County of Santa Cruz

HEALTH SERVICES AGENCY

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ENVIRONMENTAL HEALTH

FLOW METER INSTALLATION
SUGGESTED GUIDELINES

GLOSSARY

Community water system: A public water system that serves at least 15 service connections used by yearlong residents OR regularly serves at least 25 yearlong residents of the area served by the system.

EH: County of Santa Cruz Environmental Health Division

Individual/ service connection: Connections from the distribution system to individual customers. These could be residences, parcels, buildings or dwelling units depending on the system.

Source/ production meters: Meters that record the total amount of water produced and input into the distribution system.

Water System: The types of systems covered by this ordinance include Community water systems, Non-Transient Non-Community water systems, Transient Non-Community water systems, State Small water systems.

BACKGROUND

EH Water Meter Ordinance: As a measure to help better manage our limited water supplies and to prepare for the Sustainable Groundwater Management Act, the Santa Cruz County Board of Supervisors approved an update to the ordinance on water system metering and reporting on August 4, 2015. Here is a summary of the amendment of Chapter 7.71 of the County Code:

- Source production metering must be installed by October 1, 2015 on all Water Systems.
- Initial reporting of monthly source production through December 31, 2015 is required by January 15, 2016. This includes monthly source production going back as far as July 1, 2013 if available.
- Annual reporting of monthly production will be due on January 15th of each year.

- Community water systems are required to install individual service connection meters by October 1, 2017. An implementation plan for the installation of meters must be submitted by January 15, 2016. Guidelines are in development for the plans and will be sent separately to those systems.

GENERAL METERING REQUIREMENTS

Existing meters. To be considered functional, existing source production and individual service connection meters should be accurate to within +/- 5%.

Emergency or standby wells. An emergency or standby well must be metered like any other groundwater source.

Multiple sources and new wells. Ideally each source should be metered however, accommodations can be made for special circumstances: e.g. manifolded wells and wells next to each other.

Source/production water meters. The full water production is required for all water systems, detailed information is available below.

SOURCE/PRODUCTION METER PHYSICAL SPECIFICATIONS

General information. Appropriate materials and correct installation of production meters is important to maintain accuracy. Most manufacturers recommend that meters be installed on only straight runs of pipe. A total of at least ten and preferably fifteen pipe diameters of straight pipe should be in front (upstream side) of the meter, and there should be ten diameters on the downstream side of the meter. If applicable, production metering is best inserted just before water exits the treatment facility into the distribution system. More details are listed below.

Meter Types:

Whenever possible, newly manufactured meters should be purchased to ensure accuracy. It is up to the water system's Certified Operator, Licensed Well Pumping Contractor and/or Plumber to determine which type of source/production metering best meets the water system's needs

In general, there are two common approaches to flow measurement, displacement and velocity, each making use of a variety of technologies.

Common positive displacement meter designs include oscillating piston and nutating disc meters. Positive displacement meters are used in often used in homes, small businesses, hotels, and apartment complexes. They are available in sizes form 5/8" to 2 inches.

Velocity-based designs include single- and multi-jet meters, turbine, propeller, ultrasonic, venture and orifice meters. These meters are available in sizes of 2 inches and larger with the exception of multi-jet meters, which are between 5/8" and 2 inches.

There are also non-mechanical designs, for example electromagnetic and ultrasonic meters, and meters designed for special uses. Most meters in a typical water distribution system are designed to measure cold potable water only.

Materials: Source/production meters should be constructed of durable materials for outside, above and below ground. **All components must be waterproof and lead-free.**

Operating: Meters should be suitable for outdoor operation under all weather conditions, direct sunlight, and ambient temperatures of 20F to 120F. Pressure ratings must be at least 100 psi.

Register Head: The register head should be non-resettable and sealed to prevent condensation. The display must include either (i) a sweep dial with 100 divisions or (ii) a rate-of-flow indicator with test hand. Electronic registers must have a "memory" capability in case of battery failure.

Calibration: Meters should be capable of calibration.

Anti-Tampering: Meters should be provided with seal wire holes in at least two (2) of the register bonnet screws, U-bands bolts or nuts, and, where applicable, flange bolts.

Operating Characteristics:

Accuracy: Meters should meet American Water Works Association (AWWA) accuracy standards.

Calibration Test Meters should be tested for accuracy before shipment. The tests should include volumetric tests at minimum, maximum, and normal flows. Complete certified test results should be furnished with each meter.

Design Life: We recommend the meters have a minimum life of at least 10 years. A warranty from the manufacturer is highly recommended as well.

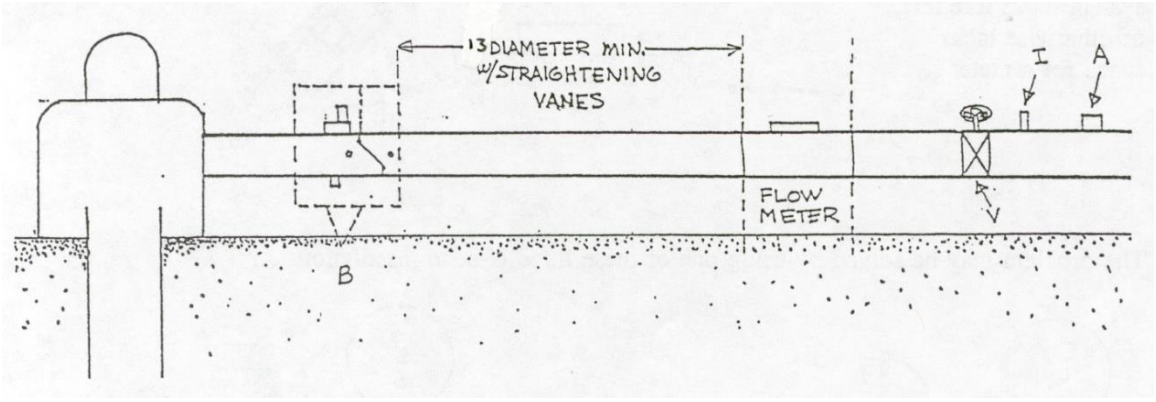
Maintenance: For meters to be effective, they must accurately read the amount of water flowing through them. Proper testing and maintenance procedures should be in place to assure accuracy.

BASIC INSTALLATION DESIGN

Basic installation requirements. Figure 1 illustrates a typical meter installation, showing the location of the meter with respect to the well and the other main line fittings.

Straight pipe recommendations. When feasible, two straight pipe sections should be provided to ensure meter accuracy: an unobstructed straight run upstream of the meter and an unobstructed straight run downstream of the meter. It is recommended that the upstream straight run be long enough to include both a meter test section and a backflow prevention device.

FIGURE 1. PREFERRED FLOW METER INSTALLATION DESIGN.



B = Backflow Prevention Device / Check Valve
V = Valve (may be upstream of flow meter)
I = Injection port
A = Air relief valve or vacuum breaker (may be upstream of flow meter)
**Whenever possible, the meter should be installed downstream from the filtration system (if there is one). The filters will protect against meter wear.*

MAIN LINE VALVES, FITTINGS, AND ACCESSORIES

Water diversion points. The meter must be installed at or near the well in such a position that all water from the well is measured. The one exception is that the meter may be installed downstream from a sand filter or other filtration system which ejects flush water. In fact, installation downstream from the filtration system is preferred since it would tend to protect against meter wear. No junctions, taps, or other diversion points may be included upstream of the meter.

Air relief valves. Air relief valves may be located either upstream or downstream from the meter.

Isolation valves. Systems with continuously pressurized lines or lines requiring lengthy drainage must include one or more isolation valves at the meter to facilitate meter maintenance.

Injection ports. All ports used for injecting chemicals, and other additives into the system must be located downstream from the backflow device and, whenever possible, should be located downstream from the meter.

Pipe and meter support. Pipe supports should be included for any new pipe used in the meter installation and on existing pipe when the modification creates a risk of pipe failure. Supports may be vertical pipe stands anchored in concrete or some other construction providing equivalent strength.

BACKFLOW PREVENTION RECOMMENDATIONS

Backflow prevention authority. Backflow prevention requirements are established by the State, the county, and other local agencies. EH does not have any separate or additional backflow prevention requirements.

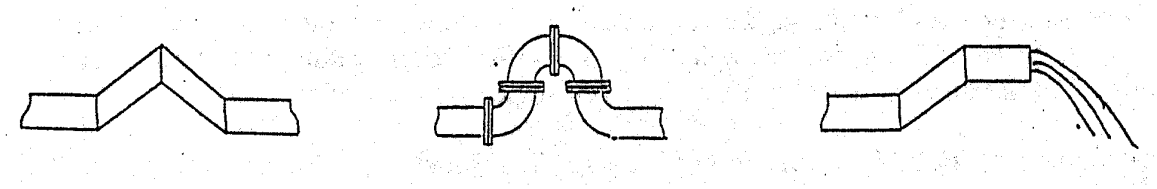
Wells supplying drinking water. Minimum backflow prevention requirements are set forth in Title 17, Public Health, California Code of Regulations (Sections 7583-7585 and 7601-7605, effective June 25, 1987). More stringent requirements may be established by local authorities.

ADDITIONAL DESIGN CONSIDERATIONS

Pipe orientation: The meter may be installed in horizontal pipe, vertical pipe, or inclined pipe, so long as sufficient straight run is provided.

Underground installation: To avoid above ground repiping, the meter may be installed on any underground main line segment located within 3 feet of the ground surface. Underground installation will require additional equipment and materials, including an extension for the meter, a vault for accessing the installed meter, and isolation valves. Any underground installation should be discussed with EH before construction begins.

Ensuring a full pipe: Whenever water is flowing and the pipe is not full, the meter will read high. Non-pressurized systems, such as those used for furrow irrigation, should include a "gooseneck" downstream from the meter, as illustrated below:



Welded Pipe | Using Elbows | Open Discharge

Full-pipe problems occur less frequently in pressurized systems. When they do, they are usually associated with the failure of an air relief valve. The best protection against this potential problem is, if possible, to locate the air relief valve downstream from the meter.

Pipe thickness: All pipes should be at least as sturdy as PVC Schedule 40 pipe to prevent deformation when the saddle meter is attached. Pipe that does not meet this minimum standard should be replaced.

VERIFYING THE METER INSTALLATION

Compliance with the Santa Cruz County Water Metering Requirements: A water system will be deemed in compliance with the water metering requirements as soon as all necessary meters have

been installed, along with notification to EH. Thereafter, installation will be subject to verification during routine site visits and inspections,

Responsibilities after installation: The well owner and/or certified operator will be responsible for maintaining, servicing, repairing, and replacing the meter when necessary.

METER REPORTING

Estimating water production when the meter is broken or malfunctioning: Any significant water production during such time will be estimated using the recordings of the backup device or some other method appropriate for the specific conditions of the site.

Well use logs: Well owners and operators are encouraged to keep accurate and detailed logs of well use and operating conditions. Monthly record keeping is required and will be submitted on an annual bases.

SERVICE CONNECTION METERING (COMMUNITY WATER SYSTEMS ONLY):

Meters are installed either in outdoor meter pits (also known as meter wells) or inside the building served. It is often best to have the meter located at the curb or property line because of easy access for reading or maintenance.

General guidelines for installing service connection meters:

- Whenever possible, newly manufactured meters should be purchased to ensure accuracy.
- In outdoor meter pits, the face of the meter should be between 18 and 24 inches from the ground surface or top of the meter pit lid.
- Meter pits or wells should have six to 12 inches of gravel at the bottom to help with drainage.
- Large meter pits should have a drain or a sump pump if a drain is not possible. There should never be standing water in a meter pit or well.
- If at all possible, the meter pit or well should not be located in an area prone to flooding.
- The meter setting should have a shut-off valve on both sides of the meter (i.e., the customer's side and the water main side).
- If possible, the meter should be installed in a horizontal position.
- The meter should be easily accessible for service, inspection, and reading even if meter reading is via remote sensing equipment.
- Protect the meter from freezing.
- Always be mindful of public safety. Don't have the meter lid sticking up or have it too low so that it creates a hole.
- Install seals on the meter to reduce tampering and indicate when tampering does occur.

Suggestions for larger meter vaults or pits:

- Large meter pits should also have a drain or a sump pump if a drain is not possible. There should never be standing water in a meter pit or well.
- To prevent disruption of service when replacing or repairing large meters, there should be a bypass that can also be metered. Having the bypass metered would be similar to a manifold set-up where you have two or more meters in parallel making service of one meter easy without service disruption or lost revenue.
- Large meter installations should have good structural support to prevent stress on the water line.
- There should be at least 10 times the pipe diameter of straight pipe before the meter and five times the pipe diameter of straight pipe after the meter.
- Some large meters recommend or require a strainer to be installed ahead of the meter.
- With large meters that are located in concrete vaults or pits, ideally, the meter face should be located over the hatchway to help with reading the meter, possibly reading the meter without even entering the pit. This will also help in lifting the meter from the pit. Remember, if the meter reader has to enter the meter vault or pit, this is considered a confined space entry and the proper safety procedures must be followed.
- Small meter installation is easier with a meter yoke (also known as a meter setter). Meter yokes have different configurations and can have any combination of built-in check valves, regulators, and lockable shutoff valves. Water systems should have their own set specifications with illustrations depicting proper meter installations.

Selecting a connection meter: Meters are selected using several factors: flow rate, size of pipe, pressure loss and safety considerations, such as fire service regulations. For sizes of one inch and smaller and low flow rates, positive displacement types of meters are common. For residential uses, 5/8" or 3/4" meters are typically used.

For medium flows, such as in apartment buildings, businesses, and public buildings, positive displacement meters in sizes of 1", 11/2", or two inches are typically used. In sizes of two and three inches, either, displacement, multi-jet, or turbine types of meters can be used. In the three- to four-inch size range, the meter type depends on the average flow rate. If the flow rate is between five and 35 percent of maximum flow rate, the positive displacement type is better. If the flow rates are going to be 10 to 15 percent of the maximum capacity, a turbine type should be used. If close accuracy at low flows is important, but large flows also have to be measured, a compound meter is best.

For large flows, velocity meters are more appropriate. Turbine meters are suitable for large flows where minimum flow rate is above 10 to 20 percent of maximum rating. Turbine meters have low pressure loss at high flow rates. Propeller meters are suitable for large mainlines or for pump station discharge.

Residential meters: These may be the final priority in the testing and maintenance program in small water systems, yet they may be the most important.

The majority of residential meters are the positive displacement type, which almost always slow down when they are worn or encrusted by minerals or debris. With residential meters, the testing program should either consist of periodic testing on a test bench or a complete change-out program.

Residential meters should be checked, cleaned, and calibrated every seven to 10 years or as indicated by the manufacturer. If your system does not have a meter test bench, check with a neighboring system or shop around for a Plumber or Well Pumping Contractor that can do testing on a certified test bench.

Testing and maintenance of the meters depends on the quality and quantity of the water. If adverse conditions, such as high minerals or large flows are encountered, meters will require more frequent attention. Water that has high levels of minerals will affect the operation of a meter over time. This should be taken into account with a system's Operations and Preventive Maintenance program by cleaning the meter to extend its life and to improve the accuracy of the meter.

Maintenance requirements will vary depending upon the material used in the meter components. Although plastic meters are less expensive, more maintenance and more frequent replacement may be necessary.

Industrial & Commercial Meters: Meters larger than two inches are usually tested in place using a calibrated field test meter. To be able to field test a meter, there must be a tap and an isolation valve immediately downstream from the meter. This temporary connection can be made with a fire hose. Even new meters should be tested.

Master meters at sources or within water treatment plants are, in some cases, difficult or impossible to test using a field test meter. In these situations, a draw-down test can be conducted, which involves comparing a known volume of water pumped out of a tank (clearwell) to the volume recorded on the meter being tested.