

APPENDIX D – Element 5 (Design and Performance) Supporting Documents

1. City of Lathrop Public Works Department Design and Construction Standards, Section 5 – Sewer System Standards
2. City of Lathrop Public Works Department Design and Construction Standards, Sewer Standard Details

SEWER SYSTEM STANDARDS

PURPOSE

These Standards are intended to establish the minimum standards for any sewer facility or sewer system in the City that meets any one or more of the following conditions:

- A. The system is or will be in City right-of-way, sewer line easement or public utility easement (PUE).
- B. The proposed system provides, or plans to provide, sanitary sewers, sewer pump stations, sewage treatment plants and sewer systems to any land development project subject to approval of the City Council, Planning Commission, or Public Works Department.

DEFINITIONS

As used in these Standards, the words defined in this Section shall have the following meaning:

ADWF	Average Dry Weather Flow.
Infiltration	The quantity of groundwater or surface water that leaks into a pipe through joints, breaks, or holes.
PF	Peaking Factor.
PWWF	Peak Wet Weather Flow = (ADWFxPF)
Service Lateral	The pipe from the sewer main to the right-of-way or easement line which provides a point of connection for each property.
Sewer	Sanitary sewer main.

GENERAL REQUIREMENTS

The design and construction of sanitary sewers, sewer pump stations, sewage treatment plants, and sewer systems in the City subject to control or permit requirements of the City, shall be in accordance with these minimum design standards. The work shall comply with these standards, except where specific modifications have been approved by the Public Works Director in writing.

- A. **Plumbing Code:** All work on house laterals, house sewers and building sewers that are outside of public right-of-ways or sewer easements will be governed by the provisions of the Uniform Plumbing Code as amended by these Standards and other applicable ordinances of the City.
- B. **Other Standards:** Where these Standards do not cover a subject fully, subject to approval by the Public Works Director, additional references

Appendix D - Element 5: (Design and Performance)

(latest edition) which may be used, include but not necessarily limited to the following:

1. “Design and Construction of Sanitary and Storm Sewers” (ASCE Manual of Engineering Practice No. 37 or Water Environment Federation (WEF) Manual No. 9).
2. “Sewage Treatment Plant Design” (ASCE Manual of Engineering Practice No. 36 or WEF Manual of Practice No. 8).
3. “Gravity Sanitary Sewer Design and Construction” (ASCE Manual, Engineering Practice No. 60 or WEF Manual of Practice No. FD-5).
4. Design of Municipal Wastewater Treatment Plants – 4th Edition (ASCE Manuals and Reports on Engineering Practice No. 76).
5. Uni-Bell Handbook of PVC Pipe, Design and Construction.
6. The State of California, Department of Transportation (Caltrans) Standard Specifications.

SEWER SYSTEM DESIGN REQUIREMENTS

Sewer Capabilities

Sewers shall be designed to carry the peak wet weather flow rates (PWWF) from all areas tributary to them. The design flow rate at any point shall be the average dry weather flow of all tributary areas times the peaking factor per Detail S-1. Sewer shall be designed for both size and depth to accommodate developments in upstream tributary areas that would logically be served by them.

- A. General: Main sewers shall be designed and constructed to transmit the design flow, which will result from the ultimate development of the entire tributary area even though said area may not be within the project boundaries.
 1. Consideration of the type of development anticipated or existing shall be given in arriving at the design flow but in no case shall any sewer mains be smaller than the size required by the General Plan in the areas determined by the City of Lathrop, current Master Plan Studies, with the sewer mains flowing half full. In no case shall any sewer be less than 6” in size.
 2. In no case shall a smaller pipe be used in any location than that upstream of said location. Sewer mains shall be designed to withstand the vertical loads that will be imposed on them.

Appendix D - Element 5: (Design and Performance)

3. In the design of a system, one of the controlling conditions shall be that the lateral system is to be at sufficient depth to provide a minimum slope for the service sewer of ¼" per foot, at the same time maintaining a minimum cover of 3 feet at any buildable location within the properties to be served, and a minimum of 4 feet of cover at the right-of-way line.
- B. Hydraulic Design:
1. Minimum velocity for any sanitary sewer shall be two (2) feet per second for pipes flowing half full.
 2. Design velocities for sanitary sewers shall be computed using Manning's formula with a constant "n" value of 0.013 or pipe manufacturer's recommendation, whichever is greater.
 3. Since sanitary sewers are to be designed with no head on the inlet, the maximum design discharge shall not exceed the flow at critical slope and velocity, due to the unstable flow conditions at critical slope and critical velocity sanitary sewers should not be designed for these conditions, but maximum design discharge shall not exceed flow under these conditions regardless of greater slope.
 4. Maximum velocities shall not exceed 10 fps.
 5. **NOTE: UNDER NO CONDITION SHALL A GRAVITY SEWER EVER BE DESIGNED TO FLOW UNDER PRESSURE OR AT 100% CAPACITY.**
- C. Minimum Size: Minimum sewer mains shall be 8 inches. However, 6-inch sewer mains shall be limited to cul-de-sacs and end runs where no future extensions will be possible.
- D. Minimum Sewer Slope: Minimum slope requirements are necessary to assure self cleansing and self oxidizing velocities in order to avoid significant generation of hazardous, odorous, and corrosive sulfur compounds.
1. Minimum Slopes/Capacity – Slopes of sewers shall equal or exceed those set forth in Table 5-1.
 2. Substandard Slopes – Slopes below the minimum slopes may be used in order to avoid pumping only when specifically approved by the City Engineer. Such approval should be solicited in advance of completion of design.
 - a. Pipe – Pipe in substandard slope areas or for flows less than 2 feet per second and pipe in all areas downstream from substandard slope areas to the point where the peak flow is

Appendix D - Element 5: (Design and Performance)

four times that in the section with substandard slope, shall be corrosion resistant sewer pipe.

**TABLE 5-1
MINIMUM PIPE SLOPES**

Pipe Size in <u>Inches</u>	<u>Minimum Slope ratio in feet per foot</u>	<u>Capacity at 0.7 depth in MGD</u>	<u>Capacity in full depth in MGD</u>
4 (service laterals)	0.0250		
6	0.0050	0.22	
8	0.0035	0.38	
10	0.0025	0.58	
12	0.0020	0.85	1.00
15	0.0015	1.32	1.60
18	0.0012	1.95	2.35

Sewer Quantities

- A. The average dry weather daily sewage flow shall be computed in accordance with Table 5-2, Table 5-3, Table 5-4, and Table 5-5 depending on the location of the sewer system:

**TABLE 5-2
WASTEWATER GENERATION FACTORS FOR EAST LATHROP**

Land Use	Generation Factor (gallons per day per acre)
Residential	
Low Density (R-1-6)	1,584
Planned Unit Development (PUD)	1,584
Medium Density (RM-3)	2,808
Commercial	
Neighborhood Commercial (CN)	1,200
Service Commercial (CS)	1,200
Professional Offices (PO)	1,200
Community Commercial (CC)	1,200
Highway Commercial (CH)	1,200
Industrial	
Limited Industrial (IL)	900
General Industrial (IG)	900

**TABLE 5-3
WASTEWATER GENERATION FACTORS FOR MOSSDALE LANDING**

Land Use	Generation Factor (gallons per day per acre)
Residential	
Low Density (LD)	1,584
Medium Density (RM)	2,808
High Density	3,969
Commercial	
Neighborhood Commercial (CN)	1,200

Appendix D - Element 5: (Design and Performance)

Land Use	Generation Factor (gallons per day per acre)
Service Commercial (CS)	1,200
Community Commercial (CC)	1,200
Highway Commercial (CH)	1,200
Village Commercial (CV)	1,200
Waterfront Commercial (CW)	1,200
Regional Commercial	3,500
Industrial	
Public (P)	100
Parks	100
Elementary School (K-8)	670
High School	1,000
Urban Reserve (UR)	0
Resource Conservation/Open Space (RCO)	0

**TABLE 5-4
WASTEWATER GENERATION FACTORS FOR CENTRAL LATHROP
SPECIFIC PLAN**

Land Use	Generation Factor (gallons per day per dwelling unit)
Residential	
Variable Density (RV)	260
High Density (RH)	190
Mixed Use (RMU)	190
Office Commercial/Residential/WWTP (MU)	260

**TABLE 5-5
WASTEWATER GENERATION FACTORS FOR STEWART TRACT**

Land Use	Generation Factor (gallons per day per acre)
Residential	
Low Density (LD)	1,584
Medium Density (RM)	2,808
High Density (RH)	3,969
Commercial	
Neighborhood Commercial (CN)	1,200
Service Commercial (CS)	1,200
Community Commercial (CC)	1,200
Highway Commercial (CH)	1,200
Village Commercial (CV)	1,200
Waterfront Commercial (CW)	1,200
Regional Commercial	3,500
Recreation Commercial	
Land Use Area 6 – Golf	100

Appendix D - Element 5: (Design and Performance)

Land Use	Generation Factor (gallons per day per acre)
Land Use Area 18 – Second Theme Park	850
Land Use Area 10 – Wild Life Park	400
Land Use Area 4 – Wild Life Park	400
Land Use Area 5 – Wild Life Park	400
Land Use Area 11 – Camp Ground	1,000
Land Use Area 14 – RV Park	2,000
Land Use Area 17 – RV Park	2,000
Land Use Area 50 – Golf	100
Land Use Area 71 – Golf	100
Land Use Area 75 – Golf	100
Land Use Area 77 – Golf	100
Land Use Area 81 – Gold Rush City Theme Park	1,350
Land Use Area 93 – Water Park	950
Land Use Area 94 – Marina	1,200
Land Use Area 61 – Golf	100
Land Use Area 37 – Golf	100
Land Use Area 58 – Golf Course Club House	100
Resort Commercial	
Land Use Area 3 – Chalets	1,600
Land Use Area 2 – Chalets	1,600
Land Use Area 7 – Chalets	1,600

Appendix D - Element 5: (Design and Performance)

Land Use	Generation Factor (gallons per day per acre)
Land Use Area 8 – Hotel	2,650
Land Use Area 15 – Specialty Retail	1,200
Land Use Area 64 – Hotel	2,650
Land Use Area 63 – Hotel	2,650
Land Use Area 80 – Entertainment Center	2,000
Land Use Area 79 – Entertainment Center	2,000
Land Use Area 95 – Hotel	2,650
Land Use Area 76 – Hotel	2,650
Land Use Area 68 – Hotel	2,650
Other	
Public (P)	100
Parks	100
Elementary School (K-8)	670
Urban Reserve (UR)	0
Resource Conservation/Open Space (RCO)	0

- B. To compute the peak flow from the average flow, the peaking factor in Standard Detail S-1 shall be used. Infiltration/Inflow (I/I) allowance of 300 gallons per acre per day and 200 gallons per inch diameter per mile, cumulative must be added to the product of the peaking factor and average flow. Designer shall submit calculations for review and approval by the City Engineer.

Sewer Location

- A. Roads: Sewer in new roads shall be located as indicated in Standard Detail No. R-36. Exceptions to these location requirements may be made only on approval of the City Engineer.

Appendix D - Element 5: (Design and Performance)

1. The preferred sewer line locations in existing roads with no curb and gutter shall be at least 2 feet off the pavement edge.
 2. The entire sanitary sewer system shall be located as mentioned above and shall be designed to clear all other existing or proposed utilities by a minimum of twelve (12) inches vertical clearance.
- B. Water-Sewer Separation: The State Department of Health requirements for separation shall be met in locating sewers (Standard Details). A minimum of 10 feet horizontal separation between water and sewer lines shall be maintained in accordance with Chapter 16 of Title 22, California Administrative Code and approved by the City Engineer.
- C. Easement: Locating sewer lines in easements shall be kept to a minimum. Whenever possible, sewers shall be placed in the public right-of-way. Sewer lines located outside the public right-of-way shall be in easements granted to the City.
1. The minimum width of any easement for sanitary sewer purpose shall be fifteen (15) feet. In special cases of terrain, depth of sewer line, etc., the easement width may be wider when required by the City Engineer.
 2. All easements shall include right of ingress and egress over adjoining property for maintenance, replacement and operation. No permanent structures shall be constructed in such easements, except fences and utilities that are subject of any overlapping easement.
 3. Where easements are parallel to a property line, they shall all be on one property and not split by the property line.
 4. Pipelines in easements shall be placed along the center of the easement.
- D. Future Extensions: When an area outside the proposed project can be logically served by future extension of a proposed sewer, the proposed sewer shall extend to the proposed project boundary or to the end of a paved street in a manner to facilitate the future extension.
- E. Alignment: Alignments shall be parallel to the street centerline whenever possible. Sewers shall be laid on a straight alignment and grade between manholes except that curved sewers may be used subject to the following requirements.
1. All curve data shall be shown on plans.
 2. Radius of curvature and joint deflections shall be 80% of the pipe manufacturer's recommendation and approved by the City Engineer; however, in no case shall the radius be less than 200 feet.

3. All deflections shall be at the pipe joints or by specially metered pipe sections. Actual bending of the pipe itself will not be allowed.
4. A manhole shall be constructed at both the B.C. and E.C. of curves where the length of curve exceeds 100 feet, otherwise a manhole shall be required at one end of the curve only.
5. Vertical curves may be used in combination with horizontal curves. Where vertical curves are used, the sewer shall be sized for the flattest slope within the curve.
6. Maximum combined horizontal and vertical deflection at any joint shall be 80% of the manufacturer's recommendation, but in no case more than 3 degrees.
7. The arithmetic sum of all horizontal and vertical deflection in curved sewers between adjacent manholes shall not exceed 22 ½ degrees.

Depth of Sewers

Sewers shall be installed at a depth which will provide suitable service to the properties connected and will allow subsequent installation of water lines in accordance with the water-sewer separation rules so as to minimize special construction of the water lines. Attention to joint spacing on the water lines will be required.

- A. **Standard Depth:** Minimum cover for any sewer main shall be five (5) feet from finished grade within the street section or three (3) feet below the street pavement section whichever is greater, and three (3) feet in sewer easements. Any deviation from this cover shall require special design and approval by the City Engineer.
- B. **Maximum Depth:** The maximum invert depth of any sewer main shall be 15 feet from finished surface unless approved by the City Engineer and in no case shall any sewer main be deeper than 20 feet. Any sewer main with an invert greater than 15 feet shall be required to use pipe material for pressure pipe such as PVC C900, PVC C905, or ductile iron as required herein.
- C. **Exceptions:** Special pipe cover shall be used when total cover over public and house connection sewers is less than four (4) feet, and may be required when total cover will not be placed immediately after pipe installations, or when other special conditions exist.
 1. Three (3) to four (4) feet of cover shall require the use of ductile iron pipe or approved bedding or encasement specifically designed for the cover conditions.
 2. Less than 3 feet of cover shall require concrete encasement. In no case shall cover less than two and one-half foot (2.5) be permitted.

Appendix D - Element 5: (Design and Performance)

3. All pipelines shall be designed and constructed to a load safety factor of 1.5.
 - a. The design engineer, during design, shall consider impact and dead loads imposed upon the pipe both during construction and after construction.
 - b. The construction plans shall show the maximum permissible trench width at the top of the pipe that shall be predetermined by the design engineer.
 - c. No sewer service shall be connected to a main greater than 12' in depth. No service lateral shall connect into sewer mains greater than 15 inches in diameter. Where groundwater is expected at or above the bottom of the pipe, the design shall comply with City Standard R-28H & R-28I.
 - d. Trench design calculations shall be submitted to the City Engineer for approval for all trenches.

Structures

- A. Manholes: Manholes shall be located at all changes in alignment or grade and at all junctions. Manholes shall be located at the following maximum intervals:

On pipes 12" diameter and under - 400 foot intervals
On pipes over 12" diameter - 500 foot intervals

1. Drop Manholes: Drop manholes shall be constructed in accordance with Standard Detail S-3 and shall be used wherever sewers enter manholes at more than 24 inches above the outlet elevation of the manhole. The use of drop manholes shall require the approval of the City Engineer.
2. Design: Manholes shall be constructed in accordance with Standard Detail S-2.
 - a. When two lines of the same size enter a manhole, or if flow in a single line must change direction by more than 20 degrees, the invert grade at the exit must be at least 0.20 foot below that of the entrance pipe or, as a maximum, the crown of the exiting pipe shall match the invert of the entering pipe.
 - b. If the pipes entering and exiting any manhole are of differing diameter, the minimum invert elevation differential (that is, fall in elevation through the manhole) shall be such that the pipes are matched crown to crown. The invert of the entering pipe shall be no higher than the crown of the exiting pipe.

Appendix D - Element 5: (Design and Performance)

- c. Drop connections are not governed by the above elevation requirements.
 - d. Designer shall submit a detailed design for all penetrations that minimizes groundwater infiltration through use of a water barrier embedded in the manhole wall or other method as approved by the City Engineer. The detailed design shall be signed by a California Licensed Civil or Structural Engineer.
 - e. All manholes installed within 500 linear feet of any pump station or other detention facility shall have a polyurethane or fiberglass coating, recommended by a reputable manufacturer as being suitable for this use, applied to the interior of the manhole.
3. Protection: Where new proposed sewers are to be connected into a manhole that is in active use, the designer shall call for such protection as is necessary to prevent construction debris from being washed into the active sewers. Plugged inlets or other suitable protection shall be called for in the active manhole before beginning manhole modifications or proposed sewer cleaning.
 4. Elevations: Finished elevations of frames and covers shall be set flush with finished grades of the completed road surface or 12 inches above finished surrounding grade when more than 10 feet outside of paved roadway.
- B. Cleanout Requirements: Dead end 6 and 8 inch sewer mains not over 200' in length shall terminate in standard manholes or rodding inlets. Dead ends over 200' long shall terminate in standard manholes unless future extension of said dead end will include a manhole within distances specified under Section 5-4.5 (A) of the uppermost manhole, in which case a temporary cleanout is permitted.
- C. Structures and Pipes: All structures and pipe placed under public roads shall be of sufficient strength to support with an adequate factor of safety the backfill, road surfacing and H-20 truck loading with impact.
1. Sewers under other pipes and structures shall be protected from damage and shall be constructed so as not to endanger the other pipe structure.
 2. The concrete blanket method is not required where the distance between the outside of crossing pipes exceeds 12" unless required by water sewer separation rule.

Flow Meters

A flow meter shall be installed at the first sanitary sewer manhole from the point of connection into the sanitary sewer system for each new subdivision. If there

are more than one point of connections, than a flow meter is required at each manhole prior to the point of connection.

Service Laterals

- A. Requirements: Wherever it is known or can be reasonably assumed that a building sewer connection is required, a service lateral shall be shown on the plans and installed to the property line as a part of the street sewer construction, prior to paving.
 - 1. Service laterals shall be installed whenever possible during construction of the sewer main using prefabricated fittings (See Standard Detail S-7A).
 - 2. Unused service connections shall be tightly sealed and staked in a manner to facilitate their future location and use.

- B. Size: Service laterals for single dwellings and small single stores or offices shall be 4 inches minimum or as required by Uniform Plumbing Code. All other service laterals shall be 6 inches or larger and at least equal to the size of the building sewer.

- C. Depth: Service laterals shall be at the minimum depths herein provided and in addition such depth shall be sufficient to provide a connection to any point on the lot, within the established building setback lines, with a cover of one foot and a slope of not less than 0.02 and a minimum of 4 feet at the property line. Any exception to this requirement shall be approved by the City Engineer.

- D. Backflow Prevention: Sewers shall be designed to preclude the backflow of sewage into service laterals. If it is infeasible to install the waste receptacles in any building at least 1 foot higher than the rim elevation of the next upstream manhole, or other structure providing hydraulic relief, then backflow prevention devices shall be installed in the building waste line on the property side of the service lateral cleanout.

- E. Curb Markings: The location of all sewer service laterals shall be marked by an “S” cast into the concrete of the curb at completion of construction (See Standard Detail R-5)

- F. Grease Traps: On-site grease trap may be required on service laterals and sized accordingly using the latest edition of the Uniform Plumbing Code (UPC). The City Engineer shall make this requirement on a case-by-case basis.

Force Mains and Lift Stations

Where extreme hardship conditions prevail and a substantial area cannot be sewerred by gravity sewers in accordance with these standards, a sewage pumping station may be installed. No sewer design shall rely on a pumping facility without prior approval of the City Engineer.

- A. Lift Station Design: Lift stations, where allowed, shall incorporate the following features:
1. Pumps or other devices shall be duplex.
 - a. Minimum desirable size is 4 inches.
 - b. Maximum velocity in suction is 5 ft/sec.
 - c. Pumps shall be capable of passing 3-inch solids
 2. Capacity shall be provided to handle ultimate peak flow from the tributary area with the largest pump out of service.
 - a. Staged installation of pumps is allowed providing space is provided for future installations. Where slide mount submersible pumps are used, a duplex installation of 100% design capacity may be used, if a spare pump assembly is supplied to the City complete.
 - b. Where design flows exceed 1.0 cfs, a low flow pump, shall be provided in addition to the design rated pumps. The low flow pump shall have a capacity of 5%-10% of the design flow and shall operate as the lead pump.
 3. Access to pump station and to wet well shall be provided with locks and the keys (Cyberlock) given to the City Engineer.
 4. A lifting loop over each pump/motor, or similar provisions for removal of pump shall be provided.
 5. Pump station and wet well shall be lighted in accordance with plans approved by the City Engineer.
 6. The wet well rim and electrical panel shall be one foot above the 100-Year Flood Elevation.
 7. Odor control facilities shall be provided at pump station and wet well. The design of which shall be approved by the City Engineer.
 8. Corrosion protection shall be provided at pump station and wet well. The design of which shall be approved by the City Engineer.

Appendix D - Element 5: (Design and Performance)

9. Pump curves, operating voltage and phasing, horsepower, etc., shall be in accordance with approved submittal per Section 74-1.04 of the Standard Specifications.
10. Submersible pumps shall be capable of running in air without damage. Moisture sensing circuit breakers in terminal changer shall be incorporated into submersible pumps.
11. NEMA weatherproof outdoor enclosures shall be provided for controls. Electric service shall be provided by underground conduit to the utility service pedestal.
12. Controls shall be programmable logic controllers (PLC) in accordance with Appendix F.
 - a. All pump stations shall be connected to the City's Supervisory Control and Data Acquisition (SCADA) system in accordance with the requirements of Appendix F.
 - b. A standby battery and charger shall be supplied.
 - c. The battery is to be able to operate the controller for two weeks with the external power source removed.
 - d. Pumps shall be equipped with Variable Frequency Drive speed controls of a type approved by the Director.
 - e. An adjustable time delay before any restart shall be incorporated which allows delays from 1 to 10 minutes.
 - f. Bubbler type controls will not be accepted.
 - g. Switches for manually operating the pumps shall be included.
 - h. SCADA shall test for leaks or clogs in the sanitary sewer force main and shall shut off pumps and send SCADA alarm if detected.
13. All lift stations shall have an onsite stand-by power source.
14. An onsite alarm with exterior lights and horn with battery backup, including switchable power failure, and low water and high water sensors shall be provided.
15. An automatic telephone dialer and message capability for all alarms shall be installed.
16. Each sewer pump shall have a gate valve and check valve on the discharge piping. Dual pressure mains may be required by the City Engineer.

Appendix D - Element 5: (Design and Performance)

17. Access and work area of pump stations shall be paved with minimum 4" AC on 6" AB, if out-of-doors, and with full concrete floor within a building.
 18. A six foot high chain link fence per Standard Detail D-19 shall be constructed to enclose the pump station.
 19. A means of dewatering force mains shall be provided.
 20. The lift station shall not be in City street right-of-way except with permission from the City Engineer.
 21. The interior of the structure, all machinery, piping, and exterior below grade shall be painted.
 22. The City shall be provided with three complete sets of manufacturer's brochures, technical data, O&M manuals, schematics, wiring diagrams, training, etc., for all equipment and controls.
 23. Submersible lift station shall meet the minimum requirements of "SWPA Handbook, Submersible Sewage Pumping Systems" by Submersible Wastewater Pump Association. Pumps shall be rail mounted with auto disconnect.
 24. Wet well storage and/or force main redundancy shall be provided in the event of force main failure.
- B. Structural: Structures shall be reinforced concrete, fiberglass, fusion epoxy coated or galvanized steel. In residential areas, structures shall be below ground. A hatch shall be provided suitable for the removal and replacement of major equipment components.
1. Hatches shall be spring loaded (Bilco type) with metal provided in brass, stainless steel, or aluminum materials.
 2. Where applicable, provide equipment-lifting eyes in roof of station.
 3. All structures shall have ample working room around machinery.
 4. Minimum clearance from machinery to wall shall be 24 inches or greater as needed for adequate maintenance.
 5. All outside exposed surfaces of all structures shall have Tex-Cote Graffiti-Guard®, 21st Century Coatings Graff-It-Off®, or approved equal applied up to a height of eight (8) feet above grade.
- C. Mechanical and Piping: All design shall satisfy the minimum requirements of the State Health Code.

Appendix D - Element 5: (Design and Performance)

1. A reduced pressure principle backflow prevention device is required on all domestic water connections.
 2. A 1 inch metered connection is to be provided adjacent to the station.
 3. An automatic air blower system is to be provided to exchange air every 6 minutes (minimum).
 4. An automatic sump pump (slope floor to sump) shall be provided with check valve in discharge pipe to wet well.
 - a. Provide standby pumping capacity equal to the largest single unit.
 - b. Make provisions for standby emergency power connection for use during power outages.
 - c. Sump pumps and air blowers shall be easily removable for maintenance.
- D. Electrical: All electrical installations shall comply with the National Electric Code and Division of Industrial Safety requirements, and the City of Lathrop Electrical Code.
1. Enclosed mounted prefabricated electrical panels shall be used above ground level outside the pump station.
 2. Running time meters shall be provided for all motors (use reset type).
 3. Explosion proof electrical appurtenances shall be provided below ground or an approved type disconnect and time delay shall be provided. Separate blower system shall be provided in all electrical panels located below ground.
 4. An approved type alternator and float switches shall be provided.
 - a. A manual switch adjacent to the motor that will override the control panel shall be provided.
 - b. Switch shall be mounted at motor height.
 5. Adequate lighting and electrical outlets shall be provided.
 - a. Outlets shall be mounted at motor height.
 - b. Color code all wiring and piping. (National Standard Coding)
 6. All enclosures shall have Tex-Cote Graffiti-Guard®, 21st Century Coatings Graff-It-Off®, or approved equal applied to all above grade surfaces up to a height of eight (8) feet above grade.

Appendix D - Element 5: (Design and Performance)

- E. Force Main Design: Force mains shall be designed in accordance with the following requirements:
 - 1. Velocity Limits
 - a. Resuspension initial velocity of a minimum of 3.5 ft/s.
 - b. Minimum velocity shall be 2 ft/s.
 - c. Maximum velocity shall be 10 ft/s.
 - 2. Provision shall be made for cleaning device for all force mains.
 - 3. All force mains shall be designed with a storage volume of 24 hours at the pump station or a fully redundant parallel force main.
 - 4. Combination air release/vacuum valves for sewage shall be provided for at all high points in a force main. The combination air release/vacuum valves shall be in accordance with City Standard Detail S-9.
 - 5. All other valves shall be specified by the Design Engineer to meet the requirements of the application as approved by the City Engineer.
- F. Wash Down Pad: All lift station sites shall be supplied with a wash down pad as required by the City Engineer. A minimum of a 2 inch City water service shall be provided for all pump stations.
- G. Emergency Shower and Eye Wash Station: All lift stations shall be supplied with an emergency shower and eye wash station.
- H. All above grade structures, signage, enclosures, and other above grade facilities shall be coated with anti-graffiti coating approved by the City Engineer up to a height of 8 feet above ground surface.

Treatment and Disposal

Treatment facilities shall include all necessary components and amenities as required by the City Engineer to insure a complete, automated, operating facility that will provide for minimum maintenance and operational costs. Storage or auxiliary pumping capacity shall be provided as required to prevent overflow during power outages, the duration of which shall be based on power company records and projections for the area in which the facilities will be constructed.

- A. Regulatory Standards: Pertinent requirements of the following agency standards, including all changes thereto, shall be considered and complied

Appendix D - Element 5: (Design and Performance)

with, except that in the event of conflict, the stricter design criteria shall govern.

1. Laws and standards of State of California Department of Public Health.
 2. The Porter Cologne Water Quality Control Act and the Regional Water Quality Control Board.
 3. Ordinances of the City including the latest City "Wastewater Facilities Master Plan".
 4. Others as appropriate.
- B. Access: All weather, paved access with a minimum width of 12 feet shall be provided to all major functional units. A turnaround area for the largest service vehicle shall be provided.
- C. Structures: Structures shall provide protection against weather and vandalism. The structures shall be designed to architecturally blend with the character of the development, and shall provide maximum efficiency and minimum operational and maintenance costs to the City. Laboratory storage and/or warehouse facilities may be required where the new development cannot practically utilize existing City facilities.
- D. Outside Lighting: All mechanical areas shall be adequately lighted for night operation and maintenance.

Secured Facilities

All facilities shall be secured in accordance with the requirements of Appendix G, Secured Facilities.

MATERIALS

Materials shall be chosen for their strength, durability, and ease of maintenance with due consideration for dead and live loads, flexural strength, and resistance to corrosion.

Pipe Joints

Pipe joints shall be selected to provide positive protection against entrance of roots and groundwater with sufficient flexibility to adjust to the trench bedding. In general, the joints shall be non-rigid and the joint sealer shall be restrained against lateral and axial movements. The installed joint shall provide positive separation between adjoining pipe sections to prevent failure of rigid materials by axial expansion.

Pipe Material

Gravity sewer pipe material shall be Polyvinyl Chloride (PVC) SDR26, ductile iron or other material approved by the City Engineer. Force main sewer pipe shall be either C900 or C905, Class 150 or greater.

- A. Polyvinyl Chloride (PVC) Pipe: Solid wall PVC pipe and fittings 4 inch through 15 inch shall conform to ASTM D-3034 and shall have a minimum cell classification of 12454-B or 13364-A or 13364-B as defined in ASTM D-1784. Additives and fillers shall not exceed 10 parts by weight per 100 parts of PVC resin in the compound.
1. PVC pipe and fittings shall be installed in accordance with ASTM D-2321 the Uni-Bell Handbook of PVC pipe, the Water Environment Federation Manual FD-5 and City standards.
 2. All pipe and fittings shall be suitable for use as a gravity sewer conduit, with provisions for expansion and contraction at each joint.
 - a. All joints shall be made with flexible elastometric seals meeting the requirements of ASTM D312-81, and shall be capable of passing all tests specified in said standard and within these specifications.
 - b. A factory-applied reference mark shall be provided on the spigot end to ensure proper positioning in the adjoining bell.
 - c. The pipe shall be uniform in color, opacity, density, and other physical properties.
 - d. Pipe shall be marked in accordance with ASTM D3034 for a gravity sewer.
 - e. All pipe shall be green in color or white with caution green tape.
 - f. Polyethylene sleeves may be required by the City Engineer at joints.
 3. Wyes and/or tees for house service connections shall be complete fittings.
 4. Solvent type joints for pipe or saddle, Y or T, are not allowed at any time.

Appendix D - Element 5: (Design and Performance)

5. Flexible pipe not installed within 120 days of the latest test shall not be used without prior written approval from the City Engineer.
6. Written certification, by the manufacturer, shall be submitted showing that all pipe and fittings meet the requirements herein.
7. Pipe stored on the job site shall be covered with canvas or other opaque material to protect it from the sun's rays. Air circulation shall be provided under the covering.
8. Contractor shall be responsible for deflection testing of all pipes. Testing shall be done twice as follows:
 - a. A 5 percent deflection test not less than 30 days following installation. The maximum allowable 30 day deflection shall be determined based on the pipe manufacturer reported ID less 5 percent and compared to the measured ID 30 days following installation.
 - b. A 7.5 percent deflection test shall be done not less than 11 months after acceptance of improvements. The maximum allowable 11 month deflection shall be determined based on the pipe manufacturer reported ID less 7.5 percent and compared to the measured ID 11 months following acceptance of improvements.
 - 1) Contractor shall post a bond with the City in an amount sufficient for the all replacement costs.
 - 2) Said bond will remain in place until all pipes have passed the 1 year, 7.5 percent deflection test.

Concrete

All concrete for sewer structures and sewer pipe encasement shall be Class B per Section 90 of the Standard Specifications unless otherwise shown herein or approved by the City Engineer.

TRENCHING, BACKFILL AND BEDDING

Trenching, Backfill and Bedding

Trenches shall be excavated to a width that will provide adequate working space, but not less than the minimum design width. Trench walls shall not be undercut. Trench width shall be per Table 5-6.

TABLE 5-6

NARROW TRENCH WIDTH, MINIMUM

<u>Nominal Pipe Size Inches</u>	<u>No. of Pipe Diameters (O.D.)</u>	<u>Trench Width, Minimum Inches</u>
4	7.0	28
6	5.0	30
8	4.0	32
10	3.4	34
12	3.0	36
15	2.6	39
18	2.3	42
21	2.2	45
24	2.0	48
27	1.9	51
30	1.8	54
33	1.7	57
36	1.6	60
42	1.6	66
48	1.5	72

- A. The trench walls can be sloped where indicated by the City Engineer to reduce trench wall failure as long as the measured width at the top of pipe does not exceed the maximum design trench width.
- B. Trenches, other than for Class "D" bedding, shall be excavated to provide space for the pipe bedding.
- C. Bell holes shall be excavated to prevent point loading of the bells or couplings of pipe laid.
- D. For flexible pipe, the trench bedding shall be 3/8" dust engineered fill as shown in Standard Detail R-28A.
 - 1. 3/8" dust engineered fill shall meet the following minimum requirements:
 - a. Sand equivalent of 30;

Appendix D - Element 5: (Design and Performance)

- b. Durability index of 60;
- c. Gradation equivalent to:

Sieve Size	Percent Passing
1/2"	100
3/8"	98
#4	68
#8	48
#16	33
#30	26
#50	17
#100	12
#200	9

- E. Sheet, shore, and brace trenches, as necessary, to prevent caving or sliding of trench walls, to provide protection for workmen and the pipe, and to protect adjacent structures and facilities.
- F. Sheet piling shall not be removed below the top of pipe if the resulting slope of the native soil increases the trench width to such an extent that the load on the pipe exceeds the safe field supporting strength of the pipe and bedding system.
- G. When a movable box is used, secure the installed pipe to prevent it from moving when the box is moved.
- H. The use of pea gravel as bedding or backfill is NOT allowed at any time.
- I. Trenches within the historic water table or where groundwater is encountered shall comply with the following conditions:
 - 1. Trench dams shall be installed every 100 feet along the sewer mainline.
 - a. Each dam shall be made of an impermeable material and prevent the flow of ground water along the sewer mainline.

Appendix D - Element 5: (Design and Performance)

- b. At a minimum, the dams shall be 12 inches wide and longer than the pipe embedment with a minimum thickness of 12 inches.
 2. The bottom of the trench shall be kept entirely free of water.
 - a. Dewater and dispose of the water so as not to cause injury to public or private property, or to cause a nuisance or menace to the public.
 - b. The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would cause damage or endanger adjacent structures or property.
 - c. The static water level shall be drawn down a minimum of one foot below the bottom of excavation to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density.
 - d. Dewatering systems shall operate continuously until backfill has been completed to one foot above the normal static groundwater level.
 3. The contractor shall control surface water to prevent entry into excavations. At each excavation, a sufficient number of temporary observation wells to continuously check the groundwater level shall be provided.
 4. Sumps shall be no deeper than five feet and shall be at the low point of excavations. Excavations shall be graded to drain to the sumps.
 5. The control of groundwater shall be such that softening of the bottom of excavations, or formations of "quick" conditions or "boils", does not occur.
 - a. Dewatering systems shall be designed and operated so as to prevent removal of the natural soils.
 - b. The release of groundwater at its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill, and prevent flotation or movement of structures, pipelines and sewers.
 - c. If an NPDES (National Pollutant Discharge Elimination System) permit is required for disposal of water from

construction dewatering activities, it shall be obtained prior to any dewatering activities.

6. Gradation and relative size of the embedment material and adjacent material must be compatible to minimize migration of fines. If bedding and backfill will allow migration of adjacent finer materials, a non-woven geo-textile is required.

TESTING AND ACCEPTANCE

Requirements

All sewer lines shall be tested for obstructions and cleaned by cleaning ball and flushing. An approved commercial sewer cleaning ball shall be used, which shall be controlled by a tag line or rope or sewer rods and permitted to move slowly through the sewer.

- A. All obstructions or irregularities shall be removed or repaired by the contractor.
 1. All testing, cleaning, and repairing shall be done to the satisfaction of the City Engineer.
 2. The contractor shall provide all necessary materials and utilities for the tests and shall dispose of all waste, including water, at his own expense.
 3. The water shall not be allowed to enter existing sanitary sewer systems.
- B. A test tee shall be installed between manholes, and testing shall be carried on between the tee and the manhole.
- C. In addition to other tests specified, PVC gravity sewer pipe shall be tested for deflection after installation.

Leakage

After laying, backfilling, and compacting, all sewers and manholes shall be tested for leakage. The program of testing must fit the condition as mutually determined by the City Engineer and the contractor.

- A. The contractor may use either an air or water test as specified below and shall furnish all labor, tools, and equipment necessary to make the tests and to perform any work incidental thereto.
- B. The contractor shall take all necessary precautions to prevent any joints from drawing air or water while pipelines or their appurtenances are being

tested. The contractor shall, at his own expense, correct any excess leakage and repair any damage to the pipeline and its appurtenances or to any structures indicated by or resulting from these tests.

C. Air Test Procedure

1. Pressurize the test section to 3.5 psi and hold above 3.0 psi for not less than five minutes.
2. Add air if necessary to keep the pressure above 3.0 psi.
3. At the end of this five-minute saturation period, note the pressure (must be 3.0 psi min.) and begin the time period.
4. If the pressure drops 0.5 psi in less than the time given in Table 5-7, the section of pipe shall not have passed the test.

**TABLE 5-7
AIR TEST PIPE HOLD TEST**

Sewer Main Size (inches)	Minimum Time in Minutes
4	2
6	3
8	4
10	5
12	6
15	7.5
18	9.25
22	11
24	12.25

5. When the prevailing groundwater is above the sewer being tested, pressure shall be increased 0.43 psi for each foot of the water table above the flow line of the sewer.
6. If the time for the pressure to drop 0.5 psi is 125 percent or less of the time given in the table, the line shall immediately be re-pressurized to 3.0 psi and the test repeated.
7. For 8” and smaller pipe only: if during the five minute saturation period pressure drop is less than 0.5 psi after the initial pressurization and air is not added, the section undergoing test shall have passed.
8. If the test is not passed, the leak shall be found and repaired to the satisfaction of the City Engineer and the length of repaired line retested.

Appendix D - Element 5: (Design and Performance)

9. House sewers shall be considered part of the lateral to which they are connected with no adjustment of test time allowed to compensate for the small diameter of the house sewers.
 10. The pressure gauge used shall be supplied by the contractor, shall have maximum division of 0.10 psi, and shall have an accuracy of 0.04 psi.
 - a. Accuracy and calibration of the gauge shall be certified by a reliable testing firm at six-month intervals or when requested by the City Engineer.
 - b. In addition, the City Engineer may compare the contractor's gauge with a City owned gauge at any time.
- D. Manholes shall be vacuum tested in accordance with ASTM C1244 prior to backfill.
- E. Hydrostatic Test: The hydrostatic test may be used in lieu of the air test. When the hydrostatic test is used, all sections of sewer shall be sealed by inserting stoppers in the lower end of the sewer, the inlet sewer of the upper manhole, and any side sewers at intervening manholes, and filling the pipe and manholes with water to a point in the upper manhole not less than 5 feet above the invert of the pipe or prevailing ground water elevation, whichever is higher. The maximum length of section tested shall be 1,000 feet.
1. The line shall be filled for at least four hours prior to testing. It shall be tested for at least two hours, maintaining the head specified above by measured additions of water. The sum of these additions shall be the measured leakage for the test period.
 2. Maximum allowable head of water above any portion of sewer being tested shall be 15 feet. Where the difference in elevation between successive manholes exceeds 15 feet, a test tee shall be installed between manholes, and testing shall be carried on between the tee and the manhole.
 3. For gravity pipelines, the allowable leakage shall not exceed 0.026 gallons per minute, per inch diameter, per 1,000 feet of main line sewer being tested. This is equivalent to 200 gallons per day, per inch diameter, per mile.
 4. Where the actual leakage in a section tested exceeds the allowable, the contractor shall discover the cause and remedy it before the sewer is accepted. If the leakage is less than allowable and leaks are observed, such leaks shall be repaired.

Appendix D - Element 5: (Design and Performance)

5. Water used in testing shall not be permitted to enter the existing sanitary sewer system.
- F. **Televising of Sanitary Sewers:** Following the placement and densification of backfill and completion of other required testing, but prior to the placing of pavement, the Contractor at his expense shall provide single circuit television equipment to televise the inside of the total length of the gravity sewer mains. The contractor shall provide a DVD of the television logs in digital format to the City Engineer. Any defective pipe or conditions that are discovered by the televising shall be corrected by the Contractor at no expense to the City. Any corrective method proposed by the Contractor shall be approved by the City Engineer prior to the performance of the corrective work.

Defective pipe or conditions shall include the following:

1. Breaks or cracks in the pipe.
2. Joint offsets.
3. Protruding, folded or otherwise deformed gaskets.
4. Standing water exceeding the following:

Pipe	Depth
6" diameter	1"
8" diameter	1.25"
10" diameter	1.3"
12" diameter	1.75"
15" diameter	2..5"
or larger	

- G. **Repair Work:** When test results indicate damaged pipe, the repair shall be as recommended by the manufacturer and as approved by the City Engineer.
- H. Force Main pressure testing shall be completed by maintaining a minimum pressure of 150 psi for a minimum of 2 hours.

Final Cleaning

Upon completion of all testing, the Contractor shall clean the sewer in such a manner as to insure that no foreign matter or debris has been left in the sewer. All foreign matter and debris shall be removed and disposed of in a manner acceptable to the City Engineer.

END OF SECTION