Los Angeles County
Metropolitan Transportation Authority

One Gateway Plaza
Los Angeles, CA 90012-2952

213.922.2000 Tel
metro.net

Metro

September 16, 2015

TO: BOARD OF DIRECTORS

THROUGH: PHILLIP A. WASHINGTON PAW
CHIEF EXECUTIVE OFFICER

FROM: RICHARD CLARKE RFC
EXECUTIVE DIRECTOR, PROGRAM MANAGEMENT

JAMES T. GALLAGHER JTG.
CHIEF OPERATIONS OFFICER

SUBJECT: RESPONSE TO DROUGHT AWARENESS MOTION

ISSUE

In response to Motion Item #52 (Attachment A) on drought awareness introduced by Mayor Eric Garcetti and approved by the Metro Board of Directors on June 25, 2015, Metro staff reviewed the current state of water use at Metro facilities and continued the development and planning of actions to further expand water conservation within Metro facilities.

Staff is to report within 90 days on the status of the water conservation strategies as outlined in the 2010 Water Action Plan. Staff is to also report on an accelerated plan that identifies additional water conservation efforts that can be implemented since the Plan's adoption.

BACKGROUND

Metro has been on the forefront of water reduction efforts for more than a decade with the implementation of water reduction efforts in its construction activities. Since 2003, we have been implementing many strategies across our agency to reduce water use in all of our operations but most extensively at the Metro Orange Line and its extension.

In 2009, a Water Use and Conservation Policy was adopted by our agency to ensure the most cost-effective and efficient use of potable water resources at all of our facilities and operating divisions (Attachment B).

To implement the Policy, our agency developed a Water Action Plan in 2010 (Attachment C). Staff from various business units, specifically Environmental Compliance/Sustainability and Operations, has been cooperatively working on several water and cost saving pilot efforts across the agency.

The Los Angeles region and the State of California are experiencing an extreme drought and persistently dry conditions since 2011. On April 25, 2014, the Governor declared a State of Emergency and issued Executive Order B-29-15 to achieve statewide reductions in potable urban water usage.

DISCUSSION

Metro has implemented numerous water conservation strategies outlined in its Water Action Plan at various locations. The strategies are implemented according to location-specific needs, availability of recycled water, and other considerations to ensure achievement of strategic goals. Attachment D shows the various strategies that are identified in the Water Action Plan and the status of implementation at each of our operating divisions.

In addition to these strategies, staff has also implemented other strategies not previously identified in the Water Action Plan. These include:

- Reduced Bus/Car Wash Schedule to reduce the amount of water and detergents used and maintain a level of bus and rail car cleanliness;
- Redesign of ventilation filter systems that currently use extensive volumes of water;
- New Air Blower System Installation to reduce the amount of excess water at the end of the wash cycle;
- Recycled Water - Stream Bay retrofit to reduce dependence to potable water;
- Recycled Water - Under Carriage Wash retrofit to reduce the dependence to potable water;
- Installation of water cistern to capture and reuse any stormwater or potable water discharged into the stormdrain or sanitary sewer;
- Implementation of Low Impact Development Strategies including bioswales to keep stormwater within the site footprint and increase groundwater recharge;
- Installation of Water Efficient Cooling Tower to reduce the use of potable water;
- Use of Smart Irrigation Controllers to increase the efficiency of potable water use for landscaping purposes;
- Turf Removal to reduce potable water use for irrigation;
- Installation of Water Sub-Meters to develop an understanding of water use at various process points within any facility; and
- Installation of New Pressure Washers to reduce potable water use.

Metro has also partnered with the Los Angeles Department of Water and Power through a Blue Ribbon Collaborative to explore ways in which we can further work together on regional water reduction strategies. Metro staff has been participating in One Water LA

workshops to develop close relationships with City of Los Angeles executives and their staff; and implement common water reduction strategies among city agencies. Finally, Metro has also partnered with the state, local and other private entities to conduct additional water conserving pilot studies at our various sites, including:

- Evaluating low impact development strategies such as the permeable pavement pilot at Division 4, and to determine feasibility for agency-wide implementation;
- Studying the feasibility of incorporating recycled water in irrigation and process waters;
- Exploring biotreatment methods to increase the polishing of re-used water in our bus wash;
- Conducting bench and pilot scale chemical treatment studies to determine the effectiveness of our current reuse/recycle water process; and make adjustments on process streams or make recommendations to engineer a better treatment process;
- Installing a linear kinetic cell system to align dissolved salts within the influent water stream prior to rinse and prevent bus window spotting; and
- Applying titanium-based coating on buses to repel grit and grime and reduce the need for full washing.

In the 2015 Metro's Energy and Resource Report, staff advised the Board that Metro has reduced its potable water consumption by 28% between 2013 and 2014. Metro's agency-wide ISO 14001-certified Environmental Management System (EMS) also provides a mechanism where additional water conserving opportunities can be discussed and implemented. Working together with Division Managers and their respective EMS teams, Environmental Compliance and Sustainability staff is able to identify training gaps to ensure awareness for the responsible consumption of water at all of our Divisions. We are also able to immediately develop and commence implementation of Action Plans that include frontline water reduction strategies. Working with our Communications and Marketing Departments, we are able to produce educational materials, signs and banners for water-related campaigns. Each of our operating Divisions has an EMS bulletin board to post new informational materials. An EMS newsletter has been launched to celebrate staff best management practice achievements as well as to engage continuous conversation on metrics that are being tracked for continual improvement.

To meet the Board mandated time-frame for achieving an additional 20% water use reduction by 2017, staff evaluated four representative and geographically distributed maintenance facilities (Bus Divisions 9 and 18 and Rail Divisions 11 and 20) to determine:

1. Options that can be implemented immediately and on a short-term basis within the next 2 years, and

2. Options that require long-term implementation beyond 2017.

The full evaluation report is provided in Attachment E.

For short-term options, the following strategies were determined to be most viable:

- *Cleanliness Criteria.* Consider the development of a modified definition of bus and rail car "cleanliness" to determine the frequency of bus/car washing. The redefinition of cleanliness would only apply to the outside of the buses and cars; it does not apply to the cleanliness of the inside of the buses and cars (since the water used inside is very limited) and the exterior windows that need to be cleaned by other methods, if necessary.

- *Bus/Car Wash Blower Adjustment.* Consider the adjustment of bus/car wash blowers to blow water back into the wash area for recovery rather than randomly or away from the water recovery area, especially at those locations where the dryers for the wash system are outside of the wash building.

- *Adjust Bus/Car Wash Nozzles.* Replace bus/car wash nozzles with higher efficiency nozzles.

- *Irrigation System.* Restrict the use of potable water for irrigation to no more than two days per week.

- *Irrigation Efficiency.* Adjust irrigation heads to eliminate overspray of non-vegetated areas and adjacent paving or other impervious surfaces. A regular inspection survey of all irrigation lines would check for leaks and other inefficiencies. In addition, the irrigation systems may be replaced with drip irrigation or smart controllers where possible.

- *Remove or Limit Ornamental Turf.* Continue with the planning of the removal of ornamental turf and the non-native and/or medium to high water-use vegetation; and replace them with low-water use and native or adapted vegetation.

- *Sanitary and Kitchen Fixtures.* Continue with the change out of sanitary fixtures to low-flow systems using low-flow water fixtures, faucet aerators, low-flow shower heads, dual flush toilets. Evaluate the continued use of waterless urinals.

- *Under-sink Reverse Osmosis (RO) Units.* Review of the use of under-sink RO units and consider other options for drinking water.

- *Training.* Expand the training of Metro personnel on water usage and water conservation measures at their facilities. Provide Maintenance Managers with water usage data at their facilities on a quarterly and annual basis, which can be used to discuss water use and conservation at their division with their staff. Consider the installation of interpretive signs in 1) bus/rail car wash areas; 2)

highly utilized restroom and shower facilities; 3) areas with low-water use vegetation; 4) graywater projects; and 5) Green Infrastructure projects.

- *Public Education and Outreach.* Provide education and outreach to our patrons through the Metro website, special outreach programs, public database of Metro's water use, and installation of interpretive signage and/or educational brochures at public facilities where Metro has implemented water conservation measures.

The following long-term options were identified:

- *Graywater.* Conduct a study to determine if graywater retrofits are suitable at our divisions and identify appropriate routes for sink and shower water for on-site treatment and use to landscape areas.

- *Green Infrastructure.* Increase the use of Green Infrastructure (bioretention, permeable pavement, vegetated swales, infiltration trenches, and other features) agency-wide to capture stormwater runoff for use in landscaped areas.

- *Subsurface Storage.* Further evaluate the increase of existing underground storage capacity (such as cisterns) that can provide for stormwater reuse for landscape irrigation, the bus/rail car wash facilities, and other potential uses.

NEXT STEPS

Staff will continue to identify, analyze, and implement additional water conservation initiatives and projects to further reduce potable water use. Staff will continue the close coordination of our various business units to implement water conservation measures.

An annual report on Metro water consumption is already included in our agency's Energy and Resource Report. Staff will include additional potable water use reduction, conservation, and fulfillment of reduction metrics in parallel and beginning with the 2016 report.

ATTACHMENTS

A. Motion Item #52, Drought Motion
B. Water Use and Conservation Policy
C. Water Action Plan
D. Implementation Status of Water Conservation Measures at Metro Facilities
E. Assessing the Implementation and Effectiveness of Metro's 2010 Water Action Plan, Strategies and Recommendations for Water Use Reduction

Prepared by: Emmanuel (Cris) CB Liban, EO, Environmental Compliance/Sustainability
213/922-2471

Metro

Los Angeles County
Metropolitan Transportation
Authority
One Gateway Plaza
3rd Floor Board Room
Los Angeles, CA

Board Report

File #:2015-0956, **File Type:**Motion / Motion Response

Agenda Number:52.

REGULAR BOARD MEETING
JUNE 25, 2015

Motion by:

MAYOR ERIC GARCETTI

June 18, 2015

Item 52, File ID 2015-0852, Drought Awareness

Currently, the Los Angeles region and the State of California are experiencing an extreme drought and persistently dry conditions since 2011. The Governor has declared a State of Emergency and issued an Executive Order in April to achieve statewide reductions in potable urban water usage.

While MTA has implemented water conservation strategies in new construction since 2003; and has implemented a Water Use and Conservation and Use Policy since 2009 resulting in a Water Action Plan in 2010 that when fully implemented would save MTA over 200 million gallons of potable water;

MTA can and needs to continue its proactive water conservation and management efforts, it is imperative to enhance and focus on additional water reduction efforts;

CONSIDER **Garcetti Motion** that the Board instruct the CEO to:

A. Reduce all potable water use by 20% by 2017 using 2015 as the benchmark.

B. Restrict irrigation using potable water to no more than two days per week. Facilities will be required to post their watering schedules. Drip Irrigation systems are exempt.

C. Remove or limit ornamental turf to reduce water consumption.

    1. Initiate a turf removal program using all available rebates.

    2. Replace landscaped areas with drought tolerant or California native plants during the renovation of existing facilities.

    3. Where possible, limit potable water use to plant establishment.

D. Within 90 days, report back on the status of all 15 water conservation strategies outlined in

MTA's 2010 Water Action Plan and an accelerated implementation plan that identifies additional water conservation efforts that can be implemented since the Plan's adoption.

E. By October 2015, MTA will disclose, via a public database, water use at all MTA facilities. The database is to be updated with each facility's water billing cycle. This data shall by integrated into the agency's Environmental Management System (EMS) training efforts.

F. MTA shall install water sub meters at all facilities to understand and track water consumption for individual operations.

G. MTA shall educate the public on water conservation measures via websites and other exiting information outlets.

H. Identify funding opportunities and collaborate with local and state agencies to implement water -related projects including groundwater re-charge, low impact development, reuse of industrial wastewater, construction of recycling and water reuse facilities, and similar infrastructure.

I. Report back to the Board within one year on the agency's resiliency to maintain service and reliability in light of diminishing water supplies and limited resources; and MTA's progress on the development and implementation of alternative technologies, procedures, and design innovations to reduce potable water use in all of the agency's activities.

Los Angeles County
Metropolitan Transportation Authority

Metro

GENERAL MANAGEMENT
Water Use and Conservation

(GEN 52)

POLICY STATEMENT

It is the policy of the Los Angeles County Metropolitan Transportation Authority (LACMTA) to limit the use of potable water resources at its facilities in the most cost-effective and efficient manner. The use of water for construction, operations, and maintenance purposes must be consistent with local, state, or federal water conservation measures. When it is necessary to protect public safety, human health and the environment, LACMTA may deviate from water conservation measures.

PURPOSE

Varying conditions require LACMTA to use potable water to fulfill its mandates. The purpose of this policy is to ensure that potable water is used in a consistent manner during any LACMTA construction and operation-related activity by:

(1) Ensuring the uniform and sustainable implementation of water conservation and efficiency actions within LACMTA.

(2) Prioritize the use of potable water only for those instances where public safety or the environment is impacted.

APPLICATION

This policy is applicable agency-wide in the planning, procurement, design, construction, operations and maintenance of all LACMTA and LACMTA-funded projects and assets.

Carmen G. Langston
APPROVED: County Counsel or N/A

Department Head

ADOPTED: CEO

Effective Date: 10/9/13

GENERAL MANAGEMENT
Water Use and Conservation

(GEN 52)

1.0 GENERAL

LACMTA uses potable water in a variety of situations to ensure the safe operation of its system and implementation of construction activities; it may selectively limit the use of potable water, using it only for essential services during periods when statewide water conservation measures are in effect. State and local statutes and guidelines outline potable water use prohibitions to reduce water consumption and encourage water conservation on both a regional and local scale. Examples of prohibited uses currently required by local jurisdictions where LACMTA operates include:

- use of a water hose to wash any hard or paved surfaces including, but not limited to sidewalks, walkways, driveways and parking areas;
- continuous leaking of water from any pipe or fixture within LACMTA's facilities;
- washing of any vehicle with a hose, if the hose does not have a self-closing water shut-off or device attached to it;
- irrigation during periods of rain or allowance of any excess irrigation water to sheetflow onto adjoining streetscape;
- irrigation between the hours of 9:00 a.m. and 4:00 p.m.;
- irrigation of landscaping for more than the required watering times per station;
- irrigation of any large landscaped areas where rain sensors are not installed; and
- use of non re-circulating systems in new conveyor car wash systems.

The use of potable water at LACMTA construction sites is permitted under best management practice for dust suppression purposes required to comply with applicable environmental regulations. Whenever feasible, non-potable water use is encouraged.

Divisions and departments may use potable water to wash LACMTA vehicles only at bus or rail washing systems designed to capture and re-circulate water.

2.0 PROCEDURES

2.1 Procedures for Using Potable Water for Pressure Washing Activities

2.1.1 Prioritize facility locations that must be regularly cleaned using pressure washing equipment.

2.1.2 If pressure washing is deemed essential, appropriate water conservation and efficiency measures must be applied.

2.1.3 Conduct pressure washing activities using cost-effective water efficient equipment.

2.1.4 Capture and dispose any generated wastewater to an appropriate facility.

2.2 Procedures for Using Potable Water for Construction

2.2.1 Develop a plan for dust suppression purposes to comply with applicable environmental statutes, regulations and guidelines.

2.2.2 Use of potable water as a dust suppression agent should always be secondary and only used if all other dust suppression technologies are neither feasible nor cost-effective.

2.3 New Construction Planning, Design and Construction; Existing Buildings Operations.

2.3.1 Use water conservation and efficiency guidelines outlined in California Green Building Code (2013), Los Angeles Low Impact Development Guide (2013), and Metro Water Action Plan (2010). Use applicable Leadership in Energy and Environmental Design (LEED) reference books for all planning, procurement, design, construction, operations, and maintenance of our linear and non-linear facilities, specifically in achieving LEED certification.

2.3.2 Prepare manuals of operation, as applicable, to ensure that water efficiency and conservation technologies are adopted, implemented and maintained.

3.0 DEFINITION OF TERMS

Potable Water – Water safe enough to be consumed by humans with low risk of immediate or long term harm, excluding recycled water from any source.

Recycled Water - Treated wastewater, suitable for direct beneficial use or controlled use, approved by the California Department of Public Health.

Sustainable – Meeting the resource needs of the present without compromising the ability of future generations to meet their own needs.

Water Conservation – Implementation of an action, behavioral change, device, technology, or improved design or process implemented to reduce water loss, waste or use. Water efficiency is a tool of water conservation that results in more efficient water use and thus reduces water demand. The value and cost-effectiveness of a water efficiency measure must be evaluated in relation to its effects on the use and cost of other natural resources and any beneficial reduction in water loss, waste or use.

Water Efficiency – The accomplishment of a function, task, process or result with the minimal amount of water feasible, or an indicator of the relationships between the amount of water needed for a specific purpose and the amount of water used, occupied or delivered.

4.0 RESPONSIBILITIES

Departments are responsible for following and applying water conservation measures.

Environmental Compliance and Services Unit (ECSD) oversees the water conservation policy and assists LACMTA Strategic Business Units in applying LACMTA water conservation measures.

5.0 FLOWCHART

Not applicable.

6.0 REFERENCES

California Building Standards Commission, 2013. California Green Building Standards Code (CalGreen), California Code of Regulations, Title 24, Part 11 (electronic access of 2013 updates http://www.bsc.ca.gov/Home/CALGreen.aspx).

Los Angeles Bureau of Sanitation, Stormwater Program (2013), Low Impact Development Guidelines (electronic access at http://www.lastormwater.org/green-la/low-impact-development/).

Metro Water Action Plan (2010). (electronic access at: http://media.metro.net/projects_studies/sustainability/images/Water_Plan2010_0825.pdf).

Ordinance Amending Chapter XII, The Water Conservation Plan of the City of Los Angeles, Article I – Emergency Water Conservation Plan of the Los Angeles Municipal Code by Amending Sections 121.00 Through 121.10 to Establish Additional Prohibited Uses of Water and Eliminate Water Rationing Requirements

South Coast Air Quality Management District Rule 403 and amendments

U.S. Green Building Council LEED® Reference Guides

7.0 ATTACHMENTS

Not Applicable

8.0 PROCEDURE HISTORY

03/24/2009 New water conservation policy

08/24/2011 Biennial review: no changes

08/29/2013 Biennial review: included additional environmentally-friendly guidelines, definitions and updated references.

Attachment C

Los Angeles County
Metropolitan Transportation Authority

Water Action Plan

Metro®

Acknowledgements

This document was prepared by ICF International and Brezack & Associates Planning, under contract through Los Angeles County Metropolitan Transportation Authority's (Metro's) Sustainability Program administered by Metro's Environmental Compliance and Services Department. Technical input was provided by staff in the following Metro departments: Facilities Maintenance – South Bay, Wayside Systems Facility Maintenance, Contracts and Administration, Wayside Systems Custodial Services, Quality Assurance, Facilities Services, and Building Services. Data and technical input was obtained from Aquacraft, Inc.

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

CCP	Car Cleaning Platform
CDPH	California Department of Public Health
CNG	compressed natural gas
D18	Bus Yard Division 18
D20	Rail Red Line Main Yard Division 20
EMS	Environmental Management System
Gateway	Gateway Headquarters
GHGs	greenhouse gases
GPCD	gallons per capita daily
gpd	gallons per day
gpf	gallons per flush
gph	gallons per hour
gpm	gallons per minute
gpv	gallons per vehicle
EMS	Environmental Management System
FTA	Federal Transit Administration
ICF	ICF International
ISO	International Organization for Standardization
LADBS	Los Angeles County Department of Building and Safety
LADWP	Los Angeles Department of Water and Power
LEED	Leadership in Energy and Environmental Design
LF	linear feet
Metro	Los Angeles County Metropolitan Transportation Authority
Mgal	million gallons
MSIP	Metro Sustainability Implementation Plan
NTU	Nephelometric Turbidity Units
O&M	operation and maintenance
OMB	U.S. Office of Management and Budget
OSHA	U.S. Department of Labor Occupational Safety and Health Administration

Plan	Water Action Plan
ppm	parts per million
RO	reverse osmosis
TDS	Total Dissolved Solids
WBMWD	West Basin Municipal Water District

Executive Summary

One of the key elements of the Los Angeles County Metropolitan Transportation Authority's (Metro) sustainability program is the development and implementation of a Water Action Plan (Plan) that will reduce water consumption in a cost effective manner. This Plan analyzes recent trends and current water consumption at selected Metro divisions to better understand the relationship between current equipment, practices and total water use. The Plan provides strategies for water conservation as recommendations and cost-benefit analysis of those recommended actions for Metro's consideration to reduce water consumption, and recommends next steps for the refinement, implementation, and ongoing optimization of the Plan and its associated strategies for conservation.

The intent of this Plan is to determine the potential for water conservation opportunities and cost-saving measures consistent with Metro's environmental policies and its future implementation of an Environmental Management System (EMS). The Plan will inform other Metro projects as part of the overall sustainability program for water use to be strategically aligned with other resource elements (e.g., fuel use, greenhouse gas [GHG] emissions, etc.).

The primary objectives of this Plan are to:

1) Obtain water usage data from current equipment and operational practices representative of water use throughout Metro's maintenance divisions.
2) Identify reasonable, cost-effective water conserving strategies that can be replicated system-wide.
3) Provide appropriate economic analysis of the costs and benefits for water conservation strategies including substitution of non-potable water supplies.

The results of this Plan can help inform Metro's decisions about future investment in sustainability strategies. The following water conservation strategies have been developed based upon a review of the existing facilities, operations, and water usage at selected divisions:

- Municipal Recycled Water Substitution for Bus Washing (Bus Facilities);
- Municipal Recycled Water Substitution for Car Washing (Rail Facilities);
- Municipal Recycled Water Substitution for Landscape Irrigation (Bus and Rail Facilities);
- Extension of Bus Runoff Capture On-Site Reclamation (Bus Facilities);
- Replacement of Sanitary Fixtures (Bus and Rail Facilities);
- On-Site Gray Water (Bus and Rail Facilities);
- Replacement of Steamer (Bus facilities);
- Replacement of Car Wash Facility (Rail Facilities);
- Replacement of Engine Compartment Cleaner (Bus Facilities);

- Replacement of Under Chassis Washer (Bus Facilities);
- Replacement of Air Scrubbing Water Curtain (Rail Facilities);
- Replacement of Small Parts Washer (Bus Facilities);
- Assessing Education and Outreach Measures (Rail and Bus Facilities, Gateway Headquarters); and
- Water Conservation at Gateway Headquarters and MSSC (Gateway Headquarters, MSSC).

Anticipated water demands, including a reasonable range of potential conservation savings were developed for each conservation strategy. Total water savings were estimated at both the bus and rail divisions at 204 million gallons per year (627 AFY). Conservation measures may provide 40 percent water savings.

A three-step path forward was recommended for refinement, implementation, and, ongoing optimization of the Water Action Plan and its associated strategies for conservation.

Step one is coordination by Metro's Environmental Compliance and Services Department with internal and external stakeholders. Step one ensures that issues are identified and understood, that strategies are appropriately prioritized for integration into both the sustainability plan, and the EMS, and, that collaboration with Metro's broader policies, goals and objectives is maintained.

Step two is the controlled implementation or piloting of the top rated strategies at Divisions 18 and 20. Divisions 18 and 20 thereby serve as water conservation laboratories for verification of water savings, retrofit costs, and cost savings. Piloting would also provide the hands-on opportunity for Metro staff to gain construction and operating experience with conservation strategies.

Strategies would be fine tuned through piloting to meet Metro's specific operational requirements. Previously installed sub-meters will be re-used, providing ongoing data and benchmarks for comparison of water use before and after strategy implementation. A "Path Forward" report would be prepared to update schedules and budgets for Metro-wide water conservation deployment.

In Step three, remaining Metro divisions would be surveyed for suitability to conservation strategy retrofits. Site specific conditions would be documented. Opportunities and constraints to implementation would be identified. As appropriate, planning and engineering documents would be developed to meet site constraints. Total water conservation savings would be evaluated using appropriate metrics such as recycle rate for bus and car washing equipment. Availability of municipal recycled water would be identified. Landscaping areas under irrigation would be measured. Leakage surveys and audits of interior and exterior water use would be completed. The Gateway Headquarters and the Metro Support Services Center would undergo water use audits to confirm performance of water conservation equipment and identify additional strategies. As necessary, the Water Action Plan would be updated to remain current with implementation plans, and planned conservation savings.

Table ES-1. Bus and Rail Cost Benefit Analysis Summary

Conservation Strategy	All Bus and Rail Facilities							
	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	Net Benefit (Benefit-Cost) ($)	Gallons Saved Per Revenue Hour	B/C Ratio	Payback Period (considering O&M)
1. Municipal Recycled Water For Bus Washing	105,894,912	325	135,000	360,043	1,396,715	13.24	11.35	1.50
2. Municipal Recycled Water For Car Washing	2,641,920	8	45,000	8,983	-6,786	4.03	0.85	20.04
3. Municipal Recycled Water For Landscape Irrigation	1,818,624	6	540,000	6,183	-513,695	0.23	0.05	349.33
4. Extension of Bus Wash On-Site Reclamation	44,544,000	137	120,000	2,400	3,060,689	5.57	26.51	0.64
5. Replacement of Sanitary Fixtures	16,374,688	50	252,320	0	931,937	1.89	4.69	3.63
6. On-Site Gray Water Reclamation with Standard Fixtures	13,201,920	41	528,000	10,560	247,095	1.53	1.47	11.59
7. Replacement of Steamer	9,161,865	28	154,740	3,095	257,329	1.15	2.66	6.39
8. Replacement of Car Wash Facility	528,384	2	1,200,000	24,000	-1,570,195	0.81	-0.31	-55.16
9. Replacement Engine Compartment Cleaner	403,690	1	154,740	3,095	-186,927	0.05	-0.21	-81.81
10. Replacement of Under Chassis Washer	35,040	0	156,000	3,120	-64,316	0.00	-3.95	-4.53
11. Replacement of Air Scrubbing Water Curtain	23,859	0	24,000	1,000	-39,291	0.04	-0.64	-26.71
12. Replacement of Small Parts Washer	13,140	0	89,940	1,799	-119,884	0.00	-0.33	-51.11
Subtotal	194,642,042	597	3,399,740	424,277	3,392,672	28.52	–	–
Note 1: Education Related Conservation Measures assume an addition water savings of 1% of overall equipment based measure savings use per year for five years	9,732,102	30	–	21,214	169,634	1.12	10.47	5.67
Annual Total (After 5 Years)	204,374,144	627	3,399,740	445,491	3,562,305	–	–	–

1. Introduction

One of the key elements of Metro's sustainability program is the development and implementation of a Water Action Plan that will reduce water consumption in a cost effective manner. This Plan analyzes recent trends and current water consumption at selected Metro divisions to better understand the relationship between current equipment, practices and total water use. The Plan provides strategies for water conservation as recommendations and cost-benefit analysis of those recommended actions for Metro's consideration to reduce water consumption.

1.1 Project Background

Metro's sustainability goal is to *be the transportation industry leader in maximizing sustainability efforts and benefits for Los Angeles County's people, economy, and environment* (Metro 2008). In June 2008, the Metro Board adopted the *Metro Sustainability Implementation Plan* (MSIP) (Metro 2008) that identified short-term projects and general guidelines to serve as the basis for specific long-term sustainability project development. In April 2009, Metro adopted the *Metro Environmental Policy* to provide guidance in carrying out the Metro's ongoing commitment to move people efficiently and effectively, using EMS as its primary tool.

One of the projects identified in the MSIP was preparation of a *Baseline Sustainability Report* (Metro 2009b) to better understand and promote sustainable operations throughout Metro. The report measured Metro's current performance to set targets, direct resources, and improve performance. One of the key findings was that water use was growing at a faster rate than increases to transit service (i.e., revenue hours, as reported annually to the National Transit Database). It was concluded that approximately 80 percent of Metro's water is used for washing bus and rail cars. Therefore, water usage is directly related to vehicle revenue hours. Given the likelihood for future water restrictions in Los Angeles County, and expected increases in water prices, Metro made a commitment to significantly reduce its water use. A key recommendation of the MSIP was development of a Water Action Plan to identify water saving measures and improve sustainability performance system-wide.

1.2 Purpose and Objectives

The intent of this Plan is to determine the potential for water conservation opportunities and cost-saving measures consistent with Metro's environmental policies and its future implementation of an EMS. The purpose of the Plan is to provide recommendations for cost effective implementation of water conservation strategies. The Plan will inform other Metro projects as part of the overall sustainability program for water use to be strategically aligned with other resource elements (e.g., fuel use, greenhouse gas [GHG] emissions, etc.).

The primary objectives of this Plan are to:

1) Obtain water usage data from current equipment and operational practices representative of water use throughout Metro's maintenance divisions.

2) Identify reasonable, cost-effective water conserving strategies that can be replicated system-wide.
3) Provide appropriate economic analysis of the costs and benefits for water conservation strategies including substitution of non-potable water supplies.

1.3 Regulatory Framework

California has determined that the waste and unreasonable use of water is unconstitutional. Article 10, Section 2 of the California Constitution declares that the general welfare of the state requires that its water resources be put to beneficial use and that waste and unreasonable use of water be prevented. Consistent with that determination, the following statewide legislation has been passed, and requirements for their implementation mandated as part of the California Water Code and State Civil Code.

While these provisions generally are required for compliance by California water suppliers, their implementation will ultimately impact Metro's operations. Therefore, identifying and proactively implementing water conservation strategies will avoid any punitive measures that Metro's water providers may implement to achieve compliance. Additionally, conserving water has a direct relationship to economic performance. Saving water saves money and lowers Metro's costs of operations.

Water Use and Conservation Policy

Metro adopted a Water Use and Conservation Policy statement in July 2009 to conserve the use of potable water resources at its facilities in the most cost-effective and efficient manner. This policy ensures that Metro curtail the use of potable water only to essential services during periods when statewide water conservation measures are in effect, and also prohibits uses including:

- Use of water hoses to wash hard or paved surfaces;
- Continuous leaking of water from pipes or fixtures;
- Washing vehicles with hoses without self-closing water shut-off values;
- Irrigation during periods of rain or causing excess irrigation water to sheetflow;
- Irrigation between the hours of 9:00 A.M. and 4:00 P.M.;
- Irrigation of landscaping more than the required watering times;
- Irrigation of large landscaped areas where rain sensors are not installed; and
- Use of non-recirculating systems in new conveyor car wash systems.

The policy also describes the procedures for using potable water for pressure washing activities, construction, and new construction planning, integration of design practices established by the Leadership in Energy and Environmental Design (LEED) guidelines and operations.

Senate Bill x7 7

In November 2009, California passed Senate Bill X7 7 (Steinberg) requiring the state to achieve a 20 percent reduction in urban per capita water use by December 31, 2020. California will be required to reduce its per capita water use by 20 percent from the current statewide estimate of 192 gallons per capita daily (GPCD) to 154 GPCD, which would amount to an annual statewide savings of approximately 1.59 Million Acre Feet (State Water Resources Control Board et al. 2010). Each hydrological region in the state was given a water conservation target; the South Coast hydrologic region will be required to meet a target of 149 GPCD. The state would be required to make incremental progress towards this goal by reducing per capita water use by at least 10 percent on or before December 31, 2015. The bill requires urban retail water suppliers to develop final and interim urban water use targets.

The *20X2020 Water Conservation Plan* (State Water Resources Control Board et al. 2010) was prepared to guide the state's urban water efficiency and conservation opportunities for the next ten years and beyond, to achieve the 20 percent per capita reduction target. The plan promotes legislative initiatives to incentivize water agencies to promote water conservation, and creates evaluation and enforcement mechanisms to ensure regional and statewide goals are met. The plan applies to potable water use, including all residential, commercial, institutional, and industrial users as well as non-revenue water. Non-potable recycled water is excluded. The use of recycled water to augment surface supplies as well as municipal stormwater capture is considered a new supply option without specified use reduction targets.

Senate Bill 407

Pertinent elements of Senate Bill 407 (2009) enacted in February 2009, changed portions of State Civil Code to require the replacement of all non-water conserving plumbing fixtures, in commercial properties built prior to 1994 with water conserving fixtures by January 2019. All non-compliant fixtures are to be replaced as a condition for issuance of a certificate of final permit approval for all building alternations or improvements. Non-compliant plumbing fixtures are intended to mean the following: toilets using more than 1.6 gallons per flush (gpf); urinal using more than 1.0 gpf; shower heads using more than 2.2 gallons per minute (gpm); and interior faucets using more than 2.2 gpm.

2. Existing Metro Service System

2.1 Metro Transit Network

In April 1993, the California State Legislature created Metro through the merger of the Los Angeles County Transportation Commission and the Southern California Rapid Transit District. Metro is responsible for operating the clean air compressed natural gas (CNG)-powered Metro bus fleet, Rapid Bus lines, and Metro's Rail Lines. In addition to its operating functions, Metro funds and constructs multimodal transportation solutions throughout Los Angeles County (Metro 2009a).

Metro's Rapid Bus program provides service throughout Los Angeles County, and since December 2000 has expanded to operate along 20 corridors to carry over 185,000 passengers daily (Metro 2009a). Metro operates a total of 11 bus divisions throughout the County. The total Metro fleet includes 2,635 buses, of which 129 are diesel powered and 2,506 are CNG powered. On average 2,261 buses are in service during the weekday.

Metro's Rail Lines operates out of 62 stations and covers over 79 miles of track. Operations include the Purple, Red, Blue Green, and Gold lines. Approximately 260,000 passengers use Metro's rail service each weekday. During the heavy peak travel times, there are as many as 250 trains operating throughout the system. Metro employs over 1,100 persons including train operators, mechanics, track engineers, clerks, and safety inspectors as part of the rail program (Metro 2009a).

Metro's 2009 ridership activity for its rail and bus activities are provided in Table 1.

Table 1. 2009 Ridership and Vehicle Revenue Hours

	Heavy Rail	Light Rail	Motor Bus (Directly Operated)	Motor Bus (Purchased)	Vanpool (Purchased)	METRO Total	Rail Total	Bus &Van Pool Total
Unlinked Passenger Trips	47,453,332	44,087,245	358,090,027	12,895,867	2,602,003	465,128,474	91,540,577	373,587,897
Vehicle Revenue Hours	262,017	393,755	7,026,975	496,904	422,155	8,601,806	655,772	7,946,034

In addition to the bus and rail facilities, Metro's Gateway Headquarters (Gateway) is located at One Gateway Plaza near Union Station. Gateway houses an estimated 1,800 employees and is the center of Metro's administrative and support services.

2.2 Water Use and Trends

The following information was taken from the *Towards a Sustainable Future: June 2009 Baseline Sustainability Report* (Metro, 2009b) and *Moving Towards Sustainability: 2010*

LACMTA Sustainability Report (Metro, 2010), which found that Metro's water use is growing at a faster rate than increases to transit service, and water consumption reductions are necessary in order to maintain cost effectiveness. The analysis provided in the report looked only at Los Angeles Department of Water and Power (LADWP) accounts (water bills), which comprise the majority (approximately 65 percent) of Metro's water use. LADWP 2008 water rates were used in the calculation and analysis of water savings and water costs for this report. In 2009, Metro used 25 percent more water from LADWP than in 2002, and 10 percent less compared to 2008, but Metro revenue hours increased only 6 percent in that time (Metro, 2010). Water costs increased nearly 28 percent from 2002 to 2009; more than $1 million on LADWP water in 2009. See Figure 1 below for a graphical representation of changes in water use.

Figure 1. Changes in Metro Water Use (2002-2009); [Metro 2010]

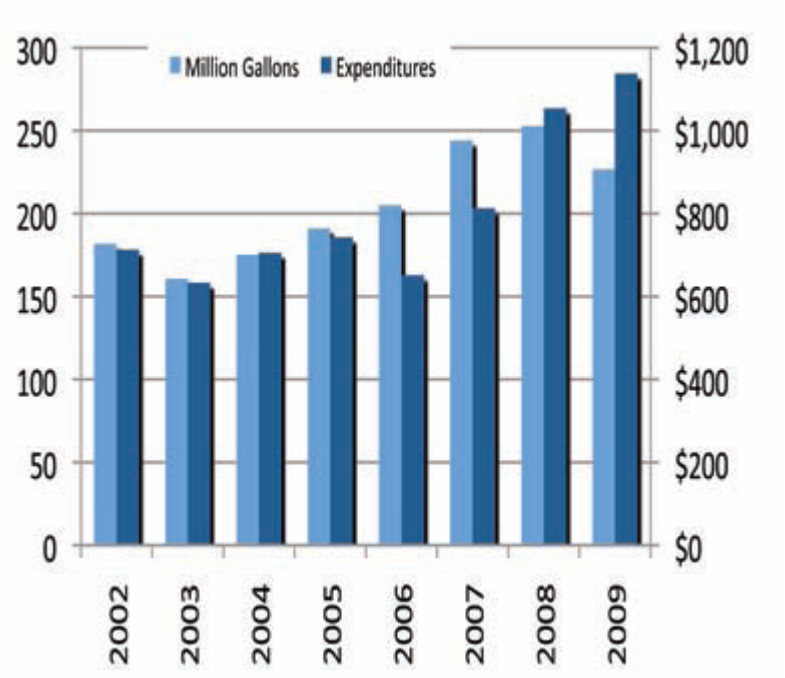


Figure 2 and Figure 3 illustrate LADWP water use in gallons per revenue hour and gallons per boarding over the period 2002 through 2009.

Figure 2. Gallons Per Revenue Hour (2002–2009); [Metro 2010]

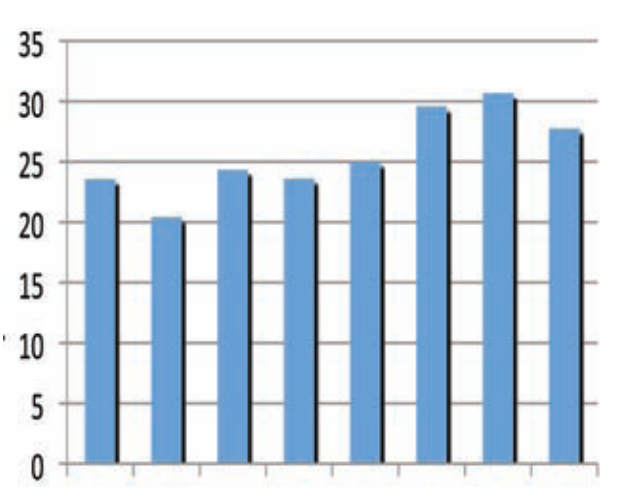
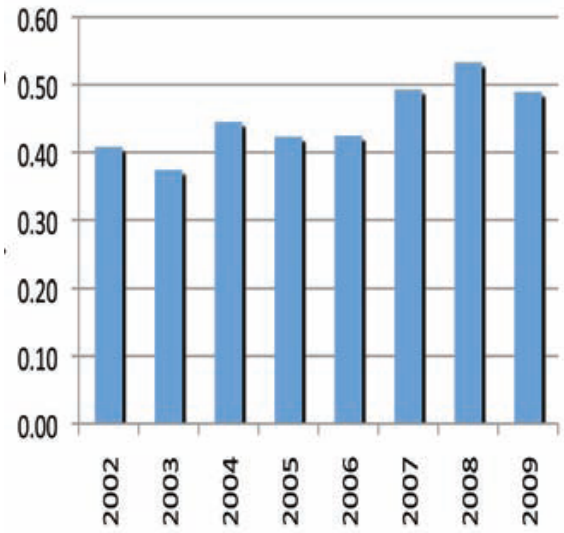
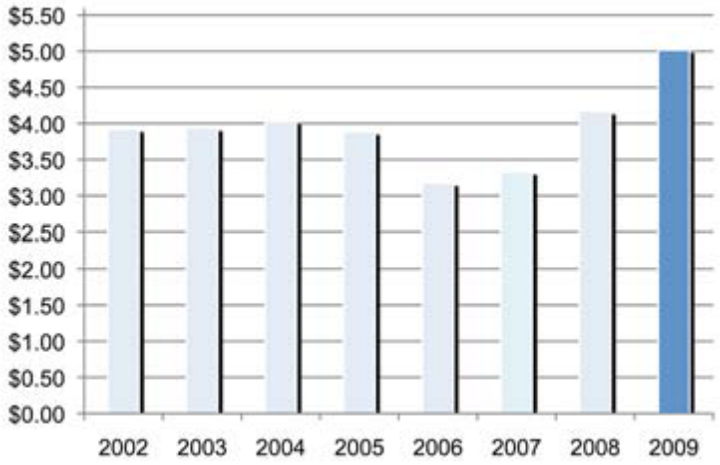


Figure 3. Gallons Per Boarding (2002–2009); [Metro 2010]



Between 2002 and 2009, the average water cost per gallon grew about 28 percent; overall water use increased by only 25 percent resulting in a total water expenditure increase of 60 percent. Sewer expenditures increased 10 percent in that time. In 2002, Metro spent $713,000 on water and $539,000 on sewer (adjusted for inflation). In 2009, Metro spent more than $1 million on water and $590,000 on sewer, which translates to a real dollar increase of $425,000 on water and $51,000 on sewer. The added cost was attributed to Metro's growing consumption and the increasing cost of water. After adjusting for inflation, the average cost of water grew 28 percent between 2002 and 2009 (does not include sewer costs), which is continued to increase (Metro 20010). Figure 4 illustrates the rising cost of water between 2002 and 2009.

Figure 4. Average LADWP Water Cost per Thousand Gallons—2009 Dollars (2002–2009); [Metro 2010]



In 2009, daily division water use varied from a low of 1,300 gallons at Division 12, to a high of 56,000 gallons at the Gateway Headquarters. Average daily water costs varied between $14 (Division 12) and $279 per day (Gateway) (Metro 20010). Figure 5 and Figure 6 present water use and expenditures at major Metro facilities.

Figure 5. Average LADWP Daily Water Use in Gallons by Major Facility (2009); [Metro 2010]

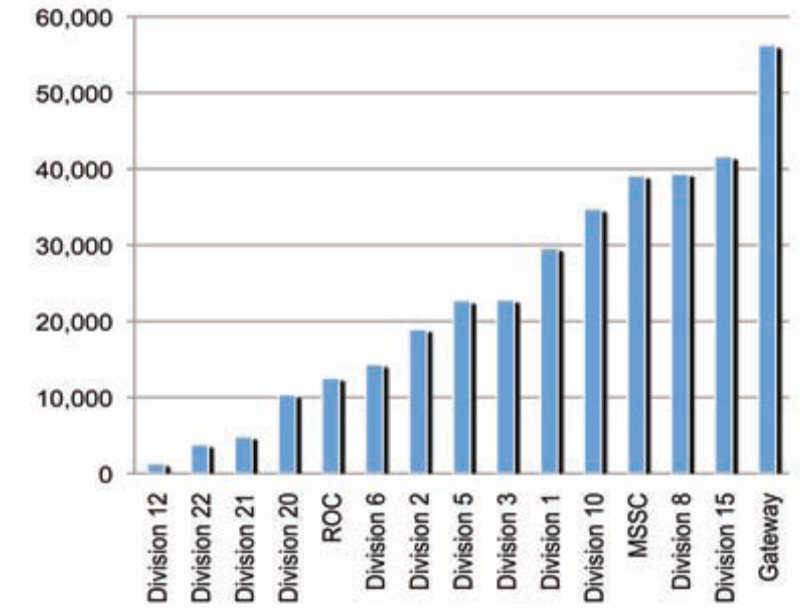
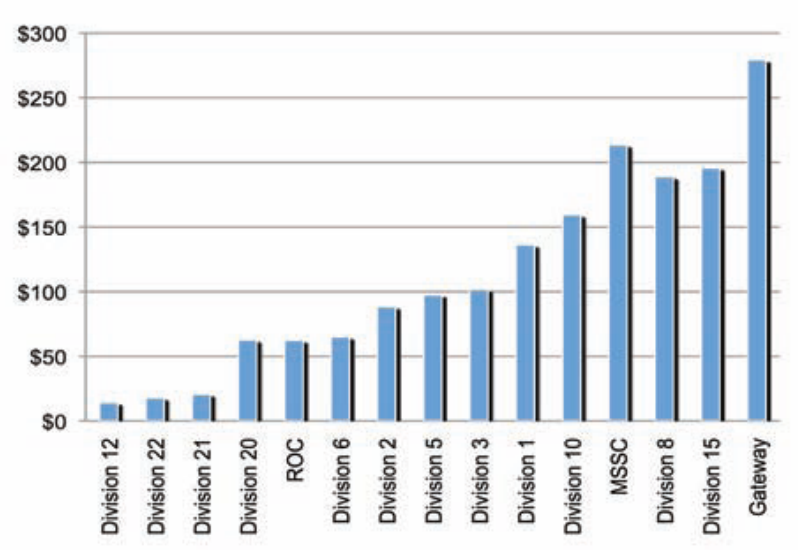


Figure 6. Average LADWP Daily Water Expenditures by Major Facility (2009); [Metro 2010]



2.3 Existing and Planned Water Conservation Measures

Metro has been making introductory installation of waterless urinals, low-flow toilets, and high efficiency faucets at several divisions. Metro is actively replacing all non-conserving faucets, urinals and toilets at the Gateway Headquarters. Metro continues to install conservation features as part of standard retrofits and has taken several steps to proactively reduce water consumption throughout all of its operations (Metro 2009c) per the Water Use and Conservation Policy.

3. Data Collection and Analysis

3.1 Methodology

The water conservation and potable water replacement strategies have been developed based on the following methodology:

- Observations of Current Operations and Equipment
- Initial Assessment of Operations, Equipment Water Use and Water Billing Records
- Data Logging of Actual Water Use
- Analysis of Logged Water Use Data
- Application of Results

The following terms used throughout this Plan have specific meaning related to the observations and strategy development for water conservation:

- **End-Use:** The point, facility or piece of equipment where water is actually used. Examples of typical end-uses are toilet flushing, sinks, urinals, bus and rail car washing bays.
- **Data Logging:** The process for acquiring information on the actual use of water.
- **Disaggregation:** The process of segregating out the data associated with each of the individual uses of water recorded at a single point.
- **Flow Trace Wizard:** The software used to read the acquired data and assist in the process of disaggregation into each end use recorded.
- **Meter:** The water meter or meters installed and operated by the water provider through which a site receives its total water supply.
- **Sub-Meter:** Additional meters set by this project to better isolate the water use by a specific piece of equipment or end-use.
- **Water Purveyor:** Suppliers of water to Metro**:** In this study the two water purveyors are LADWP and the California Water Company (Cal Water).
- **Recycled Water:** Term used to define municipal recycled water, a non-potable supply of water originating as municipal wastewater, that has been cleaned to standards established by the State and may be made available for a variety of uses including irrigation, bus and rail car washing.

Observations

Relevant data was collected to develop a comprehensive understanding of existing water use at selected divisions. Data review included Cal Water and LADWP billing records and plumbing as-built diagrams. After reviewing relevant data, onsite interviews with facility managers to discuss water conservation opportunities within the sites; verify major water using equipment,

operational practices and behaviors; administrative procedures, obtain loading data and catalogue information of major maintenance equipment; and inform managers of the Plan in order to solicit feedback.

Initial Assessment

Metro identified two divisions as representative of the equipment and operations for rail and bus maintenance facilities. Bus Yard Division 18 (D18) and Rail Red Line Main Yard Division 20 (D20) were selected by Metro for discrete and focused logging of water use. A complete physical site investigation and screening of the selected divisions was conducted on February 9 and 10, 2010 to confirm suitability of existing water meters for data logging; identify all major end uses of water; review all aspects associated with water use at the sites; confirm the facility fence line relative to water use and discharge; inspect installed equipment and sub-metering opportunities; observe site activities to understand current operational standards; and identify and review associated regulatory constraints.

Coordination with purveyors of alternative water supplies confirmed their availability to Metro, discussed supply reliability and water quality consistent with Metro's requirements for bus and rail cleanliness.

Data logging was conducted at the selected sites. Through the review of relevant data, and from the information obtained during the site visits, a plan was prepared for field deployment of data logging equipment.

Data Logging

Field data logging was conducted over a two-week period during typical division operations to provide information on the timing and volumes of water by end-use. An end-use of water refers to the point at which a given piece of equipment places water into use. Typical end-uses are sinks, toilets, bus washing equipment, etc.

Data Analysis

Statistical analysis of logged data was performed to verify sample representation. Since the use of water is measured at either the main water meter or installed sub-meters, the logged data may represent many uses occurring simultaneously. It is therefore necessary to disaggregate the recorded or logged meter data into its various end-uses. The disaggregated data was used to determine daily total water use for selected divisions. Data provided in this report includes:

- Total metered water use at the sites;
- Data from the data loggers summarized on a daily basis to show total daily water use for the site with descriptive statistics; and
- Normalized daily use by cars or buses washed.

Application of Results

Based upon the review of logged water data at the selected divisions, water conservation strategies were developed to identify the greatest potential water savings opportunities. A cost benefit analysis was developed for each of the water strategies to determine its financial feasibility. Cost-benefit analysis is a commonly used financial tool for evaluating projects to determine if a given project will result in benefits above its proposed costs. Cost-benefit analyses commonly calculate the net benefits, or total benefits minus total costs, to determine if the net benefits of a given project are positive. Another commonly used metric is the benefit-cost ratio, or the total benefits divided by the total costs. A benefit-cost ratio greater than 1 suggests that a project will result in benefits over and above its proposed costs.

In order to compare the costs and benefits of a project, cost-benefit analysis involves calculating the net present value of a project's costs and benefits, or the sum of the present values of the cash flows for both benefits and costs. Calculating the present value of cash flows, and thus the net present value of costs and benefits, requires information on the length (i.e., number of years) of the project and the suggested discount rate. A discount rate is used in recognition of the fact that a dollar in future years is not worth the same as a dollar today. The choice of a discount rate is subjective, though the U.S. Office of Management and Budget (OMB), in its guidance for conducting regulatory analyses (OMB Circular A-4), suggests using discount rates of 3 percent and 7 percent for calculating net present values.

For the purpose of conducting cost-benefit analyses of the proposed water conservation strategies, the costs and benefits of the different measures were estimated. The benefits of the strategies are calculated from the water savings that result from using recycled water based upon the current costs of potable and recycled water. These benefits are expressed as an annual avoided cost (i.e., savings) of water from installing and using a given strategy. Costs of the strategies result from upfront capital costs and annual operation and maintenance (O&M) costs. It was assumed that the capital costs would accrue in the first year, and the O&M costs would accrue annually. For the cost-benefit analyses of the strategies, a 40-year time horizon and a 5 percent discount rate was assumed. Using these parameters, the net benefits and benefit-cost ratio for the proposed water conservation strategies were calculated.

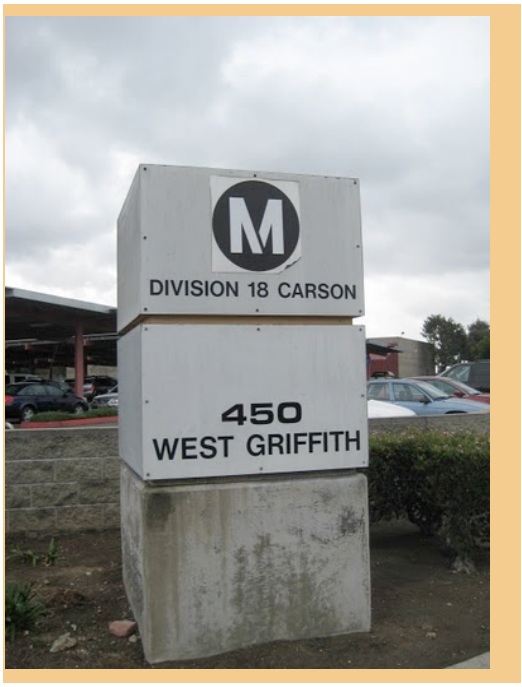
Capital or construction costs and O&M cost were estimated based on experience with similar projects and estimates provided by equipment vendors. The economic analysis was presented in business case terms considering the water savings for each strategy per revenue hour for the bus and or rail system.

3.2 Water Use Analysis

Metro identified two sites (D18 and D20) as being representative of the typical facilities and operational facilities throughout the system. Gateway Headquarters is the largest water user at Metro; therefore a preliminary evaluation of water use at Gateway was also conducted.

Facility Profile (Division 18)

D18 was selected by Metro for data logging because it represents a typical Metro Bus Division given water using equipment and operation. Potable water is provided to Division 18 by Cal Water. This general description of D18 equipment and operations is based upon information collected during staff interviews and a physical site investigation and water fixture review conducted on February 9, 2010.



D18 is located in Carson, California, at 450 West Griffith Street, and was constructed in 1984. D18 serves as a bus maintenance and washing facility, and employee break station. Maintenance repair is performed for roughly 30 buses per day; buses are serviced every 3,000 miles or approximately every 6 months. Approximately 2,000 buses are washed per day throughout all of Metro bus facilities, and roughly 180 buses are washed per day at D18. Based upon discussions with staff, bus washing typically occurs between 5:30 P.M. to 2:00 A.M. and most frequently between December and April.

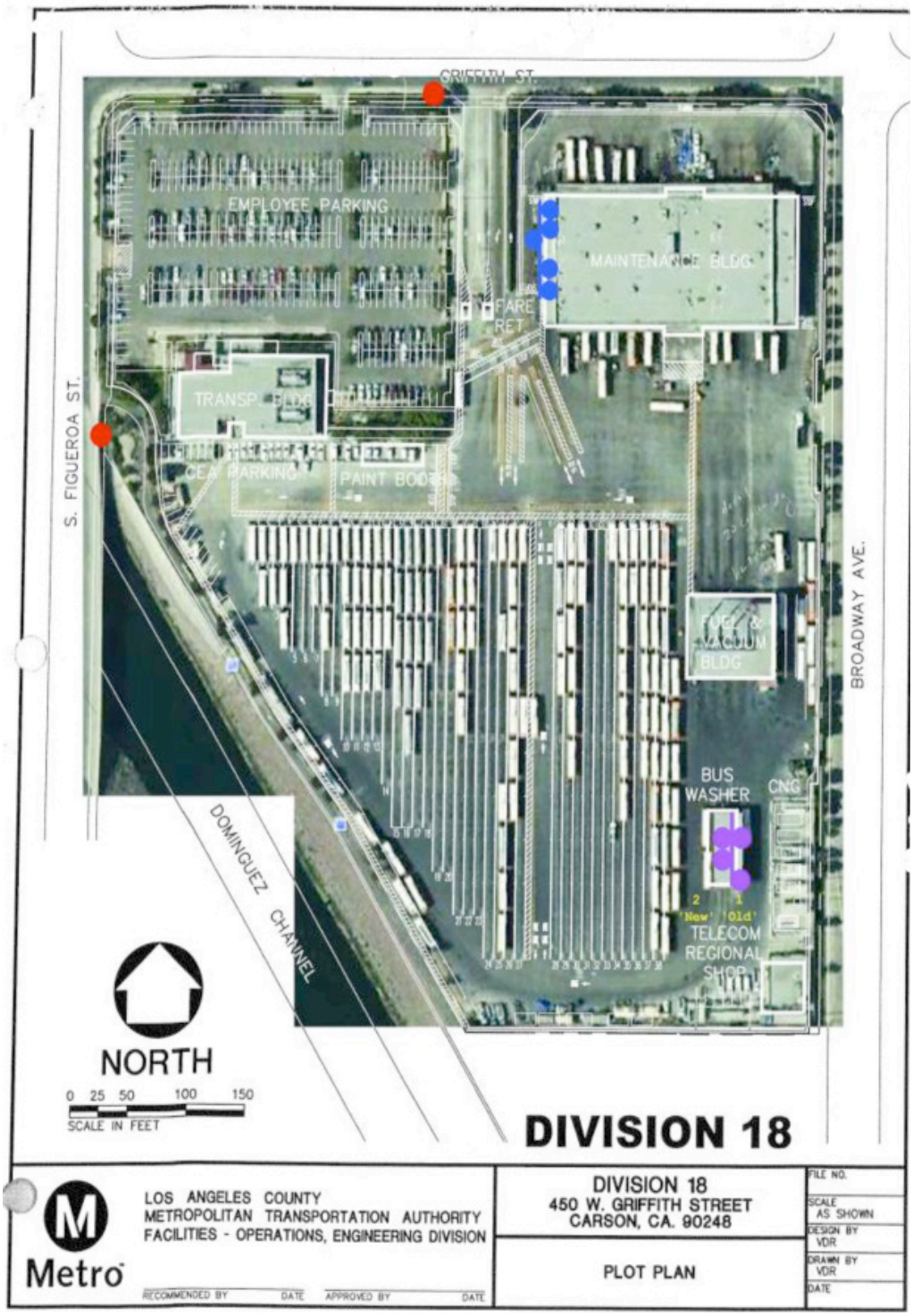
There are approximately 600 employees stationed at D18; operators have a 4-5 hour shift and return to D18 for a 2- to 3hour break before returning to work. Employees typically work three shifts, seven days per week.

D18 facilities (from north to south) are:

- A maintenance building where the majority of the bus maintenance activities occur;
- A transportation building that provides services for off duty employees and administrative offices;
- A fuel and vacuum building used for bus detailing and interior bus washing;
- Two exterior bus washing facilities (bays); and
- A telecom regional shop housing staff offices.

There are no evaporative cooling facilities at D18. Figure 7 presents a layout of D18 facilities and locations of water meters.

Figure 7. Aerial Division 18 with meter locations



	Cal Water meters
	Steam wash sub-meters
	Wash bay sub-meters

Bus Washing Facility

The bus washing facility consists of two bus wash bays (Washer 1 and Washer 2) located on the south side of D18. The second bus washing facility (Washer 2) at D18 was constructed in 2008; however, during the data logging period Washer 2 was used less often than Washer 1. Most Metro Bus Divisions have one bus washing facility, with the exception of Divisions 5, 8, 9, 10, and 18.

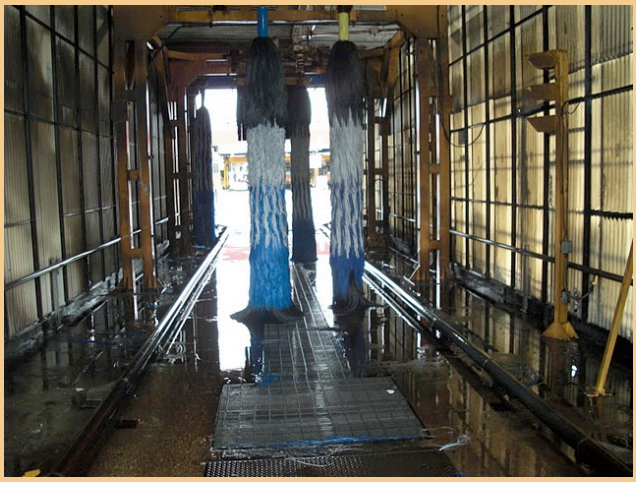
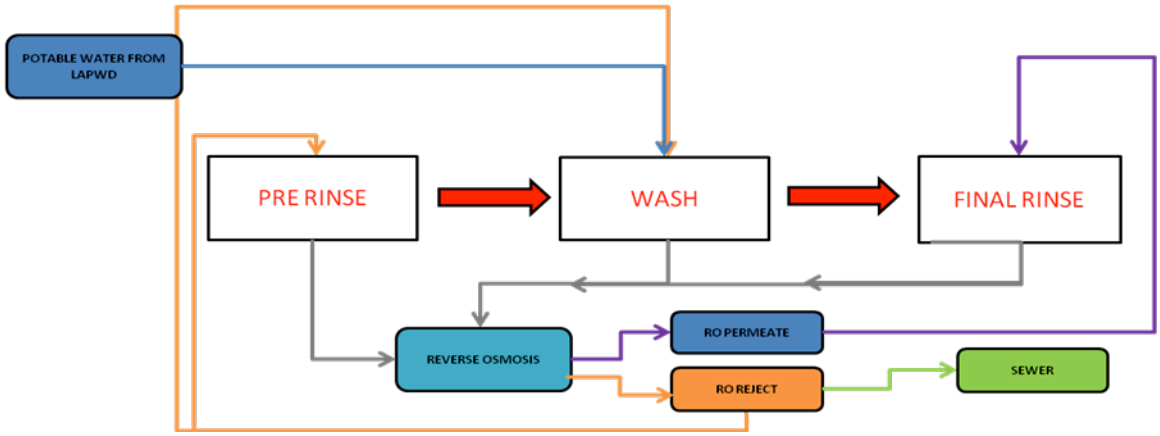


Figure 8 presents a schematic of the bus washing process. Bus washing consists of a pre-wash, wash, and final rinse. Both Washers include an on-site reclamation system that captures runoff water for reuse in the wash process, and a reverse osmosis (RO) filter that cleans the water for use in the final rinse. The RO filters reduce the Total Dissolved Solids (TDS) in the water to produce a pure water (permeate) that is low in minerals to prevent water spotting after the final rinse. As part of the RO process, the RO filters discharge mineral water (referred to as reject) that is plumbed back into the bus wash process and is reused for washing. After a bus has been washed, water drains through the grated floor to a clarifier for capture and recycling; however only a portion of runoff from the bus washing facilities reaches the clarifiers as the run-out areas do not extend far enough to capture all of the drainage.

Figure 8. Schematic Bus Wash Water Flow Diagram



The newer design of Washer 2 uses fewer pumps, different clarifiers, and a different layout than Washer 1.

Maintenance Building

The largest end uses of water at the maintenance building are the steam pressure washer (Whitco Cleaning Systems), small parts cleaner (Insta Clean Small Parts Washing Unit), under carriage washer (Chassi Jet), and hot water pressure washer (Hydrotek). The steam pressure washer is used to degrease and clean engines and equipment. The steam pressure washer has no auto shut off valve and is operated intermittently throughout the day; it uses approximately 10 gpm when in operation. The small parts cleaner is on a cycle/timer and runs on demand. The under carriage washer has a cycle operation, is used on-demand and infrequently. Due to the high content of solids and grease, the wash water at the maintenance facility is impractical to recycle.

Approximately 150 employees work at the D18 maintenance building. The maintenance building includes men's and women's locker rooms, kitchens, and bathrooms that contribute to the water use in the facility. Individual point-of-use cartridge filters are deployed throughout the maintenance building for on-site improvement of potable water.

Table 2 presents a summary of water end use fixtures located at Division 18.

Table 2. D18 Water Fixture Data

	Toilets/Urinals (1)	Sinks (2)	Showers (1)	Other Water Features
Women's Facilities				
Locker Room - Maintenance Building	3 toilets	3	1	
Restrooms – Maintenance and Transportation Buildings	4 toilets (1.6 gpf)/ 2 toilets	6	1	
Men's Facilities				
Locker Room - Maintenance Building	3 toilets/ 4 urinals	2	2	
Restrooms – Maintenance and Transportation Buildings	4 toilets/ 3 urinals/ 4 waterless urinals/ 5 toilets (1.6 gpf w/ dual flush)/ 1 urinal (less 1 gpf)	11	2 (manual shut off)	
Kitchen (Maintenance Building and Transportation Building)		2		1 ice machine/ 1 commercial beverage vending machine

Table 2. D18 Water Fixture Data (continued)

	Toilets/Urinals (1)	Sinks (2)	Showers (1)	Other Water Features
Break Room/Office (Maintenance Building and Transportation Building)		2		1 ice machine
Janitor Closet (Maintenance Building and Transportation Building)		2		
TOTAL	12 toilets/ 9 toilets (1.6 gpf)/ 7 urinals/ 1 urinal (less than 1 gpf)/ 4 waterless urinals	28	6	2 ice machines/ 1 commercial beverage vending machine

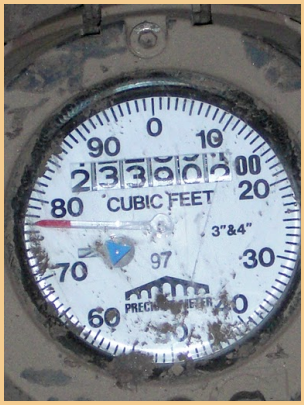
Notes:

(1) Except as otherwise noted, all restrooms are equipped with pre-1986 toilets, urinals and shower heads

(2) All utility sinks are manually operated and not equipped with infrared sensors or foot pedals.

Transportation Building

The transportation building primarily services off duty employees and houses administrative offices. Individual point-of-use cartridge filters are deployed throughout the transportation building for staff use.



Fuel Station

The fuel station is used for bus detailing and internal washing. Internal bus washing is performed using towels and mops, and is considered a low water use. Approximately 20 buses are serviced at the fuel station per day. Metro currently uses an offsite laundry service for cleaning, and is considering purchasing an onsite washing unit.

Landscaping

Division 18 has minimal ornamental landscaping around the perimeter of the site, which is irrigated by spray irrigation. Several broken sprinklers were observed around the site at the time of the evaluation.

Data Logging Results and Analysis (Division 18)

An initial site review and plumbing inspection of Division 18 was performed to determine existing main and sub-meter locations and appropriate locations for data logging equipment. This section presents a review of the historical water use at D18 and the results of the data logging effort at the sub and main meters.

There are two active Cal Water meters at D18 presented in Figure 10. The steam pressure washer and small parts cleaner at the maintenance building, and the bus wash bays are

supplied from the main meter, along with other site uses such as indoor (office) and miscellaneous uses. Meter locations for two Cal Water meters, six (one fixed, five temporary) maintenance building submeters, and seven (2 fixed, 1 temporary at Washer 1, and 2 fixed, 3 temporary at Washer 2) bus wash sub-meters are shown in Figure 10.

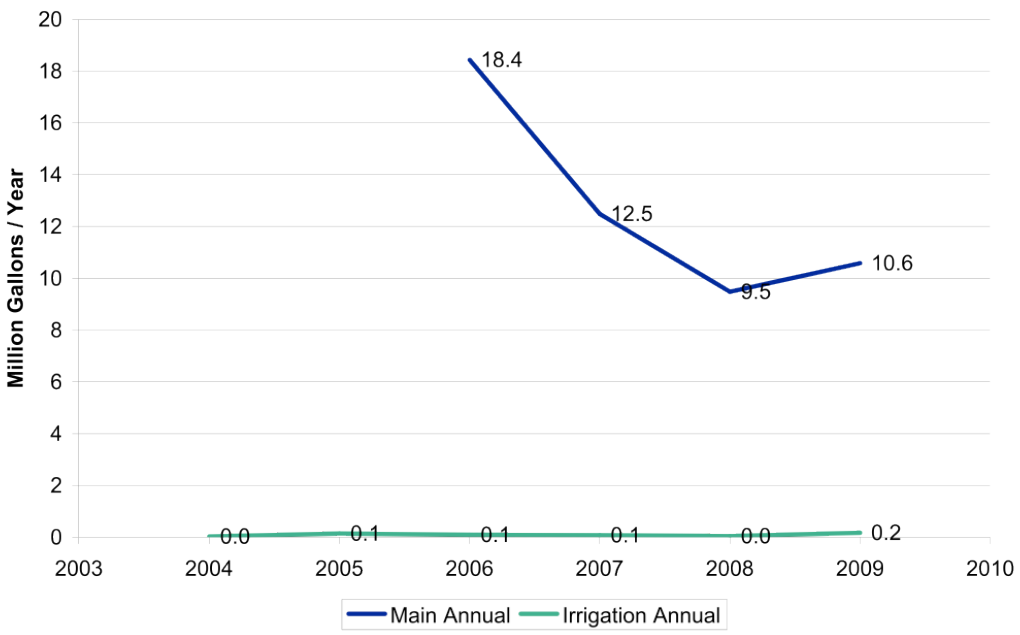
Cal Water meter identification and meter readings are presented in Table 3 . The main meter (3" x 4" Precision-brand) located on Griffith Street delivers all of the process water used at the site. This meter recorded an average water use of 28,992 gallons per day (gpd) in 2009. Some irrigation along the west of D18 flows through a separate meter (Badger 70 1") along S. Figueroa Street, which recorded an average use of 475 gpd of water in 2009.

Table 3. D18 Cal Water Meters and Annual History

Approximate Street Address	Account Number	Make and Model	2008			2009		
			Gallons	AF	GPD	Gallons	AF	GPD
D18 Main:								
450 W Griffith St, Gardena, CA 90248	5939300000	Precision 3" x 4"	9,481,648	29.1	25,977	10,581,956	32.5	28,992
D18 Irrigation:								
Figueroa Bridge & Dominguez Channel Carson CA	5482966523	Badger 70 1"	41,140	0.1	113	173,536	0.5	475
		Facility Total:	9,522,788	29.2	26,090	10,755,492	33.0	29,467

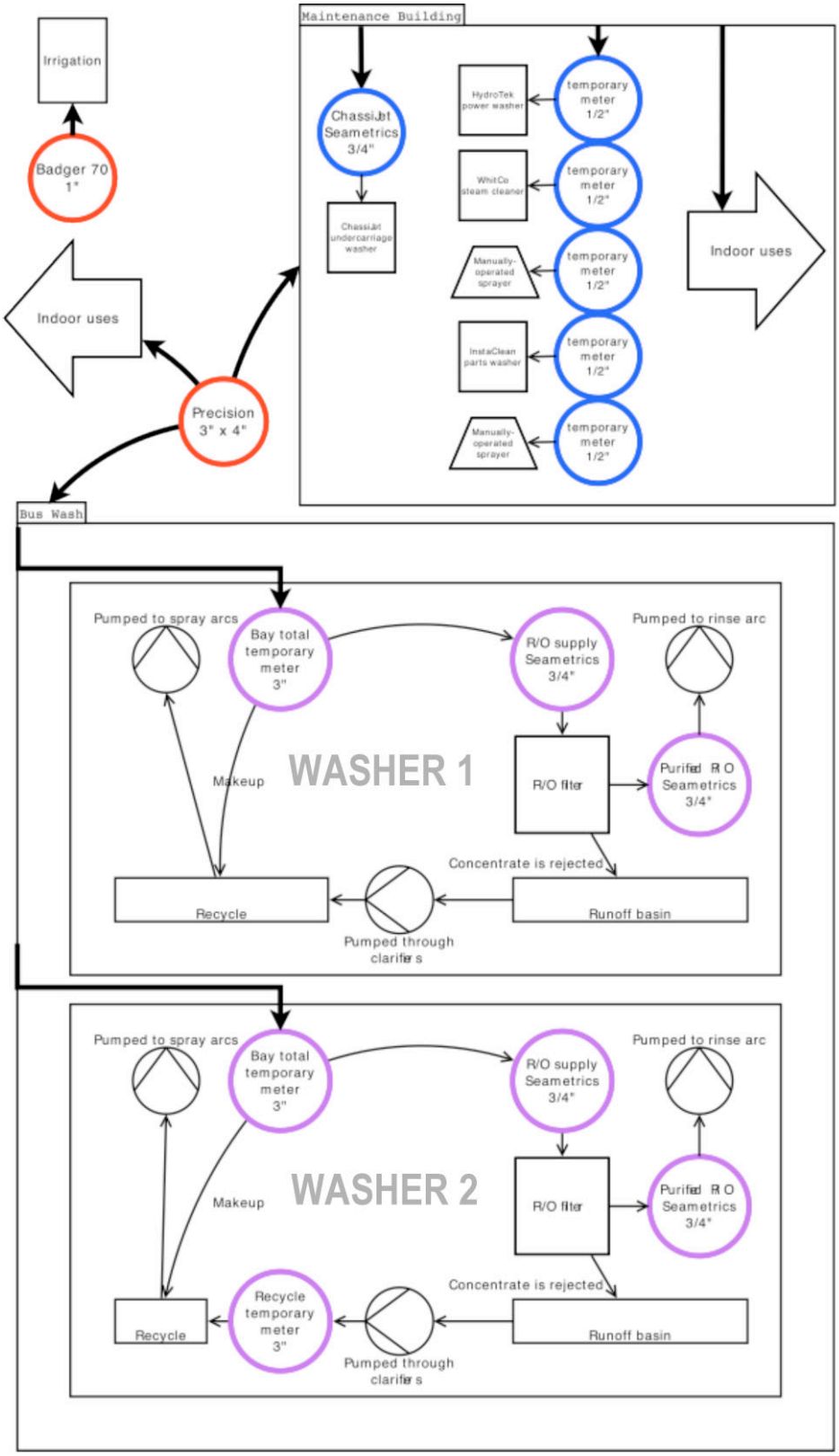
Figure 9 shows historical usage for the above mentioned meters with a decreasing trend since 2006, from a recent annual high of 18.5 million gallons (Mgal) to the latest 10.7 Mgal in 2009. Metro staff provided the following explanation for the observed decrease: the bus wash recycling system was disabled before early 2007 when bus wash controls were repaired; leaking underground lines were repaired in 2007; and a new steamer with timer shut-off control (manual start timer) was installed in April 2007, replacing a model without an automatic shut-off.

Figure 9. D18 Historical Billed Use



The Cal Water meter (Precision 3”x4”) along Griffith Street measures all of the water flowing into the site. As part of the data logging effort, sub-meters (Seametrics) were installed to monitor flow at the major water using facilities (i.e., maintenance building, bus wash bays) using the main Cal Water meter. A total of five sub-meters were installed, one at the under carriage washer and four at the bus wash bays, as shown in Figure 10. These meters were installed on April 8, 2010 along with eight temporary meters that were removed April 20, 2010.

Figure 10. D18 Existing and Installed Meter Layout

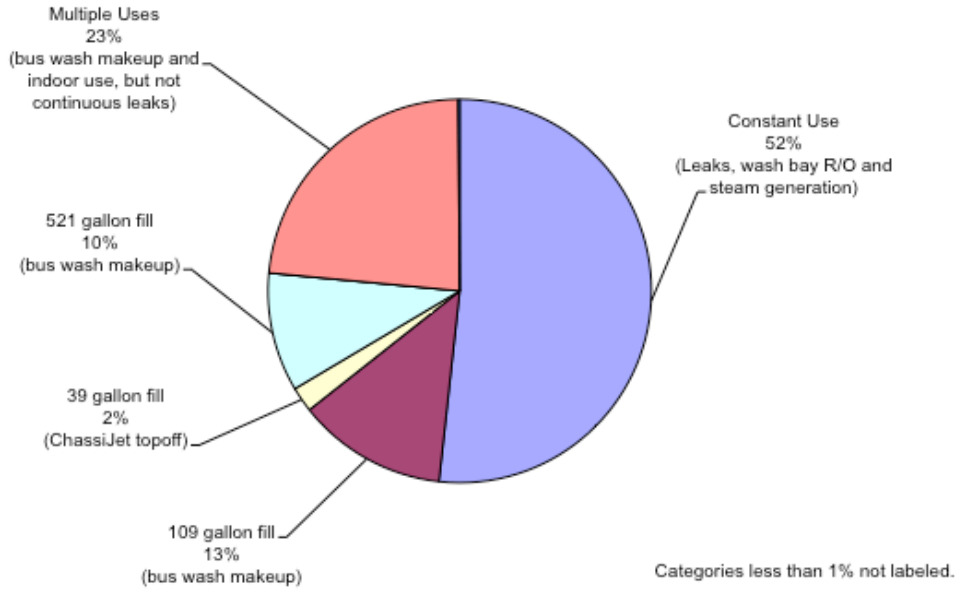


Daily Disaggregated Operations

Based on repeating flow patterns through the main meter, water use was disaggregated into discrete events using TraceWizard software. Flow trace analysis allows identification of specific water use events based on their flow and volume characteristics. These events can then be linked to specific water using devices (end-uses) in the facility through more detailed on-site auditing.

Discrete flow events for all end-uses of water were categorized based on flow rates, duration, and time-of-day. In general, these characteristics identify certain equipment and often a small number of fixtures account for a majority of the water use. Limitations to this technique arise when equipment is used simultaneously, which tends to mask the individual events. For example, simultaneous events flowing at variable rates will appear in combination as a single event at a high flow rate. Disaggregating simultaneous events may result in a mixed-use category where no further disaggregation is possible. Figure 11 presents the disaggregated water use by volume.

Figure 11. Disaggregated Water Use Summary by Volume



Some observations about the flow trace data collected at D18:

- No uses are characteristic of evaporative cooling.
- Constant use averages 825 gallons per hour (gph) (13.8 gpm), with relatively little influence from the number of vehicles washed. Based on the facilities on site, the constant use is believed to be RO draw, steam generation or other unaccounted for use. This flow may be masking the presence of a leak.
- Two categories of filling events, 109 gallons and 521 gallons on average, are highly influenced by the number of vehicles services. These events are likely make-up fills for the bus wash systems. These events would be part of the bus wash make-up sub-metering above.
- Filling events averaging 39 gallons occur throughout the day and account for 2 percent of the daily flow. Based on the facilities on site, these are either the under carriage washer or makeup fills for the bus wash system.
- The Multiple Uses category contains events that cannot be individually distinguished, and includes proportions of all other uses (i.e., bus wash make-up or indoor use) except constant flow. This appears to be very highly influenced by the number of vehicles washed throughout the day; uses contributing to this category are almost certainly bus washing equipment.
- TraceWizard distinguished a few toilet flushes at an average of 3.3 gpf. Compared to the major uses on site, most toilet use is likely indistinguishable in the Multiple Uses category. Indoor water use was not separately measured as part of the data logging effort.

Table 4 shows the daily water use recorded during the logging period for the main meters at D18, disaggregated to the extent possible.

Table 4. TraceWizard Analysis on D18

	Events	Total Gallons	Duration (seconds)		Highest Flow Rate GPM	Volume (Gallons)			
			Average	Standard Deviation		Min	Max	Average	Standard Deviation
Constant		217813.5			220.7				
109 gal fill	486	53174.3	117.2	29.9	167.1	66.6	173.4	109.4	22.1
39 gal fill	230	8955.7	54.0	24.2	104.1	15.0	68.1	38.9	9.8
521 gal fill	81	42182.3	268.1	95.6	519.2	189.1	943.0	520.8	131.2
Leak	65	16.7	70.6	36.9	0.3	0.0	0.9	0.3	0.2
Multiple Uses	1587	98342.3	111.9	133.7	199.7	0.3	725.5	62.0	111.4
Toilet	182	592.5	14.3	12.0	29.4	2.4	6.4	3.3	0.9

The 2009 historical average daily water use at D18 was approximately 38,232 gallons. The majority of water was used for bus washing, but there was a small amount used in the maintenance building for pressure washing and parts washing. During the logging period a total of 1,943 buses were washed (1,561 at Washer 1 and 382 at Washer 2). Taking into consideration recycling that occurs at D18, typical use of potable water per bus ranged from 157 to 212 gallons per bus, which substantially reduces water use per bus ratio.

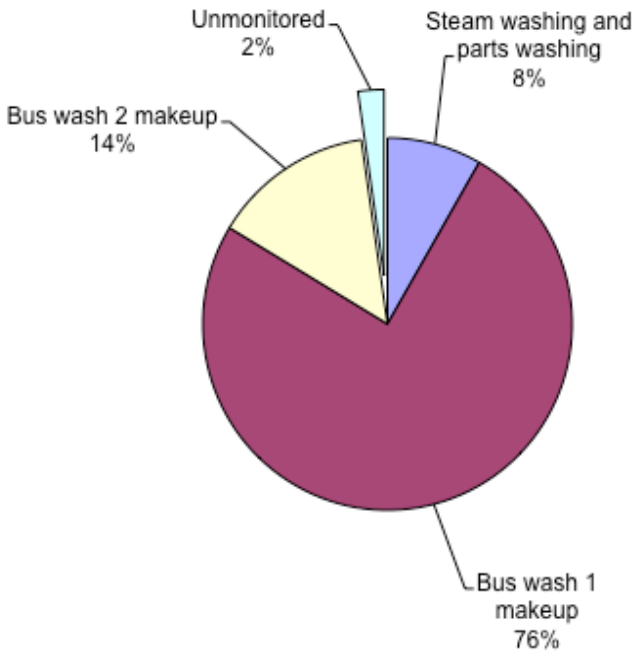
A fairly constant flow of 825 gph was also noted on the flow trace analysis. This is a substantial amount of water, and should be investigated to determine if it consists of leaks or other constant uses that could otherwise be eliminated. The toilet flushes that can be identified on the flow trace analysis appear to be 3.5 gpf toilets, which could easily be replaced along with shower and faucet aerators.

During the data logging period, the main meter recorded an average of 38,232 gpd with the irrigation meter shut off. This is approximately 10,000 gpd higher than the historical 2009 daily average. Sub-meter flows account for 98 percent of the main meter flow. Facility totals for the study period are shown in Table 5 and Figure 12.

Table 5. Average Daily Data Logging Totals (April 8 to April 20, 2010)

Meter	Ave Logged Use (gpd)	Percent of Total (%)
Bus Wash 1	29,082	76%
Bus Wash 2	5,389	14%
Maintenance Building steam and parts washing	3,169	8%
Unmonitored, including indoor use at Maintenance Building	592	2%
Main	**38,232**	**100%**

Figure 12. D18 Logged Use by Facility



D18 Bus Wash Facility

Approximately 1,943 bus washes were observed during the data logging, which provides a good understanding of the water use for bus washing. Dual bus wash bays on the south side of D18 account for 90 percent of water use at this site. Both bays include a recycle system, as well as RO filters that produce purified water. Reject water from the RO system is recycled to the storage tank and used as part of the initial wash water. Therefore, as long as the capacity of recycled water storage is not exceeded, the RO units do not create extra process water demand. Depending on the capacity of recycled water storage, the RO filter does not necessarily create extra process demand because the high mineral content water removed from the RO system (referred to as reject) is recycled to the storage tank and used as part of the initial wash water.

Water used for washing is a balance between recycled water, which can accumulate grit and suspended solids that limit effectiveness, and fresh make-up water. Total water use refers to the volume pumped through spray arcs, and make-up refers to the demand to replace lost recycled water with fresh water. Water used for rinsing is a balance of potable water, which can leave spots on the finish, and RO product water. Overall, total water used cannot be entirely drawn from the recycle system; some fresh water will ordinarily be consumed with this design.

RO filters produce pure water (referred to as permeate or product water) and mineral reject water from incoming water supply. During the logging period, the RO rate at both wash bays was between 24 and 27 percent, which means for every gallon of permeate, about 3 gallons of reject are produced. The permeate is pumped to and stored in a tank, while the reject is discharged into the recycle system to be reused for washing.

It is important to note that subsystems on each bus wash can be controlled by individual valves. At the beginning of the data logging effort, the RO systems were both active. Patterns of use by the maintenance staff observed during the logging period suggest the preference for Bay 1 over Washer 2. At the beginning and end of the logging period, Washer 2 was apparently closed for maintenance; it was unclear whether this is representative of longer-term use.

Vehicle counts were collected based on control circuit activity. There are two bus models washed at D18: articulated three-axle buses and smaller two-axle buses. The method of vehicle counting did not distinguish between models.

Wash Washer 1

Washer 1 is the older of the two wash bays. During the logging period, Washer 1 accounted for 81 percent of all buses washed. Two fixed meters were installed on this system, and one temporary meter was used during the logging period. Meters monitored total make-up water to Washer 1, total water to the RO filter, permeate produced by the RO filter, along with pump duty cycles and vehicle counts. An average of 270.1 gallons per vehicle is used, of which 211.9 gallons (79 percent) comes from potable make-up and 58.2 gallons (21 percent) is recycle. Of the water delivered through the meter, 91 percent is used directly for wash water make-up and 9 percent goes to the RO system, as shown in Figure 13.

Figure 13. Washer 1 End-Uses for Portable Makeup Water

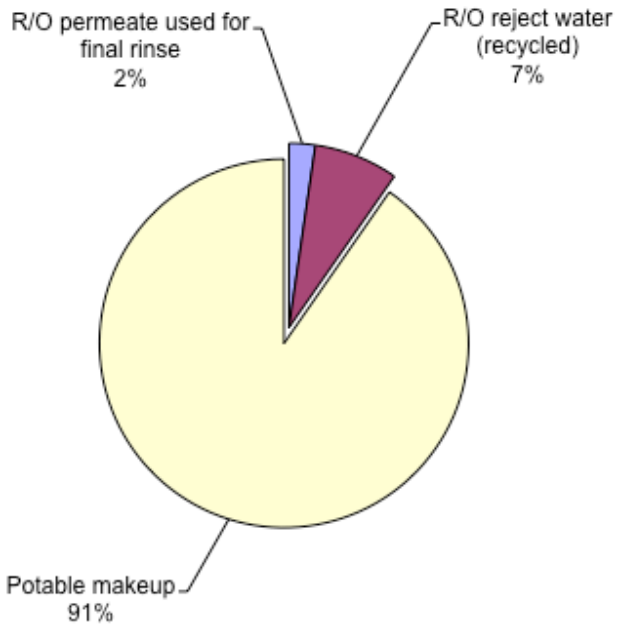


Table 6 shows the estimated daily water use for the main meter, shown as potable make-up water, reverse osmosis use, estimated recycle water delivered from the clarifier system, and the total wash water applied to the buses (potable make-up plus recycle). Table 6 shows a logging average of 29,082 gpd of total fresh water use at Washer 1 for 136 vehicles per day, including 28,852 gpd of make-up and RO. The last column of Table 6 shows the estimated potable make-

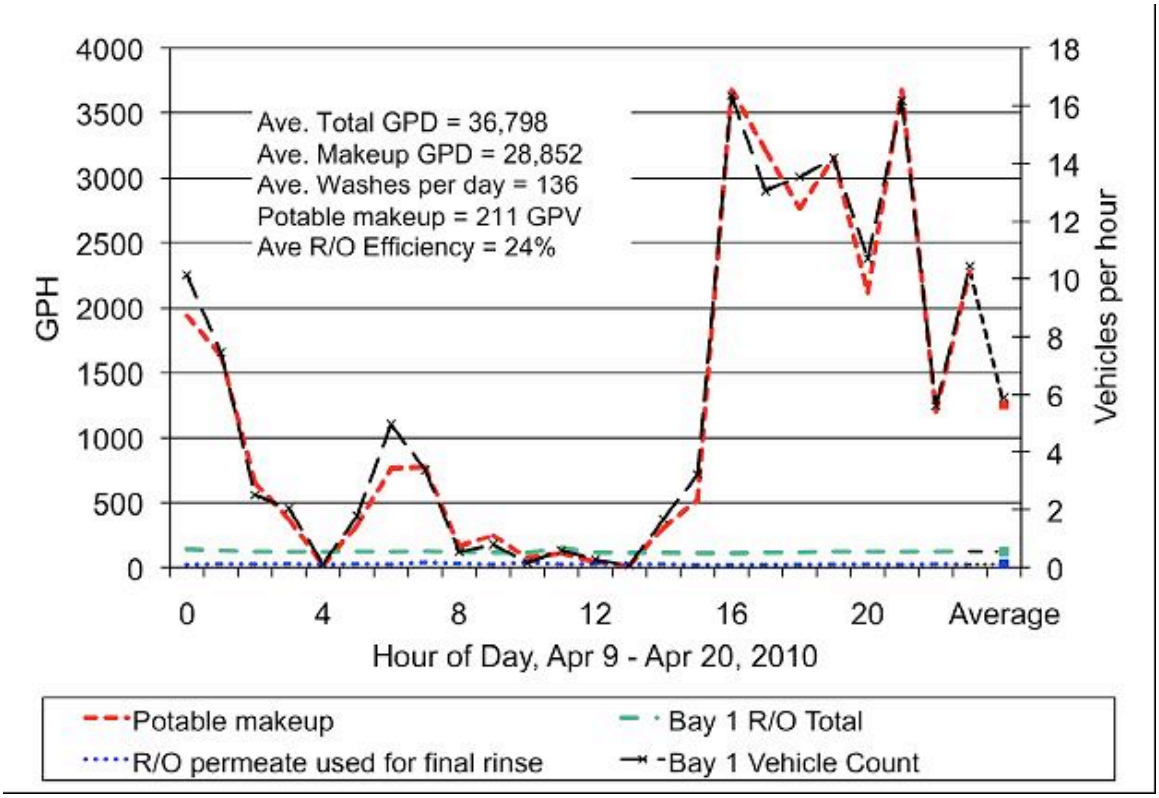
up use normalized on the basis of the number of buses washed. The descriptive statistics for the data are shown at the bottom of the table. On an overall basis, Washer 1 uses an average of 212 gallons of make-up water per vehicle. More details about the individual uses are provided below.

Table 6. Washer 1 Daily Logged Volume (gpd)

	Vehicles	Potable Makeup	RO Total	RO Permeate	Est. Wash Total	Est. Recycled Portion	Daily RO Rate	Makeup gpv
9-Apr	166	26700	1720	530	44490	40%	31%	161
10-Apr	105	20900	3030	890	28493	27%	29%	200
11-Apr	103	17000	2920	840	28103	40%	29%	165
12-Apr	130	26500	2160	580	34996	24%	27%	205
13-Apr	143	33700	3030	850	38508	12%	28%	236
14-Apr	184	42400	3300	800	49172	14%	24%	230
15-Apr	146	36100	3260	760	39288	8%	23%	247
16-Apr	194	43700	2920	670	51644	15%	23%	226
17-Apr	108	22700	2910	760	29403	23%	26%	210
18-Apr	97	16500	2880	420	26412	38%	15%	171
19-Apr	140	33700	2850	320	37727	11%	11%	241
20-Apr	47	10700	1010	160	13406	20%	16%	230
Overall	1561	330600	31990	7580	421642	22%	24%	211.9
Days	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Average	136	28852	2791.9	661.5	36798			211.9
Median	135	26600	2915	715	36362	21%	25%	218
StDev	41	10518.3	686.3	233.2	10732.8	11%	6%	26
95% Confidence	24	6215.8	405.6	137.8	6342.6	7%	4%	15

The average logged hourly flow for Washer 1 end-use is shown in Figure 14 along with the number of vehicles washed. This graph shows a very close relationship between the hourly water use and the number of buses washed. It is also important to note that during the data logging period, the major portion of bus washing occurs between 4:00 P.M. and 03:00 A.M. The minimum occurs from 4:00 A.M. to 2:00 P.M.

Figure 14. Average Hourly Usage at D18 Washer 1



Average logged daily makeup for Washer 1 and total RO are shown in Figure 15 along with the number of vehicles washed. The RO filter ran continuously with only one interruption on April 12, 2010 from noon to 6:00 P.M. A portion of the flow trace analysis for the main meter during the period from 10:00 A.M. to 4:00 P.M. is shown in Figure 16. This shows a constant flow through the meter of 8 to12 gpm. This flow should be investigated further in order to confirm; it could be due to either leakage, a malfunctioning device, operation of the RO unit, or activities in the maintenance building.

Figure 15. Flow Through Main Meter during Period of Minimum Washing (10:00 A.M. to 4:00 P.M.)

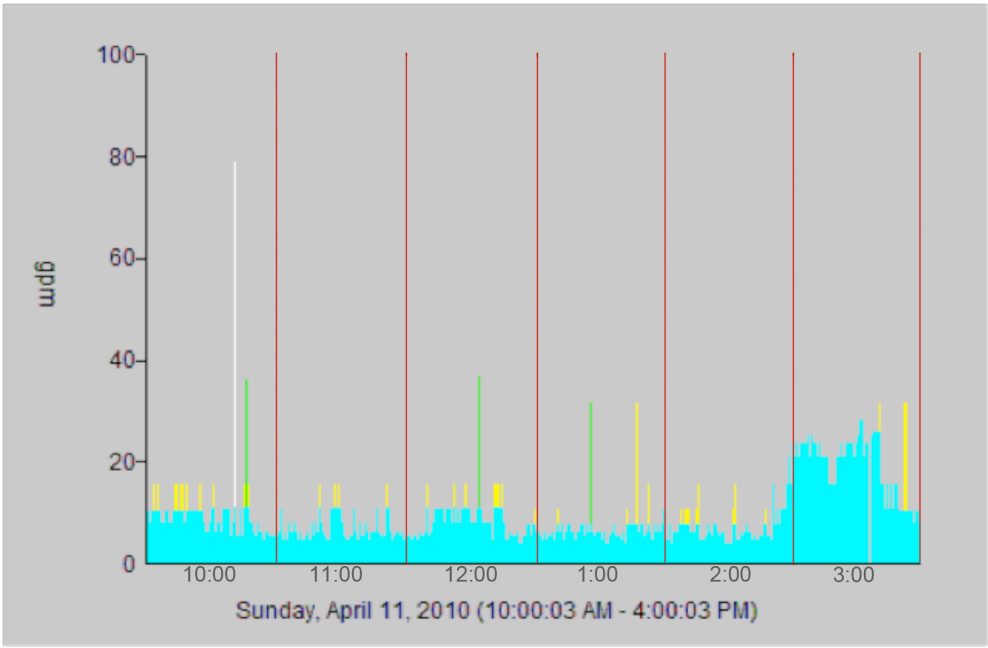
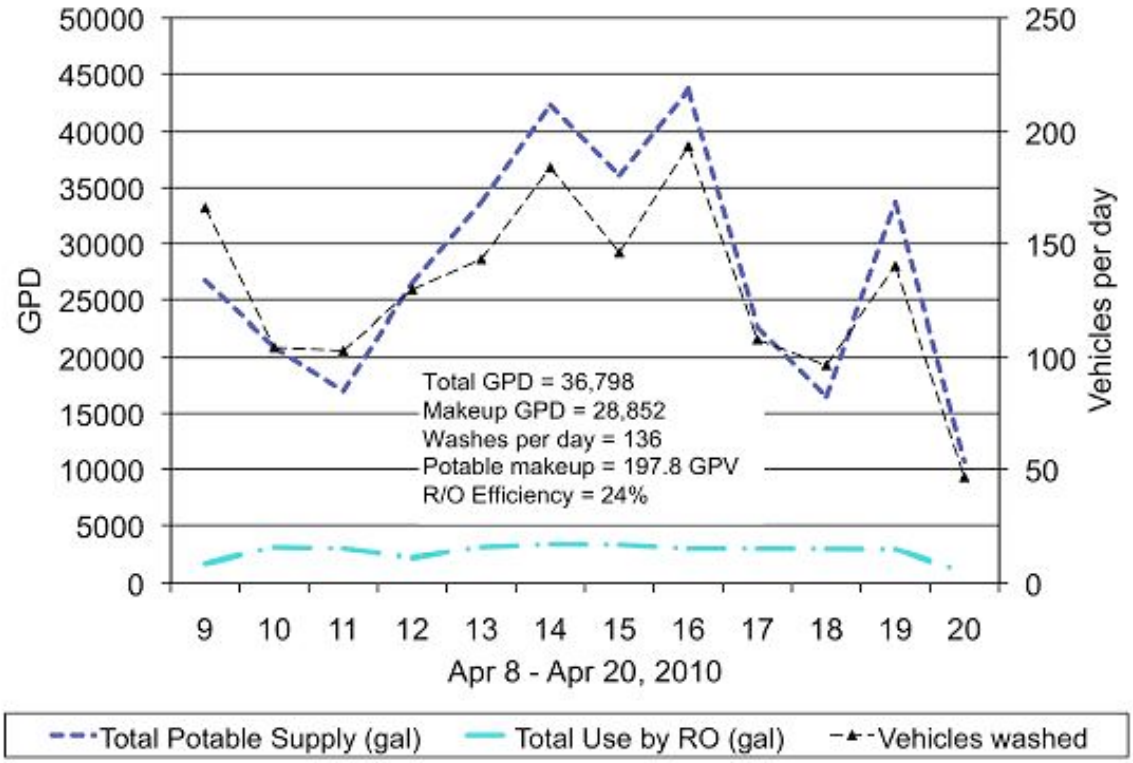


Figure 16. Average Daily Usage at D18 Washer 1



Wash Washer 2

As mentioned previously, Washer 2 was constructed in 2008; however, the logging period accounted for only 19 percent of all buses washed and used only 16 percent of flow to the bays. Two fixed meters and two temporary meters were used during the logging period.

Maintenance issues may have closed Washer 2 at some points during logging. The newer design of Washer 2 uses fewer pumps, different clarifiers and a different plumbing layout than Washer 1. Perhaps because of these design differences, Washer 2 used on average 21 percent less potable make-up per bus washed than Washer 1. Table 7 lists the daily water use monitored through the various sub-meters at Washer 2. Table 7 shows a logging average of 8,468 gpd of total use and 5,389 gpd of make-up and RO for 37 vehicles per day at Washer 2. Note that the average gallons of make-up water per vehicle washes was only 157 gallons, compared to 21 gallons per vehicle (gpv) for Washer 1.

Table 7. Washer 2 Daily Logged Volume (gpd)

	Vehicles	Potable Makeup	Recycle Flow	RO Total	RO Permeate	Wash Total	Recycled Portion	Daily RO Eff.	Makeup gpv
9-Apr	34	3400	4800	2400	100	8200	59%	4%	100
10-Apr	29	3800	4000	7300	120	7800	51%	2%	131
11-Apr	7	1900	2300	200	320	4200	55%	160%	271
12-Apr	53	6000	7200	100	750	13200	55%	750%	113
13-Apr	36	5500	4500	4800	570	10000	45%	12%	153
14-Apr	53	9400	3000	3800	810	12400	24%	21%	177
15-Apr	29	5900	1400	100	620	7300	19%	620%	203
16-Apr	56	8800	2600	0	650	11400	23%		157
17-Apr	23	5000	1400	0	390	6400	22%		217
18-Apr	12	2300	800	0	470	3100	26%		192
19-Apr	40	6300	1800	900	560	8100	22%	62%	158
20-Apr	10	1200	400	700	160	1600	25%	23%	120
Total	382	59500	34200	20300	5520	93700	36%	27%	155.8
Days	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Average	34.6	5388.7	3097.4	1838.5	499.9	8486.0			155.8
Median	31.5	5250.0	2450.0	450.0	515.0	7950.0	25%	23%	157.3
Standard Deviation	16.9	2573.8	1969.5	2403.6	243.1	3619.0	16%	290%	49.3
95% Confidence	10.0	1521.0	1163.9	1420.4	143.7	2138.7	9%	171%	29.1

Meters monitored the total make-up water to Washer 2, recycled flow from the clarifiers, total water to the RO filter, permeate produced by the RO filter, along with pump duty cycles and vehicle counts. An average of 245.3 gallons per vehicle is used, of which 155.8 gallons

(64 percent) is potable make-up and 89.5 (37 percent) is recycle. Of the potable water delivered to Washer 2, 9 percent ends up as RO permeate and 25 percent shows up in the wash system as reject, as shown in Figure 17.

Monitoring at Washer 2 also included the recycle line from the cyclonic clarifiers. Average logged hourly flow for recycle and Washer 2 end-uses is shown in Figure 18 with the number of vehicles washed. Again, this figure shows the close correlation between water use and car washing.

Figure 17. Washer 2 End-Uses for Potable Water

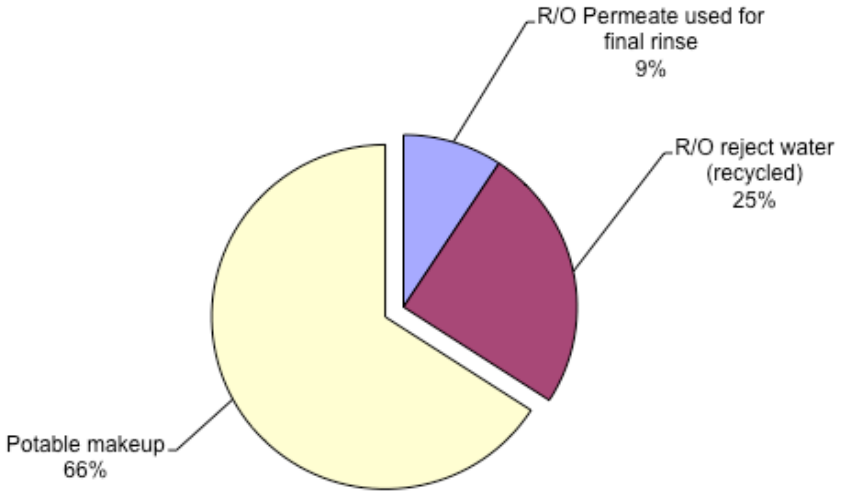
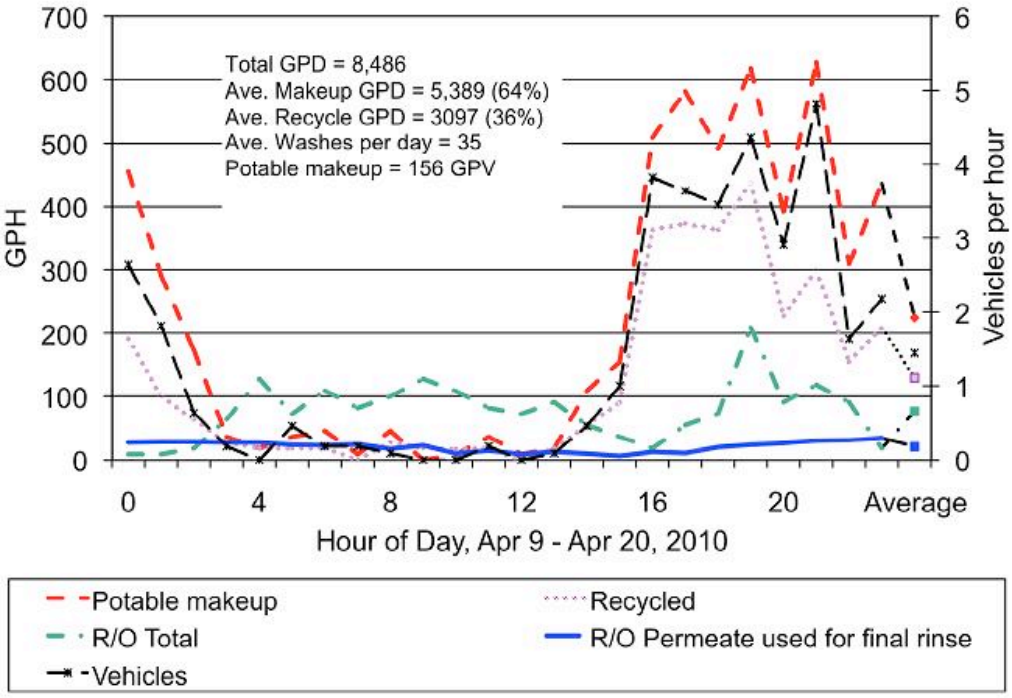
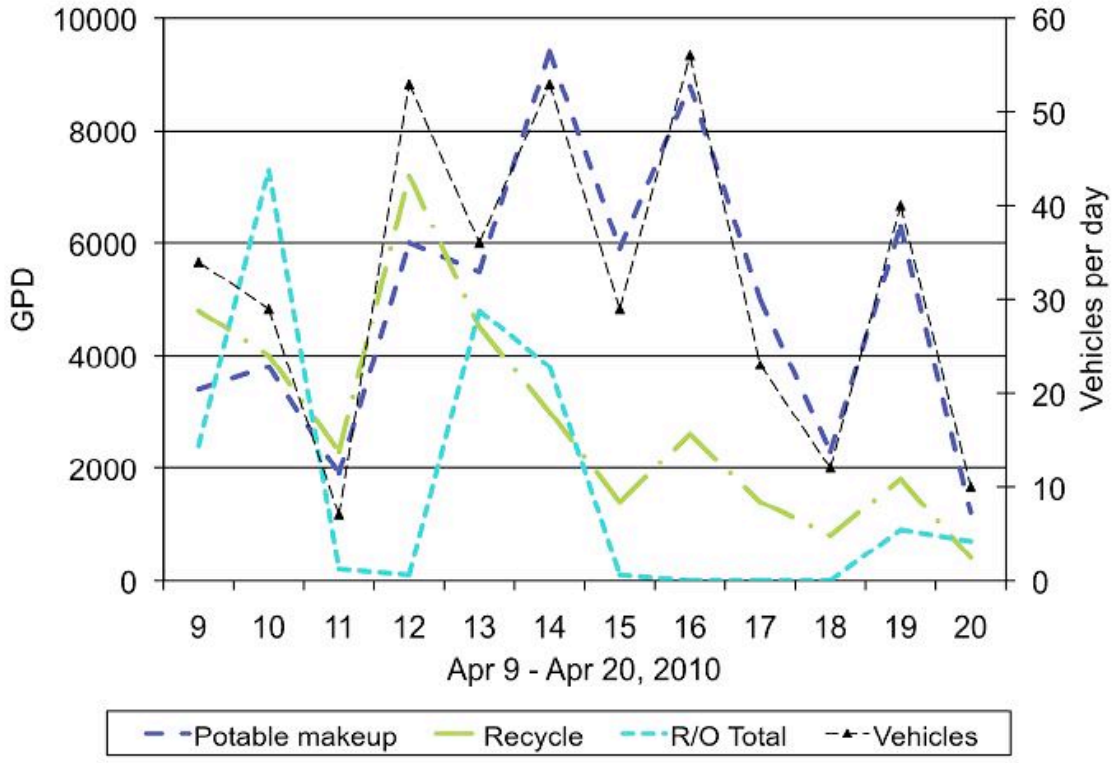


Figure 18. Hourly Usage at D18 Washer 2



Average logged daily make-up for Washer 2, total RO and recycle flow are shown in Figure 19, along with the number of vehicles washed. Controls for the RO filter appear to be adjusted several times during the logging period, which is standard protocol at D18. This figure shows that during the first part of the period the recycle rate was higher and potable water use was lower, while during the last half of the flow trace analysis less recycle and more potable water was used.

Figure 19. Daily Usage at D18 Washer 2



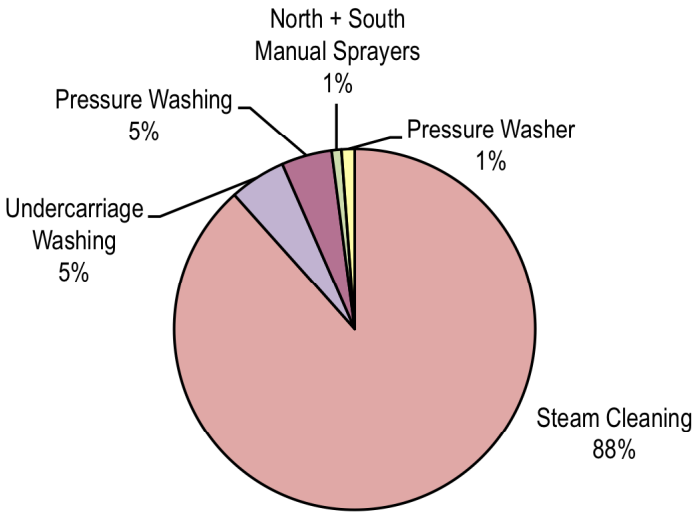
D18 Maintenance Building

The maintenance building washing facilities consist of under carriage washing and engine compartment cleaning, using potable supply from the main meter. A significant proportion of use at this facility is hot water. End-uses at the maintenance building include once-through manually-operated sprayers and automatic and manual power washers. Unlike the bus wash, the steam and power washing facilities do not recycle wash water. Recycling bus wash water is much easier than using effluent from steam and power washing, which tends to have a much higher grit, grease and oil content. Note that indoor and sanitary uses are included as part of the unmonitored 2 percent of main meter flow.

One fixed and five temporary sub-meters were installed at the maintenance building. Most of the washing equipment is plumbed with hose bib fittings at low flow rates; before the data logging, none of the facilities at the maintenance building had a dedicated sub-meter. Steam and power

washing averaged 3,169 gpd over the logging period. Proportional water use for each washing function is broken down in Figure 20.

Figure 20. End-Use Totals for D18 Maintenance Building



The highest water use equipment at the maintenance building is a hot pressure washer (or steam wand) using over 2,800 gpd, or 88 percent of the maintenance building washing. As a result of its outdated design, hot water is constantly running though the wand, but used only intermittently since the installation of the timer control. Daily use for this and other equipment is shown in Table 8. This facility is a good candidate for installation of a permanent meter for future end-use monitoring.

Table 8. Maintenance Building Washing Fixtures (gpd)

Day	Hours of Monitoring	ChassiJet under-Carriage Washer	Hydrotek Pressure Washer	InstaClean	North Manual Spray	South Manual Spray	WhitCo Steam Cleaner	Total
4/8	9	129	12	1	2	2	1,941	2,087
4/9	24	0	47	41	15	23	1,967	2,093
4/10	24	16	147	37	2	9	1,852	2,063
4/11	24	171	120	52	1	4	3,459	3,807
4/12	24	351	201	41	67	2	2,867	3,529
4/13	24	195	87	24	39	2	3,258	3,605
4/14	24	137	51	60	37	4	2,938	3,227
4/15	24	156	178	27	4	0	3,065	3,430
4/16	24	174	149	78	18	14	2,192	2,625
4/17	24	160	105	7	0	4	2,552	2,828
4/18	24	182	219	44	3	0	3,582	4,030
4/19	24	187	252	16	36	0	2,712	3,203
4/20	11	31	127	13	14	25	760	970
Total	284	1,889	1,695	441	238	89	33,145	37,497
Average GPD	160	143	37	20	8	2,801	3,169	
Average GPH	6.7	6.0	1.6	0.8	0.3	116.7	132.0	

Facility Profile (Division 20)

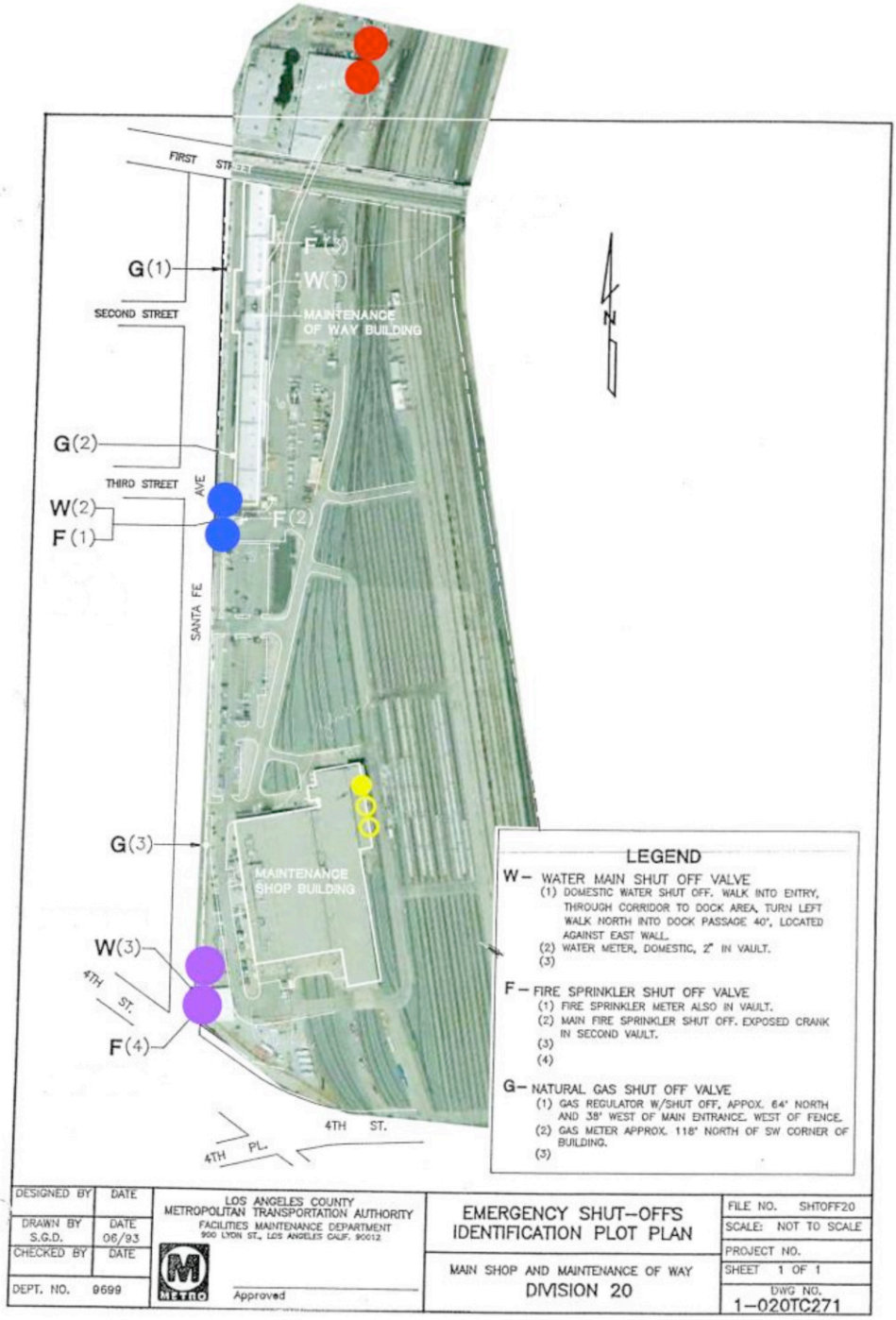
Division 20 (D20) was selected by Metro for data logging because it represents a typical Metro Rail Division. With its planned conversion to newer car washing equipment, the site has benefits to providing insight to historical, current, and post-retrofit operations and water use. This general description of D20 facilities is based on information collected during staff interviews, physical site investigation, and water fixture review conducted on February 10, 2010.

D20 is a train car maintenance and service facility constructed in 1989, with the exception of Buildings 61A and 61B that are of the original Los Angeles rail line. All of Metro's rail facilities have a centralized management system and use similar equipment to D20. There is no irrigated acreage at D20; however some rail divisions (e.g., Division 11) may have a minor amount of irrigated acreage. There are no cooling towers at D20 or at any other Metro rail divisions. The facilities at D20 are comprised of (from south to north):

- Maintenance Shop Building where all of the cars are serviced and majority of employees are stationed;
- Blow down area including water curtain on exhaust ventilation;
- Car Cleaning Platform (CCP) used to clean interior of rail cars;
- Building 61A that serves light administration and field crews;
- Building 61B that consists of a store room and nonrevenue maintenance; and
- Rail Car Wash facility.

Figure 21 presents a layout of D20 facilities and water meter locations.

Figure 21. Aerial Division 20 with Meter Locations



	Car wash meters
	61A meters
	61B meters
	Water curtain sub-meter

Potable water is provided to D20 from LADWP. According to the facility manager, approximately 20 percent of water is recovered onsite for reuse. A dual piping system (industrial and domestic) exits at D20; the industrial water system is fed from the potable supply through backflow prevention devices throughout the facility.

Rail Car Wash Facility

The D20 rail car wash facility is an automatic remote-operated drive through booth located on a side-rail at the north side of the site. Car washing mostly occurs mid-morning (between 8:00 A.M. and 10:00 A.M.). A hot water pressure system is also operated as needed at the site of the car maintenance facility. A wash reclaim and recycle system is also installed; a portion of water used for rinsing can be monitored by a separate miniature turbine-design water meter. The existing RO system at the rail car wash facility is currently turned off and its normal recycling ratio is unknown; however there is a sub-meter installed on the recycling water line.

The rail car wash will be replaced and upgraded by Metro within the next two years as part of ongoing site expansion. It is anticipated that a more efficient car washing and water reclamation system will be provided.

Car Cleaning Platform

The CCP is used to clean the interior of cars by hand using buckets and mops. Water use for car cleaning is estimated at approximately 5 gallons per car. Metro has plans to extend the CCP north and south to add 2 additional platforms. The only water end-use fixture unit at the CCP is a utility sink that provides the bucket fill source.

Maintenance Shop Building

The maintenance shop building's major water uses consist of a water curtain used on the air ventilation exhaust system and a parts washer (EHGV Hydroblaster).

The water curtain is used to clean air from the prep area where cars are blow-off before maintenance. Air is exhausted from the maintenance building and run through a water curtain prior to discharge. The water curtain serves as an air scrubber removing collected dust prior to air discharge. Water at the blow down area is used primarily for mechanical parts maintenance and cleaning at rate of approximately 2 to 4 gpm when in use.

Floor cleaning within the maintenance shop building is completed with mops or with an automated power sweeper (approximately 20 gallon capacity machine). The automated power sweeper is used infrequently.

The Butler Building serves as an auxiliary storeroom adjacent to the maintenance shop that houses fire service and parts storage. No water end-uses are associated with the storeroom.

The maintenance shop building has restrooms, a kitchen, and other water end-use fixtures that contribute to the water use at D20.

Building 61A

Building 61A serves light administration, field crews, and has approximately 20 offices. The water fixtures found at Building 61A include toilets, sink, and showers. No upgrades to any of the water fixtures are planned at Division 20; however there were 2 to 3 waterless urinals recently installed at Building 61A.

Building 61B

Building 61B includes a store room and other non-revenue maintenance facilities. Major water end use equipment consists of a parts washer and pressure washer. There are also 3 water cooler fans.

Table 9 presents a summary of water fixtures located within Division 20.

Table 9. Division 20 Water Fixtures

	Toilets/Urinals (1)	Sinks (2)	Showers (1)	Other Water Features
Kitchen – Maintenance Shop Building		1		1 ice machine
Janitor Closet (Maintenance Shop Building, 61A, 61B)		3		
Interior of Maintenance Building		1		2 portable water cooler fans
Women's Restroom – (Maintenance Shop Building, 61A, 61B)	7 / 2 toilets (1.6 gpf)	8 / 1 utility sink	3	
Men's Restroom – (Maintenance Shop Building, 61A, 61B)	3 urinals (2 gpf)/ 5 toilets (2 gpf)/ 3 urinals/ 4 toilets/ 2 waterless urinal/ 5 toilets (1.6 gpf)/ 1 urinal (1 gpf)/ 1 toilet (1 gpf)	11	3	
Office Break Room 61A		1		
61A Interior Misc Fixtures				2 eyewash stations, 1 ice machine
TOTAL	11 toilets/ 5 toilets (2 gpf)/ 5 toilets (1.6 gpf)/ 1 toilet (1 gpf)/ 3 urinals/ 3 urinals (2 gpf)/ 1 urinal (1 gpf)/ 2 waterless urinals	25/ 1 utility sink	6	2 ice machines; 2 portable water cooler fans; 2 eyewash stations

Notes:

(1) Except as otherwise noted, all restrooms are equipped with pre-1986 high volume flushing toilets, urinals and shower heads

(2) All utility sinks are manually operated and not equipped with infrared or foot pedals.

Landscaping

There is no landscaping irrigation at Division 20.

Data Logging Results and Analysis (Division 20)

An initial site review and plumbing inspection of Division 20 was performed to review site facilities and operations, as well as to determine existing main and sub-meter locations and appropriate locations to employ data logging equipment. This section presents a review of the historical water use at D20 and the results of the data logging effort at the sub- and main-meters.

The data logging effort focused on the rail car wash facility, Buildings 61A and 61B. Each of the three facilities has a dedicated LADWP water meter, shown in Table 10, along with two fire suppression meters unrelated to daily water consumption. The rail car wash has two meters (Neptune 2" T-10s) located outside the site fence, which are manifolded into a single service line. Building 61A is served by one meter (2" Neptune T-10) located in the site parking lot. Building 61B is also served by one meter (2" Neptune T-10) located at the southwest corner of the site. The data logging monitored these four meters as well as a fixed sub-meter for water curtains adjacent to the CCP.

LADWP historical water use for these meters is shown in Table 10.

Table 10. D20 LADWP Meters and Annual History

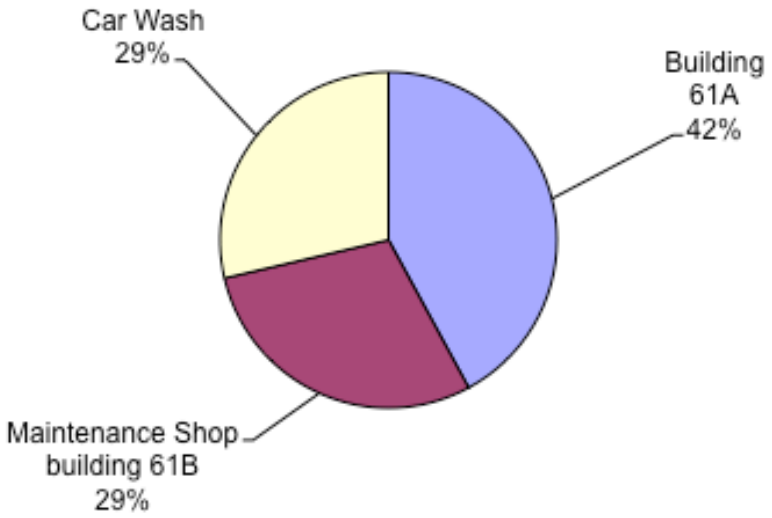
	Approximate Street Address	Meter Number	Make and Model	2008			2009		
				Gallons	AF	GPD	Gallons	AF	GPD
D20 Car Wash:									
"	801 Banning St (outside D20 fenceline in a parking lot)	90034073	2" Neptune T-10	373,252	1.1	1,014	318,648	1.0	873
		90034082	2" Neptune T-10	385,968	1.2	1,049	330,616	1.0	906
			Car wash total:	759,220	2.3	2,063	649,264	2.0	1,779
D20 Building 61A Office:									
"	304 S Santa Fe Ave	90034080	2" Neptune T-10	1,656,072	5.1	4,500	1,733,864	5.3	4,750
		7198567	Hershey (fire suppression)	0	0.0	0	0	0.0	0
D20 Building 61B Maintenance Shop:									
"	300 S Santa Fe Ave	7232919	Hershey (fire suppression)	0	0.0	0	0	0.0	0
		90034079	2" Neptune T-10	1,611,940	4.9	4,380	2,033,812	6.2	5,572
Facility Total:				4,027,232	12.4	10,944	4,416,940	13.6	12,101

Over the data logging period, the daily water use at D20 averaged 9,600 gpd, which was 2,501 gpd less than the 2009 annual average. Historically, 85 percent of D20 water use is indoor, with the rail car wash using 15 percent outdoors. During the logging period 71 percent of the water was used indoor for Buildings 61A and 61B, while the car wash used 29 percent outdoors for the rail car wash. Daily logged use for D20 is shown in Table 11 and Figure 22.

Table 11. D20 Average Daily Logged Volume

Meter	Average Daily Use (GPD)	% Total
Office (Building 61A)	4,113	42%
Maintenance Shop (Building 61B)	2,867	29%
Car Wash	2,620	29%
Total	9,600	100%

Figure 22. D20 Logged Use by Facility



D20 Disaggregated Water Use

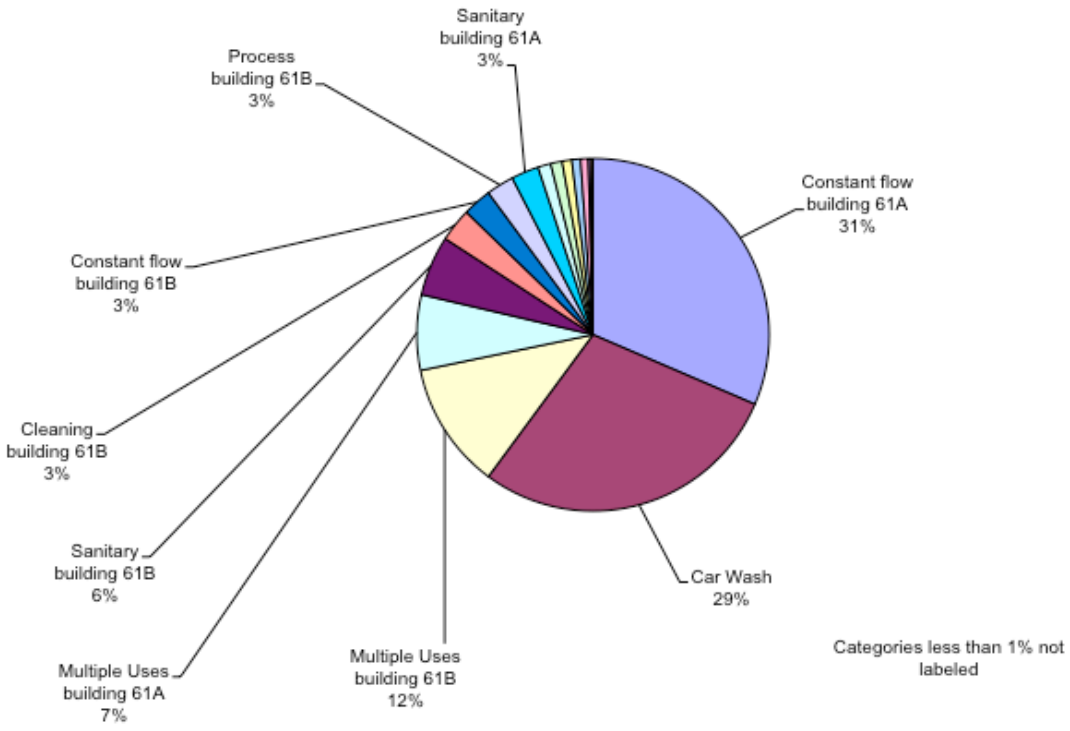
Flow data acquired from LADWP meters serving Buildings 61A and 61B were analyzed using TraceWizard software. Flow trace analysis allows identification of specific water use events based on their flow and volume characteristics. These events can then be linked to specific water using devices (end-uses) in the facility through more detailed on-site auditing.

As described above, discrete flow events for all end-uses of water were categorized based on flow rates, duration, and time-of-day. In general, these characteristics identify certain equipment and often a small number of fixtures account for a majority of the water use. Limitations to this technique arise when equipment is used simultaneously, which tends to mask the individual events. For example, simultaneous events flowing at variable rates will appear in combination as a single event at a high flow rate. Disaggregating simultaneous events may result in a mixed-use category where no further disaggregation is possible.

Figure 23 presents the disaggregated end-uses of water at D20. At both Buildings 61A and 61B, constant use was detected. Some end-uses, such as toilet flushing, faucet use and showering,

are represented only when these events occur, which is rare. Based on the employee shift schedule at D20, bathroom use likely peaks between shift changes, resulting in multiple simultaneous water use events. Thus, the Multiple Use category is judged to contain a high proportion of small events, like toilet flushing, faucet use and showering, and a low proportion of constant- and high-flow-rate mechanical processes. Moreover, these small events are proportionally underrepresented in the total.

Figure 23. D20 Disaggregated End Use Total



These end-uses are based on fixtures and processes statistically described in Table 12. Note that constant use is flow occurring at a steady rate, and may not occur as independent events. Table 13 gives a daily interpretation of these flows.

Table 12. D20 Disaggregated End Uses

Building		Events	Total Gallons	Duration (seconds)		Highest Flow Rate GPM	Volume (gallons)			
				Average	Standard Deviation		Min	Max	Average	Standard Deviation
61A	Cooling		37031.1			16.0				
61A	Multiple Uses	4531	8131.4	67.2	94.5	54.6	0.1	57.7	1.8	3.6
61A	Toilet	879	2972.8	65.4	62.7	29.0	1.5	10.7	3.4	1.0
61A	Faucet	79	925.3	412.4	365.7	36.2	1.5	50.9	11.7	11.0
61A	4.0 GPM process	12	230.6	430.0	307.7	50.6	2.1	43.4	19.2	14.7
61A	Leak	2364	202.2	65.9	60.2	0.4	0.0	1.2	0.1	0.1
61A	6.4 GPM process	2	69.8	655.0	63.6	15.4	5.8	64.1	34.9	41.2
61B	Multiple Uses	5539	13686.3	56.2	69.3	50.4	0.1	65.3	2.5	3.9
61B	Toilet	1741	6491.8	33.8	27.6	38.6	1.9	7.7	3.7	0.8
61B	9PM process	24	3608.1	1177.5	264.0	37.0	19.3	229.4	150.3	61.6
61B	Cooling	5	3112.6	17868.0	21592.8	2.2	167.1	2027.6	622.5	793.4
61B	4.0 GPM process	68	2987.7	603.2	452.6	40.2	8.4	197.9	43.9	39.4
61B	Leak	4609	1394.8	116.5	144.8	0.4	0.0	3.5	0.3	0.3
61B	6.4 GPM process	21	1240.3	643.3	322.8	33.8	15.7	136.8	59.1	31.4
61B	Faucet	56	1047.5	565.4	350.1	23.2	2.5	48.1	18.7	11.5
61B	29.0 GPM process	1	836.3	1760.0		29.0	836.3	836.3	836.3	

Table 13. D20 Disaggregated End Use Daily Logged Volume (gpd)

Logging Day	Car Wash GPD	Office (Building 61A)							
		4.0 GPM Process	6.4 GPM Process	Faucet	Cooling	Leak	Multiple Uses	Sanitary	61A Main Total
6-Apr	7465.4								
7-Apr	5248.4	0.0	0.0	36.9	2648.4	12.4	991.3	200.1	3889.1
8-Apr	7285.2	0.0	0.0	0.0	3079.4	8.3	835.7	318.9	4242.2
9-Apr	2756.6	4.0	5.8	28.3	3088.0	8.6	774.9	302.4	4211.9
10-Apr	231.9	0.0	0.0	225.5	3041.2	23.5	251.2	123.3	3664.7
11-Apr	600.3	0.0	64.1	88.7	3074.3	21.3	288.3	131.3	3667.9
12-Apr	197.1	27.8	0.0	59.4	3101.8	17.8	675.2	271.3	4153.2
13-Apr	3494.4	0.0	0.0	133.0	3096.9	15.4	1098.5	252.7	4596.4
14-Apr	3614.1	0.0	0.0	54.6	3098.1	16.2	761.1	385.0	4315.1
15-Apr	5583.6	80.6	0.0	73.3	3099.1	13.2	1049.8	281.0	4597.1
16-Apr	1234.5	118.2	0.0	113.0	3102.7	17.6	656.6	282.2	4290.3
17-Apr	613.0	0.0	0.0	70.5	3091.8	13.8	383.2	124.3	3683.5
18-Apr	190.3	0.0	0.0	40.6	3095.0	23.7	365.0	180.3	3704.5
19-Apr	355.2	0.0	0.0	36.9	3102.2	14.3	896.2	391.3	4440.8
Overall	**2619.8**	**19.1**	**5.8**	**76.8**	**3070.4**	**16.1**	**674.4**	**246.2**	**4108.8**

Table 13. D20 Disaggregated End Use Daily Logged Volume (gpd) (Continued)

Logging Day	Maintenance Shop (Building 61B)										
	29.0 GPM Process	4.0 GPM Process	6.4 GPM Process	9PM Process	Faucet	Cooling	Leak	Multiple Uses	Sanitary	Water Curtain	61B Main Total
7-Apr	0.0	0.0	0.0	8.0	65.0	0.0	124.7	967.0	561.4	8.0	1726.1
8-Apr	0.0	359.6	43.9	3.0	83.0	344.2	121.7	1463.3	640.5	35.0	3059.2
9-Apr	0.0	0.0	122.7	3.0	175.5	0.0	139.3	1170.9	688.0	2.0	2299.4
10-Apr	836.4	74.3	160.6	2.0	79.3	0.0	130.1	520.8	332.7	3.0	2136.2
11-Apr	0.0	41.9	86.4	2.0	73.5	0.0	126.1	606.6	428.0	1.0	1364.5
12-Apr	0.0	534.6	61.4	2.0	72.4	443.6	121.7	1527.8	608.2	40.0	3371.6
13-Apr	0.0	686.5	109.6	2.0	84.1	297.0	99.8	1732.4	620.2	33.0	3631.6
14-Apr	0.0	363.9	45.2	2.0	78.5	0.0	114.7	1656.1	553.4	0.0	2813.7
15-Apr	0.0	74.8	0.0	2.0	105.4	0.0	139.9	1451.7	684.7	3.0	2458.6
16-Apr	0.0	737.3	256.2	2.0	91.1	2026.2	48.2	1257.1	425.7	178.0	4843.7
17-Apr	0.0	0.0	83.6	2.0	49.7	0.0	125.5	530.5	389.2	1.0	1180.6
18-Apr	0.0	0.0	196.1	2.0	35.9	0.0	113.4	617.5	384.3	1.0	1349.4
19-Apr	0.0	211.9	137.7	0.0	160.1	0.0	92.2	1232.3	842.1	1.8	2676.3
Overall	**69.5**	**248.1**	**103.0**	**2.3**	**87.0**	**258.3**	**115.6**	**1136.5**	**539.1**	**24.9**	**2559.5**

Note that the disaggregated Maintenance Shop main includes flow to the water curtain sub-meter.

D20 Constant Use

Constant use combined from the 61A and 61B meters is the largest end-use at D20, accounting for 33 percent of total flow. The average flow of the constant use is similar at both sites (~2.0 gpm) and could possibly be the same type of equipment. It is interesting to note that Building 61A runs continuously during the entire flow trace. At Building 61B, however, the use is intermittent and only occurs for 4 days out of 12, all of which fall on weekdays. Figure 24 shows a typical daily profile of the constant demand over the logging period. The constant use is at a small enough flow rate where it could be attributed to a leaky toilet. A portion of the flow trace analysis from approximately 2:00 A.M. to 8:00 A.M. is shown in Figure 25. This figure indicates the base or constant flow that occurs throughout the logging period shown in solid dark blue.

Figure 24. Hour-of-Day Profile for D20 Constant Flow

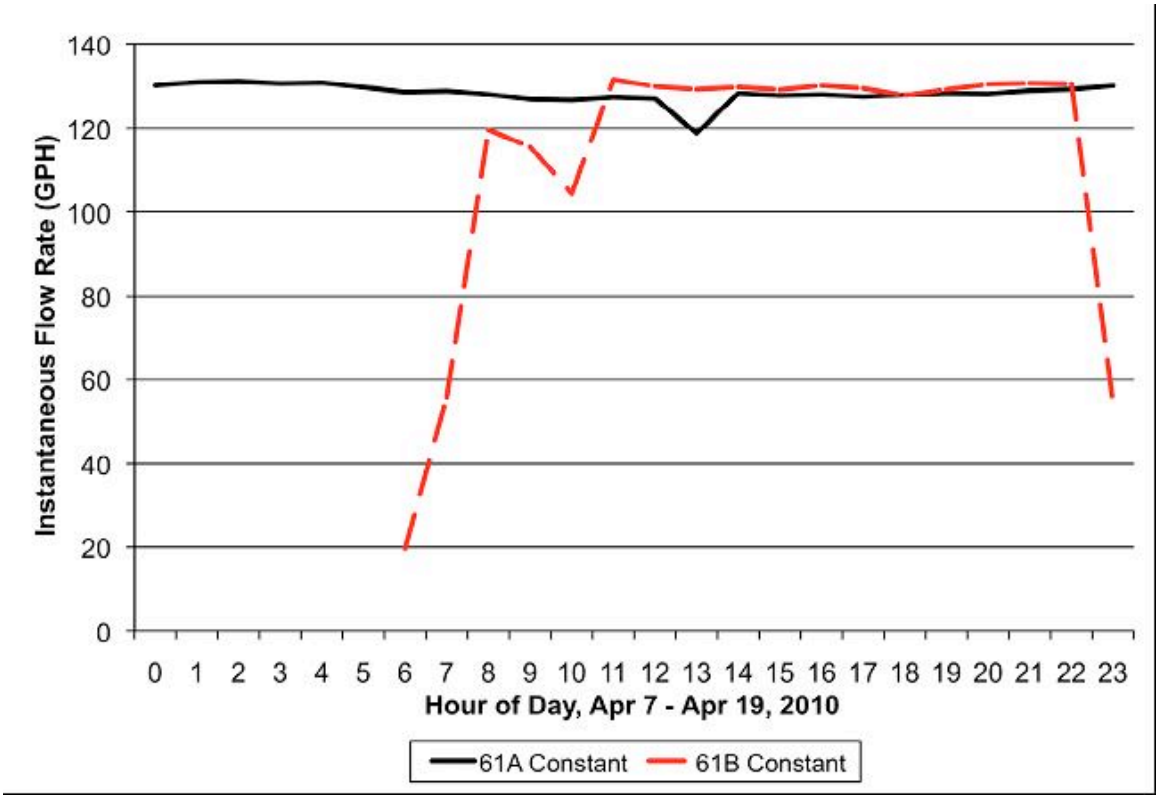
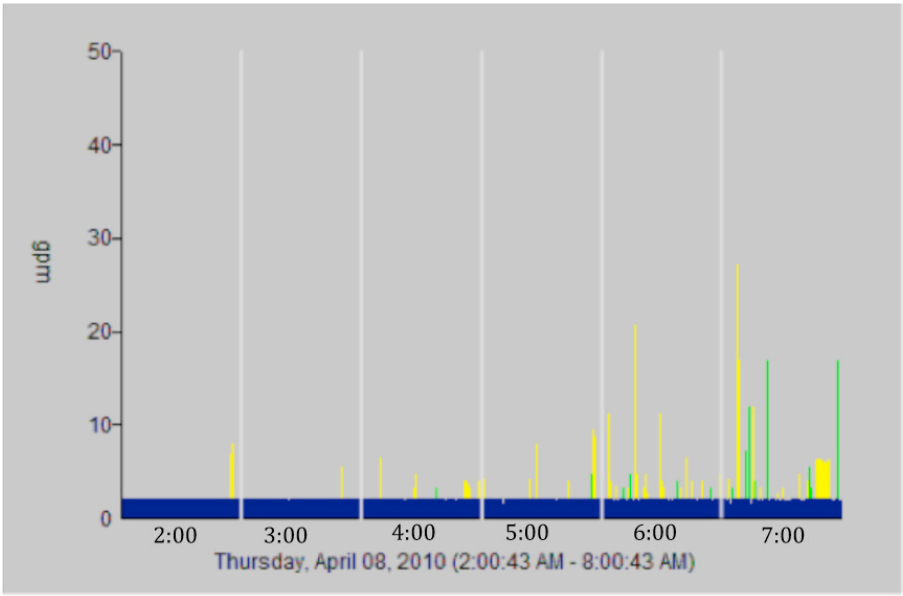


Figure 25. Constant Flow Through Building 61A Meter 2:00 AM until 8:00 AM



Observations from the data logged at D20 is as follows:

- Constant flow at Building 61A is 24-hour, occurring independently of daily occupancy or heat load.
- The same pattern at Building 61B appears controlled and independent of the air scrubber. This is characteristic of a manually-controlled scheduled process.
- Whatever is accounting for the 2 gpm constant demands at both buildings 61A and 61B should be identified, since it accounts for a large volume of water
- From its appearance on the flow trace analysis the constant flow through the meter at 61B could easily be a 2 gpm leak given that it never varies or ceases during the entire logging period.

The difference in flow between buildings 61A and 61B is 2,812 gpd, which is close to the 2,705 gpd difference between the historical (annual) and logged 61B daily average. This suggests that 61B equipment ran continuously through 2009. The possibility of a leak should be eliminated through on-site audit and leak detection.

D20 Maintenance Shop Air Scrubber

A meter (3/4” Seametrics) was installed for the air curtains located on the east end of the maintenance shop. This line also supplies indoor hose bibs. Average daily use during the logging period, shown above in Table 14, was 24.9 gpd.

D20 Rail Car Wash

The rail car wash facility is a remote-operated booth on the north side of D20. Though a wash recycle system is operating, this system is considered an outdated design and has been

replaced at other rail facilities with a new wash system. Specifically at D20, the portion of water used for rinsing can be monitored with a separate miniature water meter, though this meter does not support data logging. Rinse water is carbon-filtered and softened through equipment that is timed for routine overnight backwash. Lastly, a RO filter for final rinse water is installed but has been permanently disabled.

The rail car wash is served by the two meters (parallel 2" Neptune) located at 801 Banning Street, which is outside the D20 fence line. Between April 6, 2010 and April 19, 2010 an average of 30.5 cars were washed daily for an average demand of 2,580 gpd. Figure 26 shows the difference between make-up flow and number of cars washed. Logging statistics are shown in Table 14.

Figure 26. D20 Car Wash Daily Totals

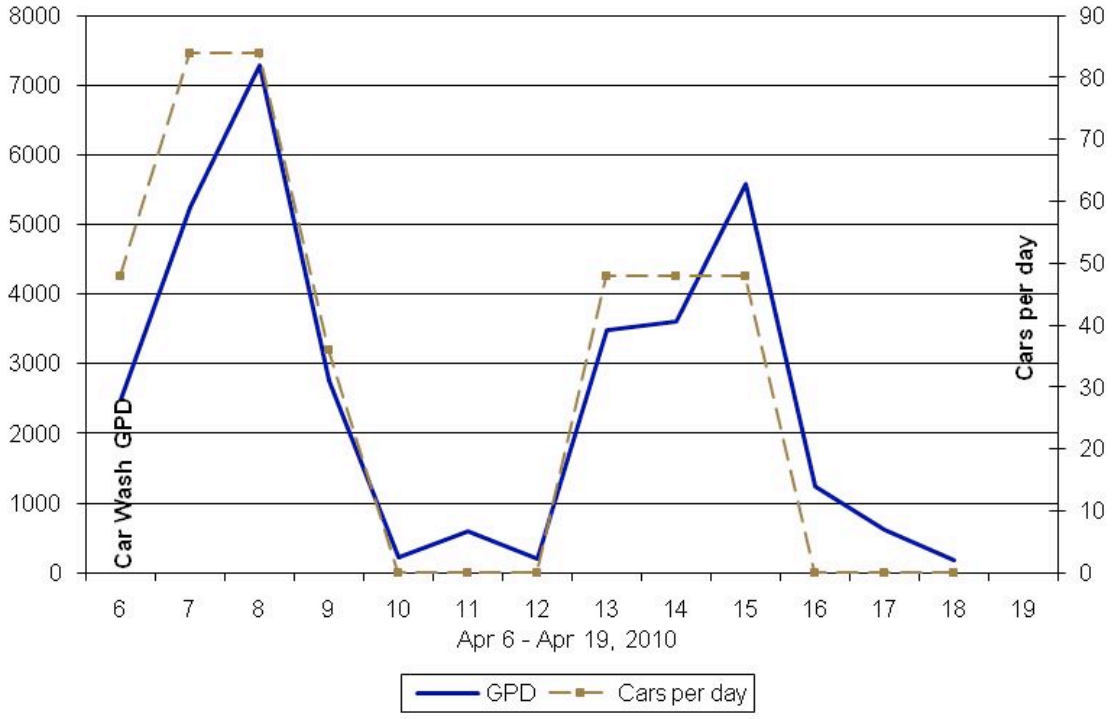


Table 14. D20 Car Wash Logging Statistics

Water Use Category	Value	Units
Study average gallons per car—this is the observed use rate	84.7*	GPV
Variable average gallons per car—this is the forecasting average	74.5–77.9	GPV
Fixed processes—this is added to daily forecast	330	GPD
Cars washed during logging	396	
Average cars per day during logging	30.5	
Average use and 95% confidence interval	2,580	±419 GPD

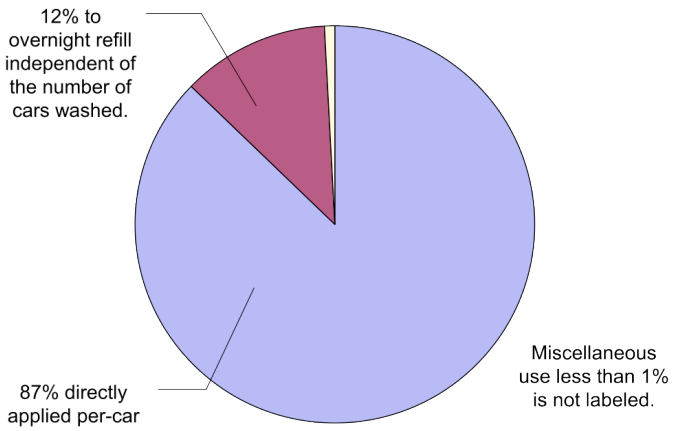
* Average including high water use days, and may not be indicative of normal wash days.

End-uses at the rail car wash include make-up, automated filter processes, and very small miscellaneous use. Make-up is directly related to the number of cars washed; automated processes run overnight and are independent of the number of cars washed the day before. There is no recycle occurring at this facility, so all of the wash water used on the cars comes directly from the potable supply. Daily totals during the logging period are shown in Table 15 and proportional use is shown in Figure 27.

Table 15. Car Wash Daily Logged Volume

Day	Cars Washed	Total Logged (gal)	Est. Makeup (gal)	Est. Overnight (gal)	Est. Misc (gal)	Average GPV
6-Apr	48	2,488	3,583	0	21	51.8
7-Apr	84	5,248	6,270	309	21	62.5
8-Apr	84	7,285	6,270	309	21	86.7
9-Apr	36	2,757	2,687	309	21	76.6
10-Apr		232	0	309	21	
11-Apr		600	0	309	21	
12-Apr		197	0	309	21	
13-Apr	48	3,494	3,583	309	21	72.8
14-Apr	48	3,614	3,583	309	21	75.3
15-Apr	48	5,584	3,583	309	21	116.3
16-Apr		1,234	0	309	21	
17-Apr		613	0	309	21	
18-Apr		190	0	309	21	
Overall	396	33,538	29,557	3,706	275	84.7

Figure 27. D20 Car Wash Proportional Demand



Data Logging Summary

The D20 rail facility uses substantially less water per day than does the bus washing facility. The rail car washing unit uses approximately 1,800 gpd, or approximately 85 gallons per car. This represents 30 percent of the total on-site water use. The Building 61A accounts for 40 percent of the total water use and uses over 4,100 gpd; this facility shows a very constant 2 gpm flow that could easily be attributed to a leak, however should be investigated further. Building 61B uses approximately 30 percent of the total D20 water.

Gateway Headquarters

Gateway Headquarters is the largest water user at Metro; therefore a preliminary evaluation of water use at Gateway was also conducted. The focus of this Plan was at the maintenance divisions with data logging conducted at sites D18 and D20. The conservation potential associated with commercial buildings such as Gateway is fairly well documented. Therefore, evaluation of water use involved a preliminary survey on February 11, 2010 to obtain a general understanding of the end-uses of water and to review ongoing end use retrofits.

Gateway is a 15-year old structure with 650,000 square-feet and 27 floors. Major interior water uses include cooling towers, restroom and employee break rooms, a sheriff's office, cafeteria, and electrolyzed water system for degreasing cleaners and sanitizers.

Approximately 25 out of the 27 floors contain the same water end-use facilities: i.e., one men's restroom (all with waterless urinals), one women's restroom, drinking fountain, and a kitchenette with one sink. Roughly 1,800 employees work out of Metro headquarters, including approximately 209 Los Angeles County sheriffs.

The cooling towers have the largest water demand at Gateway. The cooling towers are comprised of six units installed during the building's original construction. Cooling towers are used to regulate temperature by dissipating heat from recirculating water. Cooling tower water

use is estimated at 1,000 gpd. A sub-meter was installed on the cooling tower water supply, but was not functional at the time of the site visit. Therefore Metro is currently unable to calculate water losses at the cooling towers. A new meter is planned for installation to accurately quantify water use. It was estimated that the existing cooling towers have roughly 10 to 15 years remaining useful life.

The cafeteria at Gateway is estimated to have a total of 1,200 transactions per day for breakfast and lunch. End use equipment consists of food preparation and hand wash sinks, an ice machine, a dishwasher, and beverage vending machines. Approximately 90 percent of Gateway printing is done at the in-house print shop. The major water using equipment at the print shop is the Heidelberg Speedmaster offset printing press, which uses approximately 2 to 3 gallons water per day. The other printers use no more than 3 to 6 gallons every 2 to 3 weeks.

4. Recommendations

Metro is developing an Environmental Management System (EMS) as a tool for environmental policy compliance. An EMS is a collection of best practices to ensure environmental compliance at all of Metro's levels of organization. The EMS process is cited by the Federal Transit Administration (FTA) as a transit property's clearest commitment to environmental compliance and stewardship.

Metro's EMS is based on the International Organization for Standardization (ISO) 14001 standards. ISO 14001 provides the framework for an EMS, and confirms its global relevance for operations in an environmentally sustainable manner.

Consistent with Metro's goals and cost for the EMS, this Water Action Plan serves as one of the many elements to achieve energy and cost savings. This plan identifies pertinent environmental laws and regulations, and identifies some of the resources, roles and responsibilities and develops an overall target for water savings based on observed water use patterns and records.

Recommendations made herein are consistent with the ISO 14001 standards for the establishment of a framework for the ongoing monitoring, reporting and improvement of Metro's plans for water conservation and replacement of water supplies for the savings of potable water.

4.1 Water Conservation Strategies

The following water conservation strategies have been developed based upon a review of the existing facilities, operations, and water usage at Divisions 18 and 20. Water savings are presented as typical daily savings for rail and bus facilities. Of the 18 major Metro Divisions, 11 (1, 2, 3, 5, 6, 7, 8, 9, 10, 15, and 18) are related to bus and van transportation, 4 are related to rail (11, 20, 21, and 22), non-revenue vehicles is Division 4, the Metro Service Support Center (MSSC) is Location 30, and the Metro Gateway Headquarters is Location 99. There are also numerous Metro properties (e.g., rail stations, bus stations, customer service centers, etc.) throughout Los Angeles County. Equipment and operations observed and evaluated at Divisions 18 and 20 are assumed to be typical for their transportation type. Therefore, the calculated water savings represent potential water savings across all of Metro's Divisions.

A financial analysis and benefit/cost ratio for the first 13 strategies is analyzed based upon an average life-cycle of 40 years, and a discounting factor of 5 percent. Appendix A presents the financial analysis tables for each strategy. Water savings per revenue hour are presented based upon Metro's 2009 ridership of approximately 8,000,000 bus revenue hours, and 656,000 rail revenue hours. Annual water use is based upon an operating year of 256 days.

On-site rainwater harvesting was also considered as a potential opportunity for potable water savings. Rainwater would be collected on-site and conveyed and stored in existing underground storage tanks at D18. Based upon typical rainfall at D18, approximately 170,000 gallons per year of rainwater may be collected as site run-off. Because of the regional Mediterranean climate, rainwater can only be collected during the winter season and could not be relied upon

as a source throughout the summer months. Additional site grading, piping and pumping would be required to convey run-off to the storage tanks to bring the stored water to its end uses. Additional treatment may be required to eliminate pollutants contributed to runoff such as petroleum hydrocarbons and particulates. Review of the complexity of the on-site retrofit and cost effectiveness of the alternatives concluded the alternative to be infeasible without additional detailed on-site engineering evaluation beyond the scope of this investigation.

Strategy 1

Municipal Recycled Water Substitution for Bus Washing (Bus Facilities)

Municipal recycled water may be substituted for potable water supplies where available. Use of recycled municipal wastewater is allowable by the Title 22 regulations of the California Code of Regulation provisions for the use of recycled water.

Use of recycled water at Metro facilities should be considered on a site specific basis considering the quality of the available recycled water and the retrofit requirements to modify existing plumbing, consistent with applicable state requirements. Pursuant to Section 60307, Article 3, Chapter 3, recycled water may be used for commercial car washing, including hand washes if the recycled water is not heated, where the general public is excluded from the washing process. Recycled water must be disinfected tertiary water, with a turbidity of no greater than 2 Nephelometric Turbidity Units (NTU), does not exceed 5 NTU for more than 15 minutes and never exceeds 10 NTU.

The cost effectiveness of recycled water use is dependent upon the availability and proximity of existing recycled water infrastructure, as well as the amount of recycled water that may be used as substitute to potable water. Recycled water is widely available throughout Los Angeles County by several municipal agencies including LADWP and West Basin Municipal Water District (WBMWD) as presented in Figure 28.

Data logging has identified that, on average, bus and car washing represents 90 percent of the total water use. Sanitary end uses for toilet and urinal flushing represent 1 percent of total water use. Therefore, the incremental benefit of recycled water use for toilet, urinal flushing and other interior uses is anticipated to be relatively small and the retrofit costs for dual plumbing relatively high. Additionally, strategies that would convert sanitary end-use fixtures to high efficiency and waterless fixtures are known to have a high cost benefit without the extensive retrofit costs.

Retrofit of existing interior facilities to a dual plumbed system for the provision of recycled water at toilet and urinals is therefore not considered. The age of the existing facilities and the high cost to meet the requirements for cross-connection between the potable and recycled water systems and the relatively low volume of these end-uses make retrofit of existing interior facilities infeasible.

Use of municipal recycled water is recommended for bus washing throughout Metro's bus facilities. As discussed above, the bus washing process includes a preliminary rinse, wash, and final rinse. Water treated through an RO system is used to prevent spotting during the final rinse

process. Concentrate reject from the RO system is conveyed back to the wash system for blending with potable water and drain water collected from the wash facilities.

Higher concentration of TDSs (over 350 parts per million [ppm]) in recycled water may contribute to spotting (Brown 2000). Recycled water quality is approximately 1000 ppm TDS, as reported by LADWP. Recycled water may be used in the preliminary rinse and wash processes, but not used for the final rinse process to reduce spotting with RO treatment.

TDS from the recycled water could be reduced through the on-site RO treatment system and used for the final rinse of the wash process in addition to the preliminary rinse and wash, resulting in potable water savings of approximately 34,471 gpd at each bus wash facility.

An evaluation of the RO treatment system to lower the TDS of recycled water to reduce spotting potential in the final rinse would be required. Further, increased use of the RO treatment system used to treat recycled water for the final rinse would impact the energy and power used for the system.

Quantitative Results

A potable water savings of 413,652 gpd could be achieved from use of recycled water for bus washing at all Metro bus facilities.

Energy Impacts

Additional energy may be required for additional treatment at the RO treatment system to accommodate the higher TDS water. Additional energy may be expended by the municipal recycled water purveyor for additional treatment and conveyance to the site.

Cost: Capital/O&M

It is assumed that municipal recycled water is readily available and no costs would be incurred for repayment of existing extension of new recycled water transmission pipelines. It is assumed that approximately 600 linear feet (LF) of onsite pipelines may be required for conversion of the bus wash system to municipal recycled water at each facility. Based upon correspondence with LADWP, the cost of recycled water is estimated by LADWP to be a 20 percent discount from potable water cost. Estimated annual cost of water for recycled water for all bus facilities is estimated to be $360,043.

Financial Analysis

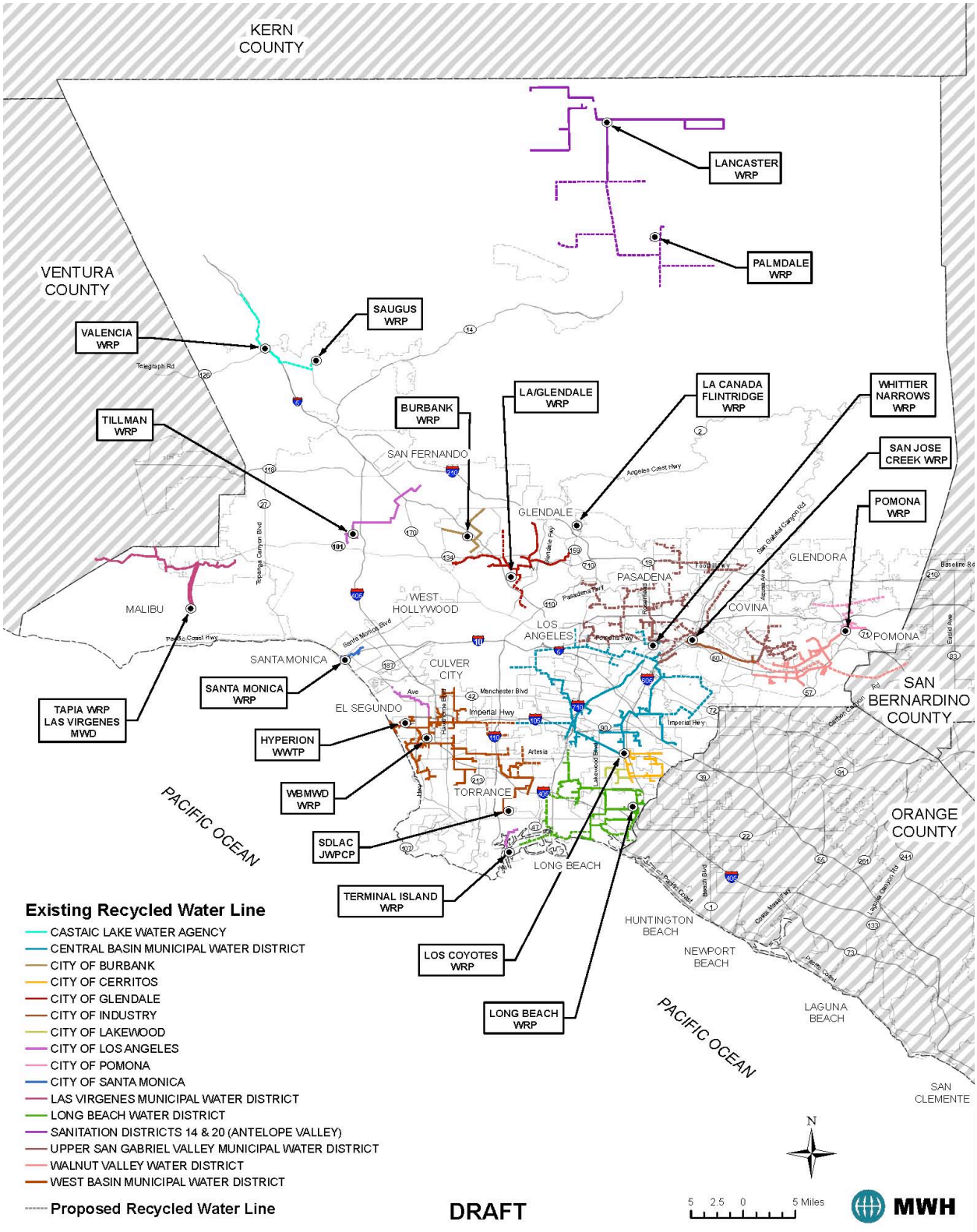
The anticipated benefits are calculated based on the cost differential between potable and recycled water, as well as the capital cost investment for retrofit of the existing facilities and on-going operations and maintenance. The life cycle benefits are estimated at $1,531,715 system wide. The life cycle costs are $135,000 system wide. The system wide net benefits are $1,396,715.

The Benefit/Cost Ratio is 11.35

Business Case

Water saved (for all bus facilities) per revenue hour is 13.24 gallons.

Figure 28. Los Angeles County Recycled Water Systems (LACRWAC) March 2008



Strategy 2

Municipal Recycled Water Substitution for Car Washing (Rail Facilities)

Regulatory requirements for the use of municipal recycled water at rail facilities is the same as described for Metro's bus facilities.

Use of municipal recycled water is recommended for car washing throughout Metro's rail facilities.

Quantitative Results

A potable water savings of 10,329 gpd could be achieved from use of recycled water for car washing at all Metro rail facilities.

Energy Impacts

Additional energy may be expended by the municipal recycled water purveyor for additional treatment and conveyance to the site.

Cost

It is assumed that municipal recycled water is readily available and no costs would be incurred for repayment of existing extension of new recycled water transmission pipelines. It is assumed that approximately 600 LF of onsite pipelines may be required for conversion of the car wash system to municipal recycled water at each facility. The cost of recycled water is estimated by LADWP to be a 20 percent discount from potable water cost. Estimated annual cost of water for recycled water for all rail facilities is estimated to be $9,000.

Financial Analysis

The anticipated benefits are calculated based on the cost differential between potable and recycled water, as well as the capital cost investment for retrofit of the existing facilities and on-going operations and maintenance. The life cycle benefits are estimated at $38,215 system wide. The life cycle costs are $45,000 system wide. The system wide net benefits are -$6,786.

The Benefit/Cost Ratio is 0.85.

Business Case

Water saved (for all rail facilities) per revenue hour is 4.0 gallons.

Strategy 3

Municipal Recycled Water Substitution for Landscape Irrigation (Bus and Rail Facilities)

Metro may convert to the use of recycled water for on-site irrigation, following permit application and approvals from the local recycled water purveyor and the California Department of Public Health (CDPH). A separate, dedicated meter for recycled water would be obtained from the recycled water provider. All hosebibs will be designed as quick-coupling, all irrigation facilities constructed according to the Title 22, Chapter 3 regulations of the California Code of Regulations provisions for the use of "purple pipe" and associated purple designation for all onsite irrigation equipment and facilities. Engineering plans for the recycled water system and conversion from potable water should be prepared and reviewed with CDPH to ensure that the conversion is compliant with appropriate Title 22 separation design and construction standards. A "spool" of the potable water supply pipe would be engineered and constructed to facilitate its removal to effectively separate the potable irrigation system from the future recycled water irrigation system, the potable irrigation meter removed, and the former potable pipeline trench then backfilled. A pressure test should be conducted in coordination with the water provider. After conversion to recycled water use and pursuant to the requirements of CDPH, signs would be erected onsite to inform staff and the public of the safe and compliant use of recycled water for on-site irrigation. Staff would be educated in the on-site irrigation uses and prohibitions associated with reclaimed water such as no off-site run-off or drift.

Quantitative Results

Approximately 7,104 gpd of potable water could be saved by substitution with municipal recycled water for landscape irrigation throughout Metro's bus and rail facilities.

Energy Impacts

Additional energy may be expended by the municipal recycled water purveyor for additional treatment and conveyance of recycled water to Metro sites. However, regionally, recycled water purveyors are completing their systems regardless of the participation by Metro. Therefore, there is no additional off-site energy demand generated by this strategy.

Cost: Capital/O&M

It is assumed that municipal recycled water is readily available and no costs would be incurred for existing or new recycled water transmission pipelines. It is assumed that an average of 1,000 LF of onsite pipeline retrofit would be required for conversion of the irrigation system to municipal recycled water at each site at a cost of approximately $45,000 at each site. Additional anticipated costs for inspection and engineering review are also included. Annual cost of recycled water for landscape irrigation is estimated to be $6,185 throughout all Metro bus facilities.

Financial Analysis

The anticipated benefits are calculated based on the cost differential between potable and recycled water, as well as the capital cost investment for retrofit of the existing facilities and on-

going operations and maintenance. The life cycle benefits are estimated at $26,305 system wide. The life cycle costs are $540,000 system wide. The net benefits are -$514,695.

The Benefit/Cost Ratio is 0.05.

Business Case

Water saved (for all bus and rail facilities) per revenue hour is 0.23 gallons.

Strategy 4

Extension of Bus Runoff Capture On-Site Reclamation (Bus Facilities)

Run off from the buses at the bus washing Washers is typically collected through floor grates, treated in a clarifier, and returned for use within the wash cycle. The current configuration of the run-off collection does not allow for all of the run-off from the buses to be collected following a bus wash. Water run-off from the buses continues after they have passed the collection floor grates. Air blowers are automatically activated to enhance the runoff while buses are on the floor grates. However, it was observed during data logging that air blowers are not consistently operated. Additionally, speed restriction during bus drive through should be strictly enforced to maximize the recapture of run-off.

Extension of the floor grates beyond the bus washing bays would allow for more run-off water to be collected for reclamation and reuse within the wash cycle.

Additionally, as an operational procedure, the air blowers should be in operation to remove the excess rinse water from the buses as they exit the wash bay.

Quantitative Results

Metro has estimated that approximately 100 gallons of water are collected from each bus travelling at 2 miles per hour on the floor gates. The existing floor grates are estimated to extend approximately 50 feet. It is estimated that an additional 50 gallons of water per bus could be collected by extending the floor grates an additional 50 feet, ensuring that the air blowers are in operation, maintaining the 2 mph speed limit, approximately 14,500 gpd of water could be saved at each bus facility, or 174,000 gpd for all bus facilities.

Energy Impacts

Consistent use of the air blowers would increase onsite power consumption.

Cost

Estimated capital cost to extend the run-out area is approximately $10,000 at each facility.

Financial Analysis

The anticipated benefits are calculated based on the cost differential between potable and on-site reclaimed water, as well as the capital cost investment for installation of new facilities and on-going operations and maintenance. The life cycle benefits are estimated at $3,180,689 system wide. The life cycle costs are $120,000 system wide. The system wide net benefits are $3,060,689.

The Benefit/Cost Ratio is 26.51

Business Case

Water saved (for all bus facilities) per revenue hour is 5.6 gallons.

Strategy 5

Replacement of Sanitary Fixtures (Bus and Rail Facilities)

Existing standard flow sanitary fixtures installed prior to 1992 should be replaced with high efficiency, low flow models. Toilets should be dual flushed or low flow with no more than 1.6 gallons per flush. Urinals should be waterless models. Sinks should be infrared sensor or pedal operated. Shower head should be low flow with no more than 1.6 gpm flow rate. Sinks should be no more than 2.2 gpm flow rate.

Quantitative Results

Approximately 4,056 gpd may be conserved by the replacement of sanitary fixtures at D18.

Approximately 3,823 gpd may be conserved by the replacement of sanitary fixtures at D20.

Total conservation potential is approximately 4,691,000 gallons per year for the data logged facilities. Throughout Metro's rail and bus divisions, this would provide a savings of approximately 16 million gallons per year.

Energy Impacts

Use of low flow showerheads and faucets will reduce energy consumption consistent with the volume of hot water conserved.

Cost

Capital costs for the replacement of sanitary fixtures at Metro's rail and bus divisions are estimated to be $252,320. Estimates for the capital costs for replacement of sanitary fixtures take rebates offered by the water purveyors into account.

Financial Analysis

The anticipated benefits are calculated based on the cost of water savings as well as the capital cost investment for retrofit of the existing facilities and on-going operations and maintenance. The life cycle benefits are estimated at $1,184,257 system wide. The life cycle costs are $252,320 system wide. The system wide net benefits are $931,937.

The Benefit/Cost Ratio is 4.69.

Business Case

Water saved (for all bus and rail facilities) per revenue hour is 1.89 gallons.

Strategy 6

On-Site Graywater Reclamation with Standard Fixtures (Bus and Rail Facilities)

Graywater, or wash water from showers and sinks, may be captured and removed from the existing plumbing to the wastewater stream and re-used on-site as a substitution for potable water in limited applications. The Los Angeles County Department of Building and Safety (LADBS) has authority for the permitting and review of graywater use and systems throughout the County. Currently, there are no applicable water quality standards for onsite treatment of graywater. However, the County provides only for the approved use of graywater in residential buildings. It is therefore recommended that any plans for the development and on-site use of graywater first be coordinated with representative of LADBS to verify applicable regulations. The LADBS allows only the following sources of graywater: untreated wastewater that has not been contaminated by toilet waste or unhealthy bodily washes. Graywater includes waste from showers, bathroom wash basins, but does not include kitchen sinks or dishwashers. LADBS allows the use of residential graywater only for subsurface irrigation. Therefore, use by Metro would be limited to only those sites that currently or plan to provide onsite irrigation. Conversion from existing spray to subsurface irrigation would be required (if approved for Metro facilities). Since discharge to surface water is specifically exempted, it is not known if graywater could be used for onsite bus and car washing.

Additional plumbing would be required to reconfigure the existing waste drainage pipelines. Treatment may be required for use of graywater for bus and car washing, if approved. Prior to reuse, Metro is encouraged to discuss graywater limitations with LADBS.

Quantitative Results

Approximately 3,438 gpd of graywater can be used for potable water substitution at each bus facility and 2,580 gpd at each rail facility, or 51,576 gpd at all Metro facilities.

The estimation of potable water savings is based upon the existing standard efficiency

Energy Impacts

Some pumping may be required to convey graywater to appropriate use sites. Energy related to additional treatment may also be required.

Cost

Estimated capital costs for conversion to graywater use is approximately $33,000 at each facility.

Financial Analysis

The anticipated benefits are calculated based on the cost differential between potable and graywater, as well as the capital cost investment for installation of new pipelines, retrofit of the existing facilities and on-going operations and maintenance. The life cycle benefits are estimated at $775,095 system wide. The life cycle costs are $247,095 system wide. The system wide net benefits are $247,095.

The Benefit/Cost Ratio is 1.47.

Business Case

Water saved (for all bus and rail facilities) per revenue hour is 1.53 gallons.

Strategy 7

Replacement of Steamer (Bus facilities)

The existing steamer should be replaced with a high efficiency model. It is estimated that the steamer wand uses approximately 2,789 gpd. Because of the modern design that incorporates a positive trigger value, higher efficiency models may use only 697 gpd.

Quantitative Results

Approximately 2,092 gpd may be conserved by the replacement of the existing steamer wand with a higher efficiency model at each bus facility.

Energy Impacts

The existing steamer wand is operated by natural gas. The high efficiency steamer would be operated by natural gas, using 289 kWh.

Cost

Capital costs for the replacement of steamer wands at each Metro's bus division is $7,500.

Financial Analysis

The anticipated benefits are calculated based on the cost of the water savings, as well as the capital cost investment for installation of new equipment and on-going operations and maintenance. The life cycle benefits are estimated at $412,069 system wide. The life cycle costs are $154,740 system wide. The system wide net benefits are $257,329.

The Benefit/Cost Ratio is 2.66.

Business Case

Water saved (for all bus facilities) per revenue hour is 1.2 gallons.

Strategy 8

Replacement of Car Wash Facility (Rail Facilities)

The existing car wash system is considered to be an outdated design using approximately 2,580 gallons per day at each rail facility. A high efficiency system saving approximately 20 percent of potable water should be installed.


Typical drive through train washing plant. Note special track drainage.

Quantitative Results

Replacement of the existing car wash system could yield a water savings of approximately 516 gpd at each rail facility or 528,384 gallons per year at all Metro rail facilities.

Energy Impacts

Higher efficiency car washers would also provide greater energy savings.

Cost

Capital costs of a car wash facility is approximately $300,000 at each rail site, with annual operations and maintenance costs of $6,000.

Financial Analysis

The anticipated benefits are calculated based on the cost of water savings, as well as the capital cost investment for installation of new facilities and on-going operations and maintenance. The life cycle benefits are estimated at -$370,195 system wide. The life cycle costs are $1,200,000 system wide. The system wide net benefits are -$1,570,195.

The Benefit/Cost Ratio is -0.31.

Business Case

Water saved (for all bus facilities) per revenue hour is 0.8 gallons.

Strategy 9

Replacement of Engine Compartment Cleaner (Bus Facilities)

The existing engine compartment cleaner system, or hot water pressure washer, is considered to be an outdated design using approximately 158 gallons per day at each bus facility. A high efficiency system saving approximately 92 gpd of potable water should be installed.

Quantitative Results

Replacement of the existing car wash system could yield a water savings of approximately 437,330 gallons per year for all Metro bus facilities.

Energy Impacts

Higher efficiency engine compartment cleaners would also provide greater energy savings.

Cost

Capital cost of a high efficiency engine compartment cleaner is approximately $13,000 per site.

Financial Analysis

The anticipated benefits are calculated based on the cost of water savings, as well as the capital cost investment for installation of new facilities and on-going operations and maintenance. The life cycle benefits are estimated at -$32,187 system wide The life cycle costs are $154,740 system wide. The system wide net benefits are -$185,927.

The Benefit/Cost Ratio is -0.21.

Business Case

Water saved (for all bus facilities) per revenue hour is 0.05 gallons.

Strategy 10

Replacement of Under Chassis Washer (Bus Facilities)

The existing under chassis water units use approximately 158 gallon per day. The existing units should be replaced with higher efficiency models.

Quantitative Results

Replacement of the existing under chassis washer may yield approximately 8 gpd of water savings at each bus facility, or 37,960 gallons per year at all Metro bus facilities.

Energy Impacts

Higher efficiency washers would also provide greater energy savings.

Cost

Capital costs for the equipment are approximately $13,000. Annual operations and maintenance of the equipment are assumed to by 2 percent of the capital costs at $260 per year.

Financial Analysis

The anticipated benefits are calculated based on the cost of water savings, as well as the capital cost investment for installation of new facilities and on-going operations and maintenance. The life cycle benefits are estimated at -$51,316 system wide. The life cycle costs are $156,000 system wide. The net benefits are -$207,316.

The Benefit/Cost Ratio is -0.33.

Business Case

Water saved (for all bus facilities) per revenue hour is 0.004 gallons.

Strategy 11

Replacement of Air Scrubbing Water Curtain (Rail Facilities)

The existing air scrubbing water curtain uses approximately 2,500 gpd at each facility and should be replaced with a higher efficiency air scrubber equipment to reduce water use.

Quantitative Results

Replacement of the water curtain with an air scrubber would yield approximately 23 gpd in water savings at each rail facility or 23,859 gallons per year at all Metro rail facilities.

Energy Impacts

Higher efficiency car washers would also provide greater energy savings.

Cost

Capital costs of replacement of the water curtains are approximately $6,000.

Financial Analysis

The anticipated benefits are calculated based on the cost of water savings, as well as the capital cost investment for installation of new facilities and on-going operations and maintenance. The life cycle benefits are estimated at -$15,291 system wide. The life cycle costs are $24,000 system wide. The system wide net benefits are -$39,291.

The Benefit/Cost Ratio is -0.64

Business Case

Water saved (for all rail facilities) per revenue hour is 0.04gallons.

Strategy 12

Replacement of Small Parts Washer (Bus Facilities)

The existing small parts washer uses approximately 63 gpd. The existing small parts washer should be replaced with a high efficiency model that incorporates better water and energy saving measures.

Quantitative Results

Approximately 3 gpd at each bus facility could be saved by replacement of the existing small parts washer, or 13,140 gallons per year throughout all Metro bus facilities.

Energy Impacts

Higher efficiency washers would also provide greater energy savings.

Cost

Capital costs for the equipment are approximately $13,000 for each unit. Annual operations and maintenance of the equipment are assumed to by 2 percent of the capital costs at $260 per year.

Financial Analysis

The anticipated benefits are calculated based on the cost of water savings, as well as the capital cost investment for installation of new equipment and on-going operations and maintenance. The life cycle benefits are estimated at -$29,994 system wide. The life cycle costs are $89,940 system wide. The system wide net benefits are -$119,884.

The Benefit/Cost Ratio is -0.33.

Business Case

Water saved (for all bus facilities) per revenue hour is 0.002 gallons.

Strategy 13

Assessing Education and Outreach Measures (Rail and Bus Facilities, Gateway Headquarters)

Some water conservation strategies that provide demand management lack specific numeric estimates of actual annual water conserved. These strategies are related to behavioral modification of employees and patrons and consist of education and outreach. This section presents an overview of the recommended education and outreach strategies with estimates of conventional and water conservation savings based on professional judgment.

Education

An employee training program will initially educate and continually update staff on the importance of water conservation as it relates to their work environment and procedures. More specifically, these strategies will educate staff on the proper implementation of equipment operation, maintenance and inspection procedures. Additionally, conservation practices are highlighted and their identification incentivized to the individual. The proposed water conservation strategies outlined in other portions of this Plan can therefore more reliably achieve and maintain identified conservation savings by integrating the strategies directly into the site's staffing practices. Delivery of these strategies would be tailored for on-site use to attain and maintain conservation savings.

Metro is currently completing its EMS pilot effort. By using EMS principles for the identification, correction and monitoring of water use and conservation measures, Metro can incentivize its employees to actively participate in the implementation of its water use and conservation policy. By raising water use and conservation to this level of employee involvement, additional conservation opportunities may be identified for continuous improvements.

Outreach

Metro buses, trains, and vans provide the opportunity to expose a wide population to the need, purpose of and participation in water conservation practices. Metro can display appropriate signage promoting water conservation within its stations and vehicles. Signs placed in staff and visitor serving restrooms reinforce the need for conservation of sanitary water uses and describe the benefits of high efficiency fixtures.

Education and Outreach Conservation Savings

For the purposes of this Plan, it was necessary to apply professional judgment to estimate the anticipated water conservation savings that would yield from education and outreach measures. It is reasonable to assume that the use of the education and outreach strategies described herein would provide an estimated additional 1 percent water savings per year above that resulting from the Equipment-Based (or non-behavioral) conservation strategies.

It is estimated that an additional 1 percent water conservation improvement would result each year for the first 5 years of project operations. This estimate is based on initial start-up operations, focus on the issue, the routine of project operations, and the identification of new and more water conserving practices and procedures that would likely be expected to result from operations within the positive, incentivized environment that is intended to result from these strategies.

Perhaps more significantly, the anticipated results of the education and outreach strategies is the preservation or "conservation hardening" of the water savings that will result. Stated differently, the education and outreach strategies would result in permanent savings without degradation. This can be concluded because of the ongoing nature of these strategies as they are integrated into the business practices.

The five-year horizon of conservation improvements applied to these strategies is realistic. It is believed that all reasonable operations strategies associated with education and outreach will have been explored, tested and optimized within that five-year period, and that these savings will then be maintained at a consistent level throughout the life of the project.

In comparison to conventional operations without the education and outreach efforts, it is believed that the associated water conservation savings described above would not be achievable. Therefore, no conservation savings are identified for education and outreach without the implementation of these strategies as described above.

Measurement

Measurement (water use data logging) and auditing (site audits) of actual water use characteristics are understood to be necessary for the maintenance of conservation savings.

Site audits of interior and exterior water use are typically offered by California public water suppliers. Audits identify leaks, off-specification performance of equipment and provide updates on the potential for retrofit and or maintenance of existing equipment and practices.

Audits would be performed on an annual basis to ensure achievement and maintenance of water conservation anticipated from the proposed strategies, considering the inclusion of a suite of other water conserving practices and facilities.

Water use data logging (including the use of sub-metering on specified end use facilities) provides direct, higher resolution and more immediate feedback to project operations than can be achieved from utility metering by the water supplier. Data logging identifies out of specification operations and reports reinforce conservation achievements to the staff and project operators.

Together these measurement strategies do not provide additional water conservation savings; however, their importance to the data logging and site audits provide a significant assurance that the conservation benefits are sustainable and that reporting requirements are achieved.

Strategy 14

Water Conservation at Gateway Headquarters and MSSC (Gateway Headquarters, MSSC)

The following water conservation strategies are recommended for implementation at the Gateway Headquarters and MSSC:

- Continue retrofit of all faucets, toilets, urinals and showerheads to high efficiency equipment. Continue water conserving operations at the Gateway cafeteria, print shop and at other major water using operations.
- Continue to provide water conservation educational materials and reminders throughout the buildings.
- Conduct interior water use evaluations and leak surveys to identify and prioritize repairs of existing pipelines and replacement of other end-use equipment.

- Conduct exterior water use evaluations and leak surveys to identify and prioritize repairs of existing irrigation pipelines and equipment. Work with landscape professionals to identify native vegetation and properly zone all irrigation based on plant type and irrigation requirements. Convert all irrigation controllers to ET -based (smart) controllers. Convert all spray irrigators to matched-precipitation type equipment. Convert all ornamental irrigation to drip-type. Reduce or eliminate all turf. Ensure appropriate use of mulch throughout all planted areas.
- Identify the availability and cost effectiveness to the conversion and use of recycled municipal wastewater for irrigation purposes.
- At the Gateway Headquarters, following replacement of the meter to the cooling towers water supply pipeline, conduct a study of the overall cooling tower water use. This study should evaluate the potential benefit-cost and water savings for the optimization of the cooling tower water use, evaluate the potential to increase the number of operational cycles for each fill, prior to blow-down, and, as appropriate, identify the costs of equipment repair and replacement. As appropriate to the findings of this study, consider the potential costs and benefits of using recycled water for cooling tower make-up.

4.2 Summary

Table 16, Table 17, and Table 18 summarize the anticipated conventional water demand, proposed water demand of each conservation strategy and the anticipated annual maximum and minimum water savings resulting from Plan implementation. Water savings estimated from both the bus and rail divisions are 204 million gallons per year (627AFY). Conservation measures may provide 40 percent savings of conventional water demands.

Table 16. Bus Cost Benefit Analysis Summary

Conservation Strategy	Typical Bus Facility									All Bus Facilities					
	Conventional Potable Water Use (gpd)	BMP Potable Water Use (gpd)	Anticipated Water Savings (gpd)	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	B/C Ratio	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	Gallons Saved Per Revenue Hour
1. Municipal Recycled Water For Bus Washing	34,471	0	34,471	8,824,576	27.08	37,504	11,250	30,004	11.35	105,894,912	325	450,053	135,000	360,043	13.24
2. Municipal Recycled Water For Car Washing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Municipal Recycled Water For Landscape Irrigation	592	0	592	151,552	0.47	644	45,000	515	0.05	1,818,624	6	7,729	540,000	6,183	0.23
4. Extension of Bus Wash On-Site Reclamation	34,471	19,971	14,500	3,712,000	11.39	15,776	10,000	200	26.51	44,544,000	137	189,312	120,000	2,400	5.57
5. Replacement of Sanitary Fixtures	5,604	1,548	4,056	1,038,328	3.19	4,413	15,420	–	4.69	12,459,936	38	52,955	185,040	0	1.56
6. On-Site Gray Water Reclamation with Standard Fixtures	34,471	31,034	3,438	880,000	2.70	3,740	33,000	660	1.47	10,560,000	32	44,880	396,000	7,920	1.32
7. Replacement of Steamer	2,789	697	2,092	763,489	2.34	2,276	12,895	258	2.66	9,161,865	28	27,310	154,740	3,095	1.15
8. Replacement of Car Wash Facility	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
9. Replacement Engine Compartment Cleaner	158	66	92	33,641	0.10	100	12,895	258	-0.21	403,690	1	1,203	154,740	3,095	0.05
10. Replacement of Under Chassis Washer	158	150	8	2,920	0.01	9	13,000	260	-3.95	35,040	0	104	156,000	3,120	0.00
11. Replacement of Air Scrubbing Water Curtain	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12. Replacement of Small Parts Washer	63	60	3	1,095	0.00	3	7,495	150	-0.33	13,140	0	39	89,940	1,799	0.00

Table 16. Bus Cost Benefit Analysis Summary (Continued)

Conservation Strategy	Typical Bus Facility									All Bus Facilities					
	Conventional Potable Water Use (gpd)	BMP Potable Water Use (gpd)	Anticipated Water Savings (gpd)	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	B/C Ratio	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	Gallons Saved Per Revenue Hour
Subtotal	112,777	53,525	59,251	15,407,601	47.28	64,466	160,955	32,305	–	184,891,207	567	773,586	1,931,460	387,654	23.11
Note 1: Education Related Conservation Measures assume an addition water savings of 1% of overall equipment based measure savings use per year for five years	112,777	53,525	2963	770380	2	3,223	–	1,615	–	9,244,560	28	38,679	–	19,383	–
Annual Total (After 5 Years)	225,553	107,051	62,214	16,177,981	50	67,689	160,955	33,920	–	194,135,767	596	812,265	1,931,460	407,037	–

Table 17. Rail Cost Benefit Analysis Summary

Conservation Strategy	Typical Rail Facility									All Rail Facilities					
	Conventional Potable Water Use (gpd)	BMP Potable Water Use (gpd)	Anticipated Water Savings (gpd)	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	B/C Ratio	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	Gallons Saved Per Revenue Hour
1. Municipal Recycled Water For Bus Washing	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2. Municipal Recycled Water For Car Washing	2,580	0	2,580	660,480	2.03	2,807	11,250	2,246	1.12	2,641,920	8	11,228	45,000	8,983	4.03
3. Municipal Recycled Water For Landscape Irrigation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4. Extension of Bus Wash On-Site Reclamation	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Replacement of Sanitary Fixtures	5,092	1,269	3,823	978,688	3.00	4,159	16,820	–	0.93	3,914,752	12	16,638	67,280	0	5.96
6. On-Site Gray Water Reclamation with Standard Fixtures	2,580	0	2,580	660,480	2.03	2,807	33,000	660	23.00	2,641,920	8	11,228	132,000	2,640	4.03
7. Replacement of Steamer	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8. Replacement of Car Wash Facility	2,580	2,064	516	132,096	0.41	561	300,000	6,000	0.01	528,384	2	2,246	1,200,000	24,000	0.81
9. Replacement Engine Compartment Cleaner	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10. Replacement of Under Chassis Washer	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11. Replacement of Air Scrubbing Water Curtain	23	0	23	5,965	0.02	25	6,000	250	0.05	23,859	0	101	24,000	1,000	0.04
12. Replacement of Small Parts Washer	–	–	–	–	–	–	–	–	0.01	–	–	–	–	–	–

Table 17. Rail Cost Benefit Analysis Summary (Continued)

Conservation Strategy	Typical Rail Facility									All Rail Facilities					
	Conventional Potable Water Use (gpd)	BMP Potable Water Use (gpd)	Anticipated Water Savings (gpd)	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	B/C Ratio	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	Gallons Saved Per Revenue Hour
Subtotal	12,856	3,333	9,522	2,437,709	7.48	10,360	367,070	9,156	–	9,750,835	30	41,441	1,468,280	36,623	14.86
Note 1: Education Related Conservation Measures assume an addition water savings of 1% of overall equipment based measure savings use per year for five years	–	–	–	121,885	0.37	518	–	458	–	487,542	1	2,072	0	1,831	–
Annual Total (After 5 Years)	–	–	–	2,559,594	7.86	10,878	367,070	9,613	–	10,238,377	31	43,513	1,468,280	38,454	–

Table 18. Bus and Rail Cost Benefit Analysis Summary

Conservation Strategy	All Bus and Rail Facilities							
	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Estimated Capital Cost ($)	Estimated Annual O&M Cost	Net Benefit (Benefit-Cost)	Gallons Saved Per Revenue Hour	B/C Ratio	Payback Period (considering O&M)
1. Municipal Recycled Water For Bus Washing	105,894,912	325	135,000	360,043	1,396,715	13.24	11.35	1.50
2. Municipal Recycled Water For Car Washing	2,641,920	8	45,000	8,983	-6,786	4.03	0.85	20.04
3. Municipal Recycled Water For Landscape Irrigation	1,818,624	6	540,000	6,183	-513,695	0.23	0.05	349.33
4. Extension of Bus Wash On-Site Reclamation	44,544,000	137	120,000	2,400	3,060,689	5.57	26.51	0.64
5. Replacement of Sanitary Fixtures	16,374,688	50	252,320	0	931,937	1.89	4.69	3.63
6. On-Site Gray Water Reclamation with Standard Fixtures	13,201,920	41	528,000	10,560	247,095	1.53	1.47	11.59
7. Replacement of Steamer	9,161,865	28	154,740	3,095	257,329	1.15	2.66	6.39
8. Replacement of Car Wash Facility	528,384	2	1,200,000	24,000	-1,570,195	0.81	-0.31	-55.16
9. Replacement Engine Compartment Cleaner	403,690	1	154,740	3,095	-186,927	0.05	-0.21	-81.81
10. Replacement of Under Chassis Washer	35,040	0	156,000	3,120	-64,316	0.00	-3.95	-4.53
11. Replacement of Air Scrubbing Water Curtain	23,859	0	24,000	1,000	-39,291	0.04	-0.64	-26.71
12. Replacement of Small Parts Washer	13,140	0	89,940	1,799	-119,884	0.00	-0.33	-51.11
Subtotal	194,642,042	597	3,399,740	424,277	3,392,672	28.52	–	–
Note 1: Education Related Conservation Measures assume an addition water savings of 1% of overall equipment based measure savings use per year for five years	9,732,102	30	–	21,214	169,634	1.12	10.47	5.67
Annual Total (After 5 Years)	204,374,144	627	3,399,740	445,491	3,562,305	–	–	–

5. Next Steps

The following three steps are recommended for the refinement, implementation, and, ongoing optimization of the Water Action Plan and its associated strategies for conservation.

5.1 Step I. Metro Confirmation

Metro's Environmental Compliance and Services Department will take the lead in coordinating with the appropriate internal and external stakeholders to ensure that their issues associated with the Water Action Plan are identified and understood. They will review the water conservation and potable water supply substitution strategies identified herein and will verify consensus on their prioritization for implementation. They will facilitate integration of the Water Action Plan as a key element of Metro's sustainability plan, confirm appropriate inclusion into the Environmental Management System and maintain collaboration with Metro's broader policies, goals and objectives.

5.2 Step II. Proof of Concept

Metro will select the most environmentally and financially advantageous water conservation strategies for controlled implementation at Divisions 18 and 20. Divisions 18 and 20 will thereby serve as water conservation laboratories to facilitate the verification and piloting of the anticipated water savings and retrofit costs, cost savings and provide appropriate hands-on opportunities for Metro to gain first hand construction and operational experience with conservation strategies. As necessary, strategies will be fine tuned to optimize deployment and meet Metro's specific requirements. The planned retrofit of Division 20's car wash will provide additional opportunities for data gathering on the cost effectiveness of modern car washing equipment. Previously installed sub-meters will be re-used to provide ongoing water use data and will provide a benchmark for water use before and after implementation of conservation strategies.

A "Path Forward" document will be prepared to update schedules and budgets for Metro-wide water conservation. This document will be used to present actual water conservation savings, benefit-cost analysis, and, make appropriate refinements to the prioritization for strategy implementation.

5.3 Step III. Site Verification

Remaining Metro divisions will be surveyed for their suitability to water conservation strategy retrofits previously piloted at Divisions 18 or 20. Site specific conditions will be documented. Opportunities and constraints to implementation will be identified. As appropriate, individual planning and engineering documents would be developed to meet individual site constraints.

Anticipated water conservation strategy performance would be evaluated. Metrics such as recycle rate for bus and car washing equipment would be confirmed, and adjusted, as needed. Proximity and availability to supplies of municipally recycled water would be identified.

Landscaping areas under irrigation would be measured. Leakage surveys and audits of interior and exterior water use would be completed in coordination with local water providers.

Water use audits would be conducted at the Gateway Headquarters and the Metro Support Services Center to confirm the performance of water conservation equipment and identify additional strategies, such as cooling tower optimization.

As necessary, the Water Action Plan would be updated to remain current with implementation plans, and planned conservation savings.

6. References

Brown, C. 2000. *Water Conservation in the Professional Car Wash Industry*. Prepared for the International Carwash Association.

Los Angeles County Metropolitan Transportation Authority (Metro). 2008. Metro Sustainability Implementation Plan, Sustainability Policy. Available: <http://www.metro.net/about_us/sustainability/images/Sustainability.pdf>. Accessed: May 2010.

———. 2009a. 2009 Long Range Transportation Plan.

———. 2009b. Towards a Sustainable Future: June 2009 Baseline Sustainability Report.

———. 2009c. General Management Water Use and Conservation. July 2009.

———. 2010. Moving Towards Sustainability: 2010 LACMTA Sustainability Report. July 2010.

State Water Resources Control Board et al. 2010. 20x2020 Water Conservation Plan. February 2010. Available: <http://www.swrcb.ca.gov/water_issues/hot_topics/20x2020/docs/20x2020plan.pdf>. Accessed: May 2010.

7. Appendix A
Water Fixture Replacement and Graywater Savings

Table A-1. Water Fixture Replacement and Graywater Savings

Conservation Strategy	Division 18								Division 20								Total			
	Conventional Potable Water Use (gpd)	BMP Potable Water Use (gpd)	Anticipated Water Savings (gpd)	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	Conventional Potable Water Use (gpd)	BMP Potable Water Use (gpd)	Anticipated Water Savings (gpd)	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Dollars Saved Per Year ($)	Estimated Capital Cost ($)	Estimated Annual O&M Cost ($)	Anticipated Annual Water Savings (gpy)	Anticipated Annual Water Savings (AFY)	Estimated Capital Cost	Estimated Annual O&M Cost ($)
Municipal Recycled Water For Bus Washing	34,471	0	34,471	8,824,576	27.08	37,504	11,250	42,779						-			8,824,576	27.08	11,250	42,779
Municipal Recycled Water For Car Washing									2,580	0	2,580	660,480	2.03	2,807	11,250	1,968	660,480	2.03	11,250	1,968
Municipal Recycled Water For Landscape Irrigation	592	0	592	151,552	0.47	644	45,000	735					0.00	-			151,552	0.47	45,000	735
On-Site Gray Water Reclamation with Standard Fixtures	34,471	31,034	3,438	880,000	2.70	3,740	33,000	660	2,580	0	2,580	660,480	2.03	2,807	33,000		1,540,480	4.73	66,000	660
On-Site Gray Water Reclamation with High Effeciency Fixtures	34,471	33,865	606	155,200	0.48	660	94,300	1,886	2,580	2,096	484	124,000	0.38	527			279,200	0.86	94,300	1,886
Extension of Bus Wash On-Site Reclamation	34,471	19,971	14,500	3,712,000	11.39	15,776	10,000	200					0.00	-			3,712,000	11.39	10,000	200
Replacement of Sanitary Fixtures	5,604	1,548	4,056	1,038,328	3.19	4,413	61,300	1,226	5,092	1,269	3,823	978,688	3.00	4,159	72,450	1,449	2,017,016	6.19	133,750	2,675
Replacement of Steamer	2,789	697	2,092	763,489	2.34	2,276	13,000						0.00	-			763,489	2.34	13,000	-
Replacement of Small Parts Washer	63	60	3	1,095	0.00	3	7,500						0.00	-			1,095	0.00	7,500	-
Replacement of Under Chassis Washer	158	150	8	2,920	0.01	9	13,000						0.00	-			2,920	0.01	13,000	-
Replacement Engine Compartment Cleaner	158	66	92	33,641	0.10	100	13,000						0.00	-			33,641	0.10	13,000	-
Replacement of Car Wash Facility									2,580	2,064	516	132,096	0.41	561	300,000	6,000	132,096	0.41	300,000	6,000
Replacement of Air Scrubbing Water Curtain									23	0	23	5,965	0.02	25	6,000	250	5,965	0.02	6,000	250
Subtotal	147,248	87,390	59,858	15,562,801	47.76	65,125	301,350	47,485	15,436	5,429	10,007	2,561,709	7.86	10,887	422,700	9,667	18,124,509	55.62	724,050	57,152
Note 1: Education Related Conservation Measures assume an addition water savings of 1% of overall equipment based measure savings use per year for five years				778140	2							128085	0.39				906225	3		
Annual Total (After 5 Years)				16,340,941	50							2,689,794	8.25				19,030,735	58		

Los Angeles County
Metropolitan Transportation Authority

One Gateway Plaza
Los Angeles, CA 90012-2952

213.922.9200 Tel
213.922.5259 Fax
metro.net

Metro®

Attachment D. Implementation Status of Water Conservation Measures at Metro Facilities

	Water Action Plan Strategies	Bus Divisions													Rail Divisions & Alignments							Non-Revenue			
		1	2	3	5	6	7	8	9	10	13	15	18	30	11	20	21	22	24	Expo	MOL	4	34	60	99
1	Recycled Water - Bus Wash	sna	sna	Note 1	sna	sna	sna	sna	sna	sna	sna	Note 2	Note 3	sna	na	na	na	na	na	na	na	na	na	na	na
2	Recycled Water - Car Wash	na	na	na	na	na	na	na	na	na	na	na	na	na	sna	sna	sna	sna	sna	sna	sna	na	na	na	na
3	Recycled Water - Irrigation	sna	sna		sna	sna	sna	sna	sna	sna	sna	Note 2	Note 3	sna	sna	sna	sna	sna	sna	sna	X[4]	sna	sna	sna	sna
4	Extend Bus Runoff											X	X		na	na	na	na	na	na	na	na	na	na	na
5	Replace Sanitary Fixtures						X		X	X			X	X	X	X					na				X
6	Graywater Reclamation																				na				
7	Replace Steamer - Bus Div.								Note 5				X		na	na	na	na	na	na	na	na	na	na	na
8	Replace Car Wash Facility - Rail Div.	na	na	na	na	na	na	na	na	na	na	na	na	na		X					na	na	na	na	na
9	Replace Engine Cleaner - Bus														na	na	na	na	na	na	na	na	na	na	na
10	Replace Under Chassis Wash - Bus														na	na	na	na	na	na	na	na	na	na	na
11	Replace Air Scrubbing Curtain - Rail	na	na	na	na	na	na	na	na	na	na	na	na	na							na	na	na	na	na
12	Replace Small Parts Washer - Bus														na	na	na	na	na	na	na	na	na	na	na
13	Education & Outreach Measures	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			na				X
14	Water Conservation - Gateway & CMF	na	na	na	na	na	na	na	na	na	na	na	na	X	na	na	na	na	na	na	na	na	na	na	X
	Other Water Conservation Measures																								
A	Reduced Bus/Car Wash Schedule	X	X	X	X	X	X	X	X	X	X	X	X	X				X	na	na	na	X	na	na	na
B	Rotoclone/Air Scrubber Redesign													X	X				X		na		na	na	na
C	Linear Kinetic Cell		X		X	X							X								na		na	na	na
D	New Air Blower System	na	na	na	na	na	na			P	na			na							na	na	na	na	na
E	Diamond Seal System			P																	na		na	na	na
F	Recycled Water - Stream Bay	sna	sna	X	sna	sna	sna	sna	sna	sna	sna	Note 2	Note 3	sna	na	na	na	na	na	na	na	na	na	na	na
G	Recycled Water - Under Carriage Wash	sna	sna	X	sna	sna	sna	sna	sna	sna	sna	Note 2	Note 3	sna	na	na	na	na	na	na	na	na	na	na	na
H	Cistern										X									X	na		na	na	na
I	Low Impact Development																		X	X	na	X		na	na
J	Water Efficient Cooling Tower	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	X
K	Bio Swales																				X			na	na
L	Smart Irrigation Controllers								X[6]												X[7]				
M	Turf Removal										na	P							na	na	na				
N	Install of Water Sub-Meters				X[8]					X[9]				X							na				X
O	Install New Pressure Washers								X				X								na			na	na

Legend

X = Water conservation measure implemented/underway
P = Piloted water conservation measure
na = Measure is not applicable
sna = Recycled water service is not available

Notes

1 = Recycled water service has been provided but the bus wash manufacturer will not warranty the new bus wash if recycled water is used.
2 = Recycled water service is close by, but not yet provided to the division; coordination with LADWP has been initiated.
3 = Recycled water service is close by, but not yet provided to the division; West Basin will be contacted to inquire about recycled water opportunities.
4 = Metro is exploring with LADWP additional opportunities for using recycled water along the Metro Orange Line.
5 = The use of new pressure washers has significantly reduced the frequency and duration of use with the existing steamers.
6 = Smart irrigation controllers have been installed at Terminal 19 - El Monte Station.
7 = Smart irrigation controllers have been installed along the Metro Orange Line Extension.
8 = Water sub-meters installed on bus washers; additional sub-meters needed for other division functions.
9 = Water sub-meters installed on the Maintenance and Transportation buildings; additional sub-meters needed for other division functions.

ASSESSING THE IMPLEMENTATION AND EFFECTIVENESS OF METRO'S 2010 WATER ACTION PLAN STRATEGIES AND RECOMMENDATIONS FOR WATER USE REDUCTION

TABLE OF CONTENTS

This report includes general as well as specific observations during the review of four representative facilities, identified issues, significant accomplishments, and a discussion of the implementation of the 14 strategies recommended in the 2010 Water Action Plan ("Plan").

1. BACKGROUND

Facilities Evaluated

For this phase of the project, Metro selected four representative and geographically-distributed bus and rail maintenance facilities for site reconnaissance, field verification, interviews with maintenance personnel, data collection, and data analysis. The facilities were chosen to provide a representative understanding of water use and typical maintenance activities within the rail divisions and bus divisions. The representative facilities include:

- Bus Maintenance Division 9
- Rail Maintenance Division 11
- Bus Maintenance Division 18
- Rail Maintenance Division 20

Since Division 18 and 20 were evaluated in the 2010 Water Action Plan, these locations were selected to maintain a long-term consistency and one-on-one comparison in the evaluation methodology. Division 9, which is contains one of Metro's largest bus fleets and is relative in size and capacity to Division 18, was also included in the evaluation. Division 11 maintains one of Metro's largest rail car fleets and is one of the older rail divisions. As such, Division 11 was included in the evaluation to facilitate an evaluation of operational changes since the 2010 Water Action Plan was adopted. The activities and equipment used at these representative locations were utilized to quantify operations at the other facilities.

Interviews

To ensure all relevant features, equipment, operations, and processes were evaluated at each facility, staff interviews were conducted prior to the site reconnaissance at each division. The interviews were held in an open, round-table format to encourage dialogue among the project team, division staff, and Metro's Sustainability Program staff. Division staff participants included Maintenance and Transportation Managers at each division. Further dialogues were held on an informal basis with additional maintenance and division transportation staff during the course of the site reconnaissance.

A set of standard interview questions (see Appendix A) were prepared in advance of each site reconnaissance to enable consistency throughout the process. Questions asked for each location were customized for their specific conditions (for example, only bus related questions were asked at bus divisions). In addition, specific items and further detail in related areas were discussed at each facility based on the initial input and discussion with staff. The interviews included questions and discussion related to various water use operations at each facility as well as how each operation relates to the various recommended water conservation strategies recommended in the Plan. The conversations also included dialogue with staff at each of the divisions visited regarding potential improvements or operational changes to reduce water use at their facility.

Following these site visits, the recommendations and opportunities to improve existing water-related infrastructure and equipment has been discussed through Metro's Environmental

Management System (EMS) Core Team meetings. Water conservation has been included as a meeting topic for both the EMS Administrative Team (whose members include management from Facilities Maintenance, Bus and Rail Operations, Quality Assurance, among others) and the Core Teams at the division level for all 17 facilities enrolled in the EMS program.

Site Reconnaissance

A site reconnaissance was scheduled for half a day at each of the four divisions (these locations were chosen because the equipment, function, or area is a contributor of the total site water consumption, and they were also specifically mentioned in the Water Action Plan.) Metro staff escorted the project team members at all times during the site reconnaissance. As part of the reconnaissance, the following practices, equipment, operations, and processes were observed and evaluated:

- Under chassis wash;
- Small parts wash;
- Bus/Rail Car wash;
- Air scrubbing water curtain;
- Restroom, laundry room, utility sink, shower, and kitchen facilities;
- Parking lots; and
- Landscape and vegetated areas.

2. GENERAL OBSERVATIONS

Several general observations were made based on the results of the site reconnaissance, interviews, and data review of the four representative divisions discussed above. The observations are related to standard water conservation Best Management Practices (BMPs) categories and include: education and outreach, indoor water use (i.e., fixtures), outdoor water use related to landscape irrigation, alternative supply sources, and industrial-type practices specifically related to Metro's washing operations. Sub-metering is also included to facilitate improved tracking of demands and savings based on classification of water use (i.e., landscaping, bus/rail washing, fixtures, etc.). General observations are listed below:

- **Staff Awareness of Water Consumption -** While Metro Division staff generally expressed an interest in water conservation at the facility, we noticed that many of the division staff were not aware of the amount of water used by their facility or the associated cost of the water; the primary reason is the water bills are delivered and processed by Metro staff located in the Gateway Building and are not provided to the divisions.

- **Staff Education/Outreach** – Through Metro's Environmental Training Institute, educational material was developed on water conservation awareness, energy efficiency, and solid waste and recycling best practices for the office and Metro maintenance facilities. This material was presented to the transportation and maintenance personnel at Metro's 11 bus divisions, four rail divisions, and to staff in the Gateway Headquarters building.

- **Sub-Metering -** Metro staff reported that a program to install water sub-metering is in the planning stages. The sub-metering has been included in the Drought Awareness Motion as Item F.

- **Clean Bus/Car Evaluation Criteria** - During the site evaluations, the team learned that Metro includes a bus/car cleanliness metric to rate the division's performance. The Metro Quality Assurance (QA) team performs unannounced and random inspections at various facilities. Once the QA team is admitted to the bus/car yard and other areas, they perform a cleanliness evaluation and complete the associated reports. Based on these inspections, bus/car cleanliness is scored and ranked in comparison to other Metro bus/car divisions.

- **Low-Flow Fixtures –** Only a few fixtures (showerheads, faucets, toilets, and urinals) have been replaced with low-flow fixtures at the four representative facilities. Although not completely retrofitted, the use of waterless urinals was noted throughout the four facilities. Some of those interviewed indicated that only a few low-flow fixtures had been installed and that low-flow showerheads are installed randomly and at the maintenance personnel's discretion as it is commonly believed that staff prefers higher-flow showerheads. Metro is currently evaluating the long-term use of waterless urinals at many of its facilities due to piping issues experiencing low or no flow conditions.

- **Graywater –** None of the facilities investigated included graywater systems.

- **Landscape –** The four representative divisions had limited landscaping, typically located along the road right-of-way and in islands within parking lots.

- **Irrigation -** With the exception of the Division 9 Transportation Building and El Monte Station, there were no drip or water efficient irrigation systems observed.

- **Recycled Water –** None of the visited facilities currently use recycled water for bus or car rail wash; with the exception of Division 11, potable water is still used in all four facilities visited. In addition to potable water, Division 11 receives industrial water from the City of Long Beach, which is used in the carwash, for irrigation, and other uses that does not require potable water.

- **Bus Wash -** There are two bus washers located at Division 18. Washer 1 was installed in 2006, and Washer 2 was installed in 2007. Washer 1 incorporates fiberglass wands to detect the presence of the approaching bus, while Washer 2 incorporates a photo eye to detect the presence of the approaching bus. Staff understands there is a delay in the wash cycle when the wand or photo eye is triggered by the approaching bus.

  It was observed at the Division 18 bus wash building that the pre-rinse sprayers at the first arch remained in the on position well after the tail of the bus passed through. It is not immediately quantifiable as to the volume of additional water is sprayed and wasted. However, the sprayer arch remains on for an additional 40 seconds for the observed bus. During high-use periods, it seems that the sprayers and wash system may run continuously and use considerable excess water in the pre-rinse process.

  It was reported at Division 18 that the buses are washed every other day using the bus number as a marker for identifying odd numbered or even numbered buses; the previous policy was to wash buses every day. This operational change was incorporated to reduce water demand; however, it was noted that the savings associated with this change was approximately 20% rather than the 50% that was estimated/expected. This was partially attributed to differences in

the length of the bus wash cycles and associated water use. While these values were provided verbally by maintenance staff, they have not been confirmed with metered water usage data, which will not be available until sub-meters are installed.

While the manufacturer's recommended time in the bus wash is 90 seconds, Service Attendants move through the wash at their own speed and may spend as little as 25 to 35 seconds in the washing facility, depending on the number of buses in line waiting to be washed. This elevates the necessity for sub-metering at the wash facility to obtain more accurate data to analyze the efficiency of a typical wash cycle.

3. SIGNIFICANT ACCOMPLISHMENTS

As reported to the Board in June 2015, in 2014 Metro consumed 298 million gallons of water across all of its providers, which is 117 million fewer gallons than Metro used in 2013. Further evaluation of water use in representative Metro Divisions show the following key activities have promoted continued water efficiency:

- A pilot for reduced bus washing schedule was implemented starting in October 2014 and has resulted in potential, but not measured, water savings;
- Change from steamer to pressure washer for under-engine cleaning was reported by staff to reduce water usage related to leaving the steamer on when not in use;
- Efficiency upgrades and repairs to existing irrigation systems;
- Compliance with locally-mandated watering schedules; and
- Renovations to some restroom facilities.

Sub-metering efforts will further refinement of these strategies, specific to the locations where they are implemented. Lessons learned at each of those locations will be used to inform the future implementation of the same or similar strategies.

4. ASSESSING THE IMPLEMENTATION AND EFFECTTIVENESS OF METRO'S 2010 WATER ACTION PLAN STRATEGIES

The 2010 Water Action Plan identified 14 strategies for water reduction and conservation. The Plan estimated that a full implementation of the Plan could save Metro over 200 million gallons of potable water annually. We assessed the implementation and effectiveness of the 14 water conservation strategies at each of the four representative facilities visited. A brief synopsis is provided below for each strategy:

Strategy 1 - Municipal Recycled Water Substitution for Bus Washing (Bus Facilities)

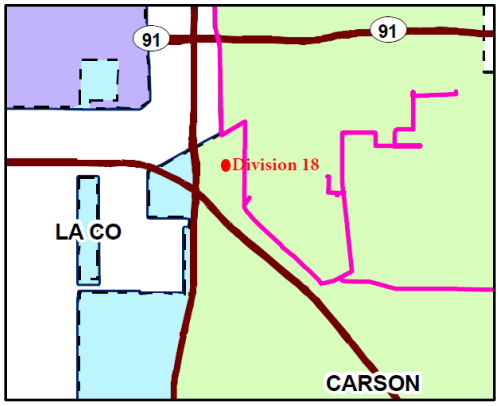
According to the Plan, municipal recycled water may be substituted for potable water supplies where available on a site specific basis considering the quality of the available recycled water and the retrofit requirements to modify existing plumbing, consistent with applicable state requirements. Use of recycled municipal wastewater is allowable by the Title 22 regulations of the California Code of Regulation provisions for the use of recycled water.

The cost effectiveness of recycled water use is dependent upon the availability and proximity of existing recycled water infrastructure, as well as the amount of recycled water that may be used

as substitute to potable water. The Plan estimated that a potable water savings of 413,652 gallons per day (gpd) could be achieved from use of recycled water for bus washing at all Metro bus facilities.

Assessment

This strategy has not yet been implemented at any of the two bus divisions visited. There is a high potential for use of recycled water at Division 18. Division 18 is located in proximity to the West Basin Municipal Water District's recycled water lines. Further discussions are needed with the West Basin Municipal Water District to serve a portion of the water demand at Division 18 with recycled water. Additional study related to water demands at Division 18 and construction costs is needed.



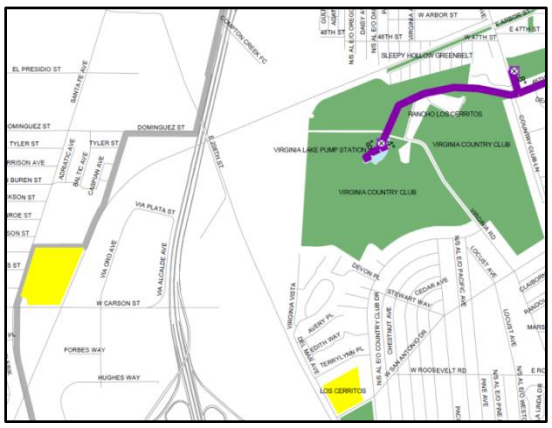
There are no recycled water lines located within the vicinity of Division 9. Because recycled water distribution facilities are not currently adequate to serve Division 9, implementation of this strategy at that location may be a lengthier process, if feasible. Further discussions are needed with the Upper San Gabriel Valley Water District to develop future plans to extend recycled water to Division 9. Additional study related to water demands at Division 9, construction costs, and the feasibility of extending recycled water lines is needed.

Strategy 2 - Municipal Recycled Water Substitution for Car Washing (Rail Facilities)

According to the Plan, regulatory requirements for the use of municipal recycled water at rail facilities is the same as described for Metro's bus facilities. The Plan estimated that a potable water savings of 10,329 gpd could be achieved from use of recycled water for car washing at all Metro rail facilities.

Assessment

This strategy has not yet been implemented at any of the two rail divisions visited. However, there is a high potential for use of recycled water at Division 20. A 36-inch recycled water line from the Central Basin Municipal Water District is located approximately 3,000 feet north of Division 20 and can provide recycled water to Division 20. Additional study related to water demands at Division 20 and construction costs is needed.



Because the recycled water distribution facilities are not currently adequate to serve Division 11, implementation of this strategy at that location may be a lengthier process, if feasible. Division 11 is located within the Long Beach Water Department's water service area and the only nearby recycled water line is an 8-inch line that serves the Virginia Country Club east of the Los

Angeles River. This terminus point is approximately 3,000 feet away from Division 11. Division 11 is currently using industrial water (raw/untreated water) provided by the Long Beach Water Department. While there is typically a cost-savings associated with purchasing industrial water instead of potable water, further investigation is needed to evaluate the potential and cost-benefit to extend the recycled water line to serve a portion of demands at Division 11.

Strategy 3 - Municipal Recycled Water Substitution for Landscape Irrigation (Bus and Rail Facilities)

According to the Plan Metro may convert to the use of recycled water for on-site irrigation, following permit application and approvals from the local recycled water purveyor and the California Department of Public Health (CDPH). Approximately 7,104 gpd of potable water could be saved by substitution with municipal recycled water for landscape irrigation throughout Metro's bus and rail facilities, based on estimates in the 2010 Water Action Plan.

Assessment

This strategy has not yet been implemented at any of the four divisions visited. Details on availability or potential availability of recycled water for the four divisions were discussed under strategies 1 and 2 above.

Limited landscaping was noted within the four facilities visited. However, Division 18 includes the most landscaping within the parking lot, adjacent to the Transportation Building, and adjacent to the road ROW.

Strategy 4 - Extension of Bus Runoff Capture On-Site Reclamation (Bus Facilities)

Run off from the buses at the bus washers is typically collected through floor grates, treated in a clarifier, and returned for use within the wash cycle. As stated in the Plan, extension of the floor grates beyond the bus washing bays would allow for more run-off water to be collected for reclamation and reuse within the wash cycle. The air blowers should be in operation to remove the excess rinse water from the buses as they exit the wash bay. It was estimated that an additional 50 gallons of water per bus could be collected by extending the floor grates an additional 50 feet, ensuring that the air blowers are in operation, maintaining the 2 mph speed limit, approximately 14,500 gpd of water could be saved at each bus facility, or 174,000 gpd for all bus facilities.

Assessment

A series of observations noted in the Plan was also noted during the recent site visits in 2015. The current configuration of the run-off collection does not allow for all of the run-off from the

buses to be collected following a bus wash. Water run-off from the buses continues after they have passed the collection floor grates. Although the air blowers are automatically activated to enhance the runoff while buses are on the floor grates, however, it was observed during site visits that air blowers are not consistently operated. Additionally, per statements from some field personnel, the speed restriction during bus drive through is not strictly enforced to maximize the recapture of run-off.

This strategy has been partially implemented at the two bus facilities visited. This strategy has been implemented at Division 18; however, recapture of bus runoff is not fully realized when buses drive away from the wash facilities more quickly than the bus fully drains off. The Plan noted that the existing grates at Division 18 extend approximately 50 feet and recommended an extension of the grates for an additional 50 feet to capture additional runoff. Division 18 has an existing trench drain that extends out approximately 60 feet past the blowers used after the bus wash rinse cycles are completed. The buses were observed to continue tracking water for another 100 feet past the existing grates. These trench drains were connected by a subsurface pipe to a large drain inlet located between the trench drains and the exit of the wash building. It was reported that the drain inlet was connected to the reclamation processing equipment located inside the wash building. Any runoff from the bus would potentially fall into the trench drain and be reclaimed for the bus wash.

It was further reported that when there are a large number of buses waiting for the wash equipment, the Service Attendants operating the bus may pull away faster, which reduces the amount of runoff captured. It was observed that the existing grates do a modest job of collecting the final rinse water of the buses as they are leaving. However, due to space restrictions, the grates have not been extended past this point.

Division 9 also has existing grates that extend out approximately 10 feet away from the blowers. The buses were observed to continue tracking water for another 125 feet past the existing grates. At Division 9 there is space available to move the grates out further to capture additional bus runoff. Although grate inlets extend out approximately 10 feet from the blowers, this strategy has not been implemented at Division 9 and buses were observed to continue tracking water for another 125 feet past the existing grate inlets.

Strategy 5 - Replacement of Sanitary Fixtures (Bus and Rail Facilities)

The Plan recommended that the existing standard flow sanitary fixtures be replaced with high efficiency, low flow models, toilets should be dual flushed or low flow with no more than 1.6 gallons per flush, urinals should be waterless models, sinks should be infrared sensor or pedal operated, and shower head should be low flow with no more than 1.6 gpm flow rate. According to the Plan, throughout Metro's rail and bus divisions, this retrofit would provide a savings of approximately 16 million gallons per year.

Assessment

This strategy has only been implemented for a few fixtures at the four representative facilities visited. While a few fixtures at the four representative facilities have been replaced, additional fixtures remain for replacement. Broader, although not complete, implementation of waterless urinals was noted throughout the four facilities; however, because of observed operations and maintenance issues at some sites, Metro is revisiting the use of waterless urinals as a water conservation strategy.

Division 9 has low-flow toilets and shower heads in-place and the installation of waterless urinals was prevalent except in the Maintenance Building.

Division 11 has limited low water use fixtures with the most of them located within the Transportation Building (Operations Center and Ancillary Shop). The remaining fixtures within the Division building are not low-flow.

Division 18 has limited low-flow fixtures except within the Transportation buildings. Shower heads in all of the restrooms with showers are low-flow at 2.5 gallons per minute (gpm).

The majority of fixtures within Location 61 Maintenance of Way Building A are low-flow. However, the remaining facilities within Division 20 need upgrades to low-flow fixtures.

Strategy 6 - On-Site Graywater Reclamation with Standard Fixtures (Bus and Rail Facilities)

The Plan recommends graywater or wash water from showers and sinks be captured and removed from the existing plumbing to the wastewater stream and re-used on- site as a substitution for potable water in limited applications. As estimated in the Plan, approximately 51,576 gpd of graywater can be used for potable water substitution at all Metro facilities.

Assessment

This strategy has limited application compared to other recommendations by the Plan. This strategy has not yet been implemented at any of the four divisions visited.

Division 18 is the only facility visited that may be able to utilize graywater due to proximity of adequate landscaping to the Transportation Building, which includes showers and sinks. However, further analysis is needed to confirm the water demand of the landscaping as compared to the potential volume of graywater.

There is a potential for graywater generated from showers at the Transportation Building to be used for irrigation at the site as well as potential to retrofit the parking lot with Green Infrastructure features, such as bio-retention

or permeable pavement. Additionally, the existing vegetation is higher water use and is an ideal candidate for replacement with low-water use vegetation.

While the technical and code compliance issues as reported in the Plan need to be addressed as part of the evaluation process, regulations and codes have evolved since the Water Action Plan was prepared in 2010. The County of Los Angeles Department of Health and the State of California Water Resources Control Board along with other local municipal agencies have been working on developing guidelines for pipeline construction for the safe use of recycled and reclaimed water. Of concern is cross contamination with potable water. Details on local codes can be found at the following websites:
http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Lawbook.shtml
http://publichealth.lacounty.gov/eh/AreasofInterest/recycledwater.htm
http://publichealth.lacounty.gov/eh/EP/cross_con/cross_con_main.htm

A graywater system can be expanded to also include the capture of stormwater runoff from the on-site surfaces (buildings and yard areas). Stormwater would be collected via storm drains. Instead of discharging to the storm drain system off-site, the on-site water would be collected and re-used in the bus wash building.

A typical rainwater harvesting system is made up of three primary components. The first is a pre-treatment system via a water quality unit. This unit would be effective in removing sediments, total suspended solids, and hydrocarbons. The system would be capable of capturing trash and debris, organics, gross solids. A settling basin within the unit would capture nutrient leaching, bad odors, higher biochemical oxygen demand contaminants, bacteria growth, and septic conditions. The second component is a storage system.

The storage system typically consists of concrete modules or other piping to create a water tight system or rain barrels. The volume would be calculated based on the area of capture and demands the system will supply. The last component of the rainwater harvesting system is the post treatment. This can be achieved through one of three methods; ultraviolet disinfection, chlorination, or ozone disinfection. Typically, of the three mentioned, ultraviolet is the most cost effective and will achieve a water filtration to the 5 micron level. A series of pumps, valves and piping to industrial water demands is required. A study of the specific demands and areas of each application will be required to develop an efficient and code compliant system.

Strategy 7 - Replacement of Steamer (Bus facilities)

The Plan recommends replacing the existing old steamers with a high efficiency model; this action will save approximately 2,092 gpd at each bus facility.

Assessment

This strategy has not yet been implemented at Divisions 9 or 18 bus facilities. At Division 18, a new pressure washer is more frequently used than the steamer and is reported by staff to use less water. However, metered water use data are not available to support this statement.

Division 18 staff members typically choose to use the pressure washer because the system starts up faster. The steamer unit requires a start-up period to heat the water to the specific temperature. Once used, the system requires a cool down period so that the internal coils in

the steamer do not corrode and experience any additional wear and tear. The system is moderately used at both facilities and is performing to manufacturer's specification. However, metered water use data are not available to support this statement.

The steamer and pressure washer at Division 9 are located within the same general area. Any run off from these activities flows to a clarifier and then to the sewer system. Because of the high levels of hydrocarbons and other oil and grease contaminants, this runoff would not be considered for use in a reclamation system. Routine maintenance of the equipment is typically performed on a quarterly basis. If a component or system appears to require replacement, then a report is generated and a maintenance crew proactively fulfils the request for repair. If the whole piece of equipment becomes inoperable, then Metro staff have other equipment on-site to fulfill the task as a back-up.

Strategy 8 - Replacement of Car Wash Facility (Rail Facilities)

The Plan states that the existing car wash system is outdated and a high efficiency system can save approximately 20 percent of potable water. Replacement of the existing car wash system could yield a water savings of approximately 528,384 gallons per year at all Metro rail facilities.

Assessment

This strategy has not been implemented at Division 11. However, construction of a new car wash building at Division 20 was recently completed, operators and facilities maintenance staff have been trained, and the car wash is operational.

At both facilities, inspections of maintenance equipment and wash systems are performed monthly. The maintenance and inspection programs at Divisions 11 and 20 are very robust. Staff described that a work order is generated and replacement or repair takes places within one day when a leak is observed or it is anticipated that any piece of equipment may fail or malfunction.

The Division 11 brushes were replaced at the beginning of 2015. The new brushes are lighter in weight; however, it is unknown if they use less water since there is currently no sub-metering at this facility. The Manager accompanying the team noted that it is difficult to clean the end cap areas of the rail car set. Although water from the car wash might reach these areas, there is no direct brush contact and these areas must be cleaned manually.

At Division 11, it was reported that the rail car wash facility utilizes industrial water from Long Beach Water Department. In 2008, the length of the wash building was extended. During construction, the reclamation and reverse osmosis systems were removed from service and were not reconnected at the completion of the construction. As a result, cars are washed with the industrial water and runoff drains into a clarifier and, ultimately, into the municipal sewer system. To address spotting issues, a water softener system is used for the final rinse arch.

During the interview session at Division 20, it was mentioned that Metro ceased washing the interior walls of the Metro Red Line tunnels at the start of the new fiscal year due to budget

considerations. However, it was observed that the rail cars return to the yard dirtier than before when the tunnels were washed. While it is not confirmed, there may be a correlation to the cleanliness of the rail cars and whether the tunnels are washed. Since debris and other particulate matter builds up in the tunnels and is not washed away, it is assumed that the particulates become airborne and affix to the exterior surface of the rail cars as they pass through.

At Division 20, a new Interclean rail car wash facility was recently completed and is now operational. It was reported that the dryers on the temporary car wash system were ineffective and that the system did not have a water reclamation system. In addition, the temporary car wash system did not include a brush system for the roof of the car resulting in inadequate cleaning of the top of the rail cars. Now that the new car wash is operational, the temporary car wash system will be demolished and its components will be stored for use as spare parts to service other washers.

At Division 20, it was reported that there is no set wash schedule for the rail car sets. The decision to wash is generally based on a visual inspection of the rail cars, which are washed if the exterior appears to be dirty. Due to the operation of the rail cars, it is challenging to systematically wash the cars. Staff indicated an interest in a specific wash schedule for the rail cars. It was also reported that newer rail cars have a wash mode limiting the speed of the rail car to the manufacturer's recommended speed, which optimizes the wash cycle.

Strategy 9 - Replacement of Engine Compartment Cleaner (Bus Facilities)

According to the Plan, the existing engine compartment cleaner system or hot water pressure washer is outdated and should be replaced with a high efficiency system. Replacement of the existing car wash system could yield a water savings of approximately 437,330 gallons per year for all Metro bus facilities.

Assessment

This strategy has not yet been implemented at the two bus divisions visited. At Division 18 a new pressure washer is more frequently used than the steamer and is reported by staff to use less water. However, metered data are not available to support this statement.

At Division 9, the engine compartment cleaner or pressure washer has been in use for over 10 years and has not been replaced. It was reported that the equipment employed at both divisions is operating at manufacturer's recommended specification.

Although the recommendation to replace the engine compartment cleaner is valid to save water, the benefit/cost ratio is negative. This recommendation needs further evaluated to determine if the water savings justifies the negative benefit/cost ratio or if it would be in Metro's best interest to continue using the existing equipment until such time that a newer model could result in higher water savings and a positive benefit/cost ratio.

Strategy 10 - Replacement of Under Chassis Washer (Bus Facilities)

The Plan recommends that the existing under chassis water be replaced with higher efficiency models; this may yield approximately 37,960 gallons per year at all Metro bus facilities.

Assessment

This strategy has not yet been implemented at the two bus divisions visited. The under chassis washer at Division 18 is the same equipment that was previously noted for the 2010 Water Action Plan. The equipment is set to manufacturer's recommended settings. The chassis wash area is in a covered area with a semi-open walled area. The chassis wash operates at a rate of approximately one linear foot per minute and washing a typical 40-foot bus requires approximately 40 minutes. However, depending on the required service, only a portion (front or end) of the bus might be cleaned. It was reported that an average of four buses use the under chassis washer per day. Similar conditions were noted at Division 9.

Degreasing agents are mixed with potable water to supply the under chassis washer. Water runoff from this system flows to a clarifier and then to the sewer system. Because of the high levels of hydrocarbons and other oil and grease contaminants, this run off would not be considered for use in a reclamation system.

Strategy 11 - Replacement of Air Scrubbing Water Curtain (Rail Facilities)

The Plan recommends that the existing air scrubbing water curtain be replaced with a higher efficiency air scrubber equipment to reduce water use by approximately 23,859 gallons per year at all Metro rail facilities.

Assessment

The air scrubbing water curtains were replaced approximately five years ago at Division 20 and in 2011 at Division 11. In both divisions, it was reported that the system functions according to the manufacturer's specifications. The runoff from these systems is directed to the on-site oil/grease interceptor before the discharge is sent to the public sewer system. It was reported

that the equipment employed at both divisions is operating at manufacturer's recommended specification.

Although the recommendation to replace the air scrubbing water curtain is valid to save water, the benefit/cost ratio is negative. This recommendation need to be further evaluated to determine if the water savings justifies the negative benefit/cost ratio or if it would be in Metro's best interest to continue using the existing equipment until such time that a newer model could result in higher water savings and a positive benefit/cost ratio.

Strategy 12 - Replacement of Small Parts Washer (Bus Facilities)

The Plan recommends that the existing small parts washer be replaced with a high efficiency model that incorporates better water and energy saving measures; approximately 13,140 gallons per year could be saved throughout all Metro bus facilities.

Assessment

This strategy has not yet been implemented at either Division 9 or 18. Both units are more than 10 years old. It was reported that the equipment employed at both divisions is operating at manufacturer's recommended specification.

Although the recommendation to replace the small parts washer is valid to save water, the benefit/cost ratio is negative and the water savings is insignificant. This recommendation may be further evaluated to determine if the water savings justifies the negative benefit/cost ratio or if it would be in Metro's best interest to continue using the existing equipment until such time that a newer model could result in higher water savings and a positive benefit/cost ratio.

Strategy 13 - Assessing Education and Outreach Measures (Rail and Bus Facilities, Gateway Headquarters)

The Plan recommends employee training on the importance of water conservation as it relates to their work environment and procedures. In addition, Metro buses, trains, and vans provide the opportunity to expose a wide population to the need, purpose of and participation in water conservation practices. Metro can display appropriate signage promoting water conservation within its stations and vehicles. Signs placed in staff and visitor serving restrooms reinforce the need for conservation of sanitary water uses and describe the benefits of high efficiency fixtures.

It was assumed in the Plan that implementation of the education and outreach measures would result in an estimated reduction in water of use of one-percent. Because of the on-going nature of this strategy, this savings can be assumed to be permanent without degradation.

The use of site audits and sub-metering were also included in this strategy. While neither of these measurement strategies provides water conservation savings, they can be used to facilitate identification of areas of water conservation savings. Interior and exterior site audits

are typically offered by public water suppliers and represent an important tool for identifying leaks and operational inefficiencies.

Strategy 14 - Water Conservation at Gateway Headquarters and MSSC (Gateway Headquarters, MSSC)

Assessment

This strategy was not investigated in detail as it relates to Gateway Headquarters and it was not within this initial scope of assessments. Gateway Headquarters has however undergone significant retrofits in the past few years: waterless urinals to low-flow systems. Ongoing maintenance of pipes possibly resulting from the conversion to waterless urinals informs the decision for a long-term use of this strategy. Other water conservation strategies related to heating and cooling the building have also been implemented.

Appendix B illustrates the implementation of the 2010 Water Action Plan strategies and other water conservation measures at Metro facilities.

5. SUMMARY OF ASSESSMENTS

In conclusion of the four site evaluations, it is recommend that 1) the 2010 Water Action Plan be re-visited and the applicability of the strategies in 2015 be re-evaluated; 2) continue education of appropriate Metro personnel on these strategies; and 3) sufficient capital funds and staff resources be allocated to implement the selected strategies.

6. RECOMMENDATIONS FOR WATER USE REDUCTION

This section addresses general and specific recommendations for water conservation and reduction in potable water demand at Metro facilities in order to reach the goal of 20% reduction in 2017. Recommendations are conceptual and are based on previous experience as well as the observations noted during site visits of the four representative divisions.

Recommendations are presented as:

1. Options that can be implemented immediately and on a short-term basis within the next 2 years, and

2. Options that require long-term implementation beyond 2017.

Although some of the short-term options may result in very small water savings relative to other long-term options, cumulatively they will contribute to the 20% reduction in potable water use by 2017.

6.1 SHORT-TERM OPTIONS

1) Wash Schedules and Cleanliness

Recommendation: Redefine the cleanliness criteria for buses and train cars to permit a reduction in the frequency of bus/car washing. The redefinition of cleanliness would only apply to outside of the buses and cars; it does not apply to the cleanliness of the inside of the buses

and cars (since the water used inside is very limited) and the exterior windows need to be cleaned by other methods, if necessary. The delicate balance is to have clean buses while using fewer resources to achieve the metric. Therefore a redefinition of the cleanliness metric would need to be in place if wash schedules are adjusted.

Currently, some of the bus divisions wash buses every other day using the odd/even bus number. It is recommended that the buses and cars be washed once a week. A visual inspection may be established to wash a bus/car out of sequence, if it is determined that the bus/car requires additional washing. The goal is to reduce the current water consumption for bus/car wash by 2.5 times or 60 percent.

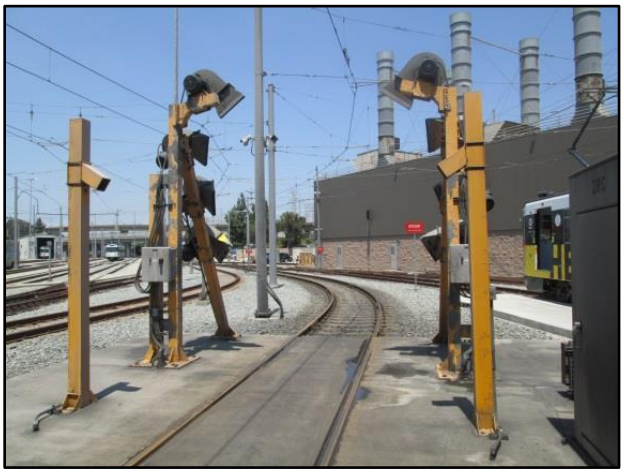
The 2014 water use for 18 divisions was 116 million gallons compare to the reported total Agency's water use of 298 million gallons (Metro's 2015 E&R Report). Per the 2010 Water Action Plan estimate, approximately 70% of water in each division is used for bus/car washing. A proposed 60% reduction will save 48 million gallons of water per year, which is a significant value in meeting the reduction goal of 20% by 2017.

2) Adjust Bus/Car Wash Blowers

Recommendation: Adjust bus wash blowers to blow water back into the wash area for recovery rather than randomly or away from the water recovery area. At some divisions (e.g., Divisions 9 and 18), the dryers for the wash system are outside of the wash building. The dryers activate when the bus reaches the wand or breaks the photo-eye in the washer area. Typically, eight dryers will cycle on; two at the top and three on each side. As the bus passes through, the dryers blow water back towards the wash building. Because the blowers are outside of the building, excess water does not directly get captured back into the reclamation system.

An extension of the floor drainage system or expansion of the trench along the perimeter would logically reduce the burden on potable water. In addition, a canopy or an extension of the wash building that includes the dryers to create a closed system for the wash cycle could be added at divisions with available real estate. As vehicles are washed they continue to track water with them as the water is continuing to drain off the vehicle shell. If the vehicles are required to stay within the trench areas for an additional 15 seconds, additional water can be captured within the trench to be reclaimed.

This recommendation is low cost and results in a quick water saving. The water returned back to the recycling system can be used again for the pre-soak and wash cycles, thereby reducing the demand on the additional potable water during these cycles. Although this will save minimal water, this has the most benefit to cost as there is minimal to no cost in adjusting the blowers as they already exist with the benefit of retaining over 50,000 gallons in an average year.



At Division 9 and 18, the dryers for the wash system are currently outside of the wash building. The dryers activate when the bus reaches the wand or breaks the photo eye in the washer. Typically, eight dryers will cycle on; two at the top and three on each side. As the bus passes through, the dryers blow water back towards the wash building. Because the blowers are outside of the building, an excess amount of water does not get captured back into the reclamation system.

An extension of the floor drainage system would logically reduce the burden on potable water. In addition, a canopy or perhaps an extension of the wash building to include the dryers to create a closed system for the wash cycle could be added. For this reason, Strategy 4 Extension of Bus Runoff Capture On-Site Reclamation of the 2010 Water Action Plan is directly related to this recommendation. In addition, the 2010 Water Action Plan rates this strategy as a high benefit/cost ratio and water savings in comparison to the other strategies.

In addition, the dryer at Division 11 is outside the wash building. Additional drainage could be added to add to the reclamation system. However, the reclamation system at Division 11 was taken off line when the wash building was extended.

3) Adjust Bus/Car Wash Nozzles

Recommendation: Replace bus/car wash nozzles with higher efficiency nozzles. Based on the 2010 Water Action Plan sub-metering analysis, Division 18 bus wash bays used 157 gallons and 212 gallon per bus wash bay per vehicle. Typically, each bus wash includes three arches and 15 nozzles per arch; although, it is noted that a few divisions have four or even five arches. Worn nozzles can produce wasted water approximately 30% over rated capacity and this wastage may not be visually detectable. Based on nozzles located at Division 18, the nozzles spray between 7 to 9.5 gallons per minute per nozzle. If there is a bus going through the wash every 5 minutes or on average about a 5-hour per day operation over 365 days, efficient replacement nozzles will produce a water savings of up to 38,151 gallons per day or approximately 13.9 million gallons per year based on the 30% spraying over rated capacity.

Additionally, there are different spray nozzles for presoak, wash, and final rinse applications. Presoak and final rinse nozzles ideally operate at lower pressures and flow rates than wash nozzles. Replacing all nozzles with the specific use type, i.e., presoak, wash, and final rinse nozzles, and installing water pressure regulators on each specific wand type, further optimizes the water savings and increases the efficiency of the wash system. Further considerations of corrosion and mineral deposits which also reduce the efficiency of the water delivery system and lead to reduced nozzle capacity and clogging, are necessary.

Another consideration would be to reduce and adjust the number of nozzles in each arch. A pilot test is recommended to demonstrate and determine the minimum number of nozzles in each arch that still perform a complete cleaning.

4) Irrigation System

Irrigation Schedule

In 2014, total water used at all Metro facilities was 298 million gallons, of which 116 million gallons was from Metro's 16 maintenance divisions (Divisions 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 15, 18, 20, 21, 22, and 30) and two other facilities (Location 4 and 34). Therefore, the water used by other facilities (including Gateway) and all irrigation and landscaping is approximately 182 million gallons. A significant portion of this demand is for landscaping along Metro lines. As directed by the Board's Motion, restricting the use of potable water for irrigation to no more than two days per week would significantly reduce water use. Adjusting the irrigation watering schedule is a low cost option that can be implemented immediately and will result in a significant reduction in potable water use. In accordance with the motion, Metro will post the watering schedules for each facility.

Irrigation Efficiency

Recommendation: Adjust irrigation heads to eliminate overspray of non-vegetated areas and adjacent paving or other impervious surfaces. All irrigation lines need to be surveyed on a regular schedule to check for leaks and other inefficiencies. In addition, the irrigation systems may be replaced with drip irrigation or smart controllers, where possible.

Overspray and Irrigation Efficiency – Adjust irrigation heads to reduce or eliminate overspray of non-vegetated areas and adjacent paving or other impervious surfaces. Perform inspection of irrigation systems while adjusting to avoid overspray. Identify leaks and other inefficiencies and adjust watering period to meet Motion requirements (no more than two days per week except for drip irrigation systems) and local watering restrictions. Post watering schedule to comply with Motion.

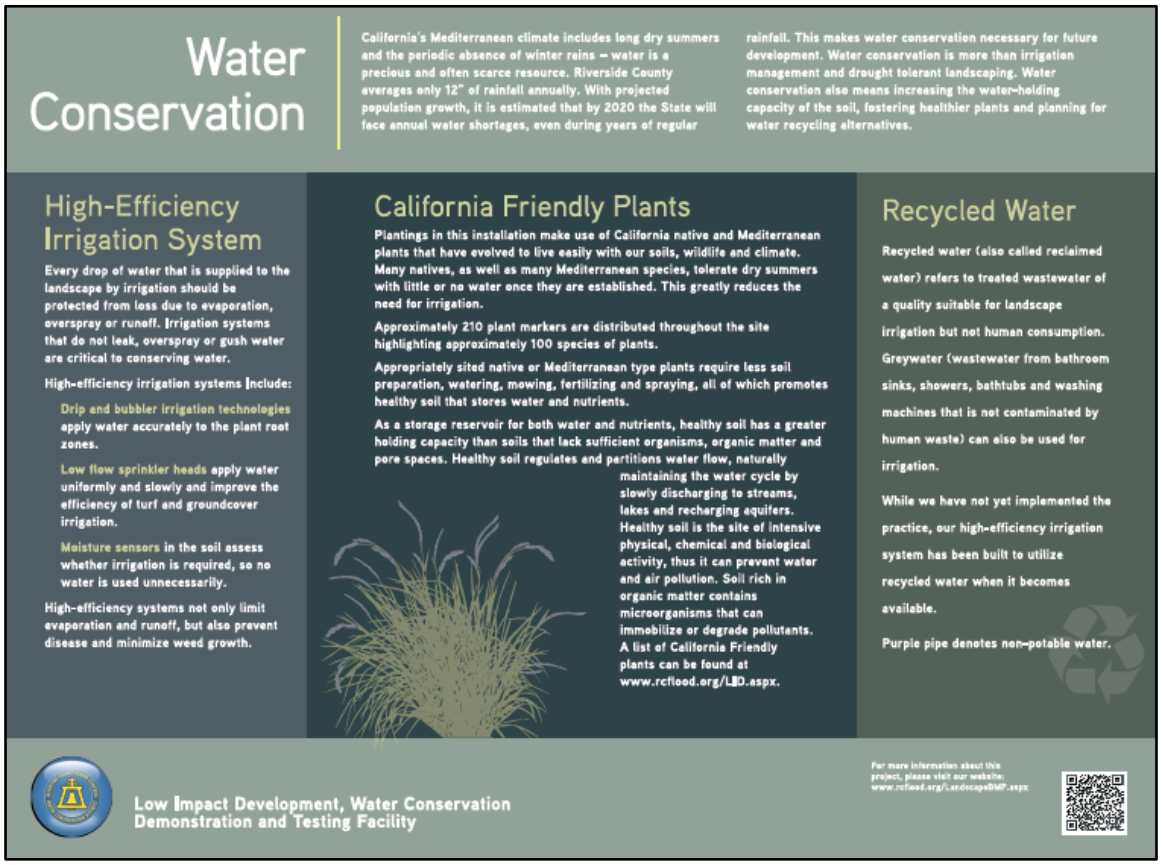
Irrigation Controllers and Systems **-** Evaluate irrigation systems for replacement and use of smart controllers. Identify older systems for replacement with drip irrigation.

Low-Water Use and Native Vegetation – Replace landscape areas with non-native and/or medium to high water-use vegetation with low-water use and native or adapted vegetation. Specific attention should be paid to the location of the Division and the watershed it is located in. Use of native habitat that can withstand the coastal environment versus the valley environment is important based on the location of the Division. Incorporating trees provides additional cooling, climate change, and aesthetic benefits within parking lots and road right-of-way (ROW).

This option is low cost and can be implemented immediately. Reduction of potable water use for irrigation could range from 4% to 20%, depending on the extent of implementation of these strategies.

Remove or Limit Ornamental Turf

As directed by the Board's Motion, Metro is in the planning process to remove or limit ornamental turf and the non-native and/or medium to high water-use vegetation, and replace them with low-water use and native or adapted vegetation. Specific attention is paid to the location (e.g., coastal verses valley environments) of the division and the watershed it is located in the use of the native habitat vegetation. Incorporating trees provides additional cooling, climate change, and aesthetic benefits within parking lots and road right-of-way and the use of rebates and other incentives will offset the cost of these measures.



5) Sanitary and Kitchen Fixtures

Change out sanitary fixtures

Change out sanitary fixtures to low-flow systems using low-flow water fixtures, faucet aerators, low-flow shower heads, dual flush toilets, and waterless urinals would significantly conserve water, although, compared to options recommended for irrigation and car/bus wash would be insignificant.

The State of California mandates all new toilet fixtures to be of 1.28 gallons/flush. Changing any fixtures older than 1992 would achieve over 50% savings. Changing old urinals to low flow or to waterless may help achieve up to 100% in water savings from urinals. However, Metro is analyzing the feasibility of widespread use of waterless urinals as there are potential piping issues with low or no flow conditions. Shower habits tend to be different between men and women, but on average with people can cut shower time from the average 7 to 9 minutes to half and using low flow shower heads, they can save water in the magnitude of 50%. If each

fixture is improved, the resulting savings may be in the range of 1.5 million gallons for the 18 Divisions.

Under-sink RO Units

The Los Angeles region is known to have good and safe tap water, but it tends to be minerals-heavy, producing a taste many find unappealing. Household-type reverse osmosis (RO) units, typically installed under the sink, are used to remove most of such minerals, making water taste better. However, RO can be high water consuming; for every gallon of drinkable water produced from RO, approximately 5 to 20 gallons of water is wasted as by-product. Such waste can be reclaimed, but it entails storage, or a direct location to receive it such as landscape area nearby. It is thus recommended that all RO units be removed. If better water taste is desired, there are other sources such as large bottled water dispensers. For an RO unit with 5 gallons/day production, the savings can range from 20 to 100 gallons/day.

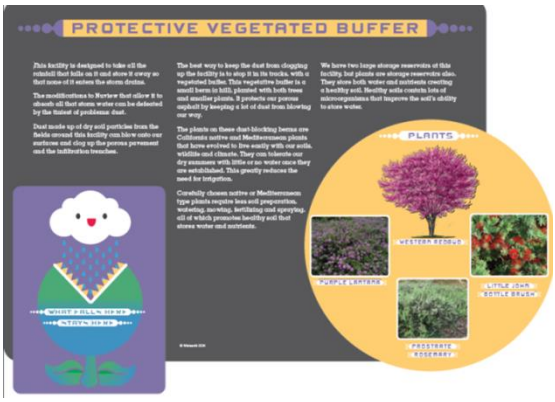
6) Training

Based on literature as well as the 2010 Water Action Plan, implementation of the education and outreach measures could result in an estimated water reduction of 0.5% to 1% per year for the first five years of implementation.

Staff Training and Outreach

Recommendation: Expand training of Metro personnel on water usage and water conservation measures at their facilities. Provide Maintenance Managers and staff with water usage data at their facilities on a quarterly and annual basis, which can be used to discuss water use and conservation at their division with their facility staff. Better informed and educated staff will tend to make more informed decisions regarding water use, priorities, and conservation. In addition, we recommend that interpretive signs be included: 1) throughout the yard, or facility without interfering with safety of equipment and employees; 2) highly utilized restroom and shower facilities; 3) areas with low-water use vegetation; 4) as part of projects utilizing graywater; and 5) as part of projects utilizing Green Infrastructure.

Public Education and Outreach



Recommendation: Metro should provide education and outreach to its patrons through Metro's website, special outreach programs, public database of Metro's water use, and interpretive signage and/or educational brochures at public facilities where Metro has implemented water conservation measures. Recommended locations for interpretive signs include: 1) Metro above-ground rail stops with low-water use vegetation, 2) other Metro rail stops focusing on water use for rail car/bus washing and general Metro conservation efforts, 3) Union station near the restroom facilities under renovation (describing low-flow fixtures and other water conservation efforts), 4) Union Station within the low-water use landscape area near the bus bays and Flyaway booth, 5) Metro Orange Line and Extension; and 6) other similar locations.

6.2 RECOMMENDATIONS THAT REQUIRE LONG-TERM IMPLEMENTATION

1) Graywater

Recommendation: Evaluate all divisions to determine if graywater retrofits are suitable and to identify appropriate routes for sink and shower water to landscape areas. If the landscape demand is not large enough to use the available graywater, it could also be routed to bus/carwash facilities for use at the presoak and soap cycles. In both cases, the graywater would undergo pre-treatment.

2) Green Infrastructure

Recommendation: Evaluate the potential for using Green Infrastructure (bio-retention, permeable pavement, vegetated swales, infiltration trenches, and other features) agency-wide to capture stormwater runoff for use in landscaped areas. These techniques reduce potable water demand for irrigation, reduce stormwater runoff, improve water quality, add aesthetic benefits, and provide an integrated and sustainable approach to managing water.

3) Subsurface Storage

Recommendation: Study the inclusion of a cistern primarily impervious surfaces with impervious cover values of up to 90 percent or higher at Metro facilities. Combined with an efficient storm drain conveyance system, a significant volume and rate of runoff occurs even in small rainfall events. The sub-watersheds at the facilities should be reviewed to appropriately place underground storage that can provide for stormwater reuse for landscape irrigation, the bus/rail car wash facilities, and potentially toilet flushing.

4) Stormwater Recharge

Metro Divisions are located within various groundwater basins. Due to the recent drought and other compliance measures, over the last 15 years there has been a bigger emphasis on using stormwater as a resource. The majority of surface areas at Metro Divisions are impervious to allow water collection, and because of this limited permeability, heat-island effects are created. One measure to reduce the effect would be to either infiltrate stormwater to the groundwater

aquifer or capture the stormwater in a cistern for use at the division. This provides for compliance with LEED, Industrial General Permits, and an enhancement to local aquifers.

As an example, Divisions located within the San Fernando groundwater basin, collaboration with the Los Angeles Department of Power and Water (LADWP) may be feasible for larger-scale projects incorporating a stormwater infiltration and groundwater recharge component. LADWP is seeking cooperative partnerships to implement a recently released initiative called a *Stormwater Capture Master Plan,* emphasizing recharge within the San Fernando basin to improve the sustainability and resiliency of local water supply through groundwater recharge. While only a portion of the stored water would be available for landscape irrigation, wash water, or toilet flushing, this represents a significant sustainability step for the region.

5) Municipal Recycled Water

Locate municipal recycled water purveyors within the proximity to Metro Divisions. Based on available recycled water lines, Metro should discuss the potential use and quality of the water available for the purposes of bus and car wash, and chassis wash. The availability of the recycled water will reduce the potable water demand for the Divisions. Where feasible and available, retrofit plumbing within the Divisions to utilize recycled water. With the exception of the final rinse, the recycled water should be used for landscape irrigation and rail car/bus wash cycles. Recycled water should be used in as many rinse cycles as possible, only limiting the final rinse to fresh potable water. While the potential savings in potable water is high and it is possible that most irrigation and washing demands could be met from this alternative supply source (if available), the associated cost and time-frame for implementation make this a longer-term strategy that is not anticipated to be fully implemented by 2017.

6) Audit/Surveys

As recommended in the 2010 Water Plan, interior and exterior site audits by public water suppliers represent an important tool for identifying leaks and operational inefficiencies. As part of this project, the Tetra Tech team is performing site investigations to develop recommendations for water conservation. Additionally, specific site audits by public agencies may be recommended based on the analysis of data in future phases of work on the project.

Apeendix:

A. Standard Interview Questions
B. Implementation of Water Conservation Measures at Metro Facilities

APPENDIX A

Standard Interview Questions

Metro Water Conservation Water Plan Survey

2010 Water Action Plan Strategies

1. Strategy 1 Municipal Recycled Water Substitution for Bus Washing (Bus Facilities)
2. Strategy 2 Municipal Recycled Water Substitution for Car Washing (Rail Facilities)
3. Strategy 3 Municipal Recycled Water Substitution for Landscape Irrigation (Bus and Rail Facilities)
4. Strategy 4 Extension of Bus Runoff Capture On-Site Reclamation (Bus Facilities)
5. Strategy 5 Replacement of Sanitary Fixtures (Bus and Rail Facilities)
6. Strategy 6 On-Site Gray-water Reclamation with Standard Fixtures (Bus and Rail Facilities)
7. Strategy 7 Replacement of Steamer (Bus Facilities)
8. Strategy 8 Replacement of Car Wash Facility (Rail Facilities)
9. Strategy 9 Replacement of Engine Compartment Clear (Bus Facilities)
10. Strategy 10 Replacement of Under Chassis Washer (Bus Facilities)
11. Strategy 11 Replacement of Air Scrubbing Water Curtain (Rail Facilities)
12. Strategy 12 Replacement of Small Parts Washer (Bus Facilities)
13. Strategy 14 Water Conservation at Gateway Headquarters and MSSC (Gateway Headquarters, MSSC)

Questions as they apply to each strategy above:
We would like to ask these questions from Facility Managers during our site visits.

General

1. What are the make and model of the bus wash and car wash systems (system)?
2. What year was the system installed?
3. What is the life cycle of the system?
4. Rate the overall condition of the system on a 1 to 5 scale (1 = poor and 5 = Excellent).
5. Rate the overall performance of the system on a 1 to 5 scale (1 = poor and 5 = Excellent).
    I. Rate the overall efficiency of the system on a 1 to 5 scale
    II. Rate the overall cleaning quality of the system on a 1 to 5 scale
    III. Rate the overall water efficiency of the system on a 1 to 5 scale
6. How is the speed of buses and cars regulated through the system?
7. Are any system plumbed into recycled water lines?
8. Is the wash water in the system recycled? If so, what is the percentage?
9. Is potable water used in the final rinse cycle?
10. Are there provisions for extending covers (roofs or awnings) over possible extensions of floor grates in the system?
11. Does the system have blowers (dryers) that cover the entire system?
12. How deep are the collection drains under the floor grates?

Maintenance

13. In the past year, has the system experienced any significant issues? Please Identify.
14. What is the recommended maintenance schedule of the systems?
15. Is the system being maintained on its recommended schedule?
16. How often does the system require unscheduled maintenance?
17. If the system requires repair, is maintenance staff on site?
18. If a new system is installed, how much longer would it take for the new system to be operational?

Site Overall

19. How many systems are on site?
20. How many times and/or hours per day is the system is used?
21. Is the system stored and or installed properly?
22. Is there a soap mixture that might require less water to dilute and perform to the same expectation?

Miscellaneous

23. Are there any rainwater harvesting systems installed on site?
24. Are there any water sub-meters on site? Please identify.
25. Are there other water conservation efforts at the site? Please identify.
26. Are there shower facilities on site?

APPENDIX B. Implementation of Water Conservation Measures at Metro Facilities

	Water Action Plan Strategies	Bus Divisions													Rail Divisions & Alignments							Non-Revenue			
		1	2	3	5	6	7	8	9	10	13	15	18	30	11	20	21	22	24	Expo	MOL	4	34	60	99
1	Recycled Water - Bus Wash	sna	sna	Note 1	sna	sna	sna	sna	sna	sna	sna	Note 2	Note 3	sna	na	na	na	na	na	na	na	na	na	na	na
2	Recycled Water - Car Wash	na	na	na	na	na	na	na	na	na	na	na	na	na	sna	sna	sna	sna	sna	sna	na	na	na	na	na
3	Recycled Water - Irrigation	sna	sna		sna	sna	sna	sna	sna	sna	sna	Note 2	Note 3	sna	sna	sna	sna	sna	sna	sna	X[4]	sna	sna	sna	sna
4	Extend Bus Runoff											X	X		na	na	na	na	na	na	na	na	na	na	na
5	Replace Sanitary Fixtures						X		X	X	X		X	X	X	X			X	X	na				X
6	Graywater Reclamation																				na				
7	Replace Steamer - Bus Div.								Note 5				X		na	na	na	na	na	na	na	na	na	na	na
8	Replace Car Wash Facility - Rail Div.	na	na	na	na	na	na	na	na	na	na	na	na	na		X			na	na	na	na	na	na	na
9	Replace Engine Cleaner - Bus														na	na	na	na	na	na	na	na	na	na	na
10	Replace Under Chassis Wash - Bus														na	na	na	na	na	na	na	na	na	na	na
11	Replace Air Scrubbing Curtain - Rail	na	na	na	na	na	na	na	na	na	na	na	na	na	X	X			na	na	na	na	na	na	na
12	Replace Small Parts Washer - Bus														na	na	na	na	na	na	na	na	na	na	na
13	Education & Outreach Measures	X	X	X	X	X	X	X	X	X	na	X	X	X	X	X	X	X	na	na	na				X
14	Water Conservation - Gateway & CMF	na	na	na	na	na	na	na	na	na	na	na	na	X	na	na	na	na	na	na	na	na	na	na	X
	Other Water Conservation Measures																								
A	Reduced Bus/Car Wash Schedule	X	X	X	X	X	X	X	X	X	na	X	X	X				X	na	na	na	X	na	na	na
B	Rotoclone/Air Scrubber Redesign													X	X	X			X		na		na	na	na
C	Linear Kinetic Cell		X		X	X							X								na		na	na	na
D	New Air Blower System	na	na	na	na	na	na			P	na			na							na	na	na	na	na
E	Diamond Seal System			P																	na		na	na	na
F	Recycled Water - Stream Bay	sna	sna	X	sna	sna	sna	sna	sna	sna	sna	Note 2	Note 3	sna	na	na	na	na	na	na	na	na	na	na	na
G	Recycled Water - Under Carriage Wash	sna	sna	X	sna	sna	sna	sna	sna	sna	sna	Note 2	Note 3	sna	na	na	na	na	na	na	na	na	na	na	na
H	Cistern										X									X	na		na	na	na
I	Low Impact Development																		X	X	na	X		na	na
J	Water Efficient Cooling Tower	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	X
K	Bio Swales																				X			na	na
L	Smart Irrigation Controllers								X[6]												X[7]				
M	Turf Removal										na	P							na	na	na				
N	Install of Water Sub-Meters				X[8]					X[9]				X							na				X
O	Install New Pressure Washers								X				X								na			na	na
P	Install Drought Tolerant Plants								X[6]		X								X	X	x			na	na
R	Water Recycling System - Steamer								P												na			na	na

Legend

X = Water conservation measure implemented/underway
P = Piloted water conservation measure
na = Measure is not applicable
sna = Recycled water service is not available

Notes

1. Recycled water service has been provided but the bus wash manufacturer will not warranty the new bus wash if recycled water is used.
2. Recycled water service is close by, but not yet provided to the division; coordination with LADWP has been initiated.
3. Recycled water service is close by, but not yet provided to the division; West Basin will be contacted to inquire about recycled water opportunities.
4. Metro is exploring with LADWP additional opportunities for using recycled water along the Metro Orange Line.
5. The use of new pressure washers has significantly reduced the frequency and duration of use with the existing steamers.
6. Drought tolerate plants and smart irrigation controllers have been installed at Terminal 19 - El Monte Station.
7. Smart irrigation controllers have been installed along the Metro Orange Line Extension.
8. Water sub-meters installed on bus washers; additional sub-meters needed for other division functions.
9. Water sub-meters installed on the Maintenance and Transportation buildings; additional sub-meters needed for other division functions.