CITY OF NEW BRAUNFELS

INTERSECTION IMPROVEMENT PROJECT

FINAL DESIGN SUBMITTAL

INTERSECTION IMPROVEMENT PROJECT

FM 1044 INTERSECTION IMPROVEMENT PROJECT

FM 1044 DESIGN SPEED - 50 MPH
KLEIN RD POSTED SPEED - 30 MPH

BY THE ACT OF SUBMITTING A BID FOR THIS PROPOSED CONTRACT, THE BIDDER WARRANTS THAT THE BIDDER AND ALL SUBCONTRACTORS AND MATERIAL SUPPLIERS HE INTENDS TO USE HAVE CAREFULLY AND THOROUGHLY REVIEWED THE DRAWINGS, SPECIFICATIONS AND ALL OTHER CONTRACT DOCUMENTS AND HAVE FOUND THEM COMPLETE AND FREE FROM AMBIGUITIES AND SUFFICIENT FOR THE PURPOSE INTENDED. THE BIDDER FURTHER WARRANTS THAT TO THE BEST OF HIS OR HIS SUBCONTRACTORS AND MATERIAL SUPPLIERS' KNOWLEDGE, ALL MATERIALS AND PRODUCTS SPECIFIED OR INDICATED HEREIN ARE ACCEPTABLE FOR ALL APPLICABLE CODES AND AUTHORITIES.

THE LOCATION OF ALL EXISTING UTILITIES SHOWN ON THESE PLANS HAS BEEN BASED UPON RECORD INFORMATION ONLY AND MAY NOT MATCH LOCATION AND/OR DEPTHS AS CONSTRUCTED. THE CONTRACTOR SHALL CONTACT EACH OF THE INDIVIDUAL UTILITIES FOR ASSISTANCE IN DETERMINING EXISTING LOCATION AND DEPTHS PRIOR TO BEGINNING CONSTRUCTION. CONTRACTOR SHALL FIELD VERIFY LOCATIONS OF ALL EXISTING UTILITY CROSSINGS PRIOR TO BEGINNING CONSTRUCTION. CONTRACTOR SHALL CONTACT EACH OF THE INDIVIDUAL UTILITIES FOR ASSISTANCE IN DETERMINING EXISTING LOCATION AND DEPTHS PRIOR TO BEGINNING CONSTRUCTION.


GAS UTILITIES ARE NOT INCLUDED IN THE CIVIL CONSTRUCTION PLANS. NO GAS IMPROVEMENTS PROPOSED.

Specifications adopted by the Texas Department of Transportation, November 1, 2014 and specification items listed and dated as follows, shall govern on this project. Required contract provisions for all Federal-aid construction contracts (form FHWA 1273, May, 2012)

CITY MANAGER
ROBERT CAMARENO
## GENERAL NOTES

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<tr>
<th>NOTE</th>
<th>SHEET A</th>
<th>SHEET B</th>
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<tr>
<td>168-1</td>
<td>Apply vegetative watering as needed to supplement natural rainfall during the vegetation establishment period. Plan quantity of irrigation water is based on the application of a total of 1.3 gal of water each week for each sq. yd. of area that is sodded or seeded. Establishment time is estimated to be 12 weeks for both sod and permanent seed mixes. Temporary seeding will require less time for establishment. Provide a schedule and coordinate watering cycles and rates per cycle with the Engineer. Obtain approval if the quantity of water to be applied is expected to exceed the plan quantity. Adjust the amount of water applied with each cycle and the number of cycles each wk, according to actual site conditions. Drought or other conditions, as determined by the Engineer, may require the application of supplemental irrigation during hours other than normal working hours.</td>
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<td>500-1</td>
<td><em>Payments on Hand</em> will not be considered in determining percentages for mobilization payments.</td>
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<td>502-1</td>
<td>Place standard markings no later than 14 days after surface treatment operations are completed.</td>
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Control: 2021-01-XXX, etc.  
Sheet

County: Comal and Guadalupe
Highway: FM 1044 and Schmidt Ave. FM 1044 and County Line Rd, W Klein Rd and Klein Way

502-2 When advanced warning flashing arrow panels and/or changeable message sign is specified, have one standby unit in good condition at the job site. Standby time shall be considered subsidiary to the bid item.

502-4 After written notification, the time frame is provided on the Form 599 to provide properly maintained signs and barricades before considered in non-compliance. Failure to make corrections as noted may result in payment for this item being withheld.

502-6 Moving an existing sign to a temporary location is subsidiary to this item. Installations with permanent supports or permanent locations will be paid for under the applicable bid item(s).

502-8 Notify the Engineer if writing 10 business days in advance of any temporary or permanent lane, ramp, connector, etc., closures/durons, restrictions to lane widths, alterations to vertical clearances, or modifications to radii. Any other modifications to the roadway that may adversely affect the mobility of oversized/overweight trucks also require 10 business days advance written notice to the Engineer. Unless shown in the TCP, no lane, ramp, connector, etc., closures are allowed during special events. At least one lane has to remain open at all times. Lane closures will not be allowed if this reporting requirement is not met.

502-10 Do not place barricades, signs, or any other traffic control devices where they interfere with sight distance at driveways or side streets.

502-11 In addition to providing a Contractor's Responsible Person and a phone number for emergency contact, have an employee available to respond on the project for emergencies and for taking corrective measures within 2 hours or within a reasonable time frame as specified by the Engineer.

502-13 If Nighttime work is required and work is not behind positive barrier then full TY 3 reflective gear is required to be worn by all workers, hard hat halos are required to be worn by the flaggers at flagging stations. TY III barricades are required to be spaced at 500 ft, and a mandatory night work meeting is required.

502-15 Moving or adjustment of traffic signal heads, VIVIDG, and radar detectors for the purpose of alignment with the shuffling of lanes in conjunction with the traffic control plan will be subsidiary to various bid items.

--Item 618--
It might be necessary to cut concrete for placement of conduit. Saw cut existing concrete, remove the concrete from the steel reinforcement (bars or fabric) and bend the steel to install the conduit. After the conduit has been placed, bend the steel back to its original position and backfill the trench with unapproved concrete. This work is subsidiary to this item.

General Notes

Sheet C

Control: 2021-01-XXX, etc.  
Sheet

County: Comal and Guadalupe
Highway: FM 1044 and Schmidt Ave. FM 1044 and County Line Rd, W Klein Rd and Klein Way

The conduit depth for illumination under the City of New Braunfels streets is 36 inches.

Use materials from Material Producers list as shown on the Construction Division's (CST) website. Category is "Roadway Illumination and Electrical Supplies."

--Item 666--

Use TY II material (vs. an acrylic or epoxy) as the sealer for the TY I markings, place the TY II a minimum of 14 calendar days (to provide adequate curing) before placing the TY I markings.

Failure to provide the new/replacement seeing data within the time specified in the specifications will result in non-payment of the bid item.

--Item 672--

Place all adhesive material directly from the heated dispenser to the pavement. Do not use portable or non-heated containers. Use adhesive of sufficient thickness so that when the marker is pressed into the adhesive, 1/8" or more adhesive will remain under 100% of the marker. The adhesive should extend not less than 1/2" but not more than 1 1/2" beyond the perimeter of the marker.

--Item 677--

Obtain approval before using the mechanical method for the elimination of existing thermoplastic pavement markings.

--Item 680--

Furnish and install all required materials and equipment necessary for the complete and operating traffic signal installation at the following intersection: FM 1044 and Schmidt Ave, FM 1044 and County Line Rd, W Klein Rd and Klein Way

All workers installing electrical materials, including conduit in trenches, service poles and all other system electrical apparatus, will be directly supervised by persons who have completed a TxDOT approved course in electrical underground installations. Furnish evidence of satisfactory completion of the underground electrical installation for roadway illumination and signal control service for all personnel responsible for direct supervision of electrical installation work.

The locations shown on the plans for signal pole foundations, controller foundations, conduit and other items may be adjusted to better fit field conditions as approved.

Furnish and install a new Henke Enterprises or Mobotex eight-phase NEMA TS2 Type 2 controller and cabinet, meeting the requirements of Departmental Materials Specifications DMS-11170. Provide detector panel toggle switches that additionally permit the user to disconnect the detector. For both ground and pole-mount cabinets, provide cabinet configuration with 16 position load bays.

General Notes

Sheet D

GENERAL NOTES
680-5 Deliver TS type 2 controller cabinet and assembly to the City of New Braunfels signal shop for programming and testing three weeks in advance prior to contractor installing equipment in the field. Coordinate drop off and pick up with Chris Nowak (830) 221-4049.

680-6 Connect all field wiring to the controller assembly. The Signal Shop representative will assist in determining how the detection cables are to be connected, and will also program the controller for operation, hook up the malfunction management unit (MMU) or conflict monitor, detector units, and other equipment, and turn on the controller. Have a qualified technician on the project site to place the exit’s signals in operation.

680-7 Contact Chris Nowak for traffic signal inspection when the installation is fully complete. Once all the punch list items have been addressed and the signal has passed final inspection then the signal turn on can be scheduled. Once the traffic signal has operated without failures for 30 days the power service account request for transfer can be submitted.

680-8 Use LED lamps from the prequalified material producer lists as shown on the Texas Department of Transportation (TxDOT) – Construction Division’s (CST) material producer list. Category is “Roadway Illumination and Electrical Supplies.” Under Item 614. No substitutions will be allowed for materials found on this list.

680-9 Demonstrate that the field wiring is properly installed, install the controller assembly, connect the wiring and turn on the controller.

680-10 The following wiring sequence shall be used when connecting section signals to the cabinet:

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<tr>
<th>Conductor No.</th>
<th>Base Color</th>
<th>Tracer Color</th>
<th>Signal Face</th>
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<tr>
<td>1</td>
<td>Black</td>
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<td>Red Ball</td>
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<td>4</td>
<td>Green</td>
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<td>5</td>
<td>Orange</td>
<td>Yellow Arrow</td>
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<td>6</td>
<td>Blue</td>
<td>Green Arrow</td>
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<tr>
<td>7</td>
<td>White</td>
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General Notes

680-11 All existing signal equipment with the exception of the signal controller and related equipment become the property of the Contractor. Deliver the controller and related equipment to the Signal shop, located at 424 S Castell Ave in New Braunfels, Texas.

680-12 Use qualified personnel to inspect and diagnose all trouble calls during the thirty-day test period. Repair any malfunction to Contractor-supplied signal equipment. Provide to the Engineer a local telephone number, not subject to frequent changes and available on a 24-hour basis, for reporting trouble calls. Response time to reported calls must be less than 2 hours. Maintain appropriate repairs within 24 hours. Place a logbook in the controller cabinet and keep a record of each trouble call reported. Notify the Engineer of each trouble call. Do not clear the error log in the conflict monitor or MMU during the thirty-day test period without approval.

680-13 Integrate the proposed traffic signal(s) into the existing Advanced Traffic Management System (ATMS) as shown on the plans. Contract ATMS software, which utilizes Ecomultite controllers, is currently in use in the City of New Braunfels. Provide controllers on this project that fully communicate with the existing ATMS software. For use when signal controller is furnished by contractor.

680-14 This project includes the installation of at least one cellular modem at the location(s) specified in the plans. Cellular modem(s) and power supply(s) will be furnished by the department. Provide all materials not supplied by the department necessary for the cellular modem installation. All materials provided by the contractor must be new unless otherwise shown on the plans. Equipment provided by the department shall be stored by the department for pick up at the City of New Braunfels Signal Shop located at 424 S Castell, New Braunfels, TX 78130. Prevent damage to all cellular modem components supplied by the department. Replace any component that is damaged or lost during transportation or installation at the contractor’s expense. Verify operation of the cellular modem(s) together with operation of its links, demonstrate that data can be transmitted at a satisfactory rate from the field location to the central location. Demonstrate that the cellular modem(s) data packets are being received at the central site via a networked computer. Transportation, installation, and incidentals for installation of the cellular modem(s) shall be considered subsidiary to item 680. For use when a cellular communication link will be established to Timegate.

680-15 Provide a submittal compliance matrix with all traffic signal submittals.

680-16 Contractor shall be responsible for field verifying the depths of the drill shafts to meet the minimum clearances specified in the plans before ordering materials.

680-17 Damage to existing facilities such as traffic signal equipment, conduit, cables, etc. caused by the contractor during construction will be replaced by the contractor at no cost to the City of New Braunfels with equipment as approved by the engineer. Replace all pavements, sidewalk, curb,
Control: 2021-01-XXX, etc.  
County: Comal and Guadalupe  
Highway: FM 1044 and Schmidt Ave. FM 1044 and County Line Rd, W Klein Rd and Klein Way

rip-rap or any item damaged during construction subsidiary to various bid items with no direct payment. Any damage that was not caused by the contractor during operations will be reimbursed for repair of damage caused by: motor vehicle, watercraft, aircraft, or railroad-train incident, vandalism or acts of God, such as earthquake, tidal wave, tornado, hurricane, or other cataclysmic phenomena of nature.

680-18 Ensure that all TMS (Traffic Management System) equipment furnished and installed is completely compatible with the existing hardware and software located within the City of New Braunfels operations center. The contractor shall contact the traffic engineer for details on the system network architecture.

680-19 Contractor shall be responsible for integrating and testing all new TMS equipment and any existing TMS equipment that is relocated into the existing network management system, subsidiary to the various bid items.

680-20 Security against theft and vandalism of all traffic signal equipment is the full responsibility of the contractor until the date of final acceptance of the project by the engineer.

680-21 Maintenance of all TMS equipment furnished and installed on this project is the full responsibility of the contractor until date of final acceptance of this project by the engineer. All required documentation must be turned in before City of New Braunfels will accept project for maintenance.

680-22 Perform all electrical work in accordance with the National Electrical Code and Texas Department of Transportation Specifications.

680-23 In accordance with the Underground Facility Damage Prevention Act (One Call Bill) the phone number for a utility locator is 1-800-545-6005. It is the Contractor's responsibility to make arrangements for utility locators as needed.

680-24 Contact Chris Nowak/New Braunfels Traffic Signal Foreman 830-221-4049 cnnowak@newbraunfels.gov for cabinet set up and traffic signal acceptable equipment list. Send submittals for traffic signal equipment to Chris Nowak.

680-25 Contact Chris Nowak for traffic signal inspection when the installation is fully complete. Once all the punch list items have been addressed and the signal has passed final inspection then the signal turn on can be scheduled. Once the traffic signal has operated without failures for 30 days the power service account request for transfer can be submitted.

680-26 All equipment and materials deemed salvageable by the CONH Traffic Signal Department shall be delivered to CONH undamaged and complete with all hardware 424 S. Castell Ave. NTH 78130. Contact Chris Nowak to schedule delivery times.

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Item 682-  
All signal heads shall be Eagle brand polycarbonate. Pedestrian signals may be by a different manufacturer than the vehicle signal heads. All back plates shall be vented aluminum with 2-inch reflective HIP borders.

682-1 Cover all signal faces until placed in operation.

682-2 All pedestrian signal faces shall be single section LED Type. Die cast polycarbonate is acceptable in lieu of die cast aluminum. All mounting attachments shall be constructed of steel pipe and mounted as shown on the plans.

682-3 For all proposed mast arm pole assemblies, use mounting bracket assembly Option "C" as shown on the State Standard Sheet(s) "Single Mast Arm Assemblies".

682-4 All signals shall be mounted vertically a minimum of 19 feet above the roadway.

682-5 Provide an extra 10" for each cable terminating in the controller cabinet. All cables shall be continuous without splices from terminal point to terminal point. All proposed signal cable shall be #12 AWG stranded copper.

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Item 686 & 687-  
Provide all signal poles from the same manufacturer. Pedestrian poles may be from a different manufacturer.

686-1 Street Name signs shall be mounted on the poles with astro brackets sign mounting hardware.

686-2 All street name signs mounted on spurs and mast arms shall be secured with additional 1-inch stainless fender washers.

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Item 688-  
The sealant used for vehicle loop wire must be approved.

688-1 The force to activate the control shall be no greater than 5 lbf. The button placement has to be coordinated with the concrete pad to access the button and if any mounting modifications are needed (extensions, brackets, etc.) to meet ADA and TIDR requirements the adjustment will be subsidiary to item 688. The concrete pad (if required) shall be paid separately.

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General Notes Sheet G
Control: 2021-01-XXX, etc.  

County: Comal and Guadalupe  
Highway: FM 1044 and Schmidt Ave. FM 1044 and County Line Rd, W Klein Rd and Klein Way  

688-3 The pedestrian push button shall be wired with a 2/C#14 loop detector cable in lieu of a #12 A.W.G. XHHW wire.  

688-4 Furnish and install new Polara Enterprises accessible pedestrian signals (APS) push buttons or approved equivalent.  

688-5 It is the responsibility of the contractor to program all audible pedestrian buttons with TXMUTCD compliant verbiage.  

---Item 6185---  
1 shadow vehicles with TMA will be required for this project. The TMA’s will be measured and paid for by the BAY for each TMA/TA set up and operational on the work zone. The contractor will be responsible for determining if one or more of these operations will be ongoing at the same time to determine the total number of TMA’s needed for the project. See TMA and TA Summary sheet for plans.  

---Item 6292---  
6292-1 Radar presence detection device must utilize true-presence detection. Systems using loocking  
6292-2 algorithms to attempt presence detection will not be accepted. In addition, radar systems will not  
6292-3 be allowed to use extensions/delayed or place the controller on locking detection to aid in  
6292-4 presence detection.  
6292-5 Radar presence detection device must be able to detect up to 10 lanes with a minimum of one of  
6292-6 these lanes with at least 16 zones and channels per unit.  
6292-7 Radar presence detection device must be mounted on the same side of the intersection as the  
6292-8 lanes it is to detect.  
6292-9 
6292 5 Furnish and install new Wavetronix SmartSensor Matrix for radar presence detectors and  
6292 6 Wavetronix SmartSensor Advance for radar advanced detection devices.
<table>
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<th>Description</th>
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**FOR CONTRACTOR INFORMATION ONLY**
**SUMMARY OF QUANTITIES**

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**LOCATION:**

**TOTALS:**
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TCP GENERAL NOTES

1. No transitions or traffic restrictions will be allowed until all materials, equipment, workforce, etc. are ready and able to continuously prosecute the work.
2. It is the intent of the plans to provide for the safe passage of traffic at all times. The contractor is to consider this in executing its construction operations.
3. Traffic must be modeled over the entire project during construction.
4. Prior to beginning work in any section of the project, place all roadside signs on temporary supports at an approved location and as work progresses, existing road signs may be used and placed on temporary supports as necessary. This work shall be subject to step 500.
5. Shadow vehicles with truck mounted attenuators will be required for this project as specified in the referenced traffic control standards. These items will be paid for under item 6185.
6. Contractor to follow BC standards for advance warning signs for all phases of construction.
7. Contractor to maintain positive drainage at all times.

CONSTRUCTION SEQUENCE

PHASE 1: CONSTRUCT TRAFFIC SIGNAL ASSEMBLY, CHANNELIZED RIGHT TURN LANE, AND SIDEWALKS
1. Set barricades, warning signs, and other traffic control appurtenances in accordance with BC, WT, and TCP standards.
2. Relocate existing signs to temporary supports as necessary.
3. Construct traffic signal assembly as shown on plans and in accordance with state standards WZ (BTS-1)-13 and BC 1107-12-21. Traffic signal heads are to be run in any mode prior to activation.

PHASE 2: CONSTRUCT SIGNING AND PAVEMENT MARKINGS
1. Set barricades, warning signs, and other traffic control appurtenances in accordance with BC, WT, and TCP standards.
2. Perform signing and permanent pavement markings utilizing standards TCP (5-15), TCP (5-21), TCP (5-34) and WZ (BTS-2)-13 PR!
3. Contractor to follow BC and TCP standards.
4. Contractor to maintain positive drainage at all times.
5. Final cleanup.
DETOURS, BARRIACDES, WARNING SIGNS, SEQUENCE OF WORK, ETC.

THE CONTRACTOR'S ATTENTION IS DIRECTED TO THE REQUIREMENTS OF ITEM 7, TEMPORARY RELATIONS AND RESPONSIBILITIES OF THE PUBLIC FOR THE STANDARD SPECIFICATIONS, IN ADDITION TO THESE REQUIREMENTS, THE FOLLOWING PROVISIONS SHALL ALSO GOVERN THIS CONTRACT:

1. GENERAL

(1) TRAFFIC MUST BE HANDLE THROUGHOUT THE PROJECT DURING CONSTRUCTION. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING SAFETY AND COMFORTABLE PASSAGE FOR VEHICLES AND PEDESTRIANS, WITH MINIMUM INCONVENIENCE TO THE PUBLIC. AS SHOWN ON THE PLANS OR AS DIRECTED/APPROVED BY THE ENGINEER.

(2) THE CONTRACTOR MAY PROVIDE/RECOMMEND MODIFICATIONS TO THE SEQUENCE OF WORK FOR CONSIDERATION BY THE ENGINEER. ANY MODIFIED MODIFICATIONS TO THE CONTRACTOR SHALL INCLUDE ANY CHANGES TO THE VARIOUS ROUTES IMPACT TO TRAFFIC, EFFECT OF VARIOUS PROJECTS IN TIME AND COST, ETC. IF THIS PROPOSAL IS IMPLEMENTED, THE CONTRACTOR IS RESPONSIBLE FOR PREPARING A DETAILED PLAN SHEET TO BE UPDATED BY A LICENSED PROFESSIONAL ENGINEER FOR INCLUSION WITH THE CHANGE ORDER. THE CONTRACTOR CANNOT PROCEED WITH ANY CONSTRUCTION OPERATIONS BASED ON A REVISED SEQUENCE UNLESS WRITTEN APPROVAL IS OBTAINED FROM THE ENGINEER.

(3) IF AT ANY TIME DURING CONSTRUCTION THE CONTRACTOR PROPOSES A PLAN OF OPERATION FOR HANDLING TRAFFIC, THE CONTRACTOR'S PLAN OF OPERATION FOR HANDLING TRAFFIC DOES NOT PROVIDE FOR SAFETY AND COMFORTABLE MOVEMENT, THE CONTRACTOR MUST IMMEDIATELY DISCONTINUE AND CORRECT THE UNFAVORABLE CONDITION.

(4) THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING SUFFICIENT NOTIFICATION TO THE CONTRACTOR OF ANY MODIFICATIONS TO THE PLANS FOR THE PROJECT DURING CONSTRUCTION.

2. SEQUENCE OF WORK

FM 1044 AND COUNTY LINE RD, WY KLEIN RD AND KLEIN WAY.

BEFORE CONSTRUCTION IS INITIATED ON EACH INTRERSECTION, INSTALL ADVANCE WARNING SIGNS, PERMANENT SIGNS AND BARRIACDES AS SHOWN ON THE PLANS AND AS DIRECTED/APPROVED BY THE ENGINEER. DAILY LANE CLOSURES WILL BE IN ACCORDANCE WITH STATE TSCP STANDARDS. DROP OFF CONDITIONS OF GREATER THAN 2 DIFFERENT WILL HAVE 3 MILES OF STOP SIGNS AT EACH ENTRANCE. AS WELL AS THROUGHOUT THE PROJECT, ACCESS TO ADJACENT PROPERTIES IS ALLOWED TO DRIVEWAYS AND SIDE STREETS.

3. SAFETY

(1) THE CONTRACTOR WILL PROVIDE, CONSTRUCT AND MAINTAIN BARRIACDES AND SIGNS IN ACCORDANCE WITH STATE STANDARDS. ANY SIGNS REQUIRED TO BE PLACED ON THE PLAN AND FOUND IN CONFORMANCE WITH THE "TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS" AND THE "STATE-HIGHWAY SIGN DESIGNS FOR TEXAS.

(2) BARRIACDES AND WARNING SIGNS SHALL BE PLACED AS INDICATED ON THE PLANS. THE CONTRACTOR WILL PROVIDE AND MAINTAIN ALL SUCH BARRIACDES AND SIGNS DESIGNED NECESSARY TO THE ENGINEER OF DIRECTED/APPREOVED BY FIELD CONDITIONS TO PROVIDE FOR THE PASSAGE OF TRAFFIC IN A SAFE MANNER AT ALL TIMES.

4. HAULING EQUIPMENT

(1) THE USE OF RUBBER-TIRED EQUIPMENT WILL BE REQUIRED FOR MOVING DIRT OR OTHER MATERIALS ALONG OR AROUND PREPARED SURFACES, WHERE THE CONTRACTOR DESIRES TO MOVE ANY EQUIPMENT NOT LICENSED FOR OPERATION ON PUBLIC HIGHWAYS, OR ON APPROXIMATELY THE CONTRACTOR SHALL PROVIDE THE INFORMATION FROM WHICH IS DIRECTED/APPROVED BY THE ENGINEER.

(2) THROUGHOUT CONSTRUCTION OPERATIONS, THE CONTRACTOR WILL BE REQUIRED TO CONDUCT THEIR HAULING OPERATIONS IN A MANNER SUCH THAT VEHICLES WILL NOT HAUL OVER PREVIOUSLY RECOMPAKED SUBSURFACES OR COMPAKED BASE MATERIAL, EXCEPT IN SHORT SECTIONS FOR DUMPING MANEUVERS.

5. FINAL CLEAN UP

UPON COMPLETION OF THE WORK AND BEFORE FINAL ACCEPTANCE AND FINAL PAYMENT IS MADE, THE CONTRACTOR SHALL CLEAR AND REMOVE FROM THE SITE ALL SUPPLIES AND DISCARDED MATERIALS AND DEBRIS OF EVERY KIND AND LEAVE THE ENTIRE PREMISES IN A CLEAN, NEAT AND NEATLY CONDITION.

6. PAYMENT

ALL BARRIACDES, SIGNS, AND FLASHERS WILL BE SUBSIDIARY TO ITEM 62 BARRIACDES, SIGNS AND TRAFFIC HANDS. ALL DISCARD AND DEMOLITION CONTROLS DEVICES WILL BE PAID FOR UNDER ITEM 350. TEMPORARY EROSION, SEGREGATION, AND ENVIRONMENTAL CONTROLS, ALL WORK ZONE PAYMENT MARKINGS WILL BE PAID FOR UNDER ITEM 80 WORK ZONE PAYMENT MARKINGS. ALL OTHER WORK AND MATERIALS WILL BE SUBSIDIARY TO THE VARIOUS Bidding ITEMS UNLESS OTHERWISE INDIATED IN THE PLANS.
### Traffic Control Plan Items

<table>
<thead>
<tr>
<th>Location</th>
<th>Signal Work Area</th>
<th>Road Work</th>
<th>Traffic Fines</th>
<th>State Law</th>
<th>Work Zone</th>
<th>Changeable Message Boards</th>
<th>Arrow Panels</th>
<th>Barrels</th>
<th>Arrow Board</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM 1044 at County Line Rd</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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<tr>
<td>FM 1044 at Schmidt Ave</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Klein Rd at Klein Way</td>
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<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
</tr>
</tbody>
</table>

### Project Limit Signs

1. Certain signs must be used in conjunction with other signs. Examples: "Flagger Ahead" must have a "Be Prepared To Stop".
2. Barricades and warning signs on this sheet are the minimum construction zone, signing, additional barricades, warning signs, arrow panels, cones, etc., required in accordance with current State and the Texas A&D or required in areas of actual construction.
3. A distance (mile or feet) may be required for use in conjunction with warning signs.
4. Incorporate signage in accordance with the Texas Code. Use changeable message boards to change messages through the duration.

### Schedule of Barricades & Advanced Warning Devices

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Design</th>
<th>Approval</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>FM 1044 at County Line Rd</td>
<td>Gilmer D. Gaston, P.E.</td>
<td>Justin W. Clark, P.E.</td>
</tr>
<tr>
<td>2</td>
<td>FM 1044 at Schmidt Ave</td>
<td>Gilmer D. Gaston, P.E.</td>
<td>Justin W. Clark, P.E.</td>
</tr>
<tr>
<td>3</td>
<td>Klein Rd at Klein Way</td>
<td>Gilmer D. Gaston, P.E.</td>
<td>Justin W. Clark, P.E.</td>
</tr>
</tbody>
</table>

### Notes

- Certain signs must be used in conjunction with other signs. Examples: "Flagger Ahead" must have a "Be Prepared To Stop".
- Barricades and warning signs on this sheet are the minimum construction zone, signing, additional barricades, warning signs, arrow panels, cones, etc., required in accordance with current State and the Texas A&D or required in areas of actual construction.
- A distance (mile or feet) may be required for use in conjunction with warning signs.
- Incorporate signage in accordance with the Texas Code. Use changeable message boards to change messages through the duration.

---

**Design:** Gilmer D. Gaston, P.E.

**Approval:** Justin W. Clark, P.E.

**Pape-Dawson Engineers**

**Top of New Boulevards**
### Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA) Summary Sheet

<table>
<thead>
<tr>
<th>LOC NO.</th>
<th>TCP NO.</th>
<th>SPECIFIC TCP PLAN SHEET</th>
<th>INITIAL TMA/TA</th>
<th>TOTAL TMA/TA</th>
<th>DURATION OF TMA/TA SET UP (DAY)</th>
<th>TRUCK ATTENUATOR (TA)</th>
<th>TRAILER ATTENUATOR (TA)</th>
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<tr>
<td>1</td>
<td>1</td>
<td>FM 1044 AT COUNTY LINE RD</td>
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<td>FM 1044 AT SCHMIDT AVE</td>
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<td>4</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>KLEIN RD AT KLEIN WAY</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

**Note:**
- **FURNISH TMA/TA**: The number of attenuators being furnished for the specific TCP.
- **RELOCATE/REUSE TMA/TA**: The number of attenuators being re-used from a previous TCP for the specific TCP.
- **TOTAL TMA/TA PER SET UP**: The number of attenuators that will be used for the specific TCP.
- **DURATION OF TMA/TA SET UP**: The number of days the attenuators will be used for the specific TCP.

**Equations:**
- **TOTAL TMA/TA**: FURNISH TMA/TA + RELOCATE/REUSE TMA/TA
- **DURATION OF TMA/TA SET UP**: TMA/TA (STATIONARY) x TOTAL TMA/TA PER SET UP

**Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA) Summary Sheet**

**��置：**
- **FURNISH TMA/TA**: 1
- **RELOCATE/REUSE TMA/TA**: 1
- **TOTAL TMA/TA**: 2
- **DURATION OF TMA/TA SET UP**: 2 days

**Note:**
- **TOTAL TMA/TA**: FURNISH TMA/TA + RELOCATE/REUSE TMA/TA
- **DURATION OF TMA/TA SET UP**: TMA/TA (STATIONARY) x TOTAL TMA/TA PER SET UP
GENERAL NOTES

1. Trail, Shadow, and LED vehicles shall be equipped with arrow boards as illustrated. All LED vehicles shall be equipped with an amber arrow board. The Engineer shall determine if the LED vehicle and/or TRAIL VEHICLE are required based on prevailing roadway conditions, traffic volume, and sight distance restrictions.

2. The use of amber high intensity rotating, flashing, oscillating, or strobe lights or vehicles are required. Blue high intensity rotating, flashing, oscillating or strobe lights when mounted on the driver’s side of the vehicle may be operated simultaneously with the amber lights or strobe lights.

3. The use of truck mounted attenuators (TMA) on the SHADOW VEHICLE and TRAIL VEHICLE is required.

4. Reflective sheathing on the rear of the amber strobe cone shall be used. The reflective sheathing shall meet the requirements of the Departmental Material Specification (DMS) 8300, Type A.

5. Flashing arrow boards shall be Type B or Type C per the Barricade and Construction (BC) standards. The board shall be controlled from inside the vehicle.

6. Each vehicle shall have two-way radio communication capability.

7. When work convoys change lanes, the SHADOW VEHICLE should change lanes first to allow the other convoy vehicles to move to the lane.

8. Vehicle spacing between the TRAIL VEHICLE and the SHADOW VEHICLE will vary depending on the size and type of convoy. The Engineer shall determine the appropriate spacing. The TRAIL VEHICLE should be able to see the SHADOW VEHICLE in time to slow down and/or change lanes as necessary. The LED vehicle, vehicle spacing between the TRAIL VEHICLE and SHADOW VEHICLE and vehicle spacing between TRAIL VEHICLE and LED VEHICLE may vary depending on terrain, work activity and other factors.

9. "X VEHICLE CONVOY" (CW21-10cT) or "WORK CONVOY" (CW21-10bT) signs may be used where the number of convoy vehicles displayed on the sign is the same as the number of vehicles in the convoy. The "X VEHICLE CONVOY" sign shall not be used on the SHADOW VEHICLE if a TRAIL VEHICLE is used.

10. On two-lane two-way roadways, the work and protection vehicles should not be used to block the roadway in front of the work truck traffic as it passes. It is recommended that the LED vehicle be placed in the road ahead of the work truck traffic to allow the truck traffic to pass the work convoy. A "DO NOT PASS" (R4-1) sign should be placed on the back of the vehicle periodically to allow motor vehicle traffic to pass. If motorists are not allowed to pass the convoy, a "DO NOT PASS" (R4-1) sign should be placed on the back of the vehicle.

TRAFFIC CONTROL PLAN
MOBILE OPERATIONS
UNDIVIDED HIGHWAYS

TCP (3-1a)

UNDIVIDED MULTILANE ROADWAY

TCP (3-1b)

TWO-WAY ROADWAY WITH PAVED SHOULDERS

TCP (3-1c)

TWO-WAY ROADWAY WITHOUT PAVED SHOULDERS

TRAFFIC OPERATIONS DRAWINGS

TxDOT

Traffic Control Plans

TCP (3-1-13)
GENERAL NOTES

1. ADVANCE WARNING, TRAIL, and SHADOW vehicles shall be equipped with Type B or Type C flashing arrow boards as per the Standard and Construction (S&C) standards. Arrow boards on work vehicles will be dimmed based on the amount of work being performed, the arrow board shall be operated from a mobile control station.

2. For TCP(3-2a) the Engineer will determine if the TRAIL VEHICLE is required based on prevailing roadway conditions, traffic volume, and sight distance restrictions, and other vehicles shown for both TCP(3-2a) and TCP(3-2b) are required.

3. The use of a high intensity rotating, flashing, or strobe lights on vehicles is required. This high intensity rotating, flashing, or strobe lights may be operated simultaneously with the other beacons or strobe lights.

4. The use of arrow board displays must be on the advancing work, SHADOW, and TRAIL vehicles are required.

5. Reflective sheeting on the rear of the TMA shall meet or exceed the reflectivity and color requirements of AMS 8500, Type 4.4.

6. Both vehicles shall have two-way radio communication capability.

7. When work convoys must change lanes, the TRAIL VEHICLE shall change lanes first to shadow the other convoy vehicles.

8. Vehicle spacing between the TRAIL VEHICLE and the SHADOW VEHICLE will vary depending on shoulder width, sight distance, and traffic volume. The thin line or changeable message sign (PCMS) or a truck mounted changeable message sign (TMCMS) will be used in the second phase of the program. The arrow board will not be required on the advancing warning vehicle.

9. The signs shown on the Advance Warning Vehicle, as an option, a portable changeable message sign (PCMS) or a truck mounted changeable message sign (TMCMS) with a minimum character height of 12", and displaying the same message as shown in the legend may be substituted for these signs. An appropriate directional arrow display, simulating the size and color of the flashing arrow board, must be used in the second phase of the PCMS/TMCMS message. When this is done, the arrow board will not be required on the Advance Warning Vehicle.

10. Standard 48" x 48" diamond shaped warning signs with the same message as those shown may be used when adequate mounting space exists.

11. The signs shown shall be used on the Advance Warning Vehicle. As an option, a portable changeable message sign (PCMS) or a truck mounted changeable message sign (TMCMS) with a minimum character height of 12", and displaying the same messages may be substituted for these signs. An appropriate directional arrow display, simulating the size and color of the flashing arrow board, must be used in the second phase of the PCMS/TMCMS message. When this is done, the arrow board will not be required on the Advance Warning Vehicle.

12. Standard diamond shape version of the CW20-5 series signs may be used as an option on the advancing work, SHADOW, and TRAIL vehicles are required.

13. The principles on this sheet may be used to close lanes from the left side of the roadway considering the number of lanes, shoulder width, and sight distance requirements.

14. The Advance Warning Vehicle may straddle the edge line when shoulder width makes it necessary.

TRAFFIC CONTROL PLAN
MOBILE OPERATIONS
DIVIDED HIGHWAYS
TCP(3-2)-13

(See Note 1)

Shoulder

120'-200'

400'

1000'

60" X 36"

CW21-10aT

TRAVEL LANE

E N T R Y R A M P

D I S C L A I M E R:
T h e  u s e  o f  th is  s ta n d a r d  is  g o v e r n e d  b y  th e  " T e x a s  E n g in e e r in g  P r a c tic e  A c t".  N o  w a r r a n t y  o f  a n y
k in d  is  m a d e  b y  T x D O T  f o r  a n y  p u r p o s e  w h a t s o e v e r .  T x D O T  a s s u m e  n o  r e s p o n s ib ility  f o r  th e  c o n v e r s io
of this standard to other formats or for incorrect results or damages resulting from its use.
TWO LANE HIGHWAY WITH Paved SHOULDERS (WORK ON TRAVEL LANE)

Shoulder

120'-200'

See Trail/Shadow Vehicle A and note 8

Forward facing arrow boards

Lead vehicle with strobes

TWO LANE HIGHWAY WITHOUT Paved SHOULDERS (WORK ON TRAVEL LANE)

120'-200'

See note 8

DIVIDED MULTILANE HIGHWAY

120'-200'

See Trail/Shadow Vehicle A and note 8

120'-200'

See note 8

UNDIVIDED MULTILANE HIGHWAY

120'-200'

See note 8

TCP (3-3d)

TWO LANE HIGHWAY WITH Paved SHOULDERS

Forward facing arrow boards

Lead vehicle with strobes

TCP (3-3b)

TWO LANE HIGHWAY WITHOUT Paved SHOULDERS

Forward facing arrow boards

Lead vehicle with strobes

TCP (3-3a)

DIVIDED MULTILANE HIGHWAY

Forward facing arrow boards

Lead vehicle with strobes

TCP (3-3c)

UNDIVIDED MULTILANE HIGHWAY

Forward facing arrow boards

Lead vehicle with strobes

DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act." No warranty of any kind is given.
1. The Barricade and Construction Standard Sheets (BC sheets) are intended to show typical examples for placement of temporary traffic control devices, construction pavement markings, and typical work zone signs. The information contained in these sheets meet or exceed the requirements shown in the "Texas Manual on Uniform Traffic Control Devices" (TMUTCD).

2. The development and design of the Traffic Control Plan (TCP) is the responsibility of the Engineer.

3. The Contractor may propose changes to the TCP that are signed and sealed by a licensed professional engineer for approval. The Engineer may develop, sign, and seal Contractor proposed changes.

4. The Contractor is responsible for installing and maintaining the traffic control devices, as shown in the plans. The Contractor should not move or change the approximate location of any device without the approval of the Engineer.

5. Geometric design of lane shifts and detours should, where possible, meet the applicable design criteria contained in manuals such as the American Association of State Highway and Transportation Officials (AASHTO), "A Policy on Geometric Design of Highways and Streets," or the TxDOT "Roadway Design Manual," engineering judgment.

6. When projects are completed, the Engineer(s) may omit the END ROAD WORK, TRAFFIC FINES DOUBLE, and other advance warning signs if the signing would be redundant and the work areas appear continuous to the motorists. If the adjacent project is completed first, the Contractor should erect the necessary warning signs as shown on these sheets, the TCP sheets or as directed by the Engineer. The BEGIN ROAD WORK NEXT X MILES sign shall be revised to show appropriate work zone distance.

7. The Engineer may require duplicate warning signs on the median side of divided highways where median width will permit and traffic volumes justify the signing.

8. All signs shall be constructed in accordance with the details found in the "Standard Highway Sign Designs for Texas," latest edition. Sign details not shown in this manual shall be shown in the plans or the Engineer shall provide a detail to the Contractor before the sign is manufactured.

9. The temporary traffic control devices shown in the illustrations of the BC sheets are examples. As necessary, the Engineer will determine the most appropriate traffic control devices to be used.

10. As shown on BC(2), the OBEY WARNING SIGNS STATE LAW sign, STAY ALERT TALK OR TEXT LATER (see Sign Detail G20-10T) and the WORK ZONE TRAFFIC FINES DOUBLE sign with plaque shall be erected in advance of the CSJ limits. However, the TRAFFIC FINES DOUBLE sign will not be required on all projects, and the Contractor shall determine if additional safety of motorist operation work, such as striping or milling edgeline rumble strips, the BEGIN ROAD WORK NEXT X MILES, CONTRACTOR and END ROAD WORK signs shall be erected at or near the CSJ limits.

11. Except for devices required by Note 10, traffic control devices should be in place only while work is actually in progress or a definite need exists.

12. The Engineer has the final decision on the location of all traffic control devices.

13. Inactive equipment and work vehicles, including workers' private vehicles must be parked away from travel lanes. They should be as close to the right-of-way line as possible, or located behind a barrier or guardrail, and as approved by the Engineer.

WORKER SAFETY APPAREL NOTES:

1. Workers on foot who are exposed to traffic or to construction equipment within the right-of-way shall wear high-visibility safety apparel meeting the requirements of the "American National Standard for High-Visibility Apparel," or equivalent revisions, and labeled as ANSI 107-2004 standard performance for Class 2 or 3 risk exposure. Class 3 garments shall be considered for high-traffic volume work areas or night time work.

2. Workers on foot who are exposed to traffic or to construction equipment beyond the right-of-way line as possible, or located behind a barrier or guardrail, and as approved by the Engineer.

3. Workers on foot who are exposed to traffic or to construction equipment must be in compliance with "High-Visibility Apparatus and Garments for Use by Roadway Maintenance and Construction Personnel," or equivalent revisions, and labeled as ANSI 107-2004 standard performance for Class 2 or 3 risk exposure. Class 3 garments shall be considered for high-traffic volume work areas or night time work.

4. Workers on foot who are exposed to traffic or to construction equipment beyond the right-of-way line shall wear high-visibility safety apparel meeting the requirements of the "American National Standard for High-Visibility Apparel," or equivalent revisions, and labeled as ANSI 107-2004 standard performance for Class 2 or 3 risk exposure. Class 3 garments shall be considered for high-traffic volume work areas or night time work.

Only pre-qualified products shall be used. The "Compliant Work Zone Traffic Control Devices List" (CWZTCD) describes pre-qualified products and their sources and may be found online at the web address given below or by contacting the Texas Department of Transportation Traffic Operations Division - TEL Phone: (512) 416-5118

The documents below can be found online at:
http://www.txdot.gov

Texas Department of Transportation
Traffic Operations Division - TEL
Phone: (512) 416-5118

BARRICADE AND CONSTRUCTION
GENERAL NOTES AND REQUIREMENTS

BC(11)-14

Sheet 1 of 12

The documents below can be found online at:
http://www.txdot.gov

Compliant Work Zone Traffic Control Devices List (CWZTCD)
Material Producer List (MPL)
Roadway Design Manual - See "Manuals (Online Manuals)
Standard Highway Sign Designs for Texas (SHSD)
Texas Manual on Uniform Traffic Control Devices (TMUTCD)
Traffic Engineering Standard Sheets
DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act." No warranty of any of this standard to other formats or for incorrect results or damages resulting from its use.

DATE: 3/23/2023

FILE: "ROAD WORK AHEAD" (CW20-1D) signs are placed in advance of these work areas to remind drivers they are still when extended distances occur between minimal work spaces, the Engineer/Inspector should ensure additional spaces in the plans or as determined by the Engineer/Inspector, shall be in place.

6. When work occurs in the intersection area, appropriate traffic control devices, as shown elsewhere in the plans or as determined by the Engineer/Inspector, shall be in place.

5. Only diamond shaped warning sign sizes are indicated. See Typical Construction Warning Sign Size and Spacing chart or the See Typical Construction Plan for this information.

4. The "ROAD WORK NEXT X MILES" sign shall be replaced by the detour signing called for in the plans.

3. Based on existing field conditions, the Engineer/Inspector may require additional signs such as FLAGGER or other appropriate signs as required. These signs shall be consistent with all of the shaper requirements. The Engineer/Inspector will determine the proper identification of any sign not shown on the BC sheets, Traffic Control Plans, and sheets of the Work Control Plans.

2. If construction closes the road at a T-intersection the Contractor shall place the "CONTRACTOR WORK ZONE AT T-INTERSECTION" (G20-5T) and "ROAD WORK NEXT X MILES" (G20-5aT) signs shall be replaced by the detour signing called for in the plans.

1. The Engineer shall determine the types and location of any conditional traffic control devices, such as flagger and accompanying signs, or other signs, that should be used when work is being performed on or near an intersection.

Note: The "ROAD WORK NEXT X MILES" left arrow (G20-1bTL) and "ROAD WORK NEXT X MILES" right arrow (G20-1bTR) "signs shall be replaced by the detour signing called for in the plans.

SAMPLE LAYOUT OF SIGNING FOR WORK BEGINNING DOWNSTREAM OF THE CSJ LIMITS

- **Work Areas in Multiple Locations within CSJ Limits**
  - **T-Intersection**
    - **Sample Layout of Signing for Work Beginning at the CSJ Limits**
      - **Sample Layout of Signing for Work Beginning Downstream of the CSJ Limits**

Notes:
- The Contractor shall determine the appropriate distance for the "ROAD WORK NEXT X MILES" signs as indicated on the plans.
- The "ROAD WORK NEXT X MILES" sign shall be placed at the portion of the road where the construction is taking place.
- The Contractor shall install a regulatory speed limit sign at the end of the work zone.

Typical Construction Warning Sign Size and Spacing chart or the See Typical Construction Plan for this information.

BARICADE AND CONSTRUCTION PROJECT LIMIT

BC(2)-14

See Typical Construction Warning Sign Size and Spacing chart or the See Typical Construction Plan for this information.

Texas Department of Transportation

Traffic Operations Division

Sheet 2 of 12
TYPICAL APPLICATION OF WORK ZONE SPEED LIMIT SIGNS

Work zone speed limits shall be regulatory, established in accordance with the "Procedures for Establishing Speed Zones," and approved by the Texas Transportation Commission, or by City Ordinance when within Incorporated City Limits.

Reduced speeds should only be posted in the vicinity of work activity and not throughout the entire project. Regulatory work zone speed signs (R2-1) shall be removed or covered during periods when they are not needed.

Guidance for use:

LONG/INTERMEDIATE TERM WORK ZONE SPEED LIMITS

This type of work zone speed limit should be included in the design of the traffic control plans when restricted geometries with a lower design speed are present in the work zone and modification of the geometry to a higher design speed is not feasible.

Long/Intermediate Term work zone speed limit signs, when approved as described above, should be posted and visible to the motorist when work activity is present. Work activity may also be defined as a change in the roadway that requires a reduced speed for motorists to safely negotiate the work area, including:
- Rough road or damaged pavement surface
- Substantial alteration of roadway geometric (diversion)
- Construction detours
- Grades
- Width
- Other conditions readily apparent to the driver

As long as any of these conditions exist, the work zone speed limit signs should remain in place.

SHORT TERM WORK ZONE SPEED LIMITS

This type of work zone speed limit may be included in the design of the traffic control plans when workers or equipment are not behind concrete barriers, and when work activity is within 50 feet of the travelway or activity in the traveled way.

Short term work zone speed limit signs should be posted and visible to the motorists only when work activity is present. When work activity is not present, signs shall be removed or covered. (See Removing or Covering on BC(4)).

General Notes:

1. Regulatory work zone speed limits should be used only for sections of construction projects where speed control is of major importance.
2. Regulatory work zone speed limit signs shall be placed on supports of a 7 foot minimum mounting height.
3. Speed zone signs are illustrated for one direction of travel and are normally posted for each direction of travel.
4. Frequency of work zone speed limit signs should be:
   - 40 mph and greater: 0.2 to 2 miles
   - 35 mph and less: 0.7 to 1 mile
5. Regulatory speed limit signs shall have black legend and border on a white reflective background (See "Reflective Sheeting" on BC(4)).

6. Longitudinal, transverse, and maintenance of the "ADVANCE SPEED LIMIT" plaque and the "SPEED LIMIT" plaque shall not be sold for directly, but shall be considered subsidiary to Item 502.
7. Turning signs from view, laying signs over or down will not be allowed, unless as otherwise noted under "REMOVING OR COVERING" on BC(4).
8. Techniques that may help reduce traffic speeds include but are not limited to:
   - Law enforcement.
   - Portable sign.
   - Portable changeable message sign (PWM).
   - Low-power (drone) radar transmitter.
   - Flagger stationed next to sign.
   - Speed monitor trailers or signs.
9. Speeds shown on details above are for illustration only.
10. For more specific guidance concerning the type of work, work zone conditions and factors impacting allowable regulatory construction speed zone reduction see "Note 2" in the TxDOT form system.
1. Barrier reflectors shall be pre-qualified, any color to the color and reflective requirements of 690-600, a site of pre-qualified barrier reflectors can be found at the TMUGR (Texas Motorist Use Guidebook Reference) page 229.  

2. The color of barrier reflectors shall be as specified in the TMUGR, the cost of the reflectors shall be considered separately by TxDOT.  

3. Where traffic is on one side of the CTB, two (2) barrier reflectors shall be installed on alternate sides of the CTB as shown in the detail above.  

4. Type A flashing warning lights are intended to warn drivers that they are approaching or are in a potentially hazardous area.  

5. The warning reflectors shall be yellow in color and shall be manufactured using a sign substrate approved for use with plastic drums listed in the TMUGR.  

6. The warning reflectors shall have a minimum of 3 barrier reflectors on the rear of the Type A flashing warning light.  

7. The Type A Warning Lights shall have a yellow reflective surface area of at least 30 square inches.  

8. The warning reflectors shall have a minimum of 3 barrier reflectors as per manufacturer's recommendations.  

9. The warning reflectors shall have a minimum of 3 barrier reflectors on the rear of the CTB as shown in the detail above.  

10. The warning reflectors shall have a minimum of 3 barrier reflectors as per manufacturer's recommendations.
**GENERAL NOTES**

1. The use of this standard is governed by the "Texas Engineering Practice Act." No warranty of any of this standard to other formats or for incorrect results or damages resulting from its use.

2. Dates are formatted as DD MMM YYYY.

**RETROREFLECTIVE SHEETING**

- Pre-qualified plastic drums shall meet the following requirements:
  - Plastic drums shall be of a fusible design, the "base" of the drum shall be the top portion and the "head" the top portion.
  - The body and base shall be shaped in such a manner that the body appears to be larger than the top portion, the body and base shall be separated by a ridge or sill.
  - Pre-qualified plastic drums shall be of a fusible design, the "base" of the drum shall be the top portion and the "head" the top portion.
  - The body and base shall be shaped in such a manner that the body appears to be larger than the top portion, the body and base shall be separated by a ridge or sill.

**BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES**

- **Direction Indicator Barricade**
  - The Direction Indicator Barricade may be used in tapers, on a background of Type B or Type C Orange retroreflective sheeting in alternating 4" to 8" stripes on a background of Type B or Type C Orange retroreflective sheeting in alternating 4" to 8" stripes.
  - Each drum shall have a minimum of 2 orange and white retroreflective circumferential stripes not less than 12" in width and a minimum of 5 orange and white retroreflective stripes not less than 8" in width.

- **Chevrons and other work zone signs with an orange background**
  - Shall be constructed of Type A reflective white or orange angle sheeting.
  - The primary channelizing device shall be orange and white chevrons not less than 8" in width and a minimum of 5 orange and white retroreflective stripes not less than 12" in width.
  - The base shall have a minimum width of 18" and a maximum height of 4 feet and shall be of a fusible design, the "base" of the drum shall be the top portion and the "head" the top portion.
  - The body and base shall be shaped in such a manner that the body appears to be larger than the top portion, the body and base shall be separated by a ridge or sill.

- **Built-in ballast**
  - Can be constructed of an integral crumb rubber base or one-piece cones may be used with the approval of the Engineer but only if it is approved by the Engineer.

- **Recycled truck tire sidewalls**
  - May be used for ballast on drums approved by the Engineer.

- **Bases with built-in ballast**
  - Shall weigh between 40 lbs. and 50 lbs.
  - This base, when filled with the ballast material, should weigh between 100 lbs. and 150 lbs.

- **Adhesives**
  - May be used to secure base of drums to pavement.

- **Ballast**
  - Shall not be placed on top of drums.

- **Holes in the bottoms**
  - Shall be allowed to accommodate water for drainage.

- **Drums**
  - Shall present a profile that is a minimum of 18 inches in width or 24 inches in height, except for the R9 series signs discussed in note 8 below.

- **Warning lights**
  - Shall not be attached to detectable pedestrian barriers, and wood or chain link fencing with a continuous surface above a rail with Type A retroreflective sheeting in alternating 4" to 8" stripes on a background of Type B or Type C Orange retroreflective sheeting.

- **Warning lights**
  - Shall not be attached to detectable pedestrian barriers, and wood or chain link fencing with a continuous surface above a rail with Type A retroreflective sheeting in alternating 4" to 8" stripes on a background of Type B or Type C Orange retroreflective sheeting.

- **Warning lights**
  - Shall not be attached to detectable pedestrian barriers, and wood or chain link fencing with a continuous surface above a rail with Type A retroreflective sheeting in alternating 4" to 8" stripes on a background of Type B or Type C Orange retroreflective sheeting.

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  - Shall not be attached to detectable pedestrian barriers, and wood or chain link fencing with a continuous surface above a rail with Type A retroreflective sheeting in alternating 4" to 8" stripes on a background of Type B or Type C Orange retroreflective sheeting.
TUBULAR MARKER

Min. 2 drums or 1 Type 3 barricade may be substituted for drums when the shoulder width is less than 4 feet. Drums may be omitted if drums are used.

Traffic cones and tubular markers shall be predominantly orange, and meet the height and weight requirements stated above. Drums, can be used to keep the cones upright and in place.

BARRICADE AND CONSTRUCTION CHANNELIZING DEVICES

Texas Department of Transportation
Traffic Operations Design

BC(10)-14

Sheet 10 of 12

1. This device is intended only for use as a replacement for Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
2. This device is intended only for use as an alternative to Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
3. This device is intended only for use as a replacement for Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
4. This device is intended only for use as a replacement for Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
5. This device is intended only for use as a replacement for Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
6. This device is intended only for use as a replacement for Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
7. This device is intended only for use as a replacement for Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
8. This device is intended only for use as a replacement for Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
9. This device is intended only for use as a replacement for Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
10. This device is intended only for use as a replacement for Type A, Field Spec. 8300. The device shall be used in accordance with the requirements stated herein.
RAISED PAVEMENT MARKERS

1. Temporary flexible-reflective roadway marker tabs used as guidemarks shall be of the types approved by TxDOT Specification Item 677 for "Eliminating Existing Pavement Markings and Markers." The removal of pavement markings may require marring or sandblasting the pavement surface as described in Item 677.

2. Subject to the approval of the Engineer, other methods that prove to be successful on a particular type pavement may be used.

3. Tab placement shall be replaced at the expense of the Contractor as per Specification Item 662, "Work Zone Pavement Markings.""PASS WITH CARE" signs at the beginning of sections where passing is prohibited and as shown on the Standard Plan Sheet WZ(STPM).

4. Pavement markings shall be installed in accordance with the TMUTCD, the plans and details as shown on the Standard Plan Sheet WZ(STPM).

5. Temporary flexible-reflective roadway marker tabs shall meet the requirements of DMS-8241.

6. Raised pavement markers used as guidemarks shall be from the approved list of prequalified reflective raised pavement markers, non-reflective traffic buttons, roadway marker tabs and other pavement markings can be found at the Material Producer List at web address shown on BC(1).

7. All work zone pavement markings shall be installed in accordance with Item 662, "Work Zone Pavement Markings.""PASS WITH CARE" signs at the beginning of sections where passing is prohibited and as shown on the Standard Plan Sheet WZ(STPM).

RAISED PAVEMENT MARKERS

1. Temporary flexible-reflective roadway marker tabs used as guidemarks shall be of the types approved by TxDOT Specification Item 677 for "Eliminating Existing Pavement Markings and Markers." The removal of pavement markings may require marring or sandblasting the pavement surface as described in Item 677.

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7. All work zone pavement markings shall be installed in accordance with Item 662, "Work Zone Pavement Markings.""PASS WITH CARE" signs at the beginning of sections where passing is prohibited and as shown on the Standard Plan Sheet WZ(STPM).

MAINTENANCE WORK ZONE PAVEMENT MARKINGS

1. Work zone pavement markings shall be removed at the end of the work zone.

2. The frequency and spacing requirements of work zone pavement markings as set forth by Item 677.

3. The markings shall be from a reflective material for maximum visibility of 300 feet of sight distance from a 300-foot section of roadway.

4. Markings shall conform to the section of roadway shown in the plans.
SUMMARY OF LARGE SIGNS

<table>
<thead>
<tr>
<th>BACKGROUND COLOR</th>
<th>SIGN DESIGNATION</th>
<th>SIGN DIMENSIONS</th>
<th>REFLECTIVE SHEETING</th>
<th>SQ FT</th>
<th>Cylindrical Structural Steel</th>
<th>Drilled Steel</th>
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<tbody>
<tr>
<td>Orange</td>
<td>G20-7T</td>
<td>96&quot;x 48&quot;</td>
<td>Type B or C</td>
<td>32</td>
<td>▲ ▲ ▲ ▲</td>
<td>▲</td>
</tr>
<tr>
<td>Orange</td>
<td>G20-7T</td>
<td>192&quot;x 96&quot;</td>
<td>Type B or C</td>
<td>128</td>
<td>▲ 16 ▲ 17 ▲ 12</td>
<td>▲</td>
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</table>

LEGEND
- Sign
- Large Sign
- Traffic Flow

GENERAL NOTES
1. See BC and SMD sheets for additional sign support details.
2. Sign locations shall be approved by the Engineer.
3. For projects more than two miles in length, Give Us a BRAKE signs shall be repeated halfway through the project. The Give Us a Brake (CW21-1T) may be used for this purpose.
4. Work zone speed limits are sometimes used in conjunction with Give Us a BRAKE signs. See BC(3) for location and spacing of construction speed zone signing when required.
5. Give Us a Brake (CW21-1T) signs and supports shall be considered subsidiary to Item 502, Barricades, Signs and Traffic Handling.
6. The 96" X 48" Working For You Give Us A BRAKE (G20-7T) may use a 1/2" or 5/8" plywood substrate or 0.125" aluminum sheathing substrate and may be supported by two 4" X 4" wood posts with drilled holes for breakaway as per BC(3) and will be subsidiary to Item 502.
7. The Working For You Give Us A BRAKE (G20-7T) 192"X 96" sign shall be pole or under the following specification limits
   Item 636 - Aluminum Sign
   Item 641 - Large Hazard Support and Assemblies
   Item 416 - Drilled Shaft Foundations
8. All signs shall be constructed in adherence with the details found in the "Standard Highway Sign Designs for Texas," latest edition. Sign details not shown in this manual shall be shown in the plans or the Engineer shall provide details to the Contractor before any sign is manufactured.

Departmental Material Specifications
<table>
<thead>
<tr>
<th>COLOR</th>
<th>USAGE</th>
<th>SHEETING MATERIAL</th>
</tr>
</thead>
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<tr>
<td>ORANGE</td>
<td>BACKGROUND</td>
<td>Type B or C</td>
</tr>
<tr>
<td>ORANGE</td>
<td>LEGEND &amp; BORDERS</td>
<td>NON-REFLECTIVE ACRYLIC FILM</td>
</tr>
</tbody>
</table>

Works Zone
“Give Us a Brake” Signs
WZ(BRK)-13
The typical advance signal project signing for long-term and intermediate-term work operations are as follows:

**GENERAL NOTES FOR WORK ZONE SIGNS**

1. Work zone durations are defined in Part 6, Section 6G.02 of the Texas Manual on Uniform Traffic Control Devices (TMUTCD).
2. Barricade signs shall NOT be used as sign supports.
3. Warning sign spacing shown in Figure 6F-2 of the TMUTCD.
4. Warning sign spacing shown is typical for both directions.
5. Temporary signs that have damaged or cracked substrates and/or substrates, they may be mounted on top of a plastic drum at or near the work area.
6. Rubber ballasts designed for channelizing devices should not be used for vehicular impact. Rubber, such as tire inner tubes, shall not be used.
7. Where pedestrians with visual disabilities normally use the closed sidewalk, location must be field adjusted to meet actual conditions.
8. Pavement markings for mid-block crosswalks shall be paid for under the construction operations are no longer.

**SIGN MOUNTING HEIGHTS**

- 1. All signs shall be retroreflective and constructed of sheeting meeting the requirements of the department's specifications shown in this sheet.
- 2. Sign height used to keep signs from turning over should be substantial placed on top of a plastic drum at or near the work area.
- 3. Signs shown may be placed on supports detailed on the BC standards or CWZTCD list, or when fabricated from approved lightweight plastic substrates, they may be placed on top of a plastic drum at or near the work area.
- 4. Warning sign spacing shown in Figure 6F-2 of the TMUTCD.
- 5. The width of existing sidewalk should be maintained if practical.
- 6. Where pedestrians with visual disabilities normally use the closed sidewalk, location must be field adjusted to meet actual conditions.
- 7. Pavement markings for mid-block crosswalks shall be paid for under construction operations are no longer.

**SIGN SUPPORT WEIGHTS**

- 1. Sign supports shall be placed on slopes.
- 2. Rubber ballasts designed for channelizing devices should not be used for vehicular impact. Rubber, such as tire inner tubes, shall not be used.
- 3. Rubber ballasts designed for channelizing devices should not be used for vehicular impact. Rubber, such as tire inner tubes, shall not be used.
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- 6. Rubber ballasts designed for channelizing devices should not be used for vehicular impact. Rubber, such as tire inner tubes, shall not be used.

**LEGEND & MATERIAL SPECIFICATIONS**

- **Color**: Black - Background, Reflective - Sheet Material
- **Usage**: Roadway, Sidewalk, Pedestrian
- **Type 3 Barricade**

**Temporary Traffic Control Devices List (C300)**

- **Signs and special pains shall be removed and stored in a safety east of the work.**

**Departmental Material Specifications**

- **Sheeting Material**: 405-1000
- **Color**: Black - Background, Reflective - Sheet Material
- **Usage**: Roadway, Sidewalk, Pedestrian
- **Type 3 Barricade**

**Floodlights**

- **Color**: Black - Background, Reflective - Sheet Material
- **Usage**: Roadway, Sidewalk, Pedestrian
- **Type 3 Barricade**

**Barricades and Signs**

- **Traffic Signal Work Barricades and Signs**
- **WZ (BTS) - 13**

**Construction Operations**

- **Sheet 1 of 2**
- **Comal County**
- **Job 7-13**
- **File:** CTXDOT - 1

**Texas Department of Transportation**

- **Traffic Operations**
- **April 1992

[See Note 4 below]

[See Note 6]

[See Note 8]
**Temporary Rumble Strips**

**RUMBLE STRIPS FOR LANE CLOSURE ON CONVENTIONAL ROADWAY**

**RUMBLE STRIPS ON ONE-LANE TWO-WAY APPLICATION**

**RISK NOTES**

1. Each Rumble Strip Array should consist of three evenly spaced rumble strips placed adjacent to center of the work zone shown in Table 2, placed transverse across the lane or lanes shown.

2. The GND-15 “ROAD WORK AHEAD” sign and any other signs used to identify the presence of the GND-15 sign should be extended beyond the Rumble Strips as necessary to provide needed warning.

3. Temporary Rumble Strips will be considered subsidiary to Lane Closures, and should be a product listed on the Compliant Work Zone Traffic Control Signs.

4. Temporary Rumble Strips shall be mounted on a flexible post or a channelizer device, channelizer, or project specific detail for the project.

5. Temporary Rumble Strips should not be used on hard surface or concrete pavements or unlined surfaces.

6. Temporary Rumble Strips should be maintained and monitored as per manufacturer's recommendations.

7. This standard sheet shall be used in conjunction with other appropriate Texas Standard, MUTCD, or project specific detail for the project.

8. The one-lane two-way application may utilize a flashing or steady light or LED sign to alert traffic before Rumble Strips are placed.

9. Temporary Rumble Strips may be used on freeways or expressways or on a limited access traffic signal.

**GENERAL NOTES**

- **Speed**
  - < 55 MPH
  - 55 MPH to 60 MPH
  - 60 MPH to 70 MPH
  - 70 MPH to 75 MPH
  - > 75 MPH

- **Rumble Strips**
  - WZ(RS-1a) 75 mph or Less
  - WZ(RS-1b) 75 mph or Less

**TYPICAL USAGE**

- **Type 3 Barricade**
  - Type 3 Barricade
  - Type 3 Barricade
  - Type 3 Barricade

**NOTE**

- **Taper Lengths** have been rounded off.

**TABLE 1**

<table>
<thead>
<tr>
<th>Taper Length</th>
<th># of Rumble Strips</th>
<th>1/8 Mile</th>
<th>1/4 Mile</th>
<th>1/2 Mile</th>
<th>1 Mile</th>
<th>3/4 Mile</th>
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<tr>
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<td>&lt; 4,500</td>
<td>&lt; 4,500</td>
<td>&lt; 4,500</td>
<td>&lt; 4,500</td>
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**TABLE 2**

<table>
<thead>
<tr>
<th>Speed</th>
<th>Approximate Distance between Strips in an Array</th>
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<tbody>
<tr>
<td>&lt; 40 MPH</td>
<td>10'</td>
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<tr>
<td>40 MPH</td>
<td>10'</td>
</tr>
<tr>
<td>45 MPH</td>
<td>15'</td>
</tr>
<tr>
<td>&gt; 45 MPH</td>
<td>20'</td>
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</tbody>
</table>
## Work Zone Short Term Pavement Markings Details

**Temporary Flexible, Reflective Roadway Markers (Tabs)**

1. Temporary flexible-reflective roadway marker tabs detailed on this page will be designated Type Y-2 (two amber reflective surfaces with yellow body) and Type W (one white or silver reflective surface with white body). Additional details may be found on BC(11).

2. Tabs shall meet requirements of Departmental Material Specification DMS-8242.

3. Dimensions indicated on this sheet are typical and approximate. Variations in size and height may occur between markers or devices made by manufacturers, by as much as 1/4 inch, unless otherwise noted.

Note 2. Non-removable prefabricated pavement markings shall meet the requirements of either DMS-8240 or DMS-8243. Non-removable prefabricated pavement markings may be used to indicate the limits of no-passing zones for up to 14 calendar days. Permanent pavement markings are in place. When the Contractor is responsible for placement of permanent pavement markings, no segment of roadway open to traffic shall remain without permanent pavement markings for a period greater than 14 calendar days unless weather conditions prevent placement. Permanent pavement markings shall be placed as soon as weather permits.

4. No two consecutive tabs nor four tabs per 1000 feet of line shall be missing or fail to meet the visual performance requirements of Note 3.

5. No segment of roadway open to traffic shall remain without permanent pavement markings for a period greater than 14 calendar days. The Contractor will be responsible for replacing devices should marking be removed.

6. Temporary flexible-reflective roadway marker tabs will require normal maintenance replacement when used on work zone or permanent construction lane closures or channelizations. Additional maintenance replacement of devices should be planned.

## Work Zone Short Term Pavement Markings Patterns

**Center Line & No-Passing Zone Barrier Lines for Two Lane Two-Way Highways**

**Lane Lines for Divided Highway**

**Wide Dotted Lines**

**Lane & Center Lines for Multilane Undivided Highways**

**TWO-WAY LEFT TURN LANE**

**Raised Pavement Markers**

1. Raised pavement markers used for work zone markings shall meet the requirements of DMS-8241.

2. Permanent prefabricated pavement markings shall meet the requirements of DMS-8242. Permanent prefabricated pavement markings may be used on temporary flexible-reflective roadway marker tabs or DMS-8243. Temporary prefabricated pavement markers may be used on work zones, the numbers may be used for up to 14 calendar days. Permanent pavement markings are in place. When the Contractor is responsible for placement of permanent pavement markings, no segment of roadway open to traffic shall remain without permanent pavement markings for a period greater than 14 calendar days unless weather conditions prevent placement. Permanent pavement markings shall be placed as soon as weather permits.

3. Raised pavement markers used for work zone markings shall meet the requirements of DMS-8241.

4. Raised pavement markers used for work zone markings shall meet the requirements of DMS-8241.
NOTES:

1. ASPHALT CONCRETE PAVEMENT SHALL BE
   TY C SAC-A PG70-28.

2. SEE TxDOT STANDARD CCGG-22.

3. HMAC MATERIAL SHALL BE TYPE "B" PG 76-22.

4. SEE SIDEWALK PLAN AND PROFILE SHEET FOR LIMITS OF PROPOSED SIDEWALK.

5. MOISTURE TREATMENT OF EXISTING SUBGRADE TO BE PAID FOR UNDER ITEM 291 REWORK 85 MTL (TY C) 18") (ORD COMP).
LEGEND
- EXIST TRAFFIC FLOW
- EXIST SIGNAL HEAD
- EXIST LUMINAIRE
- EXIST CABINET CONTROLLER
- EXIST SERVICE POLE
- EXIST STRAIN POLES

EXISTING SIGNAL SCHEDULE

<table>
<thead>
<tr>
<th>FY</th>
<th>FR</th>
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<tbody>
<tr>
<td>(30 MPH) SCHMIDT AVE</td>
<td>(55 MPH) FM 1044</td>
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<tr>
<td>E1, E2, E5, E6</td>
<td>E3, E4</td>
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EXISTING CONDITIONS LAYOUT
### Pole Schedule

<table>
<thead>
<tr>
<th>Pole/Run</th>
<th>Pole Type</th>
<th>Signals</th>
<th>Ped PB Type/Sign</th>
<th>Location</th>
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<tbody>
<tr>
<td>P-1</td>
<td>PED (15')</td>
<td>1-SIDE OF POLE</td>
<td>1-CDP</td>
<td>NAGIVATOR, RT 10-30.58, L1</td>
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<td>P-2</td>
<td>PED (15')</td>
<td>1-SIDE OF POLE</td>
<td>1-CDP</td>
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### Conduit Schedule

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**TOTAL:** (LF) 445 280 125 40 50 175 125 125 215 440 485

**NOT TO SCALE**
NOTES:
1. SEE PROPOSED SIGNAL LAYOUTS AND DETAILS FOR ADDITIONAL INFORMATION.
2. CONTRACTOR TO FIELD VERIFY EXISTING HEIGHT OF STRAIN POLES AND ENSURE FINAL LOCATION OF PROPOSED SIGNAL HEADS PROVIDE THE NECESSARY MINIMUM VERTICAL CLEARANCE.

FM 1044 AND SCHMIDT SIGNAL ELEVATION VIEWS

SCHMIDT AVE
SMITH AVE

NORTHBOUND ELEVATION VIEW
FM 1044

SOUTHBOUND ELEVATION VIEW
FM 1044

EASTBOUND ELEVATION VIEW
SCHMIDT AVE
### SUMMARY OF SMALL SIGNS

<table>
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<th>SIGN NO.</th>
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<th>DIMENSIONS</th>
<th>POST TYPE</th>
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**NOTE:**

1. Sign supports shall be located as shown on the plans, except that the Engineer may shift the sign supports within design guidelines, where necessary to achieve a more desirable location or to avoid conflict with utilities, unless otherwise shown on the plans.

2. For installation of bridge mounted clearance signs, see Bridge Mounted Clearance Sign Assembly Standard Sheet.

3. For Sign Support Descriptive Codes, see Sign Mounting Details Small roadside Signs General Notes & Details SWSD(G).

---

**ALUMINUM SIGN BLANKS THICKNESS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Minimum Thickness</th>
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<tr>
<td>Greater than 15</td>
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**NOTES:**

1. CONTRACTOR SHALL INSTALL SIGNAL POLE FOUNDATION LOCATIONS NEAR UNDERGROUND UTILITIES PRIOR TO INSTALLING POLE FOUNDATION. CONTRACTOR SHALL INSTALL POLE FOUNDATION TURNAROUND (TRENCH) TO COMPLY WITH CONSTRUCTION CONDITIONS.
2. PREVIOUS SODLAGE INSTALLATIONS AND ELECTRICAL SERVICE SHALL BE IDENTIFIED AND APPROVED BY CITY OF NEW BRAUNFELS PRIOR TO CONSTRUCTION.
3. SIGNAL HEADS SHALL HAVE A MINIMUM OF 19 FEET OF CLEARANCE ABOVE THE ROADWAY SURFACE.
4. CABLE RUNS IN 2" CONDUIT SEPARATE FROM SIGNAL CABLE.
5. INSTALL LED VEHICLE SIGNAL HEADS FOR ALL PHASES TO INSTALLING POLE FOUNDATIONS.
6. INSTALL 24" WHITE PAVEMENT MARKING FOR ALL PHASES.
7. INSTALL 24" WHITE PAVEMENT MARKING FOR ALL PHASES.
8. CONTRACTOR SHALL FURNISH AND DELIVER TS 2 TYPE 2 CONTROLLER CABINET AND ASSEMBLY TO THE CITY OF NEW BRAUNFELS.
9. CONTRACTOR SHALL REMOVE EXISTING STOP SIGNS WHEN TRAFFIC SIGNAL BECOMES OPERATIONAL.
10. CONTRACTOR SHALL REMOVE AND DELIVER ANY EQUIPMENT DEEMED SALVAGEABLE TO CITY OF NEW BRAUNFELS.
11. CONTRACTOR SHALL INSTALL 24" WHITE PAVEMENT MARKING FOR ALL PHASES.
12. CONTRACTOR SHALL INSTALL MED NOSE YELLOW PAVEMENT MARKING FOR ALL PHASES.
13. CONTRACTOR SHALL INSTALL MED NOSE BLACK PAVEMENT MARKING FOR ALL PHASES.
14. CONTRACTOR SHALL INSTALL MED NOSE GREEN PAVEMENT MARKING FOR ALL PHASES.
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57. CONTRACTOR SHALL INSTALL MED NOSE RED PAVEMENT MARKING FOR ALL PHASES.
58. CONTRACTOR SHALL INSTALL MED NOSE YELLOW PAVEMENT MARKING FOR ALL PHASES.
59. CONTRACTOR SHALL INSTALL MED NOSE BLACK PAVEMENT MARKING FOR ALL PHASES.
NOTES:

1. CONTRACTOR SHALL NOTE SENSIBLE SIGNAL PILLAR LOCATIONS NEAR UNDERGROUND UTILITIES PRIOR TO INSTALLING POLE FOUNDATION.
2. MINIMUM CLEARANCE OF 40' RADIUS FROM SIGNAL AND 10' RADIUS FROM PRIMARY OR SECONDARY SHALL BE MAINTAINED BETWEEN PROPOSED TRAFFIC SIGNAL EQUIPMENT AND EXISTING OVERHEAD ELECTRICAL LINES.
3. ALL SIGNAL HEADS SHALL HAVE THE MINIMUM OF 19 FEET CLEARANCE ABOVE ROADWAY SURFACE.
4. CONTRACTOR IS RESPONSIBLE FOR VERIFYING VERTICAL CLEARANCE BEFORE POURING POLE FOUNDATIONS.
5. SEE "TRAFFIC SIGNAL FOUNDATION" (TS-FD) STANDARDS FOR DRILLED SHAFT DETAILS.
6. SEE "SIGNAL MAST ARM ASSEMBLY" (SMA-80), STANDARDS FOR SIGNAL POLE AND MAST ARM DETAILS.
7. SEE "MISCELLANEOUS TRAFFIC SIGNAL DETAILS" (MTS) STANDARDS FOR PEDESTAL POLE DETAILS.
8. CONTRACTOR IS RESPONSIBLE FOR VERIFYING VERTICAL CLEARANCE BEFORE POURING POLE FOUNDATIONS.
CONTRACTOR SHALL CONTACT TEXAS-811 FOR UTILITY LOCATION DIGTESS @ 1-800-DIG-TESS OR AT LEAST 72 HOURS PRIOR TO COMMENCING EXCAVATION. ALL UTILITY LOCATIONS SHALL BE VERIFIED IN THE FIELD BY THE CONTRACTOR.

EXISTING CONDITIONS

NOTES:
1. ALL DIMENSIONS SHOWN ARE IN FEET UNLESS SPECIFIED OTHERWISE. MILL EXISTING FEATURES ARE SHOWN WITHOUT SCALE, I.E. PROPORTIONAL. THE CONTRACTOR SHALL CONSIDER ALTERNATIVES TO CONVENTIONAL PULL PLUG.
2. UTILITIES SHOWN ARE APPROXIMATE, CONTRACTOR SHALL VERIFY THE LOCATION OF EXISTING UTILITIES PRIOR TO BEGINNING WORK, CONTRACTOR SHALL NOT PERFORM ANY WORK ON EXISTING UTILITY LINES UNTIL FULL VERIFICATION IS PROVIDED.
3. CONTRACTOR SHALL ADEQUATELY SECURE UTILITY LINES PRIOR TO EXCAVATION OR DISTURBANCE. CONTRACTOR SHALL CONSIDER THE POTENTIAL FOR UNDERGROUND IDEOLOGICAL LINES.
4. LOCATION OF EXISTING SIGNS, POLES, CABLES AND ELECTRICAL SERVICE SHALL BE IDENTIFIED AND APPROVED BY CITY PRIOR TO COMMENCEMENT OF WORK. THE CONTRACTOR SHALL ADEQUATELY SECURE EXISTING UTILITY LINES PRIOR TO EXCAVATION OR DISTURBANCE.

CONTRACTOR SHALL CONTACT TEXAS-811 FOR UTILITY LOCATION DIGTESS @ 1-800-DIG-TESS OR AT LEAST 72 HOURS PRIOR TO COMMENCING EXCAVATION.

CONTRACTOR SHALL ADEQUATELY SECURE UTILITY LINES PRIOR TO EXCAVATION OR DISTURBANCE. CONTRACTOR SHALL CONSIDER THE POTENTIAL FOR UNDERGROUND IDEOLOGICAL LINES.
GENERAL NOTES FOR ALL ELECTRICAL WORK:

1. The location of all conduits, junction boxes, ground boxes, and electrical services is to be determined in accordance with the plans.

2. Provide new and unused materials. Ensure all materials and installations comply with the applicable articles of the National Electrical Code (NEC). TxDOT standards and codes are followed for the selection, layout, and installation of all electrical work and are listed by Underwriters Laboratories LLC or a nationally recognized testing lab (NRTL) such as UL, ETL, or CSA. Materials must be listed and approved unless specifically approved by the Engineer.

3. Junction boxes, conduit, and hardware, except for high-voltage or nuclear installations, must be approved by the Underwriters Laboratories LLC or a nationally recognized testing lab (NRTL) such as UL, ETL, or CSA. Materials must be listed and approved unless specifically approved by the Engineer.

4. Provide the following test equipment as required by the Engineer to confirm compliance with the NEC and, unless otherwise noted in the plans, to test conductors and connections. Ensure all equipment and test methods comply with the applicable articles of the NEC. Test equipment must be calibrated for the intended application.

5. Provide the following test equipment as required by the Engineer to confirm compliance with the NEC and, unless otherwise noted in the plans, to test conductors and connections. Ensure all equipment and test methods comply with the applicable articles of the NEC. Test equipment must be calibrated for the intended application.

CONDUIT

4. MATERIALS

1. Provide conduit, junction boxes, fittings, and hardware as per TxDOT Departmental Material Specifications (DMS) and TxDOT Standards, such as UL, ETL, and CSA. Provide conduit in accordance with the NEC and, unless otherwise noted on the plans, with the applicable articles of the NEC. Substituted types of conductors and/or conduit may be used. Provide equivalent conduit and fittings as required.

2. Provide conduit, junction boxes, fittings, and hardware as per TxDOT Departmental Material Specifications (DMS) and TxDOT Standards, such as UL, ETL, and CSA. Provide conduit in accordance with the NEC and, unless otherwise noted on the plans, with the applicable articles of the NEC. Substituted types of conductors and/or conduit may be used. Provide equivalent conduit and fittings as required.

CONDUITS & NOTES

6. Junction boxes and in any interior volume of less than 100 cu. in. and supported by entering raceways must have threaded entries or hubs identified for the intended service. Ensure all materials and installations comply with the applicable articles of the NEC. Provide conduit within 3 ft. of the enclosure or within 18 in. of the enclosure if all entering raceways must have threaded entries or hubs identified for the intended service. Ensure all materials and installations comply with the applicable articles of the NEC. Provide conduit within 3 ft. of the enclosure or within 18 in. of the enclosure if all entering raceways must have threaded entries or hubs identified for the intended service. Ensure all materials and installations comply with the applicable articles of the NEC.

7. During construction, temporarily cap or plug open ends of all conduit and raceways immediately after completion of any work and prior to installing any conductors. Ensure all materials and installations comply with the applicable articles of the NEC.

8. Provide proper bonding of all metallic components. Ensure all materials and installations comply with the applicable articles of the NEC. Use cold-rolled seamless copper tubes for all conduit and raceway connections. Ensure all materials and installations comply with the applicable articles of the NEC.

9. Provide proper bonding of all metallic components. Ensure all materials and installations comply with the applicable articles of the NEC. Use cold-rolled seamless copper tubes for all conduit and raceway connections. Ensure all materials and installations comply with the applicable articles of the NEC.

CONSTRUCTION METHODS

1. The location of all conduits, junction boxes, ground boxes, and electrical services is to be determined in accordance with the plans.

2. Provide proper bonding of all metallic components. Ensure all materials and installations comply with the applicable articles of the NEC. Use cold-rolled seamless copper tubes for all conduit and raceway connections. Ensure all materials and installations comply with the applicable articles of the NEC.
CONDUIT MOUNTING OPTIONS

CONDUIT MOUNTING CHANNEL

Channels with round or short slotted holes are allowed, if the load-carrying capacity is not reduced by more than 15%.

Channels with round or short slotted hole patterns are allowed, if the load-carrying capacity is not reduced by more than 15%.

Electrical Conduit to Bridge Deck Attachment

Expansion Anchor Notes for Bridge Deck Attachment

1. Use torque-controlled mechanical expansion anchors that are approved for use in precast concrete by the International Code Council, Evaluation Service (ICC-ES). The chosen anchor product shall have a designated ICC-ES Evaluation Report number, and its approved scope shall be referenced on the ICC-ES website under Division 031600 for Concrete Anchors.

2. Unless otherwise approved by the Engineer, do not use adhesive anchors; do not use expansion anchors that are not approved for use in precast concrete by the International Code Council, Evaluation Service (ICC-ES). The chosen anchor product shall have a designated ICC-ES Evaluation Report number, and its approved scope shall be referenced on the ICC-ES website under Division 031600 for Concrete Anchors.

3. Use anchors manufactured with stainless steel expansion wedges. Anchors manufactured with carbon steel expansion wedges are not allowed. Anchor bodies can be either pre-drilled carbon steel or stainless steel, or manufactured with carbon steel expansion wedge and stainless steel body.

4. Install anchors as shown on the plans and in accordance with the anchor manufacturer's published instructions. Arrange a systematic demonstration test to evaluate the procedures and tools. The test shall be witnessed and approved by the Engineer prior to furnishing anchors on the structure.

5. Prior to hole drilling, use an electronic device to ensure the location of existing rebar. Once the rebar is confirmed, proceed with the drilling process. To determine the required minimum length of anchors, refer to the minimum anchor length specified in the project drawings. The test shall be witnessed and approved by the Engineer prior to furnishing anchors on the structure.

6. Use anchors of minimum 1600 lbs tensile capacity in tension lines. Use anchors of minimum 2000 lbs tensile capacity in compression lines, concrete, bridge decks, or girders. Use anchors of minimum 1200 lbs tensile capacity in compression lines, concrete, bridge decks, or girders. Use anchors of minimum 1000 lbs tensile capacity in compression lines, concrete, bridge decks, or girders.
ELECTRICAL CONDUCTORS

A. MATERIAL INFORMATION

1. Provide type THHN insulated conductors in accordance with Departmental specifications. Conductors shall have insulation color code as listed on the Material Producers List (MPL) on the department web site or the Engineer to witness the tests.

2. Use approved splicing methods. Splicing materials, insulating adhesive tape, and gel-filled insulating splice covers must be UL listed.

3. Use listed compression connectors or listed wire nuts with factory applied sealant for temporary wiring connections. Use only approved splicing methods.

4. Use listed corridor or splice type pressure connectors, terminal blocks, or split bolt connectors for temporary connections. Use only approved splicing methods.

5. Use listed wire nuts with factory applied sealant for temporary wiring connections. Use only approved splicing methods.

6. Use listed wire nuts with factory applied sealant for temporary wiring connections. Use only approved splicing methods.

7. Use listed wire nuts with factory applied sealant for temporary wiring connections. Use only approved splicing methods.

8. Use listed wire nuts with factory applied sealant for temporary wiring connections. Use only approved splicing methods.

9. Use listed wire nuts with factory applied sealant for temporary wiring connections. Use only approved splicing methods.

10. Use listed wire nuts with factory applied sealant for temporary wiring connections. Use only approved splicing methods.

B. CONSTRUCTION METHODS

1. Use only a rich, high-grade mixture of cement and sand for setting the temporary connections. Use only approved splicing methods.

2. Use only a rich, high-grade mixture of cement and sand for setting the temporary connections. Use only approved splicing methods.

3. Use only a rich, high-grade mixture of cement and sand for setting the temporary connections. Use only approved splicing methods.

4. Use only a rich, high-grade mixture of cement and sand for setting the temporary connections. Use only approved splicing methods.

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16. Use only a rich, high-grade mixture of cement and sand for setting the temporary connections. Use only approved splicing methods.

17. Use only a rich, high-grade mixture of cement and sand for setting the temporary connections. Use only approved splicing methods.
GROUND BOXES

1. Provide polymer concrete ground boxes measuring 16x30x24 in. (WxLxD) or smaller in accordance with Departmental Material Specification (DMS) 11070 "Ground Boxes" and Item 624 "Ground Boxes."*

2. Provide Type A, B, C, D, and E ground boxes as shown in the plans, and as listed on the Material Producers List (MPL) on the Department web site under "Roadway Illumination and Electrical Supplies," Item 624.

3. Ensure ground box cover is correctly labeled in accordance with DMS 11070.

4. Provide larger ground boxes in accordance with Item 624 and as shown in the plans.

ELECTRICAL DETAILS

GROUND BOXES

A. MATERIALS

1. Ground boxes are shown in plans. See DMS 11070 or the specifications and labeling requirements for ground boxes when called for by descriptive code.

2. Cast ground box aprons in place. Reinforcing steel may be field bent. Ensure the depth of concrete for the cover extends from finished grade to the top of the ground box. Ground box aprons, including concrete and reinforcing steel, are subsidiary to ground boxes when called for by descriptive code.

3. Keep both ends of the box clear of dirt. Bolt covers down when not working in ground box.

4. Install all conduits and ells in a neat and workmanlike manner. Uniformly space conduits within the ground box, but be sure to install conduit terminating in a ground box.

5. Maintain sufficient space between conduits to allow for proper installation of bushings.

6. Place aggregate under the box, not in the box. Aggregate should not encroach on the interior volume of the box.

7. When a ground rod is present in a ground box, bond all equipment grounding conductors together and to the ground rod with stranded copper-foil bonding jumper. Ensure the bonding jumper is a separate conductor. The equipment grounding conductor is subsidiary to various bid items.

8. When a type B or D ground box is stacked to meet volume requirements, it is allowable to use an appropriately sized hole for conduit entry in the side wall at least 18 inches below grade.

9. Install a grounding bushing on the upper end of all RMC terminating in a ground box. Install a PVC bushing or bell end fitting on the upper end of all PVC conduits terminating in a ground box.

10. When a type B or D ground box is stacked to meet volume requirements, it is allowable to use a 2 ft. long stranded copper-foil bonding jumper the same size as the grounding conductor. The bonding jumper is subsidiary to various bid items. Verify existing ground boxes with metal covers are shown on the plans, with metal covers fully described as required.

11. If other ground boxes with metal covers are within the project limits but are not part of the contract, the specific boxes can be identified by the contractor to the owner by the contractor to the owner by the plan.

12. Bond metal ground box covers to the grounding conductor with a form ground type lug.

*Note for 1/2" bolts w/ nuts, wrench is required for field.
**MAIN DISCONNECT & BRANCH CIRCUIT BREAKERS**

1. Provide service hubs for all conduit entries into the top of enclosure.
2. Two Type C galvanized steel (SS) enclosures may be used for Type C panelboards. Provide SS enclosures in accordance with EN 61439-1, EN 61439-2, and EN 61439-3.
3. Provide aluminum (Al) and stainless steel (SS) enclosures for Types A, C, and D panelboards as specified in EN 61439-1, EN 61439-2, and EN 61439-3. In Type C panelboards, provide SS enclosures as specified in EN 61439-1, EN 61439-2, and EN 61439-3.

**ELECTRICAL SERVICE NOTES**

1. Provide all work, materials, services, and any incidentals needed to install a service disconnect as specified in the electrical service description.
2. Coordinate work with the Engineer and the Utility provider for metering and connections with the utility requirements. In line with the electrical service description, meter(s) shall be located in the service enclosure. The utility company requires the location of each meter to be approved by the Engineer. The service enclosure shall have provisions for an electrical service drawing. The service enclosure shall have a master key control panel located in the enclosure. The master key control panel shall include provisions for an electrical service drawing. The service enclosure shall have a master key control panel located in the enclosure. The master key control panel shall include provisions for an electrical service drawing. The service enclosure shall have a master key control panel located in the enclosure. The master key control panel shall include provisions for an electrical service drawing.
3. Provide all work, materials, services, and any incidentals needed to install a service disconnect as specified in the electrical service description.
4. Provide all work, materials, services, and any incidentals needed to install a service disconnect as specified in the electrical service description.

**ELECTRICAL SERVICE DATA**

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**EXPLANATION OF ELECTRICAL SERVICE DESCRIPTIVE CODE**

- **ELEC SERV TP X**: Loadcenter Type
- **Loadcenter Rating**: The loadcenter rating specifies the capacity of the loadcenter. A loadcenter rating of 1P/30 indicates a loadcenter rated for 30 amperes for a single-phase (1P) service.
- **Service Entrance**: The service entrance is the point where the electrical service enters the service enclosure.

*Standard 3-prong receptacle and photocell.**

**TOP MOUNTED PHOTOCELL**

- **The photocell should be wired as shown in the diagram.**
- **Flashing**: The photocell should be wired as shown in the diagram.**

**ELECTRICAL DETAILS**

- **SERVICE NOTES & DATA**
- **ED(5)-14**
1. Do not pass luminaire conductors through the signal controller cabinet.

2. Include an equipment grounding conductor in all conduits throughout the electrical system. Bond all exposed metal parts to the grounding conductor.

3. Practice roadway runouts, when required, in accordance with the notes and construction sections of this contract. roadwayRunouts

4. Bond the electrical service enclosure to the tank ground fitting. Provide proper insulation resistance test on all illumination and signal pole for attaching conduit.

5. Bond anchor bolts to rebar cage in two locations using #3 bars or #4 bars and stainless steel bands. Install properly sized stainless steel washers on each bolt to bands using two-bolt brackets. Install brackets near top and bottom of steel bands. Ensure bands are a minimum width of 3/8 in. Secure enclosures to the signal pole for attaching conduit.

6. Drill and tap signal poles for 1/2 x 13 UNC tank ground fitting. 3 Wire 120/240 Volt

7. For all conduits, ensure the burial depth is a minimum of 18". Ensure the seal conduit ends.

8. Terminate conduits entering the top of enclosures with a conduit-sealing hub or threaded boss such as meter hub. Install a grounding bushing on all conduits that are required. Bond all exposed metal parts to the grounding conductor.

9. Lock all enclosures and bolt down all ground box covers before applying power on traffic signal cables after termination.

10. Terminate conduits entering the top of enclosures with a conduit-sealing hub or threaded boss such as meter hub. Install a grounding bushing on all conduits that are required. Bond all exposed metal parts to the grounding conductor.

TRAFFIC SIGNAL NOTES

11. For all conduits, ensure the burial depth is a minimum of 18". Ensure the minimum burial depth for conduit placed under a roadway is 24".
1. Provide duct cable in accordance with Departmental Material Specification (DMS) 11060. "Duct Cable" and item 622. "Duct cable." Provide duct cable as listed on the Preferred List (PL) on the Department web site under "Roadway Illumination and Electrical Supplies." Item 622.

2. Provide High-Density Polyethylene (HDPE) conduit as shown on the Department web site. "Duct cable." Provide HDPE conduit as listed on the Department web site under "Electrical and Electrical Supplies." Item 622.

3. Supply duct cable with a minimum 2 ft. splices, unless otherwise shown in the plans. Provide duct cable and HDPE conduit as shown by detailed sections in the plans. Bend duct cable and HDPE conduit as recommended by the manufacturers, with a minimum bending radius of 24 in. for 2 in. duct, and 36 in. for larger sizes. Conduit manufacturers' recommendations when handling duct cable and HDPE conduit reels and during installation of duct cable and HDPE conduit.

4. Do not splice conductors within duct cable or HDPE conduit. Couple duct cable and HDPE conduit entering a ground box or foundation to a PVC elbow, when generalized sheet metal boxes are called for in the plans and any portion of the RMC elbow is buried less than 18" from possible contact, ground the RMC elbow. When the upper end of an RMC elbow does not fall within the ground box, it may be extended with a 1-1/2" SCH 40 PVC conduit nipple. If not, a rigid extension and ground bushing is required. Ensure conductor size shown in the plans.

5. Furnish and install duct cable with factory installed conductors, sized as shown in the plans and as required by the National Electrical Code (NEC). The NEC contains specific requirements for duct cable to be applied to nonmetallic underground conduit with conductors termed Type NUCC.

6. When conduit casing is called for in the plans, extend duct cable or HDPE conduit through the conduit casing in one continuous length without connection to the casing. Compact backfill aggregate does not encroach into the interior of the box. Ensure the aggregate does not encompass the interior of the box.

7. Seal the ends of duct cable or HDPE conduit with duct seal, expandable foam, or other approved method after completing the pull tests required by Item 622.

8. Provide minimum cover of 24 in. under roadways, 18 in. in other locations, or as shown on the plans.

9. Furnish and install listed fittings to couple duct cable or HDPE conduit to other types of conduits. Provide conduit couplings, such as insulated-connections, or other approved method using listed conduit couplings. Ensure conductor size is maintained when connecting to approved electrofusion and couplings, or connected using an approved method using an epoxy adhesive specifically designed for HDPE couplings and connectors are sized to fit the manufacturer's instructions. Do not use PVC glue on HDPE. Do not use water pipe fittings, or connect conduit with metal shielded flexible.

10. Provide duct cable and HDPE conduit as shown by descriptive code or on the plans. Use Rigid Metallic Conduit (RMC) to couple duct cable or HDPE conduit to other types of conduits, such as PVC conduit, to prevent kinking.

11. Bend duct cable and HDPE conduit as recommended by the manufacturer, with a minimum bending radius of 24 in. for 2 in. duct, and 36 in. for larger sizes. Conduit manufacturers' recommendations when handling duct cable and HDPE conduit reels and during installation of duct cable and HDPE conduit.

12. Provide High-Density Polyethylene (HDPE) conduit in accordance with DMS 11060 and Item 622. "Duct cable." Provide HDPE conduit as listed on the Department web site under "Electrical and Electrical Supplies." Item 622.

13. Supply duct cable with a minimum 2 ft. splices, unless otherwise shown in the plans. Provide duct cable and HDPE conduit as shown by detailed sections in the plans. Bend duct cable and HDPE conduit as recommended by the manufacturers, with a minimum bending radius of 24 in. for 2 in. duct, and 36 in. for larger sizes. Conduit manufacturers' recommendations when handling duct cable and HDPE conduit reels and during installation of duct cable and HDPE conduit.

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15. Seal the ends of duct cable or HDPE conduit with duct seal, expandable foam, or other approved method after completing the pull tests required by Item 622.

16. Provide minimum cover of 24 in. under roadways, 18 in. in other locations, or as shown on the plans.

17. Furnish and install listed fittings to couple duct cable or HDPE conduit to other types of conduits. Provide conduit couplings, such as insulated-connections, or other approved method using listed conduit couplings. Ensure conductor size is maintained when connecting to approved electrofusion and couplings, or connected using an approved method using an epoxy adhesive specifically designed for HDPE couplings and connectors are sized to fit the manufacturer's instructions. Do not use PVC glue on HDPE. Do not use water pipe fittings, or connect conduit with metal shielded flexible.

18. Provide duct cable and HDPE conduit as shown by descriptive code or on the plans. Use Rigid Metallic Conduit (RMC) to couple duct cable or HDPE conduit to other types of conduits, such as PVC conduit, to prevent kinking.

19. Bend duct cable and HDPE conduit as recommended by the manufacturer, with a minimum bending radius of 24 in. for 2 in. duct, and 36 in. for larger sizes. Conduit manufacturers' recommendations when handling duct cable and HDPE conduit reels and during installation of duct cable and HDPE conduit.

20. Provide High-Density Polyethylene (HDPE) conduit in accordance with DMS 11060 and Item 622. "Duct cable." Provide HDPE conduit as listed on the Department web site under "Electrical and Electrical Supplies." Item 622.

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23. Seal the ends of duct cable or HDPE conduit with duct seal, expandable foam, or other approved method after completing the pull tests required by Item 622.

24. Provide minimum cover of 24 in. under roadways, 18 in. in other locations, or as shown on the plans.

25. Furnish and install listed fittings to couple duct cable or HDPE conduit to other types of conduits. Provide conduit couplings, such as insulated-connections, or other approved method using listed conduit couplings. Ensure conductor size is maintained when connecting to approved electrofusion and couplings, or connected using an approved method using an epoxy adhesive specifically designed for HDPE couplings and connectors are sized to fit the manufacturer's instructions. Do not use PVC glue on HDPE. Do not use water pipe fittings, or connect conduit with metal shielded flexible.

26. Provide duct cable and HDPE conduit as shown by descriptive code or on the plans. Use Rigid Metallic Conduit (RMC) to couple duct cable or HDPE conduit to other types of conduits, such as PVC conduit, to prevent kinking.

27. Bend duct cable and HDPE conduit as recommended by the manufacturer, with a minimum bending radius of 24 in. for 2 in. duct, and 36 in. for larger sizes. Conduit manufacturers' recommendations when handling duct cable and HDPE conduit reels and during installation of duct cable and HDPE conduit.

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31. Seal the ends of duct cable or HDPE conduit with duct seal, expandable foam, or other approved method after completing the pull tests required by Item 622.

32. Provide minimum cover of 24 in. under roadways, 18 in. in other locations, or as shown on the plans.

33. Furnish and install listed fittings to couple duct cable or HDPE conduit to other types of conduits. Provide conduit couplings, such as insulated-connections, or other approved method using listed conduit couplings. Ensure conductor size is maintained when connecting to approved electrofusion and couplings, or connected using an approved method using an epoxy adhesive specifically designed for HDPE couplings and connectors are sized to fit the manufacturer's instructions. Do not use PVC glue on HDPE. Do not use water pipe fittings, or connect conduit with metal shielded flexible.
BATTERY BOX GROUND BOXES NOTES

A. MATERIALS

1. Provide polymer concrete or fiberglass reinforced plastic (FRP) battery box ground box and cover in accordance with Department Material Specification (DMS) 11071 "Battery Box Ground Boxes." Battery box will accommodate up to 4 batteries, each measuring 8" L x 13.5" W x 10" H. Label battery box ground box cover in accordance with DMS 11071.

2. Supply a marine grade batteries with covers; secure the marine grade batteries with covers to the stainless steel rack in the bottom of the ground box with the down straps.

3. Cast battery box aprons in place. Rebar should not encroach on the interior volume of the box.

4. Bolt covers down when not working in battery box ground boxes. Keep bolt holes in the box clear of dirt.

B. CONSTRUCTION METHODS

1. Ensure conduit entry will not interfere with placement of the batteries in the battery box ground box.

2. Remove all gravel and dirt from conduit. Cap all conduits prior to placing aggregate and setting battery box ground box. Provide Grade 3 or 4 coarse aggregate as shown on Table 2 of Item 302 "Aggregates for Surface Treatments." Ensure the aggregate bed is in place and is a minimum of 9 in. deep prior to setting the box. Install battery box ground box on this aggregate bed.

3. Cast battery box aprons in place. Rebar should not encroach on the interior volume of the apron.

4. Honor the depth of concrete for the apron extends from finished grade to the top of the aggregate bed. Battery box ground box aprons, including concrete and reinforcing steel, are subsidiary to battery box ground boxes when called for by descriptive code.

5. Cast battery box aprons in place. Rebar should not encroach on the interior volume of the box.

6. Bolt covers down when not working in battery box ground boxes. Keep bolt holes in the box clear of dirt.

7. Install all conduits in a neat and workmanlike manner.

8. Supply a marine grade batteries with covers; secure the marine grade batteries with covers to the stainless steel rack in the bottom of the ground box with the down straps.
DISCLAIMER: The use of this standard is governed by the "Texas Engineering Practice Act." No warranty of any kind is made by TxDOT for any purpose whatsoever. TxDOT assumes no responsibility for the conversion of this standard to other formats or for incorrect results or damages resulting from its use.

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DAMPING PLATE MOUNTING DETAILS

- Mounting Clamp
- Damping Plate
- Connection bolts between damping plate and mounting clamp
- 5'-6" of damping plate

MAST ARM DAMPING PLATE DETAILS

- Mounting Clamp
- Damping Plate
- Connection bolts between damping plate and mounting plate

SECTION A-A

- Mounting clamp
- Damping plate
- Connection bolts

SECTION B-B

- Mounting clamp
- Damping plate
- Connection bolts

ELEVATION

- Mounting clamp
- Damping plate
- Connection bolts

PLAN

- Mounting clamp
- Damping plate
- Connection bolts

SECTION A-A

- Mounting clamp
- Damping plate
- Connection bolts

SECTION B-B

- Mounting clamp
- Damping plate
- Connection bolts

**Relevant Notes:**
- Recommended supporting assemblies to achieve required height for horizontal section heads
- Connection bolts with or without backing plate
- Bottom of damping plate will be maintained as shown. The attachments (with or without backing plate) and bottom of damping plate will be maintained as shown.
GENERAL NOTES

CURB RAMPS

1. Place a curb ramp or blended transition at each pedestrian street crossing.

2. All stairs shown on a plan are minimum 12 inches wide, cross slopes of 1% and level running shall be used. Cut curb ramps are preferred to adjusted curb ramps.

3. Minimum allowable grade for all transition is 1%. A 1% grade consists of a 6" curb ramp with a rise of 5" placed at the landing area.

4. Provide a smooth transition where the curb ramp connects to the pedestrian access route. Provide a smooth transition where the curb ramp connects to another pedestrian access route. Provide a smooth transition where the curb ramp connects to the pedestrian access route at each pedestrian street crossing.

5. Provide a smooth transition where the curb ramp connects to the pedestrian access route at each pedestrian street crossing.

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DETECTABLE WARNING MATERIALS

1. Place a detectable warning surface that consists of raised textured material that is used to indicate the approach to a curb ramp.

2. Place a detectable warning surface that consists of raised textured material that is used to indicate the approach to a curb ramp.

3. Place a detectable warning surface that consists of raised textured material that is used to indicate the approach to a curb ramp.

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PEDESTRIAN FACILITIES
CURB RAMPS

PED-18

TYPICAL CROSSING LAYOUTS
SEE SHEET 1 OF 4 FOR DETAILS AND DIMENSIONS

SKEWED INTERSECTION WITH "LARGE" RADIUS

SKEWED INTERSECTION WITH "SMALL" RADIUS

NORMAL INTERSECTION WITH "SMALL" RADIUS

LEGEND:

SHOWS DOWNWARD SLOPE.

DEMONSTRATES PREFERRED LOCATION OF PEDESTRIAN push buttons IF applicable.

DEMONSTRATES PLANTING OR NON-WALKING SURFACE not part of pedestrian circulation path.
PRESENCE (RPDD)

1. PREFERRED PLACEMENT FOR MAST ARMS, STRAIN POLES AND TIMBER POLES. MOUNT ON MAST ARM POLES. MOUNT BELOW CONNECTION OF MAST ARM TO MOUNT AS HIGH AS POSSIBLE TO A MAXIMUM OF 30 FT ON STRAIN AND TIMBER POLES.

2. PREFERRED PLACEMENT FOR MAST ARMS. MOUNT ON AND BELOW MAST ARM ON NEAR SIDE OF ARM.

3. ALTERNATE PLACEMENT LOCATION MOUNT AS HIGH AS POSSIBLE TO A MAXIMUM OF 30 FT TO PREVENT OCCLUSION OF THE LEFT TURN LANE. THIS PLACEMENT TO BE USED ONLY IF RPDD CANNOT BE MOUNTED IN THE PREFERRED PLACEMENT LOCATIONS.

ADVANCE (RADD)

A. PREFERRED PLACEMENT FOR MAST ARMS. ALIGN RADD WITH CENTER OF TRAVEL LANES.

B. PREFERRED PLACEMENT FOR MAST ARMS. MOUNT ON BACK SIDE OF OPPOSING MAST ARM.

C. STRAIN OR TIMBER POLE PLACEMENT. MOUNT ON SIDE POLE.

D. ALTERNATE STRAIN, OR TIMBER POLE PLACEMENT. MOUNT LUMINARE ARM ON SIDE POLE WITH A MAXIMUM 40 FT MOUNTING HEIGHT.

SKEWED INTERSECTION RPDD PLACEMENT

NOTES:

1. A MINIMUM 6 FT HORIZONTAL OFFSET MUST BE MAINTAINED BETWEEN THE RADD AND THE DETECTION ZONE.

2. THE RADD SHALL BE MOUNTED SUCH THAT AT LEAST 30 FT ALONG THE FARDEST LANE TO BE MONITORED IS WITHIN THE FIELD OF VIEW OF THE RADD.

3. AIM RADD AT THE CENTER OF THE LANE TO BE MONITORED APPROXIMATELY 40 FT FROM THE RPDD UNIT.

4. MOUNT RADD SO THAT ITS FIELD OF VIEW IS NOT OCCLUDED BY POLES, SIGNS, OR OTHER STRUCTURES.

5. MOUNTING HEIGHT SHALL NOT BE LESS THAN 15 FT OR GREATER THAN 40 FT RADD MOUNTING LOCATION SHALL HAVE A MINIMUM 30 FT LATERAL OFFSET FROM CENTER OF TRAVEL LANES TO BE MONITORED.

LEGEND

\[\text{ON} \quad \text{OFF} \quad \text{RADD} \quad \text{RPDD}\]

EXTENT OF DETECTION RANGE

IN FRONT OF STOP BAR

ENSURE RPDD IS INSTALLED IN FRONT OF STOP BAR.

INSTALLING ON MAST ARM RESULTS IN PLACEMENT BEING STOP BAR.

RPDD LOCATION

40 FT MAX

30 FT MAX

19 FT MIN CLEARANCE

15 FT MIN CLEARANCE

6 FT MIN

NOT MONITORED OFFSET FROM CENTER OF TRAVEL LANES APPROXIMATELY 50 FT FROM RPDD UNIT.

REFERENCES

RADD-RPDD-20

Radar Presence Detector (RPDD)
Radar Advanced Detection Device (RADD)

San Antonio District Standard
Texas Department of Transportation

SCALE

0.5" = 100'

PLAN VIEW

ELEVATION VIEW

NOTES:

1. PRESENTATION 2020

San Antonio District Standard
Texas Department of Transportation

SCALE

0.5" = 100'

PLAN VIEW

ELEVATION VIEW
Typical Pedestal Pole Assembly

Anchor Bolt Pattern

Typical Controller Mount Details

Controller Mount Notes:
- Anchor bolts shall be furnished with the controller; contact and installed by the contractor.
- The controller shall be supported with a casting prepped to the ground box.
- One 2" PVC shall remain empty for future use.

Concrete shall be tested as miscellaneous concrete.

Controller Foundation shall be as shown on the plans, unless otherwise directed by the engineer.

Notes:
- Conduit encased loops at the locations shown on the plans shall be extended to the ground box shown for each loop installed.
- The number of loop wire turns shall be as shown on the typical loop detector details.

Typical Pedestal Push Button Location

The controller shall verify the pedestrian signal and pedestrian push button locations prior to installation.
### TABLE OF DIMENSIONS

<table>
<thead>
<tr>
<th>Arm Length (ft)</th>
<th>Type I Arm (1 Signal)</th>
<th>Type II Arm (1 Signal)</th>
<th>Type III Arm (1 Signal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
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<td>36</td>
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</tbody>
</table>

### SHOPPING PARTS LIST

- **15'-0" Minimum - 19'-0" Maximum - 17'-6" Nominal**
- **30' Poles With Luminaire**
- **24' Poles With Luminaire**
- **19' Poles With Luminaire**

<table>
<thead>
<tr>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA-80(1)-12</td>
<td>Traffic Signal Support Structures</td>
</tr>
</tbody>
</table>

See Sheet "MA-C" for ILSN Arm Connection details.

See Sheet "MA-D" for Mast Arm details.

See Sheet "Lum-A" for Luminaire detail.

See Sheet "TS-FD" for additional hardware listed in the table.

### FOUNDATION

- **48" diameter**
- **Anchor Bolt Assemblies (1 per pole)**

### BRACKET ASSEMBLIES

- **2 Bracket Assemblies**
- **Support Structures**

- **Traffic Signal Arm**

- **30' Poles With Luminaire**
- **24' Poles With Luminaire**
- **19' Poles With Luminaire**

See Sheet "MA-C(ILSN)" for ILSN Arm Connection details.

See Sheet "MA-D" for Mast Arm details.

See Sheet "Lum-A" for Luminaire detail.

See Sheet "TS-FD" for additional hardware listed in the table.
SLIP JOINT DETAIL

4 x 9/16" slip holes and 1/4" x 3" fasteners in 304 Stainless steel allow for easy projection after making welding in accordance with AWS A5.2 (SMAW)•

TENON DETAIL

27° Sin 60°

ARM COUPLING DETAILS

1/2" Dia Threaded Coupling. "Sky Bracket" or "Easy Bracket" with Stainless steel bands (or Cables) and cast bracket as in "Astro-Brac", SMA-80(2)-12

VIBRATION WARNING

MA-1

WIND ZONE

August 1995

Traffic Operations Division

Texas Department of Transportation

TRAFFIC SIGNAL SUPPORT STRUCTURES

SINGLE MAST ARM ASSEMBLY

(80 MPH WIND ZONE)

SMA-80(2)-12
REFLECTIVE RAISED PAVEMENT MARKERS
FOR VEHICLE POSITIONING GUIDANCE

CENTERLINE FOR ALL TWO LANE ROADWAYS

CENTERLINE & LANE LINES
FOR FOUR LANE TWO-WAY HIGHWAYS

CENTERLINE AND LANE LINES FOR TWO-WAY LEFT TURN LANE

LANE LINES FOR ONE-WAY ROADWAY (NON-FREeway FACILITIES)
Raised pavement markers Type II-C-R shall have clear face toward normal traffic and red face toward wrong-way traffic.

GENERAL NOTES
1. All raised pavement markers placed in broken lines shall be placed in line with and midway between the stripes.
2. On concrete pavements the raised pavement markers shall be placed to one side of the longitudinal joints.

NOTE
Profile markings shall not be placed on roadways with a posted speed limit of 45 MPH or less.

MATERIAL SPECIFICATIONS

RAISED MARKERS
DETERMINANTS
EPOXY AND ADHESIVES
GENERAL NOTES
PERMANENT REFLECTORIZED PAVEMENT MARKINGS

POSITION GUIDANCE USING RAISED MARKERS
RELECTORIZED PROFILE MARKINGS

SECTION A

RAISED PAVEMENT MARKERS

Texas Department of Transportation
Traffic Safety Division

NOTE
A quick test check for the thickness of base line and profile marking is approximately equal to a stack of 5 quarters to a maximum height of 8 quarters.

NOTE
Profile markings shall not be placed on roadways with a posted speed limit of 45 MPH or less.
GENERAL NOTES

1. Longitudinal crosswalk lines should not be placed in the wheel path of vehicles. Center the crosswalk lines on travel lane, lane lines, and shoulder lines (if present).

2. A minimum 6" clear distance shall be provided to the curb face. If the last crosswalk line falls into this distance, it must be omitted.

3. For divided roadways, adjustments in spacing of the crosswalk lines should be made in the section so that the crosswalk lines are maintained in their proper location across the travel portion of the roadway.

4. At skewed crosswalks, the crosswalk lines are to remain parallel to the lane lines.

5. Each crosswalk shall be a minimum of 6" wide.

6. The High-Visibility Longitudinal Crosswalk is the preferred crosswalk pattern on State Highways. Other crosswalk patterns as shown in the "Texas Manual on Uniform Traffic Control Devices" may be used. All crosswalk designs and dimensions shall comply with the "Texas Manual on Uniform Traffic Control Devices."

7. Final placement of Stop Bar and Crosswalk shall be approved by the Engineer in the field.

MATERIAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>MARKINGS</th>
<th>DEPTIAL MATERIAL SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAVEMENT MARKERS</td>
<td>DMS-4200</td>
</tr>
<tr>
<td>BITUMINOUS ADHESIVE</td>
<td>DMS-8100</td>
</tr>
<tr>
<td>TRAFFIC PAINT</td>
<td>DMS-8200</td>
</tr>
<tr>
<td>HOT APPLIED THERMOPLASTIC</td>
<td>DMS-8220</td>
</tr>
<tr>
<td>PERMANENT PREFABRICATED MARKINGS</td>
<td>DMS-8240</td>
</tr>
</tbody>
</table>

All pavement marking materials shall meet the required Departmental Material Specifications as specified by the plans.

NOTES:

1. Use stop bars with "Stop Here for Pedestrians" signs for unsignalized mid block cross walks.

2. Use stop bars with "Stop Here on Red" signs at mid block crosswalks controlled by traffic signals or pedestrian hybrid beacons.

UNIVERSAL MILE BLOCK HIGH-VISIBILITY LONGITUDINAL CROSSWALK
NOTE

There are various devices approved for the Triangular Slipbase System. Please reference the Material Producers List for approved slip base systems.

The devices shall be installed per manufacturers' recommendations. Installation procedures shall be provided to the engineer by the contractor.

GENERAL NOTES:

1. Slip base shall be permanently fastened to include manufacturing, load, design, and installation of working are subject to approval of the Texas Traffic Standards Engineer.

2. Several base plates may be used as a base plate where a number of sign supports are mounted on a single plate. The base plates shall be used in conjunction with the sign supports. The sign supports shall be provided by the manufacturer.

3. The designed load shall be based on the characteristics of the slip base system and the type of traffic expected. The slip base system shall be capable of withstanding the load resulting from the expected traffic.

4. Anchor bolts shall be provided by the manufacturer and shall be specified in the anchor bolt specification. The anchor bolts shall be bored and the anchor bolts shall be removed from the concrete footing when the concrete is cured.

5. The slip base system shall be installed in accordance with the manufacturer's instructions. The slip base system shall be installed in such a manner as to provide a load-carrying surface for the sign supports.

6. The slip base system shall be designed to carry the load resulting from the expected traffic. The slip base system shall be capable of withstanding the load resulting from the expected traffic.

7. The slip base system shall be designed to carry the load resulting from the expected traffic. The slip base system shall be capable of withstanding the load resulting from the expected traffic.

8. The slip base system shall be designed to carry the load resulting from the expected traffic. The slip base system shall be capable of withstanding the load resulting from the expected traffic.

9. The slip base system shall be designed to carry the load resulting from the expected traffic. The slip base system shall be capable of withstanding the load resulting from the expected traffic.

10. The slip base system shall be designed to carry the load resulting from the expected traffic. The slip base system shall be capable of withstanding the load resulting from the expected traffic.

CONCRETE ANCHOR

Concrete anchor consists of 1/2" diameter Concrete Anchor Bolt, 1/2" nut, 1/2" washers, 1/2"hex nut and 1/2" washer. The anchor bolts shall be bored and the anchor bolts shall be removed from the concrete footing when the concrete is cured.
A. GENERAL SITE DATA

1. BASIS OF DESIGN
   - See Location Map on the Title Sheet

2. PHYSICAL DESIGN
   - Project Longitude: VARIABLE
   - Project Latitude: VARIABLE
   - Zoning Designation: VARIABLE
   - Zoning Information: See Title Sheet

3. SHEET MAPPING
   - Drainage Patterns: Shown on Envelope Maps
   - Aspects: Shown on Envelope Maps
   - Approx. Slopes: Shown on Envelope Maps
   - Approx. Slopes of Substantial Fluctuations: Shown on Typical Sections

4. MATERIALS ANDratulations of Soil Stabilization Practices: Shown on SW3P Sheets
   - Major Controls and Locations of Stabilization Practices: Shown on SW3P Sheets
   - Approx. Slopes: Shown on SW3P Sheets
   - Approx. Slopes of Sharing Fluctuations: Shown on SW3P Sheets

5. PROJECT DESCRIPTION
   - Some description as stated on Title Sheet

6. SITE DATA
   - Non-Joint Bid Utilities are covered by this SW3P
   - Joint Bid Utilities are covered by this SW3P (if marked)

7. GENERAL SITE DATA
   - Project Name: Name
   - Segment Number: Segment Number
   - A. Same description as stated on Title Sheet

8. PROJECT LOCATION
   - A. Sinkhole
   - B. Shallow washout
   - C. Stabilized area
   - D. Ditch
   - E. Culvert
   - F. Bridge
   - G. Reservoir
   - H. Wetland
   - I. Water body
   - J. Creek
   - K. Drainage ditch
   - L. Storm drain
   - M. Sewer line
   - N. Gas line
   - O. Electrical line
   - P. Telephone line
   - Q. Utility pole
   - R. Self-storage tank
   - S. Roadway
   - T. Building
   - U. Area
   - V. Other:

9. EXISTING CONDITION
   - Description of existing vegetation covers: (Provide type and description of vegetation covers)
   - Percentage of existing vegetation covers: (Provide type and description of vegetation covers)

10. EXISTING VEGETATION COVERS
    - Existing vegetation covers: (Provide type and description of vegetation covers)
      - Thin and Patchy
      - Thick and Uniformly Established
      - None or Minimal Cover
      - Other:

11. SCIENTIFIC AND ENVIRONMENTAL CONDITIONS
    - Description of soil: (Provide classification and description of soil)
      - Site Access: GAC
      - Site runoff coefficient: Site runoff coefficient
      - Site runoff coefficient: Site runoff coefficient

12. OUTLINE WORK:
    - Work not performed
    - A classified stream does not pass through project.
    - A classified stream passes through project.
    - None
    - Name of nearby waters that will receive discharges
    - Disturbed areas of the project

13. SITE (is in a Municipal Separate Storm Sewer System (MS4))
    - MS4 Operator: City of New Braunfels
    - City of New Braunfels

14. STORM WATER POLLUTION CONTROL
    - The proposed facility was designed to consider the hydraulic design standards to convey stormwater in a manner that is protective of the public safety and property. The extent of runoff from the facility is limited to the design. Additional factors for affecting postconstruction discharges from the proposed facility includes:
      - New or renovated stormwater discharges to natural streams.
      - Existing or renovated drainage discharges to natural streams.
      - Stormwater discharges from new or renovated drainage discharges to natural streams.
      - Stormwater discharges to existing drainage discharges to natural streams.
      - Stormwater discharges from existing drainage discharges to natural streams.

15. OTHER REQUIREMENTS & PRACTICES
    - Offsite waterway tracking of sediments and discharges that are not to be included.
    - Excess sediment on road shall be removed on a regular basis as directed/approved by the Engineer.
    - Sediment shall be constructed in a manner to minimize the runoff of pollutants.
    - Storm sewer inlets shall be constructed in a manner to minimize the amount of sediment that may enter receiving waters. Construction material for stormwater sites, stockpiles and haul roads shall be constructed to minimize and control the amount of sediment that may enter receiving waters.

16. STORM WATER POLLUTION
    - The proposed facility was designed to consider the hydraulic design standards to convey stormwater in a manner that is protective of the public safety and property. The extent of runoff from the facility is limited to the design. Additional factors for affecting postconstruction discharges from the proposed facility includes:
      - New or renovated stormwater discharges to natural streams.
      - Existing or renovated drainage discharges to natural streams.
      - Stormwater discharges from new or renovated drainage discharges to natural streams.
      - Stormwater discharges to existing drainage discharges to natural streams.
      - Stormwater discharges from existing drainage discharges to natural streams.

17. OTHER PRACTICES
    - Offsite waterway tracking of sediments and discharges that are not to be included.
    - Excess sediment on road shall be removed on a regular basis as directed/approved by the Engineer.

18. STORM WATER POLLUTION PREVENTION PLAN (SWPPP)
    - Texas Department of Transportation
    - STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

19. OTHER REQUIREMENTS & PRACTICES
    - Offsite waterway tracking of sediments and discharges that are not to be included.
    - Excess sediment on road shall be removed on a regular basis as directed/approved by the Engineer.