Geotechnical Investigations

1.1 General

The preliminary sub soil investigation has been carried out by Vax Consultants; Chennai (approved by NHAI). Subsoil condition is analyzed along with evaluation of field and laboratory data for determination of necessary physical and chemical characteristic of the in-situ soil strata.

1.1.1 Objective

The objective of Geo-technical Investigation is to evaluate the following:

- To ascertain the sub-soil strata at Cross drainage Structures site
- To study standing Ground Water Level
- To study the physical and engineering properties of soil strata and rock strata (if encountered).
- To evaluate allowable safe bearing capacity and settlements of soils/rock to design foundations for bridge.
- To Recommend type and depth of foundation
- To recommend improvements to the weak soil strata if any.

1.1.2 Scope and Methodology of the Work

The scope of work entrusted includes making bore holes at the proposed bridge locations and conducting the following Field (in situ) investigations and Laboratory Tests.

Field (In-situ) Investigations

1) Drilling bore holes of 150 mm diameter to a maximum depth of 20 to 25m or minimum of 3m in rock if rock is encountered earlier.
2) Collecting disturbed and undisturbed soil samples at regular depth intervals
3) Conducting field-testing such as Standard Penetration Tests as per IS 2131-1981 at every 1.5m depth intervals or wherever strata changes in Boreholes to determine N values as well as relative density and stiffness of the soil strata.
4) To study and record the standing Ground Water Table Level.
5) To ascertain the sub-soil strata and ground topography.

Laboratory Testing

The scope of Laboratory Testing is as follows:

1) Grain Size Analysis as per IS 2720 part 4 – 1985.
2) Specific Gravity as per IS 2720- part 3

3) Atterberg Limits as per IS 2720 part 5 1985.
4) Determination of natural moisture content as per IS 2720 part 2 - 1973.
5) Determination of natural density as per IS 2720
6) Determination of Strength Parameters(c & ϕ) as per IS 2720 - Part 13
7) Determination of water absorption, Specific Gravity and Unit weight of rock core samples

The following tests are conducted to obtain the soil/rock parameters.

1) Sieve Analysis
2) Moisture content tests
3) Specific Gravity test
4) Direct Shear test
5) Crushing Strength of rock samples

The details of geotechnical investigation done is given in **Table 1.1**

Table 1.1 Details of Geo Technical Investigations

Sl. No.	Bridge Number	Design Chainage (km)	Type of Structure	BH No.	Termination Depth from GL(m)	Remarks
Bridges						
1	10/1	9+032	T-beam	1	15.00	N=23
2	33/2	32+885	T-beam	1	15.00	N =49
3	41/1	40+420	T-beam	1	30.00	N>50
				1	25.50	N >50
				1	24.00	N >50
4	43/4	42+800	T-beam	1	25.00	N>50
				1	25.50	N >50
				1	25.50	N >50
5	46/1	45+160	RCC Slab	1	13.50	N >50
6	53/1	52+230	T-beam	1	25.50	N >50
				1	25.50	N >50
7	53/2	52+768	RCC Slab	1	15	N >50
8	55/2	54+860	T-beam	1	13.5	N >50
9	63/1	62+290	RCC Slab	1	12	N >50
10	69/2	68+700	T-beam	1	12.00	N >50
ROBs						
1		21+985	PSC Girder	1	21	N >50
				1	19.50	N >50
2		24+285	PSC Girder	1(A1)	25.00	N>50

Sl. No.	Bridge Number	Design Chainage (km)	Type of Structure	BH No.	Termination Depth from GL(m)	Remarks
				2(P1)	30.00	N >50
				3(P2)	30.00	N>50
				4(P3)	25.00	N>50
				5(A2)	30.00	N>50
Underpasses						
1		4+260	Single Cell Box	1	13.5	N >50
2		5+985	Single Cell Box	1	13.5	N =7
3		10+700	Single Cell Box	1	13.5	N =26
4		12+980	Single Cell Box	1	12	N >50
5		17+280	Single Cell Box	1	13.5	N =49
6		22+088	Single Cell Box	1	15.00	N =48
7		42+670	Single Cell Box	1	13.50	N >50
8		50+560	Single Cell Box	1	13.50	N >50
9		54+300	Single Cell Box	1	13.5	N >50
10		61+020	Single Cell Box	1	10.5	N >50
11		66+570	Single Cell Box	1	10.5	N >50
12		69+785	Single Cell Box	1	13.50	N >50

1.2 Subsurface Condition

The ground topography and geology was studied and the subsurface condition at each bore hole location was obtained. It was observed, in general, that the subsoil composition is of Clayey Silt with sand and gravel. At some locations. The bore logs are attached in the investigation report. The sub soil characteristics of the bore logs are described in Table 1.2

Table 1.2 Sub Soil Profile

Sl. No.	Design Chainage (km + m)	Bore Hole No.	Depth from Ground Surface (m)	Description of Strata
Bridges				
1.	9+032	1	1.50	Blackish Clayey Silt
			4.50	Blackish and Brownish Fine Sand with

Sl. No.	Design Chainage (km + m)	Bore Hole No.	Depth from Ground Surface (m)	Description of Strata
				Clayey Silt
			7.50	Greyish Clayey Silt
			10.50	Grayish medium Fine Sand with Clayey Silt
			15.00	Brownish Clayey Silt
			15.00	Brownish Greyish Silty Stiff Clay
			18.00	Brownish and Greyish Hard Clayey Silt with Kankar
			21.00	Brownish Medium Sand with Hard Clayey Silt
			25.00	Brownish Hard Clayey Silt
2.	32+885	1	1.50	Brownish Stiff Clay
			4.50	Brownish Sand
			7.50	Greyish Stiff Silty Clay with Sand
			15.00	Greyish/Brownish Silty Sand
3	40+420	1	1.50	Coarse Sand with Pebbles
			3.00	Medium Fine Sand with Kankar
			6.00	Brownish with Greyish Stiff Clayey Silt and Medium Sand
			7.50	Greyish Clayey Silt and Brownish Medium Sand
			9.00	Light Greyish Coarse Sand with Clayey Silt and Pebbles
			10.50	Greyish Clayey Silt with Fine Sand
			12.00	Brownish with Greyish Clayey Silt and Fine Sand with Pebbles
			15.00	Light Green with Clayey silt and Fine Sand
			16.50	Brownish Clayey Silt with Fine Sand
			18.00	Brownish Coarse Sand with Clayey Silt
			19.50	Brownish Clayey Silt with Fine Sand
			21.00	Brownish with Greyish Clayey Silt and Fine Sand
			22.50	Light Green with Clayey silt with Fine Sand
			24.00	Light Green with Clayey silt with Fine Sand
			25.50	Light Green with Clayey silt with Fine Sand
			27.00	Brownish Clayey Silt with Fine Sand
			28.50	Light Green with Brownish Clayey silt and Fine Sand with Kankar
			30.00	Brownish with Light Green Clayey Silt and Fine Sand
		2	3.00	Soft Clay
			7.50	Brownish Silty Fine Sand
			9.00	Brownish Medium Sand
			13.50	Brownish Silty Fine Sand
			16.50	Brownish Hard Clay with Fine Sand

Sl. No.	Design Chainage (km + m)	Bore Hole No.	Depth from Ground Surface (m)	Description of Strata
			19.50	Greyish Hard Clay
			25.50	Reddish Hard Clay with Medium Sand
			3.00	Brownish Silty Sandy Clay
			6.00	Brownish Silty Clayey Sand
		3	10.50	Silty Sand
			18.00	Greyish Silty Clay
			24.00	Reddish & Whitish Sandy Clay
			1.50	Sand with
			3.00	Medium Sand with Clay
			4.50	Medium Fine Sand
			7.50	Greyish Stiff Clay with Silt and Kankar
			9.00	Greyish with Brownish stiff clayey Silt
			12.00	Greyish with Brownish Clayey Silt with Fine Sand
			13.50	Light Green Clayey Silt with Fine Sand
		1	16.5	Light Green Clayey Silt with Coarse Sand
			18.00	Light Green Clayey Silt & Medium Sand with Pebbles
			19.50	Gravel with Coarse Sand Pebbles
4.	42+800		21.00	Light Green with Brownish Silty Sand with Clay
			22.50	Light Green with Brownish Clayey Silt and Fine Sand
			25.00	Light Green Coarse Sand with Clay
			3.00	Reddish Silty Medium Sand
			7.50	Brownish Stiff Clay
		2	13.50	Brownish Medium Silty Caly
			16.50	Brownish Stiff Clay
			25.50	Greyish Hard Clay with Sand
			3.00	Greyisj/Brownish Clayey Medium Sand
		1	9.00	Greyish Sandy Clay
			25.00	Brownish Clayey Silty Sand
			3.00	Greyish Clay with Gravel
5.	45+160	1	6.00	Greyish Sandy Clay
			10.50	Brownish Medium Sand
			13.50	Greyish Clay
		1	21.00	Brownish Silty Dense Fine sand with occasional Clay
			25.00	Brownish Clayey Sand with Gravel
6.	52+230		15.00	Brownish Medium Sand with occasional silt and gravel
		2	21.00	Greyish Clayey Sand with Gravel
			25.50	Brownish Silty Fine Sand
			4.50	Brownsh Clayey Silty Fine Sand
7.	52+768	1	6.00	Geyish Clay
			15.00	Brownish /Greyish Silty Clay with Sand
8.	54+860	1	3.00	Brownish Sand with Clay
			4.50	Brownish caly with Sandy Gravel

Sl. No.	Design Chainage (km + m)	Bore Hole No.	Depth from Ground Surface (m)	Description of Strata
			6.00	Brownish Clayey Sand
			7.50	Brownish Silty Sand with Gravel
			9.00	Brownish Clay with Gravel Sand
			12.00	Whitish Silty Fine Sand
			13.50	Greyish Silty Fine Sand
9.	62+290	1	6.00	Reddish Stiff Clay with Fine Sand
			9.00	Brownish Medium Sand
			12.00	Whitish Clay with Silty Fine Sand
10.	68+700	1	1.50	Brownish Silty Sand with Clay
			3.00	Brownish Medium Sand
			6.00	Whitish Silty Sand with Gravel
			9.00	Greyish Silty Clay
			12.00	Whitish Clay with Silty Sand
ROBs				
1.	21+985	1	3.00	Dark Brownish Stiff Clay
			6.00	Blakish Brown Stiff Clay
			10.50	Brownish Sand
			12.00	Blackish Sand
			15.00	Dark Brownish Sand
			18.00	Brownish Silty Clay
			21.00	Brownish Grey Sandy Hard Clay
		2	3.00	Brownish Clay
			6.00	Blackish Clay
			15.00	Brownish Medium Sand
			18.00	Brownish Clay with Sand
			19.50	Brownish Grey Sandy Hard Clay
2	24+285	1(A1)	4.50	Greyish Silty Fine Sand
			12.00	Brownish Clayey Silt
			15.00	Brownish Greyish Silty Stiff Clay
			18.00	Brownish and Greyish Hard Clayey Silt with Kankar
			21.00	Brownish Medium Sand with Hard Clayey Silt
			25.00	Brownish Hard Clayey Silt
		2(P1)	1.50	Brownish Fine Sand with Clayey Silt
			6.00	Brownish Silty Fine Sand
			7.50	Brownish And Greyish with Clayey Silty Fine Sand
			10.50	Brownish and Greyish Clayey Silt
			12.00	Greyish Stiff Clayey Silt with Kankar
			21.00	Greyish Stiff Clayey Silt
			25.50	Brownish Stiff Clayey Silt
			30.00	Brownish Dense Fine Sand with Kankar
		3(P2)	4.50	Brownish Clayey Silt
			7.50	Greyish and Stiff Clayey whitish Silt
			9.00	Greyish and Stiff Clayey Silt

Sl. No.	Design Chainage (km + m)	Bore Hole No.	Depth from Ground Surface (m)	Description of Strata
			19.50	Greyish Hard Clayey Silt with Kankar
			30.00	Dense hard Clayey Silt
		4(P3)	3.00	Brownish Clayey Silt
			4.50	Brownish Medium Fine Sand with Clayey Silt
			6.00	Brownish and Greyish Medium Fine Sand with Clayey Silt
			9.00	Brownish and Greyish Medium Fine Sand with Clayey Silt
			12.00	Brownish and Greyish Medium Fine Sand with Clayey Silt and Kankar
			19.50	Greyish Stiff Clayey Silt
			25.00	Brownish Dense Fine Sand with Hard Clayey Silt
		5(A2)	1.50	Brownish Silty Fine Sand with Clay
			3.00	Brownish Silty Fine Sand
			4.50	Brownish Silty Fine Sand with Clay
			6.00	Greyish Stiff Clayey Silt
			7.50	Brownish and Greyish Clayey Silt
			9.00	Greyish and Brownish Clayey Silt and Kankar
			12.00	Greyish Clayey Silt and Kankar
			13.50	Greyish and Brownish Clayey Silt and Kankar
			15.00	Brownish Clayey Silt and Kankar
			16.50	Gryeish Stiff Clayey Silt and Kankars
			21.00	Brownish Hard Stiff Clayey Silt and Kankar
			22.50	Brownish Hard Clayey Silt
			24.00	Brownish and Greyish Stiff Clayey Silt
			25.50	Brownish Hard Clayey Silt
			28.50	Greyish and Brownish with Clayey Silt
			30.00	Brownish with Hard Clayey Silt
UNDERPASSES				
1	4+260	1	6.00	Brownish Loose silty Sand
			13.50	Greyish Hard Silty Clayey Sand
2.	5+985	1	7.00	Brownish Medium Dense Sand
			13.50	Blackish Soft Clay with Fine Sand
3.	10+700	1	3.00	Dark Brownish Medium Stiff Clay
			4.50	Dark Brownish Silty Sand
			9.00	Dark Brownish Stiff Silty Clay
			10.50	Brownish Sandy Clay
			13.50	Yellowish Brown Stiff Clay
4.	12+980	1	12.00	Medium Sand
5.	17+280	1	3.00	Brownish Silty Fine Sand
			4.50	Brownish Sand
			7.50	Greyish Soft Clay
			13.50	Greyish & Brownish Fine Sandy Clay
6.	22+088	1	4.50	Dark Brownish Silty Sand

Sl. No.	Design Chainage (km + m)	Bore Hole No.	Depth from Ground Surface (m)	Description of Strata
			7.50	Dark Greyish Stiff Silty Clay
			10.50	Brownish Silty Sand
			15.00	Greyish Stiff Silty Clay
7.	42+670	1	4.50	Brownish Silty Sand
			9.00	Greyish Sandy Clay
			13.50	Reddish Brown Sandy Silty Clay
8.	50+560	1	7.50	Brownish Silty Fine to Coarse Sand with occasional Clay
			9.00	Brownish Clay with Gravel
			12.00	Brownish Silty Clay with Sand
			13.50	Greyish Silty Sand with Clay
9.	54+300	1	13.50	Dark Brownish Stiff Clay with Sand
10.	61+020	1	7.50	Reddish Silty Sandy Clay with Gravel
			10.5	Brownish Silty Clay with Fine Sand
11.	66+570	1	10.500	Brownish Stiff to very Stiff Clay with Silty Fine to Medium Sand
12	69+785	1	6.00	Brownish Core Sand with Gravel
			13.50	Grayish Silty Clay with Fine Sand

Based on the sub soil findings, suitable foundations are proposed.

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INTRODUCTION:

M/S Wilbur Smith Associates Pvt. Ltd. was awarded with the work of preparation of Detailed Project Report for Nagapatnam – Tanjavur – Trichy Section of NH67 – Package No. NHDP – III/DL4/01 in the State of Tamilnadu. **M/S Vax Consultants Pvt. Ltd., Chennai** was awarded with the work of conducting Geo-Technical Investigation at Bridge locations.

The scope of work includes, making standard soil investigation boreholes at all bridge locations, conducting field and laboratory tests on soil and rock samples collected, submitting report with soil condition at the bridge locations with recommendations for foundations for the bridge sub-structure.

Table No. 1, 2 and 3 indicate the Bridge location and number of boreholes, which are covered in the *entire scope of work.*

Table No. 1: List of Bridges (Following are the bridges and boreholes covered in Stage – II Report)

S. No.	Proposed Chainage	Proposed Scheme	Span Details	Super Structure	No of BHs
Bridges & ROBs					
1	22+625	Additional Two lane	1 x 10.9	RCC Slab	1
2	32+580	New Four lane(Bypass Location)	1 x 16	T-beam	1
3	40+440	New Four lane(Bypass Location)	5 x 24	T-beam	2
4	42+520	New Four lane(Bypass Location)	5 x 24	T-beam	2
5	47+230	New Four lane(Bypass Location)	1 x16	T-beam	1
6	52+100	New Four lane(Bypass Location)	7 x 24	T-beam	2
7	52+600	New Four lane(Bypass Location)			1
8	54+760	New Four lane(Bypass Location)	1 x 9	RCC Slab	1
9	64+750	New Four lane(Bypass Location)	1 x 8	RCC Slab	1
10	70+690	New Four lane(Bypass Location)	2 x 15	T-beam	1
11	132+200	New Four lane (Existing bridge Recon.)	3 x 8.8	RCC Slab	1 (2)
12	22+560	Additional Two lane	1 x 30	PSC girder	2
13	135+365	New Four lane (Existing bridge Recon.)	1 x 28	PSC girder	1 (2)
Underpasses					
14	4+300	New Four lane	10.0 x 5.50 (Single cell) – VUP	RCC BOX	1
15	6+000	New Four lane	10.0 x 5.50 (Single cell) – VUP	RCC BOX	1
16	10+700	New Four lane	10.0 x 5.50 (Single cell) – VUP	RCC BOX	1
17	13+000	New Four lane	10.0 x 5.50 (Single cell) – VUP	RCC BOX	1
18	18+200	New Four lane	10.0 x 5.50 (Twin cell) – VUP	RCC BOX	1
19	42+950	New Four lane	10.0 x 5.50 (Twin cell) – VUP	RCC BOX	1
20	50+350	New Four lane	4.00 x 4.00 (Single cell) – VUP	RCC BOX	1
21	54+300	New Four lane	10.0 x 5.50 (Single cell) – VUP	RCC BOX	1
22	63+450	New Four lane	10.0 x 5.50 (Twin cell) – VUP	RCC BOX	1
23	67+800	New Four lane	10.0 x 5.50 (Twin cell) – VUP	RCC BOX	1
24	68+600	New Four lane	4.00 x 4.00 (Single cell) – VUP	RCC BOX	1
25	71+700	New Four lane	4.00 x 4.00 (Single cell) – VUP	RCC BOX	1

Table No. 2: List of Bridges (Following are the bridges and boreholes covered in Stage – I Report)

S. No.	Proposed Chainage	Proposed Scheme	Span Details	Super Structure	No of BHs
Bridges & ROBs					
1	81+400	New Four lane	1 x 28.00 (ROB)	PSC girders	2
2	82+735	Additional Two lane	3 x 19.75	T-Beam	2
3	82+790	Additional Two lane	1 x 11.40	RCC Slab	1
4	83+535	Additional Two lane	1 x 12.70	RCC Slab	1
5	91+635	New Four lane (Existing bridge Recon.)	1 x 11.40	RCC Slab	1
6	94+700			RCC Slab	1
7	95+200			RCC Slab	1
8	95+800			RCC Slab	1
9	97+185	New Four lane along bypass location	3 x 20.00	T-Beam	2
10	101+555	New Four lane (Existing bridge Recon.)	1 x 7.450	RCC Slab	1
11	106+985	New Four lane (Existing bridge Recon.)	1 x 8.40	RCC Slab	1
12	107+890	New Four lane (Existing bridge Recon.)	3 x 6.00	RCC Slab	1
13	108+860	Additional Two lane	1 x 7.50	RCC Slab	1
14	108+950	New Four lane (Existing bridge Recon.)	1 x 6.75	RCC Slab	1
15	112+440	New Four lane (Existing bridge Recon.)	1 x 7.70	RCC Slab	1
16	117+080	Additional Two lane	1 x 16.3	T-Beam	1
17	119+345	New Four lane (Existing bridge Recon.)	1 x 10.5	RCC Slab	1
18	119+710	New Four lane (Existing bridge Recon.)	1 x 9.80	RCC Slab	1
19	120+285	Additional Two lane	1 x9.40	RCC Slab	1
20	128+175	New Four lane (Existing bridge Recon.)	1 x 20.1	RCC T beam	1
21	128+840	New Four lane (Existing bridge Recon.)	1 x 23.0 (ROB)	PSC girders	2
22	132+200	New Four lane (Existing bridge Recon.)	3 x 8.80	RCC Slab	1
23	135+365	New Four lane (Existing bridge Recon.)	1 x 28.0 ROB	PSC girders	1
24	135+745	New Four lane (Existing bridge Recon.)	3 x9.1	RCC Slab	1
Underpasses					
25	80+430	New Four lane	10.0 x 5.50 (Single cell) – VUP	RCC BOX	1
26	80+515	New Four lane	10.0 x 5.50 (Single cell) – VUP	RCC BOX	1
27	81+950	New Four lane	10.0 x 5.50 (Single cell) – VUP	RCC BOX	1
28	86+050	New Four lane	10.0 x 5.50 (Single cell) – VUP	RCC BOX	1
29	88+750	New Four lane	10.0 x 5.50 (Twin cell) – VUP	RCC BOX	1
30	89+900	New Four lane	10.0 x 5.50 (Twin cell) – VUP	RCC BOX	1
31	94+200	New Four lane	4.00 x 4.00 (Single cell) – VUP	RCC BOX	1

Note: At Chainages 132+200 and 135+365, recommendations and details for one BH (at A2) were submitted in Stage – I. Details of Boreholes at A1 were presented in Stage – II Report.

Table No. 3: List of Bridges (Following are the bridges and boreholes covered in Stage – III Report)

S. No.	Proposed Chainage	Proposed Scheme	Span Details	Super Structure	No of BHs
Bridges & ROBs					
1	9+180	New Four lane (Bypass location)	1 x 10.00	RCC Slab	1
2	24+470	New Four lane (Bypass location)	6 x 23.20 ROB		5
3	40+440	New Four lane (Bypass location)	5 x 24	T-beam	1
4	42+520	New Four lane (Bypass Location)	5 x 24	T-beam	1
5	44+930	New Four lane (Bypass Location)	1 x 8.00	RCC Slab	1
6	52+100	New Four lane(Bypass Location)	7 x 24.00	T-Beam	1

For bridges (Structures) at Chainages 40+440, 42+520, 52+100 (three structures, three boreholes), was not conducted earlier as there was water logging during the first stage of fieldwork. The same are covered in the second stage of fieldwork. Similarly, investigation at structures at Chainages 9+180, 24+470 and 44+930 (three structures, seven boreholes) were conducted in the second stage of field activity.

Thus, the scope of this Report is to provide the investigation details at the above-mentioned (Table 3) six bridge locations.

Detailed scope of work is the same as stated earlier and the same is enumerated below:

- Making required numbers of Standard Soil Investigation boreholes on the proposed alignment at abutment and pier locations, as directed by the client.
- Drilling in soils and rock strata to depths specified by the client
- Collecting soil and rock samples at regular depth intervals
- Conducting SPTs at every 1.5m depth intervals
- Conducting laboratory tests on soil and rock samples collected from the boreholes
- Submitting report with field and laboratory test results along with recommendations for foundations of bridge structures.

DESCRIPTION OF STRUCTURE:

The span arrangement and location details of the proposed bridge structures are given in **Table No. 3.**

The abutments and piers are subjected to IRC vehicular loads apart from gravity loads due to self-weight of superstructure and lateral loads due to thermal expansion, water current loads and braking forces. The abutments are subjected to large-scale lateral loads due to earth pressure and Live Load Surcharge effects.

The proposed Geo-Technical Investigation is basically to obtain the sub-soil profile effective for the bridges under consideration and the foundation design parameters.

HYDRAULIC PARTICULARS

Hydraulic parameters are incorporate in other relevant Reports and hence not provided here.

SOIL INVESTIGATION:

The details of field investigation, tests and laboratory tests conducted are presented here.

FIELD BORING AND SAMPLING:

150mm diameter boreholes are made at locations mentioned in Table No. 3 above.

The boreholes are terminated in hard strata as directed by the client. SPTs were conducted at every 1.5m depth intervals and samples were collected for identification and testing.

UDS samples were attempted to collect in strata where 5 < SPT <25.

The sub-soil water level was observed and this data was presented in the individual bore-logs along with the other field-test results and field data.

All the soil samples and some core samples were transported to the laboratory at Chennai for testing and finalizing the report.

LABORATORY TESTS

The laboratory-testing scheme is so designed to obtain the design parameters for the foundations. The following parameters are evaluated:

- Type of soil and it's gradation properties
- Consistency Limits;
- Natural Density;
- Natural Moisture Content (NMC);
- Strength Parameters such as Cohesion, Angle of Shearing Resistance and others;

In order to determine the above parameters, the following tests are conducted:

- Sieve analysis on the coarse grained soil fraction;
- Tests to determine Natural Moisture Content (NMC);
- Specific Gravity
- Direct shear test
- Crushing Strength of rock samples

All the test results are presented in the tabular forms. Comprehensive field information along with SPT values is presented on separate sheet.

:

SOIL PROFILE

The sub-soil profile at all the bridge locations is basically layered and the same is provided in individual bore logs.

DISCUSSION ON FOUNDATIONS:

The parameters that govern the type of foundations and depth of foundations are as below:

a) Design scour level under high flood conditions,

b) The strength of stratum just below the design scour level and,

c) Location of sub-soil water table

Each of the above conditions is considered and recommendations for foundations are made.

The subsoil profile indicates feasibility for providing open shallow foundations.

Most of the structures can be provided with open shallow foundations as mentioned below. However, the sub-soil conditions at Chainage 22+560, 40+440, Ch. 42+520, 52+100 do not suggest feasibility of open shallow foundations as the soil at such depths is found to be loose/soft as the case may be. Hence, at those chainages, Bored cast-in-situ piles of appropriate diameter and length are suggested. As per the stipulations of IRC:78 – 2000, the river bridges shall be provided with a minimum pile diameter of 1200mm and hence the same is suggested. The ROB at Chainage 22+560 may be provided with 1000mm diameter piles.

SBC calculations and Pile Capacity determinations are appended.

RECOMMENDATIONS:

Based on the sub-soil conditions encountered at the bridge locations, the following recommendations are made for various bridges under consideration.

- The details of SBCs and Capacities of Pile Foundations are presented in **Table No. 4.** It may be noted that, in the absence of hydraulic data at the bridge locations, appropriate scour depths are assumed while determining the SBCs and Pile Capacities.

Table No. 4: Recommended SBC details

S. No.	Proposed Chainage of Structure	Foundation Level	SBC (kN/Sq.)
1	9+180	4.5m below Ground Level	300
2	22+625	15m long Bored Cast in situ Piles	1750
3	24+470	1000mm diameter 17.5m long Bored piles	1600
4	32+580	15m long Bored Cast in situ Piles	1750
5	40+440	1200mm diameter, 17.5m long Bored Piles	2000
6	42+520	1200mm diameter, 17.5m long Bored Piles	2000
7	44+930	4.5m below Ground Level	350
8	47+230	5m below Ground Level	400
9	52+100	4.5m below Ground Level	300
10	52+600	17.5m long Bored Cast in situ Piles	2000
11	54+760	4m below Ground Level	350

12	64+750	4m below Ground Level	350
13	70+690	4m below Ground Level	400
14	132+200	5m below Ground Level	375
15	22+560	17.5m long Bored Cast in situ Piles	2000
16	135+365	4m below Ground Level	350
17	4+300	3m below Ground Level	100
18	6+000	3m below Ground Level	300
19	10+700	4.5m below Ground Level	200
20	13+000	3m below Ground Level	100
21	18+200	3m below Ground Level	300
22	42+950	3m below Ground Level	300
23	50+350	4.5m below Ground Level	300
24	54+300	3m below Ground Level	250
25	63+450	3m below Ground Level	300
26	67+800	3m below Ground Level	300
27	68+600	4.5m below Ground Level	300
28	71+700	3m below Ground Level	300

- Foundation Concreting in case of open Foundations shall be done in dry conditions.

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Ground surface level:	
Ground Water Table:	
Type of boring:	**Rotary**
Inclination:	**Vertical**
Boring:	**0.00-13.5m**

Location :	**CH:4+300**
Bore hole No:	**BH-1**
Soil Sampler Used	**SPT & UDS**
Date started:	**26-11-05**
Date Completed:	**26-11-05**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface(m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Loose silty Fine **SAND**	*Refer Summary of Laboratory Test Results*		4.50	-4.500	2	2	3	5	SPT	1	1.50	
					2	3	4	7	SPT	2	3.00	
					2	3	5	8	SPT	3	4.50	
Brownish Loose silty **SAND**			6.00	-6.000	2	4	5	9	SPT	4	6.00	
Greyish Stiff silty Clayey **SAND**			9.00	-9.000	3	4	7	11	SPT	5	7.00	
					3	4	8	12	SPT	6	9.00	
Greyish Hard silty Clayey **SAND**			13.50	-13.500	10	11	12	23	SPT	7	10.50	
					10	15	20	35	SPT	8	12.00	
					16	24	29	53	SPT	9	13.50	

Borehole Terminated at the depth of 13.5 meters

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Ground surface level:	
Ground Water Table:	
Type of boring:	**Rotary**
Inclination:	**Vertical**
Boring:	**0.00-13.5m**

Location	**CH:6+000**
Bore hole No	**BH- 1**
Soil Sampler Used	**SPT & UDS**
Date started	**26-11-05**
Date Completed	**26-11-05**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Medium dense **SAND**	*Refer Summary of Laboratory Test Results*				5	7	8	15	SPT	1	1.50	
					4	5	7	12	SPT	2	3.00	
					6	8	10	18	SPT	3	4.50	
					8	10	12	22	SPT	4	6.00	
			7.00	-7.000	9	11	12	23	SPT	5	7.00	
Blackish Soft **CLAY** with fine **SAND**					1	1	2	3	SPT	6	9.00	
					1	2	4	6	SPT	7	10.50	
					1	1	2	3	SPT	8	12.00	
			13.50	-13.500	1	3	4	7	SPT	9	13.50	

Borehole Terminated at the depth of 13.5 meters

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Geo-technical Engineering Division

Project: Geo - Technical Investigation for Preparation of DPR to Four / Six Laning of Nagapattinam - Tanjaoor - Trichy Section of NH - 67 in Tamil Nadu.

Ground surface level**:**		Chainage	**9/032**
Ground Water Table**:**	2.0m	Bore hole No:	**1**
Type of boring:	**Rotary/Calyx Rig**	Soil Sampler Used	**SPT & UDS**
Inclination:	**Vertical**	Date started	**03-05-2006**
Boring:	**0.00 to 15.00**	Date Completed	**05-05-2006**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Dark Grayish silty **CLAY**			1.50	-1.500	2	2	3	5	SPT		1.50	
Greyish fine Sand with **CLAY**					2	3	4	7	SPT	S1	3.00	
					3	2	3	5	SPT	S2	4.50	
					3	4	5	9	SPT		6.00	
					4	4	6	10	SPT		7.50	
					6	9	9	18	SPT	S3	9.00	
			10.50	-10.500	6	7	10	17	SPT	S4	10.50	
Brownish Hard **CLAY**					7	10	10	20	SPT		12.00	
					7	9	13	22	SPT	S5	13.50	
			15.00	-15.000	5	8	15	23	SPT	S6	15.00	

Borehole Terminated at Depth of 15.00 meters

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Ground surface level:	
Ground Water Table:	
Type of boring:	Rotary
Inclination:	Vertical
Boring:	0.00-13.5 m

Location	CH:10+700
Bore hole No	BH 1
Soil Sampler Used	SPT & UDS
Date started	28-11-2005
Date Completed	28-11-2005

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface(m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Dark Brownish Medium Stiff **CLAY**	*Refer Summary of Laboratory Test Results*		3.00	-3.000	3	3	3	6	SPT	1	1.50	
					3	3	4	7	SPT	2	3.00	
Dark Brownish Silty **SAND**			4.50	-4.500	7	8	10	18	SPT	3	4.50	
Dark Brownish Stiff Silty **CLAY**			9.00	-9.000	5	5	7	12	SPT	4	6.00	
					5	6	9	15	UDS	5	7.50	
					6	7	10	17	SPT	6	9.00	
Brownish Sandy **CLAY**			10.50	-10.500	10	11	13	24	SPT	7	10.50	
Yellowish Brown Stiff **CLAY**			13.50	-13.500	9	12	13	25	SPT	8	12.00	
					8	12	14	26	SPT	9	13.50	

Borehole Terminated at the depth of 13.5 meters

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Ground surface level:	
Ground Water Table:	
Type of boring:	**Rotary**
Inclination:	**Vertical**
Boring:	**0.00-12 m**

Location	**CH:13+000**
Bore hole No	**BH- 1**
Soil Sampler Used	**SPT & UDS**
Date started	**1-12-2005**
Date Completed	**2-12-2005**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Medium **SAND**	Refer Summary of Laboratory Test Results				3	4	5	9	SPT	1	1.50	
					4	5	5	10	SPT	2	3.00	
					5	6	6	12	SPT	3	4.50	
					7	9	10	19	SPT	4	6.00	
					9	13	15	28	SPT	5	7.50	
					11	16	20	36	SPT	6	9.00	
					13	18	22	40	SPT	7	10.50	
			12.00	-12.000	16	21	35	56	SPT	8	12.00	

Borehole Terminated at the depth of 12.0 meters

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Ground surface level:	
Ground Water Table:	
Type of boring:	Rotary
Inclination:	Vertical
Boring:	0.00-13.5 m

Location	CH:18+200
Bore hole No	BH-1
Soil Sampler Used	SPT & UDS
Date started	27-11-05
Date Completed	27-11-05

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface(m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Silty fine **SAND**	*Refer Summary of Laboratory Test Results*				3	4	5	9	SPT	1	1.50	
			3.00	-3.000	3	5	7	12	SPT	2	3.00	
Brownish **SAND**			4.50	-4.500	2	2	3	5	SPT	3	4.50	
Greyish Soft **CLAY**					3	3	6	9	SPT	4	6.00	
			7.50	-7.500					UDS	5	7.50	
Greyish & Brownish Fine Sandy **CLAY**					7	9	13	22	SPT	6	9.00	
					9	11	16	27	SPT	7	10.50	
					12	14	18	32	SPT	8	12.00	
			13.50	-13.500	15	19	20	49	SPT	9	13.50	

Borehole Terminated at the depth of 13.5 meters

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Ground surface level:	
Ground Water Table:	
Type of boring:	**Rotary**
Inclination:	**Vertical**
Boring:	**0.00-21.0 m**

Location	**CH:22+560**
Bore hole No	**BH1A1**
Soil Sampler Used	**SPT & UDS**
Date started	**28-11-2005**
Date Completed	**29-11-2005**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface(m)	R.L of lower contact	SPT Details 15	30	45	N	Samples Type	No	Depth(m)	Remarks
Dark Brownish Stiff **CLAY**	*Refer Summary of Laboratory Test Results*				3	5	6	11	SPT	1	1.50	
			3.00	-3.000	4	6	7	13	SPT	2	3.00	
Blackish Brown Stiff **CLAY**					4	4	7	11	SPT	3	4.50	
			6.00	-6.000	5	6	6	12	SPT	4	6.00	
Brownish **SAND**					8	9	12	21	SPT	5	7.50	
					9	10	13	23	SPT	6	9.00	
			10.50	-10.500	8	9	10	19	SPT	7	10.50	
Blackish **SAND**			12.00	-12.000	8	10	11	21	SPT	8	12.00	
Dark Brownish **SAND**					12	20	24	44	SPT	9	13.50	
			15.00	-15.000	12	21	25	46	SPT	10	15.00	
Brownish Silty **CLAY**					10	11	13	24	SPT	11	16.50	
			18.00	-18.000	11	12	14	26	SPT	12	18.00	
Brownish Grey Sandy Hard **CLAY**					16	50 Blows/5cm			SPT	13	19.50	
			21.00	-21.000	30	50 Blows/3cm			SPT	14	21.00	

Borehole Terminated at the depth of 21.00 meters

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Ground surface level:	
Ground Water Table:	
Type of boring:	Rotary
Inclination:	Vertical
Boring:	0.00-19.5 m

Location	CH:22+560
Bore hole No	BH2A2
Soil Sampler Used	SPT & UDS
Date started	28-11-2005
Date Completed	29-11-2005

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish **CLAY**	*Refer Summary of Laboratory Test Results*		3.00	-3.000	2	3	5	8	SPT	1	1.50	
					3	4	6	10	SPT	2	3.00	
Blackish **CLAY**			6.00	-6.000	4	5	7	12	SPT	3	4.50	
					5	6	9	15	SPT	4	6.00	
Brownish Medium **SAND**			15.00	-15.000	6	8	9	17	SPT	5	7.50	
					8	9	10	19	SPT	6	9.00	
					9	10	12	22	SPT	7	10.50	
					10	11	13	24	SPT	8	12.00	
					12	16	22	38	SPT	9	13.50	
					13	20	25	45	SPT	10	15.00	
Brownish Clay with **SAND**			18.00	-18.000	10	12	15	27	SPT	11	16.50	
					18	50 Blows/10cm			SPT	12	18.00	
Brownish Grey Sandy Hard **CLAY**			19.50	-19.500	34	50 Blows/6cm			SPT	13	19.50	

Borehole Terminated at the depth of 19.50 meters

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Ground surface level:	
Ground Water Table:	
Type of boring:	**Rotary**
Inclination:	**Vertical**
Boring:	**0.00-15.0 m**

Location	**CH:22+625**
Bore hole No.	**BH1-A2**
Soil SamplerUsed	**SPT & UDS**
Date started	**26-11-2005**
Date Completed	**26-11-2005**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Dark Brownish Silty **SAND**	*Refer Summary of Laboratory Test Results*				2	3	3	6	SPT	1	1.50	
					6	7	8	15	SPT	2	3.00	
			4.50	-4.500	8	13	10	23	SPT	3	4.50	
Dark Greyish Stiff Silty **CLAY**					4	6	10	16	SPT	4	6.00	
			7.50	-7.500	4	7	11	18	SPT	5	7.50	
Brownish Silty **SAND**					8	9	14	23	SPT	6	9.00	
			10.50	-10.500	9	9	16	25	SPT	7	10.50	
Greyish Stiff Silty **CLAY**					10	15	21	36	SPT	8	12.00	
					10	17	23	40	SPT	9	13.50	
			15.00	-15.000	17	20	28	48	SPT	11	15.00	

Borehole Terminated at the depth of 15.00 meters

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Geo-technical Engineering Division

Project: Geo - Technical Investigation for Preparation of DPR to Four / Six Laning of Nagapattinam - Tanjaoor - Trichy Section of NH - 67 in Tamil Nadu.

Ground surface level**:**		Chainage	**24/285**
Ground Water Table**:**	**2.20m**	Bore hole No:	**1(A1)**
Type of boring:	**Rotary/Calyx Rig**	Soil Sampler Used	**SPT & UDS**
Inclination:	**Vertical**	Date started	**26-04-2006**
Boring:	**0.00 to 25.00**	Date Completed	**28-04-2006**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Silty fine Sand with **CLAY**			1.50	-1.500	3	3	3	6	SPT	S1	1.50	
Brownish, Greyish Silty **CLAY**			3.00	-3.000	4	4	5	9	SPT	S2	3.00	
Greyish fine Sandy Gravel wit **CLAY**			6.00	-6.000	5	6	6	12	SPT	S3	4.50	
					6	7	8	15	SPT		6.00	
Brownish SILTY **CLAY**			12.00	-12.000	5	5	7	12	SPT	S4	7.50	
					4	6	5	11	SPT		9.00	
					4	6	7	13	SPT	S5	10.50	
					5	6	10	16	SPT	S6	12.00	
Greyish, Brownish Silty Clay with **SAND**			18.00	-18.000	8	12	20	32	SPT	S7	13.50	
					10	17	23	40	SPT	S8	15.00	
					9	19	22	41	SPT		16.50	
					15	18	20	38	SPT	S9	18.00	
Brownish fine Sand with **CLAY**			21.00	-21.000	20	20	29	49	SPT		19.50	
					18	22	24	46	SPT		21.00	
Brownish Silty **CLAY**			25.00	-25.000	18	20	23	43	SPT		22.50	
					21	24	27	51	SPT	S10	25.00	

Borehole Terminated at Depth of 25.00 meters

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Project: Geo - Technical Investigation for Preparation of DPR to Four / Six Laning of Nagapattinam - Tanjaoor - Trichy Section of NH - 67 in Tamil Nadu.3

Ground surface level**:**		Chainage	**24/285**
Ground Water Table**:**	**2.40m**	Bore hole No:	**2(P1)**
Type of boring:	**Rotary/Calyx Rig**	Soil Sampler Used	**SPT & UDS**
Inclination:	**Vertical**	Date started	**03-05-2006**
Boring:	**0.00 to 30.00**	Date Completed	**06-05-2006**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Silty **CLAY**					2	2	3	5	SPT	S1	1.50	
			3.00	-3.000	2	3	5	8	SPT		3.00	
Brownish Silty Clay with fine **SAND**					3	6	8	14	SPT	S2	4.50	
			6.00	-6.000	4	7	10	17	SPT	S3	6.00	
Brownish Hard **CLAY**					6	6	9	15	SPT	S4	9.00	
					5	8	10	18	SPT	S5	10.50	
					10	10	12	22	SPT		12.00	
					9	10	11	21	SPT	S6	13.50	
					10	12	13	25	SPT		15.00	
					6	8	10	18	SPT	S7	16.50	
					7	9	13	22	SPT	S8	18.00	
					6	10	11	21	SPT		19.50	
					6	11	15	26	SPT	S9	21.00	
					7	15	19	34	SPT		22.50	
			24.00	-24.000	9	16	20	36	SPT	S10	24.00	
Brownish Silty fine **SAND**					10	20	21	41	SPT		25.50	
					11	18	26	44	SPT		27.00	
					15	22	36	58	SPT	S11	28.50	
			30.00	-30.000	17	27	40	67	SPT	S12	30.00	

Borehole Terminated at Depth of 30.00 meters

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Project: Geo - Technical Investigation for Preparation of DPR to Four / Six Laning of Nagapattinam - Tanjaoor - Trichy Section of NH - 67 in Tamil Nadu.

Ground surface level**:**		Chainage	**24/285**
Ground Water Table**:**	**2.20m**	Bore hole No:	**3(P2)**
Type of boring:	**Rotary/Calyx Rig**	Soil Sampler Used	**SPT & UDS**
Inclination:	**Vertical**	Date started	**28-04-2006**
Boring:	**0.00 to 30.00**	Date Completed	**01-05-2006**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Silty **CLAY**			3.00	-3.000	4	5	5	10	SPT		1.50	
					5	6	8	14	SPT		3.00	
Greyish Silt Clay with Medium **SAND**			7.50	-7.500	6	8	9	17	SPT	S1	4.50	
					7	9	11	20	SPT	S2	6.00	
					8	10	14	24	SPT	S3	7.50	
Brownish Stiff **CLAY**			25.50	-25.500	9	14	18	32	SPT		9.00	
					11	18	27	45	SPT		10.50	
					10	15	16	31	SPT	S4	12.00	
					9	18	18	36	SPT		13.50	
					11	18	22	40	SPT	S5	15.00	
					14	20	25	45	SPT		16.50	
					12	17	33	50	SPT		18.00	
					16	20	29	49	SPT	S6	19.50	
					17	21	30	51	SPT		21.00	
					15	23	31	54	SPT		22.50	
					12	17	38	55	SPT		24.00	
					14	20	40	60	SPT		25.50	
Brownish Silty Clay with medium **SAND**			30.00	-30.000	21	24	44	68	SPT	S7	27.00	
					19	30	43	73	SPT		28.50	
					25	35	45	80	SPT		30.00	

Borehole Terminated at Depth of 30.00 meters

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Project: Geo - Technical Investigation for Preparation of DPR to Four / Six Laning of Nagapattinam - Tanjaoor - Trichy Section of NH - 67 in Tamil Nadu.

Ground surface level**:**		Chainage	**24/285**
Ground Water Table**:**	**2.40m**	Bore hole No:	**4(P3)**
Type of boring:	**Rotary/Calyx Rig**	Soil Sampler Used	**SPT & UDS**
Inclination:	**Vertical**	Date started	**30-04-2006**
Boring:	**0.00 to 25.00**	Date Completed	**02-05-2006**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Silty Sand with **CLAY**					3	3	4	7	SPT		1.50	
			3.00	-3.000	3	4	5	9	SPT	S1	3.00	
Brownish Silty clay with **SAND**					5	5	5	10	SPT		4.50	
					4	5	6	11	SPT		6.00	
					6	6	8	14	SPT	S2	7.50	
					5	10	11	21	SPT		9.00	
			10.00	-10.500	5	11	12	23	SPT		10.50	
Brownish Stiff **CLAY**					7	11	14	25	SPT		12.00	
					5	10	13	23	SPT	S3	13.50	
					7	11	15	26	SPT		15.00	
					9	13	25	38	SPT		16.50	
					10	13	27	40	SPT	S4	18.00	
					8	15	27	42	SPT		19.50	
					11	16	30	46	SPT		21.00	
					10	14	29	43	SPT	S5	22.50	
			25.00	-25.000	15	20	29	49	SPT		25.00	

Borehole Terminated at Depth of 25.00 meters

Vax Consultants Pvt. Ltd.,
Foundation and Structural Engineers

Geo-technical Engineering Division

Project: Preparation of Detailed Project Report for Nagapatnam – Tanjavur – Trichy Section of NH67 – Package No. NHDP – III/DL4/01 in the State of Tamilnadu - Geo-Technical Investigation.

Ground surface level:	
Ground Water Table:	
Type of boring:	**Rotary**
Inclination:	**Vertical**
Boring:	**0.00-15.0 m**

Location	**CH:22+625**
Bore hole No.	**BH1-A2**
Soil SamplerUsed	**SPT & UDS**
Date started	**26-11-2005**
Date Completed	**26-11-2005**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Dark Brownish Silty **SAND**	*Refer Summary of Laboratory Test Results*				2	3	3	6	SPT	1	1.50	
					6	7	8	15	SPT	2	3.00	
			4.50	-4.500	8	13	10	23	SPT	3	4.50	
Dark Greyish Stiff Silty **CLAY**					4	6	10	16	SPT	4	6.00	
			7.50	-7.500	4	7	11	18	SPT	5	7.50	
Brownish Silty **SAND**					8	9	14	23	SPT	6	9.00	
			10.50	-10.500	9	9	16	25	SPT	7	10.50	
Greyish Stiff Silty **CLAY**					10	15	21	36	SPT	8	12.00	
					10	17	23	40	SPT	9	13.50	
			15.00	-15.000	17	20	28	48	SPT	11	15.00	

Borehole Terminated at the depth of 15.00 meters

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Geo-technical Engineering Division

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Ground surface level:	
Ground Water Table:	
Type of boring:	Rotary
Inclination:	Vertical
Boring:	0.00-15.0 m

Location	CH:32+580
Bore hole No	BH-1
Soil Sampler Used	SPT & UDS
Date started	25-11-2005
Date Completed	25-11-2005

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Stiff **CLAY**	*Refer Summary of Laboratory Test Results*		1.50	-1.500	2	3	2	5	SPT	1	1.50	
Brownish **SAND**					8	8	8	16	SPT	2	3.00	
			4.50	-4.500	6	7	10	17	SPT	3	4.50	
Greyish Stiff Silty **CLAY** with Sand					8	7	8	15	SPT	4	6.00	
			7.50	-7.500	8	9	10	19	SPT	5	7.50	
Greyish/Brownish Silty **SAND**					12	15	16	31	SPT	6	9.00	
					13	16	17	33	SPT	7	10.50	
					18	19	22	41	SPT	8	12.00	
					18	25	20	45	SPT	9	13.50	
			15.00	-15.000	20	24	25	49	SPT	11	15.00	

Borehole Terminated at the depth of 15.00 meters

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Chennai.

Geo-technical Engineering Division

Project: Geo - Technical Investigation for Preparation of DPR to Four / Six Laning of Nagapattinam - Tanjaoor - Trichy Section of NH - 67 in Tamil Nadu.

Ground surface level**:**		Chainage	**40/420**
Ground Water Table**:**	**2.00m**	Bore hole No:	**1**
Type of boring:	**Rotary/Calyx Rig**	Soil Sampler Used	**SPT & UDS**
Inclination:	**Vertical**	Date started	**13-05-2006**
Boring:	**0.00 to 30.00**	Date Completed	**15-05-2006**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Silty **SAND**			3.00	-3.000	4	4	6	10	SPT	S1	1.50	
					5	6	9	15	SPT		3.00	
Greyish Yellowish Silty Sand with **CLAY**			9.00	-9.000	8	9	11	20	SPT	S2	4.50	
					8	11	13	24	SPT		6.00	
					7	11	15	26	SPT	S3	7.50	
					8	11	17	28	SPT	S4	9.00	
Brownish Sand and pebbles with **CLAY**			21.00	-21.000	10	13	18	31	SPT	S5	10.50	
					9	12	20	32	SPT	S6	12.00	
					8	13	22	35	SPT	S7	13.50	
					10	16	25	41	SPT		15.00	
					11	18	27	45	SPT	S8	16.50	
					10	25	36	61	SPT		18.00	
					12	23	34	57	SPT	S9	19.50	
					18	25	95	120	SPT		21.00	
Brownish Silty Clay with fine **SAND**			30.00	-30.000	20	27	43	70	SPT		22.50	
					19	22	45	67	SPT		24.00	
					17	23	41	64	SPT		25.50	
					15	20	38	58	SPT	S10	27.00	
					16	25	30	55	SPT		28.50	
					14	21	23	44	SPT	S11	30.00	

Borehole Terminated at Depth of 30.00 meters

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Geo-technical Engineering Division

Project: Preparation of Detailed Project Report for Nagapatnam – Tanjavur – Trichy Section of NH67 – Package No. NHDP – III/DL4/01 in the State of Tamilnadu - Geo-Technical Investigation.

Ground surface level:	
Ground Water Table:	
Type of boring:	Rotary/CalyxRi
Inclination:	Vertical
Boring:	0.00-25.5 m

Location	CH:40+440
Bore hole No	BH1A1
Soil Sampler Used	SPT & UDS
Date started	1-12-2005
Date Completed	2-12-2005

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface(m)	R.L of lower contact	SPT Details 15	30	45	N	Samples Type	No	Depth(m)	Remarks
Soft **CLAY**	*Refer Summary of Laboratory Test Results*				2	3	6	9	SPT	1	1.50	
			3.00	-3.000	2	4	7	11	SPT	2	3.00	
Brownish Silty Fine **SAND**					5	6	7	13	SPT	3	4.50	
					5	8	9	17	SPT	4	6.00	
			7.50	-7.500	8	10	14	24	SPT	5	7.50	
Brownish Medium **SAND**			9.00	-9.000	10	11	16	27	SPT	6	9.00	
Brownish Silty Fine **SAND**					11	16	18	34	SPT	7	10.50	
					13	21	22	43	SPT	8	12.00	
			13.50	-13.500	12	23	25	48	SPT	9	13.50	
Brownish Hard **CLAY** with Fine Sand					30	50 Blows/ 14cm			SPT	10	15.00	
			16.50	-16.500	36	50 Blows/ 18cm			SPT	11	16.50	
Greyish Hard **CLAY**					27	50 Blows/ 11cm			SPT	12	18.00	
			19.50	-19.500	31	50 Blows/10cm			SPT	13	19.50	
Reddish Hard **CLAY** with Medium Sand					30	50 Blows/9cm			SPT	14	21.00	
					38	50 Blows/9cm			SPT	15	22.50	
					35	50 Blows/6cm			SPT	16	24.00	
			25.50	-24.000	40	50 Blows/4cm			SPT	17	25.50	

Borehole Terminated at the depth of 25.50 meters

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Geo-technical Engineering Division

Project: Preparation of Detailed Project Report for Nagapatnam – Tanjavur – Trichy Section of NH67 – Package No. NHDP – III/DL4/01 in the State of Tamilnadu - Geo-Technical Investigation.

Ground surface level:	
Ground Water Table:	
Type of boring:	**Rotary**
Inclination:	**Vertical**
Boring:	**0.00-24.0 m**

Location	**CH:40+440**
Bore hole No	**BH2A2**
Soil Sampler Used	**SPT & UDS**
Date started	**21-11-2005**
Date Completed	**23-11-2005**

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details 15	30	45	N	Samples Type	No	Depth(m)	Remarks
Brownish Silty Sandy **CLAY**	*Refer Summary of Laboratory Test Results*		3.00	-3.000	1	3	4	7	SPT	1	1.50	
					2	4	4	8	SPT	2	3.00	
Brownish Silty Clayey **SAND**			6.00	-6.000	3	4	5	9	SPT	3	4.50	
					3	5	6	11	SPT	4	6.00	
Silty **SAND**			10.50	-10.500	15	16	23	39	SPT	5	7.50	
					14	17	25	42	SPT	6	9.00	
					10	15	20	35	SPT	7	10.50	
Greyish Silty **CLAY**			18.00	-18.000	12	18	28	46	SPT	8	12.00	
					15	21	24	45	SPT	9	13.50	
					18	20	22	42	SPT	10	15.00	
					16	22	24	46	SPT	11	16.50	
					38	50 Blows/ 12cm			SPT	12	18.00	
Reddish & Whitish Sandy **CLAY**			24.00	-24.000	40	50 Blows/10cm			SPT	13	19.50	
					33	50 Blows/3cm			SPT	14	21.00	
					38	50 Blows/4cm			SPT	15	22.50	
					35	50 Blows/6cm			SPT	16	24.00	

Borehole Terminated at the depth of 24.00 meters

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Project: Preparation of Detailed Project Report for Nagapatnam – Tanjavur – Trichy Section of NH67 – Package No. NHDP – III/DL4/01 in the State of Tamilnadu - Geo-Technical Investigation.

Ground surface level:	
Ground Water Table:	
Type of boring:	Rotary/CalyxRig
Inclination:	Vertical
Boring:	0.00-25.5 m

Location	CH:42+520
Bore hole No	BH1A1
Soil SamplerUsed	SPT & UDS
Date started	19-11-2005
DateCompleted	20-11-2005

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details				Samples			Remarks
					15	30	45	N	Type	No	Depth(m)	
Brownish Silty Medium **SAND**	*Refer Summary of Laboratory Test Results*		3.00	-3.000	5	4	8	12	SPT	1	1.50	
					4	5	9	14	SPT	2	3.00	
Brownish Stiff **CLAY**			7.50	-7.500	4	4	8	12	SPT	3	4.50	
					4	5	8	13	SPT	4	6.00	
					6	7	12	19	SPT	5	7.50	
Brownish Medium Silty **SAND**			13.50	-13.500	10	17	16	33	SPT	6	9.00	
					10	16	18	34	SPT	7	10.50	
					11	15	20	35	SPT	8	12.00	
					16	24	28	52	SPT	9	13.50	
Brownish Stiff **CLAY**			16.50	-16.500	15	23	30	53	SPT	10	15.00	
					21	38	48	86	SPT	11	16.50	
Greyish Hard **CLAY** with Sand			25.50	-25.500	20	36	47	83	SPT	12	18.00	
					22	38	46	84	SPT	13	19.50	
					24	40	50 Blows/10cm		SPT	14	21.00	
					26	43	50 Blows/9cm		SPT	15	22.50	
					28	50 Blows/14cm			SPT	16	24.00	
					31	50 Blows/12cm			SPT	17	25.50	

Borehole Terminated at the depth of 25.50 meters

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Ground surface level:	
Ground Water Table:	
Type of boring:	Rotary
Inclination:	Vertical
Boring:	0.00-25.5 m

Location	CH:42+520
Bore hole No	BH2A2
Soil Sampler Used	SPT & UDS
Date started	17-11-2005
Date Completed	19-11-2005

Description of Strata	Soil Classification	Thick of stratum	Depth from ground surface (m)	R.L of lower contact	SPT Details 15	30	45	N	Samples Type	No	Depth(m)	Remarks
Greyish/Brownish Clayey Medium **SAND**	*Refer Summary of Laboratory Test Results*		3.00	-3.000	3	4	5	9	SPT	1	1.50	
					4	5	6	11	SPT	2	3.00	
Greyish Sandy **CLAY**			9.00	-9.000	4	6	7	13	SPT	3	4.50	
					5	7	13	20	SPT	4	6.00	
					7	12	13	25	SPT	5	7.50	
					9	13	16	29	SPT	6	9.00	
Brownish Clayey Silty **SAND**			25.00	-25.000	15	77 Blows/28cm			SPT	7	10.50	
					18	80Blows/26cm			SPT	8	12.00	
					17	30	47	77	SPT	9	13.50	
					17	27	46	73	SPT	10	15.00	
					18	25	45	70	SPT	11	16.50	
					28	50 Blows/5cm			SPT	12	18.00	
					30	50 Blows/7cm			SPT	13	19.50	
					33	50 Blows/8cm			SPT	14	21.00	
					20	50 Blows/8cm			SPT	15	22.50	
					25	50 Blows/8cm			SPT	16	24.00	
					30	50 Blows/17cm			SPT	17	25.50	

Borehole Terminated at the depth of 25.50 meters