PUBLIC WORKS

Street Sweeping Management

Stewardship in Action

Environmental Services Division

Street Sweeping Program

December 2025

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Mission Statement

The mission of Public Works is to provide exceptional services to maintain Buckeye's infrastructure.

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Executive Summary

The City of Buckeye Street Sweeping Program operates within clearly defined labor constraints that directly determine service capacity and performance outcomes. Of a 10-hour workday, staff average just over 4 hours performing required non-sweeping activities—including travel, equipment fueling and cleaning, inspections, meetings, maintenance, and mandated breaks—leaving just over 5 hours of actual sweeping time available per operator per day. At the proven effective operational speed of 5 miles per hour for optimal particulate and debris pickup, this equates to approximately 25–26 miles of effective sweeping per day, aligning with the program's established 25-mile daily performance goal. These calculated available work hours define the practical production limits of the team with the existing curb miles of the city, and are accomplished using zone assignments and route planning. This establishes a data-supported benchmark for evaluating staffing levels, service frequency, and the program ability to meet regulatory air quality standards and debris control obligations.

Why Street Sweeping?

Street sweeping in the arid Southwest is a fundamental Environmental Quality and compliance tool that controls dust, protects stormwater, and keeps roads safe and functional. By removing larger debris and trash to minuscule particulates, its mission directly supports air quality standards, drainage infrastructure, and roadway operations needed in a desert environment.

Research has shown that the average urban area in the United States generates nearly 100 pieces of roadway litter per person in the United States (Burns & McDonnell, 2021). Another study, specifically for the Southwest Region of the United States, shows that although the desert may be the source of much PM_{10} and $_{2.5}$ air pollutants, the local area air quality is significantly negatively impacted by urban use of the road, referred to as entrainment (Clements et al., 2013; Brown et al., 2017).

With this data, the Street Sweeping Program mission is to protect public health, air quality, and surface water by removing dust, debris, and pollutants from paved surfaces while enhancing roadway safety and neighborhood cleanliness in our desert environment.

Further, as noted in Appendix B - State Implementation Plan, local municipalities in the area near Phoenix, Arizona, are federally mandated to maintain a street sweeping program specifically to reduce particulate matter from roadways to stop the creation of fugitive dust from developed areas.

Environmental Quality (APWA 26.1)

Air Quality

Health impacts of significant PM_{10} exposure include respiratory and cardiovascular illness, asthma and COPD, and are linked with higher hospitalizations and premature death in local populations. Children, older adults, and people with existing heart or lung disease are the most affected, even when concentrations are only moderately elevated.

In the arid Sonoran Desert of Maricopa County, vehicle traffic and wind constantly re-entrain fine dust from paved surfaces, creating particulate pollution that can trigger federal PM_{10} non-attainment issues. For this reason, a core duty of the street sweeping program is to maintain regular sweeping of public streets to reduce the "silt loading" available on pavements from creating fugitive road dust emissions.

The overall purpose of street sweeping activities is to remove accumulated dust and fine particulates before they become airborne, thereby supporting compliance with the City of Buckeye Air Quality Code and Maricopa County fugitive dust and track-out control requirements. Agencies responsible for regional dust control must operate equipment capable of effectively removing PM_{10}-sized particulates and must provide service at frequencies and using methods sufficient to offset local dust deposition and replenishment rates. In the Sonoran Desert environment, no minimum sweeping schedule has been prescribed; instead, municipalities are required to implement best management practice (BMP)–based programs designed to protect public health and maintain compliance with applicable PM_{10} standards mandated in the State Implementation Plan. Accordingly, sweeping frequencies should be established and adjusted as necessary to achieve and sustain those standards.

Stormwater Quality

Street sweeping is a frontline best management practice (BMP) for stormwater and watershed protection, even in areas that see infrequent monsoon or winter rains. Frequent sweeping provides an ability to capture trash, organics, metals, and hydrocarbons before they wash into Municipal Separate Storm Sewer Systems and to surface waters (even in dry washes, these pollutants can store to be a later problem). The removal of debris also ensures rainfall drains quickly, reducing localized flooding and ponding.

Sweeping also acts as a visible sanitation activity, impacting public perception. It meets public expectations for clean neighborhoods, and causes the public to see and consider the need for sanitation activities.

Road Safety and Maintenance

Sweeping helps maintain the safety and functionality of roadways that see high speeds, construction track-out, storm debris, and litter from foot traffic and commercial use. Removing loose material from pavements reduces skid risk, protects vulnerable road users, and keeps critical corridors open after wind or rain events.

Safety concerns also include gravel, glass, fugitive waste, and storm debris. These items may cause loss of traction, tire damage, or lane obstructions. Other safety concerns include construction track-out on paved streets, required under dust control rules, to prevent crashes and dust plumes.

Finally, sweeping preserves pavement and striping by limiting abrasive wear from accumulated sand and fines.

Community Quality and Perception

Street sweeping is frequently noted by residents as improving neighborhood appearance while simultaneously supporting a healthier environment. Clean streets reinforce public trust that the city government is actively managing dust, trash, and construction impacts that are common to growing desert communities. It does this by enhancing the visual cleanliness of residential areas, downtowns, and arterials. Clean roads support property values, reduce visible dust and litter, which are common sources of complaints to Public Works staff, and provide a tangible, easy-to-communicate service that links daily operations to environmental quality goals.

Street Sweeping Equipment

Modern Street Sweeping is performed using mechanical sweeping vehicles and regenerative-air sweeping vehicles.

A mechanical broom sweeper is a vehicle that uses rotating gutter brooms and a central pickup broom and conveyor system to physically dislodge and collect debris from the roadway surface. This type of sweeper is effective at removing coarse materials such as sand, gravel, soil track-out, landscaping rock, and litter, which are common on streets in arid and rapidly developing areas. Mechanical sweepers perform well on rough, cracked, or chip-seal pavements and are well suited for construction cleanup, heavy post-storm sediment removal, and routine debris control. While less effective at capturing fine particulate matter associated with PM_{10}, their ability to remove larger material helps prevent debris from being broken down by traffic into finer, more easily resuspended dust.

A regenerative-air sweeper vehicle is designed primarily for the removal of fine silt and dust from paved surfaces. It uses high-velocity air jets to dislodge particles followed immediately by vacuum recovery through filtration systems. This process minimizes dust generation during sweeping and makes regenerative sweepers particularly effective for air-quality management and particulate matter (PM_{10}) control on smooth asphalt surfaces such as residential and collector streets. Regenerative sweepers are most effective when coarse debris has already been removed, and pavement conditions are relatively intact; their performance can decline on heavily deteriorated surfaces or where large debris is present. As a result, they are often used strategically as part of a broader sweeping program focused on reducing fine particulate emissions (Sutherland, 2011).

Municipalities in the arid Southwest face unique roadway maintenance and air-quality challenges due to high windblown dust loads, unpaved shoulders, rapid development, and variable pavement conditions. Mechanical broom sweepers and regenerative-air sweepers serve distinct but complementary roles in addressing these conditions. Removal of coarse material is a necessary precursor to long-term PM_{10} control, especially in arid environments where deposition rates are high and re-entrainment occurs rapidly; therefore, maintaining both technologies allows municipalities to match equipment to roadway condition and debris types, protecting advanced sweepers from damage while maximizing PM_{10} reduction where conditions are favorable. This combined approach is consistent with EPA-supported research demonstrating that integrated sweeping strategies are more effective and cost-efficient in arid regions than reliance on a single sweeping technology (EPA, 1992; WRAP, 2006; Kuhn et al., 2003; EPA, 2011). The table below, Table - Sweeper Choice, indicates the various scenarios governing mechanical sweeper and regenerative-air sweeper use rational.

(Table on next page)

Table - Sweeper Choice

Road / Scenario	Preferred Sweeper	Rationale
Construction cleanup	Mechanical	Handles heavy debris and gravel
Chip-seal / rough pavement	Mechanical	Maintains contact with uneven surfaces
Residential/Arterials / collectors	Regenerative-air	PM_{10} and fine silt removal
Commercial corridors	Combination	High debris + fine dust
Post-storm sediment	Combination	Remove coarse material, then fines
State Implementation Plan - credit sweeping	Regenerative-air	Demonstrated PM control

(Los Angeles, 2021)

Street Sweeping Frequency

Studies show that road surface dust does not accumulate linearly with time following a cleaning event, and that environmental and operational variables (wind redistribution, traffic turbulence, and sweeper technology) largely govern equilibrium dust loadings on paved streets. Although varying sweeping frequencies may have varying environmental quality results, public presence also allows for overall confidence in city action, and supports the need for maintaining the same frequency on all roads.

Cost-Effectiveness for Dust Accumulation Patterns

Federal research, including EPA's AP-42, identifies paved road emissions as a function of surface silt loading (sL), and recognizes that silt loading increases during extended dry periods and declines temporarily following precipitation or effective cleaning events (EPA, AP-42 §13.2.1). In Arizona's arid climate, where rainfall is infrequent and evaporation rates are high, the Western Regional Air Partnership notes that roadway dust can re-accumulate rapidly due to traffic entrainment, windblown deposition from adjacent desert soils, and seasonal weather patterns (WRAP, 2006). Regional field data analyses indicate that measurable silt reloading may occur within several days of sweeping, with substantial rebound commonly observed within approximately one week under active conditions (WRAP, 2006; EPA, AP-42 §13.2.1). Wind events and seasonal variability—particularly pre-monsoon winds and prolonged dry seasons typical of Arizona—further affect redistribution and deposition rates (WRAP, 2006). That said, AP-42 does not prescribe fixed sweeping intervals. To keep real world application consistent with these findings, sweeping frequency should reflect the rapid but variable re-accumulation patterns observed in desert environments rather than assume indefinite buildup or negligible rebound. Excessively frequent sweeping may yield diminishing returns relative to cost, particularly where reloading rates are moderate, while infrequent sweeping allows silt loading to return to emission-producing levels (EPA, AP-42 §13.2.1; WRAP, 2006). Given the documented variability in deposition rates across seasons and operational conditions in Arizona, a reasonable and resource-effective standard would be to conduct sweeping at least once every fourteen (14) days. A 14-day interval aligns with documented short-term re-accumulation trends in arid western settings while balancing operational efficiency, cost considerations, and particulate matter emission reduction objectives (EPA, AP-42 §13.2.1; WRAP, 2006).

Cost-Effectiveness for Debris Control

Although there is no universal, scientific, or regulatory consensus explicitly mandating mechanical street sweeping for urban settings related to debris control; the necessary frequency and method depend heavily on factors such as population density, debris type, and local surface water quality goals. However, some studies and municipal reports suggest that a weekly scheduled is associated with higher pollutant removal efficiency compared to less frequent sweeping, like a monthly schedule (Schilling, June 2005).

Optimal Speed Efficiency for a Regenerative Street Sweeper

Dust suppression is key in the Sonoran Desert, with PM_{10} and $PM_{2.5}$ of significant concern for environmental quality. Regenerative-air street sweepers, the most used sweeper in the City of Buckeye, provide the best pickup efficiency for dust suppression, and this equipment operates most effectively at or below 5 mph (8 km/h) (Sutherland 2011). Research by the City of San Diego, testing mechanical sweepers at speeds of 3–6 mph and 6–12 mph, concluding that lower operational speeds did not negatively impact collection, but performance was decreased at higher speeds, supporting the use of lower (3–6 mph) rates (San Diego, 2010). Additionally, testing of an Elgin RegenX regenerative air sweeper, commonly used in Buckeye, found that pickup efficiency declined as operating speed increased, also showing optimal efficiency at or below 5 mph (Worldsweeper, 2021). A PM test protocol used in Canada for PM_{10}/$PM_{2.5}$ efficiency specified that sweeper operating speeds of 3–6 mph (5–10 km/h) are appropriate for high-efficiency PM capture in regenerative and similar technologies (Toronto, 2016).

Optimal Speed Efficiency for Debris Controls

Street-sweeping research conducted for the U.S. Environmental Protection Agency demonstrated that mechanical broom sweepers exhibit higher debris pickup efficiency than regenerative sweepers, and similarly, operate efficiently at lower speeds, particularly for small particulate matter and loose roadway debris. Sartor and Boyd concluded that as forward speed increases, broom contact time with the pavement decreases, reducing the ability to dislodge and convey debris into the hopper (Sartor and Boyd, 1972).

Operational guidance and field testing from mechanical sweeper manufacturers indicate that optimal working speed of 5 mph is most effective balance between debris pickup and route productivity. At higher speeds, debris tends to scatter rather than be captured by the gutter broom and conveyor system (Tymco; Schwarze Industries). Additional studies show that excessive speeds reduce fine particle capture for mechanical broom sweepers (Amato et al. 2010).

Efficiency Summary

For particulate matter, a 14-day street sweeping frequency strikes a balance between maintaining road cleanliness, managing costs, and adapting to environmental conditions. This interval aligns with studies on dust accumulation and emission dynamics in urban settings. Regenerative-air sweepers are recommended for this purpose.

Conversely, mechanical sweepers are best for cleaning larger debris in high-traffic and commercial areas. Weekly sweeping may be advised for these arterials to handle the higher volume of trash. Residential roads typically need biweekly sweeping, while collector streets often have less debris. Arterials, however, generally accumulate the most trash and may benefit from weekly collection.

Both particulate matter and debris control require sweepers to operate at an optimal speed of 5 miles per hour. Operational constraints might necessitate adjustments, but drivers maintain this speed for maximum efficiency.

Operations Efficiencies - Routing Software (APWA 26.4)

The City of Buckeye has enabled routing software as an integral part of its operations. Although the team is highly experienced, the routing software assists the team with a variety of methods to achieve collection efficiency. Routing Software modernizes street sweeping through intelligent route optimization, real-time tracking, and performance analytics—driving cleaner streets, improved resource management, and measurable cost savings.

Routing software improves street sweeping efficiency by using digital algorithms and real-time data to plan, analyze, and optimize cleaning routes. It transforms manual operations into digital workflows that may be easily shared within a team, and support accurate, datadriven decision-making. This provides control over operational costs, fuel efficiency, and consistent sweeping coverage with varied staff.

Optimized Routes: The software calculates efficient paths by analyzing traffic patterns, street width, and congestion. This minimizes non-sweeping travel, cutting unnecessary mileage and reducing fuel consumption.

Balanced Workloads: Routing helps distribute assignments evenly among vehicles/operators, creating manageable and efficient schedules for a team.

Real-Time Data and Monitoring: GPS tracking allows management to view and confirm route completion, with instant visibility.

Dynamic Rerouting and Adaptability: When unexpected conditions arise—such as parked cars, construction zones, or road closures—drivers can quickly adjust and reroute in real time. This flexibility ensures routes are completed efficiently despite changing conditions.

Operational Resource Reduction: Minimized fuel use, reduced mileage, and more accurate cleaning allows improved street sweeping results, increasing overall effectiveness of the program.

Real World Application - The City of Buckeye

The City of Buckeye, Public Works Department, began street sweeping with second-hand equipment soon after regional requirements were issued by the federal government. The first new sweeper was purchased in the mid-90s. The city has been actively pursuing efficiency and performance since program inception. Currently, the city maintains a robust street sweeping program.

As one of the fastest-growing cities in the country, Buckeye has consistently added 48 curb miles of streets every year, and now maintains a fleet of 8 sweepers. City streets are designated into 5 zones, each with 200 miles per zone, and a goal of sweeping 100 miles per week in each zone.

As of the writing of this document, the Street Sweeping team performing these actions consists of a 5 Equipment Operators and a Foreman. Many of the team have more than 15 years of experience. Each staff member is tasked with maintaining a specific zone of the city, and is encouraged to maintain 25 miles of sweeping activity per day. Each member is also tasked to gain operational understanding of each piece of equipment and each route as a part of on-the-job training.

Using institutional knowledge, the team created a list of typical activities and assigned an average number of hours per activity per year. This list identified several routine activities, including water tank fills, travel time, equipment clean-outs, breaks, daily maintenance, meetings, CDL inspections, and end-of-day tasks. It also accounted for bio breaks and miscellaneous activities such as callouts, non-standard database entries, weekly cabin clean-outs, yard maintenance, and training sessions. This was then averaged to the available minutes per workday and generating minutes per workday for each activity recorded in Table - Daily Primary Activities.

With the time for these well-recognized activities, using a 10-hour workday, staff found an estimated 292 minutes per day, or 4.9 hours (+/- 30 minutes) spent on non-sweeping activities, while 5.1 hours of actual sweeping worktime was established. This 5.1 hours of available sweeping time, occurring with the recommended operating speed of 5 miles per hour for a sweeper, dictated a standard number of miles that may be effectively swept per day of 25.5 miles. This coincides with a staff goal of accomplishing 25 miles of sweeping per day, and with the literature finding the optimal driving speed for sweepers.

Residential and collector roads are maintained with a 14 – day sweeping frequency; however, with commercial and industrial districts under development, the high traffic and high visibility areas of major arterial roads, which are hubs for shopping areas, are consistently found inundated with excessive debris and fugitive trash. These safety hazards and sanitation concerns push some of the arterial roads to weekly routes and on-call services, while most collectors remain on a 14-day sweep cycle.

(Table on next page)

Table - Daily Primary Activities

Average Minutes / Day	Activities	Note*
45	Water Tank Fill Time	Fill two to three times per day at 15 - 30 mins each event
72 (1.2hrs)	Travel Time	Daily travel to and from locations, and watering stations - an average for travel throughout entire city
35	Clean-out	Washing debris hopper at the end of each day
30	Breaks	Two 15 min breaks
10	Daily Maintenance	Change and clean water nozzles, brooms (side and rear) clean windshield/mirrors, repair water hoses
15	Meetings	Team cohesion and Instruction meetings
20	CDL Inspections	Pre and Post safety check
15	End of Day actions	Data entry and fueling at end of day
20	Bio break	Bathroom Breaks and Personal Needs
30	Other	Call outs and related, non-standard data entry, weekly cabin clean-out, yard maintenance, training, meetings, and additional hopper cleanouts throughout the day
308 (5.1hrs)	Sweeping	

*Some activities are performed weekly or bi-weekly. This time is broken into daily increments for this table.

Efficiencies

Efforts are being made to improve operational efficiency, focusing on maximizing street-sweeping time. Key strategies address the major time-consuming functions to minimize staff involvement in non-sweeping tasks. The primary non-sweeping task is travelling time.

Satellite Yards:

Travel time may be reduced by establishing additional satellite yards near major subdivisions. These smaller yards would serve as convenient hopper dump sites and vehicle storage areas, allowing operators to begin and end their shifts closer to their assigned routes. While this approach could significantly reduce daily travel, it would also require additional staff time for yard maintenance and could increase overall operating costs. A cost-benefit analysis comparing reduced travel time with added maintenance expenses would help determine feasibility. The analysis should also consider the cost of finding and purchasing property, and setting the property to be used as a yard. This analysis should be revisited periodically, as population growth and traffic congestion are likely to affect travel time in future years.

Water Station Hubs:

Travel time may be reduced by increasing watering stations/hubs. Water is essential for sweeping operation—it lubricates parts and controls dust emissions. Currently, water tanks must be refilled two to three times per day, costing time to travel to watering stations. Installing additional water stations across the city could help minimize refilling travel time. However, each new station costs approximately $5,000 to install. A cost-efficiency comparison is necessary to weigh installation costs against potential time savings.

Hopper Emptying Process:

Travel time to fill the roll-off with sweeper debris. Operational adjustments may improve efficiency in debris disposal. Because regenerative air sweepers cannot lift their hoppers, they must dump collected material to the ground before a backhoe loads it into a roll-off container. If sweepers could discharge directly into the roll-off from an elevated position, the process could save time and reduce yard maintenance needs. This approach presents challenges related to wet waste handling, roll-off positioning, and equipment safety.

Benchmark

A benchmark analysis was performed in collaboration with the firm Burgess and Niple to determine the state of street sweeping among municipalities of similar sizes and in a similar region. This report may be found in the Appendices.

The data showed that the characteristics of different municipalities affected their operational results. These characteristics include size of the municipality, compactness of the service areas, population density, proximity to services, and more. Generally, smaller municipalities with compact service areas managed to sweep more lane miles daily compared to those covering larger areas. However, factors such as sweeping speed, route design, equipment capacity, and local road conditions might also have influenced productivity, and might be accounted for in future regional studies.

Buckeye's operational profile illustrated challenges due to its large service area and low population density. With the second largest service area and the lowest population density among its peers, Buckeye faces resource challenges due to travel distances, but has implemented route optimization technologies to assist in travel efficiencies. The municipality's broom-down efficiency and daily productivity were at the lower end of the peer group, whereas its per capita staffing ratios were among the highest. Unlike most peers, Buckeye maintained a uniform bi-weekly service frequency across all road classifications, offering higher levels of service.

Conclusions

Key Findings from Benchmarking Analysis

The benchmarking analysis demonstrates that street sweeping programs are designed in response to each municipality's unique conditions and priorities. Differences in municipal size, population density, geographic features, regulatory frameworks, and available budgets lead to a range of operational strategies and service levels across communities.

Literature Review and Program Evaluation

The literature review, which considered factors such as sweeping frequency, operational speeds, and equipment types, indicates that the City's Street Sweeping Program effectively achieves regional air quality goals. Utilizing current equipment, staffing resources, and routing technology, the program operates efficiently, is guided by appropriate management oversight, and maintains practical staffing constraints. The program is also flexible enough to respond to challenges related to population growth and changes in land use.

Opportunities for Operational Improvements

There are several opportunities to enhance operational efficiency within the street sweeping program. To identify which potential improvements would bring the most value, it is essential to carefully weigh the anticipated time savings against the associated costs.

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Appendix A - Glossary

Street Sweeping & Road Dust Technical Glossary

AP-42 - The EPA's *Compilation of Air Pollutant Emission Factors*, which provides standardized methods for estimating emissions, including PM_{10} emissions from paved roads based on silt loading, traffic, and vehicle weight.

Arterial Street - A high-capacity roadway designed to carry large volumes of traffic between major areas; typically prioritized for fine particulate control due to higher traffic speeds and volumes.

Best Available Control Measures (BACM) - Control strategies identified by the EPA as effective for reducing emissions from specific sources, including fugitive dust from paved roads.

Chip Seal - A roadway surface treatment consisting of asphalt emulsion and aggregate; characterized by rough texture and high dust retention, reducing the effectiveness of fine-particle sweepers.

Collector Street - A roadway that channels traffic between local streets and arterials; often targeted for routine sweeping due to moderate traffic and dust accumulation.

Construction Track-Out - Soil, sand, or aggregate deposited onto paved roads by construction vehicles leaving unpaved sites; a major source of coarse debris and future PM_{10} emissions.

Coarse Debris - Roadway material generally larger than 75 microns, including gravel, sand, and soil clods, which can be broken down into fine particulate matter by traffic.

Fugitive Dust - Airborne particulate matter generated from non-point sources such as roadways, construction sites, and disturbed soils, not emitted through a stack or vent.

Fugitive Trash - Airborne or unbagged trash generated from human activities.

Gutter Broom - A rotating broom mounted on a mechanical sweeper used to move debris from the curb line into the sweeper's pickup path.

Leaf litter - Fallen leaves and small organic plant debris that accumulate on streets, and gutters as a result of natural vegetation cycles.*

Mechanical Broom Sweeper - A street sweeper that uses rotating brooms and conveyors to physically dislodge and collect debris, primarily effective for coarse materials and uneven pavement.

Nonattainment Area - A geographic area that does not meet National Ambient Air Quality Standards (NAAQS) for pollutants such as PM_{10}.

Particulate Matter (PM) - Airborne particles classified by size; it refers to particulate matter which are inhalable and regulated. Sources include both natural and anthropogenic suspended solids in the Arid Southwest.

Pickup Broom - The central rotating broom on a mechanical sweeper that lifts debris onto a conveyor or into a hopper.

PM_{10} - Inhalable particulate matter with an aerodynamic diameter of 10 microns or less, commonly generated by road dust resuspension in arid regions.

$PM_{2.5}$ - Atmospheric particulate matter that has a diameter of less than 2.5 micrometers, which is roughly 3% of the diameter of a human hair. Primarily caused by combustion processes, including vehicle emissions, power plants, industrial activities, wildfires, and wood burning.

Paved Road Emissions - Particulate matter released into the air due to vehicle-induced resuspension of dust and debris from paved road surfaces.

Raveling - The deterioration of pavement where aggregate loosens and dislodges, increasing dust generation and reducing sweeping effectiveness.

Re-entrainment - the process where contaminants that were previously settled get mixed back into a system

Regenerative-Air (RA) Sweeper - A Street sweeper that uses high-velocity air to dislodge fine particles and immediately vacuums them through filtration, minimizing dust generation.

Resuspension - The process by which road-deposited dust is lifted back into the air by vehicle movement, wind, or mechanical disturbance.

Road-Deposited Dust (RDD) - Material that accumulates on paved road surfaces from windblown soil, traffic wear, construction activity, and surrounding land use.

Silt Loading - The mass of fine particles (typically <75 microns) per unit area on a paved surface, commonly expressed as grams per square meter (g/m^2).

SIP (State Implementation Plan) - A federally enforceable plan developed by states to demonstrate compliance with the Clean Air Act, often including street sweeping as a PM_{10} control measure.

Storm Sediment - Soil and debris deposited on roadways following rainfall events, particularly common in desert environments with unprotected shoulders.

Street Sweepings – (Street Sweeper Debris) material collected by mechanical or vacuum street sweeping equipment during routine roadway cleaning operations, consisting primarily of sediment, litter, organic debris, and other accumulated roadway contaminants.**

Street Washing - The application of water to road surfaces, sometimes in conjunction with sweeping, to remove fine particulate matter and reduce resuspension.

Surface Roughness - The texture and condition of pavement, influencing how dust adheres to the surface and how effectively sweepers can remove it.

Vacuum-Assisted Sweeper - A sweeper that uses suction to collect debris, often combined with air agitation; includes regenerative-air and true vacuum designs.

Windblown Deposition - The accumulation of soil and dust on paved roads from adjacent disturbed or barren land due to wind transport.

*Note about leaf litter: (APWA 26.3)

In many parts of the United States, street sweeping programs are heavily influenced by seasonal leaf litter from dense urban tree canopies and frequent precipitation. Leaves can accumulate rapidly, clog drainage systems, and contribute significant nutrient loads to stormwater runoff; however, these conditions are largely absent in the arid Sonoran Desert climate and sparse vegetation of Buckeye, Arizona. The limited rainfall, reduced tree canopy, and desert-adapted landscaping significantly reduce the operational importance of leaf litter collection. As a result, street sweeping in Buckeye is more appropriately focused on the management of wind-blown sediment and dust rather than seasonal organic debris.

** Note about Street Sweepings (APWA 26.2)

Street sweeper debris is regulated under state solid waste regulations. In Arizona, the state regulates the material under general solid waste laws administered by the Arizona Department of Environmental Quality (ADEQ). The applicable rules come from Arizona Revised Statutes (A.R.S.) §49-701 et seq. and Arizona Administrative Code (AAC) Title 18, Chapter 13 (Solid Waste Management). Specifically, AAC, R18-13-302, "refuse" includes "street cleanings". This means street sweeping debris is legally considered solid waste. This classification informs the handling, storage, and disposal requirements for sweeping materials.

Appendix B - State Implementation Plan

Municipalities within Maricopa County have been part of a State Implementation Plan (SIP) for Particulate Matter at 10 microns (PM_{10}) since the early 1990s. This plan came about due to repeated exceedances of the federal particulate matter standards established under the Clean Air Act. After the 1987 PM_{10} National Ambient Air Quality Standards were adopted, the Phoenix Area was classified as a PM_{10} nonattainment area, with windblown dust, paved and unpaved road dust, construction activities, and disturbed desert land identified as significant sources. Initially, the region was labeled as a moderate nonattainment area, but due to ongoing violations, it was reclassified as a "serious" PM_{10} nonattainment area in 1996. This reclassification imposed more stringent planning and control requirements and established a mandatory attainment deadline of December 31, 2001.

When the region failed to meet the PM_{10} standard by the 2001 deadline, Arizona became subject to Clean Air Act section 189(d), requiring serious nonattainment areas that miss their attainment date to submit SIP revisions demonstrating annual PM_{10} emission reductions of at least five percent per year until attainment is achieved. In response, the Arizona Department of Environmental Quality (ADEQ), working with the Maricopa Association of Governments (MAG), submitted a series of revised SIPs, including a serious area PM_{10} SIP approved by the EPA in 2002, followed by the MAG 2007 Five Percent Plan. This plan was later revised to the MAG 2012 Five Percent Plan, which was approved by the EPA in June 2014, satisfying the five-percent reduction requirement and halting potential federal funding sanctions and Federal Implementation Plan obligations.

A key element of the Phoenix PM_{10} SIP is its reliance on local government implementation. Cities and towns throughout Maricopa County were required to adopt formal resolutions and ordinances committing to implement SIP control measures. These actions included paved road dust controls such as street sweeping programs, unpaved road stabilization, construction track-out requirements, vacant-lot dust controls, and enforcement mechanisms. Once submitted to the EPA and approved as part of the SIP, these municipal commitments became federally enforceable, meaning failure to implement them could expose both the local jurisdiction and the state to enforcement or sanctions under the Clean Air Act.

Implementation of the Phoenix SIP is ongoing; municipalities remain responsible for continuing dust-control practices, maintaining ordinances, conducting inspections and enforcement, and updating emission inventories as needed. Street sweeping, paved-road dust management, and fugitive dust control remain core, recurring SIP elements because PM_{10} exceedances in the area are episodic and closely tied to weather, land disturbance, and traffic conditions. As a result, the Phoenix PM_{10} SIP functions as a long-term operational framework, requiring sustained municipal participation rather than a one-time compliance effort, to ensure continued progress toward attainment and maintenance of the federal PM_{10} standards.

Appendix C – Street Sweeping Standard Operating Procedure, and Best Practices Manual – (APWA 26.1), and Schedule (APWA 26.5)

- Continued on next page-

STANDARD OPERATING PROCEDURES (SOP)	
City of Buckeye - Public Works Department	
SOP Title: **Street Sweeper Program**	
Applicable APWA Chapter: **26**	ID#
Origination Date: **8-14-2025**	Created By: **Jim Sandstrom**
Revision Date: **3-31-2026**	Revised By: **Robert van den Akker**
Approved By:	

Summary:

Implementing Best Management Practices will enable city street sweeping to be conducted efficiently, safely, and sustainably. By integrating strategic planning, specialized equipment management, environmental stewardship, and adaptive operational procedures, the municipality can protect infrastructure, enhance public health, and maintain cleaner suburban environments. Continuous performance review, community collaboration, and operator training are key to the program's long-term success.

Responsibilities:

The Public Works Department is responsible for maintaining the right-of-way.

It is the mission of the Street Sweeper Program to provide regular scheduled street sweeping to remove particulate matter and debris, maintaining the highest possible environmental quality of the right-of-way (ROW) with the purpose of promoting pollution prevention and maintaining a high level of aesthetics.

The Sweeper Program shall:

1. Maintain a debris free right-of-way.
2. Regularly remove dust (PM10 and PM2.5)

Each driver shall:

1. Be responsible for completing their assigned route with as much efficiency and to the best of their ability.

2. Provide the best customer care possible to residents and staff.
3. Be responsibility to perform light duty maintenance on their equipment, including changing brooms, cleaning equipment, and confirming operational order of parts.

Fleet Management: Shall be responsible for engine operations and maintenance, and electronics operations. The Fleet Management Division is the ultimate owner of the street sweeper.

Scope:

This procedure applies to all roads maintained by the city, including arterials, collectors and residential roads.

Materials and Equipment:

All machines shall comply with regional emissions standards (PM10 certified) and are chosen based on the environmental and debris challenges of each area, acceptance by Fleet Management Division on ease of maintenance, and operational knowledge and acceptance of the equipment by Street Sweeping Program staff.

Select between **mechanical** broom sweepers or **regenerative-air** sweepers depending on street conditions, debris types, and dust suppression needs

Equipment Maintenance:

- Routinely inspect and clean brushes, hoses, filters, water nozzles and other specialized components
- Regularly check mechanical parts to ensure optimal function and prevent breakdowns
- Maintain water tanks for dust suppression in a filled and functional state
- Clean sweeper components at the end of each day at designated cleaning stations

Technology Integration: All sweepers are equipped with GPS, real-time tracking, and data logging systems to monitor performance and optimize routes.

Procedures: Follow the route and schedule provided through the approved routing system

- **Site Inspection -** Inspect areas for oversized debris (branches, large trash, wire, rope) that could damage equipment before starting operations
- **Prioritization -** Identify and prioritize routes based on last swept dates and where pollutant buildup is highest
- **Systematic Dust and Debris Control:**
  - Start sweeping at the curb-line to capture debris early
  - Use overlapping passes for complete coverage when required
  - Employ water or other dust-suppression techniques to minimize airborne particulate matter
- **Operational Execution:**
  - Safely drive the sweeper, collect debris, and once full, offload at an approved dumping station
  - Utilize route tracking software to monitor progress and ensure all scheduled areas are serviced
  - Notify the Foreman, through approved recording and reporting methods, of low hanging tree limbs, blocked street signs, residential blower/sweeping debris to the ROW, and on-street parking concerns.
- **End Work Shift:**
  - Staff shall complete their route shift /other sweeper operation duties 45 minutes before the end of the work-day
  - Clean out the hopper and all equipment
  - Hose down the wash out bay
  - Each day, one staff will collect all deposited debris from the sweepers and deliver to the roll-off for disposal

Safety and Compliance:

- **Employee Training -** All street sweeping personnel shall receive ongoing training on:
    - Safe operation of all City sweepers
    - Proper debris disposal methods
    - Proper cleaning of equipment
    - Environmental and pollutant impacts
    - Routing and work order software
- **Safety Equipment –** All workers must use appropriate personal protective equipment (PPE), including high-visibility clothing, gloves, and safety boots when required
- **Regular Refresher Courses –** Certification is updated as required, while training on methods, processes, and common practices occur bi-weekly. Updates are maintained to keep staff informed of new technologies and best practices
- **Improvement with Performance Reviews –** There is a regularly schedule to have a supervisor ride along with the team, as well as field Quality Control checks to analyze sweeping operations, gauge effectiveness, and pinpoint areas for improvement. Additionally, there are check-ins with employees three times per year to discuss operations and job requirements.
- **Adaptive Management –** The team remains prepared to modify sweeping frequency, equipment deployment, or operational procedures based on prioritization changes, or public benefit or need. The minor adjustments are addressed using a work order system, while more significant changes occur using a routing database and system.
- **Environmental Considerations - Pollutant Control -** Sweeper operation processes are continually reviewed to ensure methods effectively collect oils, litter, organic matter, and dust and pollutants to prevent them from entering stormwater drains or be re-entrained.
- **Sustainable Practices -** Techniques and equipment are prioritized which meet the environmental quality standards while remaining financially viable, thereby serving the population.

Operator Performance Metrics

The following metrics will be used for monitoring sweeping efficiency:

- **Miles Swept per Shift:** Measure total distance covered by each operator to assess productivity. Operators are required to sweep a minimum of 25 miles per day to meet performance standards
- **Route Efficiency:** Compare time spent across routes to identify opportunities for adjustment or reassignment
- **Equipment Adaptability:** Designate each operator with a primary sweeper and assign other backup sweepers to build ownership and versatility skills which will also meet the minimum mileage standards set by the city
- **Pickup Effectiveness:** Evaluate how much debris is removed versus left behind. This can be measured through periodic post-sweep inspections

Additional Documentation and Processes

Field Operations and Workforce Needs

- Wide Coverage Areas: Operators manage extensive suburban routes that may span hundreds of square miles
- Mobile Workspaces: Sweepers function as tools, cleaning machines and mobile offices for managing routes and logging performance data and work orders
- Self-Sufficiency: Field operators must be equipped to make real-time decisions, often taking breaks and meals within the cab
- Professional Responsibility: As public representatives, operator professionalism is crucial to maintaining positive community perceptions

Night Shift Considerations - Permanent or Temporary Night Shifts will be considered when:

- High daytime traffic and parking constraints that hinder effective sweeping
- Areas with heavy debris accumulation where day operations are impractical

- Compliance with noise ordinances that limit daytime activity are not a challenge
- Seasonal increases in debris (e.g., Monsoon season) or after other large-scale wind and rain events
- The cost of operating a night shift is less than the cost of daytime interference and improved cleaning efficiency through unobstructed routes, smoother traffic conditions and operator safety

Street Sweepers are Specialized Tools

Street sweepers are purpose-built machinery tools combining complex mechanical, hydraulic, and vacuum systems that far exceed the operational scope of standard city vehicles. They serve not only as vehicles but as dedicated cleaning tools essential for environmental stewardship. Their operation and upkeep require specialized training and maintenance beyond routine vehicle care. There are measurable benefits from reduced pollution, enhanced infrastructure protection, and improved public health as seen through their impact from the Maricopa County Air Quality non-attainment area

Regulatory Compliance and Cost-Effectiveness

All operations must adhere to local, state, and federal regulations concerning stormwater management and air quality, and must maintain comprehensive records and compliance verification

Grant Funding and Strategic Investment

CMAQ Grant Participation - The City of Buckeye shall proactively pursue funding through the Congestion Mitigation and Air Quality (CMAQ) program, administered locally by the Maricopa Association of Governments (MAG). This funding supports the acquisition of PM-10 certified street sweepers

Role of the Public Works Environmental Department - The department will collect and submit all field data such as roadway mileage, sweeping coverage, updating maps, equipment specifications, quotes and any other documents requested from the Finance Department's Grant Manager

Grant Oversight and Application - The Finance Department's Grant Manager is responsible for monitoring MAG's Transportation Improvement Program (TIP) schedules and ensuring timely proposal submission

Alignment with Environmental Goals - CMAQ grants strengthen the city's environmental performance, improve regional air quality, and optimize investments in specialized equipment

Route Expansion and Staffing Protocols

The Environmental division will monitor daily operational metrics and geographic developments to determine when new sweeping routes are needed to maintain service standards. Route expansion includes the addition of new routes, met by the limit of 25 miles per day, and sweeping each road a minimum of every 14 business days. New route consideration will be based on:

- Operator workload averages near or exceeding 25 miles per day
- Growth in sweeping mileage from new roads
- Route completion performance and historical trends

The criteria for evaluating the routes will occurring using GPS data and service logs to track daily operator mileage, monitoring high-debris areas and field reporting, and accounting for seasonal demands and traffic-related debris accumulation

Transitional Coverage Strategy

- Initial coverage of new routes (e.g., Route 6) will be managed by existing drivers:
- All active operators will rotate temporary sweeping duties on new routes
- This interim approach ensures service continuity without immediate hiring

Review Cycle:

- Evaluations will continue as route mileage expands
- Sweeping performance, workload distribution, and equipment utilization will guide future adjustments

Justification for Hiring New Personnel - A full-time operator will be added when

- Route completion rates fall to 60% or below across existing routes, despite temporary reassignment efforts
- Debris levels or public feedback indicate insufficient coverage

Performance Metrics:

- Route completion performance and historical trends
- Operator feedback and fatigue indicators
- Budgetary capacity and fleet readiness

Weather Event Response Protocols

Weather-related responses include monsoon storms, heavy rainfall, windstorms, and other conditions that result in significant debris accumulation. These events require immediate attention to ensure roadway safety and maintain sweeping program continuity.

Deployment Strategy

- Upon the onset of a storm or high-wind event, all available street sweeping personnel will be mobilized for priority cleanup operations
- Operators may be reassigned to temporary routes targeting flood-prone areas where debris—such as sand, rocks, and vegetation—may obscure traffic stop bars, lane lines, and other pavement markings
- Priority is given to collector and arterial roadways, especially those impacting traffic control and safety
- Sweeping activities will begin in areas with the most visible debris, based on field evaluations conducted immediately after the event

Public Safety and Liability Considerations

- Maintaining visible road markings is critical for guiding drivers and preventing traffic incidents
- This "all hands-on deck" approach reflects the City's commitment to prompt storm response
- By rapidly restoring visibility of traffic lines and signage, the risk of vehicular accidents and potential legal claims is significantly reduced

- Crews may coordinate with other departments and divisions for enhanced response capabilities

Metrics for Inclement Weather Response:

- Roadway safety observations and field reports
- Response time and crew deployment efficiency

Current Sweeping Schedule Feb 2026

- Continued on next page -

Sweeping Schedule: Miles and Routes

Feb-26

Total 1105.3

Average: **207.3**

Zone Total:	Route 1	Route 2	Route 3	Route 4	Erik - Route 5	Route 6
	207.8	208.6	213.4	203.8	203.1	68.6

WEEK 1

Route 1 — 100.7

Monday 25.0	
Tartesso Collector Roads	25.0
Tuesday 24.7	
Festival South of Sun Valley Pkwy	23.9
Airport Entrance	0.8
Wednesday 25.2	
Tartesso Unit 2B	22.5
Sundance Parcel 28b	2.7
Thursday 25.8	
Tartesso Unit 2A	21.4
Bentridge	4.4

Route 2 — 103.4

Tuesday 30.1	
Westpark	30.1
Wednesday 24.8	
Sonora Vista	9.3
Riata West & Rosier Rd	15.5
Thursday 23.7	
Tartesso 1AMD	13.0
Phoenix Skyline West One	10.7
Friday 24.8	
Sundance Cove	4.1
Sundance Parcel 15	3.4
Sundance Parcel 17,18,19,20,20a,21	11.6
Coyote Ridge	4.5
Sundance Parcel 23b	1.2

Route 3 — 107.2

Monday 26.3	
Verrado SW Section	15.8
Verrado Parcels 4.501-5.506	3.1
Verrado Marketside	7.4
Tuesday 23.4	
Verrado NE Section	23.4
Wednesday 29.1	
Sundance Parcel #2	5.5
Crystal Vista	5.2
Northwood Park Estates	3.8
Rancho Vista	6
Estrella Vista	8.6
Thursday 28.4	
Verrado Way, Indian School Rd	24.2
Market St	1.1
McDowell Road	3.1

Route 4 — 106.0

Tuesday 26.7	
Sundance parcels #25,26,27	5.8
Canyon Views	20.9
Wednesday 29.7	
Vista De Montana	19.0
Blue Horizons (Middle Part)	10.7
Thursday 24.2	
Sundance #31,32,33,35	7.3
Sundance #10,47,48,49a	5.5
Sundance parcel #42,43,34b	5.9
Van Buren (Jackrabbit to Perryville)	2.0
Sundance Parcels 45a,45b, 45c	3.5
Friday 25.4	
Blue Horizons (Outside)	24.0
Sundance #14	1.4

Route 6 — 68.6

Tuesday 25.6	
Copper Falls	10.7
Villages at Sundance	9.8
Terra Vista	5.1
Wednesday 27.7	
Desert Moon Estates	9.2
Encantada Estates	4.7
Algodon	4.3
Mayfield	3.9
Mystic Vista	5.6
Thursday 0	
Friday 15.3	
Sundance Parcels 22,23a,24,28a,29	7.9
Anderson Parc	3.8
Acacia Crossings	3.6

WEEK 2

Route 1 — 107.1

Monday 26.1	
Festival Ranch East Side	26.1
Tuesday 26.1	
Festival Ranch W of Desert Vista Blvd south of Beardsley Pkwy	26.1
Wednesday 27.3	
Festival Ranch North Area	27.3
Thursday 27.6	
Festival Ranch Various Parcels	27.6

Route 2 — 105.2

Tuesday 24.6	
Sundance parcel # 16	1.8
Windmill Village & Harrison St	11.0
Arroyo Seco South	3.5
Victory Phase 3	2.8
Verrado East District (West Side)	5.5
Wednesday 27.8	
Watson Estates	14.5
Sunset Point	7
Sunset Vista	4.7
Maricopa Road	1.6
Thursday 27.0	
Verrado Victory Phase 6,7 & 8	10.7
Victory Phase 2 & 5	8.9
Verrado Middle West Section	5.3
Monroe Ranch	2.1
Friday 25.8	
O.T.B	25.8

Route 3 — 106.2

Monday 25.8	
Verrado Middle East Section	14.2
Verrado East District	11.6
Tuesday 27.8	
Verrado South Phases A,B,C	11.7
Sienna Hills	16.1
Wednesday 26.1	
Verrado NW Section	18.2
Victory Phase 1	7.9
Thursday 26.5	
Miller Park	1.5
Sunrise Ln, Tiger Mountain	13.5
Victory Blvd, Verrado Way	
Van Buren, 215th, Roosevelt	11.5

Route 4 — 97.8

Tuesday 25.2	
Arroyo Seco North	22.4
Sundance Parcels 12,13	2.8
Wednesday 24.3	
Blue Hills	7.8
Valencia	8.3
Sheppard Estates/Ironwood Vista	3.8
Buckeye Park	1.5
Estrella Gardens	2.9
Thursday 25.3	
Doves Cove	6.0
Miller Manor	4.8
Santarra	5.1
Park Side	4.0
Park Place & 255th Ave	5.4
Friday 23.0	
Sundance # 36,37a,37b,38	8.4
Sundance # 7	4.9
Sundance Parcels 40 & 41	4.9
Sundance Parcels 46a & 46b	4.8

Erik - Route 5

Bi Weekly Sweeping

Rooks Rd (Baseline to Southern)	2.0
Hazen (Westbound only)	0.2
Broadway (SR 85 to Rainbow)	16.0
Southern (W of SR 85 to Rainbow)	12.1
Miller Rd	16.9
Jackrabbit Trail	9.5
Durango Rd (Rainbow to BESD)	4.5
Watson (N of yard at canal to Beloat)	2.5
Beloat /Irwin Rooks to Rainbow	8
Lower Buckeye (Miller to Rainbow)	6.5
Palo Verde and W Buckeye Rd	3.9
Skyline park (North of parcel #7)	5.2
Rooks Rd (Beloat to MC 85)	1
Broadway, Connector, Lwr Buckeye	3.1
Patterson Rd and LP Rd	5.2
Turner Rd	2.6
South 7th Street	0.8
Liberty School Rd	0.5
McDowell (W of Sun Valley Pkwy)	0.5
247th (Yuma to elementary school)	3
Apache (Yuma to Baseline)	9
Yuma Road (199th to Miller)	16.9
Pima Rd, Yuma, 253rd Ave	1.4
Sundance (full loop)	10.7
Sundance Ave	0.2
Watson Road (Parcel 7 to Southern)	11.0
Rainbow (Southern to Yuma)	6.0
Baseline (Miller to West of SR 85)	5.2
Dean Road	3.6
McDowell Rd (195th to Perryville)	1.3

33.8

Weekly Sweeping - High Visibility Areas

Verrado Way (Van Buren to Thomas)	7.6
Watson (Durango to Parcel 7)	5.9
Yuma Road (Apache to Dean	14.8
Miller Road (I 10 to Lower Buckeye	4
Monroe (Miller to 9th St)	1.5

Appendix D – Sweeping Program – Operator Expectations

- Continued on next page-

BUCKEYE
ARIZONA
PUBLIC WORKS

Sweeping Program - Operator Expectations

Effective: April 24, 2025
Update: February 4, 2026

Mission

Help Keep Buckeye Streets Clean

Goal: Provide scheduled sweeping to remove dust and debris from the right-of-way, maintaining the highest possible cleanliness.

Removing dust and debris offers many benefits. Debris removal keeps storm drains clear, reduces the possibility of flooding, prevents pollutants from entering our retention basins and waters, and avoids costly roadway maintenance. It also instills residential confidence in the government work, and reinforces community pride and value. Dust removal keeps neighborhoods and streets as clean as possible, and reduces resuspension of the material due to vehicular traffic, helping maintain healthy air quality.

Expectations include, but are not limited to, the following. New expectations may be added as needed; all Operators will be notified of any updates.

1. Equipment Operation and Maintenance
   1.1. Read and understand this Operator Expectations and the Management Plan.

   1.2. Complete daily pre-trip and post-trip inspections; report critical defects immediately to the Foreman and Fleet Maintenance. Non-critical issues should be scheduled for repair on Friday or Monday to minimize downtime.

   1.3. Read the owner's manual for each sweeper. Know how each component works, and be able to adjust components for best sweeping results with the variety of street surfaces and material types seen or possible in Buckeye.

   1.4. Understand the equipment, and recognize need for replacement of any wear items before they become a problem (i.e. drag shoe wear, etc…).

   1.5. Do not operate the sweeper when a critical defect is found. Pull over safely if discovered while driving.

1.6. Verify repairs when picking up equipment from Fleet Maintenance. If parts are on order, coordinate future service when available, preferably Friday.

1.7. Perform routine maintenance such as greasing bearings, cleaning nozzles, adjusting chains, and changing brooms.

1.8. Keep your sweeper clean - Daily:
   1.8.1. Wash out the hopper, elevator, chains, screen, dust separator, section and blast tubes
   1.8.2. Wash the entire exterior.
   1.8.3. Clean the cab.

1.9. Dump the hopper at the end of each shift, or more frequently.

1.10. Enter all defects in required software and report them upon drop-off to Fleet Maintenance.

1.11. Return tools to storage after use, report lost or missing tools immediately. Clean and organize tool yard, maintenance area whenever used.

1.12. Picking equipment up from Fleet Maintenance: visually inspect each defect in the maintenance logbook. Verify that the defects have been corrected. Report defects not marked as completed or not addressed to the Foreman immediately.

1.13. Perform routine equipment maintenance including, but not be limited to, greasing bearings, broom adjustments, cleaning water nozzles, changing drag shoes, adjusting chains, identifying any wear items before they become a problem.

2. Sweeping Standards and Procedures
   2.1. Ensure curb-to-curb cleaning, re-sweeping areas as needed to achieve desired results. Sweep the turn lanes in the medians.

   2.2. Maintain a sweeping speed of 5 mph, not exceeding 7 mph in residential areas.

   2.3. Use all available water during sweeping to control dust and prevent component damage; clean nozzles immediately if clogged and never run the sweeper without water.

   2.4. Use the closest dump site and metered hydrant; minimize travel time and do not return to the yard early.

   2.5. Avoid damage hazards such as branches, wires, or large debris/rocks, dead animals. Remove these items manually or call the Foreman for assistance.

2.6. After storms, prioritize emergency cleanup areas where debris blocks traffic markings or poses safety risks.

2.7. Festivals and special events – remain in assigned zones all day, use the designated water and dump site, and return to the yard at your regular cleaning time.

3. Communication and Reporting
   3.1. Notify the Foreman any time equipment is returned to Fleet Maintenance for repair or service.

   3.2. Track daily sweeping mileage and report monthly totals on the last workday of each month.

   3.3. Communicate promptly regarding critical defects, accidents, or incidents—contact your Foreman immediately, or Manager as needed.

   3.4. If non-critical parts need replacement, schedule with the Foreman and Fleet.

   3.5. Participate in biweekly Sweeping Crew meetings and monthly safety meetings.

   3.6. When assigned on-call duty, text Operations Manager, Robert van den Akker, 623-208-3640, when leaving home (include location and reason) and report again upon job completion.

   3.7. Notify the Foreman if calling in sick or when requesting time off (at least one week's notice on the Foreman's calendar).

4. Performance, Safety, and Conduct
   4.1. Be proficient in Routeware and Cartegraph systems.

   4.2. Adhere to performance measures:
      4.2.1. Sweep 25 miles per day
      4.2.2. Contact the Foreman for additional assignments when finished
      4.2.3. Minimize downtime and remain productive

   4.3. Safety: Always wear a safety vest outside the sweeper, always wear a seat belt while operating, and never text or use or handheld phone while driving.

   4.4. Have breakfast or coffee before reporting to work; stops for purchases after clock-in, aside from approved lunch and break times, are not permitted.

   4.5. Assist the Environmental Program Team during equipment downtime.

4.6. Leave yard promptly after vehicle check, and return to yard at or after approved shift end time.

These expectations may be updated at anytime

Appendix E - Resident Facing Data

- Continue on next page -

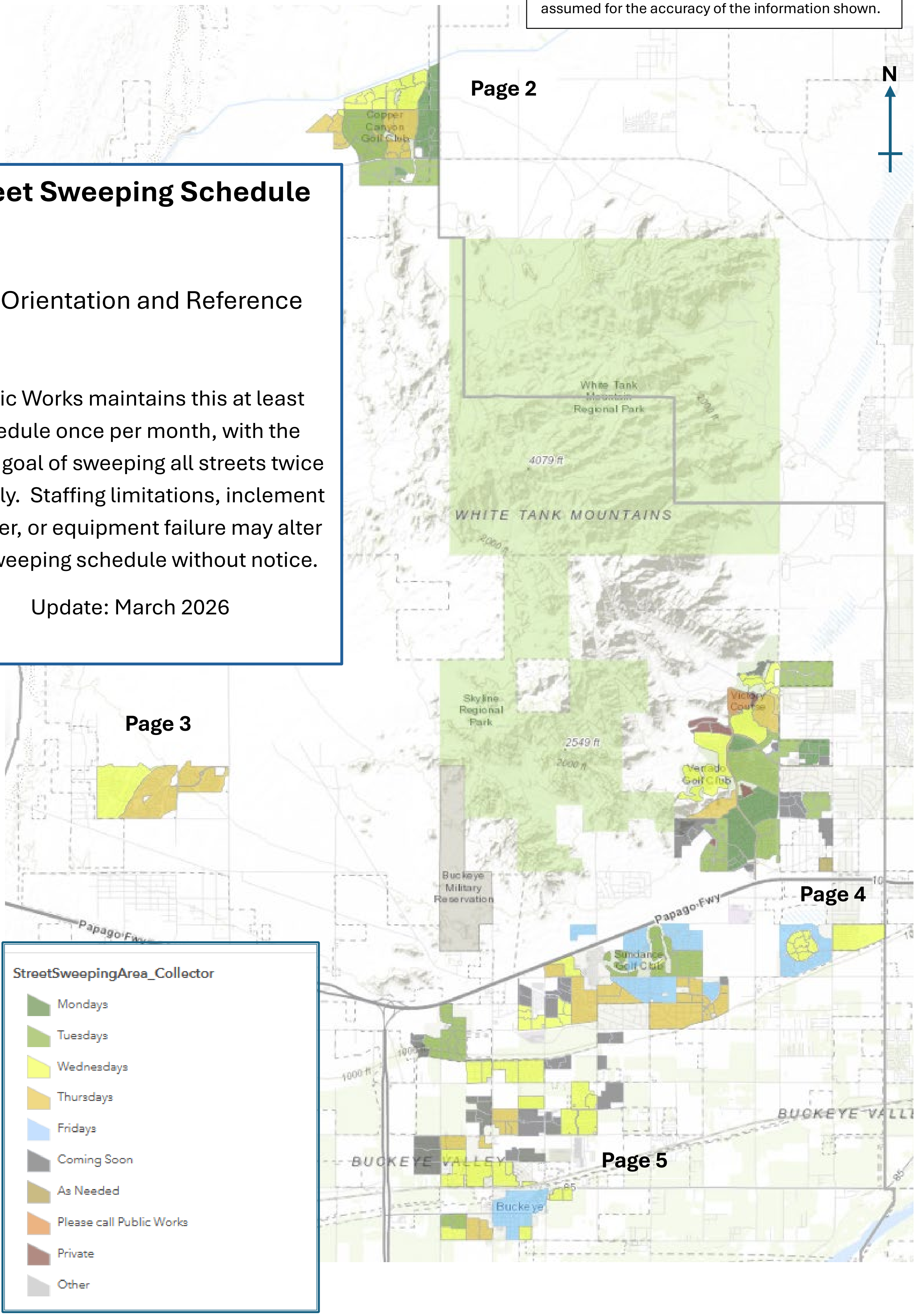
Information on all maps is for sweeping program purposes only. This map is not warranted for legal or professional purposes. The user accepts all limitations, including missing, incomplete, or incorrectly depicted mapping data. No liability is assumed for the accuracy of the information shown.

Street Sweeping Schedule

For Orientation and Reference

Public Works maintains this at least schedule once per month, with the higher goal of sweeping all streets twice monthly. Staffing limitations, inclement weather, or equipment failure may alter the sweeping schedule without notice.

Update: March 2026



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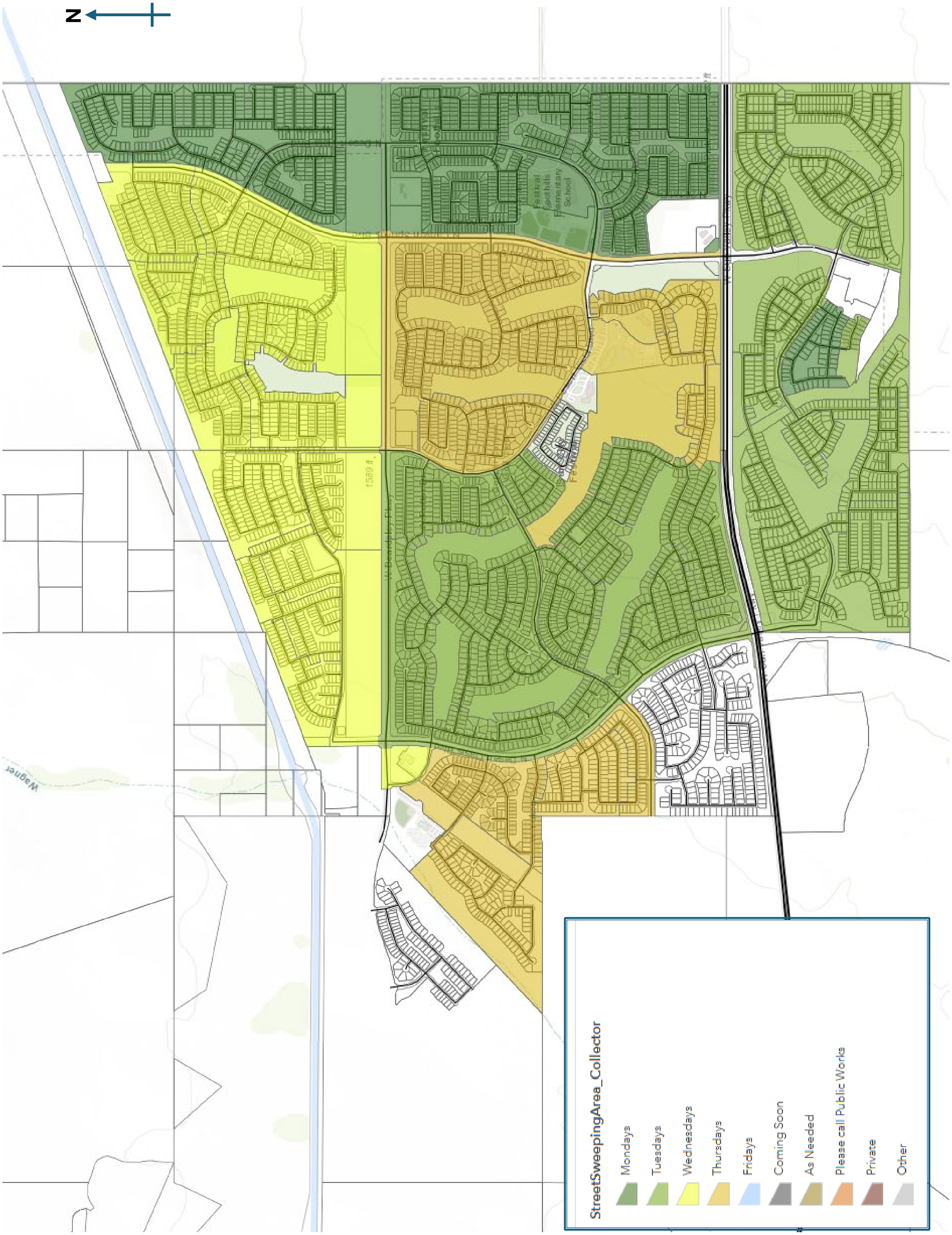
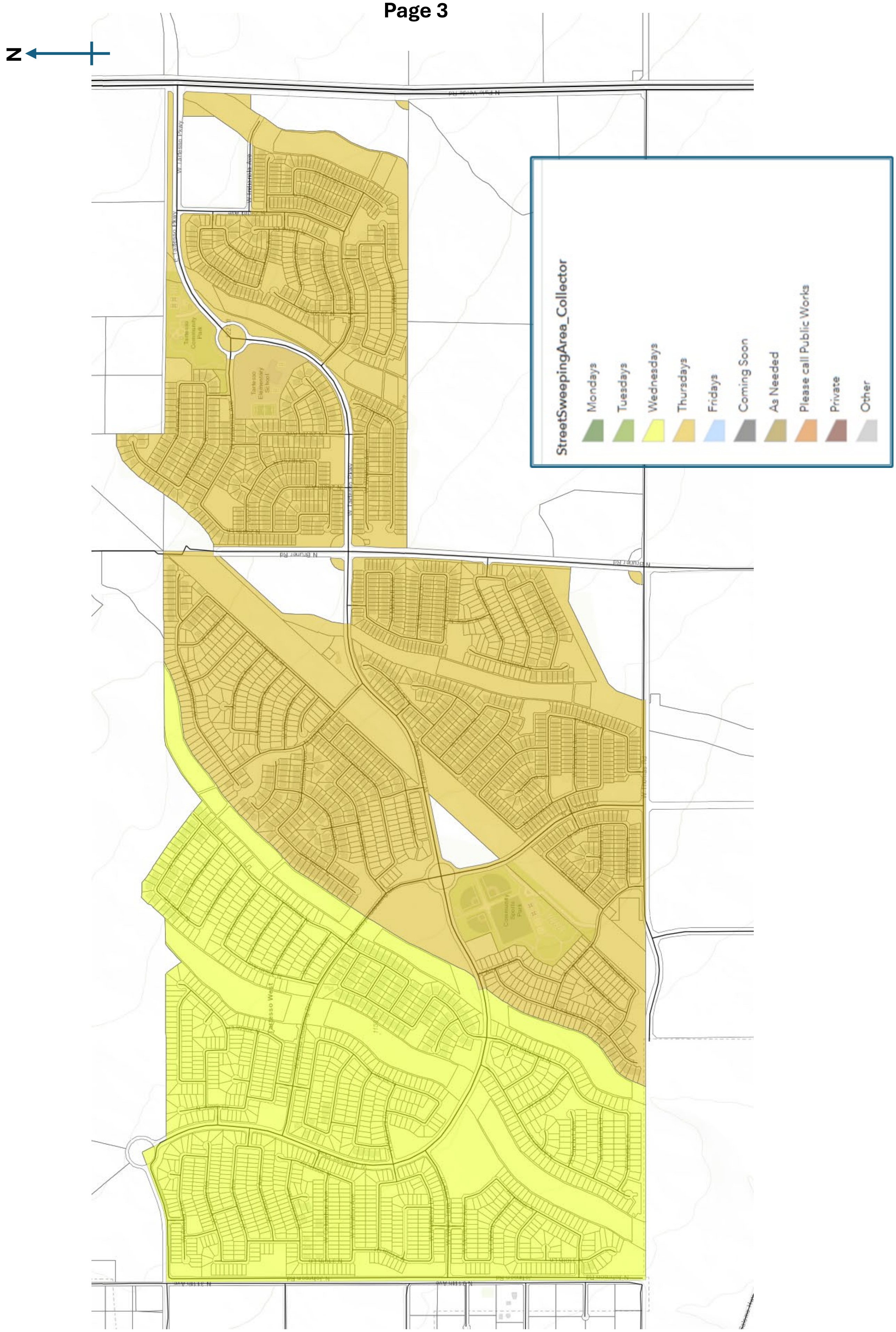

N
StreetSweepingArea_Collector
Mondays
Tuesdays
Wednesdays
Thursdays
Fridays
Coming Soon
As Needed
Please call Public Works
Private
Other

Page 3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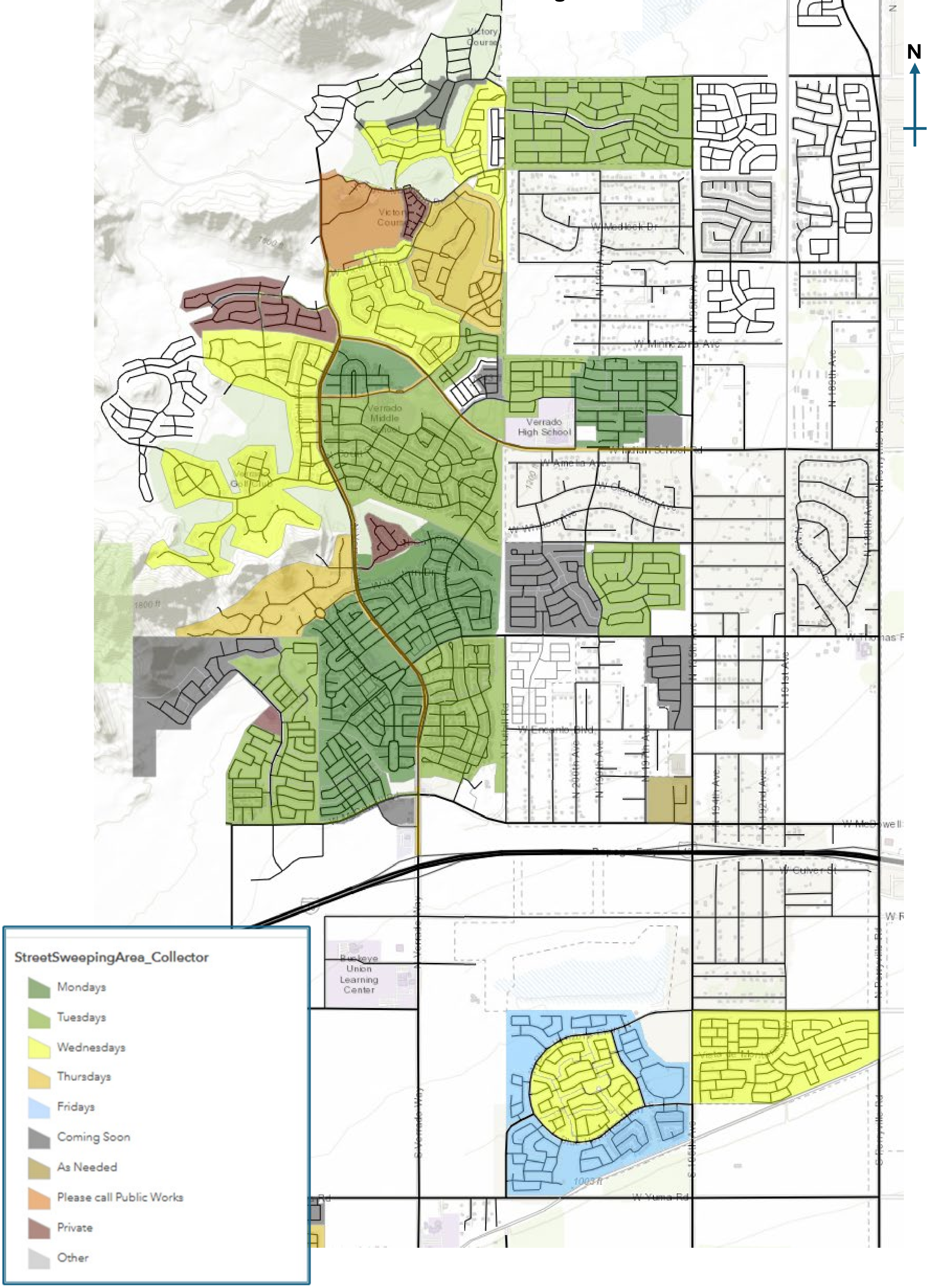
As Needed
Please call Public Works
Private
Other

Page 4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W Medlock Dr
W Minnezona Ave
Verrado High School
Verrado Middle School
W Indian School Rd
W Amelia Ave
W Encanto Blvd
W McDowell
W Culver St
W Yuma Rd
Buckeye Union Learning Center
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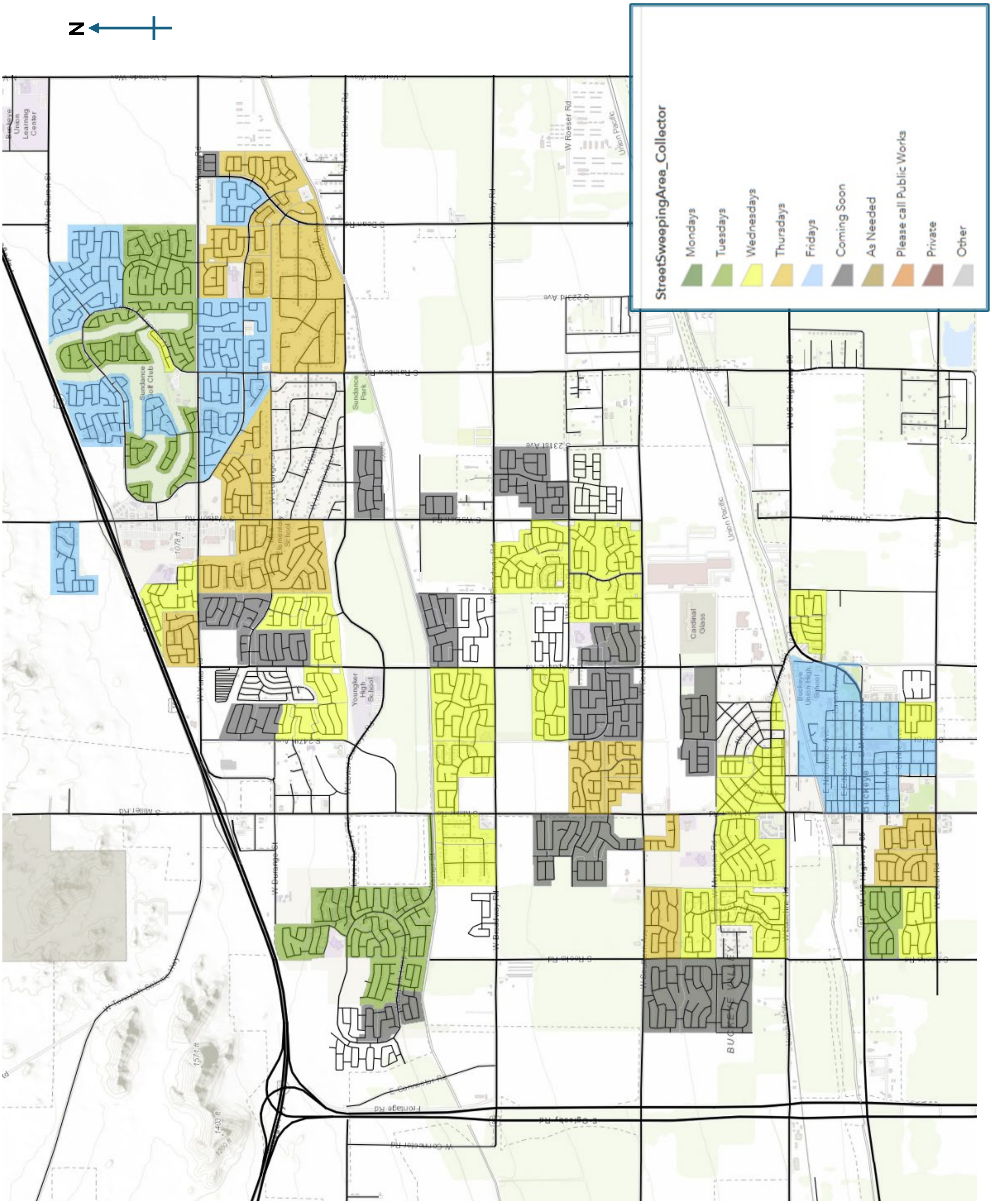
Coming Soon
As Needed
Please call Public Works
Private
Other

Page 5


N
StreetSweepingArea_Collector
Mondays
Tuesdays
Wednesdays
Thursdays
Fridays
Coming Soon
As Needed
Please call Public Works
Private
Other

Appendix F – Maricopa County ORDINANCE P-25, Buckeye Public Works NOC/NOV

- Continue on next page -

ORDINANCE P-25

MARICOPA COUNTY ORDINANCE
AIR POLLUTION CONTROL REGULATIONS
P-25
LEAF BLOWER RESTRICTION

INDEX

Adopted 02/20/08

SECTION 1 – GENERAL

A. **PURPOSE:** The Leaf Blower Restriction Ordinance prohibits the use of leaf blowers for the following activities:

1. Blowing of landscape debris into public roadways; and
2. Operating leaf blowers on surfaces that have not been stabilized.

B. **APPLICABILITY**: The Leaf Blower Restriction Ordinance applies to the operation of leaf blowers in sections of Area A that are within Maricopa County, including those areas within incorporated cities and towns in such sections.

SECTION 2 – DEFINITIONS: For the purpose of this ordinance, the following definitions shall apply:

A. **AREA A** – As defined in Arizona Revised Statutes (ARS) §49-541(1), the area in Maricopa County delineated as follows:
Township 8 North, Range 2 East and Range 3 East
Township 7 North, Range 2 West through Range 5 East
Township 6 North, Range 5 West through Range 6 East
Township 5 North, Range 5 West through Range 7 East
Township 4 North, Range 5 West through Range 8 East
Township 3 North, Range 5 West through Range 8 East
Township 2 North, Range 5 West through Range 8 East
Township 1 North, Range 5 West through Range 7 East
Township 1 South, Range 5 West through Range 7 East
Township 2 South, Range 5 West through Range 7 East
Township 3 South, Range 5 West through Range 1 East
Township 4 South, Range 5 West through Range 1 East

B. **ENFORCEMENT OFFICER:** Any officer of Maricopa County that has authority to enforce County rules, regulations and ordinances.

C. **LANDSCAPE DEBRIS:** Debris generated or accumulated as a result of, or moved in the course of, landscape operations. Landscape debris includes, but is not limited to, grass clippings, leaves, branches, vegetative matter, rubbish, soil and rock.

D. **LEAF BLOWER**: Any device that generates a stream of air that is designed, or used, to move landscape debris.

E. **PERMITS FOR THE CONTROL OF FUGITIVE DUST FROM DUSTGENERATING OPERATIONS:** Any site that has been issued a permit by the Control Officer as required by Rule 200 §305 of the Maricopa County Air Pollution Control Rules and Regulations.

F. **PERSON:** Any individual, public or private corporation, company, partnership, firm, association or society of persons, the federal government and any of its departments or agencies, or the state and any of its agencies, departments, or political subdivisions.

G. **PUBLIC ROADWAY:** Any street, alley, road, highway or thoroughfare of any kind that is used by the public or that is open to the public as a matter of right, including those roadways within gated communities, for the purpose of vehicular travel.

H. **STABILIZED SURFACE:** As defined in A.R.S.§11-877(A)(3), stabilized surfaces are surfaces that have been treated with asphaltic concrete, cement concrete, hardscape, penetration treatment of bituminous material and seal coat of bituminous binder and a mineral aggregate, decomposed granite cover, crushed granite cover, aggregate cover, gravel cover, grass or other continuous vegetative cover, or any combination of these stabilizers.

SECTION 3 – REQUIREMENTS

A. **RESTRICTED OPERATION OF A LEAF BLOWER:**

1. A person shall not operate a leaf blower in a manner that causes landscape debris to be blown into a public roadway.
2. A person shall only operate leaf blowers on a stabilized surface.

B. VIOLATIONS, NOTICES, AND PENALTIES:

1. When the Enforcement Officer has reasonable cause to believe that any person has violated or is in violation of any provision of this ordinance, the Enforcement Officer shall issue, for the first violation of this ordinance, a warning notice stating which requirement of the ordinance was violated.
2. The Enforcement Officer may impose a civil penalty of $50 for the second violation of this ordinance. Upon a third violation of this ordinance, the Enforcement Officer may impose a civil penalty of $100. After the fourth and subsequent violations of this ordination, the Enforcement Officer may impose a civil penalty of $250.

SECTION 4 – EXEMPTIONS

A. **SITES WITH PERMITS FOR THE CONTROL OF FUGITIVE DUST FROM DUST-GENERATING OPERATIONS:** Any site that has been issued a permit by the Control Officer for the control of fugitive dust from dust-generating operations is exempt from all sections of this ordinance.

BUCKEYE, AZ

NOTICE

CITY OF BUCKEYE
Public Works Department

Select one: Notice of Opportunity to Correct (NOC) a violation / Notice of Violation (NOV)

Address: ______________________ APN: ______________
Date: __________ Time: __________ Re-Inspection Date: ______________
City Staff: ______________________ Phone: 623-349-________

Responsible Party: ______________________ **Signature:** ______________

Corrective action needed: ______________________ action needed by date: ______________

In accordance with §9-1-8, §9-4-1-D., §9-9-5, §20-14-1, the City has the right to enter residential, commercial, industrial, and institutional establishments for inspection related to compliance with city code for solid waste storage, collection and safety, environmental health (sanitation) compliance, and to ensure protection of the right of way. You may obtain the City of Buckeye code on municode.com

It is your duty to resolve the violations noted below as quickly as possible:

General Pollution Prevention, Solid Waste Storage, Stormwater, and Construction

- ☐ Residential subscription required §9-1-5, §9-2-1-A.
- ☐ Payment of service required §9-1-5
- ☐ Solid Waste and Recycling must be placed before 5:30am §9-1-10
- ☐ Waste must be bagged and tied §9-2-2-B.4, §9-4-3-B.2
- ☐ Illegal dumping/waste storage/waste transit: shall not create a health hazard, safety hazard or public nuisance §9-1-11-K., §9-2-6-A., §9-4-3-B.1. , B.9., and B.10.
- ☐ Dirt track-out 25' or more not allowed §9-9-3-D.5.
- ☐ Dirt road traffic speed shall be <15 MPH §9-9-3-G.
- ☐ Excessive water discharge not allowed §10-3-13
- ☐ Treatment of sewage required §16-5-4
- ☐ Incineration without a permit not allowed §9-4-3-B.7.
- ☐ Automotive tires not allowed §9-2-3-D.2., §9-2-4-L.9.
- ☐ Medical waste not allowed in residential trash §9-2-2-B.6.
- ☐ Hazardous or other prohibited materials not allowed §9-2-3-D., §9-1-11
- ☐ Freon containing materials not allowed §9-2-3-D.5.
- ☐ Premises that are nauseous, foul or offensive to the senses or prejudicial to the public health or comfort prohibited §10-3-8.
- ☐ ROW encroachment by any material prohibited §19-2-1-D
- ☐ Human and animal waste disposal required §16-5-3
- ☐ Approved sewage treatment system required §16-5-4
- ☐ Sanitary conditions required §9-1-11-K & L, and §9-2-6-A
- ☐ Approved method of waste storage required 9-4-3-B.2.
- ☐ Littering/waste on public or private property, in unapproved way prohibited (trash, refuse, human/animal waste) §9-1-11-L., §9-4-3-B.1, §10-3-5, §16-5-3
- ☐ Demolition/construction waste 30 day limit §9-4-3-B.6.

Carts – Trash and Recycle - residential

- ☐ Extra trash cart not accounted for §9-1-9-A.
- ☐ Use City provided cart §9-1-11-A.
- ☐ Do not damage cart §9-1-11-D.3.
- ☐ Cart too heavy (200lbs) §9-1-11-M.
- ☐ Place out after 6pm on the day preceding collection §9-2-2-B.2.
- ☐ Remove cart by 11pm on collection day §9-2-2-B.2.
- ☐ Customer shall maintain a sanitary cart §9-1-11-D.
- ☐ Place cart facing street and next to sidewalk in street §9-2-2-B.1.,
- ☐ Place cart on pad in alley (Verrado) §9-2-2-B.1., or
- ☐ Place cart <2 feet from road if no sidewalk §9-2-2-B.1.
- ☐ Lid must be closed §9-2-2-B.3., §9-1-11.D.4.
- ☐ Cart contents must fall out of cart easily §9-2-2-B.5.
- ☐ No Construction debris allowed in cart §9-1-14, §9-2-3-B.
- ☐ Recyclables shall not be bagged §9-2-2-B.8.
- ☐ Only recyclable materials in recycle cart §9-4-3-B.11., §9-2-2-B.9.
- ☐ Cart placement/removal by City only §9-2-1-G
- ☐ Required to collapse cartons §9-1-11-D.4.G., §9-2-4-K.7.
- ☐ Required to soak ash §9-1-11-D.4.G., §9-2-4-K.7.
- ☐ City staff may enter property to take cart at termination of service §9-1-11-O
- ☐ Interfering with collection not allowed §9-4-3-B.8.
- ☐ Tree in ROW-18' height clearance required §9-1-13-A.
- ☐ Obstacle-15' clearance from trash required §9-1-13-B.
- ☐ Poorly maintained container prohibited 9-4-3-B.3.
- ☐ Cause interference with collection 9-4-3-B.4. & 8.
- ☐ Mishandling hazardous waste prohibited §9-4-3-B.9
- ☐ Burning of waste prohibited 9-4-3-B.7.
- ☐ Contaminating recyclables prohibited 9-4-3-B.11.
- ☐ Scavenging prohibited 9-4-3-B.12.

Bulk Trash - residential

- ☐ Placed out for collection the weekend before pick-up (but no earlier) §9-2-4-B. & C.
- ☐ Shall be placed on resident's property, shall be curbside, not in an alley, on sidewalk or street §9-2-4-E.
- ☐ Not placed near anything that would interfere with collection (5' clearance) §9-2-4-F.
- ☐ Pile shall be 6' × 6' × 6' or less §9-2-4-G.
- ☐ Thorny branches/cacti shall be boxed §9-2-4-J.
- ☐ Long items must be <3'long, <50lbs, and bundled – stacked and tied §9-2-4-L.
- ☐ Bag loose/small items §9-2-4-L.4.
- ☐ Construction debris <25lbs §9-2-4-L.

Appendix G - Street Sweeping Benchmarking Study: Greater Phoenix Area

- Continue on next page -

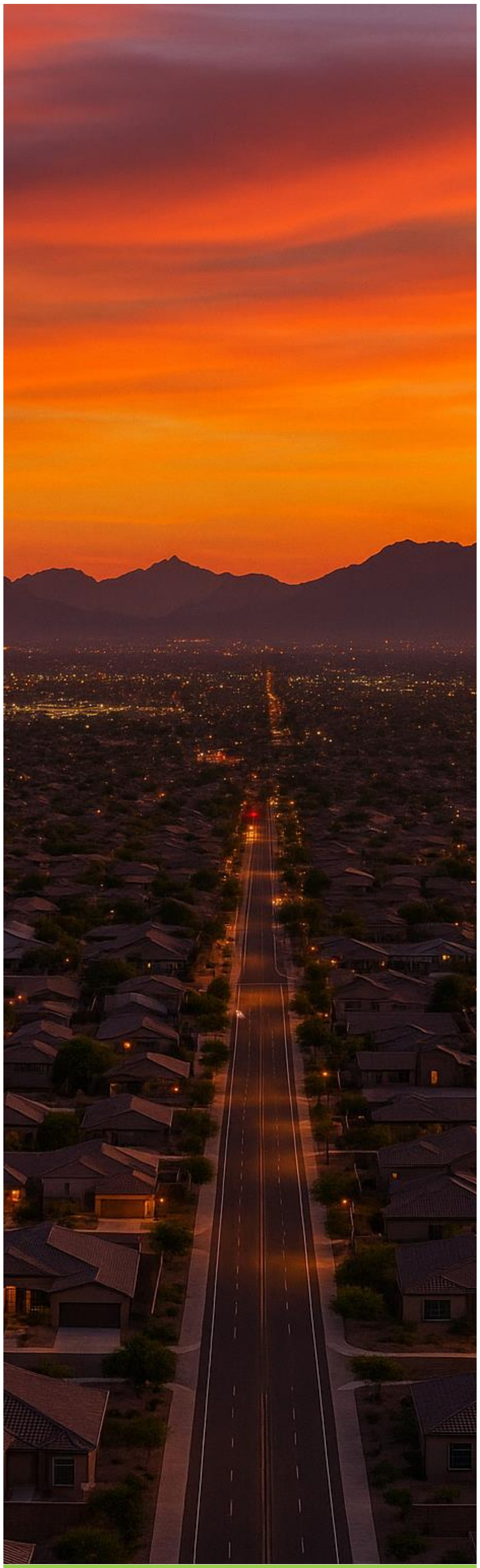
BURGESS & NIPLE

REPORT

Street Sweeping Benchmarking Study: Greater Phoenix Area

City of Buckeye, Arizona | December 2025

CONTENTS



Sections

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1.0 Introduction & Study Objectives

The City of Buckeye (Buckeye) engaged Burgess & Niple, Inc. (B&N) to perform a street sweeping benchmarking study to evaluate Buckeye's street sweeping program in relation to peer municipalities. Street sweeping operations represent an important component of municipal public works services, contributing to stormwater management, roadway maintenance, aesthetic quality, and environmental compliance. Understanding how operational practices, resource allocation, and service delivery approaches compare across municipalities of varying sizes and characteristics provides valuable context for program planning and management decisions.

This study focused on operational characteristics, resource allocation, and program practices of peer municipalities within the greater Phoenix area.

The municipalities included in the study were:

1. Buckeye, City of
2. Casa Grande, City of
3. Chandler, City of
4. Gilbert, Town of
5. Glendale, City of
6. Goodyear, City of
7. Mesa, City of
8. Peoria, City of
9. Phoenix, City of
10. Scottsdale, City of
11. Surprise, City of
12. Tempe, City of

These municipalities varied in population, geographic area, and population density, providing diverse operational contexts for comparison. **Figure 1.1** illustrates the geographic distribution of the participating municipalities within the study area.

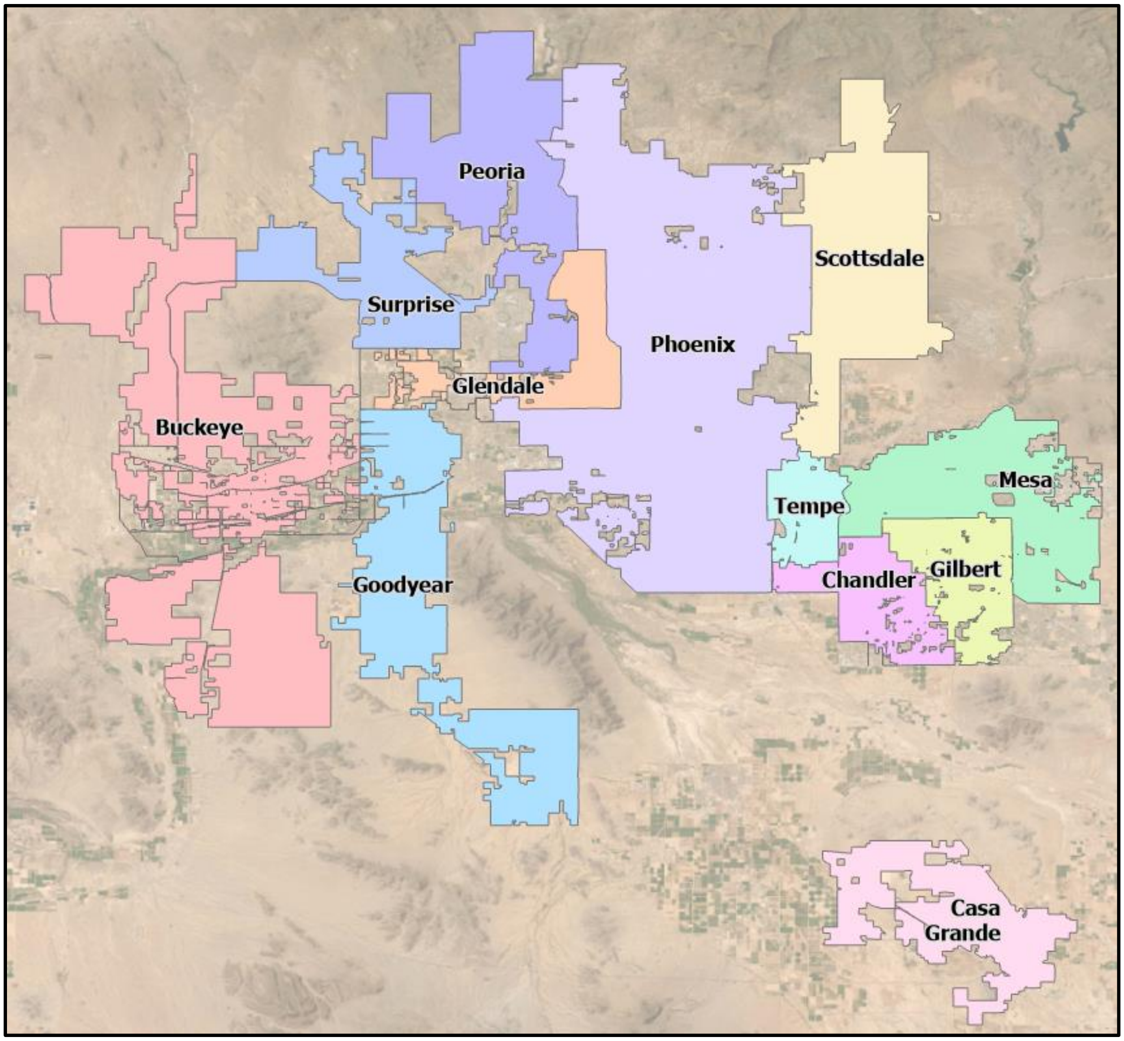
Each municipality provided information through a structured questionnaire process. Data collected included fleet types and capacities, operator staffing levels and training, daily shift characteristics, water and debris management practices, service frequencies, productivity measures, and tracking methodologies.

The objectives of the study were to:

1. Compile and present standardized data on street sweeping operations across participating municipalities.
2. Identify trends, common practices, and notable variations in the received data.
3. Compare Buckeye's program characteristics to those of its peers.

This report presents the benchmarking dataset, analyzes operational patterns and trends across participating municipalities, and provides focused comparison of Buckeye's program to peer practices. Throughout the analysis, consideration was given to the diverse operational contexts represented by the participating municipalities. Differences in population size, geographic area, population density, road network characteristics, climate conditions, regulatory requirements, policy objectives, and budget constraints influence street sweeping operations.

Figure 1.1 Distribution Map of Studied Municipalities



2.0 Methodology

B&N followed a structured approach to gather and analyze information for this study. The process was designed to collect verified data from peer municipalities that reflected the municipalities' practices and operational characteristics at the time of data collection. The following subsections describe the methodological approach, data sources, calculations, quality control measures, and limitations of the study.

2.1 Study Approach and Scope

B&N staff met with Buckeye staff to review project objectives and confirm the scope of the benchmarking effort. This meeting established the key areas of interest and the types of information needed for the study. During the meeting, Buckeye and B&N determined the municipalities to be included in the study, based on geography and operational similarities within the greater Phoenix area.

The study sought to capture quantitative performance data and qualitative operational approaches of 11 municipalities (excluding Buckeye) to provide context for Buckeye's street sweeping program. Of the 11 municipalities included, B&N received responses from all of them. Buckeye's data was included in the data analysis, for a total of 12 municipalities in this study.

2.2 Data Collection and Sources

B&N developed a questionnaire tailored to capture details on street sweeping operations. The questionnaire was structured to collect information across the following topic areas:

1. Street sweeper types and equipment specifications
2. Number and types of street sweepers in active service
3. Water holding capacity by sweeper type
4. Water fill policy, locations, and average one-way distance and time
5. Debris disposal/drop-off method, sites, and average one-way distance and time
6. Operator shift duration and breakdown (broom-down time vs. non-sweeping activities)
7. Daily mileage tracked and tracking methodology
8. Service frequency and scheduling practices by road classification
9. Sweep cycle and schedule by road classification
10. Routine maintenance practices for sweepers
11. Approximate sweeping speed by road classification
12. Typical number of hours per operator per day on non-sweeping duties
13. Average miles swept per operator per day and per month
14. Approximate municipal area
15. Total lane miles scheduled per sweep cycle
16. Full-time sweeping operators and typical years of experience

The questionnaire was distributed to designated contacts at the identified peer municipalities. Responses were received and reviewed for completeness and clarity. Where additional detail was needed, B&N provided follow-up questions to selected municipalities to confirm or expand on their initial responses.

In addition to the questionnaire data, B&N collected supplementary data from the following sources:

- U.S. Census Bureau: 2020 population data for participating municipalities
- Maricopa Association of Governments (MAG): 2024 population estimates for participating municipalities

2.3 Key Metrics and Calculations

The collected data was organized and normalized to enable comparative analysis across municipalities of different sizes and characteristics. Several calculated metrics were developed to facilitate meaningful comparisons.

2.3.1 Projected 2025 Population

The projected 2025 population of each municipality was calculated based on 2020 U.S. Census Bureau data and 2024 MAG population data to provide a consistent baseline for normalized comparisons. The Compound Annual Growth Rate (CAGR) for each municipality was calculated based on the 2020 and 2024 population data. The projected 2025 population was calculated by multiplying the 2024 population data by the respective CAGR. A four-year exponent was applied to address post-pandemic volatility by assuming geometric growth from 2020 to 2024.

Mathematical Formula:

$$\text{CAGR} = \left(\frac{P_{2024}}{P_{2020}}\right)^{1/4} - 1, \quad P_{2025} = P_{2024} \times (1 + \text{CAGR})$$

Where P = Population

2.3.2 Population Density per Square Mile

Population density was calculated as the projected 2025 population per square mile within the incorporated boundaries of each municipality. The projected 2025 population was divided by the approximate incorporated area of the municipality in square miles.

Mathematical Formula:

$$\text{Population Density} = \frac{\text{Projected 2025 Population}}{\text{Area (sq mi)}}$$

2.3.3 Operators per 100,000 Residents

This metric normalized operator staffing levels relative to population served, enabling comparison across municipalities of different sizes. The number of full-time equivalent (FTE) operators was divided by the projected 2025 population, and the result was multiplied by 100,000.

Mathematical Formula:

$$\text{Operators per 100k} = \frac{\text{Number of Operators}}{\text{Projected 2025 Population}} \times 100{,}000$$

2.3.4 Operators per 100 Square Miles

This metric normalized operator staffing levels relative to geographic service area, providing context for spatial workload distribution. The number of FTE operators was divided by the municipality's incorporated area in square miles, and the result was multiplied by 100.

Mathematical Formula:

$$\text{Operators per 100 sq mi} = \frac{\text{Number of Operators}}{\text{Area (sq mi)}} \times 100$$

2.3.5 Water Fill and Debris Dump Time and Distance Conversions

Some municipalities provided water fill and debris dump data in minutes, while others provided data in miles. To enable comparison, B&N converted time-based values to distance and vice versa using a standardized assumption. Travel speed of off-route travel to fill water tanks or dump debris was assumed to be 25 miles per hour (mph).

Mathematical Formulas:

$$\text{Distance (miles)} = \frac{\text{Time (minutes)}}{60} \times 25\text{ mph}$$

$$\text{Time (minutes)} = \frac{\text{Distance (miles)}}{25\text{ mph}} \times 60$$

2.4 Data Verification and Quality Control

Responses received from municipalities were reviewed for completeness, clarity, and internal consistency. Where questions arose regarding reported values or apparent inconsistencies, B&N conducted follow-up communications with municipality contacts to verify or clarify the data.

During the review process, B&N identified instances where reported data appeared anomalous or where units of measurement were inconsistent with other responses. In cases where anomalous values could not be confirmed or readily converted to comparable units through follow-up communication, those specific data points were excluded from the comparative analysis. This approach was taken to maintain data integrity and avoid misrepresenting municipal operations. Data gaps existed where municipalities were unable to provide information for certain questions. These gaps were documented and are noted in the analysis where they impact comparative observations.

2.5 Study Limitations and Assumptions

The study was subject to several limitations and relied on key assumptions that should be considered when interpreting the findings:

Data Collection Period: The data collected represented a snapshot of operations at the time municipalities completed the questionnaire. Operational practices, staffing levels, equipment, and performance metrics may have changed since data collection.

Self-Reported Data: Information was provided by municipal staff based on their knowledge and available records. Variations in record-keeping practices, tracking methodologies, and data availability influenced the completeness and precision of responses.

Operational Definitions: Municipalities may have interpreted questionnaire terms differently. For example, definitions of "broom-down time," "lane miles," and "non-sweeping activities" may have varied across municipalities based on local conventions and tracking practices.

Missing Data: Not all municipalities provided responses to all questions. Missing data limited certain comparative analyses. Where data was incomplete, the affected municipalities were excluded from specific calculations or comparisons.

Calculation Assumptions: Several assumptions were made to enable data normalization and comparison. For example, travel speed for water fill and debris dump activities was assumed for time-to-distance conversions and operator counts were assumed to represent full-time equivalent positions dedicated to street sweeping operations when not explicitly stated by the municipality.

Geographic and Operational Context: Municipalities in the study varied significantly in population size, geographic area, population density, road network characteristics, climate conditions, and policy priorities. These contextual factors influenced operational practices and performance metrics in ways that may not be fully captured by the quantitative data collected.

Anomalous Data Exclusion: Where data appeared inconsistent with other responses and could not be verified or converted to comparable units, specific data points were excluded from analysis. This approach was necessary to maintain data quality but may have resulted in incomplete representation of certain municipalities in specific comparisons.

Road Classification Ratio Assumption: Per the U.S. Department of Transportation Federal Highway Administration 2022 Highway Statistics Series for Public Road Lengths, Arizona, it was assumed that the percentages of the road classifications in the studied municipalities were as follows:

Interstate/Highway	Arterial	Collector	Local/Residential
1.6%	10.8%	17.4%	70.3%

3.0 Benchmarking Data & Results

3.1 Benchmarking Data Overview

The data collected from participating municipalities was compiled into a summary table to facilitate comparative review. Figure 3.1 presents the key operational metrics, staffing characteristics, and performance data reported by each municipality. The data was analyzed to identify patterns, operational trends, and notable variations in street sweeping practices across the peer municipalities.

Selected metrics were plotted graphically to enable visual analysis and comparison. The following figures present operational and performance characteristics that illustrate the diversity of approaches and outcomes across the participating municipalities. The charts focus on key metrics that influence operational efficiency, resource allocation, and service delivery.

Figure 3.1 Benchmarking Table

		Municipality Name											
#	Topic	Buckeye	Casa Grande	Chandler	Gilbert	Glendale	Goodyear	Mesa	Peoria	Phoenix	Scottsdale	Surprise	Tempe
1	Street sweeper types & how many types each operator is trained to use	**Types:** Regenerative air; Mechanical. **Training**: Both.	**Types:** Mechanical. **Training**: Mechanical.	**Types:** Mechanical; Regenerative air. **Training**: Both*.	**Types:** Mechanical; Regenerative air. **Training**: Both*.	**Types:** Mechanical. **Training**: Mechanical.	**Types:** Regenerative air; Mechanical. **Training**: Both*.	**Types:** Mechanical; Regenerative air. **Training**: Both.	**Types:** Mechanical. **Training**: Mechanical*.	**Types:** Mechanical. **Training**: Mechanical.	**Types:** Regenerative air. **Training**: Regenerative air.	**Types:** Mechanical; Vacuum. **Training**: Both*.	**Types:** Mechanical. **Training**: Mechanical*.
2	Water-holding capacity (gallons) by sweeper type	Regenerative air, 475 gal; Mechanical, 360 gal.	Broom Bear, 350 gal; Pelican, 225 gal.	Xbroom, 300 gal; TYMCO 600, 220 gal.	330 gal.	Mechanical, 300 & 400 gal.	Regenerative, 200 gal; Mechanical, 300 gal.	Xbroom, 300 gal; Tennant, 100 gal.	Typical 280–300 gal; Average 300 gal.	Elgin Broom Bear, 360 gal; Avalanche 350 gal.	TYMCO 600, 220 gal; Elgin RegenX, 270 gal.	Broom Bear, 300 gal; TYMCO, 330 gal; Schwarze, 650 gal.	Xbroom, 300 gal.
3	Water fill: policy, locations, average one-way distance/time	Designated hydrants; 7 locations; **~2 mi**	Any hydrant; 15-20 locations; **<0.25 mi**	Yard fill (Armstrong Yard); **~15 min**	2 set yards (North and South); Any hydrant if needed; Average one-way not tracked	Assigned hydrants (not required); **~20 mi**	Any hydrant; **<1 mi**	Permit hydrants (5 total); **~5 mi**	Reclaimed water at 2 sites (MOC & WRF); 4 designated hydrants as backup; **~15 min**	Closest available hydrant; within a few blocks (**<1 mi****)	Any hydrant; **~3–5 min**	Designated hydrants (9 total); **~7 mi**	Yard at 2090 W Rio Salado or Kyrene South water plant; Any hydrant if needed; **~10–15 min**
4	Debris disposal: method, # of dump sites, average one-way distance	4 dump sites; **~4 mi**	Transfer site, 2 dump sites; **4-5 mi**	Yard; Otto Trucking hauls to Butterfield Landfill; 7–10 end-dump loads/month	Roll-offs: 2 North yard and 2 South yard	2 locations: Glendale Municipal Landfill & Yard (2×15 yd roll-offs); **~15–20 mi**	Central dump site; **~10 mi**	Permitted dump sites 7; **~5 mi** (often co-located with hydrants)	5 dump sites; 2 x 20-yd bins at each site; **~5–6 mi** (far NE portion farther)	Transfer to dump truck unless near yard; dump 3–4×/day; **0 mi*****	3 sites (N, central, S)	1 central site; **~5 mi**	3 roll-offs: 2 at Yard, 1 at Kyrene plant
5	Operators shift duration and broom-down time	**Shift duration:** 10 hr/day; **Broom-down:** ~5.4 hr/day	**Shift duration:** 8 hr/day; **Broom-down:** 6 hr/day	**Shift duration:** 10 hr/day; **Broom-down:** ~7 hr/day	**Shift duration:** 10.5 hr/day; **Broom-down:** ~7 hr/day	**Shift duration:** 10 hr/day; **Broom-down:** ~6–7 hr/day	**Shift duration:** 10 hr/day; **Broom-down:** ~8.5 hr/day	**Shift duration:** 10.5 hr/day; **Broom-down:** ~8 hr/day	**Shift duration:** 10 hr/day; **Broom-down:** ~8 hr/day	**Shift duration:** 10 hr/day; **Broom-down:** ~6-8 hr/day	**Shift duration:** 10.5 hr/day; **Broom-down:** ~7-8 hr/day	**Shift duration:** 10.5 hr/day; **Broom-down:** ~7 hr/day	**Shift duration:** 10 hr/day; **Broom-down:** not stated

		Municipality Name											
#	Topic	Buckeye	Casa Grande	Chandler	Gilbert	Glendale	Goodyear	Mesa	Peoria	Phoenix	Scottsdale	Surprise	Tempe
6	Daily mileage tracked & tracking methodology; scheduling unit; software	Yes; Operator logs + Routeware; Curb miles	Yes; Calculated EOD; Pre-planned annual schedule	Yes; Paper logs; Lane miles	Yes; Routeware; Lane miles	Yes; Operator logs; Routeware (Smart City) + internal; Units not stated	Yes; Central Square (Lucity); Lane miles	Yes; Cityworks/City Data Hub; Lane miles	Yes; Route plan + operator report; Zonar → Samsara, work orders in INFOR (Hansen); Units not stated	Yes; Operator daily logs; Lane miles	Yes; City database, basic operator data entry; Curb miles	Yes; Operator logs; Lane miles	Starting KloudGin for usage; Lane miles (mileage not yet collected)
7	Sweep cycle / schedule	**All:** Bi-weekly	**Residential:** weekly **Collector:** weekly **Downtown:** semi-weekly **Arterial:** weekly	**Residential:** 4–7 weeks; **Arterials:** 4 weeks (curbs and medians semi-monthly)	**Residential:** monthly; **Arterials:** semi-monthly	**All:** Monthly (and post-storm as needed)	**Residential:** monthly; **Collectors:** monthly; **Arterials:** bi-weekly	**Residential:** 4 weeks; **Collectors:** 4 weeks; **Arterials:** weekly	**Residential:** 6 weeks; **Arterials:** 4 weeks; **Downtown:** weekly; Two special routes	**Residential:** quarterly; **Collector:** 14 days; **Downtown:** 2×/week; **High-priority^^^:** weekly	**Residential/ Commercial/ Industrial:** monthly; **Collector/Arterial:** semi-monthly; **Downtown:** semi-weekly; **Medians:** monthly; **Multi-use paths:** monthly; (and post-storm: as needed)	**Residential:** monthly; **Collectors:** 2 weeks; **Arterials:** monthly	**Residential:** 30 days; **Collectors:** 30 days; **Arterials:** weekly
8	Do operators perform routine field maintenance?	**Yes**	**Yes** Any small routine maintenance	**Yes** Walk-arounds, lubrication, broom replacements & adjustments	**Yes** Routine; rear main brooms changed by Fleet	**Yes** Adjust/replace gutter brooms, clean nozzles, minor repairs	**Yes**	**Yes** Fleet assists w/ broom changes; operators lube and daily clean	**Yes** Nozzles, side brooms, main slat broom, filters, daily grease, washing, general items	**Yes** Routine PM; wash/clean brooms, elevator, hopper; adjust brooms/heads; minor parts/fluids	**Yes** Fuel, wash, grease, adjust, change brooms, adjust heads	**Yes**	**Yes** Side broom changes; clean in/out; grease; pre-trip; fuel; water
9	Approximate sweeping speed (mph) by road classification	Residential: 5 Collector: 7–9 Arterial: 9–10	Residential: 3–5 Collector: 5–7 Arterial: 7–10	Residential: 5–14 Collector: 5–14 Arterial: 5–14	Residential: 6 Collector: 6 Arterial: 6	Residential: 8–10 Collector: 8–10 Arterial: 8–10	Residential: 7 Collector: 10–12 Arterial: 10–12	Residential: 5–9 Collector: 5–9 Arterial: 5–9	Residential: 8–10 Collector: 8–10 Arterial: 8–10	Residential: 6 Collector: 8 Arterial: 8	Residential: 6–8 Collector: 6–8 Arterial: 6–8	Residential: 5–9 Collector: 5–9 Arterial: 5–9	Residential: 5–10 Collector: not stated Arterial: 10–12
10	Typical number of hours per day spent on non-sweeping duties	~4.6	~1-1.5	~1	~1.5	~2	-	~2	~2	~2	~1–2	~2	~1–2

		Municipality Name											
#	Topic	Buckeye	Casa Grande	Chandler	Gilbert	Glendale	Goodyear	Mesa	Peoria	Phoenix	Scottsdale	Surprise	Tempe
11	Average miles swept per operator per day and scheduled lane miles per operator per day	**Swept:** ~21 mi/day; **Scheduled:** ~25 mi/day	**Swept:** 20-60 mi/day; **Scheduled:** not stated	**Swept:** ~48 mi/day; **Scheduled:** ~48 mi/day****	**Swept:** 35–40 mi/day; **Scheduled:** not tracked	**Swept:** ~38 mi/day; **Scheduled:** not stated	**Swept:** 45–50 mi/day; **Scheduled:** not stated	**Swept:** 180 mi/day (centerline miles); **Scheduled:** 227 mi/day (centerline miles) (no units of time in original response).	**Swept:** ~26 lane mi/day; **Scheduled:** ~25 mi/day	**Swept:** ~24 mi/day; **Scheduled:** not stated	**Swept:** 28–32 mi/day; **Scheduled:** not stated	**Swept:** ~30 mi/day; **Scheduled:** ~30 mi/day	**Swept:** ~37.5 mi/day; **Scheduled:** not stated
12	Approximate municipal area (sq mi)	393	114	65	76	65	191	141	181	518	184	110	40
13	Total lane miles scheduled per sweep cycle (monthly)	1,000.4	710	1,616	~2,625	~2,633^	1,488	3,600	587	~12,896	~3,118^	350	2,582
14	Average lane miles swept per week outside regular schedule	~1.2	~4.6	<50	Not tracked	~1	~40–50	~60 (centerline miles)	~1	Not tracked	~14-21^^	~5	~5–6
15	Full-time sweeping operators & typical years of experience	5 Operators; Avg 8.2 years	3 Operators; 1-7 years	8 Operators; Years not stated	6 Operators; 6–20 years	4 Operators; Avg 5 years Add'l 4 cross-trained to assist	3 Operators; Avg 6 years	6 Operators; Avg 5 years	5 Operators; 3–11 years	26 Operators; 5+ years	6 Operators; 3–15+ years	4 Operators; 20+ years each	4 Operators; 2–15+ years
16	Population (2025 Projected)	121,059	69,226	289,005	298,513	264,113	123,168	530,193	206,213	1,719,936	252,134	168,382	195,675

Notes

* Assumed that operators are trained on all sweepers of municipality

gal: gallon(s)

mi: miles

min: minutes

MOC: Municipal Operations Center

WRF: Water Reclamation Facility

** Assumed per City's definition of "block"

*** Municipality's sweepers typically do not travel off-route to dump debris and are met by dump truck on-route for dumping

**** Assumed daily swept miles = scheduled miles

^ Calculated from average swept lane miles per day per operator, number of shift days per month, and total number of operators

^^ Calculated from average sweeper speed

^^^ Assumed high-priority = arterial for analysis purposes

~: approximately

yd: cubic yard

hr: hour(s)

Avg: average

yd: cubic yard

hr: hour(s)

Population data calculated per Section 2.0 Methodology

Add'l: Additional

3.2 Service Frequency by Road Classification

Street sweeping service frequencies varied significantly across municipalities and road classifications. Service frequency represents how often streets are swept and is typically expressed as the number of sweeps per week. Road classification influences service frequency priorities, with higher-volume roadways generally receiving more frequent service due to increased debris accumulation and visibility to the traveling public.

Road Classification Distribution Assumption: Per the U.S. Department of Transportation Federal Highway Administration 2022 Highway Statistics Series for Public Road Lengths, it was assumed that the percentages of road classifications in the studied municipalities were as follows:

Interstate/Highway	Arterial	Collector	Local/Residential
1.6%	10.8%	17.4%	70.3%

Figure 3.2 illustrates weekly service frequencies by road classification across participating municipalities. The data reveals considerable variation in sweeping schedules, reflecting different policy objectives, regulatory requirements, and resource availability.

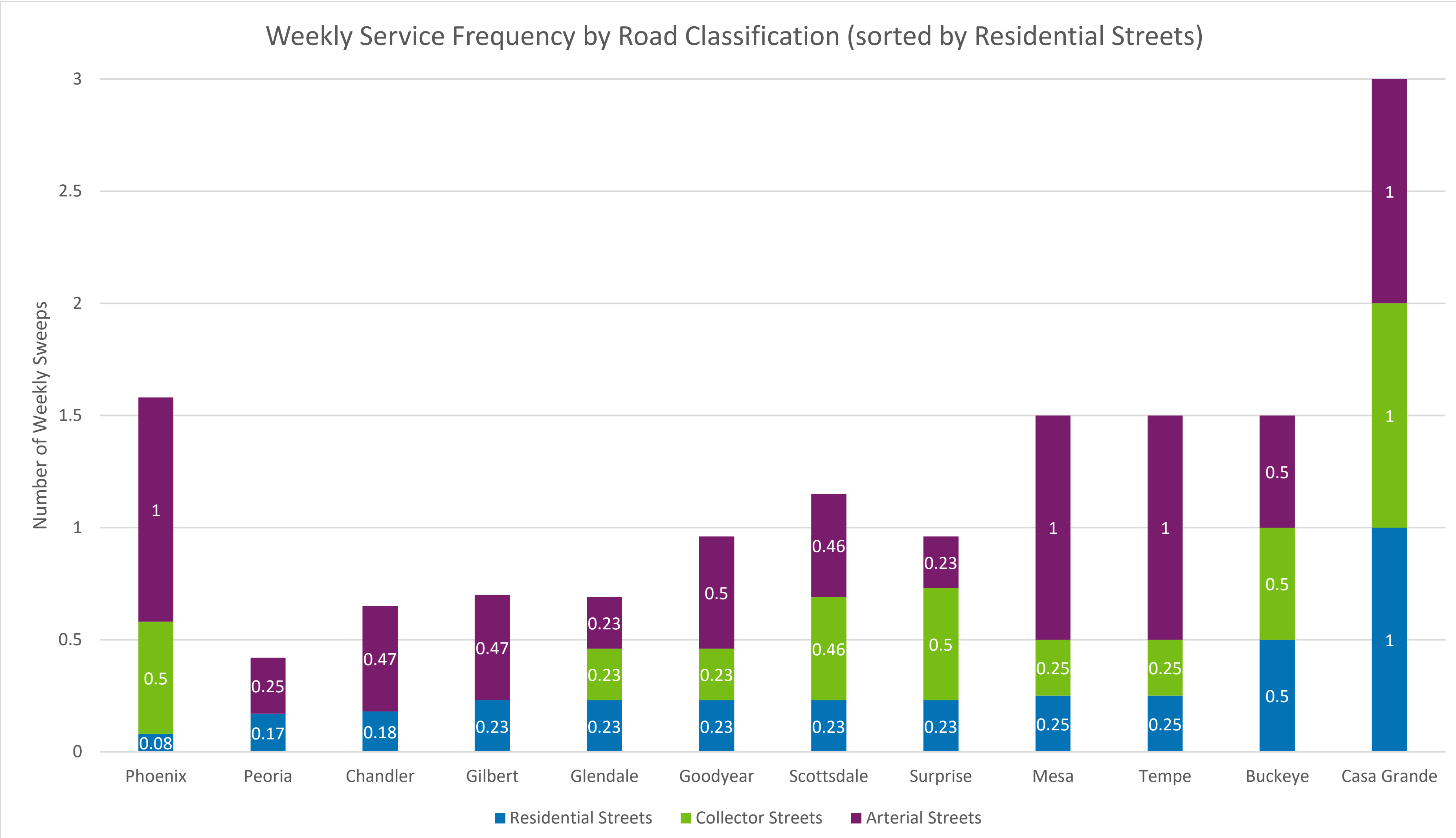
Residential Streets: Weekly service frequency for residential streets ranged from 0.08 sweeps per week (Phoenix) to 1.0 sweeps per week (Casa Grande). The lower end of this range represents approximately one sweep every 12-13 weeks (quarterly service), while the upper end represents weekly service. Most municipalities reported residential sweeping frequencies between 0.23 and 0.25 sweeps per week, corresponding to monthly schedules, or similar. The wide variation reflects different approaches to residential street maintenance priorities and available resources.

Collector Streets: Collector street frequencies ranged from 0.23 sweeps per week (Glendale, Goodyear, and Mesa) to 1.0 sweeps per week (Casa Grande). The majority of municipalities swept collector streets on a monthly basis, or similar. These mid-tier roadways typically receive more frequent service than residential streets due to higher traffic volumes and their role in connecting local streets to arterial networks. It was noted that some municipalities did not explicitly list collector street frequencies in the responses.

Arterial Streets: Arterial street sweeping frequencies ranged from 0.23 sweeps per week (Glendale and Surprise) to 1.0 sweeps per week (Phoenix, Mesa, Tempe, and Casa Grande). Several municipalities (Phoenix, Mesa, Tempe, and Casa Grande) provided weekly service to arterial roadways. Arterial streets generally received the most frequent service among road classifications due to high traffic volumes, increased debris generation, and prominence in the transportation network.

The diversity in service frequencies across road classifications suggests that municipalities establish sweeping schedules based on local conditions, regulatory requirements, and policy priorities that are municipality-specific.

Figure 3.2 Weekly Service Frequency by Road Classification



3.3 Operational Efficiency and Productivity

Operational efficiency, measured as the percentage of total shift time spent with brooms down actively sweeping, directly influences daily productivity outcomes. Figure 3.3 presents the relationship between broom-down efficiency and average daily lane miles swept per operator across participating municipalities.

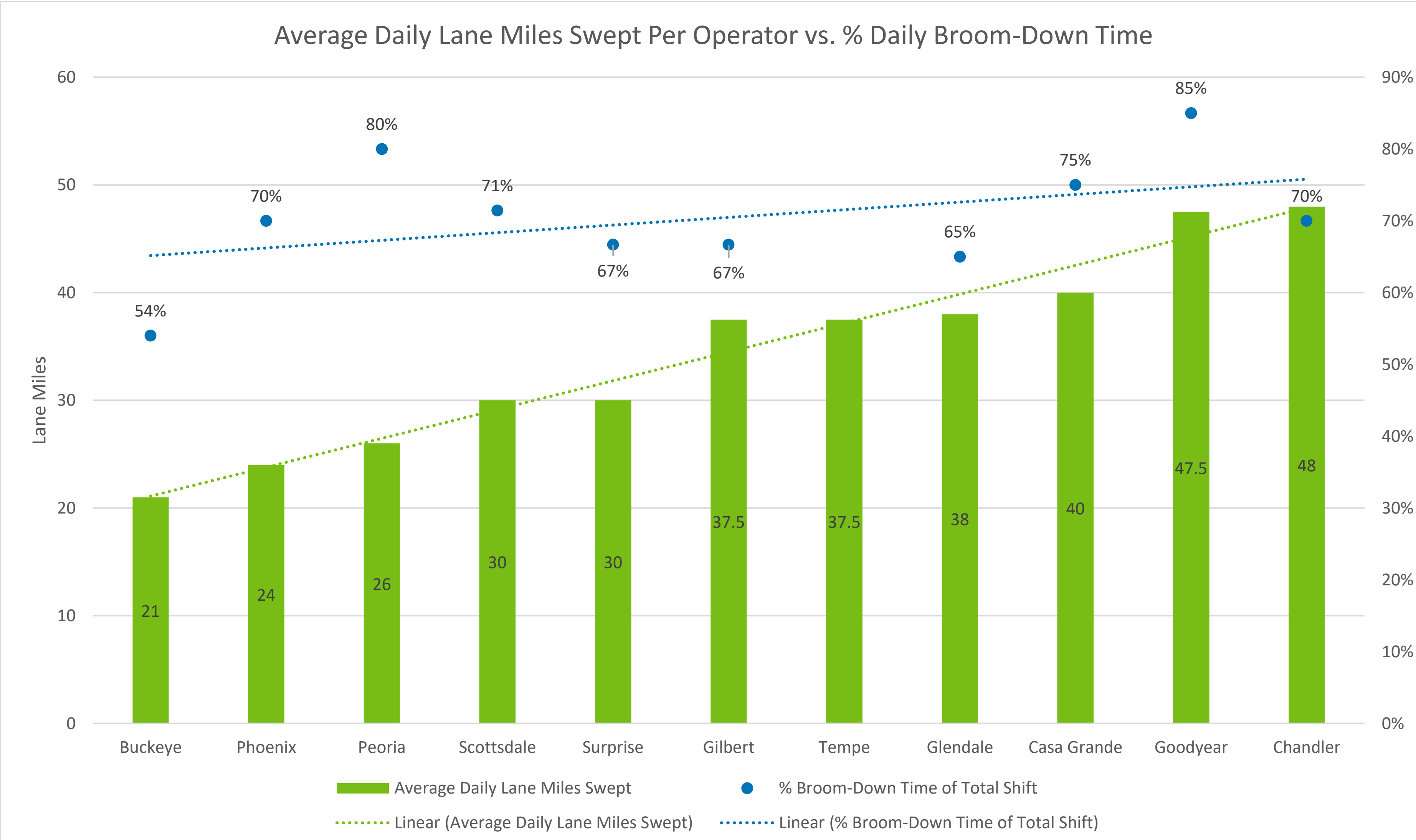
The data demonstrates a positive correlation between operational efficiency and daily productivity. Municipalities that allocated a higher percentage of shift time to active sweeping operations generally achieved greater daily lane miles swept. This relationship indicates that maximizing broom-down time contributes to increased service coverage and productivity.

Broom-down efficiency ranged from 54% to 85% across the study group, while average daily lane miles swept ranged from 21 to 48 miles. Municipalities at the higher end of the productivity spectrum achieved 70-85% broom-down time and correspondingly swept 40-48 daily lane miles.

Several factors contribute to this correlation. Higher broom-down efficiency indicates that operators spend more time actively cleaning streets and less time on non-sweeping activities such as travel to water fill or dump locations, breaks, or equipment positioning. Efficient route design, proximity of water and dump facilities to sweeping routes, and streamlined operational procedures enable municipalities to maximize productive sweeping time. Fleet age and type of equipment may also lead to more operational and maintenance inefficiencies.

However, the correlation is not perfectly linear, suggesting that factors beyond broom-down time influence productivity. Sweeping speed, equipment capacity, route complexity, and local road conditions also affect how many lane miles can be swept during a given period of active sweeping. Municipalities with similar broom-down percentages achieved different daily mileage totals, reflecting variations in these additional factors.

Figure 3.3 Average Daily Lane Miles Swept Per Operator vs. % Daily Broom-Down Time



Notes:

1. 11 of 12 municipalities reported

3.4 Service Area Size and Daily Productivity

The geographic size of a municipality's service area influences daily sweeping productivity. Figure 3.4 illustrates the relationship between municipality area in square miles and average daily lane miles swept.

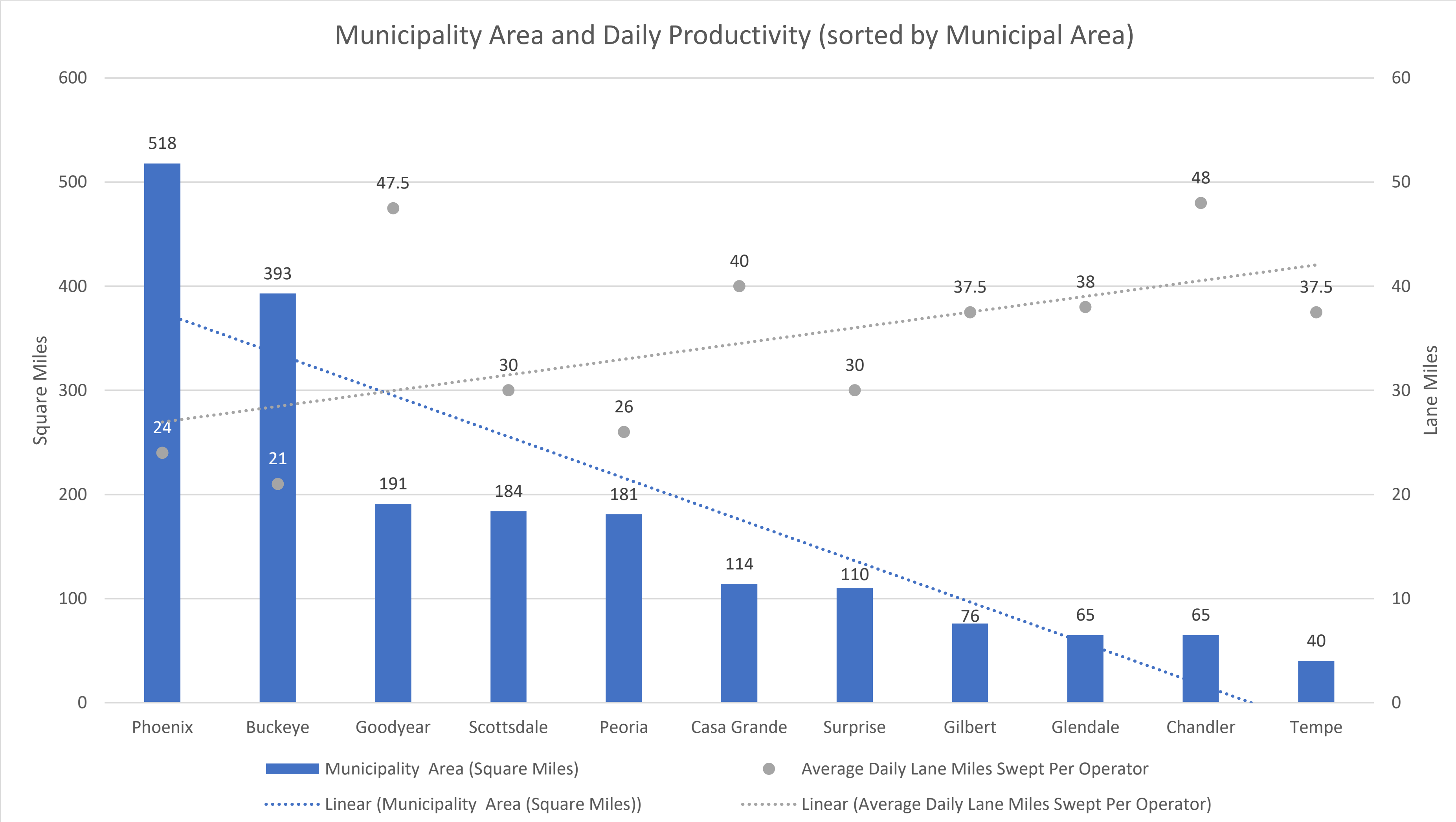
The data reveals a negative correlation between service area size and daily lane miles swept. Municipalities with smaller geographic areas tended to sweep more daily lane miles, while municipalities covering larger areas swept fewer daily lane miles. This inverse relationship reflects the operational challenges associated with serving dispersed geographic areas.

Municipality area ranged from 40 to 518 square miles across the study group. Municipalities at the smaller end of this spectrum (40-114 square miles) achieved daily lane miles ranging from 30 to 48 miles. In contrast, municipalities with larger service areas (181-518 square miles) generally swept 21-30 daily lane miles.

Several factors contribute to this pattern. Smaller, more compact municipalities benefit from reduced travel distances between sweeping routes and support facilities such as water fill stations and debris dump locations. Route density in compact service areas allows operators to maximize time spent sweeping rather than traveling between dispersed locations. Additionally, smaller geographic areas typically have more centralized operations, reducing non-productive travel time.

Larger municipalities face greater logistical challenges. Operators may need to travel relatively longer distances to reach routes, fill water tanks, or dump debris, reducing the time available for active sweeping. Route networks in larger service areas are often more dispersed, requiring additional time for positioning equipment and transitioning between routes. Additionally, the geometries of municipal boundaries and service area geographies of larger municipalities may cause operational complexities and inefficiencies. These factors result in lower broom-down efficiency and consequently fewer daily lane miles swept.

Figure 3.4 Municipality Area and Daily Productivity



Notes:

1. 11 of 12 municipalities reported

3.5 Staffing Levels and Normalized Metrics

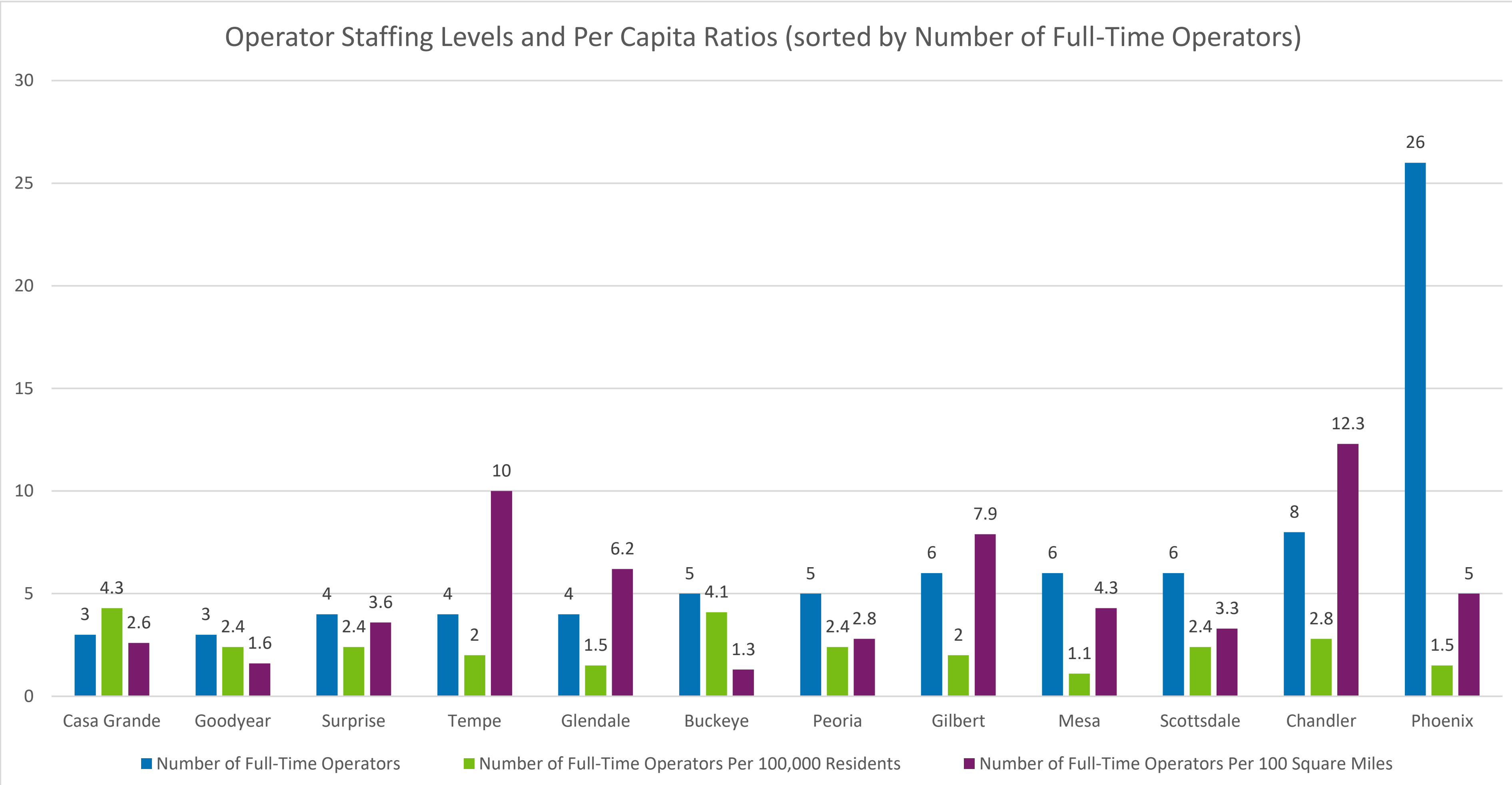
Street sweeping operator staffing levels varied considerably across participating municipalities, reflecting differences in service area size, population served, and operational scale. Figure 3.5 presents the number of operators and the normalized metric of operators per 100,000 residents for each municipality.

The number of full-time equivalent (FTE) operators ranged from 3 to 26 across the study group. This variation corresponds to differences in municipality size, with larger municipalities requiring more operators to maintain service coverage. Phoenix, the largest municipality by population, employed 26 operators, while smaller municipalities operated with 3-8 operators.

When normalized relative to population served, the metric of operators per 100,000 residents ranged from 1.1 to 4.3 across participating municipalities. The average staffing ratio was approximately 2.4 operators per 100,000 residents. This normalized metric enables comparison across municipalities of different sizes by accounting for population scale.

The data shows a slight downward trend in operators per 100,000 residents as the total number of operators increases. Larger municipalities with more operators tended to have marginally lower per capita staffing ratios, while smaller municipalities with fewer operators had higher ratios. This pattern suggests modest economies of scale in street sweeping operations, where larger programs achieve relatively greater population coverage per operator. However, this trend is not uniform, as operational efficiency, service area geography, and local service level objectives also influence staffing decisions.

Figure 3.5 Operator Staffing Levels and Per Capita Ratios



3.6 Data Quality and Completeness

The analysis of street sweeping operations data required consideration of data quality, completeness, and comparability across municipalities. Variations in record-keeping practices, tracking methodologies, and operational definitions influenced the completeness of responses. Additionally, certain data points were excluded from analysis where units of measurement were inconsistent or values appeared anomalous and could not be verified.

Data Gaps and Incomplete Responses: Not all municipalities provided complete responses to every questionnaire item. Many questionnaire items had more than one question per item and not all questions were answered by each muncipality in their initial responses. Follow-up correspondence with the muncipalities led to a minimum of 8 complete responses per questionnaire item. In circumstances where a municipality did not provide a particular metric, the municipality was excluded from certain data analyses.

Anomalous Data Excluded from Analysis: Certain data points were excluded from specific analyses where reported values appeared inconsistent with other responses or used units that could not be readily converted:

- **Average daily lane miles swept**: One municipality reported mileage in centerline miles rather than lane miles. This data point was excluded from analyses involving average daily lane miles swept per operator.
- **Non-sweeping time**: One municipality reported non-sweeping time that exceeded the total shift duration. This data point was excluded from efficiency calculations.
- **Total lane miles per sweep cycle (monthly)**: Municipalities reported varying totals that were often not aligned with the reported average daily lane miles swept per operator. These values were not heavily relied upon for trend analysis.

These exclusions were necessary to maintain data integrity and avoid misrepresenting municipal operations. Where municipalities were excluded from specific calculations or comparisons due to missing or anomalous data, this is noted in the relevant analysis sections.

3.7 Observed Trends

Several patterns emerged from the analysis of street sweeping operations data across participating municipalities:

Service Frequency Diversity: Residential street sweeping frequencies varied considerably, from quarterly service to weekly service. This diversity reflects different regulatory environments, policy priorities, and resource availability rather than standardized industry practices. Arterial and collector streets generally received more frequent service than residential streets, but substantial variation existed across municipalities for these classifications as well.

Efficiency and Productivity Correlation: Municipalities that achieved higher broom-down efficiency as a percentage of total shift time generally swept more daily lane miles. This positive correlation indicates that maximizing time spent actively sweeping contributes to greater service coverage. However, the relationship is not perfectly linear, suggesting that other factors such as sweeping speed, route design, and equipment capacity also influence productivity outcomes.

Geographic Scale and Productivity: Smaller municipalities with more compact service areas typically achieved higher daily lane miles swept compared to municipalities with larger geographic areas. This inverse relationship reflects the operational advantages of reduced travel distances between routes and support facilities. Larger service areas may face greater logistical challenges in positioning equipment and accessing water and dump locations, resulting in lower daily productivity.

Staffing Approaches: Staffing levels normalized per capita showed modest economies of scale, with larger municipalities achieving slightly lower operators per 100,000 residents compared to smaller municipalities. However, staffing decisions are influenced by multiple factors beyond population, including service area geography, road network density, and local service level objectives. The average staffing ratio across the study group was approximately 2.4 operators per 100,000 residents.

Operational Context Variation: The data demonstrates that street sweeping programs are tailored to local conditions and priorities. Differences in municipality size, population density, geographic area, climate, regulatory requirements, and budget constraints result in diverse operational approaches. No single operational model or set of performance benchmarks emerged as universal across the participating municipalities.

Data Completeness Challenges: Incomplete responses in questionnaire categories limited certain comparative analyses. The variation in data availability reflects differences in tracking methodologies and record-keeping practices across municipalities.

4.0 Comparison to Buckeye

This section presents a focused comparison of Buckeye's street sweeping operations to the peer municipalities included in the study. The analysis examines Buckeye's position relative to the range of practices and performance metrics observed across the study group. The comparison is organized by operational category and presents data from the benchmarking analysis to provide context for Buckeye's program characteristics.

4.1 Municipality Characteristics

Buckeye's municipal characteristics influenced operational approaches and provided important context for interpreting performance metrics. Buckeye served a projected 2025 population of approximately 121,000 residents across a service area of 393 square miles, resulting in a population density of 308 people per square mile.

Compared to peer municipalities, Buckeye had the second largest geographic service area in the study group. Municipality areas ranged from 40 to 518 square miles, with Buckeye's 393 square miles ranking second only to Phoenix's 518 square miles. However, Buckeye's population density was the lowest among participating municipalities with population density across the study group ranging from 308 to 4,892 people per square mile.

The combination of large geographic area and low population density positioned Buckeye as the most dispersed municipality in the study. This characteristic influenced several operational aspects including route design, travel distances to water fill and debris dump locations, and overall operational efficiency.

4.2 Equipment and Fleet Composition

Buckeye operated a mixed fleet consisting of both regenerative air and mechanical broom sweepers. The regenerative air sweepers had a water holding capacity of 475 gallons, while mechanical sweepers held 360 gallons. Buckeye's equipment capacities were among the higher values in the study group, with water tank capacities across all municipalities ranging from 200 to 650 gallons, averaging 310 gallons. The water holding capacity of Buckeye's regenerative air sweepers (475 gallons) ranked second highest among equipment reported in the study. This larger capacity theoretically reduces the frequency of water fill trips.

Buckeye's approach of operating multiple sweeper types aligned with several participating municipalities. Half of the 12 municipalities (including Buckeye) operated mixed fleets. This diversification provided operational flexibility for different road classifications and sweeping conditions.

4.3 Staffing and Resource Allocation

Buckeye employed 5 full-time equivalent (FTE) operators dedicated to street sweeping operations. Operator counts across the study group ranged from 3 to 26, with Buckeye positioned in the lower-middle portion of this range. Buckeye's operators had an average of 8.2 years of experience, which exceeded the average experience levels reported by several peer municipalities.

When normalized relative to population served, Buckeye's staffing ratio was 4.1 operators per 100,000 residents. This metric ranked second highest among participating municipalities. The study group range for this metric was 1.1 to 4.3 operators per 100,000 residents, with an average of approximately 2.4. Buckeye's ratio of 4.1 was notably higher than the study group average, indicating relatively higher staffing intensity per capita compared to most peers.

Buckeye's operators per 100 square miles metric was calculated at 1.3, which was the lowest value in the study group. This metric ranged from 1.3 to 12.3 across participating municipalities. The low value reflected Buckeye's large geographic service area relative to operator count. This spatial staffing pattern aligned with Buckeye's low population density and dispersed development characteristics.

4.4 Operational Efficiency and Daily Productivity

Buckeye's operational efficiency and daily productivity metrics positioned the municipality at the lower end of the performance spectrum observed across the study group. Buckeye reported a shift duration of 10 hours per day with approximately 5.4 hours dedicated to broom-down time. This resulted in a broom-down efficiency of 54% of the total shift duration.

Buckeye's broom-down efficiency was the lowest among participating municipalities. Efficiency rates across the study group ranged from 54% to 85%, with Buckeye at the minimum value. The corresponding non-sweeping time of 4.6 hours per day was the highest reported in the study. Non-sweeping time across peer municipalities ranged from 1.0 to 4.6 hours per day, with most municipalities reporting 1.0 to 2.0 hours.

The lower broom-down efficiency reflected Buckeye's operational challenges related to geographic dispersion. With designated hydrant locations averaging 2 miles one-way for water fills and 4 dump sites averaging 4 miles one-way for debris disposal, operators spent considerable time traveling between sweeping routes and support facilities. The large service area and dispersed route network contributed to extended travel times that reduced the proportion of the shift available for active sweeping.

Buckeye's average daily lane miles swept per operator was approximately 21 miles per day. This was the lowest value reported in the study group, across all municipalities, average lane miles swept per operator ranged from 21 to 48 with an average of 34.5.

The positive correlation observed between broom-down efficiency and daily productivity across the study group was reflected in Buckeye's position. As the municipality with the lowest broom-down efficiency, Buckeye correspondingly achieved the lowest daily lane miles swept. The relationship between Buckeye's large service area and lower daily productivity was consistent with the inverse correlation observed between municipality size and daily productivity across the peer group.

Buckeye's monthly lane miles scheduled per sweep cycle was approximately 1,000 miles. This value was among the lower monthly totals in the study, though it aligned with Buckeye's service frequency approach and operator count. Monthly lane miles across municipalities ranged from 350 to 12,896, with considerable variation corresponding to municipality size and service frequency schedules. Monthly lane miles reported by peer municipalities suggested broad interpretation of the topic and may require refinement.

4.5 Service Frequency and Scheduling

Buckeye's service frequency approach differed from most peer municipalities in its uniformity across road classifications. Buckeye swept all road classifications on a bi-weekly schedule, corresponding to 0.5 sweeps per week or 26 sweeps per year for residential, collector, and arterial streets.

Residential Streets: Buckeye's bi-weekly residential sweeping frequency positioned the municipality in the upper portion of the study group range with the second highest frequency behind Casa Grande (weekly). Residential frequencies across participating municipalities ranged from 0.08 to 1.0 sweeps per week (quarterly to weekly service). Most municipalities provided monthly or less frequent service to residential streets, making Buckeye's bi-weekly schedule more frequent than the median.

Collector Streets: Buckeye's bi-weekly collector street service frequency was more frequent than several peer municipalities. Collector frequencies across the study group ranged from 0.23 to 1.0 sweeps per week. Buckeye's 0.5 sweeps per week fell in the middle to upper range, with most municipalities providing monthly or bi-weekly service.

Arterial Streets: Buckeye's bi-weekly arterial street sweeping was more frequent than the majority of municipalities but less frequent than several peer municipalities that provided weekly service to arterial streets. Arterial frequencies ranged from 0.23 to 1.0 sweeps per week across the study group, with four municipalities providing weekly arterial service. Buckeye's approach represented a moderate service level for arterials.

The uniform service frequency across road classifications distinguished Buckeye from most peer municipalities, which typically differentiated service levels by road classification. Eight of the twelve municipalities provided more frequent service to arterial streets compared to residential streets. Buckeye's consistent bi-weekly schedule across classifications simplified route planning and scheduling but did not reflect the typical prioritization of higher-volume roadways observed in peer municipalities.

Buckeye tracked daily mileage using operator logs and Routeware software, reporting in curb miles rather than lane miles. This tracking approach aligned with practices at most peer municipalities, though the unit of measurement (curb miles vs. lane miles) differed from seven municipalities that tracked in lane miles.

4.6 Water and Debris Management

Buckeye's water fill operations utilized designated hydrants at 7 locations, with an average one-way travel distance of approximately 2 miles. This approach fell in the lower to middle range of peer practices. Water fill distances across municipalities ranged from less than 0.25 miles to 20 miles, with most municipalities reporting 1 to 7 miles. Buckeye's designated hydrant approach provided defined locations for operators while maintaining reasonable travel distances.

For debris disposal, Buckeye utilized 4 dump sites with an average one-way travel distance of approximately 4 miles. This positioned Buckeye at the middle portion of the study group range. Debris dump distances across municipalities ranged from 0 miles (on-route dump truck service) to 17.5 miles. Most municipalities reported dump distances of 4 to 7 miles, placing Buckeye within the typical range. Debris disposal responses were limited compared to other metrics with 8 of the 12 municipalities providing data for this metric.

One municipality (Phoenix) achieved zero dump travel distance through an innovative approach of meeting sweepers on route with a dump truck, eliminating the need for sweepers to leave their routes. While Buckeye's 4-mile average dump distance was reasonable compared to most peers, opportunities existed for reducing non-sweeping time through alternative debris management approaches.

The combination of 2-mile water fill distances and 4-mile dump distances may have contributed to Buckeye's non-sweeping time allocation. With multiple fills and dumps required during a 10-hour shift, these travel distances accumulated to reduced broom-down efficiency. Peer municipalities with more centralized water and dump facilities, shorter travel distances, or alternative service delivery models (such as on-route dump trucks) appeared to have achieved higher operational efficiency.

4.7 Summary of Comparative Position

Buckeye's street sweeping program exhibited several characteristics that positioned the municipality distinctly within the peer group:

Service Area and Density: Buckeye served the second largest geographic area and had the lowest population density in the study group, creating operational challenges related to route dispersion and travel distances.

Staffing Approach: Buckeye maintained relatively high per capita staffing ratios (4.1 operators per 100,000 residents) compared to the study group average (2.4), but low spatial operator density (1.3 per 100 square miles) due to the large service area. This staffing pattern reflected a geographic coverage approach rather than a population density approach.

Operational Efficiency: Buckeye's broom-down efficiency (54%) was the lowest in the study group, with non-sweeping time (4.6 hours) the highest. These metrics appear to have reflected the operational realities of serving a large, dispersed service area with considerable travel time between routes and support facilities.

Productivity: Buckeye's daily lane miles swept per operator (21 miles total) were the lowest values observed in the study group. The relationship between low operational efficiency and low daily productivity aligned with the positive correlation observed across all municipalities.

Service Frequency: Buckeye's uniform bi-weekly service across all road classifications differed from most peers, who typically differentiated service levels by road classification. Buckeye's residential service frequency was more frequent than many peers, while arterial service was less frequent than municipalities providing weekly arterial service.

Water and Debris Management: Buckeye's water fill and debris dump travel distances (2 miles and 4 miles, respectively) were reasonable compared to peer municipalities but may have contributed to the extended non-sweeping time given the frequency of these activities during shifts.

Buckeye's operational profile reflected the challenges of serving a large, low-density service area. The municipality's approach prioritized consistent service coverage across the entire geographic area through relatively high per capita staffing and uniform bi-weekly service frequencies.

5.0 Conclusion

This street sweeping benchmarking study compiled and analyzed operational data from twelve municipalities within the greater Phoenix area to provide comparative context for Buckeye's street sweeping program. The study collected information on equipment types and capacities, staffing levels, daily operations, service frequencies, productivity metrics, and management practices through a structured questionnaire process and supplementary data sources.

The analysis revealed substantial diversity in street sweeping operations across participating municipalities. Service frequencies ranged from quarterly to weekly schedules for residential streets, with most municipalities differentiating service levels by road classification. Operational efficiency, measured as broom-down time as a percentage of total shift duration, ranged from 54% to 85%. Daily productivity varied, with municipalities sweeping between 21 and 48 lane miles per operator per day. Staffing approaches differed, with operators per 100,000 residents ranging from 1.1 to 4.3.

The data demonstrated that municipal characteristics influenced operational outcomes. Smaller municipalities with compact service areas generally achieved higher daily lane miles swept compared to municipalities covering larger geographic areas. The positive correlation between operational efficiency and daily productivity indicated that maximizing broom-down time contributed to increased service coverage. However, other factors including sweeping speed, route design, equipment capacity, and local road conditions may have also influenced productivity.

Buckeye's operational profile reflected the municipality's large geographic service area and low population density. With the second largest service area and lowest population density in the study group, Buckeye faced operational challenges related to route dispersion and travel distances. The municipality's broom-down efficiency and daily productivity positioned at the lower end of the peer group range, while per capita staffing ratios ranked among the highest. Buckeye's uniform bi-weekly service frequency across all road classifications differed from most peers, providing elevated levels of service for all road classifications, when compared to peers.

The benchmarking analysis demonstrated that street sweeping programs are tailored to local conditions and priorities. Differences in municipality size, population density, geographic characteristics, regulatory requirements, and budget constraints resulted in diverse operational approaches across the study group.

Appendix A
Sources Cited

Appendix A - Sources Cited

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