CITY UTILITIES
DESIGN STANDARDS MANUAL

Book 1
General Requirements (GR)
GR11 Life Cycle Cost Analysis

June 2015

GR11.01 Purpose

The purpose of this Chapter is to provide a standardized basis of analysis for consistent 20-year life cycle cost analysis of gravity sewers, lift stations, and low-pressure sewer systems. For further details related to the life cycle cost evaluation and project examples with worksheets, refer to the document entitled **20 Year Lifecycle Evaluation** dated May 16, 2013.

City Utilities will determine the appropriateness to develop a life cycle cost (LCC) analysis for particular projects. The LCC analysis content, interest rate, miscellaneous cost elements, etc. shall be discussed with City Utilities prior to starting the development of the engineering cost analysis.

It is the intent that the 20-Year Life Cycle Cost Summary Excel worksheets included in Appendix A and Appendix B of this document be used to complete 20-year life cycle evaluations. However, other methods may be used to evaluate the LCC. The information included in the worksheets shall be considered "typical" for City Utilities sanitary collection systems.

GR11.02 Life Cycle Cost Methodology

1. Present Worth Analysis

   The purpose of a life cycle cost analysis is to evaluate all of the present and future costs to construct and maintain a facility over its life.

   The worksheet model considers four different future cost components:

   - Future construction costs to replace equipment or capital upgrades
   - Annual utility expenditures to operate the lift stations and/or low pressure systems
   - Labor expenses related to annual maintenance, cleaning, or at the time of expected repair and replacement schedules for the facility
   - Remaining salvage or residual value at the end of 20 years, assuming the assets all have 40-year useful lives

2. Inflation and Discount Rates

   The Consumer Price Index (CPI) measures the cost of living increases for all urban consumers from year to year. The average annual compounded increase in CPI will be different for different time periods. The past five years average annual rate of inflation was used for the Life Cycle Cost Analysis.

3. Construction Costs Data Sources

   Typical initial construction costs for gravity sewers, lift stations, and low pressure sewer systems in the worksheets are costs that were developed based upon average installed costs from public sector projects from recent years.

4. Operation and Maintenance Data Source

   Operation and maintenance (O&M) costs for lift station O&M, gravity sewer O&M, and low pressure sewer system O&M are provided in Appendix A and Appendix B.

5. Salvage Value

   The following items will have a 40-year design life:
   - Gravity Sewers
   - Lift Station Structures
   - Force Mains
   - Grinder Pump Station Basins

   The salvage value of the items above is considered to be zero at the end of the 40-year design life. However, since the worksheet is for a 20-year life cycle, each of these items will include a salvage value. The salvage value will be the remaining value at the end of the 20-year period, assuming 40 year straight-line depreciation of the asset.

6. Life Cycle Cost Computations

   A timeline of estimated initial and future costs is calculated in Appendix A and Appendix B.

   After all costs are converted to year 2010 costs, the costs are inflated to convert them to current year dollars at the time of construction (the current year is referred to as "Year X" in the worksheets).

7. Fixed Worksheet Cell Values

   - Construction Inflation (5-year ENR Cost Index)
   - Yearly Power Cost Increase
   - Yearly Labor Cost Increase
   - Discount Rate (5-year CPI)

GR11.03 Gravity Sewer Option – Life Cycle Analysis

1. Design Life

   Assume the design life of the gravity sewer will be 40 years and residual/salvage values will be calculated accordingly.

2. Initial Construction

   Gravity Sewer: All gravity sewer construction costs will be considered the same regardless of the property on which construction is proposed. The cost per linear foot of initial construction of gravity sewer includes but is not limited to the following:
   - Pipe Materials
   - Manholes
   - Excavation
   - Backfill
   - Pavement

- Pavement Subbase

Oversizing: An oversizing cost can be added as a lump sum to the gravity sewer construction section. It should be added to the miscellaneous construction cost.

Land: It has been assumed that all sewers are located within the right-of-way, therefore, no easement acquisition nor property purchase is included in the Gravity Sewer Option LCC worksheets. If land acquisition or easements are required, these costs may be added as a lump sum in the Gravity Sewer Construction Cost worksheet as a miscellaneous cost.

3. Operation and Maintenance

   Cleaning and Inspecting: A unit cost per foot to clean and inspect sanitary sewers has been input into the 20-year LCC worksheets.

   Maintenance: This cost is included with cleaning and inspecting, therefore, no separate cost has been included in the worksheets for maintenance.

   Replacement: Since the life expectancy of gravity sewer is considered to be 40 years, replacement is not considered in this analysis.

   Rehabilitation: Since the life expectancy of gravity sewer is considered to be 40 years, rehabilitation is not considered in this analysis.

4. Salvage Value

   Since the design life of gravity sewers is estimated at 40 years, gravity sewers will have a residual/salvage value at the end of the 20-year life cycle.

GR11.04 Lift Station Option – Life Cycle Analysis

1. Design Life and Replacement Schedules

   Design Life:
   - Lift Stations Structure: 40 years
   - Pumps and Controls: 20 years
   - Motors: 10 years
   - Impellers: 7 years
   - Valves: 25 years
   - Force Main: 40 years

   Replacement Schedules:
   - Lift Station Structure: Not required; a salvage value at the end of 20 years will be included.
   - Pumps and Controls: Replacement required at Year 20.
   - Motors: Repair/replacement at Year 10; this cost is included in the Yearly Maintenance Cost because it is not a capital cost.

- Impellers: Repair/replacement at Year 7 and Year 14; this cost is included in the Yearly Maintenance Cost because it is not a capital cost.
- Valves: Not required; a salvage value at the end of 20 years will be included.
- Force Main: Not required; a salvage value at the end of 20 years will be included.

2. Initial Construction

   Gravity Sewer: For gravity sewer on the development to convey flow to the lift station, use the separate table for the Lift Station Option in the Gravity Sewer Worksheet.

   Pumps, Wet Well, and Valve Vault (Installed): A lump sum cost is included in the Lift Station Construction Cost worksheet.

   Electrical Feed to Site: Appendix A and Appendix B assumes that three-phase power is available at the lift station site. If this is not the case, $25,000 (cost to bring three-phase power one-quarter mile to the site) should be input in the "miscellaneous" line of the 20-Year Life Cycle Cost Summary worksheet.

   Force Main: The Lift Station Construction Cost worksheet includes typical installation costs for 4-inch through 10-inch force mains. Installation by open-cut method using Class 200/SDR-21 PVC pipe material has been assumed. HDPE and ductile iron are acceptable. Confirm the unit cost of pipe material; this can be adjusted by inputting material unit cost per linear foot in Appendix A and Appendix B.

   Land: For "private development", the typical lift station foot print is small and has been considered as negligible, therefore, no land cost is included. For "public projects" a lump sum cost has been included in Appendix A and Appendix B.

   Site Work: Included in the unit cost for lift stations.

   SCADA (Supervisory Control And Data Acquisition): Costs included in Pumps, Wet Well, and Valve Vault (Installed). City Utilities should be consulted to determine if the SCADA requirements have been updated such that re-evaluation of the typical costs provided in Appendix A and Appendix B is required.

   Communications: Current City Standards include a radio and antennae pole or telephone service compatible with the City's SCADA communication network. This equipment cost is included in Pumps, Wet Well, and Valve Vault (Installed).

3. Operation and Maintenance
   Subcategories of O&M costs are as follows:

   Corrective Maintenance (CM):
   - Mechanical and electrical labor and repair parts

Preventative Maintenance (PM):

- Regular and systematic inspection
- Replacement of worn parts, materials, and systems
- Cleaning

Routine Maintenance:

- Response to alarms
- Bi-weekly inspections
- Cleaning wet well and floats
- Exercising valves
- Lubricating valves and equipment
- Site maintenance

Capital Improvements: These are intermittent major expenditures associated with normal equipment wear. The total costs of these combined replacements exceed $25,000 and are assumed to occur at Year 20.

Lift Station O&M:
The costs include corrective maintenance, preventative maintenance and routine maintenance. They do not include capital improvements and power costs. Two different lift station annual O&M costs were used; one for lift stations 20-horsepower and under and one for lift stations larger than 20-horsepower.

4. Power Usage
   Typical power requirements expressed in dollars per year are automatically calculated for a single pump horsepower in Appendix A and Appendix B.
5. Communications

   If a monthly phone service fee is required for SCADA instead of the standard radio and antennae pole, a yearly service fee has been entered in Appendix A and Appendix B.

GR11.05 Low Pressure Sewer Option – Life Cycle Analysis –Septic Elimination ONLY

1. Design Life and Replacement Schedules

Design Life:

- Grinder Pump Station Structure: 40 years
- Grinder Pumps: 10 years
- Controls: 20 years
- Low pressure force main piping: 40 years
- Air Release Valves: 15 years

Replacement Schedule:

- Grinder Pump Station Structure: Not required; a salvage value at the end of 20 years will be included.
- Grinder Pumps: Repair/replacement at Year 10; this cost is included in the yearly maintenance cost.
- Controls: Replacement required at Year 20.
- Air Release Valves: Repair/replacement required at Year 15.
- Force Main: Not required; salvage value of entire low pressure system is included at the end of 20 years.

2. Initial Construction
   Grinder Pump Stations: A cost for simplex stations has been entered in the worksheet.

   Electrical Feed To Sites: A cost for power feed from home to grinder pump station has been entered in the worksheet.

   Low Pressure Force Main: The Grinder Station Construction worksheet in Appendix B includes typical installation costs for 1.25-inch through 4-inch DR-11 HDPE pipe material. Confirm the unit cost of pipe material; this can be adjusted by inputting material unit cost per linear foot in the worksheet.

   Land: Assumed that low pressure sewer force main will be located within right-of-way, therefore, no land or easement costs.

3. Operation and Maintenance

   Grinder Pump Stations O&M: A yearly grinder station maintenance cost per pump has been entered in Appendix B.

   Electrical O&M: A replacement cost, to occur at the end of year 20 for the control panel including material and installation has been entered in Appendix B.

   Low Pressure Sewer O&M: A yearly maintenance cost for cleaning low pressure sewer has been entered in Appendix B.

   Air Release Valves: A unit cost for replacement at Year 15 has been entered in Appendix B.

4. Power Usage

   The approximate power cost to operate a grinder pump station is $24 per year per pump station. This cost will be incurred by the homeowner. The present worth value of power for the grinder pump stations is calculated in the worksheet, however, this cost is not included in the overall "20-Year Life Cycle Cost" of the Low Pressure Sewer Option in Appendix B.