultraviolet
    - Lamp operating correctly
    - Flow rate within acceptable range
    - Check for leaks
    - Secondary disinfection process operating correctly.

Chlorine Contact Tanks

- Tank access structures (wood):
    - Structural deformation: broken/missing members and/or missing rungs
    - Rot
    - Parasite damage
    - Loose, broken, split and/or damaged connections/anchorage
- Tank access structures (metal):
    - Structural deformation: broken/missing members and/or missing rungs
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion
- Concrete:
    - Foundation for settlement
    - Tank for cracks, spalling, scaling, reinforcing steel corrosion, pop outs and/or signs of leakage
    - Excessive vegetation
- Piping, fittings and valves:
    - Fittings for bent/cracked fittings and/or signs of leakage
    - Pipes for bent/cracked pipes and/or signs of leakage
    - Supports/hangers: loose supports/hangers and/or broken/missing valve handle, bent valve stem and/or cracked valve body
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
    - Insulation: loose, damaged, deteriorated and/or missing insulation.

Component Inspection Guidance

Barrier & Fencing

Fence/Gate

A fence consists of a line of posts secured to the ground and connected with railings, pickets, planks, braces and other fence members secured in place. Posts out of plumb may be checked by eyesight, string line or transit. Fencing and gates commonly found on water systems include those made of wood, metal, concrete and masonry/stone.

Gates are closable openings in a fence that permit people, animals and/or vehicles to move from one side of the fence to the other. Wood gates are constructed with wood rails, pickets, planks, braces and other members securely fastened into a single unit. Metal gates are fabricated with pipe/tube framing covered with metal chain link or other woven wire mesh, preformed panel or metal laced fabric and kept in shape with wires, rods or turn buckles.

Security components such as barbed, razor or concertina wire may be installed at the top of a fence or attached either directly to the posts or on a metal angle bracket attached to the top of the posts.

Checks to be made:

1. Fence panels and railings (wood):
    - Splits/cracking/broken:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Physically damaged and broken
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes less than 1/8" diameter, surface sag and frass observed
        - Large holes greater than 1/8" diameter, surface channels, punctures and crushing
    - Out of plumb more than 3" in 8'
    - Erosion/vegetation:
        - Soil erosion under fence wall
        - Vines, trees or shrubs climbing over or growing into fence
2. Fence panels (metal):
    - Fence fabric
        - Defective
        - Loose or sagging greater than 2" in diameter
        - Damaged or missing
    - Defective, loose, damaged or missing
    - Loose connections/anchorage:
        - Loose bolts or wire fasteners
        - Loose or bent pipe posts or railing
        - Missing or broken components
    - Out of plumb more than 3" in 8'
    - Corrosion:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced by loss of base metal
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vines, trees or shrubs climbing over or around posts

3. Fence panels (concrete):
   - Cracking:
     - Hairline cracks to 1/16" wide
     - Wide cracks more than 1/16" wide
     - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
   - Spalling:
     - Less than 1" deep or 6" in diameter
     - More than 1"in depth or greater than 6” in diameter or loss of more than 10 percent of surface area of a member
     - Disintegration of surface area, with corrosion of exposed reinforcing steel
   - Scaling:
     - Loss of surface up to 1/2" deep, with exposure of coarse aggregates
     - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
     - Loss of surface exceeds 1" reinforcing steel usually exposed
   - Reinforcing steel corrosion:
     - Rusting/discoloration evident
     - Cracks occurring parallel to reinforcement
   - Out of plumb more than 3" in 8'
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vines, trees or shrubs climbing over or around posts
4. Fence panels (masonry/stone):
   - Deteriorated mortar joint material:
     - Cracked mortar joint material
     - Loose/missing mortar joint material
     - Eroded mortar greater than 1/2" deep
   - Damaged bricks, stones or concrete masonry unit (CMU):
     - Cracked, split, damaged
     - Loose, missing
   - Out of plumb more than 3" in 8'
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vines, trees or shrubs climbing over or around posts
5. Fence posts (wood):
   - Splits/cracking/broken:
     - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
     - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
     - Physically damaged and broken
   - Rot, fungus or decay:
     - Moist stained area
     - Discolored, soft or crushed area
   - Parasite damage:
     - Holes less than 1/8" diameter, surface sag and frass observed
     - Large holes greater than 1/8" diameter, surface channels, punctures and crushing
   - Out of plumb more than 3" in 8'

- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or around posts

6. Fence posts (metal):
    - Loose connections/anchorage:
        - Loose bolts or wire fasteners
        - Loose or bent pipe posts or railing
        - Missing or broken components
    - Out of plumb more than 3" in 8'
    - Corrosion:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced by loss of base metal
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vines, trees or shrubs climbing over or around posts
7. Fence posts (concrete):
    - Cracking:
        - Hairline cracks to 1/16" wide
        - Wide cracks more than 1/16" wide
        - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
    - Spalling:
        - Less than 1" deep or 6" in diameter
        - More than 1” in depth or greater than 6" in diameter or loss of more than 10 percent of surface area of a member
        - Disintegration of surface area, with corrosion of exposed reinforcing steel
    - Scaling:
        - Loss of surface up to 1/2" deep, with exposure of coarse aggregates
        - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
        - Loss of surface exceeds 1", reinforcing steel usually exposed
    - Reinforcing steel corrosion:
        - Rusting/discoloration evident
        - Cracks occurring parallel to reinforcement
    - Out of plumb more than 3" in 8'
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vines, trees or shrubs climbing over or around posts
8. Fence posts (masonry/stone):
    - Deteriorated mortar joint material:
        - Cracked mortar joint material
        - Loose/missing mortar joint material
    - Out of plumb more than 3" in 8'
    - Damaged bricks, stones or CMU:
        - Cracked, split, damaged
        - Loose, missing
    - Erosion/vegetation:
        - Soil erosion around piers
        - Vines, trees or shrubs climbing over or around piers

9. Gates (wood):
    - Defective gate:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Damaged or missing wood sections
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes less than 1/8" diameter, surface sag and frass observed
        - Large holes greater than 1/8” diameter, surface channels, punctures and crushing
    - Out of plumb more than 3" in 6'
    - Connections:
        - Loose wood at connection site
        - Broken, split or damaged wood at connection site
    - Missing fasteners or anchorage
10. Gates (metal):
    - Defective gate fabric:
        - Loose or sagging gate fabric
        - Damaged or missing gate fabric
    - Defective gate panels:
        - Loose gate panels
        - Damaged or missing gate panels
    - Loose connections:
        - Loose bolts or wire fasteners
        - Loose or bent pipe post/bracing
        - Missing or broken hinges, latches or other components
    - Out of plumb more than 1/2" in 6'
    - Corrosion:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by loss of base metal
11. Security wires:
    - Loose, broken or missing brackets or bolts
    - Loose, defective, sagging, broken or missing wire
    - Corroded wire:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced by loss of base metal
    - Corroded brackets:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced by loss of base metal.

Control & Instrumentation

Control

Controls are the central part of a piece of machinery or system that controls its operation. Ask maintenance personnel for comments on the performance and condition of the system before starting the inspection.

Checks to be made:

1. Controls—system:
    - Defective controls, broken or disconnected
    - System air leakage
    - Defective electrical connectors
    - Defective mounting hardware or support, loose or missing
2. Indicators, transmitters and sensors:
    - Inoperable or missing
    - Damaged or illegible
    - Corrosion
3. Operators:
    - Defective operator, broken or disconnected
    - System air leakage
    - Defective electrical connectors
    - Defective assembly hardware
4. Controls—piping, tubes and fittings:
    - Defective fittings, bent or cracked, leaking air
    - Defective pipe, bent, leaking air
    - Defective supports or hangers, loose or missing
    - Defective pipe labeling/color coding, damaged or missing
    - Corrosion
5. Controls—panels:
    - Defective mounting hardware or support
    - Damaged enclosure
    - Defective assembly hardware
    - Corrosion
6. Controls—air compressors:
    - Leaking tank, piping, fittings and valves
    - Broken or loose assembly bolts
    - Loose or missing mounting hardware
    - Defective pressure gauge
    - Damaged electrical equipment
    - Corrosion
    - Inoperable air compressor
    - Loose or missing belt guard
7. Controls—air dryers, refrigerated:
    - Defective or missing dryer
    - Corrosion.

Electrical

Generator

Engine Generator

Engine-generators convert fuel into electrical power. Each unit consists of an engine and generator working together as a unit. Since the two pieces of equipment work together as a unit, the inspection will cover both mechanical and electrical components. Engine-generators are used as primary or secondary power services and require the same inspection.

Checks to be made:

1. Generator sets:
    - Corrosion evidenced by pitting or blistering
    - Corrosion with loss of base metal
    - Panel fasteners loose, broken or missing
    - Unit not grounded
    - Indicator or gauges broken or inoperative
    - Fuel or coolant leaks
    - Damaged or missing battery
    - Missing parts or components
    - Missing identification, wiring diagram, specification tags
    - Loose, missing, corroded or damaged conduit or cable connections
    - Broken or disconnected fuel lines
    - Unit mounting loose, broken or missing
    - Dirty or clogged radiator
    - Worn or loose belts
    - Inspect maintenance records and test logs for recurring problems and testing frequency
    - General housekeeping of the equipment for maintenance and upkeep
    - Evidence of overheating or carbon tracking
    - Type and size of the generator including capacity, fuel type, voltage, phase and power factor
    - Estimated connected load and comparison to unit specifications
2. Automatic transfer switch:
    - Corrosion evidenced by pitting or blistering
    - Corrosion with loss of base metal
    - Enclosure mounting loose or broken
    - Panel fastener loose, broken or missing
    - Indicators or gauges damaged or inoperative
    - Enclosure damaged and cannot be sealed or closed
    - Unused opening not sealed
    - Handle bent or inoperative
    - Security devices missing or inoperative
    - Carbon tracking from flash over
    - Discoloration or deformity from overheating

- Unit is not grounded
- Switch or push buttons missing or damaged
- Missing identification, wiring diagrams or operation instruction
- Free space and clearance around the switch from debris or stored material
- Housekeeping and maintenance of the equipment.

Motor

Checks to be made:

1. Motor control center:
    - Check with operating or area personnel for deficiencies
    - Check starter lights, replace if required
    - Check for excessive heat, odors, noise and vibration
    - Clean motor control center exterior and surrounding area.

Liquid & Gas

Pump

Pumping Station

The primary purpose of the pumping station is to provide an immediate and continuous flow of water to protect large or high hazard areas. The secondary function is to provide a means for pressurizing the distribution system. The pressure is derived from the difference in elevation between the water level in the storage tank and the elevation of the water mains.

Checks to be made:

1. Pump base and coupling:
    - Loose, broken or missing pump/motor assembly/mounting bolts
    - Defects, loose/missing set screws, defective coupling and/or loose/missing coupling guard
    - Deterioration of protective covering/corrosion
    - Abandoned pump assemblies that require disposal
2. Pumps:
    - Damaged or cracked pump housing and/or broken pump base
    - Excessive noise and vibration
    - Loose, broken or missing pump assembly/mounting bolts
    - Leakage
    - Deterioration of protective covering/corrosion
3. Motors:
    - Damaged or cracked housing, end belts and/or motor base
    - Broken/loose motor hardware for loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
    - Excessive noise and vibration
    - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
4. Controls:
    - Electrical arcing noise

- Damage to panel, burned out pilot lamps and/or access to panel blocked
- Deterioration of protective covering/corrosion

5. Piping and fittings:
   - Bent/cracked fittings and/or signs of leakage
   - Bent/cracked pipes and/or signs of leakage
   - Loose supports/hangers and/or broken/missing supports/hangers
   - Loose, damaged, deteriorated and/or missing insulation
   - Galvanic anode cathodic protection system reduction in thickness and/or loose fasteners or broken welds
   - Corrosion, pitting, blistering and/or loss of base metal
   - Check impressed current cathodic protection system
6. Valves:
   - Leaking packing glands/gaskets, broken/missing handle, bent stem and/or cracked body
   - Corrosion
7. Metering devices:
   - Damaged, inoperable and/or missing devices
   - Corrosion, pitting, blistering and/or loss of base metal
8. Hydrants:
   - Damaged, missing hydrant caps, gaskets or chains and/or broken/cracked hydrant
   - Leakage, seepage, drips and steady leaks with main valve closed
   - Corrosion, pitting, blister and/or loss of base metal
9. Engines:
   - Physical damage to exterior, leaking fuel or coolant, broken/loose/missing hardware, corroded terminals and wires, loose wires/connections and/or loose/broken belts
   - Corrosion, pitting, blistering and/or loss of base material.

Tank

Potable Water Storage

Potable water storage serves several major functions. The primary purpose is to provide a ready supply of water to meet consumption needs of various users. The secondary function is to provide a means for pressurizing the water distribution system. The pressure is derived from the difference in elevation between the water level in the storage tank and the elevation of the water mains. Elevated water storage towers typically fall within two basic types of construction. The first is the “Tower Supported” type, which includes several legs to support and stabilize the tank section. The other type is the “Pedestal” type, which is characterized by its lack of support legs with only a main central support shaft between the ground and the tank section. Due to the height to which the towers are constructed, many are fitted with obstruction lights to alert aircraft to their presence. Many also serve as support platforms for rotating airfield beacons as well as minor communication antennas. Construction materials may be steel or concrete.

Elevated Storage Tanks

Checks to be made:

1. Concrete foundations:
   - Cracks, spalling, efflorescence or exposed reinforcing

2. Structural steel supports:
    - Damaged or fatigued connections
    - Surface corrosion
    - Pitting
    - Holes or loss of base material
    - Loss of protective coatings
    - Damaged connections, missing or damaged fasteners or broken welds
3. Steel ladders/platforms:
    - Damaged or fatigued connections
    - Surface corrosion
    - Pitting
    - Holes or loss of base material
    - Loss of protective coatings
    - Damaged connections, missing or damaged fasteners or broken welds
4. Steel riser pipe:
    - Leakage in pipe joints
    - Corrosion
    - Damage, abrasions, dents
    - Loss of insulation, split seams or missing insulation
    - Loss of protective coatings
    - Damaged connections, missing or damaged, fasteners or broken welds
5. Steel tank shell plates:
    - Damage, dents, abrasions and/or signs of leakage
    - Defective connections/anchorage, loose bolts, rivets, mechanical fasteners and/or broken welds
    - Deterioration of protective covering/corrosion
    - Leakage at joints
6. Overflow piping/vents:
    - Blockage, debris in pipe/vents
7. Concrete tanks and pedestals:
    - Surface weathering, staining, chipping, spalling or cracks
    - Deterioration, leaks, crumbly expansion joints
    - Damaged
8. Altitude valves:
    - Signs of improper operation
9. Cathodic protection system:
    - Adequate operational records.

Underground & Above Ground Tanks

Checks to be made:

1. Concrete foundations:
    - Cracks
    - Spalling
    - Efflorescence
    - Exposed reinforcing
2. Structural steel supports:

- Connections for signs of damage or fatigue
- Evidence of surface corrosion
- Evidence of pitting
- Holes or loss of base material
- Loss of protective coatings
- Damaged connections, missing or damaged fasteners or broken welds

3. Steel ladders/platforms:
    - Connections for signs of damage or fatigue
    - Evidence of surface corrosion
    - Evidence of pitting
    - Holes or loss of base material
    - Loss of protective coatings
    - Damaged connections, missing or damaged fasteners or broken welds
4. Steel riser, vent and overflow pipe:
    - Leakage in pipe joints
    - Corrosion
    - Signs of physical damage, abrasions or dents
    - Loss of insulation, split seams or missing insulation
    - Loss of protective coatings
    - Damaged connections, missing or damaged fasteners or broken welds
5. Steel tank shell plates:
    - Shell for physical damage, dents, abrasions and/or signs of leakage
    - Defective connections/anchorage, loose bolts, rivets, mechanical fasteners and/or broken welds
    - Deterioration of protective covering/corrosion
    - Signs of leakage at joints
6. Concrete tanks and pedestals:
    - Tank for surface weathering, staining, chipping, spalling or cracks
    - Surface deterioration, cracking or spalling
    - Deterioration, leaks, crumbly expansion joints
    - Tank for physical damage.

Well

Water Sources

The purpose of the water source is to provide a ready supply of water to meet the consumption needs of various users. The system consists of pumps, piping and auxiliary equipment required to access water from the source.

Checks to be made:

1. Well head:
    - Cracks, spalling, efflorescence or exposed reinforcing
    - Connections for signs of damage or fatigue
    - Evidence of surface corrosion
    - Evidence of pitting
    - Holes or loss of base material
    - Loss of protective coatings

- Damaged connections, missing or damaged fasteners or broken welds

2. Pump base and coupling:
   - Loose, broken or missing pump/motor assembly/mounting bolts
   - Defects, loose/missing set screws, defective coupling and/or loose/missing coupling guard
   - Deterioration of protective covering/corrosion
   - Abandoned pump assemblies that require disposal
3. Pumps:
   - Damaged or cracked pump housing and/or broken pump base
   - Excessive noise and vibration
   - Loose, broken or missing pump assembly/mounting bolts
   - Leakage
   - Deterioration of protective covering/corrosion
4. Motors:
   - Damaged or cracked housing, end belts and/or motor base
   - Broken/loose motor hardware for loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
   - Excessive noise and vibration
   - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
5. Controls:
   - Electrical arcing noise
   - Damage to panel, burned out pilot lamps and/or access to panel blocked
   - Deterioration of protective covering/corrosion
6. Piping and fittings:
   - Bent/cracked fittings and/or signs of leakage
   - Bent/cracked pipes and/or signs of leakage
   - Loose supports/hangers and/or broken/missing supports/hangers
   - Loose, damaged, deteriorated and/or missing insulation
   - Galvanic anode cathodic protection system reduction in thickness and/or loose fasteners or broken welds
   - Corrosion, pitting, blistering and/or loss of base metal
   - Check impressed current cathodic protection system
7. Valves:
   - Leaking packing glands/gaskets, broken/missing handle, bent stem and/or cracked body
   - Corrosion
8. Metering devices:
   - Damaged, inoperable and/or missing devices
   - Corrosion, pitting, blistering and/or loss of base metal
9. Engines:
   - Physical damage to exterior, leaking fuel or coolant, broken/loose/missing hardware, corroded terminals and wires, loose wires/connections and/or loose/broken belts
   - Corrosion, pitting, blistering and/or loss of base material.

Liquid & Gas/Plumbing

Pipe

Non-Potable Water Distribution

The non-potable water distribution system is the network of pumps, piping and auxiliary equipment required to carry non-potable water from its source to the using facilities. It serves to distribute and regulate the water supply.

Checks to be made:

1. Pump base and coupling:
    - Loose, broken or missing pump/motor assembly/mounting bolts
    - Defects, loose/missing set screws, defective coupling and/or loose/missing coupling guard
    - Deterioration of protective covering/corrosion
    - Abandoned pump assemblies that require disposal
2. Pumps:
    - Damaged or cracked pump housing and/or broken pump base
    - Excessive noise and vibration
    - Loose, broken or missing pump assembly/mounting bolts
    - Leakage
    - Deterioration of protective covering/corrosion
3. Motors:
    - Damaged or cracked housing, end belts and/or motor base
    - Broken/loose motor hardware for loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
    - Excessive noise and vibration
    - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
4. Controls:
    - Electrical arcing noise
    - Damage to panel, burned out pilot lamps and/or access to panel blocked
    - Deterioration of protective covering/corrosion
5. Piping and fittings:
    - Bent/cracked fittings and/or signs of leakage
    - Bent/cracked pipes and/or signs of leakage
    - Loose supports/hangers and/or broken/missing supports/hangers
    - Loose, damaged, deteriorated and/or missing insulation
    - Galvanic anode cathodic protection system reduction in thickness and/or loose fasteners or broken welds
    - Corrosion, pitting, blistering and/or loss of base metal
    - Check impressed current cathodic protection system
6. Valves:
    - Leaking packing glands/gaskets, broken/missing handle, bent stem and/or cracked body
    - Corrosion
7. Metering devices:
    - Damaged, inoperable and/or missing devices
    - Corrosion, pitting, blistering and/or loss of base metal

8. Hydrants:
    - Damaged, missing hydrant caps, gaskets or chains and/or broken/cracked hydrant
    - Leakage, seepage, drips and steady leaks with main valve closed
    - Corrosion, pitting, blister and/or loss of base metal
9. Manholes:
    - Deterioration, cracks/spalling concrete, exposed reinforcing, eroded joints (concrete masonry unit [CMU]) and/or loose/broken/displaced bricks
    - Damaged/bent frame/manhole cover, damaged/broken ladder, missing rungs, missing cover and/or offset manhole frame/entrance
    - Debris
10. Engines:
    - Physical damage to exterior, leaking fuel or coolant, broken/loose/missing hardware, corroded terminals and wires, loose wires/connections and/or loose/broken belts
    - Corrosion, pitting, blistering and/or loss of base material.

Valve

Checks to be made:

1. Valve body:
    - Surface corrosion, excessive rust, protective coating (paint, galvanizing) worn or missing, corrosion evidenced by pitting or blistering, deep corrosion evidenced by holes or loss of base metal
    - Body is cracked
    - Components are worn, broken or missing
2. Leakage:
    - Valve shows signs of exterior leakage at seals, glands, gaskets, packing or pipe connections
    - Shut off valve shows evidence of incomplete closure, internal leakage
3. Blockage:
    - Valve is blocked
    - Reduced flow
4. Installation:
    - Valve connections are misaligned, flange missing fasteners
    - Supports are inadequate, broken or missing
    - Excessive vibration
5. Operator (mechanical or automatic):
    - Broken, corroded, rusted
    - Missing components
    - Inoperable
    - Lever or shaft bent
    - Valve is stuck, inoperable or blocked
    - Electronic/pneumatic/Direct Digital Control (DDC)/electric control mechanism is inoperable.

Liquid & Gas/Treatment & Processing

Chemical Handling

Chemical Feeder Equipment

Checks to be made:

- Hopper for bent/deformed hopper, damaged/missing cover, loose/missing mounting hardware and/or cracked/open/leaking shell
- Slaker for damaged/missing covers, damaged/missing/spray nozzles, loose/missing mounting hardware, noisy slaker bearings and/or noisy slaker motor/drive
- Mixing vat for damaged/missing cover, loose/missing mounting hardware and/or noisy agitator motor/drive
- Cylinder storage for loose/missing cylinder connectors/chains/straps, missing cylinder label, chlorine odor and/or damaged/improper fusible plugin for cylinder device
- Instrumentation/controls for corroded flow control device, damaged/missing/inoperable flow control device and/or chlorine odor.

Disinfection Equipment

Chlorinator

Checks to be made:

1. Check with operating or area personnel for deficiencies
2. Put on safety equipment prior to checking equipment
3. Clean chlorinator and check for leaks
4. Check water trap for proper level and bleed air
5. Check and clean water strainers
6. Grease fittings
7. Make minor adjustments to chlorinator, as needed.

Chlorine Detector

Checks to be made:

1. Put on safety equipment prior to checking equipment
2. Test alarm and inspect fan and sensor wiring
3. Test detector with chlorine test kit
4. Flush sensor unit with fresh water and drain and fill reservoir
5. Check drip rate and reservoir level in sight glass
6. Check “O” rings; replace as required
7. Inspect sensor mounting grommet, fan operation, detector mounting bolts and drain tube connection
8. Check charcoal filter cartridge; replace as needed
9. Check basket for cracked or worn areas
10. Check detector for leaks under pressure
11. Clean unit and surrounding area.

Mechanical Handling Equipment

Mechanical Stirrer/Mixer

Checks to be made:

1. Motor/gear box for cracked/damaged housing or end bells and/or broken base
2. Motor/gear box hardware for loose bolts, broken/missing inspection covers and/or broken/missing assembly bolts
3. Excessive noise and vibration
4. Coupling or shaft for loose/missing set screws, defective coupling and/or loose/missing coupling guard
5. Paddles for defects, chemical build-up on paddles and/or broken/eroded paddles
6. Deterioration of protective covering/corrosion.

Comminutor

Checks to be made:

1. Check with operating or area personnel for deficiencies
2. Change gearbox oil and lubricate fittings
3. Check comminutor and motor for excessive noise, vibration and overheating
4. Lubricate fittings and check oil in gearbox
5. Check operation.

Grit Collector

Checks to be made:

1. Check with operating or area personnel for obvious deficiencies
2. Lubricate fittings and check oil level in gearbox
3. Change oil in gearbox
4. Check chain linkage and operation
5. Clean area around drive mechanism.

Physical Treatment

Screening Tanks

Checks to be made:

1. Foundation settlement, cracks and/or exposed reinforcing
2. Concrete tank damage: cracks, spalling, scaling, reinforcing steel corrosion, pop outs and/or signs of leakage
3. Metal shell tanks: dents, abrasions and/or signs of leakage
4. Defective connections/anchorage or loose bolts, rivets, mechanical fasteners and broken welds
5. Deterioration of protective covering/corrosion
6. Excessive vegetation.

Bars and Screens

Checks to be made:

1. Physical damage to bar racks

2. Physical damage to screens
3. Note severity of torn or elongated mesh coarse screens
4. Missing screens.

Sludge Collector

Checks to be made:

1. Excessive noise and vibration
2. Motor/gear reducer for cracked/damaged housing or end bells and/or broken base
3. Motor/gear reducer hardware for loose bolts, broken/missing inspection covers and/or broken/missing assembly bolts
4. Chain and sprocket for loose or worn chains/sprockets/rollers, misaligned sprockets/rollers and/or rattling/grinding noise indicating defective bearing mechanism
5. Defective electrical connectors for loose conduit or connectors, exposed wires and/or missing cover plates
6. Chain guards for loose, damaged and/or missing chain guard
7. Deterioration of protective covering/corrosion.

Grit Removal

Checks to be made:

1. Check with operating or area personnel for obvious deficiencies
2. Lubricate fittings and check oil level in gearbox
3. Change oil in gearbox
4. Check chain linkage and operation
5. Clean area around drive mechanism.

Solids Handling/Treatment

Lift Station

Lift stations consist of a system of pipes, valves, pumps, motors and controls used to lift sewage to a higher elevation. Some lift stations have comminutors that grind and shred the solid material in the raw wastewater flow into small particles. They are equipped with an electric motor and hardened steel cutters that reduce the solids in size as they pass through.

Checks to be made:

1. Comminutors:
    - Cracking or spalling of pit concrete
    - Extensive disintegration of surface area, with corrosion of exposed reinforcing steel
    - Out of plumb
    - Cracked joint sealant/caulk, loose/missing joint sealant/caulk
    - Loose cover or grate, missing or damaged cover or grate
    - Surface corrosion:
        - Corrosion evident by pitting or blistering
        - Corrosion evident by holes or loss of base metal
    - Missing tie-down bolts or isolators (mounting hardware)
    - Defective control system:

    - Loss of air pressure
    - Surcharged tank or pit
- Cracked/damaged housing or end bells, broken motor base
- Rattling noise, indicating metal to metal contact; electrical arcing noise
- Loose motor assembly bolts, broken or missing motor inspection covers
- Loose conduit or connectors, exposed wires or missing cover plates
- Controls:
    - Missing
    - Loose
    - Control panel blocked, not accessible for inspection
- Surface corrosion:
    - Corrosion evidenced by pitting or blistering
    - Corrosion evidenced by holes or loss of base metal

2. Wet and dry well systems—pits/tanks—concrete:
    - Cracking, spalling, pop outs and scaling
    - Reinforcing steel corrosion:
        - Rusting/discoloration evident
        - Cracks occurring parallel to reinforcement
    - Excessive vegetation:
        - Vines, trees or shrubs obstructing access to tank; growing on or next to tank
3. Wet and dry well systems—pits/tanks—metal:
    - Cracking or buckling:
        - Deformation, twisting or bending of pit/tank walls and frame
        - Stress or fatigue cracks in frame or wall
    - Water dripping from pipe penetration through dry well wall, leaking gasket at manhole
    - Leakage at other than manhole gasket, missing or damaged cover or grate
    - Abrasions on tank walls, no leaks; impact damage, dents, no leaks
    - Defective connections/anchorage:
        - Loose bolts, rivets or mechanical fasteners; evidence of leakage
        - Cracked or broken welds, evidence of leakage
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
    - Excessive vegetation:
        - Vines, trees or shrubs obstructing access to tank; growing on or next to tank
4. Pump base and coupling:
    - Loose pump or motor mounting bolts, broken or missing pump or motor mounting bolts
    - Loose set screws, missing set screws
    - Loose tie-down bolts, missing or damaged base tie-down bolts or isolators
    - Loose coupling guard, missing coupling guard
    - Surface corrosion:
        - Corrosion evidence by pitting or blistering
        - Corrosion evidence by holes or loss of base metal
    - Inactive pump assembly, abandoned, requiring proper disposal
5. Pumps:

- Cracked pump housing, broken pump base
- Leaking at pump fitting or seals, cracked or damaged pump housing
- Rattling noise; grinding noise, indicating metal to metal contact
- Surface corrosion:
    - Corrosion evidenced by pitting or blistering
    - Corrosion evidenced by holes or loss of base metal

6. Motors:
    - Cracked/damaged housing or end bells, broken motor base
    - Rattling noise; grinding noise, indicating metal to metal contact; electrical arcing noise
    - Loose motor assembly bolts, broken or missing motor inspection covers, broken or missing motor assembly bolts
    - Loose conduit or connectors, exposed wires or missing cover plates
    - Odor caused by overheated motor windings, starter coils or contacts
7. Sewage ejectors:
    - Cracking or spalling of pit concrete
    - Extensive disintegration of surface area, with corrosion of exposed reinforcing steel
    - Out of plumb
    - Cracked joint sealant/caulk, loose/missing joint sealant/caulk
    - Loose cover or grate, missing or damaged cover or grate
    - Surface corrosion:
        - Corrosion evident by pitting or blistering
        - Corrosion evident by holes or loss of base metal
    - Loose pump or motor tie-down bolts; missing pump or motor tie-down bolts or isolators
    - Control system failure, loss of air pressure, surcharged tank or pit
    - Cracked/damaged housing or end bells, broken motor base
    - Rattling noise; grinding noise, indicating metal to metal contact; electrical arcing noise
    - Loose motor assembly bolts, broken or missing motor inspection covers
    - Loose conduit or connectors, exposed wires or missing cover plates
    - Controls:
        - Missing
        - Loose
        - Control panel blocked, not accessible for inspection
    - Surface corrosion:
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
8. Controls:
    - Electrical arcing noise
    - Visual signs of overheated cable insulation, connections or components
    - Physically damaged control panel enclosures
    - Burned out pilot lamps
    - Control panel blocked, not accessible for inspection
    - Surface corrosion:
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
    - Odor caused by overheated motor windings, starter coils or contacts
    - Enclosure not properly rated for location
    - Level-control devices not operational

- Vacuum-pumps not operational

9. Valves:
    - Surface corrosion, excessive rust, protective coating (paint, galvanizing) worn or missing
    - Corrosion evidenced by pitting or blistering, deep corrosion evidenced by holes or loss of base metal
    - Body is cracked
    - Components are worn, broken or missing
    - Valve shows signs of exterior leakage at seals, glands, gaskets, packing or pipe connections
    - Shut off valve shows evidence of incomplete closure, internal leakage
    - Valve is blocked or has reduced flow
    - Valve connections are misaligned, flange missing fasteners
    - Supports are inadequate, broken or missing
    - Excessive vibration
    - Operator (mechanical or automatic):
        - Broken, corroded, rusted, missing components, inoperable, lever bent, shaft bent
        - Valve is stuck, inoperable or blocked
        - Electronic/pneumatic/DDC/electric control mechanism is inoperable
10. Piping and fittings:
    - Reduced, restricted flow, blocked flow
    - Bent or cracked fitting, not leaking: waste water leaking into/out, seepage, infiltration; broken joint fitting
    - Bent or cracked pipe, not leaking: waste water leaking into/out, seepage, infiltration; broken pipe
    - Surface corrosion:
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal.

Waste Stabilization Lagoons (Non-Overflow)

Raw sanitary sewage flows to lagoon(s) by gravity or force-main through a facility's collection system. Non-overflow lagoon systems are designed for no discharge by relying on evaporation and seepage (if not lined) to exceed inflow.

Checks to be made:

1. General:
    - Verify sludge depth
    - Review flow records/capacities
    - Vegetation encroachment
    - Bank erosion
    - Liner integrity (Bentonite, ethylene propylene diene monomer, other)
    - Signs of leakage
2. Pipe/fittings:
    - Flow: reduced, restricted or blocked
    - Defective joint/fitting:
        - Damaged fitting

    - Sewage leaking
- Defective/damaged pipe
- Control valves damaged/leaking

3. Valves:
    - Valve body:
        - Surface corrosion, excessive rust, protective coating (paint, galvanizing) worn or missing
        - Corrosion evidenced by pitting or blistering, deep corrosion evidenced by holes or loss of base metal
        - Body is cracked.
        - Components are worn, broken or missing
    - Leakage:
        - Valve shows signs of exterior leakage at seals, glands, gaskets, packing or pipe connections
        - Shut off valve shows evidence of incomplete closure, internal leakage
    - Blockage: Valve is blocked or has reduced flow
    - Installation:
        - Valve connections are misaligned, flange missing fasteners
        - Supports are inadequate, broken or missing
        - Excessive vibration
    - Operator (mechanical or automatic):
        - Broken, corroded, rusted, missing components, inoperable, lever bent, shaft bent
        - Valve is stuck, inoperable or blocked
        - Electronic/pneumatic/DDC/electric control mechanism is inoperable.

Treatment Equipment

Raw Water Reservoir

The purpose of a raw water reservoir is to stabilize influent water to result in consistent treatment requirements and higher, more consistent water quality.

Checks to be made:

1. Influent valve:
    - Conduct periodic inspection
    - Check that locks and guards are in place and undamaged
    - Check for leaking valve packing glands/gaskets, broken/missing valve handle, bent valve stem and/or cracked valve body
    - Check valves for corrosion
    - Check for proper and easy operation/actuation
    - Check operating mechanism for operation under correct conditions, free and full travel of actuator arm/coupling
2. Influent weirs:
    - Conduct periodic inspection
    - Check that there are no obstructions, debris or broken components
    - Check that screen or bars are clear and undamaged

- Examine concrete for cracks, spalling, scaling, reinforcing steel corrosion, pop outs and/or signs of leakage

3. Overflow structure:
   - Conduct periodic inspection
   - Check that there are no obstructions, debris or broken components
   - Examine concrete for cracks, spalling, scaling, reinforcing steel corrosion, pop outs and/or signs of leakage
4. Overflow pond and outfall:
   - Conduct periodic inspection
   - Check that there is no evidence of leakage from pond or outfall channel
   - Ensure that locks, guards, fences and gates are in place, undamaged and operational
   - Examine concrete for cracks, spalling, scaling, reinforcing steel corrosion, pop outs and/or signs of leakage
   - Check for excessive vegetation in or along channel.

Potable Water Distribution

The potable water distribution system is the network of pumps, piping and auxiliary equipment required to carry potable water from its source to the using facilities. It serves to distribute and regulate the water supply.

Checks to be made:

1. Pump base and coupling:
   - Loose, broken or missing pump/motor assembly/mounting bolts
   - Defects, loose/missing set screws, defective coupling and/or loose/missing coupling guard
   - Deterioration of protective covering/corrosion
   - Abandoned pump assemblies that require disposal
2. Pumps:
   - Damaged or cracked pump housing and/or broken pump base
   - Excessive noise and vibration
   - Loose, broken or missing pump assembly/mounting bolts
   - Leakage
   - Deterioration of protective covering/corrosion
3. Motors:
   - Damaged or cracked housing, end belts and/or motor base
   - Broken/loose hardware for loose assembly bolts
   - Excessive noise and vibration
   - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
4. Controls:
   - Electrical arcing noise
   - Damaged control panel, burned out pilot lamps and/or access to panel blocked
   - Deterioration of protective covering/corrosion
5. Piping and fittings:
   - Bent/cracked fittings and/or signs of leakage
   - Bent/cracked pipes and/or signs of leakage

- Loose supports/hangers and/or broken/missing supports/hangers
- Loose, damaged, deteriorated and/or missing insulation
- Reduction in thickness and/or loose fasteners or broken welds in galvanic anode cathodic protection system
- Corrosion, pitting, blistering and/or loss of base metal
- Check impressed current cathodic protection system

6. Valves:
   - Leaking packing glands/gaskets, broken/missing handle, bent stem and/or cracked body
   - Corrosion
7. Metering devices:
   - Damaged, inoperable and/or missing devices
   - Corrosion, pitting, blistering and/or loss of base metal
   - Bypassed
   - Flow rate calibration
8. Hydrants:
   - Damaged, missing hydrant caps, gaskets or chains and/or broken/cracked hydrant
   - Leakage, seepage, drips and steady leaks with main valve closed
   - Corrosion, pitting, blister and/or loss of base metal
9. Manholes/vaults:
   - Deterioration, cracks/spalling concrete, exposed reinforcing, eroded joints (CMU) and/or loose/broken/displaced bricks
   - Damaged/bent frame/manhole cover, damaged/broken ladder, missing rungs, missing cover and/or offset manhole frame/entrance
   - Debris
10. Engines:
    - Damaged exterior:
      - Leaking fuel or coolant
      - Broken/loose/missing hardware
      - Corroded terminals and wires
      - Loose wires/connections
      - Loose/broken belts
      - Corrosion, pitting, blistering and/or loss of base metal.

Treatment Process Drive

Checks to be made:

- Mechanical stirrer/mixer:
  - Motor/gear box for cracked/damaged housing or end bells and/or broken base
  - Motor/gear box hardware for loose bolts, broken/missing inspection covers and/or broken/missing assembly bolts
  - Excessive noise and vibration
  - Coupling or shaft for loose/missing set screws, defective coupling and/or loose/missing coupling guard
  - Paddles for defects, chemical build-up on paddles and/or broken/eroded paddles
  - Deterioration of protective covering/corrosion

- Air compressor/blower:
    - Excessive noise and vibration
    - Mounting hardware/supports
    - Air tank for defects or leaks
    - Compressor/blower assembly for loose, broken and/or missing bolts
    - Pressure gauge for defects or damage
    - Motor hardware for loose/broken/missing motor assembly bolts and/or broken/missing motor inspection cover
    - Compressor drive for loose coupling fasteners, damaged/missing coupling, damaged drive shaft and/or torn/damaged coupling shock absorber
    - Deterioration of protective covering/corrosion
    - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
    - Check blower belts for wear and tension.

Water Filter Packaged

Packaged filtration is simply all of the features of filtration—chemical addition, flocculation, sedimentation, filtration—mounted as a unit on a frame for simple hookup of pipes and services. It is most widely used to treat surface water supplies for removal of turbidity, color and coliform organisms with filtration processes.

Checks to be made:

- Foundation/mounting frame
    - Foundation for settlement
    - Frame for bent or damaged members, corrosion
- Pump assemblies:
    - Physical damage
    - Excessive pump noise and vibration
    - Pump hardware: loose, broken or missing pump assembly/mounting bolts
    - Leakage: leaking pump housing and/or leaking or damaged pump seals
    - Motor physical damage: cracked or damaged housing, end belts and/or motor base
    - Broken/loose motor hardware: loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
    - Excessive motor noise and vibration: excessive rattling; grinding noise, indicating metal to metal contact and/or electrical arcing noise
    - Defective electrical connectors: loose conduit or connectors, exposed wires and/or missing cover plates
    - Pump drive defects: loose coupling fasteners, damaged coupling or drive shaft, torn/damaged coupling shock absorbers and/or missing coupling or belt guard
    - Float control hardware: loose, deformed or binding linkage and/or inoperable float control mechanism
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
- Piping, fittings and valves:
    - Bent, cracked fittings and/or signs of leakage
    - Bent/cracked pipes and/or signs of leakage

    - Supports/hangers: loose supports/hangers and/or broken/missing supports/hangers
    - Valves: leaking valve packing glands/gaskets, broken/missing valve handle, bent valve stem and/or cracked valve body
    - Deterioration of protective covering/corrosion: missing paint/galvanizing, pitting, blistering and/or loss of base metal
    - Insulation: loose, damaged, deteriorated and/or missing insulation
- Gauges, recording meters and sight glasses:
    - Moisture behind gauge lens, dial face not readable, broken lens and/or gauge inoperable
    - Recording meter for corrosion on housing, broken lens, damaged/missing pen holders and/or recording device inoperable
    - Sight glass for rush inside lens, sight glass graduations not readable and/or broken sight glass
- Chemical feeder equipment:
    - Hopper for bent/deformed hopper, damaged/missing cover, loose/missing mounting hardware and/or cracked/open/leaking shell
    - Slaker for damaged/missing covers, damaged/missing/spray nozzles, loose/missing mounting hardware, noisy slaker bearings and/or noisy slaker motor/drive
    - Mixing vat for damaged/missing cover, loose/missing mounting hardware and/or noisy agitator motor/drive
    - Cylinder storage for loose/missing cylinder connectors/chains/straps, missing cylinder label, chlorine odor and/or damaged/improper fusible plugin for cylinder device
    - Instrumentation/controls for corroded flow control device, damaged/missing/inoperable flow control device and/or chlorine odor
- Component access structures (metal):
    - Structural deformation: broken/missing members and/or missing rungs
    - Loose, broken, split and/or damaged connections/anchorage
    - Deterioration of protective covering/corrosion.

Structure

Access Vault (Dry)

Tunnel Structure

Checks to be made:

1. Metal panel:
- Out of alignment:
    - Bowing of metal panel
    - Deflection of panel joints
    - Shear displacement of panels greater than 1/2"
- Surface deterioration of liner:
    - Staining
    - Corrosion, rust
    - Plant growth

    - Small surface cracks
    - Crazing
- Surface damage:
    - Punctures, holes, tears
    - Impact damage, denting
    - Completely damaged or missing sections
- Separation of expansion joints

2. Tile:
    - Weathering:
        - Color change, discoloration
        - Textural change; tile exhibits rough, worn surface
        - Noticeable loss of strength of tile liner
    - Surface damage:
        - Spalling
        - Chipping or flaking tile
        - Loose tile
        - Damaged or missing tile
3. Concrete:
    - Lining movement:
        - Settlement of roof or wall sections
        - Lateral movement or separation
    - Cracking
    - Surface weathering:
        - Staining
        - Efflorescence, mineral crystal formation
        - Plant growth
    - Surface damage:
        - Spalling, chipped concrete
        - Settlement in concrete
        - Alkali-aggregate expansion
        - Cavitation
        - Crazing, fine cracks
        - Concrete section exhibiting holes
        - Form scabbing
        - Delamination
    - Steel deterioration:
        - Exposed steel reinforcing
        - Corrosion of steel reinforcing
        - Broken, damaged, loose, corroded or missing anchorages or fasteners
    - Out of alignment:
        - Bowing of concrete liner
        - Deflection of concrete liner
        - Shear displacement of liner greater than 1/2"
    - Separation of construction joints
4. Masonry:
    - Lining movement:
        - Settlement of roof
        - Lateral movement or separation

- Surface deterioration:
    - Staining
    - Efflorescence, mineral crystal formation
    - Plant growth
    - Crazing, fine cracks
- Surface damage:
    - Spalling, chipped masonry
    - Missing joint mortar
    - Damaged or missing rows of masonry
- Broken, damaged, loose, corroded or missing anchorage or fasteners
- Steel deterioration:
    - Exposed rusted
    - Corroded steel reinforcing or framing
- Weepholes: Blocked or clogged weepholes

5. Unlined tunnel:

- Weathering/surface deterioration:
    - Tunnel roof and wall rock is slightly weathered
    - Staining
    - Friable rock surface
    - Tunnel roof and wall rock is moderately weathered
    - Tunnel roof and wall rock is severely weathered
    - Strength loss of rock
- Seepage:
    - Dampness or wet roof/wall rock
    - Water dripping from roof/wall rock, not associated with rock discontinuities
    - Water dripping from roof/wall rock, associated with rock discontinuities
    - Water flowing (greater than 1 gpm) into the tunnel through the roof/wall, not associated with rock discontinuities
    - Water flowing (greater than 1 gpm) from the tunnel roof/wall, associated with rock discontinuities
- Rock instability:
    - Open joints or rock discontinuities in tunnel roof/wall
    - Loose rock reinforcement measures (e.g., rockbolts, rock dowels, anchors)
    - Cracks greater than 1/2" open in roof/wall rock or obvious sagging of roof rock
    - Rock fall or slabs accumulated on tunnel floor, obvious indications that rockfall originated from roof
    - Rock bursts
- Shotcrete/gunite liner:
    - Liner exhibits staining or discoloration
    - Multiple cracks in an isolated area
    - Loss of bonding with underlying rock
    - Sections missing from tunnel roof.

Tunnel Floor

Composition of a tunnel floor will vary depending on the usage of a tunnel. Utility tunnels may have the same composition bottom as the walls of a tunnel or a concrete slab. Inspection of the paved tunnel floor and ballast system, if applicable, should be performed

by appropriate personnel in accordance with the written guidance for those respective systems.

Checks to be made:

1. General:
   - Standing water pooled along tunnel floor
   - Rock floor soft to walk on
   - Individual footings or columns of center walls appear to have settled
   - Floor heave.

Tunnel Portal

A portal is an entrance into a tunnel that does not involve a significant change in grade (i.e., unlike a shaft entrance). The portals are constructed at the end of tunnels to protect and support tunnel exits and entrances under masses of soil or rock, to prevent drainage infiltration into a tunnel and drain surface runoff water down the front slope and to emphasize the structural significance of a tunnel through architectural features. Frequently, a horizontal berm will be constructed at some height over the portals to catch falling rocks, provide surface runoff drainage and provide a working platform for installing vertical rock reinforcement or instrumentation.

Portals can be divided into three categories, depending on anticipated ground behavior: 1) rock conditions are such that there is no need for a portal façade, and the tunnel lining is extended and left exposed at the tunnel approaches 2) if the potential exists for rock falls or surface water seepage along the front slope, then a structural façade wall should be constructed around the entire opening or 3) if earth pressures are expected from the front slope, then the portals must be designed as retaining walls. Any retaining walls lining the approach cuts can be considered as counterforts supporting the portal.

Portal facades can be constructed of a variety of materials, including concrete, masonry block or cut stone. Details concerning the type, configuration and composition of the portals can be obtained from the design or construction drawings.

Checks to be made:

1. General:
   - Surface weathering:
     - Staining
     - Efflorescence, mineral crystal formation
     - Plant growth
   - Surface deterioration (concrete):
     - Spalling, chipped concrete
     - Cavitation
     - Crazing
   - Surface deterioration (masonry or cut stone):
     - Spalling, chipped masonry
     - Missing joint mortar
     - Damaged or missing rows of masonry
     - Broken, damaged, loose, corroded or missing anchorage or fasteners
   - Surface damage:
     - Punctures, holes, tears

    - Impact damage
- Cracking
- Movement, displacement or settlement of wall
- Deterioration of rock reinforcement system:
    - Corroded rock reinforcement measures (e.g., rockbolts, rock dowels, anchors, anchor plates)
    - Loose or failed rock reinforcement measures (e.g., rockbolts, rock dowels, anchors)
- Slope stability—front slope above or adjacent to portal:
    - Soil creep
    - Surface sloughing
    - Ground surface cracking
    - Rock falls
    - Landslides.

Resources

Name	Work Group/Company Name	E-mail Address	Date Added
Jeff Harsha	NPS	Jeff_Harsha@nps.gov	4/12/2012
Mary Hudson	NPS	Mary_Hudson@nps.gov	4/12/2012

References

The following is a list of suggested references that parks may wish to use in developing their own water system standards:

- N/A.

Related Documents

The following documents provide additional information on the asset category discussed in this inspection guidance:

- Water System Asset Business Practice
- Water System Asset Best Management Practice
- Critical Systems List
- Life-Cycle Estimate.

Appendix A Inspection Guidance Change Log

Business Practice Title:	Water System (5100) Asset Inspection Guidance
Responsible Group:	Comprehensive Asset Strategic Tools (CASTL) Development Group
Title of Business Practice Origin White Paper:	N/A
Last Change Made On:	June 2, 2014

#	Page #	Change Description	Reason for Change	Requested By	Requested On	Change Made On	Approved By	Approved On
2.0	N/A	Initial Release	Initial Release				Mike Seibert	6/2/2014

National Park Service
U.S. Department of the Interior

1201 Eye Street, NW, 10th Floor
Washington, DC 20005

Inspection Guidance: 5200 Wastewater System

Version 2.0

Effective Date: June 2, 2014

End Date: Until Amended or Rescinded

SRS Code: 4.B.1.

Table of Contents

Introduction **1**
Common Components and Critical Systems **2**
Comprehensive Condition Assessments **2**
Safety 2
Tips for Inspections 3
Wastewater Treatment 3
Wet and Dry Well Systems 4
Aeration Tank Systems 8
Clarifier Systems 10
Filtration Systems 14
Disinfectant Systems 15
Sludge-Processing Systems 17
Control Systems 18
Component Inspection Guidance 20
Barrier & Fencing 20
Fence/Gate 20
Control & Instrumentation 24
Control 24
Electrical 25
Generator 25
Liquid & Gas 26
Pump 26
Tank 27
Liquid & Gas/Plumbing 29
Pipe 29
Valve 30
Liquid & Gas/Treatment & Processing 31
Chemical Handling 31
Disinfection Equipment 31
Mechanical Handling 32
Physical Treatment 33
Treatment Equipment 33
Treatment Process Drive 33
Solids Handling/Treatment 34

Wet/Dry Well 38
Marking 39
Sign 39
Structure 41
Sewer Manhole 41
Water Control 42
Drain 42
Resources 43
References 43
Related Documents 43
Appendix A Inspection Guidance Change Log A-1

Introduction

This document contains the inspection guidance for wastewater systems. The critical components associated with a wastewater system should be inspected using the guidelines found in this document. Other asset types can be collocated with a wastewater system, however. Where this exists, these components should be inspected using the guidelines for that asset type.

All wastewater system condition assessments should include a complete visual inspection of all constructed architectural, civil/structural and mechanical components. A field inspection should be performed using both a system and component inspection method to identify all maintenance and repair deficiencies that need correction. In other words, the inspector should determine if there is sufficient evidence to warrant complete replacement of a system versus repairing only specific components of that system (e.g., replacing the entire wastewater distribution system as opposed to replacing tanks/valves).

A systematic approach to visual inspections must be employed to document all problems with a given wastewater system. Some deficiencies are easily identifiable, such as leaking valves or corroded tanks. However, many deficiencies are more subtle (e.g., depression around wellhead) and will require further examination to identify. Using a systematic approach reduces the likelihood that deficiencies will be missed.

During an inspection, the inspector should thoroughly document the information that will be needed in the preparation of cost estimates and inspection reports. At a minimum, the following should be recorded for each deficiency:

- The wastewater system deficiency should be defined (e.g., leaking valves, corroded tanks, missing fasteners or supports)
- The corrective action should be specified with the appropriate verb (e.g., build/add, repair, replace, realign, adjust, relocate, remove, reopen, maintain, monitor)
- Location data should be provided with global positioning system (GPS) reading coordinates and/or a wheeled distance from a recognizable component, and, if possible, the geographical location should be marked on a map (e.g., 50 feet northeast of lift station on main distribution line)
- Data should be quantified in sufficient detail to permit later development of budget-level cost estimates using the appropriate unit of measure (e.g., 120 linear feet of polyvinyl chloride piping, 220 square feet or 7 each). It may also be useful to note whether on-site or imported materials will be used
- The relative priority of the deficiency should be noted as high, medium or low
- Additional comments or notes should be included that will help to define the project needs or special circumstances to consider.

While this document lays out universal inspection guidance, it does not establish one standard for all wastewater systems. Wastewater systems are constructed and maintained to different standards, as defined by a park unit's management plan. Park-level standards must be considered when completing wastewater system assessments and should guide the corrective action (and costs) to address identified deficiencies.

Common Components and Critical Systems

Table 1 lists classifications used for the wastewater system asset category. Any classification in the Facility Management Software System (FMSS) can be used to categorize components of a wastewater system, but Table 1 contains those most commonly used.

Table 1. Wastewater System Common Component List

Top-Level Classification	Classification	Critical System
Barrier/	Fence/Gate	No
Control & Instrumentation/	Control	Yes
Electrical/	Generator	No
Liquid & Gas/	Pump	Yes
Liquid & Gas/	Tank	Yes
Liquid & Gas/Plumbing/	Pipe	Yes
Liquid & Gas/Plumbing/	Valve	No
Liquid & Gas/Treatment & Processing/	Chemical Handling	Yes
Liquid & Gas/Treatment & Processing/	Disinfection Equipment	Yes
Liquid & Gas/Treatment & Processing/	Mechanical Handling	Yes
Liquid & Gas/Treatment & Processing/	Physical Treatment	Yes
Liquid & Gas/Treatment & Processing/	Treatment Equipment	Yes
Liquid & Gas/Treatment & Processing/	Treatment Process Drive	Yes
Liquid & Gas/Treatment & Processing/	Solids Handling/Treatment	Yes
Liquid & Gas/Treatment & Processing/	Wet/Dry Well	Yes
Signage & Marking/	Sign	No
Structure/Access/	Sewer Manhole	No
Water Control/	Drain	No

Comprehensive Condition Assessments

Safety

All inspections should be conducted in accordance with guidance found in the National Park Service (NPS) Reference Manual 50B and related federal, state and local safety and health standards. Examples include:

- Occupational Safety & Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910
- OSHA 29 CFR 1926
- National Fire Protection Association (NFPA) Life Safety Code
- NFPA 70E: Standard for Electrical Safety in the Workplace
- U.S. Environmental Protection Agency 40 CFR.

In addition, inspectors should request current copies of all operating unit safety plans applicable to wastewater systems before conducting the inspection. This will ensure that operating unit as well as required regulatory elements are taken into account.

Tips for Inspections

It is recommended that the park review all relevant inventory documents and the results of the most recent inspection before performing the condition assessment. Doing so will help familiarize the inspectors with the inventory and allow them to note previously reported deficiencies.

Below is a short list of items that may be useful during a field inspection:

- Fully charged GPS unit for collecting point and line data
- Digital camera with a fully charged battery and spares
- Sufficient storage space on the GPS unit and camera memory cards
- Paper maps, paper and a pencil/pen for field notes
- Compass
- Measuring tape and/or measuring wheel:
    - Hand tape measure, 10 foot–25 foot
    - Reel tape measure, 50 foot–100 foot
- Previous inspection information or a list of current work orders for that wastewater system
- Necessary field gear (appropriate footwear, sun protection, clothing and rehydration equipment)
- Gloves
- Flashlight
- Magnifying glass
- Eye protection
- Communication device (e.g., cell phone, radio).

When conducting an inspection of a wastewater system, it is easier to inspect each type of wastewater system as a whole unit, rather than breaking it down into the component classifications listed in Table 1. In order to facilitate the inspection of wastewater systems, inspection guidance is presented below for a variety of wastewater system types. Inspection guidance is also provided for each of the component classifications listed in Table 1 for ease of reference.

Wastewater Treatment

The wastewater treatment system provides for the collection and disposal of a facility's domestic waste products. Sources include all visitor center and comfort station sanitary waste, employee residence sanitary waste, restaurant facilities, overnight accommodation facilities, recreational vehicle dump-stations, fish-cleaning stations, etc. Waste treatment can range from a simple system for individual buildings to complex waste treatment plants that handle tens of thousands of gallons per day. There is not one universal system used throughout the NPS, but an attempt has been made to address the most common systems and equipment.

In general, the treatment process begins with a primary treatment or headwork that may include bar screen and rough separation equipment. This is followed by secondary treatment, which may include further separation equipment, aerators and centrifuges. The tertiary treatment usually includes filtration and chemical disinfection. A final treatment may be used for additional disinfection depending on the location of the discharge.

Checks to be made:

Wet and Dry Well Systems

- Pits/tanks (concrete):
    - Cracking, spalling, pop outs and scaling
    - Reinforcing steel corrosion:
        - Rusting/discoloration evident
        - Cracks occurring parallel to reinforcement
    - Excessive vegetation:
        - Vines, trees or shrubs obstructing access to tank
        - Growing on or next to tank
- Pits/tanks (metal):
    - Cracking or buckling:
        - Deformation, twisting or bending of pit/tank walls and frame
        - Stress or fatigue cracks in frame or wall
    - Leakage:
        - Water dripping from pipe penetration through dry well wall
        - Leaking gasket at manhole
        - Leakage at other than manhole gasket
        - Missing or damaged cover or grate
    - Physical damage:
        - Abrasions on tank walls, no leaks
        - Impact damage, dents, no leaks
        - Defective connections/anchorage:
            - Loose bolts, rivets or mechanical fasteners; evidence of leakage
            - Cracked or broken welds, evidence of leakage
        - Corrosion:
            - Missing protective coating (paint, galvanizing)
            - Corrosion evidenced by pitting or blistering
            - Corrosion evidenced by holes or loss of base metal
        - Excessive vegetation:
            - Vines, trees or shrubs obstructing access to tank
            - Growing on or next to tank
- Pump assembly:
    - Damaged pump:
        - Cracked or damaged pump housing
        - Broken pump base
    - Excessive pump noise and vibration:
        - Rattling noise
        - Grinding noise indicating metal to metal contact
    - Broken/loose pump hardware:
        - Loose pump assembly or mounting bolts
        - Broken or missing pump assembly or mounting bolts
    - Leakage:
        - Leaking pump housing
        - Leaking or damaged pump seals
    - Damaged motor:

        - Cracked/damaged housing or end bells
        - Broken motor base
    - Broken/loose motor hardware:
        - Loose motor assembly bolts
        - Broken or missing motor inspection covers
        - Broken or missing motor assembly bolts
    - Excessive motor noise and vibration:
        - Rattling noise
        - Grinding noise indicating metal to metal contact
        - Electrical arcing noise
    - Defective electrical connectors:
        - Loose conduit or connectors
        - Exposed wires or missing cover plates
    - Pump drive defects:
        - Loose coupling fasteners
        - Damaged coupling or drive shaft, still operable
        - Torn or damaged coupling shock absorbers
        - Loose, damaged or deformed coupling
        - Missing coupling
    - Float control hardware defects:
        - Loose, deformed or binding linage
        - Inoperable float control mechanism
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
- Pneumatic ejectors:
    - Ejector control system and valve defects:
        - Control system failure
        - Defective pneumatic valve
        - Loss of air pressure
    - Ejector tank defects:
        - Loose inspection cover
        - Physically damaged tank
        - Missing or damaged access cover
        - Waste water/air leaking from fittings
        - Leaking gaskets
    - Air compressor defects:
        - Cracked air compressor housing
        - Broken or damaged air compressor base
    - Damaged compressor motor:
        - Cracked/damaged housing or end bells
        - Broken motor base
    - Broken/loose compressor motor hardware:
        - Loose motor assembly bolts
        - Broken or missing motor inspection covers
        - Broken or missing motor assembly bolts
    - Excessive motor noise and vibration:
        - Rattling noise

        - Grinding noise indicating metal to metal contact
        - Electrical arcing noise
    - Defective electrical connectors:
        - Loose conduit or connectors
        - Exposed wires or missing cover plates
    - Compressor drive defects:
        - Loose coupling fasteners
        - Damaged coupling or drive shaft, still operable
        - Torn or damaged coupling shock absorbers
        - Missing coupling or belt guard
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
- Headwork screens, communitors and grinders:
    - Bar or screens defects
    - Drum defects:
        - Openings
        - Unusual sound from drum indicating possible bearing failure
    - Cutter blade defects:
        - Cutter blades deformed, missing or broken
        - Cutter blades appear dull; tearing solids versus cutting
    - Motor defects:
        - Cracked/damaged housing or end bells
        - Broken motor base
    - Motor hardware defects:
        - Loose motor assembly bolts
        - Broken or missing motor inspection covers
        - Broken or missing motor assembly bolts
    - Excessive motor noise and vibration:
        - Rattling noise
        - Grinding noise indicating metal to metal contact
        - Electrical arcing noise
    - Defective electrical connectors:
        - Loose conduit or connectors
        - Exposed wires or missing cover plates
    - Motor drive defects:
        - Loose coupling fasteners
        - Damaged coupling or drive shaft, still operable
        - Torn or damaged coupling shock absorbers
        - Loose, damaged or deformed coupling
        - Missing coupling
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
- Pipes, fittings and valves:
    - Leaking/damaged fittings:
        - Bent or cracked fitting, not leaking

        - Water leaking
    - Leaking/damaged pipe:
        - Bent or cracked pipe, not leaking
        - Water leaking
    - Loose/missing supports or hangers:
        - Loose supports or hangers
        - Broken or missing supports or hangers
    - Defective insulation:
        - Loose insulation
        - Damaged or deteriorated insulation
        - Missing insulation
    - Leaking valve:
        - Leaking check valve
        - Leaking valve packing glands/gaskets
    - Damaged valve:
        - Broken or missing valve handle
        - Bent stem, valve operable
        - Cracked valve body
        - Bent stem, valve inoperable
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by excessive loss of base metal
- Ladders (wood):
    - Defective connections/anchorage:
        - Loose connections/anchorage
        - Broken, split or damaged connections
    - Splits, physically damaged:
        - Broken, split or physically damaged rungs or rails
        - Missing rungs
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes, surface sag and frass observed
        - Surface channels, punctures and crushing
- Ladders (metal/fiberglass):
    - Defective connections/anchorage:
        - Missing or loose bolts or fasteners
        - Impact damage, broken brackets
    - Cracks or deformation:
        - Impact damage, dents
        - Stress or fatigue cracks
        - Cracked or broken welds
        - Missing rungs
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by excessive loss of base metal.

Aeration Tank Systems

- Aeration tank (concrete):
  - Cracking, spalling, pop outs and scaling
  - Reinforcing steel corrosion:
    - Rusting/discoloration evident
    - Cracks occurring parallel to reinforcement
  - Excessive vegetation:
    - Vines, trees or shrubs obstructing access or growing on or next to tank
- Aeration tank (metal):
  - Foundation settlement:
    - Concrete foundation cracked, no visible effect on tank operation
    - Concrete foundation cracked, reinforcing exposed and/or piping deformed
  - Shell physical damage:
    - Dents and abrasions, no leakage or visible effect on tank operation
    - Dents and abrasions, evidence of leakage (stains)
    - Dents and abrasions, steady fluid leakage
  - Defective connections/anchorage:
    - Loose bolts, rivets or mechanical fasteners; evidence of leakage
    - Cracked or broken welds, evidence of leakage
  - Deteriorated protective covering/corrosion:
    - Missing protective coating (paint, galvanizing)
    - Corrosion evidenced by pitting or blistering
    - Corrosion evidenced by excessive loss of base metal
  - Excessive vegetation:
    - Vines, trees or shrubs obstructing access or growing on or next to tank
- Air compressor/blower:
  - Excessive compressor/blower noise and vibration:
    - Rattling noise
    - Grinding noise indicating metal to metal contact
    - Clicking or slapping noise
  - Defective compressor/blower mounting hardware or supports:
    - Loose hardware or supports
    - Damaged hardware or supports
    - Missing hardware or supports
  - Leaking air tank, pipes, fittings and valves:
    - Leaking valve packing glands/seals, evidenced by leaking air
    - Damaged pipes, fittings or valves
    - Stress cracks in tank, evidenced by leaking air
  - Broken/loose compressor/blower assembly bolts:
    - Loose compressor or motor assembly bolts
    - Broken or missing compressor or motor assembly bolts
  - Loose compressor/blower base:
    - Loose base tie-down bolts
    - Missing base tie-down bolts or isolators
  - Defective pressure gauge:
    - Broken gauge or gauge lens
    - Leaking pressure gauge

- Damaged compressor/blower motor:
  - Cracked/damaged housing or end bells
  - Broken motor base
- Broken/loose motor hardware:
  - Loose motor assembly bolts
  - Broken or missing motor inspection covers
  - Broken or missing motor assembly bolts
- Compressor/blower drive defects:
  - Loose coupling fasteners
  - Damaged coupling or drive shaft, still operable
  - Torn or damaged coupling shock absorbers
  - Loose, damaged or deformed coupling
  - Missing coupling
- Corrosion:
  - Missing protective coating (paint, galvanizing)
  - Corrosion evidenced by pitting or blistering
  - Corrosion evidenced by holes or loss of base metal
- Defective electrical connectors:
  - Loose conduit or connectors
  - Exposed wires or missing cover plates
- Defective diffusers/blower discharge equipment:
  - Appropriate discharge header pressure
  - Aeration diffusers plugged or otherwise nonfunctional

- Pipes, fittings and valves:
  - Leaking/damaged fittings:
    - Bent or cracked fitting, not leaking
    - Spray system domestic water dripping
    - Wastewater leaking
  - Leaking/damaged pipe:
    - Bent or cracked pipe, not leaking
    - Spray system domestic water dripping
    - Wastewater leaking
  - Loose/missing supports or hangers:
    - Loose supports or hangers
    - Broken or missing supports or hangers
  - Leaking valve:
    - Leaking check valve
    - Leaking valve packing glands/gaskets
  - Damaged valve:
    - Broken or missing valve handle
    - Bent stem, valve operable
    - Cracked valve body
    - Bent stem, valve inoperable
  - Defective insulation:
    - Loose insulation
    - Damaged or deteriorated insulation
    - Missing insulation
  - Corrosion:
    - Missing protective coating (paint, galvanizing)

        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by excessive loss of base metal
- Tank access structures (wood):
    - Defective connections/anchorage:
        - Loose connections/anchorage
        - Broken, split or damaged connections
    - Splits, physically damaged:
        - Broken, split or physically damaged rungs or rails
        - Missing rungs
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes, surface sag and frass observed
        - Surface channels, punctures and crushing
- Tank access structures (metal/fiberglass):
    - Defective connections/anchorage:
        - Missing or loose bolts or fasteners; impact damage, broken brackets
    - Cracks or deformation:
        - Impact damage, dents
        - Stress or fatigue cracks
        - Cracked or broken welds
        - Missing rungs
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by excessive loss of base metal.

Clarifier Systems

- Clarifier tank (concrete):
    - Cracking, spalling, pop outs and scaling
    - Reinforcing steel corrosion:
        - Rusting/discoloration evident, cracks occurring parallel to reinforcement
    - Excessive vegetation:
        - Vines, trees or shrubs obstructing access or growing on or next to tank
- Clarifier tank (metal):
    - Foundation settlement:
        - Concrete foundation cracked, no visible effect on tank operation
        - Concrete foundation cracked, reinforcing exposed and/or piping deformed
    - Shell physical damage:
        - Dents and abrasions, no leakage or visible effect on tank operation
        - Dents and abrasions, evidence of leakage (stains)
        - Dents and abrasions, steady fluid leakage
    - Defective connections/anchorage:
        - Loose bolts, rivets or mechanical fasteners, evidence of leakage
        - Cracked or broken welds, evidence of leakage

    - Deteriorated protective covering/corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by excessive loss of base metal
    - Excessive vegetation:
        - Vines, trees or shrubs obstructing access or growing on or next to tank
- Clarifier tank (fiberglass):
    - Shell physical damage:
        - Dents or abrasions
        - No leakage or visible effect on operation
        - Hardware corroded, damaged or missing
    - Damaged protective coating:
        - Pitted or blistering
        - Surface erosion due to prolonged ultraviolet exposure
    - Damaged doors and/or ventilation openings:
        - Damaged hardware, panels, screens, windows
- Skimmer squeegee:
    - Flight/scraper defects:
        - Worn flights adjusted to limit
        - Damaged or torn flight
    - Flight travel mechanism defects:
        - Loose or worn chain, sprockets and/or rollers
        - Misaligned sprockets and/or rollers
        - Rattling or grinding noise indicating defective bearing mechanism
    - Damaged motor:
        - Cracked/damaged housing or end bells
        - Broken motor base
        - Broken/loose motor hardware:
            - Loose motor assembly bolts
            - Broken or missing motor inspection covers
            - Broken or missing motor assembly bolts
        - Excessive motor noise and vibration:
            - Rattling noise
            - Grinding noise indicating metal to metal contact
            - Electrical arcing noise
    - Defective electrical connectors:
        - Loose conduit or connectors
        - Exposed wires or missing cover plates
    - Drive mechanism defects:
        - Loose coupling fasteners
        - Damaged coupling or drive shaft, still operable
        - Torn or damaged coupling shock absorbers
        - Loose, damaged or deformed coupling
        - Missing coupling
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal

- Return activated sludge/waste activated sludge pump assemblies:
    - Damaged pump:
        - Cracked or damaged pump housing
        - Broken pump base
        - Excessive pump noise and vibration:
            - Rattling noise
            - Grinding noise indicating metal to metal contact
    - Broken/loose pump hardware:
        - Loose pump assembly or mounting bolts
        - Broken or missing pump assembly or mounting bolts
    - Leakage:
        - Leaking pump housing
        - Leaking or damaged pump seals
    - Damaged pump motor:
        - Cracked/damaged housing or end bells
        - Broken motor base
    - Broken/loose motor hardware:
        - Loose motor assembly bolts
        - Broken or missing motor inspection cover
        - Broken or missing motor assembly bolts
        - Excessive motor noise and vibration:
            - Rattling noise
            - Grinding noise indicating metal to metal contact
            - Electrical arcing noise
    - Defective electrical connectors:
        - Loose conduit or connectors
        - Exposed wires or missing cover plates
    - Pump drive defects:
        - Loose coupling fasteners
        - Damaged coupling or drive shaft, still operable
        - Torn or damaged coupling shock absorbers
        - Loose, damaged or deformed coupling
        - Missing coupling
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
- Pneumatic ejectors:
    - Ejector control system and valve defects:
        - Control system failure
        - Defective pneumatic valve
        - Loss of air pressure
    - Ejector tank defects:
        - Loose inspection cover
        - Physically damaged tank
        - Missing or damaged access cover
        - Wastewater/air leaking from fittings
        - Leaking gaskets

- Air compressor defects:
  - Cracked air compressor housing
  - Broken or damaged air compressor base
- Damaged compressor motor:
  - Cracked/damaged housing or end bells
  - Broken motor base
- Broken/loose compressor motor hardware:
  - Loose motor assembly bolts
  - Broken or missing motor inspection covers
  - Broken or missing motor assembly bolts
- Excessive motor noise and vibration:
  - Rattling noise
  - Grinding noise indicating metal to metal contact
  - Electrical arcing noise
- Defective electrical connectors:
  - Loose conduit or connectors
  - Exposed wires or missing cover plates
- Compressor drive defects:
  - Loose coupling fasteners
  - Damaged coupling or drive shaft, still operable
  - Torn or damaged coupling shock absorbers
  - Loose, damaged or deformed coupling
  - Missing coupling
- Corrosion:
  - Missing protective coating (paint, galvanizing)
  - Corrosion evidenced by pitting or blistering
  - Corrosion evidenced by holes or loss of base metal

- Pipes, fittings and valves:
  - Leaking/damaged fittings:
    - Bent or cracked fitting, not leaking
    - Spray system domestic water dripping
    - Wastewater leaking
  - Leaking/damaged pipe:
    - Bent or cracked pipe, not leaking
    - Spray system domestic water dripping
    - Wastewater leaking
  - Loose/missing supports or hangers:
    - Loose supports or hangers
    - Broken or missing supports or hangers
  - Leaking valve:
    - Leaking check valve
    - Leaking valve packing glands/gaskets
  - Damaged valve:
    - Broken or missing valve handle
    - Bent stem, valve operable
    - Cracked valve body
    - Bent stem, valve inoperable
  - Defective insulation:
    - Loose insulation

        - Damaged or deteriorated insulation
        - Missing insulation
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by excessive loss of base metal
- Tank access structures (wood):
    - Defective connections/anchorage:
        - Loose connections/anchorage
        - Broken, split or damaged connections
    - Splits, physically damaged:
        - Broken, split or physically damaged rungs or rails
        - Missing rungs
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes, surface sag and frass observed
        - Surface channels, punctures and crushing
- Tank access structures (metal/fiberglass):
    - Defective connections/anchorage:
        - Missing or loose bolts or fasteners
        - Impact damage, broken brackets
    - Cracks or deformation:
        - Impact damage, dents
        - Stress or fatigue cracks
        - Cracked or broken welds
        - Missing rungs
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by excessive loss of base metal.

Filtration Systems

- Slow-rate sand filter beds:
    - Media failure due to overloading (plugging), lack of proper depth, improper specification
    - Distribution piping system damaged—pipe/fitting failure
    - Underdrain system failure due to pipe/bedding/vent system damage
    - Liner failure due to ultraviolet deterioration or other physical damage
    - Vegetation encroachment surrounding or in beds
    - Control valves damaged or nonfunctional
    - Pumping systems damaged or nonfunctional:
        - Pump seal damage
        - Impeller damage
        - Drive motor seal, winding or bearing damage
- Mechanical/backwash filter systems:
    - Vessel failure due to improper construction, physical damage or corrosion

- Media failure due to improper specification, chronic organic overloading or loss through systemic wash-out
- Differential-pressure gauges damaged or nonfunctional
- Flow-metering equipment damaged or nonfunctional
- Pump systems damaged or nonfunctional
- Control system damaged or nonfunctional
- Piping system and control valves damaged or nonfunctional
- Air compressor equipment damaged or nonfunctional.

Disinfectant Systems

- Contact tanks (concrete):
  - Cracking, spalling, pop outs and scaling
  - Reinforcing steel corrosion:
    - Rusting/discoloration evident
    - Cracks occurring parallel to reinforcement
  - Excessive vegetation:
    - Vines, trees or shrubs obstructing access or growing on or next to tank
- Contact tanks (metal):
  - Foundation settlement:
    - Concrete foundation cracked, no visible effect on tank operation
    - Concrete foundation cracked, reinforcing exposed and/or piping deformed
  - Shell physical damage:
    - Dents and abrasions, no leakage or visible effect on tank operation;
    - Dents and abrasions
    - Evidence of leakage (stains)
    - Dents and abrasions, steady fluid leakage
  - Defective connections/anchorage:
    - Loose bolts, rivets or mechanical fasteners, evidence of leakage
    - Cracked or broken welds, evidence of leakage
  - Deteriorated protective covering/corrosion:
    - Missing protective coating (paint, galvanizing)
    - Corrosion evidenced by pitting or blistering
    - Corrosion evidenced by excessive loss of base metal
  - Excessive vegetation:
    - Vines, trees or shrubs obstructing access or growing on or next to tank
- Disinfectant injection equipment:
  - Flow-metering equipment defective:
    - Flume or weir damaged, transducer damaged/nonfunctional
    - Control equipment damaged/ nonfunctional
    - Flow meter damaged/nonfunctional
  - Sodium-hypochlorite pumping systems defective:
    - Fiberglass storage tank damaged/bulkhead-fitting leaking
    - Supply/discharge tubing damaged/leaking
    - Metering pumps damaged/ nonfunctional
    - Injection fittings damaged/nonfunctional
  - Ventilation equipment damaged/nonfunctional:
    - Fan damaged/nonfunctional

        - Louvers damaged/ nonfunctional
        - Actuators damaged/nonfunctional
        - Equipment corroded by atmospheric chlorine
    - Chlorine gas cylinder storage defects:
        - Loose or missing cylinder securing devices, chain/straps
        - Missing cylinder labeling
        - Chlorine odor, indicating leaking cylinder valve
        - Damaged or improper fusible plug in cylinder valve
        - Debris or storage blocking access to cylinders or equipment
    - Instrumentation/control defects:
        - Corroded flow control device, operable
        - Corroded pressure gauge, operable
        - Corroded recording device, operable
        - Damaged, missing or inoperable flow control device
        - Damaged, missing or inoperable recording device
        - Chlorine odor indicating instrumentation leakage
    - Pipe, fitting and valve defects:
        - Corrosion evident by minor pitting
        - Corrosion evident by blistering, severe pitting
        - Chlorine odor, indicating leak at fitting or valve
        - Frayed or damaged flexible piping from cylinder to manifold piping
        - Damaged or missing pipe insulation
- Pipes, fittings and valves:
    - Leaking/damaged fittings:
        - Bent or cracked fitting, not leaking
        - Spray system domestic water dripping
        - Wastewater leaking
    - Leaking/damaged pipe:
        - Bent or cracked pipe, not leaking
        - Spray system domestic water dripping
        - Wastewater leaking
    - Loose/missing supports or hangers:
        - Loose supports or hangers
        - Broken or missing supports or hangers
    - Leaking valve:
        - Leaking check valve
        - Leaking valve packing glands/gaskets
    - Damaged valve:
        - Broken or missing valve handle
        - Bent stem, valve operable
        - Cracked valve body
        - Bent stem, valve inoperable
    - Defective insulation:
        - Loose insulation
        - Damaged or deteriorated insulation
        - Missing insulation
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering

        - Corrosion evidenced by excessive loss of base metal
- Tank access structures (wood):
    - Defective connections/anchorage:
        - Loose connections/anchorage
        - Broken, split or damaged connections
    - Splits, physically damaged:
        - Broken, split or physically damaged rungs or rails
        - Missing rungs
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes, surface sag and frass observed
        - Surface channels, punctures and crushing
- Tank access structures (metal/fiberglass):
    - Defective connections/anchorage:
        - Missing or loose bolts or fasteners
        - Impact damage, broken brackets
    - Cracks or deformation:
        - Impact damage, dents
        - Stress or fatigue cracks
        - Cracked or broken welds
        - Missing rungs
    - Corrosion:
        - Missing protective coating (paint, galvanizing)
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by excessive loss of base metal
- Ultraviolet disinfectant systems:
    - Contact tank/pipe/trough damaged or leaking
    - Flow-control valves damaged/nonfunctional
    - Control panel damaged or nonfunctional
    - Ballasts damaged or nonfunctional
    - Lamps/sheaths/seals damaged or nonfunctional
    - Ground-fault interruptors damaged or nonfunctional
    - Intensity-sensing device damaged or nonfunctional.

Sludge-Processing Systems

- Sand drying beds:
    - Distribution system piping and control valves defects:
        - Pipe cracked, broken or otherwise damaged
        - Valves cracked, broken or damaged seat/seals
    - Filtration media ineffective due to improper specification, improper depth or chronic organic overloading
    - Underdrain/vent system defects due to damaged pipe or plugging
    - Supply or filtrate-pumping system defects:
        - Pump seals damaged
        - Drive-bearings damaged
        - Impeller and/or wear-rings damaged

        - Volute cracked or broken
        - Pump drive motor bearings damaged
        - Motor windings damaged
    - Control system damaged or nonfunctional:
        - Enclosure properly rated for location
        - Liquid-level components damaged
        - Flow-metering components damaged
        - Cables/terminal blocks damaged from overheating or electrical short
    - Motor starters, control transformers, relays, switches damaged
- Centrifuge dewatering systems:
    - Drive motor(s) damaged:
        - Bearing or winding failure
        - Drive-belt failure due to adjustment or wear
        - Scroll or bowl bearing failure
    - Auger defects:
        - Drive motor damaged—bearing or winding failure
        - Conveyor auger and/or bearing damage
        - Conveyor drive motor winding or bearing damage
    - Human machine interface (HMI)/control system defects:
        - Touch screen nonfunctional
        - Programmable logic control (PLC) power supply failure
        - Input-output module failure
        - Relay(s) failure
        - Motor-starter failure
        - Ethernet module failure
        - Enclosure damaged or corroded
        - Wiring/terminal blocks/control switches damaged by overheating/short
        - Enclosure ventilation/cooling system damaged or inoperable
    - Feed-pump damaged or inoperable:
        - Bearing failure
        - Seal failure drive-system component failure
        - Motor winding or bearing damage
        - Rotor and/or stator damaged
        - Impeller(s) and/or wear-ring damage
    - Pump grinder damaged or inoperable:
        - Motor windings and/or bearings damaged
        - Coupling damaged, cutter stack bearings damaged
        - Cutters/spacers damaged.

Control Systems

- Control center supervisory control and data acquisition (SCADA) system:
    - Operator-interface personal computer defects:
        - Computer processing unit (CPU) nonfunctional
        - Uninterrupted power supply (UPS) nonfunctional
        - Printer nonfunctional
        - Monitor nonfunctional
        - Keyboard/mouse nonfunctional
        - SCADA operating system software inoperable/replacement required

        - SCADA operating system software modifications required (operating screens/ladder-logic construction)
        - Satellite HMI hardware (touch screens) inoperable or replacement required
- PLC system:
    - Enclosure properly rated for location, damaged or corroded:
        - PLC power module inoperable
        - PLC/CPU damaged/nonfunctional
        - PLC input-output modules inoperable
        - Relay(s) and bases damaged/nonfunctional
        - Terminal and fuse blocks damaged/nonfunctional
        - Power cabling and wireways damaged
        - Fiber optic cabling/junction boxes/signal transition devices damaged/nonfunctional
        - UPS damaged/nonfunctional
        - Ethernet hub damaged/nonfunctional
- Motor control center (MCC) and/or other power/control interface equipment:
    - Enclosure and/or operating doors corroded or otherwise damaged
    - Power and/or hand-off-auto control switches, indicator lamps, overload resets damaged/nonfunctional
    - Control transformer(s) and/or primary/secondary fusing damaged/nonfunctional
    - Motor-starters damaged/nonfunctional
    - Cabling and terminal blocks damaged/ nonfunctional
    - Relays damaged/nonfunctional
    - MCC/motor starting panel line/load power cable damaged
- Control data input systems:
    - Weir or flume damaged
    - Transducer/control device damaged/nonfunctional
    - Magnetic flowmeter/control device damaged/nonfunctional
    - Liquid-level equipment defects:
        - Transducer/control device damaged/nonfunctional
        - Float/control device and relay damaged/nonfunctional
        - Pressure (air/liquid) sensor/control device damaged/nonfunctional
    - Dissolved oxygen equipment defects:
        - Sensor and/or cable damaged/nonfunctional
        - Control device damaged/ nonfunctional
    - Enclosure defects:
        - Enclosure properly rated for location
        - Enclosure corroded or otherwise damaged
    - Data cable bundle defects:
        - Cable overheated/shorted or otherwise physically damaged/nonfunctional
        - Data cable co-mingled with power cable in wireway
- Adjustable frequency motor drives:
    - Enclosure defects:
        - Enclosures properly rated for location
        - Enclosure corroded or otherwise physically damaged
    - Disconnect/control device/drive defects:

        - Power disconnect damaged/ nonfunctional
        - Control switches, indicator lamps, cabling and overload resets damaged/nonfunctional
        - Integral programming device/keypad/display damaged/nonfunctional
        - Fuses and/or control transformer(s) damaged/ nonfunctional
        - Relays/bases damaged/nonfunctional
    - Motor drive damaged or nonfunctional
    - Line/load power cables damaged/nonfunctional.

Component Inspection Guidance

Barrier & Fencing

Fence/Gate

A fence consists of a line of posts secured to the ground and connected with railings, pickets, planks, braces and other fence members secured in place. Posts out of plumb may be checked by eyesight, string line or transit. Fencing and gates commonly found on wastewaster systems include those made of wood, metal, concrete and masonry/stone.

Gates are closable openings in a fence that permit people, animals and/or vehicles to move from one side of the fence to the other. Wood gates are constructed with wood rails, pickets, planks, braces and other members securely fastened into a single unit. Metal gates are fabricated with pipe/tube framing covered with metal chain link or other woven wire mesh, preformed panel or metal laced fabric and kept in shape with wires, rods or turn buckles.

Security components such as barbed, razor or concertina wire may be installed at the top of a fence or attached either directly to the posts or on a metal angle bracket attached to the top of the posts.

Checks to be made:

1. Fence panels and railings (wood):
    - Splits/cracking/broken:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Physically damaged and broken
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes less than 1/8" diameter, surface sag and frass observed
        - Large holes greater than 1/8" diameter, surface channels, punctures and crushing
    - Out of plumb more than 3" in 8'
    - Erosion/vegetation:
        - Soil erosion under fence wall
        - Vines, trees or shrubs climbing over or growing into fence

2. Fence panels (metal):
   - Fence fabric
     - Defective
     - Loose or sagging greater than 2" in diameter
     - Damaged or missing
   - Defective, loose, damaged or missing
   - Loose connections/anchorage:
     - Loose bolts or wire fasteners
     - Loose or bent pipe posts or railing
     - Missing or broken components
   - Out of plumb more than 3" in 8'
   - Corrosion:
     - Missing protective coating-galvanizing/paint, no pitting evident
     - Corrosion evidenced by pitting or blistering
     - Rust/corrosion evidenced by loss of base metal
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vines, trees or shrubs climbing over or around posts
3. Fence panels (concrete):
   - Cracking:
     - Hairline cracks to 1/16" wide
     - Wide cracks more than 1/16" wide
     - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
   - Spalling:
     - Less than 1" deep or 6" in diameter
     - More than 1"in depth or greater than 6” in diameter or loss of more than 10 percent of surface area of a member
     - Disintegration of surface area, with corrosion of exposed reinforcing steel
   - Scaling:
     - Loss of surface up to 1/2" deep, with exposure of coarse aggregates
     - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
     - Loss of surface exceeds 1" reinforcing steel usually exposed
   - Reinforcing steel corrosion:
     - Rusting/discoloration evident
     - Cracks occurring parallel to reinforcement
   - Out of plumb more than 3" in 8'
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vines, trees or shrubs climbing over or around posts
4. Fence panels (masonry/stone):
   - Deteriorated mortar joint material:
     - Cracked mortar joint material
     - Loose/missing mortar joint material
     - Eroded mortar greater than 1/2" deep
   - Damaged bricks, stones or concrete masonry unit (CMU):
     - Cracked, split, damaged
     - Loose, missing
   - Out of plumb more than 3" in 8'

- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or around posts

5. Fence posts (wood):
    - Splits/cracking/broken:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Physically damaged and broken
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes less than 1/8" diameter, surface sag and frass observed
        - Large holes greater than 1/8" diameter, surface channels, punctures and crushing
    - Out of plumb more than 3" in 8'
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vines, trees or shrubs climbing over or around posts
6. Fence posts (metal):
    - Loose connections/anchorage:
        - Loose bolts or wire fasteners
        - Loose or bent pipe posts or railing
        - Missing or broken components
    - Out of plumb more than 3" in 8'
    - Corrosion:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced by loss of base metal
    - Erosion/vegetation:
        - Soil erosion around posts
        - Vines, trees or shrubs climbing over or around posts
7. Fence posts (concrete):
    - Cracking:
        - Hairline cracks to 1/16" wide
        - Wide cracks more than 1/16" wide
        - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
    - Spalling:
        - Less than 1" deep or 6" in diameter
        - More than 1” in depth or greater than 6" in diameter or loss of more than 10 percent of surface area of a member
        - Disintegration of surface area, with corrosion of exposed reinforcing steel
    - Scaling:
        - Loss of surface up to 1/2" deep, with exposure of coarse aggregates
        - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
        - Loss of surface exceeds 1", reinforcing steel usually exposed

- Reinforcing steel corrosion:
    - Rusting/discoloration evident
    - Cracks occurring parallel to reinforcement
- Out of plumb more than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or around posts

8. Fence posts (masonry/stone):
    - Deteriorated mortar joint material:
        - Cracked mortar joint material
        - Loose/missing mortar joint material
    - Out of plumb more than 3" in 8'
    - Damaged bricks, stones or CMU:
        - Cracked, split, damaged
        - Loose, missing
    - Erosion/vegetation:
        - Soil erosion around piers
        - Vines, trees or shrubs climbing over or around piers
9. Gates (wood):
    - Defective gate:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Damaged or missing wood sections
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes less than 1/8" diameter, surface sag and frass observed
        - Large holes greater than 1/8” diameter, surface channels, punctures and crushing
    - Out of plumb more than 3" in 6'
    - Connections:
        - Loose wood at connection site
        - Broken, split or damaged wood at connection site
    - Missing fasteners or anchorage
10. Gates (metal):
    - Defective gate fabric:
        - Loose or sagging gate fabric
        - Damaged or missing gate fabric
    - Defective gate panels:
        - Loose gate panels
        - Damaged or missing gate panels
    - Loose connections:
        - Loose bolts or wire fasteners
        - Loose or bent pipe post/bracing
        - Missing or broken hinges, latches or other components

- Out of plumb more than 1/2" in 6'
- Corrosion:
    - Missing protective coating-galvanizing/paint, no pitting evident
    - Corrosion evidenced by pitting or blistering
    - Corrosion evidenced by loss of base metal

11. Security wires:
    - Loose, broken or missing brackets or bolts
    - Loose, defective, sagging, broken or missing wire
    - Corroded wire:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced by loss of base metal
    - Corroded brackets:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Rust/corrosion evidenced by loss of base metal.

Control & Instrumentation

Control

Controls are the central part of a piece of machinery or system that controls its operation. Ask maintenance personnel for comments on the performance and condition of the system before starting the inspection.

Checks to be made:

1. Controls—system:
    - Defective controls, broken or disconnected
    - System air leakage
    - Defective electrical connectors
    - Defective mounting hardware or support, loose or missing
2. Indicators, transmitters and sensors:
    - Inoperable or missing
    - Damaged or illegible
    - Corrosion
3. Operators:
    - Defective operator, broken or disconnected
    - System air leakage
    - Defective electrical connectors
    - Defective assembly hardware
4. Controls—pipes, tubes and fittings:
    - Defective fittings, bent or cracked, leaking air
    - Defective pipe, bent, leaking air
    - Defective supports or hangers, loose or missing
    - Defective pipe labeling/color coding, damaged or missing
    - Corrosion
5. Controls—panels:
    - Defective mounting hardware or support

- Damaged enclosure
- Defective assembly hardware
- Corrosion

6. Controls—air compressors:
    - Leaking tank, pipes, fittings and valves
    - Broken or loose assembly bolts
    - Loose or missing mounting hardware
    - Defective pressure gauge
    - Damaged electrical equipment
    - Corrosion
    - Inoperable air compressor
    - Loose or missing belt guard
7. Controls—air dryers, refrigerated:
    - Defective or missing dryer
    - Corrosion.

Electrical

Generator

Engine Generator

Engine-generators convert fuel into electrical power. Each unit consists of an engine and generator working together as a unit. Since the two pieces of equipment work together as a unit, the inspection will cover both mechanical and electrical components. Engine-generators are used as primary or secondary power services and require the same inspection.

Checks to be made:

1. Generator sets:
    - Corrosion evidenced by pitting or blistering
    - Corrosion with loss of base metal
    - Panel fasteners loose, broken or missing
    - Unit not grounded
    - Indicator or gauges broken or inoperative
    - Fuel or coolant leaks
    - Damaged or missing battery
    - Missing parts or components
    - Missing identification, wiring diagram, specification tags
    - Loose, missing, corroded or damaged conduit or cable connections
    - Broken or disconnected fuel lines
    - Unit mounting loose, broken or missing
    - Dirty or clogged radiator
    - Worn or loose belts
    - Inspect maintenance records and test logs for recurring problems and testing frequency
    - General housekeeping of the equipment for maintenance and upkeep
    - Evidence of overheating or carbon tracking

- Type and size of the generator including capacity, fuel type, voltage, phase and power factor
- Estimated connected load and comparison to unit specifications

2. Automatic transfer switch:
    - Corrosion evidenced by pitting or blistering
    - Corrosion with loss of base metal
    - Enclosure mounting loose or broken
    - Panel fastener loose, broken or missing
    - Indicators or gauges damaged or inoperative
    - Enclosure damaged and cannot be sealed or closed
    - Unused opening not sealed
    - Handle bent or inoperative
    - Security devices missing or inoperative
    - Carbon tracking from flash over
    - Discoloration or deformity from overheating
    - Unit is not grounded
    - Switch or push buttons missing or damaged
    - Missing identification, wiring diagrams or operation instruction
    - Free space and clearance around the switch from debris or stored material
    - Housekeeping and maintenance of the equipment.

Liquid & Gas

Pump

Pumping Station

The primary purpose of the pumping station is to provide an immediate and continuous flow of water to protect large or high hazard areas. The secondary function is to provide a means for pressurizing the distribution system. The pressure is derived from the difference in elevation between the water level in the storage tank and the elevation of the water mains.

Checks to be made:

1. Pump base and coupling:
    - Loose, broken or missing pump/motor assembly/mounting bolts
    - Defects, loose/missing set screws, defective coupling and/or loose/missing coupling guard
    - Deterioration of protective covering/corrosion
    - Abandoned pump assemblies that require disposal
2. Pumps:
    - Damaged or cracked pump housing and/or broken pump base
    - Excessive noise and vibration
    - Loose, broken or missing pump assembly/mounting bolts
    - Leakage
    - Deterioration of protective covering/corrosion
3. Motors:
    - Damaged or cracked housing, end belts and/or motor base

- Broken/loose motor hardware for loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
- Excessive noise and vibration
- Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates

4. Controls:
    - Electrical arcing noise
    - Damage to panel, burned out pilot lamps and/or access to panel blocked
    - Deterioration of protective covering/corrosion
5. Pipes and fittings:
    - Bent/cracked fittings and/or signs of leakage
    - Bent/cracked pipes and/or signs of leakage
    - Loose supports/hangers and/or broken/missing supports/hangers
    - Loose, damaged, deteriorated and/or missing insulation
    - Galvanic anode cathodic protection system reduction in thickness and/or loose fasteners or broken welds
    - Corrosion, pitting, blistering and/or loss of base metal
    - Check impressed current cathodic protection system
6. Valves:
    - Leaking packing glands/gaskets, broken/missing handle, bent stem and/or cracked body
    - Corrosion
7. Metering devices:
    - Damaged, inoperable and/or missing devices
    - Corrosion, pitting, blistering and/or loss of base metal
8. Hydrants:
    - Damaged, missing hydrant caps, gaskets or chains and/or broken/cracked hydrant
    - Leakage, seepage, drips and steady leaks with main valve closed
    - Corrosion, pitting, blister and/or loss of base metal
9. Engines:
    - Physical damage to exterior, leaking fuel or coolant, broken/loose/missing hardware, corroded terminals and wires, loose wires/connections and/or loose/broken belts
    - Corrosion, pitting, blistering and/or loss of base material.

Tank

Septic Tank

The septic tank in a modern system is a water tight container, usually concrete, sometimes fiberglass. Older steel tanks were used in many areas but might be considered a problem due to their small size and because, eventually, they rust out and fail. The tank is normally always "full" of liquid and waste. Since the tank is normally water tight, if 100 gallons of water runs from the facility, 100 gallons of water enters the tank and pushes 100 gallons of effluent out of the tank into the soil absorption system.

Checks to be made:

1. General:
    - Backup anywhere in the system

- Discharge of effluent to the surface, stream, etc.
- Static effluent level above outlet in the Distribution-box
- System pumped as necessary (verify sludge depth)

2. Septic tanks (concrete):
   - Cracking, spalling, pop outs and scaling
   - Reinforcing steel corrosion:
     - Rusting/discoloration evident
     - Cracks occurring parallel to reinforcement
   - Excessive vegetation:
     - Vines, trees or shrubs obstructing access to or growing on or next to the tank
3. Septic tanks (metal):
   - Cracking or buckling:
     - Deformation, twisting or bending of pit/tank walls and frame
     - Stress or fatigue cracks in frame or wall
   - Leakage:
     - Water dripping from pipe penetration through dry well wall
     - Leaking gasket at manhole
     - Leakage at other than manhole gasket
     - Missing or damaged cover or grate
   - Physical damage:
     - Abrasions on tank walls, no leaks
     - Impact damage, dents, no leaks
   - Defective connections/anchorage:
     - Loose bolts, rivets or mechanical fasteners, evidence of leakage
     - Cracked or broken welds
     - Evidence of leakage
   - Corrosion:
     - Missing protective coating (paint, galvanizing)
     - Corrosion evidenced by pitting or blistering
     - Corrosion evidenced by holes or loss of base metal
   - Excessive vegetation:
     - Vines, trees or shrubs obstructing access to tank or growing on or next to tank
4. Tank covers, cleanout-access ports:
   - Cracked, damaged or misaligned tank cover or cleanout-access port
5. Valves:
   - Valve body:
     - Surface corrosion, excessive rust, protective coating (paint, galvanizing) worn or missing, corrosion evidenced by pitting or blistering, deep corrosion evidenced by holes or loss of base metal
     - Body is cracked
     - Components are worn, broken or missing
   - Leakage:
     - Valve shows signs of exterior leakage at seals, glands, gaskets, packing or pipe connections
     - Shut off valve shows evidence of incomplete closure, internal leakage
   - Blockage:
     - Valve is blocked

    - Reduced flow
- Installation:
    - Valve connections are misaligned, flange missing fasteners
    - Supports are inadequate, broken or missing
    - Excessive vibration
- Operator (mechanical or automatic):
    - Broken, corroded, rusted
    - Missing components
    - Inoperable
    - Lever or shaft bent
    - Valve is stuck, inoperable or blocked
    - Electronic/pneumatic/ Direct Digital Control (DDC)/electric control mechanism is inoperable

6. Pipes and fittings:
- Restricted flow:
    - Reduced, restricted flow
    - Blocked flow
- Defective joint fitting:
    - Bent or cracked fitting, not leaking
    - Waste water leaking into/out, seepage, infiltration
    - Broken joint fitting
- Defective pipe:
    - Bent or cracked pipe, not leaking
    - Waste water leaking into/out, seepage, infiltration
    - Broken pipe
- Corroded piping:
    - Surface corrosion
    - Corrosion evidenced by pitting or blistering
    - Corrosion evidenced by holes or loss of base metal.

Liquid & Gas/Plumbing

Pipe

Non-Potable Water Distribution

The non-potable water distribution system is the network of pumps, piping and auxiliary equipment required to carry non-potable water from its source to the using facilities. It serves to distribute and regulate the water supply.

Checks to be made:

1. Pump base and coupling:
- Loose, broken or missing pump/motor assembly/mounting bolts
- Defects, loose/missing set screws, defective coupling and/or loose/missing coupling guard
- Deterioration of protective covering/corrosion
- Abandoned pump assemblies that require disposal

2. Pumps:
- Damaged or cracked pump housing and/or broken pump base

- Excessive noise and vibration
- Loose, broken or missing pump assembly/mounting bolts
- Leakage
- Deterioration of protective covering/corrosion

3. Motors:
   - Damaged or cracked housing, end belts and/or motor base
   - Broken/loose motor hardware for loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
   - Excessive noise and vibration
   - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
4. Controls:
   - Electrical arcing noise
   - Damage to panel, burned out pilot lamps and/or access to panel blocked
   - Deterioration of protective covering/corrosion
5. Pipes and fittings:
   - Bent/cracked fittings and/or signs of leakage
   - Bent/cracked pipes and/or signs of leakage
   - Loose supports/hangers and/or broken/missing supports/hangers
   - Loose, damaged, deteriorated and/or missing insulation
   - Galvanic anode cathodic protection system reduction in thickness and/or loose fasteners or broken welds
   - Corrosion, pitting, blistering and/or loss of base metal
   - Check impressed current cathodic protection system
6. Valves:
   - Leaking packing glands/gaskets, broken/missing handle, bent stem and/or cracked body
   - Corrosion
7. Metering devices:
   - Damaged, inoperable and/or missing devices
   - Corrosion, pitting, blistering and/or loss of base metal
8. Hydrants:
   - Damaged, missing hydrant caps, gaskets or chains and/or broken/cracked hydrant
   - Leakage, seepage, drips and steady leaks with main valve closed
   - Corrosion, pitting, blister and/or loss of base metal
9. Manholes:
   - Deterioration, cracks/spalling concrete, exposed reinforcing, eroded joints (concrete masonry unit [CMU]) and/or loose/broken/displaced bricks
   - Damaged/bent frame/manhole cover, damaged/broken ladder, missing rungs, missing cover and/or offset manhole frame/entrance
   - Debris
10. Engines:
    - Physical damage to exterior, leaking fuel or coolant, broken/loose/missing hardware, corroded terminals and wires, loose wires/connections and/or loose/broken belts
    - Corrosion, pitting, blistering and/or loss of base material.

Valve

Checks to be made:

1. Valve body:
    - Surface corrosion, excessive rust, protective coating (paint, galvanizing) worn or missing, corrosion evidenced by pitting or blistering, deep corrosion evidenced by holes or loss of base metal
    - Body is cracked
    - Components are worn, broken or missing
2. Leakage:
    - Valve shows signs of exterior leakage at seals, glands, gaskets, packing or pipe connections
    - Shut off valve shows evidence of incomplete closure, internal leakage
3. Blockage:
    - Valve is blocked
    - Reduced flow
4. Installation:
    - Valve connections are misaligned, flange missing fasteners
    - Supports are inadequate, broken or missing
    - Excessive vibration
5. Operator (mechanical or automatic):
    - Broken, corroded, rusted
    - Missing components
    - Inoperable
    - Lever or shaft bent
    - Valve is stuck, inoperable or blocked
    - Electronic/pneumatic/DDC/electric control mechanism is inoperable.

Liquid & Gas/Treatment & Processing

Chemical Handling

Mixer

Checks to be made:

1. Check with operating or area personnel for deficiencies
2. Clean drive motor exterior and check for corrosion on motor exterior and base plate
3. Check motor operation for vibration, noise, overheating, etc.
4. Check alignment and clearances of shaft and coupler
5. Tighten or replace loose, missing, or damaged nuts, bolts and screws
6. Lubricate motor and shaft bearings as required
7. Clean area around motor.

Disinfection Equipment

Chlorinator

Checks to be made:

1. Check with operating or area personnel for deficiencies
2. Put on safety equipment prior to checking equipment

3. Clean chlorinator and check for leaks
4. Check water trap for proper level and bleed air
5. Check and clean water strainers
6. Grease fittings
7. Make minor adjustments to chlorinator, as needed.

Chlorine Detector

Checks to be made:

1. Put on safety equipment prior to checking equipment
2. Test alarm and inspect fan and sensor wiring
3. Test detector with chlorine test kit
4. Flush sensor unit with fresh water and drain and fill reservoir
5. Check drip rate and reservoir level in sight glass
6. Check “O” rings; replace as required
7. Inspect sensor mounting grommet, fan operation, detector mounting bolts and drain tube connection
8. Check charcoal filter cartridge; replace as needed
9. Check basket for cracked or worn areas
10. Check detector for leaks under pressure
11. Clean unit and surrounding area.

Mechanical Handling

Comminutor

Checks to be made:

1. Check with operating or area personnel for deficiencies
2. Change gearbox oil and lubricate fittings
3. Check comminutor and motor for excessive noise, vibration and overheating
4. Lubricate fittings and check oil in gearbox
5. Check operation.

Grit Collector

Checks to be made:

1. Check with operating or area personnel for obvious deficiencies
2. Lubricate fittings and check oil level in gearbox
3. Change oil in gearbox
4. Check chain linkage and operation
5. Clean area around drive mechanism.

Mixer

Checks to be made:

1. Check with operating or area personnel for deficiencies
2. Clean drive motor exterior and check for corrosion on motor exterior and base plate
3. Check motor operation for vibration, noise, overheating, etc.
4. Check alignment and clearances of shaft and coupler
5. Tighten or replace loose, missing or damaged nuts, bolts and screws

6. Lubricate motor and shaft bearings as required
7. Clean area around motor.

Physical Treatment

Grit Removal

Checks to be made:

1. Check with operating or area personnel for obvious deficiencies
2. Lubricate fittings and check oil level in gearbox
3. Change oil in gearbox
4. Check chain linkage and operation
5. Clean area around drive mechanism.

Treatment Equipment

Inspection guidance for treatment equipment can be found under the appropriate wastewater treatment system type in the Wastewater Treatment section of this document (see page 3).

Treatment Process Drive

Checks to be made:

- Mechanical stirrer/mixer:
    - Motor/gear box for cracked/damaged housing or end bells and/or broken base
    - Motor/gear box hardware for loose bolts, broken/missing inspection covers and/or broken/missing assembly bolts
    - Excessive noise and vibration
    - Coupling or shaft for loose/missing set screws, defective coupling and/or loose/missing coupling guard
    - Paddles for defects, chemical build-up on paddles and/or broken/eroded paddles
    - Deterioration of protective covering/corrosion
- Air compressor/blower:
    - Excessive noise and vibration
    - Mounting hardware/supports
    - Air tank for defects or leaks
    - Compressor/blower assembly for loose, broken and/or missing bolts
    - Pressure gauge for defects or damage
    - Motor hardware for loose/broken/missing motor assembly bolts and/or broken/missing motor inspection cover
    - Compressor drive for loose coupling fasteners, damaged/missing coupling, damaged drive shaft and/or torn/damaged coupling shock absorber
    - Deterioration of protective covering/corrosion
    - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
    - Check blower belts for wear and tension.

Solids Handling/Treatment

Lift Station

Lift stations consist of a system of pipes, valves, pumps, motors and controls used to lift sewage to a higher elevation. Some lift stations have comminutors that grind and shred the solid material in the raw wastewater flow into small particles. They are equipped with an electric motor and hardened steel cutters that reduce the solids in size as they pass through.

Checks to be made:

1. Comminutors:
    - Cracking or spalling of pit concrete
    - Extensive disintegration of surface area, with corrosion of exposed reinforcing steel
    - Out of plumb
    - Cracked joint sealant/caulk, loose/missing joint sealant/caulk
    - Loose cover or grate, missing or damaged cover or grate
    - Surface corrosion:
        - Corrosion evident by pitting or blistering
        - Corrosion evident by holes or loss of base metal
    - Missing tie-down bolts or isolators (mounting hardware)
    - Defective control system:
        - Loss of air pressure
        - Surcharged tank or pit
    - Cracked/damaged housing or end bells, broken motor base
    - Rattling noise, indicating metal to metal contact; electrical arcing noise
    - Loose motor assembly bolts, broken or missing motor inspection covers
    - Loose conduit or connectors, exposed wires or missing cover plates
    - Controls:
        - Missing
        - Loose
        - Control panel blocked, not accessible for inspection
    - Surface corrosion:
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
2. Wet and dry well systems—pits/tanks—concrete:
    - Cracking, spalling, pop outs and scaling
    - Reinforcing steel corrosion:
        - Rusting/discoloration evident
        - Cracks occurring parallel to reinforcement
    - Excessive vegetation:
        - Vines, trees or shrubs obstructing access to tank; growing on or next to tank
3. Wet and dry well systems—pits/tanks—metal:
    - Cracking or buckling:
        - Deformation, twisting or bending of pit/tank walls and frame
        - Stress or fatigue cracks in frame or wall
    - Water dripping from pipe penetration through dry well wall, leaking gasket at manhole
    - Leakage at other than manhole gasket, missing or damaged cover or grate

- Abrasions on tank walls, no leaks; impact damage, dents, no leaks
- Defective connections/anchorage:
    - Loose bolts, rivets or mechanical fasteners; evidence of leakage
    - Cracked or broken welds, evidence of leakage
- Corrosion:
    - Missing protective coating (paint, galvanizing)
    - Corrosion evidenced by pitting or blistering
    - Corrosion evidenced by holes or loss of base metal
- Excessive vegetation:
    - Vines, trees or shrubs obstructing access to tank; growing on or next to tank

4. Pump base and coupling:
    - Loose pump or motor mounting bolts, broken or missing pump or motor mounting bolts
    - Loose set screws, missing set screws
    - Loose tie-down bolts, missing or damaged base tie-down bolts or isolators
    - Loose coupling guard, missing coupling guard
    - Surface corrosion:
        - Corrosion evidence by pitting or blistering
        - Corrosion evidence by holes or loss of base metal
    - Inactive pump assembly, abandoned, requiring proper disposal
5. Pumps:
    - Cracked pump housing, broken pump base
    - Leaking at pump fitting or seals, cracked or damaged pump housing
    - Rattling noise; grinding noise, indicating metal to metal contact
    - Surface corrosion:
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
6. Motors:
    - Cracked/damaged housing or end bells, broken motor base
    - Rattling noise; grinding noise, indicating metal to metal contact; electrical arcing noise
    - Loose motor assembly bolts, broken or missing motor inspection covers, broken or missing motor assembly bolts
    - Loose conduit or connectors, exposed wires or missing cover plates
    - Odor caused by overheated motor windings, starter coils or contacts
7. Sewage ejectors:
    - Cracking or spalling of pit concrete
    - Extensive disintegration of surface area, with corrosion of exposed reinforcing steel
    - Out of plumb
    - Cracked joint sealant/caulk, loose/missing joint sealant/caulk
    - Loose cover or grate, missing or damaged cover or grate
    - Surface corrosion:
        - Corrosion evident by pitting or blistering
        - Corrosion evident by holes or loss of base metal
    - Loose pump or motor tie-down bolts; missing pump or motor tie-down bolts or isolators
    - Control system failure, loss of air pressure, surcharged tank or pit
    - Cracked/damaged housing or end bells, broken motor base
    - Rattling noise; grinding noise, indicating metal to metal contact; electrical arcing noise

- Loose motor assembly bolts, broken or missing motor inspection covers
- Loose conduit or connectors, exposed wires or missing cover plates
- Controls:
    - Missing
    - Loose
    - Control panel blocked, not accessible for inspection
- Surface corrosion:
    - Corrosion evidenced by pitting or blistering
    - Corrosion evidenced by holes or loss of base metal

8. Controls:
    - Electrical arcing noise
    - Visual signs of overheated cable insulation, connections or components
    - Physically damaged control panel enclosures
    - Burned out pilot lamps
    - Control panel blocked, not accessible for inspection
    - Surface corrosion:
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by holes or loss of base metal
    - Odor caused by overheated motor windings, starter coils or contacts
    - Enclosure not properly rated for location
    - Level-control devices not operational
    - Vacuum-pumps not operational
9. Valves:
    - Surface corrosion, excessive rust, protective coating (paint, galvanizing) worn or missing
    - Corrosion evidenced by pitting or blistering, deep corrosion evidenced by holes or loss of base metal
    - Body is cracked
    - Components are worn, broken or missing
    - Valve shows signs of exterior leakage at seals, glands, gaskets, packing or pipe connections
    - Shut off valve shows evidence of incomplete closure, internal leakage
    - Valve is blocked or has reduced flow
    - Valve connections are misaligned, flange missing fasteners
    - Supports are inadequate, broken or missing
    - Excessive vibration
    - Operator (mechanical or automatic):
        - Broken, corroded, rusted, missing components, inoperable, lever bent, shaft bent
        - Valve is stuck, inoperable or blocked
        - Electronic/pneumatic/DDC/electric control mechanism is inoperable
10. Pipes and fittings:
    - Reduced, restricted flow, blocked flow
    - Bent or cracked fitting, not leaking: waste water leaking into/out, seepage, infiltration; broken joint fitting
    - Bent or cracked pipe, not leaking: waste water leaking into/out, seepage, infiltration; broken pipe

- Surface corrosion:
    - Corrosion evidenced by pitting or blistering
    - Corrosion evidenced by holes or loss of base metal.

Waste Stabilization Lagoons (Non-Overflow)

Raw sanitary sewage flows to lagoon(s) by gravity or force-main through a facility's collection system. Non-overflow lagoon systems are designed for no discharge by relying on evaporation and seepage (if not lined) to exceed inflow.

Checks to be made:

1. General:
    - Verify sludge depth
    - Review flow records/capacities
    - Vegetation encroachment
    - Bank erosion
    - Liner integrity (Bentonite, ethylene propylene diene monomer, other)
    - Signs of leakage
2. Pipes/fittings:
    - Flow: reduced, restricted or blocked
    - Defective joint/fitting:
        - Damaged fitting
        - Sewage leaking
    - Defective/damaged pipe
    - Control valves damaged/leaking
3. Valves:
    - Valve body:
        - Surface corrosion, excessive rust, protective coating (paint, galvanizing) worn or missing
        - Corrosion evidenced by pitting or blistering, deep corrosion evidenced by holes or loss of base metal
        - Body is cracked.
        - Components are worn, broken or missing
    - Leakage:
        - Valve shows signs of exterior leakage at seals, glands, gaskets, packing or pipe connections
        - Shut off valve shows evidence of incomplete closure, internal leakage
    - Blockage: Valve is blocked or has reduced flow
    - Installation:
        - Valve connections are misaligned, flange missing fasteners
        - Supports are inadequate, broken or missing
        - Excessive vibration
    - Operator (mechanical or automatic):
        - Broken, corroded, rusted, missing components, inoperable, lever bent, shaft bent
        - Valve is stuck, inoperable or blocked
        - Electronic/pneumatic/DDC/electric control mechanism is inoperable.

Wet/Dry Well

When inspecting the internal mechanism of a wet/dry well, do NOT touch any electrical wires or components unless you have PERSONALLY de-energized the circuit. Verify that the alarm and pump are on separate circuits.

Checks to be made:

- Physical container/vault
  - Walls, floor and cover for structural deficiencies:
    - Spalling concrete
    - Cracks
    - Exposed reinforcing bar
    - Deteriorated/eroded mortar
    - Loose bricks/CMUs
    - Excessive corrosion
    - Deep gouges
    - Evidence of water infiltration or seepage
    - Separation at joints
  - Access frame:
    - Bent, broken or missing members
    - Excessive corrosion
    - Cracks
    - Joint separation or looseness
  - Access cover/door:
    - Correct fit
    - Good seal
    - Dents
    - Ease of operation (opens/closes without excessive effort)
    - Secure closure (latches and/or locks working correctly)
    - Structural deficiencies (as described above)
  - Steps:
    - Structural integrity
    - Bent, broken or missing members
    - Secure attachment to walls and/or cover
    - Safety hazards
    - Excessive corrosion
    - Deterioration
    - Spalling concrete
    - Exposed reinforcing bar
    - Excessive cracking
    - Proper pitch and tread width
    - Railing (if any) securely attached
  - Iron racks and pulling irons:
    - Excessive corrosion
    - Firm anchorage to walls or cover
    - Bent, broken or missing members
  - General safety hazards
    - Debris or dirt accumulation
    - Rodent, insect or reptile infestation

        - Mold or mildew accumulation
        - Broken or inoperative safety equipment
- Internal mechanism
    - Open up wet well and visually inspect the pumping of each pump
    - Completely pump down the wet well to its lowest point and make a visual inspection
    - Inspect wet well for excessive grease build up on surface, clean when needed
    - If the system has a pump or pumps, verify the operation of every pump and its control system. Check operations of float and activate the various components
    - Check wet well floats for rag build up, clean as needed
    - Pumps and piping are checked visually for defects
    - Power backup generator needs to be checked and started (fuel level, battery and general condition)
    - Visually inspect exposed electrical cables, junction boxes, etc.

Marking

Sign

Signs are displayed to convey information. Four basic types of signs are common to the NPS: identification signs, directional signs, information/education signs and regulatory signs. Signs differ in purpose and size (e.g., small directional metal sign versus kiosk/bulletin board with a roof). Signs may be made of acrylic, aluminum, concrete, fiberglass embedment, fiberglass, glass, high-pressure laminate, laminate, masonry/stone, metal, plastic, recycled plastic, steel, timber and wood.

Checks to be made:

1. Signage—general:
    - Loss of reflective properties
    - Peeling or flaking of thermoplastic markings
    - Missing sign resulting in potentially hazardous condition
    - Signs contain incorrect information
2. Kiosk/bulletin boards:
    - Warped, rotting or loose shingles on kiosk roof
    - Ultraviolet damage to Lexan/Plexiglas case, cracked or checked
    - Kiosk/bulletin board contains incorrect information
3. Signage (wood):
    - Loose, damaged, illegible or missing sign face
    - Splits/cracks/broken posts:
        - Surface fibers separated, less than 25 percent of thickness affected
        - Surface fibers separated, greater than 25 percent of thickness affected
        - Physically damaged and broken
    - Rot, fungus or decay of posts:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage of posts:

    - Holes less than 1/8", surface sag and frass observed
    - Large holes greater than 1/8", surface channels, punctures and crushing
- Out of level:
    - Less than or equal to 3" in 4'
    - More than 3" in 4'
- Out of plumb:
    - Less than or equal to 3" in 8'
    - More than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or obscuring sign
- Decaying or leaning trees (if sign is mounted to tree)

4. Signage (metal):
- Loose, damaged, illegible or missing sign face
- Out of level:
    - Less than or equal to 3" in 4'
    - More than 3" in 4'
- Out of plumb:
    - Less than or equal to 3" in 8'
    - More than 3" in 8'
- Corrosion of posts:
    - Surface corrosion, no pitting evident
    - Corrosion evidenced by pitting or blistering
    - Rust/corrosion evidenced loss of base metal
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or obscuring sign

5. Signage (concrete):
- Loose, damaged, illegible or missing sign face
- Cracking:
    - Hairline crack
    - Medium cracks 1/16" wide
    - Wide cracks more than 1/16" wide
    - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
- Spalling:
    - Less than 1" deep or 6" in diameter
    - More than 1" in depth or greater than 6" in diameter, or loss of more than 10 percent of surface area of a member
    - Disintegration of surface area, with corrosion of exposed reinforcing steel
- Scaling:
    - Loss of surface up to 1/2" deep, with exposure of coarse aggregates
    - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
    - Loss of surface exceeds 1", reinforcing steel usually exposed
- Reinforcing steel corrosion: rusting/discoloration evident, cracks occurring parallel to reinforcement
- Out of level:
    - Less than or equal to 3" in 4'
    - More than 3" in 4'

- Out of plumb:
    - Less than or equal to 3" in 8'
    - More than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or obscuring sign

6. Signage (masonry/stone):
    - Loose, damaged, illegible or missing sign face
    - Deteriorated, cracked or loose/missing mortar joint material
    - Out of level:
        - Less than or equal to 2" in 8'
        - More than 2" in 8’
    - Out of plumb:
        - Less than or equal to 3" in 8'
        - More than 3" in 8'
    - Damaged bricks, stones, or CMU:
        - Cracked, split, damaged
        - Loose, missing
    - Erosion/vegetation:
        - Soil erosion around sign footing
        - Vines, trees or shrubs climbing over or obscuring sign.

Structure

Sewer Manhole

Sanitary Sewer Manholes and Cleanouts

Manholes and cleanouts are covered openings which provide access for cleaning and repairing, in an underground pipe system.

Checks to be made:

1. Deteriorated walls/bottom/roof:
    - Hairline cracks, no water leaking
    - Wide cracks, visible water leakage
    - Exposed reinforcing
    - Eroded joints (brick, CMU)
    - Loose, broken, displaced brick or CMU
2. Deteriorated protective coating:
    - Peeling or blistering area of protective coating
3. Debris in manhole:
    - Sand/mud/debris in manhole
    - Sewer pipe fragments in manhole (indicating broken pipe)
    - Surcharged manhole
4. Physically damaged:
    - Bent/damaged frame or manhole cover
    - Damaged/broken ladder rungs
    - Missing rungs

- Missing manhole/cleanout covers
- Manhole entrance/frame is offset.

Water Control

Drain

Drain Fields

Clarified effluent flows from the septic tank into a drain field or soil absorption system; typically, perforated pipes buried in leaching trenches or in a leaching bed. The job of the soil absorption system is to treat the effluent by removing contaminants. This happens as the effluent soaks into the soil where bacterial action and filtration take place to convert unsanitary liquid to a sanitary condition before it flows onward deeper into the soil or ultimately to other locations.

Checks to be made:

1. General:
    - Effluent or sewage appears at the surface of the yard
    - Breakout of effluent observed (odors as well)
    - Saturated soil absorption area
2. Valves:
    - Valve body:
        - Surface corrosion, excessive rust, protective coating (paint, galvanizing) worn or missing, corrosion evidenced by pitting or blistering, deep corrosion evidenced by holes or loss of base metal
        - Body is cracked
        - Components are worn, broken or missing
    - Leakage:
        - Valve shows signs of exterior leakage at seals, glands, gaskets, packing or pipe connections
        - Shut off valve shows evidence of incomplete closure
        - Internal leakage
    - Blockage:
        - Valve is blocked
        - Reduced flow
    - Installation:
        - Valve connections are misaligned, flange missing fasteners
        - Supports are inadequate, broken or missing
        - Excessive vibration
    - Operator (mechanical or automatic):
        - Broken, corroded, rusted, missing components
        - Inoperable, lever bent, shaft bent
        - Valve is stuck, inoperable or blocked
        - Electronic/pneumatic/DDC/electric control mechanism is inoperable
3. Pipes and fittings:
    - Restricted flow:
        - Reduced, restricted flow

    - Blocked flow
- Defective joint fitting:
    - Bent or cracked fitting
    - Waste water leaking into/out, seepage, infiltration
    - Broken joint fitting
- Defective pipe:
    - Bent or cracked pipe, not leaking
    - Waste water leaking into/out, seepage, infiltration
    - Broken pipe.

Resources

Name	Work Group/Company Name	E-mail Address	Date Added
Jeff Harsha	NPS	Jeff_Harsha@nps.gov	4/12/2012
Mary Hudson	NPS	Mary_Hudson@nps.gov	4/12/2012

References

The following is a list of suggested references that parks may wish to use in developing their own wastewater system standards:

- N/A.

Related Documents

The following documents provide additional information on the asset category discussed in this inspection guidance:

- Wastewater System Asset Business Practice
- Wastewater System Asset Best Management Practice
- Critical Systems List
- Life-Cycle Estimate.

Appendix A Inspection Guidance Change Log

Business Practice Title:	Wastewater System (5200) Asset Inspection Guidance
Responsible Group:	Comprehensive Asset Strategic Tools (CASTL) Development Group
Title of Business Practice Origin White Paper:	N/A
Last Change Made On:	June 2, 2014

#	Page #	Change Description	Reason for Change	Requested By	Requested On	Change Made On	Approved By	Approved On
2.0	N/A	Initial Release	Initial Release				Mike Seibert	6/2/2014

National Park Service
U.S. Department of the Interior

1201 Eye Street, NW, 10th Floor
Washington, DC 20005

Condition Inspection Guidance: 6300 Marina/Waterfront System

Version 1.0

Effective Date: April 19, 2017

End Date: Until Amended or Rescinded

Table of Contents

Introduction **1**

Common Components and Critical Systems **2**

Comprehensive Condition Assessments **2**

Safety 2

Tips for Condition Inspections 3

Preparing for Condition Inspections 3

Underwater Inspections 3

Component Inspection Guidance 4

Barrier & Fencing 5

Fence/Gate 5

Electrical System 7

Generator 7

Lighting 8

Sacrificial Anode System 10

Exhibit 10

Sculpture Base 10

Furnishing 11

Exterior Furnishing 11

Liquid & Gas/Plumbing 11

Pipe 11

Marking & Signage 13

Aids to Navigation 13

Sign 13

Specialty Equipment 15

Anchoring System 15

Stationary Compaction 17

Structure 18

Deck Structure 18

Dock 18

Piling 30

Wall 32

Structure/Base & Foundation 41

Base and Sub-base 41

Structure/Door 41

Exterior Door 41
Surface 43
Land Surface 43
Roof Surface 44
Traffic Surface 45
Turfgrass/Pasture Crop 47
Water Control 48
Shore Protection: Coastal/Shoreline Protection System 48
Resources 53
Related Documents 53
Appendix A Change Log A-1

Introduction

This document contains the condition inspection guidance for marina/waterfront systems. The Department of the Interior policy on deferred maintenance requires the National Park Service (NPS) to perform condition assessments on its asset portfolio at a minimum of every five years.

A complete visual inspection of all constructed architectural, civil/structural and mechanical components should be part of all marina/waterfront system condition inspections. A field inspection should use both system and component inspection methods to identify all maintenance and repair deficiencies for correction. In other words, the inspector should determine if evidence is sufficient to warrant complete replacement of a system versus repair of only specific components of that system (e.g., replacing the entire deck as opposed to repairing minor cracks in the deck).

Visual inspections must employ a systematic approach to document all deficiencies within the marina/waterfront system. Some deficiencies announce themselves, such as missing decking on a pier. Other deficiencies, however, are more subtle and may require further examination to identify. Using a systematic approach reduces the likelihood that an inspector will miss deficiencies.

During an inspection, the inspector should thoroughly document the information that will be needed to prepare cost estimates and inspection reports. At a minimum, for each deficiency, the inspection should:

- Clearly define the marina/waterfront system deficiency (e.g., piles observed to have serious deterioration at mud-line, missing steps from the access to the dock, cleats show 80% corrosion).
- Specify a corrective action with an appropriate action verb (e.g., build/add, repair, replace, realign, adjust, relocate, remove, reopen, maintain, monitor).
- Provide location data with a measurable distance from a recognizable marina/waterfront system component, and, if possible, mark the physical location on a map.
- Quantify data in sufficient detail to permit later development of budget-level cost estimates using the appropriate unit of measure (e.g., replace “3 linear feet of rubber bumper along the east side” with “3 linear feet of silicone molded bumper”).
- Note the relative priority of the deficiency as high, medium or low in the representative work order record.
- Include additional comments or notes to help define the project needs or identify special circumstances.

While this document lays out universal condition inspection guidance, it does not establish one standard for all marina/waterfront systems. Different standards guide marina/waterfront system construction and maintenance, as defined by a park unit’s management plan. Inspectors must consider park-level standards when completing marina/waterfront system assessments and recommending corrective actions (and costs) to address identified deficiencies.

After performing a condition assessment, parks will obtain attribute-level facilities data as well as deficiency work orders. Parks are responsible for reviewing the data for accuracy and entering all data into the Facility Management Software System (FMSS), as appropriate.

Common Components and Critical Systems

Table 1 lists typical classifications for marina/waterfront systems. Any classification in the FMSS can categorize components of a marina/waterfront system, but Table 1 contains those that such systems are most likely to use.

Table 1. Marina/Waterfront System Common Component List

Top-Level Classification	Classification	Critical System
Barrier/	Fence/Gate	No
Electrical/	Generator	No
Electrical/	Lighting	No
Electrical/	Sacrificial Anode System	Yes
Exhibit/	Sculpture Base	No
Furnishing/	Exterior Furnishing	No
Liquid & Gas/Plumbing/	Pipe	No
Marking and Signage/	Aids to Navigation	Yes
Marking and Signage/	Sign	No
Specialty Equipment/	Anchoring System	Yes
Specialty Equipment/	Stationary Compaction	No
Structure/	Deck Structure	Yes
Structure/	Dock	Yes
Structure/	Piling	Yes
Structure/	Wall	Yes
Structure/	Walkable Structure	Yes
Structure/Base and Foundation/	Base and Sub-base	Yes
Structure/Door	Exterior Door	No
Surface/	Land Surface	Yes
Surface/	Roof Surface	Yes
Surface/	Traffic Surface	Yes
Surface/	Turfgrass/Pasture Crop	No
Water Control/	Shore Protection	Yes

Comprehensive Condition Assessments

Safety

Parks should conduct all inspections in accordance with National Park Service (NPS) Reference Manual 50B guidance and related federal, state and local safety and health standards. Examples include:

- Occupational Safety & Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910
- OSHA 29 CFR 1926

- National Fire Protection Association (NFPA) Life Safety Code
- NFPA 70E: Standard for Electrical Safety in the Workplace
- U.S. Environmental Protection Agency 40 CFR.

In addition, inspectors should request current copies of all operating unit safety plans applicable to marina/waterfront systems before conducting the inspection. This ensures the inspection takes into account the operating unit as well as required regulatory elements.

Tips for Condition Inspections

Preparing for Condition Inspections

Inspectors should review all relevant inventory documents and the results of the most recent inspection before performing the condition assessment. Doing so will help familiarize the inspectors with the inventory and allow them to note previously reported deficiencies.

Below is a short list of additional items that may be useful during a field inspection:

- Fully charged global positioning system (GPS) unit for collecting point and line data
- Digital camera with a fully charged battery and spares
- Sufficient storage space on the GPS unit and camera memory cards
- Blueprints, drawings, paper and a pencil/pen for field notes
- Compass
- Previous inspection information or a list of current work orders for the marina/waterfront system
- Flotation vests/jackets
- Necessary field gear (appropriate footwear, sun protection, clothing and rehydration equipment)
- Gloves
- Flashlight
- Magnifying glass
- Eye protection
- Binoculars
- Measuring tape/wheel
- Fully charged or powered communication device (e.g., cell phone, radio).

Underwater Inspections

Underwater inspections have three levels, ranging from a visual inspection to a much more thorough, detailed inspection process. It is important to identify the three levels of underwater inspection and the frequency for conducting each type of inspection to determine the structural soundness of the marina/waterfront system.

A Level I general examination is the most common type of underwater inspection. It consists of an underwater visual inspection, does not involve cleaning any structural elements and is much quicker than the other levels of examination. Level I should confirm as-built structural plans and detect objects that show obvious major damage or deterioration due to overstress, ship impact, severe corrosion or extensive biological growth. The underwater assessor would use a visual and/or tactile observation technique to make Level I condition assessments. Visual documentation, using a still camera or an underwater

remotely operated vehicle with an attached camera or photography capability, may be included with the findings to provide representative results of the asset's condition.

A Level II detailed examination detects and identifies damaged and deteriorated areas of marina/waterfront systems that biofouling organisms or surface deterioration may hide. The data should be sufficient to approximate the relative condition and load-carrying or support capacity of the structures. Level II examinations require inspectors to clean structural elements and, because cleaning the structural elements is time-consuming, it is generally restricted to areas that are critical or are representative of the entire structure. The amount of information needed to identify the general condition of the overall asset governs the extent and thoroughness of cleaning. Inspectors commonly use simple instruments, such as calipers, measuring scales, ice picks, scrapers and chipping hammers, both to clean the submerged surfaces and to take physical measurements.

A Level III highly detailed examination is the least common and most thorough inspection. It is also the most time-consuming and therefore the most expensive of underwater inspection techniques. A Level III inspection often requires inspectors to use non-destructive testing (NDT) techniques, such as ultrasonic thickness testing of steel, but may also require partially destructive techniques, such as sample coring through concrete and wood structures. This type of evaluation detects hidden or interior damage loss in cross-sectional areas and material homogeneity. A Level III examination usually requires prior surface cleaning. NDT technologies are generally limited to key structural areas, areas that may be suspect, or structural members which may be representative of the underwater structure. An inspector may take a small percentage of accurate measurements to validate large numbers of simple measurements and in some hard-to-measure areas. Where the visual scrutiny, cleaning or simple measurements reveal extensive deterioration, a small sampling of detailed measurement will enable gross estimates of the structure's integrity.

Component Inspection Guidance

The guidance in this section covers inspections of the following components:

- Barrier & Fencing
- Electrical System
- Exhibit
- Furnishing
- Liquid & Gas/Plumbing
- Marking & Signage
- Specialty Equipment
- Structure
- Structure/Base & Foundation
- Structure/Door
- Surface
- Water Control

Barrier & Fencing

Fence/Gate

A fence consists of a line of posts secured to the ground and connected with railings, pickets, wires, planks, braces and other fence members secured in place. Inspectors may check for posts that are out of plumb by eyesight, string line or transit. Wood gates are constructed with wood rails, pickets, planks, wires, braces and other members securely fastened into a single unit. Metal gates are fabricated with pipe/tube framing covered with metal chain link or other woven wire mesh, preformed panel or metal-laced fabric and kept in shape with wires, rods or turn buckles.

Checks to make:

1. Fence panels and railings (wood):
   - Splits/cracking/broken:
     - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
     - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
     - Physically damaged and broken
   - Rot, fungus or decay:
   - Moist stained area
   - Discolored, soft or crushed area
   - Parasite damage:
   - Holes less than ⅛" diameter, surface sag and frass observed
   - Large holes greater than ⅛" diameter, surface channels, punctures and crushing
   - Out of plumb: more than 3" in 8'
   - Erosion/vegetation:
     - Soil erosion under fence wall
     - Vines, trees or shrubs climbing over or growing into fence
2. Fence posts (wood):
   - Splits/cracking/broken:
     - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
     - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
     - Physically damaged and broken
   - Rot, fungus or decay:
     - Moist stained area
     - Discolored, soft or crushed area
   - Parasite damage:
     - Holes less than ⅛" diameter, surface sag and frass observed
     - Large holes greater than ⅛" in diameter, surface channels, punctures and crushing
   - Out of plumb: more than 3" in 8'
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vines, trees or shrubs climbing over or around posts

3. Fence posts (metal):
   - Loose connections/anchorage:
     - Loose bolts or wire fasteners
     - Loose or bent pipe posts or railing
     - Missing or broken components
   - Out of plumb: more than 3" in 8'
   - Corrosion:
     - Missing protective coating—galvanizing/paint, no pitting evident
     - Corrosion evidenced by pitting or blistering
     - Rust/corrosion evidenced by loss of base metal
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vines, trees or shrubs climbing over or around posts
4. Fence posts (concrete):
   - Cracking:
     - Hairline crack
     - Wide cracks more than $^{1}/_{16}$" wide
     - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
   - Spalling:
     - Less than 1" deep or 6" in diameter
     - More than 1" in depth or greater than 6" in diameter or loss of more than 10 percent of surface area of a member
     - Disintegration of surface area, with corrosion of exposed reinforcing steel
   - Scaling:
     - Loss of surface up to ½" deep, with exposure of coarse aggregates
     - Loss of surface from ½" to 1" deep with coarse aggregates clearly exposed
     - Loss of surface exceeds 1", reinforcing steel usually exposed
   - Reinforcing steel corrosion:
     - Rusting/discoloration evident
     - Cracks occurring parallel to reinforcement
   - Out of plumb: more than 3" in 8'
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vines, trees or shrubs climbing over or around posts
5. Fence piers (masonry/stone):
   - Deteriorated mortar joint material:
     - Cracked mortar joint material
     - Loose/missing mortar joint material
   - Out of plumb: more than 3" in 8'
   - Damaged bricks, stones or concrete masonry unit (CMU):
     - Cracked, split or damaged
     - Loose or missing
   - Erosion/vegetation:
     - Soil erosion around piers
     - Vines, trees or shrubs climbing over or around piers
6. Gates (wood):
   - Defective gate:

  - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
  - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
  - Damaged or missing wood sections
- Rot, fungus or decay:
  - Moist stained area
  - Discolored, soft or crushed area
- Parasite damage:
  - Holes less than ⅛" diameter, surface sag and frass observed
  - Large holes greater than ⅛" diameter, surface channels, punctures and crushing
- Out of plumb: more than 3" in 6'
- Connections:
  - Loose wood at connection site
  - Broken, split or damaged wood at connection site
- Missing fasteners or anchorage

7. Gates (metal):
   - Defective gate fabric:
     - Loose or sagging gate fabric
     - Damaged or missing gate fabric
   - Defective gate panels:
     - Loose gate panels
     - Damaged or missing gate panels
   - Loose connections:
     - Loose bolts or wire fasteners
     - Loose or bent pipe post/bracing
     - Missing or broken hinges, latches or other components
   - Out of plumb: more than ½" in 6'
   - Corrosion:
     - Missing protective coating—galvanizing/paint, no pitting evident
     - Corrosion evidenced by pitting or blistering
     - Corrosion evidenced by loss of base metal.

Electrical System

Generator

Engine Generator

Engine-generators convert fuel into electrical power.

Checks to make:

1. Generator sets:
   - Exhaust system components
   - Corrosion evidenced by pitting or blistering
   - Corrosion with loss of base metal
   - Panel fasteners loose, broken or missing
   - Condition of unit grounding
   - Indicator or gauges broken or inoperative

- Fuel, coolant or oil leaks
- Damaged or missing battery and periodic testing of battery capacity
- Missing parts or components
- Missing identification, wiring diagram or specification tags
- Loose, missing, corroded or damaged conduit or cable connections
- Broken, disconnected or damaged fuel lines
- Unit mounting loose, broken or missing
- Dirty or clogged radiator
- Worn or loose belts
- General housekeeping of the equipment for maintenance and upkeep
- Evidence of overheating or carbon tracking
- Type and size of the generator including capacity, fuel type, voltage, phase and power factor
- Estimated connected load and comparison to unit specifications

2. Automatic transfer switch:
    - Corrosion evidenced by pitting or blistering
    - Corrosion with loss of base metal
    - Enclosure mounting loose or broken
    - Panel fastener loose, broken or missing
    - Indicators or gauges damaged or inoperative
    - Enclosure damaged and cannot be sealed or closed
    - Unused opening not sealed
    - Handle bent or inoperative
    - Security devices missing or inoperative
    - Carbon tracking from flash-over
    - Discoloration or deformity from overheating
    - Condition of unit grounding
    - Switch or push buttons missing or damaged
    - Switch does not function properly
    - Missing identification, wiring diagrams or operation instruction
    - Free space and clearance around the switch from debris or stored material
    - Housekeeping and maintenance of the equipment.

Lighting

Exterior Lighting Fixtures and Controls

Lighting consists of various types, sizes and shapes of lighting fixtures together with a wide range of lamp sources combined with a large variety of light controllers.

Checks to make:

1. Fixtures:
    - Inadequately supported
    - Insecure
    - Improperly located
    - Evidence of unauthorized removal
    - Incorrect types installed in hazardous locations
    - Cracked or broken luminaries and fixture parts

- Indications of objects being supported from or hung on fixtures
- Evidence of overheating, undersized or other damage to sockets
- Exposed or damaged connecting wiring

2. Lamps:
   - Oversized:
     - Blistering
     - Loose base
     - Thermal cracks from contact with fixture
     - Bare lamps or poor socket lamp connections
   - Operation of fluorescent fixtures shows poor burning and starting characteristics and loud humming ballasts
3. Controls:
   - Corrosion, pitting or loss of base metal
   - Signs of damage
   - Improper grounding or hot spots
   - Damaged security door or devices
   - Signs of fire or scorching.

Special Security Lighting Systems

Special security lighting consists of various types, sizes and shapes of lighting fixtures together with a wide range of lamp sources combined with a large variety of light controllers. Special security lighting enhances the security of people and property.

Checks to make:

1. Fixtures:
   - Inadequately supported
   - Insecure
   - Improperly located
   - Incorrect types installed in hazardous locations
   - Cracked or broken luminaries and fixture parts
   - Indications of objects being supported from or hung on fixtures
   - Evidence of overheating, undersized or other damage to sockets
   - Exposed or damaged connecting wiring
2. Lamps:
   - Oversized:
     - Blistering
     - Loose base
     - Thermal cracks from contact with fixture
     - Bare lamps or poor socket lamp connections
   - Operation of fluorescent fixtures shows poor burning and starting characteristics and loud humming ballasts
3. Controls:
   - Corrosion, pitting or loss of base metal
   - Signs of damage
   - Improper grounding or hot spots
   - Damaged security door or devices
   - Signs of fire or scorching.

Sacrificial Anode System

Parks should monitor cathodic protection systems in a manner similar to those with specific government requirements. All agencies require dated records of inspection performance, findings and any corrections made.

Checks to make:

- Cathodic protection records missing or not complete
- Cathodic protection records indicate inspections not on schedule
- Cathodic protection system not installed
- Cathodic protection system not operative
- Cathodic protection not painted over
- Cathodic protection section loss
- Missing connection points, corrosion on connection point or fraying on connection point.

Utility Pedestal

A source of utilities located on a dock, wharf or pier for vessels that may include electrical, water/wastewater, communication or dock lighting services.

Checks to make:

- Proper grounding
- Watertight or detached fittings
- Corrosion
- Burnt-out light bulbs
- Damaged structure
- Chipped or cracked painting
- Excessive insects or rodents.

Exhibit

Sculpture Base

Checks to make:

1. Stone bases (granite, marble, limestone, concrete, brick and tile):
   - Deteriorated surface
   - Cracking
   - Missing pieces of sculpture
   - Evidence of moisture intrusion
   - Spalling or broken areas
   - Exposed reinforcing
   - Out of plumb
   - Deteriorated mortar joints (eroded/sandy/cracked/missing)
   - Soft or spalling surfaces
   - Scratched surfaces
2. Metal bases (bronze, aluminum, steel or cast/wrought iron):
   - Deteriorated surface

- Cracking
- Evidence of moisture intrusion
- Rust/tarnish/corrosion
- Exposed reinforcing
- Out of plumb
- Scratched surfaces

3. Glass bases:
    - Broken or missing panes of glass
    - Scratched surfaces.

Furnishing

Exterior Furnishing

Benches

Checks to make:

1. Wood (log or lumber):
    - Structural soundness of seating surface (welds and metal framework, backrest and base)
    - Gouges, wood slivers and protruding fasteners (bolts and spikes) on seating surface and backrest (if applicable)
    - Loose/rusted nails and fasteners
    - Loose bases (asphalt, concrete or earth)
    - Corroded or loose bolted areas
    - Fading/weathering of wood surface
    - Flaking/peeling of painted surfaces
    - Erosion around base
    - Missing/damaged components
    - Vandalized and/or presence of graffiti
2. Granite/stone:
    - Structural soundness of seating surface, backrest (if applicable) and base
    - Spalling or chipping of surface
    - Excessively damp surfaces
    - Missing/damaged metal plate
    - Vandalized and/or presence of graffiti
    - Erosion around base.

Liquid & Gas/Plumbing

Pipe

Non-Potable Water Distribution

The non-potable water distribution system is the network of pumps, piping and auxiliary equipment that carries non-potable water from its source to the using facilities. It distributes and regulates the water supply.

Checks to make:

1. Pump base and coupling:
   - Loose, broken or missing pump/motor assembly/mounting bolts
   - Defects, loose/missing set screws, defective coupling and/or loose/missing coupling guard
   - Deterioration of protective covering/corrosion
   - Abandoned pump assemblies that require disposal
2. Pumps:
   - Damaged or cracked pump housing and/or broken pump base
   - Excessive noise and vibration
   - Loose, broken or missing pump assembly/mounting bolts
   - Leakage
   - Deterioration of protective covering/corrosion
3. Motors:
   - Damaged or cracked housing, end belts and/or motor base
   - Broken/loose motor hardware for loose motor assembly bolts, broken/missing motor inspection covers and/or broken/missing motor assembly bolts
   - Excessive noise and vibration
   - Defective electrical connectors, loose conduit or connectors, exposed wires and/or missing cover plates
4. Controls:
   - Electrical arcing noise
   - Damage to panel, burned out pilot lamps and/or access to panel blocked
   - Deterioration of protective covering/corrosion
5. Piping and fittings:
   - Bent/cracked fittings and/or signs of leakage
   - Bent/cracked pipes and/or signs of leakage
   - Loose supports/hangers and/or broken/missing supports/hangers
   - Loose, damaged, deteriorated and/or missing insulation
   - Galvanic anode cathodic protection system reduced in thickness and/or loose fasteners or broken welds
   - Corrosion, pitting, blistering and/or loss of base metal
   - Impressed current cathodic protection system
6. Valves:
   - Leaking packing glands/gaskets, broken/missing handle, bent stem and/or cracked body
   - Corrosion
7. Metering devices:
   - Damaged, inoperable and/or missing devices
   - Corrosion, pitting, blistering and/or loss of base metal
8. Hydrants:
   - Damaged, missing hydrant caps, gaskets or chains and/or broken/cracked hydrant
   - Leakage, seepage, drips and steady leaks with main valve closed
   - Corrosion, pitting, blistering and/or loss of base metal
9. Manholes:
   - Deterioration, cracks/spalling concrete, exposed reinforcing, eroded joints and/or loose/broken/displaced bricks

- Damaged/bent frame/manhole cover, damaged/broken ladder, missing rungs, missing cover and/or offset manhole frame/entrance

10. Engines:
    - Physical damage to exterior, leaking fuel or coolant, broken/loose/missing hardware, corroded terminals and wires, loose wires/connections and/or loose/broken belts
    - Corrosion, pitting, blistering and/or loss of base material.

Marking & Signage

Aids to Navigation

Aids to navigation are devices used to navigate or regulate a specific waterway or docking facility that may have visual, audible and/or lighting features (examples include day markers, can buoys, pencil buoys, nun buoys or range markers—see graphic). Inspectors should check lighting and audibility associated with aids to navigation, where applicable.

Checks to make:

- Day marker:
  - Unstable foundation
  - Loss of structural integrity
  - Illegible
- Can buoy/pencil buoy/nun buoy:
  - Corrosion
  - Cracks and/or tears
  - Fading
  - Illegible
  - Rotting connection point
  - Ultraviolet light damage/breakdown
- Range marker:
  - Misaligned
  - Unstable foundation
  - Loss of structural integrity.

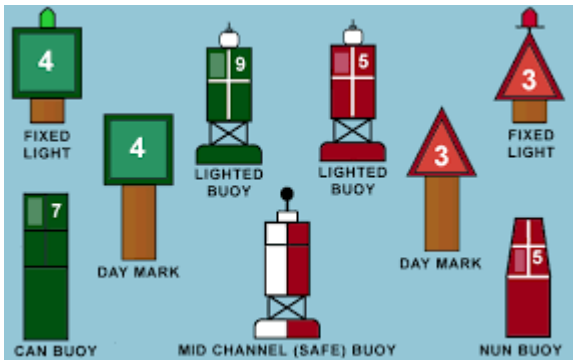

Figure 1. Navigation Markers and Signs

Sign

Signs convey information. Four basic types of signs are common to the NPS: identification signs, directional signs, information/education signs and regulatory signs. Signs differ in purpose and size (e.g., small directional metal sign versus kiosk/bulletin board with a roof). Signs may be made of acrylic, aluminum, concrete, fiberglass embedment, fiberglass, glass, high-pressure laminate, laminate, masonry/stone, metal, plastic, recycled plastic, steel, timber and wood.

Checks to make:

1. Kiosk/bulletin boards:
    - Warped, rotting or loose shingles on kiosk roof
    - Ultraviolet damage to Lexan/Plexiglas case, cracked or checked
    - Incorrect information

2. Signage (wood):
   - Incorrect information
   - Loose, damaged, illegible or missing sign face
   - Splits/cracks/broken posts:
     - Surface fibers separated, less than 25 percent of thickness affected
     - Surface fibers separated, greater than 25 percent of thickness affected
     - Physically damaged and broken
   - Rot, fungus or decay of posts:
     - Moist stained area
     - Discolored, soft or crushed area
   - Parasite damage of posts:
     - Holes less than ⅛", surface sag and frass observed
     - Large holes greater than ⅛", surface channels, punctures and crushing
   - Out of level:
     - Less than or equal to 3” in 4'
     - More than 3" in 4'
   - Out of plumb:
     - Less than or equal to 3" in 8'
     - More than 3" in 8'
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vines, trees or shrubs climbing over or obscuring sign
   - Decaying or leaning trees (if sign is mounted to tree)
3. Signage (metal):
   - Incorrect information
   - Loose, damaged, illegible or missing sign face
   - Out of level:
     - Less than or equal to 3" in 4'
     - More than 3" in 4'
   - Out of plumb:
     - Less than or equal to 3" in 8'
     - More than 3" in 8'
   - Corrosion of posts:
     - Surface corrosion, no pitting evident
     - Corrosion evidenced by pitting or blistering
     - Rust/corrosion evidenced loss of base metal
   - Erosion/vegetation:
     - Soil erosion around posts
     - Vines, trees or shrubs climbing over or obscuring sign
4. Signage (concrete):
   - Incorrect information
   - Loose, damaged, illegible or missing sign face
   - Cracking:
     - Hairline crack
     - Medium cracks 1/16" wide
     - Wide cracks more than 1/16" wide
     - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2 inches

- Spalling:
  - Less than 1" deep or 6" in diameter
  - More than 1" in depth or greater than 6" in diameter or loss of more than 10 percent of surface area of a member
  - Disintegration of surface area, with corrosion of exposed reinforcing steel
- Scaling:
  - Loss of surface up to ½" deep, with exposure of coarse aggregates
  - Loss of surface from ½" to 1" deep with coarse aggregates clearly exposed
  - Loss of surface exceeds 1", reinforcing steel usually exposed
- Reinforcing steel corrosion:
  - Rusting/discoloration evident
  - Cracks occurring parallel to reinforcement
- Out of level:
  - Less than or equal to 3" in 4'
  - More than 3" in 4'
- Out of plumb:
  - Less than or equal to 3" in 8'
  - More than 3" in 8'
- Erosion/vegetation:
  - Soil erosion around posts
  - Vines, trees or shrubs climbing over or obscuring sign

5. Signage (masonry/stone):
   - Incorrect information
   - Loose, damaged, illegible or missing sign face
   - Deteriorated mortar joint material:
     - Cracked mortar joint material
     - Loose/missing mortar joint material
   - Out of level:
     - Less than or equal to 2" in 8'
     - More than 2" in 8'
   - Out of plumb:
     - Less than or equal to 3" in 8'
     - More than 3" in 8'
   - Damaged bricks, stones or CMU:
     - Cracked, split or damaged
     - Loose or missing
   - Erosion/vegetation:
     - Soil erosion around sign footing
     - Vines, trees or shrubs climbing over or obscuring sign.

Specialty Equipment

Anchoring System

Anchoring systems are devices or systems of devices that secure a dock, wharf, pier, mooring field and/or an aid to navigation. This device may be submerged or above water.

Figure 2. Anchoring System

Checks to make:

1. Metal
   - Deformation
   - Failed or missing members
   - Parasites
   - Broken and/or cracked
   - Section loss
   - Misalignment
   - Corrosion
2. Concrete:
   - Blowout
   - Deformation
   - Spalling and/or cracking
   - Chipping
   - Section loss
   - Misalignment
   - Displacement
   - Missing/damaged connections
3. Cable:
   - Fraying
   - Corrosion
   - Missing/damaged connections.

Cantilever Anchor System

The cantilever anchor system mechanically secures a cantilever dock to the shoreline.

Checks to make:

1. Wood/steel/concrete:
   - Stability
   - Integrity
   - Undermining
   - Adverse environmental impact.

Figure 3. Winch

Fixed Winches

Checks to make:

- Corrosion, improperly mounted, fraying cable, improper winch wound or missing winch clutch/dog
- Controls and power drive equipment in improper operating condition.

Crane/Boat Lifts/Personal Watercraft/Straddle Hoist

A fixed mechanical device to lift vessels from the water, also called a crane.

Checks to make:

1. Manual:
   - Broken, frayed or deteriorated straps

- Loss of structural integrity
- Broken connection points
- Corrosion

2. Motorized:
   - Loss of structural integrity
   - Broken connection points
   - Corrosion
   - Controls and drive motor function improperly
3. Pneumatic:
   - Loss of structural integrity
   - Broken connection points
   - Corrosion
   - Leaky or worn hoses, pipes and fittings
   - Air compress and controls function improperly.

Figure 4. Cantilever Anchor System

Stationary Compaction

Stationary compaction equipment consists of hopper type compactors in horizontal or vertical configurations, as well as baling compactors in various configurations. Compactors typically discharge into specially designed attached stationary containers. Balers reduce waste volume (usually cardboard and paper) by compressing materials into a cubic form and binding it with straps or wire. Both types of compactors use hydraulic pumps and cylinders for force needed to compress waste.

Checks to make:

1. Controls:
   - Controls not in good operating condition
   - Weatherproof enclosures show evidence of leakage
   - Safety interlocks, if provided, are not operational
   - Alarms, if present, function improperly
2. Compactor:
   - Paint deterioration, rusting or loss of base metal
   - Holes or major dents in the hopper or chute that cause improper operation
   - Evidence of leaks around hydraulic lines, connections or cylinder seals
   - Leaks on the hydraulic fluid tank or pump
   - Hopper, chute and ram are dirty or contain debris
3. Baler:
   - Paint deterioration, rusting or loss of base metal
   - Holes or major dents in the hopper or chute that cause improper operation
   - Evidence of leaks around hydraulic lines, connections or cylinder seals
   - Leaks on the hydraulic fluid tank or pump
   - Hopper, chute and ram are dirty or contain debris
   - Ram guides not in good condition
   - Safety guards and interlocks not functional
4. Operating standards:
   - Areas around compaction equipment are dirty or contain debris

- Vector, bird and animal entry is possible or not controlled
- Trash is uncontained
- Odor is present.

Structure

Deck Structure

Cribs

Cribs are square or rectangular structures that provide support from the structural frame of a dock, pier or wharf to the ocean/lake floor.

Figure 5. Deck Crib

Checks to make:

1. Wood/plastic:
   - Blowout
   - Broken or missing members
   - Rotting
   - Parasites
   - Broken, cracked or section loss
   - Misalignment
2. Metal:
   - Blowout, deformed, failed or missing members
   - Parasites
   - Broken, cracked or section loss
   - Misalignment
   - Corrosion
3. Concrete:
   - Blowout
   - Deformed
   - Spalling, cracking, chipping or section loss
   - Misalignment
   - Displacement.

Dock

Docks are structures where vessels can be secured.

Figure 6. Dock

Checks to make:

1. Decking material:
   - Wood/fiberglass board:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment

  - Defective connectors or anchorage
  - Unevenness between decking sections
  - Surface deterioration
  - Deep abrasions or excessive wear above water level
  - Loss of structural integrity
- Concrete/masonry:
  - Missing, damaged, fractured or loose areas
  - Cracking, spalling, scaling, reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connectors or anchorage
  - Surface deterioration
  - Deep abrasions or excessive wear above water level

Figure 7. Floating Dock

- Metal:
  - Missing steel members, corrosion, cracking or buckling
  - Defective connections or anchorage
  - Misalignment
  - Structural damage by impact or other means
  - Deteriorated protective covering
  - Defective connectors or anchorage
  - Unevenness between decking sections
  - Surface deterioration
  - Damage or corrosion from electrolysis
  - Deep abrasions or excessive wear above water level
- Recycled plastic:
  - Missing, broken or split surfaces/members
  - Deep abrasions or excessive wear
  - Fungus buildup
  - Misalignment
  - Defective connectors or anchorage
  - Warping or unevenness between decking sections
  - Surface deterioration

2. Dock frame:
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between decking sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level

  - Loss of structural integrity
- Metal:
  - Missing steel members, corrosion, cracking or buckling
  - Defective connections or anchorage
  - Misalignment
  - Structural damage by impact or other means
  - Deteriorated protective covering
  - Defective connectors or anchorage
  - Unevenness between decking sections
  - Surface deterioration
  - Damage or corrosion from electrolysis
  - Deep abrasions or excessive wear above water level
- Concrete:
  - Missing damaged, fractured or loose areas
  - Cracking, spalling, scaling, reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connectors or anchorage
  - Surface deterioration
  - Deep abrasions or excessive wear above water level

3. Railing:
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between rail sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level
     - Loss of structural integrity
   - Metal:
     - Missing steel members, corrosion, cracking, buckling
     - Defective connections or anchorage
     - Misalignment
     - Structural damage by impact or other means
     - Deteriorated protective covering
     - Defective connectors or anchorage
     - Unevenness between decking sections
     - Surface deterioration
     - Damage or corrosion from electrolysis
     - Deep abrasions or excessive wear above water level
   - Fiberglass:
     - Missing or broken pieces
     - Deterioration
     - Loss of structural integrity
     - Splintering
     - Damaged connections

- Recycled plastic:
  - Missing, broken or split surfaces/members
  - Deep abrasions or excessive wear
  - Fungus buildup
  - Misalignment
  - Defective connectors or anchorage
  - Warping or unevenness between rail sections
  - Surface deterioration

4. Fender:
   - Fastening hardware doesn't protrude, missing or broken sections
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between rail sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level
     - Loss of structural integrity
   - Plastic/vinyl:
     - Loss of resiliency
     - Missing or broken sections
   - Rope:
     - Rotting
     - Fraying
     - Loss of mass
   - Foam:
     - Loss of resiliency
     - Degradation
     - Tearing
     - Loss of flotation integrity
5. Gangway:
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between decking sections
     - Surface deterioration
     - Deep abrasions or excessive wear above level
     - Loss of structural integrity
   - Metal:
     - Missing members
     - Corrosion, cracking or buckling
     - Defective connections or anchorage

Figure 8. Block from Floating Dock

  - Misalignment
  - Structural damage by impact or other means
  - Deteriorated protective covering
  - Defective connectors or anchorage
  - Unevenness between decking sections
  - Surface deterioration
  - Damage or corrosion from electrolysis
  - Deep abrasions or excessive wear above water level
- Concrete:
  - Missing, damaged, fractured or loose areas
  - Cracking, spalling, scaling, reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connectors or anchorage
  - Surface deterioration
  - Deep abrasions or excessive wear above water level

6. Cleats:
   - Loose
   - Broken
   - Missing
   - Loss of structural integrity
7. Flotation
   - Corrosion of metal components
   - Improperly mounted
   - Loss of structural integrity
   - Water logging.

Mooring Fields

Mooring fields designate an area to moor vessels for an extended period of time. Mooring involves holding a vessel by means of a mooring buoy or similar device, which is fastened to a stationary underwater device that the vessel does not carry aboard as regular equipment.

Figure 9. Mooring Field

Checks to make:

1. If grid:
   - Loss of grid integrity
   - Damaged points of connection
   - Damaged connectors
   - Corrosion
2. Anchor:
   - Unstable
   - Loss of structural integrity
   - Severe corrosion
3. Cable:
   - Damaged cabling
   - Damaged connectors

- Corrosion

4. Floats:
   - Same as Anchor, above
5. Hardware
   - Missing
   - Broken
   - Corroded.

Piers

A fixed, open or closed type structure usually extending perpendicular from the shore into navigable water, designed for berthing, unloading or loading cargo, repair, fueling and general servicing of vessels. Piers usually provide berthing space on both sides of their entire length.

Figure 10. Pier

Checks to make:

1. General:
   - Wood:
     - Missing, broken or split piles or pile caps
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Surface deterioration
     - Defective connections
     - Unevenness between decking sections
   - Concrete:
     - Missing, damaged, fractured or loose piles, pile caps or members
     - Cracking, spalling, scaling, reinforcing steel corrosion, hardware pop-outs or misalignment
     - Erosion or displacement of material from behind bulkheads
     - Deteriorated sacrificial anodes from electrolysis
     - Defective connections
     - Unevenness between decking sections
   - Metal:
     - Missing members
     - Corrosion, cracking or buckling
     - Defective connections or anchorage
     - Deteriorated protective covering
     - Misalignment
     - Structural damage by impact or other means
     - Corrosion
     - Deteriorated sacrificial anodes from electrolysis
     - Defective connections
     - Unevenness between decking sections

2. Marine hardware/manhole covers, deck scuppers or drainage slots:
   - Metal:
     - Defective marine hardware/manhole covers/scuppers/drainage slots
     - Corrosion
   - Plastic:
     - Cracked or broken drains or ribs
3. Pier frame:
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between decking sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level
     - Loss of structural integrity

Figure 11. Wooden Pier

   - Metal:
     - Missing members, corrosion, cracking or buckling
     - Defective connections or anchorage
     - Misalignment
     - Structural damage by impact or other means
     - Deteriorated protective covering
     - Defective connectors or anchorage
     - Unevenness between decking sections
     - Surface deterioration
     - Damage or corrosion from electrolysis
     - Deep abrasions or excessive wear above water level
   - Concrete:
     - Missing, damaged, fractured or loose areas
     - Cracking, spalling, scaling, reinforcing steel corrosion, hardware pop-outs or misalignment
     - Erosion or displacement of material from behind bulkheads
     - Defective connectors or anchorage
     - Surface deterioration
     - Deep abrasions or excessive wear above water level
4. Railing:
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between rail sections

  - Surface deterioration
  - Deep abrasions or excessive wear above water level
  - Loss of structural integrity
- Metal:
  - Missing members, corrosion, cracking or buckling
  - Defective connections or anchorage
  - Misalignment
  - Structural damage by impact or other means
  - Deteriorated protective covering
  - Defective connectors or anchorage
  - Unevenness between decking sections
  - Surface deterioration
  - Damage or corrosion from electrolysis
  - Deep abrasions or excessive wear above water level
- Fiberglass:
  - Missing or broken pieces
  - Deterioration
  - Loss of structural integrity
  - Splintering
  - Damaged connections
- Recycled plastic:
  - Missing, broken or split surfaces/members
  - Deep abrasions or excessive wear
  - Fungus buildup
  - Misalignment
  - Defective connectors or anchorage
  - Warping or unevenness between rail sections
  - Surface deterioration

5. Fender:
   - Fastening hardware doesn't protrude, missing or broken sections
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between rail sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level
     - Loss of structural integrity
   - Plastic/vinyl:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Fungus buildup
     - Misalignment
     - Defective connectors or anchorage
     - Warping or unevenness between rail sections
     - Surface deterioration

  - Loss of resilience
  - Missing portions
- Rope:
  - Rotting
  - Fraying
  - Loss of mass
- Foam:
  - Loss of resilience
  - Degradation

6. Gangway:
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect, rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between decking sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level
     - Loss of structural integrity
   - Metal:
     - Missing members, corrosion, cracking or buckling
     - Defective connections or anchorage
     - Misalignment
     - Structural damage by impact or other means
     - Deteriorated protective covering
     - Defective connectors or anchorage
     - Unevenness between decking sections
     - Surface deterioration
     - Damage or corrosion from electrolysis
     - Deep abrasions or excessive wear above water level
   - Concrete:
     - Missing, damaged, fractured or loose areas
     - Cracking, spalling, scaling, reinforcing steel corrosion, hardware pop-outs or misalignment
     - Erosion or displacement of material from behind bulkheads
     - Defective connectors or anchorage
     - Surface deterioration
     - Deep abrasions or excessive wear above water level.

Wharves

A wharf is an open type structure for berthing vessels. The structure is parallel to the shoreline and may be connected to the shore at more than one

Figure 12. Wharf

point, but it does not have continuous access to the shore.

Checks to make:

1. General:
   - Wood:
     - Missing, broken or split pile caps
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Surface deterioration
     - Defective connections
     - Unevenness between decking sections
   - Concrete:
     - Missing, damaged, fractured or loose piles, pile caps or members
     - Racking, spalling, scaling, reinforcing steel corrosion, hardware pop-outs or misalignment
     - Erosion or displacement of material from behind bulkheads
     - Deteriorated sacrificial anodes from electrolysis
     - Effective connections
     - Unevenness between decking sections
   - Metal:
     - Missing members
     - Corrosion, cracking or buckling
     - Defective connections or anchorage
     - Deteriorated protective covering
     - Misalignment
     - Structural damage by impact or other means
     - Corrosion
     - Deteriorated sacrificial anodes from electrolysis
     - Defective connections
     - Unevenness between decking sections
2. Marine hardware/manhole covers, deck scuppers or drainage slots:
   - Metal:
     - Defective marine hardware/manhole covers/scuppers/drainage slots
     - Corrosion
   - Plastic:
     - Cracked or broken drains or ribs
3. Wharf frame:
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between decking sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level

  - Loss of structural integrity
- Metal:
  - Missing members, corrosion, cracking or buckling
  - Defective connections or anchorage
  - Misalignment
  - Structural damage by impact or other means
  - Deteriorated protective covering
  - Defective connectors or anchorage
  - Unevenness between decking sections
  - Surface deterioration
  - Damage or corrosion from electrolysis
  - Deep abrasions or excessive wear above water level
- Concrete:
  - Missing, damaged, fractured or loose areas
  - Cracked, spalling, scaling, reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connectors or anchorage
  - Surface deterioration
  - Deep abrasions or excessive wear above water level

4. Railing:
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between rail sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level
     - Loss of structural integrity
   - Metal:
     - Missing members, corrosion, cracking or buckling
     - Defective connections or anchorage
     - Deteriorated protective covering
     - Misalignment
     - Structural damage by impact or other means
     - Defective connectors or anchorage
     - Unevenness between decking sections
     - Surface deterioration
     - Damage or corrosion from electrolysis
     - Deep abrasions or excessive wear above water level
   - Fiberglass:
     - Missing or broken pieces
     - Deterioration
     - Loss of structural integrity
     - Splintering
     - Damaged connections

- Recycled plastic:
  - Missing, broken or split surfaces/members
  - Deep abrasions or excessive wear
  - Fungus buildup
  - Misalignment
  - Defective connectors or anchorage
  - Warping or unevenness between rail sections
  - Surface deterioration

5. Fender:
   - Fastening hardware doesn't protrude, missing or broken sections
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between rail sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level
     - Loss of structural integrity
   - Plastic/vinyl:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Fungus buildup
     - Misalignment
     - Defective connectors or anchorage
     - Warping or unevenness between rail sections
     - Surface deterioration
     - Loss of resiliency
   - Rope:
     - Rotting
     - Fraying
     - Loss of mass
   - Foam:
     - Loss of resiliency
     - Degradation
     - Tearing
6. Gangway:
   - Wood:
     - Missing, broken or split surfaces/members
     - Deep abrasions or excessive wear
     - Insect rot, fungus or decay
     - Parasite damage
     - Misalignment
     - Defective connectors or anchorage
     - Unevenness between rail sections
     - Surface deterioration
     - Deep abrasions or excessive wear above water level

  - Loss of structural integrity
- Metal:
  - Missing members, corrosion, cracking or buckling
  - Defective connections or anchorage
  - Misalignment
  - Structural damage by impact or other means
  - Deteriorated protective covering
  - Defective connectors or anchorage
  - Unevenness between decking sections
  - Surface deterioration
  - Damage or corrosion from electrolysis
  - Deep abrasions or excessive wear above water level
- Concrete:
  - Missing, damaged, fractured or loose areas
  - Cracking, spalling, scaling, reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connectors or anchorage
  - Surface deterioration
  - Deep abrasions or excessive wear above water level.

Piling

Pilings are heavy rod- or shaft-like beams or groups of beams of wood, steel, concrete or metal driven into the earth as a foundation or support for a structure.

Checks to make:

1. Wood:
   - Missing, broken or split surfaces/members
   - Deep abrasions or excessive wear
   - Insect rot, fungus or decay
   - Parasite damage
   - Erosion or displacement of material from behind bulkheads
   - Misalignment
   - Defective connectors or anchorage
   - Surface deterioration
   - Deep abrasions or excessive wear above water level
2. Concrete:
   - Missing, damaged, fractured or loose areas
   - Cracking, spalling, scaling
   - Reinforcing steel corrosion, hardware pop-outs or misalignment
   - Erosion or displacement of material from behind bulkheads
   - Defective connectors or anchorage
   - Surface deterioration
   - Deep abrasions or excessive wear above water level
3. Metal:
   - Missing members, corrosion, cracking or buckling
   - Defective connections or anchorage

- Misalignment
- Structural damage by impact or other means
- Deteriorated protective covering
- Defective connectors or anchorage
- Surface deterioration
- Damage or corrosion from electrolysis
- Deep abrasions or excessive wear above water level.

Binwall/Sheet Pile

A binwall/sheet pile is a sidewall that extends around the perimeter of the dock from the deck to or below the sea or ocean bottom to create a void that is filled with material, typically rip rap or gravel. These can be constructed of metal, wood, concrete or recycled lumber.

Checks to make:

1. Wood:
    - Missing, broken or split supports
    - Deep abrasions or excessive wear
    - Insect rot, fungus or decay
    - Parasite damage
    - Misalignment
    - Surface deterioration
    - Undermining or blowing out
    - Defective connections
2. Metal:
    - Missing members
    - Corrosion, cracking or buckling
    - Defective connections or anchorage
    - Deteriorated protective covering
    - Undermining or blowing out
    - Misalignment
    - Structural damage by impact or other means
    - Defective connections
3. Masonry/stone:
    - Displacement
    - Missing mortar
    - Spalling, undermining or blowing out
    - Missing stones.

Dolphins

Dolphins are a pile or group of piles bound together to form a structure. A dolphin can be used to guide vessels into their berthing areas, as an anchoring point, or to protect other structures or vessels from damage, impact or abrasion.

Checks to make:

1. Piles—wood:
    - Missing or damaged pile caps

- Missing, broken or split piles
- Deep abrasions or excessive wear
- Insect, rot or fungi damage
- Misalignment

2. Cabling:
   - Damage to cables and connectors
   - Corrosion
3. Wedge blocks, chock and bolts:
   - Damaged wedge blocks or chocks deformed
   - Corroded, damaged bolts or hangers
   - Insect rot or fungi damage
   - Damaged banding or bolts.

Wall

Exterior Walls

Checks to make:

1. Painting:
   - Alligatoring
   - Checking
   - Blistering
   - Crawling
   - Cracking
   - Scaling
   - Peeling
   - Wrinkling
   - Flaking
   - Fading
   - Loss of gloss
   - Excessive chalking
   - Mildew
   - Bleeding
   - Staining caused by insect screens or splashing
   - Discoloration
   - Complete absence of paint
2. Weather tightness:
   - Lack of weather tightness, where butting dissimilar surfaces, between joints
3. Parapet walls and copings:
   - Cracks, spalling or defective joints
   - Other damage
4. Stucco:
   - Corrosion, disintegration
   - Cracks
   - Water stains
   - Delamination/broken areas
5. Concrete:

- Cracks
- Spalling
- Broken areas
- Settlement
- Exposed reinforcing
- Termite tubes to wood surfaces

6. Masonry:
   - Eroded or sandy mortar joints
   - Mortar cracking and pulling away from brick or CMUs
   - Efflorescence, soft, spalling or cracked bricks or CMUs
   - Settlement or expansion cracks
   - Termite tubes to wood surfaces
7. Siding—cement/asbestos:
   - Stains
   - Loose fastenings
   - Broken sheets
   - Deteriorated areas
8. Siding—shingle/asbestos:
   - Cracked, missing shingles
   - Deteriorated areas
9. Siding—aluminum:
   - Corrosion
   - Loose fastenings
   - Other damage
10. Siding—ferrous and other metal:
    - Scars
    - Scuffs
    - Rust
    - Corrosion
    - Breaks in protective coatings
    - Puncture of metal
    - Loose, missing or broken fastenings
    - Sagging or buckling
    - Support failure
11. Siding—wood:
    - Looseness
    - Warping
    - Surface cracking, checking
    - Swelling of joints
    - Loose or missing knots
    - Rotting
    - Fungus or termite infestation
    - Stains
    - Evidence of continued dampness
    - Skirting and other wooden parts for interference with ventilation and condensation control
    - Damage or rot from closeness to soil levels

- Need for corrective or preventive treatment

12. Siding—vinyl:
    - Looseness
    - Warping
    - Surface cracking
    - Missing sections
    - Other damage
13. Weather stripping:
    - Lack of weather tightness around framed openings, where butting dissimilar surfaces, between joints
14. Trim/flashing—wood:
    - Looseness
    - Warping
    - Surface cracking, checking
    - Swelling of joints
    - Loose or missing knots
    - Rotting
    - Fungus or termite infestation
    - Stains
    - Evidence of continued dampness
15. Wall insulation:
    - Missing or insufficient insulation
    - Loose, torn, damaged facing material
16. Vents/cleanouts and chimney screen:
    - Clogged with fly ash
    - Rust, tears and other damage
    - Bolts and screws for rust
    - Corrosion
    - Loose, broken or missing parts
17. Deflection:
    - Rotting or fungus growth
    - Evidence of dampness of long duration
    - Damage or possible damage to wooden parts due to closeness or direct contact with soil
18. Columns—concrete:
    - Cracks
    - Spalling
    - Broken areas
    - Settlement
    - Exposed reinforcing
19. Columns—wood/timber:
    - Warping, checking, splitting, bowing, sagging or broken members
20. Columns—steel:
    - Corrosion
    - Cracking, bowing, settlement
    - Missing fireproofing
    - Asbestos fireproofing

21. Columns—masonry:
    - Eroded or sandy mortar joints
    - Mortar cracking and pulling away from brick or CMUs
    - Efflorescence, soft, spalling or cracked bricks or CMUs
    - Settlement or expansion cracks
22. Beams/girders/joists/rafters/trusses/studs/sills:
    - Warping, checking, splitting, bowing, sagging or broken members
    - Deflection
    - Rotting or fungus growth
    - Evidence of dampness of long duration
    - Damage or possible damage to wooden parts due to closeness or direct contact with soil
    - Insect damage
    - Corrosion
    - Settlement
23. Sheathing:
    - Warping, sagging
    - Rotting or fungus growth
    - Evidence of dampness of long duration
    - Damage or possible damage to wooden parts due to closeness or direct contact with soil
    - Insect damage.

Fittings

Checks to make:

1. Miscellaneous partitions:
    - Wood:
        - Missing
        - Cracking, splintered, broken
        - Warping
        - Rot
        - Abrasion or scuff marks
        - Deteriorated paint/finish
        - Evidence of mechanical damage or personal abuse
        - Missing/damaged hardware
    - Metal:
        - Missing
        - Loose
        - Indentations
        - Bent
        - Corrosion
        - Deteriorated paint/finish
        - Evidence of mechanical damage or personal abuse
        - Missing/damaged hardware
    - Marble:
        - Missing
        - Cracked

  - Loose
  - Holes
  - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners
  - Missing/damaged hardware
2. Water closet partitions:
   - Wood:
     - Missing
     - Cracking, splintered, broken
     - Warping
     - Rot
     - Abrasion or scuff marks
     - Deteriorated paint/finish
     - Evidence of mechanical damage or personal abuse
     - Missing/damaged hardware
   - Metal:
     - Missing
     - Loose
     - Indentations
     - Bent
     - Corrosion
     - Deteriorated paint/finish
     - Evidence of mechanical damage or personal abuse
     - Missing/damaged hardware
   - Marble:
     - Missing
     - Cracked
     - Loose
     - Holes
     - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners
     - Missing/damaged hardware
   - Phenolic:
     - Missing
     - Cracked
     - Loose
     - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners
     - Missing/damaged hardware
3. Toilet/shower/tub doors and hardware:
   - Wood:
     - Splitting
     - Rotting
     - Cracking
     - Loose or poor fit
     - Binding
     - Missing
     - Scratches
     - Indentations
     - Loose/damaged or inoperative hardware
     - Mechanical damage
     - Personal abuse

  - Delimitation
- Metal:
  - Corrosion
  - Warped or bent
  - Binding
  - Poor fit
  - Loose/damaged hardware
  - Mechanical damage
  - Personal abuse
- Marble:
  - Missing
  - Cracked
  - Loose
  - Holes
  - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners
  - Missing/damaged hardware
- Phenolic:
  - Missing
  - Cracked
  - Loose
  - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners
  - Missing/damaged hardware

4. Cabinets/counters:
   - Wood:
     - Missing
     - Cracking, splintered or broken
     - Warping
     - Rot
     - Abrasion or scuff marks
     - Deteriorated paint/finish
     - Evidence of mechanical damage or personal abuse
     - Missing/damaged hardware
   - Metal:
     - Missing
     - Loose
     - Indentations
     - Bent
     - Corrosion
     - Deteriorated paint/finish
     - Evidence of mechanical damage or personal abuse
     - Missing/damaged hardware.

Partitions

Checks to make:

1. Drywall/plaster/paneling:
   - Wallboard, plasterboard, hard pressed fiberboard and cement-asbestos board:
     - Open joints
     - Cracking

  - Buckling or sagging
  - Support failure
  - Loose
  - Failure of nailing or adhesive
  - Abrasions
  - Breaks or holes
  - Discoloration from weather or utility leaks
- Plaster:
  - Cracking
  - Buckling or sagging
  - Support failure
  - Spalling, crumbling or falling from moisture absorption
  - Efflorescence, peeling or flaking from moisture or sealer failure
  - Discoloration from weather or utility leaks
- Wood:
  - Checking or cracking
  - Splintered or broken
  - Warping or sagging
  - Support failure
  - Rot
  - Termite or other insect or fungus infestation
  - Abrasion or scuff marks
  - Mechanical damage
  - Personal abuse
- Soft fiberboard (acoustical and insulation):
  - Open joints
  - Buckling or sagging
  - Support failure
  - Loose
  - Missing
  - Failure of fastenings or adhesive
  - Abrasions
  - Breaks or holes
- Metal:
  - Corrosion
  - Rust abrasions
  - Indentations
  - Punctures
  - Deterioration of protective coating

2. Ceramic tile/masonry/glass block:
   - Chipped or cracked
   - Loose
   - Missing
   - Holes
   - Defective mortar joints
   - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners
3. Trim:
   - Wood:
     - Missing

  - Cracking, splintered or broken
  - Warping
  - Rot
  - Termite or other insect or fungus infestation
  - Abrasion or scuff marks
  - Personal abuse
- Resilient (linoleum, vinyl plastic):
  - Curling
  - Loose or adhesive failure
  - Abrasions
  - Indentations
  - Punctures or tears
  - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaner
  - Evidence of mechanical damage or personal abuse
- Ceramic/porcelain/marble:
  - Chipped or cracked
  - Loose
  - Missing
  - Holes
  - Defective mortar joints
  - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaners

4. Mirrors/fixtures:
   - Mirrors:
     - Missing
     - Cracking or broken
     - Abrasion
     - Deteriorated backing
     - Missing/damaged mounting hardware
   - Fixtures:
     - Missing
     - Loose
     - Inoperative
     - Bent
     - Other damage
5. Corner guards/rub rails:
   - Wood:
     - Missing
     - Loose
     - Cracked
     - Warped
     - Damaged/missing hardware
     - Worn finish
   - Metal:
     - Missing
     - Bent
     - Damaged/missing hardware
     - Worn finish
   - Resilient (vinyl plastic):
     - Curling

  - Loose or adhesive failure
  - Abrasions
  - Indentations
  - Punctures or tears
  - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaner,
  - Evidence of mechanical damage or personal abuse.

Wall Finishes

Checks to make:

1. Maintenance:
   - Painting:
     - Alligatoring
     - Checking
     - Blistering
     - Crawling
     - Cracking
     - Scaling
     - Peeling
     - Wrinkling
     - Flaking
     - Fading
     - Loss of gloss
     - Excessive chalking
     - Mildew
     - Bleeding
     - Staining caused by insect screens or splashing
     - Discoloration
     - Complete absence of paint
     - Paint film is less than 3 mm in thickness on metal surfaces
2. Wall coverings:
   - Resilient covering (linoleum, vinyl plastic):
     - Curling
     - Loose or adhesive failure
     - Abrasions
     - Indentations
     - Punctures or tears
     - Etched, pitted or dull surfaces caused by use of acidulous or abrasive cleaner
     - Evidence of mechanical damage or personal abuse
   - Canvas and paper covering:
     - Breaks
     - Wrinkling
     - Fading
     - Adhesive failure
     - Evidence of mechanical damage or personal abuse.

Structure/Base & Foundation

Base and Sub-base

Base and sub-base are the compacted and prepared layers of gravel and/or soil or that builders place and grade before installing the final surface (see image). Inspection of base and sub-base generally occurs during the inspection of the surface pavement. Geosynthetics (e.g., geotextile, geonets, sheet drains, geogrids, geocells) are plastic or non-woven fabrics, sheets, nets, grids or honeycomb-like mats usually made of polypropylene or polyethylene that can help stabilize the treadway.

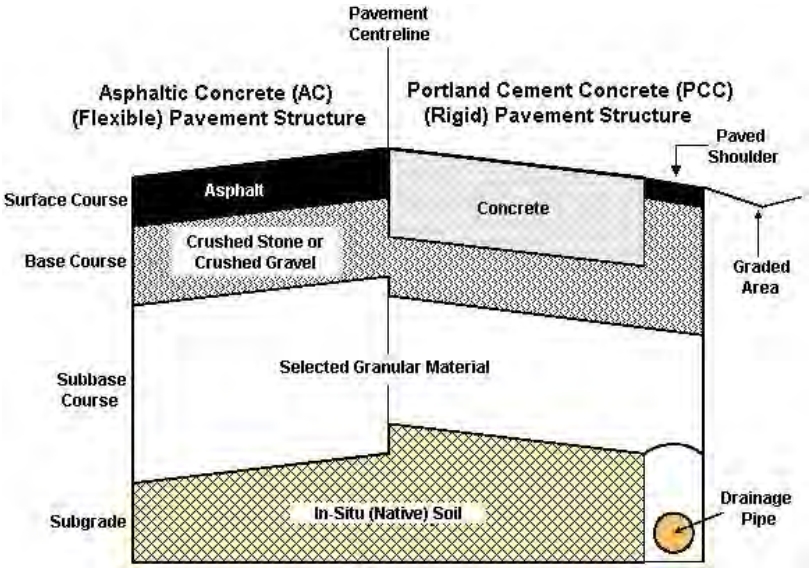

Figure 13. Base and Sub-base

Checks to make:

1. Exposed and/or worn out geosynthetic layer
2. Shoulders:
   - High shoulders (secondary ditches)
3. Standing water:
   - Standing water on the surface that seeps into the subgrade, causing a general softening of the entire path
4. Rutting:
   - Longitudinal depressions in the paths caused by high moisture content in the subsurface soil or base
   - Inadequate surface course thickness
5. Depressions:
   - Localized low areas one or more inches below the surrounding tread surfaces caused by settlement, excessive moisture content or improper drainage.

Structure/Door

Exterior Door

Checks to make:

1. General:
   - Wood and trim:
     - Splitting
     - Rotting
     - Cracking
     - Loose
     - Poor fit
     - Binding
     - Missing
     - Loose or missing caulking
     - Lack of weather tightness
   - Glass:
     - Missing or broken panes
     - Disintegration of putty
   - Trim:
     - Looseness
     - Scratches
     - Indentations
     - Mechanical damage
     - Personal abuse
2. Maintenance:
   - Paint/caulk:
     - Worn/peeling paint
     - Missing/deteriorated caulking
     - Corrosion
     - Abrasion
     - Loss of finish coating
     - Broken seals/weather-stripping
   - Adjust/secure/lubricate:
     - Loose, broken or missing hardware
     - Binding, jamming, poor fit
3. Components/hardware:
   - Loose, missing, broken parts
   - Binding or misalignment
   - Improper installation or adjustment
   - Lack of lubrication
   - Corrosion
   - Abrasion
   - Loss of finish coating
4. Exterior doors and frames:
   - Wood:
     - Splitting
     - Rotting
     - Cracking
     - Loose
     - Poor fit
     - Binding
     - Missing

  - Scratches
  - Indentations
  - Loose/damaged hardware
  - Inoperative hardware
  - Mechanical damage
  - Personal abuse
  - Delimitation
  - Loose or missing caulking
  - Lack of weather tightness
- Metal:
  - Corrosion
  - Warping
  - Binding
  - Poor fit
  - Bent
  - Loose/damaged hardware
  - Mechanical damage
  - Personal abuse
  - Loose/missing caulking
  - Lack of weather tightness
- Fiberglass:
  - Warping
  - Binding
  - Cracked
  - Poor fit
  - Loose/damaged hardware
  - Mechanical damage
  - Personal abuse
  - Loose/missing caulking
  - Lack of weather tightness

5. Access panels/locks:
   - Corrosion
   - Warping
   - Binding
   - Poor fit
   - Bent
   - Loose/damaged hardware
   - Mechanical damage
   - Personal abuse.

Surface

Land Surface

Boat Launches/Ramps

Boat launches/ramps introduce a vessel into the water or for removal. They serve as a landing facility for watercraft vessels and provide access to the water.

Checks to make:

1. Wood:
    - Split, cracked, broken or missing
    - Rot, fungus or decay
    - Parasite damage
    - Defective connectors or anchorage
    - Marine growth
2. Asphalt/concrete/masonry:
    - Cracking, spalling or surface unevenness
    - Displacement of material under ramp surfaces
    - Tread traction
    - Marine growth
    - Potholes or missing pavement
3. Earth:
    - Softening
    - Excessive vegetation
    - Corrugation
    - Depressions and potholes
    - Marine growth
4. Metal:
    - Corrosion
    - Disfigured
    - Marine growth
5. Loose rock:
    - Displaced materials
    - Potholes
    - Unevenness.

Roof Surface

Marina/Waterfront Roofing

Roofing provides shade or weather support on a dock or covers boat slips that contain boat launches.

Checks to make:

1. Roof rafters, joists and sheathing:
    - Splits
    - Broken members
    - Open joints
    - Loose boards
    - Sag of members
    - Displacement of joints
    - Insect damage
2. Trusses – timber:
    - From ground:
        - Twisted and bowed members
        - Excessive number and size of knots
        - Slope of grain over 1" in 10'

  - Checks and splits in ends of web members
  - Separation or slippage at joints
  - Sag
  - Overloading
- From truss:
  - Loose bolts, split rings, shear plates and fastening devises
  - Checks and splits in bracing, chord members, splice plates (scabs), web members and filler blocks
  - Missing filling blocks
  - Looseness of tie rods

3. Steel splice plates:
   - Rupture
   - Shearing
   - Crushing
   - Rust.

Traffic Surface

This material lies atop the base layer and provides the driving surface.

Figure 14. Paved Road

Paved and Unpaved Surfaces

A road may have several (possibly different) layers of surfacing. The top or exposed layer is sometimes called the “wearing surface.” Paved road surfaces use different materials, but the two most common are asphalt concrete and Portland cement concrete.

Asphalt concrete, or simply asphalt, is a composite material commonly used to construct pavement, highways and parking lots. It consists of asphalt binder and mineral aggregate mixed together, laid down in layers and compacted. Asphalt concrete pavement is a “flexible” pavement surface because of its ability to deform slightly to adjust to ground settlement or other movements. For NPS purposes, the road surface designation of “asphalt” also includes chip seal, slurry seal, fog seal and other non-structural coatings over the underlying asphalt concrete (or Portland cement concrete) surface.

A concrete surface is of Portland cement concrete, sometimes with embedded iron reinforcement bars. Concrete is a “rigid” surface since it does not deform with the movement of the underlying base and sub base.

Other possible surface types include brick or stone pavers (interlocking masonry blocks that form the wearing surface) and cobblestone (small one- to two-inch stones in a sand, asphalt or concrete matrix to form the wearing surface). NPS considers surfaces of crushed aggregate (gravel, without asphalt), native soil, pit run gravel or sand to be unpaved surfaces.

The NPS has an ongoing arrangement with the Federal Highway Administration (FHWA) to regularly inspect the paved surfaces of park roads. FHWA does not inspect some roads, however, and NPS manually rates those roads. For these few cases, the NPS can use the following guidance for its inspections.

Checks to make:

1. Asphalt surfaces:
   - Alligator, longitudinal or transverse cracking
   - Potholes or patches (bowl-shaped holes in the pavement surface)
   - Patch deterioration
   - Rutting (surface depressions in the wheel paths)
   - Bleeding (shiny, black surface film of asphalt on the road surface)
   - Block cracking
   - Corrugation
   - Polished aggregate:
     - Smooth surfaces
   - Pumping and water bleeding (water forced through cracks in the surface)
   - Raveling and weathering:
     - Aggregate or binder wear or pitting
   - Edge cracking
   - Buckling
2. Cement and concrete slab:
   - Buckling, corner breakage, cracking or spalling or depressions
   - Durability cracking (closely spaced fine cracks or spalling)
   - Faulting of transverse joints and cracks with a difference in elevation per each slab greater than 3/8"
   - Joint seal damage:
     - Loose or extruded joint material
     - Plant growth
     - Hardening of seal material
     - Absence of joint seal
     - Lack of cohesive bond between seal and slab sides or presence of foreign material
   - Longitudinal cracking (cracks which are parallel to the pavement centerline or asphalt lay-down direction)
   - Patch deterioration
   - Scaling and pop-outs, including loss of mortar, exposed aggregate or exposed reinforcing bars
   - Pumping and water bleeding (water forced through cracks in surface)
   - Swelling
   - Polished aggregate:
     - Smooth surfaces
   - Punch outs
   - Shrinkage cracking or raveling
3. Unpaved surfaces:
   - Improper cross sections, ponding or severe depressions
   - Road width, either too narrow or too wide
   - Inadequate drainage
   - Corrugation, causing vehicle vibration
   - Excessive dust
   - Minor surface hazards (exposed roots and loose rocks)
   - Gullies, berms, sloughing
   - Washed-out/eroded (from heavy use or improper drainage) road sections.

Road Shoulder

This component includes any section of road surface outside of the traffic lanes. Shoulders may be sealed or unsealed depending on the location. Inspectors should treat sealed shoulders in the same manner as a sealed pavement.

Checks to make:

1. Concrete surfaces:
   - Erosion, scouring, voids or undermining of surface
   - Staining of concrete surface with signs of efflorescence deposit, spalling of cracks or exposed reinforcing bars
   - Scaling and pop outs, including loss of mortar:
     - Exposed aggregate
     - Exposed reinforcing bars
2. Paved surfaces:
   - Alligator, longitudinal or transverse cracking
   - Potholes or patches (bowl-shaped holes in the pavement surface)
   - Rutting (surface depressions in the wheel paths)
3. Unpaved surfaces:
   - Standing water on the roadway surface which seeps into the subgrade, causing a general softening of the entire roadway
   - Excessive vegetation impeding water runoff
   - Rutting (longitudinal depressions in the wheel paths)
   - Corrugating (“washboarding”) (a series of ridges and depressions across a road surface)
   - Depressions (localized low areas one or more inches below the surrounding road surfaces
   - Potholes
   - Grooving and shoving.

Turfgrass/Pasture Crop

Checks to make:

- Turf thin/spotty/poorly established
- Improper mowing or mowing damage
- Inadequate drainage/excessive water
- Turf species improper
- Thatch layer excessive
- Turf wilted/stressed
- Presence of holes, burrows, ruts or depressions
- Edge poorly defined
- Debris/organic matter on surfaces
- Insect/disease/pest problems
- Vandalized
- Inadequate or lack of irrigation
- Weed/exotic species problems.

Water Control

Shore Protection: Coastal/Shoreline Protection System

A coastal/shoreline protection system protects marinas, vessels and the shoreline from the effects of waves and wake action. These systems may include breakwaters, bulkheads, groins, jetties, quay walls, seawalls or wave attenuators.

Breakwaters

Structures located outside of a harbor or coastline to protect the inner water and shoreline from the effect of heavy seas. These barriers help ensure safe mooring and loading or unloading of vessels within the harbor. Their composition can include tires, rip rap, rubble, concrete or other materials. The NPS does not consider tires an environmental hazard, but if concerns arise over their use, consult with the environmental program.

Checks to make:

- Concrete:
  - Cracking, spalling, scaling
  - Reinforcing steel corrosion, hardware pop-outs, corrosion or misalignment
  - Loss of flotation
  - Defective connections
  - Separation of components
  - Loss of integrity (e.g., breached or sections missing)
- Metal/sheet steel:
  - Missing members
  - Corrosion, cracking or buckling
  - Defective connections or anchorage
  - Deteriorated protective covering
  - Misalignment
  - Loss of flotation
  - Structural damage by impact or other means
  - Defective connections
  - Loss of integrity (e.g., breached or sections missing)
- Masonry/stone:
  - Displacement
  - Missing mortar
  - Spalling missing stones
  - Loss of flotation
  - Loss of integrity (e.g., breached or sections missing)
- Tires:
  - Displacement of materials
  - Corrosion of connectors
  - Cable wear
  - Loss of flotation
  - Loss of integrity (e.g., breached or sections missing)
- Rip rap:
  - Displacement of materials
  - Loss of integrity (e.g., breached or sections missing).

Bulkheads

Bulkheads are wall-like constructions that protect the shoreline and prevent erosion. These can be of concrete, timber, steel or reinforced concrete.

Checks to make:

- Concrete/reinforced concrete:
  - Cracking, spalling, scaling
  - Reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connections
  - Separation of components
- Wood:
  - Missing, broken or split piles or pile caps
  - Deep abrasions or excessive wear
  - Insect rot, fungus or decay
  - Parasite damage
  - Misalignment
  - Surface deterioration
  - Defective connections
  - Unevenness between decking sections
- Metal/sheet:
  - Missing members
  - Corrosion, cracking or buckling
  - Defective connections or anchorage
  - Deteriorated protective covering
  - Misalignment
  - Structural damage by impact or other means
  - Defective connections
  - Unevenness between decking sections.

Groins

Groins minimize the rate of erosion by influencing offshore currents and waves. Groins project outward perpendicular to the shoreline and are typically constructed of large rocks, pre-cast concrete units, or reinforced or pre-stressed concrete piles or timber cribbing filled with rock.

Checks to make:

- Concrete:
  - Cracking, spalling, scaling
  - Reinforcing steel corrosion, hardware pop-outs, corrosion or misalignment
  - Loss of flotation
  - Defective connections
  - Separation of components
  - Loss of integrity (e.g., breached or sections missing)
- Masonry/stone/rip rap:
  - Displacement
  - Missing mortar
  - Spalling missing stones

  - Loss of flotation
  - Loss of integrity (e.g., breached or sections missing).

Jetties

Jetties are structures, such as a rubble mound or wall, at or near the entrance of a harbor or a river, that direct and confine the flow of water to prevent sandbars.

Checks to make:

- Rip rap/rubble:
  - Displacement of materials
  - Loss of integrity

Quay Walls

Quay walls are heavy gravity platform structures fronting navigable water, parallel to the shore. A quay wall acts as a bulkhead to support an embankment or provides a berthing area for vessels.

Checks to make:

- Wood:
  - Missing, broken or split piles or pile caps
  - Deep abrasions or excessive wear
  - Insect rot, fungus or decay
  - Parasite damage
  - Misalignment
  - Surface deterioration
  - Defective connections
  - Unevenness between decking sections
- Concrete:
  - Missing, damaged, fractured or loose piles, pile caps or members
  - Cracking, spalling or scaling
  - Reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connections
  - Separation of components
- Metal/sheet steel:
  - Missing members
  - Corrosion, cracking or buckling
  - Defective connections or anchorage
  - Deteriorated protective covering
  - Misalignment
  - Structural damage by impact or other means
  - Defective connections
  - Unevenness between decking sections
- Masonry/stone:
  - Displacement
  - Missing mortar
  - Spalling missing stones.

Seawalls

Seawalls are coastal defense structures built along, and parallel to, the shoreline that protect against erosion from wave action or flooding from heavy waves. Seawalls are constructed of rubble mound, reinforced concrete, steel or concrete piles driven into the ground.

Checks to make:

- Wood:
  - Missing, broken or split piles or pile caps
  - Deep abrasions or excessive wear
  - Insect, rot, fungus or decay
  - Parasite damage
  - Misalignment
  - Surface deterioration
  - Undermining or blowing out
  - Defective connections
- Concrete:
  - Missing, damaged, fractured or loose piles, pile caps or members
  - Cracking, spalling or scaling
  - Undermining or blowing out
  - Reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connections
  - Separation of components
- Metal/sheet steel:
  - Missing steel members
  - Corrosion, cracking or buckling
  - Defective connections or anchorage
  - Deteriorated protective covering
  - Undermining or blowing out
  - Misalignment
  - Structural damage by impact or other means
  - Defective connections
- Masonry/stone:
  - Displacement
  - Missing mortar
  - Spalling
  - Undermining or blowing out
  - Missing stones.

Floodwalls

Floodwalls are vertical barriers to temporarily contain the waters of a river or other waterway during any rise to unusual levels, such as seasonal or extreme weather events. Locations where space is scarce typically use floodwalls, such as cities or where building levees or dikes would interfere with other interests (e.g., existing buildings or historical architecture).

Checks to make:

- Wood:

  - Missing, broken or split piles or pile caps
  - Deep abrasions or excessive wear
  - Insect rot, fungus or decay
  - Parasite damage
  - Misalignment
  - Surface deterioration
  - Undermining or blowing out
  - Defective connections
- Concrete:
  - Missing, damaged, fractured or loose piles, pile caps or members
  - Cracking, spalling or scaling
  - Undermining or blowing out
  - Reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connections
  - Separation of components
- Metal/sheet steel:
  - Missing steel members
  - Corrosion, cracking or buckling
  - Defective connections or anchorage
  - Deteriorated protective covering
  - Undermining or blowing out
  - Misalignment
  - Structural damage by impact or other means
  - Defective connections
- Masonry/stone:
  - Displacement
  - Missing mortar
  - Spalling
  - Undermining or blowing out
  - Missing stones.

Wave Attenuators

Wave attenuators are underwater structures of concrete, aluminum or other material that help to dissipate the energy of wave action to protect the marina. Wave attenuators may also be boards attached to the outermost docks to protect the inner portion of the marina.

Checks to make:

- Wood:
  - Deep abrasions or excessive wear
  - Insect rot, fungus or decay
  - Parasite damage
  - Misalignment
  - Surface deterioration
  - Undermining or blowing out
  - Defective connections
- Concrete:
  - Missing, damaged, fractured or loose piles, pile caps or members
  - Cracking, spalling or scaling

  - Undermining or blowing out
  - Reinforcing steel corrosion, hardware pop-outs or misalignment
  - Erosion or displacement of material from behind bulkheads
  - Defective connections
  - Separation of components
- Metal/sheet steel:
  - Missing members
  - Corrosion, cracking or buckling
  - Defective connections or anchorage
  - Deteriorated protective covering
  - Undermining or blowing out
  - Misalignment
  - Structural damage by impact or other means
  - Defective connections
- Masonry/stone:
  - Displacement
  - Missing mortar
  - Spalling
  - Undermining or blowing out
  - Missing stones.

Resources

Name	Work Group/ Company Name	E-mail Address	Date Added
Maria Davis	KEFJ	Maria_Davis@nps.gov	8/22/2012
Ron Giblin	KALA	Ron_Giblin@nps.gov	8/22/2012
Deb Harvey	Commercial Services	Deborah_Harvey@nps.gov	8/22/2012

Related Documents

- Marina and Waterfront Asset Business Practice
- Critical Systems List
- Life-Cycle Estimates.

Appendix A Change Log

Inspection Guidance Title:	Marina and Waterfront System (6300) Asset Inspection Guidance
Responsible Group:	Comprehensive Asset Strategic Tools (CASTL) Development Group
Title of Inspection Guidance Origin White Paper:	N/A
Last Change Made On:	April 19, 2017

#	Page #	Change Description	Reason for Change	Requested By	Requested On	Change Made On	Approved By	Approved On
1.0	N/A	Initial Release	Initial Release	N/A	N/A	N/A	Mike Seibert	4/19/2017

National Park Service
U.S. Department of the Interior

1201 Eye Street, NW, 10th Floor
Washington, DC 20005

Inspection Guidance: 7100 Monuments and Memorials

Version 2.0

Effective Date: June 2, 2014

End Date: Until Amended or Rescinded

SRS Code: 4.B.1

Table of Contents

Introduction **3**
Common Components and Critical Systems **4**
Comprehensive Condition Assessments **4**
Safety 4
Tips for Inspections 5
Component Inspection Guidance 6
Barrier and Fencing 6
Fence/Gate 6
Electrical 10
Lighting 10
Exhibit/Sculpture 10
Fountain/Pool 10
Sculpture 13
Sculpture Base 18
Sculpture Finish 18
Sculpture Lettering 19
Structure 20
Wall 20
Structure/Access 23
Stairs 23
Structure/Base & Foundation 24
Foundation 24
Structure/Door 25
Exterior Door 25
Structure/Window 26
Exterior Window 26
Surface 26
Roof Surface 26
Traffic Surface 29
Surface/Finish 32
Exterior Finish 32
Water Control 33
Drain 33
Resources **34**

References.....34

Related Documents.....34

Appendix A **Inspection Guidance Change Log** A-1

Introduction

This document contains the inspection guidance for monuments and memorials. The critical components associated with the monument or memorial will be inspected using the guidelines found in this document. Other asset types can be collocated with monuments and memorials, however. Where this exists, these components should be inspected using the guidelines for that asset type.

Monument or memorial condition assessments should include a complete visual inspection of all constructed architectural, civil/structural and mechanical components. The field inspection should be performed using both a system and component inspection method to identify all maintenance and repair deficiencies that need correction. In other words, the inspector should determine if there is sufficient evidence to warrant complete replacement of a system versus repairing only specific components of the system. Decisions to repair or replace a component or system monument or memorial should be made in conjunction with a cultural resource professional, as discussed below.

A systematic approach to visual inspections must be employed to document all problems with a given monument or memorial. Some deficiencies are easily identifiable, such as leaning sculptures or inadequate drainage and standing water. However, many deficiencies are more subtle and will require further examination to identify. Using a systematic approach reduces the likelihood that deficiencies will be missed.

During the inspection, the inspector should thoroughly document the information that will be needed in the preparation of cost estimates and inspection reports. At a minimum, the following should be recorded for each deficiency:

- The deficiency should be defined (e.g., missing mortar, cracked granite, illegible inscription)
- The corrective action should be specified with the appropriate verb (e.g. build/add, repair, replace, realign, adjust, relocate, remove, reopen, maintain, monitor)
- Location data should be provided (at a minimum, two or three photographs of each deficiency establishing the problem and where it is in the context of the monument or memorial should be included in the final inspection report. This visual information will be key to help document the problem and determine if it is becoming worse over time)
- Data should be quantified in sufficient detail to facilitate preparation of class C cost estimates and include necessary labor, equipment and materials (e.g., 100 square feet of granite needs cleaning and repointing, three benches need replacement)
- The relative priority of the deficiency should be identified as high, medium or low
- Additional comments or notes should be provided that will help to define the project needs or special circumstances to consider.

To complete an assessment of a monument or memorial successfully, the maintenance staff should include cultural resources or conservation staff in the inspection and identification of corrections or deficiencies. In many cases, maintenance staff might also want to refer to relevant park planning documents outlining management goals and

objectives, such as General Management Plans, Cultural Landscape Reports, Cultural Landscape Inventories and Historic Structure Reports.

While this document lays out universal inspection guidance, it does not establish one standard for all monuments and memorials. Monuments and memorials are constructed and maintained to different standards, as defined by the park unit's management plan. These park-level standards must be considered when completing monument and memorial assessments and should guide the corrective action (and cost estimates) to address identified deficiencies.

Common Components and Critical Systems

Table 1 lists classifications commonly used for the monument and memorial asset category. Any classification in the FMSS can be used to categorize components of a monument or memorial, but Table 1 contains those most commonly used.

Table 1. Monument and Memorial Common Component List

Top-Level Classification	Classification	Critical System
Barrier/	Fence/Gate	No
Electrical/	Lighting	No
Exhibit/Sculpture/	Fountain/Pool	No
Exhibit/Sculpture/	Sculpture	Yes
Exhibit/Sculpture/	Sculpture Base	Yes
Exhibit/Sculpture/	Sculpture Finish	Yes
Exhibit/Sculpture/	Sculpture Lettering	Yes
Structure/	Wall	Yes
Structure/Access/	Stairs	No
Structure/Base & Foundation/	Foundation	Yes
Structure/Door/	Exterior Door	Yes
Structure/Window/	Exterior Window	Yes
Surface/	Roof Surface	Yes
Surface/	Traffic Surface	No
Surface/Finish/	Exterior Finish	Yes
Water Control/	Drain	Yes

Comprehensive Condition Assessments

Safety

All inspections should be conducted in accordance with guidance found in the National Park Service (NPS) Reference Manual 50B and related federal, state and local safety and health standards. Examples include:

- Occupational Safety & Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910
- OSHA 29 CFR 1926
- National Fire Protection Association (NFPA) Life Safety Code
- NFPA 70E: Standard for Electrical Safety in the Workplace
- U.S. Environmental Protection Agency 40 CFR.

In addition, inspectors should request current copies of all operating unit safety plans applicable to monuments and memorials before conducting the inspection. This will ensure that operating unit as well as required regulatory elements are taken into account.

Tips for Inspections

Parks should determine whether they have the expertise to conduct monuments and memorials inspections. Some components of a monument or memorial can be complex and may require a higher level of knowledge to complete an adequate inspection. Parks can contract with base funds or request project funding to have these assets inspected by an outside vendor if in-house knowledge or ability is not available. Otherwise, park staff can inspect monuments and memorials.

Inspections shall be coordinated with all park groups (e.g., cultural resources, natural resources) that have jurisdiction of the systems to be inspected. A planning meeting with facility personnel, systems users and managers should be held prior to starting field work. The maintenance history can be discussed to point out problematic components. It is also important to verify the latest set of drawings or system documentation.

Comprehensive inspections may require specialized equipment, such as lifts, to be able to fully inspect the monument and memorial. All inspectors should be aware of safety concerns and protocols regarding the area they are working in and any equipment that might be necessary. All inspectors should be trained in fall protection and authorized to use a lift, if needed. Inspectors may also need confined space training.

It is recommended that the park review all relevant inventory documents and the results of the most recent inspection before performing the condition assessment. Doing so will help familiarize the inspectors with the inventory and allow them to note previously reported deficiencies.

Below is a short list of items that may be useful during a field inspection:

- Fully charged GPS unit for collecting point and line data
- Digital camera with a fully charged battery and spares
- Sufficient storage space on the GPS unit and camera memory cards
- Paper maps, paper and a pencil/pen for field notes
- Compass
- Measuring tape and/or measuring wheel:
    - Hand tape measure, 10 foot–25 foot
    - Reel tape measure, 50 foot–100 foot
- Previous inspection information or a list of current work orders for that monument or memorial
- Necessary field gear (appropriate footwear, sun protection, clothing and rehydration equipment)
- Gloves
- Flashlight
- Magnifying glass
- Eye protection
- Communication device (e.g., cell phone, radio).

Component Inspection Guidance

Barrier and Fencing

Fence/Gate

A fence consists of a line of posts secured to the ground and connected with railings, pickets, planks, braces and other fence members secured in place. Posts out of plumb may be checked by eyesight, string line or transit. Fencing and gates commonly found on monuments and memorials include those made of wood, metal, concrete and masonry/stone.

Gates are closable openings in a fence that permit people, animals and/or vehicles to move from one side of the fence to the other. Wood gates are constructed with wood rails, pickets, planks, braces and other members securely fastened into a single unit. Metal gates are fabricated with pipe/tube framing covered with metal chain link or other woven wire mesh, preformed panel or metal laced fabric and kept in shape with wires, rods or turn buckles.

Security components such as barbed, razor or concertina wire may be installed at the top of a fence or attached either directly to the posts or on a metal angle bracket attached to the top of the posts.

Checks to be made:

1. Fence panels and railings (wood):
    - Splits/cracking/broken:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Physically damaged and broken
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes less than 1/8" diameter, surface sag and frass observed
        - Large holes greater than 1/8" diameter, surface channels, punctures and crushing
    - Out of plumb more than 3" in 8'
    - Erosion/vegetation:
        - Soil erosion under fence wall
        - Vines, trees or shrubs climbing over or growing into fence
2. Fence panels (metal):
    - Fence fabric
        - Defective
        - Loose or sagging greater than 2" in diameter
        - Damaged or missing
    - Defective, loose, damaged or missing
    - Loose connections/anchorage:

    - Loose bolts or wire fasteners
    - Loose or bent pipe posts or railing
    - Missing or broken components
- Out of plumb more than 3" in 8'
- Corrosion:
    - Missing protective coating-galvanizing/paint, no pitting evident
    - Corrosion evidenced by pitting or blistering
    - Rust/corrosion evidenced by loss of base metal
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or around posts

3. Fence panels (concrete):
- Cracking:
    - Hairline cracks to 1/16" wide
    - Wide cracks more than 1/16" wide
    - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
- Spalling:
    - Less than 1" deep or 6" in diameter
    - More than 1"in depth or greater than 6” in diameter or loss of more than 10 percent of surface area of a member
    - Disintegration of surface area, with corrosion of exposed reinforcing steel
- Scaling:
    - Loss of surface up to 1/2" deep, with exposure of coarse aggregates
    - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
    - Loss of surface exceeds 1" reinforcing steel usually exposed
- Reinforcing steel corrosion:
    - Rusting/discoloration evident
    - Cracks occurring parallel to reinforcement
- Out of plumb more than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or around posts

4. Fence panels (masonry/stone):
- Deteriorated mortar joint material:
    - Cracked mortar joint material
    - Loose/missing mortar joint material
    - Eroded mortar greater than 1/2" deep
- Damaged bricks, stones or concrete masonry unit (CMU):
    - Cracked, split, damaged
    - Loose, missing
- Out of plumb more than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or around posts

5. Fence posts (wood):
- Splits/cracking/broken:
    - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected

    - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
    - Physically damaged and broken
- Rot, fungus or decay:
    - Moist stained area
    - Discolored, soft or crushed area
- Parasite damage:
    - Holes less than 1/8" diameter, surface sag and frass observed
    - Large holes greater than 1/8" diameter, surface channels, punctures and crushing
- Out of plumb more than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or around posts

6. Fence posts (metal):
- Loose connections/anchorage:
    - Loose bolts or wire fasteners
    - Loose or bent pipe posts or railing
    - Missing or broken components
- Out of plumb more than 3" in 8'
- Corrosion:
    - Missing protective coating-galvanizing/paint, no pitting evident
    - Corrosion evidenced by pitting or blistering
    - Rust/corrosion evidenced by loss of base metal
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or around posts

7. Fence posts (concrete):
- Cracking:
    - Hairline cracks to 1/16" wide
    - Wide cracks more than 1/16" wide
    - Disintegration of concrete surfaces, with loss of surface exceeding depth of 2"
- Spalling:
    - Less than 1" deep or 6" in diameter
    - More than 1” in depth or greater than 6" in diameter or loss of more than 10 percent of surface area of a member
    - Disintegration of surface area, with corrosion of exposed reinforcing steel
- Scaling:
    - Loss of surface up to 1/2" deep, with exposure of coarse aggregates
    - Loss of surface from 1/2" to 1" deep with coarse aggregates clearly exposed
    - Loss of surface exceeds 1", reinforcing steel usually exposed
- Reinforcing steel corrosion:
    - Rusting/discoloration evident
    - Cracks occurring parallel to reinforcement
- Out of plumb more than 3" in 8'
- Erosion/vegetation:
    - Soil erosion around posts
    - Vines, trees or shrubs climbing over or around posts

8. Fence posts (masonry/stone):
    - Deteriorated mortar joint material:
        - Cracked mortar joint material
        - Loose/missing mortar joint material
    - Out of plumb more than 3" in 8'
    - Damaged bricks, stones or CMU:
        - Cracked, split, damaged
        - Loose, missing
    - Erosion/vegetation:
        - Soil erosion around piers
        - Vines, trees or shrubs climbing over or around piers
9. Gates (wood):
    - Defective gate:
        - Surface fibers separated, extending over entire member, less than 25 percent of thickness affected
        - Surface fibers separated, extending over entire member, greater than 25 percent of thickness affected
        - Damaged or missing wood sections
    - Rot, fungus or decay:
        - Moist stained area
        - Discolored, soft or crushed area
    - Parasite damage:
        - Holes less than 1/8" diameter, surface sag and frass observed
        - Large holes greater than 1/8” diameter, surface channels, punctures and crushing
    - Out of plumb more than 3" in 6'
    - Connections:
        - Loose wood at connection site
        - Broken, split or damaged wood at connection site
    - Missing fasteners or anchorage
10. Gates (metal):
    - Defective gate fabric:
        - Loose or sagging gate fabric
        - Damaged or missing gate fabric
    - Defective gate panels:
        - Loose gate panels
        - Damaged or missing gate panels
    - Loose connections:
        - Loose bolts or wire fasteners
        - Loose or bent pipe post/bracing
        - Missing or broken hinges, latches or other components
    - Out of plumb more than 1/2" in 6'
    - Corrosion:
        - Missing protective coating-galvanizing/paint, no pitting evident
        - Corrosion evidenced by pitting or blistering
        - Corrosion evidenced by loss of base metal
11. Security wires:
    - Loose, broken or missing brackets or bolts

- Loose, defective, sagging, broken or missing wire
- Corroded wire:
    - Missing protective coating-galvanizing/paint, no pitting evident
    - Corrosion evidenced by pitting or blistering
    - Rust/corrosion evidenced by loss of base metal
- Corroded brackets:
    - Missing protective coating-galvanizing/paint, no pitting evident
    - Corrosion evidenced by pitting or blistering
    - Rust/corrosion evidenced by loss of base metal.

Electrical

Lighting

Exterior Lighting Fixtures and Controls

Checks to be made:

1. Lighting fixtures:
    - Inadequately supported, insecure and improperly located; evidence of unauthorized removal and relocation
    - Incorrect types installed in hazardous locations, change in facility class requires replacement
    - Cracked or broken luminaries and fixture parts, missing pieces
    - Indications of objects being supported from, hung on or stored in fixtures
    - Evidence of overheating, undersized or other damage to sockets; exposed or damaged connecting wiring
    - Graffiti/vandalism
    - Corrosion
2. Lamps:
    - Oversized, blistering, loose base; thermal cracks from contact with fixture; bare lamps in hazardous locations; poor socket lamp connections and proper types for special applications
    - Operation of fluorescent fixtures shows poor burning and starting characteristics and loud humming ballasts
    - Graffiti/ vandalism
    - Corrosion
3. Lighting voltage:
    - Unauthorized connections of other electrical equipment on lighting circuits
    - Interference with branch circuits for power and lighting from motor starting or stopping, such as excessive light flicker
4. Illumination levels:
    - Proper illumination levels and ambient conditions, such as dirty walls and surfaces.

Exhibit/Sculpture

Fountain/Pool

Figure 1. Fountain with Pool

Pools and decorative fountains may be locations or assets of a monument or memorial.

Checks to be made:

1. Fountain mechanical components:
    - Anemometer not functioning (display pools)
    - Timer not functioning
    - Cracked lute
    - Backflow protection nonfunctional (Reduced Pressure Zone Device [RPZ], double-check valve, etc.)
    - Backflow valve test tag out of date
    - Clogged filter(s)
    - Leaking, cracked, deteriorated hoses
    - Leaking connections
    - Gaskets visible at joints (future failure)
    - Loose, rusted or broken hose clamps
    - Poor air circulation in utility (pump room)
    - Space or air vent not functional
    - Pump strainer(s) bent/clogged
    - Suction covers missing/broken/misshapen
    - Utility vault sump pump nonfunctional
    - High water alarm nonfunctional
    - Control panel not working properly
2. Fountain pad:
    - Damaged/deteriorated surface
    - Cracking
    - Missing components
    - Evidence of moisture intrusion
    - Spalling or broken areas
    - Exposed reinforcing
    - Vandalized and/or presence of graffiti
    - Out of plumb, uplifted or settled
    - Undermined/eroded
3. Fountain aesthetic components*:*
    - Uneven/excessive fountain structure settlement
    - Coping stones loose
    - Missing caulking
    - Cracked, dented or leaking fountain pool
    - Deteriorated/missing sealant (grout, caulk, etc.)
    - Damaged ornamentation
4. Fountain interior components:
    - Fountain interior cracked/damaged
    - Damaged sidewalls (concrete, tile)
    - Clogged drain inlets
    - Poor drainage
    - Collapsing, leaning, bulging of wall
    - Peeled, cracked or damaged surface treatments

5. Fountain water flow components:
    - Poor water circulation
    - Low water level and/or insufficient water supply
    - Auto-fill not working
    - Blocked inlet openings
    - Low/high fountain pressure (debris in feed lines)
    - Chemically contaminated water
    - Sand filters not functioning
    - Backwash not working
    - Leaking supply/suction piping or pump(s)
    - Non-operating or noisy pump(s)/motors
    - Blocked or damaged fountain spouts/nozzles
    - Nozzles out of adjustment
    - Operational non-Ground Fault Interrupt (GFI) electrical outlets
6. Pool mechanical components:
    - Anemometer not functioning (display pools)
    - Timer not functioning
    - Cracked lute
    - Backflow protection nonfunctional (RPZ, double check valve, etc.)
    - Backflow valve test tag out of date
    - Clogged filter(s)
    - Leaking, cracked, deteriorated hoses
    - Leaking connections
    - Gaskets visible at joints (future failure)
    - Loose, rusted or broken hose clamps
    - Poor air circulation in utility (pump room) space or air vent not functional
    - Pump strainer(s) bent/clogged
    - Suction covers missing/broken/misshapen
    - Utility vault sump pump nonfunctional
    - High water alarm nonfunctional
    - Control panel not working properly
7. Pool aesthetic components:
    - Uneven/excessive pool structure settlement
    - Coping stones loose, missing caulking
    - Cracked, dented or leaking fountain pool
    - Deteriorated/missing sealant (grout, caulk, etc.)
    - Debris or soil buildup in pool
    - Excessive vegetation growth in pool (algae, weeds, etc.)
    - Damaged ornamentation
    - Pool sign missing (no wading, swimming, skateboarding, etc.)
8. Pool interior components:
    - Loose or torn, cracked/damaged, discolored pool liner
    - Damaged sidewalls (concrete, tile)
    - Clogged drain inlets
    - Poor drainage
    - Collapsing, leaning, bulging of wall

- Peeled, cracked or damaged surface treatments

9. Pool water flow components:
    - Poor water circulation
    - Low water level and/or insufficient water supply
    - Auto-fill not working
    - Blocked inlet openings
    - Chemically contaminated water
    - Sand filters not functioning
    - Backwash not working
    - Leaking supply/suction piping or pump(s)
    - Non-operating or noisy pump(s)/motors
    - Nozzles out of adjustment
    - Operational non-GFI electrical outlets.

Sculpture

This guidance applies to decorative columns as well as sculptures. For additional guidance for column inspection, refer to the Exterior Finish section (see page 35).

Checks to be made:

1. Materials:
    - Adobe (rare in monuments and memorials):
        - Erosion
        - Detachment
        - Delamination
        - Crumbling
        - Cracking
        - Coving
        - Chipping
        - Pitting
        - Spalling or broken areas
        - Biological growth
        - Soiling
        - Staining
        - Vegetative growth
        - Graffiti/vandalism
    - Aluminum:
        - Dented surface
        - Cracking
        - Pinholes
        - Corrosion
        - Exposed or deteriorated reinforcing
        - Out of plumb
        - Scratched surfaces
        - Graffiti/vandalism
        - Broken/missing elements
        - Deteriorated welding
        - Deteriorated finish—paint or lacquer
        - Staining

    - Biological growth
    - Failing attachments/anchor points/joints
- Brass:
    - Dented surface
    - Cracking
    - Pinholes
    - Corrosion
    - Exposed or deteriorated reinforcing
    - Out of plumb
    - Scratched surfaces
    - Graffiti/vandalism
    - Broken/missing elements
    - Deteriorated brazing
    - Deteriorated finish—wax or lacquer
    - Staining
    - Biological growth
    - Failing attachments/anchor points/joints
- Bronze:
    - Dented surface
    - Cracking
    - Pinholes
    - Corrosion/patina
    - Removal of patina
    - Exposed or deteriorated reinforcing
    - Out of plumb
    - Scratched surfaces
    - Graffiti/vandalism
    - Broken/missing elements
    - Deteriorated brazing
    - Deteriorated finish—wax or lacquer
    - Staining
    - Biological growth
    - Failing attachments/anchor points/joints
- Concrete:
    - Crazing
    - Cracking
    - Missing elements
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Vegetative growth
    - Soiling
    - Staining

    - Chipping
- Copper:
    - Dented surface
    - Cracking
    - Pinholes
    - Corrosion/patina
    - Exposed or deteriorated reinforcing
    - Out of plumb
    - Scratched surfaces
    - Graffiti/vandalism
    - Broken/missing elements
    - Deteriorated brazing
    - Deteriorated finish—wax or lacquer
    - Staining
    - Biological growth
    - Failing attachments/anchor points/joints
- Granite:
    - Cracking
    - Missing elements
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Iron:
    - Dented surface
    - Cracking
    - Pinholes
    - Corrosion
    - Exposed or deteriorated reinforcing
    - Out of plumb
    - Scratched surfaces
    - Graffiti/vandalism
    - Broken/missing elements
    - Deteriorated welding
    - Deteriorated finish—wax, paint or lacquer
    - Biological growth
    - Failing attachments/anchor points/joints
- Limestone:
    - Cracking
    - Missing elements

    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Marble:
    - Cracking
    - Missing elements
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Sandstone:
    - Erosion
    - Detachment
    - Delamination
    - Crumbling
    - Cracking
    - Chipping
    - Pitting
    - Missing elements
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining

    - Chipping
    - Vegetative growth
- Stainless steel:
    - Dented surface
    - Cracking
    - Pinholes
    - Corrosion
    - Exposed or deteriorated reinforcing
    - Out of plumb
    - Scratched surfaces
    - Graffiti/vandalism
    - Broken/missing elements
    - Deteriorated welding
    - Deteriorated finish—paint or lacquer
    - Staining
    - Biological growth
    - Vegetative growth
    - Failing attachments/anchor points/joints
- Terra cotta:
    - Detachment
    - Delamination
    - Crazing
    - Cracking
    - Chipping
    - Spalling
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
    - Graffiti/vandalism.

Headstone/Markers

Checks to be made:

1. Headstone/markers:
    - Deteriorated surface
    - Cracking
    - Missing pieces
    - Evidence of moisture intrusion
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Eroded or sandy mortar joints
    - Mortar cracking
    - Soft or spalling surfaces
    - Scratched surfaces.

Interpretive Displays

Checks to be made:

1. Paintings and tapestries:
    - Deterioration
    - Discoloration
2. Displays:
    - Deterioration
    - Discoloration
    - Information is inaccurate/dated
    - Corrosion evident pitting and blistering of base material
    - Corrosion evident with loss to base section.

Sculpture Base

Checks to be made:

1. Stone bases (granite, marble, limestone, concrete, brick and tile):
    - Deteriorated surface
    - Cracking
    - Missing pieces of sculpture
    - Evidence of moisture intrusion
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints (eroded/sandy/cracked/missing)
    - Soft or spalling surfaces
    - Scratched surfaces
2. Metal bases (bronze, aluminum, steel, cast/wrought iron):
    - Deteriorated surface
    - Cracking
    - Evidence of moisture intrusion
    - Rust/tarnish/corrosion
    - Exposed reinforcing
    - Out of plumb
    - Scratched surfaces
3. Glass bases:
    - Broken or missing panes of glass
    - Scratched surfaces.

Sculpture Finish

Checks to be made:

1. Patina:
    - Eroding cover
    - Missing cover
2. Gold Leaf:
    - Eroding cover
    - Missing cover.

Sculpture Lettering

Checks to be made:

1. Lettering:
    - Aluminum:
        - Failure of attachment
        - Corrosion
        - Pitting
        - Missing
        - Graffiti/vandalism
        - Chipped
        - Broken
        - Scratched
        - Dented
    - Brass:
        - Failure of attachment
        - Corrosion
        - Pitting
        - Missing
        - Graffiti/vandalism
        - Chipped
        - Broken
        - Scratched
        - Dented
    - Bronze:
        - Failure of attachment
        - Corrosion
        - Pitting
        - Missing
        - Graffiti/vandalism
        - Chipped
        - Broken
        - Scratched
        - Dented
    - Copper:
        - Failure of attachment
        - Corrosion
        - Pitting
        - Missing
        - Graffiti/vandalism
        - Chipped
        - Broken
        - Scratched
        - Dented
    - Gilded:
        - Chipping
        - Fading
        - Erosion of material
        - Graffiti/vandalism

    - Animal activity
    - Biological growth
- Painted:
    - Chipping
    - Fading
    - Erosion of material
    - Graffiti/vandalism
    - Animal activity
    - Biological growth
- Stainless steel:
    - Failure of attachment
    - Corrosion
    - Pitting
    - Missing
    - Graffiti/vandalism
    - Chipped
    - Broken
    - Scratched
    - Dented.

2. Inscription:
    - Illegibility
    - Eroded inscription
3. Plaques:
    - Loose or missing
    - Improper attachment
4. Glass:
    - Broken or missing panes of glass
    - Scratched surfaces
5. Covering:
    - Eroding cover
    - Missing cover.

Structure

Wall

Checks to be made:

1. Materials:
    - Adobe:
        - Erosion
        - Detachment
        - Delamination
        - Crumbling
        - Cracking
        - Coving
        - Chipping
        - Pitting
        - Spalling

- Brick:
    - Cracked
    - Pitted
    - Spalling
    - Eroded fireskin
    - Graffiti/vandalism
    - Deteriorated or missing joint material
    - Scratched surfaces
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
    - Caving/failing surfaces
- Concrete:
    - Crazing
    - Cracking
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Granite:
    - Cracking
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Limestone:
    - Cracking
    - Spalling or broken areas

    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Marble:
    - Cracking
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Sandstone:
    - Erosion
    - Detachment
    - Delamination
    - Crumbling
    - Cracking
    - Chipping
    - Pitting
    - Spalling
    - Broken
- Terra cotta:
    - Detachment
    - Delamination
    - Crazing
    - Cracking
    - Chipping
    - Spalling
    - Broken.

Figure 2. Stone Steps Deficiency

Structure/Access

Stairs

Checks to be made:

1. Iron rungs:
    - Loose rungs
    - Corroded or cracked rungs
    - Missing rungs
2. Log:
    - Loose or missing steps
    - Strength/sturdiness of ladder
    - Visible signs of decay
3. Logs pinned to rock:
    - Loose or missing logs
    - Strength/sturdiness of logs
    - Corroded pins/loose pins
    - Visible signs of decay
4. Treated timber:
    - Water has damaged edges of steps
    - Loose or missing steps
    - Strength/sturdiness of steps
    - Visible signs of decay
5. Rocks pinned to ledge:
    - Water has damaged edges of steps
    - Corroded pins
    - Loose or missing steps
6. Steps—stone:
    - Continuous stone steps installed where grade exceeds 10 percent in order to prevent erosion
    - No steps are present where there should be
    - Water damage has dislodged steps or made them not level or loose
    - Steps are too small and likely to be dislodged
    - Steps are not keyed with rock
    - Steps are too high (>10" high)
    - Stones are separated where they are intended to be congruous.

Figure 3. Stone Steps Post-Deficiency

Handrails

Checks to be made:

1. Metal:

- Missing members, corrosion, cracking or buckling, defective connections or anchorage, deteriorated protective covering, misalignment
- Structural damage by impact or other means
- Deteriorated protective covering
- Surface deterioration
- Damage or corrosion
- Deep abrasions
- Excessive wear above water level.

Structure/Base & Foundation

Foundation

Checks to be made:

1. Materials:
    - Poured concrete:
        - Crazing
        - Cracking
        - Spalling or broken areas
        - Exposed reinforcing
        - Out of plumb
        - Deteriorated mortar joints
        - Scratched surfaces
        - Graffiti/vandalism
        - Sugaring/disaggregating
        - Mineral or salt deposits
        - Biological growth
        - Soiling
        - Staining
        - Chipping
        - Vegetative growth
    - Crushed stone/rubble:
        - Displaced material
        - Erosion of material
        - Depressions
        - Vegetation growth
        - Damaged/exposed erosion control fabric
        - Animal burrowing
        - Root damage from tree/vegetation
    - Earthen:
        - Erosion of soil/clay due to rain
        - Vegetation growth
        - Animal burrowing
        - Depressions/cavities
        - Damaged/exposed erosion control fabric
        - Root damage from tree/vegetation
    - Masonry:
        - Cracked

Figure 4. Monument/Memorial Foundation

- Pitted
- Spalling
- Eroded surface materials
- Graffiti/vandalism
- Deteriorated or missing joint material
- Scratched surfaces
- Mineral or salt deposits
- Biological growth
- Soiling
- Staining
- Chipping
- Vegetative growth
- Caving/failing surfaces.

Structure/Door

Exterior Door

Checks to be made:

1. General:
   - Wood and trim: Splitting, rotting, cracking, loose, poor fit, binding, missing, loose or missing caulking, lack of weather tightness
   - Glass: Missing or broken panes, disintegration of putty
   - Trim: Looseness, scratches, indentations mechanical damage, personal abuse
2. Maintenance:
   - Paint/caulk: Worn/peeling paint; missing/deteriorated caulking; corrosion, abrasion, loss of finish coating; broken seals/weather-stripping
   - Adjust/secure/lubricate: Loose, broken or missing hardware; binding, jamming, poor fit
3. Components/hardware:
   - Loose, missing, broken parts; binding, misalignment, improper installation or adjustment, lack of lubrication; corrosion, abrasion, loss of finish coating
4. Exterior doors and frames:
   - Wood: Splitting; rotting; cracking; loose; poor fit; binding; missing; scratches; indentations; loose/damaged hardware; inoperative hardware; mechanical damage; personal abuse; delimitation; loose or missing caulking and lack of weather tightness
   - Metal: Corrosion; warping; binding; poor fit; bent; loose/damaged hardware; mechanical damage; personal abuse; loose/missing caulking and lack of weather tightness
   - Fiberglass: Warping; binding; cracked; poor fit; loose/damaged hardware; mechanical damage; personal abuse; loose/missing caulking and lack of weather tightness
5. Access panels/locks:
   - Corrosion; warping; binding; poor fit; bent; loose/damaged hardware; mechanical damage; personal abuse.

Structure/Window

Exterior Window

Checks to be made:

1. Paint/caulk/glaze:
    - Worn/peeling paint; missing/deteriorated caulking; missing/loose glazing compound, corrosion, abrasion, loss of finish coating; broken seals/weather-stripping; fogging/moisture between panes
2. Glass:
    - Missing or broken panes, disintegration of putty
3. Trim:
    - Looseness, scratches, indentations, mechanical damage, personal abuse
4. Adjust/secure:
    - Loose, broken or missing hardware; binding, jamming, poor fit of frames
5. Hardware:
    - Loose, missing, broken parts; binding, misalignment, improper installation or adjustment, lack of lubrication; corrosion, abrasion, loss of finish coating
6. Screens:
    - Loose, broken or missing hardware; binding, jamming, poor fit of frames; metal parts for rust, corrosion, holes in fabric; wooden parts for rotting, stain, other damage
7. Shutters:
    - Splitting, rotting, cracking, loose, missing, misalignment and freedom of swing or little or no free motion as required
8. Blinds, window shades:
    - Insecure or broken fasteners; poor operation; frayed or broken cords or tapes; broken or damaged slats; worn or torn material
9. Wood sash, frame, casing and trim:
    - Splitting, rotting, cracking, loose, poor fit, binding, missing, scratches, indentations, mechanical damage, personal abuse, loose or missing caulking, lack of weather tightness
10. Metal sash and trim:
    - Rust, corrosion, warping, binding, poor fit, lack of weather tightness
11. Storm sash:
    - Binding, jamming, poor fit of frames; metal parts for rust and corrosion; wood parts for rotting and other damage
12. Wood sash, frame, casing and trim:
    - Splitting, rotting, cracking, loose, poor fit, binding, missing, loose or missing caulking, lack of weather tightness
13. Metal sash and trim or metal storm sash:
    - Rust, corrosion, warping, binding, poor fit, lack of weather tightness.

Surface

Roof Surface

Checks to be made:

1. Materials:

- Asphalt—roll:
    - Weathering
    - Cracking
    - Alligatoring
    - Buckling
    - Blistering
    - Insufficient or uncemented laps
    - Tearing from nails
    - Too close to edge
    - Other damage to coatings
- Asphalt—shingle:
    - Weathering
    - Lifting
    - Cracking
    - Curling
    - Buckling
    - Blistering
    - Loss of granules
    - Excessive exposure
- Concrete:
    - Crazing
    - Cracking
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Granite:
    - Cracking
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping

    - Vegetative growth
- Metal:
    - Need for rust removal and painting or protective coating
    - Holes
    - Looseness
    - Punctures
    - Broken seams
    - Inadequate side and end laps
    - Inadequate expansion joints
    - Rust or corrosion and damage resulting from contact of dissimilar metals
- Slate:
    - Spalling
    - Chipping
    - Cracking
    - Detachment
    - Flaking
    - Anchor/attachment failure
- Shingles:
    - Rotten
    - Missing
    - Broken
    - Uplifted
    - Punctured
    - Evidence of Moisture
    - Weathering
    - Warped
    - Broken
    - Loose
    - Split
    - Curling
    - Missing
    - Flashing failures
    - Where possible, without damaging roof covering, use screwdriver to probe under edge of roof covering at overhang to check for rotted decking or dampness (wall, vent, valley and edge flashing: open joints, loose, proper fastenings and other damage)
- Terra cotta:
    - Detachment
    - Delamination
    - Crazing
    - Cracking
    - Chipping
    - Spalling
- Tile:
    - Crazing
    - Cracking
    - Spalling
    - Graffiti/vandalism

- Deteriorated or missing joint material
- Scratched surfaces
- Mineral or salt deposits
- Biological growth
- Soiling
- Staining
- Chipping
- Vegetative growth.

Traffic Surface

Plaza

A monument or memorial plaza is the horizontal surface area enclosing or adjacent to a monument or memorial.

Checks to be made:

1. Materials:
   - Concrete:
     - Crazing
     - Cracking
     - Spalling or broken areas
     - Eroded surface materials
     - Exposed reinforcing
     - Out of plumb
     - Deteriorated mortar joints
     - Uneven, uplifted, sunken—hazardous
     - Scratched surfaces
     - Graffiti/vandalism
     - Sugaring/disaggregating
     - Mineral or salt deposits
     - Biological growth
     - Soiling
     - Staining
     - Chipping
     - Vegetative growth
   - Granite:
     - Cracking
     - Spalling or broken areas
     - Eroded surface materials
     - Exposed reinforcing
     - Out of plumb
     - Deteriorated mortar joints
     - Uneven, uplifted, sunken—hazardous
     - Scratched surfaces
     - Graffiti/vandalism
     - Sugaring/disaggregating
     - Mineral or salt deposits
     - Biological growth

    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Marble:
    - Cracking
    - Spalling or broken areas
    - Eroded surface materials
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Uneven, uplifted, sunken—hazardous
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Pavers—brick:
    - Cracked
    - Broken
    - Eroded fireskin
    - Erosion problems
    - Uneven, uplifted, sunken—hazardous
    - Vandalized and/or presence of graffiti
    - Joint material missing or pulled out
    - Vegetative growth
- Pavers—concrete:
    - Crazing
    - Cracked
    - Pitting
    - Spalling
    - Potholes (or patches)
    - Broken
    - Eroded surface materials
    - Uneven, uplifted, sunken—hazardous
    - Graffiti/vandalism
    - Deteriorated or missing joint material
    - Scratched surfaces
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Pavers—stone:

    - Cracked
    - Pitting
    - Spalling
    - Potholes (or patches)
    - Broken
    - Eroded surface materials
    - Uneven, uplifted, sunken—hazardous
    - Graffiti/vandalism
    - Deteriorated or missing joint material
    - Scratched surfaces
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Sandstone:
    - Erosion
    - Detachment
    - Delamination
    - Crumbling
    - Cracking
    - Chipping
    - Pitting
    - Spalling or broken areas
    - Exposed reinforcing
    - Out of plumb
    - Deteriorated mortar joints
    - Scratched surfaces
    - Graffiti/vandalism
    - Sugaring/disaggregating
    - Mineral or salt deposits
    - Biological growth
    - Soiling
    - Staining
    - Chipping
    - Vegetative growth
- Slate:
    - Spalling
    - Chipping
    - Cracking
    - Detachment
    - Flaking
    - Broken
    - Anchor/attachment failure
- Terra cotta:
    - Detachment
    - Delamination
    - Crazing

- o Cracking
- o Chipping
- o Spalling
- o Broken.

Surface/Finish

Exterior Finish

Checks to be made:

1. Painting:
   - Alligatoring; checking; blistering; crawling; cracking; scaling; peeling; wrinkling; flaking; fading; loss of gloss; excessive chalking; mildew; bleeding; staining caused by insect screens or splashing; discoloration; complete absence of paint (NOTE: Painting of concrete is not recommended unless required for waterproofing.)
2. Weather tightness:
   - Lack of weather tightness, where butting dissimilar surfaces, between joints
3. Parapet walls and copings:
   - Cracks, spalling, defective joints and other damage.
4. Stucco:
   - Corrosion, disintegration; alligator cracks; water stains; broken areas
5. Concrete:
   - Cracks; spalling; broken areas; settlement; exposed reinforcing, termite tubes to wood surfaces
6. Masonry:
   - Eroded or sandy mortar joints; mortar cracking and pulling away from brick or CMUs; efflorescence, soft, spalling or cracked bricks or CMUs; settlement or expansion cracks; termite tubes to wood surfaces
7. Siding—cement/asbestos:
   - Stains; loose fastenings; broken sheets
8. Siding—aluminum:
   - Corrosion from corrosive atmosphere; loose fastenings; other damage
9. Siding—ferrous and other metal:
   - Scars; scuffs; rust; corrosion; breaks in protective coatings; puncture of metal; loose, missing, or broken fastenings; sagging, buckling, support failure
10. Siding—wood:
    - Looseness; warping; surface cracking, checking; swelling of joints; loose or missing knots; rotting; fungus or termite infestation; stains; evidence of continued dampness; skirting and other wooden parts for interference with ventilation and condensation control, damage or rot from closeness to soil levels and need for corrective or preventive treatment
11. Siding—vinyl:
    - Looseness; warping; surface cracking, missing sections, other damage
12. Weather stripping:
    - Lack of weather tightness around framed openings, where butting dissimilar surfaces, between joints
13. Trim/flashing—wood:

- Looseness; warping; surface cracking, checking; swelling of joints; loose or missing knots; rotting; fungus or termite infestation; stains; evidence of continued dampness

14. Deflection:
    - Rotting or fungus growth
    - Evidence of dampness of long duration
    - Damage or possible damage to wooden parts due to closeness or direct contact with soil
15. Columns—concrete:
    - Cracks; spalling; broken areas; settlement; exposed reinforcing
16. Columns—wood/timber:
    - Warping, checking, splitting, bowing, sagging or broken members
17. Columns—steel:
    - Corrosion, cracking, bowing, settlement
    - Missing fire proofing
    - Asbestos fire proofing
18. Columns—masonry/stone:
    - Eroded or sandy mortar joints; mortar cracking and pulling away from brick or CMUs; efflorescence, soft, spalling or cracked bricks or CMUs; settlement or expansion cracks
19. Beams/girders/joists/rafters/trusses/studs/sills:
    - Warping, checking, splitting, bowing, sagging or broken members
    - Deflection
    - Rotting or fungus growth
    - Evidence of dampness of long duration
    - Damage or possible damage to wooden parts due to closeness or direct contact with soil
    - Insect damage
20. Sheathing:
    - Warping, sagging
    - Rotting or fungus growth
    - Evidence of dampness of long duration
    - Damage or possible damage to wooden parts due to closeness or direct contact with soil
    - Insect damage.

Water Control

Drain

Rain Water Drainage

Checks to be made:

1. Maintenance:
    - Loose fixtures; water leaks; loose, missing, deteriorated or damaged components, hangers or fittings
    - Inadequate or excessive water flow
    - Slow or clogged drains
2. Ejectors and pumps:

- Rust damage; leaks; excessive noise and vibration; loose, missing or damaged parts
- Condition of motor and pump
- Condition of floats and controllers
- Damaged or loose electrical connections
- Aged, deteriorated or inoperative pump

3. Piping and fittings:
   - Condition of pipes, fittings and valves
   - Aged or abandoned piping.

Resources

Name	Work Group/Company Name	E-mail Address	Date Added
Catherine Dewey	NPS – Architectural Conservator, Acting Historic Architecture Program Manager, National Capital Region	Catherine_Dewey@nps.gov	7/31/2013
Beth Roberts	NPS – Facility Management Systems Specialist Network CARI - NATC - VICK	Elizabeth_Roberts@nps.gov	7/31/2013

References

The following is a list of suggested references that parks may wish to use in developing their own monuments and memorials standards:

- Monument Research and Preservation Program.

Related Documents

The following documents provide additional information on the asset category discussed in this business practice:

- Monuments and Memorials Asset Business Practice
- Monuments and Memorials Asset Best Management Practice
- Critical Systems List
- Life-Cycle Estimates.

Appendix A Inspection Guidance Change Log

Inspection Guidance Title:	Monuments and Memorials (7100) Asset Inspection Guidance
Responsible Group:	Comprehensive Asset Strategic Tools (CASTL) Development Group
Title of Business Practice Origin White Paper:	N/A
Last Change Made On:	June 2, 2014

#	Page #	Change Description	Reason for Change	Requested By	Requested On	Change Made On	Approved By	Approved On
2.0	N/A	Initial Release	Initial Release	N/A	N/A	N/A	Mike Seibert	6/2/2014