A User’s Guide to BRIDGE CLEANING
Introduction

This guide is to inform the reader of cleaning methods appropriate for the removal of debris and chemicals, natural or manufactured, that can accumulate on a bridge. The guide describes how to plan and execute a bridge cleaning operation considering best practices and introduces the reader to environmental protection, maintenance of traffic and safety requirements. The removal of animals from the structure and debris within the waterway are not within the scope of this guide.

Background

Once a bridge is put into service, it begins a life of exposure to, and accumulation of, debris and chemicals, natural or manufactured. Chemicals such as road deicing agents, automotive fluids and animal excrement can attack or be absorbed by the various bridge elements. Debris such as general road grit, winter sand, animal nests, corrosion scale, scaled or spalled concrete, refuse and organic matter can not only retain chemicals, but allow these chemicals to be absorbed by the bridge elements. Debris accumulation can also affect the ability of the bridge to expand and contract as designed. Joints can jam, and bearings can freeze, directing forces to bridge elements not designed to carry such forces. Finally, waterway carried debris can cause contraction or local scour, and if not removed, can jeopardize the stability of the bridge and public safety.

Some of the chemicals and smaller debris may be routinely rinsed away during rain events. However, larger debris and the surfaces of the bridge not exposed to the elements, especially the underside of a bridge, may be unaffected by rainfall and thus be subject to continuous debris buildup.
and chemical exposure over time. The nesting of birds can be a persistent problem, which may further expose the bridge to their highly acidic waste. Since the effectiveness of natural bridge cleaning is limited, activities to remove debris and chemicals are necessary to preserve the service life of the bridge.

Bridge materials and their inherent protective systems have evolved and improved over time. Newer bridges typically have materials and protective systems that are more durable and less vulnerable to the chemicals and debris found in the highway environment. However, improvements in the materials, details and construction practices do not eliminate the need to clean a bridge.

Conversely, older bridges typically have materials and protective systems that are more vulnerable to chemicals and debris buildup, thereby requiring more frequent and thorough cleaning. Older structures such as trusses and multiple simple span bridges have more surfaces for exposure, both above and below the bridge, as compared to newer bridges. In general, all bridges can benefit greatly from regular cleaning.
Maintenance personnel should be aware of the potential for hazardous materials that will require special procedures for the safety of the workers and the environment. Paint systems and other materials used on older bridges, unless previously removed, may be contaminated with lead or contain asbestos and should be tested before performing any significant cleaning operation.

The FHWA Bridge Preservation Guide recommends bridge cleaning as a cyclical maintenance activity. While the cost benefit ratio of bridge cleaning relative to service life is still being researched and will vary based on the quality of the initial construction and the severity of the environment, there is no debate that bridge cleaning provides the following benefits:

- Removal of elements such as chlorides and moisture trapping debris that can accelerate corrosion.
- Allows the bridge to function as intended by keeping the bearing and joints free to move.
- Promotes drainage with scuppers and inlet drains that function properly.
- Provides bridge inspectors a better opportunity to spot deficiencies.
- Extends the service life of coatings systems

**Accumulation of Contaminants**

There are many locations on a bridge which are susceptible to the accumulation of contaminants and keeping the bridge free from contaminants is considered a cost-effective bridge preservation activity. What follows is a list of areas on a bridge where contaminants can have a notable negative affect on the performance life of a bridge:
- Bridge decks, curbs, sidewalks and parapets can collect high levels of de-icing chemicals from winter operations.
- Expansion joints trap debris. Cleaning is critical to the performance of the joint system and reduces the potential damage to the expansion joint material.
- Overhead steel members and other bridge elements in the “splash zones” such as abutments, bearings, piers & pier caps, wing walls and head walls.
- Truss Bridge members such as lower chords, gusset plates, built-up members and panel points should be cleaned thoroughly.
- Bridge bearings and seats (at piers and abutments) can collect dirt, moisture and salts when not cleaned regularly.
- Superstructure members adjacent and below a leaking deck joint, scupper, or other drainage feature.
Cracks in pavement and concrete where vegetation grows and collects moisture, dirt and other debris.

Drains, downspouts, scuppers and troughs should be cleaned to ensure the drainage system is functioning as intended.

Planning and Preparation

Each bridge site will present its own unique challenges so investing the time to plan for the logistics and the operation will allow the crews to work efficiently and ultimately clean more bridges. A few of the considerations to be addressed during the planning stages are outlined in the following sections.

Bridge Components to be Cleaned

A review of the bridge in advance of the work will help to identify the scope of the cleaning operation. Communicating the scope of work and areas of emphasis to the work crews will lead to better outcomes and more efficient operations. The general areas of a bridge which require cleaning are as follows:

- Bridge deck (roadway and shoulders).
- Deck joints and expansion joint drainage trough.
- Drainage grates and scuppers (drain pipes that terminate within one foot of the bottom of the superstructure should also be included)
- Sidewalks, medians, curbs.
- Rails and parapet walls.
- Abutment seats, backwalls and pier seats.
- Bearings.
- Pier columns and abutments if in “splash zone”.
- Bottom flanges of beams and girders above roadway.
- The end of beams and girders under deck joints a distance approximately equal to the height of the beam or girder.
- End diaphragms.
- Truss Members in the splash zone; members at or below road level with an emphasis on panel points.

**Equipment**

The proper equipment will improve the safety and effectiveness of an operation. Providing the proper equipment specific to the bridge site and cleaning
operation for the work crews is essential. Here are examples of equipment typically used for bridge cleaning operations:

- Street sweeper, bucket loader, truck, wheelbarrow, shovels, industrial vacuums, brushes and brooms.
- Large capacity tank (5000 gallon) and tractor to haul it. A pump to fill the tanker and to spray the water.
- Hoses and nozzles.
- Vehicles to transport personnel and equipment.
- Poles for “punching” out clogged drains.
- Sand bags or other devices for blocking drains.
- Access equipment such as bucket trucks, under bridge inspection equipment (snoopers), scissor lifts, boom lifts, traveler systems and ladders.

A great reference of access methods to bridges and “Types of Access Equipment” is the FHWA Bridge Inspection Reference Manual, Section 2.5.2.

The predominant forms of access include:

- Ladders
- Rigging
- Scaffolds
- Boats & Barges
- Rope Access
- Permanent Catwalks
- Work Bridge
- Manlift & Scissor Lift
- Bucket Trucks
Frequency of Cleaning

Bridge owners should set performance targets for activities such as bridge cleaning as a method to preserve the useful service life of their bridges. For example, the performance target could be to sweep a bridge every year and wash the bridge every second year. These targets are generally a baseline and do not account for the unique circumstances of some bridges. The following factors may help bridge owners establish the appropriate cleaning frequency:
- The types of contaminants that might collect on a bridge and its elements.
- The immediate danger that such deposits could create, such as drainage backed up from a blocked scupper.
- The locations on the bridge where specific contaminants would collect.
- The most appropriate method of cleaning and the necessary equipment to do the cleaning.
- Any special access equipment for reaching the location of the elements to be cleaned.
- Necessary maintenance of traffic and the impact on traffic flow.
- Possible operations, such as inspections, routine maintenance, etc., with which the bridge cleaning could be combined.
- Any local or statewide environmental regulations that could govern timing of cleaning and release of materials to the environment near the bridge site.

Depending on the analyses of all factors, it may be appropriate to establish different frequencies of bridge cleaning of different elements or groups of elements. For instance, it may be possible to conduct frequent cleaning (and minor maintenance) of bridge deck joints and seals, and less frequent cleaning of substructure caps, bearings and beam ends.

**Environmental Regulations**

When planning for bridge cleaning and washing operations, one needs to determine the proper removal
method of contaminants, and to consider the potential environmental impact of the contaminants and the cleaning operation. The State and Federal environmental regulatory agencies have permitting and compliance requirements that must be followed and the permittee is generally required to comply with the more restrictive regulations. Using best management practices (BMPs) to minimize the environmental impact is an important component of regulatory compliance.

While federal environmental, waste disposal, and wildlife regulations are consistent nation-wide, state regulations can vary. It is not the scope of this guide to cover these regulations in complete detail, but it is important for the reader to be aware of these regulations. A careful review should be performed as part of the planning process and all applicable regulations must be followed.
A few of the national regulatory requirements are covered by the National Environmental Policy Act, the Clean Water Act, the Migratory Bird Act and the Endangered Species Act.

State and Local regulatory requirements may include the transport of invasive or nuisance species, water quality standards, municipal storm system permits and impacts to watersheds.

Some transportation agencies have collaborated with their state’s environmental and wildlife agencies to review and receive guidance for their bridge cleaning operations. This programmatic approach has resulted in greater empowerment to perform the work where and when needed, and the work is now being performed more effectively and comprehensively to preserve the bridge’s service life AND to protect the environment. For example, Washington State DOT has a state-wide permit that:

○ Allows flushing the bridge after the bridge has undergone a “dry” cleaning.

○ Requires drains to be protected using BMPs to prevent the dirty water from entering the stream or river below.

○ Requires steel bridges that have flaky paint to be hand cleaned only and not washed.

○ Requires bridges not over waterways to be hand cleaned, and drains protected, then the bridge may be flushed.

Standard Practice for Washing and Cleaning of Concrete Bridge Decks and Substructure Bridge Seats including Bridge Bearings and Expansion Joints to Prevent Structural
Deterioration. Washington DOT, December 2013 found here:

https://www.wsdot.wa.gov/research/reports/fullreports/811.2.pdf

A research report by PennDOT titled Evaluation of Bridge Cleaning Methods on Steel Structures looks at effective practices for removing soluble salts from steel structures. The full report can be found here:

PennDOT Final Report FHWA-PA-2013-007-PIT WO 2

**Maintenance of Traffic**

The type and location of the structure, the highway facility and speed of traffic, the cleaning process and associated access requirements will directly influence the Maintenance and Protection of Traffic plan. In addition to the protection of workers and the travelling public, the traffic control measures may need to account for
the possible discharge and overspray into traffic lanes adjacent to or below the bridge. The MPT plan should be effective and allow the traveling public safe passage over or under the bridge.

During an initial site review, here are a few questions that may help formulate the MPT plan:

- Can access equipment be positioned outside of traveled lanes?
- Can supply equipment, such as the water truck, be positioned outside of traveled lanes?
- Can debris be contained outside of traveled lanes?
- What is required to protect the motoring public?

Most transportation agencies have standard details for a variety of the common MOT set-ups such as short term, lane closures, shoulder closures, rolling closures and detours. Refer to the current version of the Manual of Uniform Traffic Control Devices (MUTCD) if no MOT standards exist.

The National Bridge Inspection Standards (NBIS) require hands on inspection for both “In-Depth” and “Fracture Critical” bridge inspections. Transportation agencies often provide guidelines for the access and MPT of such inspections. This too serves as a good reference for bridge cleaning operations.

Safety

The safety of the workers and the traveling public is paramount. State Highway Agencies have formal safety programs and these resources would be of assistance in developing a job hazard analysis for bridge cleaning.
operations. Fall protection, working over water, working with high pressure systems and hazardous materials such as lead paint, are just a few of the safety considerations that may be encountered when planning a bridge cleaning operation. At a minimum, all operations must comply with the Occupational Health and Safety Administrations (OSHA) Standards.

The Cleaning Operation

To clean a bridge, it is important to get as close to the elements as possible, depending on the cleaning process to be used. For example, sweeping debris into a container with hand tools will require direct access to the bridge element being cleaned, whereas the use of a high-pressure spray or high-volume water may not need to be as close as hand tools require.

Initial removal of contaminants by mechanical means is preferred and may streamline the permitting process. Mechanical methods include sweeping, hand cleaning and vacuuming. The debris removed during this operation shall be collected and disposed of in an appropriate permitted landfill or as directed by the owner’s representative.

Washing the Bridge

If possible, the water for power washing should come from the waterway under the bridge that is being washed. At locations where the bridge is over either salt or brackish water, is not over a waterway, or a bridge over a protected water source, an alternate fresh water source must be located.

All deck drains, scuppers, inlets and flumes must be blocked with sandbags or other alternatives to prevent
accidental discharge of wash water to surface waters or roadways below.

The power wash system should be capable of producing no less than 1200 PSI and should be the “low water volume” type. It is recommended that pressures not exceed 6000 PSI to protect the bridge elements.

Wash water shall be directed to adjacent vegetation or filtered by other approved methods. Wash water and debris may also be contained and removed to a permitted waste disposal facility.

All superstructure and deck washing shall be completed before performing substructure washing.

The Contractor shall rinse, not power wash, the residue off painted surfaces without damaging the protective coating.

Pressure washing shall not be allowed when ambient temperatures are less than 40 °F or when ambient temperatures are expected to drop below 40 °F before the bridge is dry. The Engineer shall be the sole decider as to when temperatures lower than 40 °F are likely to occur.

It should be noted, washing efficiency decreases with an increase in the elevation between the nozzle and target area, and if the pressure washer nozzle is lower than the target area. This decrease in effectiveness can be avoided by using proper access equipment.

**Cleaning Agents**

Chemical cleaning compounds such as detergents and chloride scavengers should only be used in accordance with the manufacturer’s recommendations and in compliance with State and Federal environmental regulations.
Incidental damage

Any incidental damage to existing coatings, joints, seals and concrete shall be repaired in accordance with the DOT specifications or manufacturers recommendations as directed by the owner.

Efficiencies in Bridge Cleaning

Agencies are always looking for operational efficiencies and grouping bridges based on their location to one another or access requirements is one option, or agencies may divide bridge cleaning operations between in-house maintenance staff and contractors depending on the need for specialized access equipment and the level of MPT required.

Combining bridge cleaning with other operations to take advantage of the expense and impact to traffic from an MPT deployment, or to use specialized equipment already mobilized on the site for other purposes are practices that can realize savings for the owner.

Example Video of Bridge Cleaning using Platform Truck and Ground Access

https://www.youtube.com/watch?v=8bhskayKkZM
Notice:

The contents of this guide on Bridge Cleaning reflect the views of the Bridge Preservation Expert Task Group, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the Federal Highway Administration (FHWA). The content does not constitute a standard, specification, or regulation. FHWA does not endorse products or manufacturers. Trade or manufacturers’ names appear herein solely because they are considered essential to the object of this report.