CITY OF PHILOMATH
Water System Master Plan,
Philomath, Oregon

Section 3

Regulatory Requirements and Basis of Planning

SECTION 3
REGULATORY REQUIREMENTS AND BASIS OF PLANNING

3.1. Regulating Agencies

Water use regulations considered under this Water System Master Plan include the Safe Drinking Water Act (SDWA) and amendments as administered by the Oregon Health Division (OHD) under OAR 333, as well as water rights and water use regulations administered by the Oregon Water Resources Department (OWRD). A brief overview of regulatory considerations and their applicability to the City is presented below.
The following is a brief summary of the regulatory requirements and standards that form the basis of the master planning effort. The requirements under Federal and State water treatment regulations are summarized first, followed by a discussion of issues relating to the water system design standards proposed for adoption by the City.

3.2. Water Treatment & Distribution Regulations & Standards

Congress passed the original Tittle XIV of the Public Health Service Act, commonly known as the Safe Drinking Water Act, in 1974, and amended it in 1986 and 1996. The Safe Drinking Water Act (SDWA) and the 1986 and 1996 Amendments are federal water quality regulations affecting all public water purveyors. Regulations under the SDWA are promulgated by the US Environmental Protection Agency (USEPA) and administered by the Oregon Health Division (OHD). Some of the general applicable requirements of the SDWA amendments are considered in order to reduce the possibility that implementation of the Water Master Plan will be in conflict with any known or upcoming provisions of the act. However, this does not include all provisions or requirements of the SWDA or OHD, but is limited to those items which are most applicable to the City's current system or which must be considered in the evaluation of alternatives.

The State of Oregon, Department of Human Resources, Health Division (OHD) is the primary regulating authority for public drinking water systems. The requirements of the federal Safe Drinking Water Act and amendments are implemented by Oregon under the Oregon Drinking Water Quality Act of 1981 (ORS 448 as amended). The state of Oregon, through OHD, has exercised primary responsibility for the administration of the drinking water programs in the state, an arrangement called Primacy. The Oregon Drinking Water Quality Act is regulated by the administrative rules outlined under OAR 333-61, Public Drinking Water Systems. In practice, the Oregon drinking water standards match the national standards established under the Safe Drinking Water Act. OHD, under the Primacy Agreement with the USEPA, has up to two years to adopt each federal rule after it is finalized.

OAR 333-61 outlines the responsibilities of the water suppliers, maximum contaminant levels and treatment requirements, sampling, reporting and public notice requirements, operation and maintenance requirements, and cross connection/backflow standards. It also contains the minimum construction standards and plan review requirements for construction of new public water systems and to major additions or modifications to existing public water systems (OAR 333-61-050 & 060). OAR 333-61-060 also outlines the minimum requirements for water system master plans adopted by the community.

The following is a brief overview of some of the applicable current and future drinking water quality standards and other applicable regulatory requirements. This overview is for reference only and does not include all requirements. Future standards described are still under development and are subject to change. This summary is largely based on a comprehensive overview of drinking water standards prepared by the Oregon Health Division that is included in **Appendix B**. The purpose of the following discussions is to provide background information for the recommendations later in this report. For a more thorough discussion of a particular standard the OHD overview in **Appendix B** should be consulted.

3.2.1 Drinking Water Contaminants

Drinking water contaminants are any substances present in drinking water that are known to adversely impact human health. They can be grouped into five general categories as follows.

- *Microbial Contaminants* - such as viruses and bacteria which can come from sewage treatment plants, septic systems, agricultural and livestock operations, and wildlife.
- *Disinfectants and Disinfection By-Products* – chemical disinfectants used in water treatment to kill harmful microbes, and the chemical by-products formed from the reaction of disinfection treatment chemicals with natural substances in the water.
- *Inorganic Chemicals* - such as salts or metals, which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming. It also includes lead and copper leached into the water from household plumbing and fixtures.
- *Organic Chemicals* - Pesticides and herbicides may come from a variety of sources, such as agriculture, urban stormwater runoff, and residential uses. It also includes synthetic and volatile chemicals which are by-products of industrial processes and petroleum production, and can also come from gas stations, urban stormwater runoff, and septic systems.
- *Radiologic Contaminants* - which can be naturally occurring or result from oil and gas production and mining operations.

Every drinking water system is vulnerable to microbial or chemical contaminants of one type or another from a variety of sources. Disease-causing microorganisms (e.g., bacteria, viruses, protozoas) can be present in surface water (e.g., lakes and streams) or from groundwater (e.g., wells or springs) from human or animal feces.

Microorganisms can also enter the water system through pipe breaks or cross connections. Organic chemicals (e.g., industrial solvents, pesticides) are mainly man-made and can enter drinking water supplies as a consequence of chemical production, storage, use, or disposal in the water source area. Inorganic chemicals can be introduced by human activities (e.g., nitrate from fertilizer) but more often result from natural occurrence in rocks, soils, and mineral deposits (e.g., radon, arsenic). Drinking water treatment which is essential to remove microbes and chemicals can also add or form contaminants in drinking water, such as disinfectant chemicals themselves, byproducts of disinfectants with other materials in the water, and treatment chemicals used in filtering water. Finally, water storage tanks, pipes, and household plumbing that are in direct contact with water can contribute contaminants from either the material used in the tanks and pipes or from internal coatings used to protect the materials from contact with the water (e.g., lead and copper, organics).

Many of the provisions of the drinking water standards apply to the water system regardless of whether it has a surface water source or a groundwater source. However, there are a number of current and anticipated future requirements that are more specifically related to the type of water source utilized. The following discussions outline some of the water quality or treatment standards that are most applicable to either groundwater or surface water. The purpose of these discussions is to provide background information for the recommendations later in this report. For a more thorough discussion of a particular standard the OHD overview in **Appendix B** should be consulted.

3.2.2 Drinking Water Standards and Health Protection

To protect health, national regulations set by the US Environmental Protection Agency limit the amounts of certain contaminants in water provided by public water systems. These limits, or standards, take several forms.

- *Maximum Contaminant Level Goal (MCLG)* – The level of a contaminant in drinking water below which there is no known or expected risk to health, allowing for a margin of safety. All regulated contaminants have an MCLG, although the MCLG is not enforceable.
- *Maximum Contaminant Level (MCL)* – The highest level of a contaminant allowed in drinking water, set as close to the MCLG as feasible using the best available treatment technology.
- *Treatment Technique (TT)* – A required treatment process intended to reduce the level of a contaminant in drinking water. For any contaminant that can not be effectively measured or detected in drinking water, the standard may be a treatment technique requirement instead of an MCL. This means that all water systems at risk of the contaminant must provide continuous water treatment to remove the contaminant at all times. Performance standards (PS) are used to determine whether or not a water system is meeting a specific treatment technique requirement. Performance Standards are measurements of water

quality parameters related to specific treatment processes, such as turbidity, disinfectant residual, pH, or alkalinity.

- *Action Level (AL)* – The concentration of a contaminant, which when exceeded, triggers treatment or other requirements which a water supplier must follow.

Public water suppliers must sample for contaminants routinely to ensure that standards are met, and report results of that sampling to the regulatory agency. Sampling frequencies for public water systems vary by the type of drinking water contaminant.

3.2.3 Public Drinking Water Regulatory Program

In Oregon, public drinking water systems are subject to the Oregon Drinking Water Quality Act (ORS 448 – Water Systems). Under this act, the Department of Human Services has broad authority to set water quality standards necessary to protect public health through insuring safe drinking water. The Department is directed under the Act to require regular water sampling by public water suppliers. These samples must be analyzed in laboratories approved by the Department. The water supplier must report the results of laboratory analysis tests to the Department. The Department must investigate water systems that fail to submit samples, or whose sample results indicate levels of contaminants that are above maximum allowable levels. Water suppliers who fail to sample the water or report the results, or whose water contains contaminants in excess of allowable levels must take corrective action and notify users.

3.2.4 Current Standards

There are now national drinking water quality standards for 95 different contaminants, including 9 microbials, 8 disinfection by-products and residuals, 18 inorganics (including lead and copper), 53 organics, and 7 radiologic contaminants. These standards either have established MCLs or treatment techniques, and are summarized in this section.

3.2.4.1 Microbial Contaminants

Microbial contaminants are regulated in an effort to reduce the risk of waterborne illness. Measurements of Coliform bacteria are used as indicators that other organisms that are potentially harmful may be present. Routine samples must be collected and analyzed for Coliform bacteria. Samples that show the presence of total coliform bacteria must be further examined for fecal coliforms or *E.coli*.

All public water systems must regularly test for coliform bacteria from locations in the distribution system identified in a coliform sampling plan. The number, frequency, and location of the samples are a function of the nature of the source, the treatment facilities, and the size of the population served. All coliform sample results are reported as "coliform absent" or "coliform present". A set of 3-4 repeat samples is required for each positive coliform sample. Repeat sampling continues until the MCL is exceeded or a set of repeat samples with negative results is obtained. No more than 5% positive samples are allowed in any month. Confirmed presence of fecal coliform or *E.coli* is considered an acute health risk and requires immediate notification of the public to take protective action such as boiling or using bottled water.

For surface waters, requirements are set to increase protection of people against gastrointestinal illness from *Cryptosporidium* and other disease producing organisms. These requirements are designed to control pathogenic microorganisms and indicators in surface water sources, including *Cryptosporidium*, *Giardia lamblia*, enteric viruses, and *Legionella*. Requirements are also set to control indicators of microbial contamination including heterotrophic plate count bacteria (HPC), and particulate matter from soil runoff (turbidity).

Water systems must provide a total level of treatment to remove/inactivate 99.9% (3-log) of *Giardia lamblia*, and to remove/inactivate 99.99% (4-log) of viruses. In addition, filtered water systems must achieve 99% (2-log) removal of *Cryptosporidium* control in their watershed control programs. Since direct levels of *Giardia lamblia*, virus, *Cryptosporidium* are analytically difficult to determine, filtration performance standards for turbidity, and CT (concentration * time) calculations for disinfection, are used to determine if a water system is meeting the required removal/inactivation levels. For conventional filtration treatment, the performance standard is 95% of turbidity measurements collected at four-hour intervals must be less than 0.3 NTU and all turbidity measurements must be less than 1 NTU. To comply with the disinfection standard, small systems (e.g., Philomath) must collect at least one residual sample each day and calculate CT at the highest flow. The CT value must meet the required minimum for the particular facility. In addition, a minimum residual of 0.2 mg/L must be maintained at every point in the distribution system. These standards are described in more detail in **Appendix B**.

3.2.4.2 Disinfectants and Disinfection Byproducts

To protect public health, limits on chemical disinfectant residuals and chemical by-products of disinfection are set. Disinfection treatment used to kill microorganisms in drinking water can react with naturally occurring organic and inorganic matter in water to form disinfection by-products. The challenge is to apply levels of disinfection treatment needed to kill microorganisms while limiting the levels of disinfection by-products produced. The primary disinfection by-products of concern in Oregon are the trihalomethanes and the haloacetic acids. Disinfectant residuals must be monitored at the same locations and frequency as coliform bacteria.

Disinfection by-products must be monitored throughout the distribution system at frequencies that vary as a function of the population served, type of water source, and specific disinfectant applied. Systems using surface water sources and conventional filtration treatment must monitor source water for total organic carbon (TOC) and control with enhanced coagulation if TOC exceeds 2.0 mg/L. Compliance with the standards is determined based on meeting maximum levels for disinfectant residuals and disinfection by-products over a running 12-month average of the sample results, computed quarterly. The individual MCLs are listed in **Appendix B.** Surface water systems serving less than 10,000 people and all groundwater systems must have demonstrated compliance with these standards no later than January 2004.

3.2.4.3 Lead and Copper

The purpose of the lead and copper standard is to set treatment technique requirements to control lead and copper in drinking water at the customer's tap. Corrosion of plumbing and plumbing fixtures in buildings and homes is the primary source of lead and copper in potable water in Oregon. Lead comes from lead solder and brass fixtures, and copper comes from copper tubing and brass fixtures.

Lead and copper are monitored by collecting samples from "high-risk" homes. One-liter samples of standing water (first draw after 6 hours of non-use) are collected at homes identified in the water system sampling plan. The number of samples required is based on the population as described in **Appendix B.** In each sampling round, 90% of samples from homes must have lead levels less than or equal to the action level of 0.015 mg/L, and copper levels less than or equal to the action level of 1.3 mg/L. Water systems with lead above the action level must conduct periodic public education, and either install treatment, change water sources, or replace plumbing.

3.2.4.4 Inorganic Contaminants

Inorganic contaminants most often come from the source of water supply, but can also enter water from contact with materials used for pipes and storage tanks. The monitoring requirements depend on the particular contaminant, the water source, and the materials used in the distribution system. Water systems must meet the MCLs listed in **Appendix B**. A separate compliance schedule has been established for Arsenic.

3.2.4.5 Organic Chemicals

Organic chemicals are most often associated with industrial or agricultural activities that affect sources of drinking water supply. Major types of organic chemicals include Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs). These include industrial and commercial solvents and chemicals, and pesticides used in agriculture and landscaping. Organic chemicals can also enter drinking water from materials in contact with the water such as pipes, valves, and paints and coatings used inside water storage tanks. At least one test for each contaminant from each water source is required during every 3-year compliance period. Public water systems serving more than 3,300 people must test twice during each 3-year compliance period for SOCs. Public water systems using surface water sources must test for VOCs annually. Quarterly follow-up testing is required for any contaminates that are detected. The exceptions are dioxin and acrylamide/epichlorohydrin. Only those systems determined by the Department to be at risk of contamination must monitor for dioxin. Water systems must meet the MCLs listed in **Appendix B**. Systems that cannot meet the MCLs must install or modify treatment systems or develop alternate sources.

3.2.4.6 Radiologic Contaminants

The purpose of this rule is to limit exposure to radioactive contaminants in drinking water. The specific contaminants are listed in **Appendix B**. These contaminants are both natural and man-made. Initial quarterly tests for one year must be completed prior to December 31, 2007 for gross alpha, radium-226, radium-228 and uranium. Subsequent monitoring will be required at 3, 6, or 9-year intervals depending on the initial results. Community systems that cannot meet MCLs listed in **Appendix B** must install treatment or develop alternate water sources.

3.2.4.7 Drinking Water Contaminant Candidate List

The EPA maintains a list of contaminants known or anticipated to occur in public water systems. The purpose of the list is to identify contaminants for future regulation. Every five years, the EPA must publish a decision on whether or not to regulate at least five contaminants.

3.2.5 Future Standards

New and revised drinking water quality standards are mandated under the 1996 federal Safe Drinking Water Act. This section is intended to summarize and preview these standards, currently under development by the USEPA and not yet final. The USEPA is expected to complete an adoption schedule for these standards by 2005. The City should be aware of and familiar with these mandates and deadlines and plan strategically to meet them.

Revisions to the *Cryptosporidium*, virus, coliform bacteria standards are expected. The EPA also plans to establish new disinfection treatment performance standards for groundwater systems at high risk of viral contamination (GWR) and to further increase filtration and disinfection performance requirements (LT2ESWTR). The EPA also plans to further increase the disinfectants and disinfection by-products standards, and to establish a radon standard. Some of these future standards are likely to require major capital investments for some water systems. A more thorough discussion of the future standards is included in **Appendix B**. The EPA has recently proposed two new rules, the Long Term 2 Enhanced Surface Water Treatment Rule and the Stage 2 Disinfection By-products Rule. Detailed discussions of these rules are included in OHD's Fall 2003 Pipeline Newsletter (see **Appendix B**). Brief summaries of the proposed rules are included below.

3.2.5.1 Long Term 2 Enhanced Surface Water Treatment Rule

The EPA currently is proposing the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) to reduce disease incidence associated with *Cryptosporidium* and other pathogenic microorganisms in drinking water. Under the LT2ESWTR, systems initially conduct source water monitoring for *Cryptosporidium* to determine their treatment requirements. Filtered systems will be classified in one of four risk bins based on their monitoring results. Systems classified in higher risk bins must provide 1 to 2.5-log additional reduction of *Cryptosporidium* levels. The proposed regulation specifies a range of treatment and management strategies collectively termed the "microbial toolbox," that systems may select from to meet their additional treatment requirements.

Cryptosporidium monitoring by large systems (serving at least 10,000 people) will begin six months after the LT2ESWTR is finalized and will last for a duration of two years. Small systems (serving less than 10,000 people) are on a delayed schedule and will start monitoring when the required large system monitoring is completed (approximately 2 ½ years after rule promulgation).

3.2.5.2 Disinfection By-products Rule

EPA is proposing the Stage 2 Disinfection By-products Rule (Stage 2 DBPR) to reduce disease incidence associated with the disinfection byproducts formed by the addition of disinfectants to drinking water. Under the Stage 2 DBPR water systems will be required to meet maximum contaminate levels for total trihalomethanes (TTHM) and haloacetic acids (HAA5) at each monitoring site in the distribution system. Under the rule, systems will first be required to conduct an Initial Distribution System Evaluation (IDSE) to identify the locations with high disinfection byproduct concentrations. These locations will be used as the sampling sites for Stage 2 DBPR compliance monitoring.

3.2.6 Consumer Confidence Reports

On August 19, 1998 the USEPA published the final rule requiring every community water system to prepare and provide customers an annual consumer confidence report (CCR). This rule was mandated by the 1996 amendments to the Safe Drinking Water Act, and became effective as of September 18, 1998. A CCR is a report card for customers on the quality of the water delivered by the water system.

Community water systems must prepare an annual consumer confidence report on source water and the levels of contaminants found in drinking water. The report must be mailed to all customers; however, governors may allow systems serving fewer than 10,000 people to publish the report in a local newspaper rather than mailing it. Governors may allow systems serving fewer than 500 to simply notify customers that a report is available.

Reports must be issued by July 1 of each year. A CCR summarizes data for the previous calendar year. Each annual report must include certain specified information as outlined below. This summary is not complete, nor does it include all requirements. A more complete summary of the CCR requirements is included in **Appendix B**.

1. Information on the source of drinking water, including source water type, commonly used names, and locations;

2. A brief definition of terms;

3. If regulated contaminants are found, the maximum contaminant level goal (MCLG), the maximum contaminant level (MCL), and the level found;

4. If an MCL is violated, information on health effects; and

5. If EPA requires it, information on levels of unregulated contaminants.

Systems must make a good faith effort to reach consumers who do not get water bills, using means recommended by the state primacy agency. This includes customers who are served by the system but are not bill-paying customers, such as renters or workers.

3.3. Water Use Regulations (Water Rights)

3.3.1 Oregon Water Resources Department (OWRD)

The OWRD regulates the use of both surface and groundwater throughout the State of Oregon. Over the years as greater demands are placed on limited water resources, OWRD has been exercising greater control over this water use. The following is a summary of some of the policies and procedures that control the use and allocation of groundwater and surface water sources.

In Oregon, all water is publicly owned. Landowners with water flowing past or under their property do not automatically have the right to divert the water without a permit. Water rights have long been used to control the withdrawal of surface water for municipal or agricultural use. OWRD is the agency charged with issuing and controlling water rights. A water right is authorization from the state to make use of water – either surface water or groundwater. Since 1909, state law has required issuance of a water right before using surface water. Groundwater has been subject to the permit requirements statewide since 1955.

In Oregon, and throughout the Western United States, the use of water is governed by the Prior Appropriation doctrine. The doctrine of Prior Appropriation evolved in the law to promote settlement and development of the West. The basic concept is that people are encouraged to put water to "beneficial use" by taking it from a stream and applying it to the land. The system is basically one of first come, first served. The first person to obtain a water right on any given stream will be the last person to be shut off in times of shortage. Each water right includes a priority date. A senior water right holder is entitled to full delivery of all water allowed under the right before any junior priority dates may be served. The process for ensuring proper distribution according to water right priority dates is called "regulation and distribution." A state watermaster is authorized to regulate junior users in order to protect senior users.

Water rights are issued only for beneficial use, without waste. Each water right includes a designated type of "use" and is limited to that purpose. General categories of beneficial use include, but are not limited to: irrigation, municipal, industrial, commercial and domestic. Since 1987, the law has specifically included instream flow protection as a beneficial use. A water right holder is entitled to use as much water as is necessary, up to the maximum amount shown on the water right, to accomplish the stated beneficial use.

Water rights are issued in two stages: The first stage is the "water right permit," which serves as the initial authorization for a water user to develop the source and begin making use of water. The second stage is the final certificate, which is issued after the water use is fully developed and put to use. Important legal distinctions exist between the permit stage and final certificate stage. At the permit stage, the water right is viewed as personal property, held by the water user. If the permit is not developed and used correctly, it may be subject to cancellation by the state. After the water right has been fully developed and used appropriately, the permit holder is entitled to a certificate. At that stage, the water right becomes "vested" and is treated as an interest in real property. A certificated water right remains valid forever, so long as it is used. If the water right is not used for a period of five or more years, it then becomes subject to forfeiture and cancellation. The process is not automatic. The state must first prove that the water right has not been used. The law includes a presumption of forfeiture upon a showing of non-use for the five-year period. The water right holder then has an opportunity to show whether the non-use was "excused" for one of a number reasons listed in the statutes. Excuses for non-use include, but are not limited to: economic hardship; other government regulations that prevent water use; or participation in a conservation reserve program.

Each permit, when initially approved by the Water Resources Department (OWRD), includes a period of time in which to complete the process of developing the source and putting water to beneficial use. Typically, surface water rights include a 5-year initial period, while ground water rights have a 3-year period. Extensions of time may be granted upon a showing of "good cause." The good cause determination is based on a number of factors, including past diligence of the permit holder.

Until several years ago, permit extensions were routinely granted by the OWRD, largely because there was little or no opposition to the extension requests. In the early 1990s, however, in the face of new Endangered Species Listings and growing attention by environmental groups, the OWRD was advised by the State Attorney General that the past practice of routine permit extensions was not legally sufficient. As a result, the OWRD made substantial changes to the permit extension process. The new rules require a more extensive analysis of the level of diligence shown by the permit holder in developing the water right, as well as consideration of other competing needs for the water. The process also includes a careful review of potential impacts on listed species, or flows necessary for Scenic Waterway purposes. If a permit extension is approved, new conditions may be added to address public interest concerns raised during the review process.

In addition to regulating water rights, the OWRD has regulatory authority over Water Management and Conservation Plans (WMCP) for public water systems. A WMCP is a plan developed by a water supplier that describes the water system and its needs, identifies it sources of water, and explains how the water supplier will manage and conserve those supplies to meet present and future needs. The requirement for completing such plans is tied to the revised rules surrounding water right permit extensions as described under OAR 690-315. These rules call for all suppliers serving over 1,000 people to complete a WMCP in association with water permit extensions. OAR 690-086 details the requirements of WMCPs.

3.4. Water System Design Standards

The City presently has detailed design criteria for water system improvements under City jurisdiction. These Public Works Design Standards (PWDS) provide a uniform set of standards for use by engineers in the design of public water distribution improvements. The intent of these standards is to provide guidelines for the design of public facilities that will provide an adequate service level for the present development as well as for future development. The PWDS cannot provide for all situations. They are intended to assist but not to substitute for competent work by design professionals.

The intent of the Standards is to:

- be consistent with current City Ordinances.
- provide design guidance criteria to the private sector for the design of public improvements within the City of Philomath.
- have sufficient structural strength to withstand all external loads which may be imposed;

- be of materials resistant to both corrosion and erosion with a minimum design life of 75 years;
- be economical and safe to build and maintain;
- meet all design requirements of the Oregon Health Division (OHD).

3.5. Basis of Cost Estimates

In order to compare between different alternatives, the comparative costs of the principal alternatives must be estimated. The cost estimates are based on numerous assumptions necessary due to the relative lack of detail available at the master planning stage. The basic assumptions are summarized below.

3.5.1 Accuracy of Cost Estimates

It is important to note that the cost estimates are estimates made without detailed engineering data or designs. The accuracy or precision of cost estimates is a function of the level to which alternatives are developed (i.e., detail and design) and the techniques used in preparing the actual estimate. Estimates are typically divided into three basic categories as follows:

a. Planning Level Estimates. These are order-of-magnitude estimates made without detailed engineering data. This type of estimate is normally accurate within +35% to –25% (i.e., final cost may be as much as 35% more or 25% less than the estimated amount). A relatively large contingency is typically included to reduce the risk of underestimating. This is particularly important since many times the project financing must be secured before the detailed design can proceed.

b. Budget Estimates. This type of estimate is prepared using process flow sheets, layouts, and equipment details during preliminary design. This type of estimate is typically accurate to within ±25%.

c. Engineer's Estimate. This estimate is prepared based on well-defined engineering data, typically when the construction plans and specifications are completed, and is sometimes called a definitive estimate. Since this type of estimate is based on comprehensive plans and elevations, piping and instrument diagrams, electrical diagrams, equipment data sheets, structural drawings, geotechnical data, and a complete set of specifications, the engineer's estimate is expected to be accurate within +15 percent to -5 percent (i.e., 15% more to 5% less than the estimate).

Since the alternatives (during the master planning process) are not developed in sufficient detail for a more precise estimate, the estimates presented in this document are order-of-magnitude estimates. Even though the final project cost may vary significantly from these estimates, the estimates are necessary to evaluate and compare the alternatives, and will be reasonably accurate relative to each other.

3.5.2 Adjustment of Cost Estimates over Time

As the costs of material, labor and equipment rise over time, comparable changes will occur in the costs presented in this study. However, since the relative costs of the alternatives compared to each other should remain reasonably constant, the recommendations based on the cost estimates should remain valid.

A commonly used indicator of these changes in construction costs is the Engineering News-Record (ENR) construction cost index. The index is computed from the prices for structural steel, Portland cement, lumber, and common labor, and is based on a value of 100 in the year 1913. The construction costs developed in this analysis are based on current ENR 20 cities index (for index number, see **Section 7**). The costs presented herein can be related to those at any time in the past or future by applying the ratio of the then-prevailing cost index to index number used at present.

3.5.3 Engineering & Administrative Costs & Contingencies

The cost of engineering services for major projects typically covers special investigations, pre-design reports, topographic surveying, geotechnical investigations, contract drawings and specifications, construction administration, inspection, project start-up, the preparation of O&M manual narratives, and performance certifications. Depending on the size and type of project, engineering costs may range from 15 to 25 percent of the contract cost when all of the above services are provided. The lower percentage applies to large projects without complex mechanical systems. The higher percentage applies to smaller, more complex projects, projects that involve remodeling of existing plants, or where full time inspection is required by the funding agencies or desired by the Owner.

The City will have administrative costs associated with any construction project. These include internal planning and budgeting/payments, administration of engineering and construction contracts, legal services, and coordination with regulatory and funding agencies. For a typical project of this size, the City's administrative, legal and permitting costs are expected to be about 10 percent of the contract cost.

3.5.4 Construction Costs Estimates

Preliminary construction costs for distribution system improvements recommended in this report are based on a number of assumptions as follows. The cost estimates reflect projects bid in late winter or early spring for summer construction. These estimates are based on construction costs for similar projects and manufacturer's information. The costs do not reflect a detailed investigation of existing utilities and soils. It is important to note that the cost estimates are planning level estimates, not engineering estimates, and are intended to be within the range of plus 35% to minus 25% of the actual project cost.

The elements which comprise these budget estimates for the piping portion of the collection system improvements include:

- Pipeline Construction Cost (materials, installation, service line reconnection, mainline connections, and hydrants)
  - 12-inch Diameter - $95 per foot
  - 10-inch Diameter - $85 per foot
  - 8-inch Diameter - $75 per foot
- Highway Bores - $180/ft
- Construction Contingencies - 10% of estimated construction cost
- Engineering Costs (surveying, engineering design, and construction administration) - 16% of estimated construction cost
- Legal, Permits & Administrative Costs (permitting, administration, legal, easement acquisition and financing) - 10% of estimated construction cost

Example: 800 lineal feet of new 12-inch pipe

Est. Construction Cost =	(800 feet of 12-inch) x $95.00/ft	$76,000
Constr. Contingencies =	$76,000 x 10%	$7,600
Engineering =	$76,000 x 16%	$12,160
Legal, Permits & Admin =	$59,900 x 10%	$7,600
Total Est. Project Cost	....	$103,360

The estimates of construction costs for reservoirs, treatment facilities, and other non-pipeline projects are based on costs for similar projects and manufacturer's information. Due to the greater complexity of these projects, construction contingencies and engineering costs of 15% and 20% were assumed respectively.

These construction costs are preliminary estimates, but they should help the City in the process of planning and allocating resources in the most cost effective manner. All costs are estimates of probable costs and do not reflect changes that could include increasing labor costs, material, and phased construction dates. Unit costs used for installation of waterlines include excavation and export of material, bedding and backfill, cutting of asphalt, repaving of streets, pipe placement, connections and fire hydrants.

Since the funding sources for the completion of the recommended improvements have not yet been confirmed, the cost estimates outlined above are based on the assumption that each of the projects will be designed and constructed separately with local funds. If multiple items are combined into a single project, there will be significant cost savings on engineering design, bidding and construction administration and inspection services.