

CITY OF LODI

PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION

PUBLIC IMPROVEMENT DESIGN STANDARDS

JULY 2019



“Building A Better Community”

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Section 1 - Streets

1.100 General

1.101 Scope

All public streets shall be designed in accordance with acceptable engineering principles and shall conform to these Standards. Primary references for supplemental information and/or details include the Caltrans Highway Design Manual, "A Policy on Geometric Design of Highways and Streets (the AASHTO "Green" Book) and current ADA Standards.

Private streets and parking lots shall be designed according to applicable development approvals, City Codes and Standards and accepted engineering principles. Any deviation requires City Engineer and Building Department approval.

1.102 Submittals

The sequential requirements listed below are based on projects subject to the City General Plan. Developers and design engineers of projects not subject to the Plan should consult with the City Engineer to determine applicable and appropriate timing of submittals.

Development Plan Stage (preliminary plan for entire parcel/development)

Development plan submittals shall include a map showing the proposed project, existing streets (rights-of-way, medians, number of lanes and regulatory traffic controls) in the vicinity (400 ft. minimum) of the project and new street rights-of-way proposed for the project. At least one map showing right-of-way and lot lines shall be submitted at a scale of no less than 1" = 200'.

Lot lines and sight-distance triangles per §1.303 shall also be shown at the following locations:

- intersections at reverse frontage lots;
- intersections at curved streets;
- intersections with adjacent building setbacks less than 20 feet.

A table showing land use categories and acreage, trip generation and total traffic shall be provided (when applicable).

Project Master Plan Stage (detailed plan for entire parcel/development)

A detailed street master plan for an entire project may be required by the City Engineer for projects involving extension of streets through adjacent property or to assure that the layout of the approved development plan will meet these Standards.

Truck and/or Emergency vehicle turning radius templates may be required by the City Engineer.

Improvement Plan Stage (specific improvement plans for portion being developed)

Improvement plans shall include the information listed in §5.200 and Appendix A-1.

1.200 Design Volumes

1.201 General

Unless otherwise designated in the General Plan Transportation Element, or approved development plan, the design volumes shall be used to determine required street classifications and shall be approved by the City Engineer. For any new development, preliminary traffic volumes shall be provided in consultation with City Engineer. A traffic impact analysis shall be required as part of development approval process when: (1) the project will generate at least 100 new peak hour vehicle trips to and from the project site and (2) project traffic is likely to substantially affect an intersection or roadway segment already identified as operating at an LOS E (except downtown as identify in General Plan).

The following table relates street classification and design volume and design speed.

Street Classification	R/W (ft)	Curb – Curb (ft)	Standard Configuration	Design Speed (MPH)	Daily Traffic Volume Range
Local	50-55	36-40	2 lanes	30	0 – 4,000
Collector*	60-68	44-52	2 lanes with LT lane/median	40	4,000 – 14,000
Minor Arterial*	80-94	64-76	4 lanes / 4 lanes with LT lane/median	50	14,000 – 24,000
Major Arterial*	118	102	6 lanes with LT lane/median	55	24,000 – 36,000

*When bike lanes only or bike lane with on-street parking are provided, additional width shall be included in the street cross section based on the applicable bike lane width identified in the Highway Design Manual (latest edition).

See §1.302 regarding cross sections.

1.202 Traffic Impact Analysis

Traffic impact analysis shall be conducted using Institute of Transportation Engineers (ITE) Trip Generation Manual (latest edition) after consultation with the City Engineer regarding scope of work, assumptions, computer programs and models to be used and other parameters.

ITE average trip generation rates shall be used as approved by the City Engineer. For mixed use development projects, individual building rates shall be added. For example, in a commercial development consisting of a large retail space with detached building pads, shopping center rates may be used for the large retail space and fast food, bank or other appropriate rates used for the pads. "Pass-by" reductions in rates shall be approved by the City Engineer.

1.300 Street Design

1.301 General Design

Minor and Standard Residential streets shall be designed to connect with nearby uses and neighborhoods. Expansion of the street grid is encouraged while gated developments and cul-de-sacs are discouraged. If gated developments and cul-de-sacs are constructed they shall contribute to connectivity by creating pedestrian, bicycle and vehicular connections to public streets. The maximum length of continuous straight streets should not exceed 1,000 feet. Continuous straight streets with residential frontage, between two collector or arterial streets, are prohibited.

Neighborhood block lengths shall not exceed 1300 feet.

On-site improvements on lots fronting arterial and major collector streets shall be designed such that exiting vehicles do not have to back out onto the street. (Use circular or hammerhead driveways, on-site circulation, etc.)

Bicycle Facilities

Bicycle facilities shall be provided as identified in the City's Bicycle Master Plan and as directed by the City Engineer. Refer to Caltrans Highway Design Manual, American Association of State Highway and Transportation Officials (AASHTO), and the California Manual of Uniform Traffic Control Devices CA MUTCD), latest editions, for the applicable design criteria.

Cul-de-Sacs

All permanent dead-end streets shall have a cul-de-sac at the end. Cul-de-sacs shall have a minimum face of curb radius of 43 feet. The reversing curves at the beginning of the turn-around shall also have a 43-foot R/W radius, except in short cul-de-sacs (bulbs) where they would intersect the curb return at the entrance. In such cases, the design shall be specifically approved by the City Engineer. Asymmetrical configurations are permitted.

Cul-de-sacs are discouraged in commercial and industrial developments and must be specifically approved by the Planning Commission or City Council. The maximum design volume on a cul-de-sac shall be 500 vehicles per day. The maximum length of a cul-de-sac, regardless of volume, shall be 750 feet.

Temporary cul-de-sacs or hammer-heads on dead-end streets, that are to be extended, may be required for Fire Department turn-around (depending on the length of the street and location of fire hydrants).

Alleys

New public alleys are not allowed unless specifically approved by the City Council, however, developments with private streets may be designed to minimize the number of access points onto arterials.

Landscaping & right-of-way fences

Requirements for roadside or median landscaping or "hardscaping" and right-of-way (reverse frontage) fences are not included in these Standards and shall be determined on a case-by-case basis by the City Engineer subject to project conditions of approval.

Miscellaneous

In unimproved / rural area, shoulder width shall be provided based on the Caltrans Highway Design Manual (latest edition) and approved by the City Engineer.

"Knuckles" on residential streets are to provide proper lot width at the setback line and shall conform to Standard Plan 133.

Lot lines should follow subdivision boundary lines unless specifically approved otherwise on the development plan. Streets shall be fully improved within tract boundaries.

1.302 Cross Section

Cross sections for standard street classifications are shown on Standard Plan 101. These cross sections may be modified by the City Engineer based on specific plans, traffic study requirements for project access lanes or other development approvals.

Streets along tract boundaries (half-streets) shall have a minimum 32-foot improved travelled way. If "No Parking" is approved by the City Council prior to approving the plans, the width may be reduced to 24 feet. Temporary curbing shall be provided at the unimproved edge of the pavement.

The standard cross slope of the street shall be 2.5%. Where necessary to match existing facilities, the cross slope on new streets may vary between 1.5% and 5%. Replacement of existing travel lanes in order to meet cross slope criteria may be required. Intersection, cul-de-sac and knuckle cross slopes should be 1.5% minimum, 4% maximum.

Upon approval of the City Engineer, the cross slope may be increased to 9% for overlays, shoulder work or other special circumstances. Grinding is normally required to minimize the effects of overlays and may include double passes, the first 6 feet wide, adjacent to the gutter at constant depth, with a second, tapered transition pass next to the first. (See §1.410, Driveway slope for additional criteria at driveways)

1.303 Sight Distance

Intersection/Driveway Sight Distance

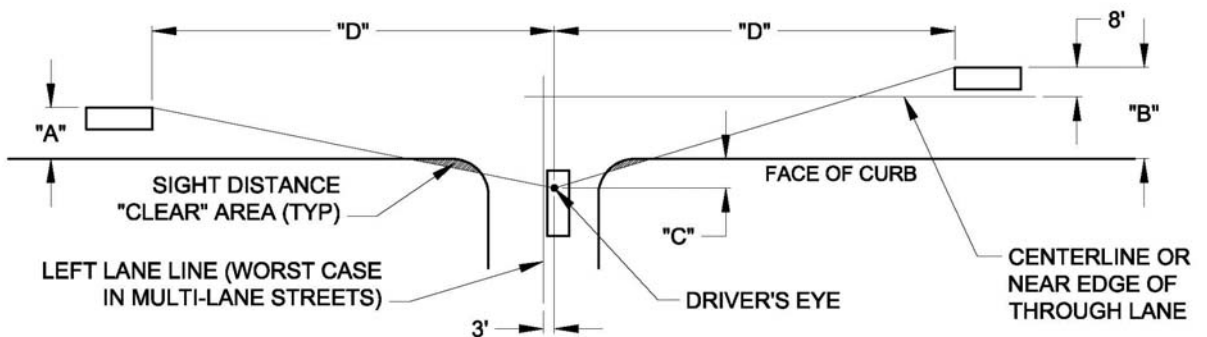
Minimum requirements for intersection and driveway sight distances are shown in the "Corner Sight Distance" table for traffic on the major (through) street and stop control on the intersection/driveway. Sight distances are from Caltrans Highway Design Manual (latest edition) Table 405.1A "Corner Sight Distances" which are intended to allow opposing traffic to cross the major street without requiring approach traffic to reduce speed.

Planned intersection controls shall be considered in determining the appropriate sight distance. For example, where a traffic signal is planned, and the intersection will be initially controlled with a two-way stop, the sight distance may be provided at the "stop" legs of the intersection.

Sight distance shall also be provided at median openings as appropriate.

Right-of-way or sight distance easements shall be provided at new reverse frontage fences, signs or other obstructions as appropriate. The "clear" area shall not contain shrubbery, mounds, signs or other obstructions over 30" high. Poles and trees shall be spaced far enough apart to provide adequate sight and tree limbs shall be at least 7 feet above the ground. (This section is not intended to preempt the zoning code with regard to front yard fences in residential areas.)

SIGHT DISTANCE REQUIREMENTS



MAJOR ST. CLASSIFICATION	DESIGN SPEED	"A" (FT)	"B" (FT)	"D" (FT)
LOCAL	30	14-16	25-27	330
COLLECTOR	40	17-19	30-34	440
MINOR ARTERIAL	50	17	52	550
MAJOR ARTERIAL	55	15	68	605

CURB RETURN RADIUS - R	"C" (FT)
< 20	8
20	10
25	12
30	13
35	15

The entering driver's eye position shall be assumed 3 feet to the right of the entering street's centerline, 3.5 feet above the pavement surface, and 11 feet clear of the nearest vehicle lane on the street being entered or 8 feet behind the stop bar, whichever is greater.

The position of the closest approaching vehicle's far front corner shall be assumed 3 feet from the edge of the nearest approaching vehicle lane and 4.25 feet above the pavement surface for each direction of travel.

The above "A" and "B" distances (in feet) assume new standard cross sections per Standard Plan 101. Existing streets shall be checked using the worst case of existing or future striping and the higher of the design speed or existing 85th percentile speed.

Stopping Sight Distance

Stopping sight distance for various street types shall be in accordance with Caltrans Highway Design Manual (latest edition) or as approved by the City Engineer.

Stop sight distance is measured from the driver's eyes, which are assumed to 3.5 feet above the pavement surface, to an object 0.5 feet high on the road.

1.304 Vertical Alignment

Vertical Curves

Vertical curves are rarely required in Lodi due to the flat terrain. Thus the following standards are brief and only describe minimum requirements. The design engineer is referred to the references cited for additional design criteria where compound curves are needed such as canal crossings.

Where the algebraic difference in longitudinal slope exceeds 1%, a parabolic vertical curve shall be

used. The minimum length of vertical curve shall be 50 feet or as required by the Caltrans Highway Design Manual (latest edition), ASSHTO "Green" Book (latest edition), whichever is larger and approved by the City Engineer.

Top of Curb and Flowline Grades

Flowline grades shall not be less than 0.25% and not greater than 6% unless specifically approved by the City Engineer. A normal design minimum of 0.30% is recommended to minimize birdbaths (puddles exceeding ¼" in depth, 6" in width or 10' in length). Where matching existing improvements, the minimum grade may be reduced with the approval of the City Engineer. With the specific approval of the City Engineer, curb height may be varied from a minimum of 4" to a maximum of 7".

The minimum top of curb elevations shall be 1-foot above the design maximum water surface of the Master Plan Storm Drainage Basin to which the proposed improvement is tributary. This minimum elevation is listed in §3.703.

Top-of-curb elevations shall be 1-foot (minimum) above the calculated hydraulic grade line for the storm drainage system.

Grades on opposite sides of the street shall be the same wherever practical.

Grades and Curves

On cul-de-sacs, knuckles and other curves (except curb returns) where the curb radius is less than 100 feet, the flowline grade shall be 0.30% minimum.

Curb Return Grades

Top of curb fall (in feet) around returns shall be per the following table:

Radius	Retrofit Minimum	New Construction	
		Minimum	Maximum
15	0.12	0.20	0.50
20	0.16	0.20	0.60
25	*	0.25	0.80
30	*	0.30	0.90
35	*	0.35	1.00
40	*	0.40	1.10
45	*	0.45	1.20
50	*	0.50	1.30

*Special Determination

At returns where the curb type changes, differences in curb height shall be taken into account in the design so as not to reduce the flowline fall.

Median Grades

Median grades shall follow street grades. Minor variation in top of median curb grades on opposite sides of the median is permitted depending on the width and nature of landscaping. For aesthetic reasons, the maximum variation at noses or other medians less than 6 feet wide should be 0.15 ± ft. Median noses and other areas with solid fill in between curbs shall be sloped to drain.

1.305 Horizontal Alignment

Street Curvature

Design of curved arterial and collector streets shall be based on criteria in the Caltrans Highway Design Manual (latest edition). The minimum radius of curvature of centerline for all streets shall be per the following table:

Minimum Horizontal Curve Radius

Street Classification	Design Speed	Radius (ft)	Notes
Local	30	300	1, 2
Collector	40	550	1, 2
Minor Arterial	50	850	1, 2
Major Arterial	55	1,000	2

Notes:

1. Minimum radius is below that indicated in Caltrans Highway Design Manual Figure 203.2 "Standards for Curve Radius" for the standard cross slope. While this is acceptable on local streets, larger radii, superelevation or reduced design speed should be considered on collector and arterial.
2. Minimum radius assumes no sight obstructions. Figure 201.6 "Stopping Sight Distance on Horizontal Curves" of the above reference should be checked when walls or other obstructions are planned within 20 feet of the right-of-way.

There shall be a tangent between reversing curves of at least 150 feet on arterial and collector streets, and 50 feet on all other streets.

Transitions

Length of pavement transitions affecting travel lanes shall be designed per applicable Caltrans Standards (Highway Design Manual Section 206). At ends of curb & gutter, the minimum transition length shall be based on a 45° pavement transition. Longer distances will be required where a driveway is located at the end of the curb & gutter.

Intersection Angle

Streets shall intersect at right angles (± 5 degrees). Curved residential streets shall have at least

50 feet of centerline perpendicular (± 5 degrees) to the projected curb line of the intersecting street. Longer perpendicular distances may be required on collector and arterial streets.

Curb Returns

Curb return radii for various street types shall be as shown on Standard Plan 611.

Angle Points

Angle points of 5 degrees or less are allowed on residential street centerlines with approval of the City Engineer. In such cases, the curb face shall be designed with a 100-foot minimum radius curve.

Opposing Streets

All streets entering upon opposite sides of any given street shall have their centerlines directly opposite each other or separated by at least 150 feet. Greater distances may be required on collector and higher classification streets based on anticipated turning volumes.

The minimum distance between streets entering a restricted access street shall be as provided by a Specific Plan adopted by the Planning Commission and City Council.

The location of any new intersection between a local street and an arterial shall be reviewed by the City Engineer to determine safety and compatibility for signal progression. The City may restrict access to right-turn-only if necessary.

1.306 Medians

Medians and median openings shall be constructed at locations shown on Specific Plans or as required as part of project approval. See §1.301 regarding landscaping.

Design geometries for parabolic median curb transitions, flares and left-turn-in-only median openings are shown in the Standard Plans.

Median curb heights shall be 8" with a minimal reverse gutter provided. Due to excessive pavement deterioration from watering, interior drainage at landscaped medians shall be provided, unless otherwise approved by the City Engineer.

1.400 Driveways

1.401 General Requirements

The following driveway standards are not applicable to State Highway or controlled access streets where access is limited by deed or map restrictions, or other development restrictions. If driveways are approved at such locations, the applicable design requirements shall be used.

New driveways on restricted access streets require City Council approval.

The number, location and width of permitted driveways are regulated by the Public Works Department and shall be based on the demonstrated needs of the parcel being served. They shall not be excessively detrimental to the abutting street capacity, safety, and/ or efficiency.

The City Engineer may modify any of the following standards in order to provide better traffic movements or because of special or unusual conditions. The ITE publication "Guidelines for Driveway Design & Location" contains additional design guidelines.

"Commercial" driveways per Standard Plan 114 shall be used on all driveways serving 4 or more parking stalls and other locations where trucks, including garbage trucks, are anticipated. Where land use changes affect existing driveways proposed for reuse, the City Engineer may require upgrading of the driveway to commercial standards.

"Residential" driveways shall be of size and location per Standard Plan 149.

"Common" driveways straddling a property line to serve two or more parcels, are permitted provided applicable width and clearances are met and approved by the City Engineer.

1.402 Special Driveways

Special driveways are those with a depressed back of driveway at the property line and a radius instead of a curb transition and are used to provide improved access at high volume driveways and minimize capacity reduction on collectors and arterials. Design geometries are shown on Standard Plan 111.

Special driveways shall be used when the driveway peak hour volume exceeds 300 vehicles per hour and may be required at lower volume driveways at critical locations approved by the City Engineer.

Depth of flow in the gutter is limited to 3 inches, see §3.502.

1.403 Width

Maximum driveway width shall be 35 feet for standard driveways and 56 feet for special driveways unless specifically approved otherwise by the City Engineer for high truck volumes or other factors.

The total width of commercial and industrial driveways shall not exceed 60% of the frontage. The total width for residential driveways shall not exceed 50% of the frontage.

The minimum width of a single driveway shall be 12 feet and 24 feet for a driveway serving a parking lot with a two-way aisle. Additional driveway width may be required on collectors and arterial streets, particularly where there is no parking and a travel lane is adjacent to the curb.

Standard driveway width is measured at the curb line and includes only the depressed section. Special driveway width is measured between curbs on the property side. Width of a raised medians separating in and out traffic is not included in the width maximums listed in this section.

1.404 Distances from Curb Returns

Commercial, industrial or other high volume driveways on collectors and arterials shall be located as far as practical from the nearest curb return and may be prohibited within 200 feet of a signalized intersection, an intersection planned for signalization, or intersections with critical capacity. At other locations, the top of the driveway transition shall be at least 10 feet from the nearest curb return provided the return meets current standards for radius and location. At streets to be widened or improved, the above distances shall be measured from the ultimate location of the curb return.

At alleys the driveway transition shall be permitted no closer than 10 feet from the projected intersecting alley curb face, and no closer than 2 feet from the nearest alley curb return.

1.405 Distances from Utility or Safety Devices

Driveway transitions shall clear all public facilities (such as street light and traffic signal standards, utility poles, fire hydrants, and street trees) by a minimum of 3 feet. Greater distances from fire hydrants are recommended. Any relocation of public facilities required to maintain such clearance shall be at the expense of the party requesting the driveway.

1.406 Distance between Driveways

A minimum of 4 feet of full curb height shall be maintained between the top of transitions of adjoining driveways. No driveway shall be constructed which results in a curb length between transitions in excess of 12 feet, unless the curb length is at least 22 feet in length. See Standard Plan 149 for additional information. Where practical, the total space between driveway transitions shall be in

multiples of 22 feet plus 4 feet (Spacing = 22X + 4).

1.407 Distances from Property Line

A minimum of 2 feet of full curb height shall be maintained between the property line and the top of the driveway transition except where common use driveways have been permitted by the City Engineer.

1.408 Removal

Any abandoned driveway shall be completely removed and replaced with standard curb, gutter and sidewalk. Driveways are considered abandoned when on-site development, fencing or other use demonstrates that the driveway is no longer needed.

1.409 Parking Lot Driveways

Parking lot driveways shall be designed in such a manner as to preclude the use of the abutting public street for vehicular circulation solely related to the parking lot. The driveway shall be commercial type per Standard Plan 114. Design of the parking lot shall conform to Standard Plan 134.

1.410 Driveway Slope

Driveways shall be designed to minimize vehicles scraping the pavement in front of the driveway or high-centering at the back of the driveway.

In new work, the driveway grade measured at a point 10 feet behind the flowline shall not exceed 0.75 feet above the flowline.

In designing overlays or driveway replacements, the deflection angle at the flowline determined by a point on the pavement 4 feet out from the flowline and a point on the driveway 10 feet behind the flowline should not exceed 9.75°.

1.500 Curb, Gutter and Sidewalk

1.501 General Requirements

Curb, gutter and sidewalk shall be installed in all new developments unless specifically deferred or otherwise waived. Curb and gutter may be required to be extended across adjacent parcels for drainage purposes. New ditches or swales are not permitted across residential frontages.

1.502 Curb and Gutter Type

Curb and gutter with a vertical "barrier" type curb shall be installed along frontages conforming to any of the following criteria:

- Collector, arterial or higher classification streets;
- Multi-family residential frontage;
- Commercial or industrial frontage;
- School, church, park or other public use frontage;

- Any curb where the street centerline radius is less than 200 feet unless specifically determined otherwise by the City Engineer;
- All curb returns;
- Installations where driveways are existing or known as part of an approved development plan unless specifically determined otherwise by the City Engineer;
- Other areas designated by the Planning Commission or City Council.

Roll ("mountable" or "wedge") type curb and gutter per Standard Plan 136 may be installed on streets within new single-family developments.

Various designs of curb and gutter have been used in the City. For minor repairs of existing improvements, the type of curb and gutter shall match existing. In replacing curb returns or over 1/2 of a block face, vertical or rolled curb & gutter per Standard Plan 135 & 136 may be required by the City Engineer. Existing curb & gutter should be considered for replacement where they are broken or water ponding extends into the pavement. In replacement projects, curb height may be varied from 4" to 7" to match existing improvements.

Four foot transitions with weakened plane joints at each end shall be used to separate different curb & gutter types.

1.503 Sidewalk

The minimum widths of sidewalk shall be per the appropriate standard plans in residential streets, 5 feet in industrial streets, 7.5 feet in commercial areas, or as noted on the Specific Plan. The above widths do not include the curb width.

Widths shall be increased by at least one foot where fences, walls or other similar clearance obstacles to pedestrians are constructed.

At poles, trees and other small structures, the minimum clear width provided shall be 4 feet. Upon specific approval of the City Engineer, the minimum width may be reduced to three feet (legal min.) in extreme cases. The "obstacle course" effect of closely spaced poles and other street hardware on opposite sides of the sidewalk shall be avoided.

New poles or other devices placed in the sidewalk on the curb side shall have a minimum horizontal distance from the face of curb of 3 feet at intersections and driveways and 1.5 feet elsewhere per AASHTO Roadside Design Guide.

Back of walk transitions necessary to accomplish the above clearances shall have smooth reversing curves or angle points with deflection angles not exceeding 30 degrees.

1.504 Curb Ramps

Curb ramps shall be installed in all new curb returns per Standard Plan 132. Ramps may also be required at "T" intersections or knuckles at a lot line on the side opposite the curb return.

Curb ramps shall be retrofit at curb returns where the adjacent street pavement is being reconstructed or a new development is being constructed on a corner lot.

Accessible paths shall be included at appropriate locations in medians, parking lots and other improvements as required by the City Engineer.

1.505 Back of Sidewalk

Improvement of the space between the back of sidewalk and the right-of-way shall be consistent with the proposed land use and shall require minimal City maintenance. Where this space is incorporated into on-site landscaping, maintenance is the responsibility of the owner/developer.

At reverse frontage fences, the space shall be filled with additional sidewalk and/or landscaping as approved in the development plan. Reverse frontage fences and landscaping are to be privately owned and maintained for private developments.

1.600 Structural Section

The structural section shall be asphalt concrete (AC) pavement with aggregate base designed in accordance with the procedures contained in the "Flexible Pavement Structural Section Design Guide for California Cities and Counties", Caltrans Highway Design Manual (latest edition) and these Standards. Full depth asphalt concrete may be specified as an alternate. The calculation shall include a safety factor applied to the AC streets.

All roadway designs shall be based on the recommendations of the results of a soils report performed by a Geotechnical Engineer. The R-value recommended in the soils report shall be used as a guide in design and approved by the City Engineer prior to design. The R-value used in design shall not exceed 60. Upon approval of the City Engineer, the plans may be prepared based on preliminary R-values with appropriate notes for timely retesting during construction for determination of final design values.

The following table provides the minimum traffic indices (T.I.) and the minimum structural section.

Street Classification	Maximum ADT	Minimum T.I.*	Minimum Section (Assumes R=50)
Dead-End	500	5.0	0.20' AC/0.30 AB or 0.35' AC
Local	4,000	6.0	0.25' AC/0.45' AB or 0.40' AC
Collector	14,000	7.0	0.30' AC/0.45' AB or 0.50' AC
Minor Arterial	24,000	9.0	0.40' AC/0.60' AB or 0.70' AC
Major Arterial	36,000	10.0	0.50' AC/0.65' AB or 0.80' AC

* The traffic index (T.I.) may be revised at the discretion of the City Engineer to reflect designated truck route and or where projected future traffic volumes.

Minimum subgrade compaction of native material shall be 8" @ 92% relative compaction (R.C.) for residential streets and 6" @ 95% R.C. (removed and replaced material), over 6" @ 90% R.C. compacted original ground on industrial, collector and arterial streets. Any fill or disturbed material below shall also be compacted to 90% R.C.

These Design Standards are to be conservatively applied to developments to provide pavement that will have at least a 20-year design life.

Upon approval, transitions and other temporary pavements may be designed for a shorter life.

New development may be required to remove and replace existing pavement as necessary to provide a high quality connection between existing and new improvements. Examples include:

- ravelling edges of existing pavements;
- additional pavement to meet cross slope standards;
- ends of streets being extended;
- flares at shoulders;
- transitions

The City may require that the developer install a reduced pavement section in anticipation of excessive street cuts for utility services to the lots. In such cases, the developer shall pay the City the difference in cost between the full section and the reduced section and the City will be responsible for the installation of the future additional pavement.

Trench structural sections shall be as shown on Standard Plan 506 unless approved otherwise and shown on the improvement plans.

Pavement cuts may be prohibited in new pavement, or within 5 years of newly resurfaced streets. In cases where such cuts are permitted, special trench cuts or other special resurfacing may be required by the City Engineer.

Section 2 - Wastewater

2.100 General

2.101 Scope

These standards apply to all public wastewater (sewer) facilities designed for installation within the City's public right-of-way or public utility easements (PUE) and are limited to wastewater mains and laterals 15 inches or less in diameter. Standards and requirements for larger sizes will be determined by the City Engineer as needed. Except where specifically noted in these Standards or as required as part of project approval, all wastewater facilities installed on private property for private use and ownership shall be designed and constructed in accordance with the provisions of the California Plumbing Code, as adopted by the City.

Wastewater lines shall be designed in accordance with acceptable engineering principles, California OSHA Standards (legal min.), State of California Title 22 requirements (legal min.), and City Standards. Storm water collection facilities shall not be connected to a wastewater line. Industrial waste sources may be connected or discharged into a wastewater line with written approval from the City Engineer.

These Standards do not cover all the applicable City, State and Federal requirements for wastewater quality and monitoring. (See Lodi Municipal Code and the Utility Manager for applicable requirements.)

2.102 Submittals

The requirements listed below are based on projects adhering to the City's General Plan. Developers and design engineers of projects not subject to the Plan should consult with the City Engineer to determine applicable and appropriate timing of submittals.

Development Plan Stage (preliminary plan for entire parcel/development)

Development plan submittals shall include a map showing the proposed project, existing septic systems and wastewater mains in the vicinity of the project.

A table showing land use categories, acreage and average peak flows shall be provided. (average and peak flow in cfs).

Project Master Plan Stage (detailed plan for entire parcel/development)

Prior to preparation of improvement plans for the first construction phase of the project, a wastewater master plan for the entire project shall be submitted for approval by the City Engineer.

The preliminary design submittal shall include the following items:

- A plan, at a scale of 1" = 100', showing the proposed system, preliminary pipe sizes, tributary subareas, existing and future tributary areas outside the project limits, zoning, projected land use, and any features affecting the system. If possible the plan shall show the entire development on a single sheet.
- Design flows at major junction points including flows coming from outside the project limits.

- A description and sketches of any pump stations including: number and size of pumps, design flow, wetwell volume and operating levels, provisions for standby power or energy operations, and maintenance access.
- Where the design includes additional tributary areas outside the project as required by the City, **and** the developer wishes to obtain reimbursement for oversize pipes, the Engineer shall submit additional calculations and design for the project only in order to estimate the reimbursable portion.

Improvement Plan Stage (specific improvement plans for portion being developed)

Improvement plans shall include the information listed in §5.200 and Appendix A-1.

2.200 Design Flow

Wastewater lines shall be designed on a peak flow basis. Design peak flows shall be estimated by applying the appropriate peaking factor to the average flow.

For analysis of existing lines or where existing land use is higher than the zoning, flow shall be calculated based on an average sewage flow of 70 gallons per capita per day with a population of 2.85 capita per single family dwelling unit and 2.0 capita per multiple family or high density dwelling unit (see table below).

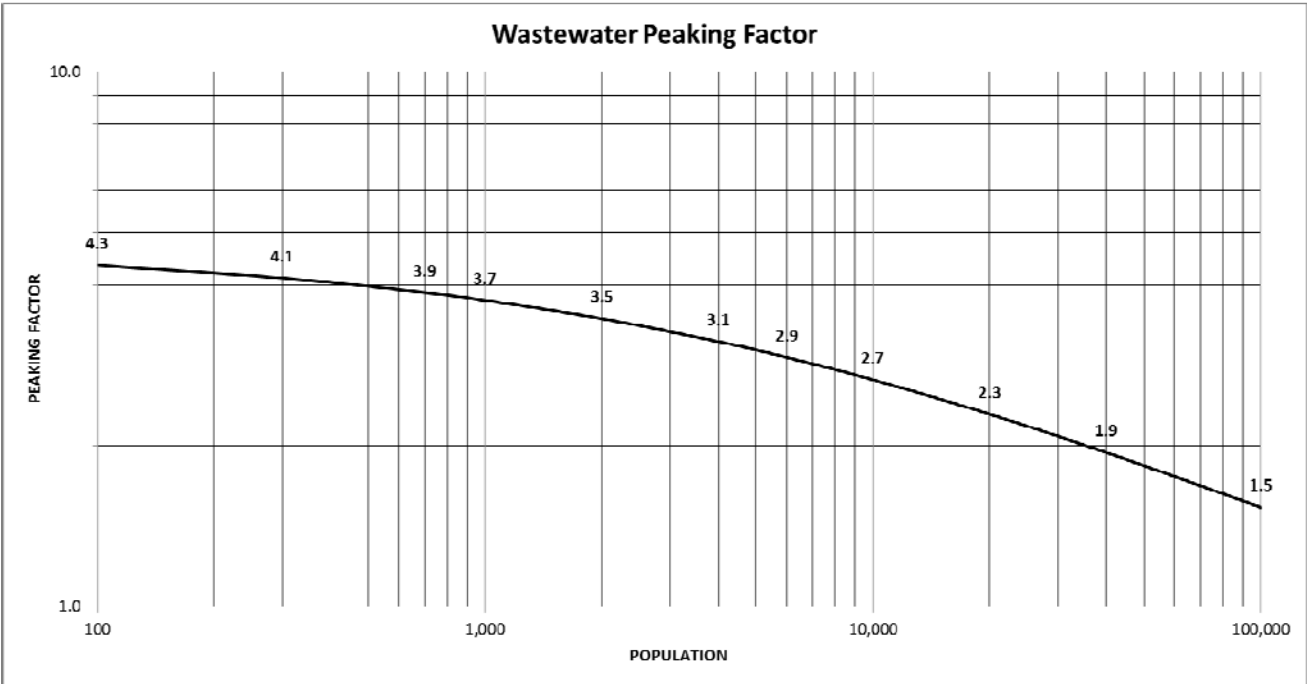
For lines serving new areas or where existing land use is lower than the zoning, the City zoning map and/or general plan shall be used to estimate average flow. The following table summarizes these criteria:

Zoning	Land Use	Pers/Unit	Units/acre	Pers/acre	Flow
LDR	Low Density Residential	2.85	6	17.1	0.00186 cfs/acre
MDR	Medium Density Residential	2.4	15	36	0.0039 cfs/acre
HDR	High Density Residential	2	25	50	0.0054 cfs/acre
C	Commercial	-	-	-	0.0031 cfs/acre
Ind	Industrial	-	-	-	0.0023 cfs/acre
n/a	School	-	-	-	0.000034 cfs/student

The above values are average figures based on the assumptions shown. At locations where a specific use is proposed for which the flow would exceed these figures, the higher value shall be used.

Peak flow shall be obtained by multiplying the average flow by the following peak factors. These peak factors include an allowance for infiltration/inflow. The peak flow factor shall be 3.2 for commercial and institutional flows and 2.8 for industrial flow.

Peaking factors for residential flow shall be selected from the figure below based upon total upstream service population.



2.300 Pipe Design

2.301 Minimum Size

New gravity wastewater lines shall be a minimum of 6 inches in residential areas and 8 inches for commercial-industrial uses.

2.302 Design Depth of Flow

Main wastewater lines (10 inches or smaller in diameter) shall be designed to flow a maximum of one-half full at peak design flow. Trunk wastewater lines (12 inches and larger in diameter) shall be designed to flow a maximum of three-fourths full at peak design flow.

2.303 Slope

All wastewater mains shall be designed to use the available slope to give peak flow velocities of no less than 2.0 feet per second based on Manning's formula using an "n" value of 0.013. Minimum slopes and the corresponding design capacity based on §2.302 and §2.303 are as follows:

<u>Size</u>	<u>Minimum Slope (ft/ft)</u>	<u>Design Cap. (cfs)</u>	<u>Full Cap. (cfs)</u>
6	0.0048	0.2	0.39
8	0.0033	0.35	0.7
10	0.0025	0.55	1.1
12	0.0019	1.45	1.56
15	0.0014	2.25	2.42

Actual velocity shall be taken into consideration to design pipe slope to achieve minimum flow velocity.

It is understood that it is impractical to meet these velocity standards at upstream ends of the collection system and they are waived in such cases. Designs in which downstream mains do not meet these velocity standards shall be specifically approved by the City Engineer.

Maximum velocity shall not exceed 10 feet per second at peak flow. Wastewater mains shall be designed with uniform slope between manholes.

2.304 Vertical Alignment

The minimum cover for wastewater lines shall be 3 feet from the existing or planned final grade, whichever is lower. Laterals shall have a nominal cover of 2.5 feet at the property line or at a point 5 feet behind the curb face or edge of paving, whichever is the greater distance from the roadway centerline. See §2.401 for additional information regarding service lateral cover and §5.701 for structural considerations.

When crossing a water main, the wastewater line shall be installed below the water main with a clearance of at least 12 inches. Where this separation cannot be maintained, the City Engineer may approve reduced clearances based on Standard Plan 415. A minimum vertical clearance of at least 3 inches shall be maintained between a wastewater line and a storm drain. Separation distances shall be measured from the nearest edges of the facilities.

At points of convergence of pipes of various sizes, the pipe crown of the inflowing pipe(s) shall be no lower in elevation than the soffit of the outflowing pipe. See §2.502 regarding drop manholes for additional information.

2.305 Horizontal Alignment

Wastewater lines shall be placed within street right-of-way unless placement in an easement is specifically approved by the City Engineer. Alignment shall be parallel to the street centerline whenever possible.

The horizontal alignment of wastewater mains in new streets, easements and private streets shall be as shown on the appropriate City of Lodi Standard Plan. In existing streets and other special cases (such as looped streets in which the utilities may be located concentrically to avoid crossings), the alignment may vary from the Standard Plans. In no case shall there be less than 10 feet horizontal clearance to a parallel water main, except as specifically approved by the City Engineer in accordance with State Department of Health Services policies.

Curved wastewater pipes are allowed. However, joint deflections or pipe curvature shall not exceed the pipe manufacturer's recommendations. The following table may be used as a conservative guide. If a shorter radius is desired, the appropriate design information (i.e. short pipe lengths, radius fittings, etc.) shall be shown on the plans.

Pipe Size (in.)	Minimum Radius of Bending Circle (ft)		
	Ductile Iron	PVC	VCP
4	190	160	200
6	190	160	200
8	190	210	200
10	190	270	200
12	190	320	200
15	n/a	390	260

Wastewater lines, including laterals, or other sanitary hazards shall not be constructed adjacent to any existing or proposed well site. California State Department of Health Services requirements shall be the minimum required separation, however these may be increased where the well location is not fixed or redrilling is planned.

2.306 Pipe Materials

The following standard pipe materials shall be used for gravity flow wastewater line construction and shall conform to the appropriate American Society of Testing and Materials (ASTM) and American Water Works Association (AWWA) specifications (latest revision):

<u>Pipe Material</u>	<u>Specifications</u>
Ductile iron pipe w/ polyethylene lining & polyethylene encasement*	ASTM A746 ASTM D3350, 30 mil thickness AWWA C105
PVC sewer pipe and fittings	ASTM D3034 SDR 35, F-679, PS 46
Vitrified clay pipe	ASTM C700 (extra strength)
<u>Laterals Material:</u>	
Vitrified Clay Pipe w/ compression joint w/ compression coupling	ASTM C700 C425 C594
PVC	ASTM D3034 SDR 35
Ductile iron pipe	ASTM D1869

*Polyethylene encasement may be omitted if a corrosivity soils report provided per Appendix A of AWWA C105 indicates encasement is not needed. Alternate linings may be approved on a case-by-case basis.

New wastewater main and/or laterals servicing exclusively industrial and commercial development may be limited to vitrified clay pipe depending on the proposed use.

Trench and pipe strength design shall be shown on the improvement plans per §5.700.

2.307 Joints and Fittings

Joints and fittings shall be selected and installed to minimize infiltration and to prevent the entrance of roots throughout the life of the system. Ductile iron pipe joints and fittings shall conform to AWWA C110 or other approved joint for wastewater applications. Joints for PVC pipe shall be flexible elastomeric type conforming to ASTM D3212. Solvent welded joints for PVC pipe are not permitted. Joints for vitrified clay pipe shall conform to ASTM C425.

Joining of pipe sections of unlike materials shall be accomplished using approved flexible band seals. Other joining methods shall not be used unless approved by the City Engineer.

2.400 Services

2.401 General

One service is allowed per parcel being served. Additional services may be specifically approved by the City Engineer in order to eliminate the need for on-site pumps or in other extreme circumstances.

The minimum diameter for services (wastewater lateral) shall be 4 inches.

A wastewater lateral installed concurrently with a wastewater main shall be of the same type and class of pipe material as the wastewater main except where land use, cover or water main separation requirements indicate otherwise. For new services on existing mains, the wastewater lateral may be of any approved pipe material as specified in §2.306.

Size and depth of services is to be determined by the design engineer for the parcel being served subject to minimums contained in City Standards. Particular attention should be given to large, deep parcels. On-site (private) lift stations may be necessary at upstream ends of mains, particularly on the east side of the City at the Central California Traction railroad.

Connections to the existing wastewater main shall be performed by City forces at the developer's expense. Connections to wastewater manholes may be performed by the developer's contractor under an encroachment permit.

Wastewater service abandonment at the wastewater main shall be performed by City force at the developer's expense.

2.402 Monitoring Structures

A monitoring structure or sampling manhole/riser shall be installed per City standards near the back of walk where required by the City Engineer. It shall be in a location accessible to City personnel at all times and may be considered as a cleanout in lieu of a separate required cleanout.

2.403 Traps and Waste Interceptors

Appropriate traps and waste interceptors shall be installed on services or on-site as determined by the City Engineer in conformance with the Lodi Municipal Code.

2.500 Manholes and Miscellaneous Structures

2.501 Manholes

Manholes shall be located in areas accessible to cleaning equipment and at:

- the end of each line;
- all changes in pipe grade, size, or alignment;
- all junctions of wastewater mains and/or laterals 6 inches or greater in diameter;

- distances not greater than 500 feet in continuous paved areas unless otherwise approved by the City Engineer
- where access to manholes is restricted, the pipe and accessible manhole shall be located such that there is a hose lay of no greater than 500 feet from an unrestricted access point to all portions of the wastewater pipe.

24-inch diameter risers may be used in lieu of standard 48-inch manholes where the depth to the invert is less than 42 inches.

Manholes/risers may be required for inspection purposes at the end of stubs exceeding 25 feet in length.

2.502 Drop Manholes

Drop manholes per Standard Plan 301 shall be provided where the inflowing pipe crown elevation is more than 2 feet above the crown elevation of the outflowing pipe. All drop manholes require approval from the City Engineer.

2.600 Lift Stations

2.601 General

Lift stations shown on the Wastewater System Master Plan shall be designed per the following standards. Other lift stations shall be specifically approved by the City Engineer after consideration of all reasonable gravity flow alternatives. Design standards for temporary stations shall be determined on a case-by-case basis.

Lift station structures, electrical, and mechanical equipment shall be located and designed such that they are protected from physical damage by a 200-year flood event and will remain fully operational and accessible during the design storm.

The lift station shall be located off the travelled way of streets and alleys and shall be provided with paved vehicular access and appropriate security as required by the City Engineer.

2.602 Design

The lift stations shall be Smith and Loveless™ Custom Series or custom wet well design with the City Engineer approval.

Impressed current cathodic protection for dry well is required and shall be designed by a qualified corrosion control engineer.

California OSHA standards shall be observed in the design of all pumping station access structures.

Pumps

At least two pumps shall be provided for each pumping station. All pumps, regardless of station type, shall be non-clogging, capable of passing a minimum 3" diameter sphere. The City has standardized on Flygt pumps (for wall wastewater stations).

If only two units are provided, they shall have the same capacity. Each shall be capable of handling the peak flow. Where three or more units are provided, they shall be designed to fit actual flow conditions

and must be of such capacity that with any one unit out of service, the remaining units will have capacity to handle peak wastewater flows.

Design pumping rate shall be the peak inflow for the ultimate tributary area. For Master Plan Stations, initial lower flow rates shall be considered in the design. It may be appropriate to provide an interim design with fewer, smaller capacity pumps or variable frequency drive pumps. However, the station and site should be designed for ultimate conditions.

Wet Wells

The wet well size and control setting shall be appropriate to avoid heat buildup in the pump motor due to frequent starting and to avoid septic conditions due to excessive detention time. Total pump starts shall be limited to no more than 10 per hour.

Wet wells shall be reinforced concrete with approved epoxy coating. Polymer concrete wet well is recommended.

The wet well floor shall have a minimum slope of 1 to 1 to a hopper bottom. The horizontal area of the hopper bottom shall not be greater than necessary for proper installation and function of the pump inlet.

Ancillary Equipment

Ancillary equipment such as air release or other valve pits shall be provided as necessary including adequate ventilation and corrosion protection.

Electrical Equipment

All electrical equipment shall be explosion proof and meet current code requirements. All drywell electrical equipment shall be NEMA 4.

Telemetry equipment compatible with the City's latest SCADA equipment shall be provided. Alarms shall be activated in cases of high water, power failure, pump failure, use of the lag pump, unauthorized entry, or any cause of pump station malfunction. Autodialer with phone service shall be provided.

Standby Power

Pump stations of greater than 0.25 mgd (174 gpm) peak flow capacity (including those shown on the Wastewater Master Plan) shall include permanent installation of standby power. Engines shall be provided with silencing equipment appropriate for the adjacent land use per zoning and General Plan standards.

Smaller capacity stations, where approved, shall either provide standby power or dual, manually switchable electrical feeds from separate transformers.

Water supply

Potable water supply with a reduced pressure backflow prevention device (Febco Model 825) is required for all pump stations.

Instructions and Equipment

Three complete sets of operational instructions (including emergency procedures and maintenance schedules), special tools, and such spare parts (i.e., mechanical seals, wear rings, filters, etc.) as may be necessary shall be provided for all pump station equipment.

Pump Station Enclosure

Permanent or publicly owned pump stations shall have a masonry block wall enclosure which matches the proposed developments. Temporary pump stations may have a chain-link fence enclosure with the approval of the City Engineer. The site shall be fully landscaped.

2.603 Force Mains

At average pump flow, a velocity of at least 2 feet per second and not more than 10 feet per second shall be maintained.

An automatic air relief valve shall be placed at high points in the force main to prevent air locking. Force mains shall enter the gravity wastewater system at a point not more than 1 foot above the flow line of the receiving manhole.

Cleanouts and other special fittings shall be provided as required by the City Engineer.

The force main and fittings, including thrust blocking, shall be designed to withstand normal pressure and pressure surges (water hammer).

The following standard pipe materials shall be used for force main construction and shall conform to the applicable ASTM or AWWA specification (latest revision).

<u>Pipe Material</u>	<u>Specification</u>
Ductile iron pipe	AWWAC151
w/polyethylene lining &	ASTM D3350, 30 mil thickness
polyethylene encasement*	AWWAC105
PVC Plastic Pipe	AWWAC900

*Polyethylene encasement may be omitted if a corrosivity soils report provided per Appendix A of AWWA C105 indicates encasement is not needed. Alternate linings may be approved on a case-by-case basis.

Pipe strength (Class) shall be determined by accepted engineering principles and the pipe specification based on the design pressure.

Trench design shall be shown on the plans per §5.700.

Friction losses through force mains shall be based on the Hazen and Williams' formula with a value for "C" equal to 130.

Separation from Water Mains

Force main separation from water mains shall conform to applicable State Dept. of Health Services regulations (legal min.), City Standards and appropriate construction details shall be shown on the plans.

Section 3- Storm Drainage

3.100 General

3.101 Scope

These standards apply to all public stormwater facilities designed for installation within a public right-of-way or PUE in the City. Except where specifically noted in these Standards, or as required as part of project approval, all stormwater facilities installed on private property for private use and ownership shall be designed and constructed in accordance with the provisions of the Uniform Plumbing Code, as adopted by the City.

Stormwater lines shall be designed in accordance with acceptable engineering principles and California OSHA Standards (legal min.), and shall conform to City Standards. Storm water collection facilities shall not be connected to a wastewater or industrial-waste line except where specifically approved by the City Engineer. Industrial waste sources shall not be connected or discharged into a stormwater line without a specific discharge permit.

These Standards do not cover all the applicable City, State and Federal requirements for storm quality and monitoring (see §5.603 for additional discussion). Additional standards adopted by the City shall be used in design of the storm drainage system.

- Storm Water Management Program
- Multi-Agency Post-Construction Stormwater Standards Manual

3.102 Submittals

The requirements listed below are based on projects subject to the City's General Plan. Developers and design engineers of projects not subject to the Plan should consult with the City Engineer to determine applicable and appropriate timing of submittals.

Development Plan Stage (preliminary plan for entire parcel/development)

Development plan submittals shall include a map showing the proposed project, existing storm drains in the vicinity of the project and new storm drains, 30" and larger proposed for the project.

A table showing land use categories and acreage, C-factors and 100 year storm volume (in acre-feet) shall be provided.

For development projects that meet the applicable Post Construction Stormwater requirements, a Project Storm Water Plan shall be submitted for approval prior to prepare the storm drain master plan for the entire development.

Project Master Plan Stage (detailed plan for entire parcel/development/tributary area)

Prior to preparation of improvement plans for the first phase, a storm drain master plan for the entire project shall be provided for approval by the City Engineer.

The submittal shall include the following items (or combined as appropriate):

- A Project Storm Water Plan conforming to Multi-Agency Post-Construction Stormwater Standards Manual shall be submitted and approved prior to submittal of the storm drain master plan.
- A plan, 1" = 100' scale, showing the proposed system, preliminary pipe sizes, tributary subareas, existing and future tributary areas outside the project limits, zoning, projected land use, and any features affecting the system.
- Hydrology and hydraulic calculations together with assumptions, charts, tables, references and methods used.
- A plan showing the 2-year and 5-year hydraulic grade lines (HGL), the proposed storm drain including slopes and sizes and top of curb in profile. Elevations should be shown at all changes in slope of the HGL, proposed storm drain and top of curb.
- Where the design includes additional tributary areas outside the project as required by the City and the developer wishes to obtain reimbursement for oversize pipes, the Engineer shall submit additional calculations and design for the project only in order to estimate the reimbursable portion.

Improvement Plan Stage (specific improvement plans for portion being developed)

Improvement plans shall include the information listed in §5.200 and Appendix A-1.

3.200 Design Flow

The Rational Method ($Q = CiA$) shall be used to determine runoff flow (Q) for areas less than 160 acres. Larger areas require special consideration and should be discussed with the City Engineer prior design.

Minimum values for the coefficient of runoff (C) and time of concentration are as follows:

Land Use or Surface Type	Runoff Coefficient C*	Time of Concentration
		T _c (min)
Parks	0.2	30
Residential - Low Density	0.4 - 0.6	25
Residential - Medium / High Density	0.5 - 0.6	20
Schools and Churches	0.5	20
Commercial	0.8	10
Industrial	0.8	10
Pavement	0.95	-
Roof	0.8	-
Compacted earth (no gravel)	0.75	-
Lawn and Open Area	0.2	-
Basin	1.0	-

*= For planning purpose only. Calculations for the C factor shall be submitted if minimum values are to be used.

Where a specific project is proposed, a composite C factor may be determined based on a weighted average of the surface C factors.

Values for rainfall intensity (i) for corresponding time of concentration shall be taken from Standard Plan 606 or computed from the formula shown.

The area (A) shall be the tributary drainage area in acres.

Preliminary estimates of detention volume (V) for development plan submittals shall be calculated based on V (acre-feet) = 0.4CA. (0.4 feet of rain = 100-yr, 48 hr. storm). For basin with no outlet or connection to the public storm drain system, the retention volume shall be 200% of 100-yr 48 hour storm or 0.8 feet of rain.

3.300 Pipe Design

3.301 Minimum Size

The minimum size for storm drain mains shall be 15-inch diameter.

All new catch basin laterals shall have a minimum diameter of 12 inches, except where an on-site service is connected to the catch basin. In such cases, the lateral shall be one size larger than the service (no less than 12 inches).

3.302 Design Depth of Flow (Hydraulic Grade Line)

Manning's formula shall be used to calculate design flow, slope, velocity and pipe diameter relationships. The friction factor, "n", shall be 0.013 for all types of pipe.

Normally, due to the hydraulic grade line determined by the trunk line or downstream basin, storm drains are surcharged.

The starting hydraulic grade line and assumed flow will be provided by the City at the downstream master plan line or intervening system if calculations are available. If the proposed project's flow is 5% or more above the assumed flow, the new calculations shall be extended downstream until the difference is less than 5% or a basin or pump station is reached.

All storm drains shall be designed for the worst case of the following scenario:

1. The peak flow from a 2-yr design storm entering the catch basin and shall have a minimum of 1 foot of freeboard between the top of curb and the hydraulic grade line with the storm drain basin at the design hydraulic grade line level.
2. The peak flow from a 5-yr design storm entering the catch basin and shall have a minimum of 1 foot of freeboard between the top of curb and the hydraulic grade line with the storm drain basin empty.

Note: The design does not need to check each catch basin. Flows may be calculated at manholes. However, the following catch basins are to be checked:

- the most upstream catch basin;
- the lowest catch basin;
- catch basins with on-site services;
- other potentially critical catch basins as designated by the City Engineer.

3.303 Slope

Storm drains shall have minimum slopes per the following table:

Size (in.)	Minimum Slope (ft/ft)
12	0.0019
15	0.0014
18	0.0011
21	0.0009
24	0.00075
30	0.00055
36	0.00044
42	0.00035
48 +	0.00030

The above slopes are intended to provide a velocity of 2.0 feet per second when flowing half full regardless of the slope of the hydraulic grade line. (In the City's surcharged system, velocities based on the design hydraulic grade line are well below 2 feet per second, except in trunk lines.)

Pipes shall use all available fall when velocities are lower than 2.0 feet per second and shall be specifically approved by the City Engineer.

Maximum velocity shall not exceed 10 feet per second.

Storm drains shall be designed with uniform slope between manholes. Siphons are not be permitted (See §3.501 regarding separation manholes).

Catch basin laterals shall have a minimum fall of 0.10 foot between the catch basin and manhole. Desirable fall is 0.30 foot or more.

3.304 Vertical Alignment

The minimum cover on main line storm drains shall be 2 feet in residential streets and 2 1/2 feet in all other streets. Ductile iron pipe shall be used on pipes with less than 3 feet in cover. See §5.701 for structural considerations.

A minimum vertical clearance of 3 inches shall be maintained between storm drain lines and other underground utilities. Clearances to water mains shall be the same as that for wastewater lines. (§2.304; Standard Plan 415)

In general, at points of convergence of pipes of various sizes, the top of pipe elevations shall match, or, when approved by the City Engineer, the maximum difference in flow lines shall be less than 4 feet. This does not apply to catch basin laterals.

3.305 Horizontal Alignment

Horizontal alignment of storm drains shall be per the applicable requirements for wastewater lines (§2.305; Standard Plan 415).

Required clearances to water mains shall be the same as wastewater lines.

Curved storm drains are allowed. However, joint deflections or pipe curvature shall not exceed the pipe manufacturer's recommendations. The appropriate design information (i.e. pipe lengths, radius fittings, etc.) shall be shown on the plans.

3.306 Pipe Materials

The following standard pipe materials shall be used for storm drain construction and shall conform to the appropriate American Society of Testing and Materials (ASTM) and American Water Works Association (AWWA) specifications (latest revision):

<u>Pipe Material</u>	<u>Specification</u>
Concrete pipe (Non-reinforced)	ASTM C14
Ductile Iron pipe	ASTM A746
w/cement lining &	AWWA C104, std. thickness
polyethylene encasement*	AWWA C105
PVC sewer pipe and fittings**	ASTM D3034 SDR 35, F-679, PS46
Reinforced concrete pipe	ASTM C76

* polyethylene encasement may be omitted if a corrosivity soils report provided per Appendix A of AWWA C105 indicates encasement is not needed.

** PVC pipe is not allowed as a main in commercial and industrial areas or in arterial streets unless otherwise approved by the City Engineer.

Cast-in-place concrete pipe may be used when specifically approved by the City Engineer. Cast-in-place pipe will not normally be permitted in existing streets.

Storm drain pipes constructed in easements shall pass the same leakage tests as wastewater lines. Trench and pipe strength design shall be shown on the plans per §5.700.

3.307 Pipe Joints

Storm drain joints shall be designed and installed to minimize infiltration and to prevent the entrance of roots throughout the life of the system.

Joints for concrete pipe shall be rubber gasketed joints per ASTM C443.

Joining of pipe sections of unlike materials shall be accomplished using approved flexible band seals. Other joining methods shall not be used unless approved by the City Engineer.

3.400 Services

3.401 General

In general, only one storm drain service is to be provided per parcel served. Additional services may be approved by the City Engineer depending on the on-site layout, available mains and land use/monitoring requirements.

Storm drain services are provided to improve public health and safety and minimize inconvenience created by on-site drainage running over the sidewalk and in the gutter. Services carrying process, wash or other wastewater shall be specifically approved by the City Engineer in conformance with the Lodi Municipal Code Chapter 13.14.060.

Parcels over 1 acre (net) shall have an on-site collection system connected to the public system. Industrial and commercial parcels under 1 acre shall utilize on-site drains to minimize drainage over the sidewalk. Thru-the-curb drains are only allowed if approved by the City Engineer.

Underground services shall connect to the public system at a manhole or catch basin. A direct tie may be approved where a suitable on-site access structure is provided and the criteria per §3.501 are met.

3.402 On-site Design Requirements

For industrial land use and commercial uses involving potential water quality hazards (including, but not limited to: automotive service, gas stations, large parking lots, and car washes) the following requirements shall apply:

- All storm drainage shall be picked up in an on-site drainage system and shall conform to the latest Storm Water Management Program, Post Construction Storm Water Standards, and Trash policy.
- The on-site drainage system shall be tied to the City's storm drain system, either at the back of a City catch basin or at a storm drain manhole on the City's system.
- In certain situation where the site stores or handles hazardous materials, an isolation valve may be required to be installed in the on-site storm drain system to prevent spills and contaminated storm water to discharge into the public storm drain system.
- An approved sand and oil trap shall be constructed on new storm drain discharge lines. The City may also require a sand and oil trap on existing storm drain discharge lines.
- All sand and oil traps shall be readily accessible and on the street side of all fences and gates, and not in the sidewalk area.
- Trash capture device capable of capturing trash greater than 5 mm may be required on the on-site storm water inlets prior to discharge to the public system.
- No storm drainage will be allowed to flow over the curb, gutter, and sidewalk into the street. Exceptions are driveway approaches and landscaped areas adjacent to sidewalks.
- With approval from the City Engineer, smaller industrial parcels may be allowed to drain through the curb face. This approval shall depend upon existing street conditions, the location of City storm drain facilities, and the size and use of the parcel. On-site drainage must still flow through a sand and oil trap.

Also, see §5.603 regarding erosion control.

3.500 Manholes and Miscellaneous Structures

3.501 Manholes

Manholes shall be placed at the intersections of all storm drains including laterals, at all locations where there is a change in size, change in horizontal or vertical alignment and at the ends of all permanent lines.

Manhole spacing shall conform to the following limits:

<u>Pipe Diameter</u>	<u>Maximum Spacing</u>
12" to 30"	500 feet
33" to 54"	750 feet
60" and over	1000 feet

Manholes will not be required at laterals where all the following conditions are met and with the approval of the City Engineer:

- maximum size of catch basin lateral is 15 inches, and;
- the main storm drain has a diameter of 48 inches or larger, and;
- the maximum top of curb to invert depth at the catch basin is 4 feet, and;
- no other existing or future manhole is within 100 feet along the main storm drain centerline.

24" diameter risers may be used in lieu of standard 48" manholes where the depth to the invert is less than 42 inches. Where the main is over 42 inches in diameter or where large pipes intersect such that a standard 48" manhole is not practical, a special design usually using standard, prefabricated sections, shall be shown on the plans. On cast-in-place pipe, saddle manholes per Standard Plan 302 may be used.

Manholes/risers may be required for inspection purposes at the end of stubs exceeding 50 feet in length.

Special "separation" manholes may be designed where wastewater and storm drain lines intersect due to grade restrictions. Criteria and details are to be approved by the City Engineer on a case-by-case basis.

3.502 Catch Basins

Side inlet catch basins (SICB) shall be located at all gutter low points and shall be spaced in such a manner that design storm flows will not encroach into the travel lanes or exceed the curb height. In addition, at special driveways the depth of flow shall not exceed 3 inches. Standard Plan 608 provides a Hydraulic Street Capacity Chart for use in determining whether the design flows encroach into the travel lanes.

The total gutter run contributing to any catch basin shall not exceed 1,000 feet. It is desirable to locate catch basins on the BCR or ECR which will intercept the most runoff and also keep the main pedestrian crossing as dry as possible.

Drop inlet catch basins may only be constructed in alleys, parking lots or as temporary installations on unimproved streets where curb and gutter has not yet been installed. In gutters where a new driveway is being installed that conflicts with an existing side inlet catch basin, upon approval of the City Engineer, a drop inlet catch basin may be installed as a junction box and the SICB must be relocated.

3.600 Pump Stations

The only pump stations permitted are those included in the Storm Drain Master Plan and private, on-site stations serving single parcel.

Storm Drain Master Plan stations shall be custom designed for the particular project and to the approval of the City Engineer.

Private systems shall be designed according to the applicable Building, Plumbing, Mechanical and Electrical Codes adopted by the City.

3.700 Detention Basins

3.701 General Requirements

The Storm Drain Master Plan system is based on the use of large publicly owned and maintained detention basins in order to meet discharge flow limitations to downstream facilities or receiving waters. Privately owned and maintained drainage basins are prohibited except in the following circumstances:

- Temporary facilities approved by the City Council, in which the design is planned for ultimate connection to the City system;
- Permanent facilities specifically approved by the City Council;
- Facilities in existence at the time of annexation, until the property is developed or otherwise improved and falls under City development requirements.

3.702 Temporary Basins

Basins Serving Single Parcels

If approved by the City Engineer, temporary basins on private property to serve single, one-ownership parcels shall be designed with the following criteria:

- A 48-hour, 10-year storm total rainfall of 3.3 inches shall be used if a reasonable outlet is provided. If no disposal other than evaporation, percolation or irrigation is provided, a 48-hour, 100-year storm, total rainfall of 4.8 inches, shall be used.
- The maximum water surface of the basin shall be 1 foot below the elevation of the top of curb at the lowest catch basin inlet within the tributary area and a maximum of 1 foot above the design hydraulic grade line at the basin.
- Fencing shall be provided around all basins greater than 1.5 feet in depth.
- Adequate all-weather access shall be provided.

- The tributary drainage system shall be designed to connect to the City's future storm drainage system.
- Any additional requirements placed as a condition of approval by the City Engineer shall be incorporated into the design.

Basins Serving Multiple Parcels

For temporary basins serving multiple parcels, the following criteria should be considered in its design. The final design shall be as approved by the City Engineer in accordance with City Council requirements of approval.

- The area cannot be reasonably served by a public storm drainage system.
- The storm water drainage system and appurtenances shall be owned and maintained by the developer/owners. The developer/owners shall pay the City for operating the storm water drainage system.
- A minimum 10-foot wide access road shall be provided around the basin.
- The maximum side slope shall be 3:1.
- Six-foot chain link fencing with PVC lath filler (slats) shall be provided around the basin with double 8-foot vehicle gates and one 3-foot pedestrian gate.
- The basin shall store a 100-year, 48-hour storm (4.8 inches) for the service area if has an outlet to the public storm system or two 100-year, 48-hour storm (9.6 inches) if it has no outlet. No allowance may be taken for evaporation or percolation in the basin volume calculations.
- Facilities shall be provided to enable the basin to be pumped or drained into a public permanent system within a 48-hour period. The pump station shall have a minimum of 2 pumps.
- The maximum design water surface of the basin shall be a minimum of 1 foot below the elevation at the top of curb of the lowest catch basin inlet within the tributary area and a maximum of 1 foot above the design hydraulic grade line at the basin.
- The tributary drainage system shall be designed to connect to the City's future storm drainage system.

3.703 Permanent Basins

Permanent basins, including fencing and other site amenities, shall be specifically designed to the site, using the above criteria for basins serving multiple parcels. The design shall be compatible with the Storm Drain Master Plan. The following table summarizes hydraulic design criteria for the basins **(adjusted to 1988 datum by adding 2.1' to all historical elevations)**:

Drainage Area/Basin	Elevation of:	
	Maximum Water Surface	Design Hydraulic Grade Line
A-1 Kofu Park	39.1	38.1
A-2 Beckman Park	35.1	34.1
B-1 Vinewood Park	37.1	36.1
B-2 Glaves Park	38.1	37.1

C	Pixley Park	49.1	48.1
D	Salas Park	41.3	40.3
E	Peterson Park	36.6	35.6
F1	Rose Gate Park	34.7	33.7
F2	Rose Gate II	30.5	29.5
F3	(Future)	30.1	29.1
G	DeBenedetti Park	28.1	27.1
H	(Drains to Mokelumne River, see below)		
I2	Villa Fiore	27.0	26.0
I3	Gateway South	26.7	25.7
K1	Reynolds Ranch	41.1	40.1
K2	(Future)	38.6	37.6
K3	(Future)	34.1	33.1
L1	(Future)	31.1	30.1
L2	(Future)	30.1	29.1

Existing outfalls for areas tributary to the Mokelumne River have been designed under various standards. Recently installed outfalls have been designed on the basis of a river hydraulic grade line one foot below the 100 year flood elevation. However, since the design and installation of these outfalls, newer FEMA flood studies have raised this flood elevation. Since no new outfalls are contemplated under the Storm Drain Master Plan, new standards have not been developed. Hydraulic design criteria for new storm drains lines in the H area shall be determined on a case by case basis by the City Engineer.

Section 4 - Water

4.100 General

4.101 Scope

These standards apply to all public water facilities designed for installation within a public right-of-way or PUE. In residential developments, on-site water mains and hydrants for fire protection shall be public. Other on-site facilities, unless specifically noted in these Standards or as required as part of project approval, shall be private and shall be designed and constructed in accordance with the provisions of the Uniform Plumbing Code, as adopted by the City (See §4.401).

Water lines shall be designed in accordance with acceptable engineering principles, City Standards, American Water Works Association (AWWA) Standards and all current State and Federal Drinking Water related regulations and statutes.

4.102 Submittals

The requirements listed below are based on projects subject to the City's General Plan. Developers and design engineers of projects not subject to the Plan should consult with the City Engineer to determine applicable and appropriate timing of submittals.

Development Plan Stage (preliminary plan for entire parcel/development)

Development plan submittals shall include a map showing the proposed project, existing wells, existing water tanks, existing water mains in the vicinity of the project and new mains proposed for the project.

A table showing land use categories and acreage, average and peak hour flows and maximum day plus estimated fire flow shall be provided. All flows shall be in gallons per minute (gpm).

Project Master Plan Stage (detailed plan for entire parcel/development)

Prior to preparation of improvement plans for the first phase, a water master plan for the entire project shall be submitted for approval by the City Engineer. The plan shall show size and location of all of the proposed mains.

Fire Flow and pressure calculations are required for commercial, industrial and medium and high density residential developments. Calculations will not normally be required for low density residential developments unless there is a question regarding the need for looping.

Improvement Plan Stage (specific improvement plans for portion being developed)

Improvement plans shall include the Information listed in §5.200 and Appendix A-1.

See §5.200 regarding timing of private well abandonments and improvement plan approval.

4.200 Design Flow

Unless City of Lodi metered information or data from other agencies is provided or required, the following water demands shall be used:

<u>Land Use</u>	<u>Unit Demand</u>	<u>Peaking Factors</u>	
		<u>Max. Day</u>	<u>Max. Hour</u>
Residential	200 gpcd	2.24	3.28
Commercial/Office	2500 gpad	2.24	3.28
Industrial	1000 gpad	2.24	3.28

gpcd = gallons per capita per day; gpad = gallons per acre per day

Per capita and density figures per §2.200 shall be used unless specific project information is available.

Fire flow for specific projects shall be as provided by the Fire Marshal. For preliminary studies, the highest applicable case of the following fire flow shall be used:

<u>Land Use</u>	<u>Fire Flow</u>
Low Density Residential	2000 gpm
Medium & High Density Residential	3000 gpm
Commercial & Industrial	4000 gpm

4.300 Pipe Design

4.301 Minimum Size

The minimum size pipe used for new water mains shall be per the following table:

<u>Location/adjacent land use</u>	<u>Size (inches)</u>
As shown in Water Master Plan	10, 12 as indicated
Commercial & Industrial	8
School, other Public Use	8
High Density Residential	8
Low & Medium Density Residential	6
Residential dead-end with <u>no</u> fire hydrant	4

Larger sizes may be required based on required fire flow or service demand.

Permanent dead-end runs shall be no longer than 250 feet unless specifically approved by the City Engineer. 8-inch mains shall be used on dead-end runs which serve fire hydrants. Reasonable looping of water mains will be required for each phase of development; the maximum unsupported length of a main is 1300 ft.

The following table may be used as a guide for maximum length (ft.) of dead-end mains:

<u>Pipe Diameter</u>	<u>Required Fire Flow (gpm)</u>		
	<u>2000</u>	<u>3000</u>	<u>5000</u>
6" lateral	100	N/A	N/A
8"	600	275	N/A
10"	1800	850	325
12"	5000	2400	900

4.302 Design Pressure

The system shall be designed to maintain a minimum residual pressure of 20 psi at the service point or fire hydrant under the worst case of either:

- maximum day flows plus fire flow, or;
- peak hour flow.

Calculations for individual developments may assume 4000 gpm at 45 psi is available at the point of connection to an 8" or larger, looped line. Other circumstances will require a special determination by the City Engineer.

The Hazen-Williams formula should be used to calculate design flow, pressure loss, velocity and pipe diameter relationships. The coefficient of friction, "C", shall be 110 for pipes 6" and smaller, 120 for 8" and 10", and 130 for 12" and larger pipes, unless loss at fittings is calculated separately using equivalent length or other approved methods. In such cases, a "C" of 130 may be used.

4.303 Slope

There are no slope requirements for water mains. However, inverts shall be shown on the profile plans as required in the Appendix.

All high points within the system shall be located at fire hydrants or permanent blow-offs.

4.304 Vertical Alignment

The minimum cover on water mains shall be 3 feet. Water main depth should be kept below 5± feet.

When crossing a wastewater or storm line, it is desirable that the water main be installed above with a clearance of 12 inches. The minimum vertical clearance per Standard Plan 415 shall be maintained.

4.305 Horizontal Alignment

Water mains shall be installed within street rights of way unless an easement installation is specifically approved by the City Engineer. Alignment shall be parallel to the street centerline wherever possible.

Parallel lines on each side of the street may be required on major arterials or other locations where crossings are determined inappropriate by the City Engineer.

The horizontal alignment of water lines in new streets, easements and private streets shall be as shown on the appropriate City of Lodi Standard Plan. In existing streets and other special cases (such as looped streets in which the utilities may be located concentrically to avoid crossings), the alignment may vary from the Standard Plans, but in no case shall there be less than 10 feet horizontal clearance to a wastewater or industrial waste line, except as specifically approved by the City Engineer in accordance with State Department of Health Services policies.

When limited right-of-way or other controls are present reduced clearances per Standard Plan 415 may be approved by the City Engineer.

Curved water mains are allowed however, joint deflections or pipe curvature shall not exceed the pipe manufacturer's recommendations. If a shorter radius is desired, the appropriate design information (i.e. short pipe lengths, radius fittings, etc.) shall be shown on the plans.

4.306 Pipe

The following standard pipe materials shall be used for water main construction and shall conform to the appropriate American Water Works Association standards (latest revision):

<u>Pipe Material</u>	<u>Standard</u>
Ductile Iron	AWWA C151
w/cement mortar lining & seal (std. thickness)	AWWA C104
polyethylene encasement*	AWWA C105
PVC (iron pipe O.D.)**	AWWA C900, DR 18 (CI 150) min.

*polyethylene encasement may be omitted if a corrosivity soils report provided per Appendix A of AWWA C105 indicates encasement is not needed.

Trench and pipe strength design shall be shown on the plans per §5.700.

4.307 Joints

Joints in water mains shall match the type of pipe being used, except:

- Solvent welded PVC is not allowed;
- Mechanical joints are only allowed at fittings;
- Cast-iron repair/adaptor couplings may be used where approved by the City Engineer.

4.400 Services

4.401 General

One service is allowed per parcel being served with the following general exceptions as specifically approved by the City Engineer:

- in residential developments with on-site public mains, one standard service per dwelling unit may be provided;
- in large parcels with separate buildings and with on-site public water main, one standard service per building may be provided (individual shut-offs per unit are required)

Due to the variety of building and main configurations, and backflow requirements, the above requirements/exceptions are not specific. Details of each project shall be specifically approved by the City Engineer.

All commercial and industrial water services shall be metered. Residential services shall be metered in accordance with City Policies.

4.402 Domestic Service

The minimum size service is 1 inch per Standard Plan 403. Larger diameter services shall be per Standard Plan 406 (1-1/2" & 2") and Standard Plan 407 (4" & larger). Size of services is to be determined by the design engineer for the parcel/land use being served.

Backflow devices shall be provided on services as required by the Lodi Municipal Code and shall conform to the appropriate Standard Plan. Sufficient space shall be provided between the service box and the first downstream tee or cross to allow future addition of a backflow device.

4.403 Fire Service

Private on-site fire protection systems, include hydrants and building sprinkler systems, shall be installed per the requirements of the City Building and Fire Codes. Fire and domestic systems shall be kept separate on-site, downstream of the service box and shall be valved such that either system can be shut-down without affecting the other. These Standards cover requirements imposed by the Public Works Department in its role as a water utility, mainly in the area of backflow and cross connection prevention, as required by State law. In addition, the City Fire Department requires that the minimum design requirements and construction specifications for public water mains and fire hydrants be applied to private on-site fire protection systems.

Backflow requirements vary depending on the type of on-site system and the degree of hazard to the public system. Standard classification of on-site systems is as follows:

Class I - Direct connections from domestic water mains only; no pumps or reservoir; no physical connections to other water supplies; no anti-freeze or other additives of any kind; and all sprinkler drains discharge to atmosphere.

No backflow device required.

Class II - Same as Class I, except that booster pumps are installed in the service lines from the public main. (An approved pressure sustaining valve is required on booster systems.) A connection for a fire pumper truck (Fire Department Connection or FDC) may be provided. The Fire Department shall not introduce any additives nor draft from outside water sources.

No backflow device required.

Class III - Direct connection to public water main, with on-site storage or pressure tanks. All storage facilities must only be filled by or connected to the public water supply, and the water in these facilities must be maintained in a potable condition.

Double Check Valve Assembly (DC) required.

Class IV - Directly supplied from public mains similar to Classes I & II, with an unapproved auxiliary water supply on or available to the premises, or a FDC for trucks with additives or an outside supply.

Reduced Pressure Principle Assembly (RP) required.

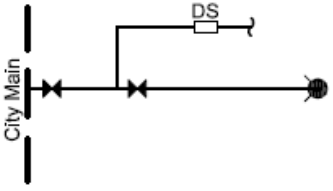
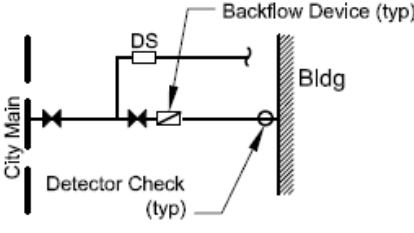
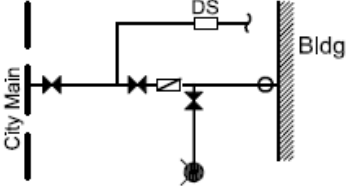
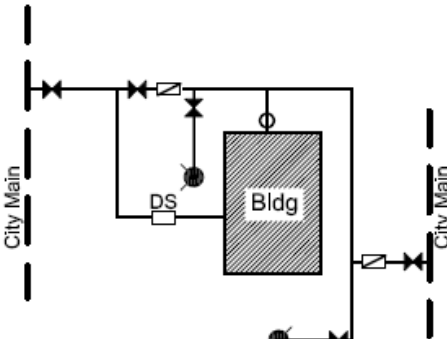
Class V - Directly supplied from public mains and interconnected with unapproved auxiliary supplies, such as: pumps taking suction from reservoirs exposed to contamination, or from rivers, ponds, wells, or other industrial water systems; or systems where antifreeze or other additives are used.

Reduced Pressure Principle Assembly required.

Class VI - Systems supplied from both an industrial water system (private system) and the public system, with or without gravity storage or pump suction tanks.

Special Determination required.

Typical types of on-site systems and the backflow requirements are described below:

System	Backflow Device Required for Class:					
	I	II	III	IV	V	VI
	None*	None*	N/A	N/A	N/A	N/A
	None*	None*	N/A	N/A	RP	N/A
	None*	None*	DC	DC	RP	SD
	DC	DC	DC	RP	RP	SD

(Domestic service valves not shown)

SD = Special Determination

* State law excludes backflow devices on Class I or II fire systems. However, backflow device can still be required under special condition. These special conditions include:

- Underground fire lines with less than 10 ft parallel clearance to wastewater lines or other pipelines carrying toxic materials.
- Water for one site is (or could easily be) looped to the public system.
- Occupancy involves use, storage or handling of type and quantities of materials in a manner which could present a significant health hazard to the domestic supply.
- Premises having usually complex piping systems which already necessitate a backflow device on the domestic service

Additional Public Works Department requirements are:

- Backflow devices shall be approved by the City Engineer (USC Foundation for Cross Connection Control listing required) and the Fire Marshal (UL or FM listing required).
- Detector checks (i.e., bypass meter to detect unauthorized use) are required on building sprinkler systems; not on hydrant systems.
- Domestic service may be taken from fire service lateral outside the R/W and shall be kept completely separated from the on-site fire system.
- An approved pressure sustaining valve is required on all booster pump installations.
- An Encroachment Permit is required for any work or facility to be located in the right-of-way.
- Piping adjacent wastewater lines or other "special conditions described above may require backflow devices on Class I and II systems or higher degrees of protection on other Class systems.

Fire Department requirements that are related to Public Works standards and specifications include the following:

- Sufficient on-site valves shall be provided to isolate individual hydrants and any sprinkler system.
- The location of all on-site facilities shall be approved by the Fire Marshal.
- Outside stem & yoke (OS&Y) or other approved indicator valves are required on building sprinkler and other above ground valves
- Fire hydrants, mains, valves and backflow devices shall be installed in accordance with City of Lodi Public Works Construction Specifications and Standard Plans.

The above requirements are general minimums and may be increased for unusual or other high hazard conditions. Owners may install devices providing a higher degree of protection, such as an air gap separation system (AG) in place of an RP device.

4.500 Valves, Fire Hydrants and Miscellaneous Appurtenances

4.501 Valves

Valves on mains shall be spaced and located in conformance with the following criteria:

- 400-foot maximum spacing in commercial, industrial and public use or other high value areas.
- 600-foot maximum spacing in residential areas.
- Water mains shall be valved on each side of railroad, freeway and canal right-of-way crossings. (These valves shall be located outside of the right-of-way being crossed unless easy access is provided.)
- At "tees", valves are required as follows:
 - 2 valves where one leg is less than 8 inches, with one of the valves being on the smaller leg.
 - 3 valves where all legs are 8 inches or larger.
- At "crosses", valves are required as follows:
 - 3 valves where one or more legs is less than 8 inches with valves on each of the smaller legs.
 - 4 valves where all legs are 8 inches or larger.
- At ends of mains or on stubs such that future extensions will not interrupt service.
- No closer than 15 feet from a blow-off.

The above valve spacing requirements assume small lot sizes and numerous connections and may be reduced where there are a minimal number of connections in-between valves.

4.502 Fire Hydrants

Fire hydrants shall be designed and installed per Standard Plan 401. Where the main is located within 15 feet of the hydrant location, the valve on the hydrant lateral shall be located at least 5 feet offset from the hydrant station and the lateral installed with a 90 degree elbow to ensure that the shutoff valve is 15' (minimum) from the hydrant (i.e. no short, straight hydrant laterals).

Fire hydrants shall be supplied from the largest available main.

Fire hydrants shall be fed from 2 directions unless specifically approved by the City Engineer and Fire Marshal.

Public fire hydrant spacing and distribution shall be determined as follows:

- At 300 feet spacing in high density, commercial, industrial zoning or high-value areas;
- At 500 feet spacing in low density residential areas;
- At 1,000 feet spacing on reverse frontage areas;
- A fire hydrant shall be located within 200 feet of the radius point of all cul-de-sacs;
- On-street hydrant spacing may be reduced at reverse frontage locations or in coordination with on-site hydrants as approved by the Fire Marshal.
- Hydrants shall be required on both sides of the street whenever one of more of the following conditions exist:
 - Streets have median center dividers that make access to hydrants difficult, cause time delays, or create undue hazard or both.
 - On Major arterials where there is more than four lanes of traffic
 - Width of street in excess of 88 feet
 - The existing street being widened or having a raised median center divider in the future pursuant to the General Plan.

On-site private hydrants shall be located by the Fire Marshal.

4.503 Blow-offs and Temporary Connections

Permanent blow-offs per Standard Plan 404 shall be located at the ends of all permanent dead-end mains.

Temporary blow-offs per Standard Plan 409 shall be located at the ends all dead-end mains planned for future extension and 4 inch and larger services per the appropriate Standard Plan.

The design of new mains shall include determination of the location and type (with or without meter/backflow assembly) of temporary connections per Standard Plan 409. The meter/backflow

assembly shall be located to provide optimal flow for main flushing and to minimize disruption of public traffic upon device removal. The meter/backflow assembly is not required on new systems with less than 150 feet of 6 inch or larger pipe.

4.504 Thrust Blocks

Water main thrust shall be taken into account in designs. At locations planned for extension, flanged fittings may be required.

In areas with unstable soils, a special design for thrust blocks is required and shall be shown on the plans; Standard Plan 405 is sufficient in other areas.

4.505 Water Sample Station

Water sample station and automatic water flushing station maybe required with each development. The locations and the number of stations will be determined by the City.

Section 5 – Miscellaneous Requirements

5.100 Maps and Easements

5.101 Maps

Final Maps and Parcel Maps shall be prepared in conformance with State laws and City ordinances. Applicable certificates and statements shall conform to the appropriate Standard Plan. Final Maps shall be submitted concurrently with the City and to the County Surveyor for checking prior to filing. Parcel Maps shall be submitted directly to the City Engineer for checking and processing.

Records of Survey shall be prepared in conformance with State laws and shall be submitted to the County Surveyor for checking and processing. A recorded copy shall be submitted to the City.

Initial submittals shall consist of three copies of the map. Legal descriptions and current title reports shall be required on the initial submittal. (Note, these Standards do not include all the applicable map and subdivision processing requirements, ie: improvement security, insurance, agreements, etc.)

Survey monuments shall be provided at all new lots/subdivisions per the following:

<u>Location</u>	<u>Required Monument</u>
Rear or Interior Lot Corner	3/4" dia. x 24" lg. iron rod at corner or offset if corner is obstructed.
Front (street) Lot Corner	3/4" dia. x 24" lg. iron rod at corner or chiseled cross in concrete offset from corner (show detail on map).
Street Right-of-Way	3/4" dia. x 30" lg. iron rod with surveyor's mark at angle points and points of tangency.
Street Centerline	3/4" dia. x 30" lg. iron rod with surveyor's mark in City Standard monument box at: (a) intersections of new and existing streets; (b) center of cul-de-sac; (c) points of tangency except where line of sight from other monument exists within the Right-of-Way (the intent is to reduce the number of closely spaced monuments); (d) elsewhere, where line of sight is not practical due to length of curve or other obstruction.
Subdivision Boundary	3/4" dia. x 30" long iron with surveyor's mark at corners. No monument is required at the intersection of street centerline and subdivision boundary.

The above are minimum requirements and are not intended to restrict or otherwise interfere with the judgement of Professional Engineers and Licensed Land Surveyors.

5.102 Easements

Public utility easements, restricted easements and other recorded easements shall be shown on maps as required in these Standards and as part of development approval. If no map is involved or where specifically approved by the City Engineer, the easement may be granted by separate deed.

The width of all public utility easements shall be as determined by the appropriate utility.

For wastewater, storm and water lines, the minimum width is 10 feet. Additional width will be required for:

- lines larger than 15 inches;
- lines deeper than 5 feet;
- locations where the easement is not entirely on one lot;
- locations where multiple lines are installed within the easement.

Appropriate easements and temporary construction easements and/or limitations and conditions shall be shown on the plans. Particular attention should be given to trench excavations and existing trees and improvements to remain and future building foundations.

5.200 Improvement Plans and Specifications

All public improvements shall be shown on plans prepared by or under the direction of a Registered Civil Engineer except for minor work done under an Encroachment Permit or other circumstances approved by the City Engineer. Privately owned improvements may be shown for information, and in some cases, may be required to be shown to avoid conflicts. Distinction between public and private improvements shall be clearly indicated.

The design engineer shall contact electric, telephone, gas, cable TV and any other applicable agencies for locations of existing utilities which shall be shown on the plans. Plans for existing underground City water, wastewater, storm and traffic facilities shall be obtained from the office of the City Engineer. The design engineer shall field verify location and elevation of any existing facility affecting the design of the new improvements.

Plans shall be printed on 24" x 36" size and final plans shall be printed on mylar with City Standard title blocks per the Standard Plans. (The City will furnish title block template in AutoCAD file upon request.) Drawing numbers will be assigned by City staff. A full size scanned of the final plans shall also be provided to the City after the City Engineer signed the plans.

The Appendix contains additional information and requirements for improvement plans including:

- General Notes - required on plans;
- Bid Item List- for improvement security and plan check fees calculation;

- Plan Submittal Checklist- indicates required items on plans which must be filled out and signed by the Engineer upon submittal of improvement plans;
- Wastewater flow calculation sheet;
- Storm drainage calculation sheet.

Since the plans will refer to City Construction Specifications, it is not required that the design engineer prepare additional specifications. However, in cases where the work is not adequately covered by the City Specifications, the plans shall provide the additional information necessary. If separate specifications are prepared, they shall be submitted for review and approval.

The plans shall identify required contractor submittals. These include:

- Asphalt mix design;
- Pipe materials and trench section to be used (when alternatives are allowed);
- Other agency encroachment permit;
- Electrical and mechanical equipment;
- Any other item of work where alternatives are allowed or the Contractor wishes to do the work in a fashion other than as shown on the plans or as required by the City.

The design engineer is responsible for the design and accuracy of the plans. The City check and approval does not relieve the owner/developer from changed or unforeseen conditions, errors contained in the plans or from complying with City, State, Federal or other agency requirements that may be determined to apply during the course of construction. In addition, owner/developer shall comply with any changes required by the City Engineer during the course of work that are necessary or required to complete the work in conformance with City Standards.

Rights-of-way, PUE's and construction easements shall be shown on the plans. The developer /owner is responsible for obtaining such rights-of-way and easements subject to the provisions of §66462.5 of the Subdivision Map Act. For work in the right-of-way of other agencies, the design engineer/owner shall obtain the permit or furnish the necessary information in order for the City to make the application if so required by the agency. The appropriate permit conditions shall be included in the design. The plans shall include a requirement that the Contractor obtain a right-of-entry from the agency under the terms of the permit.

Required utility relocations shall be shown or referenced on the plans as appropriate. Notes requiring the Contractor to arrange for utility relocations are discouraged since this generally delays the project.

Items to be salvaged and either reused or delivered to the City shall be clearly identified on the plans. Generally, any reusable sign, casting, metal barricade, or other item determined by the City Engineer shall be salvaged and delivered to the City per the Construction Specifications unless they are approved for reuse in the project.

Completed San Joaquin County well and septic tank abandonment permits shall be submitted prior to City approval of the plans and/or map. This requirement may be deferred upon specific approval of the City Engineer if the facilities are in use and are needed during construction.

The plans shall include a requirement for project/job-site signing on projects over 2 acres in size or as required by the City Engineer on projects involving significant disruption of roadways. The sign shall include the names and telephone numbers of the contractor, project engineer/manager and developer/owner.

It is recommended that a pre-construction conference be conducted on all but minor projects. A City representative(s) will attend and the City will provide a meeting room upon request.

5.300 As-built Plans and Certifications

The developer's engineer shall submit the following certifications, plans and other information prior to acceptance of the project:

- Monument preservation forms
- As-built plans showing elevations of utilities and top of curb at all locations designed for future extension;

In addition, where construction problems or other indications exist that improvements are not located within the right-of-way as shown on the plans, the City Engineer may require a topographic or other survey.

The above certifications shall consist of a City Engineer approved letter, map, or other form, signed and stamped by the responsible Registered Civil Engineer or Licensed Land Surveyor, as appropriate.

5.400 Traffic Control

Applicable traffic control requirements shall be included in all plans. References to City and State of California Department of Transportation (Caltrans) specifications and standards are acceptable where the work is primarily not located with the travelled way of existing streets.

Street and lane closures will require specific details to be shown on the plans. Such details may include restrictions on the time of day and duration of work.

5.500 Soils Reports

Soils reports shall be provided for all improvements related to Final Subdivision Maps and may be required for other projects depending on the nature of the project and its location. The report shall include the following as applicable:

- Location map showing test locations and street layout;
- Statement regarding presence of critically expansive soils or other adverse soil conditions, which if not corrected, would lead to structural defects. Additional analytical work may be required depending on the initial findings;
- R-values per Caltrans test method 301; one test per 600 ± feet of street or at locations of visible changes in material, with a statement that the depth of the sample is consistent with final subgrade depth based on the grading plan;
- Optimum moisture and dry density per Caltrans Methods 216 and 226 at each R-value test location;

- Soil corrosivity tests as appropriate where buried steel structures are proposed (such as lift stations) or per Appendix A of AWWA C104 where use of ductile iron pipe is proposed;
- Trench design values and recommendations;
- Applicable information required per Chapter 70 of the Uniform Building Code;
- Grading recommendations and specifications if more restrictive than these Standards.

The soils report shall be signed by a Registered Geotechnical Engineer and referenced on the plans and Map (if any) and appropriate measures incorporated into the design.

5.600 Grading and Earthwork

5.601 Grading Plans

Grading plans shall show existing and proposed contours (@ 0.5 foot maximum intervals) including sufficient information on adjacent property and improvements to review the adequacy of the design. A summary of earthwork calculations shall be provided upon request.

The design shall comply with the appropriate street cross section, vertical alignment, minimum top of curb grade and driveway slope standards described in §1.300 and §1.410.

Concrete, concrete block or other approved permanent retaining walls/curbs shall be provided where the difference in grade at the property line exceeds 6 inches. At a minimum, cut and fill requirements of the Uniform Building Code, Chapter 70 shall apply.

5.602 Dust Control

Applicable dust control measures shall be taken to ensure compliance with all local, State and Federal requirements. This may include, but not be limited to, a Dust Control Plan through the San Joaquin Valley Air Pollution Control District (SJVAPCD) and proper Best Management Practice (BMP) implementation.

5.603 Erosion Control and Storm Water Pollution Prevention

Applicable erosion control and storm water pollution prevention measures shall be taken to ensure compliance with all local, State and Federal requirements. This may include, but not be limited to, an Erosion Control Plan (ECP) and a Storm Water Pollution Prevention Plan (SWPPP). Refer to the State's Construction General Permit, the City's Municipal Separate Storm Sewer Systems (MS4) permit, the City's Stormwater Management Plan (SWMP), and the City's Post-Construction Stormwater Standards Manual.

5.700 Trench and Pipe Strength Design

5.701 General

The design engineer shall coordinate the design of the trench and pipe strength with the soils investigation and the type of pipe materials proposed for the project. The design engineer may limit the number of materials for the project. Options for pipe materials and/or embedment materials may be

provided, however, the plans shall clearly require the Contractor to make timely submittals on proposed materials and installation methods.

The Standard Plans for pipe material/class and embedment conditions may be referenced on the improvement plans when appropriate based on the soils report, depth of burial and other conditions. However, these Plans are very conservative in their assumptions; the design engineer may wish to submit calculations supporting less restrictive designs. (Most of the references cited show designs with significantly lower compaction requirements. These are not appropriate in streets or other areas where settlement is detrimental.) Supplementary details shall be provided on the plans as needed.

These Standards do not address construction equipment loads or compaction effort that may damage the pipe. The design engineer should review the soils report carefully for presence of material that will be difficult to compact and should consider specifying imported material in such cases. For shallow installations, specifying Installation of pipe after street compaction is obtained should be considered.

The Standard Plans referenced below include the following assumptions:

- no control on maximum trench width (ie embankment soil load conditions);
- backfill weight = 130 lb/ft³
- H-20 traffic loading;
- impact load factor per the following table:

Impact Load Factor				
Depth of Cover (ft.)				
Pipe Dia (ft.)	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
1	1.3	1.0	1.0	1.0
2	1.3	1.0	1.0	1.0
3	1.3	1.0	1.0	1.0
4	1.3	1.15	1.0	1.0
5	1.3	1.2	1.1	1.0

The primary references for trench design, in addition to the cited Standards, are "Gravity Sanitary Sewer Design and Construction" and "Buried Pipe Design".

5.702 Soils Investigation

Prior to design, trench conditions shall be investigated by borings, soundings, or test pits along the route of the trench. This soils investigation will include, but will not be limited to, testing to determine the unconfined compressive strength (ASTM D-2573) or penetration resistance (ASTM D-1586) of the trench soils. Results shall indicate whether trench conditions are stable or unstable. A stable trench is a trench that stands without caving or sloughing and has an unconfined compressive strength (ASTM D-2573)

greater than 500 pounds per square foot or a penetration resistance (ASTM D-1586) greater than 8 blows per foot. All other soils shall be considered unstable.

Soils in the pipe zone shall be classified per the Unified Soil Classification System (ASTM D2487) and per the applicable embedment material classifications described in the appropriate ASTM standard for the pipe materials proposed for use in the project.

Where crushed rock pipe embedment is to be used, native soil gradation curves and a filter design shall be prepared (or filter fabric specified).

Appendix

A- 1 Improvement Plan Requirements

A - 1.1 General Requirements

After approval of the preliminary design, the design shall be incorporated into public improvement plans for the project. In general, the plans shall contain the following:

- Key/Title Sheet;
- Grading Plan;
- Civil Plans;
- Traffic Control and/or Striping Plans;
- Landscaping Plan;
- Erosion Control Plan;
- Post Construction Storm Water Implementation Plan;
- Structural, mechanical, and electrical drawings for appropriate facilities;
- Specifications for materials and construction procedures for the portions of the project not already covered in the City Standard Construction specifications;
- Applicable soils investigation data;
- Required submittal list

Sheets may be combined or omitted depending on the size and complexity of the project. Itemized quantity listings (bid items) are not required to be shown on the plans. (See §A-2 regarding bid items)

A - 1.2 Plan Notes

The following general notes shall be included in all construction plans, modified as indicated for the particular project. Additional instructions or conditions related to contractual or other agreements between or among the owner/developer, design engineer and contractor shall be listed separately under a section titled "Special Conditions". Notes relating to specific portions of the work or special requirements shall be clearly keyed to the plan and grouped on each sheet under the heading "Construction Notes". Some typical construction notes are also shown below.

GENERAL NOTES

1. WORK SHALL CONFORM to City of Lodi Public Improvement Design Standards, Construction Specifications and Standard Plans unless specifically shown otherwise on these plans.
2. STANDARD PLANS applicable to this project include: (list the following and any others that apply) 101, xxx
3. CONSTRUCTION STAKING for curb & gutter, wastewater lines, storm drains, water lines, street centerlines, paving edges and other public facilities as directed by the City shall be done by a Registered Civil Engineer or Licensed Land Surveyor.
4. CENTERLINE AND PROPERTY LINE DATA
5. EXISTING UTILITIES shall be protected. Utility agencies shall be notified and allowed to mark their utilities in the field at least 48 hours before excavation.
6. <<<< CALL "USA" (800) 642-2444 >>>>
7. STREET AND LOT ROUGH GRADING shall be done before underground work.
8. UNDERGROUND UTILITIES in the street and sidewalk area shall be installed before construction of curb, gutter or sidewalk. These utilities include services, fire hydrant laterals, street light conduit, electric, gas, cable TV and telephone lines.
9. EXCAVATION SAFETY REQUIREMENTS include submitting a CAL OSHA permit or letter of notification to the City before commencing excavations over five feet deep.
10. Refer to City Construction Specification §6-19.04 "Excavation Safety" for additional requirements.
11. ALL TESTING for leakage or over deflection shall be witnessed by a City inspector.
12. BALLING AND CLEANING of storm drain and sanitary sewers shall be done before interior video inspection. Utilities shall be kept clean until City acceptance.
13. STREET LIGHT SYSTEM shown on these plans is for reference only. The system shall be installed according to City Electric Utility Department plans.
14. BENCH MARK MONUMENTS furnished by the City shall be installed at locations shown or as directed by the City Engineer.

CONSTRUCTION NOTES (examples)

1. TV LOGS OF EXISTING MAINS will be prepared by the City of Lodi upon request of the Contractor prior to construction. Replacement of any underground mains damaged during construction of this project will be the responsibility of the Contractor.
2. R-VALUE TESTS shall be taken after grading to verify adequacy of structural section. Sections shown are based on the R-values shown on the plans and are for bidding purposes only.
3. A pre-construction conference will be held for this project. The Contractor's job superintendent (and major subcontractor, if any- identify) shall attend.

4. A project identification sign shall be installed at (describe location or show on plans) as shown below. The sign shall have (describe color, lettering- 2" high minimum- and material)

Rolling Glen Subdivision

brought to you by:

Lodi New Age Development phone 333-3333

being built by:

Lodi Constructors International phone 333-4444

project design by:

Lodi Engineering

phone 333-5555

A- 1.3 Checklist

Normal plan drafting and miscellaneous requirements are listed below. The list is to be checked off by the design engineer and submitted with the initial submittal of the plans, except Items noted * may be added after the first check. Incomplete plans will be returned without processing. Note that incomplete topography makes it impossible to adequately design and review improvement plans. City staff field review each project as part of the review process. Plans not showing existing improvements affecting the design will be returned.

This checklist is not a repeat or a listing of City Standards. The design engineer is still responsible for complying with these Standards in the design and preparation of improvement plans.

Improvement Plan Checklist

- A copy of the Approved Post Construction Storm Water Plan

General all sheets:

- Sheet size and City of Lodi title block conforming to Standard Plan 604
- * RCE signature, stamp and expiration date
- North arrow (to top or right as appropriate)
- Scale (1"=20', 1"= 40' or as needed for details and sections)
- Abbreviations and symbols conforming to Standard Plan 502 & 503
- Existing topography (including signs and striping) in project work area, field checked and accurately shown including the side of the street opposite the work to the curb (or right-of-way if no curb)
- Reference plan drawing numbers shown (ie. "Ref. 88D124" for improvements from another project)

- * Reference to adjacent sheet drawing numbers in the project set (ie. "See 91D090")
- Detail drawings as appropriate, particularly if conditions do not fit Standard Plans
- Repeated information consistent between sheets
- Grades shown consistently in percent or decimal form
- "Construct", "install", "existing" and "future" items consistently noted
- *The phrase "work by others" is not to be used. The appropriate party should be identified and the limits of such work clearly shown
- Distinction between public and private improvements clearly noted.

Key/Title Sheet

- General Notes per §A- 1.2
- Vicinity Map:
 - o site location with major streets noted
 - o north arrow
- Key Map (1"=100') with:
 - o project boundary, street R/W & names
 - o lot lines and lot numbers
 - o *sheet drawing # references and limits
 - o north arrow & scale
 - o reference bench mark and *ones to be installed
 - o underground mains and above ground utilities
 - o main size and direction-of-flow between manhole
 - o gutter direction-of-flow arrows and high point marker
 - o street light locations
 - o boundary fencing location & type
- Typical Cross Sections (drawn looking up-station)
 - o street sections or table w/street name and stationing limits
 - o pavement structural section including compaction
 - o street names noted
 - o back-of-walk to R/W treatment shown

- trench sections or table reference to Standard Plan 501
- Miscellaneous
 - table of street segment, design R-value and traffic index
 - submittal listing
 - "Special Conditions" notes
 - dust control provisions
 - *salvage items identified

Grading Plan*

- Existing and design grades or contours Including adjacent property
- Locations of borings, R-value or other tests
- Applicable soils report information
- Septic tank & leach field location and abandonment information
- Well location and abandonment information
- Irrigation risers & standpipes, size & direction on pipes; removal notes
- Retaining wall or other grade control details
- Erosion control details

*Put appropriate information on key or civil sheets if no grading plan

Civil - Street Plans

- City/County/State R/W boundaries as applicable
- Name of Street or Easement shown
- Names of intersecting streets and adjacent drawing #'s shown
- R/W lines identified
- Property lines & lot numbers
- Street dimensioned at end of sheet and at transitions
- Public utility & sight easements dimensioned
- Private & public utilities shown
- Existing utility crossings shown (gas, telephone, electrical)
- Transition pavement with flares at boundary limits

- Street signs at intersections
- Centerline survey monuments
- Horizontal curve data
- Existing poles, signs and structures; any required relocation noted
- Stationing shown west to east, south to north, left to right and bottom to top; no negative stationing
- Basis of stationing from City reference noted
- Equations at stationing crossings provided
- Street name at street intersections referenced
- Match lines shown, preferably at even stations
- Stationing corresponds with subdivision map data
- Offsets shown perpendicular to base of stationing
- *Streetlights, conduit and transformers per Electric Utility Dept. plans
- Traffic control
- Traffic signal work
- Traffic striping
- Curb, gutter & sidewalk:
 - Standard Plan number for curb and gutter noted
 - gutter direction-of-flow, high points & low points shown
 - vertical to rolled 4 foot curb & gutter transition shown
 - pavement strip removal and replacement at toe of gutter dimensioned and noted
 - utility pole clearance dimensioned
 - curb ramps
 - asphalt ramps for sidewalk transitions where no sidewalk exists
 - gutter pan detail shown if last asphalt concrete lift is postponed
 - commercial, special & common driveways noted

Civil - Street Profile

- Original ground grades shown
- Top of curb grades shown (flowline for curb & gutter replacements)

- Edge of pavement, street centerline and R/W grades shown if matching existing pavement
- Top of curb profile line
- Symbols at grade break & beginning and end of curves shown per Standard Plan 503
- Elevations shown at grade break, beginning & end of curve return, and point of intersection
- Vertical curve data

Underground Utilities Plan (General)

- Horizontal alignment of main dimensioned
- Main size and direction-of-flow between manholes shown
- Radius and stationing at main noted if not concentric with street centerline
- Services shown:
 - o at corner lots and along curved right-of-way, services shall be shown and dimensioned to nearest lot line
 - o for 1" water and 4" wastewater at standard location, services may shown with an abbreviated notation
 - o larger services shall be shown and dimensioned to nearest lot line
- *Pipe markers installed at dead-ends or in fields
- Manholes are concentric or noted if eccentric (show orientation)

Underground Utilities Profile - General

- Main:
 - o length and size between manholes noted (length computed between inside edge of structure walls)
 - o direction-of-flow arrows with slope shown and invert elevations noted
- Station, length, invert @ property line and size of laterals larger than minimum noted
- Pipe invert elevations shown at manholes, grade breaks, catch basins and ends of lines
- Existing utilities shown or approximated with note "verify depth and/or location in field before start of construction"
- Crossings and horizontal alignment in accordance with City of Lodi Specifications and California State Health Standards noted
- Size, length and elevation of stubs noted
- Manholes:
 - o station

- size and type noted if other than standard diameter barrel
- top of manhole elevation noted
- "adjust to grade" for existing structures noted

Wastewater - Miscellaneous

- * Monitoring structures shown where required
- *Sand/grease traps shown where required

Storm Drain- Miscellaneous

- Drainage flow transition from project boundaries to existing flowline shown
- Grade break (if unavoidable) in lateral noted with distance to manhole noted
- * Sand/oil trap provided for on-site drainage per City requirements
- Catch basins installed at lot lines and 18" from curb returns

Water - Miscellaneous

- Blind flanges with stubs at cross and tee for future extensions noted
- Valve on main provided no closer than 15 feet from temporary blow-off
- No services between last valve and temporary blow-off
- No services within 15 feet of permanent dead-end blow-off
- Fire Hydrants:
 - hydrants located per Fire Dept fire hydrant plan & Standard Plan No. 401 guidelines
 - fire hydrant assembly or components itemization consistently shown
 - lateral and valve oriented perpendicular to or parallel to face of curb
 - elevations at top-of-curb or back-of-walk provided
 - guard posts shown, if required

2nd Plan Check Submittal.

- Revised plans
- Landscape Plans with MWEL0
- Joint trench plan (for reference only)
- Rule 20 plan (underground overhead)

A-2 Bid Item List

The following list is provided as a general guide for consistency in City projects and improvement security estimates. Items used for each project will vary, but the order and units shall be followed. The final listing shall be numbered.

<u>ITEM</u>	<u>UNITS</u>
Clearing & grubbing	Acre
Lot grading	EA
Earthwork	CY
Imported Fill	CY
Remove existing pavement	SF
Remove existing sidewalk	SF
Remove existing curb & gutter	LF
Remove concrete underground structures	CY
Remove existing abandoned utilities	LF
Tree removal	EA
Remove existing barricade	EA
Stabilized Construction Entrance	EA
Concrete Washout Structure	EA
Erosion Control	Acre
Landscape & Irrigation	SF
Street Trees	EA
Median Landscape & Irrigation	SF
Masonry Wall (7')	LF
Masonry Wall (8')	LF
Retaining Wall < 2'	LF
Retaining Wall < 3'	LF
Retaining Wall (3' to 4')	LF
Retaining Wall (over 4')	LF
Fence Removal	LF
Roadway Excavation	CY
Compact Original Ground (0.50')	SF
Compact Original Ground (0.67')	SF
Compact Native Material (0.50')	SF
Aggregate Base, Class II (0.30')	SF
Aggregate Base, Class II (0.40')	SF
Aggregate Base, Class II (0.50')	SF
Aggregate Base, Class II (0.60')	SF
Aggregate Base, Class II (0.70')	SF
Aggregate Base, Class II (0.80')	SF
Aggregate Base, Class II (0.90')	SF
Aggregate Base, Class II (1.0')	SF
Asphalt Concrete, Type B (0.25')	SF
Asphalt Concrete, Type B (0.30')	SF
Asphalt Concrete, Type B (0.35')	SF
Asphalt Concrete, Type B (0.40')	SF
Asphalt Concrete, Type B (0.50')	SF
Asphalt Concrete, Type B (0.60')	SF
Asphalt Concrete, Type B (0.70')	SF
Asphalt Concrete, Type B (0.80')	SF
Asphalt Concrete, Type B (0.90')	SF
Asphalt Concrete, Type B (1.0')	SF
Asphalt Overlay (0.10')	SF
Asphalt Overlay (0.15')	SF

Slurry	SF
Sawcut	LF
Grind	SF
Rolled Curb, Gutter, & Sidewalk	LF
Vertical Curb & Gutter	LF
Sidewalk	SF
Vertical Curb, Gutter & Sidewalk (5')	LF
Vertical Curb, Gutter & Sidewalk (7')	LF
Curb Return, including HC Ramp	EA
Mid-block HC Ramp	EA
Concrete subgrade compaction	SF
Residential Driveway (16' wide)	EA
Commercial Driveway (24' wide)	EA
Special Commercial Driveway	EA
Median Curb	LF
Dead End Barricade (Standard Plan 128)	EA
Dead End Barricade (Standard Plan 139)	EA
Sidewalk Barricade	EA
6" Asphalt Concrete Berm	LF
5' Asphalt Concrete Ramp	EA
Header Board	LF
Street Name Sign & Post	EA
Flexible Paddle Markers/Delineators	EA
Remove-Relocate Existing Sign	EA
Street Lights (Pedestal Type 100 Watt)	EA
Street Lights (Mast Type 100 Watt)	EA
Street Lights (Mast Type 250 Watt)	EA
Survey Monument	EA
Traffic Signal	EA
Traffic Signs	EA
Traffic Striping	LF
12" Storm Drain Pipe (PVC)	LF
12" Storm Drain Pipe (RCP)	LF
15" Storm Drain Pipe (PVC)	LF
15" Storm Drain Pipe (RCP)	LF
18" Storm Drain Pipe (PVC)	LF
18" Storm Drain Pipe (RCP)	LF
21" Storm Drain Pipe (RCP)	LF
24" Storm Drain Pipe (RCP)	LF
30" Storm Drain Pipe (RCP)	LF
36" Storm Drain Pipe (RCP)	LF
42" Storm Drain Pipe (RCP)	LF
48" Storm Drain Pipe (RCP)	LF
48" Storm Drain Manhole	EA
60" Storm Drain Manhole	EA
72" Storm Drain Manhole	EA
Side Inlet Catch Basin	EA
Drop Inlet Catch Basin w/AC Apron	EA
24" Riser	EA
Connect to Existing Storm Drain	EA
Adjust Manhole to Grade	EA
6" Sanitary Sewer Pipe (VCP)	LF
6" Sanitary Sewer Pipe (PVC)	LF
8" Sanitary Sewer Pipe (VCP)	LF
8" Sanitary Sewer Pipe (PVC)	LF
10" Sanitary Sewer Pipe (VCP)	LF
10" Sanitary Sewer Pipe (PVC)	LF

12" Sanitary Sewer Pipe (VCP)	LF
12" Sanitary Sewer Pipe (PVC)	LF
15" Sanitary Sewer Pipe (VCP)	LF
15" Sanitary Sewer Pipe (PVC)	LF
18" Sanitary Sewer Pipe (VCP)	LF
18" Sanitary Sewer Pipe (PVC)	LF
21" Sanitary Sewer Pipe (VCP)	LF
24" Sanitary Sewer Pipe (VCP)	LF
Sanitary Sewer Manhole (48")	EA
Sanitary Sewer Manhole (60")	EA
Sanitary Sewer Drop Manhole	EA
Sanitary Service with Cleanout	EA
4" Service with No Cleanout	EA
Sanitary Sewer Riser	EA
Lamphole	EA
Connect to Existing Sanitary Sewer	EA
Adjust Manhole to Grade	EA
6" Water Pipe (DIP)	LF
6" Water Pipe (PVC)	LF
8" Water Pipe (DIP)	LF
8" Water Pipe (PVC)	LF
10" Water Pipe (DIP)	LF
10" Water Pipe (PVC)	LF
12" Water Pipe (DIP)	LF
12" Water Pipe (PVC)	LF
14" Water Pipe (DIP)	LF
14" Water Pipe (PVC)	LF
6" Gate Valve	EA
8" Gate Valve	EA
10" Gate Valve	EA
12" Gate Valve	EA
14" Gate Valve	EA
Adjust Valves to Grade	EA
Fire Hydrant Assembly	EA
Blowoff (Permanent)	EA
Blowoff (Temporary)	EA
Connect to Existing Water	EA
1" Water Service w/Meter Box	EA
1" Water Service w/No Meter Box	EA
1½" Water Service w/Meter Box	EA
2" Water Service w/Meter Box	EA