FOR CONTRACT NO.: 06-342524
PROJECT ID: 0600000381

INFORMATION HANDOUT

WATER QUALITY

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION (401 PERMIT)

PERMITS

UNITED STATES ARMY CORPS OF ENGINEERS
NON-REPORTING NATIONWIDE 404 PERMIT
NATIONWIDE PERMIT SUMMARY

AGREEMENTS

CALIFORNIA DEPARTMENT OF FISH AND GAME

UNITED STATES FISH AND WILDLIFE SERVICE (Biological Opinion)

MATERIALS INFORMATION

FOUNDATION RECOMMENDATION

FOUNDATION REVIEW

FINAL HYDRAULIC REPORT

AS-BUILT FOR EXISTING FLOWER SWITCH CANAL BRIDGE (42-0067)

PROJECT REPORT

CONSOLIDATED IRRIGATION DISTRICT

GEOTECHNICAL DESIGN REPORT

CRASH CUSHION (TYPE SMART)

CRASH CUSHION (TYPE QUADGUARD II)

CRASH CUSHION (TYPE TAU-II)

ROUTE: Fre-180-R71.8/74.5

Javier Almaguer
California Department of Transportation
855 M St., Ste. 200
Fresno, CA 93721

4 September 2012

CLEAN WATER ACT §401 TECHNICALLY CONDITIONED WATER QUALITY CERTIFICATION FOR DISCHARGE OF DREDGED AND/OR FILL MATERIALS FOR THE KINGS CANYON EXPRESSWAY-SEGMENT 2 PROJECT, WDID#5C10CR00022, FRESNO COUNTY

WATER QUALITY CERTIFICATION STANDARD CONDITIONS:

1. This Certification is subject to modification or revocation upon administrative or judicial review, including review and amendment pursuant to § 13330 of the California Water Code and § 3867 of Title 23 of the California Code of Regulations (23 CCR).

2. This Certification is not intended and shall not be construed to apply to any discharge from any activity involving a hydroelectric facility requiring a Federal Energy Regulatory Commission (FERC) license or an amendment to a FERC license unless the pertinent certification application was filed pursuant to 23 CCR § 3855(b) and the application specifically identified that a FERC license or amendment to a FERC license for a hydroelectric facility was being sought.

3. The validity of any non-denial certification action shall be conditioned upon total payment of the full fee required under 23 CCR § 3833, unless otherwise stated in writing by the certifying agency.

4. Certification is valid for the duration of the Kings Canyon Expressway-Segment 2 Project (Project) described in the attached "Project Information Sheet." This Certification is no longer valid if the Project (as summarized in the "Project Information Sheet" and described in the water quality certification application) is modified, or coverage under the Project permit issued by the U.S. Army Corps of Engineers pursuant to § 404 of the Clean Water Act has expired. The California Department of Transportation (Discharger) shall notify the Central Valley Regional Water Quality Control Board (Central Valley Water Board) in writing **within seven days** of Project completion.

5. All reports, notices, or other documents required by this Certification or requested by the Central Valley Water Board shall be signed by a person described below or by a duly authorized representative of that person.
   a. For a corporation: by a responsible corporate officer such as (1) a president, secretary, treasurer, or vice president of the corporation in charge of a principal business function; (2) any other person who performs similar policy or decision-making functions for the corporation; or (3) the manager of one or more manufacturing, production, or operating facilities if

authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

b. For a partnership or sole proprietorship: by a general partner or the proprietor.
c. For a municipality, State, federal, or other public agency: by either a principal executive officer or ranking elected official.

6. Any person signing a document under Standard Condition No. 5 shall make the following certification, whether written or implied:

   "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

ADDITIONAL TECHNICALLY CONDITIONED CERTIFICATION CONDITIONS:

In addition to the six standard conditions, the Discharger shall satisfy the following:

1. The Discharger shall notify the Central Valley Water Board in writing **seven days** prior to beginning any in-water activities.

2. Except for activities permitted by the U.S. Army Corps of Engineers under § 404 of the Clean Water Act, soil, silt, or other organic materials shall not be placed where such materials could pass into surface water or surface water drainage courses.

3. All areas disturbed by Project activities shall be protected from washout or erosion.

4. The Discharger shall maintain a copy of this Certification and supporting documentation (Project Information Sheet) at the Project site during construction for review by site personnel and agencies. All personnel (employees, contractors, and subcontractors) performing work on the proposed Project shall be adequately informed and trained regarding the conditions of this Certification.

5. An effective combination of erosion and sediment control Best Management Practices (BMPs) shall be implemented and adequately working during all phases of construction.

6. All temporarily affected areas shall be restored to pre-construction contours and conditions upon completion of construction activities.

7. The Discharger shall perform surface water sampling: 1) when performing any in-water work; 2) in the event that Project activities result in any materials reaching surface waters or; 3) when any activities result in the creation of a visible plume in surface waters. The following monitoring shall be conducted immediately upstream out of the influence of the Project and approximately 300 feet downstream of the active work area. Sampling results shall be submitted to this office by the first day of the second month following sampling. The sampling frequency and monitoring locations may be modified for certain projects with written permission from the Central Valley Water Board Executive Officer.

Parameter	Unit	Type of Sample	Frequency of Sample
Turbidity	NTU	Grab	Every 4 hours during in-water work
Settleable Material	ml/L	Grab	Same as above
pH	Standard Units	Grab	Daily during concrete activity
Visible construction related pollutants	Observation	Visible Inspections	Continuous throughout the construction period

8. Activities shall not cause in surface waters:

   (a) where natural turbidity is between 0 and 5 Nephelometric Turbidity Units (NTUs), increases exceeding 1 NTU;
   (b) where natural turbidity is between 5 and 50 NTUs, increases exceeding 20 percent;
   (c) where natural turbidity is between 50 and 100 NTUs, increases exceeding 10 NTUs;
   (d) where natural turbidity is greater than 100 NTUs, increases exceeding 10 percent.

   In determining compliance with the above limits, appropriate averaging periods may be applied provided that beneficial uses will be fully protected. Averaging periods may only be used with prior permission of the Central Valley Water Board Executive Officer.

9. Activities shall not cause settleable material to exceed 0.1 ml/L in surface waters as measured in surface waters downstream from the Project.

10. Activities shall not cause the pH to be depressed below 6.5 nor raised above 8.3.

11. The discharge of petroleum products or other excavated materials to surface water is prohibited. Activities shall not cause visible oil, grease, or foam in the work area or downstream. The Discharger shall notify the Central Valley Water Board immediately of any spill of petroleum products or other organic or earthen materials.

12. The Discharger shall notify the Central Valley Water Board immediately if any of the above conditions are violated, along with a description of measures it is taking to remedy the violation.

13. The Discharger shall comply with all California Department of Fish and Game Code § 1600 requirements for the Project.

14. The Discharger must obtain coverage under the NPDES General Permit for Storm Water Discharges Associated with Construction Activities issued by the State Water Resources Control Board for any project disturbing an area of one acre or greater.

15. In the event of any violation or threatened violation of the conditions of this Certification, the violation or threatened violation shall be subject to any remedies, penalties, process, or sanctions as provided for under State law and § 401(d) of the federal Clean Water Act. The applicability of any State law authorizing remedies, penalties, process, or sanctions for the violation or threatened violation constitutes a limitation necessary to ensure compliance with this Certification.

16. If the Discharger or a duly authorized representative of the Discharger fails or refuses to furnish technical or monitoring reports, as required under this Certification, or falsifies any information provided in the monitoring reports, the Discharger will be subject to civil liability, for each day of violation, or criminal liability.

17. In response to a suspected violation of any condition of this Certification, the Central Valley Water Board may require the Discharger to furnish, under penalty of perjury, any technical or monitoring reports the Central Valley Water Board deems appropriate, provided that the burden, including cost of the reports, shall be in reasonable relationship to the need for the reports and the benefits to be obtained from them.

18. The Discharger shall allow staff of the Central Valley Water Board, or an authorized representative(s), upon the presentation of credentials and other documents, as may be required by law, to enter the Project premises for inspection, including taking photographs and securing copies of project-related records, for the purpose of assuring compliance with this Certification and determining the ecological success of the Project.

CENTRAL VALLEY WATER BOARD CONTACT PERSON:

Debra Mahnke, Water Resource Control Engineer
1685 E Street
Fresno, CA 93706
(559) 445-6281
dmahnke@waterboards.ca.gov

WATER QUALITY CERTIFICATION:

I hereby issue an order certifying that the proposed discharge from the California Department of Transportation Kings Canyon Expressway-Segment 2 Project, WDID# 5C10CR00022, will comply with the applicable provisions of § 301 ("Effluent Limitations"), § 302 ("Water Quality Related Effluent Limitations"), § 303 ("Water Quality Standards and Implementation Plans"), § 306 ("National Standards of Performance"), and § 307 ("Toxic and Pretreatment Effluent Standards") of the Clean Water Act. This discharge is also regulated under State Water Resources Control Board Water Quality Order No. 2003-0017-DWQ "Statewide General Waste Discharge Requirements For Dredged Or Fill Discharges That Have Received State Water Quality Certification."

Except insofar as may be modified by any preceding conditions, all certification actions are contingent on (a) the discharge being limited to and all proposed mitigation being completed in strict compliance with the Discharger's project description, the attached "Project Information Sheet," and the Discharger's water quality certification application; and (b) compliance with all applicable requirements of the Central Valley Water Board's *Water Quality Control Plan for the Tulare Lake Basin*, Second Edition, revised January 2004.

Any person aggrieved by this action may petition the State Water Resources Control Board to review the action in accordance with California Water Code § 13320 and California Code of Regulations, title 23, § 2050 and following. The State Water Resources Control Board must receive the petition by 5:00 p.m., 30 days after the date of this action, except that if the thirtieth day following the date of this action falls on a Saturday, Sunday, or state holiday, the petition must be received by the State Water Resources Control Board by 5:00 p.m. on the next business day. Copies of the law and regulations

applicable to filing petitions may be found on the Internet at:
http://www.waterboards.ca.gov/public_notices/petitions/water_quality or will be provided upon request.

Clay L. Rodgers

for Pamela C. Creedon
Executive Officer

Enclosure: Water Quality Order No. 2003-0017-DWQ
Attachment: Project Information Sheet

cc: Jason Brush, Supervisor, Wetlands Regulatory Office, U.S. Environmental Protection Agency, Region 9, San Francisco (email)
Paul Maniccia, Chief, Sacramento South Branch, Regulatory Unit, Department of the Army, Corps of Engineers, Sacramento
Bill Orme, Water Quality Certification Unit Chief, Division of Water Quality, State Water Resources Control Board, Sacramento (email)
Jeffrey Single, Regional Manager, San Joaquin Valley-Southern Sierra Region, California Department of Fish and Game, Fresno

PROJECT INFORMATION SHEET

Application Date: 18 April 2012

Applicant: California Department of Transportation

Applicant Representative: Javier Almaguer, Interim Biology Branch Chief

Project Name: Kings Canyon Expressway-Segment 2 Project

Application Number: WDID# 5C10CR00022

Type of Project: 4-Lane Expressway construction

Project Location: Sections 1, 2, 11, 12, Township 14 South, Range 22 East, MDB&M. Sections 6, 7, Township 14 South, Range 23 East, MDB&M. Latitude: 36.735914° and Longitude: -119.528909°

Project Duration: The duration of the Project will be approximately 300 work days. Construction is tentatively scheduled between July 2013 and October 2014.

County: Fresno

Receiving Water: Fowler Switch Canal and Lone Tree Channel, Tulare Lake Hydrologic Basin, South Valley Floor Hydrologic Unit, Consolidated Hydrologic Area (# 551.70)

Water Body Type: Irrigation Canals

Designated Beneficial Uses: The *Water Quality Control Plan for the Tulare Lake Basin*, Second Edition, revised January 2004 designates beneficial uses for surface and ground waters within the region. Beneficial uses that could be impacted by the Project include: Municipal and Domestic Water Supply; Agricultural Supply; Industrial Process Supply, Groundwater Recharge, Water Contact Recreation; Non-Contact Water Recreation; Warm Freshwater Habitat; and Wildlife Habitat.

Project Description: The Kings Canyon Expressway-Segment 2 Project consists of constructing a 4-lane expressway on the north side of the existing SR 180. The Fowler Switch Canal and Lone Tree Channel will be realigned and spanned by bridges, and frontage roads will be constructed for property access. The expressway will maintain a 62-foot median with side ditches for runoff and utilities will be relocated between Quality and Madison Avenue.

Preliminary Water Quality Concerns: Increased turbidity and potential discharge of construction materials may result.

Proposed Mitigation to Address Concerns: Work within the waterways will be completed during the dry season when no flows are anticipated. Impacts to waterways will be minimized or avoided by utilizing temporary concrete washout facilities, temporary fiber rolls, temporary drainage inlet protection, temporary hydraulic mulch (polymer stabilized fiber matrix), street sweeping, and temporary construction entrances.

Fill/Excavation Area: A 0.32-acre segment (518 linear feet) of Lone Tree Channel will be permanently filled and bypassed by a concrete lined channel matching the new alignment. An additional 0.03 acres (49 linear feet) of Lone Tree Channel and 0.17 acres (675 linear feet) of Fowler Switch Canal will be temporarily impacted by the Project. The Project will remove and replace 235 cubic yards of existing concrete lining from the Fowler Switch Canal.

Dredge Volume: None

U.S. Army Corps of Engineers Permit Number: Nationwide Permit # 14

Department of Fish and Game Streambed Alteration Agreement: The Discharger applied for a Streambed Alteration Agreement on 11 April 2012.

Status of CEQA Compliance: The California Department of Transportation approved an Environmental Impact Report on 29 September 1995.

As a Responsible Agency under California Environmental Quality Act (CEQA), the Central Valley Water Board reviewed the Environmental Impact Report and found that impacts to water quality were adequately addressed. Mitigation for impacts to water quality is discussed in the "Proposed Mitigation to Address Concerns" section above, and the "Compensatory Mitigation" section below.

Compensatory Mitigation: To mitigate for the loss of 0.023 acres of waters of the U.S., the Discharger will construct 0.346 acres of lined canal within the Project area. To mitigate for the loss of the remaining 0.296 acres of waters, the Discharger will pay in-lieu fees in the amount of $44,400 to the National Fish and Wildlife Foundation for creation of 0.296 acres of vegetated channel.

Application Fee Provided: Total fees of $12,668 have been submitted as required by 23 CCR § 3833(b)(3)(A) and by 23 CCR § 2200(e).

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, SACRAMENTO
CORPS OF ENGINEERS
1325 J STREET
SACRAMENTO CA 95814-2922

REPLY TO
ATTENTION OF

June 25, 2012

Regulatory Division (SPK-2011-00212)

State of California
Department of Transportation, District 6
Attn: Ms. Carrie Swanberg
855 M Street, Suite 200
Fresno, California 93721

Dear Ms. Swanberg:

We are responding to your, April 18, 2012, request for a Department of the Army Nationwide Permit (NWP) verification for Segment 2 of the State Route (SR) 180 Sequoia/Kings Canyon Expressway Project (EA 06-34252). On April 19, 2012, we notified you by email that your Pre-construction Notification (PCN) was incomplete. Our letter requesting additional information was sent to you on May 14, 2012. On June 12, 2012, as requested, we received additional information to complete your PCN. We reviewed the additional information and determined your PCN was complete on June 18, 2012

This approximately 6.7-acre project involves activities, including discharges of fill material, into waters of the U.S., specifically Fowler Switch Canal and Lone Tree Channel, to construct a new expressway, bridges, and water crossings. The project is located north of the existing State Route 180 between Academy Avenue and Smith Avenue, Section 6, Township 14 South, Range 23 East, Mount Diablo Meridian, Latitude 36.735978°, Longitude -119.531397°, Fresno County, California.

Based on available information, we concur with the amount and location of other water bodies on the site as depicted on the enclosed, June 1, 2012, *Kings Canyon Expressway Segment 2 Wetland Delineation Map* drawing prepared by Caltrans Associate, Dena Gonzalez. The approximately 0.55 acre of other water bodies present within the survey area are potential waters of the United States regulated under Section 404 of the Clean Water Act. A copy of our RGL 08-02 Preliminary Jurisdictional Determination Form for this site is enclosed. Please sign and return a copy of the completed form to this office.

Additionally, based on the information you provided, the proposed activity, resulting in the permanent loss of approximately 0.320 acre and temporary impacts to approximately 0.2 acre of open waters, is authorized by Nationwide Permit Number 14, Linear Transportation Projects. However, until Section 401 Water Quality Certification for the activity has been issued or waived, our authorization is denied without prejudice. Once you have provided us evidence of water quality certification, the activity is authorized and the work may proceed subject to the conditions of certification and the Nationwide Permit.

Furthermore, we understand the State of California, Department of Transportation (Caltrans) is the National Environmental Policy Act (NEPA) lead Federal agency for this project, and as such, will ensure the authorized work complies with the NEPA, the Endangered Species Act, the National Historical Preservation Act, and any other applicable federal laws. Your work must comply with the following General Conditions listed on the enclosed *Nationwide Permit Summary* sheet (specifically 2, 4, 8, 9, 12-14, 18-21 and 25), the Regional Conditions listed on the enclosed *Final Sacramento District Regional Conditions for California, excluding Lake Tahoe Basin* (specifically 5-14), and the following special conditions:

Special Conditions

1. To mitigate for the loss of 0.023 acre of waters of the United States, you shall construct 0.346 acre of lined canal within the project area as shown in the, May 22, 2012, Kings Canyon Expressway Segment 2 USACE Impact Maps document.

2. To mitigate for the loss of the remaining 0.296 acre of waters of the United States, you shall submit a check in the amount of $44,400 ($150,000 per acre x 0.296 acres) payable to the National Fish and Wildlife Foundation (NFWF) for the creation of 0.296 acre of vegetated channel. Tulare-Buena Vista Lakes, Hydrologic Unit Code #18030012, must be indicated in the in-lieu fee agreement in order to insure the proper location of future mitigation. Within fourteen (14) days of receiving a receipt that your fees have been deposited, you shall submit a copy (typically Exhibit B) to this office for recordation.

3. This permit is contingent upon the permittee applying for and being issued a Section 401 Water Quality Certification. Evidence of a water quality certification must be submitted to this office, prior to commencing work in Waters of the U.S. All terms and conditions of the Section 401 Water Quality Certification are expressly incorporated as conditions of this permit.

4. This Corps permit does not authorize you to take an endangered species, in particular Vernal Pool Fairy Shrimp (*Branchinecta lynchi*), or designated critical habitat. In order to take a listed species legally, you must have separate authorization under the Endangered Species Act (e.g., an Endangered Species Act Section 10 permit, or a Biological Opinion under Endangered Species Act Section 7, with "incidental take" provisions with which you must comply). The enclosed Fish and Wildlife Service Biological Opinion (Number 1-1-03-F-0097, dated July 27, 2005), contains mandatory terms and conditions to implement the reasonable and prudent measures that are associated with "incidental take" that is also specified in the Biological Opinion. Your authorization under this Corps permit is conditional upon your compliance with all of the mandatory terms and conditions associated with "incidental take" of the attached Biological Opinion, and any future amendments to it, which terms and conditions are incorporated by reference in this permit. Failure to comply with the terms and conditions associated with incidental take of the Biological Opinion, where a take of the listed species occurs, would constitute an unauthorized take, and it would also constitute non-compliance with your Corps permit. The U. S. Fish and Wildlife Service is the appropriate authority to determine compliance with the terms and conditions of their Biological Opinion, and with the Endangered Species Act. You must comply with all conditions of this Biological Opinion, including those ascribed to the Corps.

5. All equipment staging, including Temporary Construction Areas (TCA's), shall take place within Corps of Engineers approved areas within the project boundary. Prior to construction implementation, you shall ensure all equipment staging, TCA's, demolition and excavation, off pavement detours, borrow and fill areas, and upland disposal areas have been evaluated under National Environmental Policy Act, Section 401 and 404 of the Clean Water Act, Section 7 of the Endangered Species Act and Section 106 of the National Historical Preservation Act and all required permits have been obtained.

6. Excavated materials shall only be placed in upland locations. The upland disposal site(s) shall be delineated for waters of the U.S. and must be approved by the Corps of Engineers prior to disposal.

7. Within 30 days prior to initiation of construction activities within waters of the United States, you shall submit to this office pre-construction photographs of the proposed discharge areas in waters of the U.S., landscape view photographs of major project features, which have been taken no more than 1 year prior to initiation of construction activities. Within 30 days following construction activities, you shall submit post-construction photographs of the same locations, showing the placement and/or removal of fill, and landscape view photographs of all major project features. The pre & post camera positions and view angles of the photographs shall be identical and identified on a map, aerial photo, or project drawing. Photos may be submitted electronically to regulatory-info@usace.army.mil.

8. You shall follow specifications and standards described in the Storm Water Pollution Prevention Plan (SWPPP) and/or Water Pollution Control Plan (WPCP), to prevent erosion and sedimentation during and after construction. Construction work within waters of the U. S. shall be performed when the flows are at their seasonal low or when they have ceased and the areas are dry, typically late summer through early fall.

9. Between construction seasons all equipment and materials, with the exception of ESA fencing, temporary falsework, and trestles, shall be removed from waters of the U.S. and all disturbed areas shall be stabilized to prevent erosion and sedimentation.

10. If any of the above conditions are violated or unauthorized activities occur, you shall stop work immediately and notify the Sacramento District, Regulatory Division Office. You shall provide us with a detailed description of the unauthorized activity(s), photo documentation, and any measures taken to remedy the violation.

11. Within 30 days after completion of the authorized work, you must sign the enclosed *Compliance Certification* form and return it to this office, along with the items required in special condition #6.

This verification is valid for two years from the date of this letter or until the Nationwide Permit is modified, reissued, or revoked, whichever comes first. Failure to comply with the General and Regional Conditions of this Nationwide Permit, or the project-specific Special Conditions of this authorization, may result in the suspension or revocation of your authorization.

We would appreciate your feedback. At your earliest convenience, please tell us how we are doing by completing the customer survey on our website under *Customer Service Survey.*

Please refer to identification number SPK-2011-00212 in any correspondence concerning this project. If you have any questions, please contact Mr. Jason Deters at our California South Branch Office, 1325 J Street, Room 1350, Sacramento, California 95814-2922, email *Jason.Deters@usace.army.mil*, or telephone 916-557-7152. For more information regarding our program, please visit our website at *www.spk.usace.army.mil/Missions/Regulatory.aspx.*

Sincerely,

for Nancy A. Haley

Paul Maniccia
Chief, California South Branch

Enclosures

Copies Furnished without enclosures

California Regional Water Quality Control Board, Central Valley Region, Fresno Branch Office, 1685 E Street, Suite 200, Fresno, California 93706

California Department of Fish and Game, Central Region, 1234 East Shaw Avenue, Fresno, California 93710

U. S. Fish and Wildlife Service, San Joaquin Valley Division, 2800 Cottage Way, Sacramento, California 95825

Mr. Robert Leidy, U.S. Environmental Protection Agency, Wetlands Office, WTR9, 75 Hawthorne Street, San Francisco, California 94105-3920

Nationwide Permit Summary

U S Army Corps of Engineers
Sacramento District

33 CFR Part 330; Issuance of Nationwide Permits – March 19, 2012

14. Linear Transportation Projects. Activities required for the construction, expansion, modification, or improvement of linear transportation projects (e.g., roads, highways, railways, trails, airport runways, and taxiways) in waters of the United States. For linear transportation projects in non-tidal waters, the discharge cannot cause the loss of greater than 1/2-acre of waters of the United States. For linear transportation projects in tidal waters, the discharge cannot cause the loss of greater than 1/3-acre of waters of the United States. Any stream channel modification, including bank stabilization, is limited to the minimum necessary to construct or protect the linear transportation project; such modifications must be in the immediate vicinity of the project.

This NWP also authorizes temporary structures, fills, and work necessary to construct the linear transportation project. Appropriate measures must be taken to maintain normal downstream flows and minimize flooding to the maximum extent practicable, when temporary structures, work, and discharges, including cofferdams, are necessary for construction activities, access fills, or dewatering of construction sites. Temporary fills must consist of materials, and be placed in a manner, that will not be eroded by expected high flows. Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The areas affected by temporary fills must be revegetated, as appropriate.

This NWP cannot be used to authorize non-linear features commonly associated with transportation projects, such as vehicle maintenance or storage buildings, parking lots, train stations, or aircraft hangars.

Notification: The permittee must submit a pre-construction notification to the district engineer prior to commencing the activity if: (1) the loss of waters of the United States exceeds 1/10-acre; or (2) there is a discharge in a special aquatic site, including wetlands. (See general condition 31.) (Sections 10 and 404)

Note: Some discharges for the construction of farm roads or forest roads, or temporary roads for moving mining equipment, may qualify for an exemption under Section 404(f) of the Clean Water Act (see 33 CFR 323.4).

A. **Regional Conditions**

1. **Regional Conditions for California, excluding the Tahoe Basin**

http://www.spk.usace.army.mil/organizations/cespk-co/regulatory/nwp/2012-nwps/2012-NWP-RC-CA.pdf

2. **Regional Conditions for Nevada, including the Tahoe Basin**

hsttp://www.spk.usace.army.mil/organizations/cespk-co/regulatory/nwp/2012-nwps/2012-NWP-RC-NV.pdf

3. **Regional Conditions for Utah**

http://www.spk.usace.army.mil/organizations/cespk-co/regulatory/nwp/2012-nwps/2012-NWP-RC-UT.pdf

4. **Regional Conditions for Colorado.**

http://www.spk.usace.army.mil/organizations/cespk-co/regulatory/nwp/2012-nwps/2012-NWP-RC-CO.pdf

B. **Nationwide Permit General Conditions**

Note: To qualify for NWP authorization, the prospective permittee must comply with the following general conditions, as applicable, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer. Prospective permittees should contact the appropriate Corps district office to determine if regional conditions have been imposed on an NWP. Prospective permittees should also contact the appropriate Corps district office to determine the status of Clean Water Act Section 401 water quality certification and/or Coastal Zone Management Act consistency for an NWP. Every person who may wish to obtain permit authorization under one or more NWPs, or who is currently relying on an existing or prior permit authorization under one or more NWPs, has been and is on notice that all of the provisions of 33 CFR §§ 330.1 through 330.6 apply to every NWP authorization. Note especially 33 CFR § 330.5 relating to the modification, suspension, or revocation of any NWP authorization.

☐ 1. **Navigation.**

☐ (a) No activity may cause more than a minimal adverse effect on navigation.

☐ (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.

☐ (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

☐ 2. **Aquatic Life Movements.** No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

☐ 3. **Spawning Areas.** Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

☐ 4. **Migratory Bird Breeding Areas.** Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

☐ 5. **Shellfish Beds.** No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

☐ 6. **Suitable Material.** No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

☐ 7. **Water Supply Intakes.** No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

☐ 8. **Adverse Effects From Impoundments.** If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

☐ 9. **Management of Water Flows.** To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

☐ 10. **Fills Within 100-Year Floodplains.** The activity must comply with applicable FEMA-approved state or local floodplain management requirements.

☐ 11. **Equipment.** Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

☐ 12. **Soil Erosion and Sediment Controls.** Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

☐ 13. **Removal of Temporary Fills.** Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be revegetated, as appropriate.

☐ 14. **Proper Maintenance.** Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

☐ 15. **Single and Complete Project.** The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

☐ 16. **Wild and Scenic Rivers.** No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

☐ 17. **Tribal Rights.** No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

☐ 18. **Endangered Species.**

☐ (a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

☐ (b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.

☐ (c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete pre-construction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

☐ (d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWPs.

☐ (e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

☐ (f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their world wide web pages at http://www.fws.gov/ or http://www.fws.gov/ipac and http://www.noaa.gov/fisheries.html respectively.

☐ 19. **Migratory Birds and Bald and Golden Eagles**. The permittee is responsible for obtaining any "take" permits required under the U.S. Fish and Wildlife Service's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such "take" permits are required for a particular activity.

☐ 20. **Historic Properties.**

☐ (a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

☐ (b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

☐ (c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

☐ (d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non- Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

☐ (e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

☐ 21. **Discovery of Previously Unknown Remains and Artifacts.** If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

☐ **22. Designated Critical Resource Waters.** Critical resource waters include, NOAA-managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

☐ (a) Discharges of dredged or fill material into waters of the United States are not authorized by NWPs 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

☐ (b) For NWPs 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWPs only after it is determined that the impacts to the critical resource waters will be no more than minimal.

☐ **23. Mitigation.** The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

☐ (a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

☐ (b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

☐ (c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

☐ (1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

☐ (2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

☐ (3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

☐ (4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

☐ (5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

☐ (d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

☐ (e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

☐ (f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

☐ (g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to a herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

☐ **24. Safety of Impoundment Structures**. To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

☐ **25. Water Quality**. Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

☐ **26. Coastal Zone Management**. In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

☐ **27. Regional and Case-By-Case Conditions**. The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

☐ **28. Use of Multiple Nationwide Permits**. The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWPs does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

☐ **29. Transfer of Nationwide Permit Verifications.** If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

> "When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below."
>
> ---
>
> (Transferee)
>
> ---
>
> (Date)

☐ **30. Compliance Certification**. Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

☐ (a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

☐ (b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(l)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

☐ (c) The signature of the permittee certifying the completion of the work and mitigation.

☐ **31. Pre-Construction Notification.**

☐ (a) **Timing**. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

☐ (1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

☐ (2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2)..

☐ (b) <u>Contents of Pre-Construction Notification</u>: The PCN must be in writing and include the following information:

☐ (1) Name, address and telephone numbers of the prospective permittee;

☐ (2) Location of the proposed project;

☐ (3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the United States expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);

☐ (4) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

☐ (5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

☐ (6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and

☐ (7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

☐ (c) <u>Form of Pre-Construction Notification</u>: he standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.

☐ (d) Agency Coordination:

☐ (1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWPs and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

☐ (2) For all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of intermittent and ephemeral stream bed, and for all NWP 48 activities that require pre-construction notification, the district engineer will immediately provide (e.g., via email, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWPs, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

☐ (3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

☐ (4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

C. District Engineer's Decision

☐ 1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. For a linear project, this determination will include an evaluation of the individual crossings to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings authorized by NWP. If an applicant requests a waiver of the 300 linear foot limit on impacts to intermittent or ephemeral streams or of an otherwise applicable limit, as provided for in NWPs 13, 21, 29, 36, 39, 40, 42, 43, 44, 50, 51 or 52, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in minimal adverse effects. When making minimal effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

☐ 2. If the proposed activity requires a PCN and will result in a loss of greater than 1/10- acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

☐ 3. If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either: (a) That the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit; (b) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or (c) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period, with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

D. Further Information

1. District Engineers have authority to determine if an activity complies with the terms and conditions of an NWP.

2. NWPs do not obviate the need to obtain other federal, state, or local permits, approvals, or authorizations required by law.

3. NWPs do not grant any property rights or exclusive privileges.

4. NWPs do not authorize any injury to the property or rights of others.

5. NWPs do not authorize interference with any existing or proposed Federal project.

E. **Definitions**

Best management practices (BMPs): Policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects on surface water quality resulting from development. BMPs are categorized as structural or non-structural.

Compensatory mitigation: The restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources for the purposes of offsetting unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved. Currently serviceable: Useable as is or with some maintenance, but not so degraded as to essentially require reconstruction.

Direct effects: Effects that are caused by the activity and occur at the same time and place.

Discharge: The term "discharge" means any discharge of dredged or fill material.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of an aquatic resource to heighten, intensify, or improve a specific aquatic resource function(s). Enhancement results in the gain of selected aquatic resource function(s), but may also lead to a decline in other aquatic resource function(s). Enhancement does not result in a gain in aquatic resource area.

Ephemeral stream: An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Establishment (creation): The manipulation of the physical, chemical, or biological characteristics present to develop an aquatic resource that did not previously exist at an upland site. Establishment results in a gain in aquatic resource area.

High Tide Line: The line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Historic Property: Any prehistoric or historic district, site (including archaeological site), building, structure, or other object included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria (36 CFR part 60).

Independent utility: A test to determine what constitutes a single and complete non-linear project in the Corps regulatory program. A project is considered to have independent utility if it would be constructed absent the construction of other projects in the project area. Portions of a multi-phase project that depend upon other phases of the project do not have independent utility. Phases of a project that would be constructed even if the other phases were not built can be considered as separate single and complete projects with independent utility.

Indirect effects: Effects that are caused by the activity and are later in time or farther removed in distance, but are still reasonably foreseeable.

Intermittent stream: An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

Loss of waters of the United States: Waters of the United States that are permanently adversely affected by filling, flooding, excavation, or drainage because of the regulated activity. Permanent adverse effects include permanent discharges of dredged or fill material that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the United States is a threshold measurement of the impact to jurisdictional waters for determining whether a project may qualify for an NWP; it is not a net threshold that is calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and services. The loss of stream bed includes the linear feet of stream bed that is filled or excavated. Waters of the United States temporarily filled, flooded, excavated, or drained, but restored to pre-construction contours and elevations after construction, are not included in the measurement of loss of waters of the United States. Impacts resulting from activities eligible for exemptions under Section 404(f) of the Clean Water Act are not considered when calculating the loss of waters of the United States.

Non-tidal wetland: A non-tidal wetland is a wetland that is not subject to the ebb and flow of tidal waters. The definition of a wetland can be found at 33 CFR 328.3(b). Non-tidal wetlands contiguous to tidal waters are located landward of the high tide line (i.e., spring high tide line).

Open water: For purposes of the NWPs, an open water is any area that in a year with normal patterns of precipitation has water flowing or standing above ground to the extent that an ordinary high water mark can be determined. Aquatic vegetation within the area of standing or flowing water is either non-emergent, sparse, or absent. Vegetated shallows are considered to be open waters. Examples of "open waters" include rivers, streams, lakes, and ponds.

Ordinary High Water Mark: An ordinary high water mark is a line on the shore established by the fluctuations of water and indicated by physical characteristics, or by other appropriate means that consider the characteristics of the surrounding areas (see 33 CFR 328.3(e)).

Perennial stream: A perennial stream has flowing water year-round during a typical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Practicable: Available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

Pre-construction notification: A request submitted by the project proponent to the Corps for confirmation that a particular activity is authorized by nationwide permit. The request may be a permit application, letter, or similar document that includes information about the proposed work and its anticipated environmental effects. Pre-construction notification may be required by the terms and conditions of a nationwide permit, or by regional conditions. A pre-construction notification may be voluntarily submitted in cases where pre-construction notification is not required and the project proponent wants confirmation that the activity is authorized by nationwide permit.

Preservation: The removal of a threat to, or preventing the decline of, aquatic resources by an action in or near those aquatic resources. This term includes activities commonly associated with the protection and maintenance of aquatic resources through the implementation of appropriate legal and physical mechanisms. Preservation does not result in a gain of aquatic resource area or functions.

Re-establishment: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former aquatic resource. Re-establishment results in rebuilding a former aquatic resource and results in a gain in aquatic resource area and functions.

Rehabilitation: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of repairing natural/historic functions to a degraded aquatic resource. Rehabilitation results in a gain in aquatic resource function, but does not result in a gain in aquatic resource area.

Restoration: The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning natural/historic functions to a former or degraded aquatic resource. For the purpose of tracking net gains in aquatic resource area, restoration is divided into two categories: re-establishment and rehabilitation.

Riffle and pool complex: Riffle and pool complexes are special aquatic sites under the 404(b)(1) Guidelines. Riffle and pool complexes sometimes characterize steep gradient sections of streams. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a course substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. A slower stream velocity, a streaming flow, a smooth surface, and a finer substrate characterize pools.

Riparian areas: Riparian areas are lands adjacent to streams, lakes, and estuarine-marine shorelines. Riparian areas are transitional between terrestrial and aquatic ecosystems, through which surface and subsurface hydrology connects riverine, lacustrine, estuarine, and marine waters with their adjacent wetlands, non-wetland waters, or uplands. Riparian areas provide a variety of ecological functions and services and help improve or maintain local water quality. (See general condition 23.)

Shellfish seeding: The placement of shellfish seed and/or suitable substrate to increase shellfish production. Shellfish seed consists of immature individual shellfish or individual shellfish attached to shells or shell fragments (i.e., spat on shell). Suitable substrate may consist of shellfish shells, shell fragments, or other appropriate materials placed into waters for shellfish habitat.

Single and complete linear project: A linear project is a project constructed for the purpose of getting people, goods, or services from a point of origin to a terminal point, which often involves multiple crossings of one or more waterbodies at separate and distant locations. The term "single and complete project" is defined as that portion of the total linear project proposed or accomplished by one owner/developer or partnership or other association of owners/developers that includes all crossings of a single water of the United States (i.e., a single waterbody) at a specific location. For linear projects crossing a single or multiple waterbodies several times at separate and distant locations, each crossing is considered a single and complete project for purposes of NWP authorization. However, individual channels in a braided stream or river, or individual arms of a large, irregularly shaped wetland or lake, etc., are not separate waterbodies, and crossings of such features cannot be considered separately.

Single and complete non-linear project: For non-linear projects, the term "single and complete project" is defined at 33 CFR 330.2(i) as the total project proposed or accomplished by one owner/developer or partnership or other association of owners/developers. A single and complete non-linear project must have independent utility (see definition of "independent utility"). Single and complete non-linear projects may not be "piecemealed" to avoid the limits in an NWP authorization.

Stormwater management: Stormwater management is the mechanism for controlling stormwater runoff for the purposes of reducing downstream erosion, water quality degradation, and flooding and mitigating the adverse effects of changes in land use on the aquatic environment.

Stormwater management facilities: Stormwater management facilities are those facilities, including but not limited to, stormwater retention and detention ponds and best management practices, which retain water for a period of time to control runoff and/or improve the quality (i.e., by reducing the concentration of nutrients, sediments, hazardous substances and other pollutants) of stormwater runoff.

Stream bed: The substrate of the stream channel between the ordinary high water marks. The substrate may be bedrock or inorganic particles that range in size from clay to boulders. Wetlands contiguous to the stream bed, but outside of the ordinary high water marks, are not considered part of the stream bed.

Stream channelization: The manipulation of a stream's course, condition, capacity, or location that causes more than minimal interruption of normal stream processes. A channelized stream remains a water of the United States. Structure: An object that is arranged in a definite pattern of organization. Examples of structures include, without limitation, any pier, boat dock, boat ramp, wharf, dolphin, weir, boom, breakwater, bulkhead, revetment, riprap, jetty, artificial island, artificial reef, permanent mooring structure, power transmission line, permanently moored floating vessel, piling, aid to navigation, or any other manmade obstacle or obstruction.

Tidal wetland: A tidal wetland is a wetland (i.e., water of the United States) that is inundated by tidal waters. The definitions of a wetland and tidal waters can be found at 33 CFR 328.3(b) and 33 CFR 328.3(f), respectively. Tidal waters rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by other waters, wind, or other effects. Tidal wetlands are located channelward of the high tide line, which is defined at 33 CFR 328.3(d).

Vegetated shallows: Vegetated shallows are special aquatic sites under the 404(b)(1) Guidelines. They are areas that are permanently inundated and under normal circumstances have rooted aquatic vegetation, such as seagrasses in marine and estuarine systems and a variety of vascular rooted plants in freshwater systems.

Waterbody: For purposes of the NWPs, a waterbody is a jurisdictional water of the United States. If a jurisdictional wetland is adjacent – meaning bordering, contiguous, or neighboring – to a waterbody determined to be a water of the United States under 33 CFR 328.3(a)(1)-(6), that waterbody and its adjacent wetlands are considered together as a single aquatic unit (see 33 CFR 328.4(c)(2)). Examples of "waterbodies" include streams, rivers, lakes, ponds, and wetlands.

Sacramento District Nationwide Permit Regional Conditions for California, excluding the Lake Tahoe Basin

1.* When pre-construction notification (PCN) is required, the permittee shall notify the U.S. Army Corps of Engineers, Sacramento District (Corps) in accordance with General Condition 31 using either the South Pacific Division Preconstruction Notification (PCN) Checklist or a signed application form (ENG Form 4345) with an attachment providing information on compliance with all of the General and Regional Conditions. In addition, the PCN shall include:

a. A written statement describing how the activity has been designed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States;

b. Drawings, including plan and cross-section views, clearly depicting the location, size and dimensions of the proposed activity, as well as the location of delineated waters of the U.S. on the site. The drawings shall contain a title block, legend and scale, amount (in cubic yards) and area (in acres) of fill in Corps jurisdiction, including both permanent and temporary fills/structures. The ordinary high water mark or, if tidal waters, the mean high water mark and high tide line, should be shown (in feet), based on National Geodetic Vertical Datum (NGVD) or other appropriate referenced elevation. All drawings for activities located within the boundaries of the Los Angeles District shall comply with the September 15, 2010 Special Public Notice: *Map and Drawing Standards for the Los Angeles District Regulatory Division*, (available on the Los Angeles District Regulatory Division website at: www.spl.usace.army.mil/regulatory/); and

c. Numbered and dated pre-project color photographs showing a representative sample of waters proposed to be impacted on the site, and all waters of the U.S. proposed to be avoided on and immediately adjacent to the activities site. The compass angle and position of each photograph shall be identified on the plan-view drawing(s) required in subpart b of this Regional Condition.

2. For all Nationwide Permits (NWPs), the permittee shall submit a PCN in accordance with General Condition 31 and Regional Condition 1, in the following circumstances:

a. For all activities that would result in the discharge of fill material into any vernal pool;

b. For any activity in the Primary and Secondary Zones of the Legal Delta, the Sacramento River, the San Joaquin River, and the immediate tributaries of these waters;

c. For all crossings of perennial waters and intermittent waters;

d. For all activities proposed within 100 feet of the point of discharge of a known natural spring source, which is any location where ground water emanates from a point in the ground excluding seeps or other discharges which lack a defined channel; and

e.* For all activities located in areas designated as Essential Fish Habitat (EFH) by the Pacific Fishery Management Council (i.e., all tidally influenced areas - Federal Register dated March 12, 2007 (72 FR 11092)), in which case the PCN shall include an EFH assessment and extent of proposed impacts to EFH. Examples of EFH habitat assessments can be found at: http://www.swr.noaa.gov/efh.htm.

3. The permittee shall record the NWP verification with the Registrar of Deeds or other appropriate official charged with the responsibility for maintaining records of title to or interest in real property for areas (1) designated to be preserved as part of compensatory mitigation for authorized impacts, including any associated covenants or restrictions, or (2) where boat ramps or docks, marinas, piers, and permanently moored vessels will be constructed or placed in or adjacent to navigable waters. The recordation shall also include a map showing the surveyed location of the preserved area or authorized structure.

4. For all waters of the U.S. proposed to be avoided on a site, unless determined to be impracticable by the Corps, the permittee shall:

a. Establish and maintain, in perpetuity, a preserve containing all avoided waters of the U.S. to ensure that the functions of the aquatic environment are protected;

b. Place all avoided waters of the U.S. and any upland buffers into a separate parcel prior to discharging dredge or fill material into waters of the U.S., and

c. Establish permanent legal protection for all preserve parcels, following Corps approval of the legal instrument;

If the Corps determines that it is impracticable to require permanent preservation of the avoided waters, additional mitigation may be required in order to compensate for indirect impacts to the waters of the U.S.

5. For all temporary fills, the PCN shall include a description of the proposed temporary fill, including the type and amount of material to be placed, the area proposed to be impacted, and the proposed plan for restoration of the temporary fill area to pre-activities contours and conditions, including a plan for the re-vegetation of the temporary fill area, if necessary. In addition, the PCN shall include the reason(s) why avoidance of temporary impacts is not practicable.

In addition, for all activities resulting in temporary fill within waters of the U.S., the permittee shall:

a. Utilize material consisting of clean and washed gravel. For temporary fills within waters of the U.S. supporting anadromous fisheries, spawning quality gravel shall be used, where practicable, as determined by the Corps, after consultation with appropriate Federal and state fish and wildlife agencies;

b. Place a horizontal marker (e.g. fabric, certified weed free straw, etc.) to delineate the existing ground elevation of the waters temporarily filled during construction; and

c. Remove all temporary fill within 30 days following completion of construction activities.

6. In addition to the requirements of General Condition 2, unless determined to be impracticable by the Corps, the following criteria shall apply to all road crossings:

a.* For all activities in waters of the U.S. that are suitable habitat for Federally-listed fish species, the permittee shall design all road crossings to ensure that the passage and/or spawning of fish is not hindered. In these areas, the permittee shall employ bridge designs that span the stream or river, including pier- or pile-supported spans, or designs that use a bottomless arch culvert with a natural stream bed;

b. Road crossings shall be designed to ensure that no more than minor impacts would occur to fish and wildlife passage or expected high flows, following the criteria listed in Regional Condition 6(a). Culverted crossings that do not utilize a bottomless arch culvert with a natural stream bed may be authorized for waters that do not contain suitable habitat for Federally listed fish species, if it can be demonstrated and is specifically determined by the Corps, that such crossing will result in no more than minor impacts to fish and wildlife passage or expected high flows;

c. No construction activities shall occur within standing or flowing waters. For ephemeral or intermittent streams, this may be accomplished through construction during the dry season. In perennial

* Regional Condition developed jointly between Sacramento District, Los Angeles District, and San Francisco District.

streams, this may be accomplished through dewatering of the work area. Any proposed dewatering plans must be approved, in writing, by the Corps prior to commencement of construction activities; and

d. All bank stabilization activities associated with a road crossing shall comply with Regional Condition 19.

In no case shall stream crossings result in a reduction in the pre-construction bankfull width or depth of perennial streams or negatively alter the flood control capacity of perennial streams.

7.* For activities in which the Corps designates another Federal agency as the lead for compliance with Section 7 of the Endangered Species Act (ESA) of 1973 as amended, pursuant to 50 CFR Part 402.07, Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act (EFH), pursuant to 50 CFR 600.920(b) and/or Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, pursuant to 36 CFR 800.2(a)(2), the lead Federal agency shall provide all relevant documentation to the Corps demonstrating any previous consultation efforts, as it pertains to the Corps Regulatory permit area (for Section 7 and EFH compliance) and the Corps Regulatory area of potential effect (APE) (for Section 106 compliance). For activities requiring a PCN, this information shall be submitted with the PCN. If the Corps does not designate another Federal agency as the lead for ESA, EFH and/or NHPA, the Corps will initiate consultation for compliance, as appropriate.

8. For all NWPs which require a PCN, the permittee shall submit the following additional information with the compliance certificate required under General Condition 30:

a. As-built drawings of the work conducted on the project site and any on-site and/or off-site compensatory mitigation, preservation, and/or avoidance area(s). The as-builts shall include a plan-view drawing of the location of the authorized work footprint (as shown on the permit drawings), with an overlay of the work as constructed in the same scale as the permit drawings. The drawing shall show all areas of ground disturbance, wetland impacts, structures, and the boundaries of any on-site and/or off-site mitigation or avoidance areas. Please note that any deviations from the work as authorized, which result in additional impacts to waters of the U.S., must be coordinated with the appropriate Corps office prior to impacts; and

b. Numbered and dated post-construction color photographs of the work conducted within a representative sample of the impacted waters of the U.S., and within all avoided waters of the U.S. on and immediately adjacent to the proposed activities area. The compass angle and position of all photographs shall be similar to the pre-construction color photographs required in Regional Condition 1(c) and shall be identified on the plan-view drawing(s) required in subpart a of this Regional Condition.

9. For all activities requiring permittee responsible mitigation, the permittee shall develop and submit to the Corps for review and approval, a final comprehensive mitigation and monitoring plan for all permittee responsible mitigation prior to commencement of construction activities within waters of the U.S. The plan shall include the mitigation location and design drawings, vegetation plans, including target species to be planted, and final success criteria, presented in the format of the *Sacramento District's Habitat Mitigation and Monitoring Proposal Guidelines*, dated December 30, 2004, and in compliance with the requirements of 33 CFR 332.

10.* The permittee shall complete the construction of any compensatory mitigation required by special condition(s) of the NWP verification before or concurrent with commencement of construction of the authorized activity, except when specifically determined to be impracticable by the Corps. When mitigation involves use of a mitigation bank or in-lieu fee program, the permittee shall submit proof of payment to the Corps prior to commencement of construction of the authorized activity.

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11. The permittee is responsible for all authorized work and ensuring that all contractors and workers are made aware and adhere to the terms and conditions of the permit authorization. The permittee shall ensure that a copy of the permit authorization and associated drawings are available and visible for quick reference at the site until all construction activities are completed.

12. The permittee shall clearly identify the limits of disturbance in the field with highly visible markers (e.g. construction fencing, flagging, silt barriers, etc.) prior to commencement of construction activities within waters of the U.S. The permittee shall maintain such identification properly until construction is completed and the soils have been stabilized. The permittee is prohibited from any activity (e.g. equipment usage or materials storage) that impacts waters of the U.S. outside of the permit limits (as shown on the permit drawings).

13. For all activities in which a PCN is required, the permittee shall notify the appropriate district office of the start date for the authorized work within 10 days prior to initiation of construction activities.

14. The permittee shall allow Corps representatives to inspect the authorized activity and any mitigation areas at any time deemed necessary to determine compliance with the terms and conditions of the NWP verification. The permittee will be notified in advance of an inspection.

15. For all activities located in the Mather Core Recovery Area in Sacramento County, as identified in the U.S. Fish and Wildlife Service's *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* dated December 15, 2005, NWPs 14, 18, 23, 29, 39, 40, 42, 43 and 44 are revoked from use in vernal pools that may contain habitat for Federally-listed threatened and/or endangered vernal pool species.

16. For activities located in the Primary or Secondary Zone of the Legal Delta, NWPs 29 and 39 are revoked.

17. For all activities within the Secondary Zone of the Legal Delta, the permittee shall conduct compensatory mitigation for unavoidable impacts within the Secondary Zone of the Legal Delta.

18. For NWP 12: Permittees shall ensure the construction of utility lines does not result in the draining of any water of the U.S., including wetlands. This may be accomplished through the use of clay blocks, bentonite, or other suitable material (as approved by the Corps) to seal the trench. For utility line trenches, during construction, the permittee shall remove and stockpile, separately, the top 6 – 12 inches of topsoil. Following installation of the utility line(s), the permittee shall replace the stockpiled topsoil on top and seed the area with native vegetation. The permittee shall submit a PCN for utility line activities in the following circumstances:

a. The utility line crossing would result in a discharge of dredged and/or fill material into perennial waters, intermittent waters, wetlands, mudflats, vegetated shallows, riffle and pool complexes, sanctuaries and refuges or coral reefs;

b. The utility line activity would result in a discharge of dredged and/or fill material into greater than 100 linear feet of ephemeral waters of the U.S.;

c. The utility line installation would include the construction of a temporary or permanent access road, substation or foundation within waters of the U.S.; or

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d. The proposed activity would not involve the restoration of all utility line trenches to pre-project contours and conditions within 30 days following completion of construction activities.

19. For NWP 13 and 14: All bank stabilization activities shall involve either the sole use of native vegetation or other bioengineered design techniques (e.g. willow plantings, root wads, large woody debris, etc.), or a combination of hard-armoring (e.g. rip-rap) and native vegetation or bioengineered design techniques, unless specifically determined to be impracticable by the Corps. The permittee shall submit a PCN for any bank stabilization activity that involves hard-armoring or the placement of any non-vegetated or non-bioengineered technique below the ordinary high water mark or, if tidal waters, the high tide line of waters of the U.S. The request to utilize non-vegetated techniques must include information on why the sole use of vegetated techniques is not practicable.

20. For NWP 23: The permittee shall submit a PCN for all activities proposed for this NWP, in accordance with General Condition 31 and Regional Condition 1. The PCN shall include a copy of the signed Categorical Exclusion document and final agency determinations regarding compliance with ESA, EFH and NHPA, in accordance with General Conditions 18 and 20 and Regional Condition 7.

21. For NWP 27: The permittee shall submit a PCN for aquatic habitat restoration, establishment, and enhancement activities in the following circumstances:

a. The restoration, establishment or enhancement activity would result in a discharge of dredged and/or fill material into perennial waters, intermittent waters, wetlands, mudflats, vegetated shallows, riffle and pool complexes, sanctuaries and refuges or coral reefs; or

b. The restoration, establishment or enhancement activity would result in a discharge of dredged and/or fill material into greater than 100 linear feet of ephemeral waters of the U.S.

22. For NWPs 29 and 39: The channelization or relocation of intermittent or perennial drainages is not authorized, except when, as determined by the Corps, the relocation would result in a net increase in functions of the aquatic ecosystem within the watershed.

23.* Any requests to waive the 300 linear foot limitation for intermittent and ephemeral streams for NWPs 21, 29, 39, 40, 42, 43, 44, 50, 51 and 52, or to waive the 500 linear foot limitation along the bank for NWP 13, must include the following:

a. A narrative description of the stream. This should include known information on: volume and duration of flow; the approximate length, width, and depth of the waterbody and characteristics observed associated with an Ordinary High Water Mark (e.g. bed and bank, wrack line or scour marks); a description of the adjacent vegetation community and a statement regarding the wetland status of the adjacent areas (i.e. wetland, non-wetland); surrounding land use; water quality; issues related to cumulative impacts in the watershed, and; any other relevant information;

b. An analysis of the proposed impacts to the waterbody, in accordance with General Condition 31 and Regional Condition 1;

c. Measures taken to avoid and minimize losses to waters of the U.S., including other methods of constructing the proposed activity(s); and

d. A compensatory mitigation plan describing how the unavoidable losses are proposed to be offset, in accordance with 33 CFR 332.

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24. For NWPs 29, 39, 40, 42, and 43: The permittee shall establish and maintain upland vegetated buffers in perpetuity, unless specifically determined to be impracticable by the Corps, next to all preserved open waters, streams and wetlands including created, restored, enhanced or preserved waters of the U.S., consistent with General Condition 23(f). Except in unusual circumstances, as determined by the Corps, vegetated buffers shall be at least 50 feet in width.

25. For NWP 46: The discharge shall not cause the loss of greater than 0.5 acres of waters of the United States or the loss of more than 300 linear feet of ditch, unless specifically waived in writing by the Corps.

26. All NWPs except 3, 6, 20, 27, 32, and 38 are revoked for activities in histosols, fens, bogs and peatlands and in wetlands contiguous with fens. Fens are defined as slope wetlands with a histic epipedon that are hydrologically supported by groundwater. Fens are normally saturated throughout the growing season, although they may not be during drought conditions. For NWPs 3, 6, 20, 27, 32, and 38, the permittee shall submit a PCN to the Corps in accordance with General Condition 31 and Regional Condition 1. This condition does not apply to NWPs 1, 2, 8, 9, 10, 11, 24, 28, 35 or 36, as these NWPs either apply to Section 10 only activities or do not authorize impacts to special aquatic sites.

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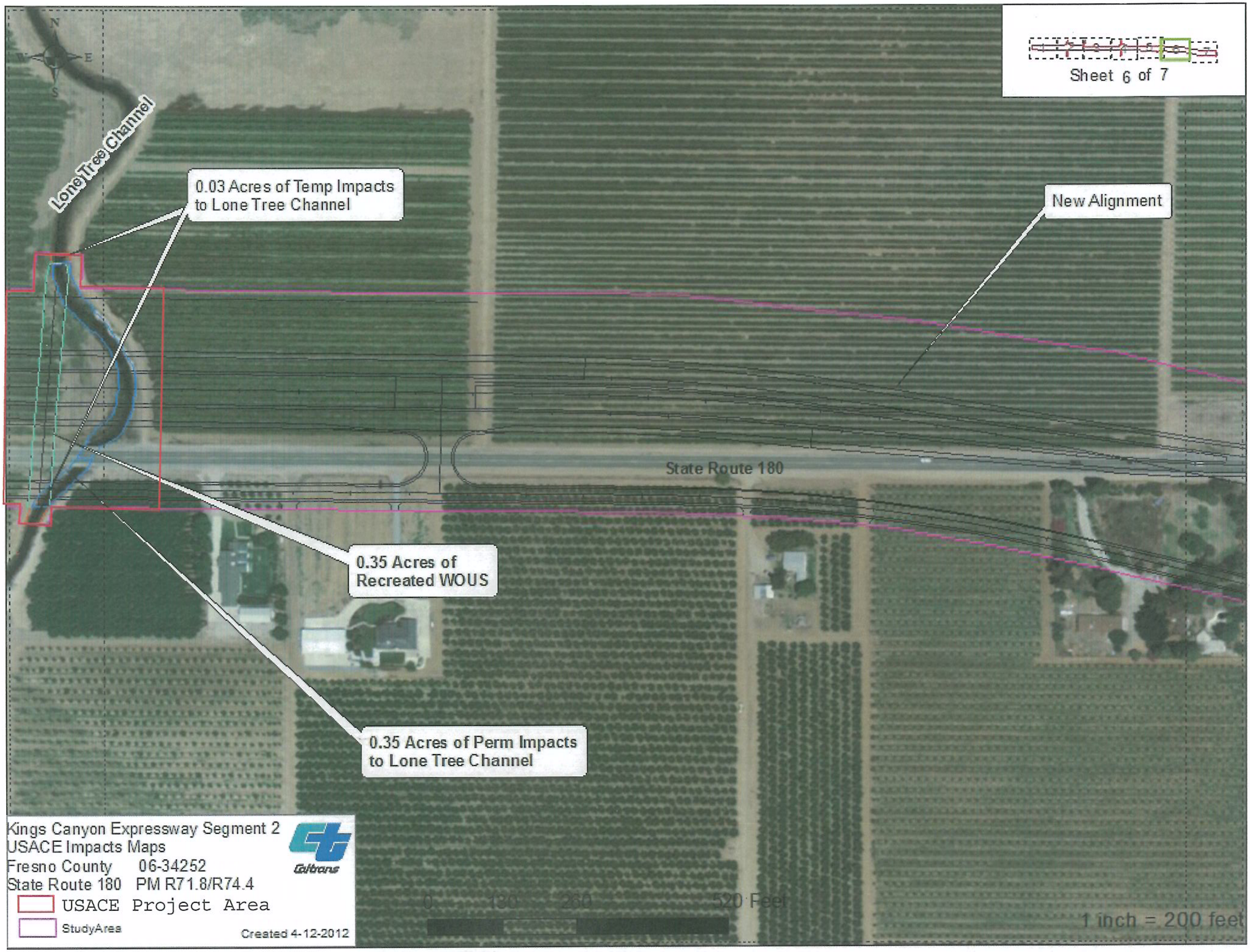

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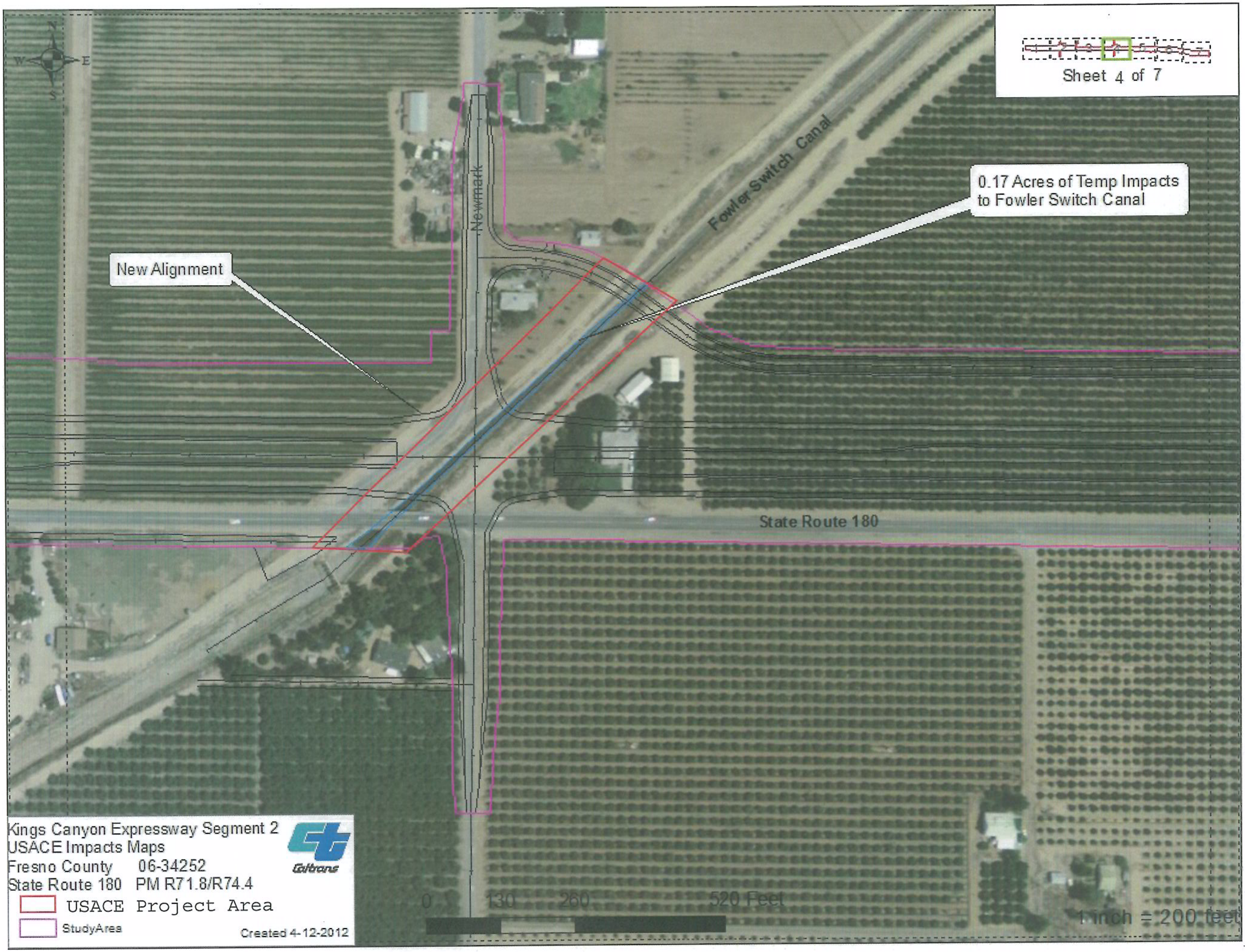
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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In reply refer to:
1-1-03-F-0097

JUL 27 2005

Mr. Gene Fong
Division Administrator
U.S. Department of Transportation
650 Capitol Mall, Suite 4-100
Sacramento, California 95814

Subject: Biological Opinion on the State Route 180 Sequoia-Kings Canyon Expressway Project, Fresno County, California

Dear Mr. Fong:

This responds to your January 30, 2003, request for formal consultation with the U.S. Fish and Wildlife Service (Service) regarding the proposed widening of State Route (SR) 180 located in Fresno County, California. Your request for formal consultation was received in our office on February 3, 2003. This document represents the Service's biological opinion on the effects of the proposed action on the threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) and the threatened vernal pool fairy shrimp (*Branchinecta lynchi*), in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act).

We have also reviewed the project's effects on the endangered San Joaquin kit fox (*Vulpes macrotis mutica*), the threatened giant garter snake (*Thamnophis gigas*), and the threatened California tiger salamander (*Ambystoma californiense*). There are no recorded occurrences of kit fox within twenty miles of the project area. Kit fox are unlikely to use the habitat within the project area for feeding or movement because the habitat has few grassy areas and is instead dominated by agriculture. The project area does include habitat that may be suitable for the giant garter snake; however, locations of the nearest historical records of the snake are not connected aquatically to the project area. The California tiger salamander is also unlikely to inhabit the project area due to the lack of upland habitat. We conclude that the proposed project is not likely to adversely affect the San Joaquin kit fox, the giant garter snake, or the California tiger salamander. These species will not be discussed in the remainder of this biological opinion.

This biological opinion is based on information provided in the *Supplemental Biological Assessment Sequoia-Kings Canyon Expressway Re-Evaluation* prepared by Caltrans, and dated January 21, 2003; and other information available to the Service.

Received
AUG 02 2005
FHWA

Consultation History

December 31, 1994:	Biological opinion (1-1-94-F-0052) issued on the effects of the construction of SR 180 on the valley elderberry longhorn beetle.
February 2, 1995:	Caltrans requested that the biological opinion be amended to reflect a change in the number of elderberry shrubs being removed.
May 2, 1995:	The Service issues a new biological opinion on the effects of the construction of SR 180 on the valley elderberry longhorn beetle (1-1-95-F-0072).
June 11, 2002:	Service biologist Nancy Pau discussed mitigation ratios for fairy shrimp and beetle habitat with Caltrans.
February 3, 2003:	The Service received a request from the Federal Highways Administration for section 7 formal consultation on the SR 180 project, due to project changes and the growth of elderberry shrubs since original consultation.
May 5, 2004:	Service biologists Susan Jones and Brian Peterson met with Caltrans staff Terry Marshall, Patricia Moyer, and John Thomas to discuss the project. After the meeting, Susan Jones and Brian Peterson inspected the proposed project site with Patricia Moyer and John Thomas.

BIOLOGICAL OPINION

Description of Proposed Action

The proposed project is located on SR 180, directly east of Temperance Avenue, which constitutes the City of Fresno Sphere of Influence boundary. The project will replace the existing rural SR 180 from east of Temperance Avenue (KP 105.0) to the Alta Main Canal (KP 125.1). The proposed improvements would include construction of a four-lane expressway from just east of Temperance Avenue to Academy Avenue, and a two-lane expressway on a four-lane right-of-way from Academy Avenue to the Alta Main Canal. The proposed project parallels the existing SR 180.

The area surrounding the project footprint is dominated by relatively flat, leveled and plowed agricultural land, used for livestock grazing, fruit orchards, grapes, and other row crops. In addition to agricultural fields, the surrounding area also contained non-native grasslands, pasture, and wetlands.

The proposed project will improve 12.6 miles of SR 180 from Temperance Avenue to the Alta Main Canal. The improvements will widen the alignment originally proposed in a Biological Assessment submitted in 1992 by approximately 265 feet to the north. Caltrans will acquire a total area of 362 acres in right-of-way acquisitions. The proposed alignment will bypass the community of Centerville by curving to the north near the Kingsburg Canal Dry Wash to a maximum distance of approximately 328 feet and returning to the existing SR 180 just east of Trimmer Springs Road. From there, the proposed alignment remains within 262 feet of the existing route, but straightens some of the existing curves up to the community of Minkler. Just west of Minkler, the proposed alignment leaves the existing route and continues in an approximate straight line to the Alta Main Canal, where the proposed alignment rejoins existing SR 180.

The area above ground within the right-of-way will be cleared from all vegetation, using bulldozers and front-end loaders. The site will then be graded according to approved plans and specifications. Imported borrow will be brought to the job site. Piles will be drilled at the Kings River, and possibly at Byrd Slough and Kings River Overflow, to construct water-crossing structures. Roadway runoff will be conveyed by a network of drainage facilities. Construction is scheduled to being between December 2005 and April 2006. Work is to be completed between the summer and fall of 2007.

The proposed project includes the following conservation measures:

1. Any elderberry shrubs with stems of one inch or larger in diameter at ground level that cannot be avoided by the proposed project will be transplanted to a compensation site agreed upon with the Service.

2. Elderberry shrubs that can be avoided within 20 feet will be designated as environmentally sensitive areas during and after construction of the proposed project. A 20-foot exclusion zone from the drip line of the shrubs will be fenced to avoid adverse effects to the shrubs during project construction. The environmentally sensitive areas will be protected from construction equipment. The contractor and work crew will be briefed on the need to avoid damage to the elderberry shrubs and the possible penalties for not complying with these requirements.

3. Transplantation and compensation plantings of elderberry shrubs will occur at the site proposed in the June 9, 2005, letter addressed to Susan Jones. The site is approximately 7.5 miles south of the proposed project, and is adjacent to the Kings River. Maps of the site are appended to this biological opinion.

4. Caltrans will compensate for the loss of 1.053 acres of potential vernal pool fairy shrimp habitat at a ratio of 0.3:1, by purchasing credits from an approved conservation bank. This ratio was agreed upon by Service biologists because of the poor quality of the habitat. The temporary bodies of water that will be affected are found only in association with road grading, and appear to have been created by the construction of existing SR 180. Compensation will occur at Madera Pools, if this site is approved by the Service prior to construction of the proposed project. Otherwise, compensation will occur through an In Lieu fund or another Service-approved site.

Status of the Species

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle was listed as a federally threatened species on August 8, 1980 (45 **FR** 52803). The beetle was first described in the early 1900's and was later determined to be endemic to moist valley oak woodlands along the margins of rivers and streams in the Sacramento and San Joaquin Valleys of California. Two areas along the American River in the Sacramento metropolitan area have been designated as critical habitat for the valley elderberry longhorn beetle (45 **FR** 52803). In addition, an area along Putah Creek, Solano County, and the area west of Nimbus Dam along the American River Parkway, Sacramento County, are considered essential habitat (Service 1984). The beetle is facultatively dependent on its host plant, the elderberry, which is a locally common component of the remaining riparian forests and savannah areas and, to a lesser extent, the mixed chaparral-foothill woodlands of the Central Valley.

Adults are generally present on elderberry shrubs from March through June. During this period, the adults mate, and the females lay eggs on living elderberry plants. The female generally lays eggs either singularly, or in small groups, in crevices in the bark or at the junctures of stems and leaves along the trunk of the plant. Presumably, eggs hatch shortly after they are laid and the larvae bore into the pith of larger stems and roots where they remain until they mature. Just prior to the pupal stage, larvae open an emergence hole in the bark and then return to the pith to pupate. Use of the elderberry shrubs by the beetle is rarely apparent as the only exterior evidence of the shrub's use by the beetle is the "exit hole" created by the larvae just prior to the pupal stage. Larvae appear to be distributed primarily in elderberry stems that are one inch in diameter or greater at ground level.

Habitat destruction was the primary factor contributing to the need to federally list the beetle. Riparian forests, the primary habitat for the beetle, have been severely depleted throughout the Central Valley over the last two centuries (Katibah 1984; Thompson 1961; Roberts *et al.* 1977). The 1984 recovery plan attributed the loss and alteration of this riparian habitat to agricultural conversion, grazing, levee construction, stream and river channelization, removal of riparian vegetation, riprapping of shoreline, recreation, and industrial and urban development (Service 1984).

The beetle probably occurs naturally at low densities, with limited dispersal capability (Barr 1991; Collinge *et al.* 2001; Huxel 2000). This makes the beetle extremely vulnerable to the negative effects associated with habitat loss and fragmentation. Small, isolated subpopulations are susceptible to extirpation from random demographic, environmental, and/or genetic effects (Shaffer 1981; Lande 1988; Primack 1998). A large area of habitat may support a single large population, whereas smaller subpopulations result from habitat fragmentation and isolation. These subpopulations may tend to lose genetic variability through genetic drift. This generally leads to inbreeding depression and a lack of adaptive flexibility. Ultimately, these smaller populations are more vulnerable to random fluctuations in reproductive and mortality rates, and are more likely to be extirpated by random environmental factors. Barr (1991) found that small, isolated habitat remnants were less likely to be occupied by beetles than larger patches, indicating that beetle subpopulations are extirpated from small habitat fragments, or may be unable to recolonize isolated patches of habitat. Barr (1991) and Collinge *et al.* (2001) consistently found beetle exit holes occurring in clumps of elderberry bushes rather than isolated bushes, suggesting that isolated shrubs do not typically provide long-term viable habitat for this species. Huxel (2000) used computer simulations of colonization and extinction patterns for the beetle, based on differing dispersal distances, and found that short dispersal simulations best matched census data in terms of site occupancy. This suggests that, in the natural system, dispersal, and thus colonization, is limited to nearby sites.

Habitat fragmentation not only isolates small populations, but it also increases the interface between habitat and urban or agricultural land, thereby increasing negative edge effects such as the invasion of nonnative species (Huxel 2000; Soule 1990) and pesticide contamination (Barr 1991). Recent evidence indicates that the invasive Argentine ant (*Linepithema humile*) poses a risk to the long-term survival of the beetle. Surveys along Putah Creek found beetle presence where Argentine ants were not present or had recently colonized, and beetle absence from otherwise suitable sites where Argentine ants had become established (Huxel 2000). The Argentine ant has been expanding its range throughout California since its introduction around 1907, especially in riparian woodlands associated with perennial streams (Holway 1995; Ward 1987). Huxel (2000) states that, given the potential for Argentine ants to spread with the aid of human activities such as movement of plant nursery stock and agricultural products, this species may come to infest most drainages in the Central Valley along the valley floor, where the beetle is found.

Direct spraying and pesticide drift in or near riparian areas is likely to adversely affect the beetle and its habitat. Pesticides have been identified as one of a number of potential causes of pollinator species' declines, and declines of other insects beneficial to agriculture (Ingraham *et al.* 1996). Although there have been no studies specifically focusing on the effects of pesticides on the beetle, it is likely that the beetle, typically occurring adjacent to agricultural lands, may have suffered pesticide-induced declines as well.

Overgrazing by livestock damages or destroys elderberry plants and inhibits regeneration of seedlings. Cattle readily forage on new growth of elderberry, which may explain the absence of beetles at manicured elderberry stands (Service 1984). Habitat fragmentation exacerbates problems related to exotic species invasion and cattle overgrazing by increasing the edge to interior ratio of habitat patches, facilitating the penetration of these influences.

Vernal Pool Fairy Shrimp

The vernal pool fairy shrimp was listed as threatened on September 19, 1994 (59 **FR** 48136). Critical habitat for this species was designated on August 6, 2003 (68 **FR** 46683), and include two primary constituent elements: 1) vernal pools, swales, and other ephemeral wetland features of appropriate sizes and depths that typically become inundated during winter rains and hold water for sufficient lengths of time necessary for the 15 vernal pool species to complete their life cycle; 2) the geographic, topographic, and edaphic features that support aggregations or systems of hydrologically interconnected pools, swales, and other ephemeral wetlands and depressions within a matrix of surrounding uplands that together form hydrologically and ecologically functional units called vernal pool complexes. A total of 839,460 acres, divided into 35 units, has been designated for the vernal pool fairy shrimp.

Vernal pool fairy shrimp have delicate elongate bodies, large stalked compound eyes, no carapace, and 11 pairs of swimming legs. The swim or glide gracefully upside-down by means of complex, wavelike beating movements. Fairy shrimp feed on algae, bacteria, protozoa, rotifers, and detritus. The females carry eggs in an oval or elongate ventral brood sac. The eggs are either dropped to the pool bottom or remain in the brood sac until the female dies and sinks. The dormant cysts are capable of withstanding heat, cold, and prolonged desiccation. When the pools refill in the same or subsequent seasons, some, but not all, of the cysts may hatch. The cyst bank in the soil may therefore be comprised of cysts from several years of breeding (Donald 1983). The early stages of the fairy shrimp develop rapidly into adults. The vernal pool fairy shrimp can mature quickly, allowing populations to persist in short-lived shallow pools (Simovich *et al.* 1992).

The vernal pool fairy shrimp is known from 32 populations extending from the Stillwater Plain in Shasta County through most of the length of the Central Valley to Pinnacles in San Benito County (Eng *et al.* 1990; Fugate 1992; Sugnet and Associates 1993). Five additional, disjunct populations exist: one near Soda Lake in San Luis Obispo County; one in the mountain grasslands of northern Santa Barbara County; one on the Santa Rosa Plateau in Riverside County; one near Rancho California in Riverside County; and one on the Agate Desert near Medford, Oregon. Three of these isolated populations each contain only a single pool known to be occupied by the vernal pool fairy shrimp. The vernal pool fairy shrimp inhabits vernal pools with clear to tea-colored water, most commonly in grass- or mud-bottomed swales, basalt flow depression pools in unplowed grasslands, or even sandstone rock outcrops or alkaline vernal pools.

A Service analysis of a report by Holland (1978) estimated that between 60 and 85 percent of the area within the Central Valley of California that once supported vernal pools had been destroyed by 1973. In the ensuing 30 years, threats to this habitat type have continued and resulted in a substantial amount of vernal pool habitat being converted for human uses in spite of Federal regulations implemented to protect wetlands. For example, the Corps Sacramento District Office has authorized the filling of 189 hectares (467 acres) of wetlands between 1987 and 1992 pursuant to Nationwide Permit 26 (Service 1992). The Service estimates that a majority of these wetlands losses within the Central Valley involved vernal pools, the endemic habitat for the vernal pool fairy shrimp.

The Corps has several thousand vernal pools under its jurisdiction (Coe 1988), which includes most of the known vernal pool fairy shrimp occurrences. It is estimated that within 20 years human activities will destroy 60 to 70 percent of the remaining vernal pools (Coe 1988). In addition to direct habitat loss, vernal pools also have been and continue to be highly fragmented throughout their ranges due to conversion of natural habitat for urban and agricultural uses. This fragmentation results in small isolated vernal pool fairy shrimp populations. Ecological theory predicts that such populations will be highly susceptible to extirpation due to chance events, inbreeding depression, or additional environmental disturbance (Gilpin and Soulé 1986; Goodman 1987). If an extirpation event occurs in a population that has been fragmented, the opportunities for recolonization would be greatly reduced due to physical (geographic) isolation from potential source populations.

The primary historic dispersal method for the vernal pool fairy shrimp likely was large-scale flooding resulting from winter and spring rains that allowed the animals to colonize different individual vernal pools and other vernal pool complexes (J. King, pers. comm., 1995). Waterfowl and shorebirds may now be the primary dispersal agents for the vernal pool fairy shrimp. The eggs of this crustacean are either ingested (Swanson *et al.* 1974; Driver 1981; Ahl 1991) and/or adhere to the legs and feathers, where they are transported to new habitats. Dispersal during flooding is currently non-functional due to the construction of dams, levees, and other flood control measures, and widespread urbanization within significant portions of the range of this species.

The vernal pool fairy shrimp is threatened by a variety of other human-caused activities. Their habitat has been lost through direct destruction and modification due to filling, grading, disking, leveling, and other activities. In addition, vernal pools have been affected by a variety of anthropogenic modifications to upland habitats and watersheds. These activities, primarily urban development, water supply/flood control projects, land conversion for agriculture, off-road vehicle use, certain mosquito abatement measures, and pesticide/herbicide use can lead to disturbance of natural flood regimes, changes in water table depth, alterations of the timing and duration of vernal pool inundation, introduction of non-native plants and animals, and water pollution. These indirect actions can result in adverse effects to vernal pool species.

Environmental Baseline

SR 180 is a major roadway that serves rural communities east of the City of Fresno, facilitates recreational travel to Kings Canyon and Sequoia National Parks, and accommodates the movement of agricultural goods. The valley elderberry longhorn beetle and the vernal pool fairy shrimp are affected by the existing SR 180, which has diminished habitat quality.

Valley elderberry longhorn beetle

Seventy-three elderberry shrubs occur within or adjacent to the proposed right-of-way, three of which contain beetle exit holes. Thirty-four shrubs with 132 stems that are one inch or larger in ground diameter are located within the new right-of-way. Given the presence of stems with beetle exit holes, the biology and ecology of this species, and the presence of suitable habitat on-site, the Service believes the beetle is reasonably certain to occur within the action area. Designated critical habitat does not occur within the action area.

Vernal pool fairy shrimp

There are two CNDDB records for the vernal pool fairy shrimp (CNDDB 2005) close to the project area. One record is within a mile of the project's eastern endpoint, and was observed in 1994. The second recorded observation occurred approximately five miles north of SR 180, and was observed in 1993.

Within the project area, 93 temporary pools were identified, and these pools were associated with the current alignment of SR 180. These pools filled with water with each rain event to a depth of at least one inch, and remained filled for at least 14 days. During surveys, versatile fairy shrimp (*Branchinecta lindahli*) were observed. The pools are heavily disturbed by agricultural runoff and traffic on SR 180. However, due to recent nearby records, the confirmed presence of another fairy shrimp species, and the ecology and biology of the vernal pool fairy shrimp, the Service believes it is reasonably certain that the vernal pool fairy shrimp inhabits the action area. Designated critical habitat does not occur within the action area.

Effects of the Proposed Action

Valley Elderberry Longhorn Beetle

The proposed action will adversely affect the beetle by the stress, damage, and mortality that could be caused from the transplanting of 34 shrubs, with 132 stems measuring 1.0 inch or greater in diameter at ground level. One elderberry plant within 20 feet of the construction area may be affected by dust from construction activities. Elderberry plants which are too small to be likely supportive of larval beetles may be destroyed without transplantation or compensation. However, were they not destroyed, such small plants could potentially grow larger and produce stems capable of serving as habitat for the beetle.

Benefits to the beetle include the creation of additional habitat through the compensation measures proposed in the project. The habitat available at the compensation site will be more conducive to beetle recovery because of the habitat quality, and the reduced risk from vehicle-related catastrophes.

Vernal Pool Fairy Shrimp

Ninety-three temporary pools will be completely filled during construction, resulting in the destruction of 1.053 acres of potential vernal pool fairy shrimp habitat, and death of any vernal pool fairy shrimp in the destroyed habitat. However, it is poor quality habitat that is being lost, and it is likely the habitat was formed as a result of the construction of SR 180. Benefits to the vernal pool fairy shrimp include the purchase of credits at a ratio of 0.3:1 (equivalent to 0.316 acre) at a Service-approved conservation bank. This habitat will be of higher quality than the pools and puddles along SR 180, resulting in a net benefit to the species.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local or private actions affecting listed species and their critical habitat that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

In general, many agricultural activities occur without Federal consultation and these activities are expected to continue on the agricultural lands adjacent to SR 180. Destruction of adjacent riparian habitat can eliminate habitat essential for the survival and recovery of the valley elderberry longhorn beetle. Since vernal pool fairy shrimp can exist in water bodies that would appear to be unlikely habitat, these pools may be filled and the shrimp may be killed as a consequence.

Conclusion

After reviewing the current status of the valley elderberry longhorn beetle and the vernal pool fairy shrimp, the environmental baseline for the action area, the effects of the proposed widening of SR 180 in Fresno County, California, and cumulative effects, it is the Service's biological opinion that the proposed project is not likely to jeopardize the continued existence of any of the above listed species, or adversely modify proposed or designated critical habitat. The proposed project involves the expansion of an existing road, which has degraded the environmental baseline in the action area, and the negative effects of the proposed project are sufficiently offset by conservation measures to avoid jeopardy to the valley elderberry longhorn beetle and the vernal pool fairy shrimp. The proposed project is not likely to affect critical habitat for the kit fox as none has been proposed or designated. The designated critical habitats for the valley elderberry longhorn beetle and the vernal pool fairy shrimp are not located within the action area and will not be affected by the proposed project.

INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activity covered by this incidental take statement. If the FHWA (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

Valley Elderberry Longhorn Beetle

The Service has determined that implementation of the proposed project will result in the incidental take of all beetles inhabiting 34 elderberry shrubs containing 132 stems measuring 1.0 inch or greater in diameter at ground level. The incidental take will be in the form of death, injury, harassment, or harm.

<u>Vernal Pool Fairy Shrimp</u>

The Service anticipates incidental take of the vernal pool fairy shrimp will be difficult to detect or quantify for the following reasons: (1) the aquatic nature of the organism and its relatively small body size make the finding of a dead specimen unlikely, (2) losses may be masked by seasonal fluctuations in numbers or other causes, and (3) the species occurs in habitat that makes them difficult to detect. Therefore, the Service is quantifying take incidental from the proposed project as the number of acres of occupied habitat that will be destroyed as a result of the proposed action. The Service estimates that all vernal pool fairy shrimp inhabiting 93 temporary pools, totaling 1.053 acres, will be subject to incidental take as a result of the proposed action. The incidental take will be in the form of death, injury, harm, or harassment.

Upon implementation of the following reasonable and prudent measures, incidental take associated with the project on the valley elderberry longhorn beetle and the vernal pool fairy shrimp will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the valley elderberry longhorn beetle or the vernal pool fairy shrimp. The compensation incorporated within the conservation measures will enhance the survival and recovery of the beetle and the fairy shrimp.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize the effect of the proposed project on the valley elderberry longhorn beetle and the vernal pool fairy shrimp.

1. Caltrans shall implement the conservation measures as described in the biological assessment and this biological opinion.

2. Caltrans shall minimize adverse effects to the valley elderberry longhorn beetle.

3. Caltrans shall ensure compliance with this biological opinion.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, FHWA shall ensure Caltrans complies with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

1. The following Terms and Conditions implement Reasonable and Prudent Measure One (1):

    a. Caltrans shall minimize the potential for harm or harassment of listed species resulting from project-related activities by implementation of the conservation measures as described in the biological assessment, and the *Description of the Proposed Action* section of this biological opinion.

b. Caltrans shall include Special Provisions that include the avoidance and minimization measures of this biological opinion in the solicitation for bid information. Caltrans will educate and inform contractors involved in the project as to the requirements of the biological opinion.

Bid info

c. Prior to initiation of any site preparation/construction activities, the Caltrans biologist or Service-approved biologist will conduct an education and training session for all construction personnel. All available individuals who will be involved in the site preparation or construction will be present, including the project representative(s) responsible for reporting take to the Service and the California Department of Fish and Game. Training sessions will be repeated for all new employees before they are allowed to access the project site. Sign-up sheets identifying attendees and the contractor/company they represent will be provided to the Service with the post-construction compliance report. At a minimum, the training will include a description of the natural history of the valley elderberry longhorn beetle and the vernal pool fairy shrimp, and their respective habitats. Training will include the general measures that are being implemented to conserve these species as they relate to the project, the penalties for non-compliance, and the boundaries (work area) within which the project must be accomplished. To ensure that employees and contractors understand their roles and responsibilities, training may have to be conducted in languages other than English.

Pre con Surveys

d. The resident engineer (RE) or their designee shall be responsible for implementing these conservation measures and shall be the point of contact for each project.

e. If borrow material is going to be used for the proposed project, Caltrans shall follow the procedures outlined below:

1. Caltrans shall require as part of the construction contract that all contractors comply with the Act in the performance of the work necessary for project completion performed inside and outside the project right-of-way.

2. Caltrans shall require documentation from the contractor that aggregate, fill, or borrow material provided for each project was obtained in compliance with the Act. Evidence of compliance with the Act shall be demonstrated by providing the RE any one of the following:

    a. a letter from the Service stating use of the borrow pit area will not result in the incidental take of listed species;
    b. an incidental take permit for contractor-related activities issued by the Service pursuant to section 10(a)(1)(B) of the Act;

c. a biological opinion or a letter concurring with a "not likely to adversely affect" determination issued by the Service to the Federal agency having jurisdiction over contractor-related activities;

d. a letter from the Service concurring with the "no effect" determination for contractor-related activities; or

e. Contractor submittal of information to the Caltrans RE indicating compliance with the State Mining and Reclamation Act (SMARA) and providing the County land use permits and CEQA clearance.

3. If a borrow site that is in compliance with the Act is not available, Caltrans will either:

a. identify/select a site that the Service has concurred with the "no effect" determination, or;

b. request reinitiation of formal consultation on the action considered herein based on new information.

f. All construction activity shall be confined within the project site, which may include temporary access roads, haul roads, and staging areas specifically designated and marked for these purposes. At no time shall equipment or personnel be allowed to adversely affect habitat areas outside the project site without authorization from the Service.

g. The Caltrans biologist shall have oversight over implementation of all the measures described in the *Terms and Conditions* of this biological opinion, and he/she shall have the authority to stop project activities, through communication with the Caltrans RE, if any of the requirements associated with these measures are not being fulfilled. If the biologist/construction liaison has requested a stop work due to take of any listed species, the Service and Fish and Game will be notified within one (1) day via email or telephone.

h. If conservation easements will be used by Caltrans, Caltrans shall obtain the written approval of the Service that the parcel(s) are suitable compensation lands prior to acquiring interest in those lands. The fee title or conservation easement shall be obtained by the California Department of Transportation at least sixty (60) calendar days prior to the date of initial groundbreaking, or on or before a date that the Service has agreed to in writing with the California Department of Transportation.

i. If conservation easements are used by the California Department of Transportation, they shall include, but not be limited to, provisions and responsibilities of the project proponent and the land trust organization approved by the Service for the protection of all habitats set aside including any future transfers of the easements or fee interest that may be anticipated. The easements shall specify the purposes for which it is established (*i.e.*, measures to minimize effects to the valley elderberry longhorn beetle associated with the SR 180 improvement project). The California Department of Transportation shall provide the Service with a true copy of the recorded conservation easements within thirty (30) calendar days of its recordation. The conservation easements shall be held by a third party approved by the Service. The conservation easement shall include a list of prohibited activities that are inconsistent with the maintenance of the preserve for the listed species including, but not limited to:

1. leveling, grading, landscaping, cultivation, or any other alterations of existing topography for any purposes, including the exploration for, or development of, mineral resources;

2. placement of any new structures on the preserve, including buildings and billboards;

3. discharge, dumping, burning, or storing of rubbish, garbage, grass clippings, dredge material, household chemicals, or any other wastes or fill materials within the preserve;

4. building of any roads or trails within the preserve areas;

5. killing, removal, alteration, or replacement of any existing native vegetation except in Service-approved prescribed burning situations, or as otherwise authorized in writing by the Service;

6. activities that may alter the hydrology of the preserve and the associated watersheds, including but not limited to: excessive pumping of groundwater, manipulation or blockage of natural drainages, inappropriate water application or placement of storm water drains, etc. unless authorized in writing by the Service;

7. incompatible fire protection activities;

8. use of pesticides, herbicides, or rodenticides on the preserve or within the watershed that can contaminate the preserve except as authorized in writing by the Service; and

9. introduction of any exotic species or species not native to the area, including aquatic species, except as approved by the Service.

j. In the event the California Department of Transportation seeks to obtain a conservation easement in lieu of fee title acquisitions for the purposes of satisfying the requirements of the terms and conditions of this biological opinion, the California Department of Transportation shall provide the language of the proposed conservation easements to the Service for prior review and approval. The conservation easements shall include language establishing a right of entry by the Service to determine compliance with the terms and conditions of this biological opinion and the terms of the conservation easements, as well as identifying the Service as a third party beneficiary with the standing to take whatever legal action is necessary to enforce the terms of this conservation easement. Should the California Department of Transportation make fee title acquisition of lands to satisfy the terms and conditions of this biological opinion, the California Department of Transportation shall encumber such lands with restrictive covenants that provide the same rights to the Service as will be established under the conservation easement described above. Such restrictive covenants shall be provided to the Service for prior review and approval before they are recorded against the conservation lands.

k. If the California Department of Transportation plans to acquire fee title or a conservation easement for lands that are not in a Service-approved conservation bank, then at least sixty (60) calendar days prior to the date of initial ground breaking at the proposed SR 180 widening project, the California Department of Transportation shall endow a Service-approved fund for monitoring and perpetual management and maintenance of the acquired acreage. The principal in the endowment must generate sufficient revenue to fully cover the costs of ongoing operations and management actions as described in the Service-approved management plan and this biological opinion, without the need to make use of the principal to adequately fund such expenditures. Specific actions funded by the endowment shall be addressed in the Service-approved management plan. The California Department of Transportation shall utilize an appropriate third party who has been approved by the Service to determine what amount of money is necessary for an endowment fund to adequately finance the monitoring and perpetual management and maintenance of the preserve for the protected species. The California Department of Transportation shall empower the Service to access and expend such funds to implement Service-approved remedial measures in the event the responsible preserve managers fail to adequately implement the Service-approved management plan. The final determination of success or failure of the management plan shall be made solely by the Service. Prior to the date of initial groundbreaking at the proposed project, the California Department of Transportation shall provide the Service with documentation that: (1) funds for the perpetual management and maintenance of the agreed-upon acres for the species being protected have been transferred to the appropriate third party approved by the Service; (2) the third party has accepted the funds and considers them adequate; and (3) that these funds have been deposited in an account (*i.e.*, endowment) that will provide adequate financing for the monitoring and perpetual management and maintenance of the protected acreage.

2. The following Terms and Conditions implement Reasonable and Prudent Measure Two (2):

a. Caltrans shall implement the Service's 1999 *Conservation Guidelines for the Valley Elderberry Longhorn Beetle*.

b. Construction areas will be watered down to control dust in the vicinity of elderberry shrubs. Areas along SR 180 adjacent to remaining elderberry shrubs located 60-80 feet from the edge of the construction easement will be watered down three times per day to prevent dirt from becoming airborne, and accumulating on the shrubs. Watering will occur more frequently if dust is observed rising from the ground between the watering intervals.

3. The following Terms and Conditions implement Reasonable and Prudent Measure Three (3):

   a. If requested, before, during, or upon completion of ground breaking and construction activities, Caltrans shall allow access by Service and/or California Department of Fish and Game personnel to the project site to inspect project effects to the listed species and their habitat.

   b. Caltrans shall comply with the *Reporting Requirements* of this biological opinion.

Reporting Requirements

1. Before construction starts on a project, the Service shall be provided with the final documents, including but not limited to, recorded conservation easements, PAR analyses, management plans, or proof of purchase of credits. Please see draft guidance from the Service, *Selected Review Criteria for Conservation Banks and Section 7 Offsite Compensation* dated August 4, 2004, or Service guidance that supercedes this document.

2. A post-construction report detailing compliance with the project design criteria described under the *Description of the Proposed Action* section of this biological opinion shall be provided to the Service within 30 calendar days of completion of the project.

3. Caltrans shall notify the Service via electronic mail and telephone within one (1) working day of the death or injury to a listed species that occurs due to project-related activities, or is observed at the project site. Notification must include the date, time, location of the incident or of the finding of a dead or injured animal, and photographs of the specific animal. In the case of an injured animal, the animal shall be cared for by a licensed veterinarian or other qualified person. In the case of a dead animal, the individual animal should be preserved, as appropriate, and held in a secure location until instructions are received from the Service regarding the disposition of the specimen or the Service takes custody of the specimen. The Service contacts are Peter Cross, Deputy Assistant Field Supervisor at 916/414-6600, and Scott Heard, Resident Agent-in-Charge of the Service's Law Enforcement Division at 916/414-6660. The California Department of Fish and Game contact is Ron Schlorff at 916/654-4262.

4. Any contractor or employee who, during routine operations and maintenance activities inadvertently kills or injures a State-listed wildlife species shall immediately report the incident to her or his supervisor or representative. The supervisor or representative must contact the California Department of Fish and Game immediately in the case of a dead or injured State-listed wildlife species. The California Department of Fish and Game contact for immediate assistance is State Dispatch at 916/445-0045.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and databases. Our conservation recommendations are as follows:

1. If Caltrans plans to continue development of SR 180, Caltrans should consider appropriate designs and compensation for effects to the San Joaquin kit fox as project effects move into less cultivated lands.

2. Since the construction of SR 180 likely resulted in the creation of temporary pools containing fairy shrimp, the SR 180 improvement project should incorporate measures that will protect future temporary pools from being affected by highway runoff.

3. As the recovery plan for federally listed vernal flora and fauna is developed, the FWHA should assist the Service in its implementation.

4. When designing projects, FHWA and Caltrans should assign highest priority to alternatives that completely avoid adverse effects to listed species.

5. FHWA and Caltrans should actively promote alternative forms of transportation to alleviate the increased need for road expansions (and consequent increased loss of habitat) required by higher traffic volumes.

6. Provide habitat for bats, including surfaces for bat roosts, on the underside of bridges and other structures, whenever possible.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation on the SR 180 project in Fresno County, California, as outlined in the request and associated documents. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have any questions regarding this biological opinion on the proposed improvement of SR 180 in Fresno County, California, please contact Amy Welsh or Susan Jones, Chief of our San Joaquin Valley Branch, at (916) 414-6630.

Sincerely,

Peter A. Cross

for Kenneth Sanchez
Acting Field Supervisor

cc:
Terry Marshall, California Department of Transportation, Fresno, California
Annette Tenneboe, California Department of Fish and Game, Fresno, California

Literature Cited

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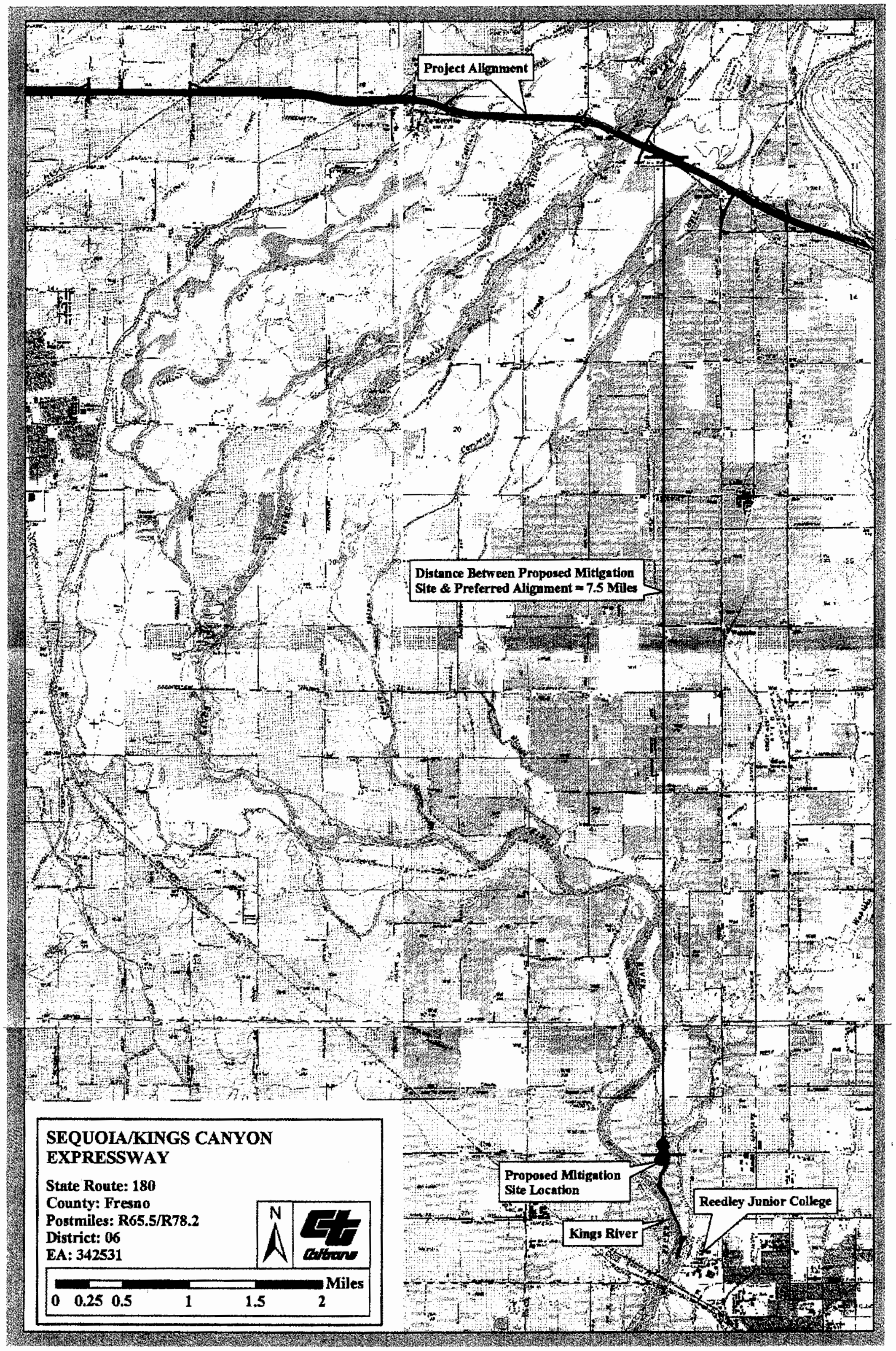
Enclosure for 1-1-03-F-0097

Topographic Map Depicting the Central and Eastern Portion of the Project with the Mitigation Site Approximately 7.5 Miles to the South



Aerial Photograph Depicting the Proposed Mitigation Site Boundary and Proximity to the Kings River to the West

State of California – The Natural Resources Agency
DEPARTMENT OF FISH AND GAME
Central Region
1234 East Shaw Avenue
Fresno, California 93710
(559) 243-4005
http://www.dfg.ca.gov

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

July 5, 2012

Carrie Swanberg
California Department of Transportation
855 M Street, Suite 200
Fresno, California 93721

Subject: Final Lake or Streambed Alteration Agreement
Notification No. 1600-2012-0076-R4
Lone Tree Canal, Fresno County
SR 180 Kings Canyon Expressway Segment 2 Project
06-FRE-180 PM 71.8-74.4 EA 06-34252

Dear Ms. Swanberg:

Enclosed is the final Streambed Alteration Agreement (Agreement) for the SR 180 Kings Canyon Expressway Segment 2 Project (Project). Before the Department of Fish and Game (Department) may issue an Agreement, it must comply with the California Environmental Quality Act (CEQA). In this case, the Department, acting as a Responsible Agency, filed a Notice of Determination (NOD) on the same date it signed the Agreement. The NOD was based on information contained in the Environmental Impact Report the Lead Agency prepared for the Project.

Under CEQA, filing an NOD starts a 30-day period within which a party may challenge the filing agency's approval of the Project. You may begin your Project before the 30-day period expires if you have obtained all necessary local, State, and Federal permits or other authorizations. However, if you elect to do so, it will be at your own risk.

If you have any questions regarding this matter, please contact Laura Peterson-Diaz, Environmental Scientist, at (559) 243-4014, extension 225, or lpdiaz@dfg.ca.gov.

Sincerely,

for Jeffrey R. Single, Ph.D.
Regional Manager

Enclosures

cc: Laura Peterson-Diaz
Department of Fish and Game

NOTICE OF DETERMINATION

TO: Office of Planning and Research
Post Office Box 3044
Sacramento, California 95814

FROM: California Department of Fish and Game
Central Region
1234 East Shaw Avenue
Fresno, California 93710

SUBJECT: Filing of Notice of Determination in compliance with Section 21108 or 21152 of the Public Resources Code

PROJECT TITLE: State Route 180 Kings Canyon Expressway Project - Agreement 2012-0076-R4

STATE CLEARINGHOUSE NUMBER: 1991022072

LEAD AGENCY: California Department of Transportation
CONTACT: Carrie Swanberg (559) 445-6406

RESPONSIBLE AGENCY: California Department of Fish and Game
CONTACT: Laura Peterson-Diaz (559) 243-4017, extension 225

PROJECT LOCATION: The Project is located on State Route (SR) 180 where it crosses the Lone Tree Canal, east of Centerville, in Fresno County, State of California; Township 14 South, Range 23 East, Section 10, United States Geological Survey (USGS) map Wahtoke, Mount Diablo meridian.

PROJECT DESCRIPTION: The California Department of Fish and Game is executing a Lake and Streambed Alteration Agreement, pursuant to Section 1602 of the Fish and Game Code, to the Project applicant. Caltrans proposes to construct a new four-lane expressway with access control on a new alignment north of the existing SR 180. In order to accomplish this, the Lone Tree Canal will be realigned and spanned by three new bridges for the new east and west bound alignment and the frontage road. Ultimately, the current SR 180 will be removed; however, during construction and the realignment of the Lone Tree Canal, a temporary culvert will be placed under the current SR 180 at the location of the new realignment of the canal. Permanent impacts to the Lone Tree Canal include 518 linear feet of channel that will be straightened and concrete lined. Equipment to be used includes a backhoe, bulldozer/ loader, crane, compacting rollers, and concrete and asphalt pavers. Construction equipment will need to enter the waterway. Work will be done during the dry season; water is not anticipated to be present when work is done in the Lone Tree Canal channel, however if water is present a Water Diversion will be required. The Project will require night work. The Project will require the removal of two Gooding's black willow (*Salix gooddingii*) over 5 to 7 inches in diameter at breast height (DBH).

This is to advise that the California Department of Fish and Game as a Responsible Agency approved the Project described above and has made the following determinations regarding the above described Project.

1. The Project will not have a significant effect on the environment.
2. A Environmental Impact Report was prepared for this Project pursuant to the provisions of CEQA.
3. Mitigation measures were made a condition of the approval of the Project.
4. A Statement of Overriding Considerations was not adopted for this Project.
5. Findings were made pursuant to the provisions of CEQA.

This is to certify that a copy of the Environmental Impact Report prepared for this project is available to the general public and may be reviewed at: Caltrans - District 6 Environmental Planning, 855 M Street, Suite 200, Fresno, California 93721. Please contact the person specified above.

Date: 7/11/12

for Jeffrey R. Single, Ph.D., Regional Manager
Central Region
California Department of Fish and Game

Date received for filing at OPR: ________________

California Department of Fish and Game
Region 4 - Central Region
1234 East Shaw Avenue
Fresno, California 93710

Streambed Alteration Agreement
Notification No. 1600-2012-0076-R4
Lone Tree Canal, Fresno County

California Department of Transportation
Caltrans District 6
Carrie Swanberg
855 M Street, Suite 200
Fresno, California 93721

SR 180 Kings Canyon Expressway Segment 2 Project
06-FRE-180 PM 71.8-74.4 EA 06-34252

This Streambed Alteration Agreement (Agreement) is entered into between the California Department of Fish and Game (DFG) and California Department of Transportation Caltrans District 6 (Permittee) as represented by Carrie Swanberg acting on behalf of Permittee.

RECITALS

WHEREAS, pursuant to Fish and Game Code (FGC) Section 1602, Permittee notified DFG on January 18, 2012, that Permittee intends to complete the Project described herein.

WHEREAS, pursuant to FGC section 1603, DFG has determined that the Project could substantially adversely affect existing fish or wildlife resources and has included measures in the Agreement necessary to protect those resources.

WHEREAS, Permittee has reviewed the Agreement and accepts its terms and conditions, including the measures to protect fish and wildlife resources.

NOW THEREFORE, Permittee agrees to complete the Project in accordance with the Agreement.

PROJECT LOCATION

The Project is located on State Route (SR) 180 where it crosses the Lone Tree Canal, east of Centerville, in Fresno County, State of California; Township 14 South, Range 23 East, Section 10, United States Geological Survey (USGS) map Wahtoke, Mount Diablo meridian.

PROJECT DESCRIPTION

The Project is limited to:

- The Kings Canyon Expressway Segment 2 Project will construct a new four-lane expressway with access control on a new alignment north of the existing SR 180. In order to accomplish this, the Lone Tree Canal will be realigned and spanned by four new bridges for the new east and west bound alignment and the frontage road to the south and a private road to the north. Both new east and west bound bridges will be 40 feet (ft.) long and 39 ft. wide. The frontage road bridge will be 40 ft. long and 35 ft. wide. The private road bridge will be 40 ft. long and 19 ft. wide.

- Ultimately the current SR 180 will be removed; however, during construction and the realignment of Lone Tree Canal, a temporary culvert will be placed under the current SR 180 at the location of the new realignment of the canal.

- Permanent impacts to Lone Tree Canal include 518 linear feet of channel that will be straightened and concrete lined. Total fill quantity is 3,000 cubic yards (cu-yd.) including 322 cu-yd. of Rock Slope Protection and 172 cu-yd. of concrete lining.

- Equipment to be used includes a backhoe, bulldozer/loader, crane, compacting rollers, and concrete and asphalt pavers. Construction equipment will need to enter the waterway.

- Work will be done during the dry season. Water is not anticipated to be present when work is done in the Lone Tree Canal channel; however, if water is present a Water Diversion will be required.

- The Project will require the removal of riparian trees including two Gooding's black willow (*Salix gooddingii*) over five (5) to seven (7) inches in diameter at breast height (DBH).

- Caltrans has already compensated for impacts to vernal pool fairy shrimp for all three segments of the Kings Canyon Expressway project at the Great Valley conservation bank.

- The Project will require night work to replace the temporary box culvert at Lone Tree Canal underneath the existing SR 180 during stage construction.

PROJECT IMPACTS

This Agreement is intended to avoid, minimize, and mitigate adverse impacts to the fish and wildlife resources that occupy the area of the Lone Tree Canal, and the immediate adjacent riparian habitat. Absent implementation of the protective measures required by this Agreement, the following species and habitat types could potentially be impacted within the area covered by this Agreement: federally threatened vernal pool fairy shrimp (*Branchinecta* *lynchi*) as well as birds, mammals, fish, reptiles, amphibians, invertebrates and plants that comprise the local riparian ecosystem.

MEASURES TO PROTECT FISH AND WILDLIFE RESOURCES

1. Administrative Measures

Permittee shall meet each administrative requirement described below.

1.1. Documentation at Project Site: Permittee shall make the Agreement, any extensions and amendments to the Agreement, and all related notification materials and California Environmental Quality Act (CEQA) documents, readily available at the Project site at all times and shall be presented to DFG personnel or personnel from another State, Federal, or local agency upon request.

1.2. Providing Agreement to Persons at Project Site: Permittee shall provide copies of the Agreement and any extensions and amendments to the Agreement to all persons who will be working on the Project at the Project site on behalf of Permittee; including but not limited to contractors, subcontractors, inspectors, and monitors.

1.3. Notification of Conflicting Provisions: Permittee shall notify DFG if Permittee determines or learns that a provision in the Agreement might conflict with a provision imposed on the Project by another local, State, or Federal agency. In that event, DFG shall contact Permittee to resolve any conflict.

1.4. Project Site Entry: Permittee agrees that DFG personnel may enter the Project site at any time to verify compliance with the Agreement.

1.5. Legal Obligations: This Agreement does not exempt the Permittee from complying with all other applicable local, State and Federal law, or other legal obligations.

1.6. Unauthorized "Take": This Agreement does not authorize the "take" (defined in FGC Section 86 as to hunt, pursue, catch, capture, or kill; or attempt to hunt, pursue, catch, capture, or kill) of State- or Federal-listed threatened or endangered species. Any such "take" shall require separate permitting as may be required.

1.7. Water Diversion: To the extent that the Provisions of this Agreement provide for the diversion of water, they are agreed to with the understanding that the Permittee possesses the legal right to so divert such water.

1.8. Trespass: To the extent that the Provisions of this Agreement provide for activities that require the Permittee to trespass on another owner's property, they are agreed to with the understanding that the Permittee possesses the legal right to so trespass.

1.9. Construction/Work Schedule: The Permittee shall submit a **construction/work schedule** to DFG (lpdiaz@dfg.ca.gov with reference to Agreement 1600-2012-0076-R4) prior to beginning any activities covered by this Agreement. The Permittee shall also notify DFG upon the completion of the activities covered by this Agreement.

1.10. Training: Prior to starting any construction activity, all employees, contractors, and visitors who will be present during Project activities shall have received training from a qualified individual on the contents of this Agreement, the resources at stake, and the legal consequences of non-compliance. A **training sign-in sheet** for the employees and contractors shall be provided to DFG and shall include the date of the training and who gave the training.

2. Avoidance and Minimization Measures

To avoid or minimize adverse impacts to fish and wildlife resources identified above, Permittee shall implement each measure listed below.

2.1. Flagging/Fencing: Prior to any activity within the stream, the Permittee shall identify the limits of the required access routes and encroachment into the stream. These "work area" limits shall be identified with brightly colored flagging/fencing. Work completed under this Agreement shall be limited to this defined area only. Flagging/fencing shall be maintained in good repair for the duration of the Project. All areas beyond the identified work area limits shall be considered Environmentally Sensitive Areas (ESA) and shall not be disturbed.

2.2. Listed Species: This Agreement does not allow for the "take," or "incidental take," of any State- or Federal-listed threatened or endangered species.

2.2.1. The Permittee affirms that no "take" of listed species will occur as a result of this Project and will take prudent measures to ensure that all "take" is avoided. The Permittee acknowledges that they fully understand that they do not have "incidental take" authority. If any State- or Federal-listed threatened or endangered species occur within the proposed work area or could be impacted by the work proposed, and thus "taken" as a result of Project activities, the Permittee is responsible for obtaining and complying with required State and Federal threatened and endangered species permits or other written authorization before proceeding with this Project.

2.2.2. Liability for any "take," or "incidental take," of such listed species remains the separate responsibility of the Permittee for the duration of the Project.

2.2.3. The Permittee shall immediately (the same day) notify DFG of the discovery of any such rare, threatened, or endangered species prior to and/or during construction.

2.3. Fish and Wildlife: If any fish or wildlife is encountered during the course of construction, said fish and wildlife shall be allowed to leave the construction area unharmed.

2.3.1. A qualified biologist approved by DFG (Approved Biologist) shall perform **general wildlife surveys** of the Project area (including access routes and storage areas) within 30 days prior to Project construction start with particular attention to evidence of the presence of the species listed above and shall report any possible adverse affect to fish and wildlife resources not originally reported. If the survey shows presence of any wildlife species which could be impacted, Permittee shall contact DFG and mitigation, specific to each incident, shall be developed. If any State- or Federal-listed threatened or endangered species are found within the proposed work area or could be impacted by the work proposed, a new Agreement and/or a 2081(b) State Incidental Take Permit may be necessary and a new CEQA analysis may need to be conducted, before work can begin.

2.4. Birds: Migratory nongame native bird species are protected by international treaty under the Federal Migratory Bird Treaty Act (MBTA) of 1918 (50 C.F.R. Section 10.13). Sections 3503, 3503.5 and 3513 of the FGC prohibits take of all birds and their active nests including raptors and other migratory nongame birds, and prohibits the needless destruction of nests.

2.4.1. To protect nesting birds, no construction shall be completed from February 1 through August 31 unless the following **avian surveys** are completed by the Approved Biologist within 30 days prior to Project initiation:

- Raptors: Survey for nesting activity of raptors within a 500-foot radius of the construction site. Surveys shall be conducted at appropriate nesting times and concentrate on trees with the potential to support raptor nests. If any active nests are observed, these nests and nest trees shall be designated an ESA and protected with a minimum 500-foot buffer during Project construction.

- Other Avian Species: Survey riparian areas for nesting activity within a 250-foot radius of the defined work area two (2) to three (3) weeks before construction begins. If any nesting activity is found, these nests and nest trees shall be designated an ESA and protected with a minimum 250-foot buffer during Project construction.

2.4.2. Avian Buffer Size: May be reduced on a case-by-case basis if DFG concurs, based on compelling biological or ecological reasoning provided by a qualified biologist, that implementation of a specified smaller buffer distance will still avoid Project-related "take" of adults, juveniles, chicks, or eggs associated with a particular nest. Any variance of the standard buffers must be approved in advance by DFG in writing. Avoidance buffers shall be maintained for the duration of the Project during the entire nesting season unless the qualified biologist has determined that the young have fledged or are no longer dependent upon parental care.

2.5. Removal of Trees/Shrubs during Fall/Winter Months: To avoid potential impacts to nesting birds, trees and shrubs designated for removal should be cut down during the time period of September 16 to January 15. Trees/shrubs may be removed between February 1 and September 15 provided the Permittee has received written approval from DFG. A qualified biologist shall survey the proposed work area to verify the presence or absence of nesting birds and submit a detailed survey report including mapping for any nests found. DFG will review the report and at the discretion of DFG, tree/shrub removal may be authorized between January 15 and September 15.

2.6. Vegetation: The disturbance or removal of vegetation shall not exceed the minimum necessary to complete operations and shall only occur within the defined work area. Precautions shall be taken to avoid other damage to vegetation by people or equipment. Vegetation or material removed from the riparian area shall not be stockpiled in the streambed or on its banks without measures to ensure its stability, preventing accidental discharge into the stream.

2.6.1. The Permittee shall document the number and species of all riparian woody-stemmed plants greater than four (4) inches DBH that are removed or are damaged during construction. Riparian trees and shrubs with a DBH of four (4) inches or greater that are damaged or removed shall be replaced by replanting like species at a 3:1 ratio (replaced to lost). Mitigation for heritage trees 24-inches or greater shall require replanting of like species at a 10:1 ratio. This documentation shall be used as the basis for replacement mitigation. (See Revegetation under Compensation below.)

2.7. Vehicles and Equipment: Any equipment or vehicles driven and/or operated within or adjacent to the stream shall be checked and maintained daily to prevent leaks of materials that, if introduced to water, could be deleterious to aquatic and terrestrial life.

2.7.1. Construction vehicle access to the stream's banks and bed shall be limited to predetermined ingress and egress corridors on existing roads. All other areas adjacent to the work site shall be considered an ESA and shall remain off-limits to construction equipment. Vehicle corridors and the ESA shall be identified by the Permittee's resident engineer in consultation with the Approved Biologist.

2.8. Staging and Storage Areas: Staging and storage areas for equipment, materials, fuels, lubricants, and solvents shall be located outside of the stream channel and banks, and to the extent possible, on previously disturbed ground. Stationary equipment such as motors, pumps, generators, compressors and welders, located within or adjacent to the stream, shall be positioned over drip-pans. Vehicles shall be moved away from the stream prior to refueling and lubrication.

2.9. Pollution: The Permittee and all contractors shall be subject to the water pollution regulations found in FGC sections 5650 and 12015.

2.9.1. Raw cement, concrete or washings thereof, asphalt, drilling fluids or lubricants, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to fish or wildlife resulting from or disturbed by Project-related activities, shall be prevented from contaminating the soil and/or entering the "Waters of the State."

2.9.2. All Project-generated debris, building materials, and rubbish shall be removed from the stream and from areas where such materials could be washed into the stream.

2.9.3. In the event that a spill occurs, all Project activities shall immediately cease until cleanup of the spilled materials is completed. DFG shall be notified immediately by the Permittee of any spills and shall be consulted regarding cleanup procedures.

2.10. Structures: The Permittee shall confirm that all structures are designed (i.e., size and alignment), constructed, and maintained such that they shall not cause long-term changes in water flows that adversely modify the existing upstream or downstream stream bed/bank contours or increase sediment deposition or cause significant new erosion.

2.11. Fill: Rock, gravel, and/or other materials shall not be imported into or moved within the stream, except as otherwise addressed in this Agreement. Only on-site materials and clean imported fill shall be used to complete the Project. Fill shall be limited to the minimal amount necessary to accomplish the agreed activities. Excess and temporary fill material shall be moved off-site at Project completion.

2.12. Spoil: Spoil storage sites shall not be located within the stream, where spoil will be washed into the stream, or where it will cover aquatic or riparian vegetation. Rock, gravel, and/or other materials shall not be imported into or moved within the bed or banks of the stream, except as otherwise addressed in this Agreement.

2.13. Erosion: No work within the banks of the stream will be conducted during or immediately following large rainfall events, or when there is water flowing within the channel. All disturbed soils within the Project site shall be stabilized to reduce erosion potential, both during and following construction. Temporary erosion control devices may be used as appropriate to prevent siltation of the stream. Any installation of permanent non-erodible materials not described in the original Project description shall be coordinated with DFG. Coordination may include the negotiation of additional Agreement Provisions for this activity.

2.14. Turbidity: Turbid water shall not be discharged into the stream, or created within the stream. The Permittee's ability to minimize siltation shall be the subject of preconstruction planning and feature implementation. Precautions to minimize siltation may require that the work site be isolated so that silt or other deleterious materials are not allowed to pass to downstream reaches. The placement of any structure or materials in the stream for this purpose, not included in the original Project description, shall be coordinated with DFG. If it is determined that silt levels resulting from Project-related activities constitute a threat to aquatic life, activities associated with the siltation shall be halted until effective DFG-approved control devices are installed, or abatement procedures are initiated.

2.15. Stream Diversion: If work cannot be completed when the stream is dry and work must occur within the wetted portion of the channel, the Permittee shall develop a **Stream Diversion Plan**. This Stream Diversion Plan shall be completed and submitted to DFG for approval prior to commencement of any proposed diversion or activities within the wetted portion of the stream. The Plan shall include, at a minimum, the following: flow diversion shall be done in a manner that shall prevent pollution and/or siltation, and which shall provide flows to downstream reaches; flows to downstream reaches shall be provided during all times that the natural flow would have supported aquatic life; said flows shall be of sufficient quality and quantity, and of appropriate temperature to support aquatic life, both above and below the diversion; and normal flows shall be restored to the affected stream immediately upon completion of work at that location.

2.16. Restoration: Excess material must be removed from the Project site, pursuant to Department of Transportation Standard Specifications Section 7-1.13. All disturbed soils and new fill, including recontoured slopes and all other cleared areas, shall be revegetated with riparian vegetation or other plants, as appropriate to prevent erosion. If the Project causes any exposed slopes or exposed areas on the stream banks, these areas shall be seeded with a blend of a minimum of three (3) locally native grass species and covered with a protective layer of weed-free straw or mulch. One (1) or two (2) sterile non-native perennial grass species may be added to the seed mix provided that amount does not exceed 25 percent of the total seed mix by count. Locally native wildflower and/or shrub seeds may also be included in the seed mix. The seeding shall be completed as soon as possible, but no later than November 15 of the year construction ends. A **seed mixture** shall be submitted to DFG for approval prior to application. At the discretion of DFG, all exposed areas where seeding is considered unsuccessful after 90 days shall receive appropriate soil preparation and a second application of seeding, straw, or mulch as soon as is practical on a date mutually agreed upon.

3. **Compensatory Measures**
To compensate for adverse impacts to fish and wildlife resources identified above that cannot be avoided or minimized, Permittee shall implement each measure listed below.

3.1. Revegetation: As indicated in the Project description, two (2) Goodding's black willow five (5) to seven (7) inches DBH will be removed from the Project area; the Permittee therefore shall develop a **Revegetation Plan** for the site and submit it to DFG for approval prior to commencement of the proposed work. All Plans shall specifically address what, where, when and how replacement shrubs and trees will be planted.

3.1.1. What species and the number of trees both removed and to be planted should be identified. Native riparian trees and shrubs (e.g., cottonwood, willow, sycamore, valley oak, etc.) between four (4) to 25-inches DBH shall be replaced in-kind at a ratio of 3:1, and trees greater then 25-inches DBH shall be replaced at a ratio of 10:1.

3.1.2. Where should be on-site whenever possible.

3.1.3. When should be the first suitable season after construction is complete.

3.1.4. How should include layout, monitoring, and maintenance to ensure a minimum of 70 percent survival for the plantings after five (5) years.

4. **Monitoring and Reporting Measures**
Permittee shall meet each reporting and monitoring requirement described below.

4.1. Monitoring Obligations of the Permittee:

4.1.1. The Permittee shall have primary responsibility for monitoring compliance with all protective measures included as "Measures" in this Agreement. Protective measures must be implemented within the time periods indicated in the Agreement. DFG shall be notified immediately if monitoring reveals that any of the protective measures were not implemented during the period indicated in this Agreement, or if it anticipates that measures will not be implemented within the time period specified.

4.1.2. The Permittee (or the Permittee's designee) shall ensure the implementation of the Measures of the Agreement, and shall monitor the effectiveness of these Measures. DFG shall be notified immediately if any of the protective measures are not providing the level of protection that is appropriate for the impact that is occurring, and recommendations, if any, for alternative protective measures.

4.2. Reporting Obligations of the Permittee:

4.2.1. The Permittee shall submit the following Reports described in the Measures above to DFG:

- Construction/work schedule (Measure 1.9) prior to Project initiation.
- Employee and contractor training sign-in sheet (Measure 1.10) within five days of the training date.
- Results of general wildlife surveys (Measure 2.3.1) prior to Project initiation.
- Results of avian surveys if construction is scheduled during the nesting season (Measure 2.4.1) or for tree removal (Measure 2.5) prior to Project initiation.
- Stream Diversion Plan if diversion is required (Measure 2.15) prior to implementation.
- The seed mixture to be used post Project for erosion control (Measure 2.16) prior to implementation.
- A Revegetation Plan (Measure 3.1) prior to implementation.

4.2.2. A Final Project Report shall be submitted to DFG within 30 days after the Project is completed. The final report shall summarize the Project construction, including any problems relating to the protective measures of this Agreement and how the problems were resolved. "Before and after" photo documentation of the Project site shall be included.

VERIFICATION OF COMPLIANCE:

DFG may verify compliance with protective measures to ensure the accuracy of Permittee's monitoring and reporting efforts at any point in time it is deemed necessary. DFG may, at its sole discretion, review relevant Project documents maintained by the Permittee, interview Permittee employees and agents, inspect the Project area, and take other actions to assess compliance with or effectiveness of protective measures for the Project.

CONTACT INFORMATION

Any communication that Permittee or DFG submits to the other shall be in writing and any communication or documentation shall be delivered to the address below by United States mail, fax, or e-mail, or to such other address as Permittee or DFG specifies by written notice to the other.

To Permittee:

California Department of Transportation (Caltrans)
District 6
Carrie Swanberg
855 M Street, Suite 200
Fresno, California 93721
(559) 445-6406
Fax: (559) 445-6236
Carrie_Swanberg@dot.ca.gov

To DFG:

Department of Fish and Game
Region 4 - Central Region
1234 East Shaw Avenue
Fresno, California 93710
Attn: Lake and Streambed Alteration Program – Laura Peterson-Diaz
Notification No. 1600-2012-0076-R4
Phone: (559) 243-4017, extension 225
Fax: (559) 243-4020
lpdiaz@dfg.ca.gov

LIABILITY

Permittee shall be solely liable for any violations of the Agreement, whether committed by Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents or contractors and subcontractors, to complete the Project or any activity related to it that the Agreement authorizes.

This Agreement does not constitute DFG's endorsement of, or require Permittee to proceed with the Project. The decision to proceed with the Project is Permittee's alone.

SUSPENSION AND REVOCATION

DFG may suspend or revoke in its entirety the Agreement if it determines that Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, is not in compliance with the Agreement.

Before DFG suspends or revokes the Agreement, it shall provide Permittee written notice by certified or registered mail that it intends to suspend or revoke. The notice shall state the reason(s) for the proposed suspension or revocation, provide Permittee an opportunity to correct any deficiency before DFG suspends or revokes the Agreement, and include instructions to Permittee, if necessary, including but not limited to a directive to immediately cease the specific activity or activities that caused DFG to issue the notice.

ENFORCEMENT

Nothing in the Agreement precludes DFG from pursuing an enforcement action against Permittee instead of, or in addition to, suspending or revoking the Agreement.

Nothing in the Agreement limits or otherwise affects DFG's enforcement authority or that of its enforcement personnel.

OTHER LEGAL OBLIGATIONS

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from obtaining any other permits or authorizations that might be required under other Federal, State, or local laws or regulations before beginning the Project or an activity related to it.

This Agreement does not relieve Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, from complying with other applicable statutes in the FGC including, but not limited to, FGC sections 2050 et seq. (threatened and endangered species), 3503 (bird nests and eggs), 3503.5 (birds of prey), 5650 (water pollution), 5652 (refuse disposal into water), 5901 (fish passage), 5937 (sufficient water for fish), and 5948 (obstruction of stream).

Nothing in the Agreement authorizes Permittee or any person acting on behalf of Permittee, including its officers, employees, representatives, agents, or contractors and subcontractors, to trespass.

AMENDMENT

DFG may amend the Agreement at any time during its term if DFG determines the amendment is necessary to protect an existing fish or wildlife resource.

Permittee may amend the Agreement at any time during its term, provided the amendment is mutually agreed to in writing by DFG and Permittee. To request an amendment, Permittee shall submit to DFG a completed DFG "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the corresponding amendment fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

TRANSFER AND ASSIGNMENT

This Agreement may not be transferred or assigned to another entity, and any purported transfer or assignment of the Agreement to another entity shall not be valid or effective, unless the transfer or assignment is requested by Permittee in writing, as specified below, and thereafter DFG approves the transfer or assignment in writing.

The transfer or assignment of the Agreement to another entity shall constitute a minor amendment, and therefore to request a transfer or assignment, Permittee shall submit to DFG a completed DFG "Request to Amend Lake or Streambed Alteration" form and include with the completed form payment of the minor amendment fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5).

EXTENSIONS

In accordance with FGC section 1605(b), Permittee may request one extension of the Agreement, provided the request is made prior to the expiration of the Agreement's term. To request an extension, Permittee shall submit to DFG a completed DFG "Request to Extend Lake or Streambed Alteration" form and include with the completed form payment of the extension fee identified in DFG's current fee schedule (see Cal. Code Regs., tit. 14, § 699.5). DFG shall process the extension request in accordance with FGC 1605(b) through (e).

If Permittee fails to submit a request to extend the Agreement prior to its expiration, Permittee must submit a new notification and notification fee before beginning or continuing the Project the Agreement covers (Fish & G. Code, § 1605, subd. (f)).

EFFECTIVE DATE

The Agreement becomes effective on the date of DFG's signature, which shall be: 1) after Permittee's signature; 2) after DFG complies with all applicable requirements under CEQA; and 3) after payment of the applicable FGC section 711.4 filing fee listed at http://www.dfg.ca.gov/habcon/ceqa/ceqa_changes.html.

TERM

This Agreement shall remain in effect for five (5) years beginning on the date signed by DFG, unless it is terminated or extended before then. All provisions in the Agreement shall remain in force throughout its term. Permittee shall remain responsible for implementing any provisions specified herein to protect fish and wildlife resources after the Agreement expires or is terminated, as FGC section 1605(a)(2) requires.

CEQA COMPLIANCE

In approving this Agreement, DFG is independently required to assess the applicability of CEQA. The features of this Agreement shall be considered as part of the overall Project description. The Permittee's concurrence signature on this Agreement serves as confirmation to DFG that the activities that shall be conducted under the terms of this Agreement are consistent with the Project described in Notification No. 2012-0076-R4. Caltrans, as CEQA Lead agency submitted an Environmental Impact Report on September 16, 1994, State Clearinghouse No. 1991022072, for the SR 180 between Temperance Avenue and Cove Road Project. A copy of Caltrans May 22, 2012 CEQA Addendum for the above Project was provided with the Section 1602 Notification. DFG, as a CEQA Responsible Agency, shall make findings and submit a Notice of Determination to the State Clearinghouse upon signing this Agreement.

EXHIBITS

The document(s) listed below is included as an exhibit to the Agreement and incorporated herein by reference.

A. Figure 1. Project Location USGS Quad Map.

AUTHORITY

If the person signing the Agreement (signatory) is doing so as a representative of Permittee, the signatory hereby acknowledges that he or she is doing so on Permittee's behalf and represents and warrants that he or she has the authority to legally bind Permittee to the provisions herein.

AUTHORIZATION

This Agreement authorizes only the Project described herein. If Permittee begins or completes a Project different from the Project the Agreement authorizes, Permittee may be subject to civil or criminal prosecution for failing to notify DFG in accordance with FGC section 1602.

CONCURRENCE

The undersigned accepts and agrees to comply with all provisions contained herein.

FOR CALIFORNIA DEPARTMENT OF TRANSPORTATION

Carrie D. Swanberg — 6-29-12

Carrie Swanberg
Acting Biology Branch Chief
Caltrans Central Region (Districts 5, 6, 9 and 10) — Date

FOR DEPARTMENT OF FISH AND GAME

for — 7/11/12

Jeffrey R. Single, Ph.D.
Regional Manager — Date

Prepared by: Laura Peterson-Diaz
Environmental Scientist

Figure 1

Exhibit A

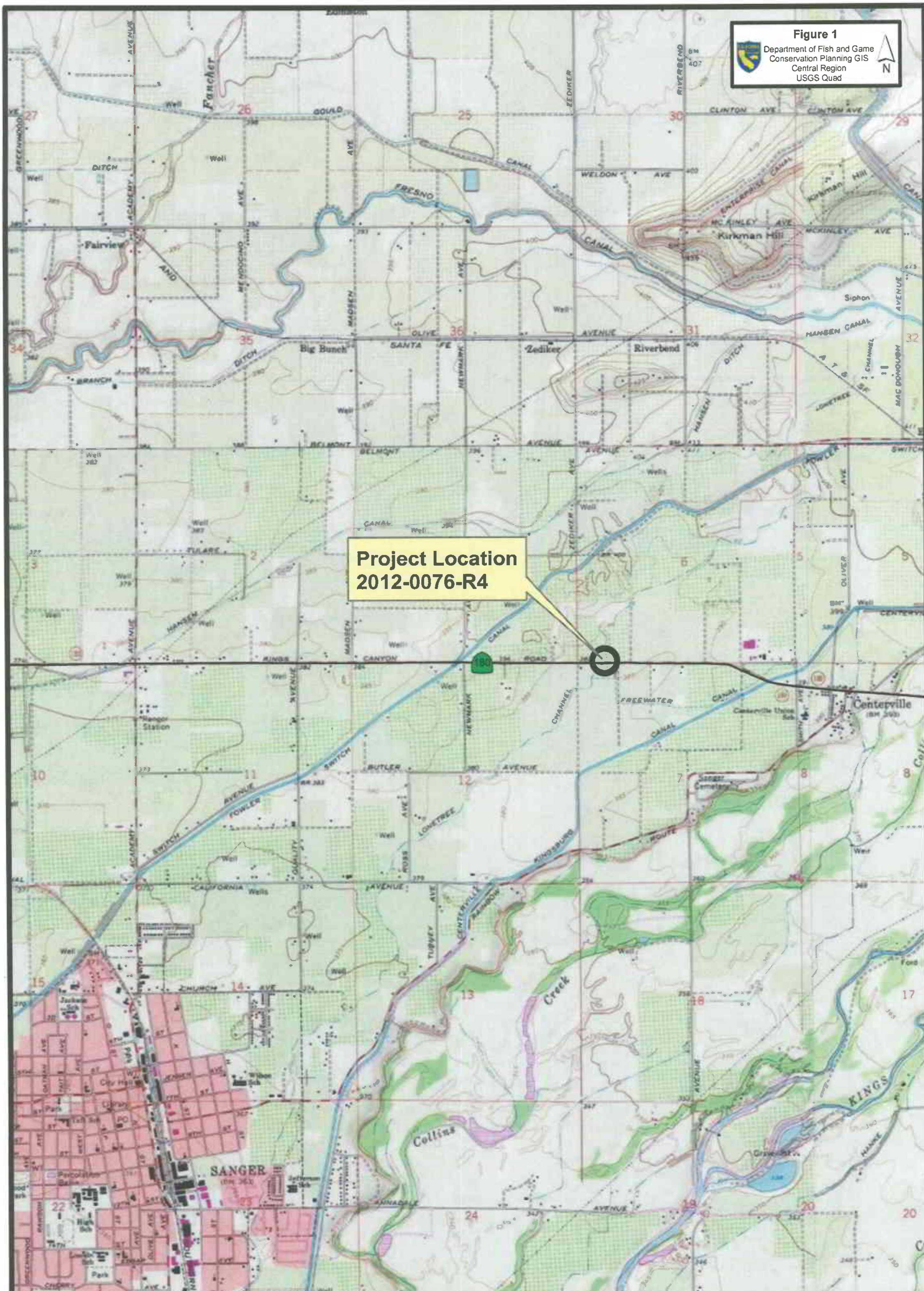


Figure 1
Department of Fish and Game
Conservation Planning GIS
Central Region
USGS Quad
N
Project Location
2012-0076-R4
Fairview
Big Bunch
Zediker
Riverbend
Kirkman Hill
Centerville
SANGER
Collins
Creek
KINGS
CLINTON AVE
MC KINLEY AVE
OLIVE AVENUE
BELMONT AVENUE
KINGS CANYON ROAD
BUTLER AVENUE
CALIFORNIA AVENUE
FRESNO
CANAL
FOWLER SWITCH
FREEWATER CANAL
KINGSBURG
Sanger Cemetery
Ranger Station
180

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: MR. GARY JOE
Chief, Design Branch 17
Office of Bridge Design Services
Structure Design
Division of Engineering Services

Attention: Mr. Rod Simmons

Date: April 10, 2012

File: 06-FRE-180 PM R71.8/74.4
EA 06-342521
ID 0600000381
Kings Canyon
Expressway Segment 2
Fowler Switch Canal Bridge
Br. No. 42-0439

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Addendum to Foundation Report

Introduction

The Office of Geotechnical Design North has prepared this Addendum to Foundation Report to provide revised foundation recommendations to the November 10, 2011 Foundation Report for the proposed Fowler Switch Canal Bridge, Br. No. 42-0439. The revised foundation recommendations are due to design changes made by Structure Design.

The following tables replace the tables in the November 10, 2011 Foundation Report. All other recommendations in the November 10, 2011 Foundation Report remain applicable.

Table 1. Foundation Design Data Sheet

Support No.	Design Method	Pile Type	Finished Grade Elev. (ft)	Cut-off Elev. (ft)	Pile Cap Size (ft)		Permissible Settlement Under Service Load (in)	Number of Piles Per Support
					B	L		
Abut 1	WSD	Class 140 Alt. “W”	397.0	391.42	Diaphragm Abut.		1	33
Abut 2	WSD	Class 140 Alt. “W”	396.0	391.42	Diaphragm Abut.		1	33

Table 2. Foundation Design Loads

Support No.	Service-I Limit State (kips)			Strength Limit State (kips)				Extreme Event Limit State (kips)			
	Total Load		Permanent Load	Compression		Tension		Compression		Tension	
	Per Support	Max Per Pile	Per Support	Per Support	Max Per Pile	Per Support	Max Per Pile	Per Support	Max Per Pile	Per Support	Max Per Pile
Abut 1	4125	125	3029	NA	NA	NA	NA	NA	NA	NA	NA
Abut 2	4125	125	3029	NA	NA	NA	NA	NA	NA	NA	NA

Table 3. Foundation Recommendations for Abutments

Support	Pile Type	Cut-off Elev. (ft)	Service Limit State Per Support (kips)		LRFD Service-I Limit State Total Load (kips) Per Pile (Compression)	Nominal Resistance (kips)	Design Tip Elev (ft)	Spec Tip Elev (ft)	Nominal Driving Resistance Required (kips)
			Total	Permanent					
Abut 1	Class 140 Alt. “W”	391.42	4125	3029	125	250	327 (a)	327	250
Abut 2	Class 140 Alt. “W”	391.42	4125	3029	125	250	327 (a)	327	250

Table 4. Pile Data Table

Support Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1	Class 140 Alt. “W”	250	0	327 (a)	327	250
Abut 2	Class 140 Alt. “W”	250	0	327 (a)	327	250

Project Information

Standard Special Provision S5-280, “Project Information”, discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:
A. LOTB for Fowler Switch Canal Bridge.

Data and Information included in the Information Handout provided to the bidders and Contractors are:
A. Addendum to Foundation Report for Fowler Switch Canal Bridge, dated 4/10/2012.

Data and Information available for inspection at the District Office:
A. None.

Data and Information available for inspection at the Transportation Laboratory are:
A. None.

Disclaimer and Contact Information

The foundation recommendations included in this addendum are based on specific project information regarding structure type, location, and design loads provided by SD. If any changes are made during final project design, OGDN should review the changes to determine if these foundation recommendations are still applicable. Any questions regarding this report should be directed to the attention of Ben Barnes at 916-227-1039.

BENJAMIN M. BARNES, P.E.
Transportation Engineer, Civil
Office of Geotechnical Design North
Geotechnical Services

REGISTERED PROFESSIONAL ENGINEER
BENJAMIN M. BARNES
No. 66090
Exp. 6/30/2012
CIVIL
STATE OF CALIFORNIA

c: Neil Bretz (D6 Project Manager)
Qiang Huang (Chief, GS/OGDN-E)
Shira Rajendra (Chief, GS Corporate)
Structure Construction R.E. Pending File
Rebecca Harnagel (DES Office Engineer, Office of PS&E)
Ted Mooradian (D6 DME)

M e m o r a n d u m

To: GARY JOE, CHIEF
Bridge Design Branch 17
Office of Bridge Design Services
Structure Design
Division of Engineering Services

Attn: Rodney Simmons

Date: January 27, 2012

File: 06-FRE-180 PM R71.8/74.4
06-342521
Project ID: 06 0000 0381
Kings Canyon Expwy Segt 2
Fowler Switch Canal Br.
Bridge No. 42-0439

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services
Geotechnical Design - North

Subject: Foundation Report for Fowler Switch Canal Bridge

Scope of Work

Per you requested, dated June 7, 2011, the Office of Geotechnical Design North (OGDN) has prepared a Foundation Report (FR) for the proposed new Fowler Switch Canal Bridge (Bridge No. 42-0439). This structure is located on Highway 180 (aka Kings Canyon Road) near the town of Sanger in Fresno County (PM 73.10). The re-construction of this bridge is to conform with the new roadway alignments proposed for the Kings Canyon Expressway Segment 2 project. The purpose of this report is to provide relevant information regarding the subsurface conditions of the proposed site, geotechnical design recommendations, and construction considerations.

Pertinent Reports and Investigation

In preparation of this report, the following documents were reviewed:

- Request for Final Foundation Recommendations, dated June 7, 2011;
- Foundation Plan, Fowler Switch Canal, 06-FRE-180-PM 73.10, Jun 26, 2011;
- Planning Study, Fowler Switch Canal, Oct, 2010;
- Geologic Map of California – Fresno Sheet, California Department of Conservation, 1965;
- Geotechnical Services Design Manual, Version 1.1, August 2009;
- Groundwater Level Data Wells 14S22E14B001M, 14S22E01P001M, 14S23E06C001M, and 13S23E31P001M from Department of Water Resources.

Project Description

The original bridge was built in 1945. The structure is a 3-span cast-in-place (CIP) continuous reinforced concrete slab bridge with stream training walls and closed end cantilever abutments. All abutments and bents are founded on spread footings.

The Kings Canyon Expressway Segment 2 project is the second phase of the Kings Canyon Road Improvement project series. The Segment 2 project proposes to re-align the existing roadway by shifting the new highway to the north and widen it from a 2-lane conventional highway to a 4-lane expressway. As part of the improvements, the existing Fowler Switch Canal bridge will be replaced with a new bridge which is offset about 100 ft to the north. The proposed structure will be a single span cast-in-place (CIP) post-tensioned (PT) slab bridge supported on diaphragm abutment. Class 140 Alternative “W” open ended pipe piles have been proposed as the foundations type for the abutments.

Table 1 and 2 below show foundation data and load demand information provided by Structure Design (SD).

Table 1 Foundation Design Data Sheet

Support No.	Design Method	Pile Type	Finished Grade Elevation (ft)	Cut-Off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (in)	Number of Piles per Support
					B	L		
Abut 1	WSD	Class 140 Alt. "W"	397	395	Diaphragm Abut.		1	30
Abut 2	WSD	Class 140 Alt. "W"	396	394	Diaphragm Abut.		1	30

Table 2 Foundation Design Loads

Support	Service-I Limit State (Kips)			Strength Limit State				Extreme Event Limit State			
	Total Load		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	4011	134	3511	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abut 2	4011	134	3511	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Field Investigation and Testing Program

Started on September 27th, 2011, two borings were advanced to the maximum depth of 80 ft. Rotary wash methods were used to advance the boreholes. Field tests such as Standard Penetration Tests (SPT) and Pocket Penetrometer tests were performed to obtain soil resistance data.

Laboratory Testing Program

Soil samples were taken near the proposed bridge on June 15, 2011 and October 4, 2011 for corrosion tests. See Section “Corrosion Evaluation” below for results.

Site Geology and Subsurface Conditions

Topography

The proposed site is located in the Great Valley geomorphic province of California on the western side of the Sierra Nevada Mountain Range and the east of the Coastal Mountain Range. The flat terrain is typical for the valley region. The ground elevations range from approximately 383 to 398feet.

Geology

The California Department of Conservation, Division of Mines and Geology, Geologic Map of California, Fresno Sheet, 1965 was used to determine the geologic formations of the project area. The project locations are mapped as being in an area of Pleistocene Non-marine Recent Alluvial Fan Deposit (Q_f) and Pleistocene Non-marine (Q_c).

Subsurface Conditions

According to the boring logs, the subsurface materials predominately consist of medium dense to dense sandy materials with interbedded layers of thin silt lenses on the upper 65 ft. Rounded cobbles and gravels were found 65 ft below existing ground surface to the maximum depth explored.

Bedrock was not encountered during subsurface exploration to the maximum explored depth of 80 ft from the existing ground.

Groundwater

According to the subsurface investigation done in September and October of 2011, groundwater elevations were measured at 356.0 ft and 365.0 ft, and they correspond to the depths of approximately 37 ft and 32 ft below existing ground. The State Department of Water Resources (DWR) has monitored groundwater level wells across California for decades. Data from four nearby monitoring wells are selected and used. Based on data obtained from the monitoring wells, the average groundwater elevations measured for these 4 wells are 354, 347, 376, and 378 ft. These elevations correspond to groundwater depths of 42, 29, 33, and 29 ft, respectively. Groundwater conditions will vary according to variations in rainfall, well pumping, and construction activities.

For design purposes, groundwater elevation was taken at 363 ft.

Scour Evaluation

Since the proposed structure is a single span bridge which does not have any intermediate support. The channel will be concrete lined. Scour is not an issue regarding the proposed structure.

Corrosion Evaluation

The minimum resistivities of the two tested soil samples were 5074 and 12,347.5 ohm-cm and the pH values were tested as 5.74 and 8.23. In order for the site to be non-corrosive, the minimum resistivity must be 1000 ohm-cm or greater and the pH must be between 5.5 and 10.0. Since the minimum resistivity is tested to be above 1000 ohm-cm, testing for chloride and sulfate contents are not needed, and therefore, not tested. According to the results from laboratory testing, the site is not anticipated to be corrosive for foundation element.

Seismic Recommendations

In accordance with Caltrans 2009 Seismic Design Procedure, the nearest active faults to the site are the Great Valley Fault 13(Fault ID No. 36) and Round Valley Fault (Fault ID No. 174) with the maximum magnitudes, M_{max}, of 6.5 and 7.3. The faults are identified as reverse and normal faults, respectively. The rupture distance from the project location to the Great Valley fault is about 53.1 mi (85.5 km) whereas the rupture distance is 61.3 mi (98.7 km) to the Round Valley fault.

Based on subsurface investigations, the estimated shear wave velocity (Vs_{30}) using SPT blow counts and the correlation formulas is 1040 ft/s (317 m/s). Using the estimated Vs_{30}, the ground motion generated from the nearest active fault is less than the statewide minimum requirement and the probabilistic method. Furthermore, the comparison between the minimum ground motion and the probabilistic method showed the minimum ground motion controls when the period is less than or equal to 0.5 second. Probabilistic method controls when the period is greater than 0.5 second. Therefore, the attached Acceleration Response Spectrum curve is based on the envelope of the minimum deterministic and USGS 5% probability of exceedance in 50 years (corresponding to a 975-year return period). The peak ground acceleration is 0.23g.

<u>Liquefaction</u>

Based on the relatively high apparent density and relatively low seismic demand, the potential for liquefaction at the proposed site is low.

<u>Surface Rupture</u>

Since there are no known faults projecting towards or passing directly through the project site, the potential for surface rupture at the site due to fault movement is considered low.

As-Built Foundation Data

The existing structure of the Fowler Switch Canal Bridge was built in 1945. The bridge was a concrete slab bridge which was founded on spread footings for both abutments and bents. The Foundation Recommendation report for the existing bridge was not found and the design load used for the existing structure and bottom of footing elevations are not known.

Foundation Recommendations

Caltrans Standard (2006) Class 140 Alternative “W” open-ended pipe piles were selected for the Abutments 1 and 2. Geotechnical capacities are derived from using the Nurdlund/Thurman method (1976) which is recommended by AASHTO LRFD Bridge Design Specifications (2007). Since the Class 140 open-ended pile has a small diameter and is considered to be a displacement pile type, both end bearing and skin friction were utilized for pile capacity calculations. Recommendations for the abutments are given below.

Table 3 Foundation Recommendations for Abutments

Support	Pile Type	Cut-off Elevation (ft)	LRFD Service Limit State Load Per Support (kips)		LRFD Service-1 Limit State Total Load (kips) Per Pile (Compression)	Nominal Resistance (kips)	Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kip)
			Total	Permanent					
Abut 1	Class 140 Alt. "W"	395	4011	3511	134	270	327 (a)	327	270
Abut 2	Class 140 Alt. "W"	394	4011	3511	134	270	326 (a)	326	270

Notes:

1. Recommendations are based on Working Stress Design (WSD) for abutment and the referenced foundation load data provided by SD.
2. The Design Tip Elevations recommended herein are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load, respectively.
3. Design Tip Elevations controlled by Settlement is not applicable.
4. The Design Tip Elevation controlled by lateral load is typically provided by SD.
5. The Specified Tip Elevation shall not be raised if controlled by lateral load.

Table 4 Pile Data Table

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance (kip)
		Compression	Tension			
Abut. 1	Class 140 Alt. "W"	270	0	327(a)	327	270
Abut. 2	Class 140 Alt. "W"	270	0	326 (a)	326	270

Notes:

1. Design tip elevations for Abutments are controlled by compression.

Construction Considerations

1. All earthwork shall follow Section 19 of the Caltrans Standard Specifications.
2. The Gates formula (Caltrans Standard Specifications Section 49-1.08) should be used for pile acceptance criteria for the Class 140 open-ended pipe piles.
3. Central relief drilling may be needed when hard driving condition occurs during pile driving. If central relief is used, drilling must be stopped at least 15 ft above the specified tip elevations.
4. To minimize the vibration on the canal resulting from pile driving, over-sized predrilling shall be utilized. Predriling shall extend from the ground level to the elevations of the bottom of the canal invert. The drilled holes shall have diameters of the piles plus 6 inches. Caltrans Standard Specification for predriling on embankment piles (Section 49-1.06) shall be followed.

Project Information

Standard Special Provision S5-280, “Project Information”, discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

LOTB for Fowler Switch Canal Bridge, dated TBD.

Data and information included in the Information Handout provided to the bidders and contractors are:

Foundation Report for Fowler Switch Canal Bridge, dated January 27, 2012.

Data and information available for inspection at the District Office:

None.

Data and information available for inspection at the Transportation Laboratory are:

None.

A full-sized Log of Test Boring (LOTB) which is to be incorporated in the project plans has been prepared by Geotechnical Services, Office of Geotechnical Support Branch D – Contracts, Graphics & Records. Mrs. Irma Gamarra-Remmen of the Contracts, Graphic & Records branch may be contacted directly for information on the LOTB.

If you have any questions, please call me, Carolyn Zhen-Ru, at (916) 227-1055 or my supervisor, John Huang, at (916) 227-1037.

CAROLYN ZHEN-RU, P.E.
Transportation Engineer, Civil
Office of Geotechnical Design – North
Branch E

JOHN HUANG, P.E.
Senior Materials and Research Engineer
Office of Geotechnical Design – North
Branch E

C: OGDN Branch Senior, John Huang
District Project Manager, Garth Fernandez
GS Corporate, Mark Willian
Structure Construction RE Pending File
DES Office Engineer, Office of PS&E, [to be assigned]
District Materials Engineer, Ted Mooradian

Appendix:
Recommended Acceleration Response Spectrum

Fowler Switch Canal Bridge

Bridge No. 42-0439

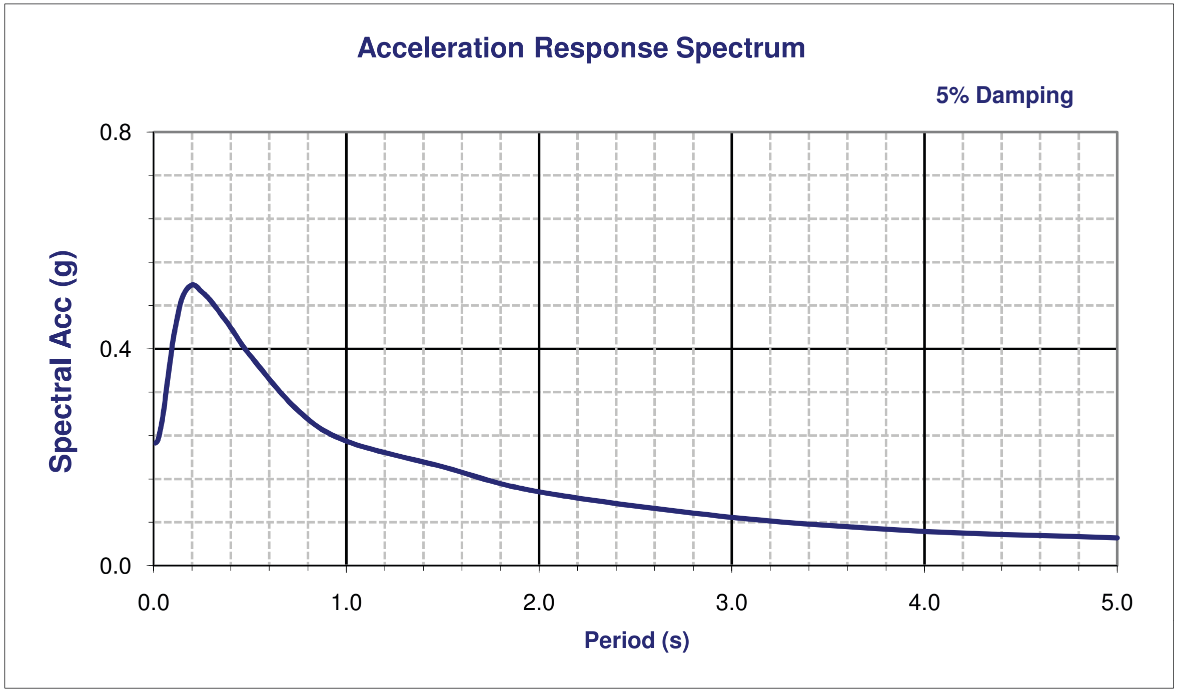
EFIS 0600000381

Latitude 36.7357

Longitude -119.5294

Control **Envelope**

Period (s)	Sa(g)
0.010	0.226
0.020	0.230
0.030	0.242
0.050	0.281
0.075	0.348
0.100	0.414
0.120	0.452
0.150	0.496
0.200	0.518
0.250	0.505
0.300	0.487
0.400	0.439
0.500	0.388
0.750	0.286
1.000	0.230
1.500	0.182
2.000	0.136
3.000	0.089
4.000	0.063
5.000	0.051



Deterministic Procedure Data

Fault	Great Valley Fault 13		**R_{rup}**	85.5	km
Fault ID	36		**R_{jb}**	85.1	km
Style	R		**R_x**	85.1	km
Mmax	6.5		**V_{S30}**	317	m/s
Dip	15	deg	**$Z_{1.0}$**	333	m
Z_{TOR}	9	km	**$Z_{2.5}$**	2.00	km

Notes

Please note the Design ARS curve is based on minimum deterministic and 5% probability of exceedence in 50 years (975 years return period) probabilitic spectra.

Final

Design Response Spectrum

State of California | Business, Transportation and Housing Agency
DEPARTMENT OF TRANSPORTATION

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To: MR. GARY JOE
Chief, Design Branch 17
Office of Bridge Design Services
Structure Design
Division of Engineering Services

Attention: Mr. Rod Simmons

Date: April 10, 2012

File: 06-FRE-180 PM R71.8/74.4
EA 06-342521
ID 0600000381
Kings Canyon
Expressway Segment 2
Fowler Switch (N. Frontage)
Br. No. 42C-0660

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Addendum to Foundation Report

Introduction

The Office of Geotechnical Design North has prepared this Addendum to Foundation Report to provide revised foundation recommendations to the November 10, 2011 Foundation Report for the proposed Fowler Switch (N. Frontage), Br. No. 42C-0660. The revised foundation recommendations are due to design changes made by Structure Design.

The following tables replace the tables in the November 10, 2011 Foundation Report. All other recommendations in the November 10, 2011 Foundation Report remain applicable.

Table 1. Foundation Design Data Sheet

Support No.	Design Method	Pile Type	Finished Grade Elev. (ft)	Cut-off Elev. (ft)	Pile Cap Size (ft)		Permissible Settlement Under Service Load (in)	Number of Piles Per Support
					B	L		
Abut 1	WSD	Class 140 Alt. "W"	395.0	391.42	Diaphragm Abut.		1	6
Abut 2	WSD	Class 140 Alt. "W"	395.0	391.42	Diaphragm Abut.		1	6

Table 2. Foundation Design Loads

Support No.	Service-I Limit State (kips)			Strength Limit State (kips)				Extreme Event Limit State (kips)			
	Total Load		Permanent Load	Compression		Tension		Compression		Tension	
	Per Support	Max Per Pile	Per Support	Per Support	Max Per Pile	Per Support	Max Per Pile	Per Support	Max Per Pile	Per Support	Max Per Pile
Abut 1	630	105	489	NA	NA	NA	NA	NA	NA	NA	NA
Abut 2	630	105	489	NA	NA	NA	NA	NA	NA	NA	NA

Table 3. Foundation Recommendations for Abutments

Support	Pile Type	Cut-off Elev. (ft)	Service Limit State Per Support (kips)		LRFD Service-I Limit State Total Load (kips) Per Pile (Compression)	Nominal Resistance (kips)	Design Tip Elev (ft)	Spec Tip Elev (ft)	Nominal Driving Resistance Required (kips)
			Total	Permanent					
Abut 1	Class 140 Alt. “W”	391.42	630	489	105	210	330 (a)	330	210
Abut 2	Class 140 Alt. “W”	391.42	630	489	105	210	330 (a)	330	210

Table 4. Pile Data Table

Support Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance (kips)
		Compression	Tension			
Abut 1	Class 140 Alt. “W”	210	0	330 (a)	330	210
Abut 2	Class 140 Alt. “W”	210	0	330 (a)	330	210

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:
A. LOTB for Fowler Switch (N. Frontage).

Data and Information included in the Information Handout provided to the bidders and Contractors are:
A. Addendum to Foundation Report for Fowler Switch (N. Frontage), dated 4/10/2012.

Data and Information available for inspection at the District Office:
A. None.

Data and Information available for inspection at the Transportation Laboratory are:
A. None.

Disclaimer and Contact Information

The foundation recommendations included in this addendum are based on specific project information regarding structure type, location, and design loads provided by SD. If any changes are made during final project design, OGDN should review the changes to determine if these foundation recommendations are still applicable. Any questions regarding this report should be directed to the attention of Ben Barnes at 916-227-1039.

BENJAMIN M. BARNES, P.E.
Transportation Engineer, Civil
Office of Geotechnical Design North
Geotechnical Services

c: Neil Bretz (D6 Project Manager)
Qiang Huang (Chief, GS/OGDN-E)
Shira Rajendra (Chief, GS Corporate)
Structure Construction R.E. Pending File
Rebecca Harnagel (DES Office Engineer, Office of PS&E)
Ted Mooradian (D6 DME)

State of California Business, Transportation and Housing Agency

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: GARY JOE, CHIEF
Bridge Design Branch 17
Office of Bridge Design Services
Structure Design
Division of Engineering Services

Attn: Rodney Simmons

Date: January 27, 2012

File: 06-FRE-180 PM R71.8/74.4
06-342521
Project ID: 06 0000 0381
Kings Canyon Expwy Segt 2
Fowler Switch Canal Br. (Frontage)
Bridge No. 42C0660

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services
Geotechnical Design - North

Subject: Foundation Report for Fowler Switch Canal Bridge (Frontage)

Scope of Work

Per you requested, dated June 7, 2011, the Office of Geotechnical Design North (OGDN) has prepared a Foundation Report (FR) for the proposed Fowler Switch Canal Bridge (Frontage) (Bridge No. 42C0660). This structure is located on Highway 180 (aka Kings Canyon Road) near the town of Sanger in Fresno County (PM 73.10). The Kings Canyon Expressway Segment 2 project proposes to widen and re-align a section of Highway 180. As part of the project, a new frontage road will also be added on the north side of the proposed alignment from Newmark Ave to 0.12 mile east of Lone Tree Canal. A bridge will be needed for the frontage road where it crosses Fowler Switch Canal. The purpose of this report is to provide relevant information regarding the subsurface conditions of the proposed site, geotechnical design recommendations, and construction considerations.

Pertinent Reports and Investigation

In preparation of this report, the following documents were reviewed:

- Request for Final Foundation Recommendations, dated June 7, 2011;
- Foundation Plan (Fowler Switch N. Frontage), 06-FRE-180-PM 73.10, May 9, 2011;
- Planning Study, Fowler Switch Canal, Oct, 2010;
- Geologic Map of California – Fresno Sheet, California Department of Conservation, 1965;
- Geotechnical Services Design Manual, Version 1.1, August 2009;

- Groundwater Level Data Wells 14S22E14B001M, 14S22E01P001M, 14S23E06C001M, and 13S23E31P001M from Department of Water Resources.

Project Description

The Kings Canyon Expressway Segment 2 project is the second phase of the Kings Canyon Road Improvement project series. The Segment 2 project proposes to re-align the existing roadway by shifting the new highway to the north and widen it from a 2-lane conventional highway to a 4-lane expressway. As part of the improvements, a frontage road will also be added on the north side of the proposed alignment from Newmark Ave to 0.12 mile east of Lone Tree Canal. A bridge will be added for the frontage road where it crosses Fowler Switch Canal. The proposed structure will be a single span cast-in-place (CIP) post-tensioned (PT) slab bridge support on diaphragm footing. Class 140 Alternative “W” open ended pipe piles have been proposed as the foundations type for the abutments.

Table 1 and 2 below show foundation data and load demand information provided by Structure Design (SD).

Table 1 Foundation Design Data Sheet

Support No.	Design Method	Pile Type	Finished Grade Elevation (ft)	Cut-Off Elevation (ft)	Pile Cap Size (ft)		Permissible Settlement under Service Load (in)	Number of Piles per Support
					B	L		
Abut 1	WSD	Class 140 Alt. "W"	398.5	396.5	Diaphragm Abut.		1	6
Abut 2	WSD	Class 140 Alt. "W"	398.5	396.5	Diaphragm Abut.		1	6

Table 2 Foundation Design Loads

Support	Service-I Limit State (Kips)			Strength Limit State				Extreme Event Limit State			
	Total Load		Permanent Loads	Compression		Tension		Compression		Tension	
	Per Support	Max. Per Pile	Per Support	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile	Per Support	Max. Per Pile
Abut 1	601	100	447	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Abut 2	601	100	447	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Field Investigation and Testing Program

Started on September 28th, 2011, two borings were advanced to the maximum depth of 80 ft. Rotary wash methods were used to advance the boreholes. Field tests such as Standard Penetration Tests (SPT) and Pocket Penetrometer tests were performed to obtain soil resistance data.

Laboratory Testing Program

Soil samples were taken near the proposed bridge on June 15, 2011 and October 4, 2011 for corrosion tests. See Section "Corrosion Evaluation" below for results.

Site Geology and Subsurface Conditions

Topography

The proposed site is located in the Great Valley geomorphic province of California on the western side of the Sierra Nevada Mountain Range and the east of the Coastal Mountain Range. The flat terrain is typical for the valley region. The ground elevations range from approximately 383 to 398feet.

Geology

The California Department of Conservation, Division of Mines and Geology, Geologic Map of California, Fresno Sheet, 1965 was used to determine the geologic formations of the project area. The project locations are mapped as being in an area of Pleistocene Non-marine Recent Alluvial Fan Deposit (Q_f) and Pleistocene Non-marine (Q_c).

Subsurface Conditions

According to the boring logs, the subsurface materials predominately consist of medium dense to dense sandy materials with interbedded layers of thin silt lenses on the upper 65 ft. Rounded cobbles and gravels were found 65 ft below existing ground surface to the maximum depth explored.

Bedrock was not encountered during subsurface exploration to the maximum explored depth of 80 ft from the existing ground.

Groundwater

According to the subsurface investigation done in September and October of 2011, groundwater elevation was measured at 365.0 ft, and this corresponds to the depth of approximately 33ft below existing ground. The State Department of Water Resources (DWR) has monitored groundwater level wells across California for decades. Data from four nearby monitoring wells are selected and used. Based on data obtained from the monitoring wells, the average groundwater elevations measured for these 4 wells are 354, 347, 376, and 378 ft. These elevations correspond to groundwater depths of 42, 29, 33, and 29 ft, respectively. Groundwater conditions will vary according to variations in rainfall, well pumping, and construction activities.

For design purposes, groundwater elevation was taken at 363 ft.

Scour Evaluation

Since the proposed structure is a single span bridge which does not have any intermediate support. The channel will be concrete lined. Scour is not an issue regarding the proposed structure.

Corrosion Evaluation

The minimum resistivities of the two tested soil samples were 5074 and 12,347.5 ohm-cm and the pH values were tested as 5.74 and 8.23. In order for the site to be non-corrosive, the minimum resistivity must be 1000 ohm-cm or greater and the pH must be between 5.5 and 10.0. Since the minimum resistivity is tested to be above 1000 ohm-cm, testing for chloride and sulfate contents are not needed, and therefore, not tested. According to the results from laboratory testing, the site is not anticipated to be corrosive for foundation element.

Seismic Recommendations

In accordance with Caltrans 2009 Seismic Design Procedure, the nearest active faults to the site are the Great Valley Fault 13(Fault ID No. 36) and Round Valley Fault (Fault ID No. 174) with the maximum magnitudes, M_{max}, of 6.5 and 7.3. The faults are identified as reverse and normal faults, respectively. The rupture distance from the project location to the Great Valley fault is about 53.1 mi (85.5 km) whereas the rupture distance is 61.3 mi (98.7 km) to the Round Valley fault.

Based on subsurface investigations, the estimated shear wave velocity (Vs_{30}) using SPT blow counts and the correlation formulas is 1040 ft/s (317 m/s). Using the estimated Vs_{30}, the ground motion generated from the nearest active fault is less than the statewide minimum requirement and the probabilistic method. Furthermore, the comparison between the minimum ground motion and the probabilistic method showed the minimum ground motion controls when the period is less than or equal to 0.5 second. Probabilistic method controls when the period is greater than 0.5 second. Therefore, the attached Acceleration Response Spectrum curve is based on the envelope of the minimum deterministic and USGS 5% probability of exceedance in 50 years (corresponding to a 975-year return period). The peak ground acceleration is 0.23g.

Liquefaction

Based on the relatively high apparent density and relatively low seismic demand, the potential for liquefaction at the proposed site is low.

Surface Rupture

Since there are no known faults projecting towards or passing directly through the project site, the potential for surface rupture at the site due to fault movement is considered low.

As-Built Foundation Data

Since this is a new bridge, there is no as-built foundation data.

Foundation Recommendations

Caltrans Standard (2006) Class 140 Alternative "W" open-ended pipe piles were selected for the Abutments 1 and 2. Geotechnical capacities are derived from using the Nurdlund/Thurman method (1976) which is recommended by AASHTO LRFD Bridge Design Specifications (2007). Since the Class 140 open-ended pile has a small diameter and is considered to be a displacement pile type, both end bearing and skin friction were utilized for pile resistance calculations. Recommendations for the abutments are given below.

Table 3 Foundation Recommendations for Abutments

Support	Pile Type	Cut-off Elevation (ft)	LRFD Service Limit State Load Per Support (kips)		LRFD Service-1 Limit State Total Load (kips) Per Pile (Compression)	Nominal Resistance (kips)	Design Tip Elevations (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance Required (kip)
			Total	Permanent					
Abut 1	Class 140 Alt. "W"	396.5	601	447	100	200	330 (a)	330	200
Abut 2	Class 140 Alt. "W"	396.5	601	447	100	200	330 (a)	330	200

Notes:

1. Recommendations are based on Working Stress Design (WSD) for abutment and the referenced foundation load data provided by SD.
2. The Design Tip Elevations recommended herein are controlled by: (a) Compression, (c) Settlement, and (d) Lateral Load, respectively.
3. Design Tip Elevations controlled by Settlement is not applicable.
4. The Design Tip Elevation controlled by lateral load is typically provided by SD.
5. The Specified Tip Elevation shall not be raised if controlled by lateral load.

Table 4 Pile Data Table

Location	Pile Type	Nominal Resistance (kips)		Design Tip Elevation (ft)	Specified Tip Elevation (ft)	Nominal Driving Resistance (kip)
		Compression	Tension			
Abut. 1	Class 140 Alt. "W"	200	0	330 (a)	330	200
Abut. 2	Class 140 Alt. "W"	200	0	330 (a)	330	200

Notes:

1. Design tip elevations for Abutments are controlled by compression.

Construction Considerations

1. All earthwork shall follow Section 19 of the Caltrans Standard Specifications.
2. The Gates formula (Caltrans Standard Specifications Section 49-1.08) should be used for pile acceptance criteria for the Class 140 open-ended pipe piles.
3. Central relief drilling may be needed when hard driving condition occurs during pile driving. If central relief is used, drilling must be stopped at least 15 ft above the specified tip elevations.
4. To minimize the vibration on the canal resulting from pile driving, over-sized predrilling shall be utilized. Predriling shall extend from the ground level to the elevations of the bottom of the canal invert. The drilled holes shall have diameters of the piles plus 6 inches. Caltrans Standard Specification for predriling on embankment piles (Section 49-1.06) shall be followed.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

LOTB for Fowler Switch Canal Bridge (Frontage), dated TBD.

Data and information included in the Information Handout provided to the bidders and contractors are:

Foundation Report for Fowler Switch Canal Bridge (Frontage), dated January 27, 2012.

Data and information available for inspection at the District Office:

None.

Data and information available for inspection at the Transportation Laboratory are:

None.

A full-sized Log of Test Boring (LOTB) which is to be incorporated in the project plans has been prepared by Geotechnical Services, Office of Geotechnical Support Branch D – Contracts, Graphics & Records. Mrs. Irma Gamarra-Remmen of the Contracts, Graphic & Records branch may be contacted directly for information on the LOTB.

If you have any questions, please call me, Carolyn Zhen-Ru, at (916) 227-1055 or my supervisor, John Huang, at (916) 227-1037.

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Office of Geotechnical Design – North
Branch E

C: OGDN Branch Senior, John Huang
District Project Manager, Garth Fernandez
GS Corporate, Mark Willian
Structure Construction RE Pending File
DES Office Engineer, Office of PS&E, [to be assigned]
District Materials Engineer, Ted Mooradian

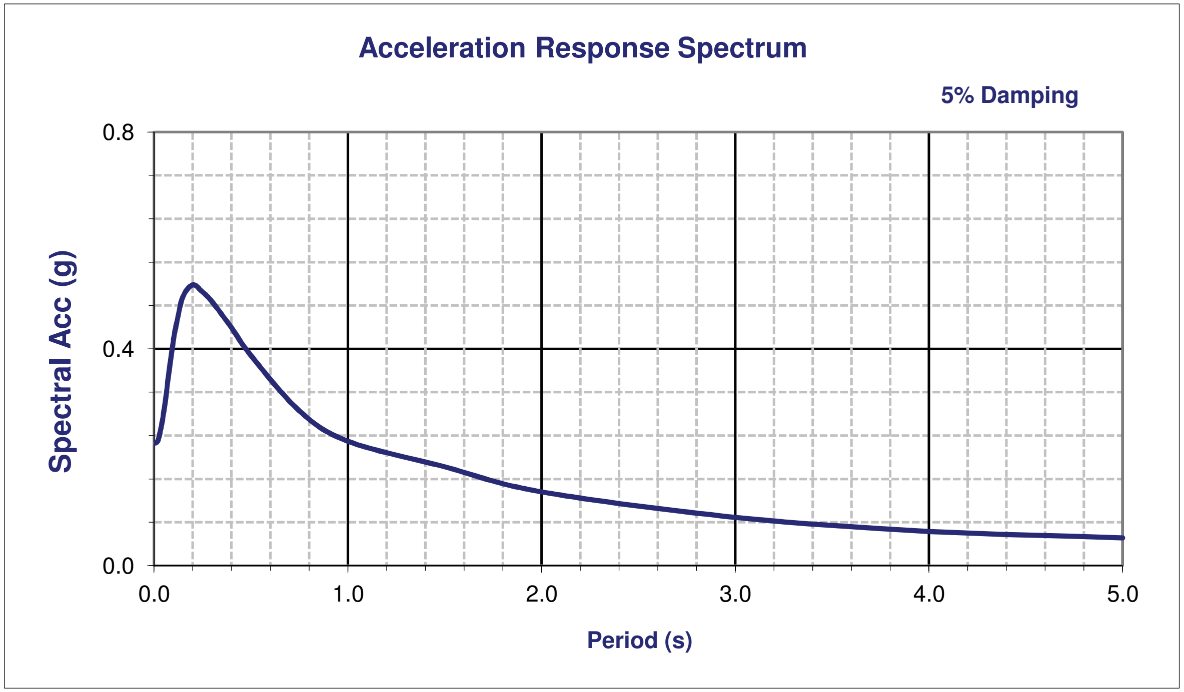
Appendix:
Recommended Acceleration Response Spectrum

Fowler Switch Canal Br (Frontage)

Latitude 36.7357
Longitude -119.5294
Control **Envelope**

Bridge No. 42C0660
EFIS 0600000381

Period (s)	Sa(g)
0.010	0.226
0.020	0.230
0.030	0.242
0.050	0.281
0.075	0.348
0.100	0.414
0.120	0.452
0.150	0.496
0.200	0.518
0.250	0.505
0.300	0.487
0.400	0.439
0.500	0.388
0.750	0.286
1.000	0.230
1.500	0.182
2.000	0.136
3.000	0.089
4.000	0.063
5.000	0.051



Deterministic Procedure Data

Fault	Great Valley Fault 13		R_{rup}	85.5	km
Fault ID	36		R_{jb}	85.1	km
Style	R		R_x	85.1	km
Mmax	6.5		V_{S30}	317	m/s
Dip	15	deg	$Z_{1.0}$	333	m
Z_{TOR}	9	km	$Z_{2.5}$	2.00	km

Notes

Please note the Design ARS curve is based on minimum deterministic and 5% probability of exceedence in 50 years (975 years return period) probabilitic spectra.

Final
Design Response Spectrum

State of California

Business, Transportation and Housing Agency

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To: GARY JOE, CHIEF
Bridge Design Branch 17
Office of Bridge Design Services
Structure Design
Division of Engineering Services

Attn: Rodney Simmons

Date: January 25, 2012

File: 06-FRE-180 PM R71.8/74.4
06-342521
Project ID: 06 0000 0381
Kings Canyon Expwy Segt 2
Lone Tree Canal Br.
Bridge No. 42-0440 L/R

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services
Geotechnical Design - North

Subject: Foundation Report for Lone Tree Canal Bridge

Scope of Work

Per you requested, dated June 7, 2011, the Office of Geotechnical Design North (OGDN) has prepared a Foundation Report (FR) for the proposed new Lone Tree Canal Bridge (Bridge No. 42-0440). This structure is located on Highway 180 (aka Kings Canyon Road) near the town of Sanger in Fresno County (PM 73.70). The re-construction of this bridge is to conform with the new roadway alignments proposed for the Kings Canyon Expressway Segment 2 project. The purpose of this memo is to provide relevant information regarding the subsurface conditions of the proposed site, geotechnical design recommendations, and construction considerations.

Pertinent Reports and Investigation

In preparation of this report, the following documents were reviewed:

- Request for Final Foundation Recommendations, dated June 7, 2011;
- Foundation Plan, Lone Tree Canal Bridge, 06-FRE-180-PM 73.10, May 26, 2011;
- Planning Study, Lone Tree Canal, Oct, 2010;
- General Plan, Bridge Across Lone Tree Channel, 06-Fre-180 PM 73.7, Jul 1, 1936;
- Geologic Map of California – Fresno Sheet, California Department of Conservation, 1965;
- Geotechnical Services Design Manual, Version 1.1, August 2009;

- Groundwater Level Data Wells 14S22E14B001M, 14S22E01P001M, 14S23E06C001M, and 13S23E31P001M from Department of Water Resources.

Project Description

The existing bridge was built in 1936. The structure is a single span, reinforced concrete rigid frame slab bridge on closed end cantilever abutments. Both abutments were founded on spread footings.

The Kings Canyon Expressway Segment 2 project is the second phase of the Kings Canyon Road Improvement project series. The Segment 2 project proposes to re-align the existing roadway by shifting the new highway to the north and widen it from a 2-lane conventional highway to a 4-lane expressway. As part of the improvements, the existing Lone Tree Canal bridge will be replaced with a new bridge which is offset about 100 ft to the north. The proposed structure will be a single span cast-in-place (CIP) post-tensioned (PT) slab bridge supported on diaphragm abutment. Spread footings have been proposed as the foundations type for the abutments.

Table 1 and 2 below show foundation data and load demand information provided by Structure Design (SD).

Table 1 Foundation Data

Support No.	Design Method	Finished Grade Elevation (ft)	BOF Elevation (ft)	Footing Size (ft)		Permissible Settlement under Service Load (in)
				B	L	
Abut 1	WSD	384	371.05	7.5	43.97	1
Abut 2	WSD	384	371.05	7.5	43.97	1

Table 2 Service Limit State I Loads

Support No.	Total Load				Permanent Load		
	Vertical Load (kips)	Effective Dimensions (ft)		Horizontal Load in Long. Direction (kip)	Vertical Load (kips)	Effective Dimension (ft)	
		B'	L'			B'	L'
Abut 1	812	7.5	43.97	N/A	646	7.5	43.97
Abut 2	812	7.5	43.97	N/A	646	7.5	43.97

Field Investigation and Testing Program

Started on October 11th, 2011, two borings were advanced to the maximum depth of 70 ft. Rotary wash method was used to advance the boreholes. Field tests such as Standard Penetration Tests (SPT) and Pocket Penetrometer tests were performed to obtain soil resistance data.

Laboratory Testing Program

Soil samples were taken near the proposed bridge on June 15, 2011 and October 10, 2011 for corrosion tests. See Section "Corrosion Evaluation" below for results.

Site Geology and Subsurface Conditions

<u>Topography</u>

The proposed site is located in the Great Valley geomorphic province of California on the western side of the Sierra Nevada Mountain Range and the east of the Coastal Mountain Range. The flat terrain is typical for the valley region. The ground elevations range from approximately 383 to 398 feet.

<u>Geology</u>

The California Department of Conservation, Division of Mines and Geology, Geologic Map of California, Fresno Sheet, 1965 was used to determine the geologic formations of the project area.

The project locations are mapped as being in an area of Pleistocene Non-marine Recent Alluvial Fan Deposit (Q_f) and Pleistocene Non-marine (Q_c).

Subsurface Conditions

According to the boring logs, the subsurface materials predominately consist of medium dense to very dense sandy materials with interbedded layers of thin clay and silt lenses on the upper about 18 ft. Rounded cobbles and gravels with matrix of sand were found 18 ft below existing ground surface to the maximum depth explored.

Bedrock was not encountered during subsurface exploration to the maximum explored depth of 70 ft from the existing ground.

Groundwater

According to the subsurface investigation done in October of 2011, groundwater elevations were measured at 368.2 ft and 371.4 ft, and they correspond to the depths of approximately 17 ft and 19 ft, respectively, below existing ground. The State Department of Water Resources (DWR) has monitored groundwater level wells across California for decades. Data from four nearby monitoring wells are selected and used. Based on data obtained from the monitoring wells, the average groundwater elevations measured for these 4 wells are 354, 347, 376, and 378 ft. These elevations correspond to groundwater depths of 42, 29, 33, and 29 ft, respectively. Groundwater conditions will vary according to variations in rainfall, well pumping, and construction activities.

For design purposes, groundwater elevation was taken at 372 ft.

Scour Evaluation

Since the proposed structure is a single span bridge which does not have any intermediate support. The channel will be concrete lined. Scour is not an issue regarding the proposed structure.

Corrosion Evaluation

The minimum resistivities of the tested soil samples were 3294 and 8362.5 ohm-cm and the pH values were tested as 5.71 and 7.3. In order for the site to be non-corrosive, the minimum resistivity must be 1000 ohm-cm or greater and the pH must be between 5.5 and 10.0. Since the minimum resistivity is tested to be above 1000 ohm-cm, testing for chloride and sulfate contents are not needed, and therefore, not tested. According to the results from laboratory testing, the site is not anticipated to be corrosive for foundation element.

Seismic Recommendations

In accordance with Caltrans 2009 Seismic Design Procedure, the nearest active faults to the site are the Great Valley Fault 13(Fault ID No. 36) and Round Valley Fault (Fault ID No. 174) with the maximum magnitudes, M_{max}, of 6.5 and 7.3. The faults are identified as reverse and normal faults, respectively. The rupture distance from the project location to the Great Valley fault is about 53.6 mi (86.3 km) whereas the rupture distance is 60.3 mi (97.9km) to the Round Valley fault.

Based on subsurface investigations, the estimated shear wave velocity (Vs_{30}) using SPT blow counts and the correlation formulas is 1070 ft/s (325m/s). Using the estimated Vs_{30}, the ground motion generated from the nearest active fault is less than the statewide minimum requirement and the probabilistic method. Furthermore, the comparison between the minimum ground motion and the probabilistic method showed the minimum ground motion controls when the period is less than or equal to 0.5 second. Probabilistic method controls when the period is greater than 0.5 second. Therefore, the attached Acceleration Response Spectrum curve is based on the envelope of the minimum deterministic and USGS 5% probability of exceedance in 50 years (corresponding to a 975-year return period). The peak ground acceleration is 0.23g.

Liquefaction

Based on the relatively high apparent density and relatively low seismic demand, the potential for liquefaction at the proposed site is low.

Surface Rupture

Since there are no known faults projecting towards or passing directly through the project site, the potential for surface rupture at the site due to fault movement is considered low.

As-Built Foundation Data

The existing structure of the Lone Canal Bridge was built in 1936. The bridge was a concrete slab bridge which was founded on spread footings. The Foundation Recommendation report was not found. The design load used for the existing structure is not known and bottom of footing elevation was about 370 ft.

Foundation Recommendations

Spread footings were selected for the Abutments 1 and 2. Geotechnical capacities are derived from using the Munfakh's method (2001) for bearing capacity and Hough method (1959) for settlement analyses. These methods are recommended by AASHTO LRFD Bridge Design Specifications (2007). Recommendations for the abutments are given below.

Table 3 Foundation Recommendations for Abutments

Support Location	Footing Size (ft)		Bottom of Footing Elevation (ft)	Minimum Footing Embedment Depth (ft)	WSD (LRFD Service-I Limit State Load Combination)		LRFD		
	B	L					Service	Strength φ_b = 0.45	Extreme Event φ_b= 1.00
					Permissible Gross Contact Stress (ksf)	Allowable Gross Bearing Capacity (KSf)	Permissible Net Contact Stress (ksf)	Factored Gross Nominal Bearing Resistance (ksf)	Factored Gross Nominal Bearing Resistance (ksf)
Abut 1	7.5	43.97	371.05	2	2.46	3.54	N/A	N/A	N/A
Abut 2	7.5	43.97	371.05	2	2.46	3.54	N/A	N/A	N/A

Notes:

1. Recommendations are based on the foundation geometry and the loads provided by Structure Design in the Foundation Design Data Sheet. The footing contact area is taken as equal to the effective footing area, where applicable.
2. See MTD 4-1 for definitions and applications of the recommended design parameters.
3. Minimum Footing Embedment Depth is measured from the bottom of canal.

Table 4 Spread Footing Data Table

Support Location	Working Stress Design (WSD)		Load and Resistance Factored Design (LRFD)		
			Service	**Strength**	**Extreme Event**
	Permissible Gross Contact Stress (Settlement) (ksf)	Allowable Gross Bearing Capacity (ksf)	Permissible Net Contact Stress (Settlement) (ksf)	Factored Gross Nominal Bearing Resistance φ_b=0.45	Factored Gross Nominal Bearing Resistance φ_b=1.00
Abut. 1	2.46	3.54	N/A	N/A	N/A
Abut. 2	2.46	3.54	N/A	N/A	N/A

Construction Considerations

1. All earthwork shall follow Section 19 of the Caltrans Standard Specifications.
2. All footing excavation shall be inspected and approved by this Office or a structural representative from the Caltrans Structure Construction when excavation are completed to the bottom of footing and prior to placement of concrete.
3. Spread footings shall be placed neatly against competent materials. All loose materials shall be removed prior to placement of concrete.
4. Shallow groundwater and difficult excavation conditions with the presence of cobbles, and caving may be encountered during footing excavation. Class “A” excavation (with seal course) and shoring may be required.
5. The top 2 feet of soil below the bottom of footing at the abutments shall be removed and replaced with structural backfill and it shall be compacted to a 95% relative compacted. Lean concrete may be used as an alternative to structural backfill.
6. During footing excavation, if unsuitable or unexpected materials are found, these materials shall be removed and replaced with structural backfill and be compacted to a 95% relative compaction. If soils are disturbed or loosen during excavation, these soil can be removed and re-compacted to a 95% relative compaction or bottom of footing elevation is to be lowered to undisturbed competent materials. Lean concrete may be used as an alternative to structural backfill.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

LOTB for Lone Tree Canal Bridge, dated TBD.

Data and information included in the Information Handout provided to the bidders and contractors are:

Foundation Report for Lone Tree Canal Bridge, dated January 25, 2012.

Data and information available for inspection at the District Office:

None.

Data and information available for inspection at the Transportation Laboratory are:

None.

A full-sized Log of Test Boring (LOTB) which is to be incorporated in the project plans has been prepared by Geotechnical Services, Office of Geotechnical Support Branch D – Contracts, Graphics & Records. Mrs. Irma Gamarra-Remmen of the Contracts, Graphic & Records branch may be contacted directly for information on the LOTB.

If you have any questions, please call me, Carolyn Zhen-Ru, at (916) 227-1055 or my supervisor, John Huang, at (916) 227-1037.

CAROLYN ZHEN-RU, P.E.
Transportation Engineer, Civil
Office of Geotechnical Design – North
Branch E

JOHN HUANG, P.E.
Senior Materials and Research Engineer
Office of Geotechnical Design – North
Branch E

C: OGDN Branch Senior, John Huang
District Project Manager, Garth Fernandez
GS Corporate, Mark Willian
Structure Construction RE Pending File
DES Office Engineer, Office of PS&E, [to be assigned]
District Materials Engineer, Ted Mooradian

Appendix:
Recommended Acceleration Response Spectrum

Lone Tree Canal Bridge

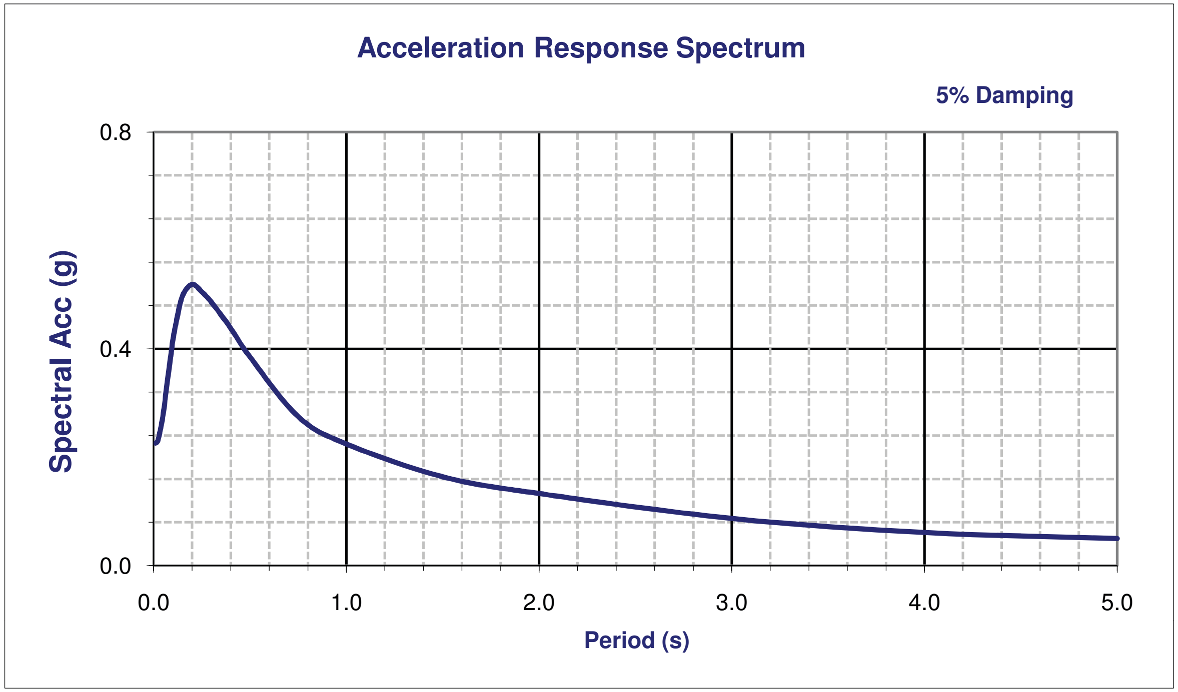
Bridge No. 42-0440 L/R

EFIS 0600000381

Latitude 36.7354
Longitude -119.5177

Control **Envelope**

Period (s)	Sa(g)
0.010	0.226
0.020	0.229
0.030	0.242
0.050	0.281
0.075	0.350
0.100	0.416
0.120	0.454
0.150	0.498
0.200	0.519
0.250	0.505
0.300	0.486
0.400	0.438
0.500	0.385
0.750	0.275
1.000	0.224
1.500	0.164
2.000	0.133
3.000	0.087
4.000	0.061
5.000	0.050



Deterministic Procedure Data

Fault	Great Valley Fault 13		**R_{rup}**	86.3	km
Fault ID	36		**R_{jb}**	85.9	km
Style	R		**R_x**	85.9	km
Mmax	6.5		**V_{S30}**	325	m/s
Dip	15	deg	**$Z_{1.0}$**	298	m
Z_{TOR}	9	km	**$Z_{2.5}$**	2.00	km

Notes

Please note the Design ARS curve is based on minimum deterministic and 5% probability of exceedence in 50 years (975 years return period) probabilitic spectra.

Final

Design Response Spectrum

State of California Business, Transportation and Housing Agency

M e m o r a n d u m

Flex your power!
Be energy efficient!

To: GARY JOE, CHIEF
Bridge Design Branch 17
Office of Bridge Design Services
Structure Design
Division of Engineering Services

Attn: Rodney Simmons

Date: January 25, 2012

File: 06-FRE-180 PM R71.8/74.4
06-342521
Project ID: 06 0000 0381
Kings Canyon Expwy Segt 2
Lone Tree Canal Bridge (S. Frontage)
Bridge No. 42C0661

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services
Geotechnical Design - North

Subject: Foundation Report for Lone Tree Canal Bridge (South Frontage)

Scope of Work

Per you requested, dated June 7, 2011, the Office of Geotechnical Design North (OGDN) has prepared a Foundation Report (FR) for the proposed new Lone Tree South Frontage Road (Bridge No. 42C0661). This structure is located on Highway 180 (aka Kings Canyon Road) near the town of Sanger in Fresno County (PM 73.70). The Kings Canyon Expressway Segment 2 project proposes to widen and re-align a section of Highway 180. As part of the project, a new frontage road will also be added on the south side of the proposed main alignment from 400 ft west of Lone Tree Canal to where it meets Kingburg Canal. A bridge will be needed for the frontage road where the frontage road crosses Lone Tree Canal. The purpose of this memo is to provide relevant information regarding the subsurface conditions of the proposed site, geotechnical design recommendations, and construction considerations.

Pertinent Reports and Investigation

In preparation of this report, the following documents were reviewed:

- Request for Final Foundation Recommendations, dated June 7, 2011;
- Foundation Plan, Lone Tree (S. Frontage), 06-FRE-180-PM 73.10, May 9, 2011;
- Planning Study, Lone Tree Canal, Oct, 2010;
- General Plan, Bridge Across Lone Tree Channel, 06-Fre-180 PM 73.7, Jul 1, 1936;

- Geologic Map of California – Fresno Sheet, California Department of Conservation, 1965;
- Geotechnical Services Design Manual, Version 1.1, August 2009;
- Groundwater Level Data Wells 14S22E14B001M, 14S22E01P001M, 14S23E06C001M, and 13S23E31P001M from Department of Water Resources.

Project Description

The Kings Canyon Expressway Segment 2 project is the second phase of the Kings Canyon Road Improvement project series. The Segment 2 project proposes to re-align the existing roadway by shifting the new highway to the north and widen it from a 2-lane conventional highway to a 4-lane expressway. As part of the improvements, a frontage road will also be added on the south side of the proposed alignment from 400 ft west of Lone Tree Canal to where the frontage road meets Kingburg Canal. A bridge will be added for the frontage road where it crosses Lone Tree Canal. This proposed structure will be a single span cast-in-place (CIP) post-tensioned (PT) slab bridge support on diaphragm footing. Spread footings have been proposed as the foundations type for the abutments.

Table 1 and 2 below show foundation data and load demand information provided by Structure Design (SD).

Table 1 Foundation Data

Support No.	Design Method	Finished Grade Elevation (ft)	BOF Elevation (ft)	Footing Size (ft)		Permissible Settlement under Service Load (in)
				B	L	
Abut 1	WSD	384	371.05	7.5	36.96	1
Abut 2	WSD	384	371.05	7.5	36.96	1

Table 2 Service Limit State I Loads

Support No.	Total Load				Permanent Load		
	Vertical Load (kips)	Effective Dimensions (ft)		Horizontal Load in Long. Direction (kip)	Vertical Load (kips)	Effective Dimension (ft)	
		B'	L'			B'	L'
Abut 1	676	7.5	36.96	N/A	545	7.5	36.96
Abut 2	676	7.5	36.96	N/A	545	7.5	36.96

Field Investigation and Testing Program

Started on October 12th, 2011, two borings were advanced to the maximum depth of 70 ft. Rotary wash method was used to advance the borehole. Field tests such as Standard Penetration Tests (SPT) and Pocket Penetrometer tests were performed to obtain soil resistance data.

Laboratory Testing Program

Soil samples were taken near the proposed bridge on June 15, 2011 and October 10, 2011 for corrosion tests. See Section “Corrosion Evaluation” below for results.

Site Geology and Subsurface Conditions

Topography

The proposed site is located in the Great Valley geomorphic province of California on the western side of the Sierra Nevada Mountain Range and the east of the Coastal Mountain Range. The flat terrain is typical for the valley region. The ground elevations range from approximately 383 to 398 feet.

Geology

The California Department of Conservation, Division of Mines and Geology, Geologic Map of California, Fresno Sheet, 1965 was used to determine the geologic formations of the project area.

The project locations are mapped as being in an area of Pleistocene Non-marine Recent Alluvial Fan Deposit (Q_f) and Pleistocene Non-marine (Q_c).

Subsurface Conditions

According to the boring logs, the subsurface materials predominately consist of medium dense to very dense sandy materials with layers of stiff clay and silt on the upper about 12 to 17 ft. Rounded cobbles and gravels with matrix of sand and silt were found 12 to 17 ft below existing ground surface to the maximum depth explored.

Bedrock was not encountered during subsurface exploration to the maximum explored depth of 70 ft from the existing ground.

Groundwater

According to the subsurface investigation done in October of 2011, groundwater elevation was measured at 368.2 ft, and this corresponds to the depths of approximately 17 ft below existing ground. The State Department of Water Resources (DWR) has monitored groundwater level wells across California for decades. Data from four nearby monitoring wells are selected and used. Based on data obtained from the monitoring wells, the average groundwater elevations measured for these 4 wells are 354, 347, 376, and 378 ft. These elevations correspond to groundwater depths of 42, 29, 33, and 29 ft, respectively. Groundwater conditions will vary according to variations in rainfall, well pumping, and construction activities.

For design purposes, groundwater elevation was taken at 372 ft.

Scour Evaluation

Since the proposed structure is a single span bridge which does not have any intermediate support. The channel will be concrete lined. Scour is not an issue regarding the proposed structure.

Corrosion Evaluation

The minimum resistivities of the tested soil samples were 3294 and 8362.5 ohm-cm and the pH values were tested as 5.71 and 7.3. In order for the site to be non-corrosive, the minimum resistivity must be 1000 ohm-cm or greater and the pH must be between 5.5 and 10.0. Since the minimum resistivity is tested to be above 1000 ohm-cm, testing for chloride and sulfate contents are not needed, and therefore, not tested. According to the results from laboratory testing, the site is not anticipated to be corrosive for foundation element.

Seismic Recommendations

In accordance with Caltrans 2009 Seismic Design Procedure, the nearest active faults to the site are the Great Valley Fault 13(Fault ID No. 36) and Round Valley Fault (Fault ID No. 174) with the maximum magnitudes, M_{max}, of 6.5 and 7.3. The faults are identified as reverse and normal faults, respectively. The rupture distance from the project location to the Great Valley fault is about 53.6 mi (86.3 km) whereas the rupture distance is 60.3 mi (97.9km) to the Round Valley fault.

Based on subsurface investigations, the estimated shear wave velocity (Vs_{30}) using SPT blow counts and the correlation formulas is 1070 ft/s (325m/s). Using the estimated Vs_{30}, the ground motion generated from the nearest active fault is less than the statewide minimum requirement and the probabilistic method. Furthermore, the comparison between the minimum ground motion and the probabilistic method showed the minimum ground motion controls when the period is less than or equal to 0.5 second. Probabilistic method controls when the period is greater than 0.5 second. Therefore, the attached Acceleration Response Spectrum curve is based on the envelope of the minimum deterministic and USGS 5% probability of exceedance in 50 years (corresponding to a 975-year return period). The peak ground acceleration is 0.23g.

Liquefaction

Based on the relatively high apparent density and relatively low seismic demand, the potential for liquefaction at the proposed site is low.

Surface Rupture

Since there are no known faults projecting towards or passing directly through the project site, the potential for surface rupture at the site due to fault movement is considered low.

As-Built Foundation Data

Since this is a new bridge, there is no as-built foundation data.

Foundation Recommendations

Spread footings were selected for the Abutments 1 and 2. Geotechnical capacities are derived from using the Munfakh's method (2001) for bearing capacity and Hough method (1959) for settlement analyses. These methods are recommended by AASHTO LRFD Bridge Design Specifications (2007). Recommendations for the abutments are given below.

Table 3 Foundation Recommendations for Abutments

Support Location	Footing Size (ft)		Bottom of Footing Elevation (ft)	Minimum Footing Embedment Depth (ft)	WSD (LRFD Service-I Limit State Load Combination)		LRFD		
							Service	Strength φ_b = 0.45	Extreme Event φ_b= 1.00
	B	L			Permissible Gross Contact Stress (ksf)	Allowable Gross Bearing Capacity (KSf)	Permissible Net Contact Stress (ksf)	Factored Gross Nominal Bearing Resistance (ksf)	Factored Gross Nominal Bearing Resistance (ksf)
Abut 1	7.5	36.96	371.05	2	2.44	3.52	N/A	N/A	N/A
Abut 2	7.5	36.96	371.05	2	2.44	3.52	N/A	N/A	N/A

Notes:

1. Recommendations are based on the foundation geometry and the loads provided by Structure Design in the Foundation Design Data Sheet. The footing contact area is taken as equal to the effective footing area, where applicable.
2. See MTD 4-1 for definitions and applications of the recommended design parameters.
3. Minimum Footing Embedment Depth is measured from the bottom of canal.

Table 4 Spread Footing Data Table

Support Location	Working Stress Design (WSD)		Load and Resistance Factored Design (LRFD)		
			Service	**Strength**	**Extreme Event**
	Permissible Gross Contact Stress (Settlement) (ksf)	Allowable Gross Bearing Capacity (ksf)	Permissible Net Contact Stress (Settlement) (ksf)	Factored Gross Nominal Bearing Resistance φ_b=0.45	Factored Gross Nominal Bearing Resistance φ_b=1.00
Abut. 1	2.44	3.52	N/A	N/A	N/A
Abut. 2	2.44	3.52	N/A	N/A	N/A

Construction Considerations

1. All earthwork shall follow Section 19 of the Caltrans Standard Specifications.
2. All footing excavation shall be inspected and approved by this Office or a structural representative from the Caltrans Structure Construction when excavation are completed to the bottom of footing and prior to placement of concrete.
3. Spread footings shall be placed neatly against competent materials. All loose materials shall be removed prior to placement of concrete.
4. Shallow groundwater and difficult excavation conditions with the presence of cobbles, and caving may be encountered during footing excavation. Class "A" excavation (with seal course) and shoring may be required.
5. The top 2 feet of soil below the bottom of footing at the abutments shall be removed and replaced with structural backfill and it shall be compacted to a 95% relative compacted. Lean concrete may be used as an alternative to structural backfill.
6. During footing excavation, if unsuitable or unexpected materials are found, these materials shall be removed and replaced with structural backfill and be compacted to a 95% relative compaction. If soils are disturbed or loosen during excavation, these soil can be removed and re-compacted to a 95% relative compaction or bottom of footing elevation is to be lowered to undisturbed competent materials. Lean concrete may be used as an alternative to structural backfill.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

LOTB for Lone Tree Canal Bridge (South Frontage), dated TBD.

Data and information included in the Information Handout provided to the bidders and contractors are:

Foundation Report for Lone Tree Canal Bridge (South Frontage), dated January 25, 2012.

Data and information available for inspection at the District Office:

None.

Data and information available for inspection at the Transportation Laboratory are:

None.

A full-sized Log of Test Boring (LOTB) which is to be incorporated in the project plans has been prepared by Geotechnical Services, Office of Geotechnical Support Branch D – Contracts, Graphics & Records. Mrs. Irma Gamarra-Remmen of the Contracts, Graphic & Records branch may be contacted directly for information on the LOTB.

If you have any questions, please call me, Carolyn Zhen-Ru, at (916) 227-1055 or my supervisor, John Huang, at (916) 227-1037.

CAROLYN ZHEN-RU, P.E.
Transportation Engineer, Civil
Office of Geotechnical Design – North
Branch E

JOHN HUANG, P.E.
Senior Materials and Research Engineer
Office of Geotechnical Design – North
Branch E

C: OGDN Branch Senior, John Huang
District Project Manager, Garth Fernandez
GS Corporate, Mark Willian
Structure Construction RE Pending File
DES Office Engineer, Office of PS&E, [to be assigned]
District Materials Engineer, Ted Mooradian

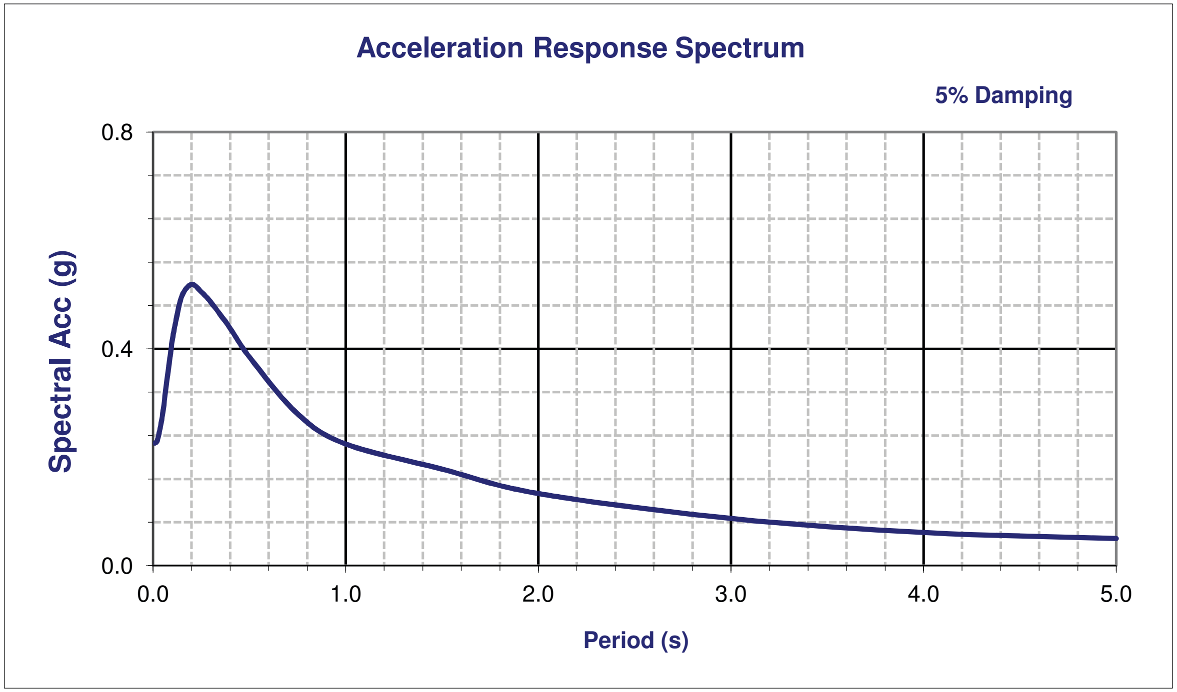
Appendix:
Recommended Acceleration Response Spectrum

Lone Tree Canal Br (S. Frontage)

Latitude 36.7354
Longitude -119.5177
Control **Envelope**

Bridge No. 42C0661
EFIS 0600000381

Period (s)	Sa(g)
0.010	0.226
0.020	0.229
0.030	0.242
0.050	0.281
0.075	0.350
0.100	0.416
0.120	0.454
0.150	0.498
0.200	0.519
0.250	0.505
0.300	0.486
0.400	0.438
0.500	0.385
0.750	0.280
1.000	0.224
1.500	0.178
2.000	0.133
3.000	0.087
4.000	0.061
5.000	0.050



Deterministic Procedure Data

Fault	Great Valley Fault 13		**R_{rup}**	86.3	km
Fault ID	36		**R_{jb}**	85.9	km
Style	R		**R_x**	85.9	km
Mmax	6.5		**V_{S30}**	325	m/s
Dip	15	deg	**$Z_{1.0}$**	298	m
Z_{TOR}	9	km	**$Z_{2.5}$**	2.00	km

Notes

Please note the Design ARS curve is based on minimum deterministic and 5% probability of exceedence in 50 years (975 years return period) probabilitic spectra.

Final

Design Response Spectrum

Memorandum

To: GARY JOE, CHIEF
Bridge Design Branch 17
Office of Bridge Design Services
Structure Design
Division of Engineering Services

Attn: Rodney Simmons

Date: January 25, 2012

File: 06-FRE-180 PM R71.8/74.4
06-342521
Project ID: 06 0000 0381
Kings Canyon Expwy Segt 2
Lone Tree Canal Br. (Private)
Bridge No. N/A

From: **DEPARTMENT OF TRANSPORTATION**
Division of Engineering Services
Geotechnical Services
Geotechnical Design - North

Subject: Foundation Report for Lone Tree Canal Bridge (Private)

Scope of Work

Per you requested, dated June 7, 2011, the Office of Geotechnical Design North (OGDN) has prepared a Foundation Report (FR) for the proposed new Lone Tree Canal Bridge (Private) (Bridge No. N/A). This structure is located on Highway 180 (aka Kings Canyon Road) near the town of Sanger in Fresno County (PM 73.70). The Kings Canyon Expressway Segment 2 project proposes to widen and re-align a section of Highway 180. As part of the project, a new frontage road will also be added on the north side of the proposed alignment from Newmark Ave to 0.12 mile east of Lone Tree Canal. A bridge will be needed for the frontage road where it crosses Lone Tree Canal. Since this bridge will become privately owned upon construction completion, a bridge number will not be assigned. The purpose of this memo is to provide relevant information regarding the subsurface conditions of the proposed site, geotechnical design recommendations, and construction considerations.

Pertinent Reports and Investigation

In preparation of this report, the following documents were reviewed:

- Request for Final Foundation Recommendations, dated June 7, 2011;
- Foundation Plan, Lone Tree (N. Frontage), 06-FRE-180-PM 73.10, May 18, 2011;
- Planning Study, Lone Tree Canal, Oct, 2010;
- General Plan, Bridge Across Lone Tree Channel, 06-Fre-180 PM 73.7, Jul 1, 1936;

- Geologic Map of California – Fresno Sheet, California Department of Conservation, 1965;
- Geotechnical Services Design Manual, Version 1.1, August 2009;
- Groundwater Level Data Wells 14S22E14B001M, 14S22E01P001M, 14S23E06C001M, and 13S23E31P001M from Department of Water Resources.

Project Description

The Kings Canyon Expressway Segment 2 project is the second phase of the Kings Canyon Road Improvement project series. The Segment 2 project proposes to re-align the existing roadway by shifting the new highway to the north and widen it from a 2-lane conventional highway to a 4-lane expressway. As part of the improvements, a frontage road will also be added on the north side of the proposed alignment from Newmark Ave to 0.12 mile east of Lone Tree Canal. A bridge will be added for the frontage road where it crosses Lone Tree Canal. The proposed structure will be a single span cast-in-place (CIP) post-tensioned (PT) slab bridge support on diaphragm footing. Spread footings have been proposed as the foundations type for the abutments.

Table 1 and 2 below show foundation data and load demand information provided by Structure Design (SD).

Table 1 Foundation Data

Support No.	Design Method	Finished Grade Elevation (ft)	BOF Elevation (ft)	Footing Size (ft)		Permissible Settlement under Service Load (in)
				B	L	
Abut 1	WSD	384	371.05	7.5	20.9	1
Abut 2	WSD	384	371.05	7.5	20.9	1

Table 2 Service Limit State I Loads

Support No.	Total Load				Permanent Load		
	Vertical Load (kips)	Effective Dimensions (ft)		Horizontal Load in Long. Direction (kip)	Vertical Load (kips)	Effective Dimension (ft)	
		B'	L'			B'	L'
Abut 1	478	7.5	20.9	N/A	321	7.5	20.9
Abut 2	478	7.5	20.9	N/A	321	7.5	20.9

Field Investigation and Testing Program

Started on October 11th, 2011, one boring was advanced to the maximum depth of 50 ft. Rotary wash method was used to advance the borehole. Field tests such as Standard Penetration Tests (SPT) and Pocket Penetrometer tests were performed to obtain soil resistance data.

Laboratory Testing Program

Soil samples were taken near the proposed bridge on June 15, 2011 and October 10, 2011 for corrosion tests. See Section "Corrosion Evaluation" below for results.

Site Geology and Subsurface Conditions

Topography

The proposed site is located in the Great Valley geomorphic province of California on the western side of the Sierra Nevada Mountain Range and the east of the Coastal Mountain Range. The flat terrain is typical for the valley region. The ground elevations range from approximately 383 to 398 feet.

Geology

The California Department of Conservation, Division of Mines and Geology, Geologic Map of California, Fresno Sheet, 1965 was used to determine the geologic formations of the project area.

The project locations are mapped as being in an area of Pleistocene Non-marine Recent Alluvial Fan Deposit (Q_f) and Pleistocene Non-marine (Q_c).

Subsurface Conditions

According to the boring log, the subsurface materials predominately consist of very dense sandy materials with stiff clay on the upper about 12 ft. Rounded cobbles and gravels with matrix of sand were found 12 ft below existing ground surface to the maximum depth explored.

Bedrock was not encountered during subsurface exploration to the maximum explored depth of 50 ft from the existing ground.

Groundwater

According to the subsurface investigation done in October of 2011, groundwater elevation was measured at 371.4 ft, and this corresponds to the depths of approximately 19 ft below existing ground. The State Department of Water Resources (DWR) has monitored groundwater level wells across California for decades. Data from four nearby monitoring wells are selected and used. Based on data obtained from the monitoring wells, the average groundwater elevations measured for these 4 wells are 354, 347, 376, and 378 ft. These elevations correspond to groundwater depths of 42, 29, 33, and 29 ft, respectively. Groundwater conditions will vary according to variations in rainfall, well pumping, and construction activities.

For design purposes, groundwater elevation was taken at 372 ft.

Scour Evaluation

Since the proposed structure is a single span bridge which does not have any intermediate support. The channel will be concrete lined. Scour is not an issue regarding the proposed structure.

Corrosion Evaluation

The minimum resistivities of the tested soil samples were 3294 and 8362.5 ohm-cm and the pH values were tested as 5.71 and 7.3. In order for the site to be non-corrosive, the minimum resistivity must be 1000 ohm-cm or greater and the pH must be between 5.5 and 10.0. Since the minimum resistivity is tested to be above 1000 ohm-cm, testing for chloride and sulfate contents are not needed, and therefore, not tested. According to the results from laboratory testing, the site is not anticipated to be corrosive for foundation element.

Seismic Recommendations

In accordance with Caltrans 2009 Seismic Design Procedure, the nearest active faults to the site are the Great Valley Fault 13(Fault ID No. 36) and Round Valley Fault (Fault ID No. 174) with the maximum magnitudes, M_{max}, of 6.5 and 7.3. The faults are identified as reverse and normal faults, respectively. The rupture distance from the project location to the Great Valley fault is about 53.6 mi (86.3 km) whereas the rupture distance is 60.3 mi (97.9km) to the Round Valley fault.

Based on subsurface investigations, the estimated shear wave velocity (Vs_{30}) using SPT blow counts and the correlation formulas is 1070 ft/s (325m/s). Using the estimated Vs_{30}, the ground motion generated from the nearest active fault is less than the statewide minimum requirement and the probabilistic method. Furthermore, the comparison between the minimum ground motion and the probabilistic method showed the minimum ground motion controls when the period is less than or equal to 0.5 second. Probabilistic method controls when the period is greater than 0.5 second. Therefore, the attached Acceleration Response Spectrum curve is based on the envelope of the minimum deterministic and USGS 5% probability of exceedance in 50 years (corresponding to a 975-year return period). The peak ground acceleration is 0.23g.

Liquefaction

Based on the relatively high apparent density and relatively low seismic demand, the potential for liquefaction at the proposed site is low.

Surface Rupture

Since there are no known faults projecting towards or passing directly through the project site, the potential for surface rupture at the site due to fault movement is considered low.

As-Built Foundation Data

Since this is a new bridge, there is no as-built foundation data.

Foundation Recommendations

Spread footings were selected for the Abutments 1 and 2. Geotechnical capacities are derived from using the Munfakh's method (2001) for bearing capacity and Hough method (1959) for settlement analyses. These methods are recommended by AASHTO LRFD Bridge Design Specifications (2007). Recommendations for the abutments are given below.

Table 3 Foundation Recommendations for Abutments

Support Location	Footing Size (ft)		Bottom of Footing Elevation (ft)	Minimum Footing Embedment Depth (ft)	WSD (LRFD Service-I Limit State Load Combination)		LRFD		
	B	L					Service	Strength φ_b = 0.45	Extreme Event φ_b= 1.00
					Permissible Gross Contact Stress (ksf)	Allowable Gross Bearing Capacity (KSf)	Permissible Net Contact Stress (ksf)	Factored Gross Nominal Bearing Resistance (ksf)	Factored Gross Nominal Bearing Resistance (ksf)
Abut 1	7.5	20.9	371.05	2	3.05	4.13	N/A	N/A	N/A
Abut 2	7.5	20.9	371.05	2	3.05	4.13	N/A	N/A	N/A

Notes:

1. Recommendations are based on the foundation geometry and the loads provided by Structure Design in the Foundation Design Data Sheet. The footing contact area is taken as equal to the effective footing area, where applicable.
2. See MTD 4-1 for definitions and applications of the recommended design parameters.
3. Minimum Footing Embedment Depth is measured from the bottom of canal.

Table 4 Spread Footing Data Table

Support Location	Working Stress Design (WSD)		Load and Resistance Factored Design (LRFD)		
			Service	**Strength**	**Extreme Event**
	Permissible Gross Contact Stress (Settlement) (ksf)	Allowable Gross Bearing Capacity (ksf)	Permissible Net Contact Stress (Settlement) (ksf)	Factored Gross Nominal Bearing Resistance φ_b=0.45	Factored Gross Nominal Bearing Resistance φ_b=1.00
Abut. 1	3.05	4.13	N/A	N/A	N/A
Abut. 2	3.05	4.13	N/A	N/A	N/A

Construction Considerations

1. All earthwork shall follow Section 19 of the Caltrans Standard Specifications.
2. All footing excavation shall be inspected and approved by this Office or a structural representative from the Caltrans Structure Construction when excavation are completed to the bottom of footing and prior to placement of concrete.
3. Spread footings shall be placed neatly against competent materials. All loose materials shall be removed prior to placement of concrete.
4. Shallow groundwater and difficult excavation conditions with the presence of cobbles, and caving may be encountered during footing excavation. Class "A" excavation (with seal course) and shoring may be required.
5. The top 2 feet of soil below the bottom of footing at the abutments shall be removed and replaced with structural backfill and it shall be compacted to a 95% relative compacted. Lean concrete may be used as an alternative to structural backfill.
6. During footing excavation, if unsuitable or unexpected materials are found, these materials shall be removed and replaced with structural backfill and be compacted to a 95% relative compaction. If soils are disturbed or loosen during excavation, these soil can be removed and re-compacted to a 95% relative compaction or bottom of footing elevation is to be lowered to undisturbed competent materials. Lean concrete may be used as an alternative to structural backfill.

Project Information

Standard Special Provision S5-280, “Project Information”, discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

LOTB for Lone Tree Canal Bridge (Private), dated TBD.

Data and information included in the Information Handout provided to the bidders and contractors are:

Foundation Report for Lone Tree Canal Bridge (Private), dated January 25, 2012.

Data and information available for inspection at the District Office:

None.

Data and information available for inspection at the Transportation Laboratory are:

None.

A full-sized Log of Test Boring (LOTB) which is to be incorporated in the project plans has been prepared by Geotechnical Services, Office of Geotechnical Support Branch D – Contracts, Graphics & Records. Mrs. Irma Gamarra-Remmen of the Contracts, Graphic & Records branch may be contacted directly for information on the LOTB.

If you have any questions, please call me, Carolyn Zhen-Ru, at (916) 227-1055 or my supervisor, John Huang, at (916) 227-1037.

CAROLYN ZHEN-RU, P.E.
Transportation Engineer, Civil
Office of Geotechnical Design – North
Branch E

JOHN HUANG, P.E.
Senior Materials and Research Engineer
Office of Geotechnical Design – North
Branch E

C: OGDN Branch Senior, John Huang
District Project Manager, Garth Fernandez
GS Corporate, Mark Willian
Structure Construction RE Pending File
DES Office Engineer, Office of PS&E, [to be assigned]
District Materials Engineer, Ted Mooradian

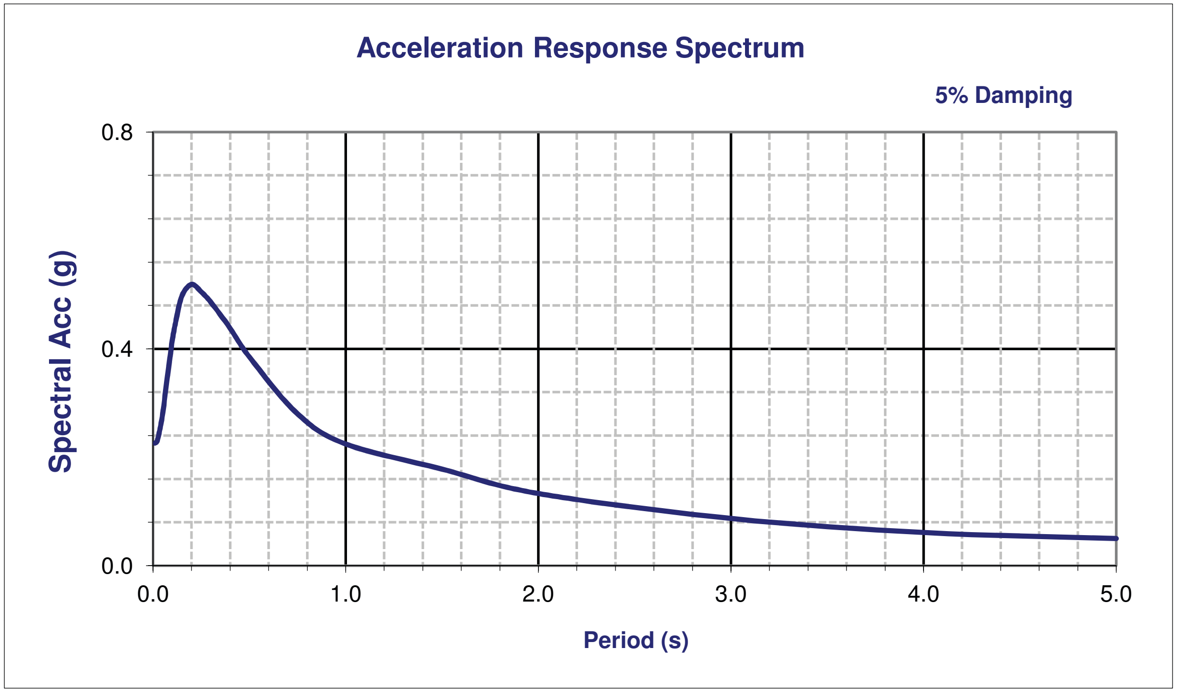
Appendix:
Recommended Acceleration Response Spectrum

Lone Tree Canal Br (Private)

Latitude 36.7354
Longitude -119.5177
Control **Envelope**

Bridge No. N/A
EFIS 0600000381

Period (s)	Sa(g)
0.010	0.226
0.020	0.229
0.030	0.242
0.050	0.281
0.075	0.350
0.100	0.416
0.120	0.454
0.150	0.498
0.200	0.519
0.250	0.505
0.300	0.486
0.400	0.438
0.500	0.385
0.750	0.280
1.000	0.224
1.500	0.178
2.000	0.133
3.000	0.087
4.000	0.061
5.000	0.050



Deterministic Procedure Data

Fault	Great Valley Fault 13		**R_{rup}**	86.3	km
Fault ID	36		**R_{jb}**	85.9	km
Style	R		**R_x**	85.9	km
Mmax	6.5		**V_{S30}**	325	m/s
Dip	15	deg	**$Z_{1.0}$**	298	m
Z_{TOR}	9	km	**$Z_{2.5}$**	2.00	km

Notes

Please note the Design ARS curve is based on minimum deterministic and 5% probability of exceedence in 50 years (975 years return period) probabilitic spectra.

Final
Design Response Spectrum

FOUNDATION REVIEW

DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

To: **Structure Design**
1. Design
2. R.E. Pending File
3. Specifications & Estimates
4. File

Geotechnical Services
1. GD - North ; South ; West
2. GS File Room

Date: 5/21/12

Fowler Switch Canal Br
Structure Name

06 - Fre - 180 - 73.10
District County Route ~~Km~~ Post M.

District Project Development

District Project Engineer

06-342521 E.A. Number

42-439 Structure Number

Foundation Report By: C. Zhen-Ru

Dated: 4/10/12 ; 2/27/12

Reviewed By: R. Simmons (SD)

R. Price (GS)

General Plan Dated: 5/16/12

Foundation Plan Dated: 2/20/12

☒ No changes. ☐ The following changes are necessary.

FOUNDATION CHECKLIST

/ Pile Types and Design Loads
/ Pile Lengths
/ Predrilling
/ Pile Load Test
/ Substitution of H Piles For Concrete Piles ☐ Yes ☑ No

/ Footing Elevations, Design Loads, and Locations
/ Seismic Data
/ Location of Adjacent Structures and Utilities
/ Stability of Cuts or Fills
Fill Time Delay

Effect of Fills on Abutments and Bents
/ Fill Surcharge
/ Approach Paving Slabs
/ Scour
/ Ground Water
Tremie Seals/Type D Excavation

Rod Simmons
Structure Design

17
Bridge Design Branch No.

[signature]
Geotechnical Services

Rev. 06/02

FOUNDATION REVIEW

DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

To: **Structure Design**

1. Design
2. R.E. Pending File
3. Specifications & Estimates
4. File

Geotechnical Services

1. GD - North ; South ; West
2. GS File Room

Date: 5/21/12

Fowler Switch Canal Br Frontage
Structure Name

06 - Fre - 180 - 23.10
District County Route ~~km~~ Post mi.

District	Project Development District Project Engineer	06-342521 E.A. Number	42C-0650 Structure Number

Foundation Report By: C. Zhan - Ru   Dated: 4/10/12 ; 2/27/12

Reviewed By: R. Simmons (SD)   R. Price (GS)

General Plan Dated: 5/10/12   Foundation Plan Dated: 5/10/12

☒ No changes.   ☐ The following changes are necessary.

FOUNDATION CHECKLIST

Pile Types and Design Loads
- Pile Lengths
- Predrilling
- Pile Load Test
- Substitution of H Piles For Concrete Piles ☐ Yes ☒ No

- Footing Elevations, Design Loads, and Locations
- Seismic Data
- Location of Adjacent Structures and Utilities
- Stability of Cuts or Fills
- Fill Time Delay

- Effect of Fills on Abutments and Bents
- Fill Surcharge
- Approach Paving Slabs
- Scour
- Ground Water
- Tremie Seals/Type D Excavation

[signature] 17
Structure Design   Bridge Design Branch No.

[signature]
Geotechnical Services

Rev. 06/02

FOUNDATION REVIEW

DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES

To: **Structure Design**

1. Design
2. R.E. Pending File
3. Specifications & Estimates
4. File

Geotechnical Services

1. GD - North ; South ; West
2. GS File Room

Date: 5/21/12

Lone Tree Canal Bridges
Structure Name

06 - Fre - 180 - 73.7
District County Route ~~km~~ Post mi.

District Project Development
District Project Engineer

06-342521 42-440 L/R ; 42C661
E.A. Number Structure Number

Foundation Report By: C. Zhen - RU Dated: 1/25/12

Reviewed By: R. Simmons (SD) R. Price (GS)

General Plan Dated: 4/5/12 Foundation Plan Dated: 4/6/12

☒ No changes. ☐ The following changes are necessary.

FOUNDATION CHECKLIST

Pile Types and Design Loads	Footing Elevations, Design Loads, and Locations	Effect of Fills on Abutments and Bents
Pile Lengths	Seismic Data	Fill Surcharge
Predrilling	Location of Adjacent Structures and Utilities	Approach Paving Slabs
Pile Load Test	Stability of Cuts or Fills	Scour
Substitution of H Piles For Concrete Piles ☐ Yes ☐ No	Fill Time Delay	Ground Water
		Tremie Seals/Type D Excavation

[signature] 17

Structure Design Bridge Design Branch No.

[signature]

Geotechnical Services

Rev. 06/02

State of California - Department of Transportation
Division of Engineering Services
Structure Design Services

FINAL HYDRAULIC REPORT

Fowler Switch Canal Bridge

Br. No. 42-0439 (NEW)

6 - FRE - 180 - PM 73.10

Located near Centerville, California

PROJECT DESCRIPTION:
Proposed 2 New Bridge Structures on Revised Alignment
(*EA: 06-342521, EFIS: 06 0000 0381*)

Prepared by:

Jose J. Vargas, P.E.
Transportation Engineer (Civil)
Structure Hydraulics & Hydrology Branch
November 30, 2011

REGISTERED PROFESSIONAL ENGINEER
JOSE J. VARGAS
No. 65612
Exp. 9/30/13
CIVIL
STATE OF CALIFORNIA

TABLE OF CONTENTS

General Notes:

1) *Unless otherwise indicated, elevations shown in this report are based on the National Geodetic Vertical Datum of 1929 (NGVD29). Field survey data (dated January 2009) for the HEC-RAS model was provided by District 6 Survey Branch with the Bridge Site Submittal (BSS) received from District 6. Additional field survey data completed in August/September 2011 was provided by Preliminary Investigations (P.I.) - North Survey Branch.*
2) *This project includes the construction of two new bridge structures at this site location: one (mainline) State bridge and one (northern frontage road) County bridge. Considering the general proximity of these 2 structures and other site-specific factors, the hydraulic design data/recommendations for the State bridge is also assumed applicable to the County bridge (Fowler Switch Canal, Br. No. 42C0660).*

GENERAL INFORMATION

It is proposed to remove the existing bridge (Br. No. 42-0067) and construct a new (mainline) State bridge (Br. No. 42-0439) along a revised State Route alignment. A new County bridge (Br. No. 42C0660) will also be constructed on a new northern frontage road as part of the project. The new, single-span bridges will span over the existing concrete-lined canal. The proposed bridge site is located along State Route 180 in Fresno County near Centerville, California *(Refer to Page 8 - **FIGURE 1 & 2**)*.

This project includes multiple bridge structures and culverts. Based on information received from Bridge Design Branch 17, the bridge structures to be located at the Fowler Switch Canal and Lone Tree Canal waterway crossings will be designed as bridge structures by the Division of Engineering Services (DES), while the remaining waterway crossings for this project will be designed (as culverts) by District 6 Hydraulics Branch.

The existing bridge was built in 1945 (never widened) and is a continuous, Reinforced Concrete (RC) slab on RC column (4) bents with stream training walls and closed-end cantilever abutments, all founded on spread footings. The existing 3-span (18 feet, 17 feet, and 18 feet) bridge structure has a total bridge length and width of 53 feet and 30.7 feet, respectively. The existing waterway underneath the bridge is a trapezoidal, concrete-lined channel with elevated earthen banks above the concrete edge.

Based on Google Maps (aerial photos), the concrete-lining for this section of lined channel begins roughly 2.1 miles upstream of the existing bridge and terminates at the "sluice gate structure", which is located approximately 112 feet downstream of the existing downstream bridge face. There is a Parshall Flume located just downstream of the existing bridge and the "sluice gate structure" is located at the downstream end of the Parshall Flume. Downstream of the "sluice gate structure", the channel is trapezoidal-shaped and has a "natural" channelbed and banks/side-slopes for about 0.9 miles before again transitioning into another trapezoidal-shaped concrete-lined channel.

A Final Hydraulic Report (FHR) request letter (dated 4/7/11) from Bridge Design Branch 17 provided a proposed General Plan (GP) sheet (dated 10/20/10). The GP sheet was used to estimate the proposed bridge details and provide additional assumptions used for this study. The proposed bridge is a single-span, Cast-In-Place (CIP)/Prestressed (PS) Reinforced Concrete (RC) slab bridge structure with a proposed structure depth of 2.0 feet. The new bridge structure is proposed to have a total length of roughly 81.5 feet (along the new State Route centerline) and a total width of 277.6 feet (along the canal centerline). The proposed foundation details at the abutments were not indicated at this time.

DESCRIPTION OF WATERSHED

Fowler Switch Canal is part of a complex system and network of local irrigation canals in Fresno County and is owned/operated by the Consolidated Irrigation District (CID). According to *The Kings River Handbook* (September 2009), the main diversion point for CID is the Fresno Weir. Less than two miles downstream of the Fresno Weir, the Consolidated Canal divides into CID's two main principal distribution channels, the Centerville and Kingsburg (C&K) Canal and Fowler Switch Canal.

Between the Fresno Weir and the bridge site, flows in the Fowler Switch Canal travel south-westerly through a trapezoidal-shaped channel which includes sections of natural channel and concrete-lined channel. The main channel area is concrete-lined within the limits of the proposed bridge sites. In addition to the controlled irrigation flows entering the channel at main diversion points, local precipitation and other runoff may also contribute to the flows transported in the canal.

PEAK DISCHARGES

According to information in the Bridge Site Submittal received from District 6, there is a flow gage at the Parshall Flume located downstream of the existing bridge. For this study, peak discharges at the Fowler Switch Canal bridge site were considered for two assumed conditions: maximum controlled discharges (irrigation flows) and natural precipitation runoff (flood flows). The estimated peak discharges at the bridge site for irrigation and flood conditions were provided by the Consolidated Irrigation District as 1,200 cubic feet per second (cfs) and 800 cfs, respectively. For the purpose of this study, the higher discharge of 1,200 cfs was assumed to represent the "Design Flood".

WATER SURFACE ELEVATIONS (WSEL's)

Field survey data (CAiCE file dated January 18, 2009) for the bridge site was provided by the District 6 Survey Branch in February 2011. Supplemental field survey data necessary for the hydraulic model was requested from Preliminary Investigations (P.I.) - North Survey Branch. However, fast and high flow conditions in the channel delayed the completion of the additionally-requested survey data until August/September 2011, when local flow conditions allowed safe access in the channel.

The available survey data was based on the NGVD29 vertical datum and was used to obtain representative channel cross-sections along the study reach. A hydraulic model of the bridge site was created using HEC-RAS (Version 4.0) software based on geometric data provided by the field surveys, proposed channel design details, and information shown on the proposed GP sheets *(Refer to Page 9 - **FIGURE 3 & 4**)*. The Hydrologic Engineering Center - River Analysis System (HEC-RAS) is a one-dimensional hydraulic analysis program developed by the U.S. Army Corps of Engineers (USACOE).

Based on photos of the site and engineering judgment, Manning's roughness coefficients ("n") for the main (concrete-lined) channel area and the immediate (natural/earthen) overbank areas were estimated as 0.015 and 0.038, respectively. A Manning's roughness value of 0.035 was assumed for the natural channel located just downstream of the Parshall Flume. Based on the assumed peak (irrigation) discharge of 1,200 cfs, the HEC-RAS model calculated a maximum local water surface elevation (WSEL) of 391.6 feet at the proposed bridge site *(Refer to Page 10 - **FIGURE 5A & 5B**)*.

PEAK VELOCITY

Based on the assumed peak discharge, the HEC-RAS model calculated a local peak (water) velocity of roughly 7.0 feet per second (ft./sec.) at the proposed bridge site.

WATERWAY CAPACITY & MINIMUM SOFFIT ELEVATION

The existing channel is concrete-lined and generally prismatic along the section where the new proposed bridge structure will be located. The existing 3-span bridge has piers located in the main waterway and there is also some minor encroachment of the main waterway due to the bridge abutment design. The proposed bridge is a single-span structure which will not have any piers in the water and will completely span over the existing concrete-lined channel.

As part of the proposed project, the existing bridge (and piers) will be removed and it is assumed the new final geometry of the concrete channel at this location will more closely match the immediate upstream and downstream channel dimensions. Once the existing bridge is removed, "streamlining" the channel at the existing bridge site would be expected to help restore the full available waterway (i.e. the waterway below the top of main earthen banks) and may improve the overall hydraulic efficiency of the channel during maximum flow conditions.

Based on the hydraulic model results and available information, the waterway capacity of the proposed new bridge structure is sufficient to convey the estimated maximum discharge with adequate freeboard. Based on a calculated WSEL of 391.6 feet and assuming 2.0 feet of freeboard for drift passage purposes, the calculated recommended minimum (bridge) soffit elevation for the bridge site is 393.6 feet. For the purpose of this study, the lowest elevation of the bottom of top deck slab (for the entire bridge) is considered the minimum bridge soffit elevation.

It should be noted that the recommended minimum (bridge) soffit elevation provided in the report is based on the water surface elevation calculated by the hydraulic model plus assumed freeboard for potential drift passage purposes. Additional or other potential freeboard which may be required for this bridge site is not included in the recommended minimum soffit elevation. The local irrigation district (Consolidated Irrigation District) and/or others, may have their own minimum freeboard, vertical/horizontal clearances, or other channel requirements and/or restrictions which may impact or control the proposed bridge/roadway design details.

DRIFT POTENTIAL

Based on available aerial photos (Google Earth), Fowler Switch Canal appears to be mostly concrete-lined from the main diversion point (Fresno Weir) downstream to the bridge site. There are some sections of natural channel which are not concrete-lined (i.e. natural channel and channelbed). Due to the natural sections of channel, there is some minor potential for small amounts of drift/debris material to be generated. In bridge inspection reports for the existing bridge, some small amounts of drift/debris accumulation have been noted at the existing pier wall located in the center of the channel.

Both proposed bridges are single-span (no piers in the waterway) and the channel is concrete-lined in the vicinity of the bridges; therefore, significant future drift-related issues are not expected. It is generally anticipated that any significant amounts of drift/debris which may potentially accumulate in the channel will be removed periodically by Caltrans Maintenance (if located within the State Right-of-Way) or others, as needed.

POTENTIAL SCOUR & LONG-TERM CHANNELBED TRENDS

Potential scour for the proposed bridge site was evaluated based on the Hydraulic Engineering Circular No. 18 (HEC-18) Manual, "*Evaluating Scour at Bridges*" (4th Edition, March 2001). Total scour at a highway crossing generally consists of three main components: general/contraction scour, local scour at piers/abutments, and long-term channelbed aggradation/degradation. Potential lateral stream/thalweg migration to the pier locations and abutments is also evaluated as part of the scour analysis procedure.

General / Contraction Scour

The existing canal is a trapezoidal, concrete-lined channel within the vicinity of the two proposed bridge structures. Provided the concrete-lining of the channel is maintained as required and remains in good condition, general and/or contraction scour is assumed "not applicable".

Local Scour at Piers / Abutments

Both bridge structures are proposed to be single-span - no piers in the waterway. The proposed abutments will be placed behind the concrete channel (outside of the waterway) and generally protected against local scour. Provided the concrete-lining of the channel is maintained as required and remains in good condition, local abutment scour for the new foundations is assumed "not applicable".

Long-Term Channelbed Trends / Lateral Thalweg Migration

The existing canal is a trapezoidal, concrete-lined channel within the vicinity of the two proposed bridge structures. Provided the concrete-lining of the channel is maintained as required and remains in good condition, long-term channelbed degradation and/or lateral migration of the channel at the bridge site is assumed "not applicable".

ADDITIONAL CONSIDERATIONS

The Caltrans Geotechnical Branch may be consulted regarding any site-specific geotechnical considerations which may potentially impact the structure foundation design or the long-term condition of the existing concrete-lined channel.

SUMMARY INFORMATION FOR THE BRIDGE DESIGNER

GENERAL NOTES:

(1) Unless otherwise indicated, elevations shown in the report are based on the National Geodetic Vertical Datum of 1929 (NGVD29).

General / Contraction Scour [1] *(Depth)*	N/A
Local Scour at Abutments [1] *(Depth)*	N/A
Long-Term Channelbed Degradation & Lateral Thalweg Migration [1] *(Depth)*	N/A
Local Peak (Water) Velocity at Proposed Bridge *(based on assumed maximum discharge)*	7.0 ft./sec.
Recommended Minimum (Bridge) Soffit Elevation [2] *(includes 2.0 feet of freeboard)*	393.6 feet

FOOTNOTES:

[1] *Provided the concrete-lined channel is maintained as required and remains in good condition, general/contraction scour, local abutment scour, local channelbed degradation, or lateral thalweg migration are assumed "Not Applicable (N/A)".*

[2] *The "Recommended Minimum (Bridge) Soffit Elevation" is provided for bridge design recommendations and includes assumed freeboard for drift passage purposes. The local irrigation district (Consolidated Irrigation District) and/or others, may have their own minimum freeboard, vertical/horizontal clearances, or other channel requirements and/or restrictions which may impact or control the proposed bridge/roadway design details.*

Hydrologic / Hydraulic Summary			
Total Drainage Basin Area: Not Applicable *(controlled flow irrigation canal)*			
	Design Flood*	**Base Flood**	**Overtopping Flood**
Frequency, *years*	N/A	N/A	N/A
Discharge *, *cubic feet per second (cfs)*	1,200	N/A	N/A
Water Surface Elevation at Bridge **, *feet*	391.6	N/A	N/A
Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.			

* *The "Design Flood" for this study is not associated with any return frequency and was assumed as the larger discharge of either irrigation or flood flows as provided by the Consolidated Irrigation District (CID), the owner/operator of this canal. The estimated maximum discharge for irrigation flows (1,200 cfs) is larger than for flood flows (800 cfs).*

** *Due to the general proximity and other site-specific factors, the estimated WSEL at the State bridge is also assumed applicable to the proposed County bridge (Fowler Switch Canal, Br. No. 42C0660).*

N/A = Not Applicable

LIST OF ACRONYMS

BSS	Bridge Site Submittal
CAiCE	Computer-Aided Civil Engineering *(software program)*
cfs	cubic feet per second
CID	Consolidated Irrigation District
CIP	Cast-In-Place
DES	Division of Engineering Services (Caltrans)
DHIPP	Digital Highway Inventory Photography Program *(Caltrans aerial images)*
EA	Expenditure Authorization
E-FIS	Enterprise Resource Planning Financial InfraStructure
FEMA	Federal Emergency Management Agency
FHR	Final Hydraulic Report
FIRM	Flood Insurance Rate Map (FEMA)
FIS	Flood Insurance Study (FEMA)
GP	General Plan
HEC-18	Hydraulic Engineering Circular No. 18 "*Evaluating Scour at Bridges*"
HEC-RAS	Hydrologic Engineering Center - River Analysis System *(software program)*
N/A	Not Applicable (or Not Available)
NGVD29	National Geodetic Vertical Datum of 1929
P.I.-North	Preliminary Investigations - North (Caltrans Survey Branch)
PS	Pre-stressed
RC	Reinforced Concrete
USACOE	United States Army Corps of Engineers
WSEL	Water Surface Elevation

REFERENCES

1) California Department of Transportation (Caltrans) - Bridge Inspection Reports (BIR's), Supplemental Bridge Reports (SBR's), Bridge File, As-Built Plans, Photos, Digital Highway Inventory Photography Program (DHIPP) - aerial photos, Final Hydraulic Report (FHR) request letter from Bridge Design Branch 17 *(dated 4/7/11)*, Proposed General Plan (GP) Sheet: "*Fowler Switch Canal*" *(dated 10/20/10)*

2) The Kings River Handbook *(September 2009, Fifth Printing)*
Kings River Conservation District (KRCD) & Kings River Water Association (KRWA)

3) Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS)
Fresno County, CA and Incorporated Areas
FIS Number: 06019CV001B & 06019CV002B
(Last Revised: February 18, 2009)

4) Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM)
Fresno County, CA and Incorporated Areas
FIRM Number: 06019C2160H
(Last Revised: February 18, 2009)

5) Additional References:

- Google (search engine)	*http://www.google.com/*
- Google Maps	*http://maps.google.com/*
- Google Earth	*(Google software program)*

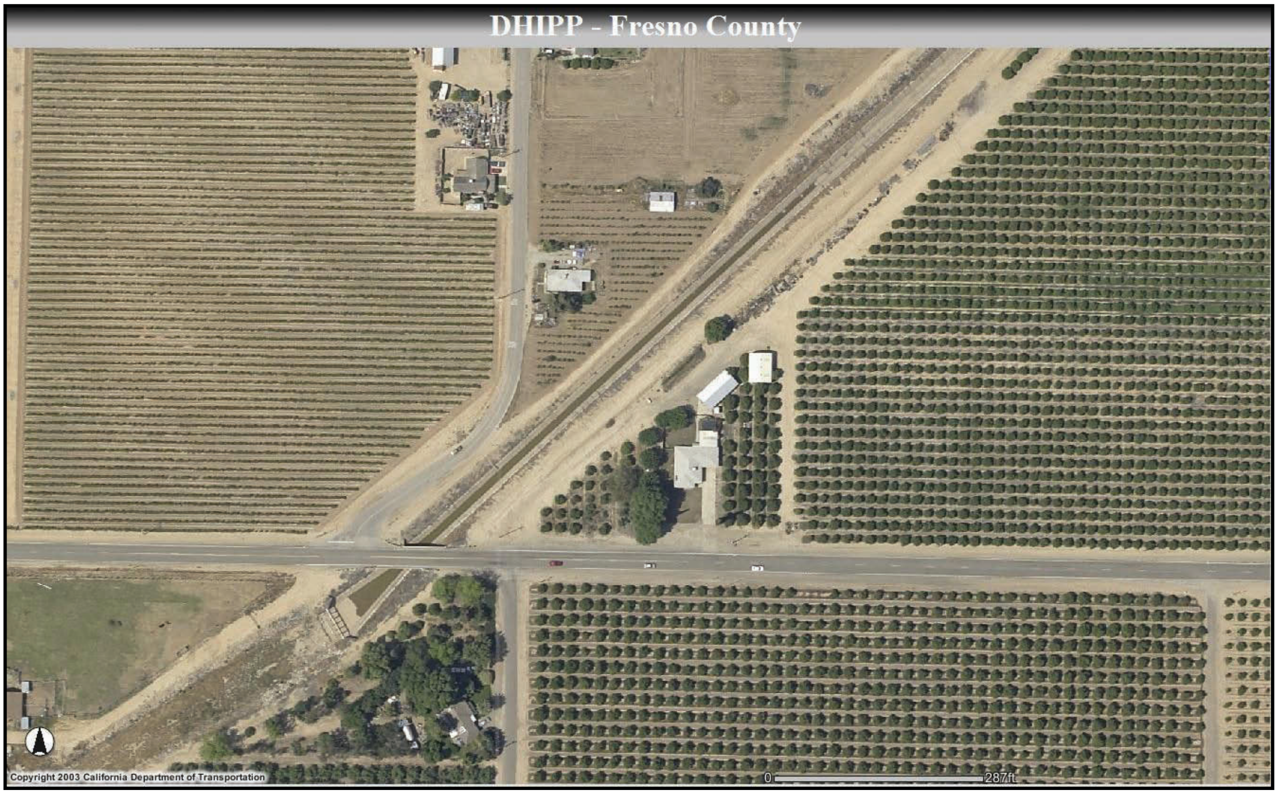


FIGURE 1 - Aerial Photo of Proposed Project Site ***(Source: Caltrans DHIPP)***

FIGURE 2 - Photo of Proposed Bridge Site
Standing north of existing bridge (on western canal bank), looking north towards proposed site.

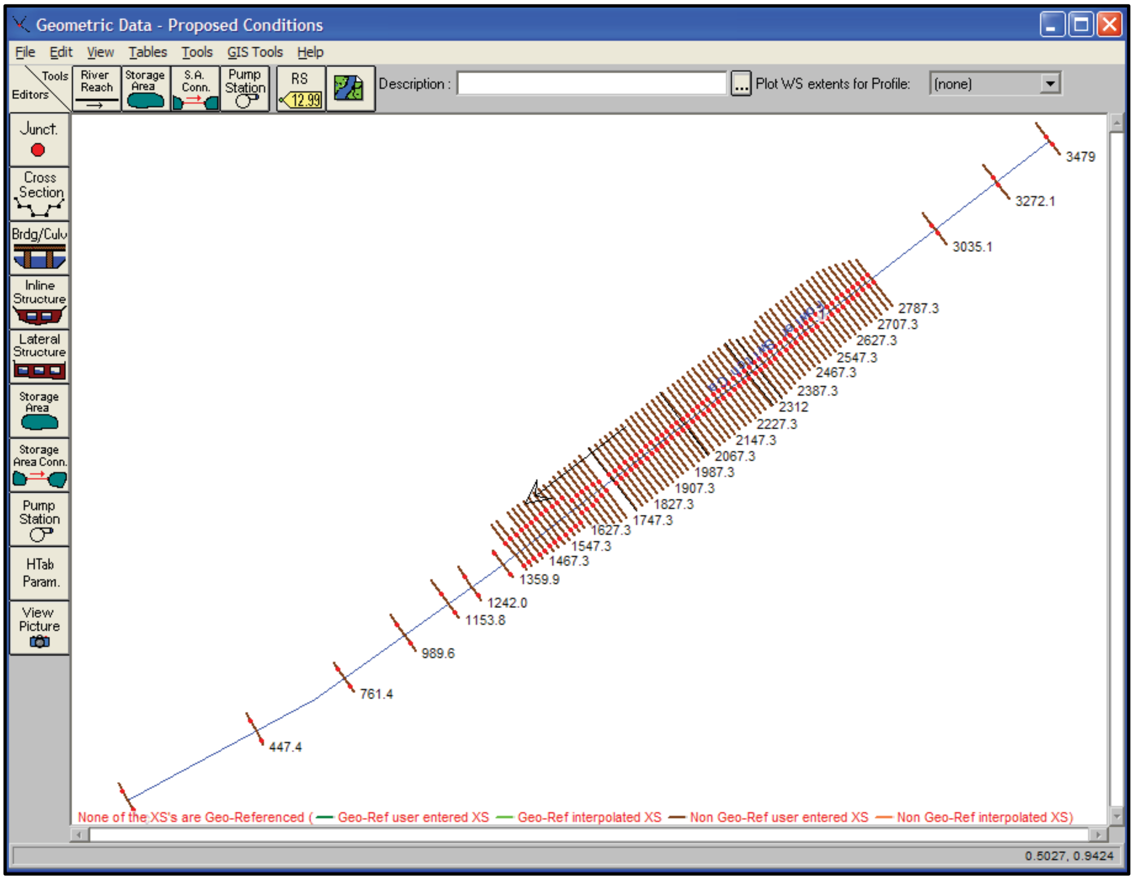
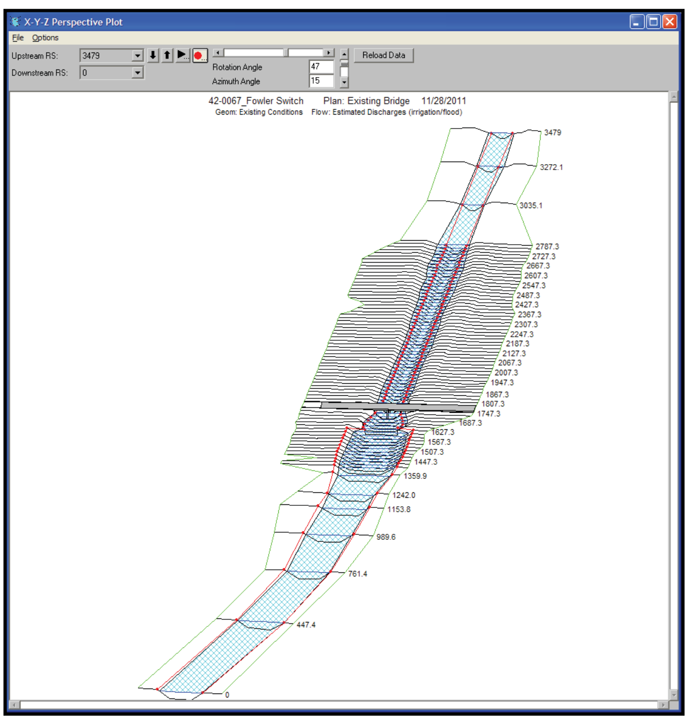


FIGURE 3 - Geometric Data of HEC-RAS Model (Proposed Conditions)



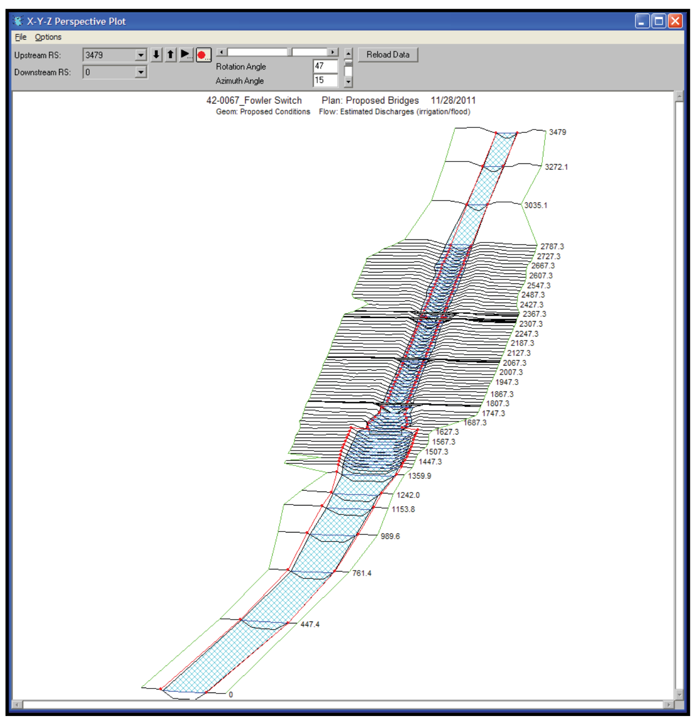


FIGURE 4 - XYZ Perspective Plot of HEC-RAS Models (Existing & Proposed Conditions)

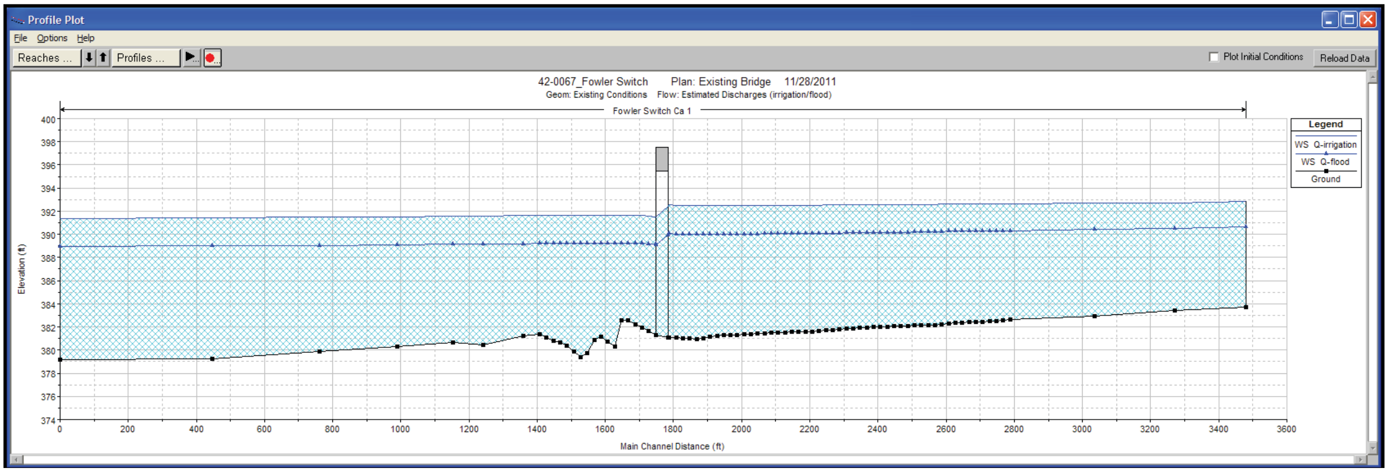


FIGURE 5A - Longitudinal Channel Profile Plot of HEC-RAS Model (Existing Conditions)

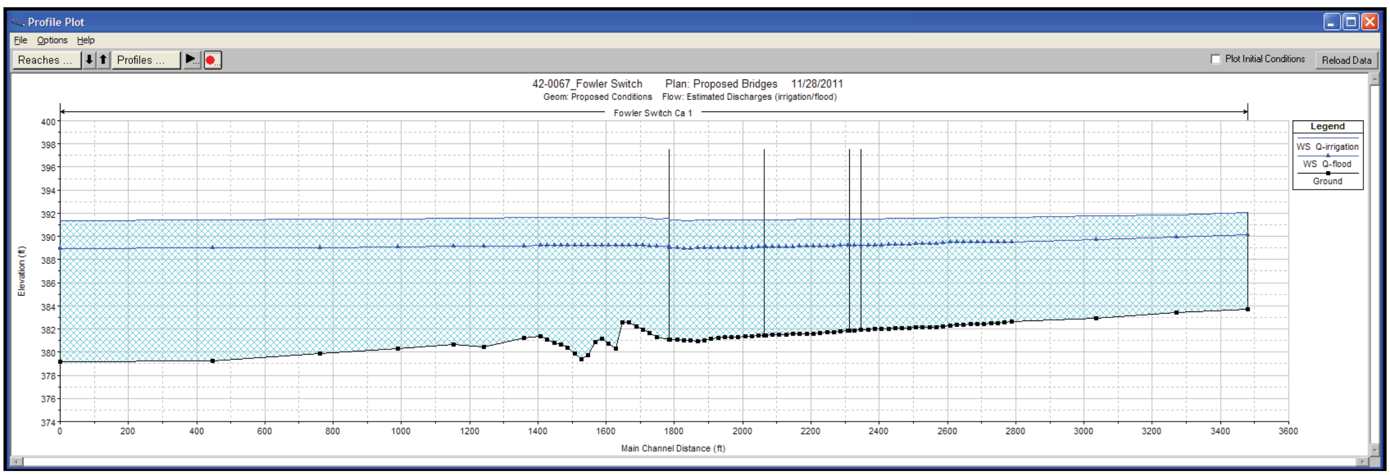


FIGURE 5B - Longitudinal Channel Profile Plot of HEC-RAS Model (Proposed Conditions)

State of California - Department of Transportation
Division of Engineering Services
Structure Design Services

FINAL HYDRAULIC REPORT

Lone Tree Canal Bridge

Br. No. 42-0440 Left/Right (NEW)

6 - FRE - 180 - PM 73.70

Located near Centerville, California

PROJECT DESCRIPTION:
Proposed 4 New Bridge Structures on Revised Alignment
(*EA: 06-342521, EFIS: 06 0000 0381*)

Prepared by:

Jose J. Vargas, P.E.
Transportation Engineer (Civil)
Structure Hydraulics & Hydrology Branch
November 30, 2011

REGISTERED PROFESSIONAL ENGINEER
JOSE J. VARGAS
No. 65612
Exp. 9/30/13
CIVIL
STATE OF CALIFORNIA

TABLE OF CONTENTS

General Notes:

1) *Unless otherwise indicated, elevations shown in this report are based on the National Geodetic Vertical Datum of 1929 (NGVD29). Field survey data (dated January 2009) for the HEC-RAS model was provided by District 6 Survey Branch with the Bridge Site Submittal (BSS) received from District 6.*

2) *This project includes the construction of four new bridge structures at this site location: two separated (mainline) State bridges, one (southern frontage road) County bridge, and one privately-owned bridge. Considering the general proximity of these 4 structures and other site-specific factors, the hydraulic design data/recommendations for the State bridges are also assumed applicable to the County bridge (Lone Tree Canal, Br. No. 42C0661) and the privately-owned bridge.*

GENERAL INFORMATION

It is proposed to remove the existing bridge (Br. No. 42-0068) and construct two new (separated) State bridge structures (Br. No. 42-0440 Left & Right) along a revised State Route alignment. A new (southern frontage road) County bridge (Br. No. 42C0661) and a new privately-owned bridge will also be constructed as part of this project. The privately-owned bridge will be located to the north of the new State bridges; no bridge number will be assigned to this bridge since the ownership/maintenance will be relinquished to a private owner at the completion of the project. The proposed bridge site is located along State Route 180 in Fresno County near Centerville, California *(Refer to Page 9 - **FIGURE 1**)*.

This project includes multiple bridge structures and culverts. Based on information received from Bridge Design Branch 17, the bridge structures to be located at the Fowler Switch Canal and Lone Tree Canal waterway crossings will be designed as bridge structures by the Division of Engineering Services (DES), while the remaining waterway crossings for this project will be designed (as culverts) by District 6 Hydraulics Branch.

The existing bridge was built in 1936 (never widened) and is a Reinforced Concrete (RC) rigid frame slab on closed-end cantilever abutments, all founded on spread footings. The existing single-span bridge structure has a total bridge length and width of 24 feet and 36.6 feet, respectively. Bridge reports describe the existing waterway underneath the bridge as a "sandy clay, trapezoidal irrigation canal".

A Final Hydraulic Report (FHR) request letter (dated 4/7/11) from Bridge Design Branch 17 provided a proposed General Plan (GP) sheet (dated 10/14/10). The General Plan sheet was used to estimate proposed bridge details and provide additional assumptions used for this study. Each new State bridge structure is proposed to have a total length of 40.0 feet (along the new State Route centerline) and a total width of roughly 41.8 feet (along the canal centerline). The proposed bridges are single-span, Cast-In-Place (CIP) reinforced concrete (RC) slab bridge structures with a proposed structure depth of 1 foot-11 inches. The proposed foundation details at the abutments were not indicated at this time.

In conjunction to the construction of the new bridges, a portion of the existing meandering channel will be replaced with a new "straightened" section of concrete-lined channel. All four new bridge structures will be located within the upstream and downstream limits of the proposed concrete-lined channel. The tentative design details of the concrete-lined channel provided on 11/10/11 and other necessary assumptions were used to model the proposed conditions.

DESCRIPTION OF WATERSHED

Lone Tree Canal is part of a complex system and network of local irrigation canals in Fresno County and is owned/operated by the Consolidated Irrigation District (CID). According to *The Kings River Handbook* (September 2009), the main diversion point for CID is the Fresno Weir. Less than two miles downstream of the Fresno Weir, the Consolidated Canal divides to CID's two main principal distribution channels, the Centerville and Kingsburg (C&K) Canal and Fowler Switch Canal.

Based on Google Earth (aerial images), both the Fowler Switch Canal and the Fresno Canal appear to contribute some amount of flow into the Lone Tree Canal, which eventually reaches the bridge site. Several flow control/diversion points are located between the Fresno Weir and the bridge site. In addition to controlled irrigation flows entering the channel at the main control/diversion points, local precipitation and other runoff may also contribute to the flows transported in the canal.

PEAK DISCHARGES

For this study, peak discharges at the Lone Tree Canal bridge site were considered for two assumed conditions: maximum controlled discharges (irrigation flows) and natural precipitation runoff (flood flows). The estimated peak discharges at the bridge site for irrigation and flood conditions were provided by the Consolidated Irrigation District as 150 cubic feet per second (cfs) and 25 cfs, respectively. For the purpose of this study, the higher discharge of 150 cfs was assumed to represent the "Design Flood".

WATER SURFACE ELEVATIONS (WSEL's)

Field survey data (CAiCE file dated January 18, 2009) for the bridge site was provided by the District 6 Survey Branch in February 2011. Supplemental field survey data (additional cross-sections located both further upstream and downstream of the existing survey limits) for the hydraulic model was requested to Preliminary Investigations (P.I.) - North Survey Branch. However, cross-section data in the main channel area was not obtained due to local high-flow conditions observed at the site during the scheduled field survey work in August/September 2011. *(The scheduled field survey for this project included both the Lone Tree Canal and the adjacent Fowler Switch Canal (Br. No. 42-0067) channels.)*

The available survey data was based on the NGVD29 vertical datum and was used to obtain representative channel cross-sections along the study reach. A hydraulic model of the bridge site was created using HEC-RAS (Version 4.0) software based on geometric data provided by the field surveys, assumed channel design details, and information shown on the proposed General Plan sheet *(Refer to Pages 9,10 - **FIGURE 2 & 3**)*. The Hydrologic Engineering Center - River Analysis System (HEC-RAS) is a one-dimensional hydraulic analysis program developed by the U.S. Army Corps of Engineers (USACOE).

It may be noted that the estimated discharge for irrigation conditions is higher than for flood conditions. Considering that most seasonal irrigation generally occurs during the drier summer months, increased vegetation conditions in the channel areas and banks were considered when estimating Manning's roughness coefficient ("n") values for the hydraulic model. Based on photos of the existing "natural" channel and engineering judgment, Manning's roughness coefficients for the main channel areas and overbank areas were estimated as 0.048 and 0.050, respectively. A Manning's roughness value of 0.015 was assumed for the proposed concrete-lined channel section.

For the purpose of providing estimated water surface elevations (WSEL's) at the proposed bridge sites, tentative design details of the concrete-lined channel section provided on 11/10/11 by Bridge Design Branch 17 were used to model the proposed conditions. The proposed channel cross-section indicated a trapezoidal concrete channel with 1.5H:1V side-slopes and an assumed Finished Grade (FG) = Original Ground (OG) of 384 feet at the "top of concrete channel". The following basic dimensions were estimated based on available information and considered for the study:

Tentative Details for the Proposed Trapezoidal Concrete-Lined Channel

Location	**Top Width** *(feet)*	**Bottom Width** *(feet)*	**Calculated Depth** *(feet)*	**Channel Invert Elevation** *(feet) NGVD29*
at upstream limit	32.7	10.0	7.6	376.4
at downstream limit	35.4	10.0	8.5	375.6

Based on the assumed peak (irrigation) discharge of 150 cfs, the HEC-RAS model calculated a maximum local water surface elevation of 380.4 feet at the proposed bridge structure. It may be noted that due to the relatively low longitudinal channel slopes and other site-specific factors, the calculated WSEL within the new concrete-lined channel section did not vary significantly; therefore, 380.4 feet was considered applicable for all proposed bridge locations within the concrete-lined channel section *(Refer to Page 10 - **FIGURE 4A & 4B**)*.

PEAK VELOCITY

The existing channel is an irrigation canal with a natural channel-bottom that currently meanders within the proposed bridge project area. The new proposed "straightened" section of trapezoidal concrete-lined channel is expected to be generally uniform along the section where the new proposed bridge structures will be located. The proposed channel straightening and concrete-lining will result in a slightly steeper longitudinal channel slope (due to a shorter stream length) and a smoother channel surface (i.e. less resistance to flow) within the new concrete-lined section, which will allow for slightly higher velocities as compared to the existing channel conditions.

However, due to the generally low longitudinal channel slopes in this valley area and other factors, the calculated local velocities for the proposed concrete-lined channel are still relatively low. Based on the assumed peak discharge and other current assumptions, the HEC-RAS model calculated a local peak (water) velocity of roughly 3.0 feet per second within the proposed limits of the concrete-lined channel section. Within the study reach, the calculated maximum peak velocity for the proposed conditions was roughly 4.0 feet per second. For comparison purposes, the calculated local peak velocity (within the study reach) for existing channel conditions was also roughly 4.0 feet per second (ft./sec.).

WATERWAY CAPACITY & MINIMUM SOFFIT ELEVATION

Based on the hydraulic model results and available information, the waterway capacity of the proposed bridge structure is sufficient to convey the estimated discharges with adequate freeboard. Based on a calculated WSEL of 380.4 feet and assuming 2.0 feet of freeboard for drift passage purposes, the calculated recommended minimum (bridge) soffit elevation for the bridge site is 382.4 feet. For the purpose of this study, the lowest elevation of the bottom of top deck slab (for the entire bridge) is considered the minimum bridge soffit elevation.

It should be noted that the recommended minimum (bridge) soffit elevation provided in the report is based on the water surface elevation calculated by the hydraulic model plus assumed freeboard for potential drift passage purposes. Additional or other potential freeboard which may be required for this bridge site is not included in the recommended minimum soffit elevation. The local irrigation district (Consolidated Irrigation District) and/or others, may have their own minimum freeboard, vertical/horizontal clearances, or other channel requirements and/or restrictions which may impact or control the proposed bridge/roadway design details.

DRIFT POTENTIAL

Based on available aerial photos (Google Earth), Lone Tree Canal appears trapezoidal-shaped and includes sections of natural and concrete-lined channel between the Fresno Weir and the bridge site. Some sections of natural channel include rock slope protection (RSP) or broken concrete on one or both channel banks which may help maintain the existing channel path (i.e. limit further meandering). Based on photos of the channel taken in the summer months (when the assumed peak irrigation discharge may occur), there are small amounts of potential drift/debris material (grasses, reeds, etc.) located along some portions of the natural channel sections which may be transported downstream toward the bridge site.

However, considering the proposed bridges are both single-span (no piers located in the waterway), significant future drift-related issues are not expected. It is generally anticipated that any significant amounts of drift which may potentially accumulate in the channel (within the State Right-of-Way) will be removed periodically by Caltrans Maintenance or others, as needed. The smoother concrete channel surface (compared to natural channelbed) may help reduce the potential of drift accumulation within the new section of concrete channel.

POTENTIAL SCOUR & LONG-TERM CHANNELBED TRENDS

Potential scour for the proposed bridge site was evaluated based on the Hydraulic Engineering Circular No. 18 (HEC-18) Manual, "*Evaluating Scour at Bridges*" (4th Edition, March 2001). Total scour at a highway crossing generally consists of three main components: general/contraction scour, local scour at piers/abutments, and long-term channelbed aggradation/degradation. Potential lateral stream/thalweg migration to the pier locations and abutments is also evaluated as part of the scour analysis procedure.

General / Contraction Scour

All four new bridge structures will be located within the proposed upstream and downstream limits of the proposed concrete-lined channel. Provided the concrete-lining of the channel is maintained as required and remains in good condition, general and/or contraction scour is assumed "not applicable".

Local Scour at Piers / Abutments

All four new bridge structures will be single-span - no piers will be located in the waterway. The proposed abutments will be placed behind the concrete channel (outside of the waterway) and protected against local scour. Provided the concrete-lining of the channel is maintained as required and remains in good condition, local abutment scour for the new foundations is assumed "not applicable".

Long-Term Channelbed Trends / Lateral Thalweg Migration

All four new bridge structures will be located within the proposed upstream and downstream limits of the proposed concrete-lined channel. Provided the concrete-lining of the channel is maintained as required and remains in good condition, long-term channelbed degradation and/or lateral migration of the channel at the bridge site is assumed "not applicable".

ADDITIONAL CONSIDERATIONS

The Caltrans Geotechnical Branch may be consulted regarding any site-specific geotechnical considerations which may potentially impact the structure foundation design or the long-term condition of the proposed concrete-lined channel.

Based on available information, the proposed concrete-lined channel section was assumed to have a total length of roughly 421 feet (along the channel centerline). When comparing the total "longitudinal channel length" (along the channel centerline/flow path) between the existing and proposed channel (horizontal) alignments, the total length will be reduced by roughly 100 feet.

Considering potential effects related to "straightening" a portion of a meandering channel with a new concrete-lined channel, some unpredictable future changes or water-related issues may be possible at the channel "transition areas" and also upstream/downstream of the concrete-lined channel section. Potential issues may include some gradual channel meandering occurring upstream and/or downstream of the new concrete-lined section, localized erosion/scour effects at the concrete channel "entrance/exit locations", and some potential re-direction of flows at the concrete channel entrance/exit locations.

In addition, if any significant future degradation occurs along the natural sections of channel, the difference in local channelbed elevations between the natural and concrete channels may eventually lead to some potential undermining issues at the upstream and/or downstream ends of concrete channel. To help minimize the risk of potential future water-related issues at the entrance/exit of the concrete-lined channel section, some energy dissipation features (i.e. rock slope protection (RSP), concrete energy dissipaters, etc.), some localized bank protection, flow-training measures, and/or other design details may be incorporated at these transitional areas.

SUMMARY INFORMATION FOR THE BRIDGE DESIGNER

GENERAL NOTES:

(1) Unless otherwise indicated, elevations shown in the report are based on the National Geodetic Vertical Datum of 1929 (NGVD29).

(2) Hydraulic analysis results are based on assumed/tentative details for the proposed concrete-lined section of channel. The existing HEC-RAS model may be modified to obtain updated results when final design details are established.

General / Contraction Scour [1] *(Depth)*	N/A
Local Scour at Abutments [1] *(Depth)*	N/A
Long-Term Channelbed Degradation & Lateral Thalweg Migration [1] *(Depth)*	N/A
Local Peak (Water) Velocity at Proposed Bridge *(based on assumed maximum discharge)*	3.0 ft./sec.
Recommended Minimum (Bridge) Soffit Elevation [2] *(includes 2.0 feet of freeboard)*	382.4 feet

FOOTNOTES:

[1] *Provided the concrete-lined channel is maintained as required and remains in good condition, general/contraction scour, local abutment scour, local channelbed degradation, or lateral thalweg migration are assumed "Not Applicable (N/A)".*

[2] *The "Recommended Minimum (Bridge) Soffit Elevation" is provided for bridge design recommendations and includes assumed freeboard for drift passage purposes. The local irrigation district (Consolidated Irrigation District) and/or others, may have their own minimum freeboard, vertical/horizontal clearances, or other channel requirements and/or restrictions which may impact or control the proposed bridge/roadway design details.*

Hydrologic / Hydraulic Summary			
Total Drainage Basin Area: Not Applicable *(controlled flow irrigation canal)*			
	Design Flood*	**Base Flood**	**Overtopping Flood**
Frequency, *years*	N/A	N/A	N/A
Discharge *, *cubic feet per second (cfs)*	150	N/A	N/A
Water Surface Elevation at Bridge **, *feet*	380.4	N/A	N/A
Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.			

* *The "Design Flood" for this study is not associated with any return frequency and was assumed as the larger discharge of either irrigation or flood flows as provided by the Consolidated Irrigation District (CID), the owner/operator of this canal. The estimated maximum discharge for irrigation flows (150 cfs) is larger than for flood flows (25 cfs).*

** *Due to the general proximity and other site-specific factors, the estimated WSEL at the State bridges is also assumed applicable to the proposed County bridge (Fowler Switch Canal, Br. No. 42C0660) and the privately-owned bridge.*

N/A = Not Applicable

LIST OF ACRONYMS

BSS	Bridge Site Submittal
CAiCE	Computer-Aided Civil Engineering *(software program)*
cfs	cubic feet per second
CID	Consolidated Irrigation District
CIP	Cast-In-Place
DES	Division of Engineering Services (Caltrans)
DHIPP	Digital Highway Inventory Photography Program *(Caltrans aerial images)*
EA	Expenditure Authorization
E-FIS	Enterprise Resource Planning Financial InfraStructure
FEMA	Federal Emergency Management Agency
FHR	Final Hydraulic Report
FG	Finished Grade
FIRM	Flood Insurance Rate Map (FEMA)
FIS	Flood Insurance Study (FEMA)
GP	General Plan
HEC-18	Hydraulic Engineering Circular No. 18 "*Evaluating Scour at Bridges*"
HEC-RAS	Hydrologic Engineering Center - River Analysis System *(software program)*
N/A	Not Applicable (or Not Available)
NGVD29	National Geodetic Vertical Datum of 1929
OG	Original Ground
P.I.-North	Preliminary Investigations - North (Caltrans Survey Branch)
RC	Reinforced Concrete
RSP	Rock Slope Protection
USACOE	United States Army Corps of Engineers
WSEL	Water Surface Elevation

REFERENCES

1) California Department of Transportation (Caltrans) - Bridge Inspection Reports (BIR's), Supplemental Bridge Reports (SBR's), Bridge File, As-Built Plans, Photos, Digital Highway Inventory Photography Program (DHIPP) - aerial photos, Final Hydraulic Report (FHR) request letter from Bridge Design Branch 17 *(dated 4/7/11)*, Proposed General Plan (GP) Sheet: "*Lone Tree Canal*" *(dated 10/14/10)*

2) The Kings River Handbook *(September 2009, Fifth Printing)*
Kings River Conservation District (KRCD) & Kings River Water Association (KRWA)

3) Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS)
Fresno County, CA and Incorporated Areas
FIS Number: 06019CV001B & 06019CV002B
(Last Revised: February 18, 2009)

4) Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM)
Fresno County, CA and Incorporated Areas
FIRM Number: 06019C2160H
(Last Revised: February 18, 2009)

5) Additional References:
- Google (search engine) *http://www.google.com/*
- Google Maps *http://maps.google.com/*
- Google Earth *(Google software program)*

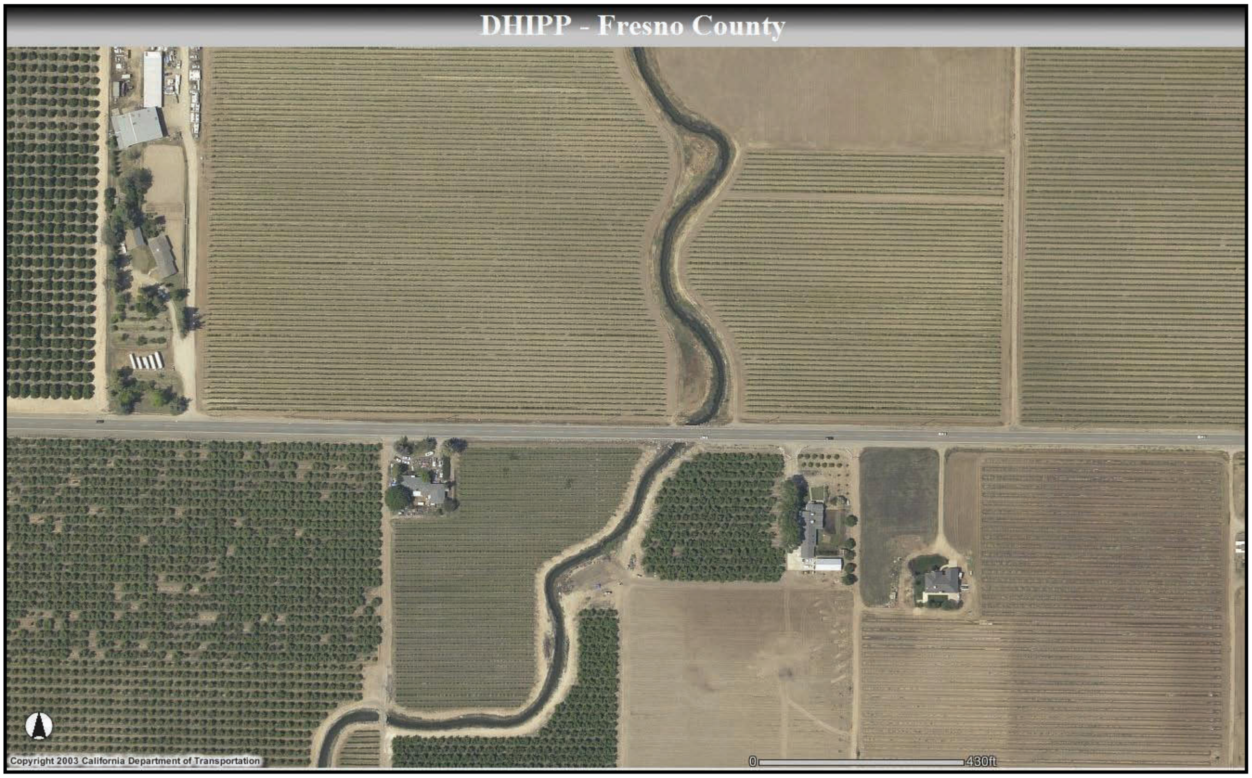


FIGURE 1 - Aerial Photo of Proposed Project Site ***(Source: Caltrans DHIPP)***

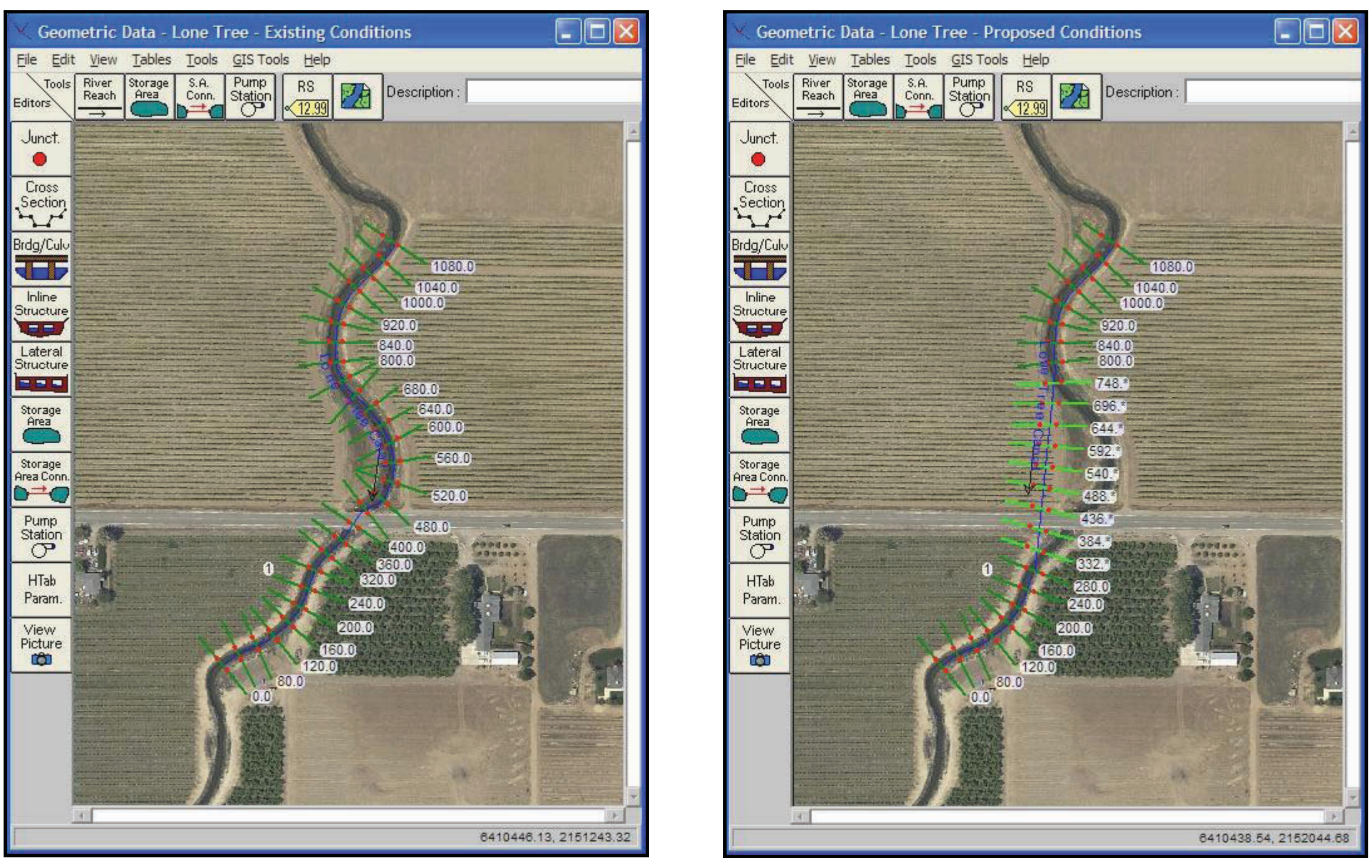


FIGURE 2 - Geometric Data of HEC-RAS Models (Existing & Proposed Conditions)

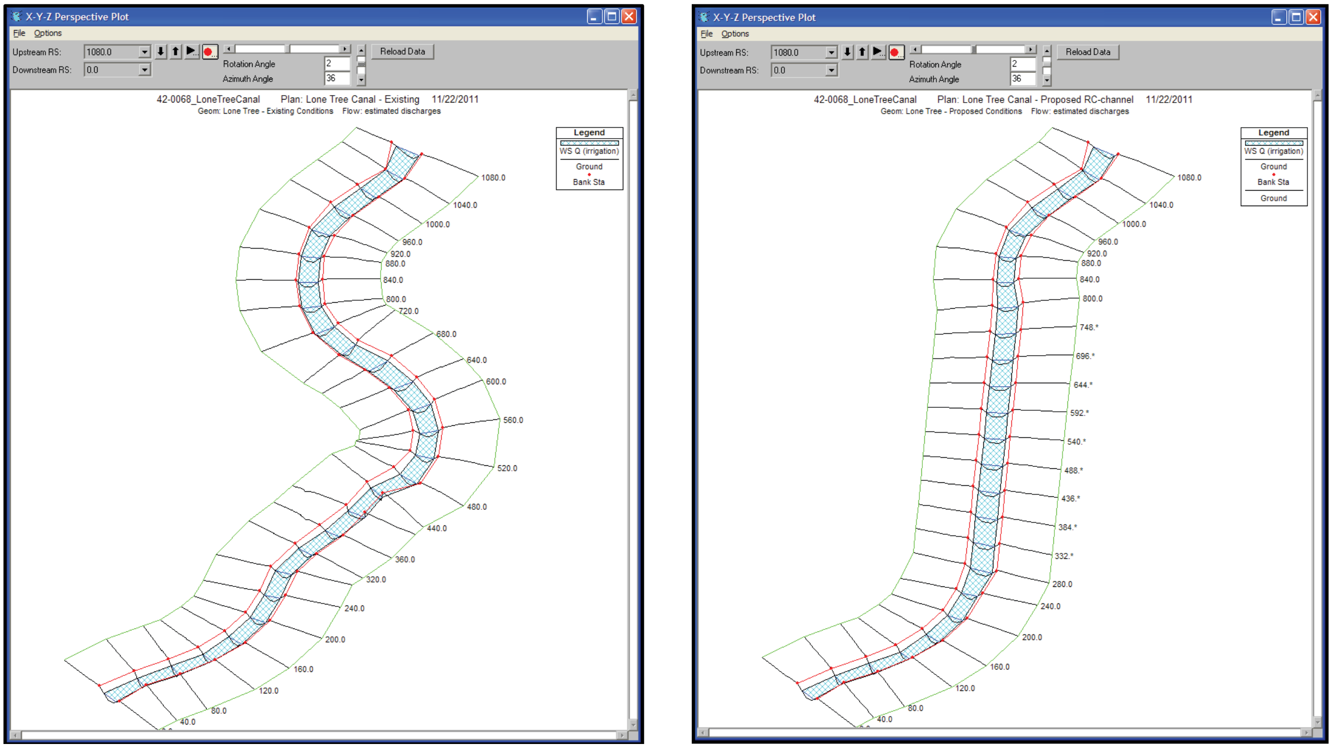


FIGURE 3 - XYZ Perspective Plot of HEC-RAS Models (Existing & Proposed Conditions)

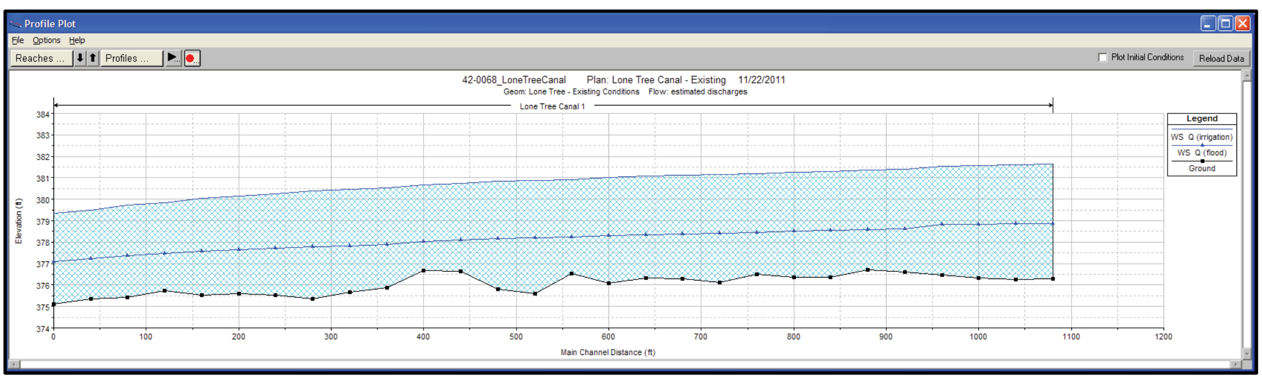


FIGURE 4A - Longitudinal Channel Profile Plot of HEC-RAS Model (Existing Conditions)

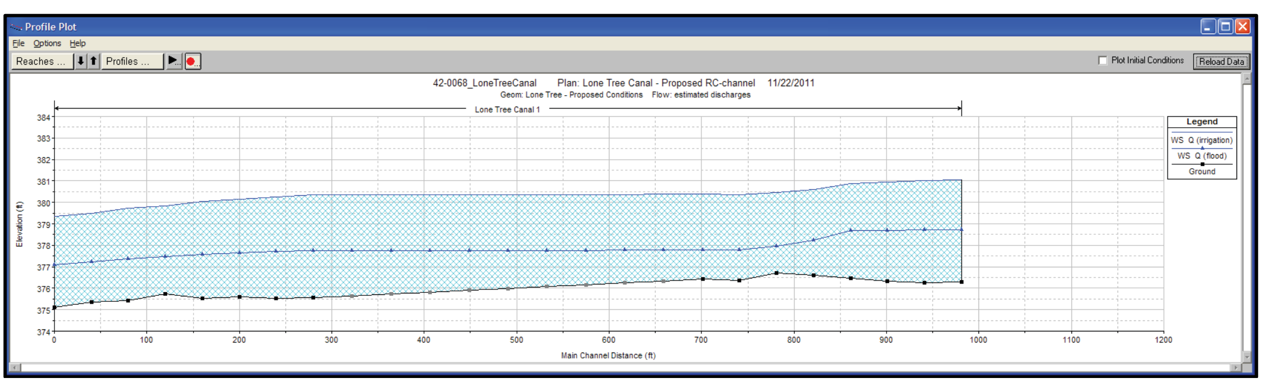
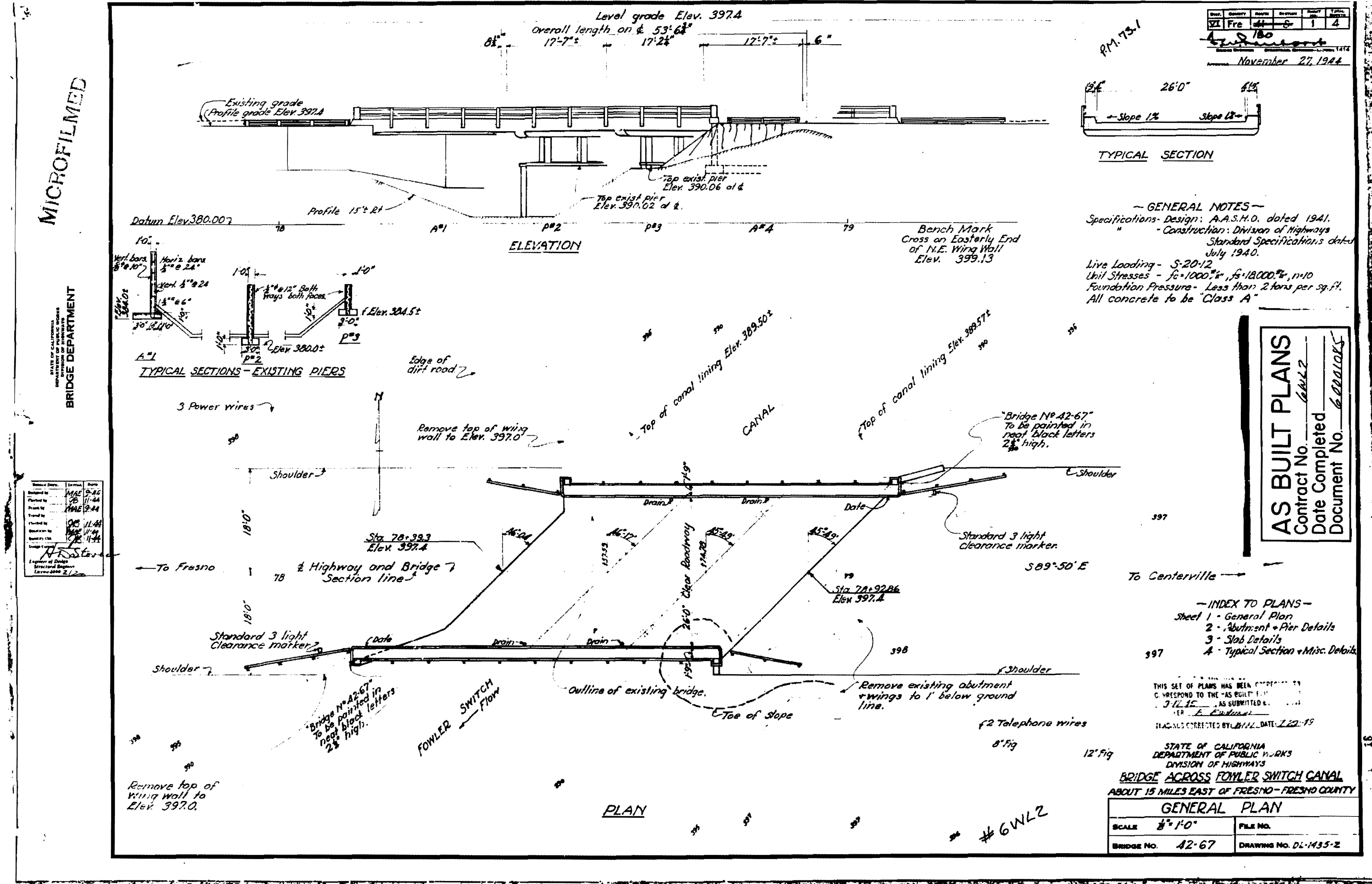
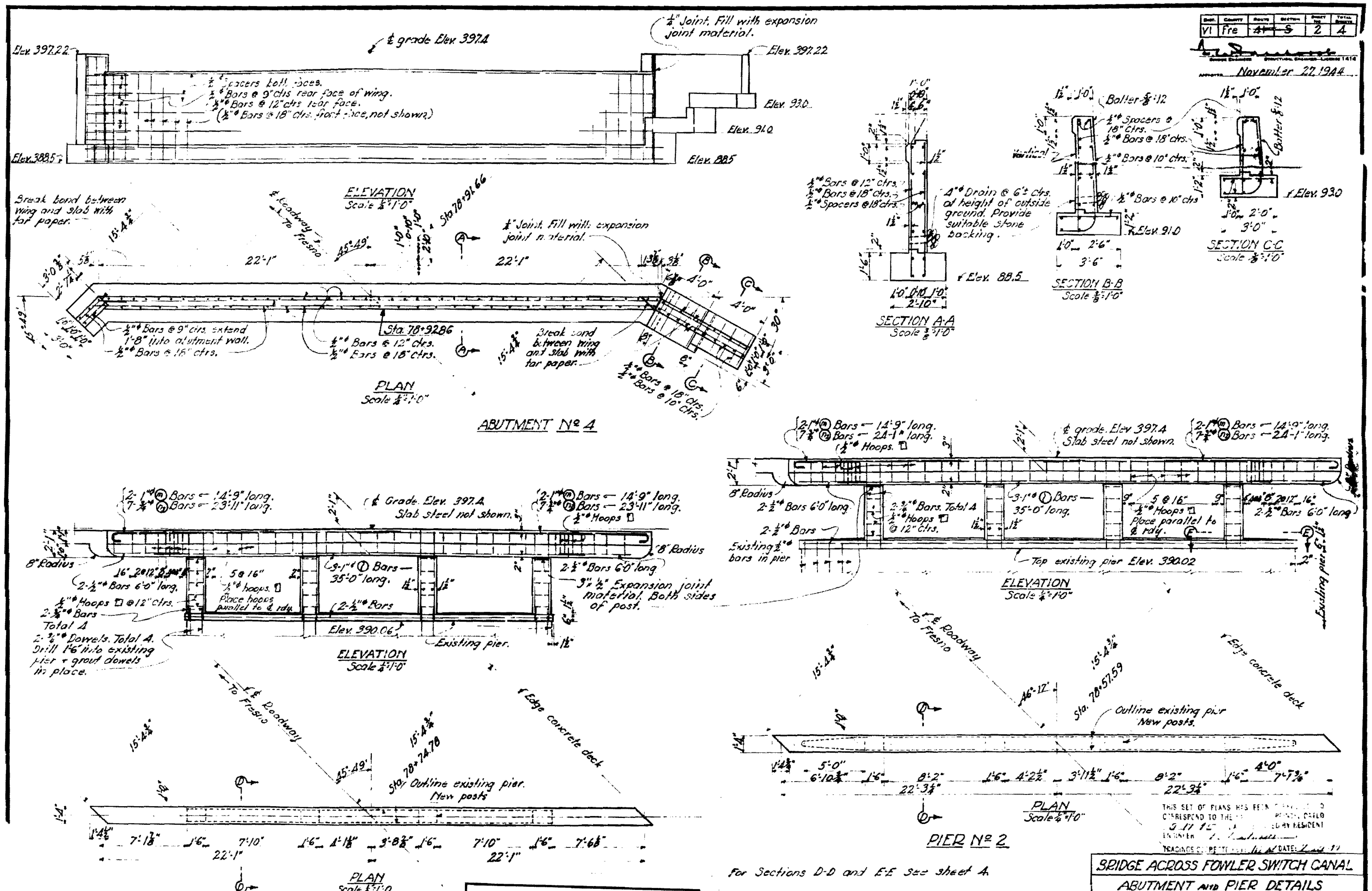


FIGURE 4B - Longitudinal Channel Profile Plot of HEC-RAS Model (Proposed Conditions)



I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.

DATE 4/14/72 SIGNATURE [signature] TITLE SR RMO



Dist.	County	Route	Section	Sheet No.	Total Sheets
VI	Fre	41	5	2	4

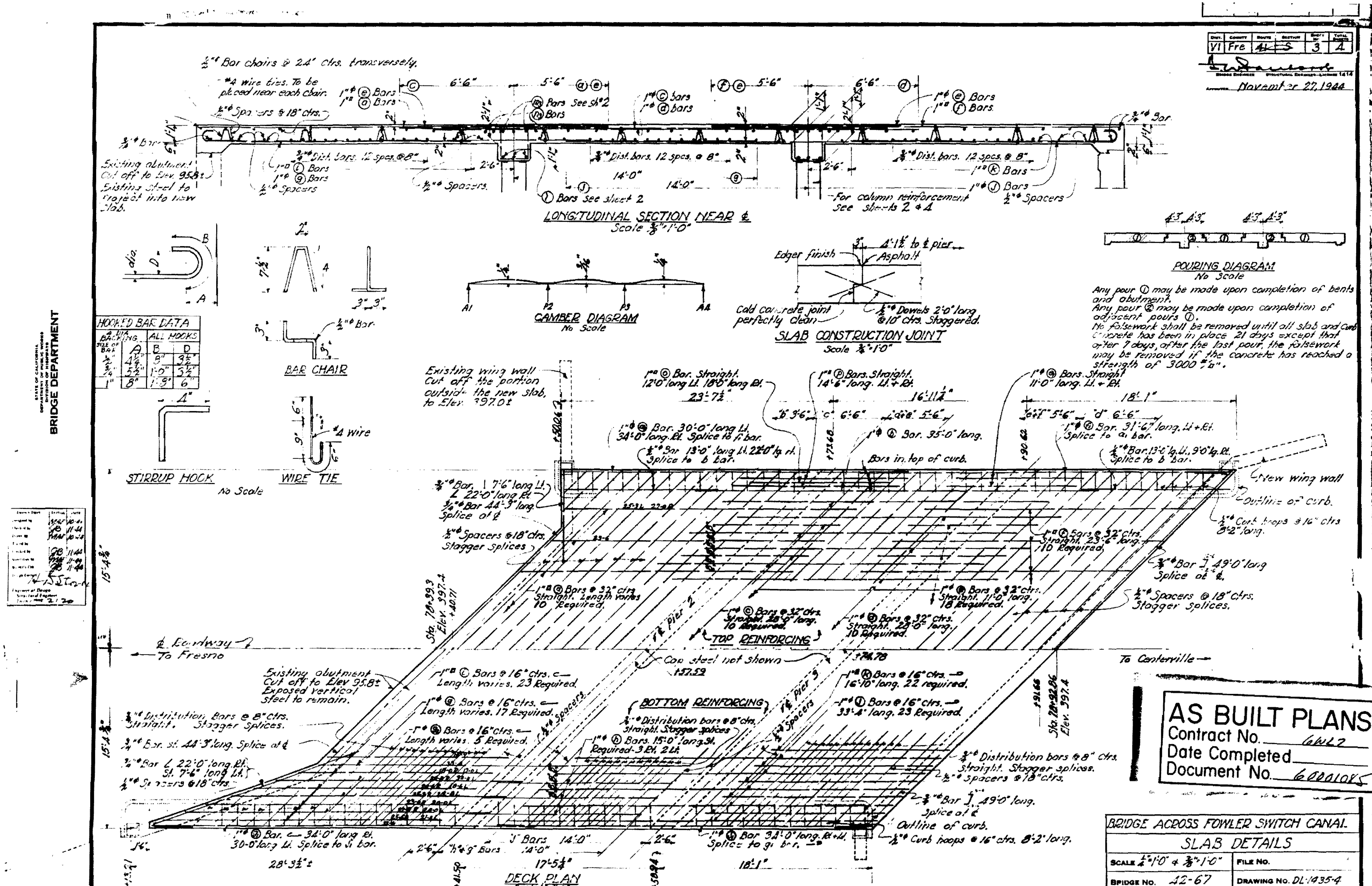
November 27, 1944

BRIDGE ACROSS FOWLER SWITCH CANAL
ABUTMENT AND PIER DETAILS
SCALE ¼"=1'-0" and ½"=1'-0" FILE NO.
BRIDGE NO. 42-67 DRAWING NO. DL-1435-3

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC WORKS
DIVISION OF HIGHWAYS
BRIDGE DEPARTMENT

AS BUILT PLANS
Contract No. 6WL2
Date Completed
Document No. 60001045

I HEREBY CERTIFY THAT THIS IS A TRUE AND ACCURATE COPY OF THE ABOVE DOCUMENT TAKEN UNDER MY DIRECTION AND CONTROL ON THIS DATE IN SACRAMENTO, CALIFORNIA PURSUANT TO AUTHORIZATION BY THE DIRECTOR OF PUBLIC WORKS.
DATE 4/14/72 SIGNATURE James E. Cant TITLE SR. RMO



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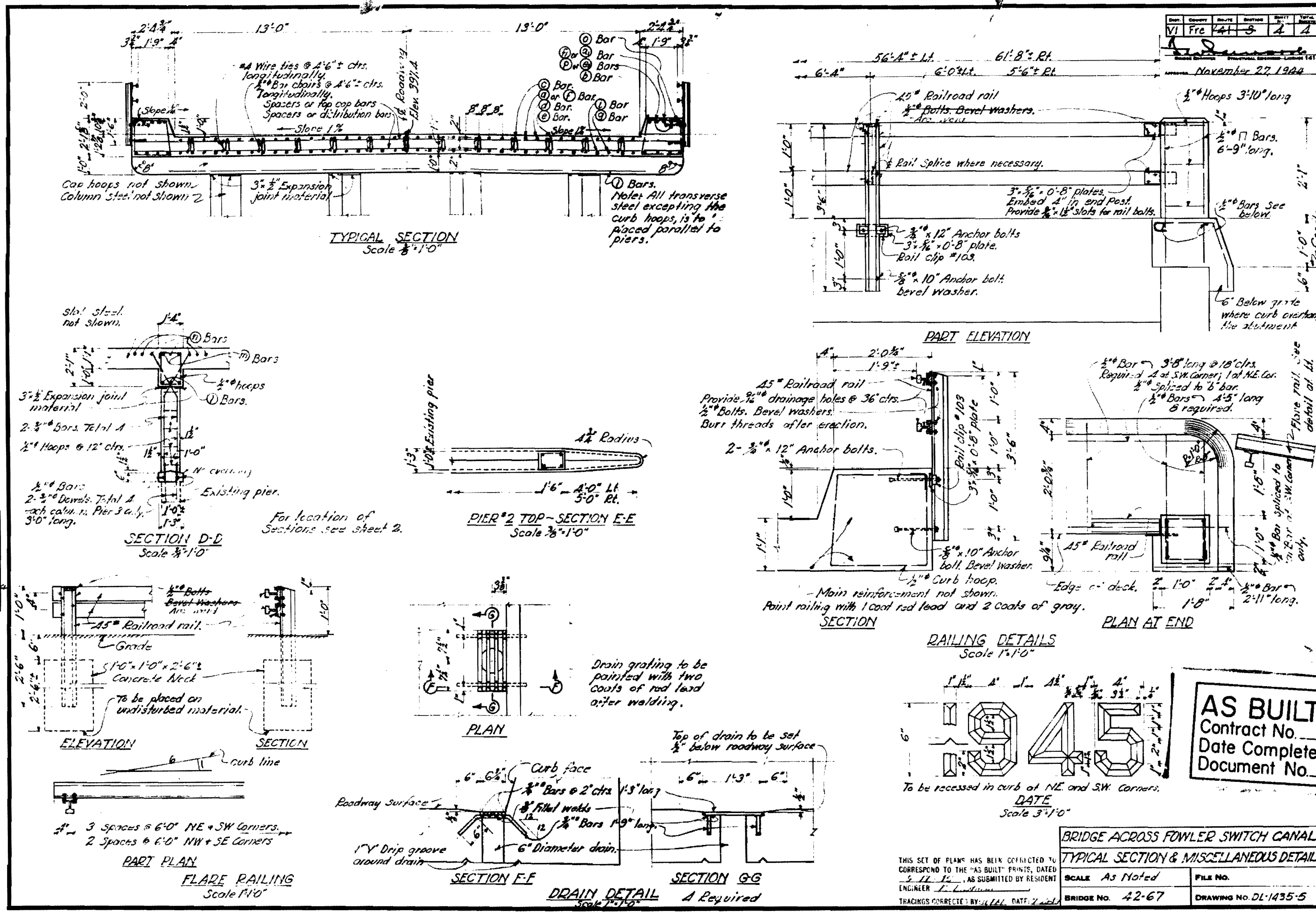
DATE 7/14/72 SIGNATURE James E. Cant TITLE SR. RMO



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DATE 4/14/72 SIGNATURE [signature] TITLE SR. RMO

California Dep[artment of Transportation
District 6

PROJECT APPROVAL REPORT

06-Fre-180-R64.6/R84.0
06250-342500
Fowler Avenue to Cove Avenue

October, 1995

Prepared by:

Teresa J. Rix, P.E.

REGISTERED PROFESSIONAL ENGINEER
TERESA J. RIX
No. 42840
Exp. 3/96
CIVIL
STATE OF CALIFORNIA

Reviewed by:

Anthony J. Telesco, P.E., Project Manager

ATTACHMENT I

Dn Rm

October 27, 1995

6-Fre-180-R65.6/R84.0
06250-342500

PROJECT APPROVAL REPORT

INTRODUCTION

Studies have been completed for a project that involves the widening and realignment of Route 180 in Fresno County from west of Temperance Avenue to Cove Avenue (PM 65.6 to PM 84.0). The preferred alternative is located on Alternative Alignment 1 and consists of a four-lane limited access highway on a four-lane right of way from Temperance Avenue to Academy Avenue, a two-lane limited access highway on a four-lane right of way from Academy to Frankwood Avenue, and a two-lane conventional highway from Frankwood Avenue to Cove Road.

PROJECT DESIGN CHANGES

There are no changes in the project design or mitigating features as a result of circulation of the EIS/EIR or the Public Hearing process.

CURRENT COST ESTIMATE

The estimated construction cost of the Preferred Alternative is as follows:

Roadway	$ 46,670,000
Structures	$ 2,649,000
Right of Way	$ 21,822,000
TOTAL	$ 71,141,000

PUBLIC HEARING

A public hearing open house was held on October 19, 1994 to solicit comments on the DEIS/EIR. Three other public open houses were held prior to the public hearing. These were attended by more than 1,000 people.

Through the Public Participation Program, agencies and the public identified areas of concern and raised questions to be addressed in the environmental document. This process also assisted in identifying the project alternatives that were then carried forward for evaluation. Key issues are summarized below.

Social and Economic Considerations:

- Displacement and relocation impacts
- Project schedule and costs
- Traffic, access, and local circulation impacts
- Growth inducement and community disruption

Environmental Considerations:

- Conversion of agricultural land
- Visual impacts
- Air quality
- Water Quality
- Noise

COMPATIBILITY WITH LOCAL AND REGIONAL PLANS

The proposed project is consistent with state and local plans, including the Council of Fresno County Governments (COFCG) Regional Transportation Plan and Congestion Management Program.

TITLE VI CONSIDERATIONS

Pedestrian crosswalks will be provided at signalized intersections, as warranted. The paved shoulders, which would be from 8 to 10 feet wide facilitate bicycle use; however there are no plans to construct dedicated bicycle lanes.

CERTIFICATION

Affected local agencies have participated as members of the Project Development Team, and have been consulted throughout the development of this project. Their views have been considered and they are in general accord with the plan as presented.

CONTROLLED ACCESS HIGHWAY AGREEMENT

A Controlled Access Highway Agreement with the County of Fresno will be required for the adopted alignment.

RECOMMENDATION

It is recommended that this Project Approval Report be Approved.

Anthony J. Telesco 10-24-

ANTHONY J. TELESCO Date
Project Manager

Concurrence by:

For ROBERT E. WADDINGTON 10-24-95 Date
District Division Chief
Project/Program Management

APPROVAL

This is to certify that I have considered the Environmental Impact Statement/Environmental Impact Report, and I approve the project.

ATTACHMENTS

Registered Engineer Seal
Location Map
Plan of Preferred Alternate

R.L. Binger 10-24-95
ROBERT L. BINGER Date
District Director

TJR:omv

cc: HQ OPP&D (3)
FHWA
HQ Programming (2)
AJT/TJR (3)
BJA
NSF
IHL
RRW
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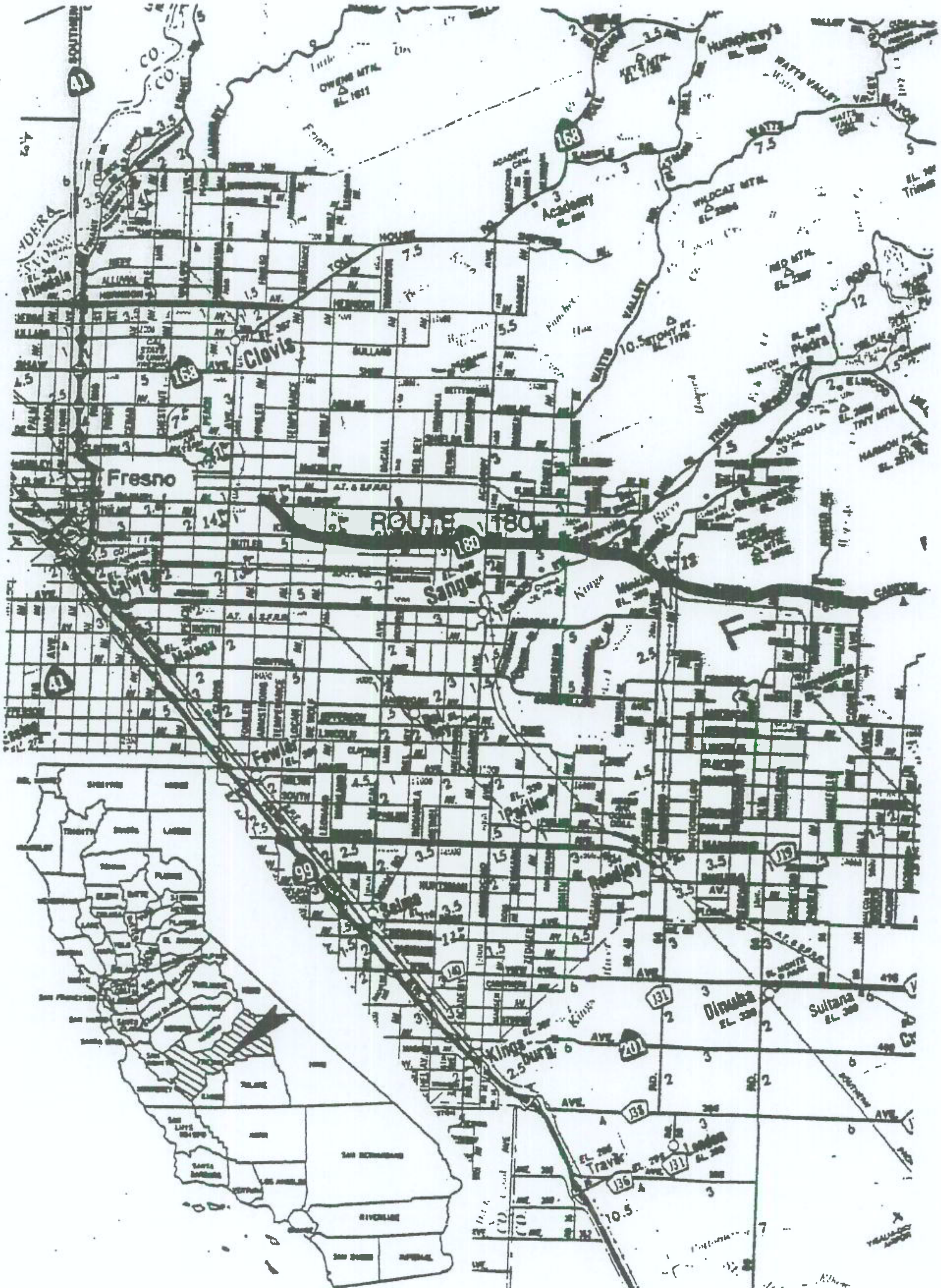

PROJECT LOCATION MAP

ATTACHMENT A

September 10, 1993
06-FRE-180-R64.6/R84.0
06250-342500
CONTRACT NO. 06SFP8806

PROJECT REPORT

Rural Route 180
Fowler to Cove Avenue

Prepared For:

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
District 6
Fresno, California

43

ATTACHMENT J

California Department of Transportation
District 6

PROJECT REPORT

06–Fre–180 R64.6/R84.0
06250–342500
Fowler Avenue to Cove Avenue

September 1993

Prepared by:

James D Bissell

James D. Bissell, P.E.

REGISTERED PROFESSIONAL ENGINEER
James D. Bissell
No. 37900
Exp. 3-31-97
CIVIL
STATE OF CALIFORNIA

Reviewed by:

Robert L. Burns, P.E., Project Manager

Centennial Engineering, Inc.
Pleasanton, California

06-FRE-180-R64.6/R84.0
06250-342500
CONTRACT NO. 06SFP8806

The project report contained herein has been prepared by or under the direction of the following Registered Engineer. The Registered Engineer can attest to the technical information contained therein and has judged the qualifications of any technical specialist who has provided engineering data upon which recommendations, conclusions, and decisions are based.

CENTENNIAL ENGINEERING, INC.

Robert L. Burns   9-08-93

Robert L. Burns, P.E., Project Manager   Date
REGISTERED CIVIL ENGINEER

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STATE OF CALIFORNIA

Centennial Engineering, Inc.
Pleasanton, California
PROJECT REPORT
TABLE OF CONTENTS

August 20, 1993

PROJECT REPORT

06-Fre-180 R64.6/R84.0
Fowler Avenue to Cove Avenue

APPROVED BY:

R. L. Binger

Robert L. Binger, P.E.
District Director

9-29-93
Date

SUBMITTED BY:

Roy V Andersen

Roy V. Andersen
Project Manager

9/14/93
Date

I. INTRODUCTION

The proposed project involves the widening and realignment of Route 180 from west of Temperance Avenue to Cove Avenue (P.M. 64.6 to P.M. 84.0). The western portion of Route 180 would be widened to a four lane divided cross-section, while a widened two lane section is proposed east of Frankwood Avenue.

Currently there are three proposed alignments for the improvement to Route 180. Alternate 1 primarily follows existing Route 180. Alternate 1A is the same as Alternate 1 except for a by-pass north of the town of Centerville. Alignment 2 is the third alternative which generally follows a path 0.25 mile north of existing Route 180. Each of these alternates connects with the proposed Urban Route 180 project west of Temperance Avenue.

The estimated cost for this project ranges between $62 million and $74 million, depending on the selected alternate. It is anticipated that funding for the project would come from the Fresno County Transportation Authority, using funds from the one half percent "Measure C" sales tax. The project is also eligible for state and federal funds.

II. PROJECT CATEGORY

This project is classified as a Category 1 per Section 2-5.2(1) of the Project Development Procedures Manual. This project meets the criteria for Category 1 projects because portions of any of the build alternatives will be on new alignment. In addition, new right-of-way will be required and a new route adoption will be required in conjunction with the proposed project. The route adoption is proposed as a controlled access highway.

III. BACKGROUND

This project report is the culmination of two prior project reports and three supplemental project reports dating back to the mid-1950's. The first report was submitted on March 25, 1955 and covered the alignment between Chestnut Avenue and 0.6 mile east of the Kings River (Lone Oak Avenue), and recommended that the existing highway be widened to a 4-lane expressway. The second project report was submitted on May 7, 1956 and covered the alignment between 0.6 mile east of the Kings River and Cove Avenue. On September 28, 1956, the second project report was approved providing 2-lanes with a 40 foot typical section on a 100-foot minimum right of way along the existing route.

Three supplemental project reports which covered the alignment between Chestnut Avenue and 0.6 miles east of Kings River (Lone Oak Avenue) were submitted on September 28, 1956, February, 1957 and July 26, 1957. The first supplemental project report was submitted September 28, 1956 and requested route adoption 0.25 mile north of the existing alignment for a full freeway facility between Chestnut Avenue and Clovis Avenue, and an expressway facility on one of several proposed alignments between Clovis Avenue and the end of the project. The first supplemental project report was approved and authorized the District to proceed with alternative development.

The first supplemental project report also included freeway interchange locations at Peach Avenue, Clovis Avenue, and Academy Avenue, and recommended initial development east of the Kings River to be a 2-lane facility as previously approved on September 28, 1956. The second supplemental project report was submitted on February 19, 1957, requesting additional freeway interchange locations at Fowler, DeWolf, McCall, and Oliver Avenues. Headquarters approval was given on March 27, 1957.

On February 19, 1957, the Fresno County Board of Supervisors requested an alignment study located 0.50 mile north of the existing route. The Fresno County Board of Supervisors and the Sanger Chamber of Commerce also verbally requested an alignment study located 1.25 miles south of the existing route. The third supplemental project report was submitted on July 26, 1957, however no record of its contents or approval can be found. The route adoption process was terminated when further route relocation study work was suspended on August 24, 1961.

In November, 1986, Fresno County voters passed Measure C, which approved a one-half percent sales tax increase that would remain in effect for up to 20 years, in order to fund transportation improvement projects. The proposed Route 180 project is one of many transportation improvements to be funded by Measure C. The Fresno County Transportation Authority (FCTA) was empowered to oversee this 20-year program.

A corridor study conducted on the project was submitted January 8, 1991 and evaluated a variety of alignments. See Section VII for more discussion of the alignments considered. This list of alignments was reduced down to three (3) alternatives for more detailed engineering design and environmental evaluation: Alternative 1, Alternative 1A, and Alternative 2 (Attachment B).

Public participation has been an important element in the development of this most recent Route 180 project. Several community and agency information meetings with the Project Development Team, the general public, local agencies and organizations have occurred to ensure that the public is kept informed about the progress of the project and to provide them with the opportunity to participate. The community has been generally supportive of the project due to the expected improvements to traffic flow and safety on an increasingly congested roadway that is used for recreational, agricultural and commute purposes.

There was some initial opposition to the project from a group that identifies itself as the STOP (Stop Taking Our Property) Committee. Consisting primarily of residents adjacent to Route 180, the group is concerned that a four lane highway will increase traffic and air pollution and encourage growth in the rural area of Fresno. Meetings with the STOP Committee were held on December 6, 1990 and November 14, 1991 to provide a forum for participation and exchange of information with committee members.

Additional meetings were held as outlined in this paragraph. An agency Scoping Meeting was held on March 1, 1991. An informal meeting with the City of Sanger was held on March 21, 1991.

A meeting specifically for property owners, adjacent to the alignment was held on May 14, 1990. In addition, three public open house meetings were held on the project. Open House #1 was held on March 28, 1990. Open House #2 was held June 7, 1990 and Open House #3 occurred May 15, 1991.

IV. EXISTING FACILITY

Route 180 is a principal arterial highway, that runs roughly east-west across the northern half of Fresno County serving traffic between the west side of the San Joaquin Valley and Sequoia and Kings Canyon National Parks (Attachment A.). The portion of the route between Route 99 and the National Parks is included in the National Highway System. The route is also important for moving agricultural goods from ranches and farms east of Fresno, and is of growing importance for commuter travel between the FCMA and eastern Fresno County.

The present route is a two-lane conventional highway traversing flat to gently rolling terrain that is used primarily for farming and grazing. The roadway width varies between 22 and 24 feet with shoulders varying between 0 and 8 feet.

V. TRAFFIC DATA

Existing and design year traffic volumes are summarized below.

TRAFFIC SUMMARY
(ADT)

Location	Current	2010		
		Alt. 1	Alt. 1A	Alt. 2
Fowler Ave. to Temperance Ave.	7,200	36,900	36,900	36,900
Temperance Ave. to Highland Ave.	7,200	34,100	34,100	30,700
Highland Ave. to Academy Ave.	7,900	27,000	27,000	24,400
Academy Ave. to Trimmer Spgs. Rd.	7,600	15,100	14,800	13,700
Trimmer Spgs Rd. to Frankwood Ave.	7,600	11,800	11,800	11,800
Frankwood Ave. to Cove Ave.	4,700	5,300	5,300	5,300

The traffic volumes shown are weighted averages of link volumes shown in Attachments C and D.

The highest traffic volumes along the project route occur from its western terminus to Reed Avenue (Post Mile 78.2). From Reed Avenue to the eastern terminus of the project (Post Mile 78.2 to 84.0) the traffic volumes drop substantially.

Existing weekday traffic counts show directional distribution of traffic on Route 180 is approximately 60 percent westbound (inbound toward Fresno) and 40 percent eastbound in the morning peak hour. In the evening peak hour, the traffic is distributed approximately 60 percent eastbound (outbound from Fresno) and 40 percent westbound. The peak hour contains approximately 8 to 10 percent of the Average Daily Traffic (ADT).

The recommended Level of Service (LOS), according to AASHTO, for rural highways such as Route 180 is B. Level of Service B represents reasonably free-flow conditions. At present, the project route from its western terminus to Academy Avenue operates at a LOS of E. The remainder of the route operates at a LOS of D.

Attachment E lists the LOS that would result from projected 2010 traffic given the current condition of Route 180. Traffic demand is expected to exceed the capacity of the existing roadway west of Academy Avenue, with marginal traffic operations between Academy and Frankwood Avenues. The existing roadway geometry will serve traffic demand adequately (at LOS C) only in the section east of Frankwood Avenue.

The accident rates for the project route between its western terminus and Trimmer Springs Road are almost twice the statewide average for similar highways. From Trimmer Springs Road to Frankwood Avenue, the accident rate is almost 30 percent higher than the statewide average.

ACCIDENT RATES
(per MVM)

Location	Actual			Expected		
	Fatal	Injury	Total	Fatal	Injury	Total
Fowler Ave. to Temperance Ave.	0.112	1.90	3.35	0.038	0.91	2.13
Temperance Ave. To Highland Ave.	0.125	1.06	2.56	0.053	.056	1.16
Highland Ave. to Academy Ave.	0.144	1.18	2.32	0.053	0.55	1.16
Academy Ave. to Trimmer Spgs Rd.	0.107	1.00	2.08	0.053	0.56	1.16
Trimmer Spgs. Rd. to Frankwood Ave.	0.040	0.83	1.99	0.054	0.75	1.53
Frankwood Ave. to Cove Ave.	0.033	0.40	0.89	0.055	0.95	1.89

The tabulated accident data are from TASAS for a three year period from June, 1988 to June, 1991. The highest concentrations of accidents are at the intersections of the higher volume county roads. Thirty-one percent of total corridor accidents occurred at intersections. The intersections with the highest number of accidents during the three year period were:

Location	Number of Accidents
• McCall Avenue	18
• Temperance Avenue	12
• Academy Avenue	10
• Highland Avenue	10

Highway accidents (not located at intersections) are fairly evenly distributed west of Rio Vista Avenue. No specific geometric factors were identified in this segment of the project corridor. The high concentrations of highway accidents where roadway geometrics may need to be improved include:

- Ran-off-road accidents concentrated at a relatively sharp curve just west of the Kings River Bridge.

- Ran-off-road accidents concentrated in a relatively sharp curve just west of Alta Avenue.

Contributing factors to total accidents are as follows:

- The primary collision factors in descending order of occurrence are:

- alcohol influence	24%
- other violations	20%
- failure to yield	18%
- speeding	17%
- improper turn	15%

- The most frequently occurring types of accidents include:

- broadside	28%
- hit object	25%
- rear end	18%

- Almost all accidents in the corridor occurred under normal roadway conditions (99%), in clear weather (85%), when there was no precipitation (95%), and when the pavement was dry (92%).

There were 13 fatal accidents within the three-year study period. Sixteen people were killed and twenty-seven injured in these fatal accidents. Sixty-nine percent of the fatal accidents involved other vehicles. Alcohol consumption was documented in 92 percent of the fatal accidents although not necessarily listed as the primary factor.

VI. DEFICIENCIES AND JUSTIFICATION

1. Traffic Capacity

Route 180 has become an increasingly important agricultural and commuter link between the Fresno-Clovis Metropolitan Area (FCMA), Sanger and the rural communities that border the Kings River. The project route also represents one of the major routes for recreational traffic to Kings Canyon and Sequoia National Parks, as well as other rural recreational areas in the mountains to the east of the FCMA.

Traffic has become noticeably congested on Route 180 in recent years, particularly west of Sanger in the a.m. and p.m. peak hours. Average daily traffic along the project route is projected to grow which will substantially increase congestion, creating stop-and-go conditions at major intersections. Without improvement, projected 2010 traffic demands will result in a continuing deterioration in level of service.

All of the alignments in this proposal would eliminate traffic congestion for through traffic on Route 180 during the design life of the project. The proposed design will also improve access onto Route 180 from the cross streets in the section from the west terminus of the project to Frankwood Avenue. The construction of the proposed 46-foot median in this area will provide refuge for through and left-turning traffic from the cross streets, and allow cross street traffic to cross one direction of Route 180 traffic at a time.

2. Safety

The existing Rural Route 180 corridor exhibits accident rates significantly higher than similar state highways. If no improvements are made to Rural Route 180, the costs of accidents in current-year dollars are expected to more than double along the corridor.

All three build alternatives will provide significantly improved safety over the no-build alternative. The most substantial improvements are expected in reducing the number of fatal injury accidents. The projected reduction in accidents would result in a total annual savings in accident costs ranging from $1.4 million (Alternative 1) to $1.7 million (Alternative 2).

VII. PROPOSAL DESCRIPTION

1. Proposal and Alternatives Under Consideration

A variety of alignments have been considered for the project since improvements on this segment of Route 180 were first considered by the California Highway Commission in 1955. A corridor study was completed for the project on January 8, 1991, to identify a reasonable range of alignments for preliminary engineering studies and environmental review.

A preliminary traffic study was done to approximate the capacity requirements for Route 180 in the year 2010. The initial study called for a six-lane divided freeway/expressway from Fowler to Temperance Avenue, a four-lane divided expressway from Temperance Avenue to the vicinity of Reed and Frankwood Avenues, and a two-lane conventional highway from Reed/Frankwood to Cove Avenue.

Six alternatives for this type of facility were identified in the study area (Attachment F). After additional studies were completed, three alternatives were selected for further consideration. All of the proposed alternatives are four lane divided highways from the end of the Urban Route 180 Freeway (approximately 1,000 feet west of Temperance Avenue) to Frankwood Avenue and a two lane conventional highway between Frankwood Avenue and Cove Avenue. All of these alternatives share a common alignment from approximately 2,000 feet east of Trimmer Springs Road to Cove Avenue. Traffic lanes, shoulders, median and right-of-way widths conform to current standards. Refer to the typical cross sections (Attachment G). The proposed alternatives have been designed for a minimum level of service (LOS) C and 70 mph design speed for the design year 2010. A design capacity of 1800 vehicles/hour/lane has been used to determine the lane requirements for LOS C.

All of these alternatives chosen for further study, have many characteristics in common. These similarities are outlined in the following paragraphs:

New bridges will be constructed across Fancher Creek, Kings River, Byrd Slough, Kings River Overflow, and Wahtoke Creek. No modification is required for the Alta Main Canal and the Friant-Kern Canal bridges.

The new bridge recently constructed at the Kings River crossing of existing Route 180 will be used for the eastbound lanes of the proposed four lane highway. The new bridge has three lanes, two through lanes for the main roadway and a left turn lane into the mobile home park east of the river. The bridge will be re-striped for two lanes only (when the mobile home park access is relocated) and another bridge of similar design and length would be constructed to the north of the existing bridge. The second bridge would serve westbound traffic, and have two 12-foot lanes, a 10-foot outside shoulder, and a 5-foot median shoulder. The highway will cross all other water courses, canals, or channels in reinforced concrete box culverts. The culverts would be sized to carry flows from a 100-year storm, or, in the case of irrigation canals, the required flow capacity.

The proposed alignment is generally elevated three feet above existing grade to minimize flooding. Drainage from the highway will be captured in roadside ditches that would be capable of carrying the water from a 10-year storm. Runoff would be conveyed to the south side of the highway in cross culverts, and eventually discharged to existing natural drainage channels. The roadside ditches would be a minimum of two feet below existing grade to prevent a significant rise in backwater. The combined elevations of the roadway and ditches designed to prevent the backwater from a 25-year flood from rising higher than the edge of the paved shoulder.

Traffic signals will be installed on an as-warranted basis. Based on estimates of turning movements for the year 2010, traffic signals will be warranted at the following intersections:

Temperance Avenue	Oliver Avenue
McCall Avenue	Piedra Road
Bethel Avenue	Reed Avenue
Academy Avenue	Frankwood Avenue

Access to the mobile home park and RV park east of the Kings River would be relocated to Piedra Road and the existing access to Route 180 would be removed. Abandoned portions of the existing Route 180 from Centerville to the Kings River and Byrd Slough to Frankwood Avenue would become cul-de-sacs and left for use as local access roads. Driveways onto existing Route 180 will be consolidated where possible to reduce conflict locations.

Alternative 1

With this alternative, the highway proceeds southeasterly from Temperance Avenue to the existing Route 180 alignment at Locan Avenue. Between Locan and Frankwood, the southern two lanes of the four lane highway are just north of the existing Route 180 pavement. To avoid the center of the community of Centerville and provide standard radius curves, Alternative 1 diverges from the existing highway alignment just west of the Kingsburg Canal, roughly paralleling the existing highway a few hundred feet to the north until it connects again with the existing alignment just west of the Kings River. The alignment diverges from existing Route 180 from about Lone Oak Road to just east of Frankwood Avenue. East of Frankwood Avenue, the two lane segment of the highway generally overlays the existing alignment. However, the sharp curves west of Alta Avenue are proposed to be replaced with an alignment that meets current standards. Intersections with left turn lanes, right turn lanes, or both, would be constructed at county roads as required along Alternative 1, except at Smith Road. Smith Road is shown to be terminated with a cul-de-sac just south of the proposed Route 180 alignment. Attachment H shows a typical layout of an at-grade intersection for the highway. An interchange at Temperance Avenue will be required in the future as traffic volumes increase beyond the capacity of an at-grade intersection, but is not being planned as part of this project. When the Temperance Avenue interchange is constructed, the existing access to homes and parcels on East Laurel Court Road is modified and Locan Avenue ends in a cul-de-sac on both sides of the highway.

Alternative 1A

This alternative follows Alternative 1 except for a by-pass around the community of Centerville. Alternative 1A follows the same alignment as Alternative 1 to just east of Lone Tree Channel where it curves north following the same alignment north of Centerville as the proposed Alternative 2, then connects with the existing Route 180 alignment east of Trimmer Springs Road.

Alternative 1A has the same design features as Alternative 1 except where it bypasses Centerville. There is no direct access to the highway proposed in this area. Existing Kings Canyon Road would provide access to the Centerville area via intersections with the proposed alignment at the east and west ends of Centerville.

Alternative 1A resulted from the consideration of different alignments that would bypass the community of Centerville. The potential displacement of historic structures due to construction within the community and the required non-standard geometrics to avoid or minimize displacement of structures resulted in the proposed alignment around Centerville.

Alternatives 1 and 1A are desirable because they retain the traditional use of the existing Route 180 corridor. (Attachment B).

Alternative 2

Under this alternative, Route 180 would be constructed as a four-lane divided expressway from the eastern end of the future Urban Route 180 freeway to Frankwood Avenue, and as a two lane conventional highway from Frankwood to Cove Avenue. However, Alternative 2 parallels the existing Route 180 alignment approximately 0.25-mile to the north, from Locan Avenue to the Kingsburg Canal, thus avoiding the community of Centerville. At the Kingsburg Canal, Alternative 2 curves to the southeast, rejoining Alternative 1 just east of Trimmer Springs Road. Alternative 2 was selected for further engineering studies and environmental review because preliminary data indicates it has the least overall impact of all the alternatives.

The highway facility proposed for Alternative 2 has the same design features as Alternative 1, as described above, with the following exceptions: The highway proposed for Alternative 2 is proposed to be designated as an expressway with controlled access from its western terminus to where it rejoins Alternative 1. Therefore, no driveways would be allowed onto the highway in this area. Access to properties north of the highway is provided via connections to county roads and existing Route 180 continues to provide parallel local access south of the highway.

Private farm roads and driveways from properties north of Alternative 2, that connect to existing Route 180 south of Alternative 2 near Trimmer Springs Road, are eliminated. This Alternative also severs Madsen Avenue and converts it into a cul-de-sac on both sides of the highway.

Current funding levels planned by the FCTA do not provide for complete construction of the facility that is required to meet the projected LOS in 2010. Therefore it may be necessary to stage the project by constructing portions of the improvements initially and defer other portions until funds become available. The limits of the alternatives where staging is feasible are as follows:

Alternative 1

A two-lane Stage 1 project on a four-lane right of way from Trimmer Springs Road to Frankwood Avenue.

Alternatives 1A and 2

A two-lane Stage 1 project on a four-lane right of way from Academy Avenue to Frankwood Avenue.

No-Build Alternative

With the no-build alternative, no substantial improvements to existing Route 180 are proposed. It would, however, be necessary to build a transition from the future Urban Route 180 freeway project to the existing Route 180 in order to maintain route continuity. This transition would follow the proposed Alternative 1 from approximately 1000 feet west of Temperance Avenue southeasterly to existing Route 180 at Locan Avenue. The roadway would transition from a four-lane expressway at the western terminus of the Urban Route 180 freeway to a two-lane facility at the connection to existing Route 180.

PHASING ALTERNATIVES

The 1991 Expenditure Plan for the Fresno County Transportation Authority (FCTA) provides funding for construction of the facility in phases. Therefore, consideration has been given to funding the project in four phases for each of the three alternatives (i.e. Alternative 1, Alternative 1A and Alternative 2). The extent of the construction phases and the estimated construction schedule is shown below:

ALTERNATIVES 1, 1A and 2		CONSTRUCTION SCHEDULE
Phase 1	Temperance Avenue to Academy Avenue (4 lanes)	July 1998 to Dec. 1999
Phase 2	Academy Avenue to Trimmer Springs (4 lanes)	July 2000 to Dec. 2001
Phase 3	Trimmer Springs to Frankwood Avenue (4 lanes)	July 2002 to Dec. 2003
Phase 4	Frankwood Avenue to Cove Avenue (2 lanes)	July 2004 to July 2006

Construction of any of the alignments requires staging activities such that traffic is maintained on the existing highway and local roads without significant road closures. Construction of Alternative 1 or 1A will first require the construction of the north lanes and structures while traffic remains on the existing alignment. Traffic will then be diverted to the newly completed north lanes while the south lanes are constructed. Construction of Alternative 2 or the by-pass portion of Alternative 1A does not require the eastbound and westbound lanes to be constructed sequentially because traffic can remain on the existing Route 180 until completion of the highway.

Construction of the two-lane portion of Route 180, east of Frankwood Avenue, would require temporary lane closures in order to facilitate the necessary construction staging. Construction of the Wahtoke Creek Bridge could require one way traffic control to construct one half of the structure if constructed in the same location as the existing bridge. This would also require staging to avoid impacts to possible environmental findings adjacent to the existing structure.

There are two recently completed projects on the eastern end of this segment of Route 180 that are included in all of the alternatives. The existing Kings River bridge has been widened to three lanes to provide a left turn lane for the mobile home and RV parks adjacent to existing Route 180 in the Kings River flood plain. The roadway at Wakefield Avenue has been realigned from west of Crawford Avenue to east of Wakefield Avenue to eliminate the 90-degree turns at Wakefield Avenue. These alterations are consistent with the project design, and no additional changes would be made to these segments of the highway in conjunction with any of the proposed alternatives.

Construction of the alternatives at the western end of the project must be consistent with the new Urban Route 180 project, which extends from Route 41 in central Fresno to Fowler Avenue. Fowler Avenue is at the eastern fringe of urban development. The Urban Route 180 project is being developed as a four- to six-lane freeway and expressway. The new facility is located on new alignment about 1.2 miles north of existing Route 180 and will terminate with a transition to the existing Route 180 alignment just east of Temperance Avenue. These changes in Route 180 are considered design requirements for the proposed project because they will be required for all alternative design proposals.

2. Alternatives Withdrawn from Consideration

The following alternatives (Attachment F) were dropped from further consideration. They include the following:

Alternatives 1N, 1M, and 1S

These alternatives were on the existing Route 180 alignment. Alternative 1N used the existing highway as a frontage road to the south of a new expressway facility, Alternative 1M incorporated the existing highway as one of the mainlines in a new expressway facility, and Alternative 1S used the existing highway as a frontage road north of a new expressway.

The advantages to these three alternatives included the utilization of existing right of way and avoidance of relinquishment expenses. However, all three of these alternates require additional right of way on one or both sides of the roadway in order to provide the proposed frontage roads. This would require significant removal and relocation of residential, commercial and agricultural structures, particularly within Centerville, and also involves potential 4(f) recreational property. These costs offset any savings realized by not relinquishing the existing roadway.

Alternative 3

This alternative ran southeasterly from Fowler to Locan Avenue, but crossed the existing Route 180 alignment and then paralleled it 0.25-mile to the south. The alignment turned north approximately one mile west of Centerville and then joined the existing Route 180 alignment to the west of Centerville.

The alternative had the advantage of the shortest travel time for the majority of the traffic that entered the new facility from the south on the main cross streets. The disadvantages included passing through the heart of Centerville and causing major relocation and construction related disturbance. However, it also lengthened travel distances for east/west through traffic.

Alternative 4

Alternative 4 was approximately 1.25 miles south of existing Route 180. This alignment followed the same alignment as Alternative 3 from Fowler Avenue southeasterly to a point between Church and California Avenues, then proceeded east, crossed the Kings River at a new location, and intersected existing Route 180 near the Friant-Kern Canal.

Alternative 4 was withdrawn from further consideration early in the corridor study process because of its potential impacts to wetlands in the Kings River floodplain. The new river crossing would require a Section 404 permit by the Corps of Engineers, which requires a complete analysis of all alternatives to taking wetlands. This would be difficult to justify since the other alternatives cross the Kings River immediately adjacent to the existing bridge crossing. This alternative also lengthened travel distances for through traffic (more than Alternative 3).

Alternative 5

Alternative 5 paralleled the existing Route 180 alignment 0.5-mile to the north along Tulare Avenue. This alignment continued to the north of Centerville and then joined existing Route 180 approximately 4000 feet east of Centerville.

Alternative 5 required more travel time for the traffic from the south on the main cross streets than Alternatives 1, 2, or 3. An interchange at Temperance Avenue required significant residential relocations and higher structure costs than Alternatives 1, 2, 3, and 6.

Alternative 6

This alternative started at Fowler Avenue and paralleled the existing Route 180 alignment approximately 1.25 miles to the north (0.25-mile north of Belmont Avenue), and joining the existing Route 180 alignment 4000 feet east of Centerville.

Alternative 6 required the greatest travel time for the majority of the traffic that entered the new facility from the south on the main cross streets. This alignment affected the greatest number of land parcels and required two additional bridges over Fancher Creek Canal. It also had more Federal Emergency Management Agency (FEMA)-designated floodplain encroachment than the other Alternatives.

3. Non-Standard Design Features

A design exception would be required for a deviation from the advisory design standard for a minimum roadway grade of 0.3 percent in order to allow a new minimum roadway grade of 0.12 percent. This lesser grade is desirable because the natural terrain in the Fresno area is generally very flat. The terrain slope averages 0.11 percent. This exception would allow the roadway profile to follow the existing terrain without inducing a "rollercoaster" effect.

4. Cooperative Features

A Cooperative Agreement with the Fresno County Transportation Authority will be required if they provide funding for design, right of way, or construction of the project. No agreement will be required if State and Federal funds are used for these activities.

5. Erosion Control

In accordance with current policy, erosion control materials will be applied to all cut and fill slopes on the project.

6. Replacement Planting

Replacement planting will be required for displaced elderberry plants and riparian woods, i.e. valley oaks and sycamores. A formal replanting program would be developed in conjunction with the U.S. Fish and Wildlife Service and the California Department of Fish and Game. Details regarding replacement planting are contained in the EIS/EIR.

7. **Route Adoption**

The proposed alternatives are not presently located on an adopted route alignment. Therefore, a new route adoption will be required along the length of the proposed alignments because portions of all of the alternatives are on new alignment and the existing highway that is to be replaced would be relinquished to Fresno County. This route adoption will be for a controlled access highway.

8. **Project Costs**

The costs of the various project alternatives are summarized below. All of the estimates include all relinquishment costs. Costs for the construction of a four lane expressway/two lane highway are shown as follows:

a. **Alternative 1**

Without Temperance Interchange			With Temperance Interchange		
Roadway	$	46,670,000	Roadway	$	48,110,000
Structures	$	2,649,000	Structures	$	3,818,000
Right of Way	$	18,707,000	Right of Way	$	21,822,000
TOTAL	$	68,026,000	TOTAL	$	73,750,000

b. **Alternative 1A**

Without Temperance Interchange			With Temperance Interchange		
Roadway	$	47,390,000	Roadway	$	49,500,000
Structures	$	2,649,000	Structures	$	3,818,000
Right of Way	$	17,844,000	Right of Way	$	20,959,000
TOTAL	$	67,883,000	TOTAL	$	74,277,000

c. **Alternative 2**

Without Temperance Interchange			With Temperance Interchange		
Roadway	$	47,380,000	Roadway	$	48,710,000
Structures	$	2,649,000	Structures	$	3,759,000
Right of Way	$	12,159,000	Right of Way	$	15,706,000
TOTAL	$	62,188,000	TOTAL	$	68,175,000

The initial costs of the two-lane staged alternatives provide for a four-lane expressway to Academy Avenue or Trimmer Springs Road, depending on the alternative as described in Section VII. Costs for the staged alternatives are shown as follows:

d. **Alternative 1 (Staged)**

Without Temperance Interchange			With Temperance Interchange		
Roadway	$	44,460,000	Roadway	$	45,900,000
Structures	$	1,130,000	Structures	$	2,299,000
Right of Way	$	18,707,000	Right of Way	$	21,822,000
TOTAL	$	64,297,000	TOTAL	$	70,021,000

e. **Alternative 1A (Staged)**

Without Temperance Interchange			With Temperance Interchange		
Roadway	$	43,640,000	Roadway	$	45,750,000
Structures	$	1,130,000	Structures	$	2,299,000
Right of Way	$	17,844,000	Right of Way	$	20,959,000
TOTAL	$	62,614,000	TOTAL	$	69,008,000

f. **Alternative 2 (Staged)**

Without Temperance Interchange			With Temperance Interchange		
Roadway	$	42,990,000	Roadway	$	44,320,000
Structures	$	1,130,000	Structures	$	2,240,000
Right of Way	$	12,159,000	Right of Way	$	15,706,000
TOTAL	$	56,279,000	TOTAL	$	62,266,000

9. Conformance to Project Size Policy

Total project construction costs for each of the alternatives exceeds the $15 million limit desirable for obtaining competitive bids. The use of staged construction is necessary in order to satisfy this requirement. As stated in Section VII-1.B each of the alternatives have been broken down into four (4) construction phases. Construction costs for each of the phases meet or slightly exceed the $15 million limit. In no case does the construction cost exceed $20 million for any of the phases, except Phase 1.

10. Right-of-Way

The approximate right-of-way requirements for the project alternatives are listed below. The Temperance Avenue interchange would require approximately 50 acres additional right-of-way for each of the alternatives.

RIGHT-OF-WAY REQUIREMENTS FOR PROJECT ALTERNATIVES

Alternative	Total Right-of-Way (Acres)	Existing Right-of-Way (Acres)	New Right-of-Way To Be Purchased
1	457	137	320
1A	457	127	330
2	471	71	400

11. Project Effectiveness in Relieving Problems

The stated deficiencies of the project route, i.e. insufficient capacity, geometric elements which do not meet current standards, and higher-than-expected accident rates are interrelated. Mitigation of some of the deficiencies without addressing others will not present a satisfactory solution.

The proposed highway was designed for a 70 mph design speed with a capacity of at least 1800 vehicles/lane/hour. Since there are expected to be signalized intersections along the proposed Route 180, these intersections will dictate the level of service along the sections of the proposed facility in the vicinity of the intersections. Otherwise, level of service will be dictated by roadway characteristics. In 2010, proposed Route 180 would operate at a minimum Level of Service (LOS) C assuming the four lane divided highway is constructed to Frankwood Avenue. If a two-lane staging alternative is implemented, the highway west of Trimmer Springs Road would operate at a minimum LOS E. Between Trimmer Springs Road and Frankwood Avenue, the two lane alternatives would operate at a minimum LOS D.

Construction of the project would meet or exceed current standards for horizontal and vertical alignments along the route. The existing roadway, which does not currently conform to current standards for lane and shoulder widths and sight distances would be corrected. As stated in Section V, correction of any of the stated deficiencies would reduce accident rates in varying amounts along the route, which in turn, would translate into annual accident cost savings.

VIII. PROPOSAL FUNDING

1. Special Funding

The proposed project is not included in the State Transportation Improvement Plan (STIP). Funding for the project is expected to come from the Fresno County Transportation Authority using revenues from Measure C, the one half percent county sales tax. This project is an HE 14, New Highway Construction Program project, and is eligible for state and federal funds.

2. Budgetary Description

The recommended budgetary project description should be as follows:

06-Fre-180-R64.6/R84.0	In Fresno County from Temperance Avenue to
06250-342500	Cove Avenue.

IX. OTHER CONSIDERATIONS

1. Park and Ride Facilities

The need for a park and ride lot has been identified at the intersection of Academy Avenue and Route 180. It is anticipated that the lot will be constructed under a separate contract. This facility is consistent with the San Joaquin Valley Unified Air Pollution Control Districts Air Quality Attainment Plan. The Plan reduces air pollution by reducing traffic over the segment of the proposed route that experiences the highest traffic volumes.

2. Non-Motorized Vehicle/Pedestrian Access

Pedestrian crosswalks will be provided at signalized intersections, as warranted, on each of the alternatives. The paved shoulders, which would be from 8 to 10 feet wide on all of the alternatives, facilitate bicycle use; however, there are no plans to construct dedicated bicycle lanes.

3. Oversized Loads

The proposed project will meet current design standards for horizontal and vertical clearances. Ramp and intersection turn radii will be constructed to accommodate STAA truck turning movements.

4. Access to Navigable Rivers

There are no navigable rivers within the project limits.

5. Wetlands and Floodplains

a. Wetlands

The alignments cross wetlands in the Kings River Flood Plain and at Lone Tree Channel, Wahtoke Creek, and an intermittent, unnamed drainage east of Crawford Avenue. Details regarding wetlands are contained in the EIS/EIR.

b. Floodplains

Based on the FEMA flood insurance rate maps, each of the proposed alternatives cross twelve (12) areas designated as Zone A (i.e. areas inundated by the 100 year flood to depths greater than one foot). All the encroachments would be transverse or perpendicular to the floodplain and have a minor effect on flood levels, increasing the depth of 100-year flood waters by less than one foot and, in most cases, by less than 0.5 foot. This minor increase in flood depth increases the flooded area by less than 0.1 acre. In the case of China Slough, Collins Creek, the Kings River, Byrd Slough, and the Kings River Overflow, the additional flooded areas are within the natural flood plain of the Kings River. Bridges would also be constructed at an elevation to accommodate the flows.

6. Permits and Other Approvals Required

Permits will be required from the U.S. Army Corp of Engineers (Section 404) and California Department of Fish and Game (1601) for the crossing of the Kings River, Wahtoke Creek, and several small intermittent drainages. The Kings River crossing will also require a permit from the State of California Reclamation Board. During construction, a National Pollutant Discharge Elimination System (NPDES) permit will be required.

7. Consistency with Other Planning

The proposed project is consistent with state and local plans, including the Council of Fresno County Governments (COFCG) Regional Transportation Plan and Congestion Management Program.

8. Disposition of Existing Facility

All of the proposed alternatives require relinquishment of portions of existing Route 180 to local governmental authorities (Fresno County). The existing facility will have to be in a state of good repair prior to relinquishment, as required by Section 73 of the Streets and Highway Code. In conformance with the Relinquishment Cost Study dated September 1992, the following repairs are expected in conjunction with relinquishment: 0.25 foot of asphalt overlay on pavement reinforcing fabric; a three-foot wide dirt shoulder section; and crack sealing and spot failure repair. In addition, each alternative has locations where the existing highway is to be abandoned and the pavement removed and replaced with clean fill dirt. These abandonment costs are included in the relinquishment estimate. The total estimated relinquishment cost for Alternative 1 is $672,000; $758,000 for Alternative 1A and $1;790,000 for Alternative 2.

9. Right-of-Way Impact Studies

Each of the proposed alternatives require the acquisition of new right-of-way and the abandonment of some existing right-of-way. The western portion of the proposed project begins on the fringe of the Fresno-Clovis Metropolitan Area (FCMA). From Temperance to Locan Avenue, the alignments traverse a rural suburban area of ranchettes and small subdivisions interspersed with agricultural lands. East of Locan Avenue, the alternatives cross agricultural land with occasional homes. There are only a few commercial businesses in the region, and they are located in or near the communities of Sanger, Centerville, and Minkler. A detailed discussion of the right-of-way impacts is included in the EIS/EIR.

10. Railroad/Utility Involvement

a. Railroad:
No railroad facilities will be affected by the proposed project.

b. Utilities:

Alternatives 1 and 1A require the relocation of existing electric, telephone and gas lines parallel to existing Route 180 along nearly the entire length of the alignment. Alternative 2 requires the modification of utility facilities in the vicinity of county road intersections between Temperance Avenue and Trimmer Springs Road. From Trimmer Springs Road to Cove Avenue, all alternatives require the same relocations because they follow a common alignment.

11. Value Engineering

A formal value engineering study was not performed for the project report stage of this project. It was determined that, in order to make appropriate value engineering recommendations for complex projects, such as the proposed project, value engineering analyses of a greater level of detail than was practical during the project report stage would be required. However a number of changes were recommended and included in this phase of the project in the interest of value engineering. These recommendations are as follows:

- The vertical alignment was refined to be more economical.

- The existing (new) Kings River bridge is included in plans for future widening on Route 180.

It is recommended that a formal value engineering team be organized during the design stage of the project. The preliminary studies generally are not so rigid in their concept that more meaningful value engineering recommendations cannot be made during design.

12. Conservation of Energy and Other Nonrenewable Resources

An energy analysis report for Route 180, prepared by Woodward-Clyde Consultants on July 1992, concluded that construction of any of the project alternatives would result in consumption of less direct energy than the no-build project alternative.

A detailed discussion of energy consumption is included in the EIS/EIR.

13. Enforcement Activities of the California Highway Patrol

The enforcement activities of the California Highway Patrol will not be affected by this project.

14. Hazardous Wastes or Materials

A Hazardous Waste Investigation was performed and the report outlined known and potential hazardous waste sites in the vicinity of the three alternatives. These sites were grouped into four categories of recommendations for further action in the event that the project is constructed. A detailed discussion of Hazardous Wastes and Materials is contained in the EIS/EIR.

15. Ramp Metering

No ramp metering is anticipated as a part of this project. The need for ramp metering would be reviewed as part of the decision to design and construct the Temperance Avenue Interchange, an optional part of this project, when warranted.

16. Traffic Management Plan

The proposed construction staging for the four lane sections of any of the alternatives would not impose significant traffic delays, therefore a Traffic Management Plan is not required. The construction of the two lane highway, west of Frankwood Avenue, immediately adjacent to the existing roadway could create traffic delays. A Traffic Management Plan will be prepared as a part of the final design for this section of the project.

17. Project Development Team

A Project Development Team (PDT) was established in conjunction with this project. The first meeting of the team was held in February, 1990, subsequent meetings have been held on a regular basis. The PDT includes representatives from Caltrans, Fresno County Transportation Authority, several local government agencies and the consulting engineer team. The Project Development Team functions as a steering committee through the project development process.

To date, the following PDT Meetings have been held and recorded:

February 15, 1990
June 4, 1990
March 1, 1991
June 17, 1992

18. Needed Agreements

An agreement will be needed with the Fresno Metropolitan Flood Control District if their facilities are used to dispose of storm water run-off from the project.

X. PROJECT REVIEWS

The following personnel and agencies have reviewed and concurred with the plans throughout their development. Other agencies and organizations have also commented on this project in an informal manner. The general public has also had the opportunity to comment on this project through the public information program.

Ken Hintzman, Coordinator, Headquarters Office of Project Planning and Design
Lee Nottingham, Geometrician, Headquarters Office of Project Planning and Design
Jim Lee, Area Engineer, FHWA
Les Jorgenson, Assistant Director, Fresno County Public Works and Development Services Department (retired)
Jerry K. Boren, Assistant Director, Fresno County Public Works and Development Services Department (retired)

XI. PUBLIC HEARING

The environmental document is anticipated to be available for circulation in the Spring of 1994. Once the document is available, a notice of public hearing will be published and a hearing will be held.

XII. CONTROLLED ACCESS HIGHWAY AGREEMENT

A Controlled Access Highway Agreement with the County of Fresno will be required for the adopted alignment after selection of the alternative.

XIII. ENVIRONMENTAL CLEARANCE

I have reviewed the Project Report and certify that the draft environmental document has been prepared in accordance with Caltrans Environmental Regulations and the attached Draft Environmental Impact Statement (DEIS) is the appropriate document for the purpose as described.

9/28/93

Bryan J. Apper
Chief, Environmental Analysis, Branch B

Date

XIV. RIGHT-OF-WAY CERTIFICATION

I have reviewed the right-of-way information contained in this Project Report and the Right-of-Way Data Sheets attached hereto and find the data to be complete, current, and accurate.

9/16/93

Randeen Walter
Deputy District Director
Right-of-Way

Date

XV. PROJECT PERSONNEL

Robert E. Waddington
Deputy District Director
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Roy V. Andersen
Project Manager
Project Development B
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Environmental Project Manager
(415) 874-3166

James D. Bissell
Centennial Engineering, Inc.
Project Engineer
(510) 460-5050

XVI. RECOMMENDATION

I have reviewed this Project Report and recommend approval and authorization to circulate the environmental document and to proceed with the notice of public hearing.

R E Waddington — 9-14-93

Robert E. Waddington
Deputy District Director
Project Development B

Date

XVII. ATTACHMENTS

A. Project Location Map
B. Project Alternatives
C. Existing Daily Traffic
D. 2010 Adjusted Daily Traffic
E. Level of Service On Route 180 in 2010
F. Corridor Study Area
G. Typical Cross Sections of 4-Lane and 2-Lane Highway
H. Typical Intersection Design
I. TASAS Table B
J. Right-of-Way Data
K. Draft Environmental Impact Statement

CONSOLIDATED IRRIGATION DISTRICT

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PHILLIP G. DESATOFF, Manager/Treasurer
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ROBERT NIELSEN JR., CARUTHERS

March 15, 2012

Julie Dick Tex
California Dept. of Transportation
855 "M" Street, Ste. 200
Fresno, CA 93721

SUBJECT: Highway 180 Crossings of Fowler Switch and Lone Tree Canals

Dear Ms. Tex:

This letter is in response to your February 28, 2012 e-mail inquiry regarding the above subject. The Fowler Switch and Lone Tree Canals are solely owned and operated by Consolidated Irrigation District (CID). No other public agencies or private entities have ownership or rights to use these canals. CID is the only agency that maintains the canals.

There are periods when our canals are dry. However, the dry season is not necessarily the same for the Fowler Switch and Lone Tree canals and it is dependent on several factors which are noted as follows.

<u>Fowler Switch Canal</u>
The irrigation season for the Fowler Switch is typically from April through mid-August. During periods of non-irrigation the canal is also used to deliver water to CID ponds for groundwater recharge. The availability of recharge water is dependent upon runoff conditions in the Kings River. In years with above normal runoff there are Schedule D releases in the River that are shared with Fresno Irrigation District (FID) in alternating years. FID would receive these potential flows in water year 2012 and CID would receive them in 2013. Schedule D flows are not typically diverted to the Fowler Switch Canal unless the flow exceeds 100 cfs. If there are flood releases in the River, CID diverts this water to the Fowler Switch regardless of the year. In a dry year, the dry season for the Fowler Switch could be from mid-August through March. In a wet year,

the dry season may only be in September and October. Historically there have even been years when CID delivered irrigation and flood water year round, but this is rare.

Lone Tree Canal

Certain lands that receive water through the Lone Tree Canal have a higher (Church) water right than lands receiving surface water through the Fowler Switch. Therefore, the irrigation season for Church water is longer, typically from mid-March through the end of September. There are unregulated field drains into the Lone Tree Canal upstream of Highway 180, so there can be storm water flows in the channel during and after rain storms.

Very truly yours,

Lupe Chavez

Lupe Chavez
Assistant General Manager

State of California
Department of Transportation

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: SANKU MOHAN
Senior Transportation Engineer
District 6 Design

Attention: Larry Lowe

Date: October 26, 2011

File: 06-FRE -180
PM R71.8/R74.4
06-342521
Project ID. 06 0000 0381
Kings Canyon Segt 2 CMS

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES - MS 5

Subject: Geotechnical Design Report

Introduction

Per your email request, dated September 22, 2011, a Geotechnical Design Report (GDR) is provided for the Kings Canyon Expressway Segment 2 project on Route 180, also known as Kings Canyon Road. This project is located in Fresno County (PM 71.8 to PM74.4). See Plate No. 1, Vicinity Map.

This project proposes to improve an existing segment of Route 180 from 0.6 mile west of Quality Avenue to 0.2 mile west of Smith Avenue. Route 180 will be changed from a conventional two-lane highway to a 4-lane expressway by widening and re-aligning the roadway to the north and adding one lane on each direction. New bridges will be constructed at the Fowler Switch and Lone Tree Canals locations. As part of the improvements, one Model 500 Changeable Message Sign (CMS) is proposed at Sta 367+65.0 (PM 72.6) which is near the intersection of Route 180 and N. Madsen Avenue.

This memorandum documents the geotechnical recommendations regarding the foundation of the CMS sign only. Foundation recommendations for the proposed bridges will be provided in separate Foundation Reports, and they will be sent to DES Structure Design.

Pertinent Reports and Investigations

In preparing of this report, following documents were reviewed:

1. Western Regional Climate Center for 1999-2010.

2. Geologic Map of California: Fresno sheet: California Division of Mines and Geology, dated 1965.
3. Boring logs for Fowler Switch Canal Bridge (Br. #42-0437), dated Sept. and Oct. 2011.
4. Groundwater Level Data Wells from Department of Water Resources.

Existing Facilities and Proposed Improvements

The proposed project extends from PM 71.8 to PM 74.4 on Route 180. Along this stretch of the roadway, Route 180 currently consists of a 2-lane undivided roadway paved with asphalt concrete aligned in a generally east-west direction. The roadway is built on level terrain on original ground. There are minor slopes of 1:4 (V:H) or flatter. There are local streets that are directly connected the highway to mostly farmland. Utility lines run parallel along the roadway on either side.

The proposed work of the project includes widening and re-aligning the roadway to a 4-lane expressway. The roadway will be offset to the north. The inside shoulder will be 14 to 26 ft wide and outside shoulder will be 10 ft wide. Side slope will be 2:1 (H:V) or flatter. As part of the project, a Model 500 CMS is proposed at Sta 367+65.0 (PM 72.6) on the eastbound side which is near the intersection of Route 180 and N. Madsen Avenue.

Physical Setting

The physical setting of the project site and the surrounding area was reviewed to provide climate, topography and drainage, man-made and natural features, geology characteristics to aid in project design and construction planning. The following is a discussion of the review:

Climate

Information regarding the climate in the project area is provided by the Western Regional Climate Center period of record from 1999 to 2010. There is one station located between Fresno and Sanger (#043256). The average annual total precipitation is 10.98 in. The majority of this precipitation falls between October and May. The average daily minimum temperature ranges from 37.8° F in January to 67.3° F in July, and the average daily maximum temperature ranges from 56.5 ° F in January to 98.0° F in July. Freezing temperatures and snowfall are not common at the project site. Yearly updates are available at the Western Regional Climate Center web site.

Topography & Drainage

The site is located in the Great Valley geomorphic province of California. It is on the west side of the Sierra Nevada Mountain Range and the east side of the Coast Mountain Range. The level terrain is typical in the Great Valley region. The approximate ground elevation near the proposed CMS is 381 ft. The vicinity around the project area is mainly occupied by farmland.

Man-made and Natural Features of Engineering and Construction Significance

There are overhead power lines that run along the exiting roadway on both sides of the. There are also overhead power lines that cross the roadway various locations. There is no railroad crosses the roadway within the project area. Fowler Switch Canal and Lone Tree Canal intersect the proposed project limits. New bridges are proposed at the intersections of these canals.

Regional Geology

The California Department of Conservation, Division of Mines and Geology Geologic Map of California, Fresno sheet (1965) was used to determine the geologic formations in the project area. A section from these maps showing the project locations are attached as Plates No. 2. The project locations are mapped as being in an area of Recent Alluvial Fan Deposits in the Great Valley (Q_f) and Pleistocene nonmarine (Q_c) formed during the Quaternary Period of the Cenozoic Era between 10 thousand and 1.6 million years ago.

Exploration

On October 5, 2011, one cone penetration test (CPT) was done to investigate the soil condition below the exiting ground surface at the proposed CMS location. See attached CPT Result for more details.

Geotechnical Testing

Corrosion

Several corrosion tests were done on the soil samples obtained at the nearby proposed locations of the Fowler Switch Canal Bridge and Lon Tree Canal Bridge. The results of these tests indicate that the soils are not expected to be corrosive. Furthermore, due to the sandy nature of the soil at the proposed CMS location, the site is not expected to be corrosive.

Geotechnical Conditions

In general, the soil characteristics within the project area, according to CPT and boring logs for Fowler Switch Canal Bridge, consist of medium dense to dense sandy materials with interbedded layers of silt lenses on the upper 65 ft. Rounded cobbles and gravels were found about 65 ft below existing ground surface. Boring logs for Lone Tree Canal Bridge were not used for the proposed CMS because the bridge is considerably far away from the CMS site.

Groundwater

The State Department of Water Resources (DWR) has monitored groundwater level wells across California for decades. There are four monitoring wells that are within the vicinity of the project areas (data recorded range from 1963-2010). Based on data obtained from the monitoring wells, the average groundwater elevations measured for these 4 wells are 354, 347, 376, and 378 ft. These elevations correspond to groundwater depths of 42, 29, 33, and 29 ft, respectively. Groundwater conditions will vary according to variations in rainfall, well pumping, and construction activities.

According to boring logs from September and October 2011, groundwater was measured to be about 32 to 37 ft below the exiting ground which correspond to elevations of 365 and 356 ft, respectively.

For design purposes, groundwater elevation was assumed to be 365 ft.

Geotechnical Recommendations

The soil conditions are expected to satisfy the 2006 standard CMS Model 500 requirements. The Office of Geotechnical Design North recommends that the proposed standard plan pile foundation for proposed Changeable Message Sign can be constructed as planned. This model should consist of a single cast-in-drilled-hole (CIDH) pile of 22-ft in embedment length and 5 ft in diameter.

Construction Considerations

1. All earthworks shall follow Section 19 of Caltrans Standard Specifications.

2. Loose sand may be encountered during pile construction. Temporary casing may be needed for CIDH piles construction if caving occurs. If temporary casing is used during installation of CIDH piles, it shall be removed while the concrete is being placed in order to develop the required pile capacity.
3. There is a chance that groundwater may be encountered during CIDH piles construction. Wet specs shall be used if groundwater is encountered.

Project Information

Standard Special Provision S5-280, "Project Information", discloses to bidders and contractors a list of pertinent information available for their inspection prior to bid opening. The following is an excerpt from SSP S5-280 disclosing information originating from Geotechnical Services. Items listed to be included in the Information Handout will be provided in Acrobat (.pdf) format to the addressee(s) of this report via electronic mail.

Data and information attached with the project plans are:

None

Data and information included in the Information Handout provided to the bidders and contractors are:

Geotechnical Design Report for EA 06-342521, dated October 26, 2011.

Data and information available for inspection at the District Office:

None.

Data and information available for inspection at the Transportation Laboratory are:

None.

If you have any questions or comments, please call me, Carolyn Zhen-Ru, at (916) 227-1055 or my supervisor, John Huang, at (916) 227-1037.

CAROLYN ZHEN-RU, P.E.
Transportation Engineer, Civil
Office of Geotechnical Design – North
Branch E

JOHN HUANG, P.E.
Senior Materials and Research Engineer
Office of Geotechnical Design – North
Branch E

c: John Huang (Geotechnical Services, Geotechnical Design North)
Garth Fernandez (D06 Project Manager)
Mark Willian (Geotechnical Services, Corporate Unit)
Ted Mooradian (D06 District Materials Engineer)
District Construction R.E. Pending File

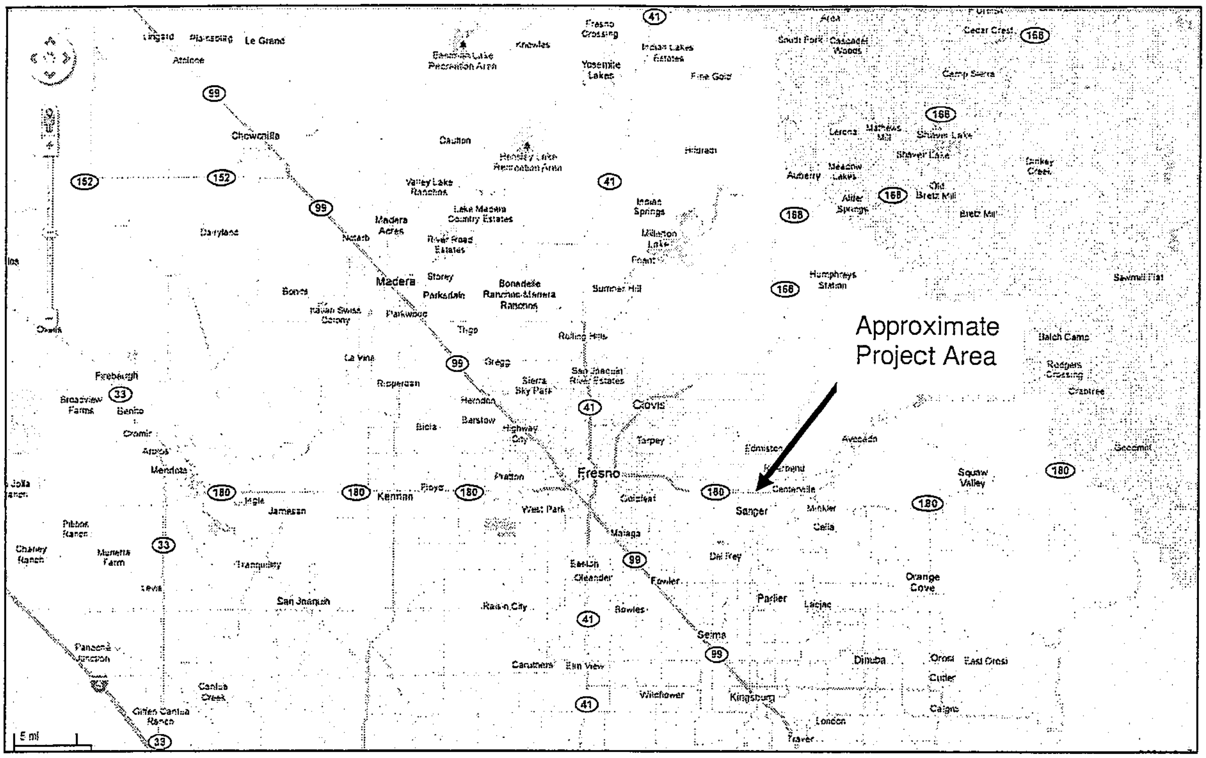
LIST OF ATTACHMENTS

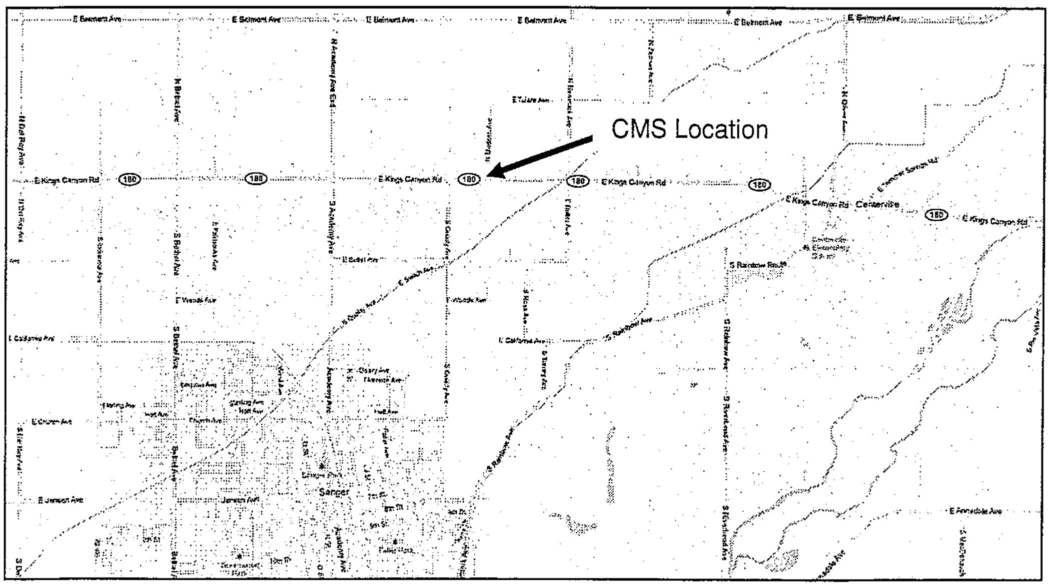
Plate 1 Vicinity Map

Plate 2 Geology Map

CPT Location Map

CPT results





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CALTRANS
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design - North

Caltrans

06 0000 0381	**VICINITY MAP**	
Date: Sept 2011		
06-FRE-180 PM R71.8/R74.4 **Geotechnical Design Report**		Plate No. 1

SCI PRODUCTS INC.
SMART CUSHION INNOVATIONS

Model SCI 70/100 GM
INSTALLATION AND REPAIR MANUAL

TABLE OF CONTENTS

SYSTEM DESCRIPTION

The Crash Cushion is a redirective, non-gating, bidirectional crash barrier designed to protect roadside hazards from out-of-control vehicles in a manner, which reduces the vehicle occupant's exposure to risk. The Crash Cushion achieves this goal while usually being completely reusable after each event and only requiring minimal replacement of consumable parts from a direct frontal or side impact.

The Crash Cushion is delivered from the factory completely assembled and ready to install. No field assembly is required.

The Crash Cushion has been tested and certified based on the requirements of NCHRP 350 for Level 2 & 3 service. This includes stopping or redirecting 2000 kg (4400 lb) pickup trucks as well as 820 kg (1800 lb) light passenger cars within NCHRP 350 guidelines.

Proper performance within these limits depends on correct installation of the system on an approved foundation. Any Crash Cushion not installed according to the drawings and the requirements of this installation manual may present an unsafe condition and should be re-installed accordingly.

Impacts with vehicles whose size or mass are outside of those tested according to NCHRP 350 or with vehicles traveling at speeds greater than those tested according to NCHRP 350 will not necessarily produce results within the test criteria. While the tests account for most crash conditions, they do not cover all situations. The Crash Cushion is in conformance with the requirements of NCHRP 350 Level 2 & 3 but is not guaranteed to safely stop a vehicle in a situation not encompassed by the test conditions.

SAFETY

All work during installation, repair and inspection of the Crash Cushion should be performed according to Federal, State and Local laws.

The Level 2 & 3-24" Hazard Crash Cushion is described by the following drawing:

Mechanism

SCI100GM – SEE APPENDIX – FIGURE 1 - ASSEMBLY DRAWING
SCI70GM – SEE APPENDIX – FIGURE 1A - ASSEMBLY DRAWING

EQUIPMENT LIST

Installation and Resetting

The following tools and equipment will be required to install and repair the Crash Cushion:

- Standard roadside work area safety equipment
- Personal safety equipment (gloves, eye/face protection, etc.)
- Means of safely unloading 3500lb.
- Compressed air source/Vaccum and bottle brush
- Safety Goggles
- Four Lifting Slings or Four Point Sling
- Rotary Impact Drill for concrete
- 7/8” X 14” or longer concrete drill bit
- Epoxy system for anchor bolts
- Combination Wrench and Deep Sockets (Including 1 ¼”, 1 ½”, 1 5/8”)
- Socket Wrench and Breaker Bar
- Torque wrench (225 ft-lb capacity) with 3’ extension
- Measuring and Layout Equipment (tape measure, chalk line, markers, etc.)
- Two 6’ pry bars
- 7/32” Allen Wrench
- Suitable Pulling Means (strap or chain)
- Come-Along
- 2 – long handled flat screwdrivers
- Misc. small tools (hammers, pliers, screw drivers, vise grips, etc.)

This list is adequate for general installation and repair. However, depending on site conditions, additional tools and equipment may be required.

FOUNDATION

Any of the following foundations will meet the requirements:

- 6” Reinforced Concrete Pad
- 8” Unreinforced Concrete Pad
- 3” Asphalt over 3” of Concrete
- 6” Asphalt over 6” of Compacted Subbase
- 8” Asphalt

Note: Concrete should be 28 Mpa or 4000 PSI minimum at full cure.

Installing the Crash Cushion on an existing foundation may result in anchor bolt locations corresponding to rebar positions in the foundation. It may be necessary to use more elaborate drilling equipment than simply an impact drill with standard concrete bits.

Prior to installing the Crash Cushion on an existing foundation, the concrete must be thoroughly inspected for signs of cracking, surface wear, shifting from original position, undercut of earth below or to the sides supporting the foundation, settling, and any other signs of age or deterioration which may make the foundation unusable. If any of these signs are evident, the foundation must be removed and a new one must be installed according to requirements stated earlier. If prior bolt patterns are present, use proper engineering calculations to assure adequate strength in the new holes.

INSTALLATION INSTRUCTIONS

Site Preparation

New foundations should be installed according to APPENDIX – FIGURE 2 – FOUNDATION DRAWING. Concrete should reach full cure strength before use. The surface of the foundation must be cleaned of all debris, dirt, mud, sand, etc., as the Crash Cushion must sit on a straight surface.

Placement of the Crash Cushion

Measure the correct distance and offset of the Crash Cushion according to the type of obstruction being shielded and the type of transition being used. The dimensions shown on the transition drawings may be used as a guide for this.

The Crash Cushion is shipped in one piece, fully assembled. Using a choked four-point attachment on panel support frames #3 & #4 behind the sled, lift the Crash Cushion off of the transporting vehicle with a boom or forklift of sufficient capacity and place it in the position marked on the foundation.

Once in place, double-check the measurements one more time to be sure of the proper location of the Crash Cushion.

Warning: Side Panels can telescope 30” beyond the last Terminal Brace at the rear of the Crash Cushion. All objects that may interfere with this motion can affect the performance of and cause undue damage to the Crash Cushion.

Anchor Installation

Embedment Requirements are as follows:

- 6” Reinforced Concrete Pad with anchor embedment of 5.5”
- 8” Unreinforced Concrete Pad with anchor embedment of 5.5”
- 3” Asphalt over 3” of Concrete with anchor embedment of 16.5”
- 6” Asphalt over 6” of Compacted Subbase with anchor embedment of 16.5”
- 8” Asphalt with anchor embedment of 16.5”

Using the holes in the base as a template, drill 7/8” holes to the proper depth as previously defined. If the Crash Cushion is being installed on an existing foundation and the drills are hitting rebar, use a core drill or similar system to ensure that straight, vertical holes are made at each location. Take care that the holes do not break out the bottom of the foundation as this may result in loss of epoxy during anchor placement.

Once the holes are drilled, clean the hole of all debris using suitable means, then scrub out the hole with a bottle brush. Remove dust one final time and ensure holes are clean of debris and dry. Inject the epoxy into each hole at an angle so as to avoid air entrapment. Use the proper amount of epoxy so that the hole will be filled when the bolt is inserted. Screw the nut on the anchor bolt flush with the end, put washer on the stud and immediately insert the anchor stud all the way to the bottom while turning the anchor. This method assures the anchor bolts are vertically plumb and the threads are coated with epoxy.

Our Epoxy will be ready for bolt tightening after 90 minutes at 78 degrees F (25 degrees C), with full cure at 24 Hours, see the container label for other temperatures and bolt up times. After sufficient time has passed to allow the epoxy to cure, torque the anchor nuts to 170 N-m (125FT-LB).

Nose Piece Installation

Installation of the front delineation plate will be determined by the use of the attenuator and state regulations. A delineation plate is shipped with the yellow background applied and no striping. It is attached by four bolts. Applying the striping to the plate is easier while it is removed from the attenuator due to the holes that need trimming. Examples of the delineation plate are as follows:


Right Shoulder


Gore Area


Left Shoulder

Transition Installation

Transitions may be required. Any use of a Crash Cushion with a possible reverse direction impact will require a transition. In all applications, be sure to install the transition anchors so that there is no extension of the studs beyond the outside face of the nut. Refer to the transition drawings for details of the required anchor locations. For horizontal stud installation in concrete, use mechanical anchors or repeat the same epoxy installation process as the anchor bolts using plugs to retain the epoxy to secure the transition to the barrier.

APPENDIX – FIGURE 4	Jersey Barrier	APPENDIX – FIGURE 9	30” Concrete
APPENDIX – FIGURE 5	Concrete Barrier	APPENDIX – FIGURE 10	36” Concrete
APPENDIX – FIGURE 6	W-Beam	APPENDIX – FIGURE 11	36” Concrete
APPENDIX – FIGURE 7	Thrie-Beam	APPENDIX – FIGURE 12	Wide Taper
APPENDIX – FIGURE 8	30” Concrete		

Final Inspection

After the anchor bolts have been tightened to the proper torque value, check that the Crash Cushion is not distorted in any way as might happen if the unit is secured to a foundation, which is not a straight surface. Check that the front section is pulled out all the way to the front stop bolts and that no part of the unit has been damaged by shipping and handling. Verify that all assembly bolts are tight and have not come loose during shipping or installation. Finally, check that no tools or other equipment have been left within the Crash Cushion structure.

RESETTING CRASH CUSHION AFTER IMPACT

In the event of any impact, the Crash Cushion will require a full evaluation to determine the necessary repairs to return it to service. To do this, proceed as follows:

Site Preparation

Do not begin work until all accident debris has been cleared and the area declared safe and accessible by government authorities.

Re-Extension and Inspection after Frontal Hit

- Remove the Spelter Socket pin from the front sled by removing the cotter pin and pulling it out. **If there is tension, pull out the sled a few inches to relieve the tension.**
- Use two long handled flat screw drivers to break cable loose from the sheave at the front of the attenuator if the zinc coating has attached the cable to the sheave. This procedure may also be needed on the rear sheaves. **The cable must move freely.**
- You then should hand pull the Spelter Socket side of the cable all the way out of the front of the attenuator to eliminate friction during pull out. You must first remove the front cable bracket then you can push the cable from behind while prying in front to start a loop.
- Inspect front part of the cable from the Spelter Socket, as it will be partially obscured after extension of the mobile frames and sheaves. **See the cable inspection procedure.**
- Remove the front delineator panel and attach pulling means to the bottom brace of the front sled. Pull the unit out until it reaches the front stop bolts. When fully pulled out, reattach the Spelter Socket onto the sled.
- Remove the front and rear sheave cover plates located on each end of the cylinder by removing the two cap screws that hold them down. See APPENDIX - FIGURE 3
- Remove the anti-rotation pins, which are the two outer pins, inserted through the holes in the sheaves from both the front and back sheaves**. Caution: do not remove the center pin. Also, the rear pins are longer than the front sheave pins and cannot be intermixed.**
- Check for shear bolt remnants in the holes on both sides of the mobile sheaves.
- Attach pulling means to the mobile sheaves.
- Slowly pull out the mobile sheaves while inspecting the cable. Be sure the cable doesn't ride up over the front sheave as the slack is reduced. Do not stand inside the cable loop or be in the pulling strap danger zone.
- Finish pulling out the mobile sheaves. They are in the proper position when you can replace two 1/4" Grade 8 shear bolts in the front corners of the mobile sheaves. Loosen the cable adjustment bolt if necessary to install shear bolts.
- If the cable passes inspection, reinstall the anti-rotation pins in the front and back sheave assemblies and reinstall the cap screws in the cover plates for those sheaves. The sheaves may be aligned by inserting a pry bar into the sheave holes.
- Tighten the cable adjustment bolt to remove any slack in the cable. If there is too much slack to tighten the cable, replace the cable as repositioning the wire rope clips should not be performed because the cable is stretched beyond tolerances.
- Inspect the cylinder, anchor bolts and side panels according to the procedures listed after this section.

Side Hit Inspection and Repair

- Inspect and replace any damaged side panels.
- Inspect and replace any damaged side keeper bolts on all panels. There are three styles of keeper bolts. The winged style is for the panel connected to the sled and bolts through the first frame behind the sled. The center keepers have a .5" shoulder while the last keeper, which is bolted to the terminal frame, has a .25" shoulder.
- Inspect and repair any damaged side guides.

Cable Inspection and Replacement Procedure

The cable should be visually inspected for damage. The most common sign of rope deterioration is broken wires. The wire must be clean and not under tension to perform a visual inspection. Visual inspection should include looking for broken wire strands, localized wear or crowns. A sharp awl or marlin spike can be used to separate wires to check if internal damage is present, indicated by loose wires or crowns. If internal inspection shows any damage to any core wires, the cable should be replaced. If there are more than six random broken wires in one rope lay or three broken wires in one strand in one rope lay, the wire rope should be replaced. A rope lay is the length along the rope in which one strand makes a complete revolution around the rope.

Inspect the Spelter Socket for broken wires, damaged eyes or other fatigue. Any signs of broken wires at the Spelter Socket will require a new cable.

Replacement of the cable may be required. The anti-rotation pins in the sheaves will need to be removed for this procedure. Remove the wire rope clips on the old cable and pull the unattached Spelter Socket out through the front of the attenuator. Feed the new cable through the front sheave bell reducer, wrap around the sheave and back to the bottom rear sheave. Insert a pry bar through the holes to the rear of the sheaves to help guide the cable around the sheave. The cable arrangement travel path is as follows: bottom rear sheave, bottom front sheave, middle rear sheave, middle front sheave, top rear sheave, top front sheave to cable adjustment bolt. The cable will be marked where the Cable Adjustment bend will be. Attach the Spelter Socket. Adjust the cable adjuster eyebolt all the way out and thread cable through the eye loop. Wrap cable back against itself with the mark at the bolt eye. Start wire rope clips on the ends of the large loop. Work the wire rope clips up by clamping the wire rope loop in front of the clips. Work the last clip up to 4" from the eyebolt loop. Then position the other three wire rope clips back at 3" intervals. When the wire clips are all positioned, tighten them to 225 ft. lbs or 305 n-m.

Cylinder Inspection

The cylinder should be inspected for:

- Dented or swollen tube jacket
- Visible cracks in any welds and fluid leakage from the welds
- Piston rod surface damage, bending or fluid leakage in seal area
- If fully collapsed or over design impact speed, disconnect piston rod from the mobile sheave after the unit is pulled out and push the piston rod in checking for free movement.

If any of these inspections are suspect, replace cylinder and have it examined by the manufacturer. Once the cylinder seal is seated in oil, the field life is 15+ years per manufacturer.

Anchor Bolt Inspection

Anchor bolts may come loose or damaged upon impact. These bolts can be replaced by welding a nut or putting a double nut on them and backing them out of the hole. Drill out the old epoxy and reinstall new bolts with new epoxy.

Side Panel Inspection

Side Panels are designed to nest and collapse with minimal or no damage upon frontal impact. The side panel bolts do sustain a shock upon impact. These bolts should be replaced if there are any signs of fatigue, bending or other visible damage. Inspect the side panels for any bending or torn metal. If damage is found, all side panels are removable by removing four bolts. It may be necessary to remove the bolts on the panel upstream to slide out a panel located in the middle of the unit. The side panel bolts used to hold the large front sled panels are different than the bolts on the center panels. Also, the panel side bolts used on the last terminal brace, which is the rearmost support, has a shorter shoulder (.23" vs .49"), as it does not have a panel overlap. These shoulders must seat into the outer overlapping panel and pin the inside panel to the frames using a torque value of 270 N-m (200 FT-LB). Be careful not to pin the edge of the outside panel as it will restrict free sliding of that panel.

Side Guide Inspection

At the bottom of each support frame, there is a guide to stabilize and guide collapse of the attenuator. Inspect each side guide for damage. These guide assemblies are very rugged. The attachment bolt should be removed and inspected on all frames impacted during a side impact. The guides should be inspected for any damage and if they are not damaged, they can be reused. Upon frontal impact, these guides should be inspected for damage. The Torque value for the Side Guides is 920 N-m (680 FT-LB).

Final Inspection

After the resetting of the Crash Cushion is complete, verify by visual inspection that all assembly bolts are tight and show no sign of damage. Finally, check that no tools and other equipment or debris have been left within the Crash Cushion structure. Verify that no other damage unrelated to the most recent impact has occurred and that no significant corrosion or other deterioration has taken place.

Non-Repairable Impacts

There can be instances where the impact is outside the scope of the Crash Cushion's design. This may render the Crash Cushion unsafe to reuse and it should be replaced.

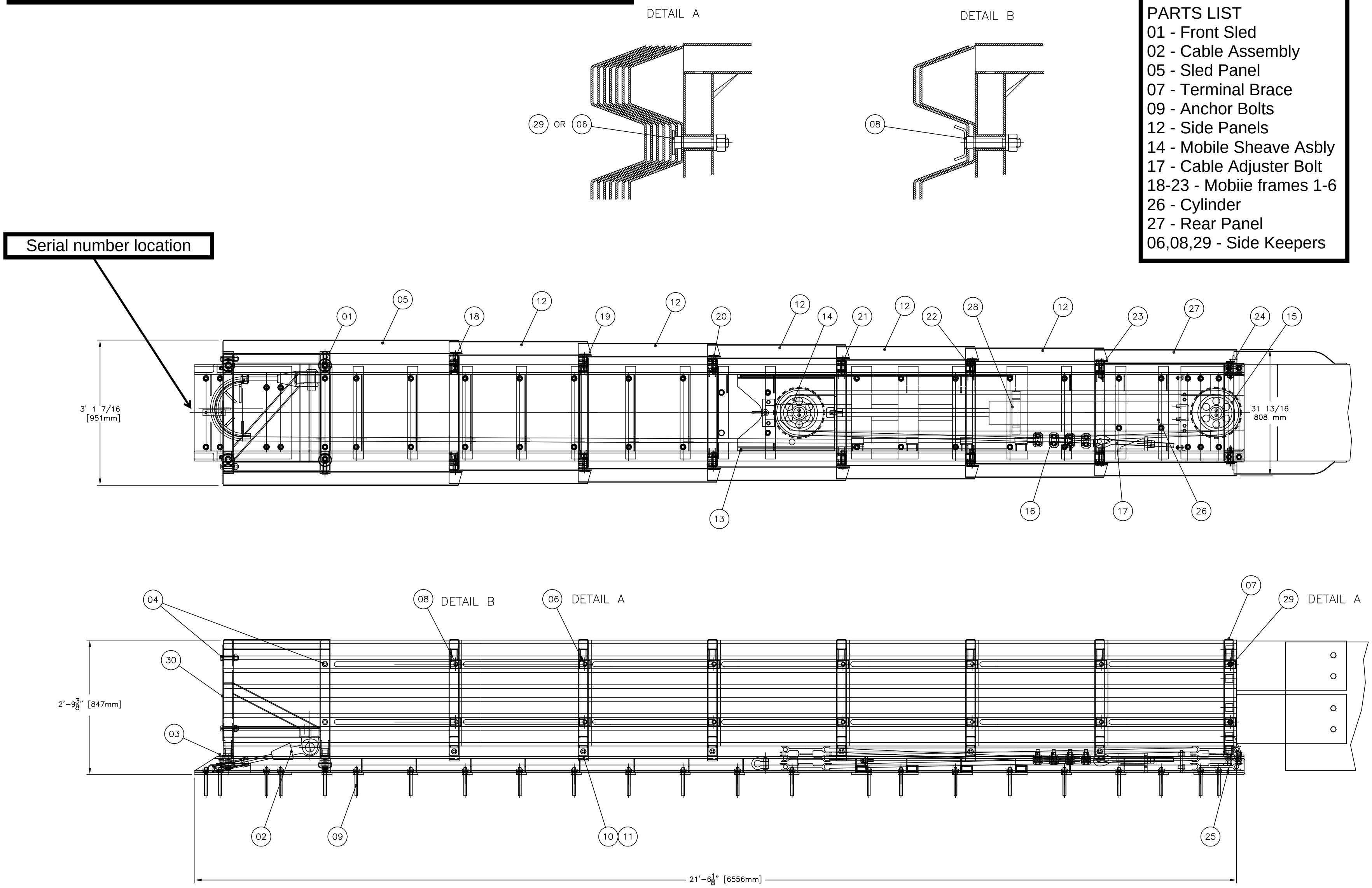
PART NUMBERS AND DESCRIPTIONS

Part No.	Description	Qty Per Unit TL2/TL3	Unit of Measure	Spare Parts Kit TL2/TL3
9400	Attenuator - w/ Concrete Anchors 24" Wide TL3 SCI100GM			
9450	Attenuator - w/ Asphalt Anchors 24" Wide TL3 SCI100GM			
9451	Attenuator - w/ Concrete Anchors 24" Wide TL2 SCI70GM			
9452	Attenuator - w/ Asphalt Anchors 24" Wide TL2 SCI70GM			
9401	Bolt Concrete Anchor 3/4" X 7" TL3 *(Included in P/N 9400)	*	KIT/48 pcs.	
9402	Bolt Asphalt Anchor 3/4" x 18" TL3 *(Included in P/N 9450)	*	KIT/48 pcs.	
9453	Bolt Concrete Anchor 3/4" X 7" TL2 **(Included in P/N 9451)	**	KIT/34 pcs.	
9454	Bolt Asphalt Anchor 3/4" x 18" TL2 **(Included in P/N 9452)	**	KIT/34 pcs.	
9403	Bolt Cable Adjuster	1	EACH	
9404	Bolt Sled Side Panel	8	EACH	
9405	Bolt Front Stop	2	EACH	
9406	Bolt Shear	2	EACH	**2/2**
9407	Bolt Side Guide	12	EACH	**2/2**
9408	Bolt Terminal Brace	4	EACH	**2/2**
9409	Brace Terminal	1	EACH	**1/1**
9410	Cable - 1-1/8" with Spelter Socket TL3	1	EACH	
9455	Cable - 1-1/8" with Spelter Socket TL2	1	EACH	
9411	Clip Wire Rope TL2 & TL3	4	EACH	
9412	Cylinder Shock Arresting TL3	1	EACH	
9445	Cylinder Shock Arresting TL2	1	EACH	
9482	Cylinder Shock Arresting Cold Temp TL3	1	EACH	
9483	Cylinder Shock Arresting Cold Temp TL2	1	EACH	
9413	Strap Cylinder TL2 & TL3	1	EACH	
9414	Frame Mobile #1 TL3	0/1	EACH	**0/1**
9415	Frame Mobile #2 TL3	0/1	EACH	**0/1**
9416	Frame Mobile #3 TL3	0/1	EACH	**0/1**
9417	Frame Mobile #4 TL2 & TL3	1	EACH	**1/1**
9418	Frame Mobile #5 TL2 & TL3	1	EACH	**1/1**
9419	Frame Mobile #6 TL2 & TL3	1	EACH	**1/1**
9420	Guide Side TL2 & TL3	6/12	EACH	**2/2**
9421	Keeper Side #1 (Sled Panels) TL2 & TL3	4	EACH	**2/2**
9422	Keeper Side #2 (Side Panels) TL2 & TL3	8/20	EACH	**4/4**
9423	Keeper Side #3 (Rear Panels) TL2 & TL3	4	EACH	**2/2**
9424	Panel Delineator (Painted Yellow) TL3	0/1	EACH	**0/1**
9456	Panel Delineator (Painted Yellow) TL2	1/0	EACH	**1/0**
9425	Panel Side TL2 & TL3	4/10	EACH	**2/2**
9426	Panel Sled	2	EACH	**1/1**
9427	Panel Rear	2	EACH	**1/1**
9428	Sheave (Pulley)	6	EACH	
9429	Sled (with guide rollers) 24" TL3	0/1	EACH	
9457	Sled (with guide rollers) 24" TL2	1/0	EACH	
9430	Tape Delineator (Optional)	O	EACH	
9439	Epoxy 22 oz. Cartridge ***	***	EACH	
9440	Nozzle Epoxy Mixing ***	***	EACH	
9441	Dispenser Epoxy	O	EACH	
9443	Boot Cylinder	1	EACH	
9444	Spare Parts Kit TL3	O	EACH	

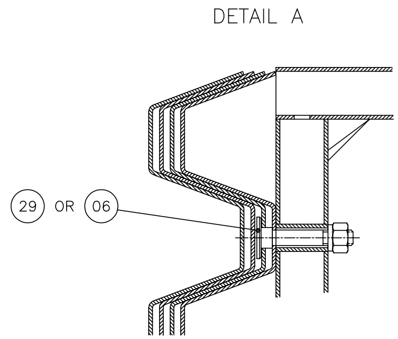
9458	Spare Parts Kit TL2	O	EACH	
	*** P/N 9400 - Includes 4-Epoxy Cartridges & 4-Mixing Nozzles			
	*** P/N 9450 - Includes 12-Epoxy Cartridges & 12-Mixing Nozzles			
	*** P/N 9451 - Includes 3-Epoxy Cartridges & 3-Mixing Nozzles			
	*** P/N 9452 - Includes 9-Epoxy Cartridges & 9-Mixing Nozzles			
Transitions and Transition Parts				
9431	Transition Jersey Barrier - Right	O	EACH	
9432	Transition Jersey Barrier - Left	O	EACH	
9433	Transition 24" Concrete - Left & Right	O	EACH	
9437	Transition Thrie & W Beam - Right	O	EACH	
9438	Transition Thrie & W Beam - Left	O	EACH	
9459	Transition Assembly 30" Concrete Straight Connection	O	EACH	
9460	Transition Assembly 36" Concrete Straight Connection	O	EACH	
9461	Transition Assembly 30" Concrete Outside Connection	O	EACH	
9462	Transition Assembly 36" Concrete Outside Connection	O	EACH	
9475	Transition Assembly Gore to End of Flared Transition	O	EACH	
9476	Transition Assembly 42" Double Sided Median Barrier	O	EACH	
9463	Transition 30" Concrete Straight Connection	O	EACH	
9464	Transition36" Concrete Straight Connection	O	EACH	
9465	Transition 30" Concrete Outside Connection	O	EACH	
9466	Transition 36" Concrete Outside Connection	O	EACH	
9467	Transition Thrie & W Beam 10 Degree Flare - Right	O	EACH	
9468	Transition Thrie & W Beam 10 Degree Flare - Left	O	EACH	
9469	Transition Concrete Spanner Brace	O	EACH	
9470	Transition Concrete #1 Tapered Spanner Brace	O	EACH	
9471	Transition Concrete #2 Tapered Spanner Brace	O	EACH	
9472	Transition Gore Tapered #1 Spanner Brace	O	EACH	
9473	Transition Gore Tapered #2 Spanner Brace	O	EACH	
9474	Thrie Beam Concrete Leg Brace	O	EACH	
9477	Transition 42" Double Sided Median Barrier-Right	O	EACH	
9478	Transition 42" Double Sided Median Barrier-Left	O	EACH	
9479	Transition 42" Double Sided Median Barrier Spanner Brace	O	EACH	
9480	Transition 42" Double Sided Median Barrier Rub Rail-Right	O	EACH	
9481	Transition 42" Double Sided Median Barrier Rub Rail-Left	O	EACH	
	O = Optional Revised 4-6-05			

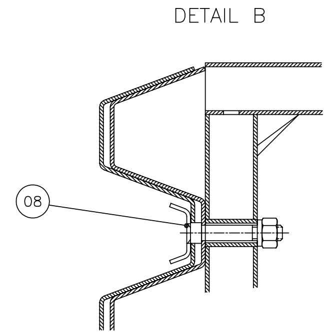
APPENDIX - FIGURE 1 - TL3 ASSEMBLY DRAWING

PARTS LIST
01 - Front Sled
02 - Cable Assembly
05 - Sled Panel
07 - Terminal Brace
09 - Anchor Bolts
12 - Side Panels
14 - Mobile Sheave Asbly
17 - Cable Adjuster Bolt
18-23 - Mobiie frames 1-6
26 - Cylinder
27 - Rear Panel
06,08,29 - Side Keepers



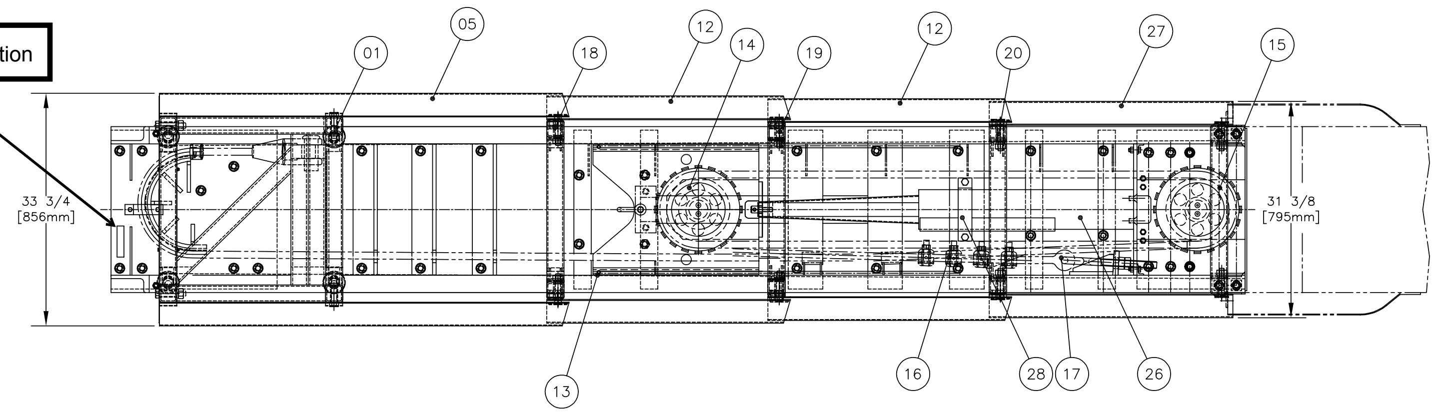
APPENDIX - FIGURE 1A - TL2 ASSEMBLY DRAWING

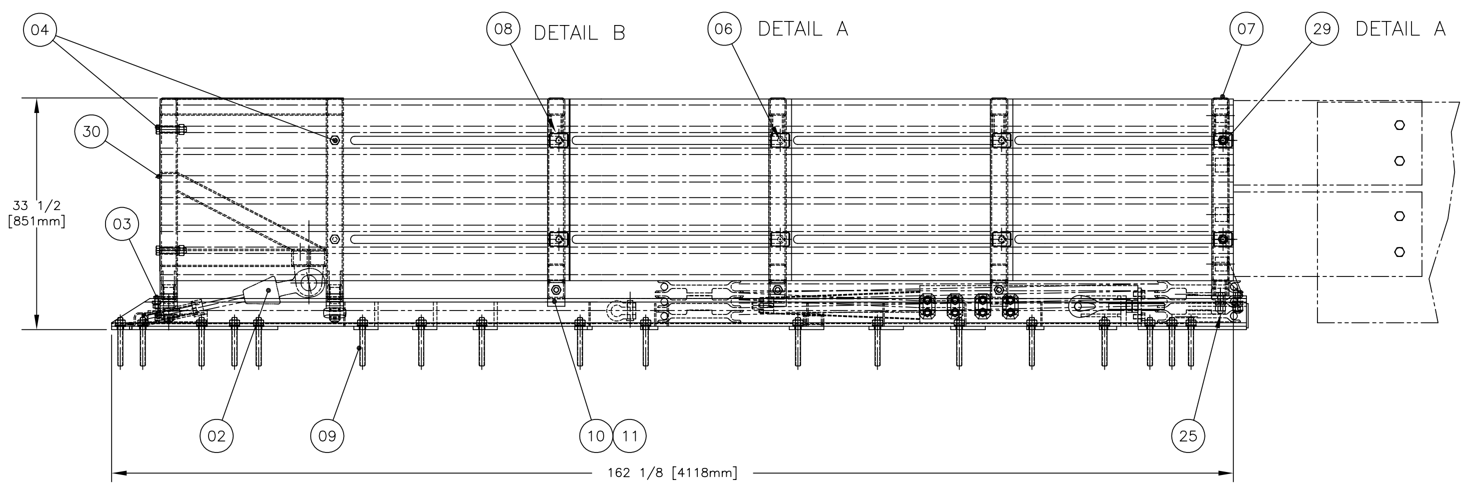




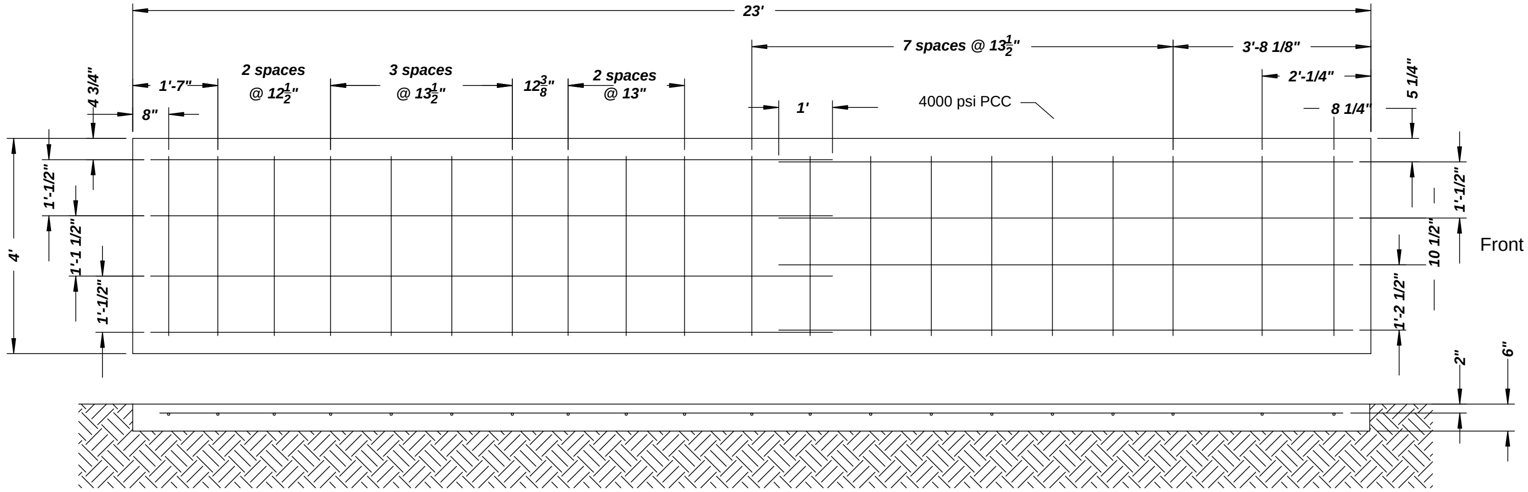
PARTS LIST
01 - Front Sled
02 - Cable Assembly
05 - Sled Panel
07 - Terminal Brace
09 - Anchor Bolts
12 - Side Panels
14 - Mobile Sheave Asbly
17 - Cable Adjuster Bolt
18-23 - Mobiie frames 1-6
26 - Cylinder
27 - Rear Panel
06,08,29 - Side Keepers

Serial number location



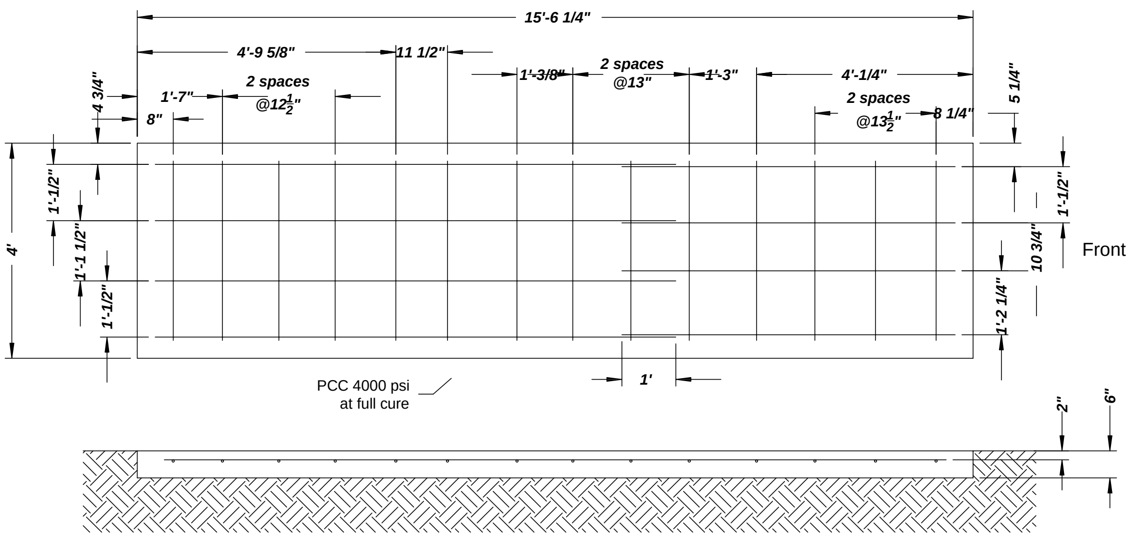


APPENDIX - FIGURE 2 - FOUNDATION DRAWING



SCI100GM
Level 3 System

Cross Slope at Top Surface Not to Exceed 1 in 12
Cross Slope Not to Vary More Than 1 in 48



SCI70GM
Level 2 System

SPECIFICATIONS

All reinforcing steel - straight #4 ASTM-A36

Embedment requirements:

- 6" reinforced concrete pad with anchor embedment of 5½"
- 8" nonreinforced concrete pad with anchor embedment of 5½"
- 3" asphalt over 3" of concrete with anchor embedment of 16½"
- 6" asphalt over 6" of compacted subbase with anchor embedment of 16½"
- 8" asphalt with anchor embedment of 16½"

The contractor shall furnish a certification for material installed to the following requirements:

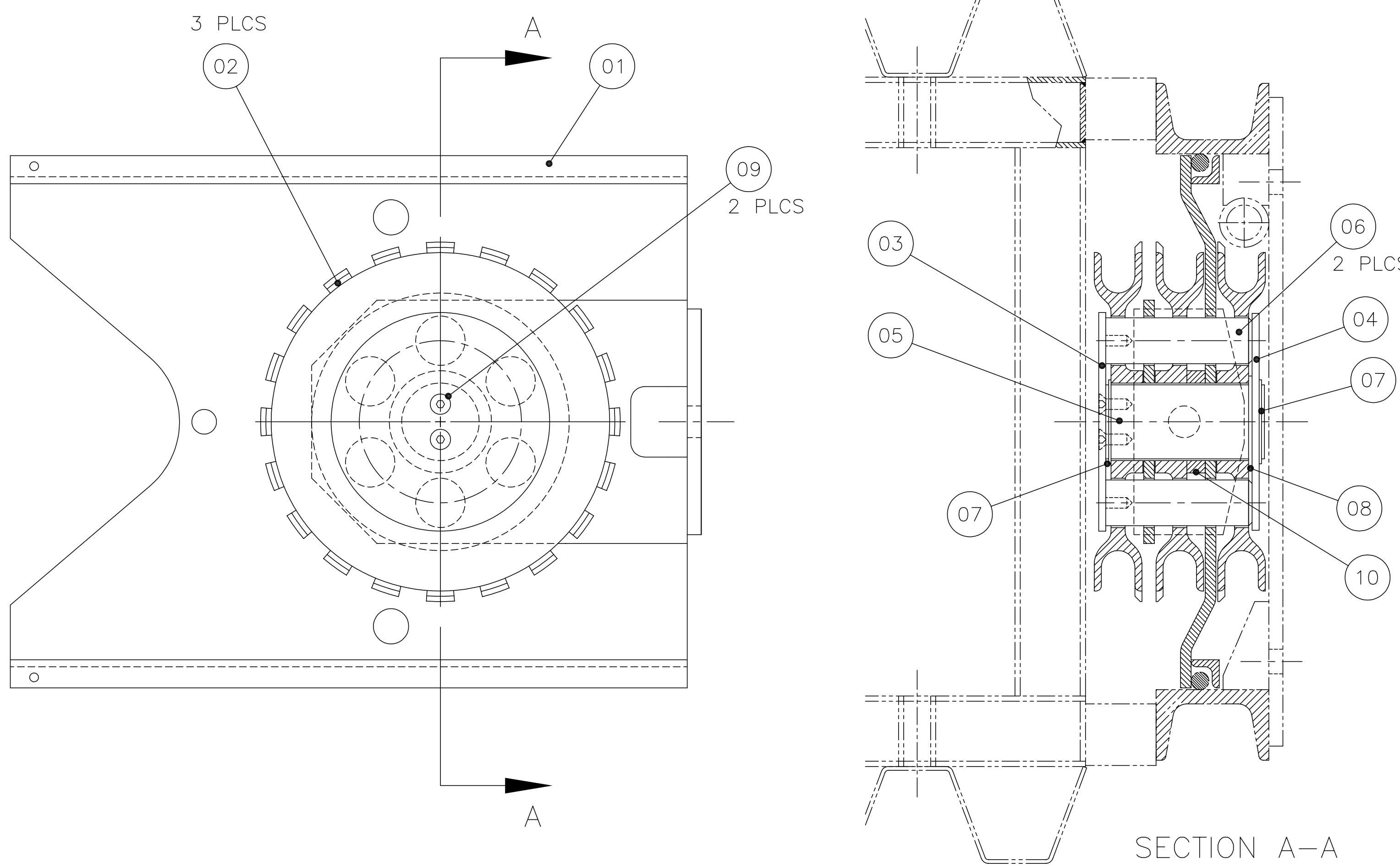
- 6" reinforced concrete (PCC) sampling per ASTM C31-84, testing per ASTM C39-84
- 8" nonreinforced concrete (PCC) sampling per ASTM C31-84, testing per ASTM C39-84
- 3" asphalt over 3" of concrete - Type SP 12.5 Level C or higher
- 6" asphalt over 6" of compacted subbase - same as above
- 8" asphalt (AC) - Type SP 12.5 Traffic Level C or higher

SCI Products Inc.
SCI70GM & SCI100GM
Crash Cushions

	by	on		
Drawn	PE	1/14/05		
Checked	LO	1/14/05	Rev. 1	Sh 2 of 6

ITEM	QTY	DESCRIPTION	MATERIAL	NOTES
1	1	MOBILE CYLINDER SHEAVE WELDMENT	ET-01-04	65 LB
2	3	SHEAVE CASTING	ET-01-06	36 LB
3	1	TOP PLATE	ET-01-10	3 LB
4	1	BOTTOM PLATE	ET-01-09	3 LB
5	1	MAIN SHEAVE PIN	ET-01-07	9 LB
6	2	STOP PIN	ET-01-08	8 LB
7	2	SNAP RING FOR ø2 5/8 SHAFT - TRUARC 5100-262	PLATED	0.3 LB
8	1	WASHER FOR ø2 5/8 SHAFT	GALV	0.3 LB
9	2	C'SUNK CAP SCREW ø3/8-NC x 5/8 LONG - FULL THREAD	GR 5 PLTD	0.4 LB
10	1	SPACER	ET-01-11	1 LB

TOTAL WEIGHT: 126 LB –



DRAWING NO. ET-01-05 REV. D
FILE: ET-01-04.DWG
DRAWN: PIE 11/27/02
CHECKED: LMO 07/09/03
SCALE: 1:2
SHEET 1 OF 1
NEXT ASSEMBLY DRAWING NO. ET-00-01

PROJECT
END TREATMENT

LEVEL 3 SYSTEM
MOBILE CYLINDER SHEAVE ASSEMBLY

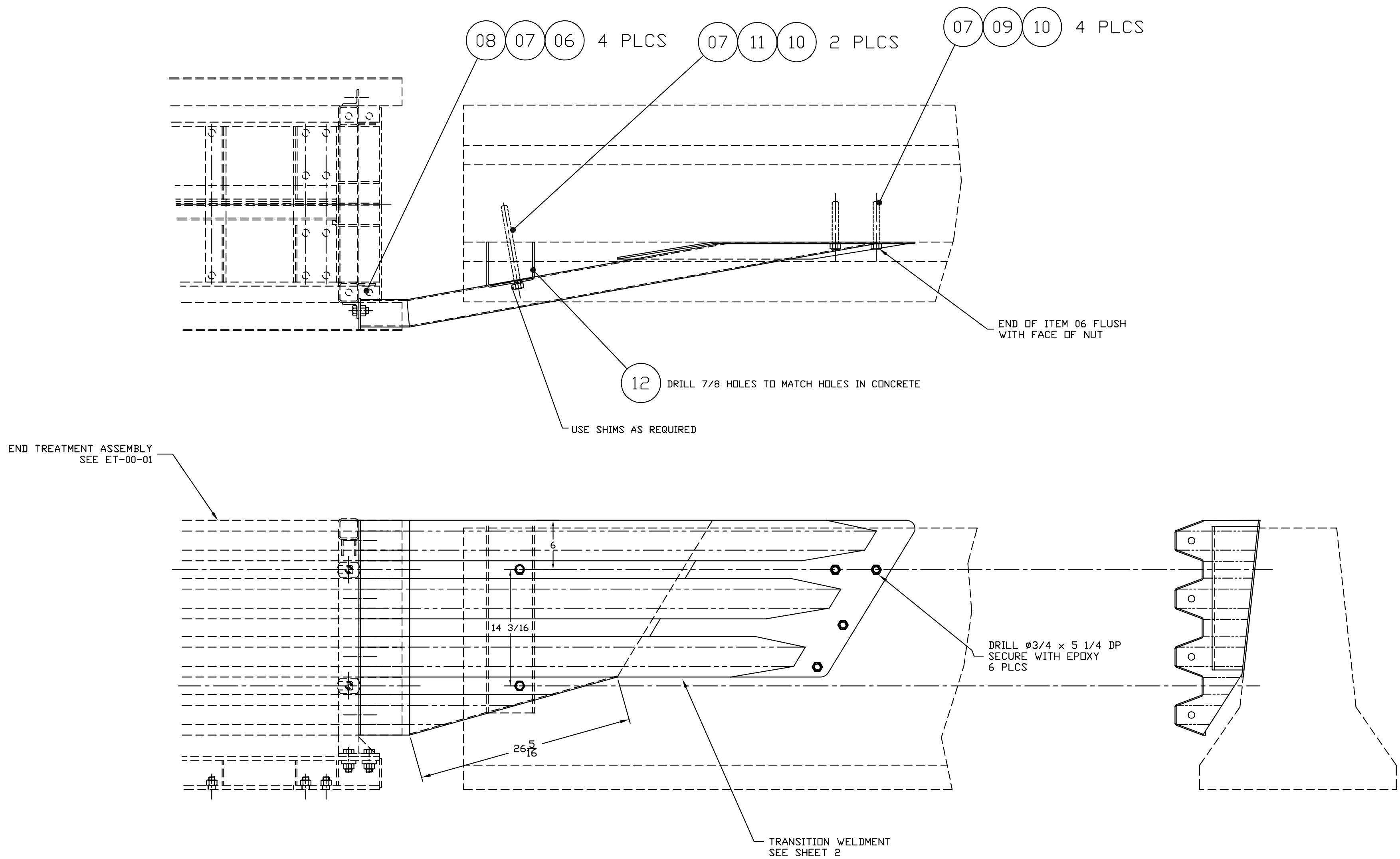
CLIENT
STABLER COMPANIES, INC

[redacted]

APPENDIX - FIGURE 3 - MOVEABLE SHEAVE ASSEMBLY

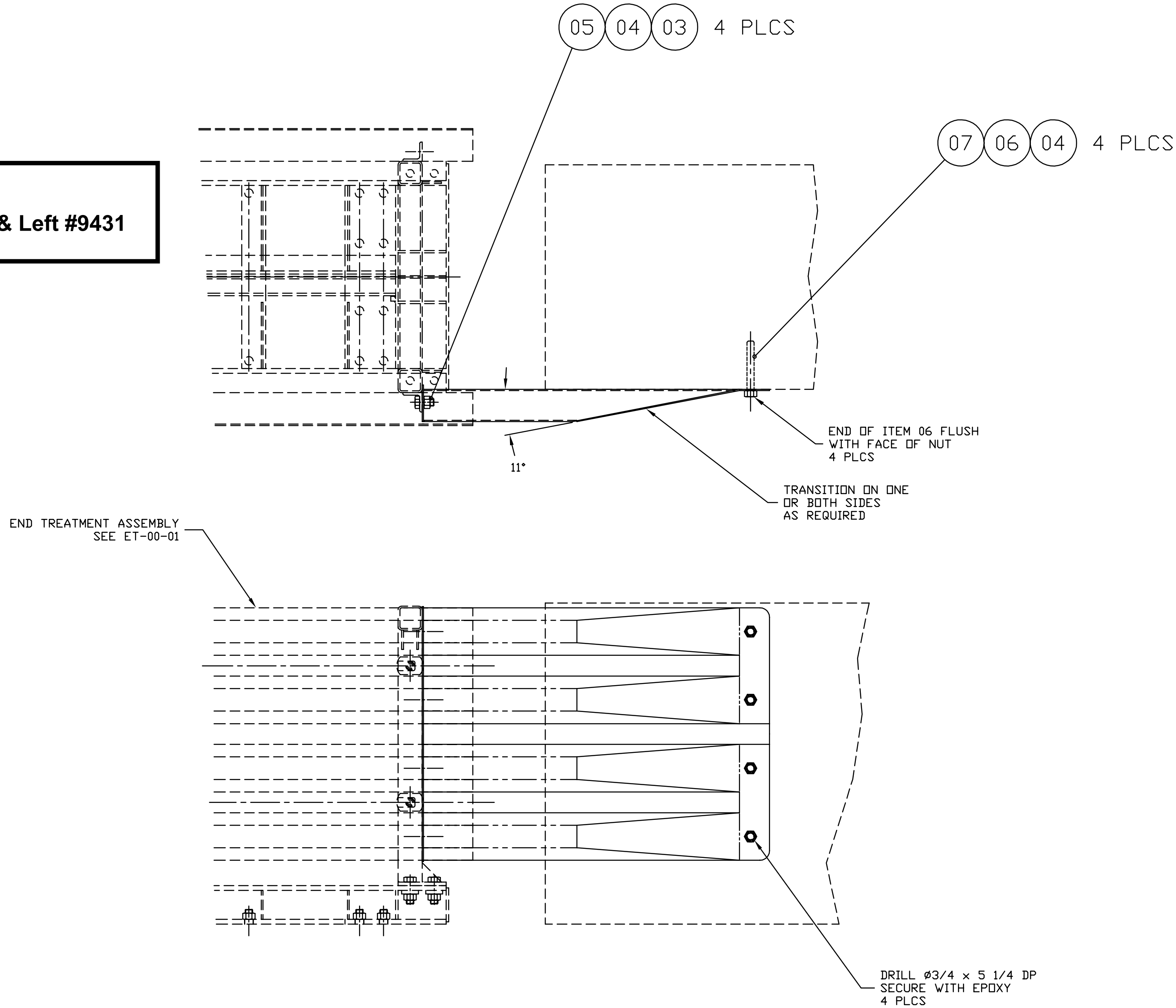
APPENDIX - FIGURE 4 - JERSEY BARRIER TRANSITION
Right Hand Model Shown

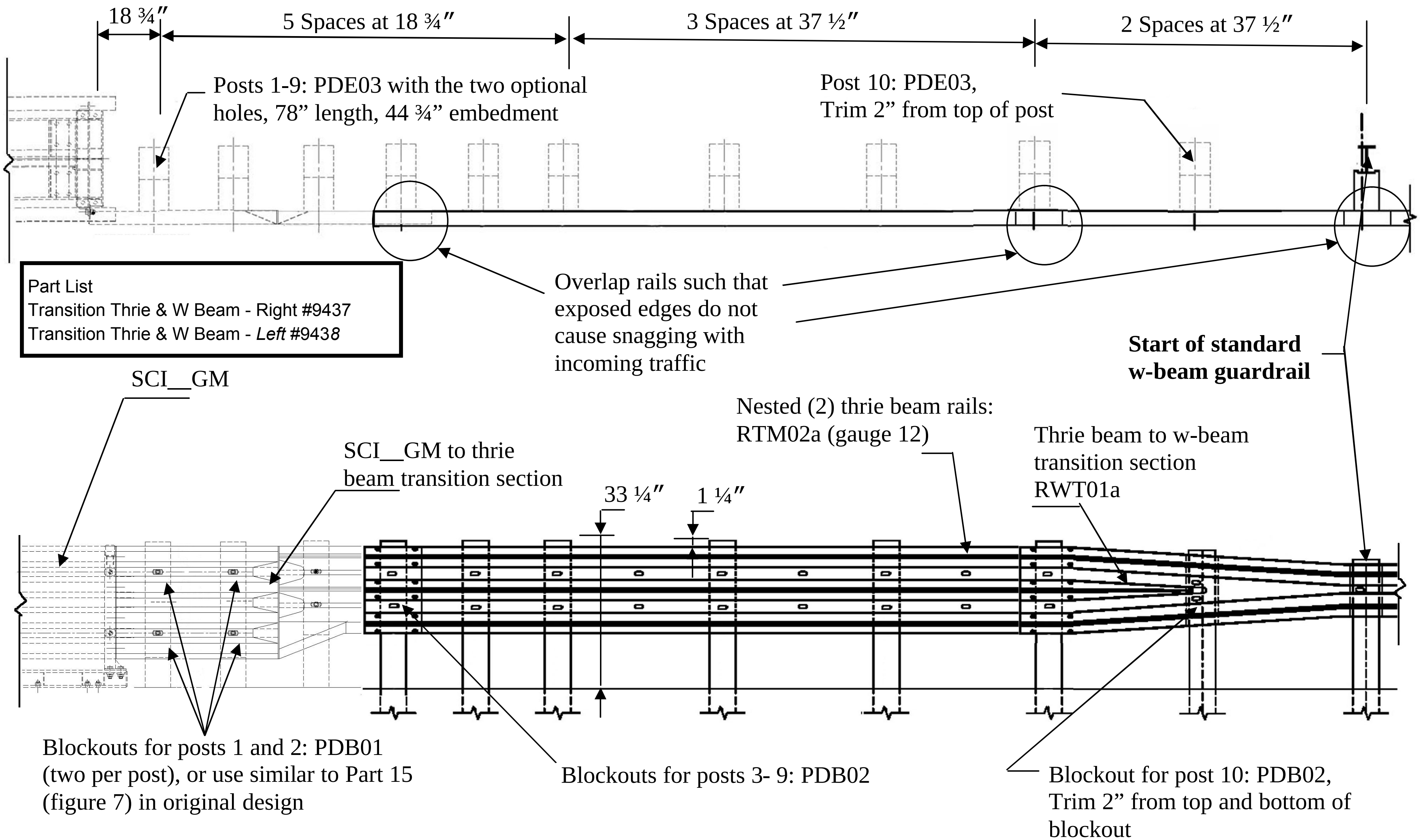
Parts List:
Transition Jersey Barrier - Right #9431
Transition Jersey Barrier - Left #9432



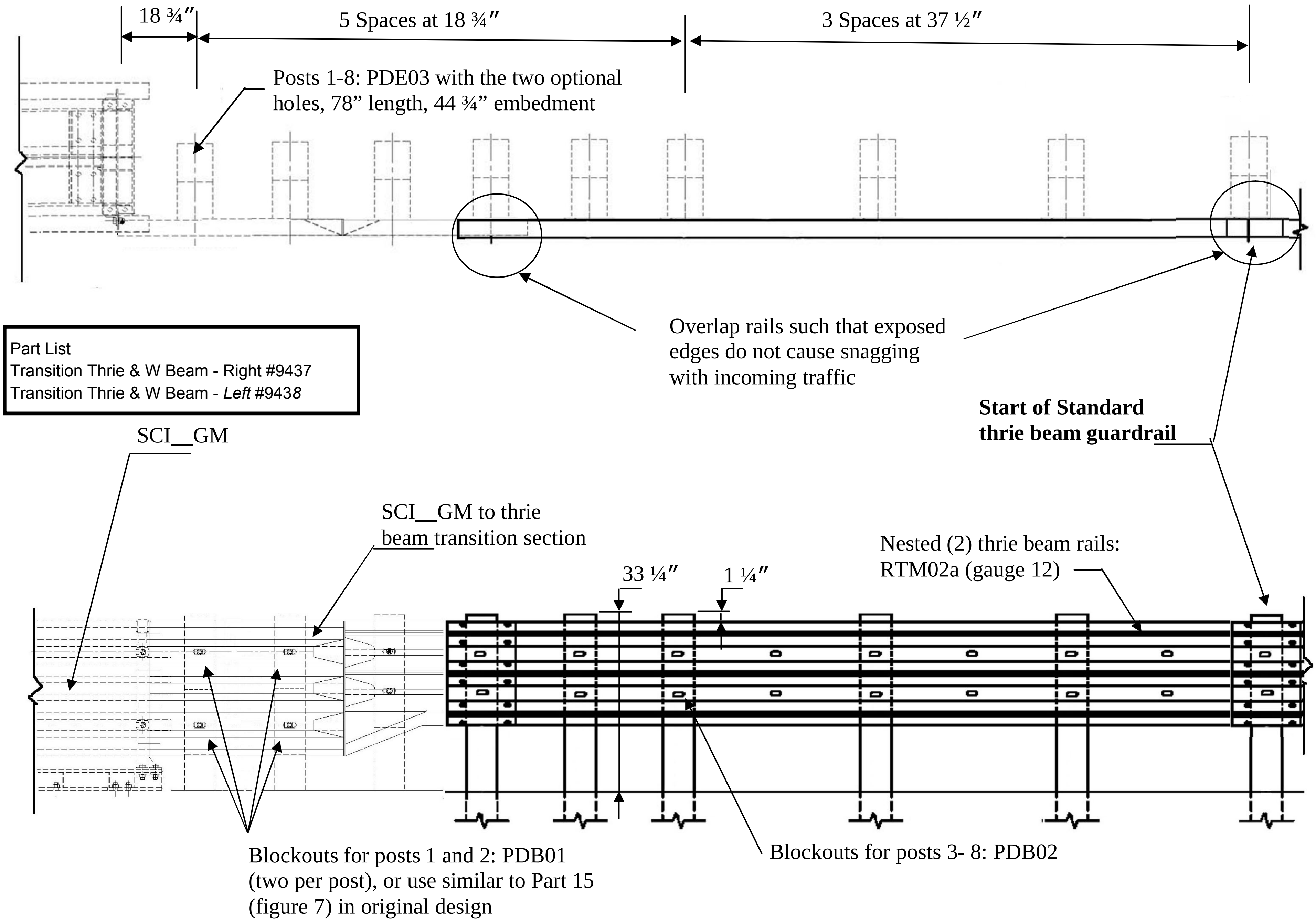
APPENDIX - FIGURE 5 - CONCRETE BARRIER TRANSITION

Parts List:
Transition 24" Concrete Block Right & Left #9431





APPENDIX - FIGURE 6 W-BEAM TRANSITION ASSEMBLY
Right Hand Transition Shown



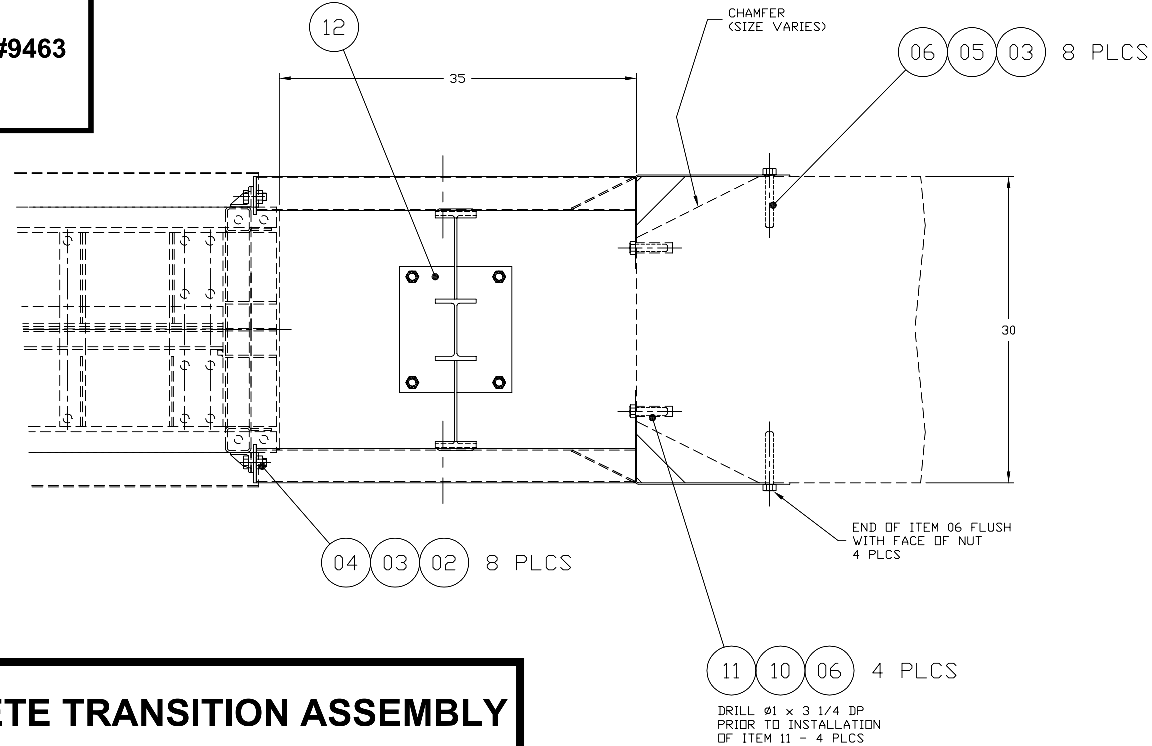
APPENDIX - FIGURE 7 - THRIE BEAM TRANSITION ASSEMBLY
Right Hand Transition Shown

Parts List:

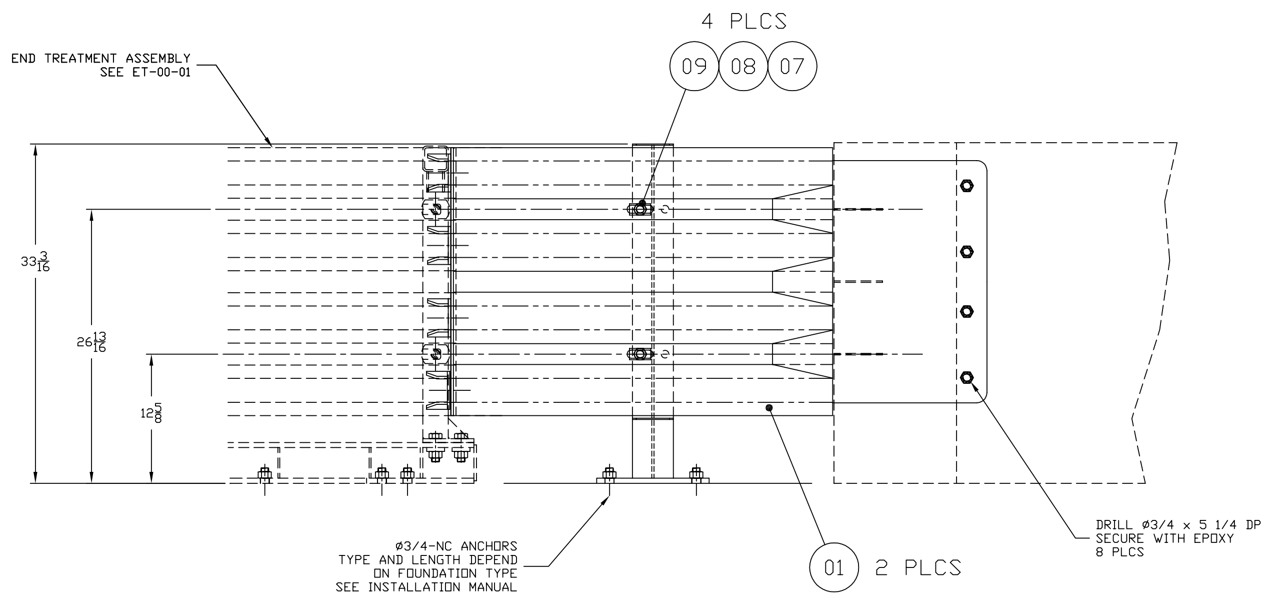
Two Sided Full Assembly #9459

01-Transition 36" Concrete Straight Connection #9463

12-Transition Concrete Spanner Brace #9469



APPENDIX - FIGURE 8 - 30" CONCRETE TRANSITION ASSEMBLY



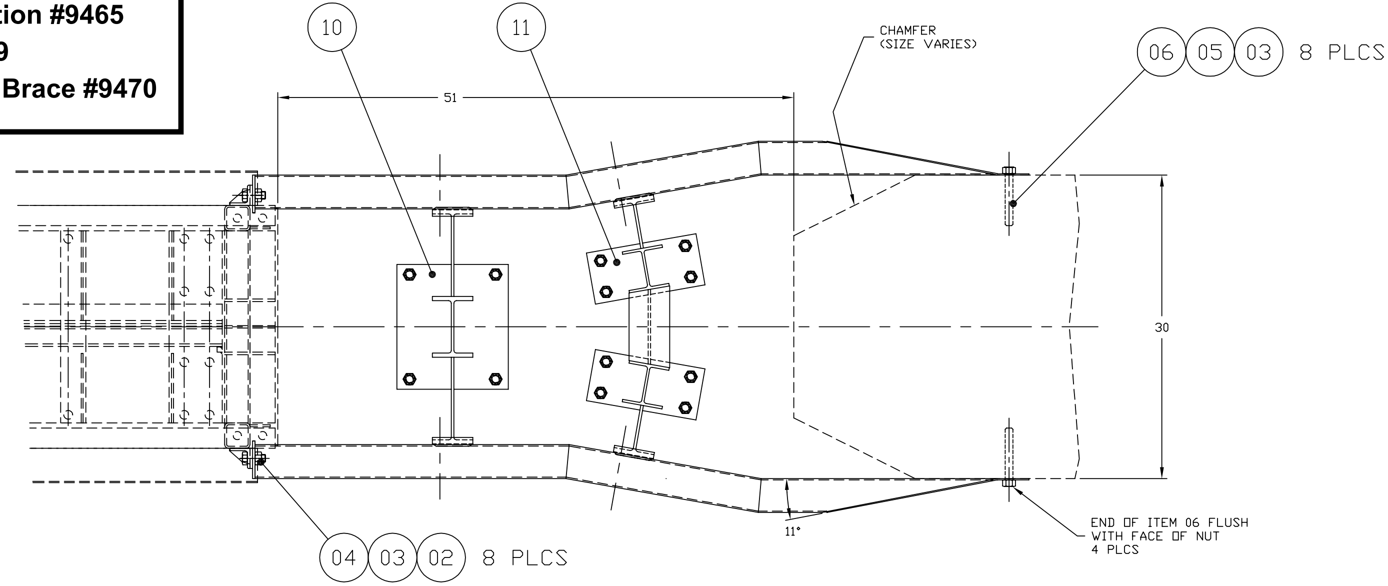
Parts List:

Two Sided Full Assembly #9461

01-Transition 30" Concrete Outside Connection #9465

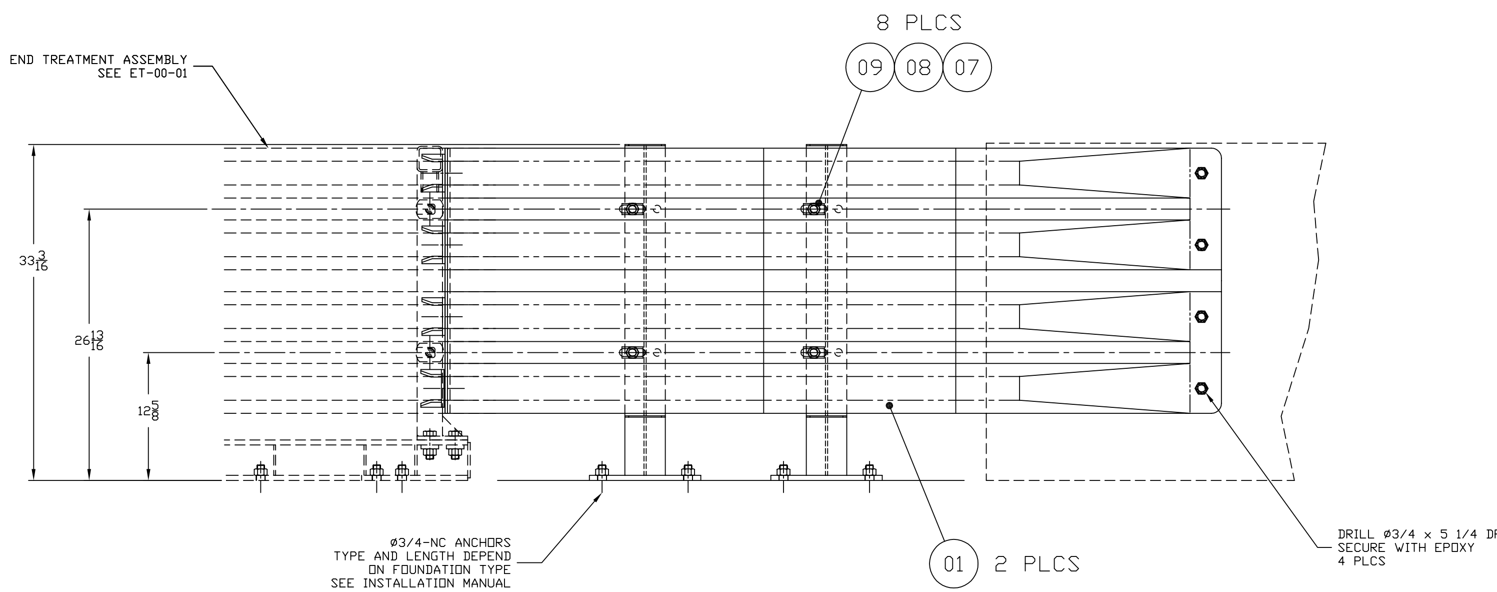
10-Transition Concrete Spanner Brace #9469

11-Transition Concrete #1 Tapered Spanner Brace #9470



APPENDIX - FIGURE 9 - 30" CONCRETE TRANSITION ASSEMBLY

Outboard Connection



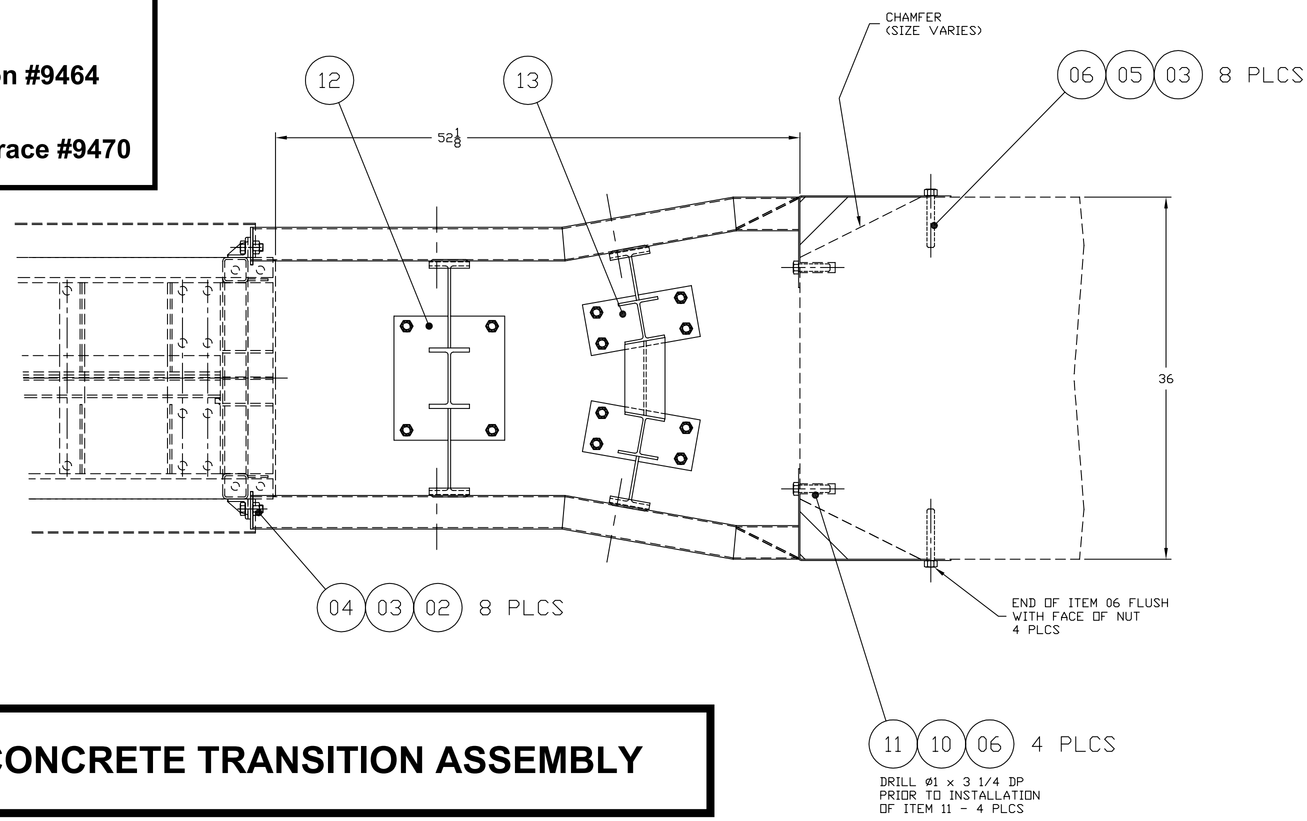
Parts List:

Two Sided Full Assembly #9460

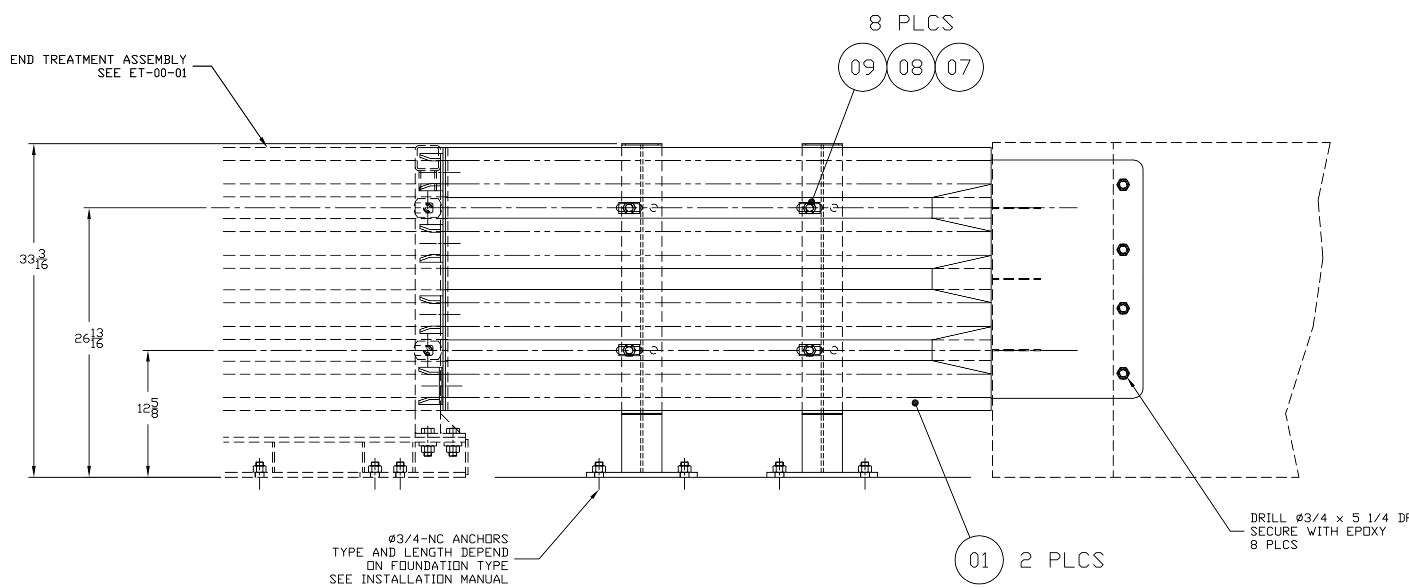
01-Transition 36" Concrete Straight Connection #9464

12-Transition Concrete Spanner Brace #9469

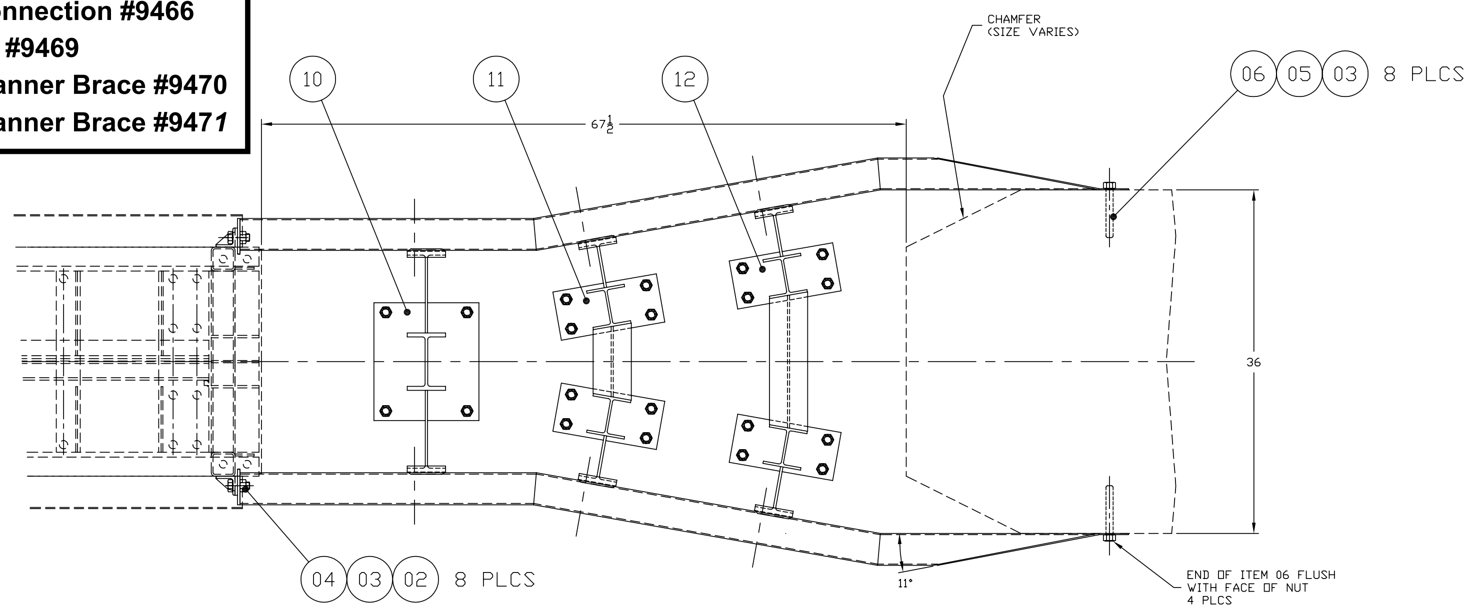
13-Transition Concrete #1 Tapered Spanner Brace #9470



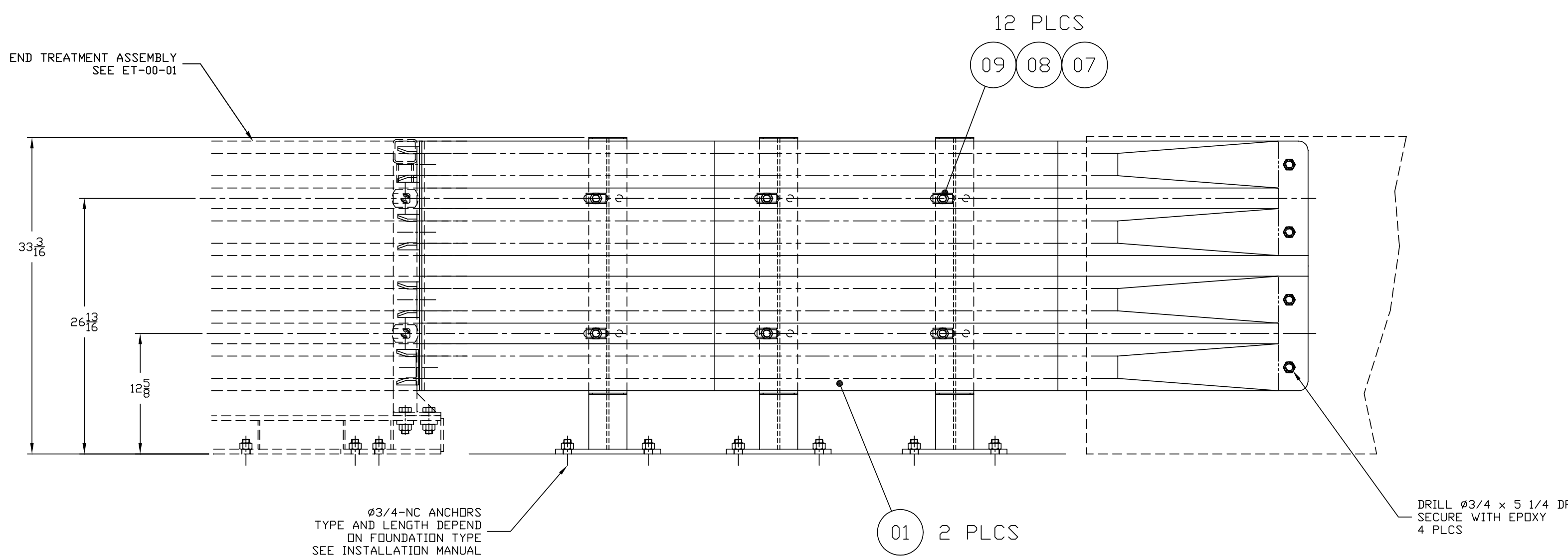
APPENDIX - FIGURE *10* - 36" CONCRETE TRANSITION ASSEMBLY



Parts List:
Two Sided Full Assembly #9462
01-Transition 36" Concrete Outside Connection #9466
10-Transition Concrete Spanner Brace #9469
11-Transition Concrete #1 Tapered Spanner Brace #9470
12-Transition Concrete #2 Tapered Spanner Brace #9471



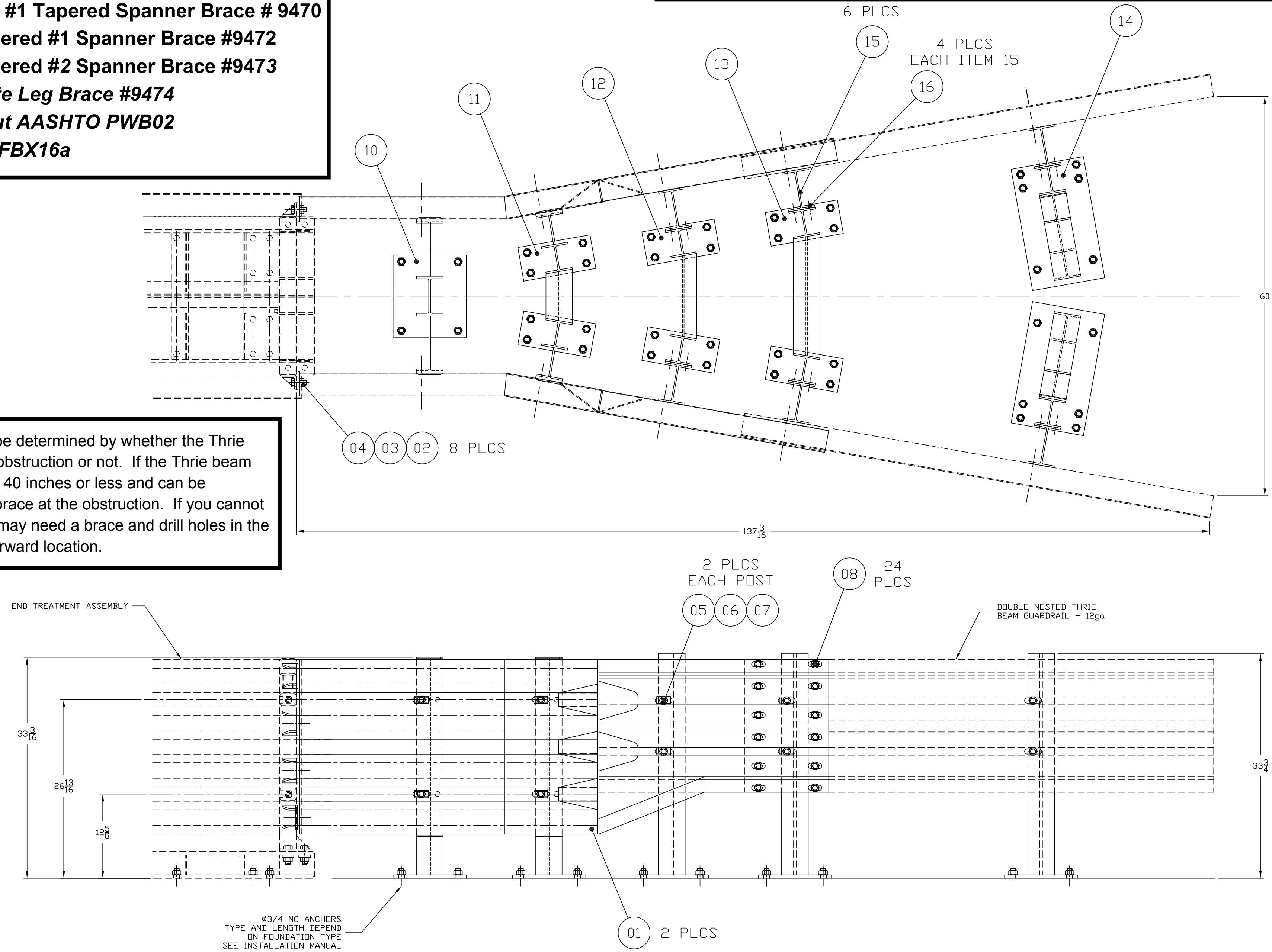
APPENDIX - FIGURE 11 - 36" CONCRETE TRANSITION ASSEMBLY
Outboard Connection



APPENDIX - FIGURE 12 - WIDE TAPER TRANSITION ASSEMBLY FOR CONCRETE AND ASPHALT

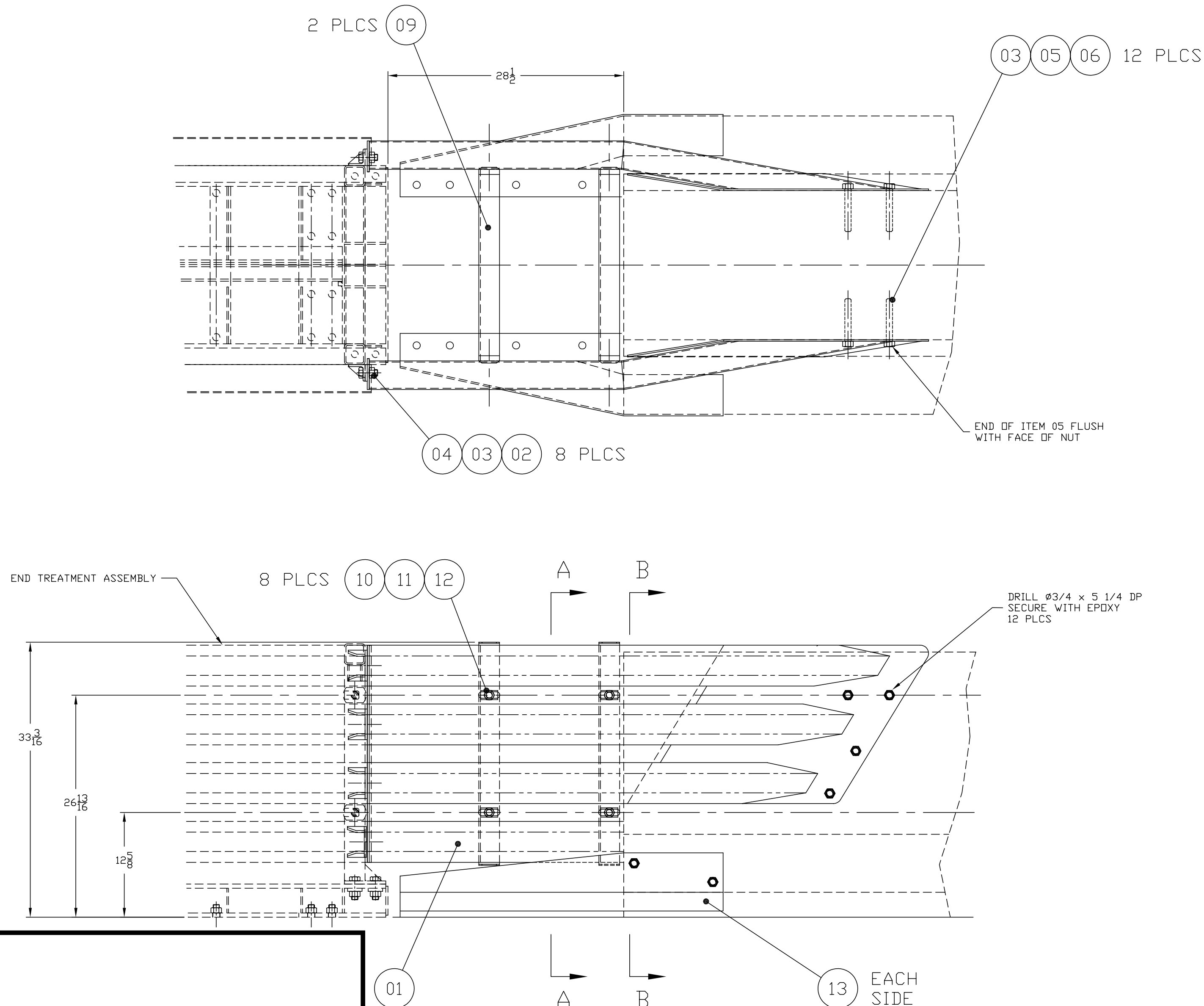
NOTES:
DIMENSIONS SHOWN ARE FOR 60" WIDTH
FOR EACH 1" OF WIDTH CHANGE ADD OR SUBTRACT THE FOLLOWING:
2.88" (73.15MM) TO LENGTH OF EACH GUARDRAIL
2.84" (72.13MM) TO OVERALL LENGTH
ADD OR SUBTRACT ADDITONAL POST ON EACH SIDE FOR EACH 13" (330 MM) CHANGE IN WIDTH

Parts List:
01-Transition Thrie 10 Degree Flare Right #9467
01-Transition Thrie 10 Degree Flare *Left #9468*
10-Transition Concrete Spanner Brace #9469
11-Transition Concrete #1 Tapered Spanner Brace # 9470
12-Transition Gore Tapered #1 Spanner Brace #9472
13-Transition Gore Tapered #*2* Spanner Brace #947*3*
14-Thrie Beam Concrete Leg Brace #9474
15-Thrie Beam Blockout AASHTO PWB02
16-Hardware AASHTO FBX16a



The use of the last brace will be determined by whether the Thrie Beam can be attached to the obstruction or not. If the Thrie beam distance from the last brace is 40 inches or less and can be attached, you will not need a brace at the obstruction. If you cannot attach to the obstruction, you may need a brace and drill holes in the Thrie Beam at the furthest rearward location.

APPENDIX - FIGURE 13 - 42" Double Sided Concrete Median Barrier Transition with 36" Base



Parts List:

Two Sided Full Assembly #9476

01-Transition 42" Double Sided Median Barrier-Right #9477

01-Transition 42" Double Sided Median Barrier-*Left* #9478

09-Transition 42" Double Sided Median Barrier *Spanner Brace #9479*

13-Transition 42" Double Sided Median Barrier *Rub Rail-Right #9480*

13-Transition 42" Double Sided Median Barrier *Rub Rail-Left #9481*

CONTENTS

NOTES FOR QUADGUARD CZ SYSTEM ON A PLATE

1. The energy absorbing system represented on this Qualified Products List (QPL) drawing is a proprietary design by Energy Absorption Systems, Inc. and marketed under the name Quadguard CZ System On A Plate. Any infringement on the rights of the designer shall be the sole responsibility of the user.

2. The Quadguard CZ System On A Plate is for temporary use and is limited to construction zones. The system may be used at any location where a temporary redirective crash cushion is called for in the plans.

3. The Quadguard CZ System On A Plate is a redirective, non-gating crash cushion.

4. The Quadguard CZ System On A Plate may be configured for design speeds up to 70 mph.

5. The Quadguard CZ System On A Plate shall be installed in accordance with the manufacturer's details, drawings, procedures and specifications as referenced in these drawings. The Contractor shall certify that all materials furnished meet the specified requirements. Temporary Concrete barrier walls abutting the Quadguard CZ System On A Plate must be adequately anchored for proper impact performance in accordance with Index No. 415.

6. Length of need and transitions shall be in accordance with the respective Quadguard drawings in the Design Standards or posted on the QPL.

7. The number of bays to be used in a specific unit will be determined by the design speed, except where the Engineer determines another speed is more applicable.

8. A yellow Type I object marker shall be centered 3' in front of the nose of the Quadguard CZ System On A Plate. Mounting hardware shall be in conformance with Index Nos. 11860 and 11865. The cost of the object marker shall be included in the cost of the Quadguard CZ System On A Plate.

9. The drivable pile anchor system may be used as an alternative to the other foundation options shown. The cost of the drivable pile anchor system shall be included in the cost of the Quadguard CZ System On A Plate.

10. Temporary Quadguard CZ System On A Plate units will be paid for under the contract unit price for Impact Attenuator-Crash Cushion (Temporary) (Redirective Option), LO.

NOTE 8 ALTERNATIVE:

The contractor has the option to install reflective sheeting on the nose of the crash cushion in lieu of placing the yellow Type I Object Marker 3 feet in front of the nose of the crash cushion. The sheeting to be used must be solid yellow, Type III or better, and must be a product listed on the Department's Qualified Products List (QPL). The sheeting to be applied to the nose of the crash cushion shall be a minimum of 360 square inches with a minimum height of 15 inches.

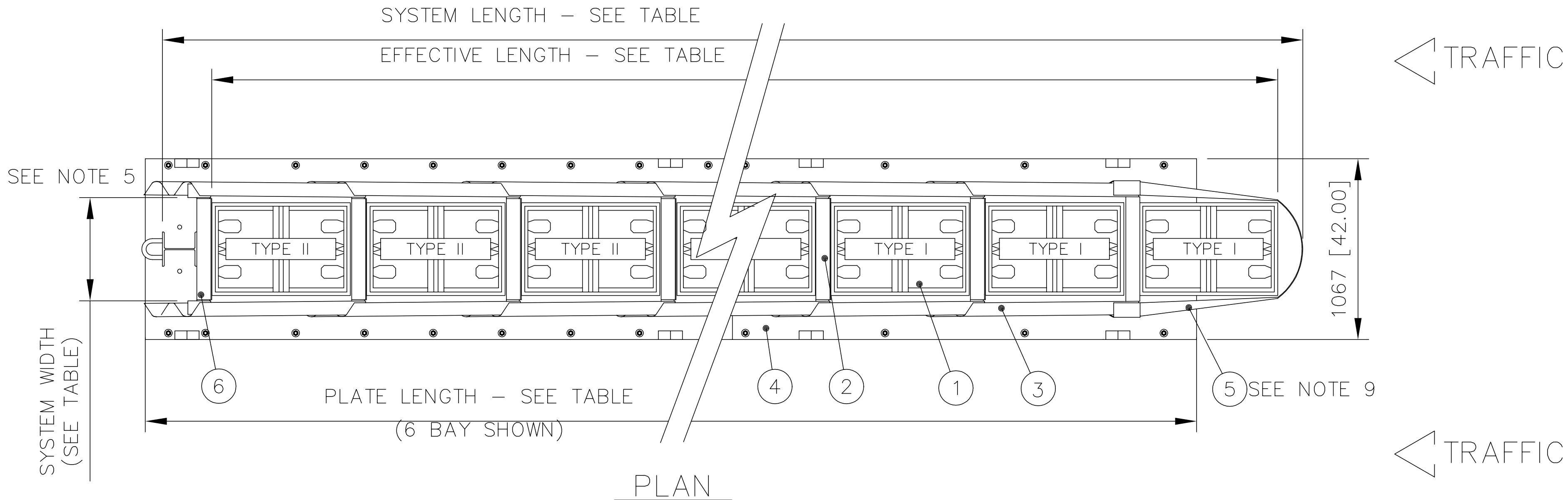
April 30, 2009

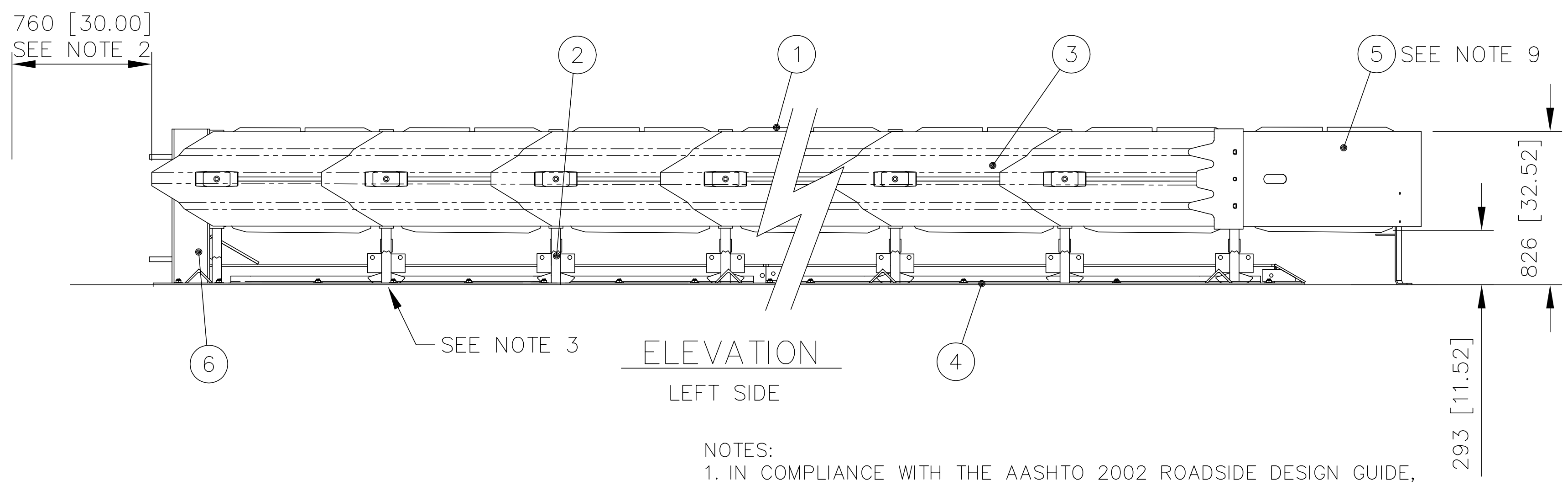
FDOT APPROVED DRAWING

QUADGUARD CZ SYSTEM ON A PLATE

Sheet No. 1 of 13

QPL No. S544-0031





NOTES:

1. IN COMPLIANCE WITH THE AASHTO 2002 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.

2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 760 [30.00] MIN.

3. CAUTION: THE QUADGUARD C.Z. MUST BE CORRECTLY ANCHORED FOR PROPER IMPACT PERFORMANCE.
ATTACH SYSTEM USING ONE OF THE FOLLOWING:
— 7" STUDS MAY BE USED TO ATTACH SYSTEM TO 28 MPa[4000 PSI] MIN. P.C. CONCRETE PER THE FOLLOWING MINIMUMS:**
a) 150[6.00] NON REINFORCED ROADWAY OR PAD
b) 180[7.00] DECK STRUCTURE
— 18" THREADED RODS MAY BE USED TO INSTALL SYSTEM ON ASPHALT.**
**REFER TO THE QUADGUARD CZ MP-3 ANCHORING SYSTEM SECTION OF THE "QUADGUARD INSTALLATION MANUAL".

4. SEE THE "QUADGUARD SYSTEM PRODUCT MANUAL", FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 323-6374.

5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.

6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

7. THE NUMBER OF BAYS INDICATED IN THE TABLE IS BASED ON CALCULATED VALUES TO ENSURE ADEQUATE SYSTEM CAPACITY TO DISSIPATE THE LONGITUDINAL IMPACT ENERGY OF A 2000 kg VEHICLE TRAVELING AT THE SPEED INDICATED.

△ 8. THE SIX BAY SYSTEM HAS BEEN FULLY TESTED AT 100 km/h UNDER THE FULL 8 TEST MATRIX OF NCHRP 350 TL-3. SYSTEMS LONGER THAN SIX BAYS SHALL ALSO BE CAPABLE OF MEETING THE OCCUPANT RISK CRITERIA AS RECOMMENDED IN NCHRP 350 FOR VEHICLES WEIGHING 2000 kg IMPACTING HEAD ON AT THE SPEED INDICATED IN THE TABLE.

9. NOSE ASSEMBLY NOT INCLUDED IN MODEL NUMBER. ORDER SEPARATELY.

UNIDIRECTIONAL
MODEL NO. SEE TABLE

* G = GREY or Y = YELLOW

BAYS	610[24] WIDTH MODEL#	762[30] WIDTH MODEL#	914[36] WIDTH MODEL#	SYSTEM LENGTH m	SYSTEM LENGTH ft-in	EFFECTIVE LENGTH m	EFFECTIVE LENGTH ft-in	PLATE LENGTH m	PLATE LENGTH ft-in	MAX DESIGN SPEED km/h [MPH]	# OF CARTRIDGES TYPE I	# OF CARTRIDGES TYPE II
3	QZ2403P*	QZ3003P*	QZ3603P*	4.00	[13'-1"]	3.56	[11'-8"]	3.47	[11'-5"]	70 [44]	3	1
4	QZ2404P*	QZ3004P*	QZ3604P*	4.90	[16'-1"]	4.47	[14'-8"]	6.21	[20'-5"]	80 [50]	3	2
5	QZ2405P*	QZ3005P*	QZ3605P*	5.82	[19'-1"]	5.38	[17'-8"]	6.21	[20'-5"]	90 [56]	4	2
6	QZ2406P*	QZ3006P*	QZ3606P*	6.74	[22'-1"]	6.30	[20'-8"]	6.21	[20'-5"]	100 [62]	4	3
7	QZ2407P*	QZ3007P*	QZ3607P*	7.65	[25'-1"]	7.21	[23'-8"]	8.96	[29'-5"]	△105 [65]	4	4
8	QZ2408P*	QZ3008P*	QZ3608P*	8.56	[28'-1"]	8.13	[26'-8"]	8.96	[29'-5"]	△110 [68]	4	5
9	QZ2409P*	QZ3009P*	QZ3609P*	9.48	[31'-1"]	9.04	[29'-8"]	8.96	[29'-5"]	△115 [71]	4	6

KEY
1 QUADGUARD CARTRIDGE
2 DIAPHRAGM
3 FENDER PANEL
4 C.Z. PLATE W/MONORAIL
5 NOSE ASSEMBLY
6 C.Z. BACKUP

Revisions	Date	Rev.	By	Ckd.	App.

REFERENCES

SERIAL# ______
SALES ORDER# ______
EH PROJECT# ______
DESIGN SPEED △See Chart Above
NOSE COLOR ______
NUMBER OF UNITS ______

DIAPHRAGM ASSY.	35-40-07
NOSE ASSY.	35-40-05
FENDER PANEL ASSY.	35-40-04
C.Z. BACKUP/PLATE ASSY.	35-40-28
LIFTING KIT	35-40-23
ANCHOR KIT	SH02, SH03 & SH04

DRAWN: S. CHAFFIN	DATE: 12/07/04
DESIGNED: R. Brougher	DATE: 12/19/01
CHECKED: A. FRANKLIN	DATE: 12/07/04
APPROVED R. BROUGHER	DATE: 12/08/04
CAD FILE: 602493.dwg	

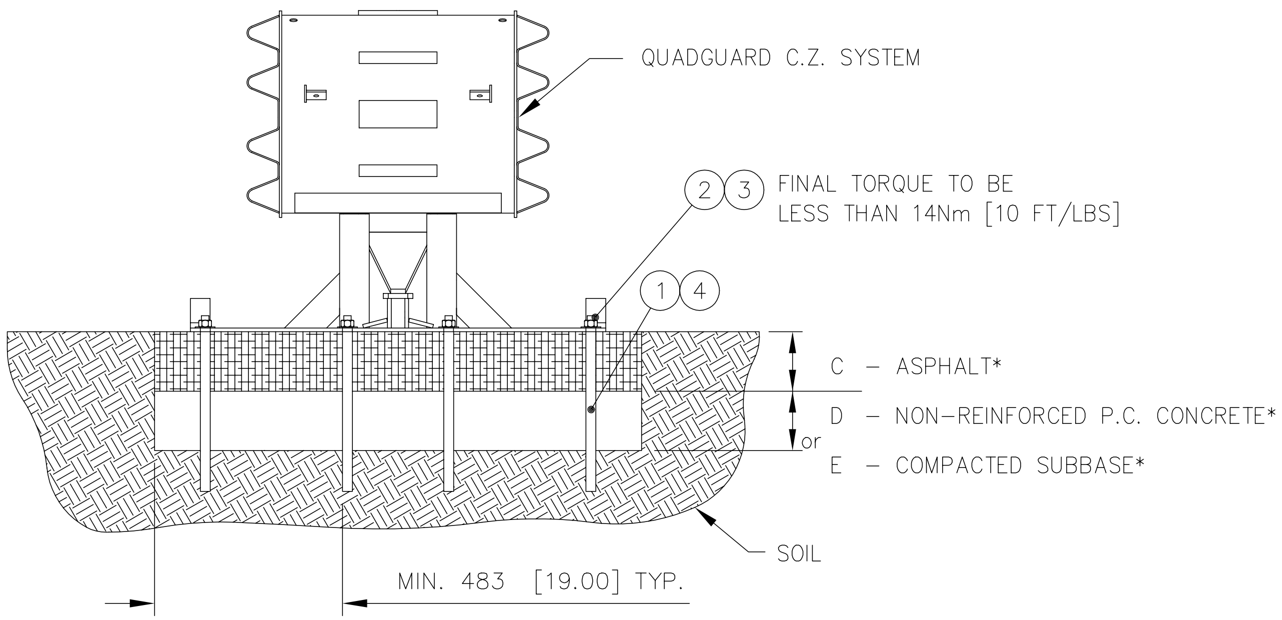
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® c.z. SYSTEM ON A PLATE
FOR CONSTRUCTION ZONES

SCALE	DWG.	SHEET	REV
1:40	60-24-93	1 of 4	–

PARTS LIST					
ITEM	STOCK NO.	DESCRIPTION	REQ'D		
		BAYS ⟶	3	6	9
1	2700731-0500	ROD,THREADED,3/4x18,G5,G	20	30	40
2	2704341-0000	NUT,HX,3/4,G,GR DH	20	30	40
3	2708081-0000	WASHER,FLAT,3/4X2,HVY,G	20	30	40
4	3525100-0000	MP-3,QUART PACKAGE	5	8	10
5	2735492-0000	LABEL,CRATE,QG CZ,LIFT KIT	1	1	1

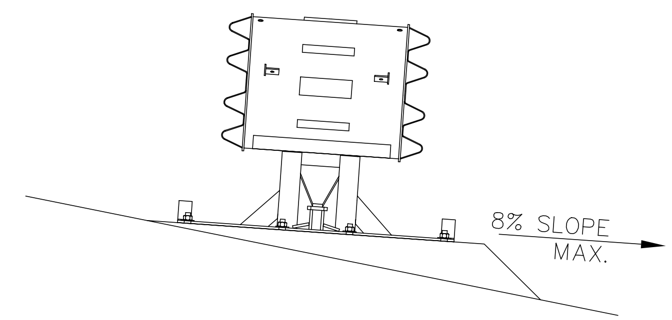
NO. OF BAYS (DIAPHRAGMS)	ASSEMBLY NUMBER
3	3540643-0000
4 THRU 6	3540646-0000
7 THRU 9	3540649-0000



QUADGUARD CZ SECTION VIEW

SCALE – 1:20

REFER TO QUADGUARD CZ ANCHORING SYSTEM INSTALLATION & SAFETY INSTRUCTIONS FOR FURTHER INFORMATION



CROSS SLOPE DETAIL

SCALE – 1:30

SEE NOTE 1

*MATERIALS:
- C – MISCELLANEOUS ASPHALTIC CONCRETE
- D – 28 MPa [4000 PSI] P. C. CONCRETE
- E – STABILIZED SUBBASE, PREPARED & COMPACTED

DEPTH COMBINATION

"C"	"D"	"E"	REQ'D STUD LENGTH
--	152mm [6"]	--	180mm [7"]
76mm [3"]	76mm [3"]	--	460mm [18"]
152mm [6"]	--	152mm [6"]	460mm [18"]
203mm [8"]	--	--	460mm [18"]

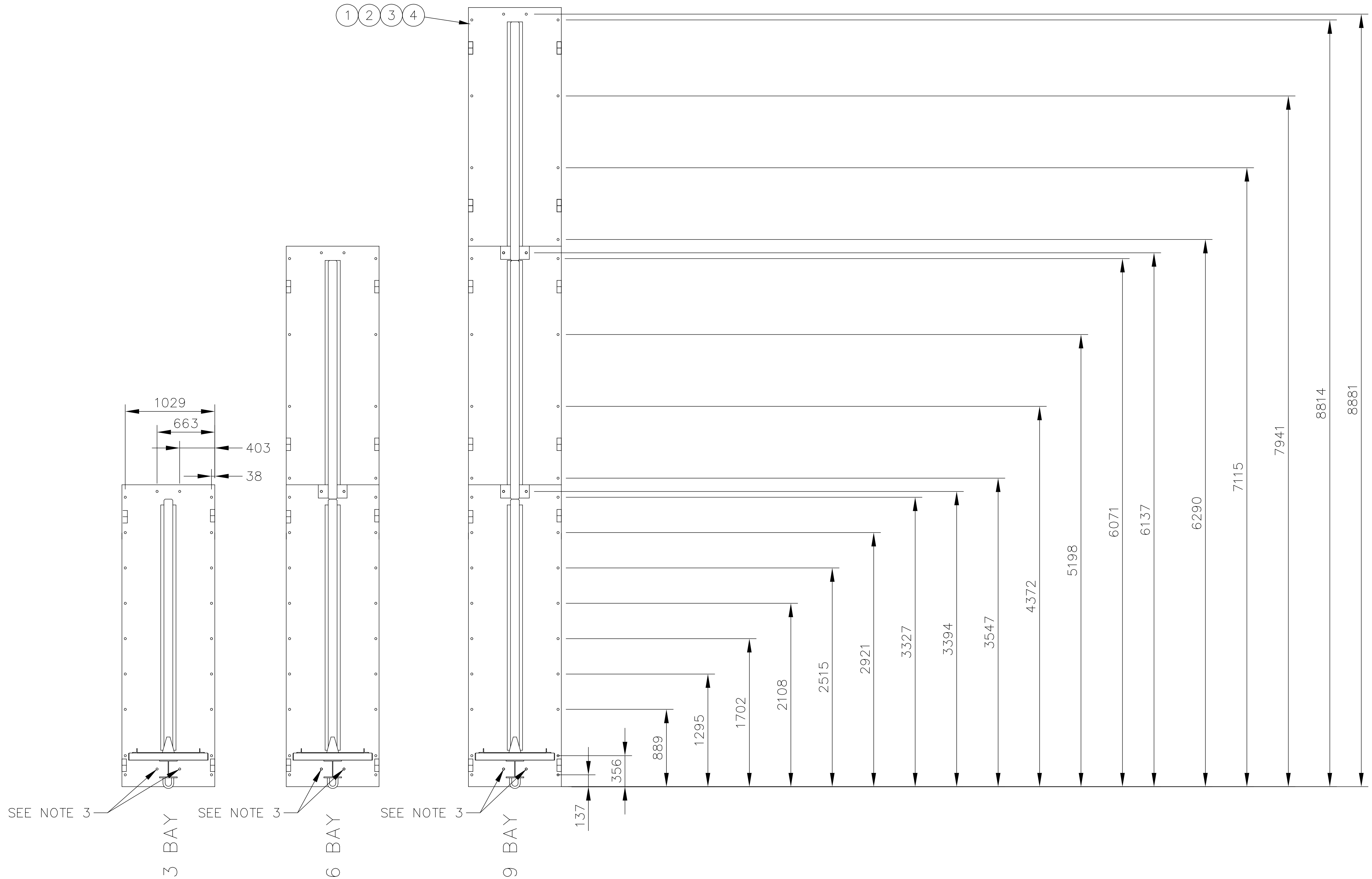
ANCHOR SYSTEM:

1. CROSS SLOPE OF PLATE SHALL NOT EXCEED 8% AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. USE THE ANCHOR PLATES AS A TEMPLATE FOR DRILLING HOLES. HOLE LOCATIONS ARE GIVEN ON SHEETS 3 AND 4 FOR REFERENCE PURPOSES ONLY.
3. USE MP-3 POLYESTER ANCHOR SYSTEM, SUPPLIED BY ENERGY ABSORPTION SYSTEMS, OR APPROVED EQUAL. QUADGUARD CZ SYSTEMS INSTALLED ON ASPHALT MUST BE INSPECTED TO ENSURE THE ANCHORS ARE STILL PROPERLY SET FOLLOWING EACH IMPACT. RE-ANCHOR AS NECESSARY.
4. EVERY HOLE IN THE BACKUP PLATE AND ADAPTER PLATE(S) MUST HAVE AN MP-3 STUD ANCHORING IT, EXCEPT AS NOTED ON SHEETS 3 & 4.

ASSEMBY NO. 354064*-0000

DRAWN: S. CHAFFIN	DATE: 12/07/04	ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
DESIGNED: R. Brougher	DATE: 12/17/01	QuadGuard® SYSTEM
CHECKED: A. FRANKLIN	DATE: 12/07/04	CZ ON A PLATE,MP-3 ANCHOR KIT,QG,
APPROVED R. BROUGHER	DATE: 12/08/04	3 BAY B/U,3 BAY ADAPTER PLATES
Q.C. J.M.E.	DATE: 12/08/04	

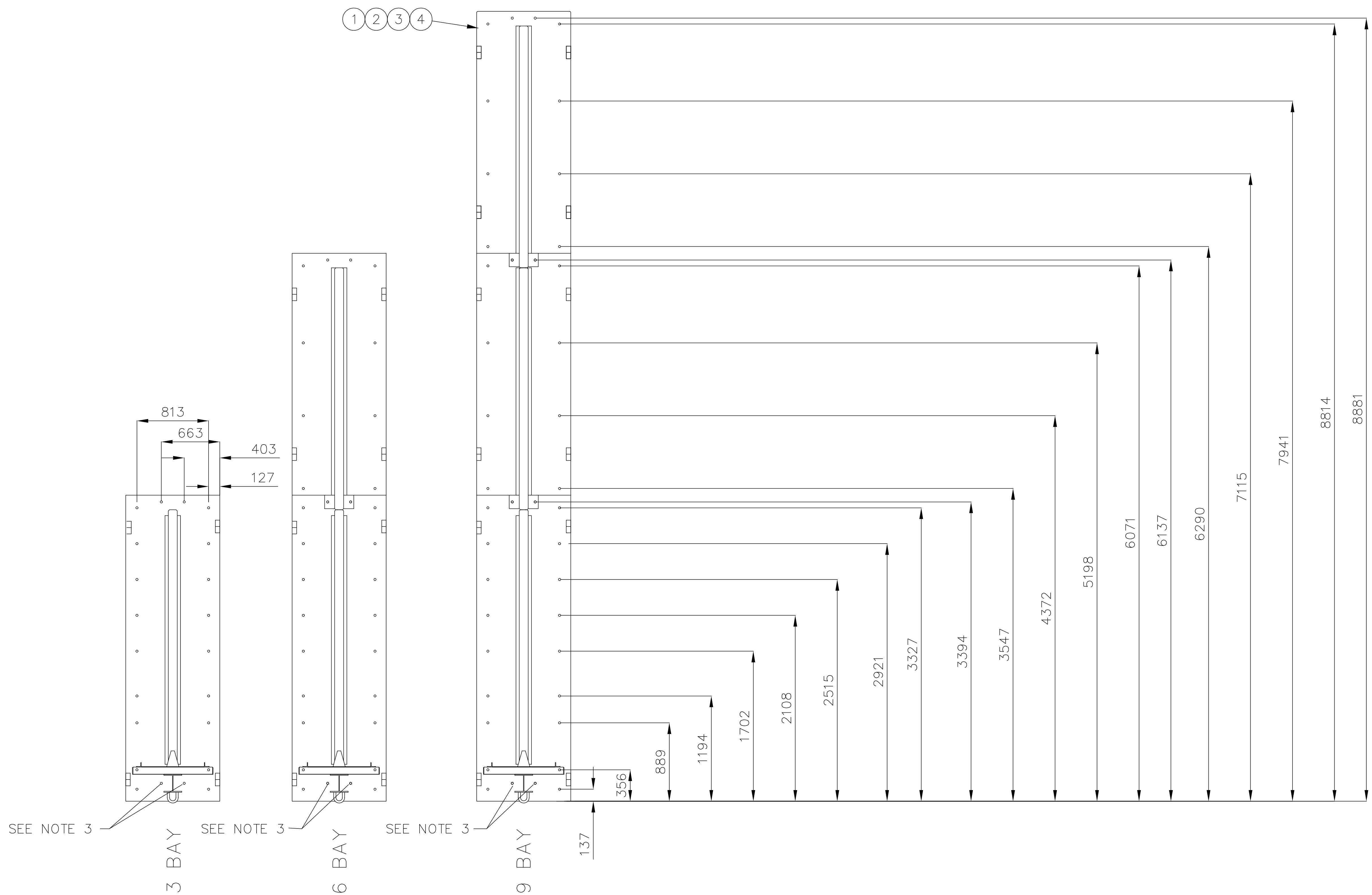
CAD FILE:	SCALE	DWG.	SHEET	REV
602493 SH02.dwg	1:50	60-24-93	2 of 4	–



ANCHOR BOLT LOCATIONS

NOTES:
1. USE THE ANCHOR PLATES AS A TEMPLATE FOR DRILLING HOLES. HOLE LOCATIONS ARE GIVEN HERE FOR REFERENCE PURPOSES ONLY.
2. UNITS ARE MILLIMETERS.
3. DO NOT ANCHOR AT THIS LOCATION.

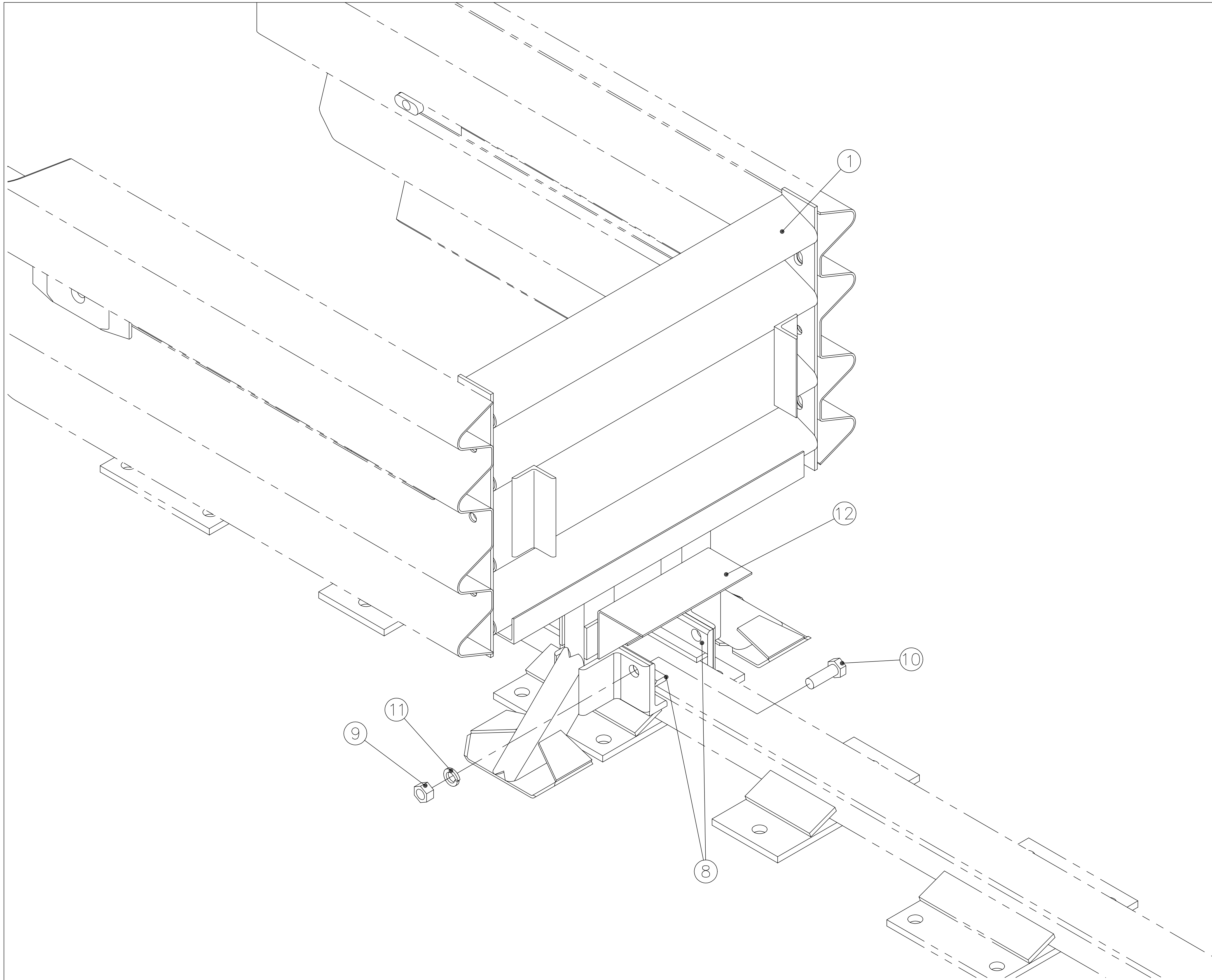
DRAWN: S. CHAFFIN	DATE: 12/07/04	ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT			
DESIGNED: R. Brougher	DATE: 12/17/01	QuadGuard® SYSTEM CZ ON A PLATE,MP-3 ANCHOR KIT,QG, 3 BAY B/U,3 BAY ADAPTER PLATES 24" & 30" SYSTEMS			
CHECKED: A. FRANKLIN	DATE: 12/07/04				
APPROVED R. BROUGHER	DATE: 12/08/04				
Q.C. J.M.E.	DATE: 12/08/04				
CAD FILE: 602493 SH03.dwg		SCALE 1:50	DWG. 60-24-93	SHEET 3 of 4	REV –



ANCHOR BOLT LOCATIONS

NOTES:
1. USE THE ANCHOR PLATES AS A TEMPLATE FOR DRILLING HOLES.
   HOLE LOCATIONS ARE GIVEN HERE FOR REFERENCE PURPOSES ONLY.
2. UNITS ARE MILLIMETERS.
3. DO NOT ANCHOR AT THIS LOCATION.

DRAWN: S. CHAFFIN	DATE: 12/07/04	ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT			
DESIGNED: R. Brougher	DATE: 12/17/01	QuadGuard® SYSTEM CZ ON A PLATE,MP-3 ANCHOR KIT,QG, 3 BAY B/U,3 BAY ADAPTER PLATES 36" SYSTEM			
CHECKED: A. FRANKLIN	DATE: 12/07/04				
APPROVED R. BROUGHER	DATE: 12/08/04				
Q.C. J. M. E.	DATE: 12/08/04				
CAD FILE: 602493 SH04.dwg		SCALE 1:50	DWG. 60-24-93	SHEET 4 of 4	REV –



PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	SEE TABLE A	DIAPHRAGM,QB,QG,G	1.00
8	2760091-0000	MONORAIL GUIDE,QG,G	2.00
9	2704341-0000	NUT,HX,3/4,G,GR DH	4.00
10	2699121-0000	BOLT,HX,3/4X2,G8,G	4.00
11	2708201-0000	WASHER,LOCK,3/4,G	4.00
12	2760292-0000	BRACKET,CART SUPPORT,DIAPHRAGM	2.00

TABLE A

ASSY. NO.	STOCK NO.	DESCRIPTION	WIDTH
3540071-0000	2761011-0000	DIAPHRAGM,QB,24,QG,G	610 [24.00]
3540072-0000	2761021-0000	DIAPHRAGM,QB,30,QG,G	760 [30.00]
3540073-0000	2761031-0000	DIAPHRAGM,QB,36,QG,G	915 [36.00]

ASSEMBLY NO. SEE TABLE A

Revisions	Date	Rev.	By	Ckd.	App.
DEL ITEMS 2,4,5,&6,ADDED ITEM 12,UPDATED CART SUPPORT	11/04/97	D	RGC	KRM	DLJ
CHGD #5 & #10 BOLT DIRECTION,#2 WAS 2760101	8/8/96	B	DLS	STT	JVM
#7 WAS 2708021-0000	07/08/97	C	JF	BB	SPT

REFERENCES

DRAWN: J. Espinoza DATE: 5-2-96
DESIGNED: DATE:
CHECKED: S. Trageser DATE: 5/17/96
APPROVED J. Machado DATE: 5/17/96
CAD FILE: 354007.dwg
NEXT ASSEMBLY:

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

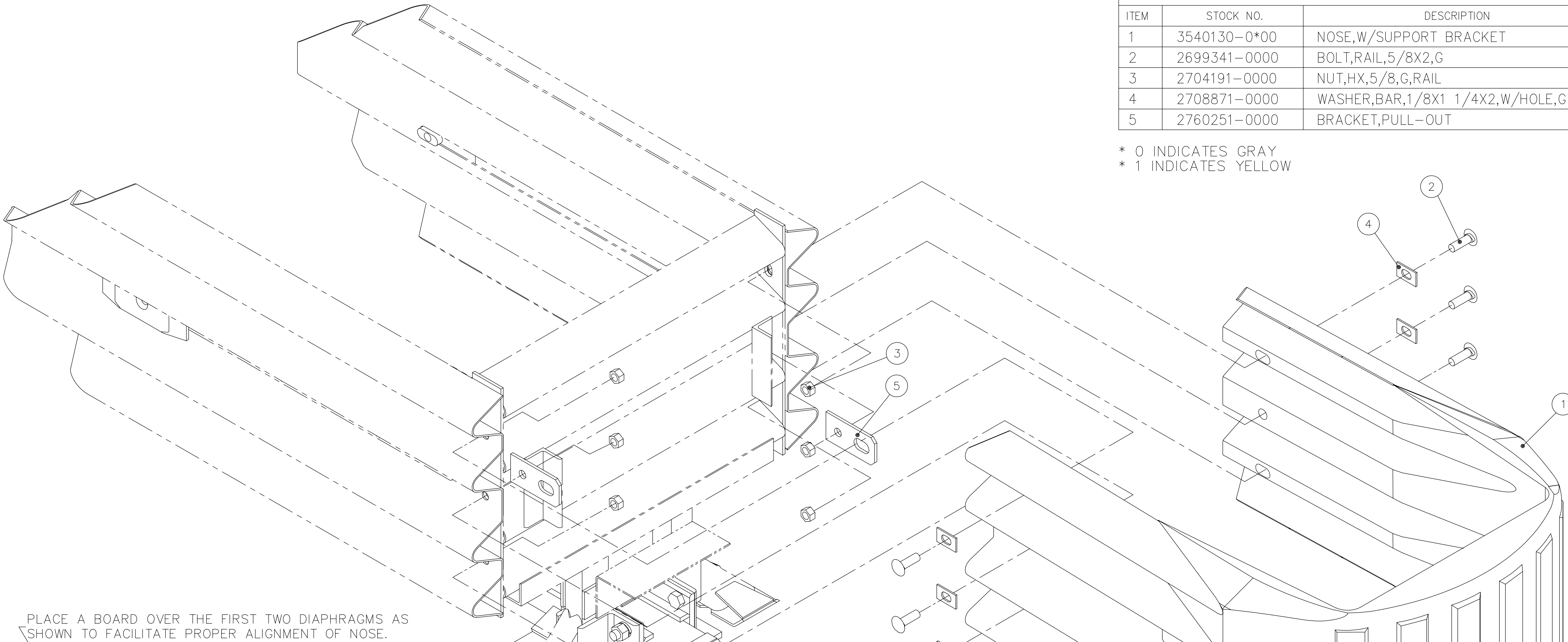
QUADGUARD® SYSTEM

DIAPHRAGM ASSY, QG

SCALE N.T.S. | DWG. 35-40-07 | SHEET 1 of 1 | REV D

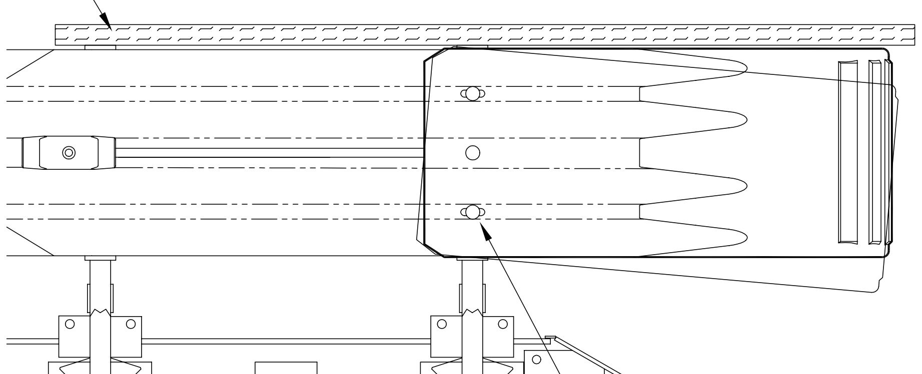
PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	3540130-0*00	NOSE,W/SUPPORT BRACKET	1.00
2	2699341-0000	BOLT,RAIL,5/8X2,G	6.00
3	2704191-0000	NUT,HX,5/8,G,RAIL	6.00
4	2708871-0000	WASHER,BAR,1/8X1 1/4X2,W/HOLE,G	6.00
5	2760251-0000	BRACKET,PULL-OUT	2.00

* 0 INDICATES GRAY
* 1 INDICATES YELLOW



DELINEATION SHOULD BE ADDED TO THE NOSE AS REQUIRED BY LOCAL POLICIES. MAX. WEIGHT TO BE ADDED: 3.18 KG [7 lbs.]. DELINEATION/REFLECTORIZATION SUPPLIED BY OTHERS.

PLACE A BOARD OVER THE FIRST TWO DIAPHRAGMS AS SHOWN TO FACILITATE PROPER ALIGNMENT OF NOSE.



TIGHTEN NUTS TO 25 FT-LBS <u>AFTER</u> ALIGNING NOSE AS SHOWN.

NOTE 1. THE TOP AND BOTTOM HOLES OF THE NOSE ARE SLOTTED TO PROVIDE ADJUSTMENT. ADJUST NOSE TO ALIGN WITH FENDER PANELS THEN TIGHTEN NUTS, SEE DETAIL "A".

DETAIL "A"
SCALE: 1:20

ASSEMBLY NO. 3540050-0100 (YELLOW)
ASSEMBLY NO. 3540050-0000 (GRAY)

REFERENCES

Revisions	Date	Rev.	By	Ckd.	App.
UPDATED CARTRIDGE SUPPORT	11/03/97	C	RGC	KRM	DLJ
ADDED DETAIL "A"	03/23/99	D	TB	KM	SPT
REVISED 'DELINEATION...' NOTE	07/11/01	E	RSG	DMO	SPT

DRAWN: D. Staus	DATE: 5/20/96
DESIGNED: MHO/JVM	DATE: 3/1/96
CHECKED: S. Trageser	DATE: 5/21/96
APPROVED M. Oberth	DATE: 5/22/96
CAD FILE: 354005.dwg	
NEXT ASSEMBLY:	

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

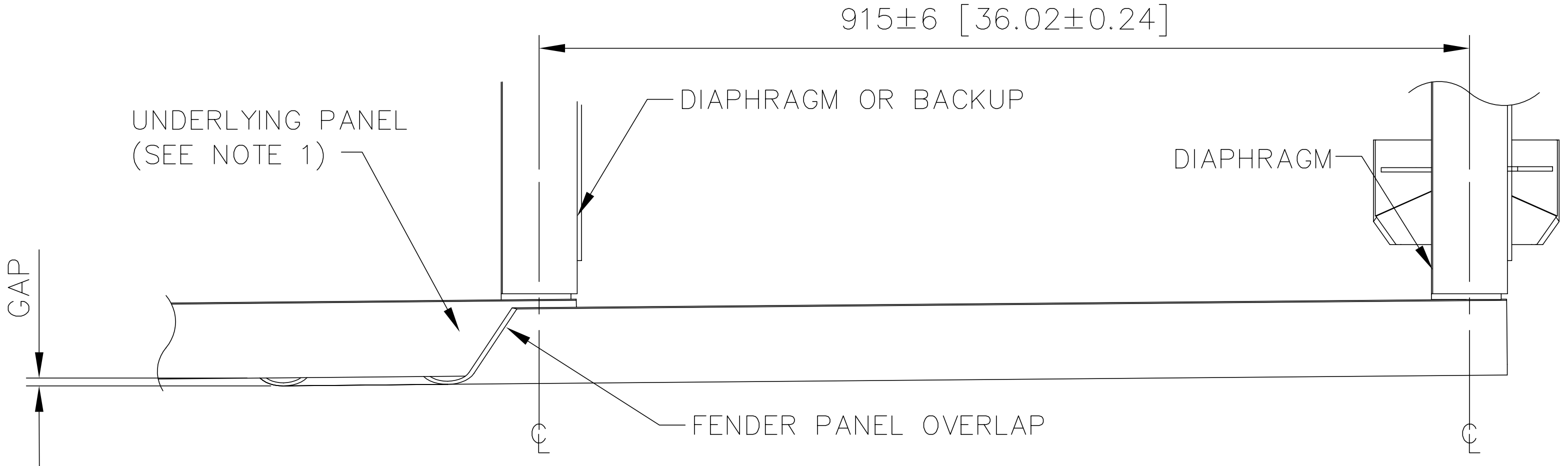
QUADGUARD® SYSTEM

NOSE ASSY,QG

SCALE	DWG.	SHEET	REV
1:10	35-40-05	1 of 1	E

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	2760081-0000	PANEL,FENDER,QG,G	1.00
2	2699341-0000	BOLT,RAIL,5/8X2,G	2.00
3	2704191-0000	NUT,HX,5/8,G,RAIL	2.00
4	2708841-0000	WASHER,MUSHROOM,CAST,QG,G	1.00
5	2706604-0000	SCREW,FL,5/8X5,G8,G,SOCKET	1.00
6	2704141-0000	NUT,HX,5/8,G	1.00
7	2708291-0000	WASHER,FLAT,5/8X1 3/4,G	1.00
8	2715343-0000	SPRING,DIE,1 1/4 OD X5/8X1 1/2	1.00

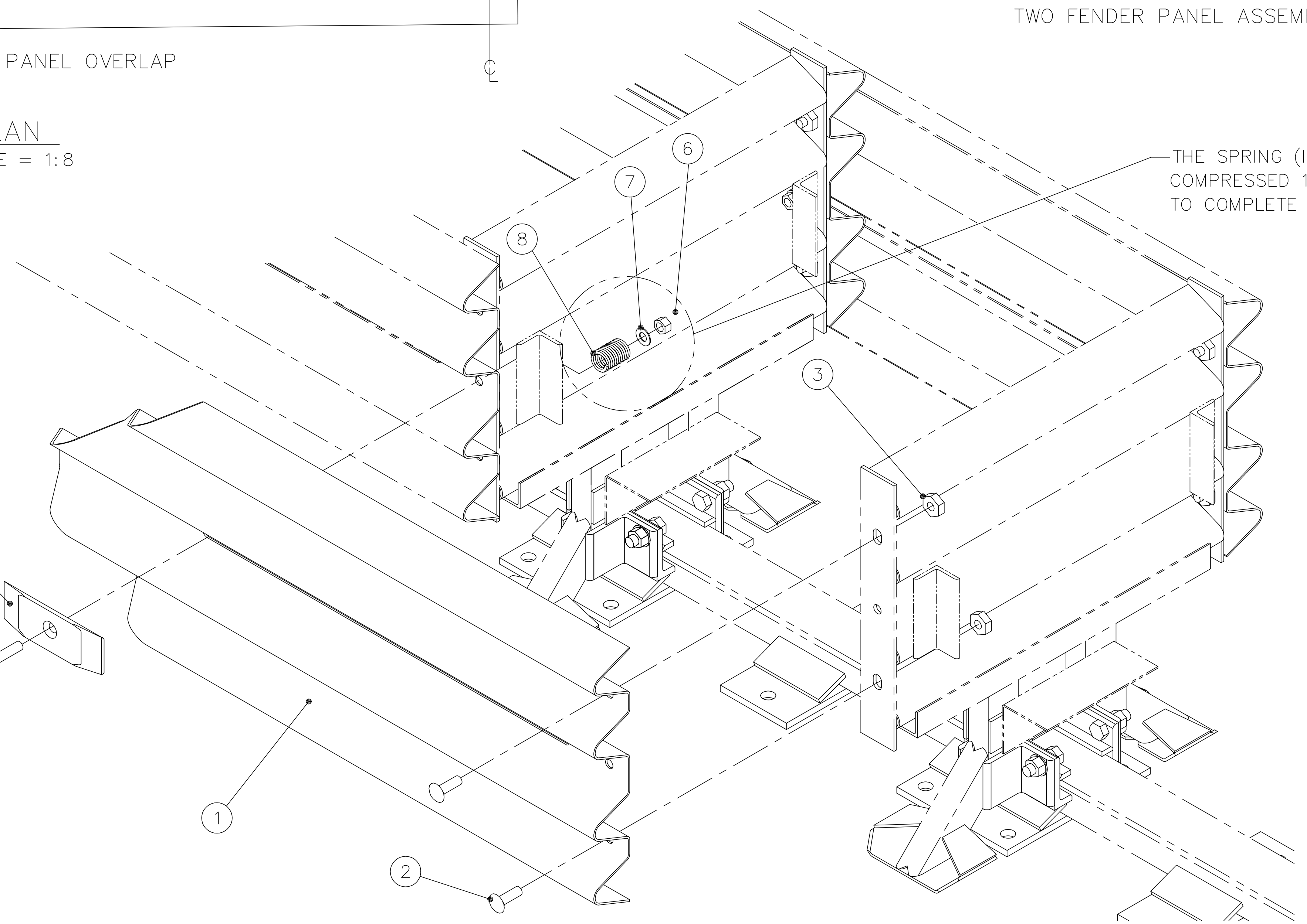
TWO FENDER PANEL ASSEMBLIES REQUIRED PER BAY.



CAUTION

20 [0.78] MAX.
FOR PROPER IMPACT PERFORMANCE.

PLAN
SCALE = 1:8



NOTES:
1. UNDERLYING PANEL IS EITHER ANOTHER FENDER PANEL OR, IN THE CASE OF THE LAST FENDER PANEL IT COULD BE A BACKUP SIDE PANEL, EXTENSION PANEL OR TRANSITION PANEL.
2. UNITS OF MEASUREMENT ARE IN MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.

ASSEMBLY NO. 3540040-0000

Revisions	Date	Rev.	By	Ckd.	App.
CORRECTED DIAPHRAGM SPACING	10/28/98	G	RGC	STT	KRM
DIAPHRAGM SPACING WAS FRONT TO FRONT	11/26/01	H	DDW	JME	DMO
8 WAS 2021611-0000, 7 QTY WAS 4.0	4/22/04	I	DK	JME	AC

REFERENCES

DRAWN: J. Espinoza	DATE: 5/21/96
DESIGNED: JVM/MHO	DATE: 3/1/96
CHECKED: S. Trageser	DATE: 5/21/96
APPROVED J. Machado	DATE: 5/21/96
CAD FILE: 354004.dwg	
NEXT ASSEMBLY: ALL MODELS	

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD® SYSTEM

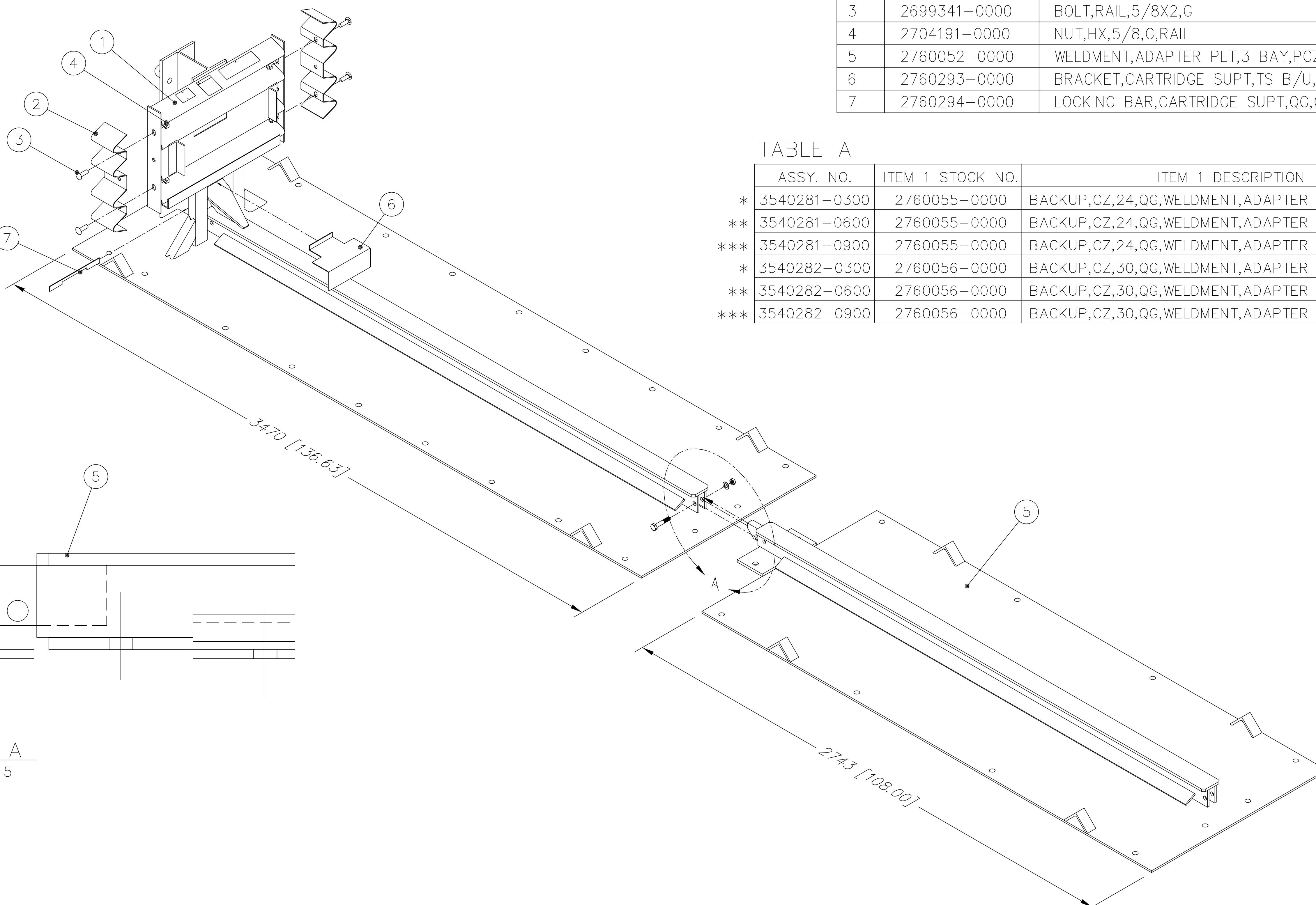
FENDER PANEL ASSY, QG

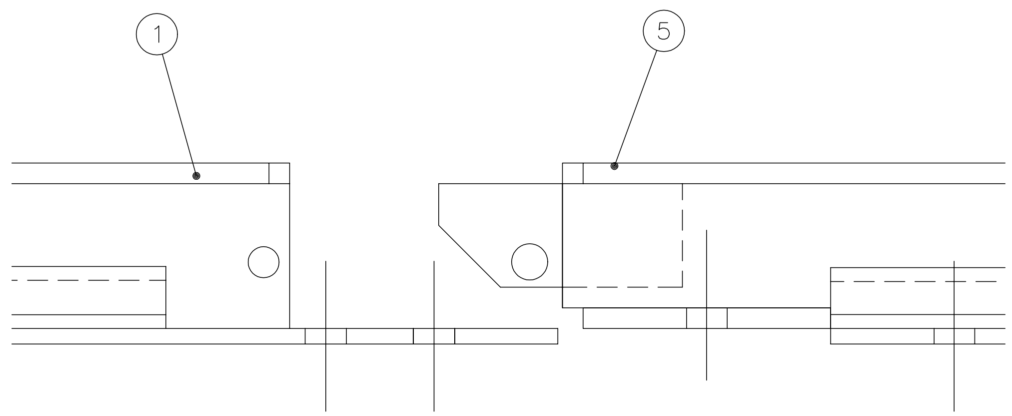
SCALE	DWG.	SHEET	REV
1:12	35-40-04	1 of 1	I

PARTS LIST		BAYS >	* 3 BAY	** 4 - 6	*** 7 -9
ITEM	STOCK NO.	DESCRIPTION	REQ'D	REQ'D	REQ'D
1	SEE TABLE A	BACKUP,CZ,ADAPTER PLATE,3 BAY,QG,G	1.00	1.00	1.00
2	2760141-0000	PANEL,SIDE,QG,G	2.00	2.00	2.00
3	2699341-0000	BOLT,RAIL,5/8X2,G	4.00	4.00	4.00
4	2704191-0000	NUT,HX,5/8,G,RAIL	4.00	4.00	4.00
5	2760052-0000	WELDMENT,ADAPTER PLT,3 BAY,PCZ	0.00	1.00	2.00
6	2760293-0000	BRACKET,CARTRIDGE SUPT,TS B/U,QG,G	1.00	1.00	1.00
7	2760294-0000	LOCKING BAR,CARTRIDGE SUPT,QG,G	1.00	1.00	1.00

TABLE A

	ASSY. NO.	ITEM 1 STOCK NO.	ITEM 1 DESCRIPTION	WIDTH
*	3540281-0300	2760055-0000	BACKUP,CZ,24,QG,WELDMENT,ADAPTER PLATE,3 BAY,G	610 [2'-0"]
**	3540281-0600	2760055-0000	BACKUP,CZ,24,QG,WELDMENT,ADAPTER PLATE,3 BAY,G	610 [2'-0"]
***	3540281-0900	2760055-0000	BACKUP,CZ,24,QG,WELDMENT,ADAPTER PLATE,3 BAY,G	610 [2'-0"]
*	3540282-0300	2760056-0000	BACKUP,CZ,30,QG,WELDMENT,ADAPTER PLATE,3 BAY,G	762 [2'-6"]
**	3540282-0600	2760056-0000	BACKUP,CZ,30,QG,WELDMENT,ADAPTER PLATE,3 BAY,G	762 [2'-6"]
***	3540282-0900	2760056-0000	BACKUP,CZ,30,QG,WELDMENT,ADAPTER PLATE,3 BAY,G	762 [2'-6"]





DETAIL A
SCALE 1:5

ASSEMBLY NO. SEE TABLE

Revisions	Date	Rev.	By	Ckd.	App.
PCN 1908, REMOVED ANCHORING REFERENCES	10/18/04	D	RGC	STT	ACF
UPDATED BASE PLATES	12/04/03	B	RGC	STT	ACF
REPLACED CHAIN ON ITEMS 5 & 1 WITH ANG	5/7/04	C	DPH	STT	ACF

REFERENCES

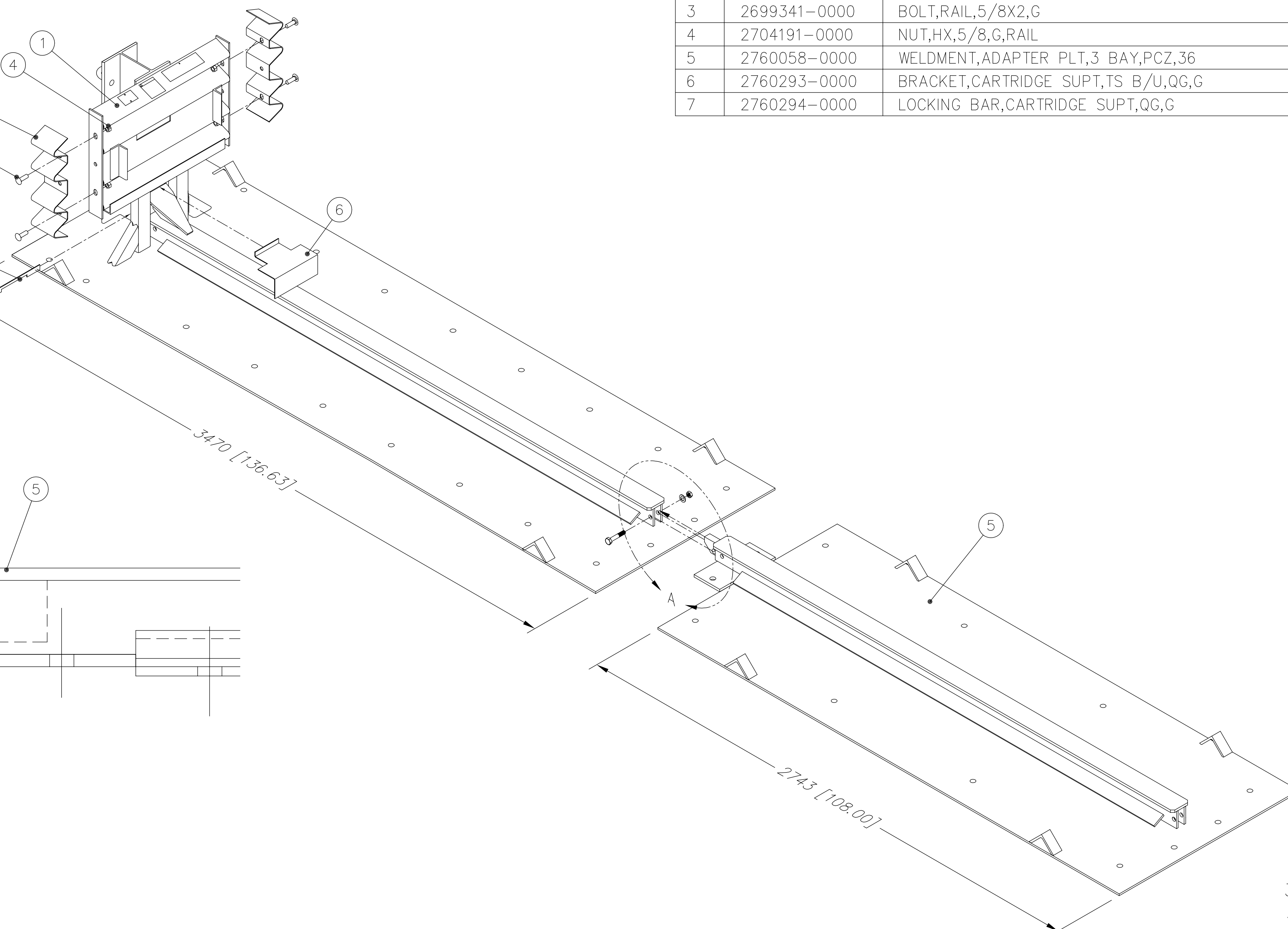
DRAWN: L. Corker	DATE: 03/19/03
DESIGNED: R. Brougher	DATE: 12/17/01
CHECKED: K. Mortensen	DATE: 04/02/03
APPROVED D. Wulff	DATE: 04/02/03
CAD FILE: 354028.dwg	
NEXT ASSEMBLY:	

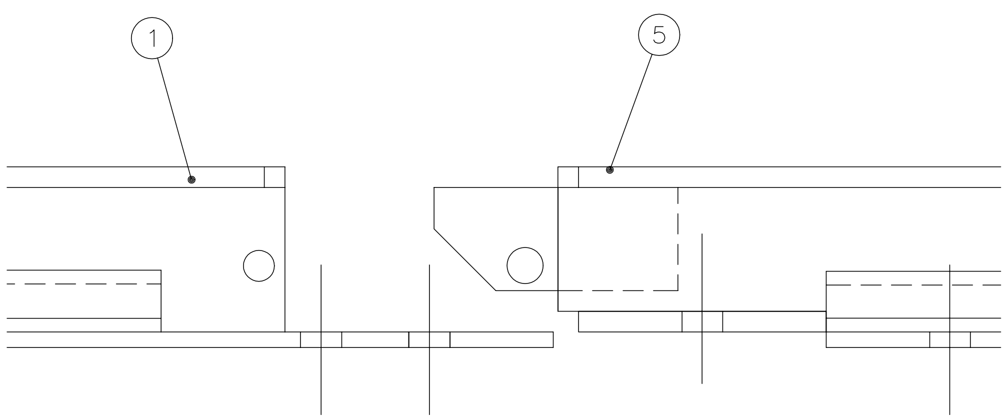
ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

QUADGUARD™ SYSTEM
24 & 30 BACKUP ASSY,
CZ,PORTABLE,QG

SCALE	DWG.	SHEET	REV
1=25	35-40-28	1 of 2	D

PARTS LIST			BAYS > * 3	** 4-6	*** 7-9
ITEM	STOCK NO.	DESCRIPTION	REQ'D	REQ'D	REQ'D
1	2760057-0000	BACKUP,CZ,36,QG,WELDMENT,ADAPTER PLATE,3 BAY,G	1.00	1.00	1.00
2	2760141-0000	PANEL,SIDE,QG,G	2.00	2.00	2.00
3	2699341-0000	BOLT,RAIL,5/8X2,G	4.00	4.00	4.00
4	2704191-0000	NUT,HX,5/8,G,RAIL	4.00	4.00	4.00
5	2760058-0000	WELDMENT,ADAPTER PLT,3 BAY,PCZ,36	0.00	1.00	2.00
6	2760293-0000	BRACKET,CARTRIDGE SUPT,TS B/U,QG,G	1.00	1.00	1.00
7	2760294-0000	LOCKING BAR,CARTRIDGE SUPT,QG,G	1.00	1.00	1.00





DETAIL A
SCALE 1:5

3540283-0300 *
3540283-0600 **
ASSEMBLY NO. 3540283-0900 ***

REFERENCES

DRAWN: L. Corker	DATE: 06/12/03
DESIGNED: R. Brougher	DATE: 12/17/01
CHECKED: B. Kornow	DATE: 06/18/03
APPROVED R. Brougher	DATE: 06/18/03
CAD FILE: 354028.dwg	
NEXT ASSEMBLY:	

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

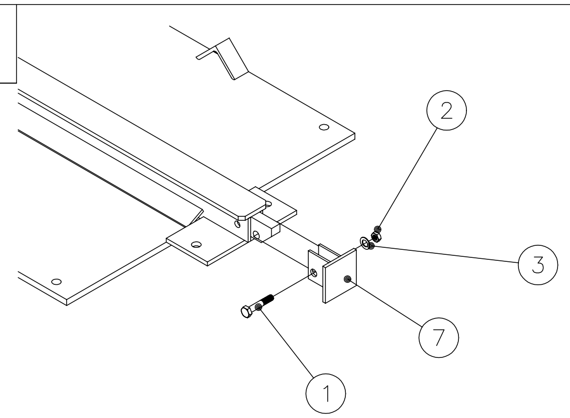
QUADGUARD™ SYSTEM

36 BACKUP ASSY,CZ,PORTABLE,QG

SCALE	DWG.	SHEET	REV
1=25	35-40-28	2 of 2	D

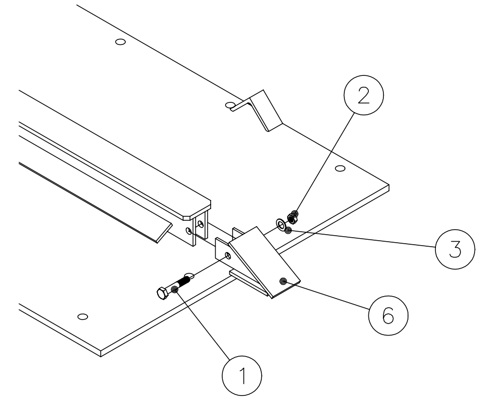
Revisions	Date	Rev.	By	Ckd.	App.
PCN 1908, REMOVED ANCHORING REFS.	10/19/04	D	RGC	STT	ACF
UPDATED BASE PLATES	12/05/03	B	RGC	STT	ACF
REPLACED CHAIN ON ITEMS 5 & 1 WITH ANG	5/7/04	C	DPH	STT	ACF

NEXT ASSEMBLY:
QPCZCVR



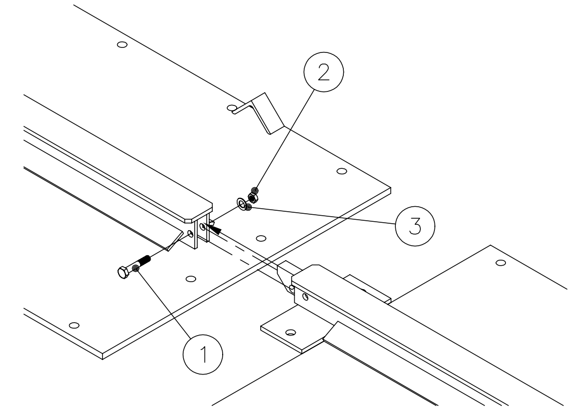
END PLATE ATTACHMENT

SCALE – 1:25
SEE NOTE 8



ENDCAP ATTACHMENT

SCALE – 1:25

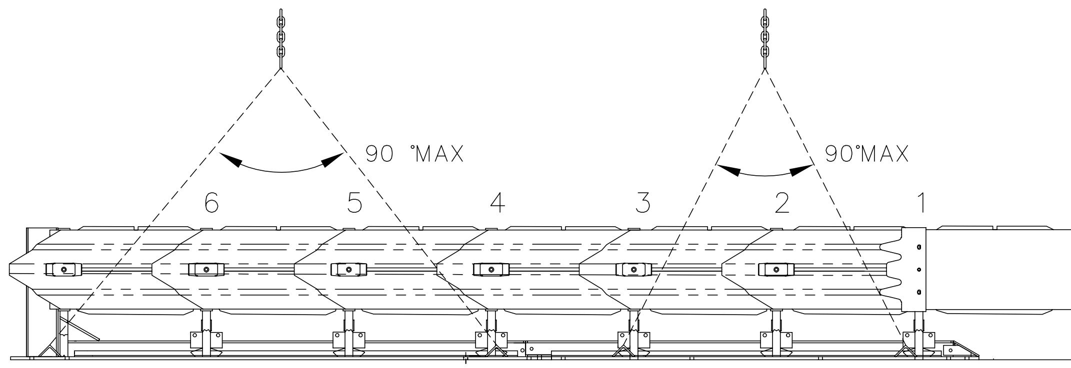


MONORAIL ATTACHMENT

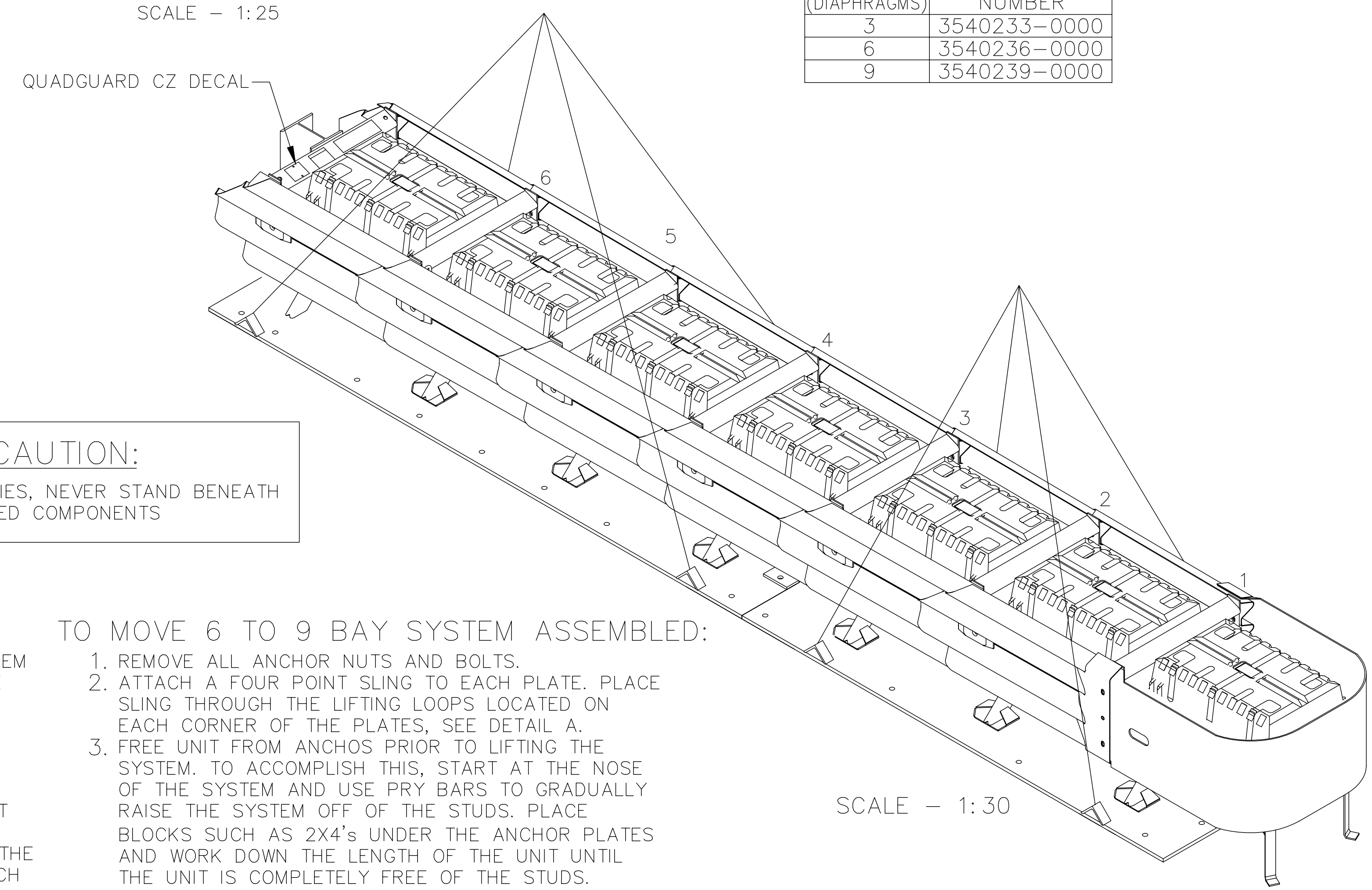
SCALE – 1:25

PARTS LIST					
ITEM	STOCK NO.	DESCRIPTION	REQ'D		
		BAYS ►	3	6	9
1	2699571–0000	BOLT,HX,5/8X3 1/2,G5,G	1	2	3
2	2704141–0000	NUT,HX,5/8,G	1	2	3
3	2708231–0000	WASHER,LOCK,5/8,G	1	2	3
4	354023Z–0000	INST.,QG PORTABLE CZ LIFT KIT	1	1	1
6	2760040–0000	ENDCAP,MONORAIL,QPCZ,G	1	1	1
7	2760042–0000	END PLATE,CZ,LIFTING KIT	0	1	1

NO. OF BAYS (DIAPHRAGMS)	ASSEMBLY NUMBER
3	3540233–0000
6	3540236–0000
9	3540239–0000



DETAIL A
6 BAY QUADGUARD cz
SCALE – 1:50



SCALE – 1:30

CAUTION:
TO AVOID INJURIES, NEVER STAND BENEATH LIFTED COMPONENTS

TO MOVE SYSTEM IN 3 BAY SECTIONS:

1. REMOVE CARTRIDGE FROM BAYS THAT HAVE A MONORAIL BOLT CONNECTING SECTIONS TOGETHER BELOW THEM
2. REMOVE MUSHROOM BOLTS FOR THE BAY THAT HAS HAD THE CARTRIDGE REMOVED. THIS WILL BECOME THE BREAK POINT FOR THE QUADGUARD SYSTEM.
3. REMOVE ALL ANCHOR BOLTS.
4. REMOVE MONORAIL BOLTS THAT CONNECT SECTIONS TOGETHER.
5. LIFT ONLY ONE 3 BAY SECTION AT A TIME. START WITH NOSE SECTION FIRST.
6. PLACE SLING THROUGH THE LIFTING LOOPS ON EACH CORNER OF THE PLATE. THE SLING NEEDS TO BE A MINIMUM OF 9 FEET LONG OUT TO EACH LIFTING LOOP. MAKE SURE THAT THE SLING IS LONG ENOUGH THAT THE ANGLE IS LESS THAN 90° AS SHOWN.
7. FREE UNIT FROM ANCHORS PRIOR TO LIFTING THE SYSTEM. TO ACCOMPLISH THIS, START AT THE NOSE OF THE SYSTEM AND USE PRY BARS TO GRADUALLY RAISE THE SYSTEM OFF OF THE ANCHORS. PLACE BLOCKS SUCH AS 2X4's UNDER THE ANCHOR PLATES AND WORK DOWN THE LENGTH OF THE UNIT UNTIL THE UNIT IS COMPLETELY FREE OF THE ANCHORS.
8. INSTALL THE END PLATE (ITEM 12) OR ENDCAP (ITEM 11) ON EACH 3 BAY SECTION OF THE MONORAIL AS SHOWN (ITEM 12 NOT NEEDED FOR THE BACKUP SECTION). IF THE TOTAL UNIT HAS 7 OR MORE BAYS, BOTH THE ENDCAP AND END PLATE WILL NEED TO BE MOVED TO THE SECTION THAT IS BEING LIFTED TO PREVENT THE DIAPHRAGMS FROM SLIDING OFF THE MONORAIL.
9. LIFT THE SYSTEM TO NEW LOCATION, REMOVE END PLATE(S) AND RE-INSTALL SYSTEM.

TO MOVE 6 TO 9 BAY SYSTEM ASSEMBLED:

1. REMOVE ALL ANCHOR NUTS AND BOLTS.
2. ATTACH A FOUR POINT SLING TO EACH PLATE. PLACE SLING THROUGH THE LIFTING LOOPS LOCATED ON EACH CORNER OF THE PLATES, SEE DETAIL A.
3. FREE UNIT FROM ANCHOS PRIOR TO LIFTING THE SYSTEM. TO ACCOMPLISH THIS, START AT THE NOSE OF THE SYSTEM AND USE PRY BARS TO GRADUALLY RAISE THE SYSTEM OFF OF THE STUDS. PLACE BLOCKS SUCH AS 2X4's UNDER THE ANCHOR PLATES AND WORK DOWN THE LENGTH OF THE UNIT UNTIL THE UNIT IS COMPLETELY FREE OF THE STUDS. ATTACH SLINGS TO A MULTIPLE SPREAD LIFTING
4. BAR/BEAM AND ADJUST SLING POSITIONS AS NEEDED IN ORDER TO BALANCE THE SYSTEM. LIFT THE SYSTEM TO NEW LOCATION AND
5. RE-INSTALL.

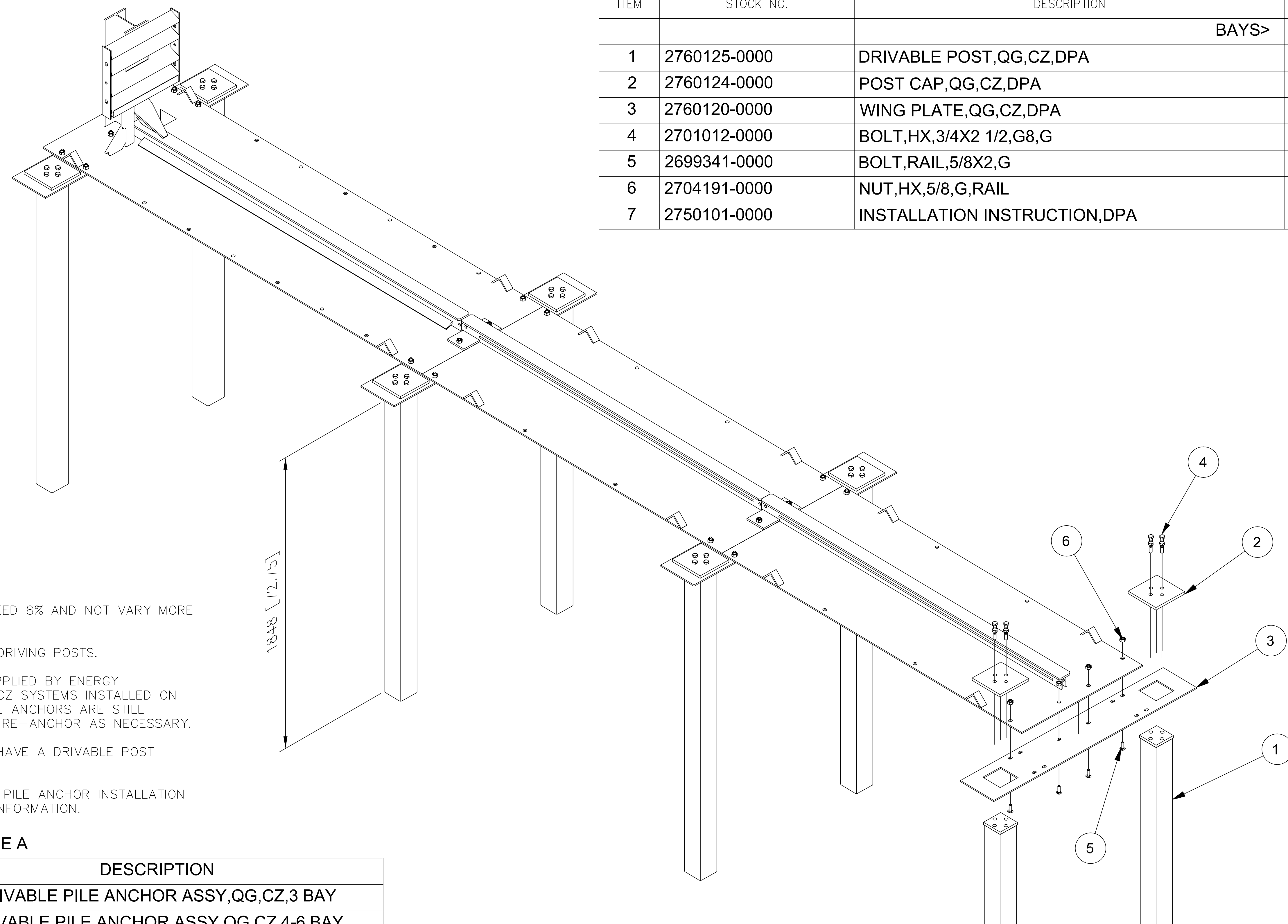
* SEE CHART

ASSEMBLY NO. 354023*–0000

Revisions	Date	Rev.	By	Ckd.	App.	Q.C.
UPDATED LIFTING PACKAGE	08/05/04	C	RGC	JME	ACF	STT
PCN 1908, DELETED SHT'S 2 & 3 W/ ALL ANCHORING	10/18/04	D	RGC	JME	ACF	STT

DRAWN: L. Corker	DATE: 03/21/03	ENERGY ABSORPTION SYSTEMS, INC. ENGINEERING AND RESEARCH DEPARTMENT
DESIGNED: R. Brougher	DATE: 12/17/01	QuadGuard® SYSTEM
CHECKED: K. Mortensen	DATE: 03/28/03	CZ ON A PLATE,QG,
APPROVED: R. Brougher	DATE: 03/28/03	LIFTING KIT & INSTRUCTIONS
Q.C.: J. Espinoza	DATE: 03/28/03	Instruction No. 354023Z–0000
CAD FILE: 354023.dwg		SCALE: AS NOTED · DWG. 35–40–23 · SHEET 1 of 1 · REV D

ITEM	STOCK NO.	DESCRIPTION	QTY.		
		BAYS>	3	4-6	7-9
1	2760125-0000	DRIVABLE POST,QG,CZ,DPA	4	6	8
2	2760124-0000	POST CAP,QG,CZ,DPA	4	6	8
3	2760120-0000	WING PLATE,QG,CZ,DPA	2	3	4
4	2701012-0000	BOLT,HX,3/4X2 1/2,G8,G	16	24	32
5	2699341-0000	BOLT,RAIL,5/8X2,G	10	16	22
6	2704191-0000	NUT,HX,5/8,G,RAIL	10	16	22
7	2750101-0000	INSTALLATION INSTRUCTION,DPA	1	1	1



NOTES:
1. CROSS SLOPE OF PLATE SHALL NOT EXCEED 8% AND NOT VARY MORE THAN 2% FROM FRONT TO BACK.
2. USE THE WING PLATES AS A GUIDE FOR DRIVING POSTS.
3. USE DRIVABLE PILE ANCHOR SYSTEM, SUPPLIED BY ENERGY ABSORPTION SYSTEMS, INC. QUADGUARD CZ SYSTEMS INSTALLED ON SOIL MUST BE INSPECTED TO ENSURE THE ANCHORS ARE STILL PROPERLY SET FOLLOWING EACH IMPACT. RE-ANCHOR AS NECESSARY.
4. EVERY HOLE IN THE WING PLATES MUST HAVE A DRIVABLE POST ANCHORING IT.
5. REFER TO QUADGUARD SYSTEM DRIVABLE PILE ANCHOR INSTALLATION ADDENDUM INSTRUCTIONS FOR FURTHER INFORMATION.

TABLE A

NO. OF BAYS	ASSEMBLY NO.	DESCRIPTION
3	3540700-0300	DRIVABLE PILE ANCHOR ASSY,QG,CZ,3 BAY
4-6	3540700-0600	DRIVABLE PILE ANCHOR ASSY,QG,CZ,4-6 BAY
7-9	3540700-0900	DRIVABLE PILE ANCHOR ASSY,QG,CZ,7-9 BAY

ASSEMBLY NO. (SEE TABLE A)

Revisions	Date	Rev.	By	Ckd.	App.
ITEM 2 DESCRIPT. WAS FTB ST 3/4X10X10,W/HOLES;ADDED ITEM 7	11/5/04	A	TB	STT	AF

REFERENCES

DRAWN: T. Busse DATE: 10/6/04
DESIGNED: DATE:
CHECKED: A. FRANKLIN DATE: 10/6/04
APPROVED R. BROUGHER DATE: 10/6/04
CAD FILE: 354070.dwg
NEXT ASSEMBLY:

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

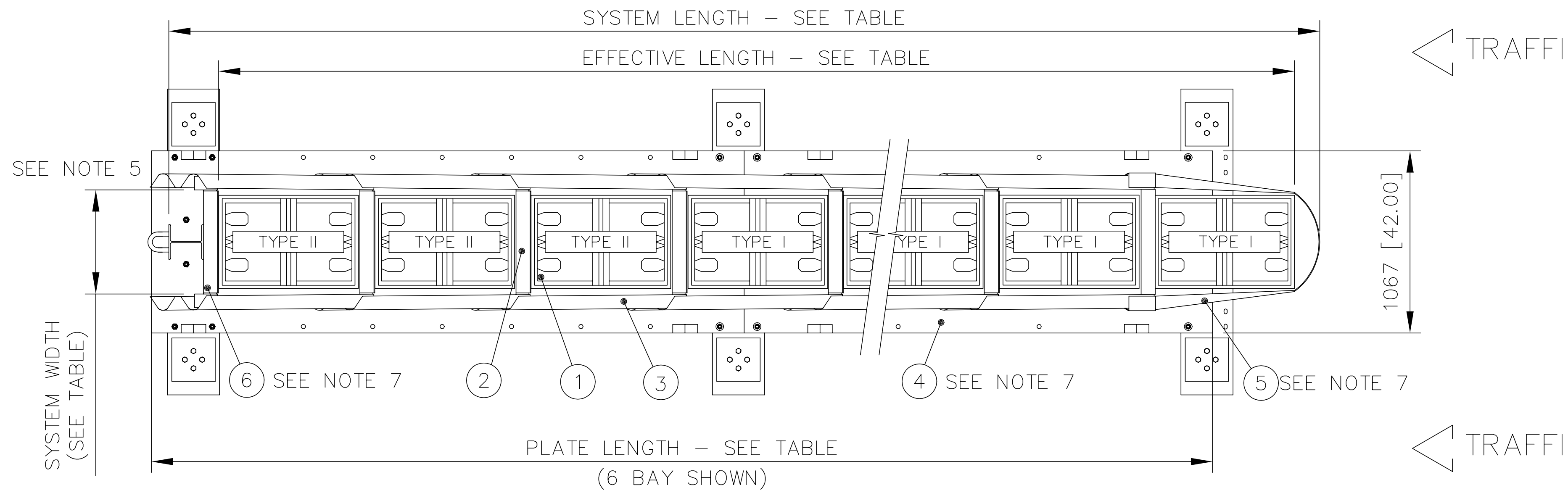
QUADGUARD® c.z. SYSTEM ON A PLATE

DRIVABLE PILE ANCHOR (DPA) ASSEMBLY

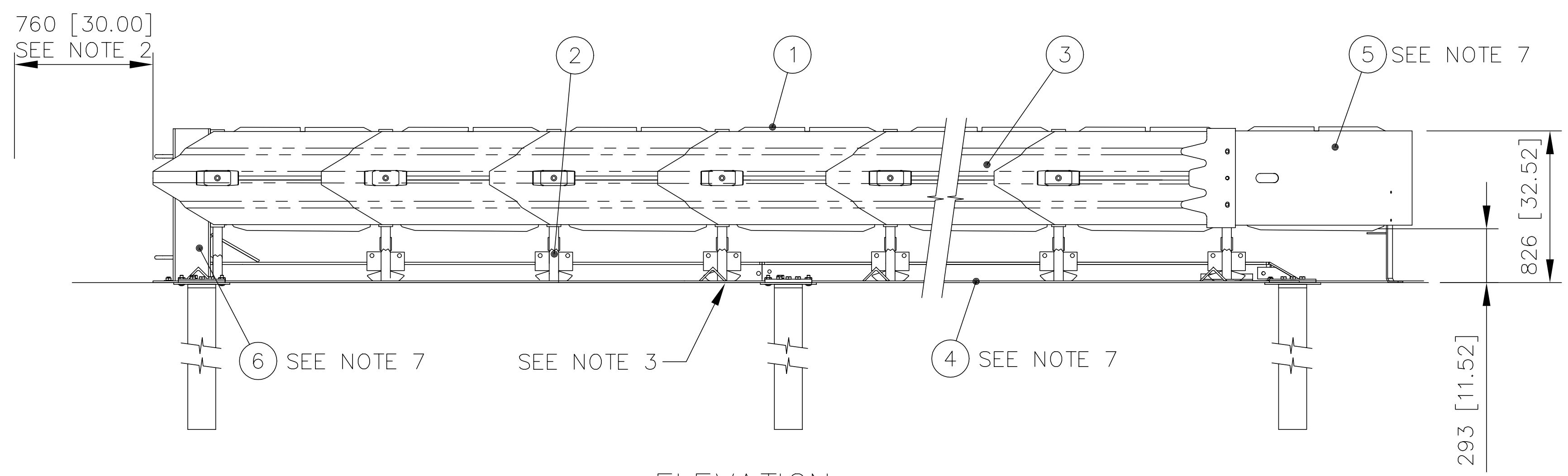
SCALE	DWG.	SHEET	REV
1:30	35-40-70	1 of 1	A

NOTES:

1. IN COMPLIANCE WITH THE AASHTO 2002 ROADSIDE DESIGN GUIDE, MANUFACTURER RECOMMENDS REMOVAL OF ALL CURBS AND ISLANDS TO ENSURE PROPER IMPACT PERFORMANCE.
2. PROVISION SHALL BE MADE FOR REAR FENDER PANELS TO SLIDE REARWARD UPON IMPACT 760 [30.00] MIN.
3. CAUTION: THE QUADGUARD C.Z. DPA MUST BE CORRECTLY ANCHORED FOR PROPER IMPACT PERFORMANCE. DPA ASSEMBLY MAY BE USED TO ATTACH SYSTEM TO STRONG SOIL. ASPHALT OVERLAYS SHOULD BE 102 [4.00] THICK OR LESS.
4. SEE THE "QUADGUARD SYSTEM PRODUCT MANUAL", FOR A DESCRIPTION OF ITS IMPACT PERFORMANCE CHARACTERISTICS AND DESIGN LIMITATIONS BEFORE PLACING A SYSTEM AT A GIVEN SITE. INFORMATION AND COPIES OF ABOVE MANUAL ARE AVAILABLE BY CALLING CUSTOMER SERVICE DEPARTMENT AT (888) 323-6374.
5. WHERE NECESSARY, THE CUSTOMER SHALL SUPPLY AN ADEQUATE TRANSITION FROM THE QUADGUARD SYSTEM TO THE OBJECT BEING SHIELDED.
6. UNITS OF MEASUREMENT ARE MILLIMETERS [INCHES] UNLESS OTHERWISE NOTED.
7. NOSE AND ANCHOR ASSEMBLIES NOT INCLUDED IN MODEL NUMBER. ORDER SEPARATELY.
8. △ THE NUMBER OF BAYS INDICATED IN THE TABLE IS BASED ON CALCULATED VALUES TO ENSURE ADEQUATE SYSTEM CAPACITY TO DISSIPATE THE LONGITUDINAL IMPACT ENERGY OF A 2000 kg VEHICLE TRAVELING AT THE SPEED INDICATED.
9. THE SIX BAY QUADGUARD SYSTEM HAS BEEN FULLY TESTED AT 100 km/h UNDER THE FULL 8 TEST MATRIX OF NCHRP 350 TL-3. SYSTEMS LONGER THAN SIX BAYS SHALL ALSO BE CAPABLE OF MEETING THE OCCUPANT RISK CRITERIA AS RECOMMENDED IN NCHRP 350 FOR VEHICLES WEIGHING 2000 kg IMPACTING HEAD ON AT THE SPEED INDICATED IN THE TABLE.



PLAN



ELEVATION

LEFT SIDE

* G = GREY or Y = YELLOW

BAYS	610[24] WIDTH MODEL#	762[30] WIDTH MODEL#	914[36] WIDTH MODEL#	SYSTEM LENGTH m	SYSTEM LENGTH ft-in	EFFECTIVE LENGTH m	EFFECTIVE LENGTH ft-in	PLATE LENGTH m	PLATE LENGTH ft-in	MAX DESIGN SPEED km/h [MPH]	# OF CARTRIDGES TYPE I	# OF CARTRIDGES TYPE II
3	QZ2403DPA*	QZ3003DPA*	QZ3603DPA*	4.00	[13'-1"]	3.56	[11'-8"]	3.47	[11'-5"]	70 [44]	3	1
4	QZ2404DPA*	QZ3004DPA*	QZ3604DPA*	4.90	[16'-1"]	4.47	[14'-8"]	6.21	[20'-5"]	80 [50]	3	2
5	QZ2405DPA*	QZ3005DPA*	QZ3605DPA*	5.82	[19'-1"]	5.38	[17'-8"]	6.21	[20'-5"]	90 [56]	4	2
6	QZ2406DPA*	QZ3006DPA*	QZ3606DPA*	6.74	[22'-1"]	6.30	[20'-8"]	6.21	[20'-5"]	100 [62]	4	3
7	QZ2407DPA*	QZ3007DPA*	QZ3607DPA*	7.65	[25'-1"]	7.21	[23'-8"]	8.96	[29'-5"]	△105 [65]	4	4
8	QZ2408DPA*	QZ3008DPA*	QZ3608DPA*	8.56	[28'-1"]	8.13	[26'-8"]	8.96	[29'-5"]	△110 [68]	4	5
9	QZ2409DPA*	QZ3009DPA*	QZ3609DPA*	9.48	[31'-1"]	9.04	[29'-8"]	8.96	[29'-5"]	△115 [71]	4	6

UNIDIRECTIONAL
MODEL NO. SEE TABLE

KEY

1. QUADGUARD CARTRIDGE
2. DIAPHRAGM
3. FENDER PANEL
4. C.Z. PLATE W/MONORAIL
5. NOSE ASSEMBLY
6. C.Z. BACKUP

Revisions	Date	Rev.	By	Ckd.	App.
ADDED NOTES 3, 7 & 8 AND LIFT KIT REF	10/18/04	A	TB	STT	ACF
DWG # WAS QPCZCVR-DPAU,REARRANGED NOTES,REM NUTS ON PLATE	01/19/05	B	RGC	TB	ACF
REVISED NOTE 7	8/23/05	C	RGC	JME	ACF

REFERENCES

SERIAL# ____
SALES ORDER# ____
EH PROJECT# ____
DESIGN SPEED △See Chart Above
NOSE COLOR ____
NUMBER OF UNITS ____

DIAPHRAGM ASSY.	35-40-07
NOSE ASSY.	35-40-05
FENDER PANEL ASSY.	35-40-04
C.Z. BACKUP/PLATE ASSY.	35-40-28
ANCHOR ASSY	35-40-70
LIFTING KIT	35-40-23
PORTABLE BARRIER ANCHOR	3540260-0000

DRAWN: T. Busse	DATE: 10/6/04	
DESIGNED:	DATE:	
CHECKED: A. Franklin	DATE: 10/6/04	
APPROVED R. Brougher	DATE: 10/6/04	
CAD FILE: QPCZDPA-U.dwg		

ENERGY ABSORPTION SYSTEMS, INC.
ENGINEERING AND RESEARCH DEPARTMENT

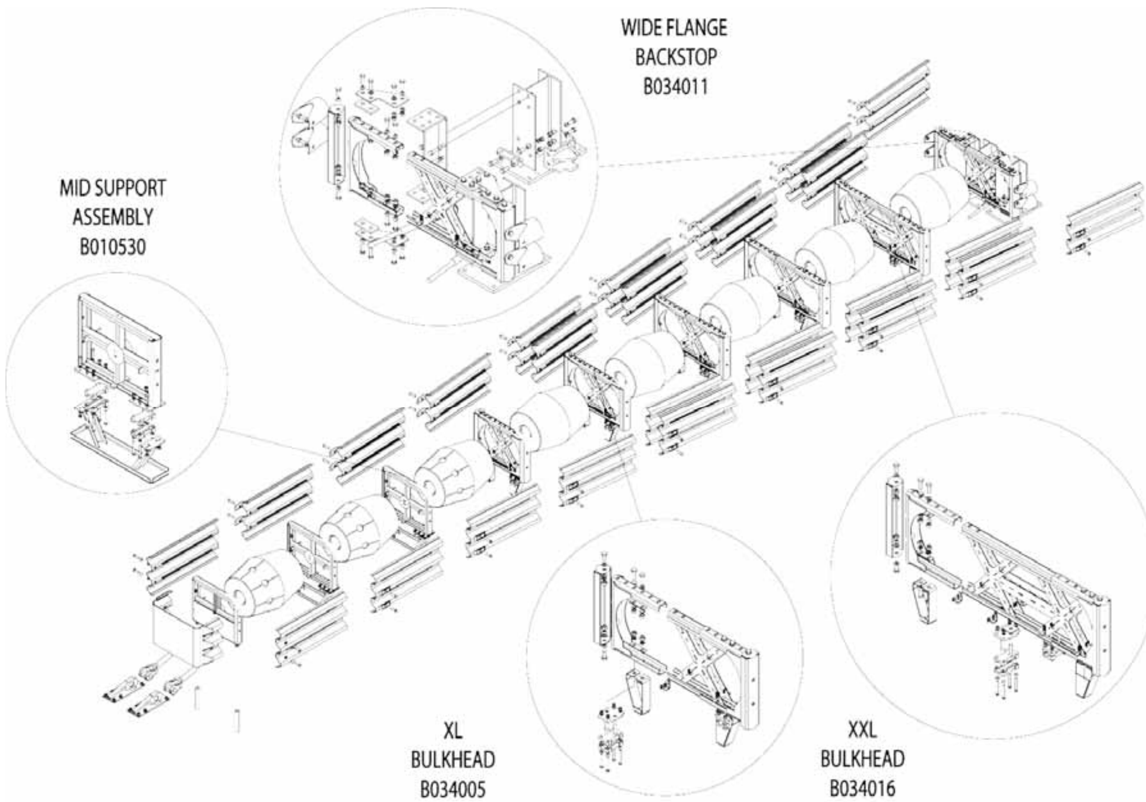
QUADGUARD® c.z. SYSTEM ON A PLATE
FOR CONSTRUCTION ZONES W/DRIVABLE PILE ANCHORAGE

SCALE	DWG.	SHEET	REV
1:40	QPCZDPA-U	1 of 1	C

Installation and Assembly Manual

UNIVERSAL TAU-II® Crash Cushion

Step By Step Instructions For Parallel & Tapered Systems



"Advancing Safety Through Innovation"

An ISO 9001:2000 Company

BARRIER SYSTEMS

UT2-I&M v27 050407

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TABLE OF CONTENTS

BARRIER SYSTEMS

PREFACE

The Barrier Systems, Inc. (BSI), Universal TAU-II crash cushion system incorporates the newest roadside safety materials and engineering processes.

As with any roadside safety device, the Universal TAU-II system must be installed properly to insure proper performance. Thoroughly review and fully understand the installation instructions and product limitations before starting the installation. Do not start the installation without the proper plans and tools required for installation.

If you need additional information, or have questions about the Universal TAU-II Crash Cushion, please call the BSI Customer Service Department at (888) 800-3691 (U.S. toll free) or (707) 374-6800.

INTRODUCTION

The TAU-II system has been tested to meet the rigorous requirements of NCHRP Report 350, Test Levels 2 and 3. The systems will be provided in lengths and capacities for both low speed and high speed applications.

The TAU-II system is redirective and non-gating, and is ideally suited for narrow hazards such as the ends of rigid barriers, tollbooths, utility poles and more. Ease of installation, numerous transition options, low maintenance requirements, and reusability of system components make the TAU-II system ideal for treating many roadside hazards.

Redirective, non-gating crash cushions are highway safety devices whose primary function is to improve the safety for occupants of errant vehicles that impact the end of rigid or semi-rigid barriers or fixed roadside hazards by absorbing the kinetic energy of impact or by allowing controlled redirection of the vehicle. These devices are designed to safely decelerate an errant vehicle to a safe stop or redirect an errant vehicle away from roadside or median hazards. These types of systems are typically applied to locations where head-on and angled impacts are likely to occur and it is desirable to have the majority of post impact trajectories on the impact side of the system.

SYSTEM OVERVIEW

The Universal TAU-II system is designed and constructed to provide acceptable structural adequacy, minimal occupant risk and safe vehicle trajectory as set forth in NCHRP 350 for redirective, non-gating crash cushions. Refer to Figure 1 to familiarize yourself with the basic parts and part names of the system.

The Universal TAU-II system is designed to shield the ends of median barriers and other fixed objects likely to be struck head-on, by absorbing and dissipating the kinetic energy of impacting vehicles. Universal TAU-II systems utilize disposable Energy Absorbing Cartridges (EACs) to absorb the kinetic energy of the impacting vehicle. The EACs are separated by diaphragms and held in place with a framework of thrie-beam corrugated steel rail panels that "telescope" rearward during head-on impacts. As the vehicle compresses the cushion, it exerts a force on the first bay containing an EAC. The diaphragms distribute the impact forces uniformly to all the remaining cartridges in each bay until the vehicle eventually stops. The depth of penetration is dependent upon both the original impact speed and the mass of the impacting vehicle. Only the Energy Absorbing Cartridges are expended after most head-on impacts.

When hit at an angle along the side, the system is restrained laterally by guidance cables that run the length of the system and attach to the bottoms of the diaphragms and terminate at the anchors at each end of the system. The front and rear cable anchors are attached to the foundation as described in Appendix A Foundation Requirements.

BEFORE TAU-II INSTALLATION

Placement and use of the TAU-II system should be accomplished in accordance with the guidelines and recommendations set forth in the "AASHTO Roadside Design Guide," FHWA memoranda and other state and local standards.

Depending on the application and circumstances at the job site, installation and assembly of a Test Level 3 system should take a two-person crew less than 3 hours.

The TAU-II is a highly engineered safety device made up of a relatively small amount of parts. Before starting the assembly, become familiar with the basic elements that make up the TAU-II system. The TAU-II system components are illustrated separately in Figure 1 (Pages 6-7).

Limitations and Warnings

The Universal TAU-II system has been rigorously tested and evaluated per the recommendations in the NCHRP Report 350 Guidelines for terminals and crash cushions. The impact conditions recommended in NCHRP 350 are intended to address typical in-service collisions.

When properly installed and maintained, the system is capable of stopping or containing and redirecting impacting vehicles in a predictable and safe manner under the NCHRP 350 impact conditions.

Vehicle impacts that vary from the NCHRP 350 impact conditions described for redirective, non-gating, crash cushions may result in significantly different results than those experienced in testing. Vehicle impact characteristics different than or in excess of those encountered in NCHRP 350 testing (speed and angle) may result in system performance that may not meet the NCHRP 350 evaluation criteria.

If you need additional information, or have questions about the Universal TAU-II Crash Cushion, please call the BSI Customer Service Department at (888) 800-3691 (U.S. toll free) or (707) 374-6800.

PROVIDED TOOLS

- Long bolt for nested slider panel installation
- Allen socket for the slider bolt assembly
- Cable socket

REQUIRED TOOLS

- ½” [12 mm] drive deep sockets:
  3/4” [19 mm], 13/16”, [20 mm],
  15/16”, [24 mm], 1 1/8” [30 mm]
  3/4” [20 mm] deep socket
- 3/4” [19mm] combination end wrench
- ½” (12 mm) drive ratchet with extensions
- Rotohammer for drilling holes in concrete:
- 7/8” [22 mm] X 10” [250 mm] bit for chemical anchors
- ½” Torque wrenchs:
- 20 ft-lbs [27 N-m] and 500 ft-lbs [680 N-m] capacity
- Measuring tape
- Safety Equipment: Glasses, Gloves
- ½” (12 mm) Air impact wrench (Optional)

Note: The tools list is a general recommendation. Depending on the specific characteristics of the job site, more or less tools may be necessary.

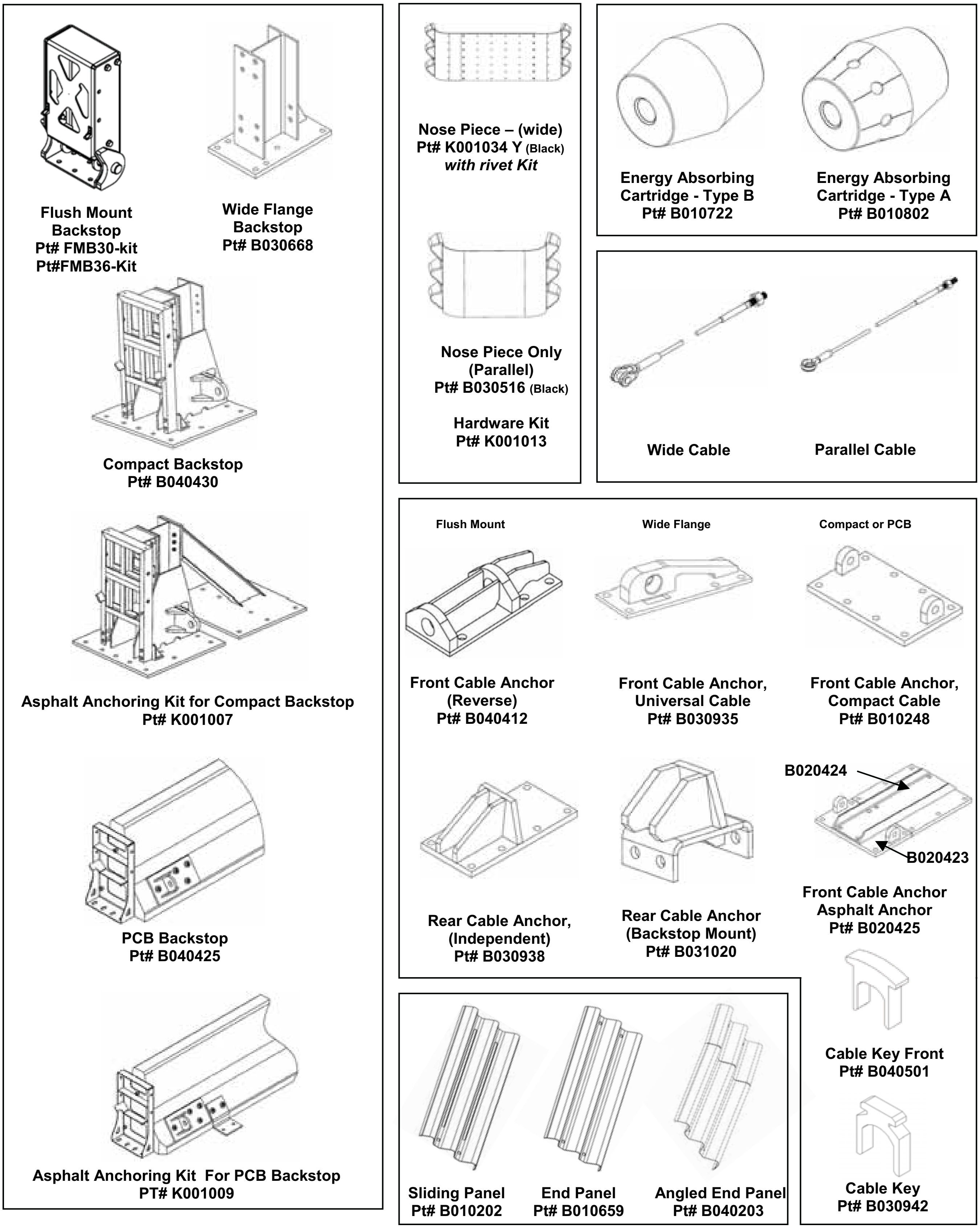
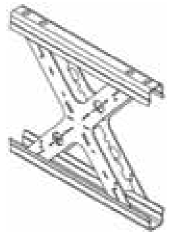
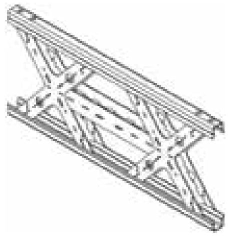


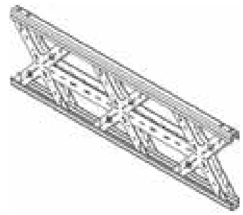
Figure 1. Illustrated parts list



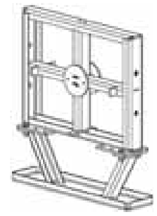
XL Bulkhead
Pt# B030521



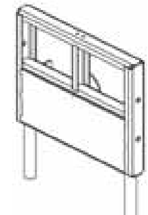
XXL Bulkhead
Pt# B030528



XXXL Bulkhead
Pt# B030529

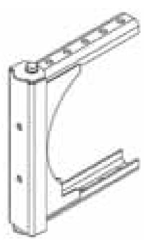


Middle Support
Pt# B030703

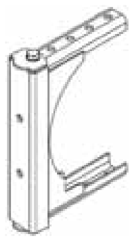


Front Support
Pt# B030704

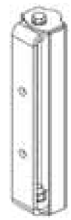
Leg Kit Pt# K001005



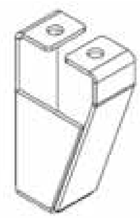
Wing Assembly
Pt# B030509



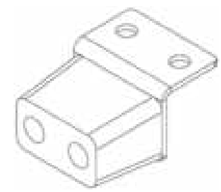
Transition Wing Assy.
Pt# B030910



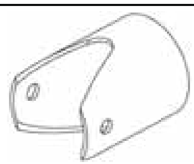
36 Inch Adapter Assy
Pt# B031201



Leg (wide)
Pt# B030425



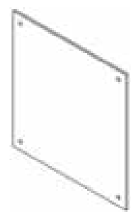
Bumper Assembly
(wide)
Pt# B031035



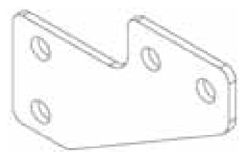
Pipe Panel Mount
Pt# B010651

Hardware Kit
Pt# K001017

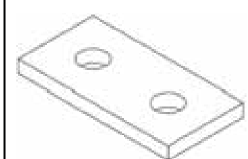
Backstop Blockout
(wide)
Pt# B030713



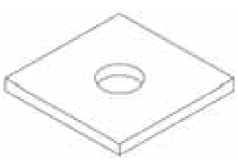
Front Collision Plate
(wide)
Pt# B030801



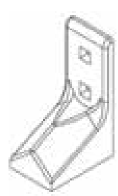
Wing Brace
(wide)
Pt# B030821



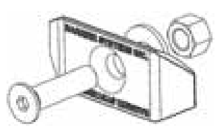
Spacer - Wing Brace
(wide)
Pt# B030823



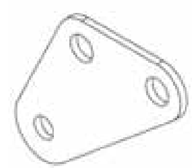
Level Spacer
Pt# B030551



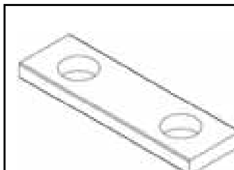
EAC Locator Kit (X4)
Pt# K001028



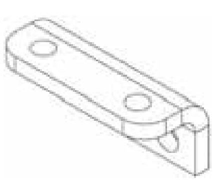
Slider Assembly Kit (x4)
Pt# K001003



Leg Adapter
(wide)
Pt# A040223

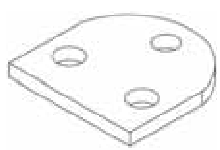


Backing Plate
(wide)
Pt# A041216

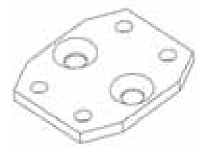


Lateral support Mount,
(Backstop Mount - wide)
Pt# B031011

Lateral Support
Cable Assembly Kit
Pt# K001031



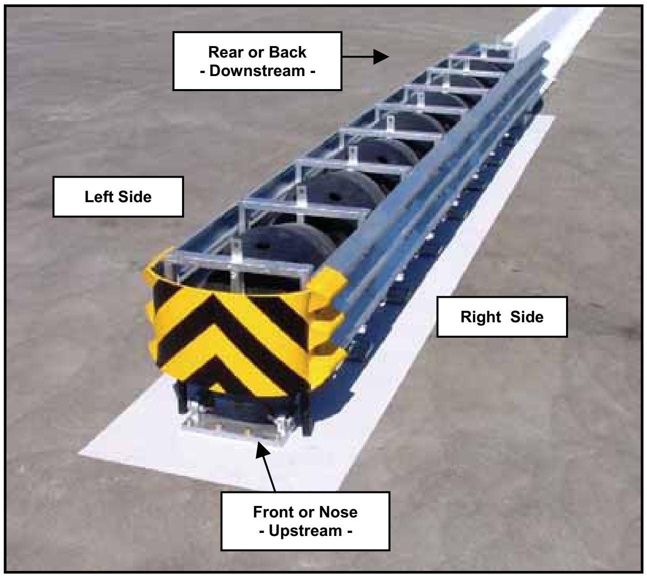
Bulkhead Mount,
Lateral Support – (wide)
Pt# B031010



Cable Guide Mounting
Plate – (wide)
Pt# B030411

Cable Guide Assembly
Kit (x4)
Pt# K001004

BARRIER SYSTEMS



Sign Conventions

The picture of the TAU-II system above is labeled to show the descriptive terms that will be used throughout this manual.

Concrete pad in front of hazard

Wide system on pallets for shipment

Preparing for installation

Depending on the size of the system ordered, the parts will be shipped on two to five pallets. Assembly of the TAU-II system is typically done at the worksite. (If preferred, the system can be assembled "off-site" and set into position as one piece, with a forklift or crane.)

Before beginning the assembly of the TAU-II system, check the packing list to be certain that all of the system components were included in the shipment.

The TAU-II Crash Cushion system has been designed to attach to concrete or asphalt foundations. BSI recommends that at a minimum, the system be anchored to standard six-inch reinforced 4,000 psi (28 MPa) Portland Cement Concrete (PCC) pad or roadway, or 8" (200 mm) AR-4000 Asphalt Concrete. When installing to concrete, care must be taken when building the concrete pad to space the rebar so as to minimize interference with the anchor bolt holes.

(See Appendix "C", Page 47, for BSI recommended foundation options and material specifications.)

NOTE:

It is important to determine the system's installation position and angle, to optimize proper function and transition.

This system is available in two configurations:

1) The system can be attached directly to the end of a concrete barrier, utilizing the "PCB Backstop" (BSI part # B040425) or the "Flush Mount Backstop" (BSI part # B040219).

2) The second configuration utilizes a "Compact Backstop" (BSI part # B010537) which is a free standing back support.

This manual describes the installation procedure for an 8 bay (Test Level 3) system.

(See the System Configuration Chart in Appendix "A", Page 44, for guidelines on choosing a system length to accommodate different traffic criteria.)

Depending on the installation design, transition hardware may be necessary. Because each transition is unique, BSI recommends that the transition hardware be properly fitted before anchoring the system. Pre-assemble the transition hardware before setting the system base plates to assure the proper spacing between the system and the object being treated.

(NOTE: See Appendix "D", Page 63, for some recommended transition types)

CONCRETE PAD INSTALLATION


Use the Base Plate of the Compact Backstop as a template

Step 1. (Compact Backstop to Concrete Foundation)
Place the Compact Backstop in the desired final installation position. Use the holes in the base plate as a template to mark the location of the anchor points. Remove the backstop and drill the anchor bolt holes. The holes should be 6” (150 mm) deep and 7/8” (22 mm) diameter. Install the anchors into the pad following the instructions included with the anchor epoxy. When the epoxy is fully cured, install the nuts and flat washers. Tighten to 120 ft-lbs (160 N-m).

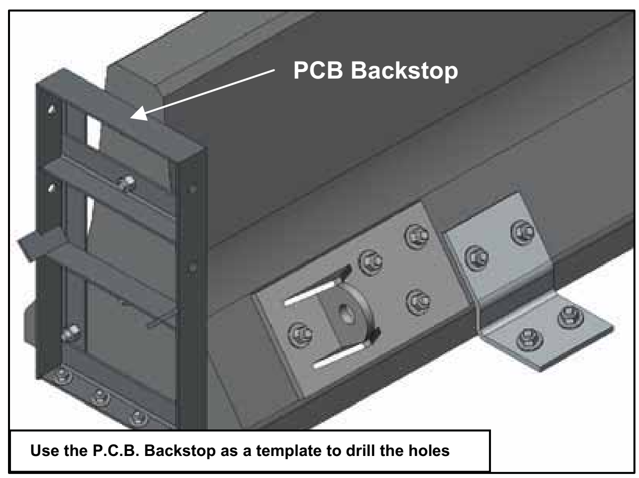

Use the P.C.B. Backstop as a template to drill the holes

Step 1. (PCB Backstop to Concrete Foundation)
Place the PCB Backstop in the desired final installation position. Use the holes in the backstop as a template to mark the location of the anchor points. The holes should be 6” (150 mm) deep and 7/8” (22 mm) diameter. Use a caulking gun and gun insert filled with anchoring compound to secure the ¾” x 8 ¼” (20 mm x 610 mm) galvanized anchors. Torque to 120 ft-lbs (160 N-m).

ASPHALT INSTALLATION


Compact Backstop Base with Asphalt Adapter

Step 1. (Compact Backstop to Asphalt)
If the unit is being installed on asphalt, the Asphalt Adapter must be attached to the Compact Backstop. Use the base as a template to mark the anchor point locations. All holes should be 15 to 16½” (380 to 420 mm) deep. Use 18” (460 mm) anchors for the Compact Backstop and the Asphalt Adapter. Install the anchors into the foundation following the instructions included with the anchor epoxy. When the epoxy is fully cured, install the nuts and flat washers. Tighten to 120 ft-lbs (160 N-m).



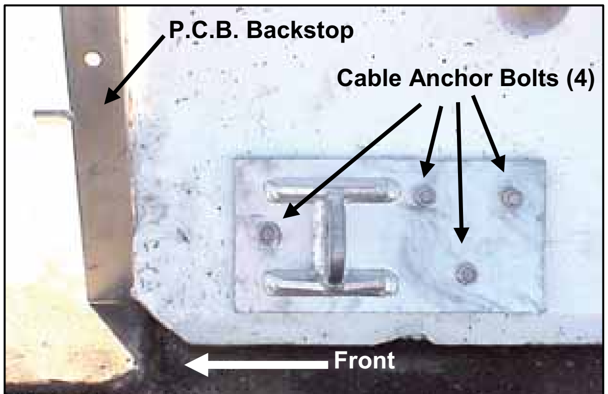
Use the P.C.B. Backstop as a template to drill the holes

Step 1. (PCB Backstop to Asphalt Foundation)
Place the PCB Backstop in the desired final installation position. Use the holes in the backstop as a template to mark the location of the anchor points. The holes should be 6” (150 mm) deep and 7/8” (22 mm) diameter. Use a caulking gun and gun insert filled with anchoring compound to secure the ¾” x 8 ¼” (20 mm x 610 mm) galvanized anchors. Torque to 120 ft-lbs. (160 N-m)

CONCRETE PAD INSTALLATION

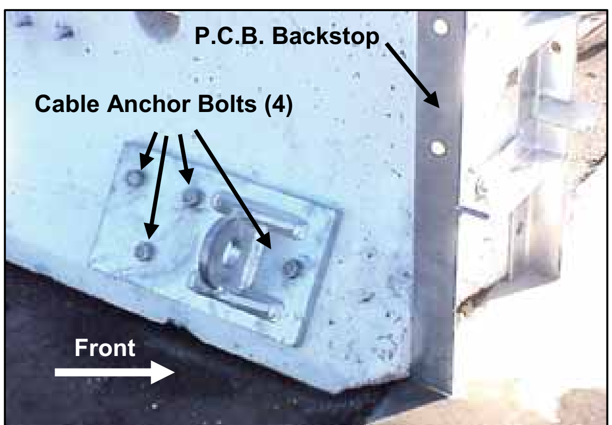
Step 2. (Concrete Rear Cable Anchors)

NOTE: IF YOU ARE USING THE COMPACT BACKSTOP, SKIP TO STEP 3.



Use the Cable Anchor Plate as a template for the bolt holes (Right Side)

Use the holes in the plate as a template to mark the location of the holes for the anchor studs. (There is one Cable Anchor for each side of the P.C.B.). The holes should be drilled 6" (150 mm) deep and 7/8" (22 mm) in diameter. Install the (all thread) studs into the PCB following the instructions included with the anchor epoxy. When the epoxy is fully cured, install the nuts and flat washers. Tighten to 120 ft-lbs (160 N-m).



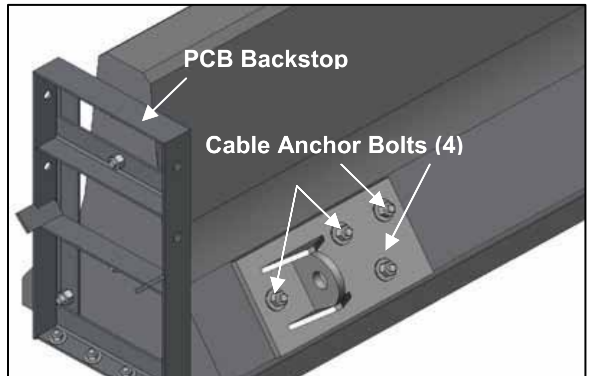
Use the Cable Anchor Plate as a template for the bolt holes (Left Side)

NOTE: For proper system performance, the concrete barrier must be rigidly attached to an adequate foundation. See Appendix "C" for Anchor Foundation Options and Page 24 for anchoring material options..

ASPHALT INSTALLATION

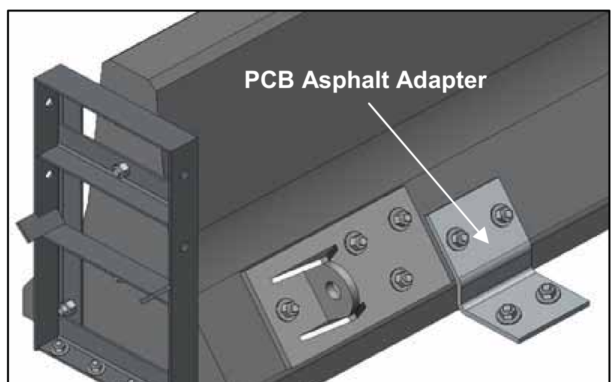
Step 2. (Asphalt Rear Cable Anchors)

NOTE: IF YOU ARE USING THE COMPACT BACKSTOP, SKIP TO STEP 3.



Use the Anchor Plate as a template for the bolt holes (Right Side)

Refer to the Installation Drawings in Appendix "C" to determine the correct Cable Anchor installation position. Use the holes in the plate as a template to mark the location of the holes for the anchor studs. (There is one Cable Anchor for each side of the P.C.B.). The holes should be drilled 6" (150 mm) deep and 7/8" (22 mm) in diameter. Install the (all thread) studs into the PCB following the instructions included with the anchor epoxy. When the epoxy is fully cured, install the nuts and flat washers. Tighten to 120 ft-lbs (160 N-m)



Attach the PCB Asphalt Adapter.

Attach the PCB Asphalt Adapter. Drill holes 6" (150 mm) deep and 7/8" (22 mm) in diameter in the concrete barrier. Drill 15 to 16 ½" (380 to 420 mm) in the foundation and install 18" (460 mm) anchors following the instructions included with the anchor epoxy. When the epoxy is fully cured, install the nuts and flat washers. Tighten to 120 ft-lbs (160 N-m).

CONCRETE PAD INSTALLATION

Use the Front Anchor Plate as a template

Step 3. (Concrete Front Cable Anchor)

Place the Front Cable Anchor in the desired final installation position. Use **Appendix C** for layout dimensions. Use the holes in the plate as a template to mark the location of the anchor points. Remove the plate and drill the anchor bolt holes to the desired size and depth. The holes should be 6” (150 mm) deep and 7/8” (22 mm) diameter.

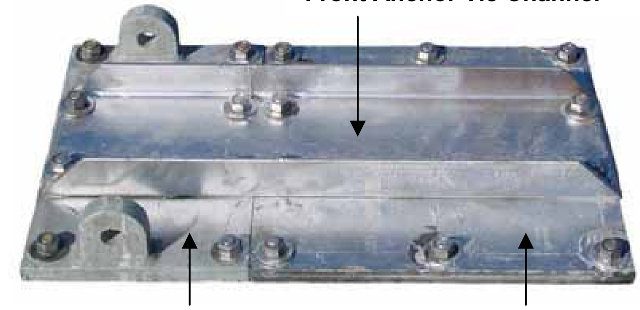
Drill the anchor bolt holes to the proper size and depth

Install and torque nuts on the anchor bolts

NOTE:

It is important that the holes are drilled straight and in the correct position so that the plate will fit back over the bolts after they have been set with anchoring material. If the total hole depth cannot be reached due to rebar interference, a “diamond tip” drill or equivalent should be used to reach the total hole depth.

ASPHALT INSTALLATION



Step 3. (Asphalt Front Cable Anchor)

The Asphalt Front Cable Anchor is a three piece unit. Place the Front Cable Anchor and the Front Anchor Backup Plate in the desired final installation position. Use the holes in the plates as a template to mark the location of the anchor points. Remove the plates and drill the anchor bolt holes to the desired size and depth. The holes should be 15 to 16 ½” (380 to 420 mm) deep and 7/8” (22 mm) diameter. **Install the cable and clevis pin before installing the Front Anchor Tie Channel.** Install the Front Anchor Tie Channel on top of the Front Cable Anchor and the Front Anchor Backup Plate.

NOTE:

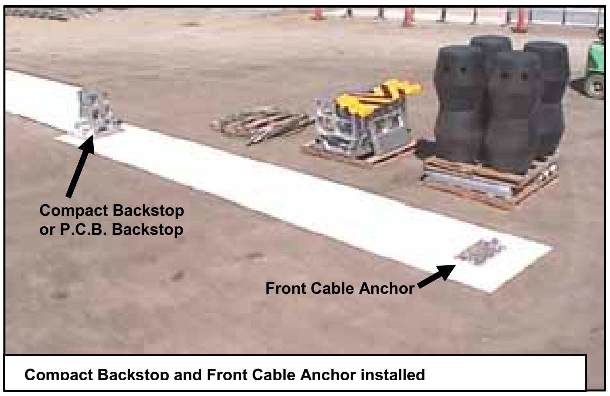
It is important that the holes are drilled straight and in the correct position so that the plate will fit back over the bolts after they have been set with anchoring material. If the total hole depth cannot be reached due to interference, a “diamond tip” drill or equivalent should be used to reach the total hole depth.

ALL FOUNDATIONS

After the anchoring epoxy is properly cured, install a nut and washer on each of the anchor bolts extending through the base plates of the Backstop and Front Cable Anchor plate.

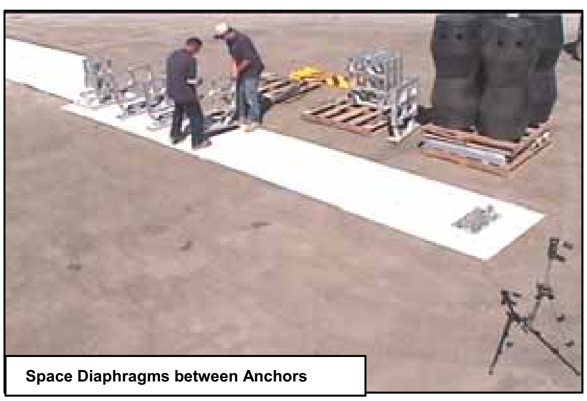
For PC Concrete foundations, torque the nuts to 120 ft-lbs (160 N-m).

For Asphaltic Concrete foundations, torque the nuts to 5 ft-lbs (8 N-m).



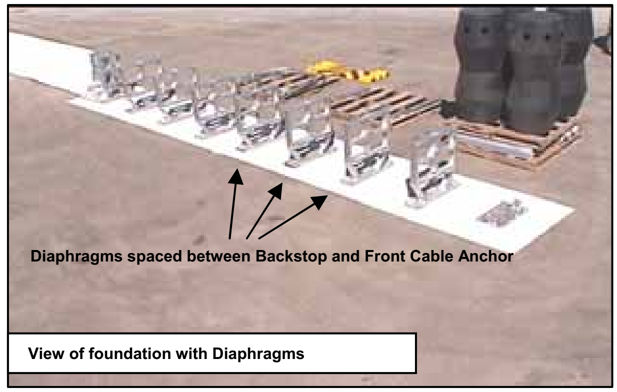
Compact Backstop and Front Cable Anchor installed

This photo shows a view of how the installation would look after the Backstop and Front Cable Anchor are securely fastened.


Space Diaphragms between Anchors

Step 4.

The Diaphragms should be spaced (one by one) evenly between the Front Cable Anchor and the Backstop. It is not important that they be exactly spaced at this point as they can easily be moved into the desired final assembly position when necessary.



View of foundation with Diaphragms

The photo above shows what the installation would look like after the diaphragms have been placed between the Backstop and the Front Cable Anchor.

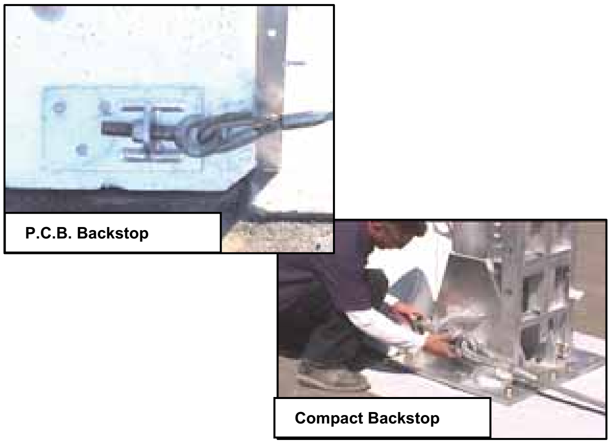
NOTE: Do not install the Front Support Assembly and nose piece at this time, it will be installed later.


Thread the Guide Cable through the Diaphragms


Thread through the bottom of each Diaphragm

Step 5.

Starting at the upstream end of the system, thread the Guide Cable through the space in the bottom of the Diaphragms. Make sure to pull the threaded cable end through first so that it will end up at the back of the unit. (Make sure that the Guide Cable is threaded through the bottom of each Diaphragm.)



P.C.B. Backstop

Compact Backstop

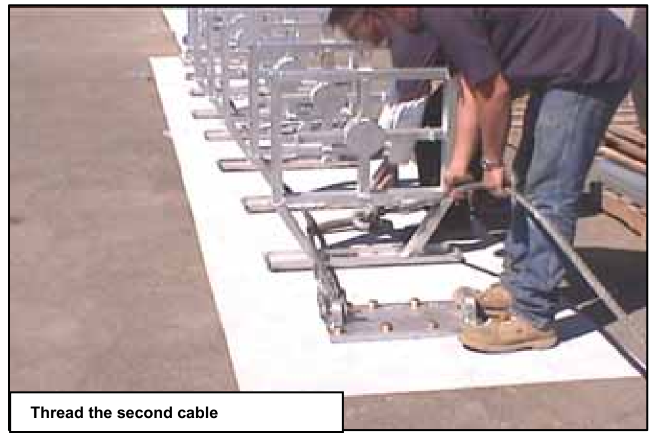
Push the threaded end of the cable through the hole in the anchor tab on the left side of the Compact Backstop. Install the nut on the end of the adjusting screw.

NOTE: Do not thread the nut beyond the end of the adjusting screw at this time. The nut will be tightened later.

Guide Cable to Front Cable Anchor

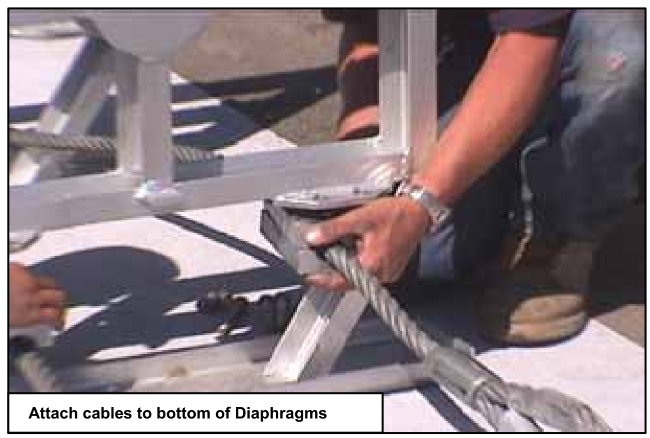
Attach the other end of the Guide Cable to the left side of the Front Cable Anchor by first removing the pin from the clevis (shackle). Place the clevis over the anchor eye and re-install the pin through the eye, making sure that the handle portion of the pin is on the inside of the anchor assembly. Firmly tighten the pin.

For asphalt installations, the cable and clevis pin have been attached in Step 3 (Page 12).



Thread the second cable

Repeat the process outlined in steps 6, 7, and 8, for the other cable. Install the second cable along the right side of the system without crossing the first cable.



Attach cables to bottom of Diaphragms

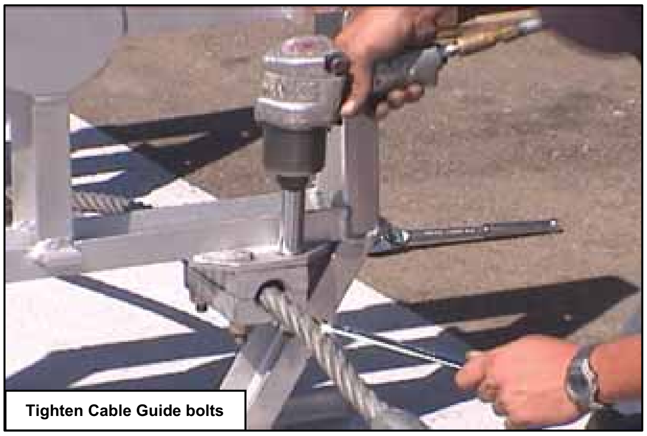
Use the Cable Guide Assembly blocks to attach the Guide Cable to the bottom cross rail of the Diaphragms. The cable blocks consist of two grooved halves that, when put together, provide a path for the Guide Cable to move through.

It is easiest to install the Cable Guides by first placing the two halves of the blocks together around the cable. Next, hold the blocks and cable up to the plate on the bottom of the Diaphragm. Push the bolt from the top down through the plate and then through the blocks.

NOTE: See Page 28, Figure 9 for cable guide positions for wide flange systems.

Install a lock washer and nut to secure the bolt. Continue the process until all four of the attachment bolts are installed on each Cable Guide Assembly.

NOTE: If properly installed, the Guide Cable should slide freely through the Cable Guide blocks and the Diaphragm should slide freely along the cable.


Tighten Cable Guide bolts

Use an impact wrench (or hand tools) to securely tighten the (4) bolts holding the Cable Guide blocks to the plate on the bottom of each Diaphragm. Use the Cable Guide Hardware Kit #K001004.


Compact Cables run thru the Cable Guide blocks on the Diaphragm bottoms

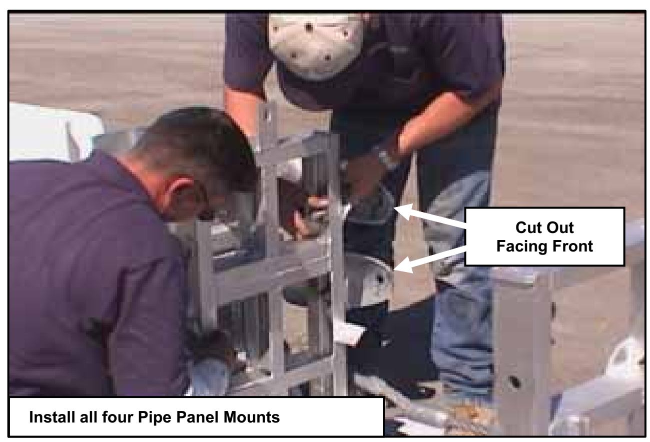
The photo above shows what the Diaphragms should look like after the Cable Guide blocks have been installed.

Pipe Panel Mounts attach to the compact backstop Diaphragm

Step 6.
Attach the Pipe Panel Mounts to the sides of the Backstop. (The End Panels are not attached directly to the Backstop Diaphragm.) The Pipe Panel Mount attaches between the Backstop Diaphragm and the End Panel to facilitate proper system performance during side impacts in this area.

The Pipe Panel Mount is made from a piece of 6" (150 mm) diameter galvanized pipe with angles of material cut out of the top and bottom of one end.

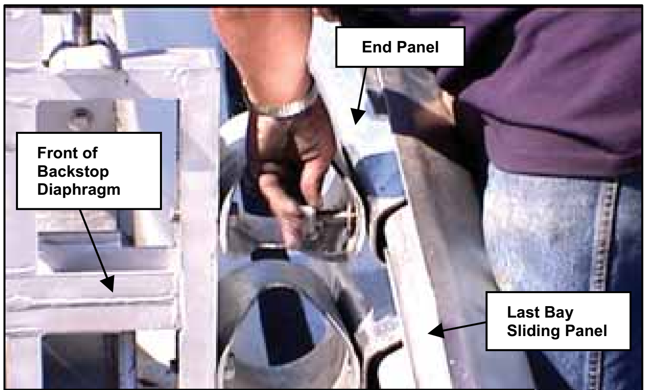
NOTE: It is important that the end of the mount that is cut flat be facing the back (downstream) end of the system and that the cut out end of the Pipe Panel Mount be facing toward the front (upstream).



Install all four Pipe Panel Mounts

To attach the Pipe Panel Mount to the Backstop Diaphragm, place a washer on the attachment bolt and push the bolt through the inside hole on the Pipe Panel Mount and continue the bolt through the hole located on the side of the Diaphragm that is a part of the Backstop as shown in the photo above. Use the Pipe Panel Hardware Kit #K001017.

BARRIER SYSTEMS

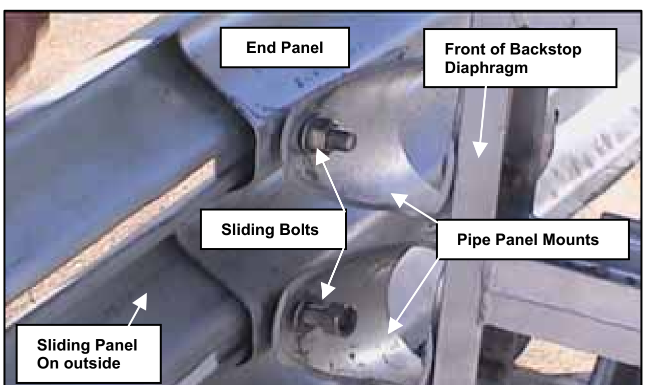


Install the End Panel and the last bay Sliding Panel together

Step 7.
At this point you will start assembling the sides of the system. The first two side panels are installed together as the Sliding Bolt attaches both of the panels to the Pipe Panel Mount located on the side of the Backstop Diaphragm. Attach the right side End Panel and right side rear-most Sliding Panel to the Pipe Panel Mount using the Sliding Bolt.

Insert the Slider Bolt through the slotted portion of the last bay Sliding Panel. Continue the bolt through the front hole of the End Panel. Continue the bolt through the bolt hole in the outside of the Pipe Panel Mount as shown in the photo above.

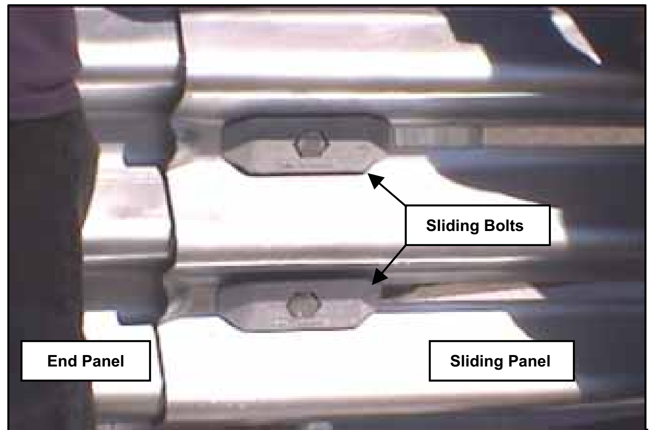
NOTE: For the system to telescope properly, the slotted Sliding Panel <u>MUST</u> be on the outside of the End Panel.



The Slider Bolt holds on the (last bay) Slider Panel and End Panel

The photo above shows the end of the Slider Bolt coming through (from the outside) the slot in the last left bay side Sliding Panel, through the front hole of the End Panel and through the outer hole of the Pipe Panel Mount.

NOTE: See configuration chart to determine if you have "stacked" or "nested" slider panels in some locations.



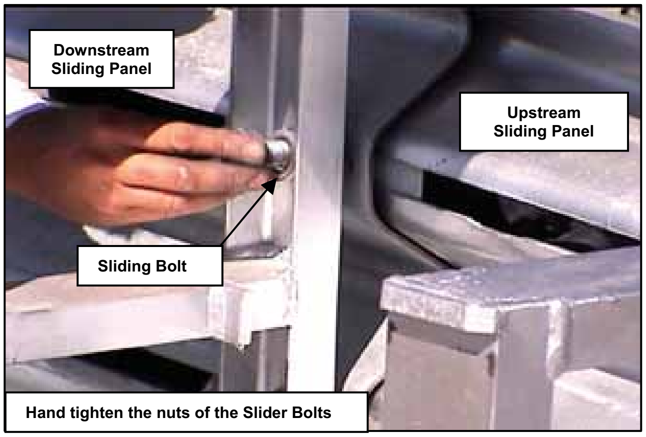
View from outside showing the End Panel and Sliding Panel attached with the Slider Bolt.

NOTE: For ease in assembly of the rest of the system, hand tighten the nut on the Slider Bolts. The bolts will be tightened in a later step. Use Slider Bolt Hardware Kit #K001003.

Install each of the Sliding Panels

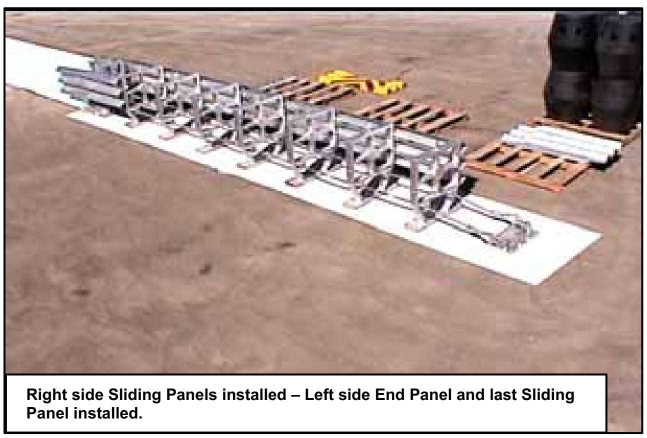
You will now attach the right side panels one-by-one, moving towards the front of the system. Attach the rear bay and second-to-last bay Sliding Panels to the first diaphragm using Sliding Bolts. Insert the Sliding Bolt through the slot in the second-to-last bay Sliding Panel. Continue pushing the bolt through the hole in the front of the last Sliding Panel and finally push the bolt through the hole in the side of the corresponding Diaphragm.

NOTE: For the system to telescope properly, the forward most slotted Sliding Panel <u>MUST</u> be on the outside.



Hand tighten the nuts of the Slider Bolts

Repeat this step until all Sliding Panels have been mounted to the Diaphragms. The forward-most Sliding Panel must always be on the outside of the system (next to the mushroom head of the sliding bolt).


Right side Sliding Panels installed – Left side End Panel and last Sliding Panel installed.

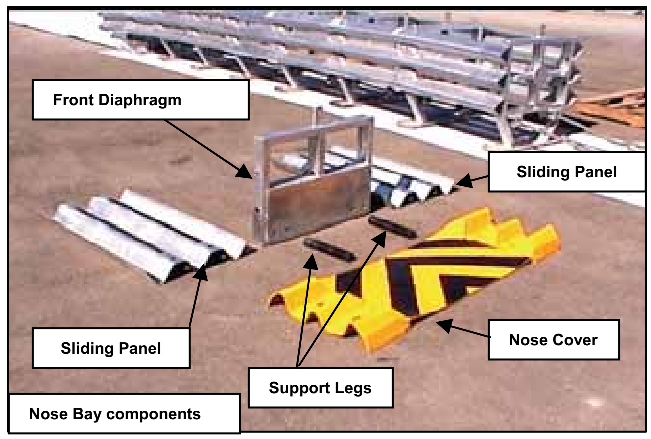
The photo above shows what the system will look like after the End Panel and all of the Sliding Panels have been installed on the right side as well as the End Panel and rear-most Sliding Panel on the left side.

Continue attaching the Sliding Panels along the left side of the system until all of the Sliding Panels are installed.

NOTE: For the system to telescope properly, the forward most slotted Sliding Panel <u>MUST</u> be on the outside.


All End Panels and Sliding Panels installed

The photo above shows what the system will look like after both of the End Panels and all of the Sliding Panels have been installed.



Nose Bay components

The final bay will be assembled separately from the rest of the system and then installed as a complete unit. The components that make up the final bay are two Sliding Panels, the Front Diaphragm, the Nose Cover and the Leg Supports.

Attach Nose Cover and Slider Panel to Front Support


Bolt the Support Legs to the bottom of the Front Support Assembly.

Step 8.
Attach the Nose Cover and left Slider Panel to the Front Support. Install the bushing in the hole of the nose piece. Install the fender washer on the machine bolt (Slider Bolt not used) and push the bolt through the bushing in the Nose Cover hole. Continue the bolt through the hole in the front edge of the last-bay Slider Panel and finally push the bolt through the hole in the Front Diaphragm. Install the washer and hand tighten the nut. (The nut will be tightened later.) Use Nose Piece Hardware Kit #K001013.

The final step in the assembly of the nose bay is to install the Support Legs. Place the nose assembly on its side. Push one of the leg support machine bolts and washer through the hole in the bottom rail of the Front Support. Screw the Leg Support onto the bolt and tighten the bolt with a wrench or socket. ***Warning: DO NOT OVER-TIGHTEN THIS BOLT.*** Use the Front Support Leg Hardware Kit #K001005.


Repeat with the right side


Carry the assembled Front Support Assembly into position to attach.

Repeat the process outlined in Step 8 with the right side of the assembly.


Front View of Assembled Nose Assembly


Rear View

Carry the complete nose bay assembly to the front of the system. Attach the Slider Panels to the diaphragm by pushing the Slider Bolt through the slots in the final bay Slider Panels and then through the hole in the front of next bay Slider Panel. Finally, push the Slider Bolt through the hole in the side of the Diaphragm and attach the flat washer and nut.

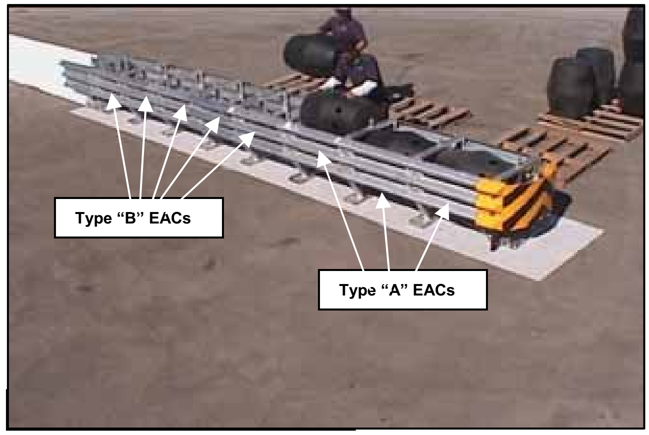
NOTE: For the system to telescope properly, the forward most slotted Sliding Panel MUST be on the outside.


View of assembled system (except Cartridges)

It is important to make sure that the system bays are fully extended to ensure that the Energy Absorbing Cartridges will fit properly. Pull the Slider Panels of each bay until fully extended, working from the base toward the nose assembly.


Torque each of the Slider Bolts

Torque all of the Sliding Bolts to 20 ft-lbs (27 N-m). Torque the Front Panel Bolts (holding nose cover) to 200 ft-lbs (270 N-m). Do not overtighten.



Step 9.
Insert a Type "A" Energy Absorbing Cartridge into each of the first three (3) bays of the 8 bay (TL-3) system. The Type "A" cartridges have holes and slots on the sides toward the end of the cartridge. Install each cartridge on its side with the holes and slots facing the front (upstream) of the system.

Insert a Type "B" Energy Absorbing Cartridge into the remaining five (5) bays. The Type "B" Cartridges have three holes on one end of the cartridge. Install each cartridge on its side with the holes facing the back (downstream) of the system.

Refer to the matrix in Appendix "A" for proper cartridge configurations.

NOTE: For proper system performance, the Energy Absorbing Cartridges must be installed in the proper order and in the proper direction as shown in Appendix "A".

Tension the Guide Cables with a torque wrench.

Step 10.
The final step in the installation of the TAU-II system is to apply tension to the Guide Cables that run underneath the system.

<u>CONCRETE INSTALLATION</u>:
Torque the nut on the end of the threaded cable end to 500 ft-lbs (680 N-m).

Torque the nut on the end of the adjustable Eye Bolt to 120 ft-lbs (160 N-m).

NOTE: For proper performance, the cables must be tensioned properly.

Step 11.
Use the check list on page 43 to confirm that all of the installation steps have been completed.

<u>ASPHALT INSTALLATION</u>

Complete Test Level 3 system (8 bay)

The above photo shows what a completely installed Test Level 3 TAU-II system with a compact backstop will look like.

INTRODUCTION

This manual is organized in steps that address each of the different installation options that are available. The Universal TAU-II system is very versatile and also easy to assemble and install if these basic guidelines are followed.

The Universal TAU-II system has been tested to meet the rigorous requirements of NCHRP Report 350, Test Levels 2 and 3. The systems are provided in lengths and capacities for both low speed and high speed applications and hazard widths up to 8.5 feet [2.6m].

The Universal TAU-II system is redirective, non-gating, and is ideally suited for hazards such as the ends of rigid barriers, tollbooths, utility poles, and more. Ease of installation, numerous non-proprietary transition options, low maintenance requirements, very low life cycle costs and reusability of system components make the Universal TAU-II system ideal for treating many roadside hazards.

Redirective, non-gating crash cushions are highway safety devices whose primary function is to improve the safety for occupants of errant vehicles that impact the end of rigid or semi-rigid barriers or fixed roadside hazards by absorbing the kinetic energy of impact or by allowing controlled redirection of the vehicle. These devices are designed to safely decelerate an errant vehicle to a safe stop or redirect an errant vehicle away from roadside or median hazards. These types of systems are typically applied to locations where head-on and angled impacts are likely to occur and it is desirable to have the majority of post impact trajectories on the impact side of the system.

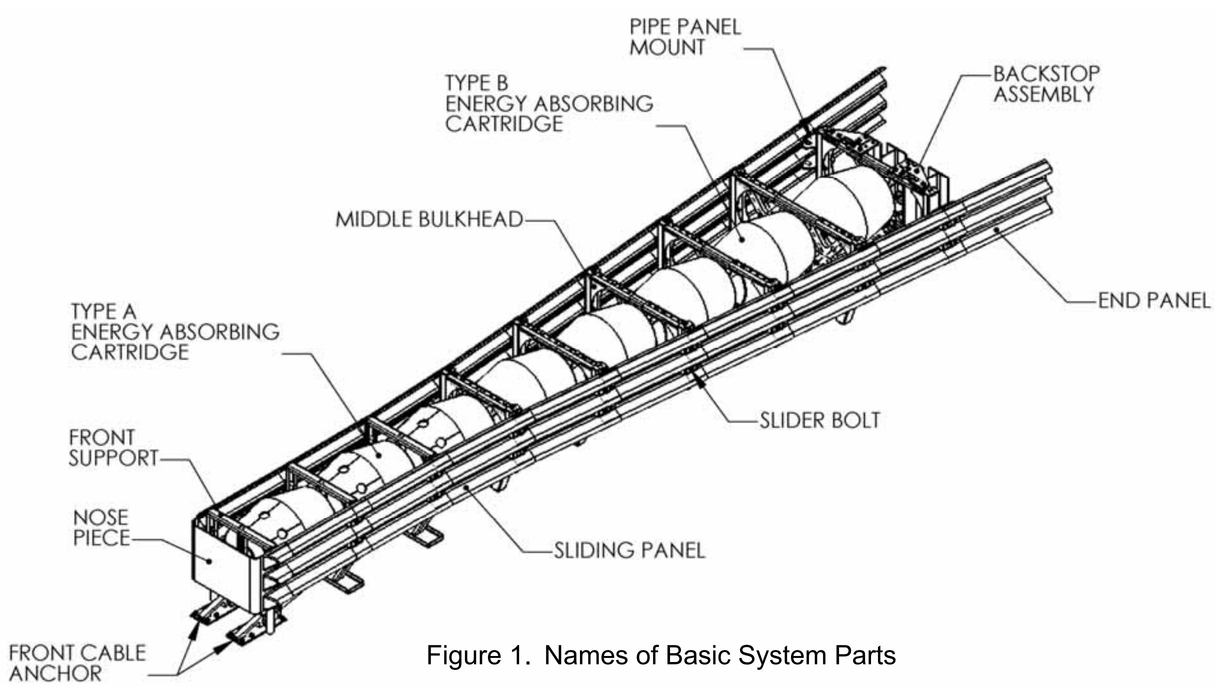


Figure 1. Names of Basic System Parts

SYSTEM OVERVIEW

The Universal TAU-II system is designed and constructed to provide acceptable structural adequacy, minimal occupant risk and safe vehicle trajectory as set forth in NCHRP 350 for redirective, non-gating crash cushions. Refer to Figure 1 to familiarize yourself with the basic parts and part names of the system.

The Universal TAU-II system is designed to shield the ends of median barriers and other fixed objects likely to be struck head-on, by absorbing and dissipating the kinetic energy of impacting vehicles. Universal TAU-II systems utilize disposable Energy Absorbing Cartridges (EACs) to absorb the kinetic energy of the impacting vehicle. The EACs are separated by diaphragms and held in place with a framework of thrie-beam corrugated steel rail panels that "telescope" rearward during head-on impacts. As the vehicle compresses the cushion, it exerts a force on the first bay containing an EAC. The diaphragms distribute the impact forces uniformly to all the remaining cartridges in each bay until the vehicle eventually stops. The depth of penetration is dependent upon both the original impact speed and the mass of the impacting vehicle. Only the Energy Absorbing Cartridges are expended after most head-on impacts.

When hit at an angle along the side, the system is restrained laterally by guidance cables that run the length of the system and attach to the bottoms of the diaphragms and terminate at the anchors at each end of the system. The front and rear cable anchors are attached to the foundation as described in Appendix "C" Foundation Requirements.

STEP 1

FOUNDATION REQUIREMENTS

The Universal TAU-II crash cushion is designed to be compatible with a variety of foundations. If an existing foundation is present, verify dimensions and system layout. If modification is required, use the BSI specifications as a guideline and adapt accordingly. If no foundation is present or currently does not meet the system requirements, construct the foundation per these BSI specifications.

There are different foundation configurations depending on the system used and the type of backstop selected. Systems up to 36” [910mm] can have a P.C.B. (Portable Concrete Barrier) Backstop, Flush Mount Backstop or a stand-alone Compact Backstop. PCB and Compact Backstop systems are compatible with the optional Asphalt Anchoring Kits. Systems 42” [1070mm] and greater use a Wide Flange Backstop and require a PCC (Portland Concrete) foundation and anchoring kit.

NOTE: Recommended maximum 8% cross slope on all foundation options.

Foundation options for all configurations are specified in the following drawings contained in APPENDIX “C”, Page 47:

Variations of these foundations may be reviewed and determinations made as to equivalence by the project engineer.

If you need additional information, or have questions about the Universal TAU-II Crash Cushion, please call the BSI Customer Service Department at (888) 800-3691 (U.S. toll free) or (707) 374-6800.

STEP 2

Anchor System to Foundation

With the proper foundation in place, anchor the Backstop, Rear Cable Anchors, and Front Cable Anchors according to the particular foundation detail (refer to Step 1).

The anchorage of the system must be in accordance with BSI foundation specifications found in Appendix “C".

To anchor the Universal TAU-II system:

1.) Determine the backstop components and Front Cable Anchor positions about the centerline of the system. The foundation drawings show positioning.

2.) Using the actual parts as templates, either mark the holes to be drilled or drill through the parts acting as guides.

3.) Hole diameter and depth depends on the foundation and the anchoring compound used. See chart below for the hole diameter as specified by the anchoring compound manufacturer. Reference BSI Foundation and Anchorage Specifications in APPENDIX “C” for specific embedment depths.

4.) Prepare the holes as specified by the anchoring compound manufacturer.

5.) With the Front Cable Anchor and backstop components in place, apply the anchoring compound to the holes as specified by the manufacturer. Insert the anchors into the holes with the nuts and washers attached.

6.) Allow anchoring compound to cure before tightening the anchors.

The anchoring package supplied with the Universal TAU-II system contains the necessary threaded rods and anchoring compound needed to install the system. Follow the instructions on the supplied package and reference the guidelines outlined below.

Anchor holes should be drilled using air-flushed or water-flushed rotary percussive drilling equipment. If diamond core or non-percussive drills are used, the hole must be thoroughly scoured using a coarse wire flue brush.

Other anchoring materials can be used if they comply with the following specifications: material should meet the ASTM C307 tensile strength of 2,000 psi (14 Mpa) and compressive strength of 10,000 psi (70 Mpa) per ASTM C109 or C579. The anchoring compound should provide a pull out strength of 20,000 lbf (89 kN) minimum in 4,000 psi (28 Mpa) concrete. Products such as HILTI HIT HY150 injection Adhesive Anchor, RE500 injection Adhesive Anchor or HVA Adhesive Anchoring System fit these criteria. Refer to Table 1 below for required hole size for recommended anchor compounds.

Mechanical / Removable Anchors

When standard chemical anchors cannot be used to secure Barrier System products as a result of state, local, site or other requirements, mechanical anchors may be used. Various mechanical anchors are available that use wedge, self-undercutting, or expansion coils to establish the locking bond with the concrete. A minimum of 18,000 lbf [80kN] ultimate load in the tension (pull out) and a shear of 22,000 lbf [98kN] is required for use with BSI products. One product recommended is the Hilti HCA item number 00252018 HCA 3/4" x 6".

Torque anchors set in PCC concrete to 120 ft-lbf [160 N-m]. Torque anchors set in asphalt to 5 ft-lbf [8 N-m].

IMPORTANT: FOLLOW MANUFACTURER’S SPECIFICATIONS FOR HOLE SIZE AND PREPARATION

ANCHORING COMPOUND	HOLE DIAMETER
US Anchor Ultra Bond Speed Set	7/8” [22 mm]
HILTI - HIT HY 150	13/16” [20.5mm]
HILTI - HVA Adhesive Anchor System	7/8” [22 mm]
HILTI - RE 500	13/16” [20.5 mm] to 1” [25 mm]

STEP 3
Assemble Bulkheads

The Universal TAU-II is comprised of multiple bulkheads assembled to create a variety of different system lengths and widths. Systems are constructed with different bulkheads depending on the size of the system that is needed.

As illustrated in Figure 2, systems can be fully parallel, fully tapered or a combination.

Every system requires a Front Support, a series of Middle Bulkhead Assemblies and a Backstop Assembly.

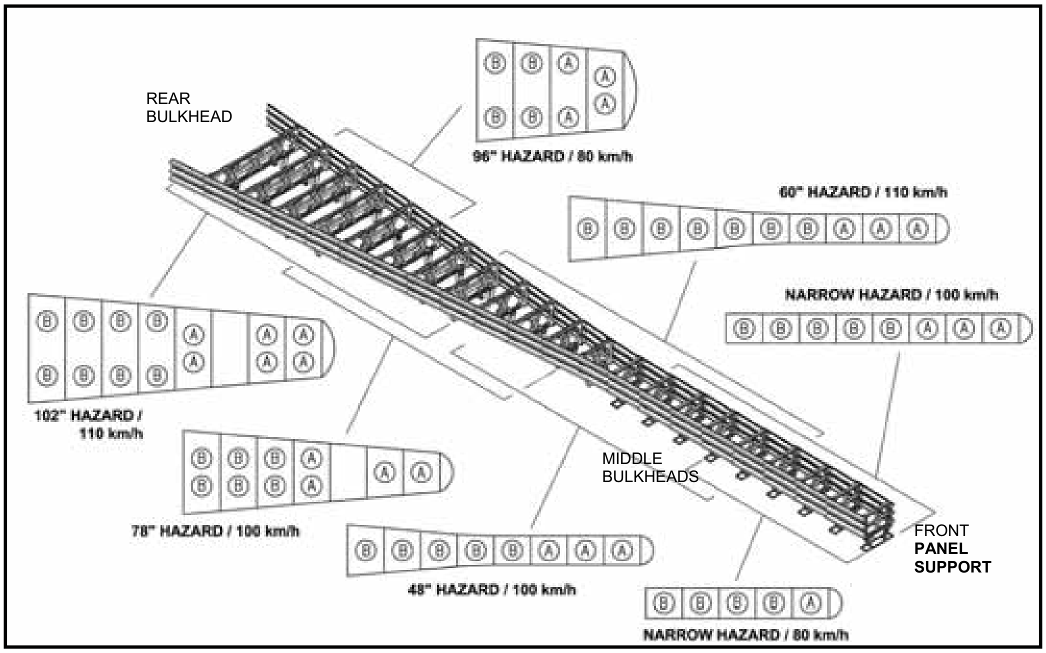
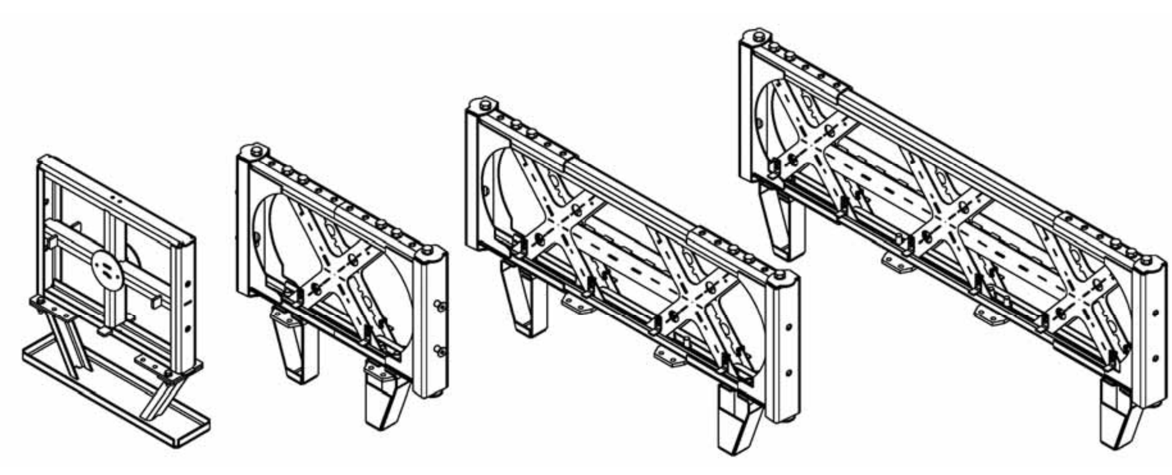


Figure 2.



Front Panel Support (1X) (2X) (3X)

Figure 3. Middle Bulkheads

The Front Support

The Front Support is different from a bulkhead in that it has polymer front support Legs and it doesn't attach to the cables underneath the system. The Front Support also has metal plates called Collision Plates, attached in the impact area on the front of the assembly. The Front Support can be built in different variations depending on the system size.

Using a Front Support:

(parallel and combination systems)

Parallel and combination systems use the Front Support (Figure 4). A tapered system designed with a large nose section may use a modified 1X, 2X or 3X bulkhead for the Front Support (Figure 5).

The polymer front support legs bolt directly to the bottom of the Front Support using the hardware provided. All fasteners use a lock washer or Locktite.

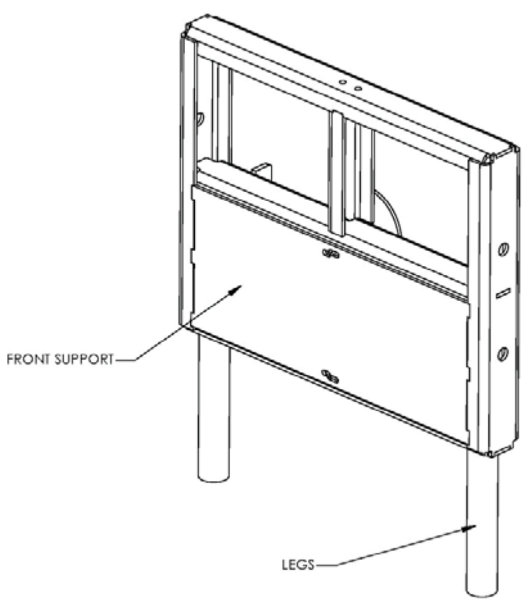


Figure 4. Use the Front Support for a parallel or combination systems.

Using a modified Bulkhead for Front Support
(Tapered systems)

An X style bulkhead can also be used as a Front Panel Support. The X style bulkheads are assembled according to the specific system requirements (Figure 5). Refer to the system drawing for the front bulkhead size needed. The Wing Assemblies slide over the ends of the bulkhead weldment and adjust to the width needed.

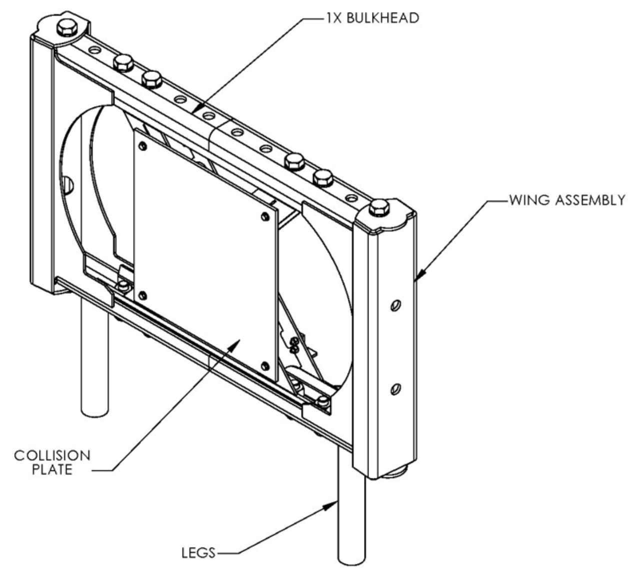


Figure 5. A 1X Style Middle Bulkhead converted into a Front Support

A Single X Bulkhead (1X) provides for Front Support widths of 30" [760] (using Transition Wing Assembly), 36" [910], 42" [1070], and 48" [1220].

A Double X Bulkhead (2X) provides for Front Support widths of 54" [1370], 60" [1525], 66" [1680], and 72" [1830].

A Triple X Bulkhead (3X) provides for Front Support widths of 78" [1980], 84" [2130], 90" [2290], and 96" [2440].

The Wing Assemblies are bolted in the appropriate location using Backing Plates and the hardware provided. All fasteners use a lock washer or Locktite (Figure 5).

The polymer front support legs bolt directly to the bottom of the assembly using free holes on the Wing Assemblies and the hardware provided (Figure 4,5). Some configurations require a leg adapter (Figure 6).

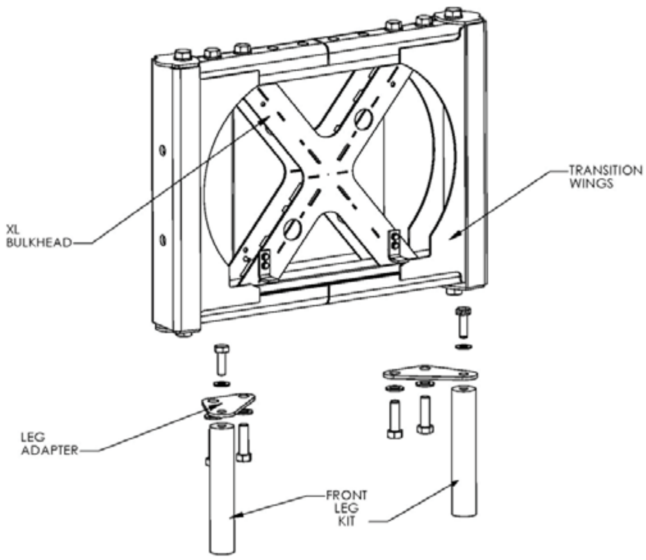


Figure 6. Leg Adapters

EAC Locating Tabs are bolted to the back of the assembly and Front Collision Plates are bolted to the front of the assembly. All fasteners use a lock washer and Locktite.

Middle Bulkhead Assemblies

The Middle Bulkheads come in two different styles: fixed and adjustable X-style. Depending on the system's cable location, the Cable Guide Mounting plates bolt to the bottom of the assembly at one of three positions.

Parallel Middle Bulkhead

The width of the Parallel Middle Bulkhead is not adjustable and is used in systems that are totally parallel or systems that start out parallel and finish with a rear taper (Figure 7).

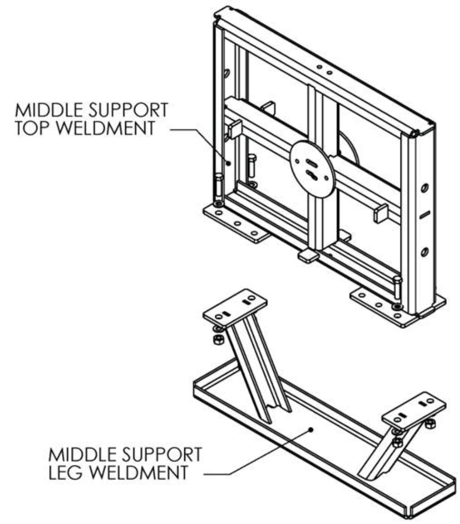


Figure 7. Parallel Middle Bulkhead

Adjustable Middle Bulkheads

The Adjustable Middle Bulkheads come in three different widths and are designated by the number of X patterns on the face of the bulkhead (Figure 3). The narrowest has a single X in its structure, the double X has two and the largest bulkhead has three X's.

All of the bulkheads have adjustable wings that are rigidly bolted on to each side (Figure 8). Using the adjustable wings, the different sized bulkheads can accommodate hazard widths up to 102" [2.6m]. The bulkheads can descend in 6" [150mm] increments until reaching the desired width.

The adjustable Middle Bulkheads are assembled according to the specific system requirements. Refer to the system drawing for the middle bulkhead sizes needed. The Wing Assemblies slide over the ends of the bulkhead and adjust to the width needed.

Single X (1) Middle Bulkheads provide for assembly widths of 30" [760] (using Transition Wing Assembly), 36" [910], 42" [1070], and 48" [1220].

Double X (2X) Middle Bulkheads provide for assembly widths of 54" [1370mm], 60" [1520mm], 66" [1680mm], and 72" [1830mm].

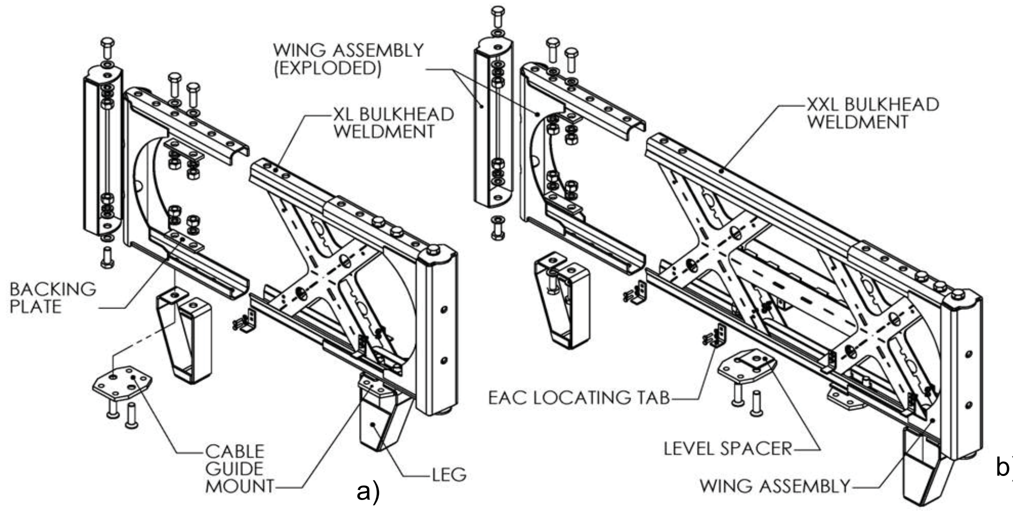


Figure 8. Adjustable Middle Bulkheads a) Single X (1X) b) Double X (2X)

Triple X (3X) Middle Bulkheads provide for assembly widths of 78” [1980mm], 84” [2130mm], 90” [2290mm], 96” [2440mm], 102” [2.6m].

The Wing Assemblies are bolted in the appropriate location using Backing Plates and the hardware provided. The Legs bolt directly to the bottom of the assembly where the Wing Assemblies attach using the same hardware. All fasteners use a lock washer or Locktite.

Cable Guide Mounts

If a parallel or 1X bulkhead is used as the Front Bulkhead Assembly, the cable is in the 1st position (Figure 9) and the Cable Guide Mounts would bolt in the corresponding location.

If a 2X or 3X bulkhead is used as the Front Bulkhead Assembly, the cable is in position 2 or 3 (Figure 9) respectively and the Cable Guide Mounts attach accordingly. If said cable position alignswith the leg mounting position the Cable Guide Mount bolts through the leg using the hardware provided for the Cable Guide Mount.

Backing Plates are used on all Leg, Wing Assembly, and Cable Guide fastenings. A Level Spacer is used when attaching components across the step between the Bulkhead

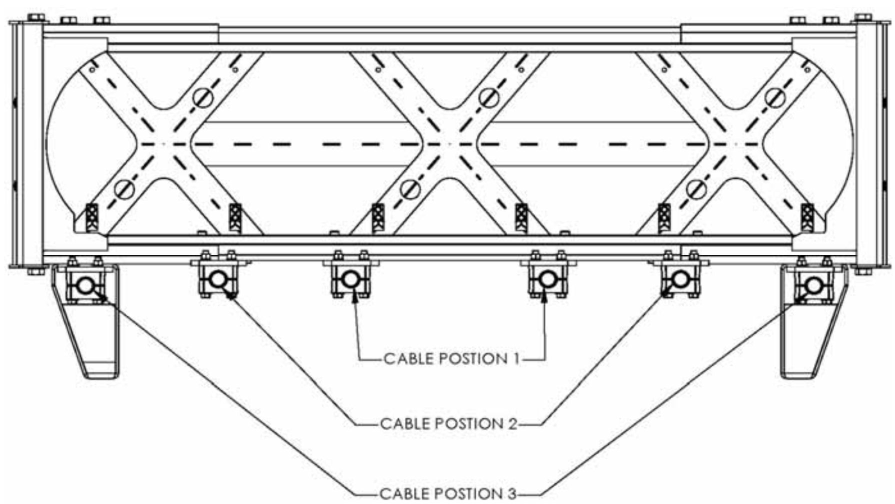


Figure 9 Guide Cable position

Weldment and the Wing Assembly.

EAC Locating Tabs

EAC Locating Tabs are bolted to the front and back of each Middle Bulkhead Assembly. All fasteners use a lock washer or Locktite (Figure 8).

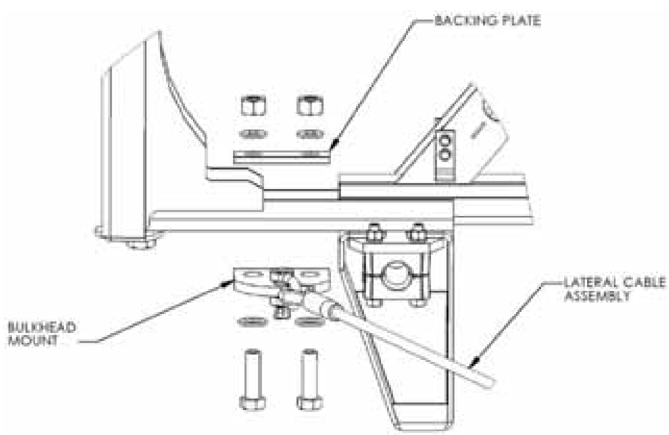


Figure 10. Lateral Cable Support

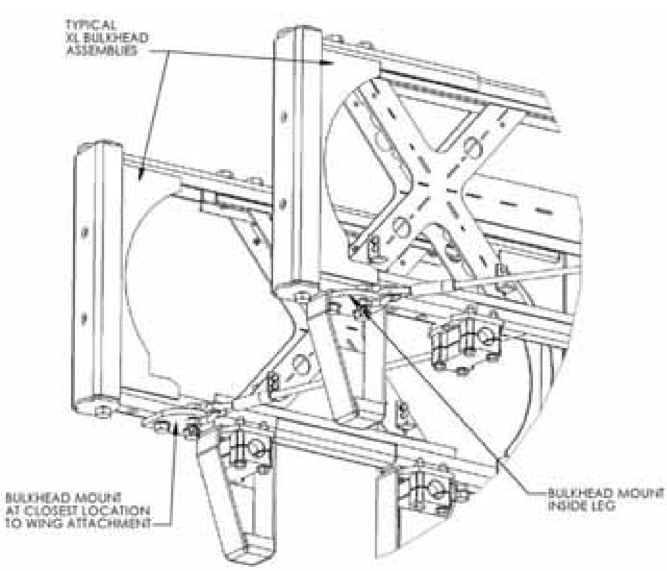


Figure 11. Lateral Cable Supports mounted inside and outside the leg

Lateral Cable Support

Some systems require a Lateral Cable Support Kit (Refer to Step 10 of this manual). The Lateral Cable Support Kit contains Bulkhead Mounts that attach to the last two bulkhead assemblies of required systems. They bolt to the outermost free holes in the Wing Assemblies (Figure 10). They do fit inside the Legs if necessary (Figure 11).

NOTE: Refer to the System Configuration chart in Appendix "A" to determine if Lateral Cable supports are required.

Empty Bay Bumpers

Some systems require an empty bay (no Energy Absorbing Cartridges). These systems utilize a Bumper Kit to minimize damage in an impact (Figure 12). The kit includes (4) Bumpers that mount to the rear bulkhead assembly of the empty bay. Two Bumpers mount to the top of the assembly at the Wing to Bulkhead joint using the same hardware. The other two Bumpers mount through the Leg to the Wing – Bulkhead joint.

NOTE: Refer to the System Configuration chart in Appendix "A" to determine if empty bays are required.

Following complete assembly of the Front, Middle, and Backstop Bulkhead assemblies, position them in order. Space them at approximately 34" [860mm] apart, center to center. Also, align them through the centerline of the system. Accuracy and care taken here will improve ease of assembly and reduce efforts to straighten the system.

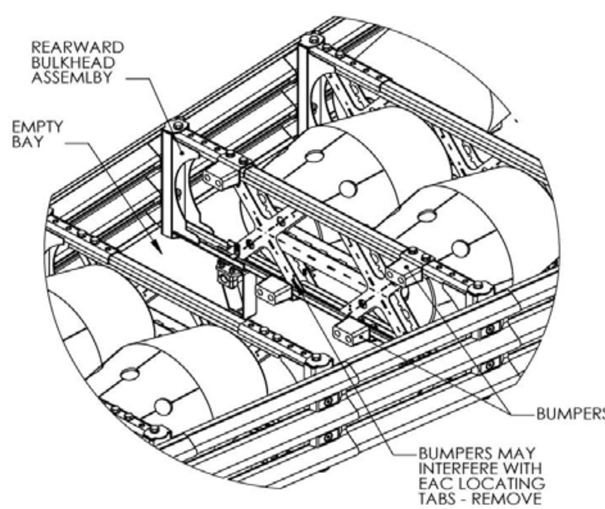


Figure 12 Empty Bay Bumpers

STEP 4

Backstop Assemblies

The Backstop Assembly is selected per application and can be configured to protect hazards up to 8.5' [2.6m] in width. Backstops can either be attached directly to a barrier wall or a suitable structure (Portable Concrete Barrier (PCB) Backstop, Flush Mount Backstop) or installed as a stand-alone system (Compact Backstop, Wide Flange Backstop). All backstops require minimum assembly if they are not pre-assembled.

PCB Backstop

The PCB Backstop (Figure 13) is configured from parts anchored directly to an existing concrete barrier wall. Refer to Step 1 and Step 2 for PCB Backstop layout and anchorage details. Pipe Panel Mounts bolt to the sides of the backstop and provide a mounting point for the Slider and End Panels.

Refer to the System Configuration Chart in Appendix "A" to determine system widths
and Capacity Limitations.

If a 36" [910mm] Backstop is desired, attach the 36" [910mm] Backstop Adapters (Figure 14) to the sides of the backstops and bolt the Pipe Panel Mounts to the pivoting sections.

If the system is installed on an asphalt foundation, the portable concrete barrier must be anchored using the supplied brackets. Also, the Backstop Brace Weldment must be bolted to the Compact Backstop prior to anchoring.

For additional information or questions about the Universal TAU-II Crash Cushion, please call the BSI Customer Service Department at (888) 800-3691 (U.S. toll free) or (707) 374-6800.

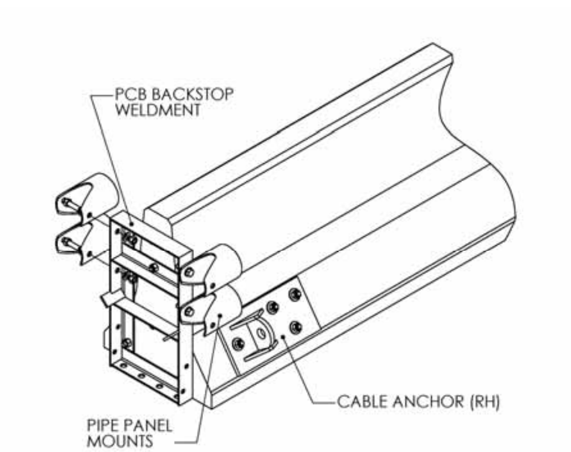


Figure 13 PCB Backstop (Parallel System)

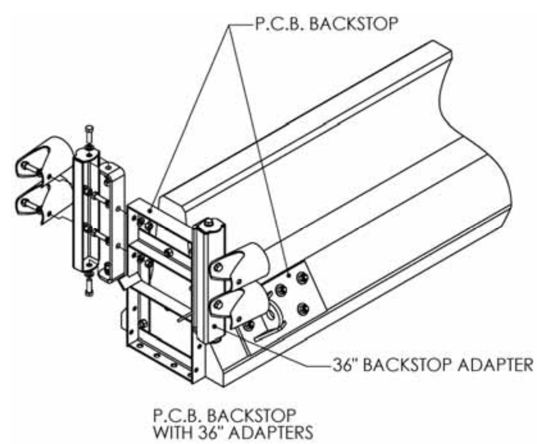


Figure 14 PCB Backstop (Tapered System)

Compact Backstop

The Compact Backstop (Figure 15) is bolted together in two halves and is usually pre-assembled. The Backstop is a stand alone design is not anchored to the hazard being protected.

Refer to Step 1 and Step 2 for Backstop layout and anchorage details.

Pipe Panel Mounts bolt to the sides of the backstop and provide a mounting point for the Slider and End Panels. Refer to the system drawing for the backstop assembly size needed.

If a 36” [910mm] Backstop is desired, attach the 36” [910mm] Backstop Adapters (Figure 16) to the sides of the backstops and bolt the Pipe Panel Mounts to the pivoting sections.

For additional information or questions about the Universal TAU-II Crash Cushion, please call the BSI Customer Service Department at (888) 800-3691 (U.S. toll free) or (707) 374-6800.

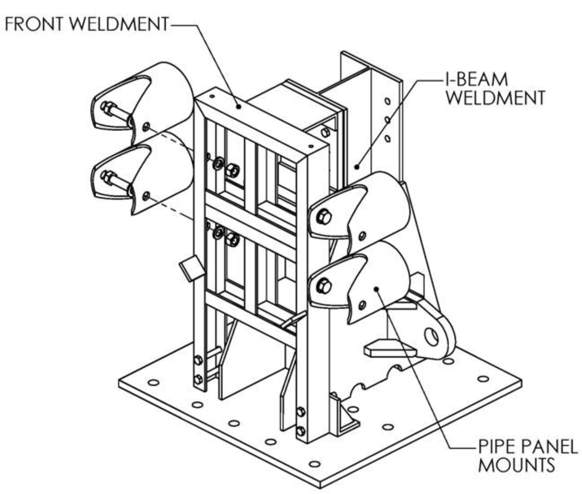


Figure 15 Compact Backstop (Parallel Systems)

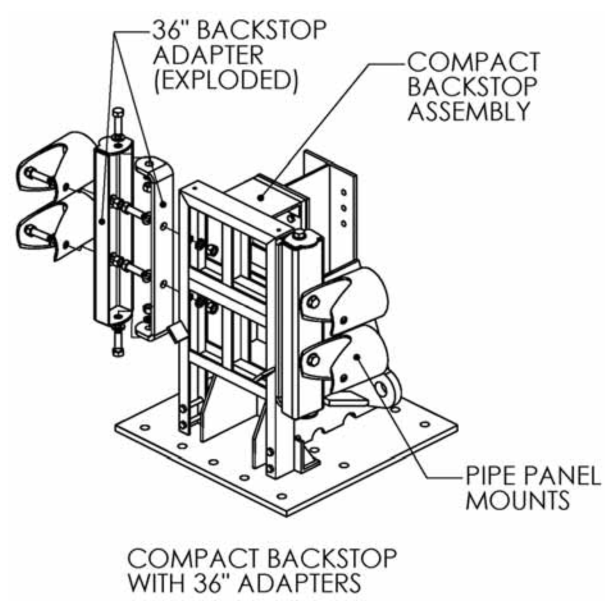


Figure 16 Compact Backstop (Tapered Systems)

Flush Mount Backstop

The Flush Mount Backstop system (Figure 17) is intended for applications where the hazard width exceeds the limitations of the PCB Backstop and are applicable in locations with limited foundation size. The Flush Mount Backstop can be attached to reinforced safety shape or vertical concrete structures up to 36” [910mm]. Systems over 24” [610mm] wide require the 36” [910mm] adapter. Edges of vertical concrete may require chamfer according to local standards.

The Cable Tensioning is moved to the front of the system so the rear cable anchors do not protrude outside of the rear extension panels.

The backstop is attached to the foundation and to the concrete backstop. Install anchors in accordance with BSI specifications. Vertical slots on the backstop allow removal replacement of the backstop. Anchors must be placed at the top of said slots to be effective. Flush Mount Backstop systems use the same cable used in all parallel systems. The cable is installed with the threaded tensioning end forward. The looped end is pinned in place at the backstop. The Front Cable Anchor uses an inserted key to keep the threaded stud from rotating during tensioning.

For additional information or questions about the Universal TAU-II Crash Cushion, please call the BSI Customer Service Department at (888) 800-3691 (U.S. toll free) or (707) 374-6800.

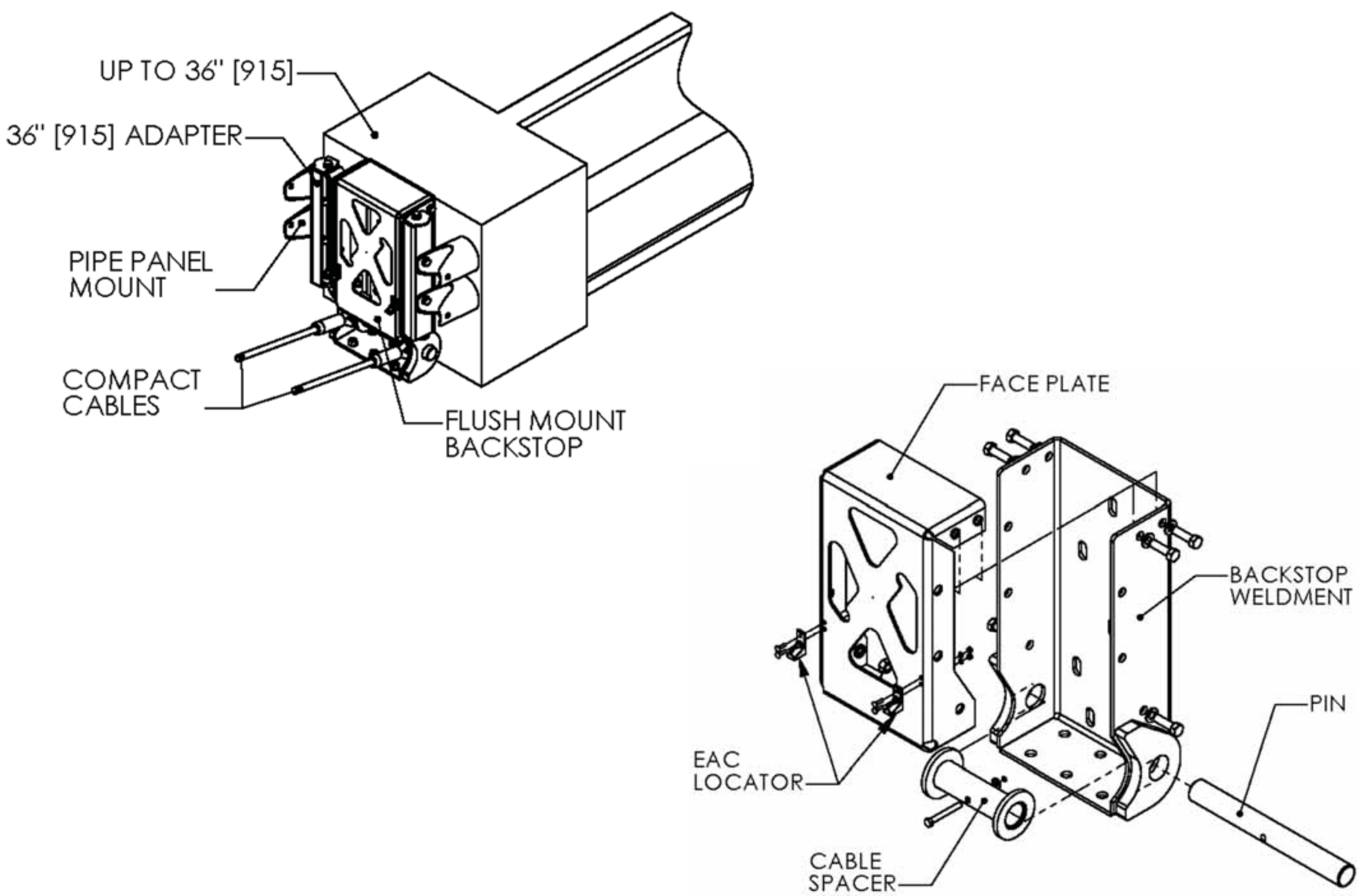


Figure 17 Flush Mount Backstop

Wide Flange Backstop

The Wide Flange Backstop (Figure 18) uses a combination of backstop elements to protect wide hazards.

The Wide Flange Backstop incorporates XL, XXL, or XXXL bulkhead assemblies attached to two Wide Flange Backstop Weldments.

The backstop bulkheads are assembled according to the specific system requirements. The Wing Assemblies slide over the ends of the bulkhead weldment and adjust to the width needed.

> XL Bulkheads provide for backstop bulkhead assembly widths of 42” [1070] (using Transition Wing Assembly), 48” [1220], 54” [1370], and 60” [1525].
>
> XXL Bulkheads provide for backstop bulkhead assembly widths of 66” [1680], 72” [1830], 78” [1980], and 84” [2130].
>
> XXXL Bulkheads provide for backstop bulkhead assembly widths of 90” [2290], 96” [2440], and 102” [2290].

Backstop Block-outs mount to the bulkhead assemblies at the Wing Assembly to Bulkhead Weldment joint. The block-outs are bolted through the Wing Assemblies and bulkhead weldment and fastened using Backing Plates and the hardware provided. The bulkhead assembly and block-outs are then bolted to the Wide Flange Backstop Weldments. Pipe Panel Mounts are fastened to the pivoting section of the Wing Assemblies. EAC Locating Tabs bolt to the front of the bulkhead assembly. All fasteners use a lock washer or Locktite.

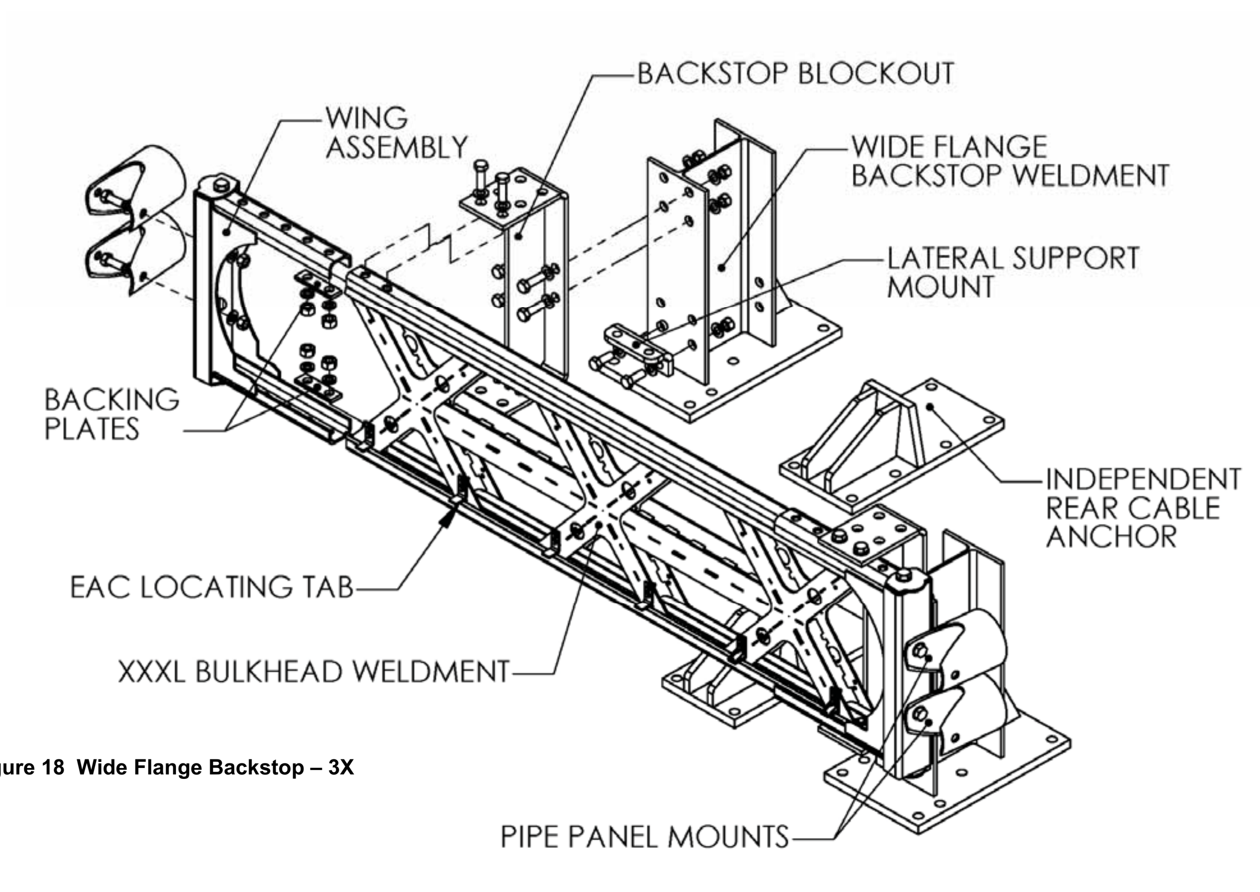


Figure 18 Wide Flange Backstop – 3X

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Depending on the position of the cables in reference to the Wide Flange Backstop positioning, either an independent rear cable anchor (Figure 18) or a backstop mounted rear cable anchor (Figure 19) will be used. The independent rear cable anchor stands alone and requires no assembly. (Reference Step 1 and Step 2 for layout and anchorage specifications). The backstop mounted rear cable anchor bolts between the flanges of the Wide Flange Backstop. They are mounted to the interior of the system. All fasteners use a lock washer or Locktite. When the front support bulkhead and backstop utilize the same bulkhead, the rear cable anchors are mounted to the backstops. When the front support bulkhead and backstop bulkheads are different, the system is supplied with independent rear cable anchors mounted on the pad surface.

Some systems require a Lateral Cable Support Kit. The Lateral Cable Support Kit contains Lateral Support Mounts that attach to the backstop assembly of required systems. They bolt to the front of the Wide Flange Backstop Weldments in the lowest hole set. If backstop mounted rear cable anchors are used, one of the bolts will be shared. All fasteners use a lock washer or Locktite.

Refer to the System Configuration Chart in Appendix "A" to determine if Lateral Cable supports are required.

If the Wing Assemblies of the particular backstop are adjusted to one of their two most extended positions (54" [1370mm], 60" [1525mm], 78" [1980mm], 84" [2130mm], and 102" [2290mm] backstops), Wing Braces and Spacers are required (Figure 19). The Wing Braces attach to the Wing Assemblies and the Backstop Block-outs on the top and bottom. The Spacers level their mounting surfaces. All fasteners use a lock washer or Locktite.

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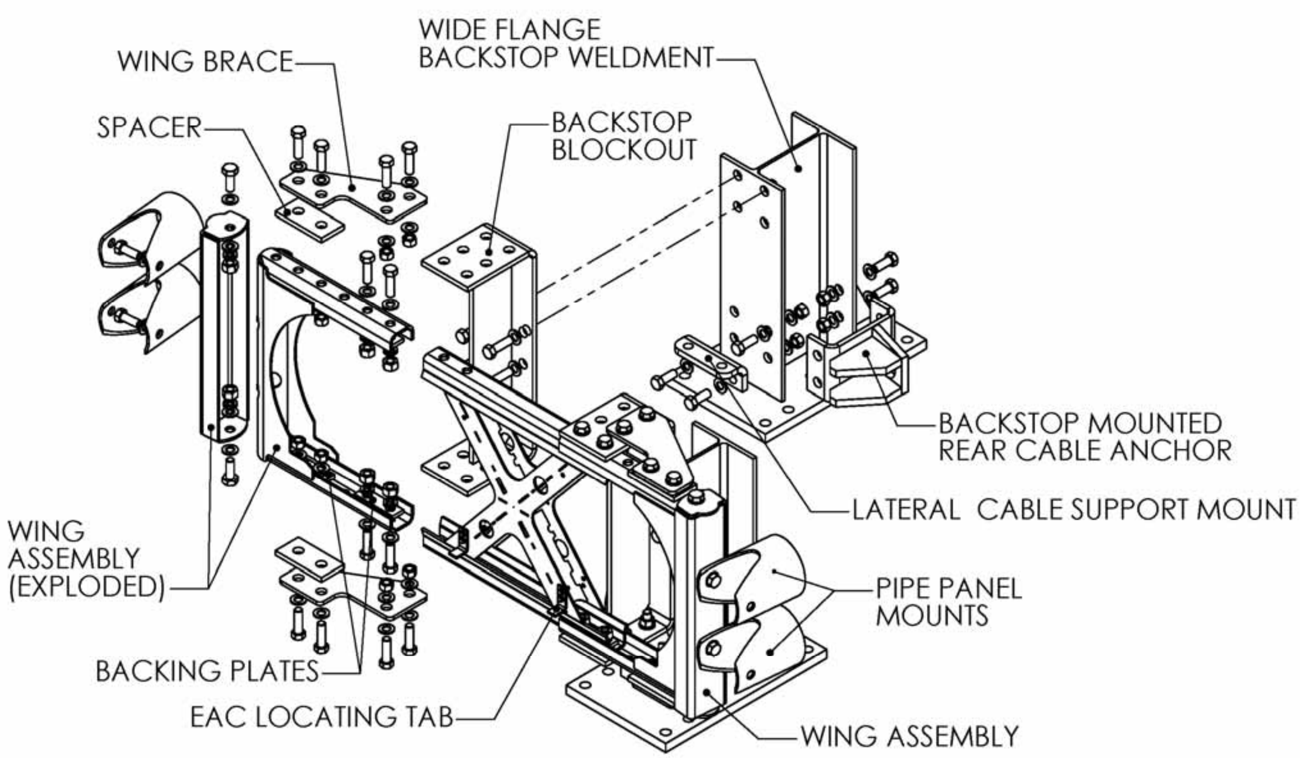

Figure 19 Backstop – 1X with Wing Braces

STEP 5

Attach Panels

The Universal TAU-II system uses two types of panels: Sliding Panels (Figure 20) and End Panels (Figure 21). Sliding Panels have a pair of holes forward and two long slots running the length of the panels. End Panels have a pair of holes at each end and do not have slots. Sliding panels are used on all collapsing bays. End panels are attached to the backstop only (Call BSI for non-proprietary transition options). Slider Bolts hold the panels to the bulkheads. Some systems require nested panels (doubled) on rearward bays.

NOTE: Refer to the System Configuration Chart in Appendix "A" to determine if/where nested panels are required. A long bolt is supplied to assist in the assembly to nest the panels.

Install the panels from back to front staggering from each side. Place the End Panels first. While holding the End Panel in place, lap the forward Sliding Panel over it and bolt through the slot, End Panel, and Pipe Panel Mount (Figure 22). Leave the nuts of the Slider Bolts loose and perform on both sides. Lap the next forward Sliding Panel and bolt through the slot, hole set in rearward Sliding Panel, and bulkhead. Leave the Slider Bolt nuts loose and progress forward alternating sides (Figure 23). If the bay requires nested panels, perform procedure with (2) panels, one nested inside the other.

The last panels to be installed will be on the first bay of the system, the Front Support. These panels lap the rearward panel and fasten to the 2nd bulkhead from the front as instructed above. The front of these panels will mount to the Front Support through the Nose Piece. Refer to Section 6 for this connection (Figure 26).

Leave the Slider Bolt nuts loose until the system is almost completely assembled and installed.

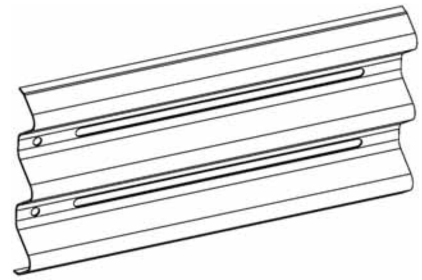

Figure 20 Slider Panel

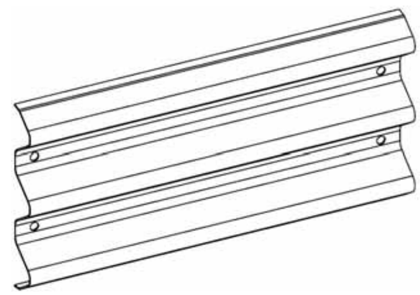

Figure 21 End Panel (no slots)

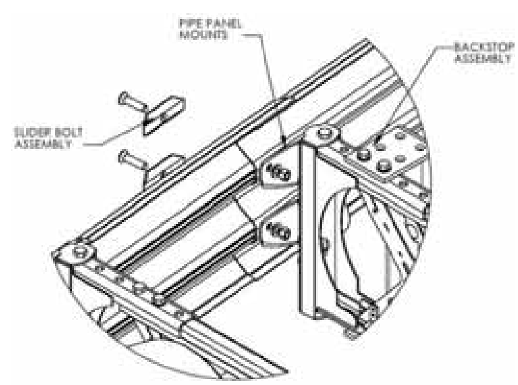

Figure 22 Attach Rear Panel

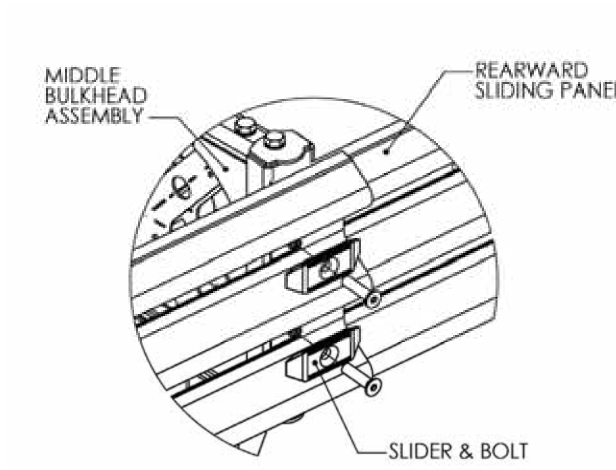

Figure 23 Attach Side Panels

STEP 6
Attach Nose Piece / Delineation Marker

Narrow systems (up to 36” [910mm] Front Support) use a one-piece polyurethane nose (Figure 24) with molded thrie beam corrugations on both ends. Wider Front Support Assemblies (42” [1070mm] and above) use two polyurethane parts (Figure 25) riveted together. The two part nose pieces have thrie beam corrugations on one side and a series of holes through the flat section. Guide Cable Torque

The Nose Piece attaches to the Front Support assembly through the Sliding Panels (Figure 26). Thick flat round washers are inserted in the mounting holes of the nose piece to limit compression of the polyurethane. Two ¾” [20mm] bolts with fender washers clamp the nose piece and Sliding Panel to the Front Support on each side. Fasteners use lock washers or Locktite.

Torque to 200 ft-lbf [270 N-m].

The two part nose pieces overlap across the width of the system. Adjust to desired profile and align holes. Using the supplied pop-rivets and washers, rivet two columns of holes. Rivets should pass through the overlapping nose pieces at the furthest possible columns apart (Figure 26).

Apply delineation markings as required (not supplied).

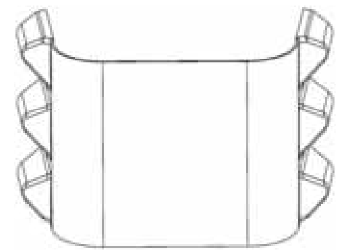

Figure 24 Nose Piece (up to 36”)

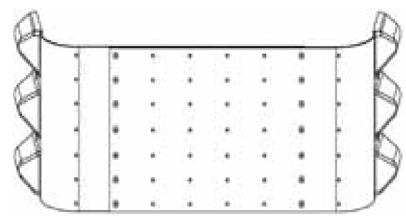

Figure 25 Nose Piece (wide)

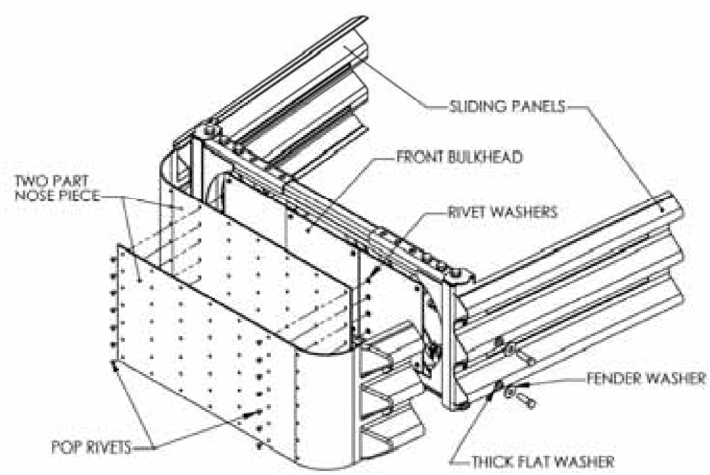

Figure 26 Wide Nose Piece Assembly

STEP 7

Install Cables and Cable Guides

Cable Location

Every system has a set of cables that run through the cable guides that attach underneath each bulkhead. The Cable Guides clamp around the cable and bolt to the bottom of the bulkheads. The Cable Guide is universal and fits all bulkhead and cable configurations. Two Cable Guide assemblies are used on every middle bulkhead assembly (Figure 27).

The cables are tentioned between the Backstop and Front Cable Anchor. The Front Cable Anchor is mounted under the first bay.

IMPORTANT NOTE: The Front Support Assembly is not attached to the cable.

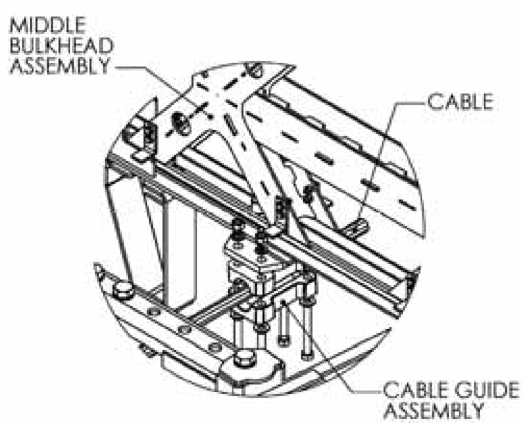

Figure 27 Cable Guide Clamp

Systems using a PCB, Compact Backstop or Flush Mount Backstop.

Systems using a PCB, Flush Mount or Compact Backstop use 1” [25mm] diameter cable (Figure 28). These Cables are identified by the loop and shackle on one end and a threaded stud swaged to the other end. (The shackle is not used on the Flush Mount Backstop).

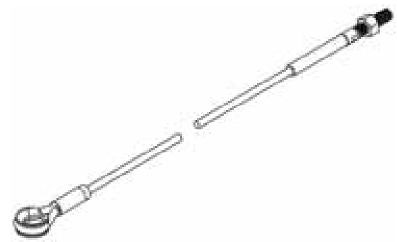

Figure 28 Compact Cable

Systems with Wide Flange Backstops

Systems with Wide Flange Backstops use a 1 1/8” [28mm] diameter cable (Figure 29). These cables have a threaded stud swaged to the rear end and a large “open swage socket” on the front end. A Key is also included which limits rotation of the cable during tensioning at the Rear Cable Anchor.

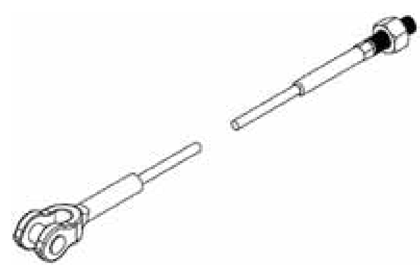

Figure 29 Universal Cable

The cables are fed through the bulkheads from the front. On parallel style bulkheads, the cables thread between the legs. On XL-XXXL bulkheads, the cables can go between the legs or through the legs, depending on the configuration. Lead with the rear of the cable. Place the rear cable end through the Rear Cable Anchor, PCB Backstop, or Compact Backstop. Start the tensioning nut with about 1” [25mm] of thread.

Without pinning the Front Cable Anchor, attach the Cable Guides to the bulkheads. Start from the last bulkhead and move forward. Cable Guides attach with ½” [12mm] hardware provided. Fasteners use lock washers or Locktite.

When all the Cable Guides are installed, pin the front cable end to the Front Cable Anchor. On Wide Flange Backstop configurations, install the Key to the Rear Cable Anchor (Figure 30).

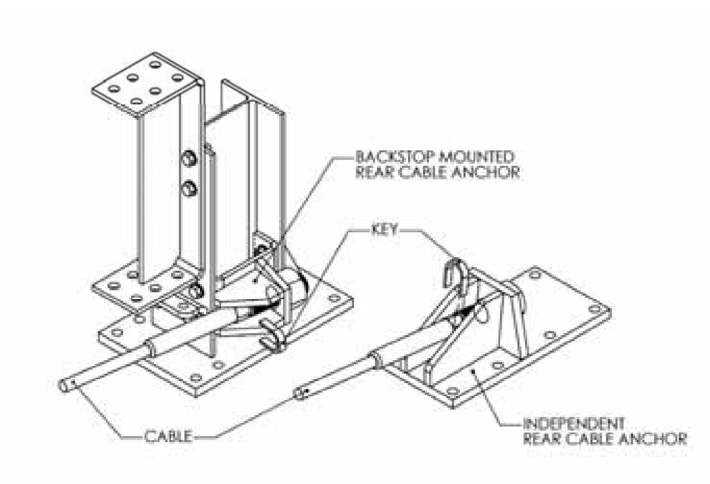

Figure 30 Backstop Cable Mount

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STEP 8

Stretch and Align the System

This step can be avoided or reduced if care is taken to align and space the bulkheads properly during assembly.

Attach a pair of chains or straps to the Front Bulkhead assembly. Using a truck or other tow vehicle, pull the system forward to fully extend the bays. The bays are fully extended when the Slider Bolts are bottomed out in the slots of the Sliding Panels.

If necessary, bump or nudge the system into alignment. Each bulkhead should be aligned along the centerline of the system.

Recommended attachment points for straps or chains are at the corners of Front Support on the top and bottom horizontal channels. When attaching to XL-XXXL bulkheads, secure as close to the Wing Assembly attachment points as possible.

NOTE: Be sure not to jerk or pull on the backstop anchors before the anchoring compound has cured and the backstop is secured to the foundation.

STEP 9

Tension Cables and Torque Slider Bolts

Tension the Cables. Torque the cables in 50 ft-lbf [65 N-m] increments alternating between the two. Reference Torque Chart below (Table 2) for torque requirements. Use the deep socket provided.

Tighten Slider Bolts to approximately 100 ft-lbf [130 N-m], loosen, and then torque to 20 ft-lbf [27 N-m]. This procedure ensures proper nesting of the panels and torque accuracy.

NOTE: Care must be taken to not over tighten the sliders. Follow the procedure outlined above.

STEP 10

Install Lateral Support Cables

Skip this section if the system does not require a Lateral Cable Support Kit.

NOTE: Refer to the System Configuration chart in Appendix "A" to determine if Lateral Support Cables are required.

If the system requires a Lateral Cable Support Kit, the cable mounts should be installed on the last two bulkhead assemblies and the Wide Flange Backstops. Refer to Figure 9 and Figure 10 of Step 3.

The Lateral Support Cables are ½" [12mm] diameter and have a ½" [12mm] shackle on one end. There are eight (8) cable assemblies in the kit. The shackles pin to the cable mounts on the bulkheads and Wide Flange Backstops (Figure 31, 32, 33, 34, 35). The two cables from each backstop are routed to the opposite sides of the last two bulkheads (Figure 35).

These cables are attached to the cables pined to the bulkheads with cable clamps. Six cable clamps are used in series of three. Place the clamps at the furthest extents of the overlapping cables. The first cable clamp should be approximately 3" [75mm] from the cable end. Subsequent clamps should be spaced at 3" [75mm] (Figure 33).

Cables should be taught with minimal slack, but do not require tensioning. Routing above or below the main system cables is acceptable. Bundle access cable and use provided plastic wrap ties to secure the bundles to the suspended cables.

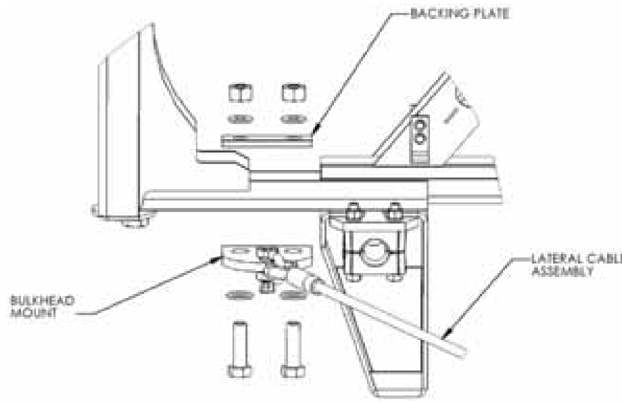


Figure 31 Lateral Support Cable

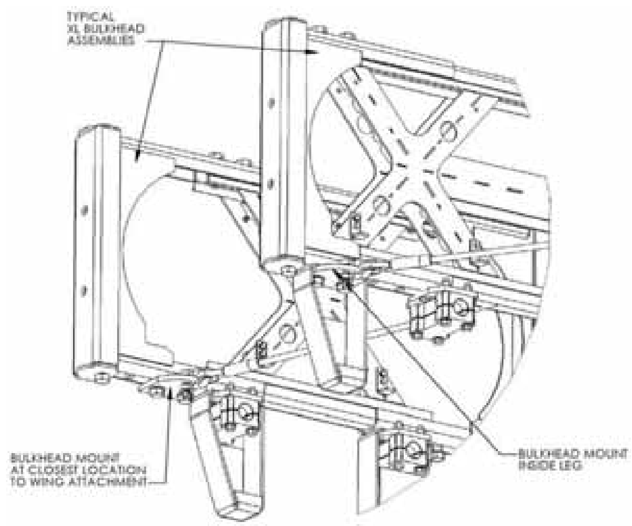


Figure 32 Lateral Support Cables

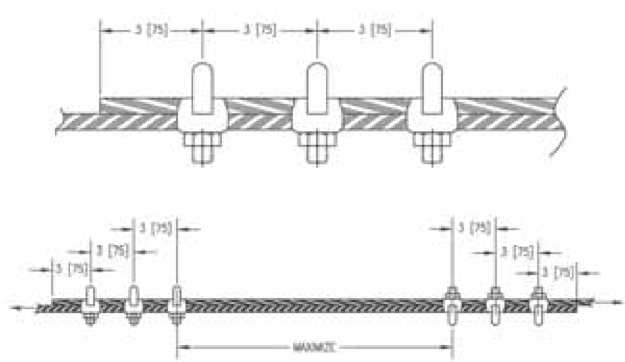


Figure 33 Install Cable Clamps

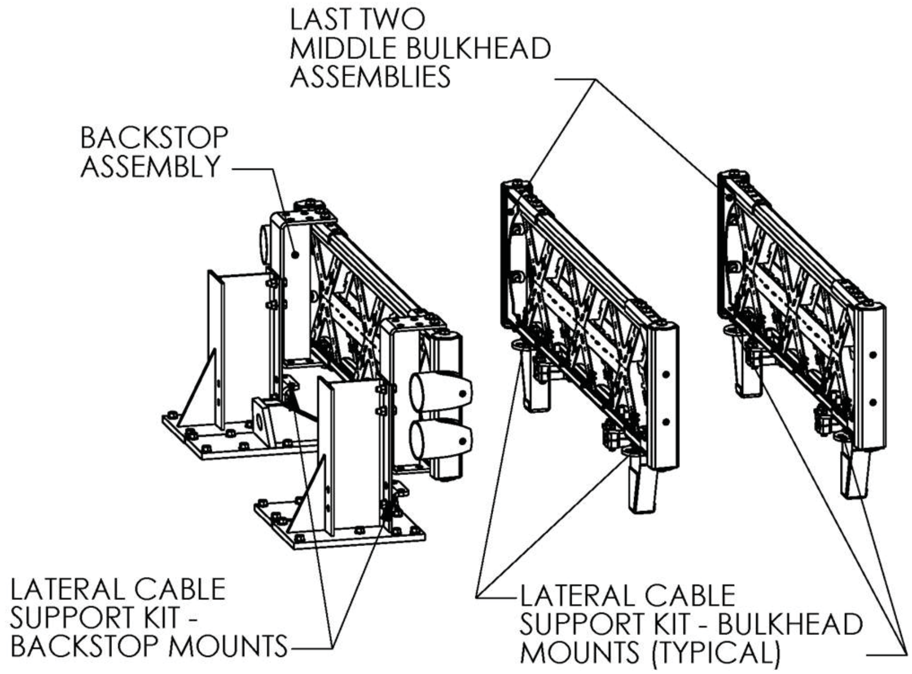


Figure 34 Cable Mounts

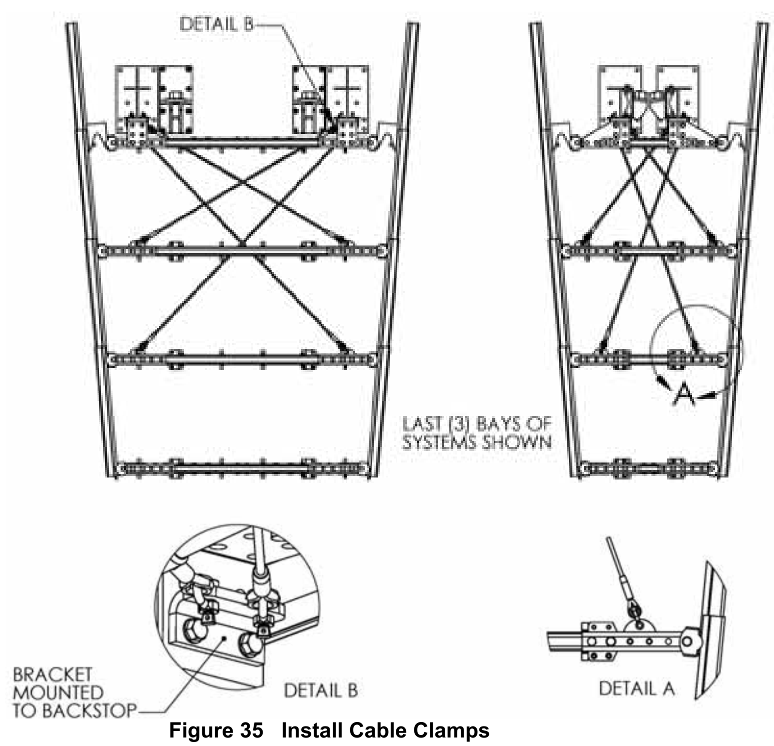


Figure 35 Install Cable Clamps

STEP 11

Insert Energy Absorbing Cartridges

There are two types of Energy Absorbing Cartridges (EAC). Each EAC has a forward and rearward end. Type “A” EAC’s (Figure 36) have eight (8) 3” [75mm] diameter holes around the circumference of the front half of the cylinder. Type “B” EAC’s (Figure 37) have a solid cylinder wall with three (3) vent holes on the rearward end.

When installing the EAC’s in a system it is important to ensure that they are placed according to manufacturer specification.

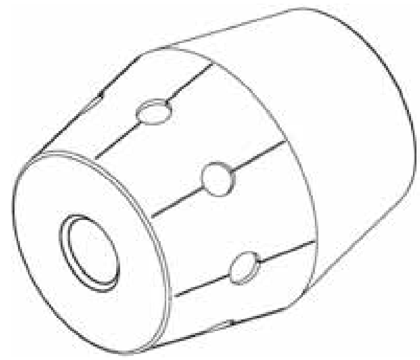


Figure 36 Energy Absorbing Cartridge – Type A

NOTE: Refer the System Configuration Chart in Appendix “A” for proper EAC placement.

When placed in the system, the front of the EAC will face the front of the system (narrow end). Text on the EAC reading “This Side Up” should be legible and at the top of the inserted EAC. The EAC should rest on the EAC Locating Tabs.

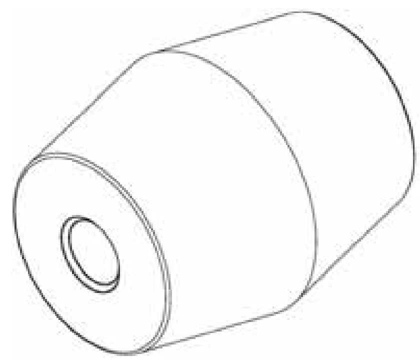


Figure 37 Energy Absorbing Cartridge – Type B

Note that bays capable of holding (2) EAC’s will always use (2) EAC’s except in specified empty bays. They will also always be placed in the widest locations available.

NOTE: A single bay will never have more than (2) EAC’s in it. Refer the System Configuration Chart in Appendix “A” for proper placement.

STEP 12

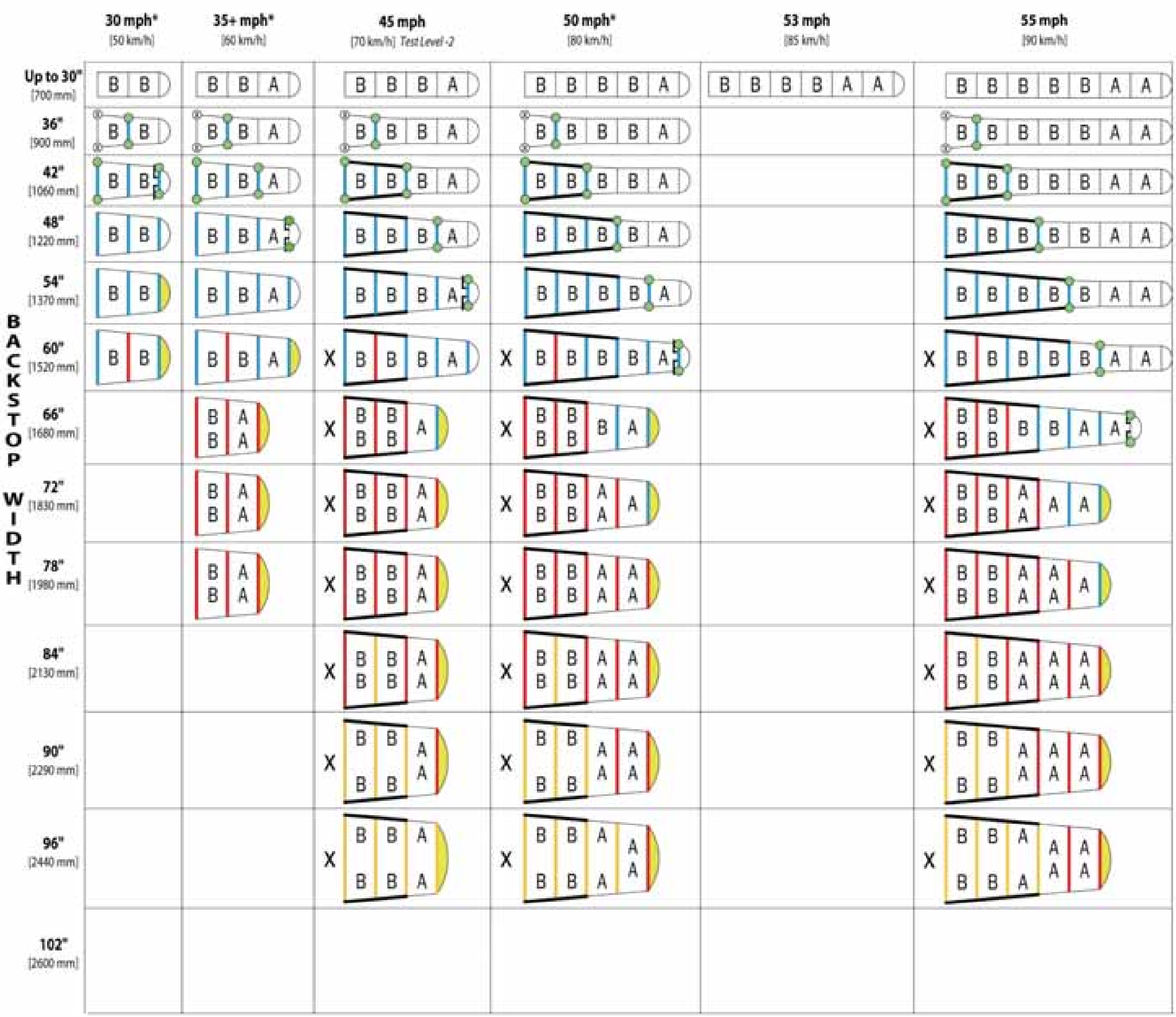
Final Inspection

Use the check list below to confirm that all of the installation steps have been completed.

Inspection Date	Inspection By:	Item
		All front cable anchor plate and backstop anchor bolts in place and epoxy cured.
		Clevis and pin, mounted to the front cable anchor, is installed with the handle portion of the pin on the inside of the anchor assembly, firmly tightened. *(This may be different depending on the type of foundation, ie, asphalt or PCC.)*
		All cable guide assemblies securely fastened.
		System cables tightened to meet torque specifications.
		Pipe panel mounts positioned properly, flat end facing back, cut out facing forward.
		Sliding panels installed properly to allow for stacking.
		Sliding panels should have no more than a ¾" (19mm) gap between stacked panels.
		Nose cover properly installed with thick spacer and tightened to specifications.
		Torque Sliding Bolt assemblies to specifications. Do NOT over tighten.
		Energy Absorbing Cartridges (EAC) installed in proper A-B position and sequence. See Configuration Chart.
		EAC air discharge holes positioned properly. Rotate cast ID to the top of the cartridge.
		Asphalt adapter installed on both sides of portable concrete barrier when applicable.
		Torque all fasteners to meet specifications.

APPENDIX A - System Configuration Chart

System Configuration Chart - Universal TAU-II® Crash Cushion



Legend:

- X Lateral Support Cables Required
- Double Slider Panels
- Single Slider Panel
- Leg Adapter Required
- Single X Bulkhead (XL)
- Double X Bulkhead (XXL)
- Triple X Bulkhead (XXXL)
- Parallel Diaphragm
- Nose Piece
- A Type A Energy Absorbing Cartridge
- B Type B Energy Absorbing Cartridge
- Transition Wing Assembly Required
- 36" Adapter Assembly Required
- Wide Nose Piece

* Speed Capacity rounded down to nearest 5 mph level. Contact Customer service for further information.

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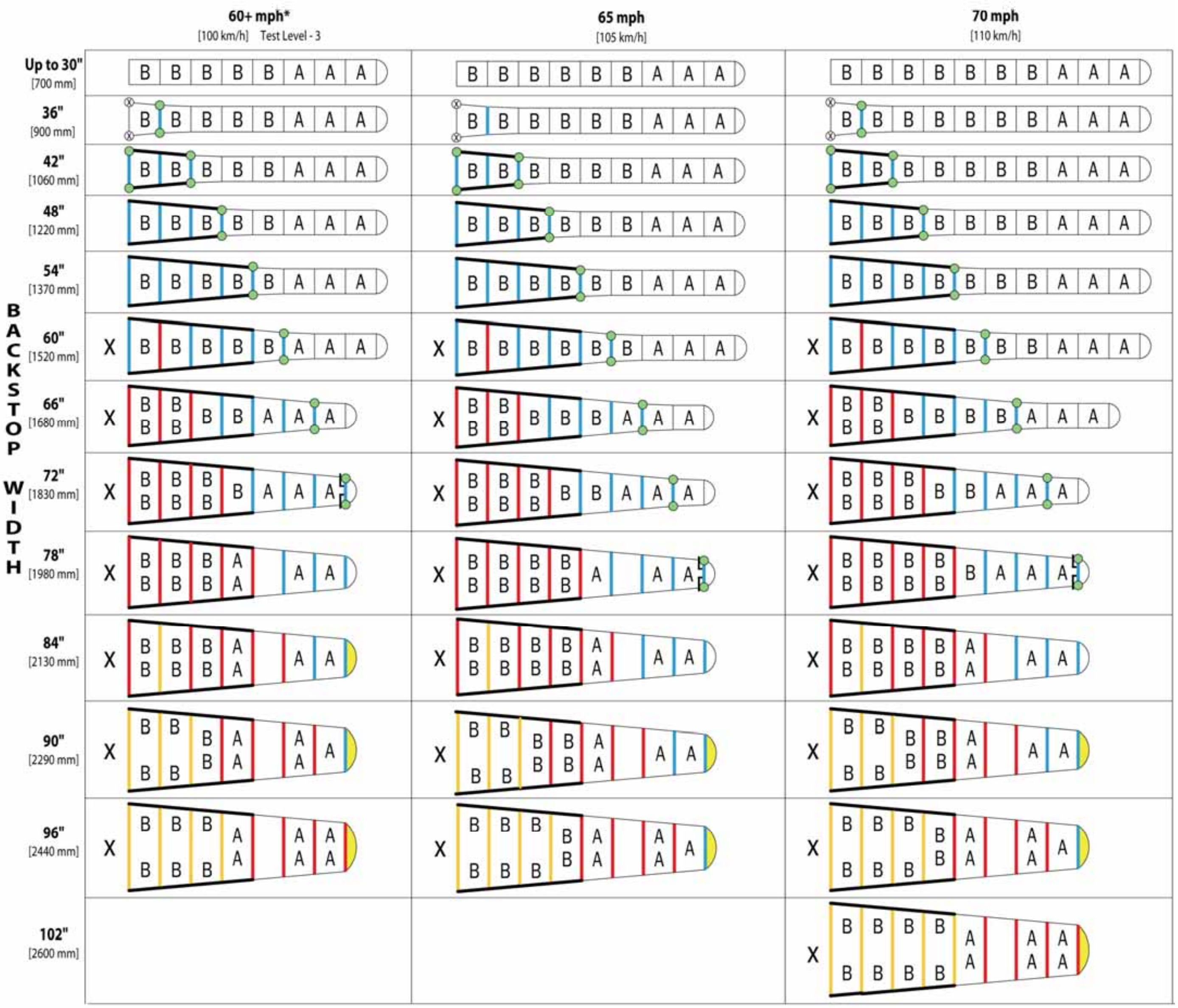
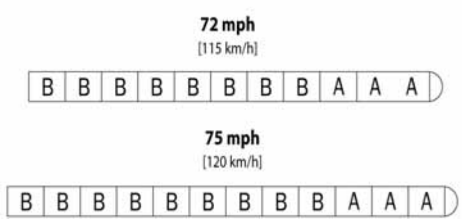


ADDITIONAL HIGHER SPEED SYSTEMS



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BARRIER SYSTEMS

APPENDIX B - System Torque Chart

CONCRETE INSTALLATION

Compact Backstop Anchors	120 ft-lbs (160 N-m)
PCB Backstop Anchors	120 ft-lbs (160 N-m)
Cable Anchor (Rear)	120 ft-lbs (160 N-m)
Cable Anchor (Front)	120 ft-lbs (160 N-m)
Cable Adj. Eye Bolt	500 ft-lbs (675 N-m)

ASPHALT INSTALLATION

Compact Backstop Anchors	5 ft-lbs (8 N-m)
PCB Backstop Anchors	5 ft-lbs (8 N-m)
PCB Asphalt Adapter	5 ft-lbs (8 N-m)
Cable Anchor (Front)	5 ft-lbs (8 N-m)
Cable Adj. Eye Bolt	120 ft-lbs (160 N-m)

SYSTEM COMPONENT INSTALLATION

Sliding Bolt Assembly	20 ft-lbs (27 N-m)
Front Panel Holding Nose Cover	200 ft-lbs (270 N-m)
Pipe Panel Mount to Backstop	70 ft-lbs (95 N-m)
Cable Guide Bolts	30 ft-lbs (48 N-m)

The Universal TAU-II Crash Cushion has been successfully tested in various configurations having the cable torque ranging from 120 ft-lbs for asphalt installation, to 500 ft-lbs of torque for concrete applications. The system will function properly under this full range of torque. If a torque wrench is not available, refer to the table below for an alternate method of reaching the desired torque range.

Ways of creating approximately 500 ft-lbs of torque:

- 6 ft. [1. 8 m] wrench extension with entire weight of 100 lbs [45 kg] applied 12" from the end
- 42 in. [1.1 m] wrench extension with entire weight of 200 lbs [90 kg] applied 12" from the end
- Use free weights or human weight

These methods should ensure torque within tested range and manufacturer tolerances.

APPENDIX C

Anchoring Foundation Options

There are three approved anchoring foundation configurations for the TAU-II system. The first method utilizes a solid concrete pad over the length of the system. The second utilizes concrete blocks at the Backstop and Front Cable Anchor locations. The third is on Asphaltic Concrete foundation.

(Variations of these foundations may be reviewed and determinations made as to equivalence by the Project Engineer.)

There are different foundation configurations depending on which backstop you are using (Compact or P.C.B.). Foundation options for both of the Backstop systems are shown in the following drawings.

DRAWINGS

FOUNDATION SPECIFICATIONS:

THE TAU-II CRASH CUSHION SYSTEM HAS BEEN DESIGNED TO ATTACH TO CONCRETE OR ASPHALT FOUNDATIONS. USE THE ANCHORAGE SPECIFIED BELOW DEPENDING ON THE FOUNDATION AT THE JOB SITE. REFERENCE UNIVERSAL TAU-II FOUNDATION DRAWINGS FOR FURTHER DETAIL.

1.) CONCRETE PAD

FOUNDATION: MINIMUM 6 IN. [150 mm] REINFORCED PCC PAD OR 8 IN. [200 mm] NONREINFORCED PCC PAD

ANCHORAGE: 3/4 IN. [20 mm] X 8 $\frac{1}{4}$ IN. [210 mm] GALVANIZED ANCHOR WITH 6 IN. [150 mm] EMBEDMENT

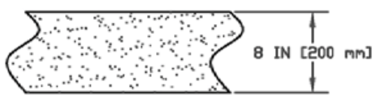
2.) ASPHALT OVER SUBBASE

FOUNDATION: MINIMUM 6 IN [150 mm] AC OVER 6 IN. [150 mm] COMPACTED DGA SUBBASE

ANCHORAGE: 3/4 IN. [20 mm] X 18 IN. [460 mm] GALVANIZED ANCHORS WITH 16 IN. [410 mm] EMBEDMENT

ASPHALT ANCHORING KIT REQUIRED

3.) ASPHALT ONLY

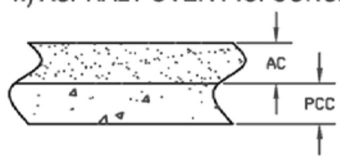


FOUNDATION: MINIMUM 8 IN. [200 mm] AC

ANCHORAGE: 3/4 IN. [20 mm] X 18 IN. [460 mm] GALVANIZED ANCHORS WITH 16 IN. [410 mm] EMBEDMENT

ASPHALT ANCHORING KIT REQUIRED

4.) ASPHALT OVER P.C. CONCRETE

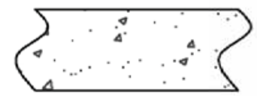


FOUNDATION: AC OVER PCC.

ANCHORAGE: 3/4 IN. [20 mm] GALVANIZED ANCHORS WITH MINIMUM 6 IN. [150 mm] EMBEDMENT IN PCC - ASPHALT ANCHORING KIT NOT REQUIRED
OR
IF 6 IN. [150 mm] EMBEDMENT IN PCC IS NOT POSSIBLE USE 3/4 IN. [20 mm] X 18 IN. [460 mm] GALVANIZED ANCHORS WITH 16 IN. [410 mm] EMBEDMENT - ASPHALT ANCHORING KIT REQUIRED

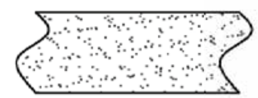
MATERIAL SPECIFICATIONS

PORTLAND CEMENT CONCRETE (PCC)



STONE AGGREGATE CONCRETE MIX, 4,000 PSI [28 MPa] MINIMUM COMPRESSIVE STRENGTH (SAMPLING PER ASTM C31-84 OR ASTM C42-84A, TESTING PER ASTM C39-84)

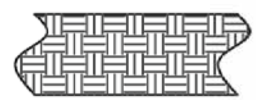
ASPHALTIC CONCRETE (AC)



AR-4000 A.C. (PER ASTM D3381 '83) .75" MAXIMUM, MEDIUM (TYPE A OR B) AGGREGATE

SIEVE SIZE	% PASSING
1"	100
3/4"	95-100
3/8"	65-80
No. 4	49-54
No. 8	36-40
No. 30	18-21
No. 200	3-8

COMPACTED SUBBASE (DGA)



6 IN. [150 mm] MINIMUM DEPTH, 95% COMPACTION, CLASS 2 AGGREGATE

SIEVE SIZE	% PASSING
3"	100
2 1/2"	90-100
No. 4	40-90
No. 200	0-25

REV.	CHANGES	DATE	BY
A	SEE ECN 00589	03/02/04	GAD

REQ'D	NEXT ASSY.	ITEM

SCALE: FULL

	DATE	INIT.
DRAWN BY	01/09/04	GAD
APPR'D BY		JSM

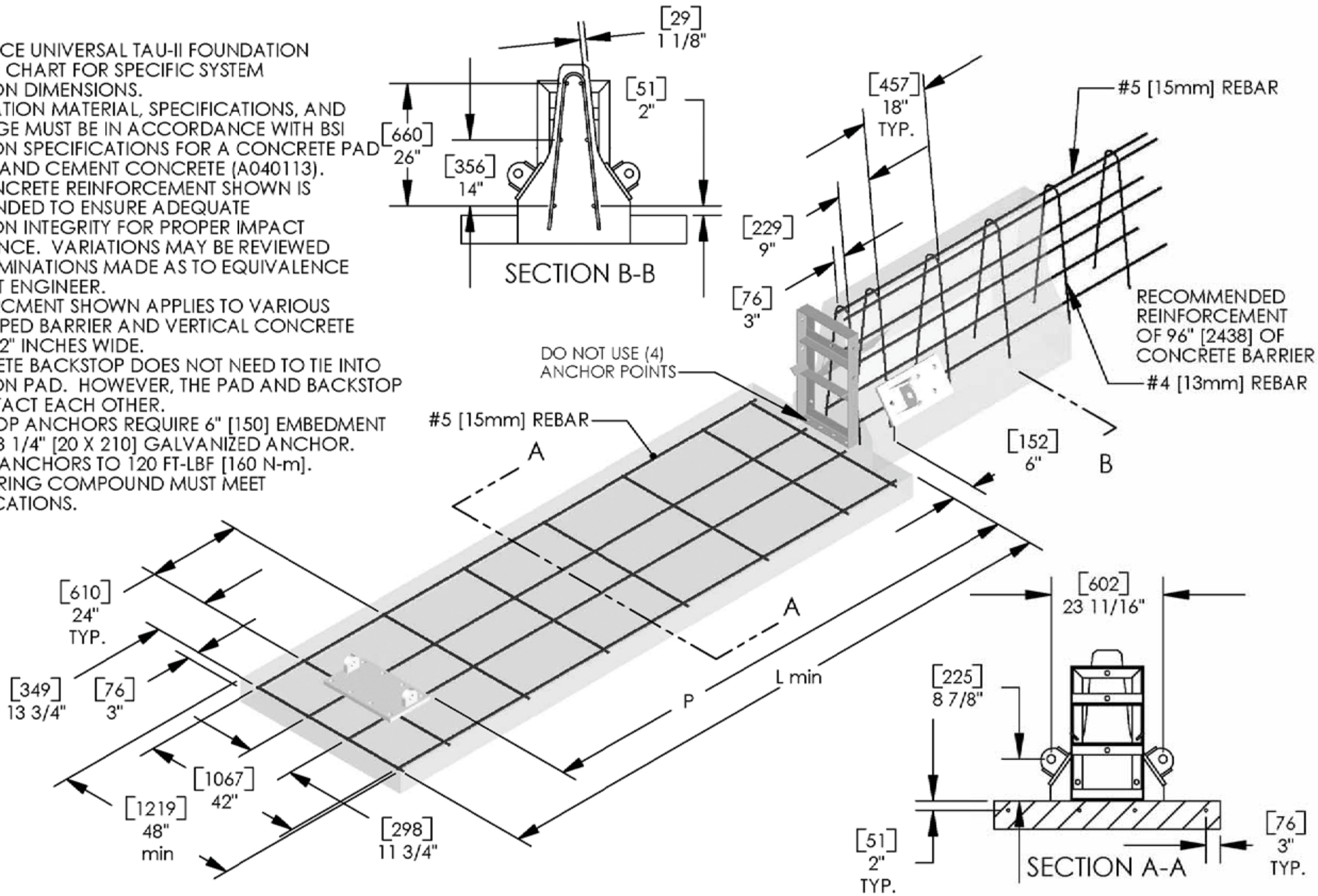
Standard Tolerance
Angular ± 1/2°
Fractional ± 1/16
Dec .XXX= ± .010
Dec .XX= ± .030

TITLE : FOUNDATION SPECIFICATIONS

MODEL	DRAWING NUMBER	REV.
	A040113	A

NOTES:

1.) REFERENCE UNIVERSAL TAU-II FOUNDATION DIMENSION CHART FOR SPECIFIC SYSTEM FOUNDATION DIMENSIONS.
2.) FOUNDATION MATERIAL, SPECIFICATIONS, AND ANCHORAGE MUST BE IN ACCORDANCE WITH BSI FOUNDATION SPECIFICATIONS FOR A CONCRETE PAD AND PORTLAND CEMENT CONCRETE (A040113).
3.) THE CONCRETE REINFORCEMENT SHOWN IS RECOMMENDED TO ENSURE ADEQUATE FOUNDATION INTEGRITY FOR PROPER IMPACT PERFORMANCE. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO EQUIVALENCE BY PROJECT ENGINEER.
4.) REINFORCMENT SHOWN APPLIES TO VARIOUS SAFETY SHAPED BARRIER AND VERTICAL CONCRETE UP TO 15 1/2" INCHES WIDE.
5.) CONCRETE BACKSTOP DOES NOT NEED TO TIE INTO FOUNDATION PAD. HOWEVER, THE PAD AND BACKSTOP MUST CONTACT EACH OTHER.
6.) BACKSTOP ANCHORS REQUIRE 6" [150] EMBEDMENT FOR 3/4" X 8 1/4" [20 X 210] GALVANIZED ANCHOR.
7.)TORQUE ANCHORS TO 120 FT-LBF [160 N-m].
8.) ANCHORING COMPOUND MUST MEET BSI SPECIFICATIONS.



REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM
				1	B010703	1

SCALE: 1:30

	DATE	INIT.
DRAWN BY	01/07/04	GAD
APPR'D BY		JSM

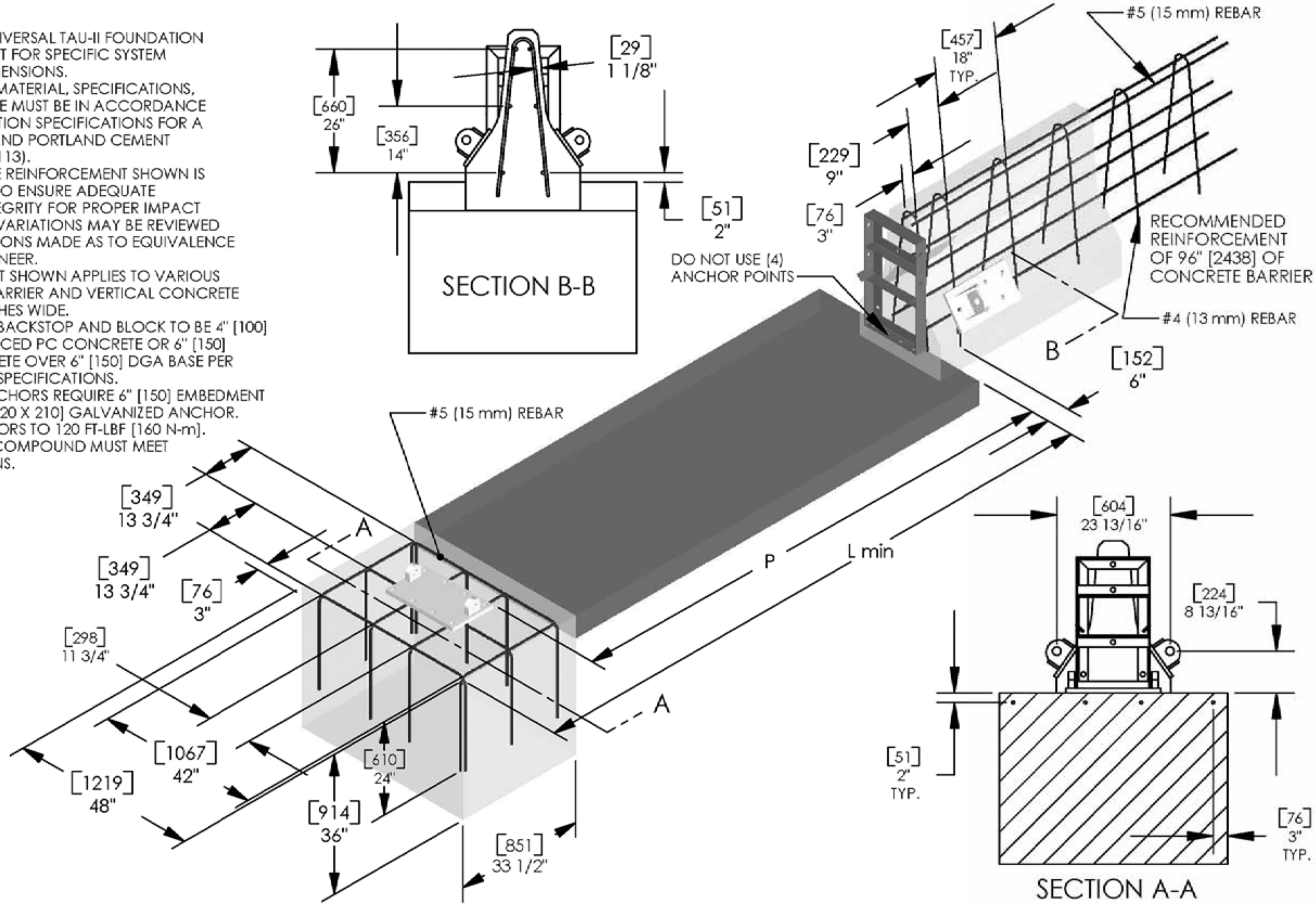
Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. . XXX= +/- .010
Dec. . XX= +/- .030

TITLE :
UNIVERSAL TAU-II FOUNDATION,
P.C.B. BACKSTOP

MODEL	DRAWING NUMBER	REV.
	A040105	

NOTES:

1.) REFERENCE UNIVERSAL TAU-II FOUNDATION DIMENSION CHART FOR SPECIFIC SYSTEM FOUNDATION DIMENSIONS.
2.) FOUNDATION MATERIAL, SPECIFICATIONS, AND ANCHORAGE MUST BE IN ACCORDANCE WITH BSI FOUNDATION SPECIFICATIONS FOR A CONCRETE PAD AND PORTLAND CEMENT CONCRETE (A040113).
3.) THE CONCRETE REINFORCEMENT SHOWN IS RECOMMENDED TO ENSURE ADEQUATE FOUNDATION INTEGRITY FOR PROPER IMPACT PERFORMANCE. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO EQUIVALENCE BY PROJECT ENGINEER.
4.) REINFORCMENT SHOWN APPLIES TO VARIOUS SAFETY SHAPED BARRIER AND VERTICAL CONCRETE UP TO 15 1/2" INCHES WIDE.
5.) PAD BETWEEN BACKSTOP AND BLOCK TO BE 4" [100] MIN NONREINFORCED PC CONCRETE OR 6" [150] ASPHALTIC CONRETE OVER 6" [150] DGA BASE PER BSI FOUNDATION SPECIFICATIONS.
6.) BACKSTOP ANCHORS REQUIRE 6" [150] EMBEDMENT FOR 3/4" X 8 1/4" [20 X 210] GALVANIZED ANCHOR.
7.)TORQUE ANCHORS TO 120 FT-LBF [160 N-m].
8.) ANCHORING COMPOUND MUST MEET BSI SPECIFICATIONS.

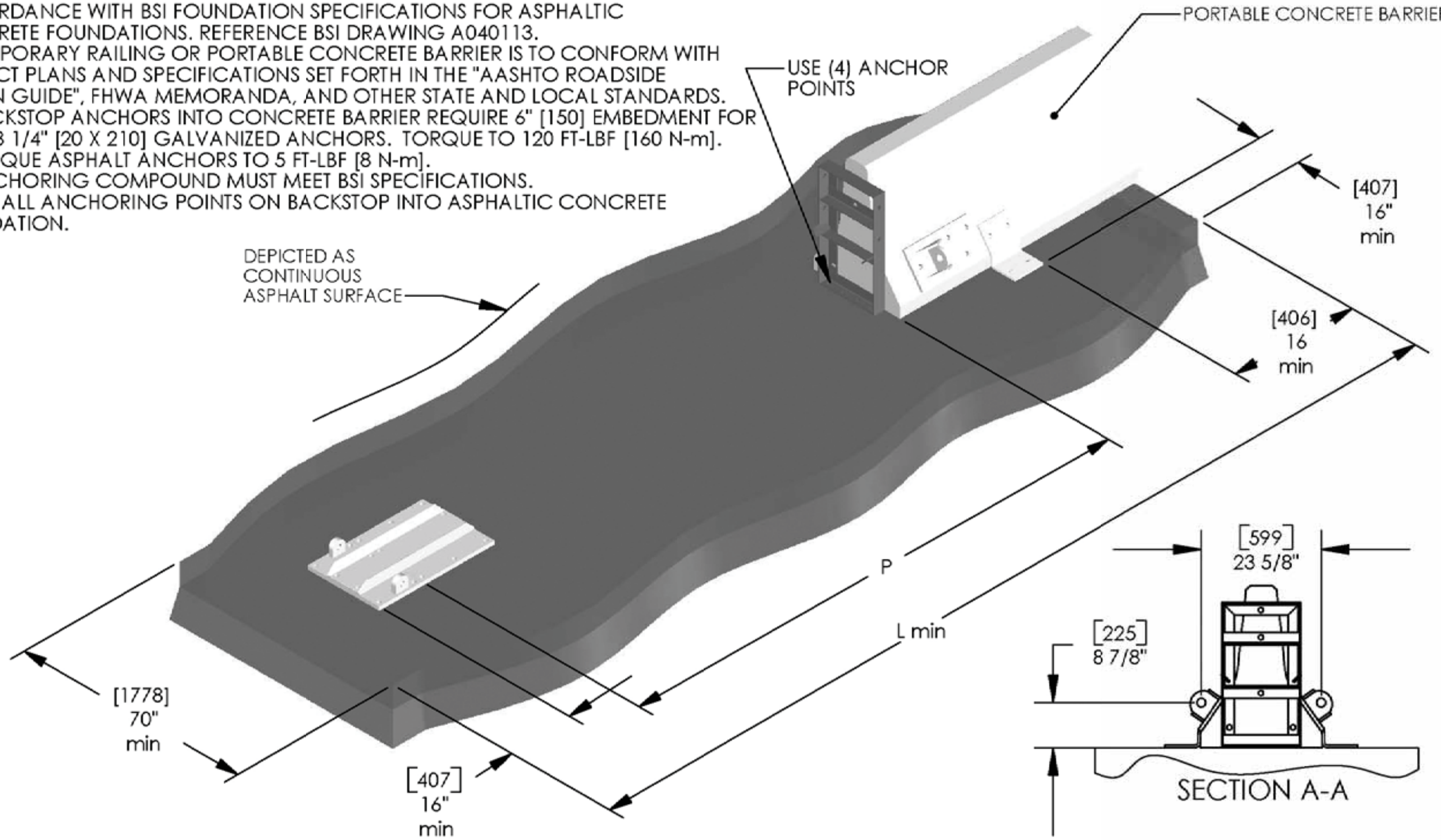


						SCALE: 1:30	Standard Tolerance Angular +/- 1/2 Deg. Fractional +/- 1/16 Dec. . XXX= +/- .010 Dec. . XX= +/- .030
						DRAWN BY 01/12/04 GAD; APPR'D BY JSM (DATE / INIT.)	
						TITLE : UNIVERSAL TAU-II FOUNDATION, P.C.B. BACKSTOP - PCC BLOCK	MODEL / DRAWING NUMBER A040117 / REV.
			1		1		
REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM	

BARRIER SYSTEMS

NOTES:

1.) REFERENCE UNIVERSAL TAU-II FOUNDATION DIMENSION CHART FOR SPECIFIC SYSTEM FOUNDATION DIMENSIONS.
2.) FOUNDATION MATERIAL, SPECIFICATIONS, AND ANCHORAGE MUST BE IN ACCORDANCE WITH BSI FOUNDATION SPECIFICATIONS FOR ASPHALTIC CONCRETE FOUNDATIONS. REFERENCE BSI DRAWING A040113.
3.) TEMPORARY RAILING OR PORTABLE CONCRETE BARRIER IS TO CONFORM WITH PROJECT PLANS AND SPECIFICATIONS SET FORTH IN THE "AASHTO ROADSIDE DESIGN GUIDE", FHWA MEMORANDA, AND OTHER STATE AND LOCAL STANDARDS.
4.) BACKSTOP ANCHORS INTO CONCRETE BARRIER REQUIRE 6" [150] EMBEDMENT FOR 3/4" X 8 1/4" [20 X 210] GALVANIZED ANCHORS. TORQUE TO 120 FT-LBF [160 N-m].
5.) TORQUE ASPHALT ANCHORS TO 5 FT-LBF [8 N-m].
6.) ANCHORING COMPOUND MUST MEET BSI SPECIFICATIONS.
7.) USE ALL ANCHORING POINTS ON BACKSTOP INTO ASPHALTIC CONCRETE FOUNDATION.



REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM
				1	B010708	1

SCALE: 1:30

	DATE	INIT.
DRAWN BY	1/8/04	GAD
APPR'D BY		JSM

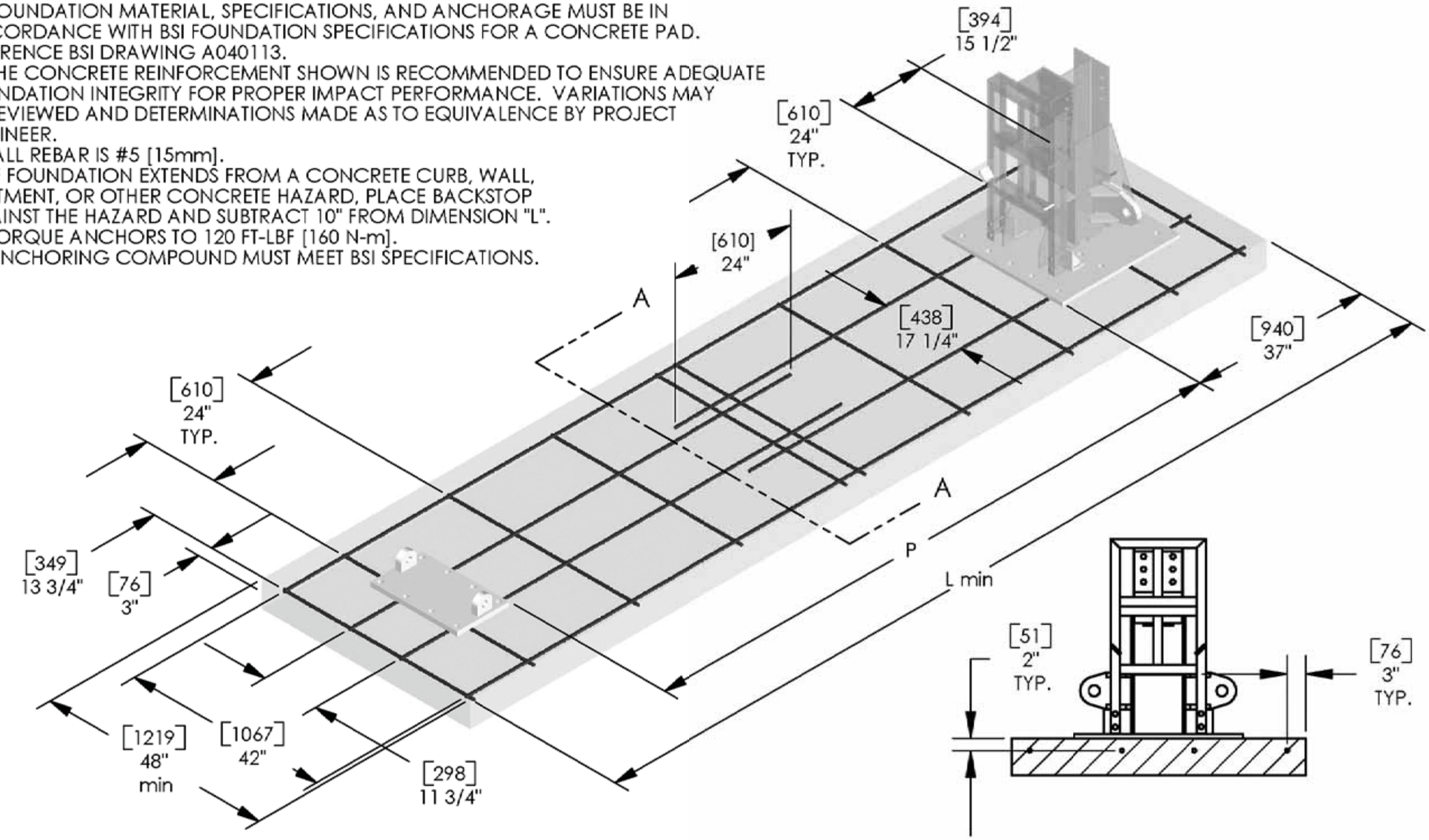
Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. . XXX= +/- .010
Dec. . XX= +/- .030

TITLE : UNIVERSAL TAU-II FOUNDATION, ASPHALT WITH PCB BACKSTOP

MODEL	DRAWING NUMBER	REV.
	A040112	

NOTES:

1.) REFERENCE UNIVERSAL TAU-II FOUNDATION DIMENSION CHART FOR SPECIFIC SYSTEM FOUNDATION DIMENSIONS.
2.) FOUNDATION MATERIAL, SPECIFICATIONS, AND ANCHORAGE MUST BE IN ACCORDANCE WITH BSI FOUNDATION SPECIFICATIONS FOR A CONCRETE PAD. REFERENCE BSI DRAWING A040113.
3.) THE CONCRETE REINFORCEMENT SHOWN IS RECOMMENDED TO ENSURE ADEQUATE FOUNDATION INTEGRITY FOR PROPER IMPACT PERFORMANCE. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO EQUIVALENCE BY PROJECT ENGINEER.
4.) ALL REBAR IS #5 [15mm].
5.) IF FOUNDATION EXTENDS FROM A CONCRETE CURB, WALL, ABUTMENT, OR OTHER CONCRETE HAZARD, PLACE BACKSTOP AGAINST THE HAZARD AND SUBTRACT 10" FROM DIMENSION "L".
6.) TORQUE ANCHORS TO 120 FT-LBF [160 N-m].
7.) ANCHORING COMPOUND MUST MEET BSI SPECIFICATIONS.



				1	B010708	1
REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM

SCALE: 1:24

	DATE	INIT.
DRAWN BY	01/08/04	GAD
APPR'D BY		JSM

Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. XXX= +/- .010
Dec. XX= +/- .030

SECTION A-A

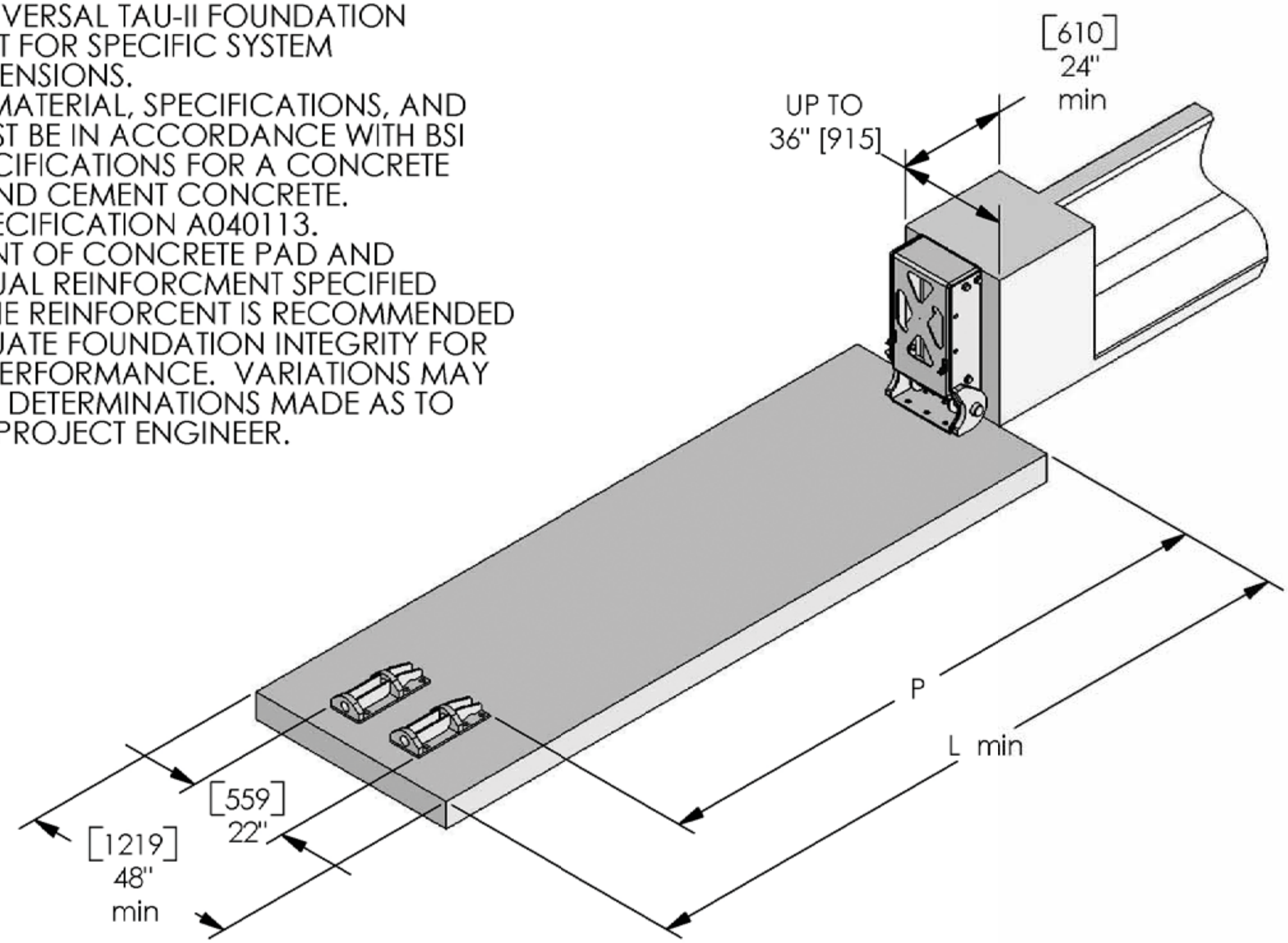
TITLE :
UNIVERSAL TAU-II FOUNDATION, COMPACT BACKSTOP

MODEL	DRAWING NUMBER	REV.
	A040102	

BARRIER SYSTEMS

NOTES:

1.) REFERENCE UNIVERSAL TAU-II FOUNDATION DIMENSION CHART FOR SPECIFIC SYSTEM FOUNDATION DIMENSIONS.
2.) FOUNDATION MATERIAL, SPECIFICATIONS, AND ANCHORAGE MUST BE IN ACCORDANCE WITH BSI FOUNDATION SPECIFICATIONS FOR A CONCRETE PAD AND PORTLAND CEMENT CONCRETE. REFERENCE BSI SPECIFICATION A040113.
3.) REINFORCEMENT OF CONCRETE PAD AND BACKSTOP TO EQUAL REINFORCMENT SPECIFIED IN BSI A040105. THE REINFORCENT IS RECOMMENDED TO ENSURE ADEQUATE FOUNDATION INTEGRITY FOR PROPER IMPACT PERFORMANCE. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO EQUIVALENCE BY PROJECT ENGINEER.



REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM
				1	B040239	1

SCALE: 1:30

	DATE	INIT.
DRAWN BY	04/28/04	GAD
APPR'D BY		OSD

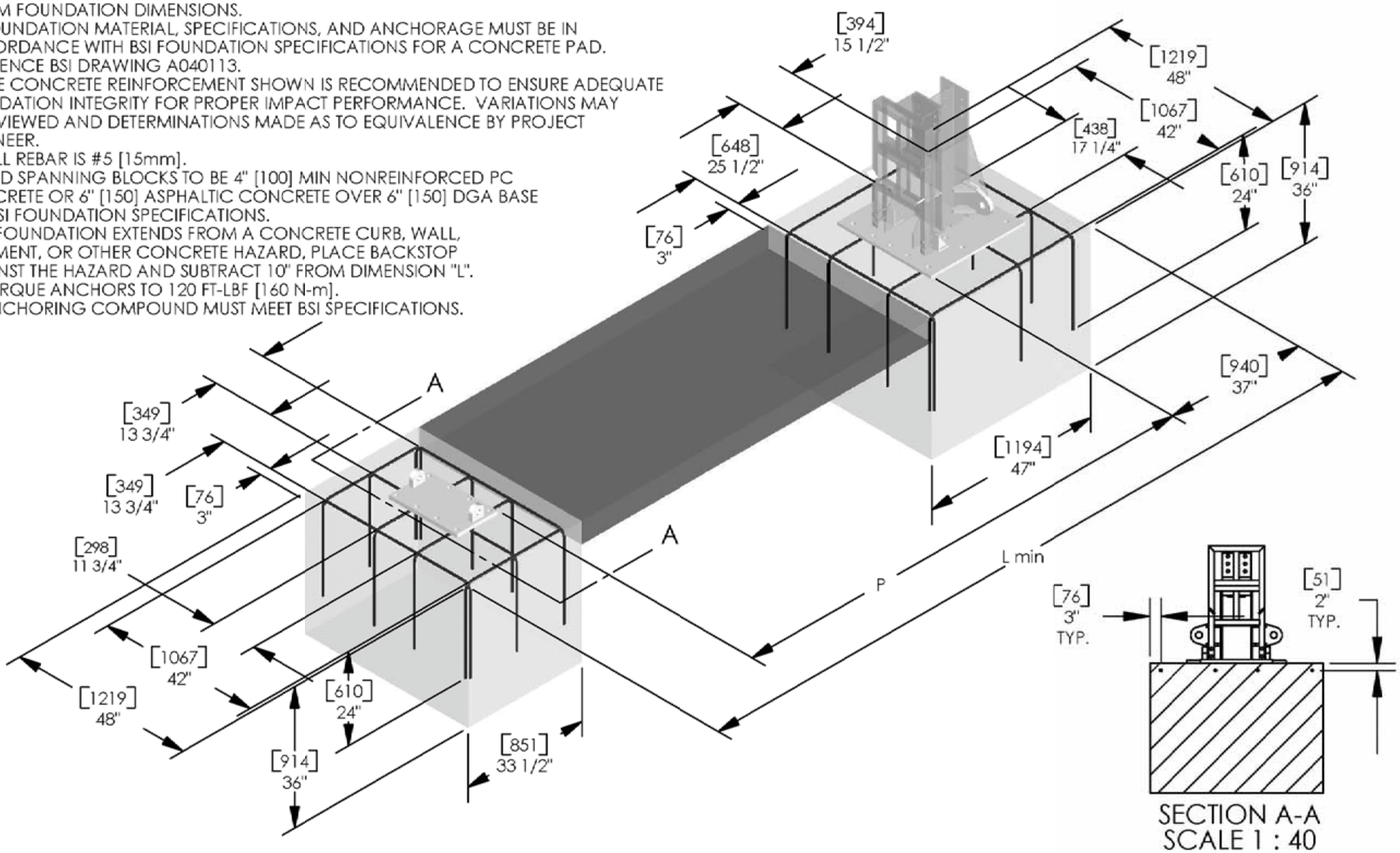
Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. . XXX= +/- .010
Dec. . XX= +/- .030

TITLE :UNIVERSAL TAU-II FOUNDATION, FLUSH MOUNT BACKSTOP - PCC PAD

MODEL	DRAWING NUMBER	REV.
	A040420	

NOTES:

1.) REFERENCE UNIVERSAL TAU-II FOUNDATION DIMENSION CHART FOR SPECIFIC SYSTEM FOUNDATION DIMENSIONS.
2.) FOUNDATION MATERIAL, SPECIFICATIONS, AND ANCHORAGE MUST BE IN ACCORDANCE WITH BSI FOUNDATION SPECIFICATIONS FOR A CONCRETE PAD. REFERENCE BSI DRAWING A040113.
3.) THE CONCRETE REINFORCEMENT SHOWN IS RECOMMENDED TO ENSURE ADEQUATE FOUNDATION INTEGRITY FOR PROPER IMPACT PERFORMANCE. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO EQUIVALENCE BY PROJECT ENGINEER.
4.) ALL REBAR IS #5 [15mm].
5.) PAD SPANNING BLOCKS TO BE 4" [100] MIN NONREINFORCED PC CONCRETE OR 6" [150] ASPHALTIC CONCRETE OVER 6" [150] DGA BASE PER BSI FOUNDATION SPECIFICATIONS.
5.) IF FOUNDATION EXTENDS FROM A CONCRETE CURB, WALL, ABUTMENT, OR OTHER CONCRETE HAZARD, PLACE BACKSTOP AGAINST THE HAZARD AND SUBTRACT 10" FROM DIMENSION "L".
6.) TORQUE ANCHORS TO 120 FT-LBF [160 N-m].
7.) ANCHORING COMPOUND MUST MEET BSI SPECIFICATIONS.



REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM

SCALE: 1:30

	DATE	INIT.
DRAWN BY	01/12/04	GAD
APPR'D BY		JSM

Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. . XXX= +/- .010
Dec. . XX= +/- .030

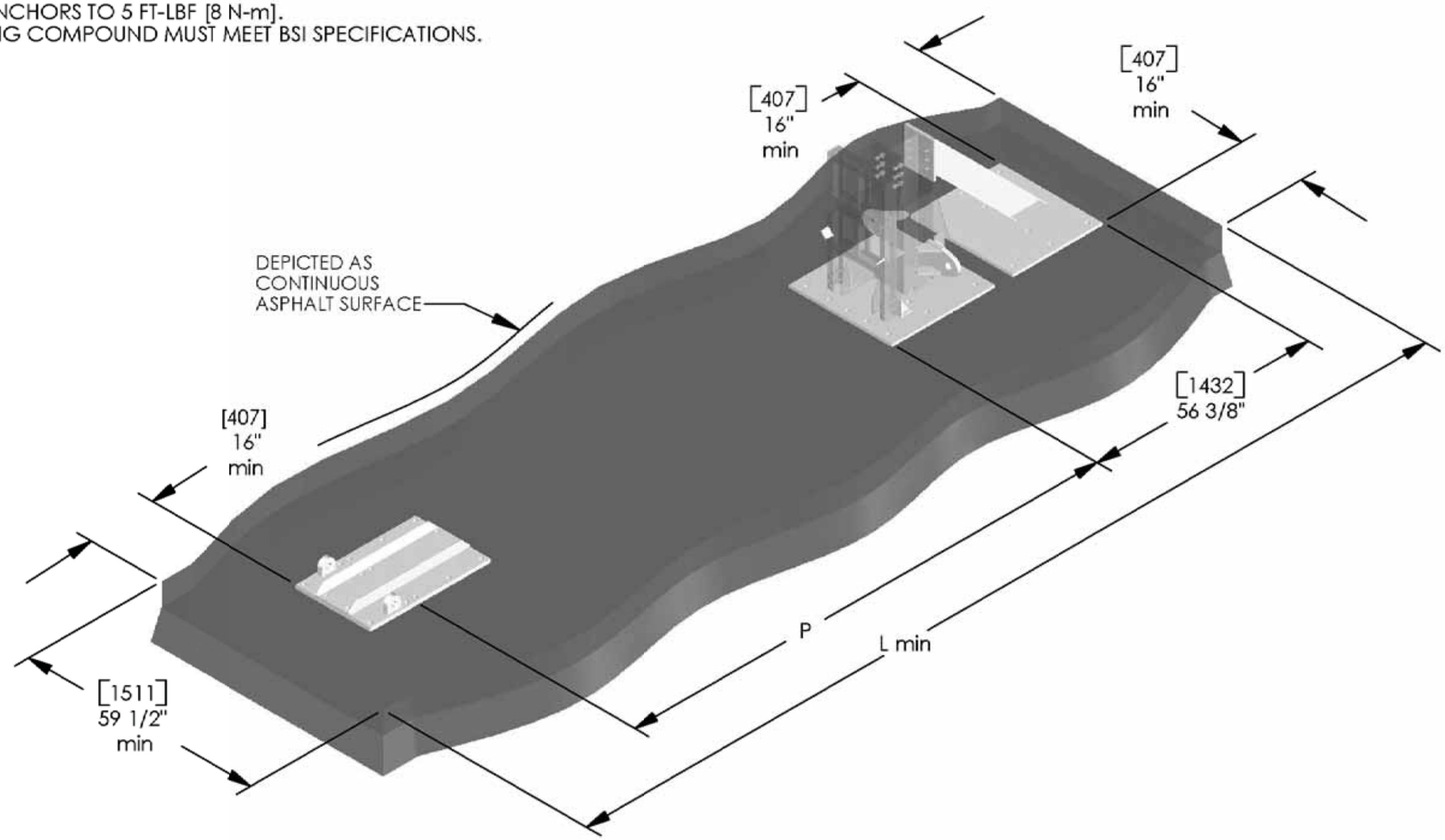
TITLE :
UNIVERSAL TAU-II FOUNDATION, COMPACT BACKSTOP, PCC BLOCKS

MODEL	DRAWING NUMBER	REV.
	A040115	

BARRIER SYSTEMS

NOTES:

1.) REFERENCE UNIVERSAL TAU-II FOUNDATION DIMENSION CHART FOR SPECIFIC SYSTEM FOUNDATION DIMENSIONS.
2.) FOUNDATION MATERIAL, SPECIFICATIONS, AND ANCHORAGE MUST BE IN ACCORDANCE WITH BSI FOUNDATION SPECIFICATIONS FOR ASPHALTIC CONCRETE FOUNDATIONS. REFERENCE BSI DRAWING A040113.
3.) TORQUE ANCHORS TO 5 FT-LBF [8 N-m].
4.) ANCHORING COMPOUND MUST MEET BSI SPECIFICATIONS.



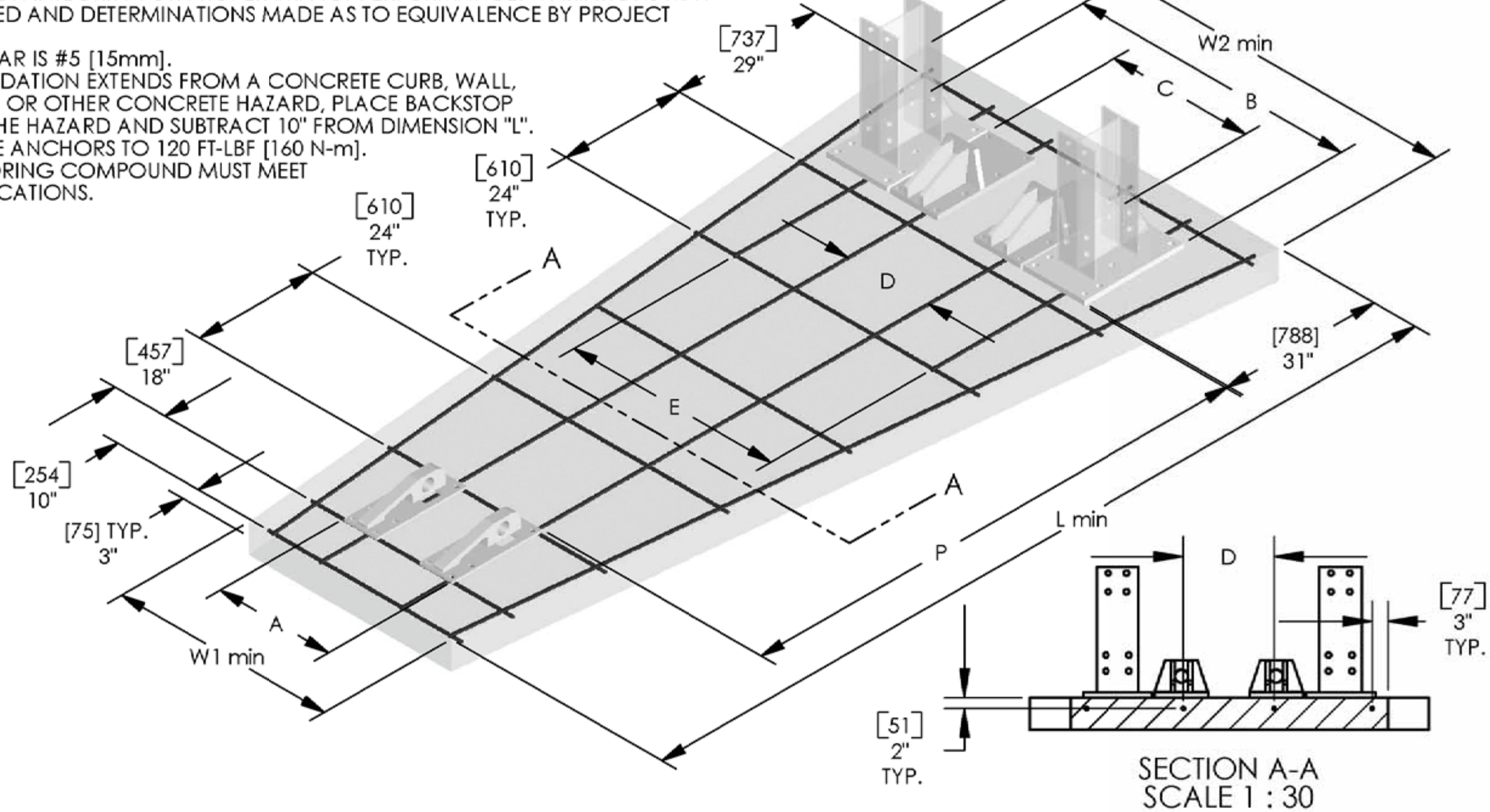
							SCALE: 1:30
							DATE / INIT. — DRAWN BY 01/08/04 GAD
							APPR'D BY JSM
				1	B010708	1	TITLE : UNIVERSAL TAU-II FOUNDATION, ASPHALT WITH COMPACT BACKSTOP
REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM	

Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. XXX= +/- .010
Dec. XX= +/- .030

MODEL	DRAWING NUMBER	REV.
	A040110	

NOTES:

1.) REFERENCE UNIVERSAL TAU-II FOUNDATION DIMENSION CHART FOR SPECIFIC SYSTEM FOUNDATION DIMENSIONS.
2.) FOUNDATION MATERIAL, SPECIFICATIONS, AND ANCHORAGE MUST BE IN ACCORDANCE WITH BSI FOUNDATION SPECIFICATIONS FOR A CONCRETE PAD. REFERENCE BSI DRAWING A040113.
3.) THE CONCRETE REINFORCEMENT SHOWN IS RECOMMENDED TO ENSURE ADEQUATE FOUNDATION INTEGRITY FOR PROPER IMPACT PERFORMANCE. VARIATIONS MAY BE REVIEWED AND DETERMINATIONS MADE AS TO EQUIVALENCE BY PROJECT ENGINEER.
4.) ALL REBAR IS #5 [15mm].
5.) IF FOUNDATION EXTENDS FROM A CONCRETE CURB, WALL, ABUTMENT, OR OTHER CONCRETE HAZARD, PLACE BACKSTOP AGAINST THE HAZARD AND SUBTRACT 10" FROM DIMENSION "L".
6.) TORQUE ANCHORS TO 120 FT-LBF [160 N-m].
7.) ANCHORING COMPOUND MUST MEET BSI SPECIFICATIONS.



				1	B033000	1
REV.	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM

SCALE: 1:24

	DATE	INIT.
DRAWN BY	01/07/04	GAD
APPR'D BY		JSM

Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. . XXX= +/- .010
Dec. . XX= +/- .030

TITLE :
UNIVERSAL TAU-II FOUNDATION, WIDE FLANGE BACKSTOP

MODEL	DRAWING NUMBER	REV.
	A040108	

UNIVERSAL TAU-II FOUNDATION DIMENSIONS

US STANDARD UNITS - INCHES

SYSTEM WIDTH (IN)	SYSTEM SPEED CAPACITY (MPH) 30	35	40 TL-2	50	53	55	60 TL-3	65	70	72	75	DRAWING NUMBER
UP TO 30" PCB BACKSTOP	30T050PBC	30T060PBC	30T070PBC	30T080PBC	30T085PBC	30T090PBC	30T100PBC	30T105PBC	30T110PBC	30T115PBC	30T120PBC	A040105 A040117
	30T050PYC	30T060PYC	30T070PYC	30T080PYC	30T085PYC	30T090PYC	30T100PYC	30T105PYC	30T110PYC	30T115PYC	30T120PYC	
L (in)	85 1/2	119 1/2	154	188	222	256	290 1/2	324 1/2	358 1/2	392 1/2	426 1/2	
P (in)	62 3/4	96 7/8	131	165 1/8	199 1/4	233 3/8	267 1/2	301 1/2	335 3/4	369 7/8	404	
UP TO 30" COMPACT BACKSTOP	30T050CBC	30T060CBC	30T070CBC	30T080CBC	30T085CBC	30T090CBC	30T100CBC	30T105CBC	30T110CBC	30T115CBC	30T120CBC	A040102 A040115
	30T050CYC	30T060CYC	30T070CYC	30T080CYC	30T085CYC	30T090CYC	30T100CYC	30T105CYC	30T110CYC	30T115CYC	30T120PYC	
L (in)	115 1/2	149 1/2	183 1/2	217 1/2	252	286	320	354	388 1/2	422 1/2	456 1/2	
P (in)	55 1/2	89 5/8	123 3/4	157 7/8	192	226 1/8	260 1/4	294 1/4	328 1/2	362 5/8	396 3/4	
UP TO 30" ASPHALT PCB BACKSTOP	30T050PBA	30T060PBA	30T070PBA	30T080PBA	30T085PBA	30T090PBA	30T100PBA	30T105PBA	30T110PBA	30T115PBA	30T120PBA	A040112
	30T050PYA	30T060PYA	30T070PYA	30T080PYA	30T085PYA	30T090PYA	30T100PYA	30T105PYA	30T110PYA	30T115PYA	30T120PYA	
L (in)	139 3/4	173 3/4	208 1/4	242 1/4	276 1/4	310 1/4	344 3/4	378 3/4	412 3/4	446 3/4	480 3/4	
P (in)	62 3/4	96 7/8	131	165 1/8	199 1/4	233 3/8	267 1/2	301 1/2	335 3/4	369 7/8	404	
UP TO 30" ASPHALT COMPACT BACKSTOP	30T050CBA	30T060CBA	30T070CBA	30T080CBA	30T085CBA	30T090CBA	30T100CBA	30T105CBC	30T110CBA	30T115CBA	30T120CBA	A040110
	30T050CYA	30T060CYA	30T070CYA	30T080CYA	30T085CYA	30T090CYA	30T100CYA	30T105CYA	30T110CYA	30T115CYA	30T120CYA	
L (in)	156 1/2	190 1/2	224 1/2	258 1/2	293	327	361	394	429 1/2	463 1/2	497 1/2	
P (in)	55 1/2	89 5/8	123 3/4	157 7/8	192	226 1/8	260 1/4	294 1/4	328 1/2	362 5/8	396 3/4	
36" PCB BACKSTOP	36T050PBC	36T060PBC	36T070PBC	36T080PBC	30T085PBC	36T090PBC	36T100PBC	36T105PBC	36T110PBC	36T115PBC	36T120PBC	A040105 A040117
	36T050PYC	36T060PYC	36T070PYC	36T080PYC	30T085PYC	36T090PYC	36T100PYC	36T105PYC	36T110PYC	36T115PYC	36T120PYC	
L (in)	85 1/2	119 1/2	154	188	222	256	290 1/2	324 1/5	358 1/2	392 1/2	426 1/2	
P (in)	62 3/4	96 7/8	131	165 1/8	199 1/4	233 3/8	267 1/2	301 1/5	335 3/4	369 7/8	404	
36" COMPACT BACKSTOP	36T050CBC	36T060CBC	36T070CBC	36T080CBC	36T085CBC	36T090CBC	36T100CBC	36T105CBC	36T110CBC	36T115CBC	36T120CBC	A040102 A040115
	36T050CYC	36T060CYC	36T070CYC	36T080CYC	36T085CYC	36T090CYC	36T100CYC	36T105CYC	36T110CYC	36T115CYC	36T120CYC	
L (in)	115 1/2	149 1/2	183 1/2	217 1/2	252	286	320	354	388 1/2	422 1/2	456 1/2	
P (in)	55 1/2	89 5/8	123 3/4	157 7/8	192	226 1/8	260 1/4	294 1/4	328 1/2	362 5/8	396 3/4	
36" ASPHALT PCB BACKSTOP	36T050PBA	36T060PBA	36T070PBA	36T080PBA	36T085PBA	36T090PBA	36T100PBA	36T105PBA	36T110PBA	36T115PBA	36T120PBA	A040112
	36T050PYA	36T060PYA	36T070PYA	36T080PYA	36T085PYA	36T090PYA	36T100PYA	36T105PYA	36T110PYA	36T115PYA	36T120PYA	
L (in)	139 3/4	173 3/4	208 1/4	242 1/4	276 1/4	310 1/4	344 3/4	378 3/4	412 3/4	446 3/4	480 3/4	
P (in)	62 3/4	96 7/8	131	165 1/8	199 1/4	233 3/8	267 1/2	301 1/4	335 3/4	369 7/8	404	
36" ASPHALT COMPACT BACKSTOP	36T050CBA	36T060CBA	36T070CBA	36T080CBA	36T085CBA	36T090CBA	36T100CBA	36T105CBA	36T110CBA	36T115CBA	36T120CBA	A040110
	36T050CBA	36T060CYA	36T070CYA	36T080CYA	36T085CYA	36T090CYA	36T100CYA	36T105CYA	36T110CYA	36T115CYA	36T120CYA	
L (in)	156 1/2	190 1/2	224 1/2	258 1/2	293	327	361	394	429 1/2	463 1/2	497 1/2	
P (in)	55 1/2	89 5/8	123 3/4	157 7/8	192	226 1/8	260 1/4	294 1/4	328 1/2	362 5/8	396 3/4	
UP TO 36" PCC PAD FLUSH MOUNT BACKSTOP	36T050FBC	36T060FBC	36T070FBC	36T080FBC	36T085FBC	36T090FBC	36T100FBC	36T105FBC	36T110FBC	36T115FBC	36T120FBC	A040420
	36T050FYC	36T060FYC	36T070FYC	36T080FYC	36T085FYC	36T090FYC	36T100FYC	36T105CYC	36T110FYC	36T115FYC	36T120FYC	
L (in)	83 1/2	117 1/2	151 1/2	185 1/2	220	254	288	322	356 1/2	390 1/2	424 1/2	
P (in)	59 1/2	93 1/2	127 1/2	161 1/2	196	230	264	298	332 1/2	366 1/2	400 1/2	
42" WF BACKSTOP	42T050WBC	42T060WBC	42T070WBC	42T080WBC		42T090WBC	42T100WBC	42T105WBC	42T110WBC			A040108
	42T050WYC	42T060WYC	42T070WYC	42T080WYC		42T090WYC	42T100WYC	42T105WYC	42T110WYC			
L (in)	125	159	193	227		295	329	363	397			
W1 (in)	44	44	44	44		44	44	44	44			
W2 (in)	51	51	51	51		51	51	51	51			
P (in)	65	99	133	167		235	269	303	337			
A (in)	22	22	22	22		22	22	22	22			
B (in)	31	31	31	31		31	31	31	31			
C (in) *	NA	NA	NA	NA		NA	NA	NA	NA			
D (in)	16	16	16	16		16	16	16	16			
E (in) *	NA	NA	NA	NA		NA	NA	NA	NA			

SYSTEM WIDTH (IN)	SYSTEM SPEED CAPACITY (MPH) 30	35	40 TL-2	50	53	55	60 TL-3	65	70	72	75	DRAWING NUMBER
48" WF BACKSTOP	48T050WBC	48T060WBC	48T070WBC	48T080WBC		48T090WBC	48T100WBC	48T105WBC	48T110WBC			A040108
	48T050WYC	48T060WYC	48T070WYC	48T080WYC		48T090WYC	48T100WYC	48T105WYC	48T110WYC			
L (in)	125	159	193	227		295	329	363	397			
W1 (in)	44	44	44	44		44	44	44	44			
W2 (in)	51	51	51	51		51	51	51	51			
P (in)	65	99	133	167		235	269	303	337			
A (in)	22	22	22	22		22	22	22	22			
B (in)	31	31	31	31		31	31	31	31			
C (in) *	NA	NA	NA	NA		NA	NA	NA	NA			
D (in)	16	16	16	16		16	16	16	16			
E (in) *	NA	NA	NA	NA		NA	NA	NA	NA			
54" WF BACKSTOP	54T050WBC	54T060WBC	54T070WBC	54T080WBC		54T090WBC	54T100WBC	54T105WBC	54T110WBC			A040108
	54T050WYC	54T060WYC	54T070WYC	54T080WYC		54T090WYC	54T100WYC	54T105WYC	54T110WYC			
L (in)	125	159	193	227		295	329	363	397			
W1 (in)	44	44	44	44		44	44	44	44			
W2 (in)	51	51	51	51		51	51	51	51			
P (in)	65	99	133	167		235	269	303	337			
A (in)	22	22	22	22		22	22	22	22			
B (in)	31	31	31	31		31	31	31	31			
C (in) *	NA	NA	NA	NA		NA	NA	NA	NA			
D (in)	16	16	16	16		16	16	16	16			
E (in) *	NA	NA	NA	NA		NA	NA	NA	NA			
60" WF BACKSTOP	60T050WBC	60T060WBC	60T070WBC	60T080WBC		60T090WBC	60T100WBC	60T105WBC	60T110WBC			A040108
	60T050WYC	60T060WYC	60T070WYC	60T080WYC		60T090WYC	60T100WYC	60T105WYC	60T110WYC			
L (in)	125	159	193	227		295	329	363	397			
W1 (in)	44	44	44	44		44	44	44	44			
W2 (in)	51	51	51	51		51	51	51	51			
P (in)	65	99	133	167		235	269	303	337			
A (in)	22	22	22	22		22	22	22	22			
B (in)	31	31	31	31		31	31	31	31			
C (in) *	NA	NA	NA	NA		NA	NA	NA	NA			
D (in)	16	16	16	16		16	16	16	16			
E (in) *	NA	NA	NA	NA		NA	NA	NA	NA			
66" WF BACKSTOP		66T060WBC	66T070WBC	66T080WBC		66T090WBC	66T100WBC	66T105WBC	66T110WBC			A040108
		66T060WYC	66T070WYC	66T080WYC		66T090WYC	66T100WYC	66T106WYC	66T110WYC			
L (in)		125	159	193		261	295	329	363			
W1 (in)		69	44	44		44	44	44	44			
W2 (in)		75	75	75		75	75	75	75			
P (in)		65	99	133		201	235	269	303			
A (in)		48 5/8	22	22		22	22	22	22			
B (in)		54 3/4	54 3/4	54 3/4		54 3/4	54 3/4	54 3/4	54 3/4			
C (in) *		NA	27 3/4	27 3/4		27 3/4	27 3/4	27 3/4	27 3/4			
D (in)		42 5/8	16	16		16	16	16	16			
E (in) *		NA	41 3/4	41 3/4		41 3/4	41 3/4	41 3/4	41 3/4			
72" WF BACKSTOP		72T060WBC	72T070WBC	72T080WBC		72T090WBC	72T100WBC	72T105WBC	72T110WBC			A040108
		72T060WYC	72T070WYC	72T080WYC		72T090WYC	72T100WYC	72T105WYC	72T110WYC			
L (in)		125	159	193		227	295	329	329			
W1 (in)		69	69	44		44	44	44	44			
W2 (in)		75	75	75		75	75	75	75			
P (in)		65	99	133		167	235	269	269			
A (in)		48 5/8	48 5/8	22		22	22	22	22			
B (in)		54 3/4	54 3/4	54 3/4		54 3/4	54 3/4	54 3/4	54 3/4			
C (in) *		NA	NA	27 3/4		27 3/4	27 3/4	27 3/4	27 3/4			
D (in)		42 5/8	42 5/8	16		16	16	16	16			
E (in) *		NA	NA	41 3/4		41 3/4	41 3/4	41 3/4	41 3/4			

SYSTEM WIDTH (IN)	30	35	40 TL-2	50	53	55	60 TL-3	65	70	72	75	DRAWING NUMBER
						SYSTEM SPEED CAPACITY (MPH)						
78" WF BACKSTOP		78T060WBC	78T070WBC	78T080WBC		78T090WBC	78T100WBC	78T105WBC	78T110WBC			A040108
		78T060WYC	78T070WYC	78T080WYC		78T090WYC	78T100WYC	78T105WYC	78T110WYC			
L (in)		125	159	193		227	295	329	329			
W1 (in)		69	69	69		44	44	44	44			
W2 (in)		75	75	75		75	75	75	75			
P (in)		65	99	133		167	235	269	269			
A (in)		48 5/8	48 5/8	48 5/8		22	22	22	22			
B (in)		54 3/4	54 3/4	54 3/4		54 3/4	54 3/4	54 3/4	54 3/4			
C (in) *		NA	NA	NA		27 3/4	27 3/4	27 3/4	27 3/4			
D (in)		42 5/8	42 5/8	42 5/8		16	16	16	16			
E (in) *		NA	NA	NA		41 3/4	41 3/4	41 3/4	41 3/4			
84" WF BACKSTOP			84T070WBC	84T080WBC		84T090WBC	84T100WBC	84T105WBC	84T110WBC			A040108
			84T070WYC	84T080WYC		84T090WYC	84T100WYC	84T105WYC	84T110WYC			
L (in)			159	193		227	295	329	329			
W1 (in)			69	69		69	44	44	44			
W2 (in)			75	75		75	75	75	75			
P (in)			99	133		167	235	269	269			
A (in)			48 5/8	48 5/8		48 5/8	22	22	22			
B (in)			54 3/4	54 3/4		54 3/4	54 3/4	54 3/4	54 3/4			
C (in) *			NA	NA		NA	27 3/4	27 3/4	27 3/4			
D (in)			42 5/8	42 5/8		42 5/8	16	16	16			
E (in) *			NA	NA		NA	41 3/4	41 3/4	41 3/4			
90" WF BACKSTOP			90T070WBC	90T080WBC		90T090WBC	90T100WBC	90T105WBC	90T110WBC			A040108
			90T070WYC	90T080WYC		90T090WYC	90T100WYC	90T105WYC	90T110WYC			
L (in)			159	193		227	295	329	329			
W1 (in)			69	69		69	44	44	44			
W2 (in)			99	99		99	99	99	99			
P (in)			99	133		167	235	269	269			
A (in)			48 5/8	48 5/8		48 5/8	22	22	22			
B (in)			78 5/8	78 5/8		78 5/8	78 5/8	78 5/8	78 5/8			
C (in) *			51 5/8	51 5/8		51 5/8	27 3/4	27 3/4	27 3/4			
D (in)			42 5/8	42 5/8		42 5/8	16	16	16			
E (in) *			65 5/8	65 5/8		65 5/8	65 5/8	65 5/8	65 5/8			
96" WF BACKSTOP			96T070WBC	96T080WBC		96T090WBC	96T100WBC	96T105WBC	96T110WBC			A040108
			96T070WYC	96T080WYC		96T090WYC	96T100WYC	96T105WYC	96T110WYC			
L (in)			159	193		227	295	329	329			
W1 (in)			93	69		69	69	69	44			
W2 (in)			99	99		99	99	99	99			
P (in)			99	133		167	235	269	269			
A (in)			72 5/8	48 5/8		48 5/8	48 5/8	22	22			
B (in)			78 5/8	78 5/8		78 5/8	78 5/8	78 5/8	78 5/8			
C (in) *			NA	51 5/8		51 1/3	51 5/8	27 3/4	27 3/4			
D (in) *			66 5/8	42 5/8		42 5/8	42 5/8	16	16			
E (in) *			NA	65 5/8		65 5/8	65 5/8	65 5/8	65 5/8			
102" WF BACKSTOP									102T110WBC			A040108
									102T110WYC			
L (in)									329			
W1 (in)									69			
W2 (in)									99			
P (in)									269			
A (in)									48 5/8			
B (in)									78 5/8			
C (in) *									51 5/8			
D (in)									42 5/8			
E (in) *									65 5/8			

UNIVERSAL TAU-II FOUNDATION DIMENSIONS

METRIC UNITS - MILLIMETERS

SYSTEM WIDTH (mm)	50	60	70 TL-2	80	85	90	100 TL-3	105	110	115	120	DRAWING NUMBER
	SYSTEM SPEED CAPACITY (KPH)											
UP TO 760mm PCB BACKSTOP	30T050PBC	30T060PBC	30T070PBC	30T080PBC	30T085PBC	30T090PBC	30T100PBC	30T105PBC	30T110PBC	30T115PBC	30T120PBC	A040105 A040117
	30T050PYC	30T060PYC	30T070PYC	30T080PYC	30T085PYC	30T090PYC	30T100PYC	30T105PYC	30T110PYC	30T115PYC	30T120PYC	
L (mm)	2172	3035	3912	4775	5639	6502	7379	8242	9106	9970	10833	
P (mm)	1594	2461	3327	4194	5061	5928	6795	7661	8528	9395	10262	
UP TO 760mm COMPACT BACKSTOP	30T050CBC	30T060CBC	30T070CBC	30T080CBC	30T085CBC	30T090CBC	30T100CBC	30T105CBC	30T110CBC	30T115CBC	30T120CBC	A040102 A040115
	30T050CYC	30T060CYC	30T070CYC	30T080CYC	30T085CYC	30T090CYC	30T100CYC	30T105CYC	30T110CYC	30T115CYC	30T120CYC	
L (mm)	2934	3797	4661	5525	6401	7264	8128	8991	9868	10732	11595	
P (mm)	1410	2276	3143	4010	4877	5744	6610	7477	8344	9211	10077	
UP TO 760mm ASPHALT PCB BACKSTOP	30T050PBA	30T060PBA	30T070PBA	30T080PBA	30T085PBA	30T090PBA	30T100PBA	30T105PBA	30T110PBA	30T115PBA	30T120PBA	A040112
	30T050PYA	30T060PYA	30T070PYA	30T080PYA	30T085PYA	30T090PYA	30T100PYA	30T105PYA	30T110PYA	30T115PYA	30T120PYA	
L (mm)	3550	4413	5290	6153	7017	7880	8757	9620	10484	11347	12211	
P (mm)	1594	2461	3327	4194	5061	5928	6795	7661	8528	9395	10262	
UP TO 760mm ASPHALT COMPACT BACKSTOP	30T050CBA	30T060CBA	30T070CBA	30T080CBA	30T085CBA	30T090CBA	30T100CBA	30T105CBA	30T110CBA	30T115CBA	30T120CBA	A040110
	30T050CYA	30T060CYA	30T070CYA	30T080CYA	30T085CYA	30T090CYA	30T100CYA	30T105CYA	30T110CYA	30T115CYA	30T120CYA	
L (mm)	3975	4839	5702	6566	7442	8306	9169	10033	10909	11773	12637	
P (mm)	1410	2276	3143	4010	4877	5744	6610	7477	8344	9211	10077	
915mm PCB BACKSTOP	36T050PBC	36T060PBC	36T070PBC	36T080PBC	36T085PBC	36T090PBC	36T100PBC	36T105PBC	36T110PBC	36T115PBC	36T120PBC	A040105 A040117
	36T050PYC	33T060PYC	36T070PYC	36T080PYC	36T085PYC	36T090PYC	36T100PYC	36T105PYC	36T110PYC	36T115PYC	36T120PYC	
L (mm)	2172	3035	3912	4775	5639	6502	7379	8242	9106	9970	10833	
P (mm)	1594	2461	3327	4194	5061	5928	6795	7661	8528	9395	10262	
915mm COMPACT BACKSTOP	36T050CBC	36T060CBC	36T070CBC	36T080CBC	36T085CBC	36T090CBC	36T100CBC	36T105CBC	36T110CBC	36T115CBC	36T120CBC	A040102 A040115
	36T050CYC	36T060CYC	36T070CYC	36T080CYC	36T085CYC	36T090CYC	36T100CYC	36T105CYC	36T110CYC	36T115CYC	36T120CYC	
L (mm)	2934	3797	4661	5525	6401	7264	8128	8991	9868	10732	11595	
P (mm)	1410	2276	3143	4010	4877	5744	6610	7477	8344	9211	10077	
915mm ASPHALT PCB BACKSTOP	36T050PBA	36T060PBA	36T070PBA	36T080PBA	36T085PBA	36T090PBA	36T100PBA	36T105PBA	36T110PBA	36T115PBA	36T120PBA	A040112
	36T050PYA	36T060PYA	36T070PYA	36T080PYA	36T085PYA	36T090PYA	36T100PYA	36T105PYA	36T110PYA	36T115PYA	36T120PYA	
L (mm)	3550	4413	5290	6153	7017	7880	8757	9620	10484	11347	12211	
P (mm)	1594	2461	3327	4194	5061	5928	6795	7661	8528	9395	10262	
915mm ASPHALT COMPACT BACKSTOP	36T050CBA	36T060CBA	36T070CBA	36T080CBA	36T085CBA	36T090CBA	36T100CBA	36T105CBA	36T110CBA	36T115CBC	36T120CBC	A040110
	36T050CYA	36T060CYA	36T070CYA	36T080CYA	36T085CYC	36T090CYA	36T100CYA	36T105CBC	36T110CYA	36T115CYA	36T120CYA	
L (mm)	3975	4839	5702	6566	7442	8306	9169	10033	10909	11773	12637	
P (mm)	1410	2276	3143	4010	4877	5744	6610	7477	8344	9211	10077	
UP TO 915mm PCC PAD FLUSH MOUNT BACKSTOP	36T050FBC	36T060FBC	36T070FBC	36T080FBC	36T085FBC	36T090FBC	36T100FBC	36T105FBC	36T110FBC	36T115FBC	36T120FBC	A040420
	36T050FYC	36T060FYC	36T070FYC	36T080FYC	36T085FYC	36T090FYC	36T100FYC	36T105FYC	36T110FYC	36T115FYC	36T120FYC	
L (mm)	2121	2985	3848	4712	5588	6452	7315	8179	9055	9919	10782	
P (mm)	1511	2375	3239	4102	4978	5842	6706	7569	8446	9309	10173	
1070mm WF BACKSTOP	42T050WBC	42T060WBC	42T070WBC	42T080WBC		42T090WBC	42T100WBC	42T105WBC	42T110WBC			A040108
	42T050WYC	42T060WYC	42T070WYC	42T080WYC		42T090WYC	42T100WYC	42T105WYC	42T110WYC			
L (mm)	3175	4039	4902	5766		7493	8357	9220	10084			
W1 (mm)	1118	1118	1118	1118		1118	1118	1118	1118			
W2 (mm)	1295	1295	1295	1295		1295	1295	1295	1295			
P (mm)	1651	2515	3378	4242		5969	6833	7696	8560			
A (mm)	559	559	559	559		559	559	559	559			
B (mm)	787	787	787	787		787	787	787	787			
C (mm)	NA	NA	NA	NA		NA	NA	NA	NA			
D (mm)	406	406	406	406		406	406	406	406			
E (mm)	NA	NA	NA	NA		NA	NA	NA	NA			

BARRIER SYSTEMS

SYSTEM WIDTH (mm)	SYSTEM SPEED CAPACITY (KPH)											DRAWING NUMBER
	50	60	70 TL-2	80	85	90	100 TL-3	105	110	115	120	
1220mm WF BACKSTOP	**48T050WBC**	**48T060WBC**	**48T070WBC**	**48T080WBC**		**48T090WBC**	**48T100WBC**	**48T105WBC**	**48T110WBC**			
	48T050WYC	**48T060WYC**	**48T070WYC**	**48T080WYC**		**48T090WYC**	**48T100WYC**	**48T105WYC**	**48T110WYC**			
L (mm)	3175	4039	4902	5766		7493	8357	9220	10084			
W1 (mm)	1118	1118	1118	1118		1118	1118	118	1118			
W2 (mm)	1295	1295	1295	1295		1295	1295	1295	1295			
P (mm)	1651	2515	3378	4242		5969	6833	7696	8560			A040108
A (mm)	559	559	559	559		559	559	559	559			
B (mm)	787	787	787	787		787	787	787	787			
C (mm)	NA	NA	NA	NA		NA	NA	NA	NA			
D (mm)	406	406	408	406		406	406	406	406			
E (mm)	NA	NA	NA	NA		NA	NA	NA	NA			
1370mm WF BACKSTOP	**54T050WBC**	**54T060WBC**	**54T070WBC**	**54T080WBC**		**54T090WBC**	**54T100WBC**	**54T105WBC**	**54T110WBC**			
	54T050WYC	**54T060WYC**	**54T070WYC**	**54T080WYC**		**54T090WYC**	**54T100WYC**	**54T105WYC**	**54T110WYC**			
L (mm)	3175	4039	4902	5766		7493	8357	9220	10084			
W1 (mm)	1118	1118	1118	1118		1118	1118	118	1118			
W2 (mm)	1295	1295	1295	1295		1295	1295	1295	1295			
P (mm)	1651	2515	3378	4242		5969	6833	7696	8560			A040108
A (mm)	559	559	559	559		559	559	559	559			
B (mm)	787	787	787	787		787	787	785	787			
C (mm)	NA	NA	NA	NA		NA	NA	NA	NA			
D (mm)	408	406	408	406		406	406	406	406			
E (mm)	NA	NA	NA	NA		NA	NA	NA	NA			
1525mm WF BACKSTOP	**60T050WBC**	**60T060WBC**	**60T070WBC**	**60T080WBC**		**60T090WBC**	**60T100WBC**	**60T105WBC**	**60T110WBC**			
	60T050WYC	**60T060WYC**	**60T070WYC**	**60T080WYC**		**60T090WYC**	**60T100WYC**	**60T105WYC**	**60T110WYC**			
L (mm)	3175	4039	4902	5766		7493	8357	9220	10084			
W1 (mm)	1118	1118	1118	1118		1118	1118	118	1118			
W2 (mm)	1295	1295	1295	1295		1295	1295	1295	1295			
P (mm)	1651	2515	3378	4242		5969	6833	7696	8560			A040108
A (mm)	559	559	559	559		559	559	559	559			
B (mm)	787	787	787	787		787	787	787	787			
C (mm)	NA	NA	NA	NA		NA	NA	NA	NA			
D (mm)	406	406	406	406		406	406	406	406			
E (mm)	NA	NA	NA	NA		NA	NA	NA	NA			
1675mm WF BACKSTOP		**66T060WBC**	**66T070WBC**	**66T080WBC**		**66T090WBC**	**66T100WBC**	**66T105WBC**	**66T110WBC**			
		66T060WYC	**66T070WYC**	**66T080WYC**		**66T090WYC**	**66T100WYC**	**66T105WYC**	**66T110WYC**			
L (mm)		3175	4039	4902		6629	7493	8357	9220			
W1 (mm)		1753	1118	1118		1118	1118	1118	1118			
W2 (mm)		1905	1905	1905		1905	1905	1905	1905			
P (mm)		1651	2515	3378		5105	5969	6833	7696			A040108
A (mm)		1235	559	559		559	559	559	559			
B (mm)		1391	1391	1391		1391	1391	1391	1391			
C (mm)		NA	705	705		705	705	705	705			
D (mm)		1083	406	406		406	406	406	406			
E (mm)		NA	1060	1060		1060	1060	1060	1060			
1830mm WF BACKSTOP		**72T060WBC**	**72T070WBC**	**72T080WBC**		**72T090WBC**	**72T100WBC**	**72T105WBC**	**72T110WBC**			
		72T060WYC	**72T070WYC**	**72T080WYC**		**72T090WYC**	**72T100WYC**	**72T105WYC**	**72T110WYC**			
L (mm)		3175	4039	4902		5766	7493	8357	8357			
W1 (mm)		1753	1753	1118		1118	1118	115	1118			
W2 (mm)		1905	1905	1905		1905	1905	1905	1905			
P (mm)		1651	2515	3378		4242	5969	6833	6833			A040108
A (mm)		1235	1235	559		559	559	556	559			
B (mm)		1391	1391	1391		1391	1391	1391	1391			
C (mm)		NA	NA	705		705	705	705	705			
D (mm)		1083	1083	406		406	406	406	406			
E (mm)		NA	NA	1060		1060	1060	1060	1060			

BARRIER SYSTEMS

SYSTEM WIDTH (mm)	50	60	70 TL-2	80	85	90	100 TL-3	105	110	115	120	DRAWING NUMBER
						SYSTEM SPEED CAPACITY (KPH)						
1980mm WF BACKSTOP		78T060WBC	78T070WBC	78T080WBC		78T090WBC	78T100WBC	78T105WBC	78T110WBC			A040108
		78T060WYC	78T070WYC	78T080WYC		78T090WYC	78T100WYC	78T105WYC	78T110WYC			
L (mm)		3175	4039	4902		5766	7493	8357	8357			
W1 (mm)		1753	1753	1753		1118	1118	1118	1118			
W2 (mm)		1905	1905	1905		1905	1905	1905	1905			
P (mm)		1651	2515	3378		4242	5969	6833	6833			
A (mm)		1235	1235	1235		559	559	559	559			
B (mm)		1391	1391	1391		1391	1391	1391	1391			
C (mm)		NA	NA	NA		705	705	705	705			
D (mm)		1083	1083	1083		406	406	406	406			
E (mm)		NA	NA	NA		1060	1060	1060	1060			
2135mm WF BACKSTOP			84T070WBC	84T080WBC		84T090WBC	84T100WBC	84T105WBC	84T110WBC			A040108
			84T070WYC	84T080WYC		84T090WYC	84T100WYC	84T105WYC	84T110WYC			
L (mm)			4039	4902		5766	7493	8357	8357			
W1 (mm)			1753	1753		1753	1118	118	1118			
W2 (mm)			1905	1905		1905	1905	1905	1905			
P (mm)			2515	3378		4242	5969	6833	6833			
A (mm)			1235	1235		1235	559	559	559			
B (mm)			1391	1391		1391	1391	1391	1391			
C (mm)			NA	NA		NA	705	705	705			
D (mm)			1083	1083		1083	406	406	406			
E (mm)			NA	NA		NA	1060	1060	1060			
2285mm WF BACKSTOP			90T070WBC	90T080WBC		90T090WBC	90T100WBC	90T105WBC	90T110WBC			A040108
			90T070WYC	90T080WYC		90T090WYC	90T100WYC	90T105WYC	90T110WYC			
L (mm)			4039	4902		5766	7493	8357	8357			
W1 (mm)			1753	1753		1753	1118	1118	1118			
W2 (mm)			2515	2515		2515	2515	2515	2515			
P (mm)			2515	3378		4242	5969	6633	6833			
A (mm)			1235	1235		1235	559	559	559			
B (mm)			1997	1997		1997	1997	1997	1997			
C (mm)			1311	1311		1311	705	705	705			
D (mm)			1083	1083		1083	406	406	406			
E (mm)			1667	1667		1667	1667	1667	1667			
2440mm WF BACKSTOP			96T070WBC	96T080WBC		96T090WBC	96T100WBC	96T105WBC	96T110WBC			A040108
			96T070WYC	96T080WYC		96T090WYC	96T100WYC	96T105WYC	96T110WYC			
L (mm)			4039	4902		5766	7493	8357	8357			
W1 (mm)			2362	1753		1753	1753	118	1118			
W2 (mm)			2515	2515		2515	2515	2515	2515			
P (mm)			2515	3378		4242	5969	6833	6833			
A (mm)			1845	1235		1235	1235	559	559			
B (mm)			1997	1997		1997	1997	1997	1997			
C (mm)			NA	1311		1305	1311	705	705			
D (mm)			1692	1083		1083	1083	406	406			
E (mm)			NA	1667		1667	1667	1667	1667			
2590mm WF BACKSTOP									102T110WBC			A040108
									102T110WYC			
L (mm)									8357			
W1 (mm)									1753			
W2 (mm)									2515			
P (mm)									6833			
A (mm)									1235			
B (mm)									1997			
C (mm)									1311			
D (mm)									1083			
E (mm)									1667			

APPENDIX D

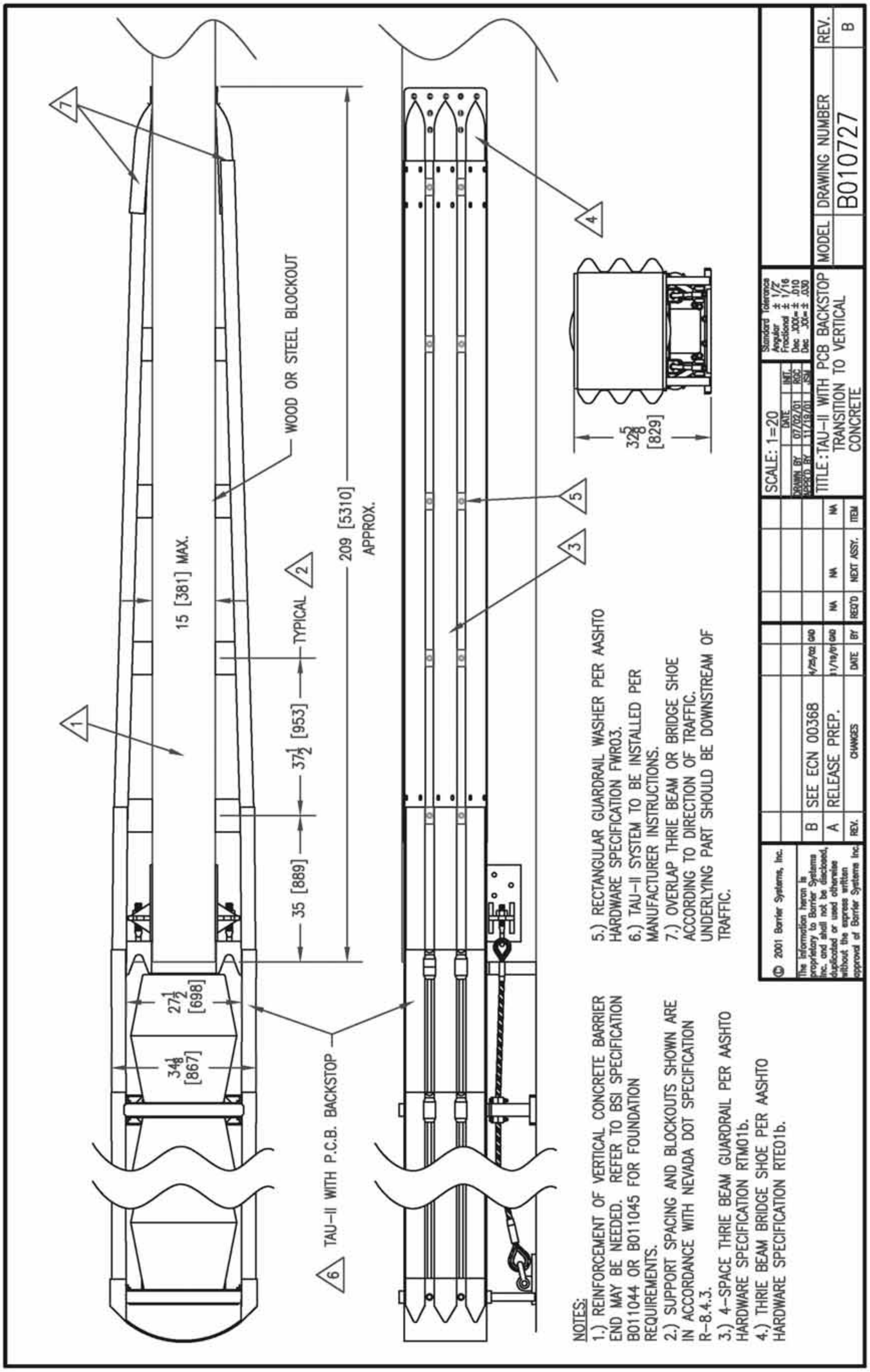
TRANSITIONS

There are a variety of transition options available for the TAU-II system. The system was designed to be compatible with a variety of generic transitions already available to the industry.

Placement and installation of the TAU-II system and transitions must be accomplished in accordance with the guidelines and recommendations set forth in the "AASHTO Roadside Design Guide," FHWA memoranda and other state and local standards.

There are different transition configurations depending on which backstop you are using (Compact or P.C.B.). Transition options for either of the backstop systems are shown in the following drawings.

DRAWINGS


15 [381] MAX.
34⅛ [867]
27½ [698]
WOOD OR STEEL BLOCKOUT
35 [889]
37½ [953]
TYPICAL 2
209 [5310] APPROX.
6 TAU–II WITH P.C.B. BACKSTOP
32⅝ [829]
1
3
4
5
7
NOTES:
1.) REINFORCEMENT OF VERTICAL CONCRETE BARRIER END MAY BE NEEDED. REFER TO BSI SPECIFICATION B011044 OR B011045 FOR FOUNDATION REQUIREMENTS.
2.) SUPPORT SPACING AND BLOCKOUTS SHOWN ARE IN ACCORDANCE WITH NEVADA DOT SPECIFICATION R–8.4.3.
3.) 4–SPACE THRIE BEAM GUARDRAIL PER AASHTO HARDWARE SPECIFICATION RTM01b.
4.) THRIE BEAM BRIDGE SHOE PER AASHTO HARDWARE SPECIFICATION RTE01b.
5.) RECTANGULAR GUARDRAIL WASHER PER AASHTO HARDWARE SPECIFICATION FWR03.
6.) TAU–II SYSTEM TO BE INSTALLED PER MANUFACTURER INSTRUCTIONS.
7.) OVERLAP THRIE BEAM OR BRIDGE SHOE ACCORDING TO DIRECTION OF TRAFFIC. UNDERLYING PART SHOULD BE DOWNSTREAM OF TRAFFIC.
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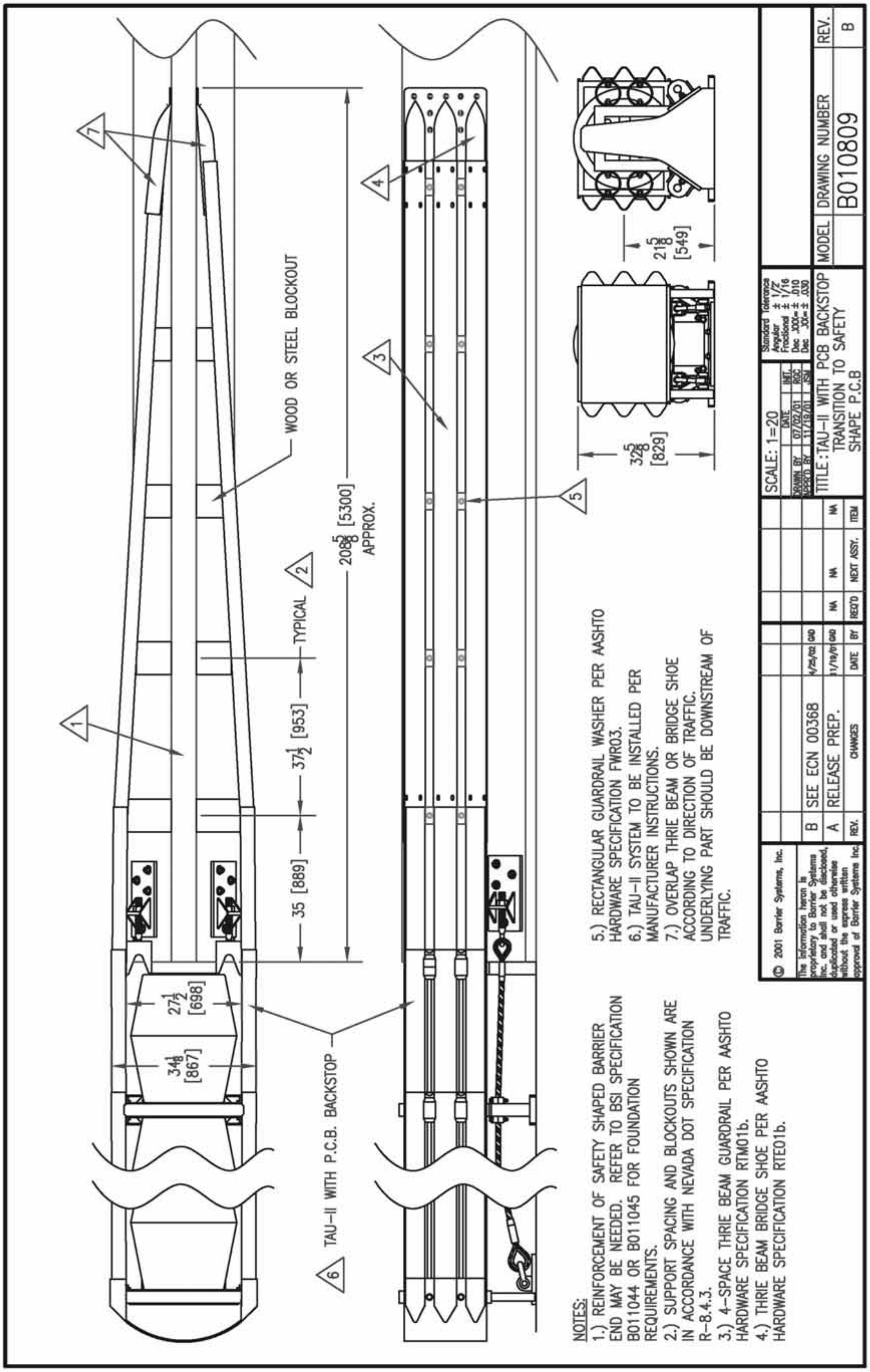
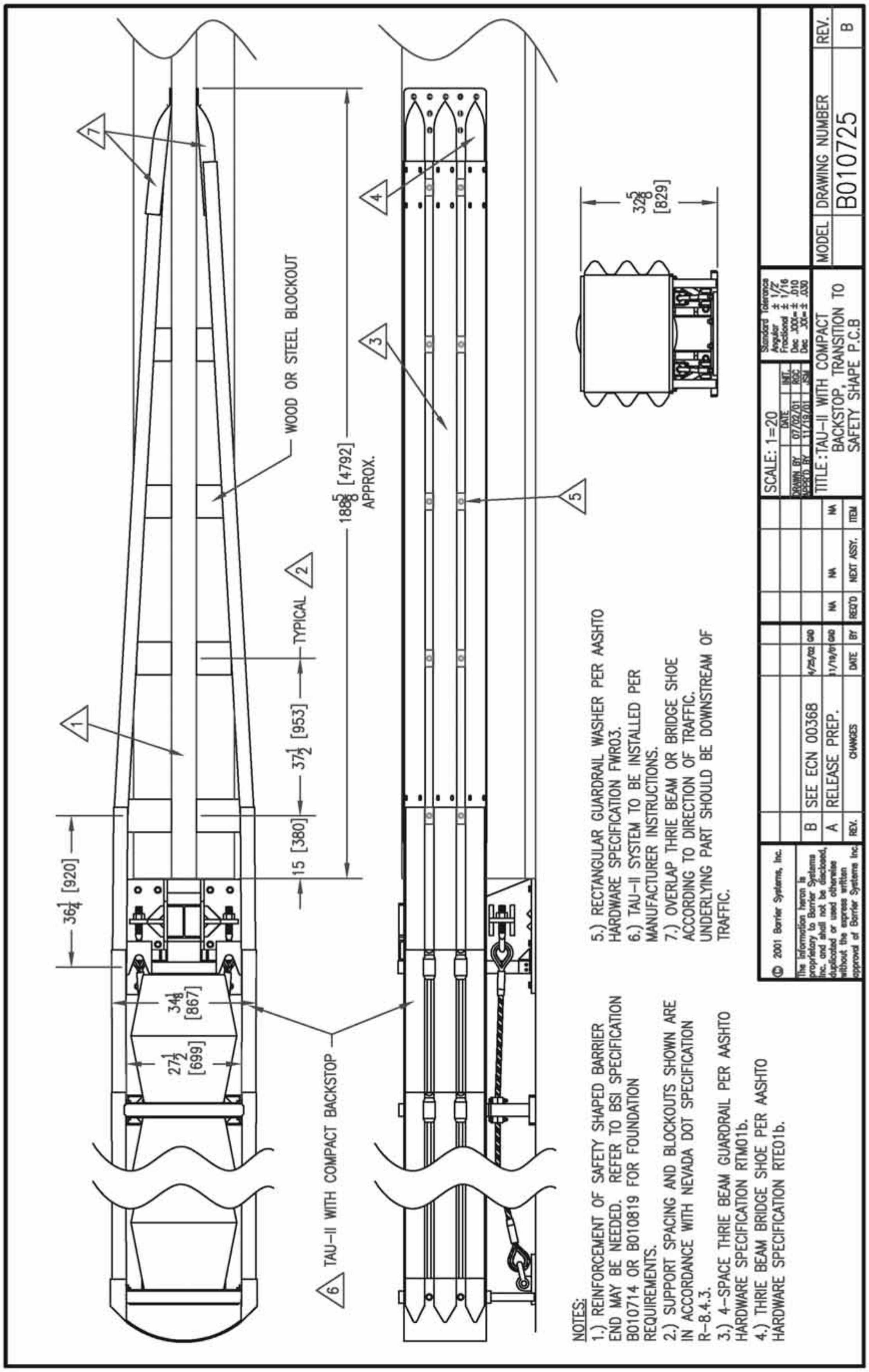
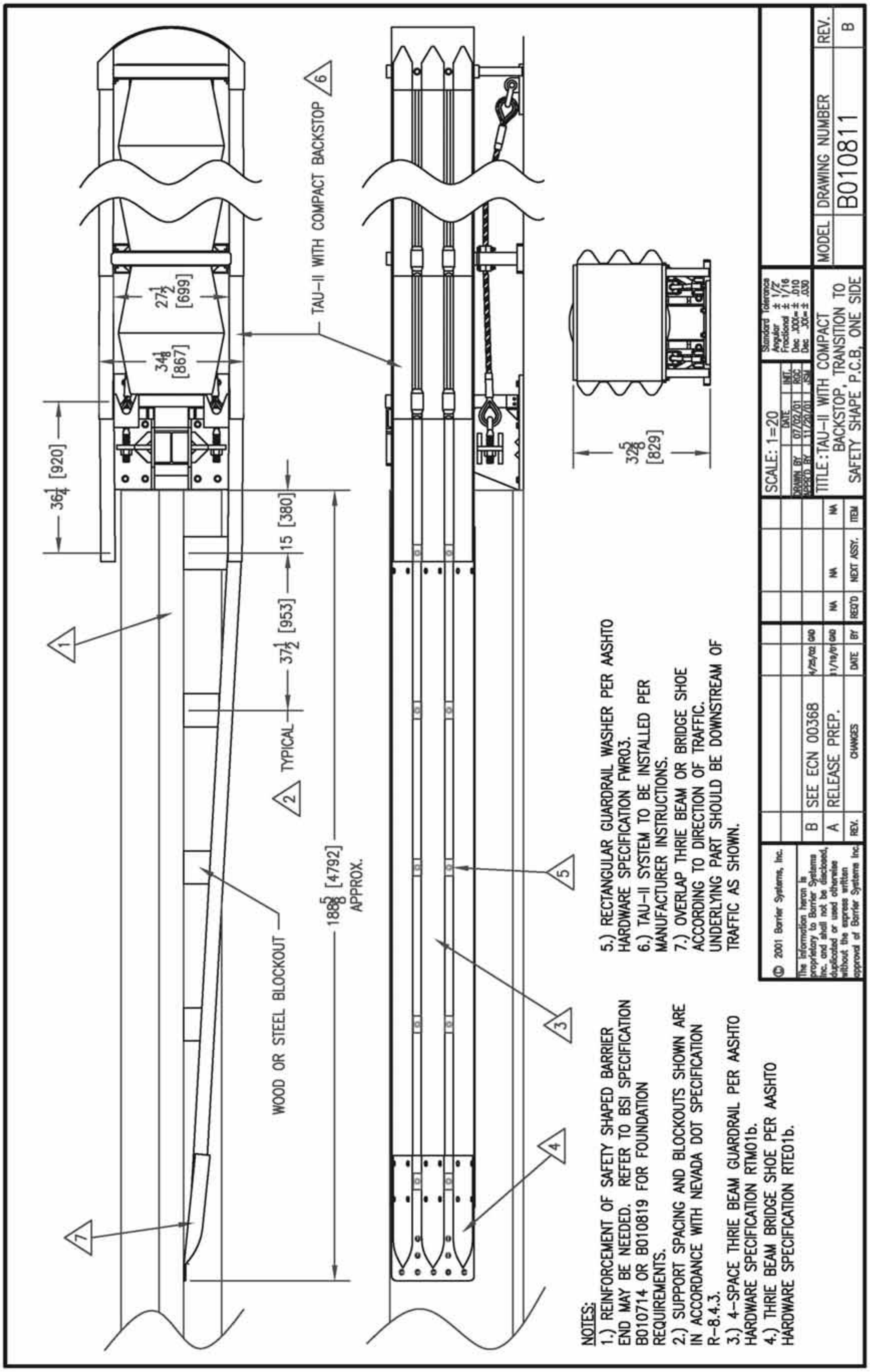
B SEE ECN 00368 4/25/02 GAD
A RELEASE PREP. 11/19/01 GAD NA NA NA
REV. CHANGES DATE BY REQ'D NEXT ASSY. ITEM
SCALE: 1=20
DATE INIT.
DRAWN BY 07/02/01 RGC
APPR'D BY 11/19/01 JSM
Standard Tolerance
Angular ± 1/2°
Fractional ± 1/16
Dec .XXX= ± .010
Dec .XX= ± .030
TITLE : TAU–II WITH PCB BACKSTOP TRANSITION TO VERTICAL CONCRETE
MODEL
DRAWING NUMBER
B010727
REV.
B



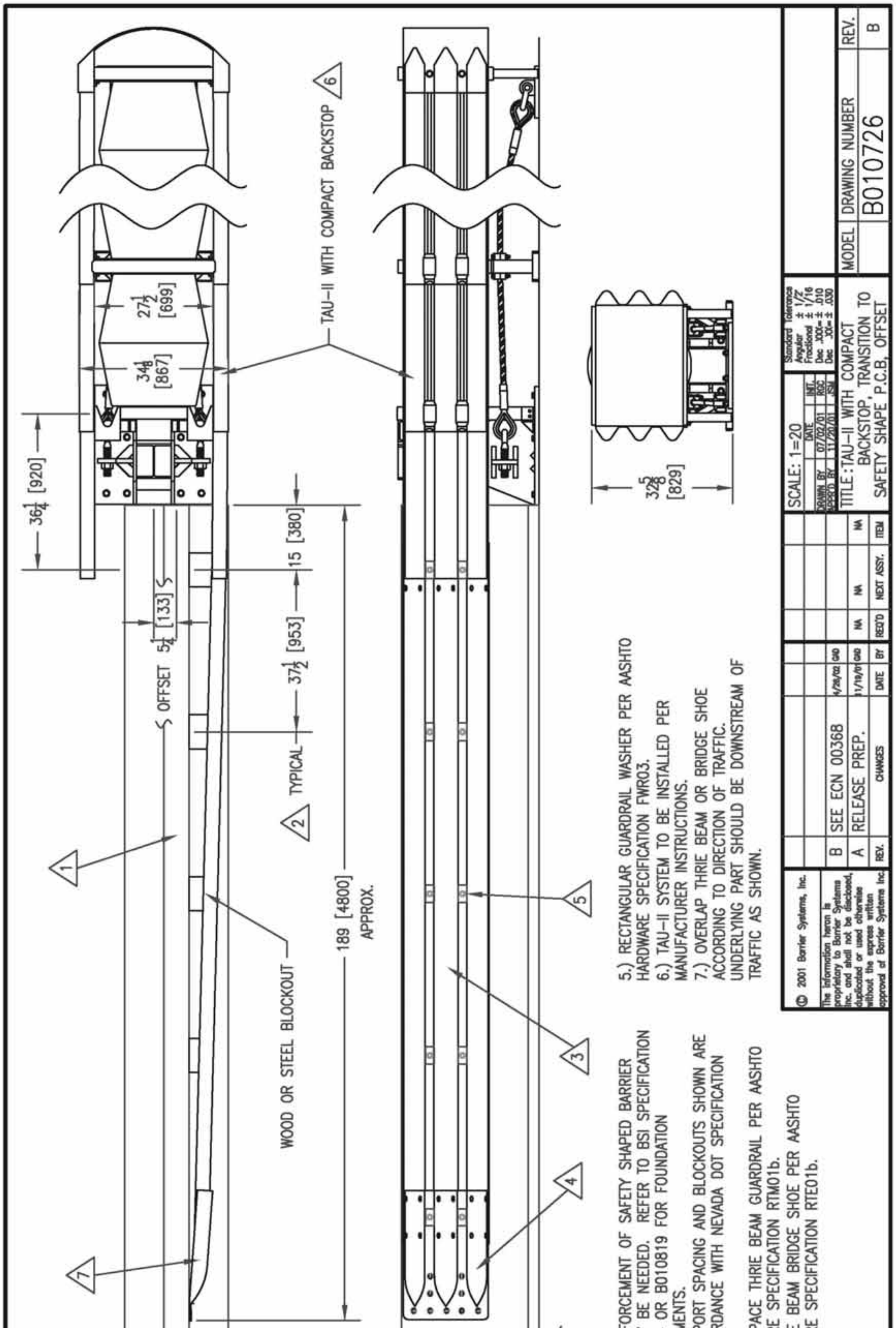
BARRIER SYSTEMS



BARRIER SYSTEMS



BARRIER SYSTEMS



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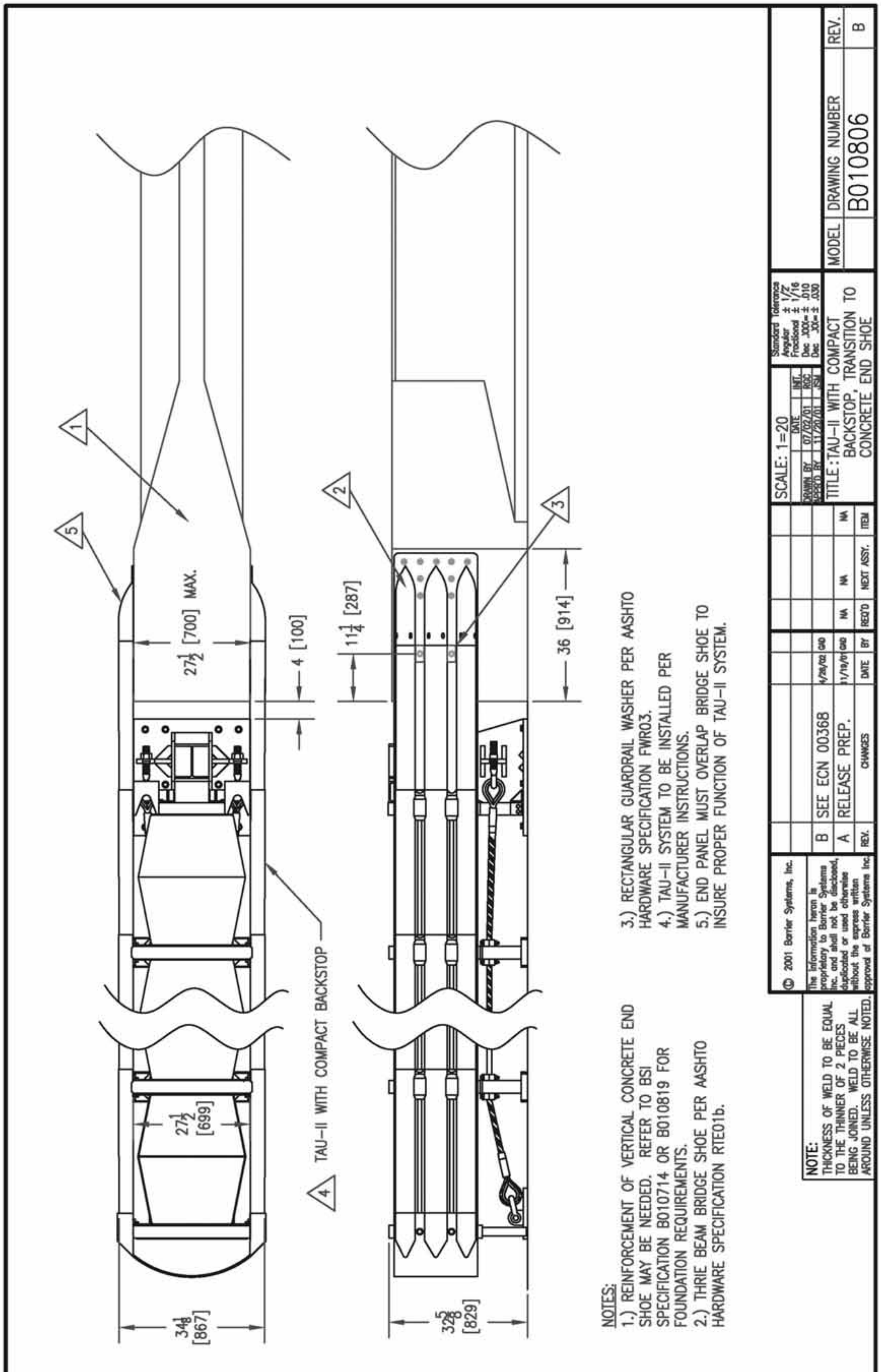

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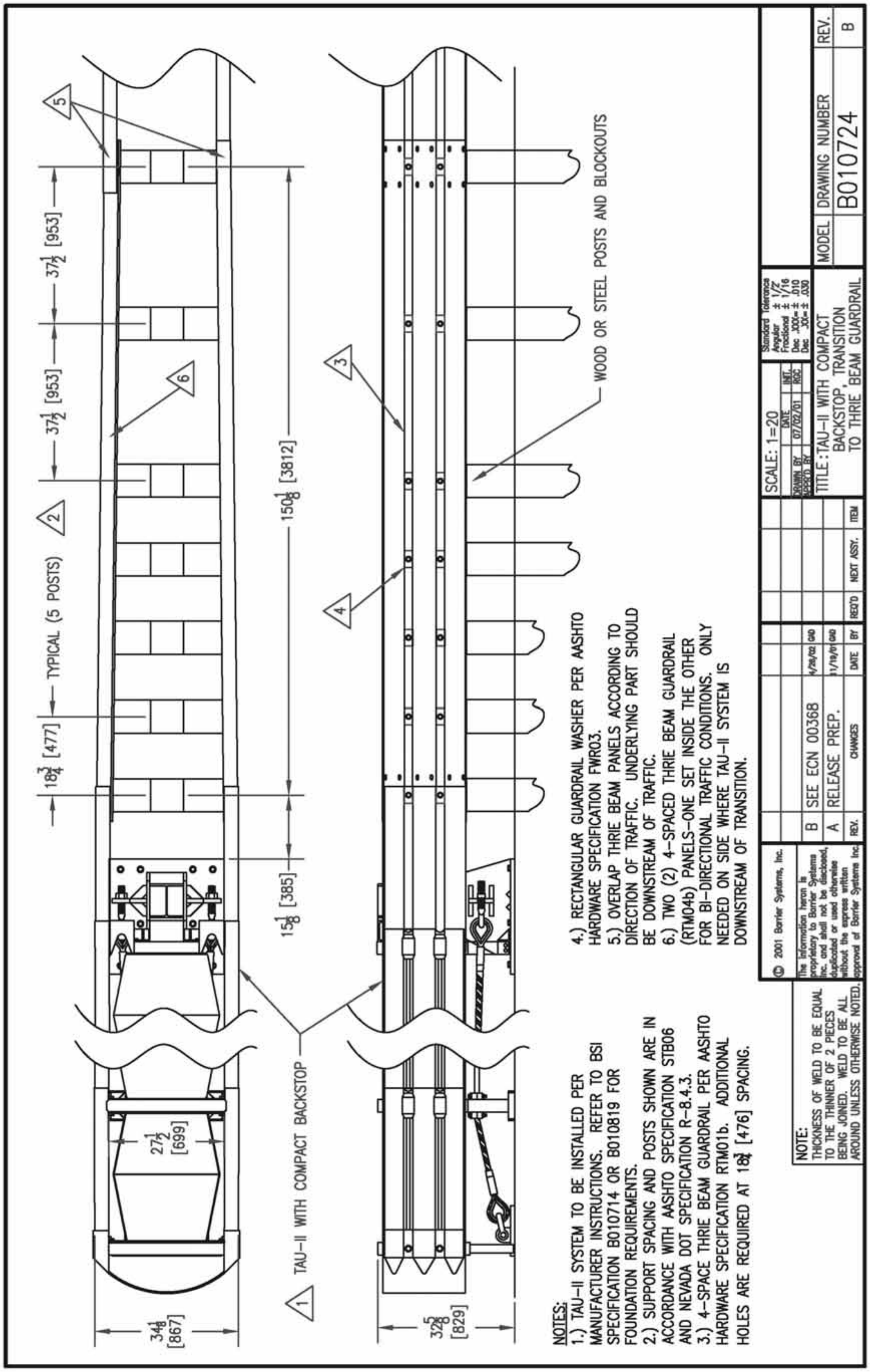
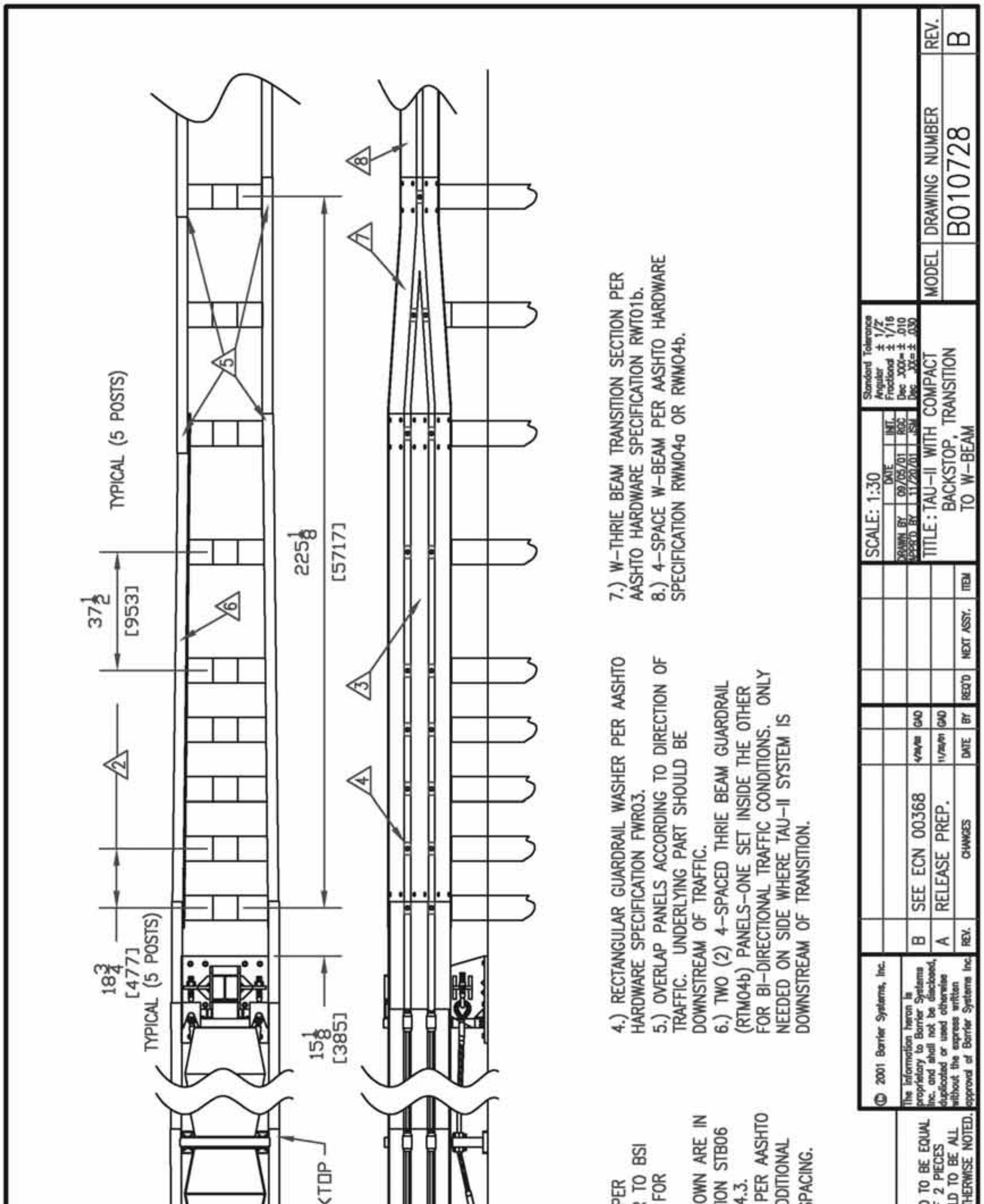


BARRIER SYSTEMS


TAU-II WITH COMPACT BACKTOP
34 1/8 [867]
27 1/2 [698]
21 5/8 [549]
32 5/8 [829]
18 3/4 [477]
TYPICAL (5 POSTS)
15 1/8 [385]
37 1/2 [953]
TYPICAL (5 POSTS)
225 1/8 [5717]
NOTES:
1.) TAU-II SYSTEM TO BE INSTALLED PER MANUFACTURER INSTRUCTIONS. REFER TO BSI SPECIFICATION B010714 OR B010819 FOR FOUNDATION REQUIREMENTS.
2.) SUPPORT SPACING AND POSTS SHOWN ARE IN ACCORDANCE WITH AASHTO SPECIFICATION STB06 AND NEVADA DOT SPECIFICATION R-8.4.3.
3.) 4-SPACE THRIE BEAM GUARDRAIL PER AASHTO HARDWARE SPECIFICATION RTM01b. ADDITIONAL HOLES ARE REQUIRED AT 18 3/4 [476] SPACING.
4.) RECTANGULAR GUARDRAIL WASHER PER AASHTO HARDWARE SPECIFICATION FWR03.
5.) OVERLAP PANELS ACCORDING TO DIRECTION OF TRAFFIC. UNDERLYING PART SHOULD BE DOWNSTREAM OF TRAFFIC.
6.) TWO (2) 4-SPACED THRIE BEAM GUARDRAIL (RTM04b) PANELS-ONE SET INSIDE THE OTHER FOR BI-DIRECTIONAL TRAFFIC CONDITIONS. ONLY NEEDED ON SIDE WHERE TAU-II SYSTEM IS DOWNSTREAM OF TRANSITION.
7.) W-THRIE BEAM TRANSITION SECTION PER AASHTO HARDWARE SPECIFICATION RWT01b.
8.) 4-SPACE W-BEAM PER AASHTO HARDWARE SPECIFICATION RWM04a OR RWM04b.
NOTE:
THICKNESS OF WELD TO BE EQUAL TO THE THINNER OF 2 PIECES BEING JOINED. WELD TO BE ALL AROUND UNLESS OTHERWISE NOTED.
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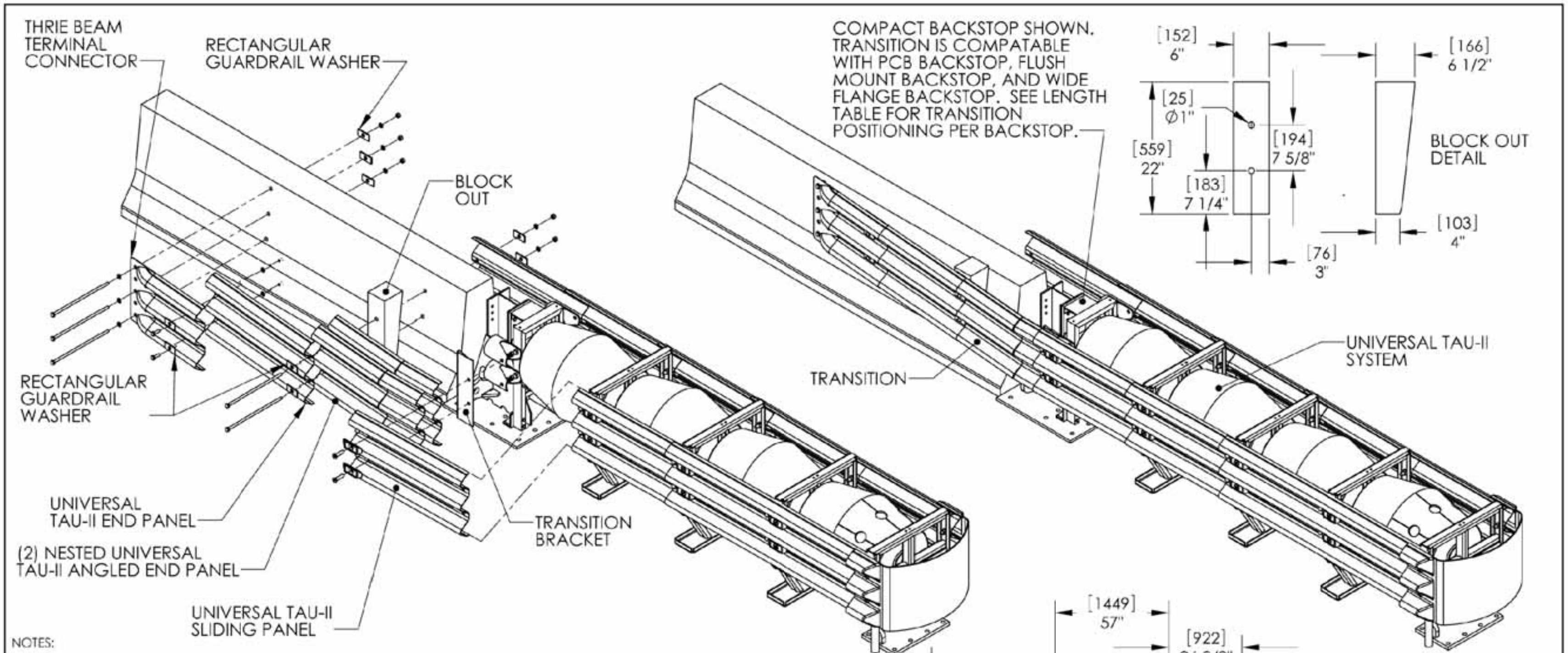
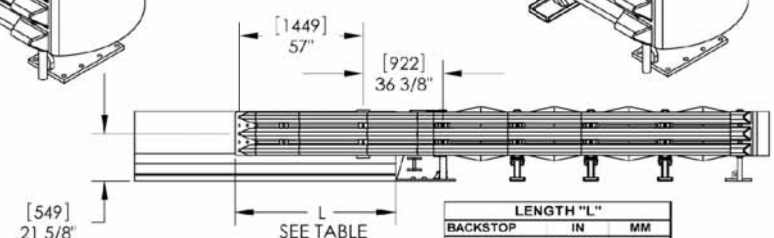
B SEE ECN 00368
A RELEASE PREP.
REV. CHANGES DATE BY REQ'D NEXT ASSY. ITEM
SCALE: 1:30
TITLE: TAU-II WITH COMPACT BACKSTOP, TRANSITION TO W-BEAM
MODEL
DRAWING NUMBER
B010728
REV.
B





NOTES:

1.) UNIVERSAL TAU-II SYSTEM TO BE INSTALLED PER MANUFACTURERS INSTRUCTIONS.
2.) TRANSITION SHOWN IS COMPATABLE WITH COMPACT BACKSTOP (SHOWN), FLUSH MOUNT BACKSTOP, PCB BACKSTOP, AND WIDE FLANGE BACKSTOP. IT IS APPLICABLE WITH ASPHALT ANCHORING PACKAGES FOR PCB BACKSTOP AND PCB BRACE KIT FOR COMPACT BACKSTOP.
3.)THRIE BEAM TERMINAL CONNECTOR PER AASHTO HARDWARE SPECIFICATION RTE01.
4.) STANDARD TIMBER OR PLASTIC OFFSET BLOCKS FIELD TRIMMED FOR USE. BLOCK OUT DETIAL SHOWS DIMENSIONS FOR F-SHAPE SAFETY SHAPED BARRIER. ACTUAL DIMENSIONS SHOULD REFLECT SHAPE OF BARRIER TRANSITIONED TO.
5.) PANELS AND BLOCKOUT ATTACHED TO BARRIER WALL WITH 5/8" [16mm] BOLTS WITH BEAM WASHER AND NUT WITH WASHER AND BEAM WASHER. 20" [500mm] BOLTS MAY BE FIELD TRIMMED. LENGTH MAY VARY WITH DIFFERENT BARRIER SHAPES. HOLES DRILLED THROUGH MEDIAN BARRIER ARE 3/4" [20mm]. MECHANICAL OR CHEMICALLY BONDED ANCHORS MAY BE USED THAT MEET OREXCEED 15.000 LBF SHEAR AND PULL OUT STRENGTH.
6.) ATTACH THRIE BEAM TERMINAL CONNECTOR TO MEDIAN BARRIER WITH (3) 5/8" [16mm] BOLTS WITH WASHERS AND NUT WITH WASHERS AND BEAM WASHERS. REFERENCE NOTE 5 FOR DETAILS.
7.) ATTACH THRIE BEAM TERMINAL CONNECTOR TO UNIVERSAL TAU-II END PANEL WITH 5/8" [16mm] X 2" [50mm] BOLTS WITH BEAM WASHER AND NUT WITH WASHER.
8.) TRANSITION BRACKET TO BE INSTALLED OVER PIPE PANEL MOUNTS UNDER THE (2) NESTED ANGLED END PANELS AND THE SLIDING PANEL. BEND IN TRANSITION BRACKET FACES REARWARD AND FITS AROUND PIPE PANEL MOUNTS. JOINT IS SECURED WITH SLIDING BOLTS. SLIDING BOLTS TO BE TORQUED PER MANUFACTURERS SPECIFICATIONS.

LENGTH "L"		
BACKSTOP	IN	MM
COMPACT	74 3/4	1900
PCB	94 3/4	2400
FLUSH MOUNT	89 3/8	2270
WIDE FLANGE	128 1/2	3260

REV	CHANGES	DATE	BY	REQ'D	NEXT ASSY.	ITEM
				1	NA	1

SCALE: 1:25

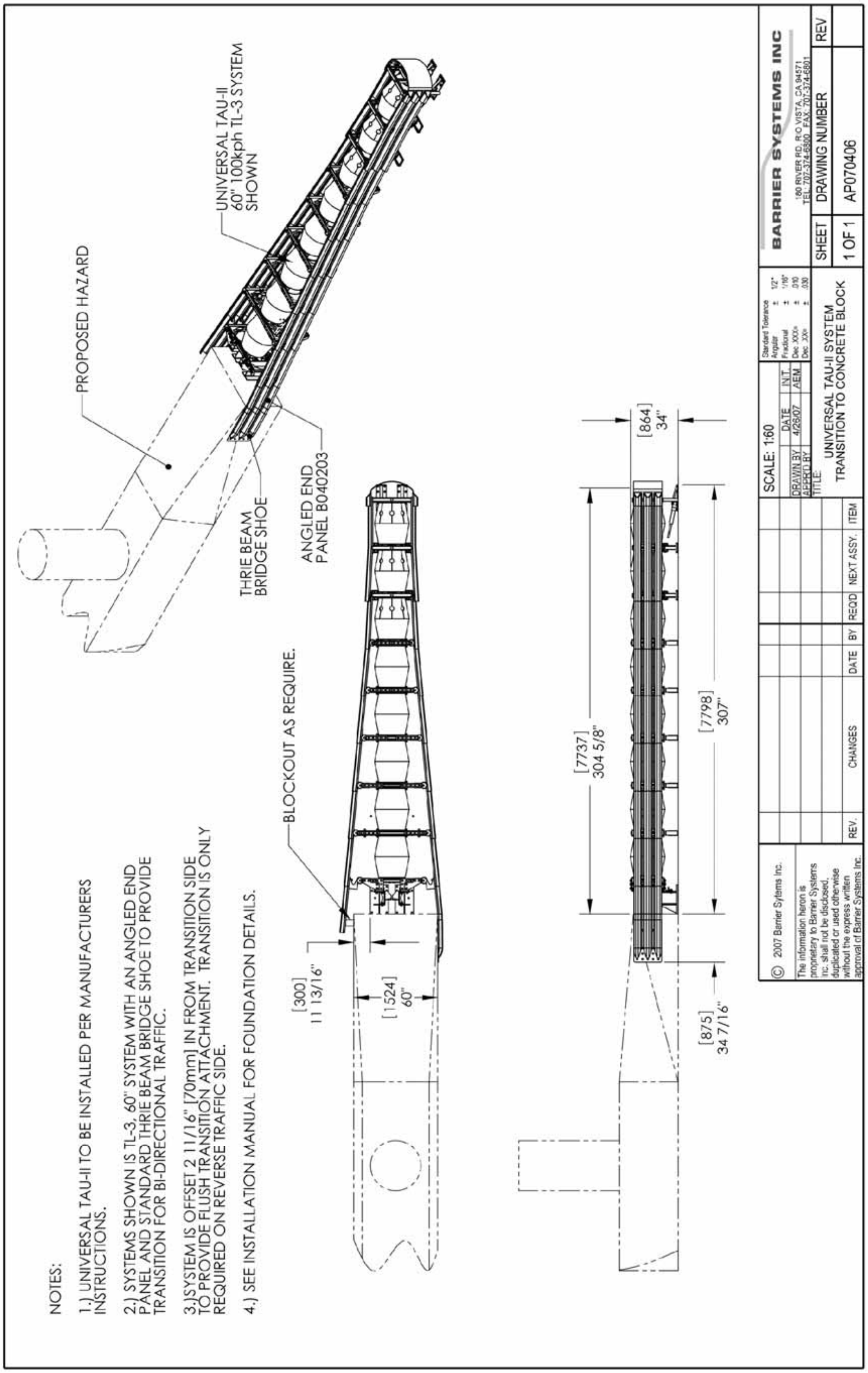
	DATE	INIT.
DRAWN BY	06/06/05	GAD
		GAD

Standard Tolerance
Angular +/- 1/2 Deg.
Fractional +/- 1/16
Dec. .XXX= +/- .010
Dec. .XX= +/- .030

TITLE: UNIVERSAL TAU-II TRANSITION TO MEDIAN BARRIER

MODEL	DRAWING NUMBER	REV
	B050606	

BARRIER SYSTEMS


NOTES:
1.) UNIVERSAL TAU-II TO BE INSTALLED PER MANUFACTURERS INSTRUCTIONS.
2.) SYSTEMS SHOWN IS TL-3, 60" SYSTEM WITH AN ANGLED END PANEL AND STANDARD THRIE BEAM BRIDGE SHOE TO PROVIDE TRANSITION FOR BI-DIRECTIONAL TRAFFIC.
3.)SYSTEM IS OFFSET 2 11/16" [70mm] IN FROM TRANSITION SIDE TO PROVIDE FLUSH TRANSITION ATTACHMENT. TRANSITION IS ONLY REQUIRED ON REVERSE TRAFFIC SIDE.
4.) SEE INSTALLATION MANUAL FOR FOUNDATION DETAILS.
PROPOSED HAZARD
UNIVERSAL TAU-II 60" 100kph TL-3 SYSTEM SHOWN
THRIE BEAM BRIDGE SHOE
ANGLED END PANEL B040203
BLOCKOUT AS REQUIRE.
[300] 11 13/16"
[1524] 60"
[7737] 304 5/8"
[7798] 307"
[864] 34"
[875] 34 7/16"
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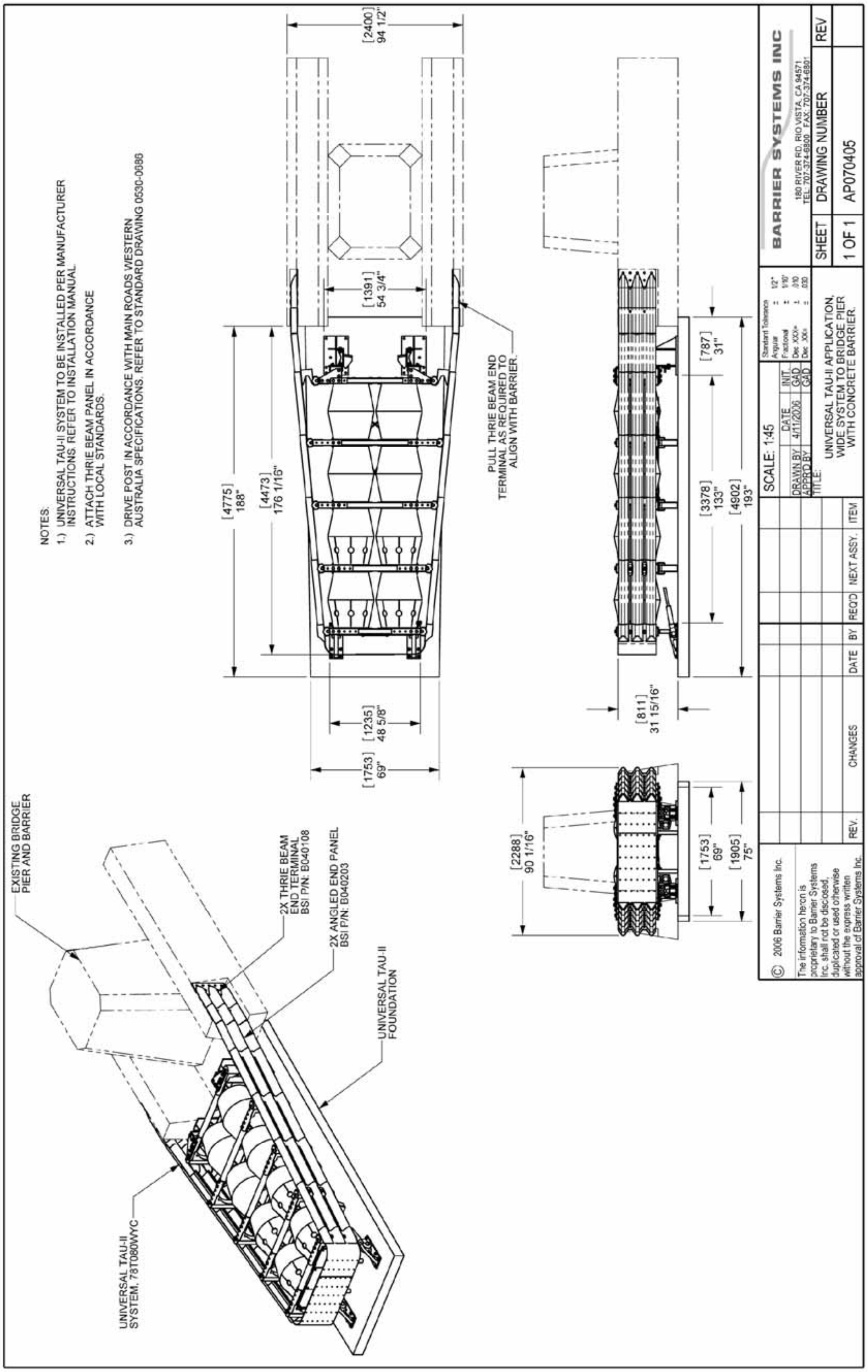
REV. CHANGES DATE BY REQ'D NEXT ASSY. ITEM
SCALE: 1:60
DRAWN BY 4/26/07 AEM
APPR'D BY
DATE INT.
Standard Tolerance
Angular ± 1/2°
Fractional ± 1/16"
Dec .XXX± ± .010
Dec .XX± ± .030
TITLE:
UNIVERSAL TAU-II SYSTEM TRANSITION TO CONCRETE BLOCK
BARRIER SYSTEMS INC
180 RIVER RD. RIO VISTA, CA 94571
TEL: 707-374-6800 FAX: 707-374-6801
SHEET 1 OF 1
DRAWING NUMBER AP070406
REV


NOTES:
1.) UNIVERSAL TAU-II SYSTEM TO BE INSTALLED PER MANUFACTURER INSTRUCTIONS. REFER TO INSTALLATION MANUAL.
2.) ATTACH THRIE BEAM PANEL IN ACCORDANCE WITH LOCAL STANDARDS.
3.) DRIVE POST IN ACCORDANCE WITH MAIN ROADS WESTERN AUSTRALIA SPECIFICATIONS. REFER TO STANDARD DRAWING 0530-0686
EXISTING BRIDGE PIER AND BARRIER
2X THRIE BEAM END TERMINAL BSI P/N: B040108
2X ANGLED END PANEL BSI P/N: B040203
UNIVERSAL TAU-II FOUNDATION
UNIVERSAL TAU-II SYSTEM, 78T080WYC
PULL THRIE BEAM END TERMINAL AS REQUIRED TO ALIGN WITH BARRIER.
[2400] 94 1/2"
[1391] 54 3/4"
[4775] 188"
[4473] 176 1/16"
[1235] 48 5/8"
[1753] 69"
[811] 31 15/16"
[787] 31"
[3378] 133"
[4902] 193"
[2288] 90 1/16"
[1753] 69"
[1905] 75"
BARRIER SYSTEMS INC
180 RIVER RD. RIO VISTA, CA 94571
TEL: 707-374-6800 FAX: 707-374-6801
SHEET
1 OF 1
DRAWING NUMBER
AP070405
REV
SCALE: 1:45
DRAWN BY
APPR'D BY
DATE
4/11/2006
INIT.
GAD
GAD
TITLE:
UNIVERSAL TAU-II APPLICATION, WIDE SYSTEM TO BRIDGE PIER WITH CONCRETE BARRIER.
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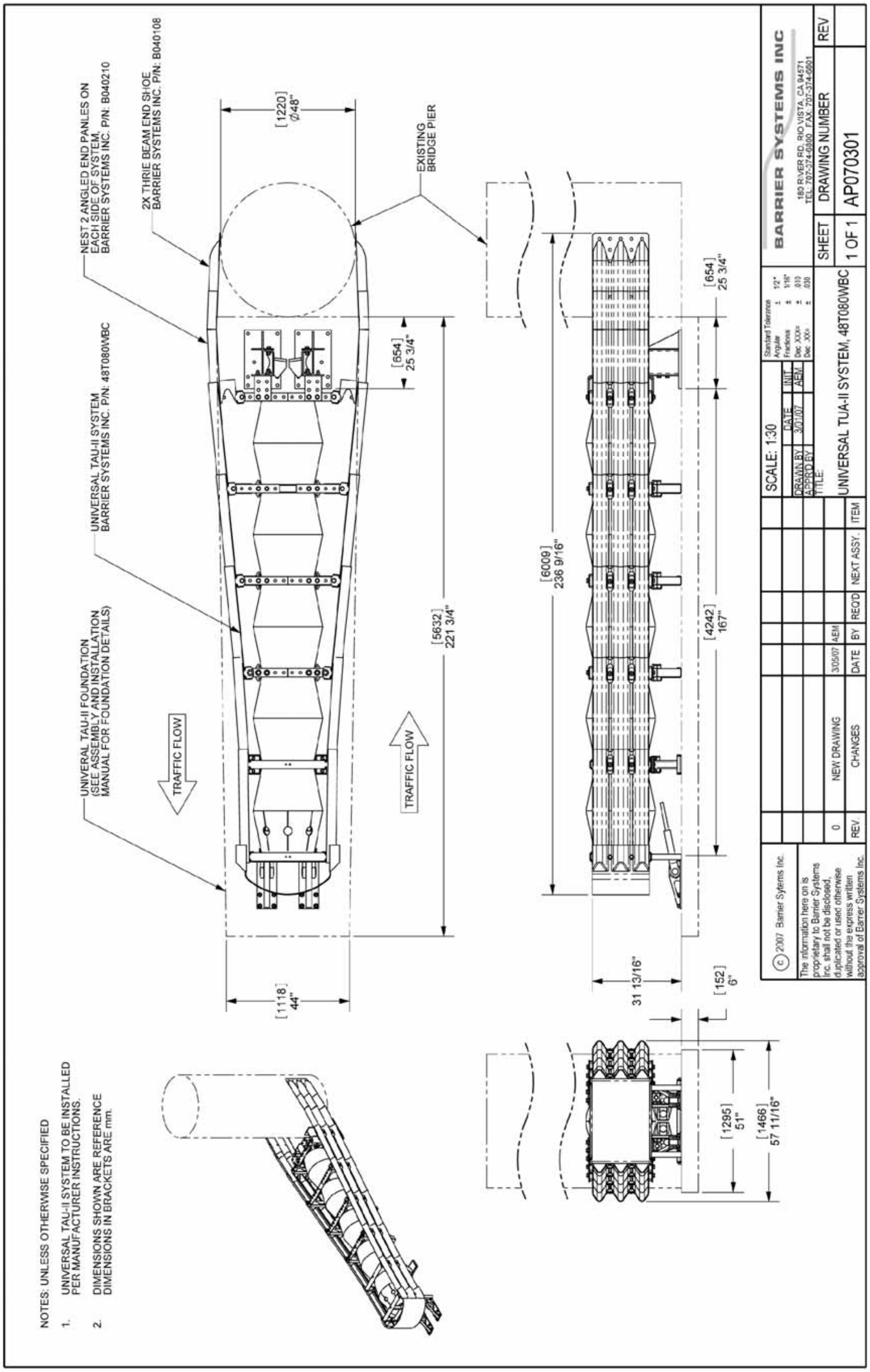
REV.
CHANGES
DATE
BY
REQ'D
NEXT ASSY.
ITEM


NOTES: UNLESS OTHERWISE SPECIFIED
1. UNIVERSAL TAU-II SYSTEM TO BE INSTALLED PER MANUFACTURER INSTRUCTIONS.
2. DIMENSIONS SHOWN ARE REFERENCE DIMENSIONS IN BRACKETS ARE mm.
UNIVERAL TAU-II FOUNDATION (SEE ASSEMBLY AND INSTALLATION MANUAL FOR FOUNDATION DETAILS)
UNIVERSAL TAU-II SYSTEM BARRIER SYSTEMS INC. P/N: 48T080WBC
NEST 2 ANGLED END PANLES ON EACH SIDE OF SYSTEM. BARRIER SYSTEMS INC. P/N: B040210
2X THRIE BEAM END SHOE BARRIER SYSTEMS INC. P/N: B040108
EXISTING BRIDGE PIER
TRAFFIC FLOW
TRAFFIC FLOW
[1220] ⌀48"
[654] 25 3/4"
[5632] 221 3/4"
[1118] 44"
[6009] 236 9/16"
[654] 25 3/4"
[4242] 167"
31 13/16"
[152] 6"
[1295] 51"
[1466] 57 11/16"
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0 NEW DRAWING 3/05/07 AEM
REV. CHANGES DATE BY REQ'D NEXT ASSY. ITEM
SCALE: 1:30
DRAWN BY DATE INIT 3/01/07 AEM
APPR'D BY
TITLE:
UNIVERSAL TUA-II SYSTEM, 48T080WBC
SHEET 1 OF 1
BARRIER SYSTEMS INC
180 RIVER RD, RIO VISTA, CA 94571
TEL: 707-374-6800 FAX: 707-374-6801
DRAWING NUMBER
AP070301
REV

Universal TAU-II® Attachment to BarrierGuard 800™ Installation Guide

Refer to the Universal TAU-II Installation and Maintenance Manual for more information, introduction, system overview, required tools, and other considerations for the Universal TAU-II systems.

The Universal TAU-II system is installed after the BarrierGuard 800 is fully deployed, installed, and anchored. Reference the BarrierGuard 800 Design, Installation, and Maintenance Manual for complete information on the BarrierGuard 800 barrier system implementation and installation.

The Universal TAU-II system utilizes a monolithic backstop that bolts directly in place of the terminal cover of the BarrierGuard 800. The front cable anchor remains as the only foundation anchorage required for the Universal TAU-II system. The front cable anchor is to be anchored to the same foundation type as the end of the BarrierGuard 800 that it is attached to (PC Concrete or Asphaltic Concrete). Anchorage shall be in accordance with BSI specifications A040113.

Installation Procedure: *Each Procedure references a page number from the Universal TAU-II Installation Manual for further information –*

1.) Remove terminal cover from BarrierGuard 800 end section (if in place).

2.) Install and fasten Universal TAU-II BarrierGuard 800 Backstop in place. **(See diagram on next page).**

3.) Locate and position Front Cable anchor (see below). Drill and secure the appropriate anchors for the foundation used per BSI specification A040113. Use the Front Cable anchor as the drilling template. Use a BSI approved anchoring compound. See pages 12 &13.

4.) Place the Middle Bulkheads along the centerline of the system spaced approximately 34” [865mm] apart. See page 13.

5.) Thread the guide Cables through the legs of the Middle Bulkheads, threaded end first, starting from the front of the system. Loosely place the threaded end into the backstop lugs and spin the nut on to hold it in place. See pages 13 & 14.

6.) Pin the guide Cables to the Front Cable Anchor with the shackles. See page 14.

7.) Install Cable Guides. See pages 14 & 15.

8.) Attach Pipe Panel Mounts. See page 15.

9.) Install the End Panels and first Slider Panels starting at the Pipe Panel Mounts. If a transition is to be installed the End Panel will be replaced by the Angled End Panel. See page 16 & 72.

10.) Install Slider Panels. Start from the back of the system and move forward, overlapping the rearward panel. Secure the panels in place with the Slider Bolts. See pages 16 & 17.

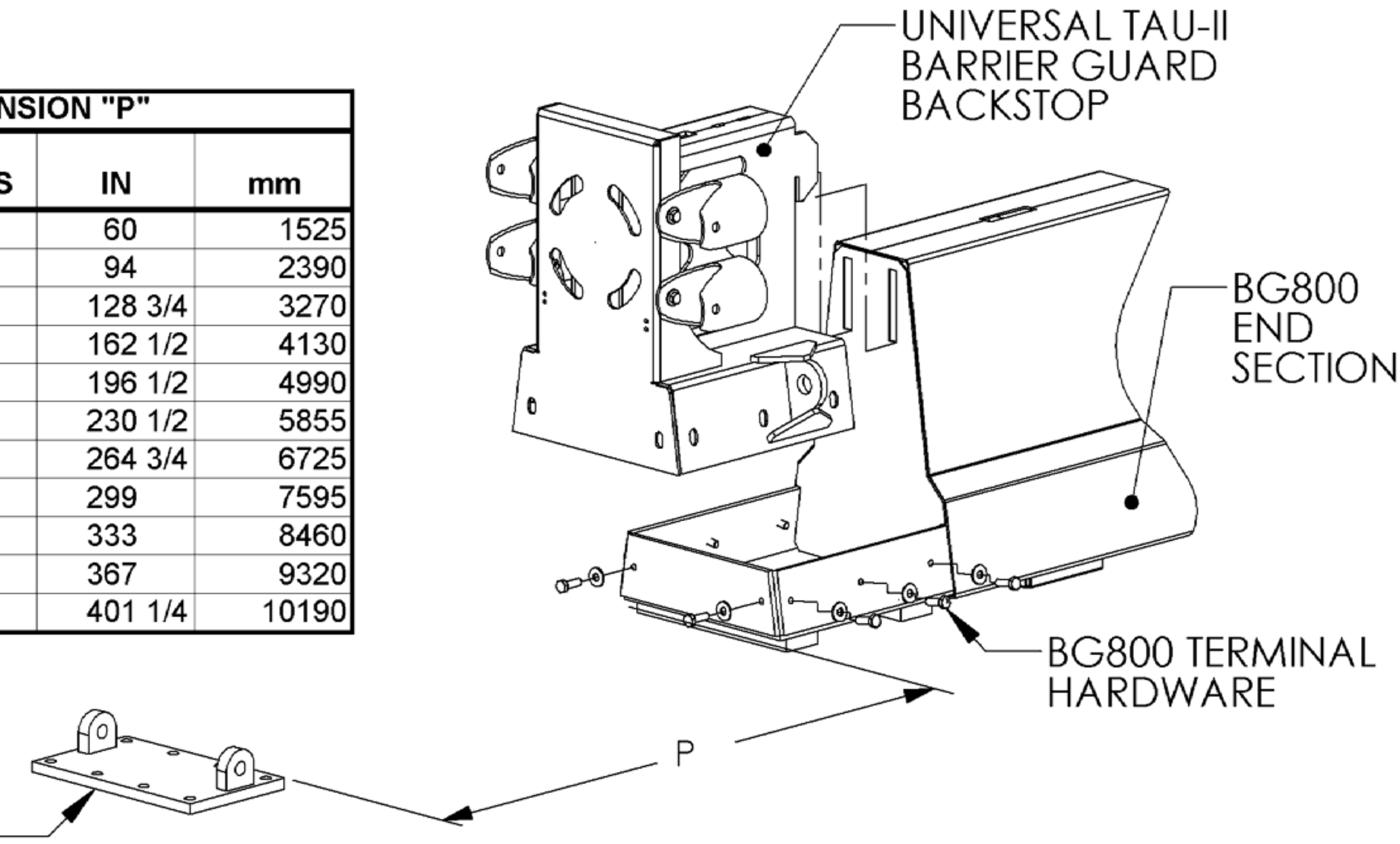
11.) Install the Front Support, attach the Slider Panels, Nose Cover, and Leg Supports and connect to the first Middle Support with Slider Bolts. See page 18.

12.) Torque Slider Bolts and Front Panel Bolts and install Energy Absorbing Cartridges. See page 19.

13.) Apply tension to cables – Torque to specification. Ensure foundation anchors are properly cured. See page 20.

(See Installation Diagram on Next Page)

DIMENSION "P"			
CAPACITY mph/kph	No. BAYS	IN	mm
31/50	2	60	1525
37/60	3	94	2390
44/70	4	128 3/4	3270
50/80	5	162 1/2	4130
53/85	6	196 1/2	4990
56/90	7	230 1/2	5855
62/100	8	264 3/4	6725
65/105	9	299	7595
68/110	10	333	8460
72/115	11	367	9320
75/120	12	401 1/4	10190



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