

TABLE OF CONTENTS

CHAPTER 8

TRAFFIC CONTROL

	Page
8.00.00	<u>INTRODUCTION</u>.....8-1
8.01.00	GENERAL.....8-1
8.02.00	GLOSSARY OF TERMS8-1
8.10.00	<u>DESIGN STANDARDS</u>.....8-3
8.10.01	<i>Responsibilities for Traffic Studies</i>8-3
8.10.02	<i>Traffic Study Format</i>8-4
8.10.03	<i>Summary of Typical Study Contents</i>8-10
8.11.00	ACCESS REQUIREMENTS AND CRITERIA8-11
8.11.01	<i>General</i>8-11
8.11.02	<i>State Highways</i>8-11
8.11.03	<i>Principal Arterials</i>8-11
8.11.04	<i>Minor Arterials</i>8-12
8.11.05	<i>Major and Minor Collectors</i>8-13
8.11.06	<i>Local Streets</i>8-13
8.11.07	<i>Basic Principles for Curb Openings and Driveways</i>8-13
8.11.08	<i>Definition of Terms</i>8-14
8.11.09	<i>General Requirements</i>8-15
8.11.10	<i>Control Dimensions</i>8-16
8.12.00	STREET LIGHTING8-17
8.12.01	<i>Street Lighting Procedure</i>8-17
8.12.02	<i>Spacing and Illumination</i>8-18
8.13.00	PARKING.....8-19
8.13.01	<i>Regular Parking</i>8-19
8.13.02	<i>Compact Parking</i>8-20
8.13.03	<i>Signing</i>8-21
8.13.04	<i>Maximum Allowable Grades Permitted in Parking Lots</i>8-21
8.13.05	<i>Handicapped Parking Posting</i>8-21
8.13.06	<i>Parking Structures</i>8-21
8.20.00	<u>CONSTRUCTION STANDARDS</u>.....8-22
8.21.00	TRAFFIC SIGNALS8-22
8.21.01	<i>General Requirements</i>8-22
8.21.02	<i>Traffic Control and Street Closure</i>8-22
8.21.03	<i>Testing</i>8-22
8.21.04	<i>Intersection Power</i>8-22
8.21.05	<i>Equipment Salvage</i>8-22
8.21.06	<i>Existing Traffic Signals</i>8-23
8.21.07	<i>Signal Heads</i>8-23
8.21.08	<i>Field Location</i>8-23
8.21.09	<i>Utilities</i>8-23
8.21.10	<i>Notification of Work</i>8-23
8.22.00	REGULATIONS AND CODE8-23
8.23.00	EQUIPMENT LIST AND DRAWINGS8-24

8.24.00	EXCAVATING AND BACKFILLING	8-24
8.25.00	REMOVING AND REPLACING IMPROVEMENTS	8-24
8.26.00	UNDERGROUND FACILITIES	8-25
8.26.01	<u>Foundations</u>	8-25
8.26.02	<u>Conduit</u>	8-25
8.26.03	<u>Pull Boxes</u>	8-27
8.26.04	<u>Detector Loop Wire Installation</u>	8-27
8.26.05	<u>Conductor and Cable</u>	8-28
8.26.06	<u>Bonding and Grounding</u>	8-29
8.26.07	<u>Maintenance</u>	8-30
8.26.08	<u>Field Testing</u>	8-30
8.27.00	TRAFFIC CONTROL IN CONSTRUCTION AREAS	8-31
8.27.01	<u>General</u>	8-Error! Bookmark not defined.
8.27.02	<u>Time of Submittal</u>	8-31
8.27.03	<u>Scope of Construction Traffic Control Plan</u>	8-32
8.27.04	<u>Elements of Construction Traffic Control Plan</u>	8-32
8.27.05	<u>Basis for Construction Traffic Control Plan</u>	8-32
8.27.06	<u>Restriction, Regulations and Opportunities</u>	8-33
8.27.07	<u>Approval</u>	8-33
8.27.09	<u>Applicability</u>	8-33
8.28.00	TRAFFIC SIGNING AND PAVEMENT MARKINGS	8-34
8.28.01	<u>General</u>	8-34
8.28.02	<u>Traffic Control Devices on Public Property</u>	8-34
8.28.03	<u>Traffic Control Devices on Private Property</u>	8-34
8.28.04	<u>Pavement Markings</u>	8-34
8.30.00	<u>MATERIAL SPECIFICATIONS</u>	8-34
8.31.00	SIGNAL HEADS	8-34
8.31.01	<u>Traffic Signal Unit Specifications</u>	8-34
8.31.02	<u>Pedestrian Signal Units</u>	8-35
8.31.03	<u>Backplates</u>	8-35
8.31.04	<u>Traffic Signal Lamps</u>	8-35
8.32.00	ELECTRICAL CABLE	8-36
8.32.01	<u>Signal Cable</u>	8-36
8.32.02	<u>Interconnect Cable</u>	8-36
8.32.03	<u>Service Cable</u>	8-37
8.32.04	<u>Loop Wire</u>	8-37
8.32.05	<u>Pedestrian Push-Button Cable</u>	8-37
8.32.06	<u>Loop Lead-In Cable</u>	8-37
8.32.07	<u>Ground</u>	8-37
8.32.08	<u>Optical Detector Lead-In Cable</u>	8-37
8.33.00	VEHICLE DETECTORS	8-37
8.33.01	<u>General</u>	8-37
8.34.00	EMERGENCY VEHICLE DETECTORS	8-40
8.35.00	DETECTORS (PEDESTRIAN PUSH-BUTTON)	8-40
8.35.01	<u>General</u>	8-40
8.36.00	TRAFFIC SIGNAL POLES, PEDESTALS AND MAST ARMS	8-40
8.37.00	CONTROLLER CABINET	8-40
8.37.01	<u>General</u>	8-40
8.38.00	ACTUATED CONTROLLERS	8-42
8.38.01	<u>General</u>	8-42

8.38.02	<u>Coordination Unit</u>	8-44
8.38.03	<u>System Telemetry</u>	8-44
8.39.00	ON-STREET MASTER.....	8-45
8.39.01	<u>General</u>	8-45
8.40.00	MISCELLANEOUS HARDWARE.....	8-47
8.40.01	<u>General</u>	8-47
8.41.00	PAINT - SIGNAL POLES.....	8-47
8.41.01	<u>New Structures</u>	8-47
8.41.02	<u>Existing Structures</u>	8-48
8.42.00	INSTRUCTIONS AND WIRING DIAGRAMS.....	8-48
8.43.00	GUARANTEE.....	8-48
8.44.00	SIGN SPECIFICATIONS.....	8-49
8.44.01	<u>Sign Face Materials</u>	8-49
8.44.02	<u>Sign Post Materials</u>	8-49
8.44.03	<u>Fire Lane Sign Specifications</u>	8-49

CHAPTER 8
TRAFFIC CONTROL

8.00.00 **INTRODUCTION**

8.01.00 **GENERAL**

The standards contained in this chapter regulate all improvements and private work to be dedicated to the public and accepted by the City and all work within the public right-of-way. They are intended to provide for adequate, coordinated, modern development with required facilities to serve and protect the potential users of the various areas of the community.

The standards in this chapter apply to new developments which are not constrained by already existing improvements. This chapter is not to be applied without qualification to in-fill development. In-fill development in an urban area is often constrained by existing improvements. To the extent deemed possible by the City, in-fill developments shall be required to conform to these STANDARDS AND SPECIFICATIONS. The City may allow modification of these STANDARDS AND SPECIFICATIONS when necessary to allow private and public construction which is compatible with surrounding in-place improvements.

8.02.00 **GLOSSARY OF TERMS**

AASHTO -- American Association of State Highway and Transportation Officials

Acceleration Lane -- A speed change lane, including tapered areas, for the purpose of enabling a vehicle entering a roadway to increase its speed to a rate at which it can more safely merge with through traffic.

Access -- Driveway or other point of access such as a street, road, or highway that connects to the general street system. Where two public roadways intersect, the secondary roadway shall be the access.

Approach -- The portion of an intersection leg which is used by traffic approaching the intersection.

Average Daily Traffic (ADT) -- The total bi-directional volume of traffic passing through a given point during a given time period, divided by the number of days in that time period.

Band Width -- The time in seconds or the percent of cycle between a pair of parallel lines which delineate progressive movement on a time-space diagram. It is a quantitative measurement of through traffic capacity provided by signal progression.

Capacity -- The maximum number of vehicles that have a reasonable expectation of passing over a given roadway or section of roadway in one direction during a given time period under prevailing roadway and traffic conditions.

Critical Volume -- A volume (or combination of volumes) for a given street which produces the greatest utilization of capacity for that street in terms of passenger cars or mixed vehicles per hour.

Cycle Time -- The time period in seconds required for one complete sequence of signal indications.

Deceleration Lane -- A speed change lane, including tapered areas, for the purpose of enabling a vehicle that is to make an exit turn from a roadway to slow to a safe turning speed after it has left the main stream of faster-moving traffic.

Delay -- Stopped time per approach vehicle in seconds per vehicle.

Design Hour Volume (DHV) -- Hourly traffic volume used for street design and capacity analysis, usually one or more peak hours during a twenty-four (24) hour period.

Design Speed -- Five to ten miles per hour (5-10 mph) above the proposed or desired speed limit of the facility under design.

Design Vehicle -- Developments intended for public use must be designed for the following types of vehicles:

Residential (excluding single-family or duplex)	SU30
Commercial Uses	WB40
Industrial Uses	WB50

For public streets, the following design vehicles must be used:

Commercial/Multi-Family Locals & Minor Collectors	SU30
Major Collectors	WB40
Arterials	WB50

Definitions for the above vehicle types are found in AASHTO Geometric Highway Design Standards.

Divided Highway -- A highway with separated roadways for traffic in opposite directions, such separation being indicated by depressed dividing strips, raised curbs, traffic islands, other physical separations, or by standard pavement markings and other traffic control devices.

Fire Trucks -- Must be considered as a WB40 truck with a minimum forty-five-foot (45') radius for design purposes.

Flowline -- The transition point between the gutter and the face of the curb. For a cross or valley pan, it is the center of the pan.

Grade -- Rate or percent of slope, either ascending or descending from or along the highway. It is usually measured along the centerline of the highway or access.

Green Time -- The length of a green phase plus its change interval, in seconds.

Hourly Volume -- The number of (mixed) vehicles that pass over a given section of a lane or roadway during a time period of one (1) hour.

Level of Service (LOS) -- A measure of the mobility characteristics of an intersection as determined by vehicle delay and a secondary factor, the volume/capacity ratio.

MUTCD -- Manual on Uniform Traffic Control Devices and the Colorado Supplement.

Sight Distance -- The length of roadway ahead visible to the driver. The minimum sight distance available should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

Signal Progression -- Progressive movement of traffic at a planned rate of speed through adjacent signalized locations within a traffic control system without stopping.

Speed Change Lane -- A separate lane for the purpose of enabling a vehicle entering or leaving a roadway to increase (acceleration lane) or decrease (deceleration lane) its speed to a rate at which it can more safely merge or diverge with through traffic.

Stopping Sight Distance -- The distance traveled by the vehicle from the instant the driver of a vehicle sights an object necessitating a stop to the instant the brakes are applied and the distance required to stop the vehicle from the instant brake application begins.

Storage Lane -- Additional lane footage added to a deceleration lane to store the maximum number of vehicles likely to accumulate during a critical period without interfering with the through lanes.

Time Space Diagram -- A chart on which the distance between signals and signal timing is plotted against time. The chart, when completed, indicates signal progression band widths and speed of traffic.

8.10.00

DESIGN STANDARDS

8.10.01 Responsibilities for Traffic Studies

Traffic studies may be required by the City in order to adequately assess the impacts of a development proposal on the existing and/or planned street system. The primary responsibility for assessing the traffic impacts associated with a proposed development shall rest with the developer, with the City serving in a review capacity.

Unless waived by the Public Works Director/City Transportation Engineer, a written study meeting the criteria contained in this chapter shall be required for a development proposal when trip generation during the AM or PM peak hour is expected to exceed one hundred (100) vehicles, as determined by the City Transportation Engineer. This study shall be the responsibility of the applicant and shall be prepared by a Professional Engineer registered in the State of Colorado, with adequate experience in transportation engineering. Upon submission of a draft traffic study, the Public Works Director/City Transportation Engineer will review the study data sources, methods, and findings. Comments shall be provided in a written form. The developer and the project engineer will then have an opportunity to incorporate necessary revisions prior to submitting a final report. All studies shall be approved by the Public Works Director/City Transportation Engineer before acceptance. The following submittals will require traffic studies:

- (A) A rezoning application or an application for annexation into the City.
- (B) A preliminary map or final plat if the property has already been rezoned for the proposed use and no traffic study was required for the rezoning, or the land use assumptions at the time of platting will result in trip generation increasing by more than fifteen percent (15%) compared to trip generation estimates made for the traffic study at the time of rezoning.

- (C) Prior to issuance of a building permit, if the property has already been zoned/platted and no previous traffic study less than two (2) years old exists.
- (D) The applicant shall be required to submit a new traffic study if, after submitting the original traffic study for any of the above submittals, the land use intensity is increased by more than fifteen percent (15%), or the land use is changed so that trip generation is increased by more than fifteen percent (15%).

All previous traffic studies relating to the development that are more than two (2) years old shall be updated, unless the Public Works Director/City Transportation Engineer determines that conditions have not changed significantly. Where access points are not defined or a site plan is not available at the time the traffic study is prepared, additional traffic analysis may be required when a site plan becomes available or the access points are defined.

The applicant will be notified at the pre-planning stage if a traffic study will be required, provided sufficient information is available for the City to determine whether the trip generation criterion has been met. If insufficient information is available but the property appears to involve a sufficiently intense land use, the applicant will be informed that a traffic study is required.

Transportation consultants are required to discuss projects with the Public Works Director/City Transportation Engineer prior to starting the study. As a minimum, topics for possible discussion at such meeting shall include trip generation, directional distribution of traffic, trip assignment, definition of the study area, intersections requiring capacity/level of service analysis, and methods for projecting build-out volume. This will provide a firm base of cooperation and communication between the City, the owner or developer, and the project's consultants in forecasting future traffic characteristics which realistically define traffic movement associated with the proposed development. Specific requirements will vary depending on the site location.

8.10.02 Traffic Study Format

In order to provide consistency and to facilitate staff review of traffic studies, the following format shall be followed in the preparation of such studies by transportation consultants.

- (A) Introduction:

The introduction portion of the report must contain the following:

1. A note stating the following: "We acknowledge that the City of Fort Lupton's review of this study is only for general conformance with submittal requirements, current design criteria and standard engineering principles and practices. WE are also aware of the provisions of section 11-6-5(B)3 of the City Code of the City of Fort Lupton.
2. A brief description of the size of the land parcel, general terrain features, the location within the jurisdiction and the region shall be included in this section. In addition, the roadways that afford access to the site and are included in the study area shall be identified. The exact limits of the study area should be based on engineering judgment and an understanding of existing traffic conditions surrounding the site. In all instances, however, the study area limits shall be mutually agreed upon by the developer, his engineer, and the Public Works Director/City Transportation Engineer. A vicinity map that shows the site and

the study area boundaries in relation to the surrounding transportation system shall be included.

3. The existing and proposed uses of the site shall be identified in terms of the various zoning categories of the City. In addition, the specific use for which the request is being made shall be identified, if known, since a number of uses may be permitted under the existing ordinances. It shall be the intent of the traffic study to evaluate the worst case traffic impacts for the proposed development allowed by the zoning. If several different uses are permitted by the zoning, the highest trip generation shall be assumed for the study.
4. A complete description (including a map) of the existing land uses in the study area, as well as their current zoning and use, shall be included. In addition, all vacant land within the study area and its assumed future uses shall be identified. This latter item is especially important where large tracts of undeveloped land are in the vicinity of the site and within the prescribed study area. Generally, much of this information can be obtained from the City's Planning Division staff.
5. Within the study area, the applicant shall describe and provide volumes for existing roadways and intersections, including geometrics and traffic signal control, as well as improvements contemplated by all affected government agencies. This would include the nature of the improvement project, its extent, implementation schedule, and the agency or funding source responsible. A map shall be provided showing the location of such facilities.

(B) Trip Generation and Design Hour Volumes:

A summary table listing each type of land use, the size involved, the average trip generation rates used (total daily traffic and a.m./p.m. peaks) and the resultant total trips generated shall be provided. Trip generation shall be calculated for the maximum uses allowed under the existing and proposed zoning based on the latest data contained within the Institute of Transportation Engineers (ITE) Trip Generation Manual; or other applicable sources. In the event that data is not available for the proposed land use, the City must approve estimated rates prior to acceptance. The calculation of design hour volumes used to determine study area impacts shall be based on:

1. Peak hour trip generation rates as published in the ITE Trip Generation Summary or other applicable sources.
2. Traffic volume counts for similar existing uses if no published rates are available.
3. Additional sources from other jurisdictions, if acceptable to the City Transportation Engineer.

Use of reduction factors to account for passerby traffic may be considered upon approval of the Public Works Director/City Transportation Engineer. Internal trip reductions and modal split assumptions will require analytical support to demonstrate how the figures were derived and will require approval by the Public Works Director/City Transportation Engineer.

(C) Trip Distribution:

The estimates of percentage distribution of trips from the proposed development to destinations in the metro region shall be clearly stated in the report using the north, south, east, and west compass points. Market studies and information concerning origin of trip attractions to the proposed development may be used to support these assumptions where available. A map showing the percentage of site traffic on each street shall be provided as part of the traffic study graphic material.

(D) Trip Assignment:

The direction of approach of site-generated traffic via the area's street system shall be presented in this section. The technical analysis steps, basic methods, and assumptions used in this work shall be clearly stated and agreed to by the Public Works Director/City Transportation Engineer. The assumed trip distribution and assignment shall represent the most logically traveled routes for drivers accessing the proposed development. These routes can be determined by observation of travel patterns to existing land uses in the study area.

(E) Existing and Project Traffic Volumes:

Graphics shall be provided which show the following traffic impacts for private access points, public intersections, and public streets.

1. A.M. peak-hour site traffic (in and out), including turning movements.
2. P.M. peak-hour site traffic (in and out), including turning movements.
3. A.M. peak-hour total traffic (in and out), including site-generated traffic. These volumes must include through and turning movement volumes for current conditions and separate set of numbers that also include twenty (20) year projections or build-out, whichever is specified by the Public Works Director/City Transportation Engineer.
4. P.M. peak-hour total traffic (in and out), including site-generated traffic. These volumes shall include through and turning movement volumes for current conditions and a separate set of numbers that also include twenty (20) year projections or build-out, whichever is specified by the Public Works Director/City Transportation Engineer.
5. Any other peak hour which may be critical to site traffic and the street system in the study area should be included in the graphics and show the same information as is provided for the a.m./p.m. peak hours.
6. Actual counts of existing total daily traffic for the street system in the study area at the time the study is being prepared.
7. Projected total daily traffic for the street system in the study area based on traffic from the proposed development and counts of existing daily traffic obtained in Item 6 above. The component of the existing daily traffic attributable to the

existing uses shall be identified and the increase in total daily traffic from the proposed uses.

8. Projected total daily traffic for the street system in the study area based on traffic from the proposed development, counts of existing daily traffic obtained in Item 6 above, traffic projections based on build-out of land use within the study area, or a twenty (20) year projection, whichever is specified by the Public Works Director/City Transportation Engineer.

All raw traffic count data, including average daily volumes and peak-hour turning movements, and analysis worksheets shall be provided in the appendices of the report. Computer techniques and the associated printouts may be used as part of the report. Volume projections for background traffic growth will be provided by the Public Works Director/City Transportation Engineer or, alternatively, a method for determining these volumes will be recommended by the City Transportation Engineer. All total daily traffic counts shall be actual machine counts and not based on factored peak-hour sampling. Latest available machine counts from the Colorado Department of Transportation, the City, and other agencies may be acceptable if not more than two (2) years old.

(F) Level of Service:

Level of Service "C" shall be the design objective for all movements, and under no circumstances will less than level of Service "D" be accepted for site and non-site traffic, including existing traffic at build-out of the study area. The design year will be approximately twenty (20) years following construction and include volumes generated by build-out of the study area or a twenty (20) year projection in background traffic, whichever is specified by the Public Works Director/City Transportation Engineer. The following interpretations of "Level of Service" have been provided:

Level of Service A. A condition of free flow with low-traffic density where no vehicle waits longer than one (1) signal cycle.

Level of Service B. A stable flow of traffic where only on a rare occasion do drivers wait through more than one (1) signal cycle.

Level of Service C. Still in the zone of stable flow but intermittently, drivers must wait through more than one (1) signal cycle and back-ups may develop behind left-turning vehicles.

Level of Service D. Approaching instability, drivers are restricted in their freedom to change lanes and delays for approaching vehicles may be substantial during peak hours.

Level of Service E. Traffic volumes are near or at the capacity of the arterial and long queues of vehicles may create lengthy delays, especially for left-turning vehicles.

Level of Service F. Congested condition of forced traffic flow where queued back-ups from locations downstream restrict or prevent movement of vehicles out of the approach creating a storage area during part or all of the peak hour.

(G) Capacity Analysis:

A capacity analysis shall be conducted for all public street intersections impacted by the proposed development and for all private property access points to streets adjacent to the proposed development and within the limits of the previously defined study area. The a.m., p.m., and any other possible peak period shall be tested to determine which peak hours need to be analyzed. Capacity calculations should also include an analysis for the twenty- (20) year projections or study area build-out conditions. The capacity analysis calculations should be based on the latest approved techniques as published in the latest update of TRB Special Report 209. All capacity analysis worksheets shall be included in the appendices of the report.

(H) Traffic Signals:

The need for new traffic signals shall be based on warrants contained in the Manual on Uniform Traffic Control Devices and any additional warrants established by the National Committee on Uniform Traffic Control Devices. In determining the location of a new signal, traffic progression is important. Generally, a spacing of one-half (1/2) mile for all signalized intersections should be maintained. This spacing is desirable to achieve good speed, capacity, and optimum signal progression. Pedestrian movements shall be considered in the evaluation and adequate pedestrian clearance provided in the signal cycle split assumptions.

To provide flexibility for existing conditions and ensure optimum two-way signal progression, an approved traffic engineering analysis shall be made to properly locate all proposed accesses that may require signalization. The section of roadway to be analyzed for signal progression will be determined by the City and will include all existing and possible future signalized intersections.

The progression pattern calculations shall use a cycle consistent with current signal-timing policies of the City. A desirable band width of fifty percent (50%) of the signal cycle shall be used where existing conditions allow. Where intersections have no signals presently but are expected to have signals, typically a sixty percent (60%) mainline, forty percent (40%) cross-street cycle split should be assumed. Cycle split assumptions shall relate to volume assumptions in the capacity analysis of individual intersections, and where computerized progression analysis techniques are used they shall be the type which utilize turning-movement volume data and pedestrian clearance times in the development of time/space diagrams. The green time allocated to the cross street shall be considered no less than the time which is required for a pedestrian to clear the main street using the Manual on Uniform Traffic Control Devices standards. Those intersections which would reduce the optimum band width if a traffic signal were installed may be required by the City to remain unsignalized and have turning movements limited by access design or median islands.

(I) Traffic Accidents:

Traffic accident data for affected street corridors may be required for the study. The study period will normally be three (3) years. Such locations will be specified by the Public Works Director/City Transportation Engineer. Where this is necessary, estimates of increased or decreased accident potential shall be evaluated for the development,

particularly if the proposed development might impact existing traffic safety problems in the study area, and safety improvements recommended where necessary.

(J) Noise Attenuation:

If a residential development is planned adjacent to a freeway or arterial roadway, the need for noise attenuation measures may be required as part of the impact analysis. It is recommended that the need for noise attenuation measures be determined using the methods outlined in Fundamentals and Abatement of Highway Traffic Noise Textbook, FHWA, September 1980.

(K) Recommendations:

In the event that analysis indicates unsatisfactory levels of service on study area roadways, a description of proposed improvements to remedy deficiencies shall be included. These proposals would include projects by the City or the Colorado Department of Transportation for which funds have been appropriated and obligated. The assumptions regarding all future roads and laneages in an analysis will require approval from the Public Works Director/City Transportation Engineer. In general, the recommendation section should include:

1. Proposed Recommended Improvements. This section must describe the location, nature, and extent of proposed improvements to assure sufficient roadway capacity. A sketch of each improvement should be provided showing the length, width, and other pertinent geometric features of the proposed improvements.
2. Level of Service Capacity Analysis at Critical Points. Another iteration of the operational analysis shall be described which demonstrates the anticipated level of service as a result of making these improvements. This level of service must be "D" or better.
3. Traffic Volume Proportions. Percentages based on the traffic impact analysis may be required by the City to determine the proportion of traffic using various public improvements (both existing and proposed) from several developments within the study area.

(L) Conclusions:

This last section of the report must be a clear, concise description of the study findings explained in a manner that a citizen could understand as the language in this section will be inserted into the Planning Commission and City Council agenda memorandums. At minimum, the summary will include information pertaining to existing site generated traffic, impacts and mitigation measures and when they will be implemented.

(M) Revisions to Traffic Study:

Revisions to the traffic study shall be provided as required by the Public Works Director/City Transportation Engineer. The need to require revisions will be based on the completeness of the traffic study, the thoroughness of the impact evaluation, and the compatibility of the study with the proposed access and development plan.

8.10.03 Summary of Typical Study Contents

- (A) Introduction:
 - 1. Land Use, Site, and Study Area Boundaries (provide map)
 - 2. Existing and Proposed Site Uses
 - 3. Existing and Proposed Uses in Vicinity of Site (provide map)
 - 4. Existing and Proposed Roadway and Intersections (provide map)
- (B) Trip Generation and Design Hour Volumes (provide table)
- (C) Trip Distribution (provide figure)
- (D) Trip Assignment (provide figure)
- (E) Existing and Projected Traffic Volumes (provide figure for each item):
 - 1. A.M. Peak Hour Site Traffic (including turning movements)
 - 2. P.M. Peak Hour Site Traffic (including turning movements)
 - 3. A.M. Peak Hour Total Traffic (including site-generated traffic and projected traffic)
 - 4. P.M. Peak Hour Total Traffic (including site-generated traffic and projected traffic)
 - 5. Any Other Peak Hour Necessary for Complete Analysis
 - 6. Total Daily Existing Traffic for Street System in Study Area
 - 7. Total Daily Existing Traffic for Street System in Study Area and New Site Traffic
 - 8. Total Daily Existing Traffic for Street System in Study Area plus New Site Traffic and Projected Traffic from Build-Out of Study Area Land Uses
- (F) Level of Service
- (G) Capacity Analysis (provide analysis sheets in appendices)
- (H) Traffic Signals (provide analysis sheets in appendices)
- (I) Traffic Accidents (optional) (provide collision diagrams and accident rates)
- (J) Noise Attenuation
- (K) Conclusions

(L) Recommendations:

1. Proposed Recommended Improvements (provide sketches of improvements)
2. Volume/Capacity Analysis at Critical Points (provide analysis sheets in appendices)
3. Traffic Volume Proportions

NOTE: Information required on figures may be combined provided that the information is clearly legible.

8.11.00 ACCESS REQUIREMENTS AND CRITERIA

8.11.01 General

New access to City streets and roadways is approved through one of the two mechanisms:

- For new developments, access is granted through City Council approval of the Preliminary Development Plan; or
 - To obtain access to City streets from existing developed property, the mechanism is dependent upon zoning.
- (A) For Planned Unit Developments, new or altered access shall be obtained through the City Preliminary or Official Development Plan amendment process. This involves applying through the Planning Division for an amendment to the appropriate development plan. The application should be accompanied by appropriate plans for the proposed access and technical justification, including justification for the extent of the improvements proposed at the access point.
- (B) For property classified as a standard zoning district (other than Planned Unit Development), the application should be made to the Planning Division and accompanied by plans of the proposed access and technical justification for the access and associated public improvements.

The Community Development Staff is available to provide advice on the extent of technical justification required for any access request. It is recommended that this advice be sought prior to submitting any application.

8.11.02 State Highways

- (A) Access to state highways is governed by the State Highway Access Code.
- (B) The City of Fort Lupton has delegated its authority to administer the State Highway Access Code to the Colorado Department of Transportation who is, therefore, responsible for the review of issuance of access permits to State Highways in the City of Fort Lupton.

8.11.03 Principal Arterials

- (A) A publicway permit shall be obtained from the Public Works Director/City Engineering Division for any public or private access constructed on a major arterial.
- (B) Private, direct access to major arterials shall be permitted only:
 - When the property in question has no other reasonable access to the general street system; or
 - When denial of direct access to the major arterial and alternative direct access to another roadway would cause unacceptable traffic operation and safety problems to the overall traffic flow of the general street system.

When direct private access must be provided, the following shall be considered:

- 1. Such access shall continue only until such time that some other reasonable access to a lower function category street is available and permitted. The publicway permit should specify the future reasonable access location(s), if known, and under what circumstances what changes will be required.
 - 2. No more than one (1) access shall be provided to an individual parcel or to contiguous parcels under the same ownership unless it can be shown that allowing only one access conflicts with safety regulations (i.e.; fire access) or if additional access would significantly benefit safety and operation of the highway and is necessary to the safe and efficient use of the property.
 - 3. An access shall be limited to right turns only unless it has the potential for signalization, left turns would not create unreasonable congestion or safety problems and lower the level of service, or if alternatives to the left turns would not cause unacceptable traffic operation and safety problems to the general street system.
- (C) Public direct access to a major arterial where left turns are to be permitted shall meet the signal-spacing criteria under Section 8.11.03 of this chapter. Those that do not meet these requirements shall be limited to right turns only, unless they meet the requirements mentioned in Section 8.10.02 above. No local streets shall be permitted to intersect major arterials.
 - (D) Spacing and Signalization:
 - 1. In general terms, full access to major arterials shall be limited to one-half (1/2) mile intervals, plus or minus approximately two hundred feet (200'), in order to achieve good speed, capacity, and optional signal progression.
 - 2. To provide flexibility for both existing and future conditions, an approved engineering analysis of signal progression shall be made to properly locate any proposed access that may require signalization.

8.11.04 Minor Arterials

- (A) A publicway permit shall be obtained from the Public Works Director/City Engineering Division for any public or private access constructed to a minor arterial.

- (B) Private direct access onto a minor arterial will be permitted if it does not have the potential for signalization; if it does have the potential for signalization; and it meets the signal-spacing requirements for intersecting public streets stated below and does not interfere with the location, planning, and operation of the general street system and access to nearby properties.
- (C) Public direct access to a minor arterial where left turns are to be permitted shall meet the following signal-spacing criteria. Those that do not meet these requirements shall be limited to right turns only, unless they meet the requirements of Section 8.11.02(B) above. No local streets shall be permitted to intersect minor arterials.
- (D) Spacing and Signalization:
 - 1. In general terms, full access to minor arterials shall be limited to one-half (1/2) mile intervals, plus or minus approximately one hundred feet (100'), in order to achieve good speed, capacity, and optional signal progression.
 - 2. To provide flexibility for both existing and future conditions, an approved engineering analysis of signal progression shall be made to properly locate any proposed access that may require signalization.

8.11.05 Major and Minor Collectors

- (A) Private access to collectors shall be governed by the following curb opening and driveway criteria. Single-family residence access to collectors is not permitted.
- (B) Public streets shall intersect collectors not closer than three hundred and thirty feet (330') from each other (centerline to centerline).

8.11.06 Local Streets

- (A) Private access to local streets shall be governed by the following curb opening and driveway criteria.
- (B) Public streets should not intersect local roadways closer than one hundred and fifty feet (150') from each other (centerline to centerline).

8.11.07 Basic Principles for Curb Openings and Driveways

- (A) Certain control values for curb openings and driveways require minimum dimensions in some instances and maximum values for other dimensions. The design of curb openings and driveways within the range of these dimensions will provide for good service on the part of the motorist using the driveway while at the same time minimizing the interference to the traffic using the street. By controlling the location and width of openings of driveways along the street, it will be possible to avoid or eliminate long, open stretches where motorists can indiscriminately drive onto the street. The width of opening established in these STANDARDS AND SPECIFICATIONS are based on studies which indicate that the various width openings will accommodate vehicles of maximum size authorized on City streets.

- (B) The opening or driveway width should be adequate to handle properly the anticipated traffic volume and character of traffic, as well as being within the limits specified for the type of property development. The controls established for curb openings and driveways shall apply to existing streets as well as new streets that may be developed in the future.
- (C) To the greatest extent possible, all openings for driveways shall be located at the point of optimum sight distance along the street. For openings and driveways to commercial establishments and service stations, there shall be sufficient space reasonably cleared of any obstructions such that drivers entering the property will have sufficient sight distance to enable them to make proper and safe movements. The profile of a driveway approach and the grading of the adjacent area shall be such that when a vehicle is located on the driveway outside the traveled portion of street the driver can see a sufficient distance in both directions to enable him to enter the street without creating a hazardous traffic situation.
- (D) Any adjustments which must be made to utility poles, street light standards, fire hydrants, catch basins or intakes, traffic signs and signals, or other public improvements or installations which are necessary as the result of the curb openings or driveways shall be accomplished without any cost to the City of Fort Lupton. Also, any curb opening or driveway which has been abandoned shall be restored by the property owner except where such abandonment has been made at the request of or for the convenience of the City.
- (E) Driveway approaches, whereby the driveway is to serve as an entrance only or as an exit only, shall be appropriately signed by and at the expense of the property owner. The property owner will be required to provide some means of ensuring that the motorists will use the driveway either as an entrance only or an exit only, but not both.

8.11.08 Definition of Terms

Several terms are used herein which have a somewhat distinct meaning. For the purpose of clarity, the definition of some of these terms are listed below:

- (A) Width of Curb Opening (W) -- The width of curb opening measured at the curb line.
- (B) Edge Clearance (E) -- The distance measured along curb line from the nearest edge of the curb opening to a point where the property line extended intersects the curb line.
- (C) Corner Clearance (C) -- At an intersecting street, the distance measured along the curb line from the projection of the intersection street right-of-way line to the nearest edge of the curb opening.
- (D) Distance Between Double Drives (D) -- The distance measured along the curb line between the inside edges of two adjacent curb openings.
- (E) Setback (S) -- The lateral distance measured perpendicular to the street right-of-way line and extending from the right-of-way line to the closest point on a structure.
- (F) Frontage -- The distance along the street right-of-way line of a single property or development within the property lines. Corner property at an intersection would have a separate frontage along each street.

- (G) Residential -- Property used primarily for residential purposes such as single-family, two-family, and multi-family units.
 - Single-Family (SF) Residential: Single, detached family dwelling units, double bungalows, or duplexes.
 - Multi-Family (MF) Residential: Three or more attached dwelling units including townhouses, condominiums, and apartments.
- (H) Commercial -- Establishments where the buying and selling of commodities, entertainment, or services is carried on, excluding service stations. Included are such uses as office buildings, restaurants, hotels, motels, banks, grocery stores, theaters, parking lots, trailer courts, and public buildings.
- (I) Service Station -- Any property where flammable liquids such as motor vehicle fuel are used, stored, and/or dispensed from fixed equipment into fuel tanks of motor vehicles.
- (J) Industrial or Warehouse -- Any establishment that manufactures or stores an article or product.

8.11.09 General Requirements

- (A) Number of Openings:
 1. Single-Family Residential. In general, each single-family residential property shall be limited to one (1) access point.
 2. Multi-Family Residential. In general, access shall be determined by information provided by the owner/developer in the traffic impact study and by comments generated during the Public Works Director/City Transportation Engineer's review and acceptance of that study.
 3. Commercial. In general, commercial property having less than one hundred and fifty feet (150') of frontage and located mid-block shall be limited to one (1) access point to the street. An exception to this rule may be where a building is constructed in the middle of a lot and parking is provided for on each side of the building. A second access point may be allowed for commercial property having more than one hundred fifty feet (150') of frontage. For commercial property located on a corner, one (1) access to each street may be permitted.
 4. Service Stations. Where there is sufficient frontage to provide for minimum and maximum requirements, two (2) access points to a street may be permitted.
 5. Industrial. Access shall be determined on a case-by-case basis. The City shall consider good traffic engineering practice and the information provided by the applicant in the traffic impact study accompanying the submittal.
- (B) Amount of Curb Opening Permitted:

The total length of curb opening on a street for access to a commercial property or service station shall not exceed thirty-five feet (35'). This requirement does not apply to residential-type curb openings.

(C) Entrance Angle:

In general, the entrance angle for all driveway approaches shall be as near ninety degrees (90°) to the centerline of the street as possible. The minimum angle which will be permitted is sixty degrees (60°).

(D) Minimum Space Between Openings:

The minimum spacing between curb openings shall be thirty-five feet (35') measured at the curb line. This spacing shall apply to double drives that serve a single property, as well as the distance between drives serving adjoining properties. A fifty-foot (50') spacing applies to commercial openings.

(E) Joint Entrances:

Whenever possible and feasible, joint entrances shall be provided to serve two adjacent properties. Joint entrances are to be centered on the common property line.

8.11.10 Control Dimensions

To accomplish the objectives of the basic principles stated earlier, certain control dimensions are necessary. There are many variables which affect these control dimensions. Some of the variables are as follows: type of street classification, type of private property development, volume and type of traffic, and width of right-of-way.

(A) Width of Curb Opening (W):

The total width of curb opening for properties on various function street classifications shall be in conformance with the detail drawings in Chapter 5 of these STANDARDS AND SPECIFICATIONS.

(B) Curb openings of thirty-five feet (35') or more shall be constructed as radius curb returns.

1. Residential. No edge clearance is required for residential access. However, the drive shall not extend beyond the property line extended.

2. Commercial.

Access onto an Arterial -- 75 Feet Minimum
Access onto a Local -- 75 Feet Minimum

NOTE: Joint access with adjoining property is encouraged. Joint access shall be the only justification for reducing the minimum edge clearance dimension.

3. Service Stations.

Access onto an Arterial -- 5 Feet Minimum
Access onto a Local -- 5 Feet Minimum

(C) Corner Clearance:

It is important to locate driveways away from major intersections. This constraint is as much for the ability to enter and leave the property as for the benefit of intersection safety and operations. Exiting a driveway during peak-hour conditions at traffic signals is difficult where the queue of standing or slow-moving vehicles never allows a sufficient gap for entry from the driveway. Corner clearness shall be in accordance with the Urban System Transportation Manual, Figure 7-12.

(D) Sight Distance:

Sight distance for curb openings to private property shall be in accordance with Chapter 5 of these STANDARDS AND SPECIFICATIONS.

8.12.00

STREET LIGHTING

8.12.01 Street Lighting Procedure

The developer shall submit a written request for street light design to Public Service Company of Colorado (P.S.CO). The Public Works Director/City Transportation Engineer will request, in writing, designs from Public Service Company. Public Service Company will submit the final design and cost estimates to the Public Works Director/City Transportation Engineer for review and approval. Developer will pay P.S.CO the total costs of installation for all street lighting within the prescribed time period. Developer will be responsible for street lighting within the development as well as on side streets surrounding the development site.

Street lighting in residential areas shall be post-top luminaires of the modern style, 100-watt high-pressure sodium on vertical, fiberglass poles, as shown in the detail drawings. Any other post-top luminaire style shall have written approval of the Public Works Director/City Transportation Engineer prior to installation. In areas other than residential, street lighting shall be steel standards of either the steel davit or mast arm variety, as shown on the detail drawing.

8.12.02 Spacing and Illumination

The spacing and illumination which shall be used is contained in the following Table 8.12.02:

TABLE 8.12.02

<u>Street Type</u>	<u>Foot Candles</u>	Average <u>Lamp Lumens</u>	<u>Pole Spacing</u>
Local Residential	0.15	9,500	250 Feet ±
Business & Residential Collector	0.25	9,500-27,500	250 Feet ±
Arterial	0.59	27,500	250 Feet ±

8.13.00 PARKING

8.13.01 Regular Parking

Conventional parking layout dimensions are provided in Table 8.13.01 and the detail drawings in the Appendix. Other angled parking layouts meeting the approval of the Public Works Director/City Engineer will be permitted where possible.

TABLE 8.13.01

Minimum Parking Layout Dimensions (In Feet) for 9-Foot Regular Parking Stalls at Various Angles

<u>Dimension</u>	<u>On Diagram</u>	<u>Angle</u>				
		<u>0</u>	<u>45</u>	<u>60</u>	<u>75</u>	<u>90</u>
Stall Width, Parallel to Aisle	A	9.0	12.7	10.4	9.3	9.0
Stall Length of Line	B	24.0	24.5	21.5	19.5	18.0
Stall Depth to Wall	C	9.0	17.0	18.5	19.0	18.0
Aisle Width Between Stall Lines	D	12.0	12.0	16.0	22.0	24.0
Stall Depth, Interlock	E	9.0	14.8	17.0	18.3	18.0
Module, Wall to Interlock	F	30.0	43.8	51.5	59.3	60.0
Module, Interlocking	G	30.0	41.6	50.0	58.6	60.0
Module, Interlock to Curb Face	H	30.0	41.8	49.4	56.9	58.0
Bumper Overhang (Typical)	I	0.0	1.5	1.8	2.0	2.0
Offset	J	--	6.3	2.7	0.5	0.0
Setback	K	24.0	11.0	8.3	5.0	0.0
Cross Aisle, One-Way	L	18.0	18.0	18.0	18.0	18.0
Cross Aisle, Two-Way	-	24.0	24.0	24.0	24.0	24.0

8.13.02 Compact Parking

Stall Layout. For ninety-degree (90°) compact parking, the minimum stall width shall be eight feet (8') and the minimum stall length at least sixteen feet (16'). Layout dimensions are provided in Table 8.13.02 and the detail drawing in the Appendix. There will be no provision for bumper overhang for compact parking.

TABLE 8.13.02
Minimum Parking Layout Dimensions (In Feet) for 8-Foot Regular Parking Stalls
at Various Angles

<u>Dimension</u>	<u>On Diagram</u>	<u>Angle</u>				
		<u>0</u>	<u>45</u>	<u>60</u>	<u>75</u>	<u>90</u>
Stall Width, Parallel to Aisle	A	8.0	11.3	9.2	8.3	8.0
Stall Length of Line	B	22.0	24.0	20.5	18.2	16.0
Stall Depth to Wall	C	8.0	17.0	17.8	17.6	16.0
Aisle Width Between Stall Lines	D	12.0	12.0	16.0	22.0	24.0
Stall Depth, Interlock	E	8.0	11.7	14.3	16.0	16.0
Module, Wall to Interlock	F	28.0	43.2	48.1	53.3	56.0
Module, Interlocking	G	28.0	35.4	44.6	54.0	56.0
Module, Interlock to Curb Face	H	28.0	43.2	48.1	53.3	56.0
Bumper Overhang (Typical)	I	0.0	0.0	0.0	0.0	0.0
Offset	J	0.0	5.7	2.3	0.6	0.0
Setback	K	22.0	11.3	8.0	4.1	0.0
Cross Aisle, One-Way	L	18.0	18.0	18.0	18.0	18.0
Cross Aisle, Two-Way	-	24.0	24.0	24.0	24.0	24.0

8.13.03 Signing

Compact parking spaces shall be designated as being for the exclusive use of compact cars with a raised identification sign. The sign for compact car stalls must comply with the following:

- (A) The legend shall read "Compact Cars Only."
- (B) The minimum size of the sign shall be twelve inches by eighteen inches (12" x 18").
- (C) Height of the sign must be a minimum of seven feet (7'). A height of four feet (4') will be permitted in non-pedestrian areas.
- (D) Signs shall be reflectorized.

8.13.04 Maximum Allowable Grades Permitted in Parking Lots

Maximum grades permitted in parking lots must not exceed eight percent (8%).

8.13.05 Handicapped Parking Posting

Each handicapped parking stall should be between twelve feet (12') and fourteen feet (14') in width, must have a stall depth of at least eighteen feet (18'), and be located near buildings and handicap ramps. A handicapped parking space will be required to be identified by an official "Handicapped Reserve Parking" (Manual on Uniform Traffic Control Devices, R7-8) sign with the handicapped person logo.

In order for handicapped parking spaces to function as intended, they will be required to be designed and signed in a uniform manner to allow for a clear understanding of the parking zone and to make enforcement possible. Signing of one, two, or three spaces for handicapped parking spaces must be done by using one sign for each space placed at the center of each end line.

8.13.06 Parking Structures

For design details and optimum layout of parking structures, reference to Parking Garage Planning and Operation, by the Eno Foundation for Transportation, Inc., Westport, 1978, or the Urban Land Institute Standards is recommended. The City will evaluate designs for such structures on an individual case basis.

8.20.00 **CONSTRUCTION STANDARDS**

8.21.00 **TRAFFIC SIGNALS**

8.21.01 **General Requirements**

The work specified in this section describes the installation of necessary material and equipment to complete traffic signals and/or other electrical systems as specified on the drawings, in the special contract provisions, or herein.

8.21.02 **Traffic Control and Street Closure**

The contractor will be required to maintain access to all private drives throughout the period of construction for this project. The contractor shall be required to erect and maintain all barricades, traffic control signs, cones, and other traffic control items necessary to provide proper traffic control during construction. The contractor shall submit three (3) copies of the traffic control plan to the Public Works Director/City Transportation Engineer for approval 72 hours prior to beginning construction. At the completion of the project the contractor shall remove all barricades, traffic control signs, cones and other necessary construction traffic control items and return all areas or permanent traffic control devices damaged during construction to their original condition at no cost to the City. Traffic control signs and devices shall be in accordance with Part VI of the "Manual on Uniform Traffic Control Devices for Streets and Highways", 1988 Edition, Revision 3 dated September 3, 1993, published by the Federal Highway Administration, and as directed by the Engineer.

8.21.03 **Testing**

The City may at its option and cost retain the services of an independent testing lab to perform all testing consultation and to assist in the review of the work and equipment.

8.21.04 **Intersection Power**

The contractor shall notify the Public Works Director/engineer two (2) weeks prior to the signal turn-on so that orders may be issued for power connection to the intersection on the specified turn-on date.

8.21.05 **Equipment Salvage**

All traffic signal equipment which is removed shall remain the property of the City. Such property is to be removed from the work site and returned by the contractor to the City of Fort Lupton Municipal Service Center located at 800 12th St/.

8.21.06 Existing Traffic Signals

When existing traffic signal installations are modified or completely rebuilt, the contractor shall avoid disturbing existing traffic signal equipment until the new or modified traffic signal system has been installed and put into operation. If the existing traffic signal equipment must be removed to accommodate the new construction, the contractor shall, with the engineer's approval and at the contractor's sole expense, install temporary overhead traffic signal equipment. The contractor shall at all times maintain a minimum of two (2) three-section (red, yellow, and green) traffic signal heads for each roadway approach.

8.21.07 Signal Heads

Signal heads installed on standards or poles at new signal locations which are not ready for actual electrical operation shall be bagged.

8.21.08 Field Location

All loops, poles, control cabinets, pull box locations, and pole foundations shall be field located by the engineer. Traffic signal poles and mast arms shall not be ordered until field verification of pole foundations is complete.

8.21.09 Utilities

All utilities shall be shown on the maps to the extent that they can, based upon utility records, surface field indications and proposed installations. During the progress of the work, all utility locations and elevations will necessarily require field verification in cooperation with the affected companies and public agencies. The contractor shall be responsible for locating all valve boxes, manholes, etc., and insuring that they are properly protected and/or adjusted.

8.21.10 Notification of Work

The contractor shall work only on weekdays between the hours of 8:30 a.m. and 4:00 p.m. The contractor must receive written approval from the engineer to work at any other time.

8.22.00 REGULATIONS AND CODE

All electrical equipment and material shall conform to the standards of the National Electrical Manufacturers Association (NEMA), U.S. West Communications Company or the Colorado State Highway Department, whichever is applicable. In addition to requirements of these specifications, the plans, the special contract provisions, all material, and work shall conform to the requirements of the National Electrical Code (hereinafter referred to as the "Code"), the Rules for Overhead Electrical Line Construction of the Public Utilities Commission, the Standards of the American Society for Testing Materials (ASTM), the American Standards Association (ASA), and any local ordinance which may apply. Wherever reference is made in these specifications or in the special contract provisions to the code, rules, or the standards mentioned above, the reference shall be construed to mean the code, rule, or standard that is in effect at the date of bidding.

8.23.00 EQUIPMENT LIST AND DRAWINGS

The contractor shall submit a list of equipment and material which he proposes to furnish within five days of the execution of the owner-contractor agreement. The submittal shall include all equipment and material as identified on the plans or in the specifications by the manufacturer's name which is necessary or customary in the trade to identify such equipment and material. The list shall be complete as to name of manufacturer, unit size, material composition and shall be supplemented by such other data as may be required by the Public Works Director/City Transportation Engineer.

Inspection or sampling of any materials, other than those already approved, according to the material specifications must be made by the engineer or his designee prior to installation. If the contractor proposes a substitution of equipment called for in the plans or specifications, he shall provide additional information to prove the substitution item is of equal or superior quality. Any material and/or equipment installed by the contractor that is not in conformance with the City of Fort Lupton specifications will be removed or changed at the contractor's expense. Upon completion of the work, the contractor shall submit an "as-built" or corrected plan showing, in detail, all construction changes including, but not limited to, wiring, cable, and location and depth of conduit.

8.24.00 EXCAVATING AND BACKFILLING

Excavations for the installation of conduit, foundations, and other traffic signal items shall be performed in such a manner as to cause the least possible injury to the streets, sidewalks, and other improvements. The trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations. Excavating shall not be performed until immediately before installation of conduit and other appliances. The material from the excavation shall be removed as the trenching progresses.

Trenches in existing or proposed roadways shall be backfilled with concrete or approved flow-fill material. After backfilling all trenches shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made.

Excavations in streets or highways shall be performed in such a manner that one (1) lane of traffic in each direction shall be open to public traffic. All lane closures shall be approved by engineer prior to closure. At the end of each day's work and any other time construction operations are suspended, all construction equipment and other obstructions shall be removed from that portion of the roadway open for use by public traffic. When excavations must remain open overnight, they shall be properly marked to warn motorists and/or pedestrians according to guidelines established in the "Manual on Uniform Traffic Control Devices for Streets and Highways" latest edition.

8.25.00 REMOVING AND REPLACING IMPROVEMENTS

The contractor shall at his sole expense, replace or reconstruct sidewalks, curbs, gutters, rigid or flexible pavement, and any other City or privately owned property which is removed, broken, or damaged by him with material which conforms to current City STANDARDS AND SPECIFICATIONS. Whenever a part of a square or slab or existing concrete, sidewalk, or driveway is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed as above specified.

The outline of all areas to be removed in Portland cement concrete sidewalks and in pavements shall be cut to a minimum depth of one-and-one-half inches (1-1/2") with an abrasive type saw prior to removing the sidewalk and pavement material. Cut for remainder of the required depth may be made by a method satisfactory to the engineer. Cuts shall be neat and true with no shatter outside the removal area.

8.26.00 UNDERGROUND FACILITIES

8.26.01 Foundations

- (A) All foundations shall be Portland cement concrete conforming to the applicable requirements of construction specifications of the City of Fort Lupton, except as herein provided.
- (B) The bottom of concrete foundations shall rest on firm ground. Cast-in-place foundations shall be poured monolithically where practicable. The exposed portions shall be formed to present a neat appearance.
- (C) Forms shall be true to line and grade. Tops of foundations, except as noted on plans, shall be finished to curb or sidewalk grade or as ordered by the engineer. Forms shall be rigid and securely braced in place and inspected prior to the pouring of concrete. Conduit ends and anchor bolts shall be placed in proper position and in a template until the concrete sets.
- (D) Anchor bolts shall conform to the specifications and each individual bolt shall have two (2) flat washers, one (1) lock washer, and two (2) nuts. Shims or other similar devices for plumbing or raking will not be permitted.
- (E) Both forms and ground which will be in contact with the concrete shall be moistened before placing concrete. Forms shall not be removed until the concrete has thoroughly set.
- (F) All abandoned foundations shall be removed and disposed of by the contractor. All conduit runs associated with an abandoned foundation shall be extended or abandoned as called for on the plans. When a foundation is removed, the hole shall be backfilled in accordance with State of Colorado and City of Fort Lupton standard practices.

8.26.02 Conduit

- (A) All cables and conductors not shown on the plans as aerial cable shall be installed in conduit unless installed in poles, pedestals, or mast arms. All metal conduit referred to in the specifications and shown on the plans shall be rigid and adequately galvanized. All PVC conduit will be of Schedule 80 or greater.
- (B) All trenches excavated in roadways, including new construction areas, shall be backfilled with concrete or State of Colorado approved flow fill, and capped with six inches (6") of Grade E Asphaltic Pavement.
- (C) Following conduit schedule is in effect unless otherwise specified in the plans:

Run Type

Quan. Size

Use

Street Crossings	1	3"	120 voltage
Street Crossings	1	2"	Low voltage
Street Crossings	1	2"	Xcel use
Signal Pole	1	3"	Signal cables
Signal Pole	1	2"	Xcel use
Controller Cabinet	2	3"	120 voltage
Controller Cabinet	2	2"	Low voltage
Interconnect	1	2"	Interconnect
Service Point	1	2"	Xcel use

- (D) The contractor, at his sole expense, may use larger conduit if desired. Where larger conduit is used, it shall be for the entire length of the run from outlet. No reducing couplings will be permitted underground.
- (E) The end of all metal conduit, existing or new, shall be well reamed to remove burrs and rough edges. Field cuts of existing or new conduit shall be made square and true, and the ends shall butt together for the full circumference thereof. Slip joints of running thread will not be permitted for coupling metal conduit. When a standard coupling cannot be used, an approved threaded union coupling shall be used. All couplings shall be screwed up until the ends of the metal conduits are brought together.
- (F) Where a "stub out" is called for on the plans, a sweeping ell shall be installed in the direction indicated and properly capped. The locations of ends of all conduits in structures or terminating at curbs shall be marked by a "Y" at least three inches (3") high cut into the face of the curb, gutter, or wall directly above the conduit.
- (G) Conduit bends, except factory bends, shall have a radius of not less than six (6) times the inside diameter of the conduit. Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practicable.
- (H) Conduit shall be laid at a depth of not less than twenty-four inches (24") below the top of curb grade in sidewalk or grass areas and to a depth of not less than thirty inches (30") below the finished grade in all other areas. Conduit under railroad tracks shall be not less than forty-eight inches (48') below the bottom of the tie.
- (I) Trench excavations for conduit shall be two inches (2") wider than the outside diameter of the conduit. Backfilling of conduit trenches shall be accomplished by placing concrete or approved flow-fill up to the bottom surface of the existing or new roadway surface material. The remaining portion of the excavation shall be backfilled with the same type of material used to construct the existing roadway surface.
- (J) Conduit shall always enter a foundation, pull box, or any other type structure from the direction of the run only.
- (K) Conduits terminating in a pole shall extend approximately two inches (2") vertically above the foundation.

- (L) All conduit runs that exceed ten feet (10') in length shall have a continuous nylon line pulled into the conduit along with the specified electrical cables. The line shall be firmly secured at each end of the conduit run with a minimum slack of three feet (3'). The purpose of this line is to be able to pull future electrical cable through the existing conduit runs.
- (M) Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel or blown out with compressed air.
- (N) New conduit runs shown on the plans are for bidding purposes only and may be changed with approval of the engineer.

8.26.03 Pull Boxes

- (A) A pull box shall always be installed in combination with a steel strain pole and at all other locations shown on the plans and at such additional points as ordered by the engineer. The contractor may install, at his own expense, any additional pull box that he may desire to facilitate the work.
- (B) Special pull boxes which are required shall be fabricated and installed in general conformance with the size and details shown on standard drawings.
- (C) Pull boxes installed in concrete or similar finished areas shall be designed for such installations and shall be stackable and manufactured of a pre-cast polymer concrete material such as Quazite or an approved equal. Unless otherwise noted, pull box lids shall have the word "Traffic" cast into them. Pull boxes shall be installed so that the covers are level with curb or sidewalk grade or level with the surrounding ground when no grade is established. The bottoms of all pull boxes shall be bedded in crushed rock.
- (D) When a new conduit run enters an existing pull box, the contractor shall remove the pull box or tunnel under the side at no less than eighteen inches (18") and enter from the direction of the run. No new conduit will be allowed to enter a new or existing pull box in any other manner than that shown on standard drawings.
- (E) Loop detector pull boxes installed in the street shall be placed according to the plans or as directed by the Public Works Director/engineer. The lids shall have the word "Traffic" cast into them.

8.26.04 Detector Loop Wire Installation

- (A) Each individual detector loop is to be terminated within a water valve housing as specified on the construction drawing, and each loop shall consist of one continuous wire, without splicing, to this termination point. Any required series or parallel connections are to be at the termination point.
- (B) All loops shall have a tag attached to the leading clockwise lead of the loop. This tag shall be marked to indicate the relative location of the loop. This marking shall correspond directly to the loop designations on the intersection drawing provided in the contract.

- (C) Detector loop roadway slots shall be cut in asphalt that has a 6 inch minimum depth and sealed one-fourth inch (1/4") below the surface level of the roadway with 3M or approved equal. This sealer is to be used whether or not the roadway is to be overlaid.
- (D) The contractor shall include cost for loop wire, saw cutting, sealant, splice and test for a complete installation of the loop to the termination point for the pay item price.

8.26.05 Conductor and Cable

- (A) Wiring shall conform to appropriate articles of the National Electric Code. Wiring within cabinets, junction boxes, etc., shall be neatly arranged.
- (B) Powdered soap stone, talc, or other approved lubricant shall be used in placing conductors in conduit.
- (C) A common neutral conductor, separate from the signal light circuit neutral, shall be used for all low-voltage circuits, including the detectors and pedestrian push-button circuits.
- (D) Splicing of cable will not be permitted in conduit or pull boxes or outside of signal heads, standards or foundations.
- (E) In no case shall any shellac compounds be used. Wire nut type connectors shall be used on all splices made above ground level. Detector loop lead-in splices in underground systems shall be waterproofed with 3M splice kits or City approved equivalent. A minimum of twelve inches (12") of slack shall be left at each splice except within hand-holes where twenty-four inches (24") shall be left.
- (F) When conductors and cables are pulled into the conduit, all ends of conductors and cables shall be taped to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped and marked.
- (G) Cable shall be stranded. For span wire type installations, cable shall be installed where specified on the plans and secured to messenger cable with cable rings in accordance with standard practices. Aerial cable shall be supported by strand vices of proper size and strength as well as insulators used where necessary.
- (H) A small permanent tag on which the direction and phase is printed, in the order named, using the codes given in "**Cable Schedule**," shall be securely attached near the end of each conductor at each controller, standard, or pull box where conductors are separated. Where direction and phase are not clearly indicated by conductor insulation, additional tags shall be used.

TABLE 8-26-05
Cable Schedule

<u>Phase/Tag</u>	<u>Tape Color</u>
1. NBLT	Red/White
2. NB	Red
3. SBLT	Green/White
4. SB	Green
5. EBLT	Orange/White
6. EB	Orange
7. WBLT	Blue/White
8. WB	Blue
9. Pedestrian	Yellow

NOTE: This is a typical cable schedule and shall be used for the wiring of all signal installations. A new cable schedule will be noted on the plans at each intersection where different phasing and/or special equipment is required. It should be noted that a band of white is used to indicate a left turn and yellow for a pedestrian movement. This is in addition to directional tape for the phase. For cable size and number of conductors see traffic signal material specifications and/or standard drawings.

- (I) Inboard and outboard heads, mounted on mast arms, are to be wired separately from head to base of pole.

8.26.06 Bonding and Grounding

- (A) Metallic cable sheaths, conduit, metal poles, and foundations shall be made mechanically and electrically secure to form a continuous system and shall be effectively grounded. Bonding and grounding jumpers shall be copper wire, No. 8 AWG, for all systems. Beldon cable sheath for loop detectors to be grounded in control cabinet only. The other end of the sheath to be left ungrounded.
- (B) Bonding of standards shall be by means of a bonding wire attached to a bolt or a three-sixteenths inch (3/16") or larger bolt installed in the lower portion of the shaft.
- (C) At each pull box the ground electrode shall be a one-piece copper ground rod of five-eighths inch (5/8") diameter and eight feet (8') in length, driven into the ground so that the top is two inches (2") above the bottom of the pull box. The ground rod connector will be placed so that the bare copper wire, No. 8, can be pulled into a pole, foundation, or attached to the control cabinet ground buss.

8.26.07 Maintenance

The contractor shall have full maintenance responsibility of the traffic signal from the date of the written notification by the Public Works Director/City Transportation Engineer to the final inspection and date of written approval of the work performed. Continuous maintenance and emergency service shall be provided by the Contractor 24 hours each day during the time frame outlined above. The Contractor shall provide and maintain a 24-hour a day continuous one number telephone answering service. All malfunctions of a controller and its accessory equipment shall be considered an emergency unless otherwise identified by the City. Equipment malfunctions and/or damage, which in the opinion of Fort Lupton's Transportation Engineer or other authorized person, constitutes a serious hazard or inconvenience to the public shall be considered an emergency. Such malfunctions or damage may include, but not necessarily be limited to, situations where:

- (A) all indications are out including bulbs and lenses, for any one traffic movement;
- (B) signal heads give conflicting indications to any intersection approach;
- (C) a signal has been knocked down;
- (D) an overhead red indication is out

Contractor shall undertake each such emergency repair no later than one hour after Fort Lupton notifies Contractor of the emergency.

In instances of repairs that are not of an emergency nature, such repairs shall be undertaken at the site within one working day after Fort Lupton notifies Contractor of the needed repair. Fort Lupton shall pay the Contractor for the materials, parts and/or supplies actually used by the Contractor in making any such repair in the amount of the Contractor's cost plus five percent (5%). Labor and equipment rates associated with work performed due to vandalism or vehicle accident damage will be reimbursed at the rate set forth in the City's Traffic Signal Maintenance Contract.

Should the Contractor fail to perform any maintenance responsibilities within the prescribed time periods, the Public Works Director/City Transportation Engineer or other authorized person shall employ the services of the City's designated Traffic Signal Maintenance Contractor to perform said maintenance work. The Contractor shall reimburse the City for labor and equipment charges associated with the utilization of the City's designated Traffic Signal Maintenance Contractor plus a fifteen percent (15%) administration fee.

8.26.08 Field Testing

Prior to completion of the work, the contractor shall cause the following tests to be made on all traffic signals in the presence of the engineer or his designee.

- (A) Each circuit shall be tested for continuity.
- (B) Each circuit shall be tested for grounds.

- (C) A functional test shall be made in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test for each traffic signal system shall consist of not less than fourteen (14) days of continuous, satisfactory operation commencing with full operation of all electrical facilities. During the fourteen-day period, the contractor will maintain the system or systems. The cost of any maintenance necessary, except electrical energy and maintenance due to damage by public traffic, shall be borne by the contractor and will be considered as included in the price paid for the contract item involved, and no additional compensation will be allowed.

8.27.00 TRAFFIC CONTROL IN CONSTRUCTION AREAS

8.27.01 General

For any construction done on, in or to an existing City roadway and/or right-of-way or for the construction of a new City roadway, appropriate traffic control during construction shall be provided. For any such construction, a construction traffic control plan shall be prepared by the contractor and/or project engineer and shall be approved by the Public Works Director/City Transportation Engineer prior to issuance of a street cut permit or public improvement construction permit.

Where a roadway does not currently exist, it is presumed that there is no motorist expectation of a travel route. Therefore, a construction traffic control plan for construction of a new roadway should strive to do two things: alert the motorist that this is a construction area, and alert the motorist that the road is not open to traffic. Construction traffic control plans shall also be prepared for construction occurring on existing City roadways where the motorist has an expectation of accessibility and shall be warned, advised, guided or regulated through any construction activity.

8.27.02 Time of Submittal

A construction traffic control plan shall be submitted to the Public Works Director/City Transportation Engineer at the earliest with the submittal of final construction plans and at the latest with the application for a right-of-way or public improvement construction permit(s). All final construction plans submitted to the City of Fort Lupton that entail constriction on an existing City roadway or construction of a new City roadway must either:

- (A) Be accompanied by a construction traffic control plan.
- (B) Include a note stating a construction traffic control plan shall be submitted to the City of Fort Lupton for approval before any permit for construction is issued. No right-of-way or public improvement construction permit shall be issued without the approved construction traffic control plan.

8.27.03 Scope of Construction Traffic Control Plan

For construction of new roadways, traffic control during construction should strive to keep the motorist from entering the facility. The primary means to accomplish this are by use of temporary barricades located in advance of the point where new construction joins old and appropriate signing. New roadways shall not be opened to general traffic, nor the construction traffic controls remove, without the approval of the Public Works Director/Engineering Construction Inspector and the Public Works Director/City Transportation Engineer. One precondition of such an opening is that permanent signage and striping be in place.

8.27.04 Elements of Construction Traffic Control Plan

- (A) All construction traffic control plans shall contain the following information:
1. Name of contracting firm and, if different, the name of the firm responsible for traffic control devices.
 2. Name and phone number(s) of 24-hour contact person responsible for traffic control devices.
 3. Description of location of activity (roadway names, north arrow, etc).
- (B) Projects identified as minor construction traffic control plans as determined by the Public Works Director/City Transportation Engineer shall include, in addition to items listed in (A) above, either one of the following:
1. A neat sketch of the roadways and the proposed traffic control devices; or
 2. A copy of a typical drawing of traffic device layout from an accepted source approved by the Public Works Director/City's Transportation Engineer.
- (C) Projects identified as major construction traffic control plans as determined by the Public Works Director/City Transportation Engineer shall include, in addition to items in (A) above, the following: The proposed traffic control devices specifically identified as to type and explicitly noted and dimensioned on as-builts, construction plan drawings or other detailed drawings.

8.27.05 Basis for Construction Traffic Control Plan

The Manual on Uniform Traffic Control Devices shall be the basis upon which the traffic control plan is designed in concert with proper, prudent and safe engineering practice. All necessary signing, striping, coning, barricading, flagging, etc. shall be shown on the plan. Other acceptable documents may be consulted or referenced, such as Traffic Control in Construction and Maintenance Work Zone (FHWA), Flagging and Traffic Control Supervisor's Training Manual (CDOT) and Work Area Traffic Control Handbook (City of Fort Lupton, Public Works/Engineering Division).

8.27.06 Restriction, Regulations and Opportunities

In concept, City streets shall not be closed overnight and work shall not force road or lane closures before 8:30 a.m. or after 3:30 p.m. If exceptions to this are required, this shall be noted on the construction traffic control plan and shall be approved by the Public Works Director/City Transportation Engineer. Travelway width may be restricted. Minimum travel lane width in construction areas shall be ten feet (10'), but proper controls, including flagging, shall be indicated. Prohibition of on-street parking should be considered and noted where applicable.

All traffic control devices necessary to provide for public safety at the work site shall be furnished and maintained by the contractor at his own expense. If the contractor does not provide the approved traffic control devices. The Public Works Director/City Transportation Engineer may install such devices, and the entire costs of such devices shall be borne by contractor. If the City is required to install the required traffic control devices due to negligence by the contractor, a minimum administrative charge of three hundred dollars (\$300) will be assessed to the contractor.

8.27.07 Approval

Staff of the Public Works and City's Transportation Engineering Section must approve (sign and date) all construction traffic control plans. In general, this responsibility rests with the Engineering Division Inspection Section. However, it is likely that most major plans will be referred to the Traffic Section for consideration. All complete road closures and all partial road closures (removing one or more travel lanes) that are proposed for overnight shall be approved by the Public Works Director/City Transportation Engineer. One (1) copy of the approved plan shall remain with the Inspection Section for their verification that the traffic control plan has been adhered to in the field. One (1) copy shall be placed in the engineering project file. The contractor shall have one (1) approved copy of the traffic control plan on site at all times.

8.27.08 Modifications

Actual conditions in the field may necessitate modifications to the construction traffic control plan. Provided that the general intent of the original plan is satisfied, these modifications may occur without revision to the plan. The Public Works Director/Engineering Construction Inspector shall be notified of any substantial changes and may refer these to the Traffic Section as needed for construction.

8.27.09 Applicability

The requirements of this chapter shall apply to any person, corporation, municipality, quasi-municipality agencies, mutual companies, electric, gas or communication utility (including cable TV) who for any reason cuts, disturbs or otherwise defaces any City road for the purposes of installing or repairing or for any reason pertaining to the presence of an underground utility or structure.

8.28.00 TRAFFIC SIGNING AND PAVEMENT MARKINGS

8.28.01 General

The installation of all traffic control devices shall conform to the Manual on Uniform Traffic Control Devices and the Colorado Standard Specifications for Road and Bridge Construction, latest edition.

8.28.02 Traffic Control Devices on Public Property

All permanently fixed traffic signals will generally be installed by the City at the developer's expense. However, if the developer submits a signage plan which is subsequently approved by the Public Works Director/City Transportation Engineer, the developer may install these traffic signs. Traffic signs shall be placed to conform to the drawing details.

8.28.03 Traffic Control Devices on Private Property

- (A) Responsibility: All traffic control devices on private property; i.e., pavement markings, regulatory signs, fire lane signs, and handicapped parking signs shall be installed and maintained by the property owner.
- (B) Placement: A signage and striping plan specifying the various types and combinations of traffic control devices shall be submitted to the Public Works Director/City Transportation Engineer for approval.

8.28.04 Pavement Markings

All Pavement Markings required to be installed as a result of new construction Or development shall be THERMOPLASTIC as per CDOT specification 627. Temporary pavement markings necessary to facilitate construction (i.e. detours) may be Installed using paint.

The contractor shall submit a plan for all pavement markings to the Public Works Director/City Transportation Engineer for approval prior to the beginning of the work. The pavement marking plan shall meet the requirements for such work as outlined in the Manual on Uniform Traffic Control Devices. All pavement marking materials must be approved by the City Transportation Engineer.

8.30.00 MATERIAL SPECIFICATIONS

8.31.00 SIGNAL HEADS

8.31.01 Traffic Signal Unit Specifications

- (A) All signal units shall be of the individual section, adjustable type, black polycarbonate or approved equivalent. Unless otherwise noted on the plans, all signal and pedestrian displays shall be ITE approved Light Emitting Diodes (LED) and conform to the appropriate sections below. All southbound overhead red and southbound overhead red-arrows shall be incandescent type and conform to sections B through F below.

- (B) Visors shall be detachable, of the eight-inch (8") or twelve-inch (12") tunnel type, open at the bottom; be black in color on the outside and flat black on the inside.
- (C) Reflectors shall be silvered glass or Alzak type units.
- (D) Lenses shall be in accordance with Institute of Traffic Engineers Specifications.
- (E) Sockets shall be fixed focus.
- (F) Doors on the signal heads for the installation of lamps and lens replacement or other maintenance shall not require use of any tool whatsoever to be opened. Doors and lenses shall be equipped with neoprene weatherproof gaskets to insure against infiltration of moisture, road film, and dust. Each three-color signal unit shall have the socket leads from all signal sections connected to a terminal board stamped with identifiable terminals. There shall be a terminal for color indication plus a common terminal where one lead from each socket shall terminate. The terminal board shall be mounted in the middle section and be properly insulated. All openings, top and bottom, shall be for one-half-inch (1/2") pipe or pipe mounting brackets. Gaskets shall be supplied for top and bottom openings.

8.31.02 Pedestrian Signal Units

Sixteen-inch (16"), one-way, ICC or equal pedestrian signal head as specified on the plans. "Walk/Don't Walk" indications shall be symbolized and side by side. Visors shall be egg crate type and heads shall be black.

8.31.03 Backplates

- (A) Where shown on the plans, black back plates shall be furnished and installed on signal faces. No background light shall show between the back plates and the signal face or between sections. All back plates are to be of aluminum or plastic construction and shall be the louvered type. Back plates shall provide a five-inch (5") border for all twelve-inch (12") signal heads.
- (B) Traffic signal heads requiring backboards shall be drilled for three-sixteenths-inch diameter by one-half-inch (3/16" x 1/2") pan head bolt with nut and lock washer. If the manufacturer fails to supply as described, it will then be the contractor's responsibility to do so. When installing backboards on the traffic signal head, the contractor will furnish three-sixteenths-inch (3/16") fender washers between bolt head and backboard
- (C) The manufacturer will fabricate all backboards with a three-sixteenths-inch (3/16") washer on both sides of each rivet which is used to hold each section of backboard together.

8.31.04 Traffic Signal Lamps

- (A) Traffic signal lamps shall meet the requirements of the latest version of the ITE Standard "Traffic Signal Lamps." All lamps shall have 8,000-hour minimum rating. Lamp manufacturers shall be limited to General Electric, Sylvania, Phillips. Size of lamps to be used in traffic signal units shall be as follows:

- (B) 69 watt, 125 volt, lamps for all eight-inch (8") traffic signals and peds.
- (C) 150 watt or 1950 lumens minimum, 125 volt, lamps for all twelve-inch (12") traffic signals.
- (D) If the manufacturer recommends a lower rating, the City of Fort Lupton will be advised of this recommendation and will have the option to decide which rating will be used.

8.32.00 ELECTRICAL CABLE

8.32.01 Signal Cable

14 AWG multi-conductor, stranded, copper wire manufactured to meet IMSA 19-1 specifications or approved equivalent. Each conductor in the cable will be individually insulated and rated at 600 volts. There shall be a minimum of four (4) and a maximum of nine (9) strands per conductor. There shall be a separate 19-conductor cable installed from the controller cabinet to the bottom handhold of each signal pole. From that point, a separate 5 or 7-conductor cable for each overhead signal shall be spliced to the 19-conductor cable.

8.32.02 Interconnect Cable

- (A) Unless otherwise noted, all traffic signal interconnect communications shall be accomplished through a fiber optic cable system. Provisions for the fiber optic system shall be annotated on the plans or described by supplemental specifications. The remaining portions of this section reference hardwire systems and are applicable when specified. The telephone hardwire interconnect wire shall be #19 AWG, 6 twisted pairs, shielded cable, with petrolatum-polyethylene gel filling compound. The cable shall meet R. E. A. Specification PE-39 (Clifford of Vermont Catalog #6P19-B1-BJFC or approved equal).
- (B) No splicing of the interconnect cable will be allowed. The cable shall be installed between two adjacent controller cabinets in continuous runs.
- (C) All telephone interconnect cable pairs will be connected to either active or spare terminal points provided in the controller cabinet. The Contractor shall identify and label all terminal points.
- (D) All interconnect wires shall be checked after installation to determine their resistance and resistance to ground. Each pair shall be shorted together at one end and a resistance check will be made at the other end or wherever a splice exists. Resistance will be checked between each conductor and ground. All resistance readings shall be recorded showing value, color and location of wire. Data is to be supplied to the Public Works Director/City's Traffic Department within 30 days of completion of the project.
- (E) At the terminal points the jackets shall be stripped and the ends taped. Gel filling compound shall be removed using filled cable cleaner.

8.32.03 Service Cable

Two (2) No. TRW-8, seven (7) strands, tinned, soft-drawn copper wire, one-sixteenth-inch (1/16") neoprene insulation, black and white in color.

8.32.04 Loop Wire

Detect-A-Duct Cable consisting of single conductor No. 14, stranded THHN with an outer protective sleeve.

8.32.05 Pedestrian Push-Button Cable

Two (2) conductor No. 14, seven (7) strands, tinned, soft-drawn copper wire, one-sixteenth-inch (1/16") neoprene insulation. Conductors to be twisted. Color coded one (1) white and one (1) black.

8.32.06 Loop Lead-In Cable

Detector loop lead-in cable shall be a four conductor .25 inch diameter, shielded and jacketed cable suitable for installation in a pavement sawslot, conduit or direct burial. Conductors shall be AWG No. 18 stranded copper with polypropylene insulation. The conductors shall be twisted at least six turns per foot. Color rotation shall be black, red, white, green. The interior of the cable shall be filled with an amorphous material which prevents water penetration. Aluminized polyester shielding shall be applied around the conductors to prevent electromagnetic interference. The Cable jacket shall consist of black high density polyethylene. The jacket shall not be degraded by prolonged exposure to typical pavement runoff components. The cable shall be suitable for operation at temperatures of -60°C to +80°C. (Canoga 30003 43#18 AWG shielded loop detector lead-in cable or approved equal.)

8.32.07 Ground

Single conductor, AWG No. 8, soft-drawn bare copper wire.

8.32.08 Optical Detector Lead-In Cable

The lead-in cable for the Emergency Vehicle Optical Detectors shall be 3M Type 138 or approved equal.

8.33.00 VEHICLE DETECTORS

8.33.01 General

(A) Unless otherwise noted, all traffic signal vehicle detection systems shall be accomplished through a video camera system. All camera systems shall be 100 percent compatible and identical in both operations and programming with the City's existing Autoscope and Solo Pro equipment. The remaining portions of this section reference

roadway imbedded inductive loop systems and are applicable when specified. This specification defines the minimum design operational and performance requirements for multiple channel, digital self-tuning inductive loop detectors, detector units shall be card rack mounted plug-in type and operate from an external 24 VDC power supply. Detector units shall be in full compliance with the environmental and size requirements of NEMA standard TS1-Section 15 and meet the design, operation, electrical and functional performance requirements of both TS1 and TS2 specifications.

- (B) The front panel shall include an erasable, write-on channel identification area and clearly indicated switch operating position. I.D. area one centimeter square per channel minimum.
- (C) All component part and test points shall be clearly identified by permanent marking of circuit referenced on the P. C. Board. Integrated circuit devices having 16 or more leads shall be socket-mounted to facilitate repair and maintenance of units. Detectors supplied to this specification shall be warranted by the supplier to be free of defects in materials and workmanship for a period of five years from date of shipment from manufacturer.
- (D) Each detector unit shall include two or four complete detector channels. Each channel shall sequentially energize its loop inputs to eliminate crosstalk (mutual coupling) between large, very closely spaced adjacent loops connected to the same unit. The sequential time sharing and digital processing of loop inductance data shall be accomplished on a single LSI microcircuit per unit for maximum reliability. The method of measuring shall be crystal reference digital period counting, multi-channel scanning. Only one channel input per unit shall be active at any point in time.
 - 1. Sequential scanning shall fully prevent crosstalk between channels of a detector connected to closely spaced or overlapped loops for directional detection.
 - 2. Sequential scanning shall allow two detection channels to operate with full performance using a common home-run cable.
 - 3. Sequential scanning shall allow two or more detection channels to be connected to a single detection amplifier with full operating performance, including separate mode and sensitivity selection capability on each channel.
- (E) Each channel of the sensor unit shall automatically self tune to any loop and lead-in inductance from 20 to 2500 microhenries within 2 seconds with full sensitivity after application or interruption of supply voltage. Units shall also track changes in loop/lead-in electrical characteristics, as might reasonably be expected to occur in undamaged loops, properly installed in sound pavements, without producing false indications or changes in sensitivity.
- (F) Each detector unit shall be provided with a loop test switch position to verify loop system integrity and reduce maintenance costs. The "open loop test" position shall indicate a previous fault via the front panel indicator. The memory shall remain intact and can be queried repeatedly. Existing detections shall not be reset and the memory shall only be reset by power interruption as by removing and re-inserting the plug-in detector units.

- (G) Each channel shall include a 16-position Push type wheel switch to allow selection of 8 pulse sensitivities, 7 presence levels and a "Reset" and an "Off" position. Each detector unit shall include 8 sensitivity selections in 2:1 steps that can be correlated to the relationship of the number of turns of wire in a loop versus the sensitivity required to detect a specified vehicle. The selections shall be designed to allow detection of licensable vehicles in loops of two or more turns electrically in series, parallel or series/parallel configuration in non-reinforced or reinforced pavements with lead-in/homerun combinations from 50-feet to 1000-feet. The number of turns in a loop, electrical configuration of multiple loops and pavement type will dictate the sensitivity required for proper, predictable detection.
- (H) If specified, channel presence time shall be modified if delay or extension time is selected. The timing switch shall select delay or extension or "Off", if no timing is desired. Internal DIP switches shall provide for selection of "Delay" time of 0 to 31 seconds in 1.0 second increments and "Extension" time of 0 to 7-3/4 seconds in .25 second increments.
- (I) Presence indicators shall be wide angle, high brightness type Led's suitable for sunlight visibility. When timing is selected and a channel is active that channel's indicator shall flash at 4 Hz during Delay and at 16 Hz during Extension to indicate timing is in progress. Further, the timing shall be aborted when the vehicle is no longer present and/or the channel control input shall become inactive. The Delay timer shall be reset when a vehicle leaves the loop prior to time out and shall abort when the control input becomes inactive. The Extension timer shall operate and reset when a vehicle leaves the loop and be aborted when the control input becomes inactive. Each timer (Delay and Extension) shall be provided with buffer circuitry to enable or disable the timer based on an external input (green gate) signal. Circuit shall be designed for AC or DC input control on AC powered units and for DC control on DC powered units.
- (J) Each detector unit shall utilize a $\Delta L = (\text{Delta-L})$ thresholding technique to provide a more constant, predictable vehicle detection sensitivity with series added inductance, i.e., many loops connected in series and/or long lead-in/homeruns will generally require the same sensitivity setting as would be required for a single loop with short lead-in, to simplify setup.
- (K) Each channel shall automatically recover from intermittent opens or multiple shorts to ground. Each channel shall tolerate and continue to operate with no change with a single point short to ground on the loop or lead-in system. Each channel shall provide a continuous, non-resettable (fail-safe) output and indication in response to an open loop/open lead-in system. The open loop indication and output shall not be resettable as long as the open exists, except that they shall be defeated when the channel "Off" position is selected.
- (L) Extended features shall include: Two serial ports (front panel RS232 and Edge connector Xmit/Recve), TS1 and TS2 compatible from manual or software switch, microloop occupancy detection, Traffic counting capable to include long-loop presence count from 15 minute to infinite intervals all accessible from either serial interface, Dual Detect and Fault LED indicators per channel, External inputs to control Timing functions and enable Remote Reset, Extended diagnostics, programming and Live status available via serial interface utilizing windows compatible software.

8.34.00 EMERGENCY VEHICLE DETECTORS

OPTICAL COMMUNICATION Detectors for emergency vehicle pre-emption shall be the 3M Model 711, 712 or 722 Optical Detector or approved equal as specified in the construction plan notes. Placement of the Detectors shall be determined by the Engineer. Optical phase selector modules for emergency vehicle pre-emption shall be 3M Model M752 or approved equal.

8.35.00 DETECTORS (PEDESTRIAN PUSH-BUTTON)

8.35.01 General

- (A) Pedestrian push-buttons shall be of the direct push-button contact type. They shall operate on a voltage not to exceed 18 volts AC. They shall be of tamper-proof design and equipped with a push-button instruction sign as shown in the Standard Details.
- (B) The assembly shall be weatherproof.
- (C) The housing shall be shaped to fit the curvature of the pole to which it is attached to provide a rigid installation. Saddles shall be provided to make a neat fit when required. Pedestrian signs shall be installed as shown on the Standard Details.

8.36.00 TRAFFIC SIGNAL POLES, PEDESTALS AND MAST ARMS

Traffic signal poles, pedestals, and mast arms shall be of the general configuration shown on standard drawings. All traffic signal poles and mast arms shall be designed to meet the requirements outlined in the 1994 edition of "Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals," published by AASHTO, for a wind velocity of 90 mph.

8.37.00 CONTROLLER CABINET

8.37.01 General

- (A) All controllers and auxiliary equipment shall be housed in a factory wired, weatherproof, metal cabinet following **NEMA** specification **TS2 type 1**. The cabinet shall have minimum interior dimensions, exclusive of stiffeners, shelf brackets, etc., of height - 46 inches, width - 29 inches, and depth - 15 inches.
- (B) The cabinet shall be constructed of 0.125 minimum thickness bare aluminum. Cabinets shall be braced internally or by folded seams in order to provide sufficient rigidity to withstand normal handling and transport to the field location without deforming.
- (C) The main door shall have a self locking, keyed, tumbler lock with two keys. Hinges shall be mounted on the cabinet in such a way that interchange-ability of doors is possible between cabinets of like size and manufacturer. Hinge pins shall be stainless steel. Doors shall have neoprene gaskets of sufficient thickness to provide a rain tight and dust tight seal.
- (D) The engineer will provide, during the construction period, an additional external lock for the controller cabinet to maintain security of the controller cabinet.

- (E) A police or auxiliary door shall be provided. It shall be constructed so that no sharp edges protrude from the main door and shall provide access to a panel with labeled switches for automatic to flashing operation and signal power on/off.
- (F) The cabinet shall be equipped with a thermostatically controlled, ball bearing fan with a capability of at least 100 cubic feet per minute. The fan shall be mounted in a weatherproof housing attached to the top of the cabinet. The thermostat shall be adjustable to turn on between 90° F and 150° F and be so mounted as to be easily accessible for adjustment from the front of the cabinet. An internally mounted incandescent lamp socket shall be provided with 150 watt capability and switched "on" only when the main door is open.
- (G) The cabinet shall have two shelves each capable of supporting 75 pounds. Shelves shall be supported on brackets which provide for height adjustments. Each cabinet shall contain a 10 mil thick plastic envelope with side opening. It shall be a minimum size of 10" x 12" and be attached to the door by screws.
- (H) Assembly wiring - All cabinet wiring shall be neatly arranged and laced or enclosed in plastic tubing. No harness or wire shall be attached to any shelf rack or other point where it may be damaged by movement of shelves or doors.
- (I) Terminal Facilities - Terminal facilities (load bays) shall be firmly attached in a position not less than 6 inches from the bottom of the cabinet so as to provide easy access and maximum convenience to the user.
- (J) Side mounted auxiliary panels should be firmly installed with the forward edge not more than 4 inches from the door sill and not less than 6 inches from the bottom of the cabinet in all cabinets.
- (K) The load bay and it's associated equipment, harness, switches, etc., shall be grouped on removable panels. Each panel or group of receptacles and connecting cables shall be arranged to permit so that work can be performed on panel backs or cables.
- (L) A load switch bay and flash transfer capability is required for each phase. Load switches shall be provided for only the phases shown on the plans.
- (M) The load bay shall be protected by a main circuit breaker. A gas tube surge arrester with MOV and a suitable radio interference filter shall be supplied. The arrester shall be a three electrode type with the following ratings:
1. Impulse Breakdown - less than 1,000 volts in less than .1 microseconds at 10 KV per micro-second.
 2. Standby Current - less than 1 milliamperere
 3. Striking Voltage - greater than 212 VDC
 4. Energy Capability - capable of withstanding pulses of peak current each of which will rise in 8 microseconds and fall in 20 micro-seconds to one-half the peak voltage at 3 minute intervals.

5. Peak Current Ratings shall be 20,000 amps. The MOV shall have ratings equal to or better than a General Electric type VI50LA20A. The RFI filter shall have a current rating equal to or greater than the main circuit breaker capacity.
- (N) Field terminals shall be screw type, capable of accommodating at least three number 12AWG wires. All terminals in the load bay shall be permanently identified by engraving, silk screening or contrasting plastic labels. Terminal blocks shall be the barrier type and no live parts shall extend above the barrier.
- (O) A convenience outlet with a ground fault interrupter fused at 15 amps shall be provided. It should be located in a position which is convenient and safe for service personnel.
- (P) All AC power busses, switch or relay lugs and/or similar activity connection points which extend more than 1-1/2 inches from the panel are to be protected by insulation for safety. The locations of these items shall provide reasonable protection for service personnel.
- (Q) Signal power relays shall be mercury wetted, equal to or greater than circuit breaker capacity. Flash transfer relays shall be as manufactured by Midtex Model 136-62 T 3A1, 120 VAC, DPDT, 30 amp with Jones Plug base and dust cover or approved equal.
- (R) Flasher. The cabinet shall be equipped for flashing operation of signal lights with a 2 circuit solid state flasher in accordance with the latest NEMA specifications (15 amps per circuit). Flashing operation shall be set for flashing yellow on all main street approaches and red on all other approaches. Pedestrian and turn signals shall be extinguished during flashing operation. The flashing mechanism shall remain in operation during shutdown or removal of controller.
- (S) Load Switches. The cabinet shall be equipped with solid state load switching assemblies in accordance with the latest NEMA specification. Each load switch to be equipped with a 3 input LED indicator. Load switches shall contain 3 separate cube type solid state relays, which use a solid state switch which is capable of operations at 240 VAC and 25 amps when properly heat sinked but derated to 10 amps when used in load pack assembly.
- (T) Conflict Monitor. The cabinet shall have provision for conflict prevention in accordance with the latest NEMA TS2 specification. Conflict prevention shall be provided by a conflicting display monitor unit that monitors all green, yellow and walk displays and detects absence of reds to cause flashing operation and stop timing if conflicting indications are detected. Removal of the monitor from the cabinet shall cause flashing operation. Conflict monitors shall be as manufactured by Eberly Designs, 12 LEP or approved equal.
- (U) Emergency Vehicle Preemption. The cabinet shall be equipped and wired with an Opticom Card rack mount for 3M Model 562 or approved equal. All equipment shall be capable of accommodating a minimum of two modules with capability of four-channel operation.

8.38.00 ACTUATED CONTROLLERS

8.38.01 General

- (A) **Compatibility - THE LOCAL CONTROLLER AND CABINET SHALL BE 100% COMPATIBLE WITH THE CITY OF FORT LUPTON'S EXISTING COMPUTERIZED SIGNAL SYSTEM WHICH UTILIZES ECONOLITE EQUIPMENT OR NECESSARY MODIFICATIONS OF THE SOFTWARE AND HARDWARE SHALL BE INCLUDED TO MAKE BOTH SYSTEMS FULLY COMPATIBLE.**
- (B) An actuated controller shall be completely solid state, electronic device capable of selecting and timing traffic movements. It shall provide timing and load switch control of each major vehicular phase, including concurrent associated pedestrian movements. The controller shall conform to the latest NEMA specifications and shall provide for complete and full operation of eight phases from within either a TS1 or TS2 type 1 cabinet.
- (C) The controller shall have all electronic components easily accessible and arranged in functional groupings on the printed circuit boards. Printed circuit boards shall be designed to facilitate identification of components for maintenance purposes. Printed circuit design shall be of NEMA specification quality and designed so that components may be removed and replaced without permanent damage to the board or track.
- (D) Timing shall be adjustable on the controller face by keyboard programming. A security code or other means shall be provided to prevent unauthorized or accidental entry.
- (E) Timing shall be readable from a display which is sufficient to make certain that all register positions can be easily and definitely recalled. Every keyboard controller shall have an easily followed legend silk screened on the face of the controller or on a metal or plastic card or placard which is securely attached by screws or rivets.
- (F) All circuitry components shall be available on the open market and the original manufacturer's part number shall be shown on the part's list.
- (G) Overlap programming shall be provided by NEMA standard overlap board and/or keyboard.
- (H) An entry mode to any single phase parameter of a keyboard controller shall not affect any other parameter or the same parameter on another phase, unless programmed by specific keyboard instructions, such as, "copy" sequences or other prescribed methods of rapid program entry.
- (I) Every controller supplied shall be the manufacturer's latest, first line production model tested and delivered by a domestic manufacturer who is regularly engaged in the construction of such equipment.
- (J) Each controller shall be supplied with a complete set of operational and service manuals, wiring schematics and part's layout up to a maximum of ten sets per order. Any controller for which these documents are not available is not a production model within the meaning of these specifications.
- (K) Each controller shall have a removable data module.
- (L) Pre-emption. All actuated controllers shall be equipped to accommodate four E.V.P. inputs and one railroad preemption input.

8.38.02 Coordination Unit

- (A) The coordination unit shall be an internal function within each local controller and shall meet, as a minimum, the following functional requirements.
- (B) The coordinator shall provide for at least four cycle lengths adjustable from 30 to 255 seconds, three offsets adjustable from 0 to 99 percent with offset correction by dwelling in coordinated phase or smooth transition, and four splits per cycle.
- (C) Standard NEMA functions shall be used to control the intersection timing.
- (D) The coordinator shall be capable of changing the controller's phase sequence upon command and telemetry failure.
- (E) The coordinator shall be capable of setting the intersection free by loss of system sync, cycle/offset false commands, free command and telemetry failure.
- (F) The coordinator shall be capable of setting the intersection into a flashing operation in accordance with the Manual on Uniform Traffic Control Devices, latest edition.
- (G) The coordinator shall be capable to operate with telemetry module without additional hardware or software.
- (H) Time-base coordination mode shall be provided as a backup with all standard coordination features available. At least two 7-day programs shall be available with 50 additional holiday programs in the event of a master controller or communications failure. Time-base standby mode shall be programmable for an entire year with automatic daylight savings and leap-year changes.

8.38.03 System Telemetry

- (A) Telemetry equipment shall be an internal plug-in module to a local controller with easy access for removal. Master controller or stand-alone chassis may contain standard plug-in module. Each telemetry unit shall be capable of transmitting data to and from local controller, local detectors and system detectors (8 per intersection). A provision shall be made to reject invalid messages. The system command shall be transferred each second to maintain time sync.
- (B) The telemetry equipment shall be designed so that all communications among intersections in one system can be accomplished over no more than two pairs of hard wire interconnect or leased phone lines. Dedicated pairs from the master to each local intersection are not permitted.

8.39.00

ON-STREET MASTER

8.39.01 General

- (A) Cabinet Assembly - The master controller shall be wired into a cabinet assembly which also includes a local intersection equipment configuration. The cabinet shall be wired complete with master connecting cables in accordance with applicable portions of the local controller cabinet specifications. The incoming power service and interconnect terminals shall be adequately equipped with surge arrestors to protect against high energy transients.
- (B) Incoming Sensor Data - The master shall have the ability to receive output data from at least eight sensors from each local intersection. It shall be possible to assign at least 32 of the incoming sensors to internal computational channels for pattern selection analysis.
- (C) Traffic Pattern Selection. The program-in-effect shall be selected on a priority basis with the following priority arrangements:
 - 1. Manual entry from keyboard
 - 2. External command from a master
 - 3. Time-of-day/day-of-week schedule
 - 4. Traffic responsive -based on sampling sensor analysis
- (D) The master shall select one of six different cycle lengths or "free" operation based on inbound or outbound volume levels. It shall be possible to program segments in the volume range levels to change to the next higher or lower cycle lengths.
- (E) The master shall be able to select any of five different offset plans per cycle. Offset plans shall be chosen based on the differential between inbound and outbound volume levels. The five offset plans shall be designated as follows:
 - 1. Heavy inbound
 - 2. Inbound
 - 3. Average
 - 4. Outbound
 - 5. Heavy outbound
- (F) When balanced flow occurs, the master shall select the Average Offset plan. When the volume in one direction exceeds the volume in the other direction by the programmed amount, a standard preferential offset shall be implemented. If the volume differential exceeds a second (higher) programmed amount, a heavy preferential offset must be implemented. It shall also be possible to reserve the heavy preferential offset plans for special pattern implementation only. Programmable settings must be provided for both entering and leaving each offset.
- (G) Split plan selection shall be identical to offset plan selection except that arterial traffic volume levels must be compared to side street volume levels. Three different split plans shall be provided:

1. Heavy arterial
 2. Average
 3. Heavy side street
- (H) The master shall call for the average split plan during normal conditions. If the arterial volume exceeds the side street volume by the programmed amount, the heavy arterial split shall be selected. In the same manner, if side street volume exceeds arterial volume by a programmed amount, the heavy side street split shall be called.
- (I) Crossing Artery Synchronization - The master controller shall have capability to coordinate with a separate master controller of the crossing artery through the common intersection for both systems.
- (J) System Diagnostics - Diagnostic tests shall be performed on system detectors, telemetry communications and intersection operation.
- (K) Sampling sensors shall be monitored for absence of calls or constant calls. If a sensor fails, it shall be automatically disconnected from the calculations for traffic responsive plan selection. If normal sensor operation resumes, the sensor shall be automatically reinstated.
- (L) Telemetry communications diagnostics shall monitor readbacks for no response condition including local telemetry and telemetry channels.
- (M) Intersection diagnostics shall be available to display intersection status condition. All fault conditions shall be reported and logged.
- (N) Count storage - The master shall have the ability to tabulate and store 15 minute count data from up to 32 different sensors. The data shall be available for automatic transfer to the central office facility upon request.
- (O) The selection of the sensors to be counted in any 24 hour period shall be completely programmable from the central office computer.
- (P) Miscellaneous Data Storage. The master shall store all of the following data:
1. The time of day and location of all sampling sensor failures. If normal operation resumes, this time shall also be recorded.
 2. The time of day, location and mode of all local intersection failures. The time that normal operation resumes must also be recorded.
 3. The time and mode of all pattern changes. Changes due to external override must be distinguished from normal pattern changes.
 4. The average volume or occupancy level for each 15 minute period for all computational channels.
- (Q) It shall be possible to transmit any of the data listed above to the central office computer automatically or upon demand.

- (R) Downloading Local Coordination Settings. It shall be possible to download any local intersection coordination setting (offset, force off or permissive period) from the master via the unit's keyboard.
- (S) Display. During normal operation, the timing pattern in effect shall be displayed on the front panel, including the cycle, offset plan and split plans selected. Also, the unit shall indicate how the timing plan was selected - through normal volume calculations, by an occupancy channel or by manual or central computer override. The master shall also indicate when the time of day mode is in effect and show whether this mode was selected manually or because of sensor failures.
- (T) External Override. The master controller shall have appropriate inputs to externally select any timing pattern and override the pattern selected through traffic analysis.
- (U) Telemetry. The master shall include a telemetry module for two way communications between the master and local controllers. The equipment shall be compatible with the telemetry equipment specified for the local controllers

8.40.00 MISCELLANEOUS HARDWARE

8.40.01 General

- (A) Aluminum pedestal mounts (Type III) shall be either of two (2) types, as called for in the plans and specifications. Center mount with two (2) side ports, plain or offset mount serrated with one (1) side port.
- (B) Covers for water valve pull boxes shall have the word "Traffic" cast into them to avoid confusion with a water department pull box.
- (C) Mast arm brackets shall be Astro brackets or City approved equivalent and shall be installed 90 degrees to the roadway.

8.41.00 PAINT - SIGNAL POLES

8.41.01 New Structures

- (A) All new signal poles and mastarms shall be factory painted with an epoxy primer and Polyurethane top coat liquid coating. Surface preparation shall be blast cleaned to Steel Structure Painting Council Surface Preparation Specification No. 6 (SSPC-SP6) requirement utilizing cast steel abrasives conforming to the Society of Automotive Engineers (SAE) Recommended Practice J827.
- (B) All accessible interior surfaces shall be coated with a lead and chromate free red oxide rust inhibitive alkyd primer to a minimum dry film thickness of 1.0 mils.
- (C) All exterior surfaces shall be coated with a rust-inhibitive Epoxy-Polyamide Primer to a minimum dry film thickness of 2.0 mils. The top coat shall consist of one coat of Semi-Gloss High-Build Acrylic Polyurethane Enamel, Tnemec Endura Shield or

approved equal, to a minimum dry film thickness of 2.0 mils. The top coat color shall be Federal Green No. 14056.

- (D) Any surface areas damaged during handling or installation shall be repaired immediately with a spot coat of epoxy primer and a polyurethane finish as specified above. The paint manufacturer's application instructions shall be followed.

8.41.02 Existing Structures

- (A) All designated previously installed signal poles and mast arms shall be field painted. All exterior surfaces shall be cleaned and examined for damaged paint, and any such damage shall be given a spot coat of primer and the entire exterior surface re-painted. Previously painted surfaces whether finish or prime coats, shall be scuff sanded to yield 500 PSI of adhesion with particular attention paid to the lower eight feet (8') of the pole. Inspection of the poles prior to application of the finish coat is required.
- (B) A finish coat of Sherwin Williams DTM (Direct to Metal) Acrylic Gloss or approved equal shall be applied over the primer or previously painted surfaces. Two coatings shall be applied leaving approximately 6 mils of dry film. The color shall be a dark green formula (Federal Green No. 14056) which is available from the City Engineer.
- (C) The painting shall be done in a neat and workmanlike manner and may be applied either by hand brushing or spraying. The engineer reserves the right to require the use of brushes for the application of paint should the work done by the paint spraying machine prove unsatisfactory or objectionable.
- (D) All designated traffic and pedestrian signal heads shall be painted flat black unless otherwise specified. Previously painted controller cabinets shall be painted white.

8.42.00 INSTRUCTIONS AND WIRING DIAGRAMS

All equipment shall be provided with three sets of complete installation instructions, including a complete chart of field connections as well as a manual for the controller, containing service instructions, wiring diagrams, trouble-shooting procedures, etc. Each and every component used shall be clearly referenced in the service manual and its value, ratings and manufacturer part number shall be given.

8.43.00 GUARANTEE

The contractor shall include in his proposal all warrants and/or guarantees with respect to materials, parts, workmanship and performance of the product to be supplied. The minimum guarantee period for the product shall be one (1) year from the date of final acceptance of the contract. The contractor shall attach to the bid a statement that all material to be supplied is either in exact accordance with the specifications or shall list in detail any and all deviations therefrom. The supplying of equipment that is not in accord with the specification and on which the contractor has indicated no exception shall be cause for rejection of the equipment and correction of the non-specification items entirely at the contractor's expense.

8.44.00

SIGN SPECIFICATIONS

8.44.01 Sign Face Materials

All stop signs, yield signs, and "Do Not Enter" sign faces shall be fabricated from Scotchlite reflective sheeting, high-intensity grade or approved equal. All other sign faces shall be fabricated from Scotchlite reflective sheeting, engineer grade or approved equal.

8.44.02 Sign Post Materials

All sign posts shall be fabricated from 12-gauge galvanized, perforated Telespar tubing or approved equal. The sign post assembly shall consist of a VLOC steel 2 foot anchor sleeve and a two inch by two inch by ten-foot (2" x 2" x 10') post. See detailed drawing in Appendix.

8.44.03 Fire Lane Sign Specifications

Size: 12 Inches by 18 Inches

Materials: Engineer Grade Reflective Sheeting

Colors: Sign Letters on White Background. The letter on the symbol sign shall be black.

Wording: "No Parking" (or)
"Fire Lane" (with appropriate arrow)

General: Letter size, border, hole locations, and corner radii shall be per the Manual on Uniform Traffic Control Devices specifications.