

# Remote-Read Water Meters Audit Report

December 17, 2021

(Report Modification: December 21, 2021)

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Mattie Parker

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**REPORT MODIFICATION:** The Remote-Read Meters Audit Report (released on December 17, 2021) included an incorrect table on page 8. The report was, therefore, modified to include the correct table.





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## Executive Summary

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As part of the Fiscal Year 2021 Annual Audit Plan, the Department of Internal Audit conducted a Remote-Read Water Meters Audit. The Remote-Read Water Meters Audit was requested after the Mayor and City Council received citizen inquiries that the water meters were registering higher water consumption than the older, legacy meters. The purpose for the audit was, therefore, to determine whether City of Fort Worth (CFW) remote-read water meters inaccurately recorded water consumption, thus resulting in higher and inaccurate water bills. Since the Water Department conducted water rate analyses, and presented their results to the Mayor and City Council, this audit did not include an analysis of water rates.

To achieve our audit objective, Internal Audit:

- analyzed CFW legacy and remote-read water meter data, as noted within the Customer Information System (CIS) software;
- analyzed customer inquiry data, as noted within the MyH2O water utility program;
- reviewed the results of legacy and remote-read meter testing completed by the Water Department's third party vendor;
- reviewed news articles regarding remote-read meter implementations at other municipalities; and,
- reviewed CFW procurement records.

Internal Audit analyzed CFW water meter data, and relied on third party meter testing, as a part of this project. Third party meter testing was based on standards established by the American Water Works Association (AWWA). AWWA standards describe minimum requirements for design, installation, performance, and manufacturing of products used in the drinking water industry, and cover water pipe, treatment chemicals, storage facilities, valves, appurtenances, and utility management practices. The third party vendor's report states that the AWWA is an international non-profit, scientific and educational association founded to improve water quality and supply, and is recognized internationally as a source for scientific and management reference resources for the water community. The AWWA website indicates that their membership includes over 4,300 utilities. The City of Fort Worth is one of those member entities.

Internal Audit reviewed two sets of water data. One data set was within the CIS software that is used for water billings. The other data set was within the City's MyH2O water utility program that is designed to improve customer engagement and provide advanced technology such as real-time monitoring. We found no evidence that the remote-read water meters were registering higher than actual consumption.



During our audit period, the Water Department was in the process of procuring a certified test bench for in-house testing. The Water Department was also in the process of developing a comprehensive, on-going testing program that includes routine third-party testing. Internal Audit inquiries noted that other cities have in-house testing equipment. For customers who feel their meters are over-registering, staff within one city indicated they accept customers' requests to witness meter testing. We feel that this option promotes transparency and could improve trust between the CFW and its Water customers. Internal Audit, therefore, recommends that upon the CFW Water Department's procurement and receipt of meter testing equipment, the Water Department accept customers' requests to witness testing of water meters.

Water Department staff indicated that upon customer high-billing inquiry, the Water Department occasionally uses in-situ (buckets) in-place testing, and has been doing so since 2016.

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## Background

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The City of Fort Worth (CFW) provides drinking water, reclaimed water and wastewater services to residents and businesses in Fort Worth and surrounding communities. The CFW's Water Department bills customers a base service charge, and the cost of water consumed. A base/fixed monthly service charge is billed based on meter size. Water consumption is billed based on rates applied by customer class (e.g., residential, commercial, etc.) and water usage tier, as determined from meter readings.

On March 5, 2013 (by Resolution No. 4185-03-2013), the City Council appointed a Water Utility Task Force to:

- determine the feasibility and desirability of pursuing public/private partnerships that may result in lower costs for utility customers, and that may add value for City ratepayers and municipal government;
- identify alternatives for the management and operation of the City's water and wastewater systems;
- assess the legal and fiscal implications of public/private partnerships; and,
- provide the Mayor and City Council with appropriate recommendations.

The Water Utility Task Force recommended the introduction of new meter reading technology (e.g., remote-read water meters).

On June 24, 2015, the City executed a contract (contract #46770) with Aqua Metric Sales Company to exchange water meters.

On August 13, 2015, the City of Fort Worth published a procurement for the development and implementation of an Advanced Metering Infrastructure (AMI) Program.

On May 17, 2016, the Mayor and City Council authorized an agreement with Aqua Metric Sales Company to plan, design and implement the AMI program at the CFW.

On September 1, 2016, the City executed a contract (Contract #48150) with Atlas Utility Supply Company to supply water service meters and appurtenances.

On September 13, 2016, the City executed a contract (Contract #48155) with Thirkettle Corporation (dba Aqua Metric Sales Company) to provide a supply of water service meters and appurtenances.

On November 30, 2017, the City executed a contract (Contract #50011) with Thirkettle Corporation (dba Aqua Metric Sales Company) to plan, design and implement the AMI program at the CFW.

As of March 2021, the City had purchased 173,328 Sensus meters from the Aqua Metric Sales Company, most of which were 5/8" x 3/4" residential meters.

Prior to implementing the AMI program, the Water Department sought to educate, receive input, answer questions, etc. from Fort Worth water customers. Prior to the COVID pandemic, the Water Department provided in-person MyH2O open houses to Fort Worth water customers. Virtual meetings and open house videos were held when City facilities were closed because of the pandemic.



The Water Department's website indicates that as of December 14, 2021, a total of 245,103 remote-read water meters had been installed. The installed meters were for service addresses in 16 of the City's 21 water billing cycles.

#### *Meter Installations*

Based on our review of the Water Department's meter inventory spreadsheet, we noted that approximately 4,900 legacy meters had been installed since August 2016, after the City's decision to implement the AMI program. Water Department management indicated that the legacy meters, which were in the City's inventory, were installed during MyH2O program development to allow the Water Department to continue to enable new development. In July 2019, the City began exchanging legacy meters, as the AMI program rolled out across the service area. Though the legacy meters were exchanged with Sensus meters, remote-read points were not installed. The remote-read point was subsequently added as a retrofit through the AMI program rollout.

As part of the AMI program, the Water Department also installed Sensus meters to new development in Fort Worth. Those meters were also installed without the remote-read point. However, the remote-read point was subsequently retrofitted to allow for remote readings. Per Aqua Metric Sales Company's website, a "remote-read point" is a radio transceiver, with two-way communication ability, that collects data from the meter register and transmits data to the collection device.

Although the retrofitted meters had remote-read capabilities, the City continued to bill based on manual meter reads, until after the implementation of the meter data management system, which occurred in summer 2020. In October 2020, and after integrating the meter data management system, the City began phasing in remote-read billings.

Water Department staff indicated that remote-read billings were generally implemented in the same order as the meter replacements. Since billing cycle 21 had a diversified customer base (e.g., wide variety of meter sizes, large industrial and commercial users, golf courses, a significant number of apartments, and a mix of residential and small commercial, etc.), Water Department staff used billing cycle 21 as the pilot deployment area. Subsequent remote-read meter installations coincided with the water billing cycle calendar, and a backup plan was incorporated to allow the contractor to install remote-read water meters at service addresses that were in close proximity to other billing cycle addresses. The City's remote-read billing installation schedule is noted in the following table.

Month and Year	Remote-Read Billings, by Billing Cycle
October 2020	21, 7, 14, and 8
November 2020 – December 2020	15 and 2
January 2021 – June 2021	9, 16, 3, 10 and 17

Source: Water Department

#### *Billing Accuracy Review*

The City's Water Department has processes in place to ensure accurate billing. It should be noted that such processes were in place before and after the City's AMI program implementation. For example, CIS (the Water Department's billing software) is set up to flag exception accounts (e.g., high consumption, low consumption, no current billing, meter reading of zero, meter exchanged, etc.). The Water Department's accounting services group reviews customer water accounts that have outstanding balances of \$500.00 or more, or an increased consumption of at least 150% from the previous month. The Water Department's billing group then reviews those exception accounts on the morning of the next business day. Water Department management stated that the accounting services group reviews approximately 300 water accounts per day, but has reviewed up to 700 per day.



In addition, Water Department management indicated that Water Department staff implemented quality control/quality assurance procedures that validate asset data in the CIS, address installation quality, and ensure ongoing performance of the communications network. Water Department staff indicated they worked with the system integrator to verify meter reading upload accuracy, and conducted point-by-point comparisons of manual readings to remote readings during the transition process.

#### *Meter Testing*

The Texas Water Development Board publishes Best Management Practices for Municipal Water Providers. The Texas Water Development Board recommends either regular testing and evaluation of 5/8" x 3/4" meters eight to 10 years in service (to determine meter accuracy), or a periodic, consistent replacement program based on the age of the meter or cumulative water volume through the meter.

Water Department staff indicated that in an effort to be transparent and help customers feel more comfortable, the Water Department has conducted on-site, in-situ (bucket) testing in the presence of customers since 2016. The bucket test is an in-place test to determine whether a water meter is recording an accurate flow. The in-situ test is used when responding to high billing inquiries, and is completed after Water Department staff has confirmed that there are no visible leaks. The following image is a depiction of a "bucket test" being conducted.



#### *MyH2O Program*

The MyH2O program was implemented to improve both customer engagement and utility operations through the implementation of advanced technology. The technology allows the CFW to better inform customers about daily water usage. Additionally, wireless networks (that include digitally-read-meters, a communications network and data management systems) provide customers with information and opportunities to monitor and reduce water usage. The customers' ability to monitor (real-time) water usage should help identify water consumption issues in a timelier manner. The Water Department's website indicates that they are in the process of final testing the MyH2O customer portal, which will provide direct customer access to water usage data.



## Audit Results

### Types of Remote-Read Meters Installed

Based on our review of news articles, some municipalities experienced remote-read water meter reliability and accuracy issues, after having Sensus iPerl meters installed in 2014, 2015 and 2016. Although the iPerl meter issues appeared to have been related to first generation roll-outs (and which appear to have been addressed by the manufacturer), we concluded that iPerl meters were not used as a part of the CFW's remote-read water meter infrastructure program.

CFW procurement records indicate that the City executed a purchase order in December 2011 for the purchase of six (6)  $\frac{3}{4}$ " Sensus iPerl meters, as a part of the City's AMI pilot program. The six iPerl meters were received on December 21, 2011. The iPerl meters cost \$725.94, and were paid for in January 2012. Water Department staff stated that the six iPerl meters were ordered to be assessed as an option for the City's AMI program. Water Department staff also said they selected the six Sensus iPerl meters, along with multiple additional meters from other manufacturers such as Hersey and Badger.

**Sensus iPerl meters (determined to have had first-generation roll-out issues during early implementation at other cities) were not purchased for the City of Fort Worth's AMI program rollout.**

Internal Audit was informed that water meter tests (performed by the Water Department's Meter Services Division, on a test bench that the CFW had at that time) revealed functional issues with the iPerl meters. Therefore, no additional iPerl meters were purchased. Based on our review of City procurement records, Internal Audit saw no evidence that any additional iPerl meters were procured. Water Department staff indicated that the six iPerl meters, purchased by the City, were not installed at any Fort Worth residence. Since Internal Audit was not provided serial numbers, we could not verify that the six iPerl meters were not installed. As of our audit fieldwork, accountability for the six iPerl meters had not been established.

The Water Department provided Internal Audit with meter data sheets, received from the vendor to support water meters shipped to the CFW. We noted that two meter data sheets had a description of  $\frac{5}{8} \times \frac{3}{4}$  iPerl for 801 water meters. Since the meter data sheets included meter serial numbers, Internal Audit attempted to trace the serial numbers to the CIS database to determine whether those serial numbers were attached to current CFW water accounts. Based on our analysis, no matches were identified, implying that none of the 801 iPerl meters had been installed at CFW water service addresses. Water Department staff confirmed that the 801 meters were never ordered or received, and the vendor sent an email, stating that the meter data sheets were sent to the City of Fort Worth in error.

CFW procurement records indicate that between August 2016 and March 2021, the City purchased 173,328 Sensus meters for approximately \$24M. The type of Sensus meters varied, and included SRII, ALLY, OMNI C2, OMNI T2, OMNI H2 and OMNI F2 models. As noted in the following table, none of the 173,328 meters were iPerl meters.



Sensus Meters Purchased							
Meter Size	Model	Type	Use			Recommended Use	Meters Purchased 08/30/2016 - 03/05/2021
			Domestic	Irrigation	Fire		
5/8" x 3/4"	SRII	Positive Displacement	X	X		Single Family & Small Commercial	141,805
5/8" x 3/4"	ALLY	Electromagnetic	X	X		Single Family & Small Commercial	30
3/4" x 3/4"	SRII	Positive Displacement	X	X		Single Family & Small Commercial	3,766
1"	SRII	Positive Displacement	X	X		Single Family, Small Commercial & Irrigation	16,374
1.5"	OMNI C2	Compound	X			Small Commercial	2,957
1.5"	OMNI T2	Turbine	X	X		Irrigation/Commercial Heavy Use	1,199
2"	OMNI C2	Compound	X			Medium Size Commercial, Multi-Commercial	3,998
2"	OMNI T2	Turbine	X	X		Irrigation/Commercial Heavy Use	1,941
3"	OMNI C2	Compound	X			Commercial and Industrial	257
3"	OMNI T2	Turbine		X		Heavy Use or Irrigation	27
3"	OMNI H2	Fire Hydrant Meter	X	X		Temporary Fire Hydrant Use (Commercial)	207
4"	OMNI C2	Compound	X			Commercial and Industrial	394
4"	OMNI T2	Turbine		X		Heavy Use or Irrigation	22
4"	OMNI F2	Turbine	X		X	Domestic with Fire Protection on Single Line	13
6"	OMNI C2	Compound	X			Commercial and Industrial	273
6"	OMNI T2	Turbine		X		Heavy Use or Irrigation	21
6"	OMNI F2	Turbine	X		X	Domestic with Fire Protection on Single Line	12
8"	OMNI C2	Compound	X			Commercial and Industrial	20
8"	OMNI T2	Turbine		X		Heavy Use or Irrigation	1
8"	OMNI F2	Turbine	X		X	Domestic with Fire Protection on Single Line	6
10"	OMNI C2	Compound	X			Commercial and Industrial	4
10"	OMNI F2	Fire Service	X		X	Domestic with Fire Protection on Single Line	1
						Total	173,328

Source: City procurement records and Water Department staff

## Remote-Read Meter Shipments

The contract between the CFW and Thirkettle Corporation (dba Aqua Metric Sales Company) required meter testing by the CFW and the vendor. However, based on discussions with Water Department staff, the CFW did not have equipment to test meters at this time.

**The Water Department rejected less than 1% of the remote-read meters purchased by the CFW.**

Section 10.1 of the contract required the City to inspect and test selected meters at the flows specified in the latest revision of the American Water Works Association (AWWA) Manual. Meters failing to register accurately, according to the test specifications, were to be rejected at no cost to the City. Additionally, rejection of multiple meters within the same group or lot were to result in rejection of the entire group or lot.

Based on available meter data sheets, there were 18 instances where more than one meter (with 10 being the largest number in one batch) was rejected. Internal Audit saw no evidence that an entire group/lot was returned or rejected.

As previously stated, the Water Department did not possess water meter testing equipment at that time. Water Department staff indicated that defective meters were identified (in the Regional Network Interface) by an alarm detected by the Water Department's AMI Report and Analysis Team. For example, meters were considered defective and were returned to the manufacturer when alarms were activated for reasons such as low radio frequency.

Of the 173,328 Sensus meters that were purchased, Water Department staff indicated that the City rejected 124 (less than one percent), but had only returned 32 of those 124 as of audit fieldwork. Water Department staff indicated that they pack rejected meters, complete Return Merchandise Authorization forms that include meter serial numbers and detail information regarding meter defects, and then ship defective meters



to Sensus, the manufacturer. Once Sensus thoroughly checks returned meters, which may include meter retests completed on a meter test bench, Sensus determines if the damage or defect is covered under the warranty. If the meter is defective from the factory, Sensus repairs or replaces the meter. If the meter is damaged or defective from the installation process, Sensus returns the meter, with their findings enclosed.

Reason Meter Was Returned	CY2019	CY2020	CY2021 (as of 06/29/2021)	Total
Blown Gasket	0	0	4	4
Configuration Error	0	0	0	0
Low Battery	0	0	0	0
Meter Reboot Error	0	1	1	2
Moisture In Register	0	7	0	7
Register Assembly Broken	0	4	6	10
Register Stopped Working	1	16	84	101
<b>Grand Total</b>	<b>1</b>	<b>28</b>	<b>95</b>	<b>124</b>

Source: Water Department

Section 11.2 of the contract required the meter manufacturer to provide an "Affidavit of Compliance" with each shipment of meters, duly certified by the manufacturer's testing facility, or an approved testing laboratory of full compliance with applicable AWWA standards. Upon request, the Water Department provided Internal Audit several Affidavits of Compliance, each dated September 18, 2020, and each supporting a different type of Sensus meter. There was no Affidavit of Compliance for meter shipments received by the CFW between FY2016 and FY2019. It should be noted that language within another section of the contract seemed to only require a single affidavit.

Section 11.3 of the contract required that each meter shipment be accompanied by a complete listing, with information such as meter ID, meter model, meter size, factory test date, flow (minimum, intermediate, maximum), etc. Based on our review of Water Department data, listings accompanied meters shipped to the CFW, the majority of which were shipped in FY2020.

### Third Party Water Meter Testing

The CFW entered into a contract with SL-serco, Inc. (Fort Worth City Secretary Contract No. 48192-A4) to assist with: 1) the development of a meter testing program; and 2) a third party meter audit that assessed the accuracy of meters being replaced and new meters being installed through the AMI program. The types of meters tested, reportedly accounted for 85 percent of Fort Worth's metering population and 90 percent of all Fort Worth residential customers.

The SL-serco report indicated that a random sample of 300 meters was delivered to the third party vendor (Fluid Meter Services) on February 10, 2021, and that on March 1, 2021, Fluid Meter Services completed accuracy testing on 297 meters. Two hundred (200) of the meters tested were legacy meters, and 97 were new Sensus meters. The third party vendor's report indicated that three meters (two out-of-the-box, and one newly installed) were damaged and were, therefore, not tested.

A third party vendor tested legacy and remote-read meters against AWWA standards.



Tolerance and Other Technical Requirements for Weighing and Measuring Devices) from the U. S. Department of Commerce's National Institute of Standards and Technology.

The SL-serco report indicates that each randomly-selected meter was tested at the industry established minimum, intermediate and maximum flow rates. The report also states that the accuracy of a meter (at each flow rate) was found by running a known amount of water through the meter, and comparing that to the amount registered by the meter. SL-serco's report indicates that meters tested were 5/8" x 3/4" positive displacement meters (Sensus, Badger, Hersey, and Precision brands) or MultiJet meters (Master brand). Those test results were then compared to the AWWA standard accuracy range, specific to each meter type and flow rate. The SL-serco report also indicates that for the 297 meters to be considered accurate or to pass testing (at minimum, intermediate and maximum flow rates established by the AWWA), water being measured must have registered within range or within standards.

***Legacy Meters:*** The third party vendor tested 200 legacy meters (MultiJet and Positive Displacement types) at the three flow rates. Based on the third party vendor's test results, the legacy Positive Placement meters had a higher pass rate at the intermediate and maximum flows. However, over one-half of the legacy meters (MultiJet and Positive Displacement types) under-registered at the minimum flow. While both legacy meter types under-registered at the minimum flow, the MultiJet meters had a higher fail rate at each flow. The third party vendor's report noted that 85% of the legacy meters tested were MultiJet.

***New, Sensus Meters:*** All 97 of the new meters tested were Positive Displacement meters. Based on internet research, displacement meters measure the flow of water based on volume of a displacement.

The third party vendor tested new meters that had never been installed (e.g., directly from the warehouse/out-of-the-box) and meters that were recently installed, but pulled for testing purposes. Similar to legacy meter testing, new Sensus meters were tested at the three flow rates. All 51 out-of-the-box meters registered correctly at the intermediate and maximum flow. Ninety-eight percent (98%) registered correctly at the minimum flow, with 2% registering below at the minimum flow, meaning those meters unregistered water volume. In reference to the 46 meters that were pulled for testing, 100% registered correctly at the intermediate and maximum flows, while 96% registered correctly at the minimum flow.

**The third party vendor tested remote-read meters that were out-of-the-box, and newly installed/those pulled from a service address.**

The new Sensus meters were accurate on an average of 100% for intermediate and maximum flow and 96% for minimum. There were no meters that over-registered during testing at any flow rate. Of the meters tested, four individual new Sensus meters under-registered flow amount. The following table summarizes meter test results at the three water flow rates.

**No remote-read meters over-registered during third party vendor testing, at any flow rate.**



METER TESTING FAILURES, PER AWWA STANDARDS										
Meter Type	Number Tested	Minimum Flow			Intermediate Flow			Maximum Flow		
		Below <sup>1</sup>	Passed	Above <sup>2</sup>	Below <sup>1</sup>	Passed	Above <sup>2</sup>	Below <sup>1</sup>	Passed	Above <sup>2</sup>
Legacy MultiJet	170	145 or 85%	25 or 15%	0 or 0%	57 or 34%	96 or 56%	17 or 10%	14 or 8%	102 or 60%	54 or 32%
Legacy Positive Displacement	30	20 or 67%	10 or 33%	0 or 0%	2 or 7%	28 or 93%	0 or 0%	8 or 27%	21 or 70%	1 or 3%
New Out-of-the-Box	51	1 or 2%	50 or 98%	0 or 0%	0 or 0%	51 or 100%	0 or 0%	0 or 0%	51 or 100%	0 or 0%
New Installed	46	2 or 4%	44 or 96%	0 or 0%	0 or 0%	46 or 100%	0 or 0%	0 or 0%	46 or 100%	0 or 0%
<b>Totals</b>	<b>297</b>	<b>168</b>	<b>129</b>	<b>0</b>	<b>59</b>	<b>221</b>	<b>17</b>	<b>22</b>	<b>220</b>	<b>55</b>

1 - Results in under billing

2 - Results in over billing

Source: SL-serco, Inc. report

Internal Audit reviewed water usage data for locations associated with the 200 legacy meters tested by the third party vendor. Our analysis of water meter data from January 2020 through June 2021 indicated that water consumption registered by 107 of 193 meters pulled for testing in February 2021 had an average water usage increase, while 85 had an average water usage decrease, and one had neither an increase nor decrease after being replaced by a remote-read meter.

One meter, pulled for testing in January 2021 had an average water usage decrease, and sufficient water usage data was not available to calculate average water usage for the remaining six (6) locations. We were, therefore, unable to make a comparison to these seven meters. In reference to the 193 meters where comparisons were feasible, Internal Audit saw no evidence that the remote-read meters inaccurately recorded higher water consumption. Since our analysis of water consumption covered the same period of time (i.e., four months before and after the 193 meters were pulled in February 2021), water consumption increases and decreases could have been a result of changes in customer behavior. However, such changes would not have been related to functionality with the remote read meters.

Age of Replaced Meter	Water Usage Before/After Replacement				
	Decreased	Increased	Neutral	Unknown	Total
4 Years	3	6	0	0	9
5 Years	7	6	0	0	13
6 Years	7	5	0	0	12
7 Years	6	8	1	0	15
8 Years	2	2	0	0	4
9 Years	6	5	0	0	11
10 Years	5	2	0	0	7
11 Years	2	9	0	0	11
12 Years	6	15	0	0	21
13 Years	11	17	0	1	29
14 Years	4	6	0	0	10
15 Years	6	6	0	0	12
16 Years	7	6	0	0	13
17 Years	6	5	0	0	11
18 Years	4	3	0	0	7
19 Years	2	3	0	2	7
20 Years	1	1	0	0	2
21 Years	1	2	0	0	3
Unknown	0	0	0	3	3
<b>Total</b>	<b>86</b>	<b>107</b>	<b>1</b>	<b>6</b>	<b>200</b>
Percentage	43.00%	53.50%	0.50%	3.00%	100.00%

Source: Water Utilities Billing System



SL-serco's report stated that as meters age, regular wear and tear causes meters to effectively slow down and under-register water use. SL-serco indicated that water quality, volume of water treated, meter type and age are factors which contribute to the level of accuracy over time. And that as meters in a system lose accuracy, a utility will begin to experience apparent water loss and customers will experience an uneven distribution of the cost burden as accounts with inaccurate meters are under-billed relative to actual usage.

## Customer Inquiries

The Water Department receives inquiries and water adjustment requests by email, phone, fax, mail, and in-person. The inquiries are then logged into the MyH2O customer inquiry data, and tracked. Based on our test results, approximately 86% (4,490 of 5,242) of the inquiries, documented within MyH2O between May 2019 and January 2021, referenced "high bill usage" or "water meter installations". Approximately 87% of the "high bill usage" and "water meter installations" inquiries (3,890 of 4,490) were related to accounts where a remote-read water meter had been installed.

**Approximately 87% of customer inquiries were related to accounts where remote-read water meters had been installed.**

A total of 5,195 customer inquiries were listed as closed/resolved. The remaining 47 were listed as open for various reasons (e.g., assign queue, pending notification, work order).

Internal Audit noted that when reviewing the Water Department's customer services escalation data for the period September 2020 through May 2021, the resolution of 97.4% (222 of 228) of customer inquiries were noted as being unrelated to the new meter. The remaining 2.6% (six of 228) were noted as being due to remote-read meters.

Since malfunctioning legacy meters could have resulted in under billings and an increase in customer inquiries, Internal Audit reviewed CIS data to determine whether there was any evidence of legacy meters not registering water consumption. We began by reviewing skip codes to identify meters that were skipped. We then further reviewed the skip data to identify meters that were skipped multiple times, for the same or different skip code/reason.

We concluded that some legacy meters were not read for various reasons. In some instances, Internal Audit considered the reasons to be City-related (e.g., cannot locate, lid stuck, meter buried, meter problem, no reading/blank, etc.). In other instances, the reasons were considered account owner-related (e.g., car on meter, gate locked, vicious animal, etc.). We saw no evidence of a consistent billing pattern, in either instance. For example, when reviewing consumption data for specific accounts, we noted that the same skip code was sometimes entered for multiple months (some of which were consecutive). However, billed consumption for those months varied, as the same consumption was not billed for each of the skipped months. Internal Audit was unable to determine the methodology by which meter readings were estimated when meters were skipped. Additionally, Internal Audit saw no correlation between customer inquiries and months in which meter readings were skipped.

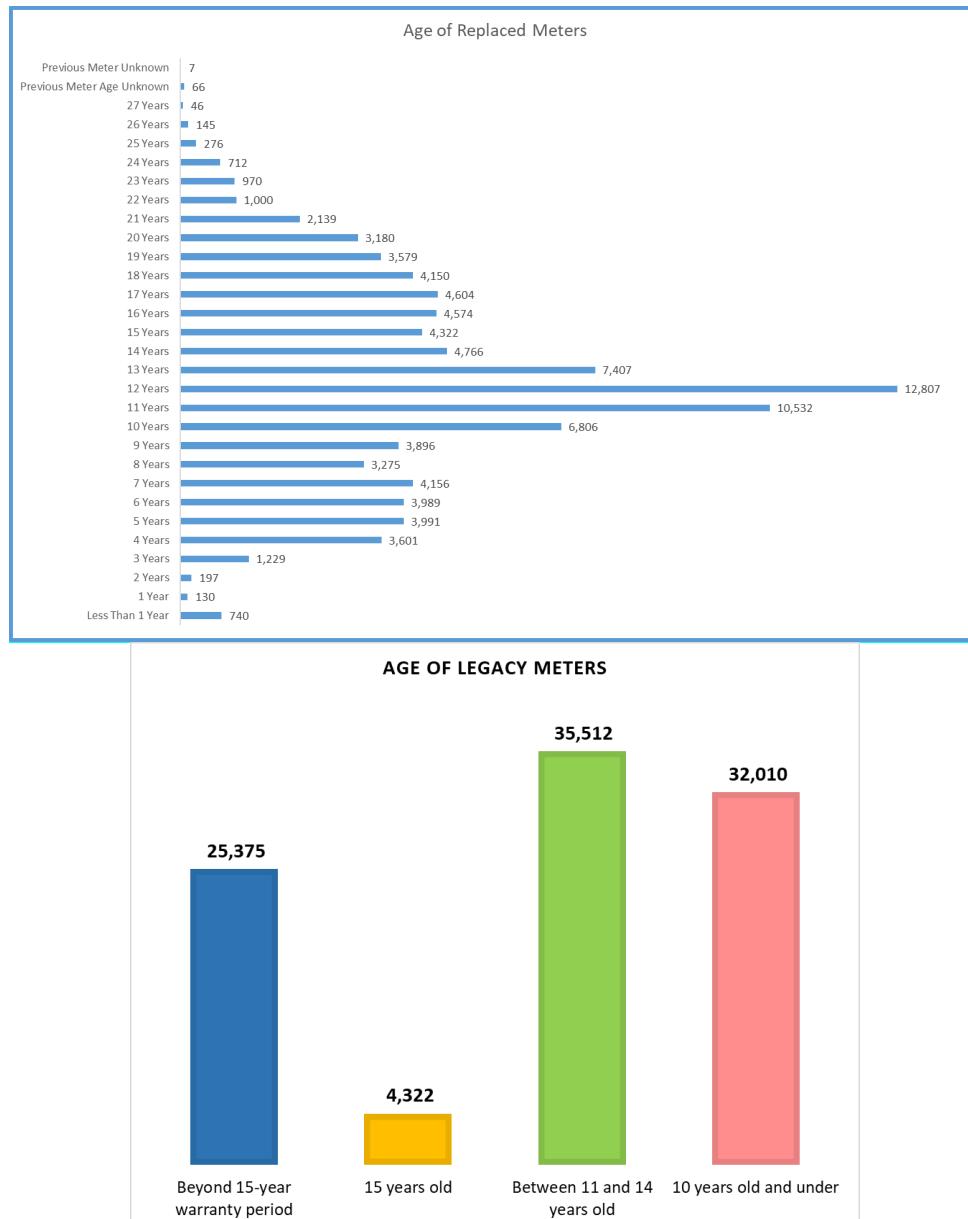


## Age of Legacy Meters

Since Water management mentioned aging infrastructure as a reason for replacing legacy meters, Internal Audit reviewed Water Department data to determine whether the legacy meters were replaced within or beyond their useful lives.

Meter installation dates were recorded for meters installed at 97,219 service addresses/meters. Internal Audit, therefore, verified the age of legacy meters replaced at these service addresses. Based on our review, approximately 30% (29,697 meters) of the meters replaced were either at or beyond 15 years.

**The age of legacy meters replaced were concentrated at 11 and 12 years old**

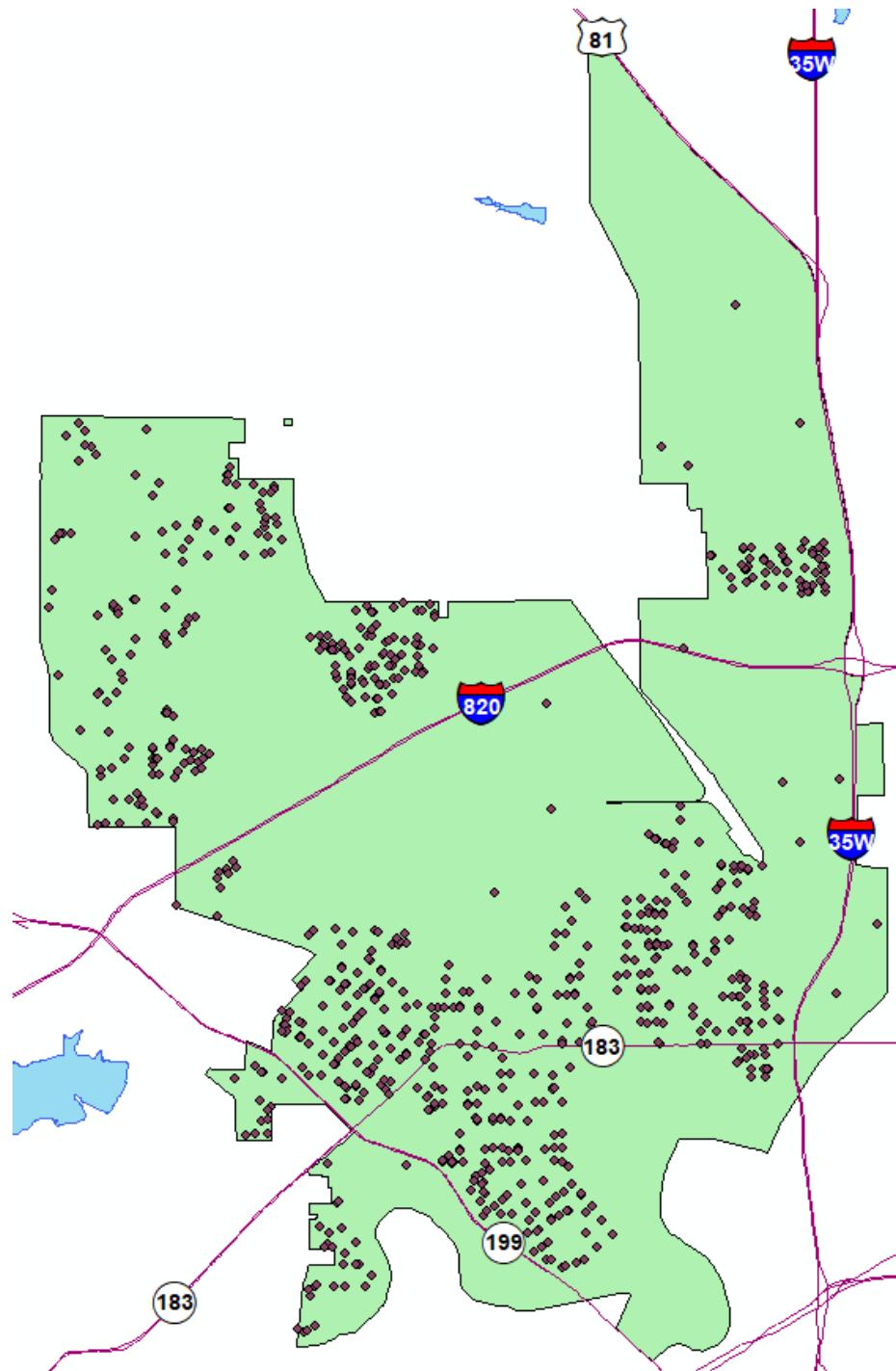




The remote-read water meter manufacturer, Sensus, warrants that their Sensus meters will perform to at least AWWA standards for 15 years from the date of the meter shipment or until a certain amount of water that has registered through the meter.



## Exhibit I – Remote-Read Water Meter Installations, by District

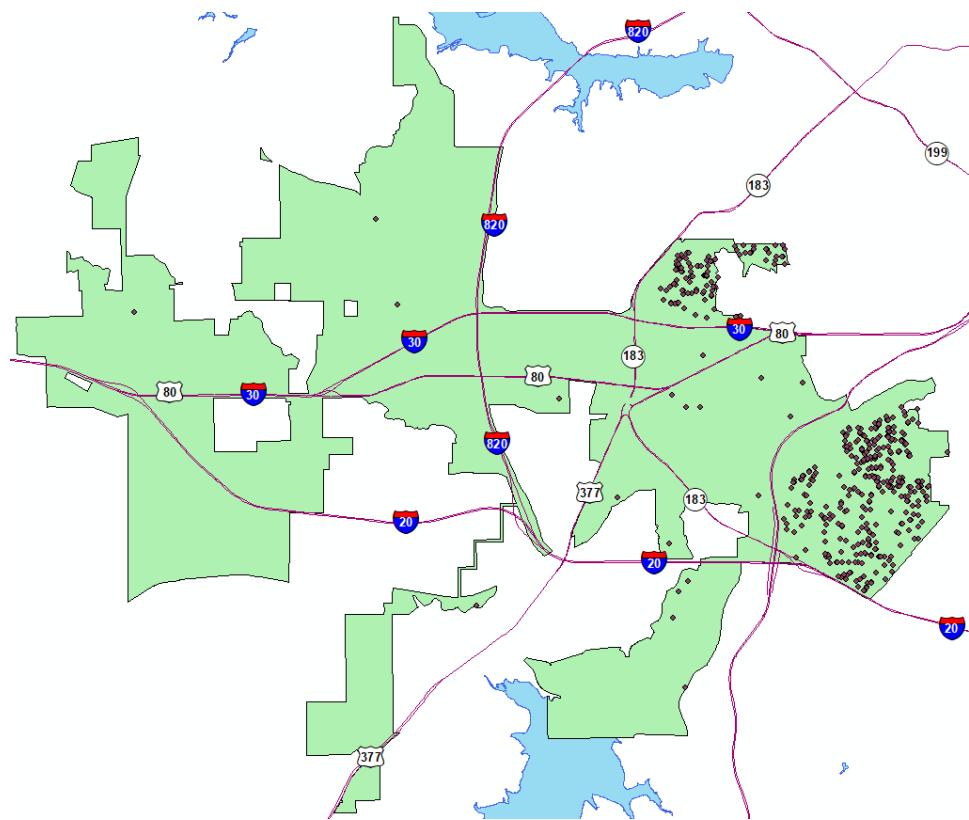


**(Council District 2 – Carlos Flores)**



## Exhibit I – Remote-Read Water Meter Installations, by District

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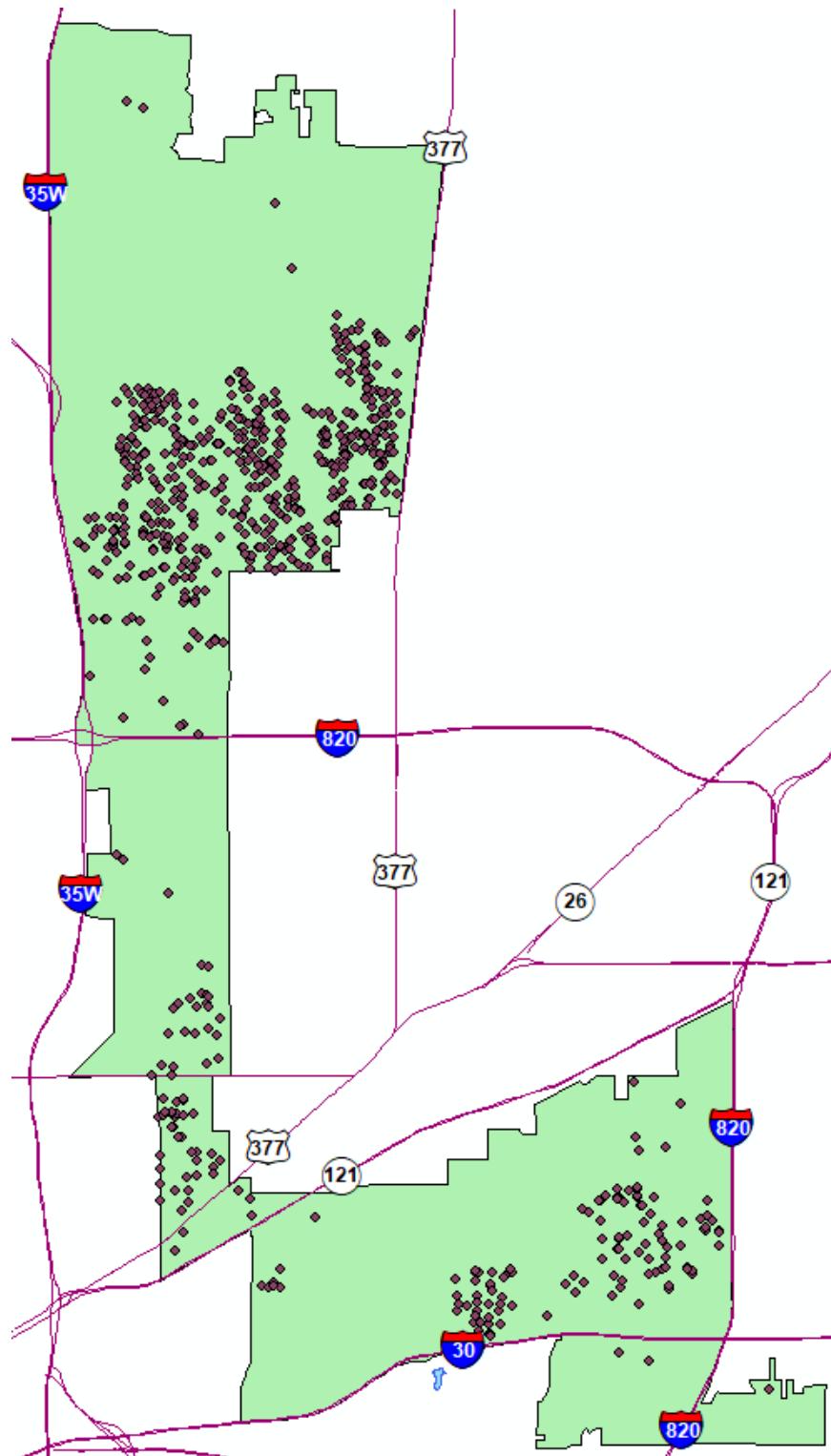


(Council District 3 – Michael D. Crain)



## Exhibit I – Remote-Read Water Meter Installations, by District

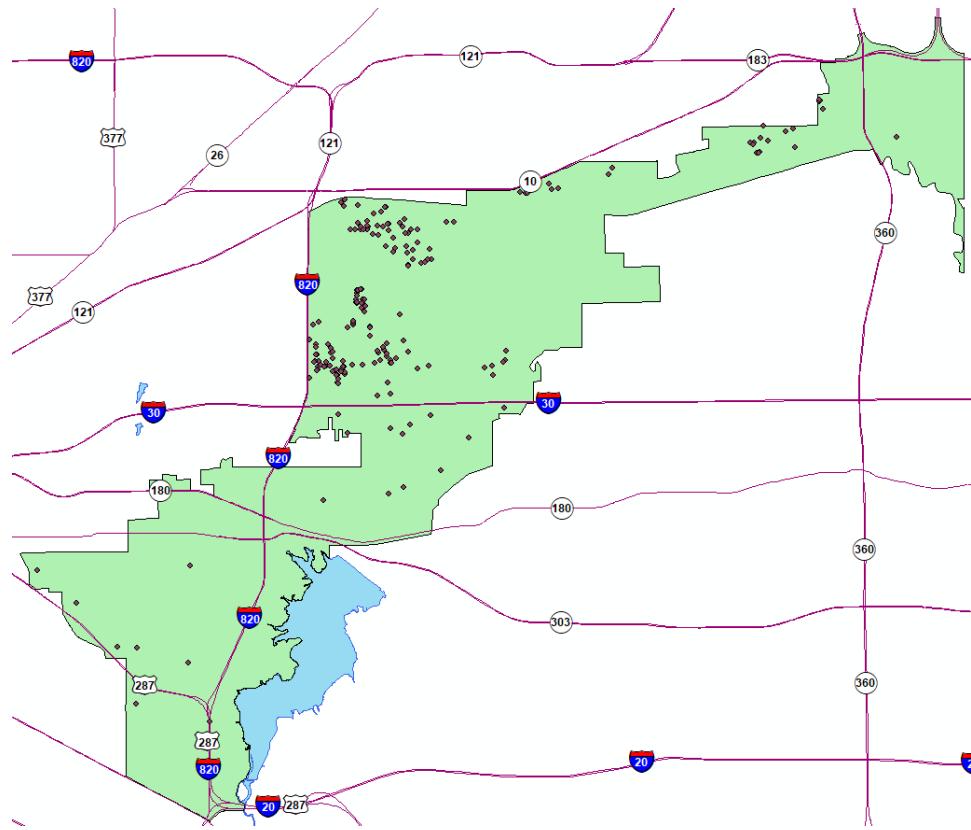
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(Council District 4 – Cary Moon)



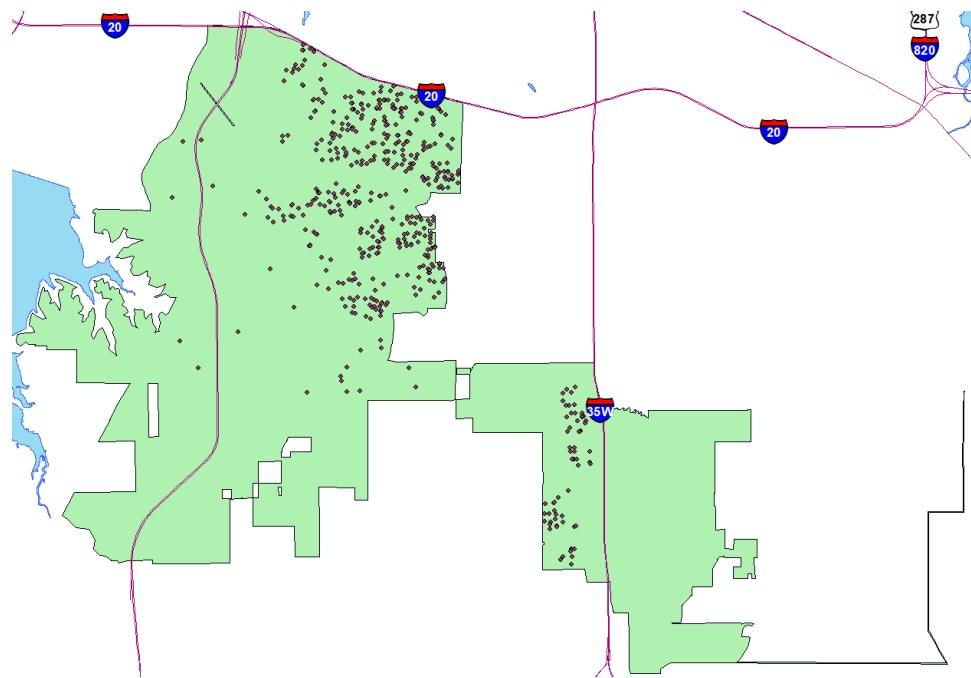
## Exhibit I – Remote-Read Water Meter Installations, by District



(Council District 5 – Gyna Bivens)



## Exhibit I – Remote-Read Water Meter Installations, by District

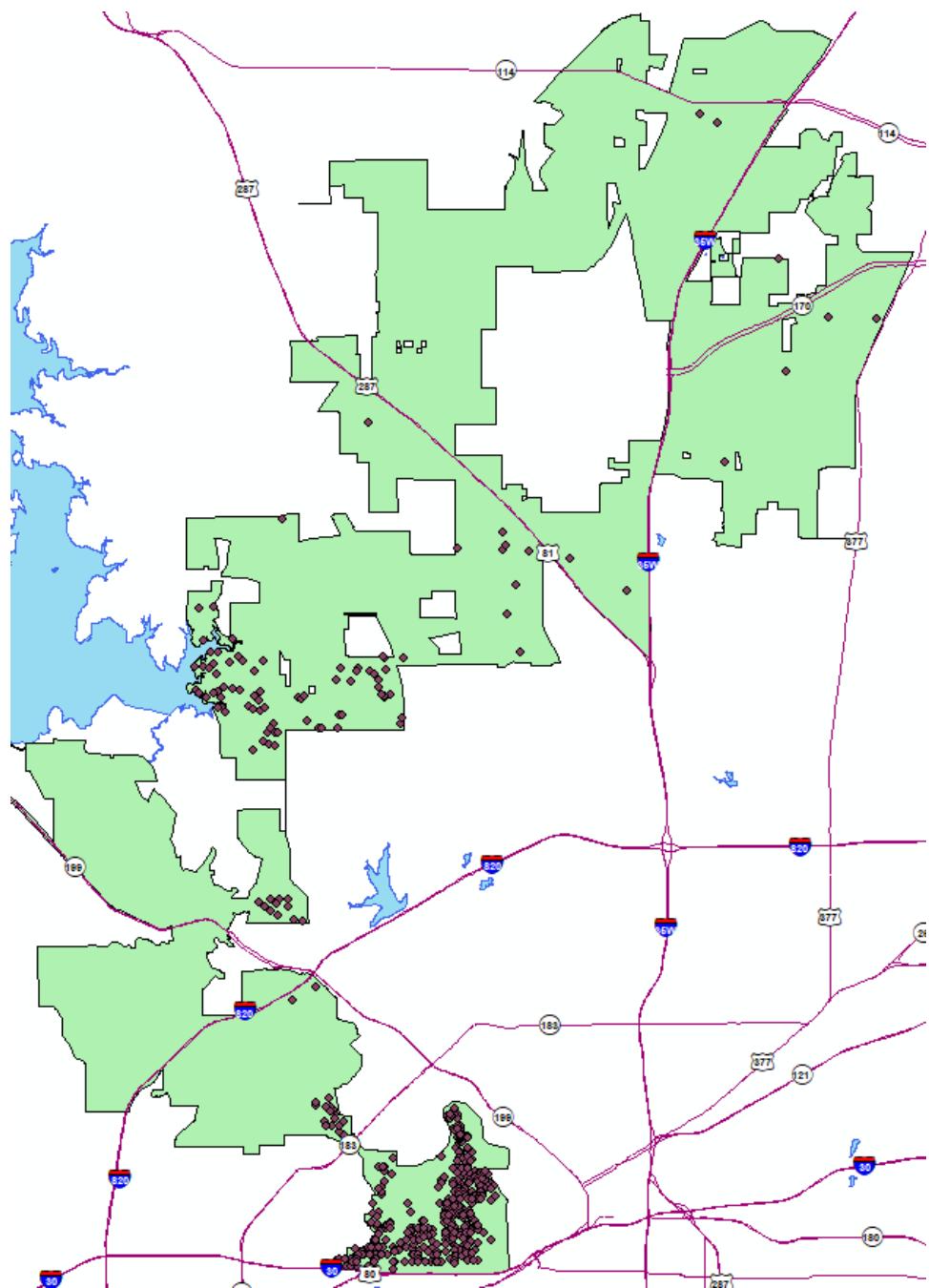


**(Council District 6 – Jared Williams)**



## Exhibit I – Remote-Read Water Meter Installations, by District

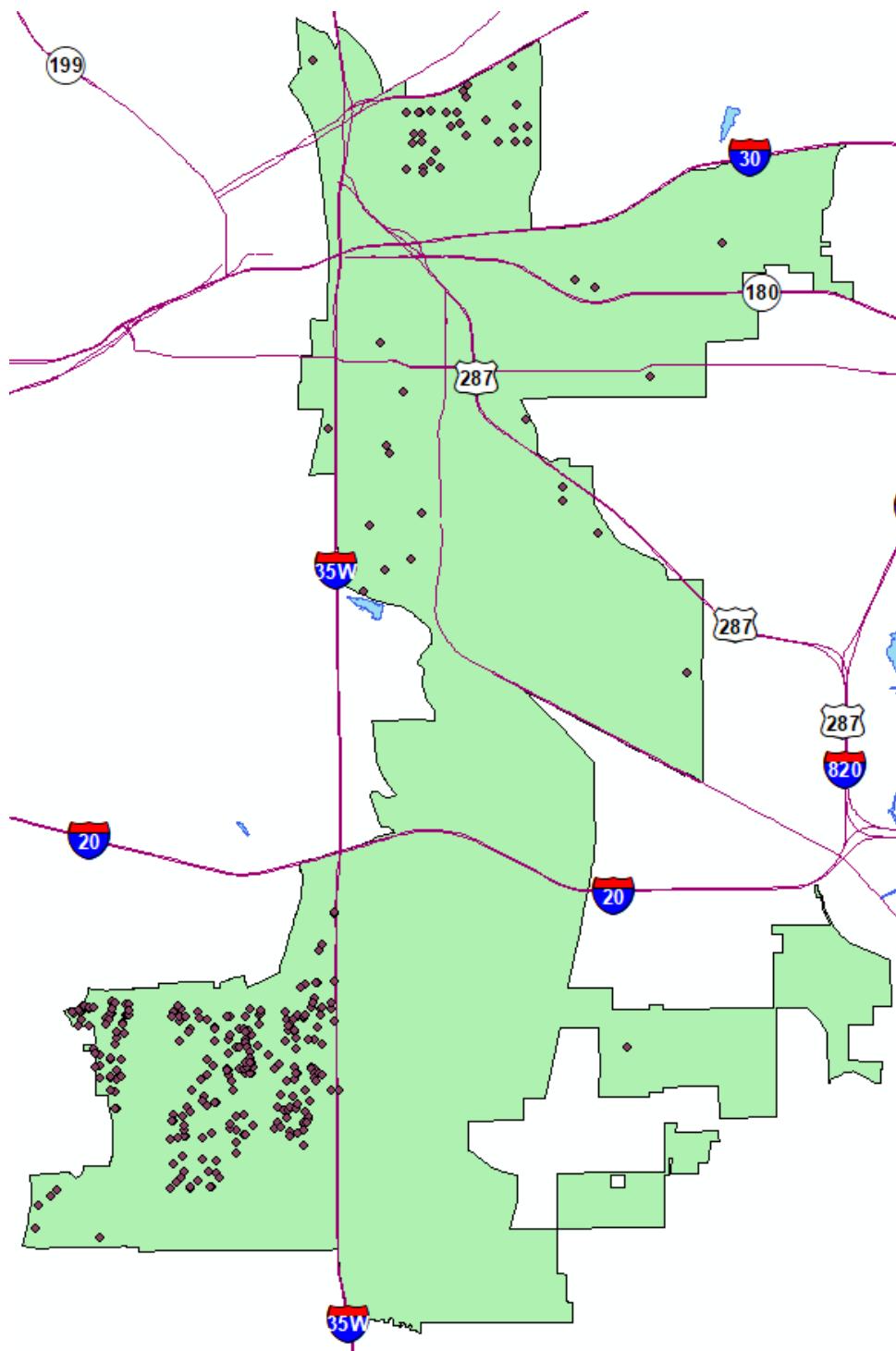
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## Exhibit I – Remote-Read Water Meter Installations, by District

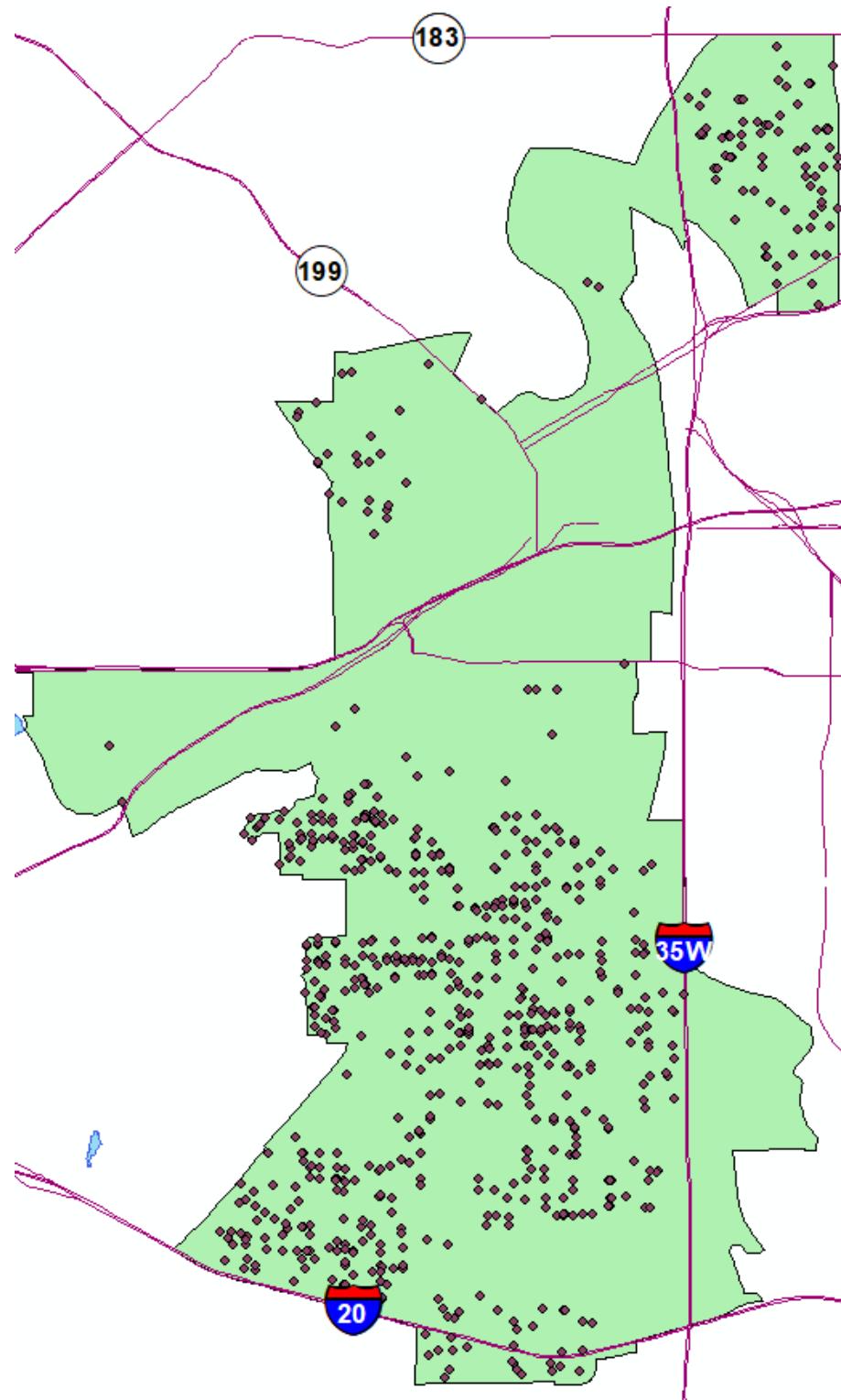
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**(Council District 8 – Chris Nettles)**



## Exhibit I – Remote-Read Water Meter Installations, by District



(Council District 9 – Elizabeth Beck)



## Acknowledgements

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The Department of Internal Audit would like to thank the City of Fort Worth's Water Department, for their cooperation and assistance during this audit.