State of California

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. MICHAEL D. KEEVER
Structures Design
Office of Bridge Design-South
Bridge Design Branch 12
MS #9

Attention: Mr. Surjit Dhillon

Date: April 10, 2003

File: 11-SD-15-KP 38.1
11-080921
Bernardo Center Dr. UC
Br. #57-0577R/L

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES
OFFICE OF GEOTECHNICAL DESIGN – SOUTH II
DESIGN BRANCH B, MS #5

Subject: Revised Foundation Recommendations

The following are Revised Foundation Recommendations for the Foundation Recommendation Report, dated December 19, 2002, for the Bernardo Center Dr. U.C. (Br. #57-0577 R/L), which was recently sent to your office. These revisions are due to the increased load from 700 kN to 850 kN at the Abutment 1 and 4 locations of the left (southbound) replacement, and the managed lanes widening. The revised Design Loading and Nominal Resistance in Compression to be used for design are shown below in Table 1. Due to the proposed piles being end-bearing in either hard igneous or sandstone bedrock material, at these locations, the drilling to assist driving elevations and the specified pile tip elevations remain unchanged from the recent Foundation Report, dated December 19, 2002.

Table 1
Driven Pile Data: Class 900, Alternative "W" Steel Pipe Piles (Closed Ended)

Location	Pile Type	Design Loading	Nominal Resistance		Drilling to Assist Driving Elevation	Design Tip Elevation	Specified Tip Elevation
			Compression	Tension			
Abutment 1 Southbound Replacement	Class 900 Alt. "W"	850 kN (95.5 tons)	1700 kN (191.1 tons)	-0-	172.0 m (564.3 ft)	170.5 m (1) (559.4 ft)	170.5 m (559.4 ft)
Abutment 4 Southbound Replacement	Class 900 Alt. "W"	850 kN (95.5 tons)	1700 kN (191.1 tons)	-0-	175.0 m (574.1 ft)	173.5 m (1) (569.2 ft)	173.5 m (569.2 ft)
Abutment 1 Managed Lanes Widening	Class 900 Alt. "W"	850 kN (95.5 tons)	1700 kN (191.1 tons)	-0-	172.0 m (564.3 ft)	170.5 m (1) (559.4 ft)	170.5 m (559.4 ft)
Abutment 4 Managed Lanes Widening	Class 900 Alt. "W"	850 kN (95.5 tons)	1700 kN (191.1 tons)	-0-	173.0 m (567.6 ft)	171.5 m (1) (562.7 ft)	171.5 m (562.7 ft)

Note: Design tip elevation is controlled by the following demands: (1) Compression

All other recommendations in the December 19, 2002 report are still applicable. Any questions regarding the above recommendations should be directed to the attention of Erich Neupert, (916) 227-4565 (CALNET 498-4565), or Mark DeSalvatore, (916) 227-5391 (CALNET 498-5391), at the Office of Geotechnical Design-South II, Branch B.

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To: MR. MICHAEL D. KEEVER
Structures Design
Office of Bridge Design-South
Bridge Design Branch 12
MS #9

Attention: Mr. Surjit Dhillon

Date: February 10, 2003

File: 11-SD-15-KP 38.1
11-080921
Bernardo Center Dr. UC
Br. #57-0577R/L

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES
OFFICE OF GEOTECHNICAL DESIGN – SOUTH II MS #5
DESIGN BRANCH B

Subject: Second Revised Foundation Recommendation

Following below are Second Revised Foundation Recommendations for the Type 1 Retaining Wall located near the Abutment 1 location between the managed lanes widening, east side, and the right bridge (northbound) left side replacement, for the Bernardo Center Dr. U.C. (Br. #57-0577R/L). These revisions are due to changes in the design height of the wall from 7.9 m to 4.8 m, and raising the bottom of footing elevation from 184.55 m to 187.25 m. These recommendations supercede the January 29, 2003, Revised Foundation Recommendations which were recently sent to your office.

The proposed retaining wall is a standard Type 1 retaining wall as shown in the "Standard Plans (July 1999)" on sheet B3-1 for Loading Case I. The retaining wall may be supported on spread footings constructed on the existing engineered fill material. The revised Gross Allowable Soil Bearing Pressure and bottom of footing elevations are listed below in Table 1.

Table 1: Spread Footing Data
Type 1 – Retaining Wall (Abutment 1)

Support Location From "SD-15M" Line	Design Height of Wall "H"	Bottom of Footing Elevation	Recommended Soil Bearing Pressures	
			ASD [1]	LFD [2]
			Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult})
Sta. 18.865 m Rt. 379+43.39 To Sta. 18.865 m Rt. 379+55.58	4.8 m (15.7 ft)	187.25 m (614.3 ft)	170 kPa	N/A

Notes: 1) Allowable Stress Design (ASD). The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 3 times the recommended Gross Allowable Soil Bearing Pressure (q_{all}).

2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{all}*).

Construction Considerations:

1. At the retaining wall location, concrete for the proposed support footings shall be placed neat against the undisturbed engineered fill on the bottom of the footing excavation. Should the bottom of the footing excavation be disturbed, then the disturbed soils shall be recompacted to 95% relative compaction prior to placement of concrete for the structure support footings.

2. At the retaining wall location, the footing excavation is to be inspected and approved by a representative of the Office of Geotechnical Design-South II, Design Branch B prior to placing any steel or concrete.

3. The contractor is to allow five (5) working days for the inspection of the excavation to be completed. The structures representative is to provide the Office of Geotechnical Design–South II, Design Branch B a one-week notification prior to beginning the five-day contractor waiting period.

All other recommendations in the Foundation Recommendations report for the Bernardo Center Dr. U.C. (Br.# 57-0577 R/L), dated December 19, 2002, are still applicable. Any questions regarding the above recommendations should be directed to the attention of Erich Neupert, (916) 227-4565 (CALNET 498-4565), or Mark DeSalvatore, (916) 227-5391 (CALNET 498-5391), at the Office of Geotechnical Design-South II, Branch B.

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To: MR. MICHAEL D. KEEVER
Structures Design
Office of Bridge Design-South
Bridge Design Branch 12
MS #9

Attention: Mr. Surjit Dhillon

Date: January 29, 2003

File: 11-SD-15-KP 38.1
11-0809**1**
Bernardo Center Dr. UC
Br. #57-0577R/L

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
Geotechnical Services
Office of Geotechnical Design – South II MS #5
Design Branch B

Subject: Revised Foundation Recommendation

The following are Revised Foundation Recommendations, for the Foundation Recommendation Report, dated December 19, 2002, for the Bernardo Center Dr. U.C. (Br. #57-0577R/L), which was recently sent to your office. This report presents the foundation recommendations for the Type 1 retaining wall located near the Abutment 1 location between the managed lanes widening, east side, and the right bridge (northbound) left side replacement, which was not included in the original report, dated December 19, 2002. The proposed retaining wall is a standard Type 1 retaining wall as shown in the "Standard Plans (July 1999)" on sheet B3-1 for Loading Case I.

The proposed retaining wall may be supported on spread footings constructed on the existing engineered fill material. The Gross Allowable Soil Bearing Pressure, stationing and bottom of footing elevations are listed below in Table 1.

Table 1: Spread Footing Data
Type 1 – Retaining Wall (Abutment 1)

Support Location From "SD-15M" Line	Design Height of Wall "H"	Bottom of Footing Elevation	Recommended Soil Bearing Pressures	
			ASD [1]	LFD [2]
			Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}^*)
Sta. 18.865 m Rt. 379+43.39 To Sta. 18.865 m Rt. 379+55.58	7.9 m (25.9 ft)	184.55 m (605.5 ft)	255 kPa	N/A

Notes: 1) Allowable Stress Design (ASD). The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 3 times the recommended Gross Allowable Soil Bearing Pressure (q_{all}).

2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*).

Construction Considerations:

1. At the retaining wall location, concrete for the proposed support footings shall be placed neat against the undisturbed engineered fill on the bottom of the footing excavation. Should the bottom of the footing excavation be disturbed, then the disturbed soils shall be recompacted to 95% relative compaction prior to placement of concrete for the structure support footings.

2. At the retaining wall location, the footing excavation is to be inspected and approved by a representative of the Office of Geotechnical Design-South II, Design Branch B prior to placing any steel or concrete.

3. The contractor is to allow five (5) working days for the inspection of the excavation to be completed. The structures representative is to provide the Office of Geotechnical Design–South II, Design Branch B a one-week notification prior to beginning the five-day contractor waiting period.

All other recommendations in the December 19, 2002, report are still applicable. Any questions regarding the above recommendations should be directed to the attention of Erich Neupert, (916) 227-4565 (CALNET 498-4565), or Mark DeSalvatore, (916) 227-5391 (CALNET 498-5391), at the Office of Geotechnical Design-South II, Branch B.

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To: MR. MICHAEL D. KEEVER
Structures Design
Office of Bridge Design-South
Bridge Design Branch 12
MS #9

Attention: Mr. Surjit Dhillon

Date: January 29, 2003

File: 11-SD-15-KP 38.1
11-080921
Bernardo Center Dr. UC
Br. #57-0577R/L

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES
OFFICE OF GEOTECHNICAL DESIGN – SOUTH II MS #5
DESIGN BRANCH B

Subject: Revised Foundation Recommendations

The following are Revised Foundation Recommendations for the Foundation Recommendation Report, dated December 19, 2002, for the Bernardo Center Dr. U.C. (Br. #57-0577 R/L), which was recently sent to your office. These revisions are due to the following:

1) The Ultimate Soil Bearing Pressure changing from 480 kPa to 960 kPa at the Bent 2 and 3 locations of the left bridge (southbound) replacement and the managed lanes widening.

2) The Gross Allowable Soil Bearing Pressure changing from 143.6 kPa to 149 kPa at the Abutments 1 and 4 locations of the right bridge (northbound) right side widening.

3) Changes in the length, stationing and bottom of footing elevations of the proposed Type 1 retaining walls at the left (southbound) bridge west side of Abutment 1 and 4 locations.

The revised Ultimate Bearing Pressures to be used for design for the left bridge (southbound) replacement and managed lanes widening and Gross Allowable Soil Bearing Pressures for the right bridge (northbound) right side widening are shown below in Table 1. Due to the proposed footings being place on either hard igneous or sandstone bedrock material, at these locations, the bottom of footing elevations and footing widths remain unchanged from the recent Foundation Report, dated December 19, 2002, even though the required bearing pressure has increased.

Table 1: Spread Footing Data

Support Location	Minimum Footing Width	Bottom of Subexcavation Elevation	Bottom of Footing Elevation	Recommended Soil Bearing Pressures	
				ASD [1]	LFD [2]
				Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}*)
Bent 2 Southbound Replacement Columns A,B,C,D,E	**4.58 m** (15.0 ft.)	**N/A**	**180.1m** (590.9 ft.)	**N/A**	**960.0 kPa (20.0 ksf)**
Bent 3 Southbound Replacement Columns A,B,C,D,E	**4.58 m** (15.0 ft.)	**N/A**	**178.6 m** (586.0 ft.)	**N/A**	**960.0 kPa (20.0 ksf)**
Bent 2 Managed Lanes Widening Column A	**4.27 m** (14.0 ft.)	**178.0 m** (584.0 ft.)	**178.6 m** (586.0 ft.)	**N/A**	**960.0 kPa (20.0 ksf)**
Bent 2 Managed Lanes Widening Column B	**4.27 m** (14.0 ft.)	**177.5 m** (582.3 ft.)	**178.0 m** (584.0 ft.)	**N/A**	**960.0 kPa (20.0 ksf)**
Bent 2 Managed Lanes Widening Column C,D	**4.27 m** (14.0 ft.)	**N/A**	**177.3 m** (581.7 ft.)	**N/A**	**960.0 kPa (20.0 ksf)**
Bent 3 Managed Lanes Widening Column A	**4.27 m** (14.0 ft.)	**N/A**	**177.3 m** (581.7 ft.)	**N/A**	**960.0 kPa (20.0 ksf)**
Bent 3 Managed Lanes Widening Column B	**4.27 m** (14.0 ft.)	**N/A**	**176.1 m** (577.8 ft.)	**N/A**	**960.0 kPa (20.0 ksf)**
Bent 3 Managed Lanes Widening Column C,D	**4.27 m** (14.0 ft.)	**N/A**	**175.5 m** (575.8 ft.)	**N/A**	**960.0 kPa (20.0 ksf)**
Abutment 1 Northbound Right Widening	**3.66 m** (12.0 ft)	**N/A**	**183.3 m** (601.4 ft.)	**149.0 kPa (3.2 ksf)**	**N/A**
Abutment 4 Northbound Right Widening	**3.66 m** (12.0 ft)	**N/A**	**180.7 m** (592.8 ft.)	**149.0 kPa (3.2 ksf)**	**N/A**

Notes: 1) Allowable Stress Design (ASD). The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 3 times the recommended Gross Allowable Soil Bearing Pressure (q_{all}).

2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}*).

The revised Gross Allowable Soil Bearing Pressures, stationing and bottom of footing elevations for the Type 1 retaining walls on the west side of the left bridge (southbound) Abutments 1 and 4 locations, are listed below in Table 2.

Table 2: Spread Footing Data
Type 1 – Retaining Walls (Abutments 1 and 2)

Support Location From "SD-15M" Line	Design Height of Wall "H"	Bottom of Footing Elevation	Recommended Soil Bearing Pressures	
			ASD [1]	LFD [2]
			Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}^*)
Sta. 42.99 m Lt. 379+20.28 To Sta. 42.99 m Lt. 379+23.52	1.2 m (3.9 ft)	191.85 m (629.4 ft)	80 kPa	N/A
Sta. 42.065 m Lt. 380+03.10 To Sta. 42.065 m Lt. 380+11.72	1.2 m (3.9 ft)	189.00 m (620.1 ft.)	80 kPa	N/A

Notes: 1) Allowable Stress Design (ASD). The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 3 times the recommended Gross Allowable Soil Bearing Pressure (q_{all}).
2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*).

All other recommendations in the December 19, 2002 report are still applicable. Any questions regarding the above recommendations should be directed to the attention of Erich Neupert, (916) 227-4565 (CALNET 498-4565), or Mark DeSalvatore, (916) 227-5391 (CALNET 498-5391), at the Office of Geotechnical Design-South II, Branch B.

Prepared by: Supervised by: Date: 2/3/03

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Bridge Design Branch 12, MS #9

Attention: Mr. Surjit Dhillon

Date: December 19, 2002

File: 11-SD-15-KP 38.1
11-080921
Bernardo Center Dr. UC
Br. #57-0577R/L

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES
OFFICE OF GEOTECHNICAL DESIGN – SOUTH II
DESIGN BRANCH B, MS #5

Subject: Foundation Recommendations

This report presents the foundation recommendations for the proposed replacement and widening of the Bernardo Center Dr. UC (Br. #57-0577R/L) bridges. The Office of Geotechnical Design-South II, Design Branch B completed a foundation investigation pursuant to the October 9, 2001 request by Structures Design, Office of Bridge Design-South for a foundation investigation and recommendations for the proposed replacement and widening of the structures.

The following foundation recommendations are based on subsurface information gathered during the recent foundation investigation (January/February and September 2002) performed by Caltrans, along with a review of the "As-built" soil data and original foundation investigations from 1964 and 1974, foundation reports from 1964 and 1975, "As-built" plans dated 1967 and 1981, as well as a memorandum from the Office of Roadway Geotechnical Engineering-South, dated July 26, 1999, investigating roadway distress at the left bridge Abutment 4 location. With regards to the current foundation recommendations, all elevations referenced within this report and shown on the Log of Test Boring sheets are based on the NAVD 1988 vertical datum.

Project Description/History

The project site is located on Interstate 15 in San Diego County just south of the city of Escondido where Bernardo Center Drive passes beneath Interstate 15. The bridge site is in an area of moderately low to steep rolling hills. The original left and right bridges consist of three span structures built in 1966. Abutments 1 and 4, of both bridges, are spread footings founded on embankment fill material. Bent 2 footings, for both original bridges, are spread footings founded on igneous bedrock, although the right bridge, Bent 2, right column footing is on structure backfill material. Bent 3 footings, for both bridges are spread footings founded on sandstone/siltstone material. The original bridges were widened in 1981. All support locations of the widened portion of the left bridge and Abutments 1 and 4 of the widened portion of the right bridge are on spread footings. Bent 2 footings of the widened portion of the left bridge are founded on igneous bedrock and Bent 3 footings are founded on sandstone/siltstone bedrock. Bent 2 and 3 support locations of the widened portion of the right bridge are supported on Cast-In-Drilled-Hole (CIDH) piles. In 1999 a geotechnical investigation was performed at the left bridge by the Office of Roadway

Geotechnical Engineering - South, (RGES) "to determine the cause of ground movement in the area of the bridge approaches, embankment fills, barrier rails, wingwalls and in encroachments attached to the structure." A memorandum provided by the Division of Structure Maintenance and Investigations, dated March 6, 2000, refers to the memorandum provided by RGES, dated July 26, 1999, and states "borings taken in the immediate vicinity of the backwall of both abutments documented the presence of sub-surface materials described in the report as fat clay, clayey sand, and silty clays". The report also states "there is a zone of highly plastic compressible clay from 3.3 m to 4.5 m below grade in the vicinity of Abutment 4, and the potential for volume change in this type of material is noted as relatively high."

Due to the current ground movement at the left bridge abutments it is currently proposed to completely remove the existing left (southbound) bridge as well as the existing abutment embankment fill material and replace it with new fill and a wider bridge structure. The proposed new left bridge will also include a managed lanes portion which will be built between the left and right bridges, and will become part of the new left bridge. The new left bridge as well as the new managed lanes portion are proposed to be three span cast in place, reinforced concrete box girder structures. Retaining wall structures are also proposed for the west side of the new southbound structure at the Abutment 1 and 4 locations.

The current proposal also includes removing the original right (northbound) bridge, but leaving the part of the bridge that was widened in 1981. A small portion of the original right bridge will then be replaced to the left side of the remaining structure, and a new widening will be built to the right side of the remaining structure. The proposed right bridge left replacement and right widening are proposed to be three-span, pre-stressed, precast I-girder structures.

Geology

The foundation investigation performed in January/February and September 2002 consisted of nine mud rotary borings all drilled with a Mobile Drill B-47 drill rig. The 2002 foundation investigation revealed that the soils encountered at the bridge site vary considerably across the length of the bridges. At Abutment 1 of the left and right bridges the embankment fill material is underlain by approximately four meters of medium dense sands, silty clays and fat clays, which is underlain by an intensely weathered igneous rock to the maximum depth explored (elev. 160.1 m in boring B-1-02). This igneous rock contact varies from approximate elevation 175.0 m at the west edge of the left bridge Abutment 1 location, to approximate elevation 179.0 m near the Abutment 1 midpoint, between the left and right bridges, and then generally drops in elevation to approximate elevation 170.0 m at the east side of the right bridge Abutment 1 location. At the east side of the right bridge Abutment 1 location, the igneous bedrock is overlain by approximately 2.5 meters of intensely weathered sandstone and siltstone.

At the Bent 2 locations, of the left bridge, the igneous bedrock is generally encountered immediately below the bent footings. At the Bent 2 locations of the right bridge, there is approximately six meters of sands, silts and clays extending down to approximate elevation 175.0 m, where approximately 2.5 m of intensely weathered sandstone and siltstone rock overlies the igneous bedrock.

At the Bent 3 locations of the left bridge, an intensely weathered sandstone, siltstone, and claystone is generally encountered immediately below the bent footings. At the Bent 3 location of the right bridge, there is approximately five meters of sand, silty sands and fat clays extending to approximate elevation 175.0 m, which is underlain by intensely weathered sandstone and claystone to the maximum depth explored (elev. 159.8 m in boring B-5-02).

At the Abutment 4 location of the left bridge, the abutment fill material is underlain by the intensely weathered sandstone, siltstone, and claystone bedrock. The top of this bedrock generally drops in elevation from approximate elevation 185.0 m at the west edge of the left bridge Abutment 4 to approximate elevation 172.0 m at the east side of the right bridge Abutment 4. At the Abutment 4 location of the right bridge, the abutment fill material is underlain by approximately two to five meters of sand and clay material before encountering the sandstone/claystone bedrock. Refer to the Log of Test Borings for site-specific soils data.

Ground Water

Ground water was encountered during the Caltrans subsurface investigation at a depth of 10.7 m (elev. 179.6 m) in boring B-4-02 on March 14, 2002 and at a depth of 3.1 m (elev. 178.3 m) in boring B-1-02 on April 11, 2002. During the 2002 foundation investigation, borings B-2-02, B-3-02, B-5-02, B-6a-02, B-6b-02, B-7-02, and B-8-02 were immediately backfilled after completion of drilling operations. Ground water was not measured in those borings. Ground water levels indicated in this report reflect the measured ground water level in the borehole on the specified date. Ground water surface elevations are subject to seasonal fluctuations and will be encountered at higher or lower elevations depending on conditions at time of construction.

Scour Potential

There is no scour potential at the site, since the bridge does not span any water course.

Corrosion

Corrosion test results for soil samples collected from borings B-3-02, B-4-02 and B-5-02 are shown below in Table 1. All of the soil samples tested are considered non-corrosive by current Caltrans standards.

Table 1 – Corrosion Test Summary

Location	Corrosion Test Number	pH	Minimum Resistivity (Ohm-Cm)	Sulfate Content (ppm)	Chloride Content (ppm)
Boring B-3-02 (Elev. 191.9-183.1 m)	02-0087	8.50	1600	36	25
Boring B-3-02 (Elev. 181.2-178.6 m)	02-0088	7.70	670	59	109
Boring B-4-02 (Elev. 190.3-182.4 m)	02-0089	7.70	640	81	175
Boring B-5-02 (Elev. 179.9-174.2 m)	02-0110	7.68	590	56	200
Boring B-5-02 (Elev. 170.8-167.7 m)	02-0111	8.00	570	49	60
Boring B-5-02 (Elev. 162.9-159.8m)	02-0113	8.73	690	110	<30

Note: Caltrans currently defines a corrosive environment as an area where the soil has a minimum resistivity of less than 1000 ohm-cm , and either contains more than 500 ppm of chlorides, more than 2000 ppm of sulfates, or has a pH of 5.5 or less.

Fault and Seismic Data

The structure site is potentially subject to strong ground motions from nearby earthquake sources during the design life of the new structure. Final Seismic Design Recommendations for the site have been provided in the memorandum dated June 6, 2002. The controlling fault for the site is the Newport-Inglewood-Rose Canyon/E fault with a maximum credible earthquake Mw=7.0 located approximately 22 kilometers southwest of the site. The corresponding Peak Bedrock Acceleration is estimated to be 0.3g. The above-mentioned memorandum states the potential for liquefaction at the site is considered to be minimal.

Foundation Recommendations – Bridge Structures

The following recommendations are for the proposed left bridge (southbound) replacement, managed lanes widening of the left bridge, and the right bridge (northbound) left side replacement and right side widening of the Bernardo Center Dr. UC bridges (Br. #57-0577 R/L), as shown on the General Plan dated May 20, 2002. A combination of shallow and deep foundations is recommended for support of the proposed Bernardo Center Dr. UC bridges. For the purposes of this report, bent columns for each structure section (i.e. Left (southbound) replacement, Managed Lanes, etc.) are lettered, beginning with the letter A and increasing from left to right.

Shallow Foundations

Spread footings are recommended for support at the Bent 2 and Bent 3 locations of the left (southbound) bridge and the managed lanes widening, as well as support of Abutments 1 and 4 of the right (northbound) bridge left side replacement and right side widening.

At the Bent 2 and 3 locations for both the left bridge (southbound) replacement and managed lanes widening, the bottom of the spread footings shall be located on undisturbed bedrock, as described earlier in the geology section. At the Abutment 1 and 4 locations of the right (northbound) bridge, right side widening, the spread footings are to be constructed on engineered fill compacted to 95% relative compaction. At the Abutment 1 and 4 locations of the right (northbound) bridge, left side

replacement, it is recommended to subexcavate the existing fill material 0.61 meters below the proposed bottom of footing elevations, and replace it with structure backfill compacted to 95% relative compaction up to the bottom of footing elevations. For limits of the material to be removed and replaced, refer to Construction Consideration #3. Bottom of footing elevations, bottom of subexcavation elevations and recommended soil bearing pressures are listed below in Table 2.

At the managed lanes widening, Bent 2, Columns A and B locations, it is recommended to subexcavate down to the bedrock and backfill with lean concrete up to the bottom of footing elevation. The bottom of subexcavation elevations are shown below in Table 2.

Table 2: Spread Footing Data

Support Location	Minimum Footing Width	Bottom of Subexcavation Elevation	Bottom of Footing Elevation	Recommended Soil Bearing Pressures	
				ASD [1]	LFD [2]
				Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}^*)
Bent 2 Southbound Replacement Columns A,B,C,D,E	**4.58 m** (15.0 ft.)	**N/A**	**180.1m** (590.9 ft.)	**N/A**	**480.0 kPa (10.0 ksf)**
Bent 3 Southbound Replacement Columns A,B,C,D,E	**4.58 m** (15.0 ft.)	**N/A**	**178.6 m** (586.0 ft.)	**N/A**	**480.0 kPa (10.0 ksf)**
Bent 2 Managed Lanes Widening Column A	**4.27 m** (14.0 ft.)	**178.0 m** (584.0 ft.)	**178.6 m** (586.0 ft.)	**N/A**	**480.0 kPa (10.0 ksf)**
Bent 2 Managed Lanes Widening Column B	**4.27 m** (14.0 ft.)	**177.5 m** (582.3 ft.)	**178.0 m** (584.0 ft.)	**N/A**	**480.0 kPa (10.0 ksf)**
Bent 2 Managed Lanes Widening Column C,D	**4.27 m** (14.0 ft.)	**N/A**	**177.3 m** (581.7 ft.)	**N/A**	**480.0 kPa (10.0 ksf)**
Bent 3 Managed Lanes Widening Column A	**4.27 m** (14.0 ft.)	**N/A**	**177.3 m** (581.7 ft.)	**N/A**	**480.0 kPa (10.0 ksf)**
Bent 3 Managed Lanes Widening Column B	**4.27 m** (14.0 ft.)	**N/A**	**176.1 m** (577.8 ft.)	**N/A**	**480.0 kPa (10.0 ksf)**
Bent 3 Managed Lanes Widening Column C,D	**4.27 m** (14.0 ft.)	**N/A**	**175.5 m** (575.8 ft.)	**N/A**	**480.0 kPa (10.0 ksf)**
Abutment 1 Northbound Left Replacement	**2.44 m** (8.0 ft.)	**183.9 m** (603.3 ft.)	**184.5 m** (605.3 ft.)	**127.0 kPa (2.6 ksf)**	**N/A**
Abutment 4 Northbound Left Replacement	**2.44 m** (8.0 ft.)	**181.6 m** (595.8 ft.)	**182.2 m** (597.8 ft.)	**127.0 kPa (2.6 ksf)**	**N/A**
Abutment 1 Northbound Right Widening	**3.66 m** (12.0 ft)	**N/A**	**183.3 m** (601.4 ft.)	**143.6 kPa (3.0 ksf)**	**N/A**
Abutment 4 Northbound Right Widening	**3.66 m** (12.0 ft)	**N/A**	**180.7 m** (592.8 ft.)	**143.6 kPa (3.0 ksf)**	**N/A**

Notes: 1) Allowable Stress Design (ASD). The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 3 times the recommended Gross Allowable Soil Bearing Pressure (q_{all}).

2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*).

The recommended gross allowable soil bearing pressures to be used for design, listed in Table 2, are based upon the following design criteria:

1) The abutment and bent footings have a minimum width as shown in Table 2.

2) All spread footings shall be constructed at or below the recommended elevations as shown in Table 2.

3) All abutment footings are positioned such that there will be a minimum horizontal distance of 1.22 meters (4.0 ft.) from the near face/top of the footing to the face of the finished slope for the seat abutments (Bridge Design Specifications 4.4.2.1), and 1.52 meters for the end-diaphragm abutments (Bridge Design Details 6-21).

4) The maximum slope in front of the abutment footings is not to exceed 1½:1 (Horizontal: Vertical).

If any of the above minimum footing widths or horizontal embedment depths are reduced, the Office of Geotechnical Design-South II, Branch B is to be contacted for reevaluation.

Deep Foundations

At Abutment 1 and 4 support locations of the left (southbound) replacement and the managed lanes widening, it is recommended to utilize driven **closed ended** Class 900 kN Alternative "W" pipe piles (non-concrete filled). The specified pile tip elevations are listed below in Table 3. The ultimate geotechnical pile capacity is two-times (2x) the specified design load for driven pipe pile with 700 kN design load.

Table 3
Driven Pile Data: Class 900, Alternative "W" Steel Pipe Piles (Closed Ended)

Location	Pile Type	Design Loading	Nominal Resistance		Drilling to Assist Driving Elevation	Design Tip Elevation	Specified Tip Elevation
			Compression	Tension			
Abutment 1 Southbound Replacement	Class 900 Alt. "W"	700 kN (78.7 tons)	1400 kN (157.4 tons)	-0-	172.0 m (564.3 ft)	170.5 m (1) (559.4 ft)	170.5 m (559.4 ft)
Abutment 4 Southbound Replacement	Class 900 Alt. "W"	700 kN (78.7 tons)	1400 kN (157.4 tons)	-0-	175.0 m (574.1 ft)	173.5 m (1) (569.2 ft)	173.5 m (569.2 ft)
Abutment 1 Managed Lanes Widening	Class 900 Alt. "W"	700 kN (78.7 tons)	1400 kN (157.4 tons)	-0-	172.0 m (564.3 ft)	170.5 m (1) (559.4 ft)	170.5 m (559.4 ft)
Abutment 4 Managed Lanes Widening	Class 900 Alt. "W"	700 kN (78.7 tons)	1400 kN (157.4 tons)	-0-	173.0 m (567.6 ft)	171.5 m (1) (562.7 ft)	171.5 m (562.7 ft)

Note: Design tip elevation is controlled by the following demands: (1) Compression

At Bents 2, and 3 support locations of the right bridge (northbound) left replacement and the northbound right widening, Cast-In-Drilled-Hole (CIDH) piles may be used for support, as requested by Structures Design, Office of Bridge Design-South. The specified pile tip elevations are listed below in Table 4. The ultimate geotechnical pile capacity for the CIDH piles will meet or exceed the required nominal resistance in compression. Refer to Table 4 below for the required nominal resistances.

Table 4: CIDH Pile Data

Location	Pile Type	Design Loading	Nominal Resistance		Bottom of Pile Cap Elevation	Design Tip Elevation	Specified Tip Elevation
			Compression	Tension			
Bent 2 Northbound Left Replacement	CIDH 610 mm	N/A	1,750 kN (197.0 tons)	600 kN (67.4 tons)	177.4 m	167.3 m (1) 172.5 m (2)	167.3 m
Bent 3 Northbound Left Replacement	CIDH 610 mm	N/A	1,750 kN (197.0 tons)	600 kN (67.4 tons)	175.5 m	163.9 m (1) 170.0 m (2)	163.9 m
Bent 2 Northbound Right Widening	CIDH 610 mm	N/A	1,550 kN (174.2 tons)	450 kN (50.6 tons)	179.3 m	168.1 m (1) 173.2 m (2)	168.1 m
Bent 3 Northbound Right Widening	CIDH 610 mm	N/A	1,550 kN (174.2 tons)	450 kN (50.6 tons)	177.6 m	165.1 m (1) 171.5 m (2)	165.1 m

Note: Design tip elevation is controlled by the following demands: (1) Compression, (2) Tension

Foundation Recommendations –Type 1 Retaining Walls

The proposed Type 1 Retaining Wall structures at the left (southbound) bridge west side of Abutment 1 and 4 locations may be supported on a combination of spread footing and pile foundations. Seven of the eight retaining wall segments will be placed on spread footings. Six of the seven segments are to be founded on engineered fill. One of the seven wall segments will be founded on bedrock. One retaining wall segment, at the Abutment 1 location, will need to be supported on deep foundations. The proposed structures are standard Type 1 Retaining Walls as shown in the "Standard Plans (July 1999)" on sheet B3-1 for Loading Case I.

Spread Footing Segments

The wall segments to be supported on engineered fill are as follows: At the Abutment 1 location, the three wall segments extending from approximate Sta. 42.9 m Lt. 379+16.96 to approximate Sta. 42.9 m Lt. 379+26.3 (from the "ML-2" line), and at the Abutment 4 location, the three wall segments extending from approximate Sta. 42.9 m Lt. 380+00.8 to approximate Sta. 42.9 m Lt. 380+10.0 (from the "ML-2" line). At these locations, all engineered fill material shall be

compacted to 95% relative compaction. The limits of engineered fill shall conform to the limits required for relative compaction under retaining wall footings without piles as defined in section 19-5.03 of the Standard Specifications. One spread footing segment of the retaining, at the Abutment 4 location, between approximate Sta. 42.9 m Lt. 379+97.2 to approximate Sta. 42.9 m Lt. 380+00.8 (from the "ML-2" line), will be founded directly on the sandstone/claystone bedrock. All retaining wall spread footings that will be constructed on the embankment slope are to be positioned such that they have a minimum horizontal footing embedment of 1.2 m, measured from the top of footing at the toe to the face of the finished slope (per Bridge Design Specifications 4.4.2.1). All spread footings shall have a minimum footing width and specified wall height as indicated in Table 5 and 6, below. The Gross Allowable Soil Bearing Pressures, for the portions of the walls to be supported on spread footings, are listed below in Tables 5 and 6.

Table 5: Spread Footing Data
Type 1 – Retaining Walls (Abutment 1)

Design Height of Wall "H"	Support Location From "ML2" Line	Minimum Footing Width "W"	Bottom of Footing Elevation	Recommended Soil Bearing Pressures	
				ASD [1]	LFD [2]
				Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}^*)
1.2 m (3.9 ft)	Approximate Sta. 42.9 m Lt. 379+16.96 To Approximate Sta. 42.9 m Lt. 379+21.40	1.0 m (3.3 ft)	192.7 m (632.2 ft)	80 kPa	N/A
2.4 m (7.9 ft)	Approximate Sta. 42.9 m Lt. 379+21.40 To Approximate Sta. 42.9 m Lt. 379+23.85	1.6 m (5.2 ft)	190.7m (625.7 ft.)	105 kPa	N/A
4.2 m (13.8 ft)	Approximate Sta. 42.9 m Lt. 379+23.85 To Approximate Sta. 42.9 m Lt. 379+26.30	2.45 m (8.0 ft.)	189.1 m (620.4 ft.)	160 kPa	N/A

Notes: 1) Allowable Stress Design (ASD). The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 3 times the recommended Gross Allowable Soil Bearing Pressure (q_{all}).

2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}^*).

Table 6: Spread Footing Data
Type 1 – Retaining Walls (Abutment 4)

Design Height of Wall "H"	Support Location From "ML-2" Line	Minimum Footing Width "W"	Bottom of Footing Elevation	Recommended Soil Bearing Pressures	
				ASD [1]	LFD [2]
				Gross Allowable Soil Bearing Pressure (q_{all})	Ultimate Soil Bearing Pressure (q_{ult}^*)
9.1 m (29.9 ft)	Approximate Sta. 42.9 m Lt. 379+97.2 To Approximate Sta. 42.9 m Lt. 380+00.8	**5.1 m** (16.7 ft)	**180.7 m** (592.8 ft)	**300 kPa**	**N/A**
3.0 m (9.8 ft)	Approximate Sta. 42.9 m Lt. 380+00.8 To Approximate Sta. 42.9 m Lt. 380+03.2	**1.9 m** (6.2 ft)	**186.7m** (612.5 ft.)	**120 kPa**	**N/A**
1.8 m (5.9 ft)	Approximate Sta. 42.9 m Lt. 380+03.2 To Approximate Sta. 42.9 m Lt. 380+05.9	**1.3 m** (4.3 ft.)	**188.0 m** (620.4 ft.)	**90 kPa**	**N/A**
1.2 m (3.9 ft)	Approximate Sta. 42.9 m Lt. 380+05.9 To Approximate Sta. 42.9 m Lt. 380+10.0	**1.0 m** (3.3 ft.)	**188.0 m** (620.4 ft.)	**80 kPa**	**N/A**

Notes: 1) Allowable Stress Design (ASD). The Maximum Contact Pressure, (q_{max}), is not to exceed the recommended Gross Allowable Soil Bearing Pressure, (q_{all}). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed 3 times the recommended Gross Allowable Soil Bearing Pressure (q_{all}).

2) Load Factor Design, (LFD). The Maximum Contact Pressure, (q_{max}), divided by the Strength Reduction Factor, (ϕ), is not to exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}*). The Ultimate Soil Bearing Capacity, (q_{ult}), will equal or exceed the recommended Ultimate Soil Bearing Pressure, (q_{ult}*).

Pile Foundation Segment

At the Abutment 1 location, along one segment of the retaining wall where the wall height "H" is 9.1 meters, it is recommended to utilize driven Class 400 kN Alternative "V" closed ended steel pipe piles for support. The specified pile tip elevations are shown below in Table 7. The ultimate geotechnical pile capacity is two-times (2x) the specified design load for driven pipe pile with 400 kN design load.

Table 7:
(Abutment 1 – Retaining Wall Segment)
Driven Pile : Class 400, Alternative "V" Steel Pipe Piles (Closed Ended)

Design Height of Wall "H"	Support Location (From ML-2 Line)	Pile Type	Design Loading	Nominal Resistance		Drilling to Assist Driving Elevation	Design Tip Elevation	Specified Tip Elevation
				Compression	Tension			
9.1 m (29.9 ft)	Approx. Sta. 42.9 m Lt. 379+26.3 To Approx. Sta. 42.9 m Lt. 379+29.8	Class 400 Alt. "V"	400 kN (45 tons)	800 kN (90 tons)	-0-	172.0 m (564.3 ft)	170.5m(1) (559.4 ft)	170.5 m (559.4 ft)

Note: Design tip elevation is controlled by the following demands: (1) Compression

General Notes:

1. All support locations are to be plotted in plan view on the Log of Test Borings as stated in "Memo to Designers" 4-2. The plotting of support locations should be made prior to requesting a final foundation review.

2. Structure excavation Type "D" is to be shown on the plans at all bent support locations.

3. When applicable, the structure engineer shall show on the plans, in the pile data table, the minimum pile tip elevation required meeting the lateral load demands. If the specified pile tip elevation required to meet lateral load demands exceeds the specified pile tip elevations given within this report, the Office of Geotechnical Design-South II, Branch B shall be contacted for further recommendations.

Construction Considerations:

Spread Footings:

1. A 30-day waiting period is required at Abutments 1 and 4 support locations where new fill material is being placed, prior to beginning construction of the abutment or retaining wall footings at those locations.

2. At the Abutment 1 and 4 support locations, for the right bridge (northbound) right side widening, as well as at the retaining wall segments to be supported on spread footings on fill material, concrete for the proposed support footings shall be placed neat against the undisturbed engineered fill on the bottom of the footing excavation. Should the bottom of the footing excavation be disturbed, then the disturbed soils shall be recompacted to 95% relative compaction prior to placement of concrete for the structure support footings.

3. At the Abutment 1 and 4 support locations, for the right bridge (northbound) left side replacement, all existing soils below the proposed bottom of footing elevations shall be subexcavated down to the elevations shown in Table 2, above, and replaced with structure backfill. The structure backfill shall be placed and compacted to 95% relative compaction. The limits of subexcavation and replacement with structure backfill below the footing is to be defined by the following limits: At the front of the footing, inclined planes sloping 1:1½ (vertical:horizontal) down and out from lines 0.3 m (1.0 ft.) outside the bottom edges of the footing down to the recommended subexcavation elevations shown in Table 2. At the back of the footing, and at the left (west) side of the footing, go out 0.3 m (1.0 ft) from the footing and then vertically down to the bottom of footing elevations shown in Table 2. Where the existing foundation meets the new foundation, the limits of subexcavated materials shall be a vertical plane to the recommended depth. The material under the existing foundations shall not be subexcavated.

4. At the Bent 2 and 3 footing locations of the left bridge (southbound) replacement, and the managed lanes widening, as well as the segment of retaining wall to be placed on bedrock at the left (southbound) Abutment 4 location, concrete shall be placed neat against the undisturbed bedrock material at the bottom of the footing excavations. Should the bottom of the footing excavation be disturbed, then the bottom of footing excavation shall be extended down at 0.15-meter intervals until undisturbed bedrock material is observed and approved by the Engineer. The subexcavated material is to be replaced with lean concrete. The native disturbed material is not to be recompacted.

5. At the Bent 2, Column A and B locations, of the managed lanes widening, all existing soils below the bottom of footing elevations shall be subexcavated down to the elevations shown in Table 2, above, and replaced with lean concrete. The minimum limits of the lean concrete are to be as follows: The level top of the lean concrete is to extend horizontally out from the bottom edge of the footing a minimum of 0.3 m, and dropping down and out to the bottom of the subexcavation at a 1 to ¾ (vertical to horizontal) ratio. All lean concrete shall be placed neat against the undisturbed bedrock at the bottom of the subexcavation and backfilled up to the bottom of footing elevations shown in Table 2. Should the bottom of the subexcavation be disturbed, the bottom of the subexcavation shall be extended down at 0.15-meter intervals until undisturbed bedrock materials are observed and approved by the Engineer. The subexcavated material is to be replaced with lean concrete. The native disturbed material is not to be recompacted.

6. At the Bent 2 and 3 locations, of the left (southbound) replacement, and the managed lanes widening, all excavations and subexcavations are to be inspected and approved by a representative of the Office of Geotechnical Design-South II, Design Branch B. At locations where no subexcavation is required, once the excavation has been completed to final grade, it is to be inspected prior to placing any steel or concrete. At locations where subexcavation is required, once the subexcavation has been completed to the required elevation, it is to be inspected prior to placing any lean concrete. The required inspection is to verify that the lean concrete is placed on top of the bedrock.

7. The contractor is to allow five (5) working days for the inspection of the excavations and subexcavations to be completed. The structures representative is to provide the Office of Geotechnical Design–South II, Design Branch B a one-week notification prior to beginning the five-day contractor waiting period.

8. Ground water will be encountered during excavation at the bent locations, therefore, structure excavation Type D should be anticipated at all bent support locations during excavation for footings. Refer to the Ground water section in this memorandum and the Log of Test Borings for ground water level information.

Driven Piles:

9. At Abutment 1 and 4 support locations of the left (southbound) replacement bridge and the managed lanes widening, as well as the one segment of retaining wall at the left (southbound) bridge Abutment 1, all piles are to be driven utilizing drilling to assist driving in accordance with Section 49-1.05 "Driving Equipment" of the Standard Specifications. The drilling to assist driving shall extend to the elevations shown in Table 3 above, for the bridge structures, and as shown in Table 7, above for the retaining wall segment on piles. Drilled holes to assist driving shall not be greater than 406 mm in diameter for the closed ended Alternative "W" pile locations, and not greater than 360 mm in diameter for the Alternative "V" pile locations. Equipment or methods used for advancing holes shall not cause quick soil conditions or cause scouring or caving of the hole. Water jets shall not be used.

10. Difficult drilling and pile installation should be anticipated due to the presence of very dense earth materials underlying the bridge site (see Log of Test Boring Sheets for details). The calculated load carrying capacity of the closed-ended pipe piles is based on end bearing only, therefore the contractor should anticipate hard driving. Field cutting and splicing of all pipe piles should be anticipated.

11. At the Abutment 1 and 4 support locations of the left (southbound) replacement bridge and the managed lanes widening, as well as the Abutment 1 retaining wall segment to be supported on piles, pile bearing will be assessed by the ENR equation. At the abutment and retaining wall support locations, any pile achieving two times (2x) the design loading shown on the contract plans within 1.2 meters of the specified pile tip elevation may be considered satisfactory and cut off with the engineers written approval. Two times the required design loading is 1400 kN for the Class 900 piles and 800 kN for the Class 400 piles.

CIDH Piles:

12. At the right (northbound) bridge left replacement and right widening Bent 2 and 3 locations, the load carrying capacity of the CIDH piles is based only on the skin friction capacity developed from 1.5 X the pile diameter (0.91 meter) below the bottom of pile cap elevation or below any fill material, to the zone within 1.5 X the pile diameter (0.91 meter) from the specified pile tip elevation. No end-bearing was considered.

13. Caving conditions may be encountered during CIDH pile construction. Temporary casing may be necessary to control caving during construction. All temporary casing is to be removed during concrete placement.

14. Ground water was encountered during drilling of test borings and ground water will be encountered during CIDH pile construction at all bent locations.

The recommendations contained in this report are based on specific project information regarding structure type, location, and design loads that have been provided by the Office of Bridge Design-South. If any conceptual changes are made during final project design, the Office of Geotechnical Design-South II, Design Branch B should review those changes to determine if these foundation recommendations are still applicable. Any questions regarding the above recommendations should be directed to the attention of Erich Neupert, (916) 227-4565 (CALNET 498-4565), or Mark DeSalvatore, (916) 227-5391 (CALNET 498-5391), at the Office of Geotechnical Design-South II, Branch B.

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