Municipal Drinking Water Quality: Environmental Health and Safety Perceptions in Phoenix, Arizona

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Municipal Drinking Water Quality: Environmental Health and Safety Perceptions in Phoenix, Arizona

Chelsey Weaver, RS, REHS

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Committee

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Abstract

The goals of the Service Learning/Capstone Experience (SL/CE) project included identifying current perceptions regarding lead in municipal drinking water and related environmental health and safety concerns in the Sunnyslope community of Phoenix, Arizona; evaluating and improving the current outreach program in order to effectively target drinking water perceptions; and identifying strengths and weaknesses in the City of Phoenix Water Services Department (WSD) and Environmental Services Division (ESD) that contribute to negative public perceptions of municipally supplied drinking water. Objectives used to meet the stated goals included developing and distributing a survey to measure perceptions of the above issues through a combination of sampling techniques throughout the Sunnyslope community. Additional objectives included improving upon the current outreach program to include water quality information in order to address safety and health concerns shared by many Phoenix residents through discussion with community and neighborhood groups, creation of a Powerpoint presentation for future use and application in outreach, and discussion with a local community block watch about perceptions. This included evaluating current outreach by WSD and ESD and comparing to the survey results; a focus group of four individuals identified further issues and improvements that can be made to potentially improve perceptions. Methods involved with the project included using the health promotion and ecological model to guide survey development so that perceptions could be appropriately gauged with a cross-sectional survey study design. A survey was developed, distributed and collected through electronic and paper delivery using both modified cluster and convenience sampling. Modified cluster sampling involved distributing surveys door-to-door and soliciting residents willing to complete the survey on paper or electronically through a provided survey link. Convenience sampling involved creating a solicitation on Nextdoor.com, which is a social media site for neighborhoods; soliciting
participants through a local block watch social media page, at meetings, and via email lists; soliciting at the Acacia Library; and soliciting participants at small local businesses in Sunnyslope. Statistical analysis was conducted using Excel; primary analyses included Chi-square tests for homogeneity and descriptive statistics in order to determine trends in perceptions. Ultimately, the project was anticipated to increase understanding of the perceptions regarding specific environmental and safety concerns of water quality within a culturally, economically and socially diverse subset of the City of Phoenix with the intent of improving outreach and transparency.

**Introduction**

**Placement Site**

The placement site for both the service learning activities and capstone experience completion was the City of Phoenix Water Services Department (WSD), Environmental Services Division (ESD) located at 2474 South 22nd Avenue in Phoenix, Arizona at the 23rd Avenue Wastewater Treatment Plant (WWTP) in Building 31. Additional activities were performed at the Water Services Department offices at City Hall located at 200 West Washington Street, and at various locations throughout Phoenix related to research and outreach, as well as survey solicitation, distribution, and collection, specifically within the Sunnyslope community. The mission of the City of Phoenix WSD is “to provide high quality, reliable, and cost-effective water services that meet public needs and maintain public support” (City of Phoenix, 2017a). The vision and purpose of the organization as stated on placards strategically placed throughout the ESD building is “we will provide superior water services while perpetuating environmental excellence and focusing on safety.”
**Issue Identification**

As a part of both service learning activities and the capstone experience, environmental health and safety aspects regarding municipally supplied drinking water quality were examined due to recent media attention and concerns by many residents in the United States. Public perceptions of the safety and quality of drinking water in the City of Phoenix have likely been impacted recently with media coverage of national crises in water distribution systems involving elevated lead levels as well as other concerns related to contaminants; national discussions about failing water infrastructure; and experience with taste and odor of tap water. The focus of the SL/CE project was to examine perceptions within the diverse community of Sunnyslope located within Phoenix, Arizona due to the likelihood of obtaining data that encompasses populations with socioeconomic and other indicators that are representative of Phoenix as a whole. We identified current perceptions about municipal drinking water quality and safety by means of analyzing attitudes, behaviors, knowledge, and exposure to media or other outreach efforts. This study may be utilized with the potential to develop stronger and focused outreach materials on municipal drinking water quality in order to educate the public residing and conducting business within the City of Phoenix.

**Project Importance**

The City of Phoenix was established in the late 1800s and began transporting water from the Verde Valley in the early 1900s for drinking water use. The first pipeline was constructed from redwood in 1920 and ten years later a concrete pipeline was built to carry more water from the Verde River (City of Phoenix, 2017b). Water distribution has changed in the last hundred years, and the methods by which to ensure this water is safe and health for the populace to drink have become more stringent. However, there are ongoing implications for municipalities that have not implemented improved technology over the years in order to comply with the
requirements of the United States Environmental Protection Agency (EPA). One substantial example is provided by the Flint, Michigan lead-contaminated drinking water crisis which began in 2014, although it was not until 2015 that most of the U.S. became aware of situation via the media and news sources. Discoveries by Virginia Tech research staff and Hurley Medical Center staff regarding respective elevated lead levels in tap water and elevated blood lead levels in children led to a flurry of activities involving lead advisories, water filter provisions and water testing by city and state agencies nearly a year and a half following the initial switch to Flint River water from the Detroit water system (Kennedy, 2016). The EPA and other governmental agencies were prompted by this series of events to push legislation that will impact the entire nation and has already revealed inadequacies in many other municipalities across the country.

The public is generally aware of crises as reported by the media and may not understand current policies within municipalities regarding water quality and lead testing. Overall, public education about water treatment and standards for water distribution is minimal and there are many gaps that could affect current perceptions. For instance, there is often the assumption that mineral laden tap water disinfected with chlorine is inferior or even unsafe in comparison to tap water sent through additional treatment by bottling plants to remove chlorine and improve taste. Consequently, marketing from bottled water companies that utilize point-of-use water treatment systems can promote these assumptions and create distrust of tap water.

There are many regulations related to drinking water quality that address municipal drinking water particularly, including the Lead and Copper Rule; Water Infrastructure Improvements for the Nation (WIIN) Act; Water Infrastructure Financing and Innovation Act (WIFIA); the Safe Drinking Water Act (SDWA) including the Drinking Water State Revolving Fund (DWSRF); Water Infrastructure Finance Authority of Arizona (WIFA); and the Reduction of Lead in Drinking Water Act (RLDWA). Several of these regulations directly relate to the
importance of understanding water quality and how the safety and health of the public are maintained. In fact, there has been increased legislation since the 1980s regarding water quality and lead due to the discovery that even low levels of lead exposure can cause neurological damage, developmental delays and other symptoms (Maas, Patch, Morgan, & Pandolfo, 2005). In 1986, the SDWA was amended as part of a “Federal Lead Ban” with an enforcement deadline in 1988 for states to reduce lead in water distribution systems (Maas et al., 2005). Previous legislation (the 1975 National Interim Primary Drinking Water Regulations) simply monitored lead at the start of the distribution system and did not address corrosion (Maas et al., 2005).

In particular, the Lead and Copper Rule (LCR) has had a substantial impact on safety and quality of water in distribution lines since 1991 when it was passed with the goal of reducing exposure by 50% in drinking water (Maas et al., 2005). The LCR mandates an action level of 15 ppb of lead during the first-draw after 6 hours standing in the times, and a maximum contaminant level goal (MCLG) of 0 due to the knowledge that any amount of lead can cause adverse health effects (Brown & Margolis, 2012). As part of the SL/CE, it was important to compare potential perceptions of safety and environmental health with actual City of Phoenix data so that accurate knowledge could be transferred and perceptions could be based on factual information.

Despite continuous improvements to protect public health through drinking water standards, progress is dependent on funding available to municipalities and systems. Public water systems provide a public health service to their residents and guarantee that their water is safe to drink, but negative perceptions of municipally supplied water quality may lead to decreased use of the system and affect funding that is used for continuous infrastructure improvement. Given the efforts to reduce lead and prevent other contaminants in drinking water, there are few, if any, studies that focus on perceptions of drinking water quality and their relation to actual reported
water quality and health data. Although the public is being protected through many regulations, we determined that it was important to evaluate whether they were aware and cognizant of these efforts, understood safety and risks of lead in their water, and/or have changed behaviors due to their perceptions.

**Literature Review**

Several survey-based studies have been conducted on the influence of perceptions related to purchasing choices between bottled water or drink tap water, as well as other related behaviors. For example, one study found that perceptions of quality and safety of bottled water are often more positive than those of tap water due to taste and branding differences although there are more water quality incidents related to bottled water (Hu, Morton, & Mahler, 2011). Water quality perceptions were also determined to be strongly correlated with bottled water use; doubts about safety of tap water lead to higher use of bottled water (Hu, Morton & Mahler, 2011). In addition, a Phoenix study on bottled water consumption found that higher socioeconomic status individuals whom believed their tap water was high quality actually had an increased likelihood of purchasing bottled water; this indicates that water quality is not the primary factor for some individuals (York, Barnett, Wutich, & Crona, 2011). Outreach may be needed about the value of tap water as well as other factors that may influence perceptions. Given that the York et al. study focused on individuals attending a farmer’s market, typically those with a college education and a higher socio-economic status, there may be different findings with a more varied sample population (2011).

Another finding showed that media coverage and headlines about public water system issues can also lead to distrust, and this is more likely in larger communities; marketing of bottled water companies can also influence negative perceptions of municipal drinking water (Hu, Morton & Mahler, 2011). Most recently, an international study found evidence of plastics
contamination in tap water, where the U.S. had one of the highest percentages of plastics detected (Kosuth, Wattenberg, Mason, Tyree, & Morrison, 2017). Given that only tap water was tested for contamination, it is difficult to state whether studies such as this may bias public perception unnecessarily and perpetuate mistrust. In another recent study regarding ethnohydrology of water quality within Phoenix, Arizona, survey questions were asked about water quality concerns; tap use; filter use; demographics; and culture (Gartin, Crona, Wutich, & Westerhoff, 2010). Specific neighborhoods were targeted through canvassing on multiple occasions, and interviewers recruited participants from households as well as public areas (Gartin et al., 2010). Water quality concerns mentioned included: aspects of water treatment and distribution systems such as old pipes affecting water quality; poor taste due to chemical additions; testing for bacteria through government water monitoring; improving infrastructure such as pipe replacement, water treatment plant (WTP) upgrades and modern treatment processes; and use of home filtration or refrigerating tap water (Gartin et al., 2010). The surveys revealed discrepancies in understanding of water treatment and distribution which impact perceptions of water quality (Gartin et al., 2010). A different study had similar questions that addressed the concern that failure to use municipal water supported by tax revenue may lead to less money being put into water infrastructure which assures safe drinking water (Hu, Morton & Mahler, 2011).

Similarly, a study on risk perception and comparison of bottled and tap water consumption utilized a survey with four sets of questions that included statements on taste, odor, chemical contamination, as well as overall health and safety of tap water (Anadu & Harding, 2000). Those surveyed from a town that had ongoing water contamination issues had higher levels of risk perception, and exposure to quarterly notices related to drinking water quality was suspected to contribute to perceptions (Anadu & Harding, 2000). This study provided some
evidence to support changing perceptions due to outreach, media influence, and advertisements related to municipally-supplied and/or bottled water. In addition, a more recent study utilizing survey techniques for data collection found that perceptions of water quality and water usage as well as views on protection of water quality by state and federal government influenced water conservation behaviors (Adams et al., 2013). This study did not focus on the perceptions themselves, causes, or methods to change perceptions, but offered insight on the relationship between perceptions and actions.

While conducting research, there were several references to The National Drinking Water Advisory Council (NDWAC), which provides input to the EPA regarding water quality issues such as improvement of the LCR and risk reduction of lead in service lines. Some of their recommendations included making education and outreach to the public mandatory for all water systems regardless if there is an lead Action Level exceedance (LaFrance, 2017). This supports efforts by the City of Phoenix to include focused lead and water quality items in future outreach. Additionally, the NDWAC provides guidance on environmental health aspects of several routes of lead exposure from paint, dust, soil and water, and encourages collaboration with the local health department as well as creation of a Household Action Level (LaFrance, 2017).

Objectives

The primary purpose of the research was to identify current perceptions regarding lead and related environmental health and safety concerns in the Sunnyslope community as well as improve the existing outreach program to include items about drinking water quality that may serve to improve public perception of municipally supplied drinking water in the City of Phoenix. This included identification of strengths and weaknesses that may contribute to negative public perceptions of municipally supplied drinking water within the City of Phoenix.
The project intended to address the existing gaps about public perceptions regarding municipally supplied drinking water quality. Although the City of Phoenix receives complaints and concerns about drinking water via phone and email as would be expected with a large city serving over 1.6 million residents, there are few research studies that center on average perceptions of drinking water within Phoenix, Arizona with regards to environmental health and safety concerns. In order to address this gap in knowledge, we developed a survey to identify perceptions about lead contamination; drinking water quality; knowledge about infrastructure; impact of the media; and other pertinent issues related to environmental health and safety of municipal drinking water in the City of Phoenix. Surveys were distributed via door-to-door and convenience sampling and inputted electronically within SurveyMonkey which facilitated tracking and analysis. This led to further identification of issues and improvements for existing outreach items for ultimate impact on perceptions utilizing a focus group session comprised of four individuals with diverse viewpoints and perspectives.

**Theories and Models**

The theory of health promotion and ecological model provided overarching guidance within the research design. Health promotion was most applicable to understanding motivations and perceptions as well as identifying information that was crucial to perceptions so that outreach could be better molded for target groups in the population. Likewise, the ecological model was used to link public policy, communities, and institutions with interpersonal and individual factors. This model helped one understand how many aspects impact public perceptions of drinking water. For example, federal, state, and local policies funnel downwards into communities where the impacts are eventually noticed. More often, media and local events are responsible for creating perceptions due to higher exposure and relevance to individuals. Cultural beliefs and perceptions of family and friends also help to shape individuals’ perceptions.
A final theory that could be applied to future action resulting from this study was the social cognitive theory. By providing the tools for community members to understand water quality and lead risk from the distribution system, the study may improve self-efficacy related to positive perceptions of municipal drinking water.

Methods

Study Design

This cross-sectional study was designed to determine the public’s perception on the safety and quality of municipal drinking water in Phoenix, Arizona and whether recent media coverage and public outreach affected perceptions. We developed and distributed a survey to 116 residents of the Sunnyslope neighborhood through modified cluster sampling at residences and convenience sampling at local businesses; an unknown number of residents were reached through convenience sampling via Nextdoor.com which directed participants to a digital version of the survey, in addition to mass emails distributing the survey link within two Sunnyslope block watch groups. We analyzed individual response data about public perceptions through both qualitative and quantitative methods for that moment in time in Sunnyslope without additional follow-up. We examined the different demographic variables related to perceptions of water quality, health, safety and lead in the Sunnyslope community between February 2018 and March 2018. The prevalence of specific perceptions were determined through chi-square test for homogeneity and descriptive statistics such as frequency tables.

Study Population

The population and study sample were restricted to the boundaries of the Sunnyslope community, which consisted of approximately Northern Avenue to the south, the North Mountain range (or Cactus Road) to the north, 19th Avenue to the west, and the Phoenix
Mountain Preserve (or 16th Street) to the east. The area encompassed was about 9.10 square miles with zip codes of 85020, 85021 and 85029 (City-Data.com, 2017). In addition, the current population estimate of the Sunnyslope community was 57,540 (City-Data.com. 2017). Due to the cultural, ethnic, economic, social and religious diversity in the Sunnyslope community, there was a greater likelihood that data collected from this community would be more representative of the City of Phoenix on average (Sunnyslope Historical Society, n.d.). Statistical significance in this type of study requires a large sample size; however, survey research often proves difficult to collect adequate numbers of responses in a short period of time. While the original goal was to collect enough surveys to reach a 95% confidence level interval within the population, approximately 658 responses based on the population size of Sunnyslope, this was not feasible due to study limitations.

**Data Collection**

The data collection method for this study was a 40-question survey broken up into 16 demographic questions and 24 research-based questions (see Appendix A). The survey was provided with a cover letter explaining the purpose of the study and potential risks and benefits as well as contact information (see Appendix B) to participants via paper for immediate collection or through a survey link provided on a slip of paper or electronically. Two questions were added to the electronic survey in order to verify that no duplicate addresses were submitted and to sort the solicitation type to aid in data analysis. The intention of the survey was to obtain data from a wide demographic within the Sunnyslope community that includes different genders, ages, socioeconomic status, residence types, race/ethnicity, employment, marital status and size of family. Therefore, a mixture of modified cluster and convenience sampling was utilized in survey distribution and collection.
Addresses within the Sunnyslope boundaries were obtained from City of Phoenix technology staff utilizing the WaterNet database; parcels with a service point were included since this indicates that there is a water line with service. Addresses were sorted by quarter section; these are arbitrary square mile quadrants used to partition the City of Phoenix for ease of classification. We used a random number formula within Excel after uploading the data and chose addresses randomly labeled with numbers between 1 and 48 per quarter section as a way to obtain data representative of the specific neighborhood. Our intent was to survey each of the 31 quarter sections but that was not reasonable in the amount of time allotted; instead, we chose quarter sections 24-29, 25-25 and 26-30 due to spread in location and differences in neighborhood structure. Surveys with cover letters and a small instruction slip were distributed on doors of randomly selected homes within each of the three quarter sections on two days within February 2018 as well as two days in March 2018.

Due to low expected response rates from door-to-door modified cluster random sampling, convenience sampling was used through survey distribution at a local block watch meeting for the East Sunnyslope Neighborhood Association and Block Watch along with slips including a link to an electronic version of the survey available at SurveyMonkey. The electronic version of the survey was created in order to allow the option of completing the survey at a later point in time and to facilitate data collection, export and analysis. In addition to the block watch meeting, a private gated condominium community that was included in the random sampling quarter sections was contacted and provided the survey link for distribution through the Home Owners Association and block watch. Similarly, the survey link was posted on Nextdoor.com along with portions of the cover letter in order to solicit an unknown number of participants within the Sunnyslope boundaries. During two separate days for several hours in March 2018, participants were also solicited for survey completion at the Acacia Library and slips with the survey link
were also distributed. Finally, the last convenience sampling occurred at two local food service establishments, Grinder’s Coffee Co. and WingStop, which were both located at Marketplace at Central, a Sunnyslope shopping center.

**Data Analysis**

Statistical analyses were performed using both SurveyMonkey and Microsoft Excel with the Real Statistics Resource Pack add-in. SurveyMonkey has the ability to filter, compare and analyze data trends minimally with the standard plan including graphs and export to Microsoft Excel. The chosen analysis methods included the chi-square test for homogeneity and descriptive statistics including frequency distributions. All of the primary data collected was categorical or open-ended in nature given the survey design. In order to interpret the data, all potential survey responses needed to be coded into numbers with a reference to the actual meaning of the data. All numbers used in data analysis had no physical or biological meaning; therefore it was appropriate to use chi-square data analysis in order to compare counts. Descriptive statistics included primarily frequency tables and graphs depicting frequencies, sums and ranges of the data. All analyses utilized an alpha value of .05 for significance and assumed normality and random sampling of data unless otherwise noted. Chi-square tests that had contingency tables with a high number of expected value counts less than five were typically excluded from further analysis.

**Results**

We received 88 total survey responses from the combined random and convenience sampling; however, one survey was omitted due to lack of completeness and an additional survey was omitted because the respondent did not reside in the Sunnyslope community. Therefore, only 86 survey responses were utilized in data analysis. Additional surveys omitted
minor demographic data which allowed for their inclusion in the primary set of data. Detailed
results of the chi-square tests for homogeneity are provided in Appendix E.

Survey participants in the Sunnyslope community affirmed that there is a wide
demographic located within this subset of Phoenix, Arizona. The incorporation of multiple
solicitation sources allowed for greater reach within the community and appeared to impact data
in a positive manner. The average survey participant was a married white female between 40 and
49 years old, living with another person in a single-family household. The typical respondent
participated via Nextdoor.com, did not have children living in the household, had a bachelor’s
degree, was registered to vote, was born in the U.S., had a combined household income between
$50,000 and $149,999, worked full time, had moderate political views, and believed there should
be a balance between environmental protection and resource use.

All but one respondent felt that it is important to maintain water infrastructure in
Phoenix; there was one respondent who selected the “Unsure” option. While the primary source
of drinking water for most households was filtered tap water (n = 39), bottled water use was a
close second (n = 32) and tap water was third most common (n = 12). In comparison, bottled
water was the primary source of drinking water outside of the household (n = 34) while filtered
tap water followed closely behind (n = 24).
Participants on average felt that bottled water is safer than tap water (n = 44); however, they appeared to be concerned with both the quality of tap water at home (n = 55) as well as from sources outside of the household (n = 55). As such, the majority of participants rated the quality of drinking water from their home tap as “Good” (n = 25) although “Fair” (n = 24) and “Poor” (n = 24) received similar responses. Also, participants on average felt that drinking water in general is safe; more respondents were unsure of the safety of drinking water in general than those who felt it is unsafe.
Figure 2 Participants were surveyed about perceptions of the safety of drinking water in general.

Comparison of age by primary source of drinking water in the household revealed statistical significance when performing a chi-square test for homogeneity (p-value = 0.023). However, more than 70% of the expected frequencies were below five, which may skew results towards significance when there is none. From the collected data (n = 85; one omitted due to no recorded age), filtered tap water was the primary source of drinking water in surveyed household (45.45%, n = 39) with bottled water following as primary source (37.21%, n = 32). Participants with ages between 30-39 as 60 – 69 most often chose filtered tap water as their primary source of household drinking water (87.5%, n = 14; 36.84%, n = 7). On the other hand, those aged 40-49, 50-59, and 70 and older most often chose bottled water for their primary source of household drinking water.

When comparing additional demographic information, the chi-square analysis indicated that education was possibly related to type of primary source of drinking water in households in Sunnyslope (p-value = 0.019) although the majority of expected cell counts were well below five which may skew significance. Likewise, the rating of tap water quality at home appeared to relate to whether an individual felt that drinking water in general is safe (p-value < 0.0001) as one would expect despite low expected cell counts. Additional analyses revealed that education
did not have a strong relationship with whether an individual perceives bottled water to be safer than tap water (p-value = 0.754). The cell counts were too low to conclude anything from comparisons such as income to primary source of drinking water at home, education to rating of tap water quality at home, income to rating of tap water quality at home, and income to primary source of drinking water at home.

Similarly, the chi-square test for homogeneity comparing primary source of drinking water in the household by solicitation type revealed that there was not a statistically significant difference (p-value = 0.384). There was also no statistically significant difference for comparisons of education by rating of tap water quality at home (p-value = 0.175). Yet, there was a statistically significant p-value of <0.0001 associated with the comparison between concern with tap water quality at home and concern with water quality outside of the home. In addition, there was a significant p-value (<.0001) associated with comparison between primary source of drinking water in the home and outside the home; however, the expected cell counts were relatively low. Finally, comparison of the ratings of quality of tap water at home respective to gender did not appear to reveal any significant relationship (p-value = 0.32).

Participants indicated several areas of concern with home water quality; top concerns were related to taste (36.05%, n = 31), metals/chemicals (36.05%, n = 31) and odor (36.05%, n=31). Open-ended responses were prompted with an “Other” option which revealed that Sunnyslope residents were concerned with their household water quality due to factors such as: the age of distribution pipes, flushing after repairs, chlorine and fluoride additives, hard or mineral-laden water, age of lines in household, medication run-off, preconceived notions of water contamination, Environmental Working Group reports, corrosion of household piping, multiple breaks in line, pharmaceutical contamination, and sickness suspected from drinking water.
Table 1 Frequency table indicating main reasons for water quality concerns at home; 86 participants were prompted to select all that apply.

<table>
<thead>
<tr>
<th>Home Water Quality Concerns</th>
<th>Frequency</th>
<th>% of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taste</td>
<td>31</td>
<td>36.05%</td>
</tr>
<tr>
<td>Appearance</td>
<td>28</td>
<td>32.56%</td>
</tr>
<tr>
<td>Metals/Chemicals</td>
<td>31</td>
<td>36.05%</td>
</tr>
<tr>
<td>Odor</td>
<td>31</td>
<td>36.05%</td>
</tr>
<tr>
<td>Waterborne Contaminants</td>
<td>16</td>
<td>18.60%</td>
</tr>
<tr>
<td>Not Safe</td>
<td>20</td>
<td>23.26%</td>
</tr>
<tr>
<td>Not Healthy</td>
<td>15</td>
<td>17.44%</td>
</tr>
<tr>
<td>No Concerns</td>
<td>17</td>
<td>19.77%</td>
</tr>
</tbody>
</table>

Participants were also given the opportunity to select multiple responses when prompted to explain individual reasons for bottled water concerns, if any. Primarily, individuals were concerned with the environmental impact of plastic water bottles (74.42%, n = 64) and plastics contamination and leaching (70.93%, n = 61).

Table 2 Frequency table indicating main reasons for bottled water concerns; 86 participants were prompted to select all that apply.

<table>
<thead>
<tr>
<th>Bottled Water Related Concerns</th>
<th>Frequency</th>
<th>% of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unregulated Contaminants</td>
<td>27</td>
<td>31.40%</td>
</tr>
<tr>
<td>Plastics Contamination/Leaching</td>
<td>61</td>
<td>70.93%</td>
</tr>
<tr>
<td>Use of Unsafe Disinfectants</td>
<td>17</td>
<td>19.77%</td>
</tr>
<tr>
<td>Different Standards</td>
<td>21</td>
<td>24.42%</td>
</tr>
<tr>
<td>Environmental Impact of Plastic</td>
<td>64</td>
<td>74.42%</td>
</tr>
<tr>
<td>Have Not Considered Concerns</td>
<td>15</td>
<td>17.44%</td>
</tr>
</tbody>
</table>

Alarmingly, respondents reported changes in perceptions after exposure to water quality issue coverage in the past three years and/or coverage of the Flint lead crisis as indicated in Table 3. Given that the majority of participants surveyed were aware of the Flint lead crisis (83.91%, n = 73), the most frequent changes in perception and/or habits experienced by respondents included worry about tap water (30.23%, n = 26), more likely to purchase water from sources other than tap (26.74%, n = 23) and use of water filtration devices at home (18.60%, n = 16). However, participants also showed similar levels of concern for drinking water both in the household and outside the household, with the majority of respondents marking the same response for both.
Table 3 Frequency table indicating changes in perceptions and/or habits about drinking water quality after exposure to media coverage; 86 participants were prompted to select all that apply.

<table>
<thead>
<tr>
<th>What Perceptions/Habits Changed?</th>
<th>Frequency</th>
<th>% of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worried About Tap</td>
<td>26</td>
<td>30.23%</td>
</tr>
<tr>
<td>Drink Less Water Overall</td>
<td>1</td>
<td>1.16%</td>
</tr>
<tr>
<td>Paid More Attention to Quality Info</td>
<td>14</td>
<td>16.28%</td>
</tr>
<tr>
<td>More Likely To Purchase Other Sources</td>
<td>23</td>
<td>26.74%</td>
</tr>
<tr>
<td>Use of Home Filtration Device</td>
<td>16</td>
<td>18.60%</td>
</tr>
<tr>
<td>Purchase Bottled Water More</td>
<td>15</td>
<td>17.44%</td>
</tr>
<tr>
<td>Don’t Drink Tap Water Now</td>
<td>7</td>
<td>8.14%</td>
</tr>
</tbody>
</table>

Although many of the findings indicated negative perceptions of municipally supplied drinking water, data also revealed that the number of participants exposed to outreach was relatively low. Survey participants were asked whether they recalled exposure to WSD outreach via internet, television, billboards, newspaper, radio, events and other mediums. Only 10 participants stated that they had been exposed to outreach while 13 respondents claimed that they were unsure. Several participants that were not exposed to outreach responded to a question that was geared towards those who had been exposed; most selected “Other” and then indicated in a follow-up question that water quality was the primary outreach message presented (16.46%, n = 13). Similarly, chi-square tests for homogeneity were performed in order to determine whether there were differences in proportions by age group depending on the type of news media that participants listened to, if any. Television and social media were analyzed comparing age group proportions; television had a p-value of 0.039 and social media had a p-value of 0.059. This indicates that there may be some differences in types of news media depending on age group, despite the small sample size.

Discussion

After data collection and during the analysis, a focus group of four individuals met to discuss the survey research objectives and goals as well as preliminary findings, recommendations for additional analyses, potential outcomes of the SL/CE activities, and future
outreach development ideas including use of a revised survey (see Appendix D). One of the recommendations included reaching out to additional staff within the outreach department in order to modify the survey for event use. Outreach staff within the ESD specifically suggested attending a collaborative meeting to present survey research study findings and the proposed water quality presentation that may enhance municipally supplied drinking water quality perceptions. Although the survey research study had a limited scope of work, there were several findings that supported interactions experienced by ESD staff that manage water quality concerns and complaints on a daily basis. Through more outreach regarding water treatment controls that mitigate potential water quality crises, address taste and odor concerns, target demographics that are most concerned with their water, and emphasize the value of water at a low cost, there will be many benefits to municipalities such as the City of Phoenix.

Our study revealed many potential focus areas for future research. Results from the survey research indicated that several of the questions may have been worded in a way that captured perceptions other than the intent, or were open for interpretation in a way that provided little useable data. Poor question design, development and/or wording may have influenced several of the responses and results. For example, findings indicated that residents are concerned with water quality in their household and outside of the household but they indicated that they felt that drinking water in general is safe. Participants seemed to be equally concerned with water quality no matter the source; however, the meaning of “concerned” can be interpreted in two separate ways: worried, anxious, distressed; or considerate of or attentive to. When developing the survey questions, the first definition of “concerned” was the one that seemed the most logical interpretation. However, the fact that the majority of residents feel that drinking water in general is safe leads the discussion that the concern regarding water quality is primarily that of consideration and attentiveness; water is a valuable and necessary resource and one would
certainly care about its quality regardless if there were suspicions of contamination. Similarly, participants may have been directed to answer a certain way based on the available responses and connotation. When asking participants to select the primary source of drinking water in their home compared to primary source of drinking water outside of the home, there were slightly different options and may have restricted responses. In addition, there were different concerns listed for tap water compared to bottled water and may have skewed answers simply by the negative or positive connotations presented in the potential options that could be selected.

In addition, results indicated that primary reasons behind water quality concerns are related to aesthetics and taste; the safety of the water is indicated by concern with heavy metals or chemical contamination. Responses also indicated that there is a strong relationship between concern with water tap water quality at home and water quality outside of the home; it appears that concern is similar no matter if the water is inside or outside the home. Ultimately, most results were not directly related to thoughts of safety or health concerns. In fact, the findings that there may be differences between primary source of drinking water within the household and outside the household may reveal lifestyle preferences, such as convenience of bottled water when not at home.

Similarly, relatively comparable numbers of participants responded that they recalled, did not recall or were unsure that they recalled water quality issue coverage in the past three years. However, the next question asked whether they recalled any coverage of the Flint, Michigan lead crisis in the past three years. The overwhelming majority of respondents indicated that they did recall this coverage. However, this response also indicates that these individuals were unsure that the lead crisis was related to water, or they may have interpreted the first question to refer to local water quality issues instead of water quality issues in general. Given that the lead crisis was directly related to drinking water quality, there should have been more “Yes” responses to the
question directly preceding. This further enforces the importance of ensuring that question wording elicits the response that is indicated. Future projects and studies related to drinking water perceptions may find it helpful to pay careful attention to wording of questions so that validated results are possible.

In addition, this study was able to provide limited feedback on what types of questions were useful in that they applied to most of the sample population. For instance, a question asked whether an individual’s tap water was tested by a certified laboratory, and if so, whether health or safety issues were discovered; this did not provide sufficient data to analyze. There were very few individuals who took the required steps to request sampling of their water, and even those who did obtain testing results did not find any issues as far as they reported on the survey. Requesting a test for water sampling generally begins through contact with the City of Phoenix and results in the customer contacting an outside company and laboratory to assist with sampling. Therefore, it can be assumed that individuals will only choose this route if there is a substantial concern with water quality. In addition, the question regarding whether individuals feel that the City of Phoenix drinking water is protected adequately was too broad and not specific enough given that the majority of respondents indicated that they were unsure. With differently worded questions, it is likely that more accurate and valuable responses would have been obtained. There is also the potential that residents are simply not informed about how the municipal government protects the water supply from contamination and degradation.

Useful findings included similar responses regarding primary source of drinking water at home no matter the solicitation type; there were no significant differences. This may indicate that similar responses to future surveys could be gathered from the community from a variety of solicitation sources without affecting data quality. Also, it appeared that there is a relationship between the primary source of drinking water inside the home and outside the home; perhaps
those who consume filtered tap water and bottled water have similar behaviors whether they are inside or outside the home.

Specifically related to outreach, there were several analyses that did reveal some statistical significance and would be beneficial to investigate further. For instance, there were promising results regarding comparison of age group means for type of news media listened to by participants. Each generation and age group uses social media and television to differing degrees, and there are likely other factors to take into consideration. Depending on the demographic of interest, this could provide beneficial information for outreach so that news outlets with more viewers or specific age groups would receive more funding or attention. Perhaps determining whether there is a better way to reach residents than water and sewer statements may lead to a more informed public.

There were several questions that were brought to the researcher’s attention during the focus group meeting, such as how perceptions of water quality can often be influenced by previous experiences in different cities and childhood locations. While a demographic question was asked in the survey regarding country of origin, there was not a question that inquired about residence in other cities or states in the U.S. Another concern mentioned was that the Phoenix population consists of many out-of-state temporary and permanent residents; many individuals come to Phoenix to escape harsh winters in other states. Given that Phoenix is an arid city with unique source water that has minerals which often cause deposits in household fixtures and has a distinct taste, many perceptions may be affected by those who have lived for a significant time in other cities or states prior to residing in Phoenix.

An additional consideration with future surveys would be to include several additional items and market to a more representative sample as much as possible so that results can be generalized to all of Phoenix. For instance, it may be worthwhile to evaluate the health
consciousness of individuals completing the survey in the event that this affects perceptions. Also, including several knowledge-based questions regarding the cost and value of municipally supplied drinking water compared to other sources of water may be beneficial for understanding public perceptions and outreach opportunities. Questions about what sources of water are used for what tasks or purposes within the household and daily routines may provide additional insight. In addition, creating questions with fewer categories that are more concise, as well as surveying a larger sample of individuals will likely give results with more weight behind them for potential outreach and action by municipalities. Finally, it is important to consider that Phoenix is comprised of a large Latino and Spanish-speaking population. Future surveys must take care to include this demographic through solicitation of neighborhoods with known Latino populations and businesses that serve this population. In addition, provision of a survey translated into Spanish and evaluated for cultural relevance would allow for more insight into perceptions that this large demographic may hold.

Cross-sectional surveys like this can only suggest association between factors and not actual causality; however, any findings of interest can be further tested through a design that provides better evidence of cause and effect such as a baseline survey, outreach, and subsequent survey to evaluate outreach materials and the short intervention.

**Conclusions**

Determining perceptions of the public regarding municipally supplied drinking water quality is not a straightforward task and is often burdened with unique experiences within the sample population. Many results can be contradicting and there are many ways to interpret questions depending on one’s demographics and background. While a survey study may not provide statistically significant data during the first distribution and attempt, there are still findings that can shape future studies and provide insight into what types of questions should be
honied in on and rephrased or extended into additional questions to provide more insight. For example, the number of households that felt that bottled water is safer than tap water indicates an opportunity for the municipality to perform outreach or create an additional survey to explore the reasons behind the responses. There were many unexpected results, such as the lack of association between education or income and primary source of drinking water at home or rating of the quality of tap water at home. However, this was a relatively small sample size when considering the size of the Phoenix population.

This survey research study, while inconclusive in several aspects of the data analyses performed, does reveal several items regarding public perceptions that are of interest to municipalities and certainly can provide a template for expansion of research to other populations in Phoenix with revised questions for greater data impact. For example, for those who prefer other sources of drinking water than municipally supplied tap water, it would be beneficial to elicit the reasons behind these decisions through a multiple response type question. Focusing on further outreach to identify and address more factors that can impact perceptions will no doubt assuage public concerns with water quality from media coverage throughout the nation. In addition, given that the majority of respondents were White, there is a need to focus on solicitation strategies to incorporate more ethnicities so that a more representative picture can be obtained in a city that has a significant population of Hispanics and other minority groups. Overall, surveys measuring perceptions are a valuable and cost-effective tool for municipalities to measure whether they are not only providing adequate public health service to customers, but that there is not a disconnect between reality and perceptions of quality, health and safety.
References


Service Learning/Capstone Experience Reflection

The Service Learning/Capstone Experience (SL/CE) with the City of Phoenix Water Services Department (WSD) – Environmental Services Division (ESD) provided a tremendous opportunity for growth as a public health professional and student in the Master of Public Health program at the University of Nebraska Medical Center’s College of Public Health. The City of Phoenix WSD – ESD maintains a positive presence when interacting with the public through outreach, social media, the press and especially one-on-one interactions with customers or clients. Given the extensive customer base and sheer number of drinking water and sanitary sewer lines that allow the City to provide necessary public health services, it is important to inspire confidence in the general public. While education and information are useful and necessary tools to encourage the public to be aware of services provided, the WSD – ESD has a delicate balance to maintain. There are times where information is taken out of context and ends up causing harm. For example, there have been several cases other than the Flint lead crisis where media attention has shifted drinking water concerns to the City of Phoenix for reasons not based in fact but rather sensationalism. While the damage to public opinion is generally short-lived, there is often uncertainty about whether a proactive or reactive approach is the best for future situation. It was a learning experience to see the decisions that must take place behind the scenes in order to prevent unintended consequences. These considerations certainly were not what I expected to encounter when starting this project.

The SL/CE activities that I performed varied significantly between the first 150 hours and the second 150 hours, mainly due to my own learning and evaluating about drinking water and outreach compared to conducting survey research and analyzing my results as well as evaluating within the focus group. In order to gain practical experience with the City of Phoenix WSD – ESD regarding drinking water and assist with outreach, I spent much of my Service Learning
conducting research about drinking water quality, standards, and how the WSD – ESD ensures that the public receives safe and healthy drinking water from the tap. Through various meetings with water quality personnel and the outreach group, I was able to evaluate existing outreach materials and gain insight into how the public feels about their drinking water on average. Given the limited resources in most municipal organizations, this opportunity was determined to be a way to offer new resources and material to present to public audiences in written and verbal formats.

Through attendance at water quality related workshops as well as outreach events, training on outreach, and my own research with journals and web-based information, I was able to develop a pilot presentation for use as a Water Quality 101 workshop that expands on the currently offered Water 101 workshop (see Appendix C). At the time of the Service Learning component, the outreach team was concerned about how this type of workshop may be received and whether approval could be obtained through upper management. However, the Capstone Experience focus group felt more strongly about the potential benefits of public education about drinking water quality and provided opportunities to obtain management buy-in at future collaborative meetings. Although my contributions with my Service Learning portion were restricted due to the time needed by municipal organizations to review all published information and presentations in order to ensure that their message is being related the way they intend, I was still able to accomplish my broad goals. Personally, my greatest accomplishment was being able to reach outside of my comfort zone and discuss topics with subject matter experts, the Public Information Officer (PIO) who coordinates all outreach activities for the WSD, and staff that implement the outreach. I think my greatest contributions with the Service Learning activities included bringing a new public health focused perspective to traditional outreach materials. The WSD – ESD chooses the type of focus that it wants for outreach and in recent years, this has
been stormwater, conservation and pollution prevention. With the introduction of outreach that specifically targets water treatment, water distribution, sampling and testing and overall water quality, there is the opportunity to create a proactive and transparent image of the City of Phoenix regarding this important topic.

The Service Learning/Capstone Experience certainly presented many challenges, particularly related to time constraints and the need for a longer period to evaluate revisions to outreach as well as collect more robust survey data. Although the powerpoint presentation that I created as a result of my Service Learning activities has not been used for outreach yet, there are upcoming opportunities to showcase some of the information and ideas that are highlighted as a direct result of the survey research study that I conducted. Instead of resigning myself to the fact that organization will not be able to use my product, I was able to brainstorm potential ideas for this presentation as well as my survey research so that there can be a positive outcome for the organization as a direct result of the SL/CE. In order to address the challenges with time and survey data collection, I spaced out the days that I solicited participants so that I could receive results as well as have time to input and analyze the data. In comparison with similar studies, I collected responses that are more thorough and was able to analyze more data; I attribute this success to the various methods of solicitation and locations that I chose. One of the most difficult challenges during the Capstone Experience was receiving approval for my survey through my committee as well as the IRB; even after approval, I was required to adjust the logo due to the potential for misrepresentation of the City of Phoenix. After these hurdles, my survey was revised and approved for distribution; despite the shortened timeframe, I managed to collect sufficient data for the purposes of the study.

Through this SL/CE, my views of public health practice have become a little more realistic and I have realized the importance of ensuring that the community is knowledgeable and
aware about the public health benefits that they receive on a daily basis. After analyzing my
survey results, it was apparent that the Sunnyslope community does not have a very positive
view of the water quality provided by the municipality. This perspective conflicts with the water
quality data collected daily and provided to the Arizona Department of Environmental Quality
(ADEQ) as well as the EPA. Phoenix drinking water is fully compliant with all regulations and
the WSD – ESD continually monitors potential concerns, including aesthetics, to ensure that
consumers are receiving a quality product that is also healthy and safe. This is an indicator that
oftentimes public health practice is misunderstood and the full impacts are not reached by the
local community because of misinformation or mainly reactive approaches by the municipality.
Taking the above into consideration, my public health education through UNMC definitely
assisted me during my SL/CE in that I was more prepared to interact with all aspects of
environmental health and consider the theories behind why people behave and think the way that
they do. In addition, I feel that this education has made me more flexible and able to explore
additional opportunities in order to enhance my experience or adjust activities based on feedback
or requests.

Acknowledgements

This survey research study would not have been possible without the assistance of Randy
Gottler, Deputy Director of the Environmental Services Division; the willingness of the Acacia
Library to allow survey solicitation onsite; Grinder’s Coffee Co. and WingStop for their
assistance in distributing surveys during business operations; and Jeff Tisot, President of the East
Sunnyslope Neighborhood Association and Block Watch for distributing emails and surveys to
members and during meetings and providing contact information for another local block watch.
Appendix A

Survey: Municipal Drinking Water Quality: Environmental Health and Safety Perceptions in Phoenix, Arizona

Demographic Information

1. Are you a resident within a Sunnyslope neighborhood more than half of the year? The boundaries of the Sunnyslope community consist of approximately Northern Avenue to the south, the North Mountain range (or Cactus Road) to the north, 19th Avenue to the west, and the Phoenix Mountain Preserve (or 16th Street) to the east and include the 85020, 85021 and 85029 zipcodes.

☐ Yes  ☐ No

2. What type of residence do you live in?

☐ Single family house  ☐ Apartment  ☐ Condominium
☐ Townhouse  ☐ Shelter/Homeless  ☐ Other

3. Do you own or rent your home?

☐ Own  ☐ Rent  ☐ Other arrangement

4. How many people, including yourself, live in your household?

___________________________________________

5. How many children 18 and under live in your household?

☐ 0  ☐ 1  ☐ 2
☐ 3 or more

6. Do you receive a water bill every month from the City of Phoenix?

☐ Yes  ☐ No  ☐ Unsure

7. Which do you identify as?

☐ Male  ☐ Female  ☐ Transgender
☐ Other gender identity  ☐ Prefer not to state
8. Which category best describes your age?

☐ 19-29      ☐ 30-39      ☐ 40-49
☐ 50-59      ☐ 60-69      ☐ 70 and older

9. What is the highest level of education you have completed?

☐ Some high school   ☐ High school diploma or GED  ☐ Associate’s degree (2-year)
☐ Vocational degree   ☐ Some college               ☐ Bachelor’s degree (4-year)
☐ Graduate degree    ☐ PhD and/or Post-Doctoral  ☐ Other

10. Are you registered to vote in the U.S.?

☐ Yes          ☐ No               ☐ Unsure
☐ Not eligible (not a U.S. citizen, etc.)

11. How would you identify your race/ethnicity?

☐ White          ☐ Black               ☐ Latino/Hispanic
☐ Native Hawaiian/Pacific Islander ☐ Asian
☐ American Indian/Alaskan Native    ☐ More than one race/ethnicity
☐ Other (Please specify):________________________ ☐ Prefer not to state

12. What is your country of birth?

☐ United States      ☐ Other (Please specify):________________________
☐ Prefer not to state

13. What is your household’s estimated yearly income?

☐ Less than $10,000  ☐ $10,000 to $14,999  ☐ $15,000 to $24,999
☐ $25,000 to $34,999  ☐ $35,000 to $49,999  ☐ $50,000 to $74,999
☐ $75,000 to $99,999  ☐ $100,000 to $149,999 ☐ $150,000 to $199,999
☐ $200,000 or more    ☐ Unsure/Prefer not to state

14. What is your employment status?

☐ Full-Time (40+ hours/week) ☐ Part-Time (<40 hours/week)   ☐ Not in Labor Force
☐ Full-Time Student           ☐ Unemployed

15. In general, would you consider your political views as:

☐ Very Conservative ☐ Conservative ☐ Moderate
☐ Liberal          ☐ Very Liberal ☐ Not sure/Other
16. Which marital status best fits you?

☐ Married  ☐ Living with a partner  ☐ Divorced
☐ Separated  ☐ Widowed  ☐ Single/Never married
☐ Civil Union/Domestic Partnership  ☐ Other/Prefer not to state

Research

17. How do you see yourself on environmental issues?

☐ The environment should be completely protected
☐ There should be a balance between environmental protection and resource use
☐ Resources should be fully utilized  ☐ Unsure

18. Do you read your City of Phoenix water bill for water quality information?

☐ Yes, every month  ☐ Yes, occasionally  ☐ No, never

19. What is the primary source of drinking water in your household?

☐ Tap water  ☐ Bottled water (including water delivery)
☐ Filtered tap water (water treatment system, filter/pitcher, refrigerator filter, etc.)
☐ Water from refill station(s)  ☐ I do not drink water at home

20. What is the primary source of drinking water outside of your household (ie. school, workplace, other residence, restaurants, etc.)?

☐ Tap water  ☐ Water from refill station(s)  ☐ Well water
☐ Filtered tap water (water treatment system, filter/pitcher, refrigerator filter, etc.)
☐ Bottled water (including water delivery)  ☐ Hydropanels (sunlight, air)
☐ I do not drink water outside of my home  ☐ Unsure

21. How would you rate the quality of water provided to your tap at home?

☐ Excellent  ☐ Good  ☐ Fair
☐ Poor  ☐ Unsure

22. Are you concerned about the quality of your tap water at home?

☐ Yes  ☐ No  ☐ Unsure

23. Are you concerned about the quality of water from sources other than your household tap water?

☐ Yes  ☐ No  ☐ Unsure
24. Do you feel that drinking water in general is safe?

☐ Yes          ☐ No          ☐ Unsure

25. What are the main reasons you are concerned with your water quality at home (Select all that apply)?

☐ Taste (chlorine, metallic, etc.)          ☐ Odor (algae, sulfur/egg, etc.)
☐ Appearance (cloudy, tint, etc.)          ☐ Waterborne contaminants
☐ Heavy metals or chemical contamination          ☐ I don’t think it’s safe to drink
☐ I don’t think it’s healthy          ☐ Other (Please Specify): _____
☐ I’m not concerned with my water quality at home

26. Have you ever had your tap water tested by a certified laboratory?

☐ Yes          ☐ No          ☐ Unsure/Maybe

27. If yes to #26, were any health or safety issues discovered?

☐ Yes          ☐ No          ☐ Unsure

28. Do you feel that City of Phoenix drinking water is protected adequately?

☐ Yes          ☐ No          ☐ Unsure

29. Do you feel that bottled water is safer than tap water in general?

☐ Yes          ☐ No          ☐ It depends on the brand
☐ They are equally safe          ☐ They are both unsafe          ☐ Unsure

30. Have you thought about any of the following concerns related to bottled water (Select all that apply)?

☐ Unregulated contaminants          ☐ Plastics contamination/leaching
☐ Use of unsafe disinfectants          ☐ Different standards than tap
☐ More expensive than tap          ☐ Environmental impact of plastic bottles
☐ I have not considered concerns with bottled water

31. Do you feel that it is important to maintain water infrastructure in Phoenix? Infrastructure refers to “pipes, water treatment plants, tanks, wells, etc.”.

☐ Yes          ☐ No          ☐ Unsure

32. Have you heard of any of the following potential contaminants in treated drinking water?

☐ Pharmaceuticals          ☐ Pesticides/Herbicides          ☐ Legionella
☐ Disinfection Byproducts – Trihalomethanes (THMs), Haloacetic Acids (HAAs), etc.          ☐ Lead
33. Do you listen to news media (television, radio, paper, social media, online articles)? If yes, which types (Select all that apply)?

☐ Television  ☐ Radio  ☐ Newspaper
☐ Social Media  ☐ Online News Article  ☐ Journal Article
☐ Magazine

34. Do you recall water quality issue coverage in the past three years?

☐ Yes  ☐ No  ☐ Unsure

35. Do you recall any coverage of the Flint, Michigan lead crisis in the past three years?

☐ Yes  ☐ No  ☐ Unsure

36. If yes to #34 or #35, did this change your perceptions about and/or habits related to drinking water quality in Phoenix?

☐ Yes  ☐ No  ☐ N/A

37. If yes to #36, what changed (Select all that apply)?

☐ I felt worried about drinking tap water  ☐ I drink less water overall
☐ I paid more attention to Phoenix drinking water information
☐ I felt more likely to purchase water from sources other than tap
☐ I purchase and use home drinking water filtration devices
☐ I purchase bottled water more often  ☐ I don’t drink tap water now
☐ Other (Please specify): ________________________________

38. Do you recall exposure to City of Phoenix Water Services Department (WSD) outreach via the Internet, television, billboards, newspaper, radio, events, etc.?

☐ Yes  ☐ No  ☐ Unsure

39. If yes to #38, in which manner were you exposed to outreach?

☐ Internet: YouTube video, Twitter, Facebook, etc.  ☐ Billboard
☐ Television: Advertisement, News, etc.  ☐ Newspaper
☐ Radio  ☐ Event: Tabling, speaker  ☐ Flyers
☐ Other (Please specify): ________________________________

40. If yes to #38, what type of outreach message was presented?

☐ Stormwater  ☐ Conservation  ☐ Water bill reduction
☐ Water quality  ☐ Pollution prevention
☐ Tap Into Quality, DrinkTap.org or the Value of Water Campaign
Appendix B

Survey Cover Letter

You are being asked to participate in a public opinion research study because you are a resident of the Sunnyslope community in Phoenix, Arizona that receives drinking water from the City of Phoenix water distribution system. In addition, you are 19 years or older and understand written and spoken English.

There is no cost to you to be in this research study. You will not be paid to be in this research study and you can choose not to participate.

Purpose of the Research Study

The purpose of this study is to look at consumer perceptions in the Sunnyslope community regarding drinking water quality, lead content and other health and safety concerns. Survey data will be obtained by both door-to-door contact asking households to complete the survey via e-mail or paper and face to face contacts at events, meetings and businesses. The survey will take approximately 15 to 30 minutes to complete.

Risk and Benefits of Research Study Participation

Potential risks to participants include a minimal risk of becoming concerned about the safety of the municipally supplied tap water. Providing factual information about the quality of drinking water distributed by the City of Phoenix at the time of the survey will minimize this risk.

Potential benefits to participants include a better understanding of the way that the City of Phoenix public water system functions, how water is distributed and treated, how the City of Phoenix ensures water quality and how the City of Phoenix compares to other water systems. However, individual participants may not benefit from being in this research study.

Potential societal benefits include advancement of knowledge about perceptions of environmental health and safety for residents receiving municipally supplied drinking water in the Sunnyslope community. The study may also help to identify potential issues and concerns that could become focus areas for increased outreach opportunities in the City of Phoenix.

If you have a problem as a direct result of being in this study, you should contact one of the people listed at the end of this consent form. Reasonable steps will be taken to protect your privacy and the confidentiality of your study data.

Participant Rights

No confidential data will be collected. The only persons who will have access to your research records are the study personnel, the Institutional Review Board (IRB), and any other person or agency required by law. The information from this study may be published in scientific journals or presented at scientific meetings but your identity will be kept strictly confidential.

You have rights as a research subject. You can decide not to be in this research study, or you can stop being in this research study (“withdraw”) at any time before, during, or after the research begins. Deciding not to be in this research study or deciding to withdraw will not affect your relationship with
the investigator, or with the University of Nebraska Medical Center or The Nebraska Medical Center hospital.

If you have any questions during the study, you should talk to one of the investigators listed below. Completing the survey is your agreement to take part in this study.

Sincerely,

Authorized Study Personnel

Principal Investigator

Chelsey Weaver, 602-748-5680, Chelsey.weaver@unmc.edu

Faculty Advisor

Chandran Achutan, 402-559-8599, cachutan@unmc.edu
Appendix C

Water Quality 101 Presentation
Appendix E

Focus Group Agenda

**Municipal Drinking Water Quality: Environmental Health and Safety**

**Perceptions in Phoenix, Arizona – Focus Group**

**March 19, 2018 Agenda**

- Introduction to SL/CE
  - Issue
  - Project Importance
  - Objectives
- Survey Methods
  - Potential applicability to Phoenix (Sunnyslope subset)
- Survey Results
  - Pivot tables, graphs
  - T-test & ANOVA
- Discussion/Recommendations
  - Implications for Outreach
  - Pilot presentation – Water Quality 101
  - Reasons why drinking water crises not likely to happen in Phoenix
- Brainstorming
- Wrap-up
Appendix F

Additional Data Analysis

- Chi Square Tests
  - Comparison of primary source of drinking water at home by age
    
    | Age Group | 1 | 2 | 3 | 4 | 5 | Total |
    |------------|---|---|---|---|---|-------|
    | 19-29      | 0 | 1 | 1 | 1 | 0 | 3     |
    | 30-39      | 1 | 0 | 14| 1 | 0 | 16    |
    | 40-49      | 1 | 13| 7 | 1 | 0 | 22    |
    | 50-59      | 2 | 8 | 3 | 2 | 0 | 15    |
    | 60-69      | 3 | 5 | 7 | 3 | 1 | 19    |
    | 70+        | 3 | 4 | 3 | 0 | 0 | 10    |
    | Total      | 10| 31| 35| 8 | 1 | 85    |

    Expected Values

    | Age Group | 1   | 2   | 3   | 4   | 5   | Total |
    |------------|-----|-----|-----|-----|-----|-------|
    | 19-29      | 0.35| 1.09| 1.24| 0.28| 0.04| 3     |
    | 30-39      | 1.88| 5.84| 6.59| 1.51| 0.19| 16    |
    | 40-49      | 2.59| 8.02| 9.06| 2.07| 0.26| 22    |
    | 50-59      | 1.76| 5.47| 6.18| 1.41| 0.18| 15    |
    | 60-69      | 2.24| 6.93| 7.82| 1.79| 0.22| 19    |
    | 70+        | 1.18| 3.65| 4.12| 0.94| 0.12| 10    |
    | Total      | 10  | 31  | 35  | 8   | 1   | 85    |

    $\chi^2 = 34.43468154$
    - The p-value is 0.023; however, >70% of frequencies have count <5

  - Comparison of quality of tap water at home rating by gender
    
    | Gender | Observed Values | 1 | 2 | 3 | 4 | 5 | Totals |
    |--------|-----------------|---|---|---|---|---|--------|
    | Male   |                 | 3 | 7 | 9 | 4 | 1 | 24     |
    | Female |                 | 3 | 18| 15| 20| 6  | 62     |
    | Totals |                 | 6 | 25| 24| 24| 7  | 86     |
Table 1: Comparison of primary source of drinking water at home by solicitation type

<table>
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<td>10</td>
<td>32</td>
<td>35</td>
<td>8</td>
<td>1</td>
<td>86</td>
</tr>
</tbody>
</table>

Expected Values

- The p-value was 0.384 which indicates no statistical significance; cell counts are low for most of the expected values

Table 2: Comparison of education by primary source of drinking water at home

<table>
<thead>
<tr>
<th>Education Level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS/GED</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Associates</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Some College</td>
<td>1</td>
<td>8</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>BS</td>
<td>3</td>
<td>11</td>
<td>14</td>
<td>2</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Grad</td>
<td>3</td>
<td>5</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>PhD</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Totals</td>
<td>10</td>
<td>31</td>
<td>35</td>
<td>8</td>
<td>1</td>
<td>85</td>
</tr>
</tbody>
</table>

Expected Values

- P-value was 0.318. No statistical significance; >30% of counts were less than 5
MUNICIPAL DRINKING WATER PERCEPTIONS

### HS/GED

<table>
<thead>
<tr>
<th>Education</th>
<th>Tap</th>
<th>Bottled</th>
<th>Filtered Tap</th>
<th>Refill</th>
<th>No Water</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS/GED</td>
<td>1.058824</td>
<td>3.282353</td>
<td>3.705882</td>
<td>0.847059</td>
<td>0.105882</td>
<td>9</td>
</tr>
<tr>
<td>Associates</td>
<td>0.588235</td>
<td>1.823529</td>
<td>2.058824</td>
<td>0.470588</td>
<td>0.058824</td>
<td>5</td>
</tr>
<tr>
<td>Some College</td>
<td>2.352941</td>
<td>7.294118</td>
<td>8.235294</td>
<td>1.882353</td>
<td>0.235294</td>
<td>20</td>
</tr>
<tr>
<td>BS</td>
<td>3.529412</td>
<td>10.94118</td>
<td>12.35294</td>
<td>2.823529</td>
<td>0.352941</td>
<td>30</td>
</tr>
<tr>
<td>Grad</td>
<td>2.235294</td>
<td>6.929412</td>
<td>7.823529</td>
<td>1.788235</td>
<td>0.223529</td>
<td>19</td>
</tr>
<tr>
<td>PhD</td>
<td>0.117647</td>
<td>0.364706</td>
<td>0.411765</td>
<td>0.094118</td>
<td>0.011765</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>0.117647</td>
<td>0.364706</td>
<td>0.411765</td>
<td>0.094118</td>
<td>0.011765</td>
<td>1</td>
</tr>
<tr>
<td>Totals</td>
<td>10</td>
<td>31</td>
<td>35</td>
<td>8</td>
<td>1</td>
<td>85</td>
</tr>
</tbody>
</table>

- The p-value is 0.0194 which is significant; however, >70% of frequencies have count <5

### Comparison of concern with water quality at home by concern with water quality outside of home

**Observed Values**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>45</td>
<td>3</td>
<td>6</td>
<td>54</td>
</tr>
<tr>
<td>No</td>
<td>3</td>
<td>16</td>
<td>2</td>
<td>21</td>
</tr>
<tr>
<td>Unsure</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>Totals</td>
<td>51</td>
<td>20</td>
<td>15</td>
<td>86</td>
</tr>
</tbody>
</table>

**Expected Values**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>32.02326</td>
<td>12.55814</td>
<td>9.418604651</td>
<td>54</td>
</tr>
<tr>
<td>No</td>
<td>12.45349</td>
<td>4.883721</td>
<td>3.662790698</td>
<td>21</td>
</tr>
<tr>
<td>Unsure</td>
<td>6.523256</td>
<td>2.55814</td>
<td>1.918604651</td>
<td>11</td>
</tr>
<tr>
<td>Totals</td>
<td>51</td>
<td>20</td>
<td>15</td>
<td>86</td>
</tr>
</tbody>
</table>

- The p-value is <.0001 which is significant; however, >30% have count <5

### Comparison of primary source of drinking water inside and outside the home

**Observed Values**

<table>
<thead>
<tr>
<th></th>
<th>Tap</th>
<th>Bottled</th>
<th>Filtered Tap</th>
<th>Refill</th>
<th>No Water</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Bottled</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Filtered Tap</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Refill</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>20</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>No Water</td>
<td>3</td>
<td>18</td>
<td>8</td>
<td>4</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>Totals</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**Expected Values**

<table>
<thead>
<tr>
<th></th>
<th>Tap</th>
<th>Bottled</th>
<th>Filtered Tap</th>
<th>Refill</th>
<th>No Water</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tap</td>
<td>9</td>
<td>32</td>
<td>35</td>
<td>8</td>
<td>1</td>
<td>85</td>
</tr>
<tr>
<td>Bottled</td>
<td>1</td>
<td>0.952941</td>
<td>3.388235</td>
<td>3.705882</td>
<td>0.847059</td>
<td>0.105882</td>
</tr>
</tbody>
</table>
### Comparison of age groups by whether television is a source of media or not

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Yes TV</th>
<th>No TV</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>19 - 29</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>30 - 39</td>
<td>13</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>40 - 49</td>
<td>14</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td>50 - 59</td>
<td>10</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>60 - 69</td>
<td>14</td>
<td>5</td>
<td>19</td>
</tr>
<tr>
<td>70 and older</td>
<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Totals</td>
<td>59</td>
<td>26</td>
<td>85</td>
</tr>
</tbody>
</table>

### Comparison of education by primary source of drinking water at home

<table>
<thead>
<tr>
<th>Education</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS diploma or GED</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Associates</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Some College</td>
<td>1</td>
<td>8</td>
<td>9</td>
<td>2</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>BS</td>
<td>3</td>
<td>11</td>
<td>14</td>
<td>2</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Graduate</td>
<td>3</td>
<td>5</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>PhD and/or Post Doc</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Totals</td>
<td>10</td>
<td>31</td>
<td>35</td>
<td>8</td>
<td>1</td>
<td>85</td>
</tr>
</tbody>
</table>

### Expected Values

<table>
<thead>
<tr>
<th>Education</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS diploma or GED</td>
<td>1.058824</td>
<td>3.282353</td>
<td>3.705882353</td>
<td>0.847059</td>
<td>0.105882</td>
<td>9</td>
</tr>
<tr>
<td>Associates</td>
<td>0.588235</td>
<td>1.823529</td>
<td>2.058823529</td>
<td>0.470588</td>
<td>0.058824</td>
<td>5</td>
</tr>
<tr>
<td>Some College</td>
<td>2.352941</td>
<td>7.294118</td>
<td>8.235294118</td>
<td>1.882353</td>
<td>0.235294</td>
<td>20</td>
</tr>
<tr>
<td>BS</td>
<td>3.529412</td>
<td>10.94118</td>
<td>12.35294118</td>
<td>2.823529</td>
<td>0.352941</td>
<td>30</td>
</tr>
</tbody>
</table>
### Observed Values

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>6</td>
<td>20</td>
<td>16</td>
<td>0</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>13</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Unsure</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>11</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td>Totals</td>
<td>6</td>
<td>25</td>
<td>24</td>
<td>24</td>
<td>7</td>
<td>86</td>
</tr>
</tbody>
</table>

### Expected Values

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>1.046512</td>
<td>4.360465116</td>
<td>4.186047</td>
<td>4.186046512</td>
<td>1.22093</td>
<td>15</td>
</tr>
<tr>
<td>Unsure</td>
<td>1.674419</td>
<td>6.976744186</td>
<td>6.697674</td>
<td>6.697674419</td>
<td>1.953488</td>
<td>24</td>
</tr>
<tr>
<td>Totals</td>
<td>6</td>
<td>25</td>
<td>24</td>
<td>24</td>
<td>7</td>
<td>86</td>
</tr>
</tbody>
</table>

- The p-value of 0.019 is significant; however, the expected cell counts are low.
- The p-value was <0.0001; however, low expected cell counts

### Frequency Tables

**What type of outreach message was presented?**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>% of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stormwater</td>
<td>2</td>
<td>2.33%</td>
</tr>
<tr>
<td>Conservation</td>
<td>7</td>
<td>8.14%</td>
</tr>
<tr>
<td>Water Bill Reduction</td>
<td>3</td>
<td>3.49%</td>
</tr>
<tr>
<td>Water Quality</td>
<td>12</td>
<td>13.95%</td>
</tr>
<tr>
<td>Pollution Prevention</td>
<td>3</td>
<td>3.49%</td>
</tr>
<tr>
<td>Tap Into Quality and similar campaigns</td>
<td>4</td>
<td>4.65%</td>
</tr>
</tbody>
</table>

- There were 10 respondents who stated that they were exposed to outreach, while 13 respondents stated that they were unsure. The frequency is given out of the 86 total survey respondents in order to depict the frequency overall of participants regarding type of outreach message.
- How many individuals were exposed to which types of outreach?
There were 10 respondents who stated that they were exposed to outreach, while 13 respondents stated that they were unsure. The frequency is given out of the 86 total survey respondents in order to depict the frequency overall of participants who have been exposed to any type of outreach.

<table>
<thead>
<tr>
<th>In what manner were you exposed to outreach?</th>
<th>Frequency</th>
<th>% of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet</td>
<td>4</td>
<td>4.65%</td>
</tr>
<tr>
<td>Television</td>
<td>5</td>
<td>5.81%</td>
</tr>
<tr>
<td>Radio</td>
<td>3</td>
<td>3.49%</td>
</tr>
<tr>
<td>Event</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Billboard</td>
<td>1</td>
<td>1.16%</td>
</tr>
<tr>
<td>Newspaper</td>
<td>2</td>
<td>2.33%</td>
</tr>
<tr>
<td>Flyers</td>
<td>4</td>
<td>4.65%</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>3.49%</td>
</tr>
</tbody>
</table>