CITY OF BENICIA

PUBLIC WORKS DEPARTMENT

ENGINEERING DESIGN STANDARDS

AND STANDARD PLANS

December 1992

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CITY OF BENICIA

ENGINEERING DESIGN STANDARDS

INDEX

Revised: April, 1992

CITY OF BENICIA
ENGINEERING DESIGN STANDARDS

SECTION 1

GENERAL

1.01 PURPOSE:

The purpose of these standards is to provide certain minimum standards for the design, construction, repair, and alteration of public works facilities and all appurtenances thereto, within the City limits.

1.01 DEFINITIONS:

A. CITY shall mean the City of Benicia, California.

B. CITY ENGINEER shall mean the City Engineer of the City of Benicia, California.

C. CONSULTING ENGINEER shall mean any person or persons, firm, partnership, or corporation legally authorized to practice civil engineering within the State of California who prepares and submits for approval improvement plans and specifications to the Department of Public Works of the City of Benicia.

D. DESIGN shall mean alignment, grade, size and other details of construction for the sanitary sewer, water, and storm drainage systems, roadway and other miscellaneous improvements as required by the City Engineer.

E. DEVELOPER shall mean any person, firm, corporation, partnership, or association engaged in the development of real property, in part or in whole, by the construction of improvements thereon.

F. EASEMENT shall mean an easement dedicated to the City, or public utility which shall be continuing and irrevocable unless formally abandoned.

G. ENCROACHMENT PERMIT shall mean the permit issued by the Public Works Department to all persons firms, corporations, partnerships, or associations proposing to construct improvements or do any work within the public right-of-way.

H. IMPROVEMENTS refer to street work, sidewalks, curbs, gutters, driveways, water mains, sanitary sewers, storm drainage, public utilities, landscaping, and fences to be installed by the developer on land to be used for a public right-of-way.

I. SOILS REPORT shall mean a report as prepared by any person or person, firm, partnership, or corporation legally licensed to prepare soils reports in the State of California.

J. STANDARD PLANS AND SPECIFICATIONS shall mean the standard plans and specifications of the City of Benicia.

K. SUBDIVISION ORDINANCE shall mean Title 16 of the Benicia Municipal Code.

L. ZONING ORDINANCE shall mean Title 17 of the Benicia Municipal Code.

SECTION 2

IMPROVEMENT PLANS

2.01 GENERAL

Complete plans and specifications for all proposed improvements, including any necessary easements, rights-of-entry, and/or dedications shall be submitted to the Public Works Department for review and must receive the required approvals prior to the start of construction. All plans shall be prepared by or under the direct supervision of a registered civil engineer in accordance with the provisions of Chapter 7 - Division 3 of the Business and Professions Code, the "Civil Engineer's Act".

2.02 FORMAT

Improvement plans and specifications shall be prepared in accordance with the following requirements:

A. **Dimensions**: Improvement plans shall be clearly and legibly drawn on sheets 24 by 36 inches in size with a 1 1/2 inch clear margin on the left edge and a minimum 1/2 inch margin on all other edges.

B. **Scale**: Horizontal scale shall be 1 inch equal to 40 feet; vertical scale shall be 1 inch equal to 4 feet; or as approved by the City Engineer prior to submittal.

C. **Content**:

1. Title Sheet.
    a. Plan view showing the entire street right-of-way layout at a scale of 1 inch equal to 100 feet, the proposed water and sewer mains, the storm drainage system, lot numbers and other miscellaneous improvements to be installed.
    b. Index of sheets.
    c. Complete legend.
    d. Typical street sections(s).
    e. Vicinity map.
    f. Assesors Parcel Number and street address.
    g. Title block located in the lower right-hand corner or the right edge of the sheet.
    h. Full description of temporary and permanent benchmarks.
    i. General and special notes relating to the construction.

j. Signature blocks for the Design Engineer, the City Engineer and the Fire Chief.

k. For grading plans, include additional signature blocks for Soils Engineer and Planning Director.

l. For landscape/irrigation plans, include additional signature blocks for Planning Director and Director of Parks/Community Services.

m. State of California registration seal, registration expiration date and signature of the design engineer on all sheets.

2. Street Plan and Profile Sheets.

a. The plan view of each street to be improved shall be shown on separate sheets indicating existing improvements, proposed improvements and future improvements if known. Proposed improvements shall include sidewalk, curb, gutter, driveways, sewer mains and lateral locations, water mains and water service locations, storm drains, catch basins, manholes, valves, fire hydrants, fencing, barricades, monuments, lot lines, survey stationing and other data as required by the City Engineer. The survey stationing shall normally read from left to right with the north arrow pointing either to the top or left edge of the sheet. All stationing shall be a continuation of existing improvements where possible.

b. When conforming to existing pavement, curb and gutter, or other facilities, detailed location and elevation information shall be provided on the improvement plans. Existing edge of pavement and street centerline shall be shown at 25 foot intervals for the length of the project and at least 100 feet beyond. Cross-sections at the same 25 foot intervals shall be accurately drawn to show the conform paving, indicating that the resultant cross-slope is no flatter than two percent (0.02) and no steeper than five percent (0.05). The cross-sections shall be drawn at a scale sufficiently large to clearly show the proposed conform work.

c. A profile view of each street shall be shown immediately below or above its plan view. The profile shall include existing grade lines, sewer mains, storm drains, water mains, public utility mains, all utility crossings, and top of curb. Elevations shall be shown

for the top of curb at grade break points, at each full station, at 25 foot intervals through vertical curves, at manhole and catch basin inverts and rims, and at water main crossings with other utilities.

3. Site Development Plan (For On-site Development). The site development plan shall include building pad, floor and garage elevations, individual lot drainage patterns, adjacent land drainage, driveway locations, fencing, existing contours, existing trees, wells, ditches and other landmarks important to the construction of the improvements.
4. Small projects may involve a combination of the above sheets.
5. Due to the fact that all plans are planned to be microfilmed, all lettering shall have a minimum height of 1/8".

2.03 GENERAL NOTES

The following general notes as a minimum shall be included on plans, as applicable:

A. All work is to be done in accordance with the standard plans and specifications of the City of Benicia, which are hereby incorporated into these plans.

B. At least 48 hours notice to the Public Works Department is required for a pre-construction meeting prior to the start of construction. Phone (707) 746-4240.

C. All revisions to these plans must be approved by the City Engineer prior to their construction, and shall be accurately shown on record drawings prior to the acceptance of the work as complete.

D. An encroachment permit is required for all work within the public right-of-way and must be secured prior to the start of any work.

E. The contractor shall notify Underground Service Alert at (800) 642-2444 at least 48 hours prior to the start of work to verify the location of existing underground utilities. The utilities shown on the plans are based upon record information, however the engineer assumes no responsibility for their accuracy or actual locations.

F. The contractor shall leave a 24-hour emergency telephone number with the Police, Fire and Public Works Departments, and keep them informed daily of any detours.

G. The contractor shall abide by the rules and regulations of the State of California Construction Safety Orders pertaining to excavations and trenches. A copy of the Construction Safety Orders is available in the Public Works Department for inspection.

H. Public safety and traffic control shall be provided in accordance with the "WATCH" manual and as directed by the City Engineer.

I. The contractor shall give at least 24 hours notice to the City Maintenance Superintendent prior to connecting to existing water facilities. At all times, the manipulation of existing valves shall be done under the direction of water division personnel.

J. All underground utilities shall be completed prior to the placement of base rock unless otherwise approved by the City Engineer.

K. Existing curb, gutter, sidewalk, survey monuments, and other public improvements within project site that are damaged or displaced shall be replaced at the contractors expense even if damage or displacement was not caused by actual work performed by the contractor.

L. When the lowest finished floor level of a house is 12 inches or less above the top elevation of the nearest upstream sanitary sewer structure there shall be a backwater overflow device or check valve installed on the sewer lateral next to the cleanout.

M. If paving and storm drain improvements are not completed by October 15, temporary silt and erosion control facilities shall be installed to control and contain silt deposits and to provide for the safe discharge of storm waters into existing storm drainage facilities. Design of the silt and erosion control facilities must be approved prior to their construction.

N. All traffic signs and street name signs shall be high reflective grade and conform to CalTrans specifications and City standard ST-15.

O. Approval of these plans by the City Engineer does not relieve the developer or his engineer from the responsibility for the design of the improvements and any deficiencies resulting from the design thereof.

P. All City standard details referenced in these plans shall be the current version available from the Public Works Department.

Q. The services of a registered civil engineer shall be retained to establish all lines, levels, grades and locations of all improvements; to verify the proper installation of all improvements; and to submit record drawings indicating all final improvements, with approved revisions, were accurately installed.

R. Cut sheets shall be submitted to the City 48 hours prior to the start of construction of an improvement requiring them.

S. The contractor shall perform the necessary tests in accordance with the City standards on newly installed storm drains, sewer, and water systems only after trenches are backfilled and street base is in place, compacted and ready for asphalt paving.

T. The contractor shall adjust to final grade all manholes, valve and monument covers within the work area unless noted otherwise.

U. The contractor shall place a "S" (for sewer) and a "W" (for water) in the wet concrete curb top at all new lateral locations.

V. The contractor shall be responsible for contacting appropriate utilities and requesting verification of service points, field verification of location, size, depth, etc. for all their facilities and to coordinate work schedules.

2.04 SUBMISSION AND CITY APPROVAL

A. Improvement plans shall be submitted in triplicate along with 2 copies of the subdivision final map (if applicable) to the City Engineer for checking to insure compliance with these standards, City of Benicia ordinances, and good engineering practice. Submittal shall include specifications, supporting calculations, lot closures, easement and right-of-way descriptions, rights-of-entry, and/or other materials as requested by the City Engineer.

B. Plans shall not be considered as approved until both the City Engineer and the Fire Chief (and the Soils Engineer and City Planning Department for grading plans) have signed the plans in the approval block on the plans. No

changes shall be permitted to an approved set of plans unless such changes are first approved by the City Engineer as described above. Excepted from approval are any features of the plans that are contrary to, in conflict with, or do not conform to any California State Law, City of Benicia Ordinance or Resolution, or generally accepted good engineering practice, in keeping with the standards of the profession, even though such errors, omissions or conflicts may have been overlooked in the Department of Public Works review of plans.

C. After formal approval of the improvement plans by the City Engineer has been received, 3 blueprint copies of the plans shall be forwarded to the Public Works Department. If additional copies of the improvement plans are requested by the City Engineer, they shall be furnished to the City. Prior to acceptance of the improvements by the City, the consulting engineer shall furnish to the City a full set of photo mylar copies (minimum of 3 mils thick) of the record "as built" drawings of the improvements to include <u>all</u> revisions.

2.05 IMPROVEMENT PLAN CHECKLIST

A. **<u>General</u>**

1. Is all existing information shown in sufficient detail?
2. Are the plan sheets 24" x 36"?
3. Is there a 1 1/2 inch margin on the left edge and at least 1/2 inch margins on the other sides?
4. Is the horizontal scale one inch equal to 40 feet; the vertical scale one inch equal to 4 feet? Has approval been given for other scales?
5. Is the lettering at least 1/8 inch?
6. Did the design engineer stamp and sign each sheet?

B. **<u>Title Sheet</u>**

1. Is the 100 scale system map shown?
2. Is there an index of plan sheets?
3. Is there a complete legend?
4. Are typical street sections shown?
5. Is the vicinity map shown?
6. Is the title block in the lower right-hand corner?
7. Is the benchmark described?
8. Are there general and special construction notes?
9. Do the plans have the signature and seal of the design engineer?
10. Are approval blocks provided for both the City Engineer and the Fire Chief?

11. Are additional approval blocks provided for the Soils Engineer and the City Planning Department on grading plans?
12. Are the APN and address shown?

C. **Plans and Profile Sheets**

1. Are the existing improvements accurately shown, and in sufficient detail?
2. Are planned improvements compatible, and shown in sufficient details?
3. Is the horizontal scale one inch equal to 40 feet, and the vertical scale one inch equal to 4 feet?
4. **Street Design:**
   a. Are street widths and geometrics appropriate for the class of street?
   b. Are street intersections at an angle of at least 70 degrees, and separated by at least 200 feet?
   c. Are street grades between one-half percent and sixteen percent?
   d. Has a two percent cross-slope been shown for all roads?
   e. For grade differences greater than two percent are vertical curve lengths in conformance with the CalTrans Highway Design Manual , and at least 50 feet in length?
   f. For conform pavements, does the pavement section match the existing?
   g. For new streets is the pavement section shown to be based on R-value tests?
   h. Is the minimum pavement section 3 inches of asphalt concrete on 6 inches of class 2 aggregate base?
   i. Are the sidewalks shown of the proper width?
   j. Are handicap ramps shown at each intersection curb return?
   k. When required are redwood headerboards at least 2 inches by 8 inches?
   l. Are street monuments located properly?
   m. Are street signs and pavement markings of the proper material and adequate?

5. **Storm Drainage:**
   a. Are the supporting calculations in accordance with the County of Solano Hydrology and Drainage Design Procedure?
   b. Is the minimum freeboard of 1.0 foot maintained at all structures?
   c. Does gutter flow meet the maximum requirements?
   d. Are pipe types specified?

e. Are minimum cover and clearance requirements satisfied?
f. Is the minimum public storm drain pipe 15 inches in diameter?
g. Are alignment criteria met?
h. Do pipe crowns match within a structure?
i. Is a 0.2 foot drop provided within any structure where the pipe deflection is 45 egrees or greater?
j. Is the hydraulic grade line shown and labeled on the profile at each structure?
k. Are easements of the proper width provided where necessary?

6. **Sanitary Sewer**:
   a. Is the minimum extendable main size 8 inches in diameter?
   b. Are laterals shown and sized properly?
   c. Are easements of the proper width provided where necessary?
   d. Are mains located 5 feet south and/or east of the street centerline, and separated by at least 5 feet from other parallel utility mains?
   e. Is the minimum slope three-quarters of one percent?
   f. Are cover requirements met?
   g. Are crossing clearance requirements satisfied?
   h. Is there no more than 45 degrees total deflection between structures?
   i. Are there no reverse curves?
   j. Are laterals stationed on the plan view?
   k. Is the maximum spacing between manholes 300 feet?
   l. Is the proper drop provided in manholes?
   m. Are there no more than 5 laterals between a rodding inlet and the next downstream manhole?

7. **Water System**:
   a. Is the system shown looped?
   b. Are mains located 10 feet north and/or west of the street centerline?
   c. Is the water main shown on the profile?
   d. Is the vertical clearance at crossings with other utilities adequate?
   e. Is the minimum cover from subgrade 2 feet?
   f. Is the minimum main size 8 inches in diameter?
   g. Are service lines specified as Type K Copper?
   h. Are the valving requirements satisfied?

8. **Street Lights**:
   a. Is the street lighting system shown on the improvement plans?
   b. Are electrolier locations shown?
   c. Are luminaire intensities specified?
   d. Are luminaire mounting heights and mast arm lengths specified?
   e. Are pole and luminaire type specified?
   f. Is electrical service point shown and approved by PG & E?
   g. Are conduit runs and pullboxes shown?

9. **Grading Plans**:
   a. Do the grading plans conform with the requirements in the project soils report?
   b. Are the additional general notes for grading included?
   c. Are the existing improvements accurately shown, and in sufficient detail?
   d. Are the planned improvements compatible, and shown in sufficient detail?
   e. Do the plans have the signature and seal of the design engineer?
   f. Are approval blocks provided for the City Engineer, Fire Chief, City Planning Department and project Soils Engineer?
   g. Does design of improvements comply with Chapter 70 of the Uniform Building Code?

SECTION 3

STREET DESIGN

3.01 CLASSES

For purposes of geometric and structural design, streets shall be classified according to the following. Deviations may be approved by the City Engineer

CLASS	DESIGN SPEED (MPH)	TRAFFIC INDEX (MINIMUM)**	RIGHT-OF-WAY WIDTH (FEET)	CURB-TO-CURB WIDTH (FEET)	CENTERLIINE RADIUS (FEET)	INTERSECTION RADIUS	
						PROPERTY LINE	CURB LINE
Major Arterial (Truck Route)	45	10.0	100	80	500	40	50
Major Arterial	45	8.5	84	68	500	32	40
Minor Arterial	35	7.5	60*	48	400	24 - 34	30-40
Collector	30	6.0	49*	40	250	15.5 - 25.5	20-30
Local	25	5.0	45*	36	100	15.5	20
Cul-de-Sac***	25	5.0	41*	32	100	15.5	20
Alley	15	4.0	20	20	N/A	N/A	N/A

NOTES:

* Plus a 10' PSE (Public Service Easement) on each side.

** The traffic index used on bus routes shall be 10.0

*** For cul-de-sacs over 500' use local street standards.

3.02 GEOMETRICS

A. All street intersections shall be as near at right angles as practicable, but in no case shall the angle of intersection be less than 70 degrees.

B. No less than 200 feet shall separate street centerline intersections.

C. The minimum longitudinal slope for all streets shall be five tenths of one percent (0.5%). This minimum grade shall be held around the outside curb of horizontal curves and around curb returns.

D. The maximum longitudinal slope for all streets shall be sixteen percent (16%).

E. All streets shall have a two percent (2%) cross-slope, except where specifically approved otherwise by the City Engineer.

F. Vertical curve lengths will be computed based upon criteria defined in the CalTrans Highway Design Manual, with a minimum length of 50 feet. A vertical curve is not required where the algebraic difference in grades does not exceed 2 percent (2%).

G. Residential cul-de-sac streets shall be provided with a 40 feet curb radius bulb turnaround, commercial and industrial cul-de-sac streets shall be provided with a 55 feet radius bulb turnaround.

3.03 PAVEMENT SECTION

A. For new construction a recommended pavement section shall be designed using the State of California Department of Transportation design method, based upon R-valves obtained from tests of the proposed subgrade at points approved by the Public Works Inspector, and approved by the City Engineer.

B. For conform pavements the minimum pavement section shall match the existing pavement section.

C. The minimum pavement section shall be 3 inches of asphalt concrete on 6 inches of class 2 aggregate base.

3.04 APPURTENANCES

A. **Valley Gutters** will not be allowed.

B. **Sidewalk, Curb and Gutter**
   1. Sidewalks shall be 4 feet wide in residential areas and at least 6 feet wide in commercial areas.
   2. A handicap ramp shall be installed at each intersection curb return.
   3. Lot line extensions may be neatly marked at the back of sidewalk or on curb.

C. **Standard City Street Monuments** shall be installed as follows:
   1. Along the street centerline.
   2. At the BC, PRC and EC of horizontal curves; at cul-de-sac swing points; at street intersections; and at all other points as required by the City Engineer.

3. Each monument shall be punched to establish the point by the consulting engineer prior to acceptance of the improvements as complete.

E. **Street Signs and Pavement Markings**

1. All street name signs and traffic signs to be installed by the developer shall be shown on the improvement plans, and specified to be of high intensity grade reflective material.
2. All pavement markings to be installed by the developer shall be shown on the improvement plans and specified to be thermoplastic.

F. **Redwood Headers**

Redwood headerboards at least 2" x 8" in size shall be installed at the edge of any street pavement that is expected to be extended in the future.

SECTION 4

STORM DRAINAGE

4.01 GENERAL

A. Storm drainage design must include provisions to insure future extension of the drainage system to serve the entire drainage basin. Calculations supporting the proposed design must be submitted for approval along with the improvement plans, and shall include:
   1. A map showing the limits of the entire drainage basin, and any sub-areas and indicating the area(s) in acres.
   2. The flow in cubic feet per second to each structure and within each pipe or channel.
   3. The time of concentration at each structure.
   4. The rainfall intensity at each structure.
   5. The size and slope of each pipe proposed between structures.
   6. The invert elevation of each pipe structure.
   7. The elevation of the top of each structure.
   8. The elevation of the hydraulic grade line at each structure.
   9. A minimum freeboard of 1.0 feet.

B. Underground storm drainage systems are required when one or more of the following criteria is satisfied:
   1. Gutter flow exceeds 2.5 cubic feet per second.
   2. Gutter flow exceeds 0.2 feet in depth.
   3. The length of gutter exceeds 1000 feet.

4.02 DESIGN

A. Storm runoff shall be calculated in accordance with the County of Solano Hydrology and Drainage Design Procedure.

B. **Pipes**
   1. Capacity:
      a. Manning's Formula shall be used to compute the capacity of all conduits, whether open or closed.
      b. The minimum allowable pipe diameter for any storm drain shall be 18 inches, with a minimum allowable velocity of 2.0 feet per second.
   2. Allowable Pipe Types:
      a. Reinforced Concrete Pipe (Class III min.)
      b. Cast-in-place Concrete Pipe

c. High density polyethylene (high strength corrugated) - Spiralite or approved equal.
d. Other types of pipe may be used but only with prior approval of the City Engineer on a case-by-case basis:
- Corrugated Metal Pipe
- Polyvinyl Chloride (private systems only)

3. Cover Requirements:
a. The minimum cover for any storm drain shall be 2 feet from subgrade to top of pipe.
b. A minimum clearance of 6 inches shall be provided at crossings with other utilities.

4. Alignment:
a. In general, storm drain lines will parallel the street centerline and be located under the gutter, or centered upon the storm drainage easement.
b. Both horizontal and vertical curves are allowable, provided that:
1) The manufacturer's recommended deflection per joint is not exceeded, and
2) Reverse curves between structures will not be permitted.

C. **Structures**
1. Changes in pipe sizes shall be made within a structure. Pipe crowns will be matched.
2. A minimum drop of 0.2 feet will be required within a structure where the angle of deflection is 45 degrees or greater.
3. The hydraulic grade line at each structure shall be shown and labeled on the profile, and shall provide for a minimum freeboard of 1.0 feet.
4. Manholes shall be located at junction points, changes in grade, or changes in conduit size.
5. Catch basins may also be used at junction points, changes in grade, or changes in conduit size.
6. A drop of more than 2.0 feet from the invert of one line to another will not be allowed within a manhole.
7. Catch basins (with curb or gutter inlets) shall be poured in place structures. No pre-cast is allowed. Other pre-cast structures shall require prior approval by the City Engineer.
8. Other structures and drop manholes (if unavoidable) shall require prior approval by the City Engineer.

D. **Easements/Location**

1. All storm drains should be located within a road right-of-way, if unavoidable, then lines shall be centered upon a dedicated storm drainage easement.
2. Easements for closed conduits shall meet the following requirements:
   a. For pipe 24 inches in diameter and smaller, the minimum easement width shall be 10 feet.
   b. For pipes in excess of 24 inches in diameter the minimum easement width shall be 15 feet.

4.03 INSTALLATION

A. **Installation**

1. The trench shall be excavated to the lines and grades established by the Engineer.
2. All new lines must receive City inspection after installation to verify proper placement. Contractor must receive authorization from the City Inspector before placement of backfill.
3. Trench backfilling, placement of aggregate base material, and compaction shall be done in conformance with City standard plan ST-7.

B. **Testing**

1. After the system is installed, trench is backfilled, street base is in place, compacted and ready for paving, all manholes, structures, and main lines shall be cleaned of all debris, silt and other material to the satisfaction of the City Engineer.

SECTION 5

SANITARY SEWER

5.01 GENERAL

A. **Line Size**

1. The minimum main size shall be 8 inch diameter, except that a last length of main which cannot be extended in the future may be 6 inches in diameter.
2. The minimum side sewer (lateral) size shall be:
   a. 4 inches in diameter for single family residential use.
   b. 6 inches in diameter for multi-family residential, commercial, or industrial uses.

B. **Easements/Location**

1. All public sanitary sewer mains should be located within the road right-of-way, or if unavoidable, centered upon a dedicated easement.
2. Easements for sanitary sewers shall meet the following requirements:
   a) For sewer mains less than 12 inches in diameter, the minimum easement width shall be 10 feet.
   b) For sewer mains 12 inches in diameter and larger, the minimum easement width shall be 15 feet.

5.02 DESIGN

A. **Flow Computation**

1. The design sanitary sewer flow shall be equal to the sum of two and one-half times the average flow and the infiltration flow.
   a. The average flow for residential areas is based on the following assumptions:
      1) A single family dwelling is composed of 3.5 persons.
      2) An allowance of 100 gallons per person per day.
   b. For commercial areas the average flow shall be 1800 gallons per acre per day.
   c. Light industrial areas shall utilize an average flow of 1600 gallons per acre per day.
   d. Heavy industrial areas require special design and will be considered on a case-by-case basis.

e. Infiltration rates shall conform to the following:

1) For new construction: 1000 gallons per acre per day.
2) For existing sewers: 3000 gallons per acre per day.

2. Pipe capacities shall be computed utilizing Manning's formula with an "n" valve of either 0.013 or the pipe manufacturer's recommendation, whichever is greater, for pipes flowing full.

B. **Mains**

1. In general, sanitary sewer mains will be located 5 feet south and/or east of street centerline.
2. Minimum slope for mains shall be three-quarters of one percent. Where possible, slope shall provide for a velocity of at least 2 feet per second.
3. Minimum depth for sewer mains shall be 4 feet of cover from top of pipe to subgrade. Ductile iron mains may have as little as 18 inches of cover from subgrade.
4. A minimum of 12 inches of vertical clearance shall be maintained in crossings with water mains, and at least 6 inches vertical clearance in crossings with other utilities.
5. At least 5 feet clearance shall separate sewer mains from other parallel utility main installations.
6. Horizontal and/or vertical curves are allowed between structures, provided that:
   a. The total deflection does not exceed 45 degrees, and
   b. The deflection at each joint does not exceed 80 percent of the manufacturer's published recommended allowable maximum.
   c. Reverse curves are not allowed.

C. **Side Sewers (Laterals)** are those portions of the sewerage system between the sewer main and the right-of-way line. The limit of City maintenance responsibility is the right-of-way line and is denoted by a clean-out. In all cases the City maintained facilities will lie within the limits of either the street right-of-way or the easement sidelines.

1. All 4-inch diameter sewer laterals shall have a minimum slope of two percent (0.02).
2. All 6-inch diameter sewer laterals shall have a minimum slope of one percent (0.01).
3. In all new work, the sewer lateral shall be installed concurrently with the sewer main, and shall be drawn to scale and stationed on the plan view of the improvement plan.

4. The angle of intersection between the side sewer and the upstream main sewer shall 90 degrees.

D. **Appurtenances**

1. Manholes
   a. Manholes shall be provided at all junctures of mains and at all changes of direction and main line size, but in no case more than 300 feet from the downstream manhole.
   b. Manholes which are not located at a change of direction or size shall have the main extended straight through. In other situations match crowns of pipes of different sizes or allow for a 0.1 foot drop through the manhole. Channels shall be formed in the bottom of the manhole to provide positive direction for low flows.
   c. A drop of more than 2.0 feet from the invert of one line to another will not be allowed within a manhole. Drop manholes, if unavoidable, require special design and approval by the City Engineer.
2. A rodding inlet may be used for the end structure of a section of main serving no more than 5 laterals since the last manhole.
3. Pressure systems (pumps) require prior approval of the City Engineer and will be allowed only if a gravity system is not feasible. The pressure systems will be private and therefore will not be maintained by the City.

E. **Pipe Materials**

Sewer pipe shall be one of the following types:

1. Polyvinyl Chloride (PVC), extra strength minimum of SDR=35.
2. Ductile Iron Pipe (DIP) class 50 wrapped with polyethylene tubing.
3. Other types of pipe may be used but only with prior approval of the City Engineer.

5.03 INSTALLATION

A. **Installation**

1. The trench shall be excavated to the lines and grades established by the Engineer.
2. All mains and laterals must receive City inspection after installation to verify proper placement. Contractor must receive authorization from the City Inspector before placement of backfill.
3. Trench backfilling, placement of aggregate base material, and compaction shall be done in conformance with City standard plan ST-7.

B. **Testing**

1. The following tests shall be performed by the contractor after the sewer system is installed, backfilled, and street base is in place, compacted and ready for paving:
   a. Air pressure test - All new main lines with connecting laterals shall be tested in separate sections. The main and laterals shall be pressurized under 4.0 psi for a minimum of 4 minutes with a maximum allowable pressure drop of 0.5 psi. If pressure drops more than this amount, then repressurize to 3.5 psi and hold for an additional 4 minutes. Pressure must not drop below 3 psi at the end of this retest.
   b. Hydrostatic test - All manholes and isolated laterals shall be tested by plugging at the main connection(s) and then filling structure or lateral with water, (laterals require a 4 foot head). The water shall stand for a 4 hour period without exceeding the allowable loss as determined by the City Engineer.
   c. Mandrel test - All mains shall be cleaned and then mandrelled to measure for obstructions. A rigid mandrel with a circular cross section of at least 98% of the inside pipe diameter shall be pulled through the pipe by hand.
2. Upon failure of any test as determined by the City Engineer the contractor shall, at his expense, remedy the cause and retest that portion of the system. Retesting may require that additional inspection fees be paid to the City.
3. For large subdivisions and for installations that fail to receive proper City inspection or fail any test, the City Engineer may require that the sewer mains be inspected internally by TV equipment using VHS tape format.

SECTION 6

WATER SYSTEM

6.01 GENERAL

The public water supply system shall encompass all mains necessary to supply water to fire hydrants, fire sprinkler systems, and water services, at a pressure between 65 psi and 150 psi. Mains should be located in the street right-of-way otherwise the lines shall be centered upon a dedicated water line easement. The minimum width of such easements shall be 10 feet for water mains less than 12 inches in diameter and 15 feet for water mains 12 inches in diameter and greater.

6.02 DESIGN

A. Layout

1. Mains shall be looped to allow for water circulation and pressure equalization. Exceptions require prior approval by the City Engineer.

2. Water mains shall typically be located 10 feet north and/or west of the street centerline.

3. The improvement plan profile shall show the water main with invert elevations at all changes in grade and at all crossings with other utilities.

4. All crossings with sanitary sewer mains shall position the water main over the sewer main with a minimum 12-inch vertical clearance. Crossings with other utilities shall provide a minimum 6 inches of vertical clearance.

5. The minimum cover from the top of water main pipe shall be 24 inches from subgrade or 36 inches from the finished grade surface, whichever is greater.

B. Mains

1. The minimum size water main shall be 8 inches in diameter. The installation of 6-inch diameter mains may be permitted beyond the last fire hydrant installation.

2. In all cases, water mains shall be of sufficient size to meet the fire flow requirements of the Fire Department.

C. **Pipe Materials**

1. Pipe shall be poly-wrapped, Class 50 ductile iron. Those areas designated by the City Engineer for corrosion control methods shall also have bolted connections made with stainless steel fasteners.

2. Service lines in sizes up to and including 2 inches in diameter shall be Type K copper soft tubing and shall be made with Mueller brand compression fittings or City approved substitutes. Sweat joints may be used with prior approval from the City Engineer.

D. **Appurtenances**

1. Valves:

   a. The distribution system shall be equipped with a sufficient number of valves so that no single shutdown will result in shutting down a transmission main or necessitate the removal from service a length of pipe greater than 500 feet in high density districts or greater than 800 feet in other areas---in no case shall more than two fire hydrants be removed from service. Valves should be so located that any section of main can be shut down without going to more than three locations to close valves.

   b. A valve shall be installed one pipe length before the end of a main planned to be extended in the future.

   c. All valves are to be specified as Mueller Resilient Seat bolt on or City approved substitute, bolted directly to the tee or fitting.

   d. Provide air release valves at system highpoints. Fire hydrants may be substituted for air release valves at such highpoints with prior approval of the City Engineer.

2. Fittings:

a. Standard approved fittings shall be used at all bends of 11 1/4 degrees or greater. All fittings shall be ductile iron with mechanical joints or City approved substitute.

b. Use tapping sleeves on all pipes over 2 inches in diameter.

3. Thrust Blocks - Provide thrust blocks at all bends, behind tees, fire hydrants, crosses, and valves, as shown in the Standard Plans.

4. Services:

a. Service lines from the water main to the property line shall normally be installed at the time the main is constructed to avoid future cutting of the street.

b. Water service lines may be as close as 18 inches to the sanitary sewer lateral but shall in all cases be a minimum of 12 inches.

c. Individual meters with separate service lines shall be provided for each separate dwelling unit or building. For commercial and industrial users, a separate meter and service line shall be provided for each building. A separate water meter may be provided for the irrigation system.

d. The minimum service line shall be 3/4 inch. Service lines up to and including 2 inches in diameter shall be Type K copper soft tubing and shall use Mueller brand compression fittings or City approved substitutes. Sweat joints may be used with prior approval from the City Engineer. Flared connections are not permitted.

e. All service lines shall have an approved backflow assembly installed on the line in accordance with Standard Plans.

f. Water meter size shall be sufficient to accommodate the design flows (in gpm) as furnished by the Engineer. The meter size shall not be less than the service line size unless approval prior by the City Engineer.

Maximum flow rates for continuous operation (as recommended by AWWA) are listed below for various meter sizes:

5/8" x 3/4" meter	10 gpm
1" meter	25 gpm
1-1/2" meter	50 gpm
2" meter	80 gpm

5. Fire Protection:

a. Hydrants

1) Fire hydrants and Fire Department connections shall be placed as required by the Fire Department within street right-of-ways and approved easements with 20 foot minimum paved access.

2) The minimum size water main serving a fire hydrant shall be 6 inches in diameter, with no more than two hydrants allowed on any 8-inch line between intersecting mains.

b. Fire Sprinkler Systems:

1) Fire sprinkler systems when required by the Fire Department shall be connected directly to the main using a hot tap to the existing main and a hot tap or tee fitting at the new mains.

2) A shut-off gate valve per City Standard Plan shall be placed directly behind the hot tap or tee fitting connection on the fire sprinkler system service line. This valve marks the end of the City's maintenance responsibility on fire sprinkler service lines.

3) All fire sprinkler systems require an approved backflow assembly. Systems greater than 2 inches in diameter also require an approved detector check assembly.

4) Further requirements are as outlined in the Uniform Building and Fire Codes and Standards and as allowed by the Fire Department.

6.03 INSTALLATION

A. Installation

1. The trench shall be excavated to the lines and grades established by the Engineer.

2. All mains and laterals must receive City inspection after installation to verify proper placement. Contractor must receive authorization from the City Public Works Inspector before placement of backfill.

3. Aggregate base backfill shall be placed and compacted in conformance with Standard Plans.

B. Testing

1. The following tests shall be performed by the Contractor after the water system is installed, backfilled, and street base is in place, compacted, and ready for paving:

   a. Pressure/Leakage Test - Test per AWWA C600-82 Section 4. Pressurizing the system to 200 psi for a minimum of 2 hours an allowable leakage is calculated using the formula:

   $$L = (SD\sqrt{P})/133200$$

   where L is the allowable leakage in gallons per hour, S is the length of pipe, D is the nominal pipe diameter in inches, and P is the test pressure in psi.

   b. Fireflow Test - Actual flows shall be performed by the Fire Department to verify calculated flow requirements are met prior to construction of any development served by the new main and fire lines.

   c. Bacteria Test - After passing the pressure test the Contractor shall flush the new lines into an approved outlet and the City will take a water sample for coliform bacteria testing. Only after the sample passes this bacteria test will the main be activated.

   d. Backflow Assembly Test - After the assembly is installed, testing is required by a City approved, AWWA-certified backflow prevention assembly tester. The assembly shall be fully functional prior to water service activation. A City-approved Statement of Compliance from the tester is required to be filed with the

City Engineer and Water Quality Division prior to water service activation.

2. Upon failure of any test as determined by the City Engineer the Contractor shall, at Contractor's expense, remedy the cause and retest that portion of the system. Retesting may require that additional inspection fees be paid to the City.

SECTION 7

STREET LIGHTS

7.01 GENERAL

A. Street lights shall be designed to conform to the National Electrical Code, PG & E standards and specifications, and these standards.

B. The engineer shall show the proposed street lighting system on the improvement plans, and shall include as a minimum the following:
   1. The location of electroliers
   2. The intensity of luminaires
   3. The mounting height and mast arm length of luminaires
   4. The pole and luminaire type referencing the appropriate PG & E standard.
   5. The electrical service point as approved by PG & E.
   6. The conduit runs and pullbox locations.

c. All street lights and lighting systems shall be dedicated to the City upon satisfactory installation.

7.02 DESIGN

A. **Spacing, Intensity and Mounting Height**
Street lights shall have the following spacing, intensity and mounting height. Deviations may be approved by the City Engineer.

CLASS	SPACING (FT.)	LUMINARE WATTAGE	MOUNTING HEIGHT (FT.)
Major Arterial	175-185	200-250	35.0
Minor Arterial	175-200	200	32.5
Collector Street	200-250	100	27.5
Local Residential	200-250	70	27.5
Local Industrial	250-300	70	27.5

B. **Poles and Arms**
   1. All poles shall be single arm except in median islands where double arm poles shall be used.

2. Arm length shall be 4 foot for all 27' - 6" mounting heights. All other arm lengths shall be determined by the street width and location of the electrolier.

C. **Location of Electroliers**

1. Whenever possible, street lights shall be located on a property line extension.
2. On residential streets with 4 foot sidewalks electroliers shall be located at the back of sidewalk. The edge of the foundation shall meet the back of sidewalk.
3. When the sidewalk width is greater than 4 feet, the electrolier shall be centered 2 feet back from the face of curb.
4. Where there is only curb and gutter, the electrolier shall be located at the back of the curb. The edge of the foundation shall meet the back of curb.
5. Whenever possible at T-intersections an electrolier shall be located on the through street along the projected centerline of the intersecting street.
6. In cul-de-sacs an electrolier shall be located at the end of the bulb.
7. At four-way intersections of major streets an electrolier shall be located at all returns.
8. At a four-way intersection of a major and a minor street an electrolier shall be located at the far right returns of the major street.
9. At four-way intersections of minor streets an electrolier shall be located at one of the returns.
10. Electroliers will normally be staggered on opposite sides of the street. Electroliers shall be placed on the outer edge of curves.

SECTION 8

GRADING PLANS

8.01 GENERAL

Grading operations shall be conducted in accordance with Chapter 15.04 of the Benicia Municipal Code which incorporates Chapter 70 of the Uniform Building Code, the recommendations contained in the project soils report, and the grading plans prepared by the project consulting engineer as approved by the City Engineer.

8.02 FORMAT

Grading plans shall be prepared using the same guidelines required (in Section 2.02) for improvement plans with the exception of street plan and profile sheets.

8.03 GENERAL NOTES

Typically, the grading plan is incorporated as a part of the complete set of improvement plans for the project, so the general notes required (in Section 2.03) for improvement plans will also apply. In addition, the following notes will be required:

A. All grading operations shall be conducted in accordance with Chapter 15.04 of the Benicia Municipal Code and the recommendations contained in the project soils report under the direct supervision of the project Soils Engineer and a registered Civil Engineer, both hired at the applicant's expense.

B. The project Soils Engineer and the Civil Engineer will be responsible for on-site inspection and quality control of grading operations. All revisions must be approved in writing by the project Soils Engineer, Civil Engineer and the City Engineer prior to continuing with work in that area.

C. The Contractor shall obtain a Grading Permit from the City. Contact the Public Works Department at (707)746-4240 for a pre-construction meeting at least 48 hours prior to commencement of work.

D. The Contractor shall protect adjacent properties in a manner that will prevent sloughing or any encroachment. This may require fencing and/or barriers be provided. Grading on adjacent properties will require written authorization from the property owner with a copy furnished to the City prior to commencing such work.

E. The Contractor shall control the dust resulting from his operations through watering or other suitable methods on the site and haul routes.

F. Upon completion of all grading work, the following three items shall be required prior to City acceptance:
   1. Final Soils Report with Statement of Compliance from project Soils Engineer.
   2. "As built" grading plan from the Civil Engineer responsible for inspection.
   3. Statement of Compliance from the Civil Engineer responsible for inspection.

G. The estimated dirt quantities are as follows:
   Cut:_____C.Y. Fill:_____C.Y.

8.04 SUBMISSION AND CITY APPROVAL

Grading plans shall use the same guidelines required (in Section 2.04) for improvement plans with the additional requirement to provide the following three items prior to acceptance by the City of all grading work:

A. Final Soils Report by project Soils Engineer to include compaction test results for streets, trench backfill and fills; other data and comments made during grading; and a statement of compliance that all work has been completed to his satisfaction in accordance with the soils report and all approved revisions.

B. "As Built" grading plan by the Civil Engineer responsible for inspection services indicating all final improvements with approved revisions were accurately installed.

C. Statement of Compliance by the Civil Engineer responsible for inspection services verifying that all grading and drainage work has been completed under his direction in accordance with the "as built" grading plans and that positive drainage away from building foundations to approved drainage facilities is provided.

RESOLUTION NO. 99-69

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF BENICIA APPROVING REVISIONS TO SECTION 6 AND STANDARD PLAN W-10 OF THE ENGINEERING DESIGN STANDARDS AND STANDARD PLANS AND AUTHORIZING A LOAN PROGRAM FOR QUALIFYING PROPERTY OWNERS FOR THE INSTALLATION OF REQUIRED BACKFLOW ASSEMBLIES

WHEREAS, the City of Benicia must bring its cross-connection control program into full compliance with the requirements of the California Department of Health Services by December 31, 1999; and

WHEREAS, the City Council adopted the Engineering Design Standards and Standard Plans by Resolution No. 90-20 on February 6, 1990; and

WHEREAS, revisions to Section 6 and Standard Plan W-10 of the Engineering Design Standards and Standard Plans are necessary to update the installation and testing requirements related to backflow assemblies in accordance with current fire and water quality standards and to improve syntax; and

WHEREAS, it is recognized the retrofitting of existing systems may pose a financial impact to small property owners or property owners who must install multiple assemblies; and

WHEREAS, funds are available in the budget of the water operations fund to provide financial assistance through a loan program.

NOW, THEREFORE, BE IT RESOLVED THAT the City Council of the City of Benicia hereby approves and adopts the revisions to Section 6 and Standard Plan W-10 of the Engineering Design Standards and Standard Plans.

BE IT FURTHER RESOLVED THAT the City Council of the City of Benicia hereby authorizes the establishment of a loan program to the extent funds are budgeted for qualifying property owners for the installation of required backflow assemblies based upon the following parameters:

1. For loan amounts of: $1,000 to $3,000, the payback period will be 12 months;
   $3,000 to $6,000, the payback period will be 24 months;
   $6,000 to $9,000, the payback period will be 36 months;
   $9,000 to $12,000, the payback period will be 48 months;
   $12,000 to $15,000, the payback period will be 60 months;
   $15,000 or more will be by special arrangement with the City of Benicia Finance Director.

2. A letter agreement format approved by the City Attorney will be used.
3. If the property owner is also a City of Benicia utilities customer, the monthly payments will be collected on the water bill and default will result in the termination of water service. If the property owner is not a City of Benicia utilities customer, a payment schedule will be established and monthly invoices issued. If default occurs, recourse will be collection via a lien or legal action.
4. The interest rate will be 5.5% annually and a 10% fee will be applied to late payments.
5. Upon completion of the work and authorization by the property owner, the payment will be made directly to the contractor.
6. Except by special arrangement with the City of Benicia Finance Director, the installation cost of one assembly will be borne by the property owner and will not be eligible for the loan program. [Such an exception may be a property owner with only one device to install but the cost of that device exceeds $1,000.]

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On motion of Council Member Gizzi, seconded by Council Member Messina, the above resolution was introduced and passed by the City Council of the City of Benicia at a regular meeting of said Council held on the 15th day of June. 1999, and adopted by the following vote:

AYES: Councilmembers Corbaley, Cox-Golovich, Gizzi, Messina and Mayor Hayes

NOES: None

ABSENT: None

Jerry Hayes, Mayor

ATTEST:

Linda S. Purdy, City Clerk

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