

This presentation premiered at WaterSmart Innovations

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Phoenix Metropolitan Area Multi-City Indoor Water Use Study: Single-Family Residential Sector

A joint effort made by the water utilities at the City of Phoenix, City of Glendale and Town of Gilbert

This material is based upon work supported by the Arizona Department of Water Resources (ADWR)

Overview: Water Use Planning

- Understanding residential water demand trends are essential for planners
 - build long term infrastructure
 - budgeting & financing
 - prepare for drought.
- We know water demand reductions have been outpacing declines in water supply but we want to better understand *why*.
 - decades of previous research across the U.S.
 - different levels of scale
 - different types of customers
 - different geographic locations
- What are the specific determinants of water demand reductions and how can we use this information for city and regional modeling?
 - inventories of indoor devices
 - classifications of outdoor landscapes



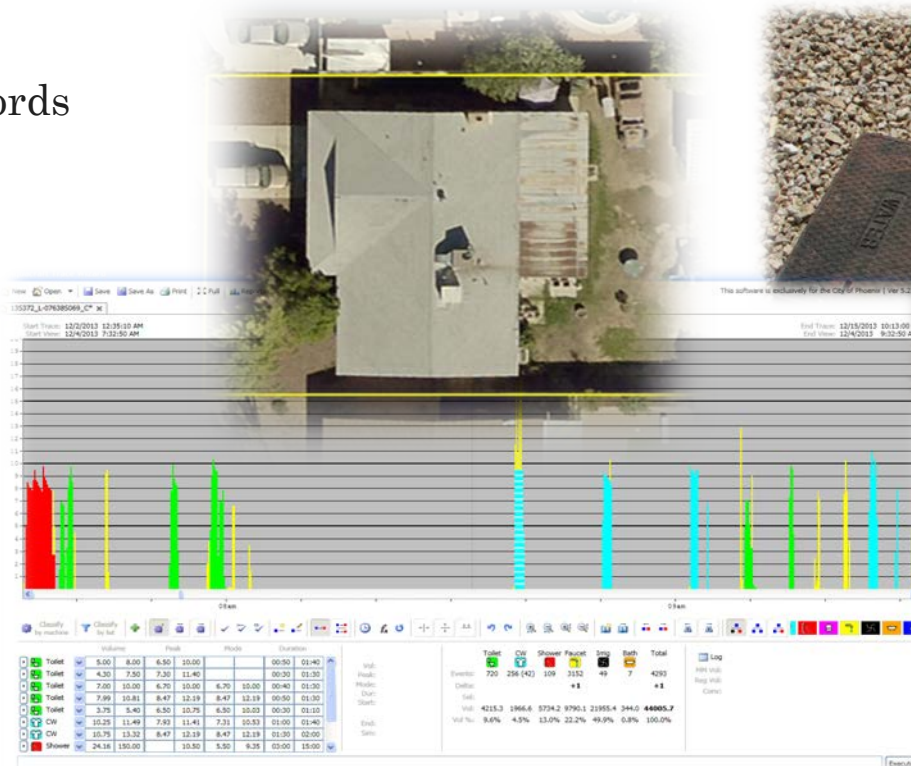
Overview: Previous Research

- Previous studies indicate that outdoor water use appears to vary greater than indoor water use
 - EPA's Watersense Program water saving standards
 - consumers can identify water-efficient products
 - increased efficiencies in available plumbing and consumer goods
- Indoor water use is dictated by the type of fixtures
 - clothes washers
 - toilets
 - showerheads
 - Faucets
- Outdoor water use is influenced by parcel attributes
 - lot size
 - Vegetation/landscape
 - Pools
 - irrigation technologies

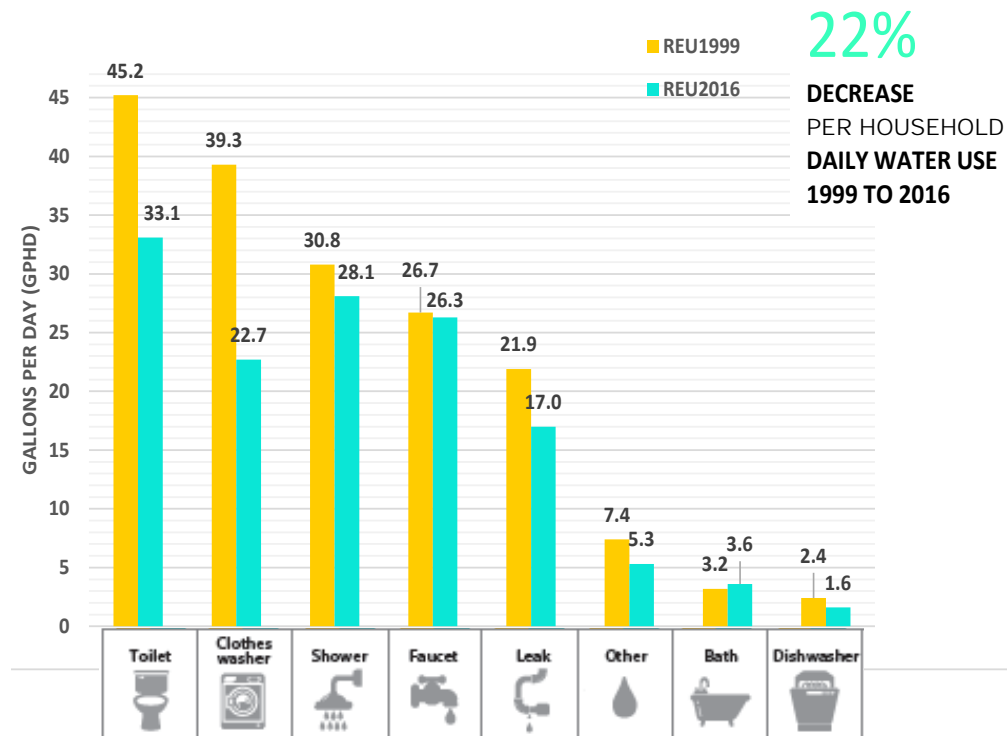


Background: Previous Research

- The City of Phoenix has done extensive internal research to uncover patterns in indoor and outdoor water use trends
 - due to both more efficient indoor devices and to less water intensive landscapes.
- Data Collection
 - monthly meter reads & billing records
 - data-logging
 - sewer metering
 - landscape coding of aerial imagery



Background: Previous Research



- In 2016, Water Resources Foundation (WRF) and Aquacraft, Inc. conducted a comparison study of 23 water utilities across North America.
- Replicated a 1999 study of detailed analysis of water use in 23,749 homes.
- Water is declining in single-family homes, falling approximately 22% between 1999 and 2016
 - most of indoor declines are due to more efficient toilets and washing machines.



Overview: Project Background

- In Dec. 2016, this study was initiated with support from the Arizona Department of Water Resources (ADWR) to compare water use in multiple jurisdictions
 - determine similarities and difference
- Coordinated efforts of 3 cities across 3 years
 - numerous city employees
 - 1.5 years of planning
 - 9 months of primary data collection
 - 6 months of analysis
- We can compare water end uses in cities that have:
 - similar climatic, economic and cultural attributes
 - different housing mixes, urban design patterns, and water rate policies

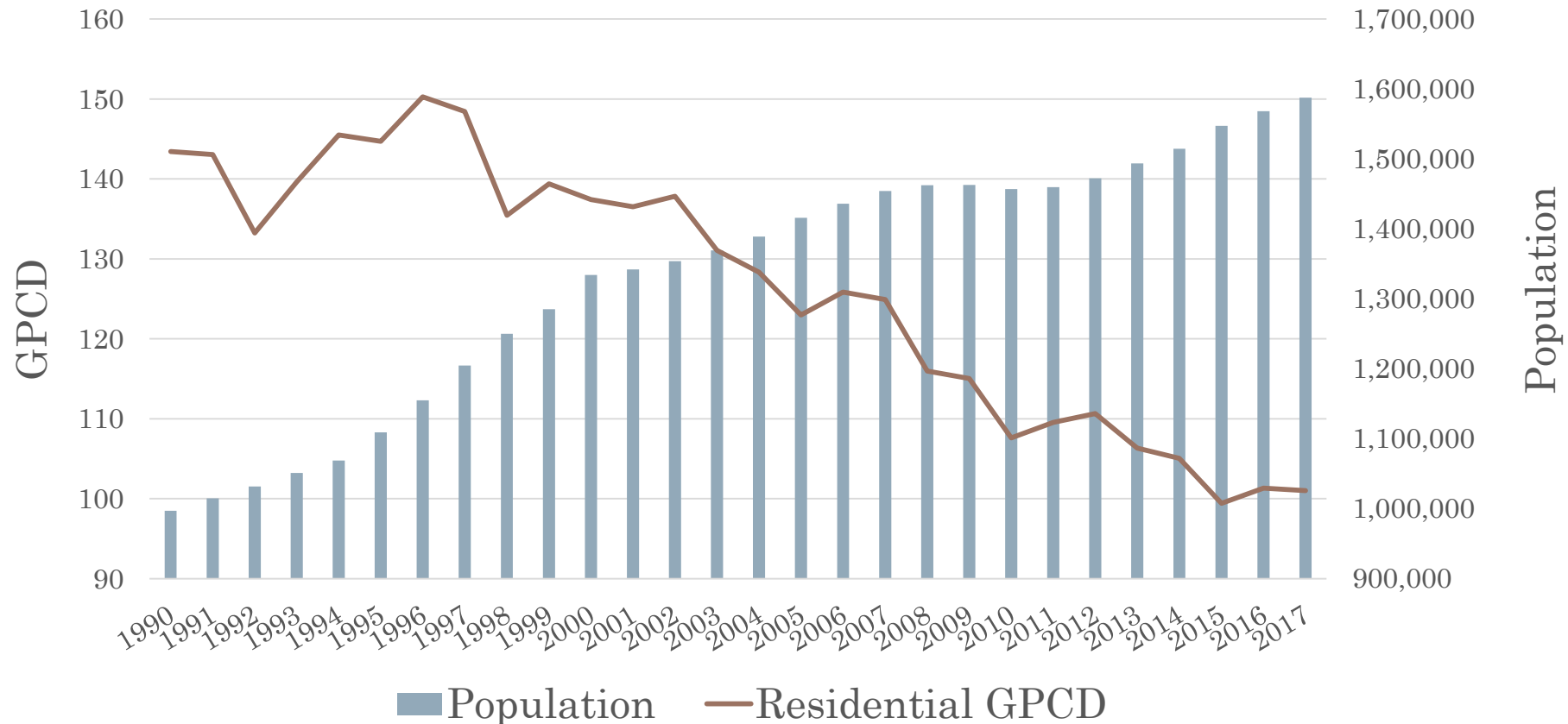


Additional background research and project support was provided by Aquacraft, Inc.



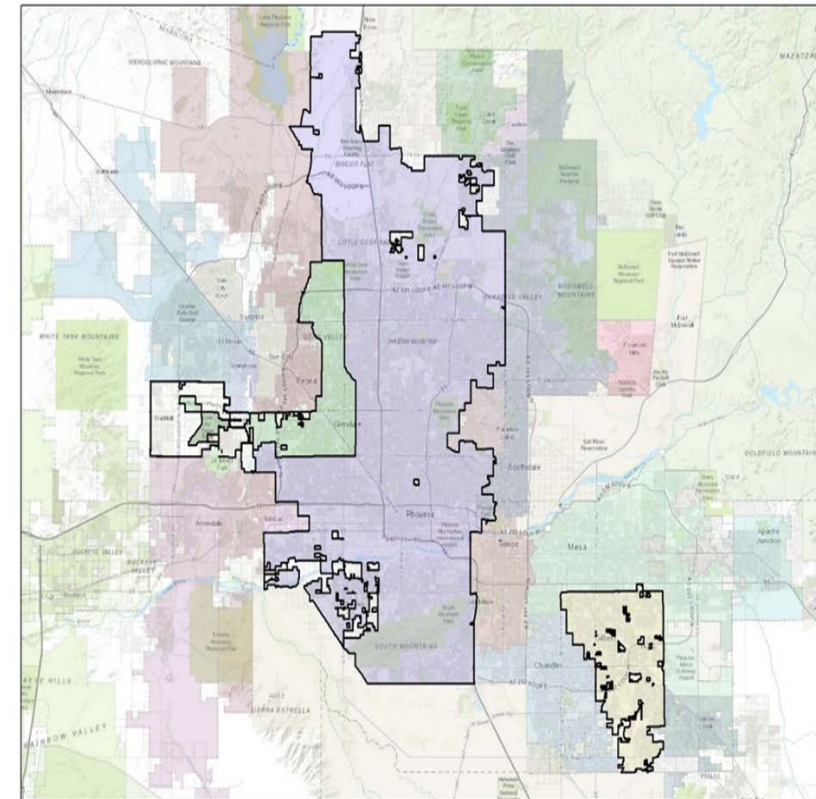
Background: Previous Research

City of Phoenix: Population and Residential Water Consumption in Gallons Per Capita Per Day (GPCD)



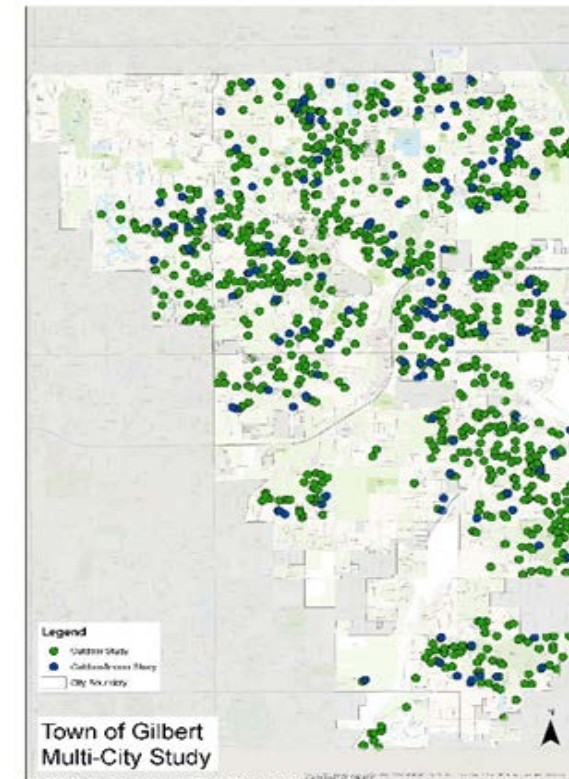
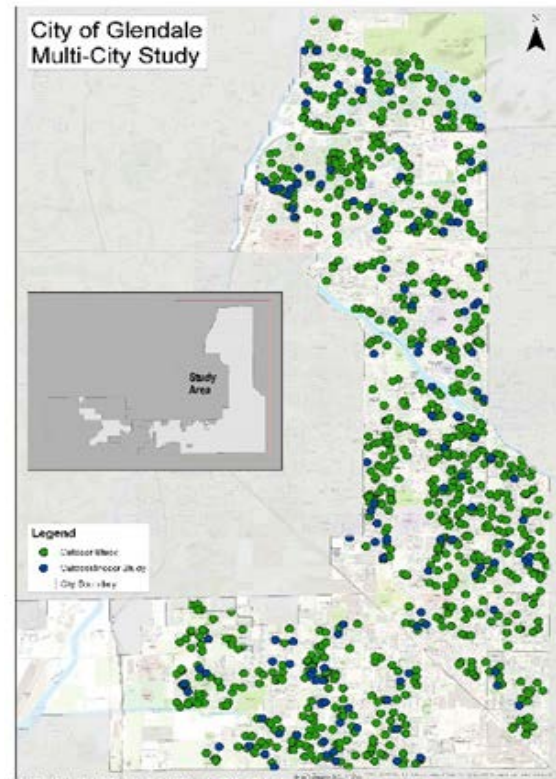
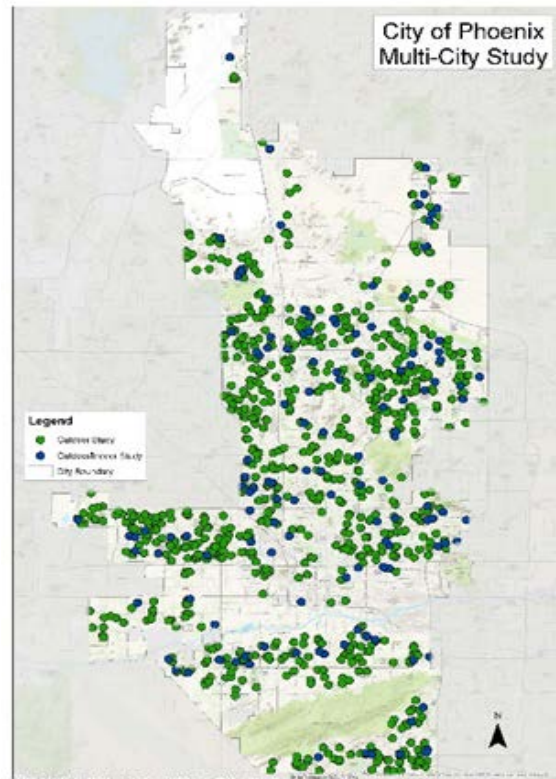
Project Goals: Indoor

- Indoor Water Use Patterns
 - How do indoor appliances and fixtures compare across the cities?
 - How does indoor water use associated with specific devices compare?
 - How does age of the home impact water use?
- And indirectly, we can also answer questions about how the following might influence device efficiency, device use, landscape characteristics, and overall estimated indoor and outdoor water use.
 - neighborhood cultures
 - occupant characteristics
 - home owner association (HOA) restrictions
 - incentive programs
 - water rates



Research Methodology: Indoor

- 382 homes were selected at random
 - subset from the 3022 homes used in the sample for outdoor use analysis
- no surveys or pre-screening done that could alter the water user's behavior (no selection bias).



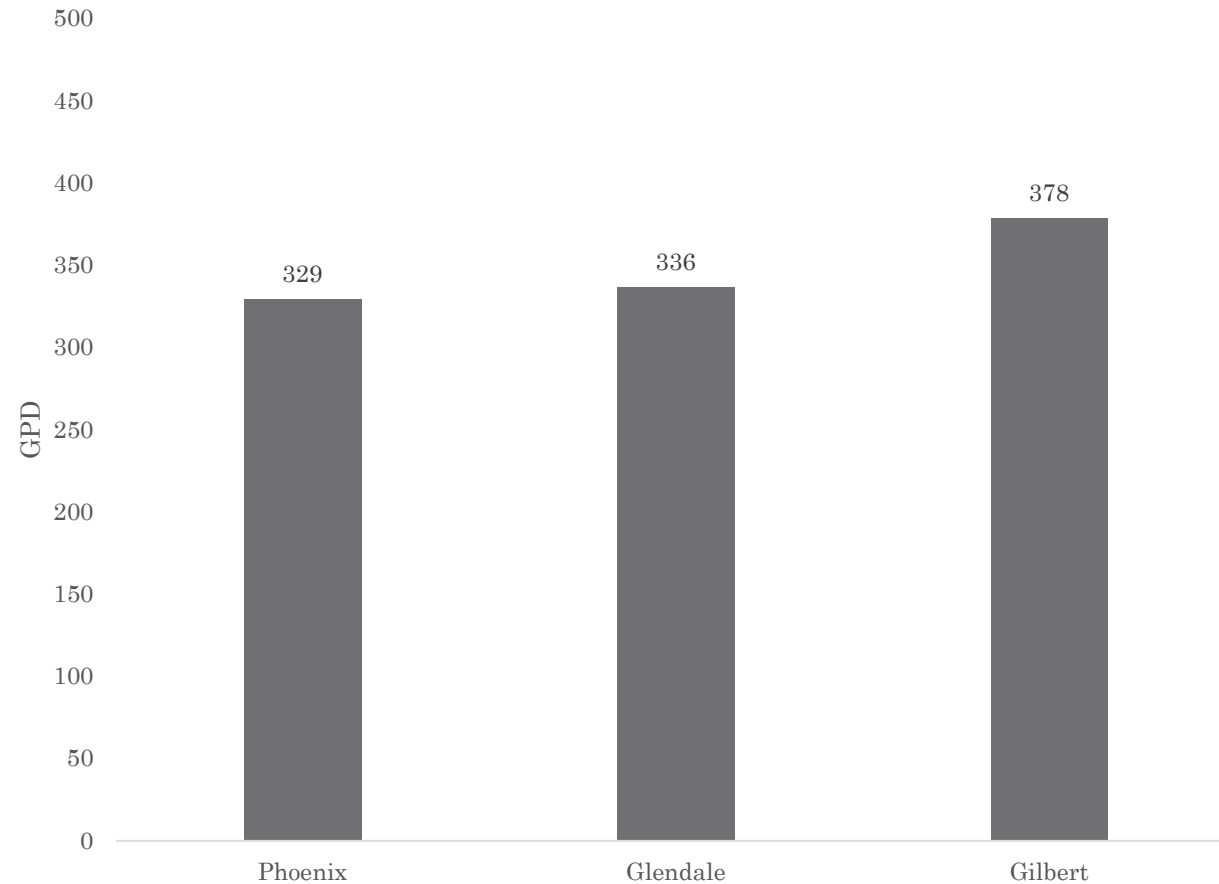
Research Methodology: Indoor

	Phoenix	Glendale	Gilbert
Household Statistics			
Total Records	305,228	52,274	47,411
Average Build Year	1979	1984	2000
Average Consumption (GPD)	333	322	382
Average Home size (ft ²)	1771	1852	2291
Average Lot Size (ft ²)	9099	9395	9066
Outdoor Sample Statistics			
Total Records	1003	1010	1009
Average Build Year	1979	1983	2000
Average Consumption (GPD)	339	337	383
Average Home size (ft ²)	1769	1848	2352
Average Lot Size (ft ²)	8638	9145	9166
Indoor Sample Statistics			
Total Records	135	130	117
Average Build Year	1983	1987	2001
Average Consumption (GPD)	304	338	372
Average Home size (ft ²)	1849	1915	2398
Average Lot Size (ft ²)	8589	8796	8921



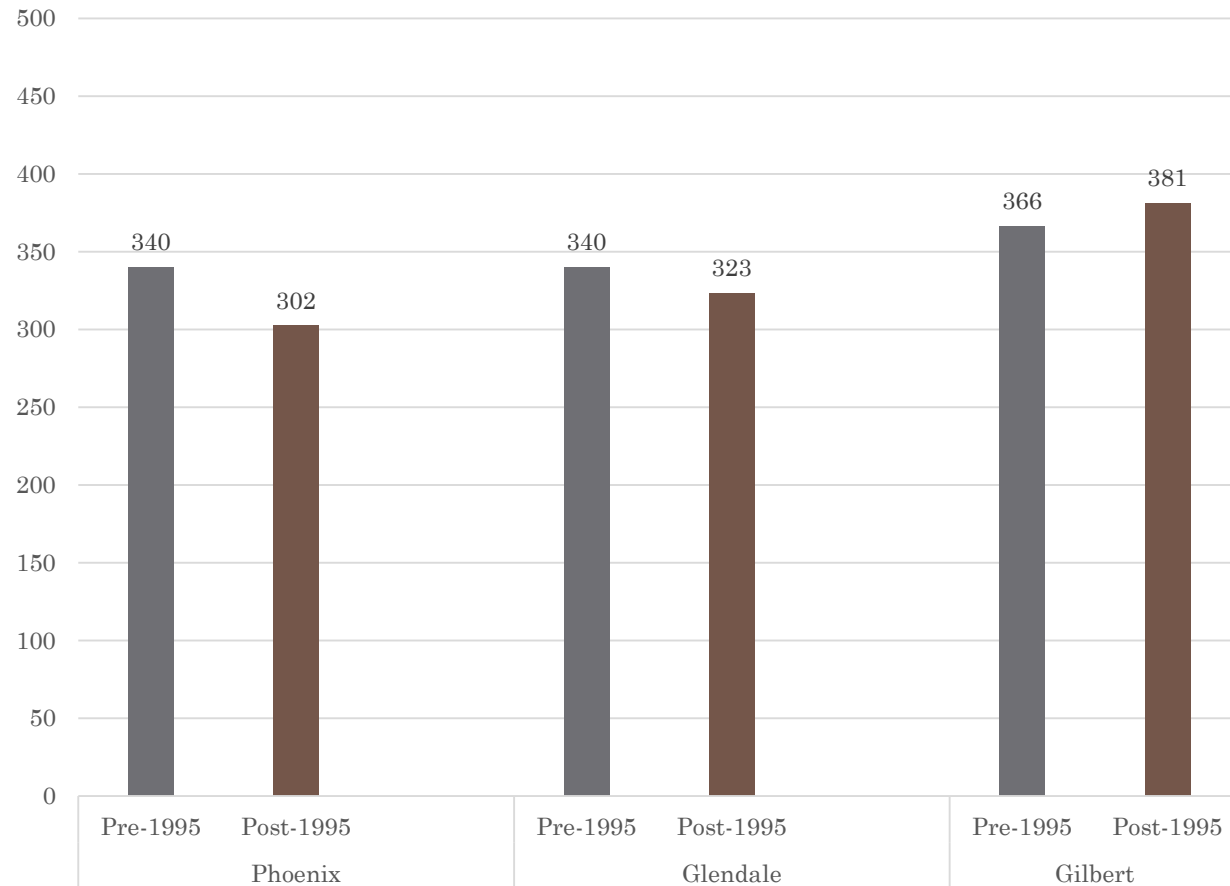
Results: Overall Water Use

- In general, all three cities have relatively similar average GPD per household.
- These results are consistent with previous estimates of overall water use in the Phoenix metropolitan area.
- Because irrigation is needed for longer durations throughout the year in desert areas these estimates are significantly higher than other U.S. averages.



Results: Overall Water Use

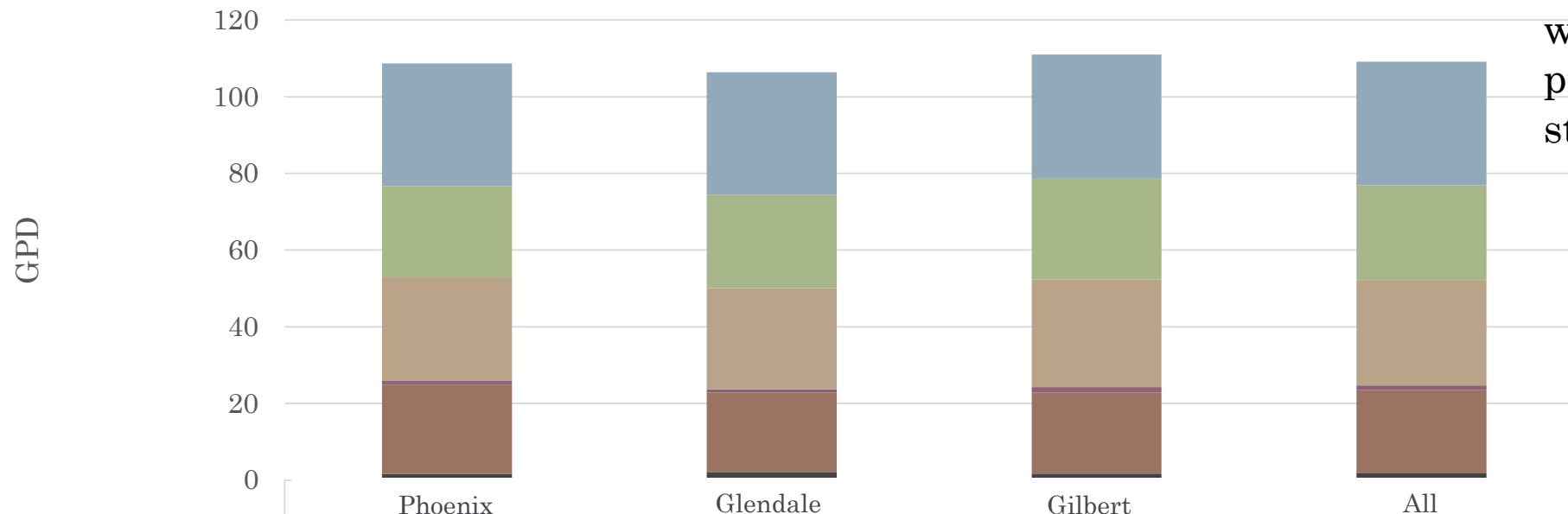
- Older homes in Phoenix and Glendale tend to be slightly more efficient in total water use compared to Gilbert.
- This is likely due to larger quantity of older homes changing outdoor landscapes by replacing turf with xeriscape, or at the least a more low water intensity landscape



Results: Indoor Water Use

Average Daily Use (GPD): Fixtures & Appliances

Consistent with previous studies

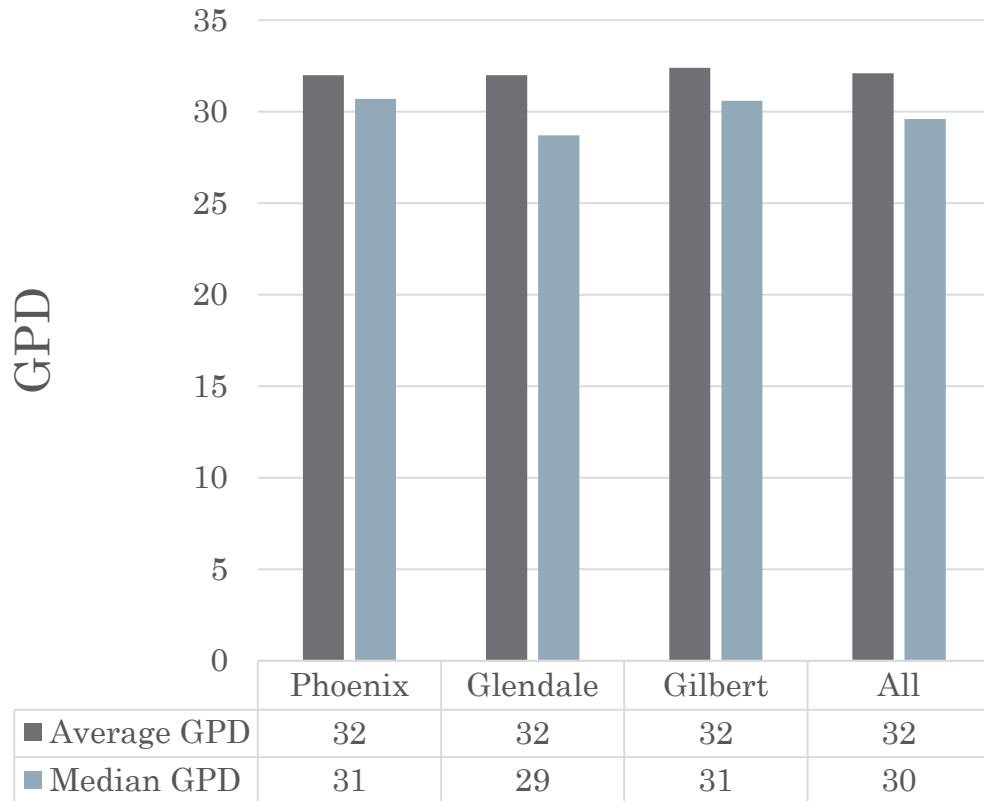


	Phoenix	Glendale	Gilbert	All
■ Toilets	32.0	32.0	32.4	32.2
■ Showers	23.8	24.3	26.3	24.9
■ Faucets	26.9	26.4	28.0	27.3
■ Dishwashers	1.1	0.9	1.5	1.2
■ **Clotheswashers	23.3	20.7	21.1	21.7
■ Bathtubs	1.6	2.1	1.7	1.8

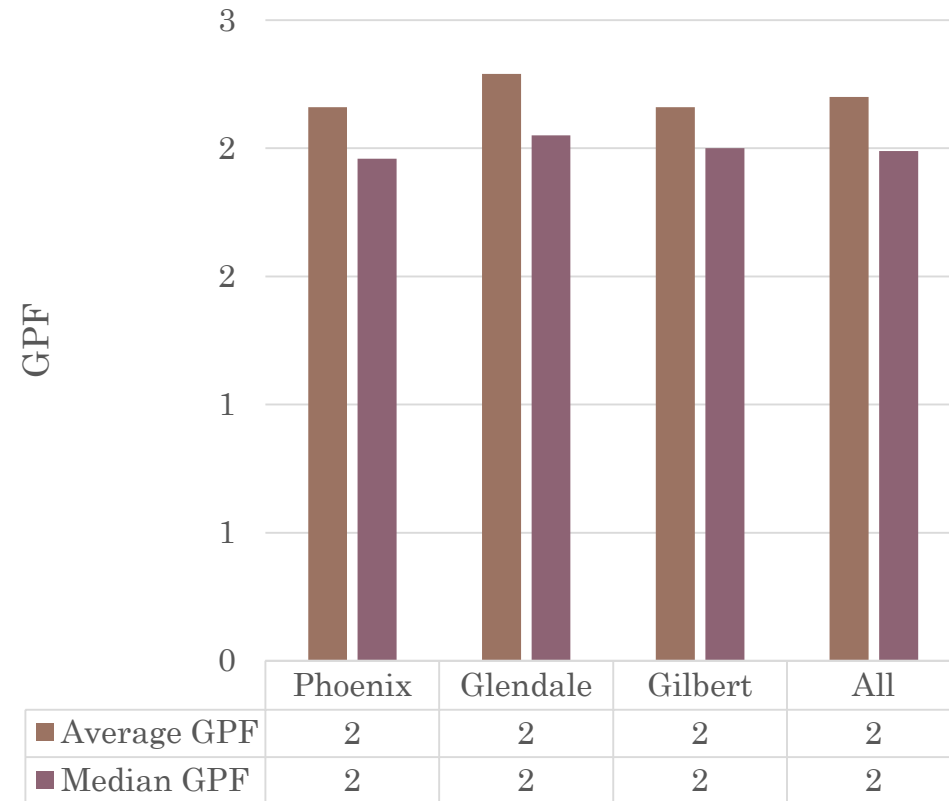


Results: Toilets

Average Daily Gallons (GPD)

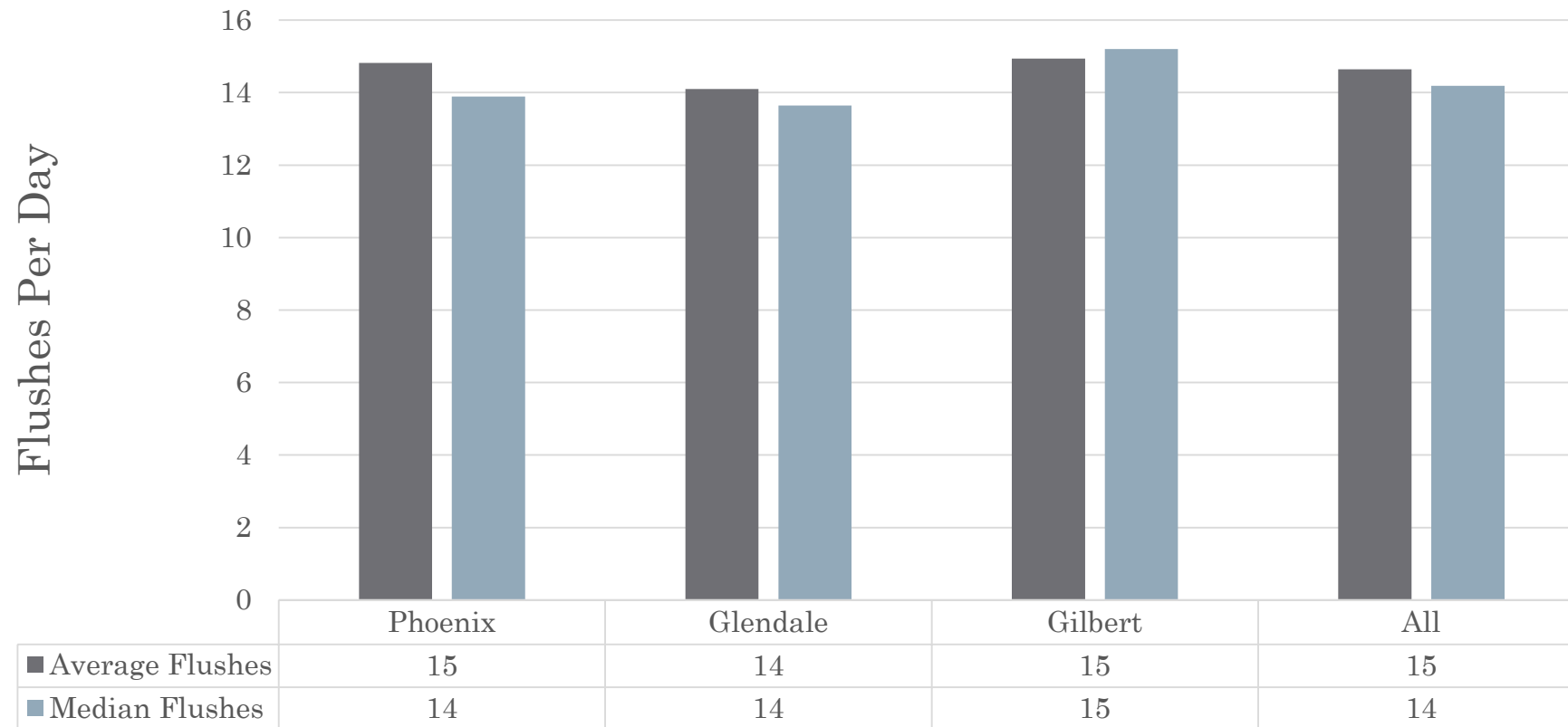


Average Gallons Per Flush (GPF)



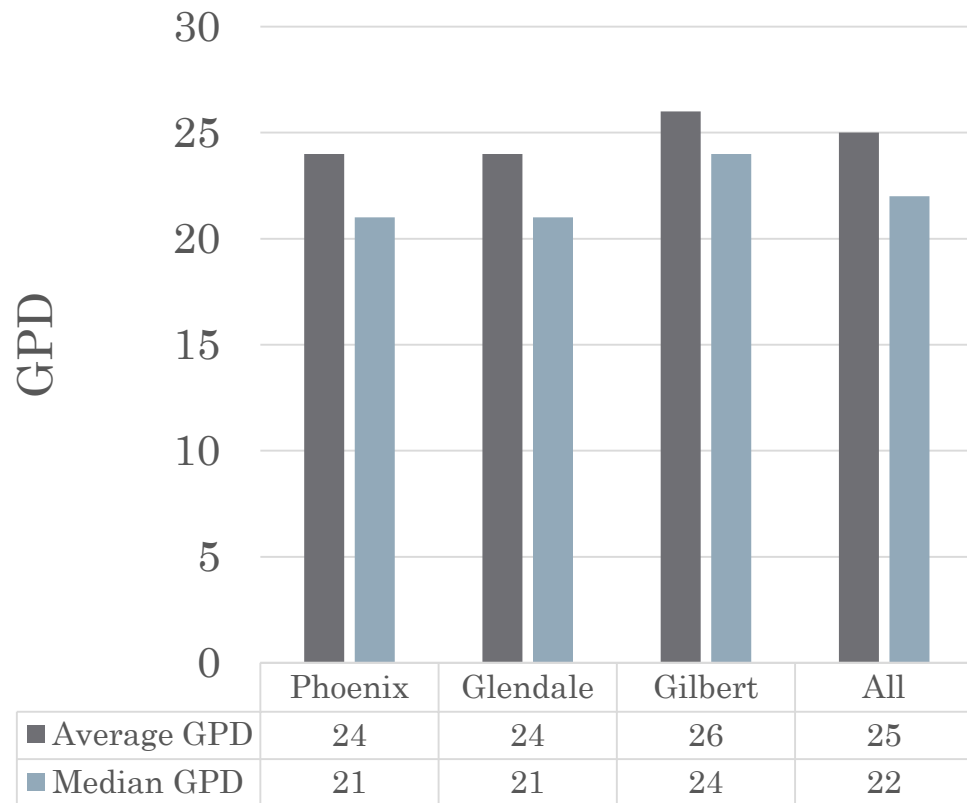
Results: Toilets

Average Flushes Per Day

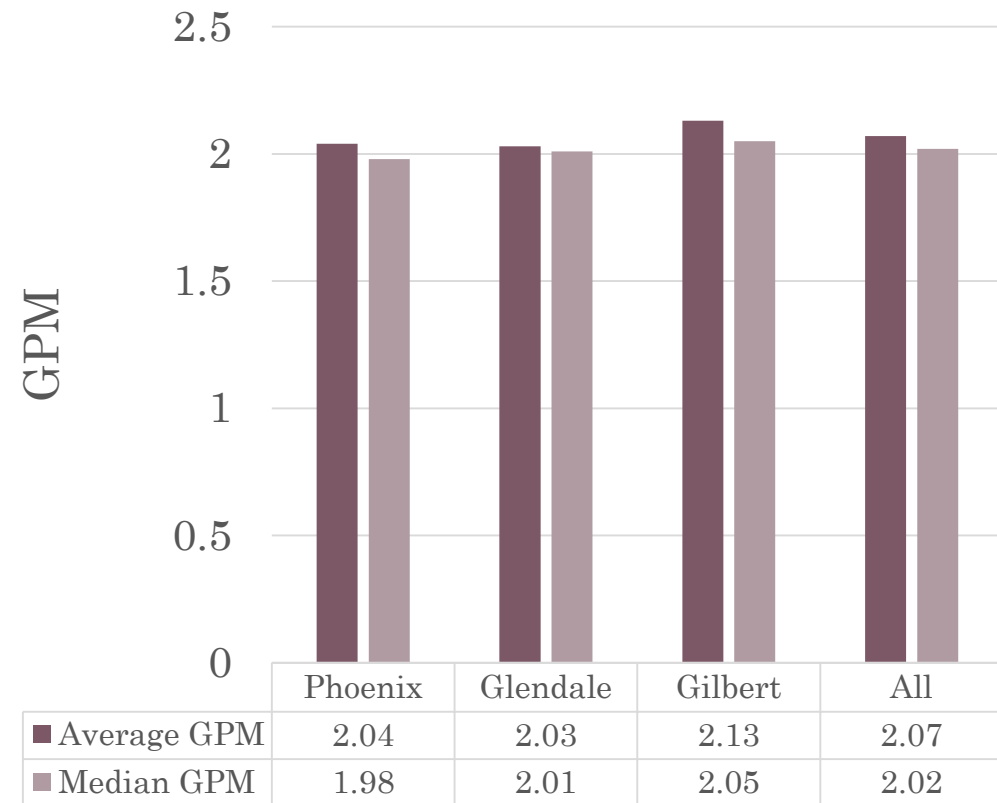


Results: Showers

Average Daily Gallons (GPD)

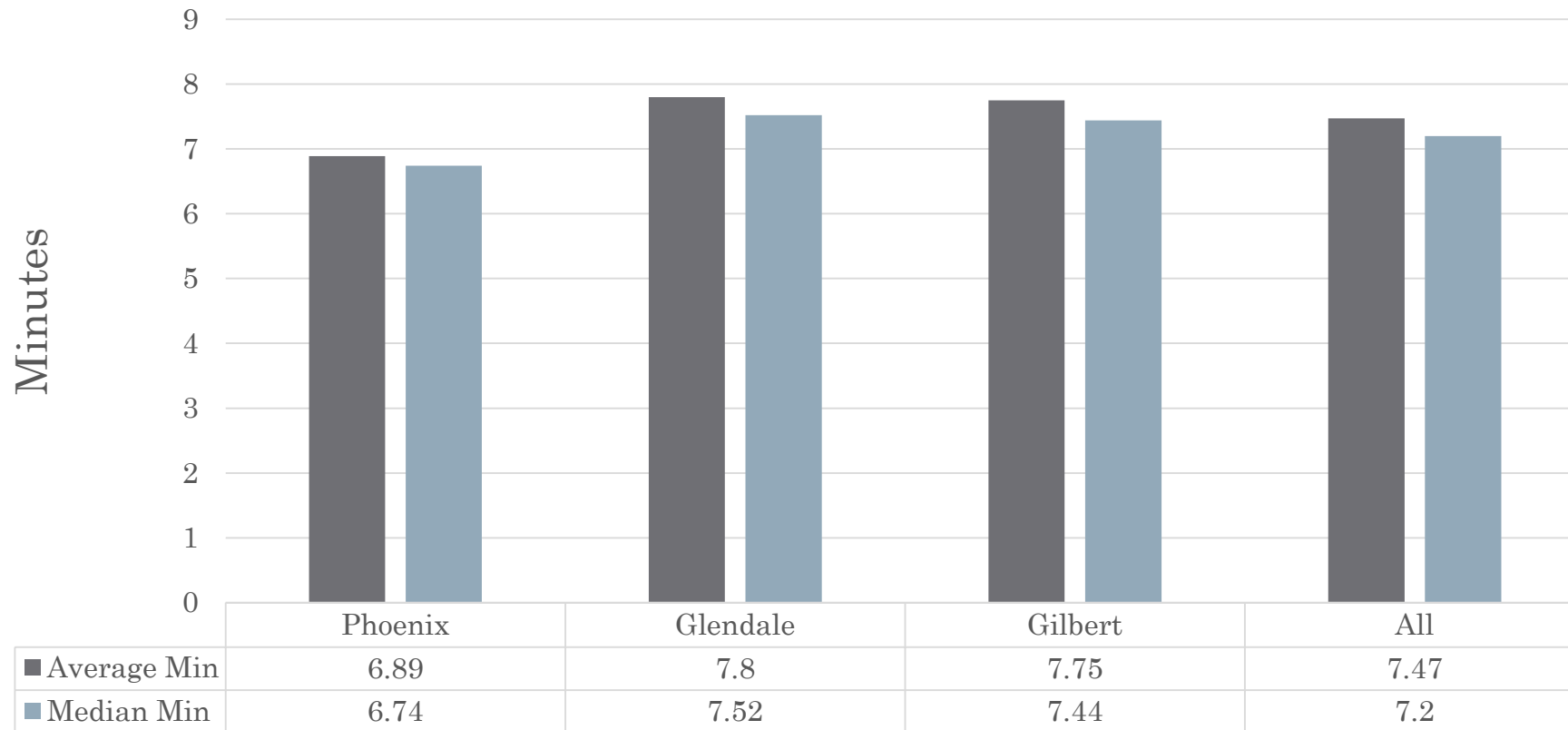


Average Gallons Per Minute (GPM)



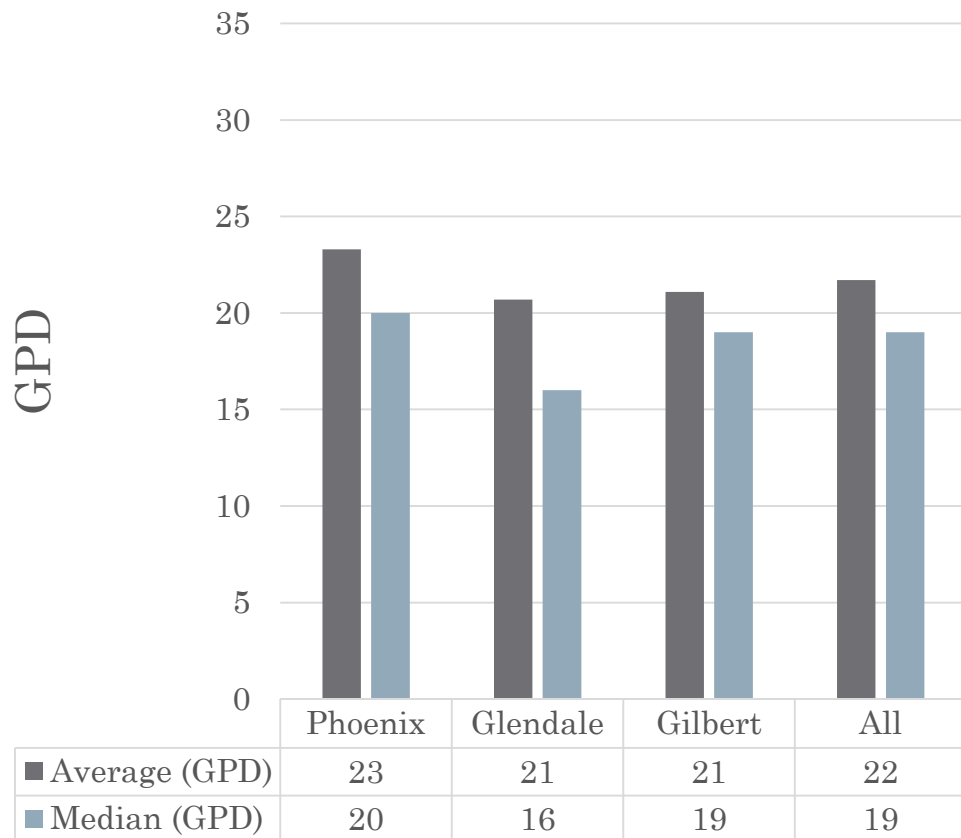
Results: Showers

Average Minutes Per Shower

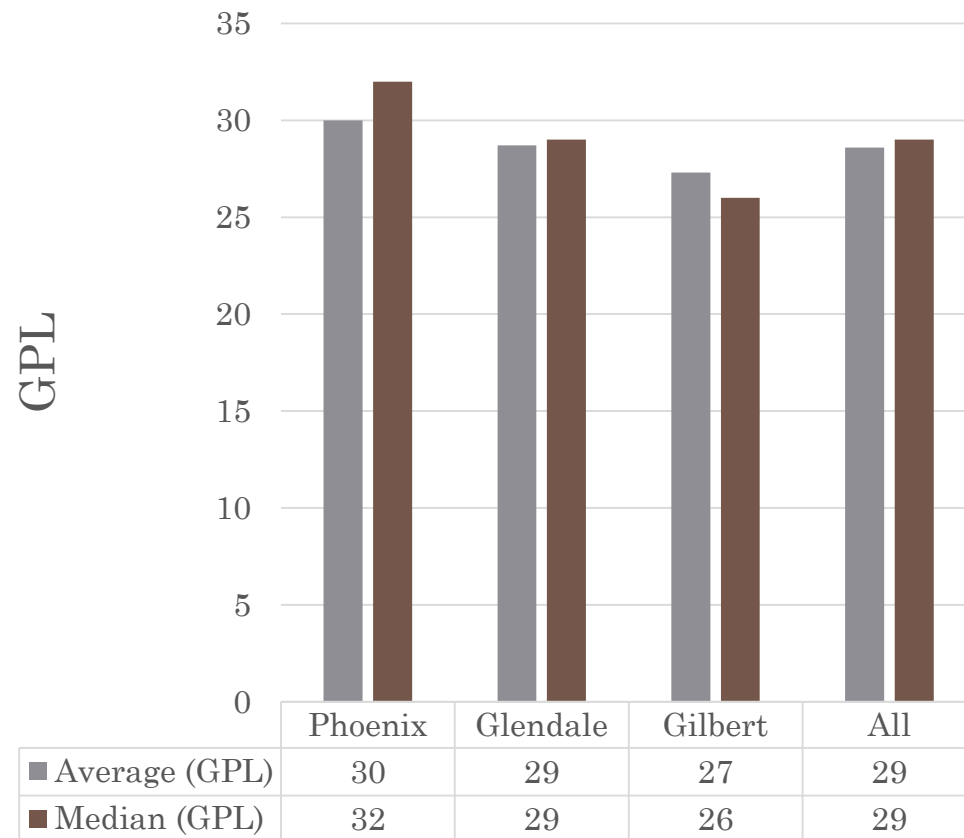


Results: Clothes Washers

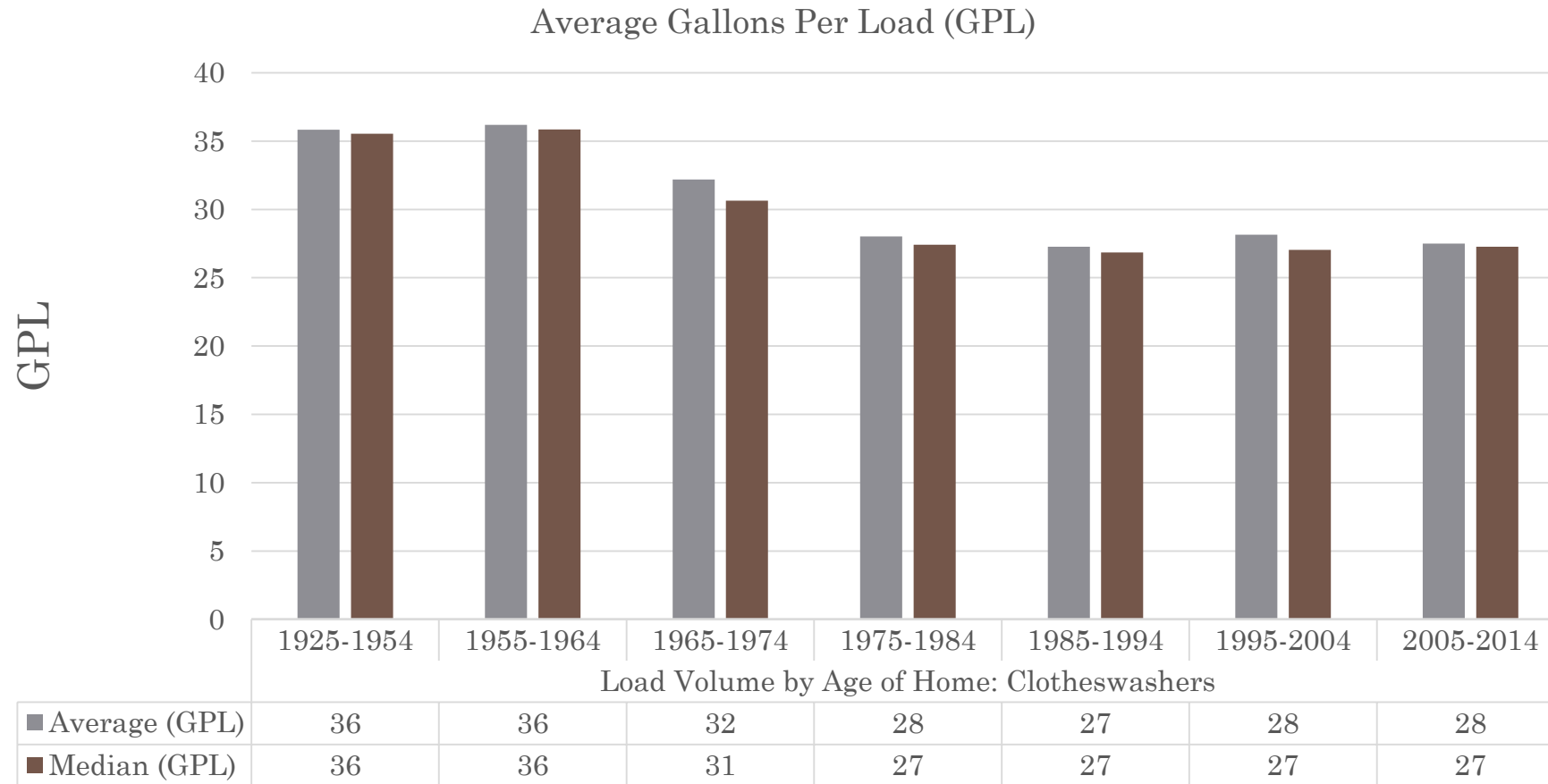
Average Daily Gallons (GPD)



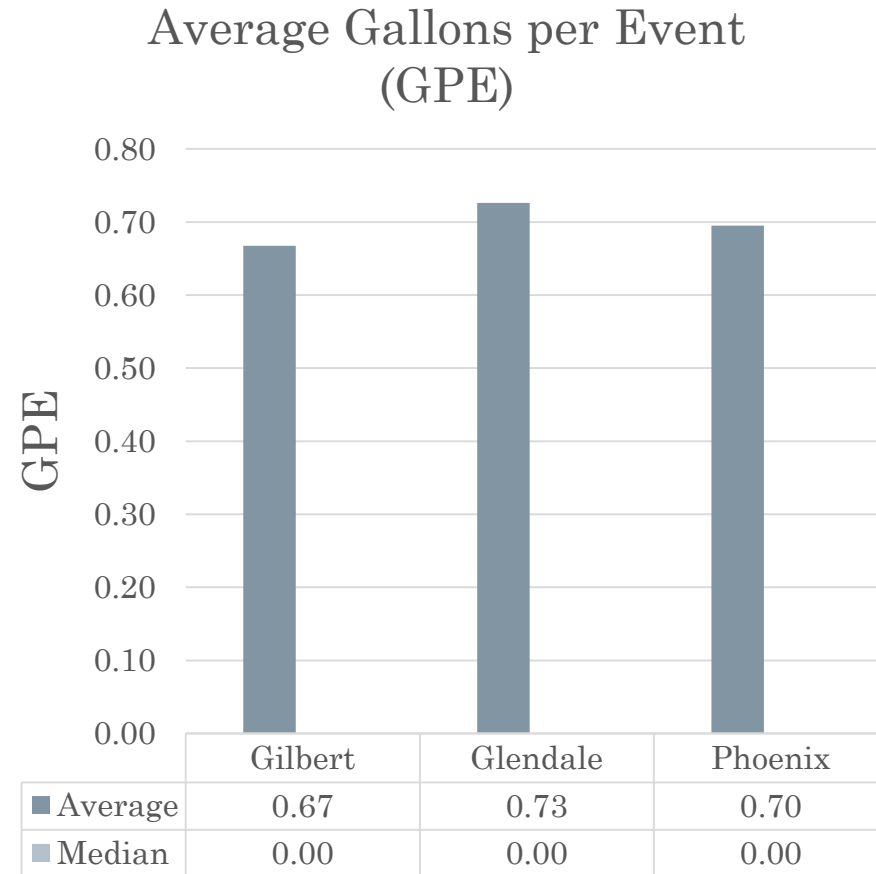
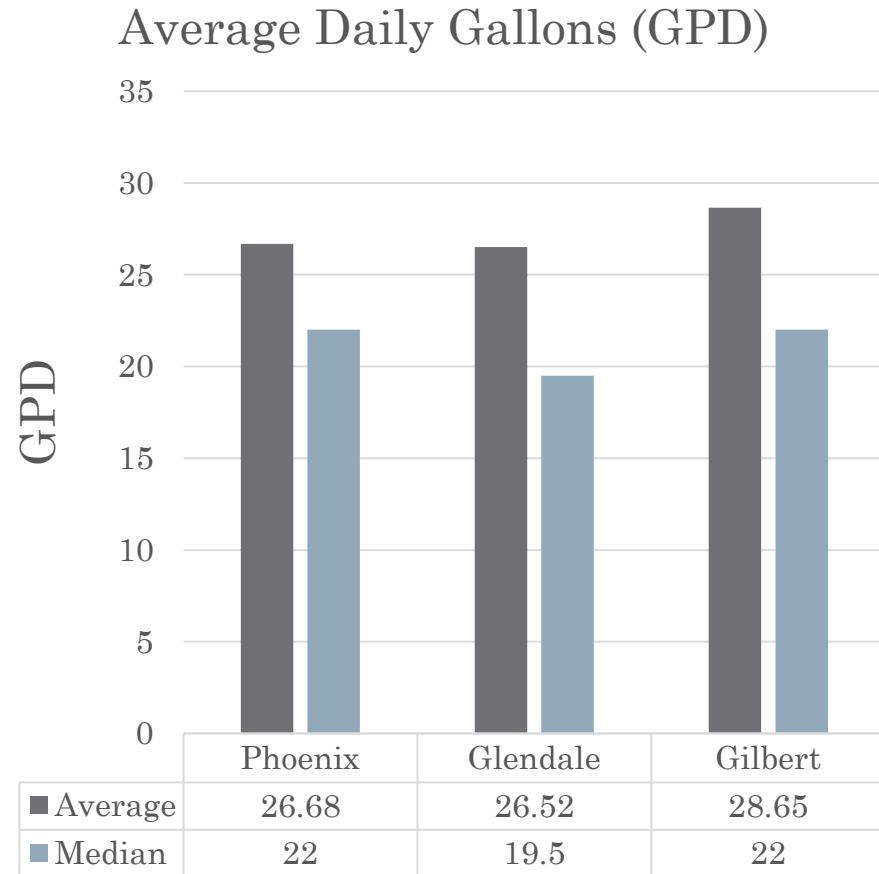
Average Gallons per Load (GPL)



Results: Clothes Washers

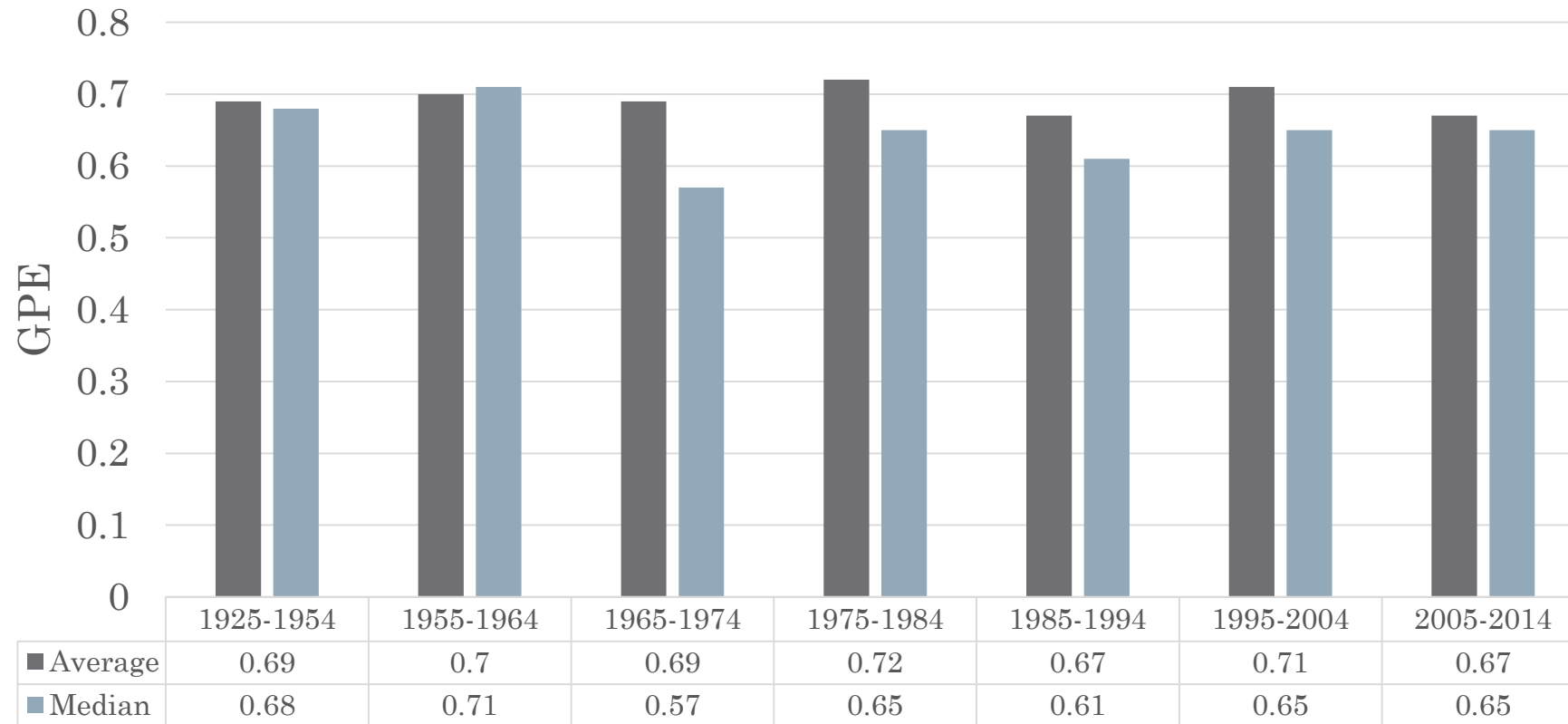


Results: Faucets

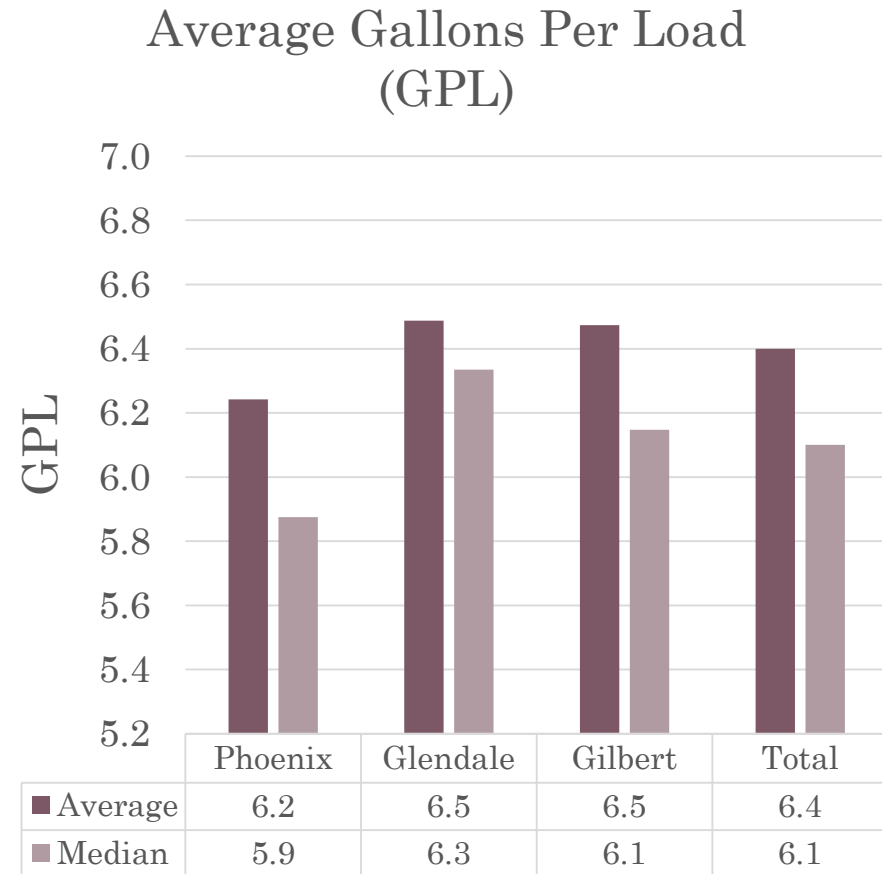
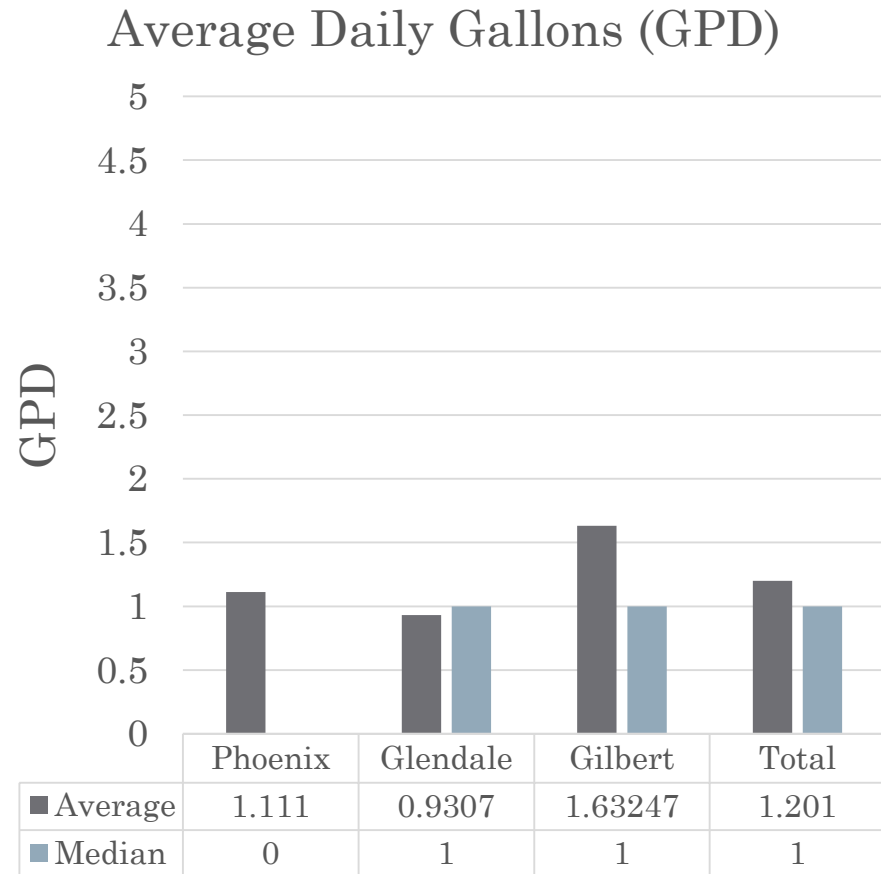


Results: Faucet

Flow Volume by Age of Home (GPE)

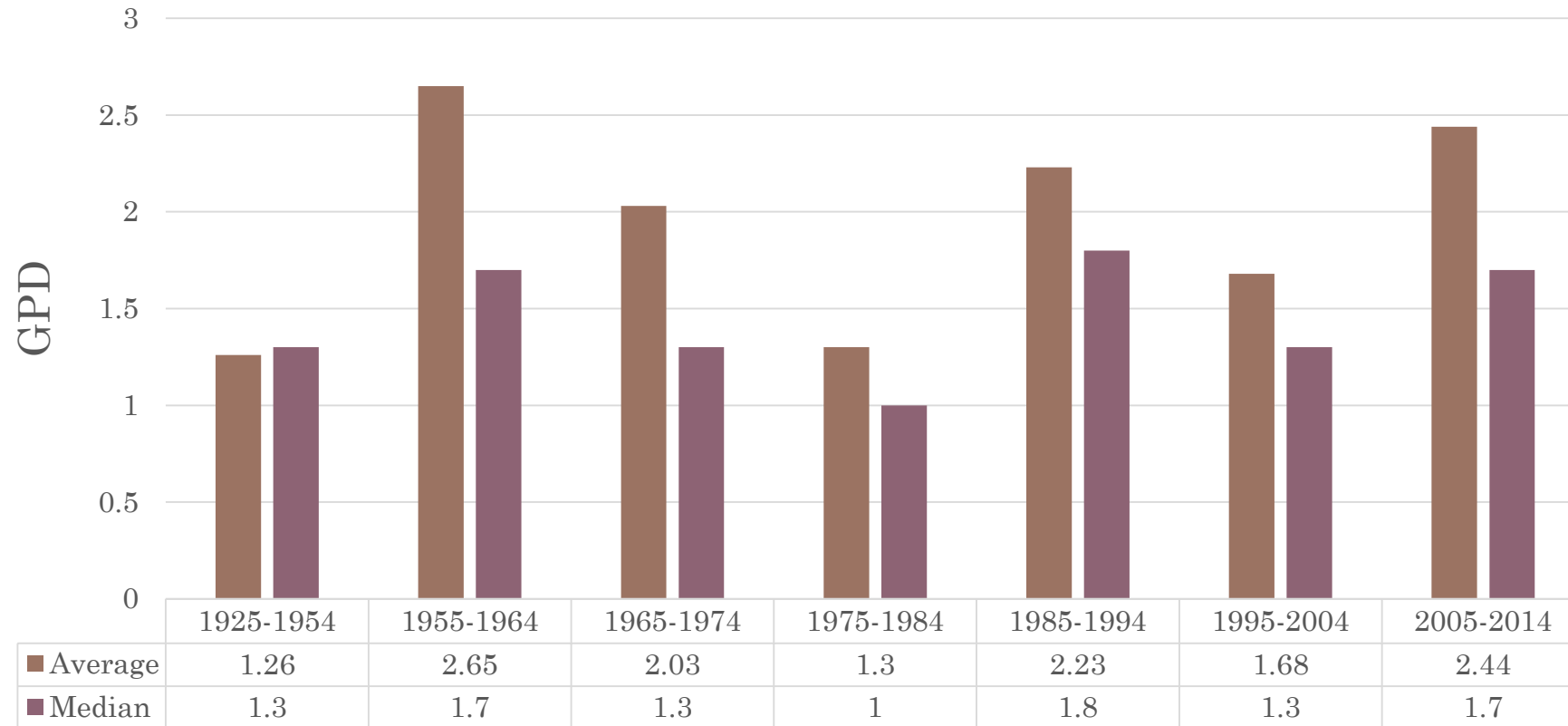


Results: Dishwasher



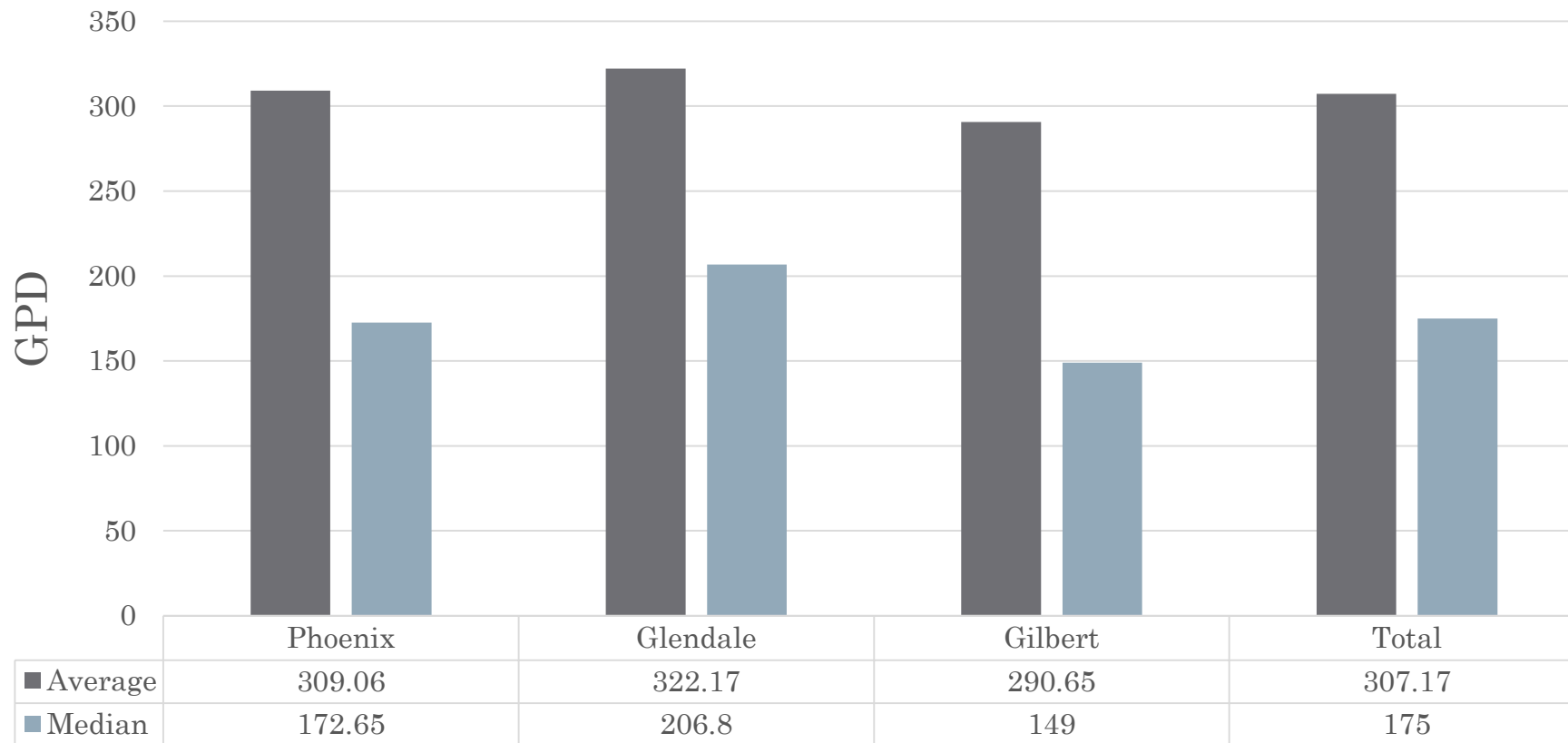
Results: Dishwasher

Average Flow Volume by Age of Home (GPD)



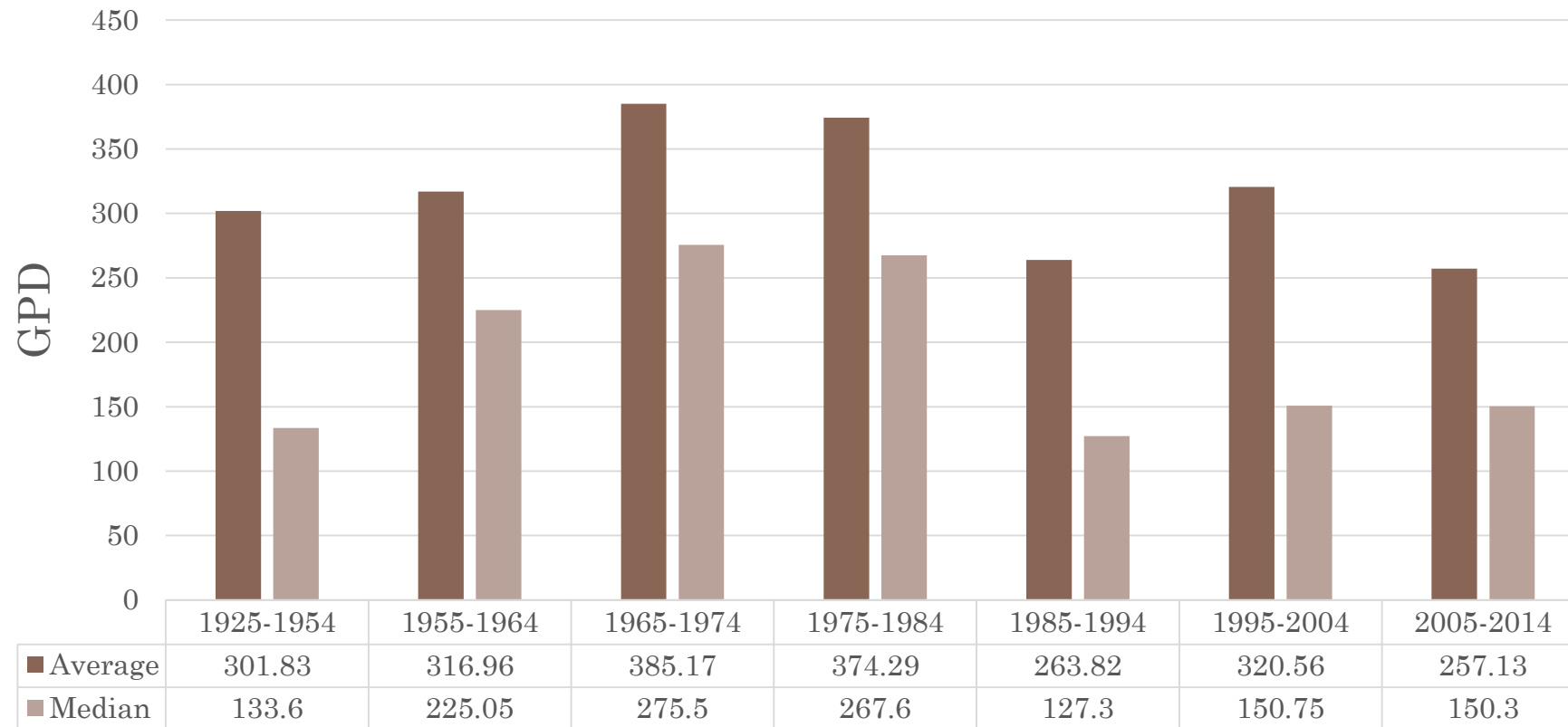
Results: Leaks, Irrigation, Unknown

Average Daily GPD



Results: Leaks, Irrigation, Unknown

Flow Volume by Age of Home (GPD)



Results: What Did We Learn?

- Little variation among the 3 cities , with the exception of dishwashers
- Largest indoor water use is attributed to toilets, showers & clothes washers
- Average person takes a 7.5 minute shower
- Average toilet efficiency is 2.2 GPF
- Age of Home influences efficiency of washing machines but not necessarily dishwashers
- Age of Home does not influence efficiency in faucet use or showers



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