TENDER

For

DETAILED GEOTECHNICAL INVESTIGATION

For

Technical Feasibility and DPR for Patna Metro Rail System in Patna

TENDER NO. RITES/UT/PATNA/GT/01/2013

August 2013

(A Govt. of India Enterprise)
Plot No. - 1, Sector – 29
Gurgaon-122001
Haryana

INDEX

RITES LTD.

TENDER AND CONTRACT DOCUMENT CONTENTS

PART I – TECHNICAL BID

SECTION 1
NOTICE INVITING TENDER

(A Govt. of India Enterprise)

1. NOTICE INVITING TENDER

General Manager (C/UT), on behalf of RITES Ltd., invites Sealed Tenders in single packet system from experienced, technically and financially sound reputed firms in Geotechnical Investigation including laboratory testing of soil & rock samples **as per eligibility criteria given in Section 3 at Clause No. 3.1** for the following work :-

"Detailed Geotechnical Investigation for Technical Feasibility and Detailed Project Report for Patna Metro Rail System in Patna"

TENDER NO. RITES/UT/PATNA/GT/01/2013

Description of work	No. of Bore Holes (Approx.)	Cost of Tender (Rs.)	Earnest Money Deposit (EMD) (Rs.)	Estimated Amount (Rs.)	Period of Completion	Last date and time for submission & opening of tenders
Detailed Geotechnical Investigation as per scope of work	32	5000	10,000	9,81,354	8 weeks	11.09.13 upto 1500Hrs **Opening :** 11.09.13 at 1530Hrs

Tender Documents can be purchased from GM (C/UT), Ground Floor, Right wing, RITES BHAWAN, PLOT – I, SECTOR – 29, Gurgaon, Haryana – 122 001, on any working day (except Sat, Sun & Public Holidays) upto 10.09.13 on payment of Rs. 5000/- in the form of Demand Draft/Pay Order of a Scheduled Bank. For details pertaining to Qualifying criteria, etc. please visit our website **new.rites.com**. Tender document can also be downloaded from our website and tender can be submitted by post/in person along with cost of tender document in separate envelope in the form of Demand Draft/Pay Order of a Scheduled.

GM/C/UT
RITES LTD

GENERAL INFORMATION

1.	**Tender No.**	**TENDER NO. RITES/UT/PATNA/GT/01/2013**
2.	**Name of Work**	**Detailed Geotechnical Investigation for Technical Feasibility and Detailed Project Report for Patna Metro Rail System in Patna**
3.	**Estimated Cost**	**Rs. 9,81,354/-**
4.	**Earnest Money Deposit**	**Rs. 10000/-**
5.	**Cost of Tender Document**	**Rs. 5000/-**
6.	**Completion Period**	**8 weeks**
7.	**Date & Time of issue of Tender documents**	Upto **10.09.13** on any working day (except Sat, Sun & Public Holidays)
8.	**Last date & Time of Submission of Tender**	**11.09.13** up to **1500** hrs
9.	**Date & Time of Opening of bid**	On **11.09.13** at **1530** hrs.
10.	**Validity of Offer**	**90 days** from due date of opening of tender
11.	**Security Deposit (S.D.)**	**Security Deposit @ 10% shall be deducted from each running payment. EMD of successful bidder to whom the work is awarded shall be adjusted against S.D. while making running payments.**

Tender for the work of: -

Detailed Geotechnical Investigation for Technical Feasibility and Detailed Project Report for Patna Metro Rail System in Patna

i) To be submitted by **1500 Hrs. on 11.09.13** to UT Division RITES LTD., GURGAON
ii) To be opened in presence of tenderers who may be present at **1530 Hrs. on 11.09.13** in the office of GM/C/UT RITES LTD.

Name of Agency _____

Signature of officer issuing the documents_____

Designation _____

Date of Issue_____

TENDER NO. RITES/UT/PATNA/GT/01/2013

TENDER

1. I/We have read and examined the Notice Inviting Tender and Instructions to Tenderer, General Rules and Directions, Conditions of Contract, Clauses of Contract like, Special Conditions of Contract and Schedule of Quantities contained in the Tender Document for the work.

2. I/We hereby tender for the execution of the work specified in 'Schedule of Quantities' within the time specified, and in accordance in all respects as per 'General Terms', 'Special Conditions of Contract & Specifications' and 'Conditions of Contract' so far as applicable.

3. Should this Tender be accepted, I/We undertake to commence the work within **15 days** of issue of Letter of Acceptance (LOA) or any other day as specified therein for the work subject to the availability of Site and further undertake to complete and deliver the whole of the Works comprised in the Contract within **8 weeks** from the date of Start of Work. Commencement of work shall mean deployment of all machine, tools & plant, equipment and manpower at worksites required as per the Contract and starting the work in full swing.

4. We agree to keep the tender open for **90 (Ninety) days** from the due date of submission thereof and not to make any modifications in its terms and conditions.

5. A sum of **Rs. 10,000/- (Ten thousand only)**, is hereby forwarded in the form of Demand Draft/Pay Order of a Scheduled Bank guaranteed by the Reserve Bank of as the **Earnest Money Deposit**.

6. If I/ We withdraw my/our tender within the Validity period of **90-days** from the due date of submission thereof or before issue of Letter of Acceptance whichever is earlier or make many modifications in the Terms and Conditions of the Tender which are not acceptable to the RITES LTD, then the RITES LTD shall, without prejudice to any other right or remedy, be at liberty to forfeit the Earnest Money absolutely.

7. On issue of Letter of Acceptance by the RITES LTD, I/We agree that the said Earnest Money shall be retained by the RITES LTD towards Security Deposit to execute all the work referred to in the Tender document upon the Terms and Conditions contained or referred to therein and to carry out such deviation as may be ordered at the rates to be determined in accordance with the provisions in Clause 12 of Contract.

8. I/We hereby agree that I/We shall submit requisite Performance Guarantee and sign the Formal Agreement with the RITES LTD within **15 days** from the date of issue of Letter of Acceptance. In case of any delay, I/We agree that the RITES LTD will be at liberty to terminate the employment of the Contractor without thereby releasing the Contractor from any of his obligations or liabilities under the Contract. In case of any delay, I/We agree that we shall not submit any Bill for Payment till the Contract Agreement is signed.

9. I/We hereby declare that I/We shall treat the tender documents and other records connected with the work as secret/confidential documents and shall not communicate information derived there from to any person other than a person to whom I/We am/are authorized to communicate the same or use the information in any manner prejudicial to the safety of the RITES LTD.

10. I/We hereby declare that I/We have not laid down any condition / deviation to any Condition of Tender in the Technical and/or Financial Bid. I/We agree that in case any condition is found to be quoted by us in the Technical and/or Financial Bid, my /our Tender may be rejected and my/our Earnest Money forfeited in full.

11. I/We understand that the RITES LTD is not bound to accept the lowest or any tender he may receive. I/We also understand that the RITES LTD reserves the right to accept the whole or any part of the tender and I/We shall be bound to perform the same at the rates quoted.

12. Until a formal agreement is prepared and executed, this bid together with our written acceptance thereof shall constitute a binding contract between us and RITES Ltd.

13. I am/We are signing this Tender offer in my/our capacity as one/those authorized to sign on behalf of my/ our company/ as one holding the Power of Attorney issued in my favour as Lead Member by the Members of the Joint Venture. I/We enclose an attested copy of the Authority to Sign/ Power of Attorney.

Encl: As in Para 12.

Witness
Signature
Name
Postal Address
Occupation

Signature of Authorized Person/s
Date
Name/s
Name of Firm
Postal Address
Seal

SECTION 2
INSTRUCTIONS TO TENDERERS

2. INSTRUCTIONS TO TENDERERS

1. All work proposed for execution by contract will be notified in a form of Notice Inviting Tender and Instructions to Tenderers (NIT & IT) issued to the Contractors who apply for the same.

2. This form will state the work to be carried out, as well as the date for submitting and opening tenders and the time allowed for carrying out the work, the amount of Earnest Money to be deposited with the tender, the amount of the Performance Guarantee to be deposited by the successful tenderer, to be deducted from bills towards Security Deposit. Copies of the specifications, designs and drawings and any other documents required in connection with the work signed for the purpose of identification by the officer inviting tender shall also be open for inspection by the Contractor at the office of officer inviting tender during office hours during the period mentioned in the NIT and IT.

2.1 CONTENTS OF TENDER DOCUMENT

2.1.1 Each set of Tender or Bidding Document will comprise the Documents listed below and addenda issued:

PART – 1:- Technical Bid

Notice Inviting Tender
Instructions to Tenderers
General Terms
Scope of Work
Special Conditions and Specifications
Schedules A to F

PART – 2:- Financial Bid

Schedule of Quantities (Bill of Quantities) duly filled in the rates quoted by the agencies

PART – 3:- General Conditions of Contract

Section 7	Conditions of Contract
Section 8	Clauses of Contract
Section 9	RITES Safety Code
Section 10	RITES Model Rules for protection of Health and Sanitary arrangements for Workers
Section 11	RITES Contractor's Labor Regulations

Note: General Conditions of Contract (Compilation of Sections 7 to 11) with upto date correction slips are available in RITES website new.rites.com. The bidders should

note that General Conditions of Contract which is not being issued to the tenderers, shall form part of tender documents and Contract documents.

3. Technical evaluation of Technical package submitted by the tenderers shall be undertaken based on details submitted in Technical package only. RITES LTD reserve the right to ask any clarification from Tenderers for details submitted with Technical package if it so desires during technical evaluation.

4. To assist in the examination, evaluation and comparison of Financial Package the Engineer/ RITES LTD may ask Tenderers individually for clarification of their tenders, including breakdowns of prices. The request for clarification and the response shall be in writing or by Tele-fax but no change in the prices or substance of the tender shall be sought, offered or permitted except as required to confirm correction of arithmetical errors discovered by the Engineer during the evaluation of tenders.

5. The tender must be signed by the person / persons competent to sign as indicated in the NIT and IT. Same stipulations will also apply in the case of Receipt for payments made on account of work to the successful Contractor who has signed the Contract Agreement.

6. Use of correcting fluid anywhere in tender documents is not permitted. Such tender is liable for rejection.

7. **Applicable for Item Rate Tender only**

Any person who submits a tender shall fill up the Tender form, stating at what rate he is willing to undertake each item of the work. Tenders, which propose any alteration in the work specified in the said form of invitation to tender, or in the time allowed for carrying out the work, or which contain any other conditions of any sort, will be liable to rejection. No single tender shall include more than one work, but contractors who wish to tender for two or more works shall submit separate tender for each. Tender shall have the name and number of the works to which they refer, written on the envelopes.

8. The rate(s) must be quoted in decimal coinage. Amounts must be quoted in full rupees by ignoring fifty paisa and less and considering more than fifty paisa as rupee one. The rates quoted by the tenderer in item rate tender in figures and words a shall be accurately filled in so that there is no discrepancy in rates written in figures and words. However, if a discrepancy is found, the rates which correspond with amount worked out by the tenderer shall unless otherwise proved be taken as correct. If the amount of an item is not worked out by the tenderer or it does not correspond with the rates written either in figures or in words then the rates quoted by the tenderer in words shall be taken as correct. Where the rates quoted by the tenderer in figures and in words tally but amount is not worked out correctly, the rates quoted by the tenderer will, unless otherwise provided, be taken as correct and not the amount. In the event that no rate has been quoted for any item(s), leaving space both in figure(s) or word(s) and the amount blank, it will be presumed that the tenderer has included the cost of this/these item(s) in other items and rate for such item(s) will be considered as zero and work will be required to be executed accordingly.

9. The officer inviting tender or his duly authorized assistant, will open tenders (simultaneously the EMD envelop and the envelop of Technical bid & Financial bid) in the presence of any intending contractors who may be present at the time, and will enter the amounts of the several tenders in a comparative statement in a suitable form. In the event of a tender being accepted, a receipt for the earnest money forwarded therewith shall thereupon be given to the contractor. In the event of a tender being rejected, the earnest money forwarded with such unaccepted tender shall thereupon be returned to the contractor remitting the same, without any interest.

10. The officer inviting tenders shall have the right of rejecting all or any of the tenders and will not be bound to accept the lowest or any other tender.

11. The receipt of an accountant or clerk for any money paid by the contractor will not be considered as any acknowledgement or payment to the officer inviting tender and the contractor shall be responsible for seeing that he procures a receipt signed by the officer inviting tender or a duly authorized cashier.

12. The memorandum of work tendered for and the schedule of materials to be supplied by the RITES LTD and their issue rates, shall be filled and completed in the office of the officer inviting tender before the tender form is issued. If a form is issued to an intending tenderer without having been so filled in and incomplete, he shall request the officer to have this done before he completes and delivers his tender.

13. The tenderers shall sign a declaration under the officials Secret Act 1923, for maintaining secrecy of the tender documents drawings or other records connected with the work given to them. The unsuccessful tenderers shall return all the drawings given to them.

14. On acceptance of the tender, the name of the accredited representative(s) of the Contractor who would be responsible for taking instructions from the Engineer in Charge shall be communicated in writing to the Engineer in Charge.

15. Sales-tax/VAT, purchase tax, turnover tax or any other tax on material, labour and Works in respect of this Contract shall be payable by the Contractor and the RITES LTD will not entertain any claim whatsoever in respect of the same. However, the service tax as per prevailing rates shall be paid extra.

16. The Contractor shall give a list of both gazetted and non-gazetted employees of the RITES LTD related to him.

17. The tender for the work shall not be witnessed by a Contractor or Contractors who himself /themselves has/ have tendered for the same work. Failure to observe this condition would render tenders of the Contractors tendering, as well as witnessing the tender, liable to summary rejection.

18. The Contractor shall comply with the provisions of the Apprentices Act 1961, and the rules and order issued there under from time to time. If he fails to do so his failure will be a breach of the Contract and the Engineer in Charge / the RITES LTD may in his discretion without prejudice to any other right or remedy available in law cancel the Contract. The Contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.

19. Before the deadline for submission of tenders, the Tender Documents may be modified by RITES Ltd. by issue of the addenda/corrigendum. addenda/corrigendum if any, will be hosted on RITES website only and shall become a part of the tender document. All tenderers are advised to see the website for addenda/corrigendum to the tender documents which may be uploaded up to 2 days prior to the deadline for submission of tender as finally stipulated.

20. The contractor is required to have valid registration with Service tax department, EPF authority and ESI authority. In absence of above registration details including Registration No. (along with evidence) with the concerned authorities, first payment shall not be released.

21. The contractor is required to have labour license and required insurances (as per para -47 under "clauses of Contract") before commencement of work at site.

22. At the same time the RITES LTD notifies the successful Tenderer that his Tender has been accepted, the RITES LTD will direct him to attend the RITES' office within 28 days of issue of Letter of Acceptance for signing the Agreement in the Performa provided in the Tender Documents. The Agreement will however be signed only after the Contractor furnishes Performance Guarantee and Additional Performance Guarantee (where applicable) and hence, where justified, the period of 28 days stipulated above will be extended suitably.

SECTION 3
GENERAL TERMS

3. GENERAL TERMS

3.1 ELIGIBILITY CRITERIA

i) The bidder should have satisfactorily completed in its own name at least one work of similar nature of minimum value of **Rs. 8 lacs (Eight Lacs only)** or two works of minimum value of **Rs. 5 Lacs (Five Lacs only)** during the last five years prior to the date of submission of the bid. Works completed prior to the cutoff date shall be considered. A weight age of 5% (Compounded annually from the date of completion of the work to the submission of the bid) shall be given for equating the works of the previous years to the current year. The cutoff date shall be calculated from the date of submission/opening of tender (i.e. for a tender which is being opened on 11.09.13, the cutoff date shall be on 11.09.13. The works completed after 11.09.13 for such tender shall not be considered). Similar nature of works means work related to Geotechnical investigation including core drilling through overburden/rocky strata for foundation analysis.

a) Only such work will be considered which are 100% physically completed in all respect for which the completion certificate to be furnished.

The bidder shall submit the details of such completed works as per the format at **Annexure-I**. In support of having completed these works, the firm should submit copies of the completion certificates from the owner companies indicating the name of work, the description of work done by the bidder, the value of contract executed by the bidder, date of start, date of completion.

ii) Even though the bidder may be qualifying the above criteria as per the records submitted by him, he shall be disqualified if he is found to have made misleading or false representation in the forms, statements and attachments submitted in proof of the qualification requirements. He is likely to be disqualified on the basis of:

- Records of poor performance such as abandoning the works, delay in completion, litigation history or financial failures etc.
- The business having been banned by any central/state Govt.
- Having not submitted all the supporting documents or not furnished the relevant details as per the prescribed format.

iii) A declaration to the above effect in the form of an affidavit on stamp paper of Rs.10/- duly attested by notary/Magistrate should be submitted as per enclosed **Annexure-II.**

iv) Joint Ventures are not eligible to bid for the tender.

3.2 EARNEST MONEY

An amount of **Rs. 10,000/- (Ten thousand only)**, must be accompanied as Earnest Money Deposit along with the Tender documents. The same can be deposited in the form of Demand Draft or Pay Order from any scheduled Bank/Nationalized Bank in favour of RITES Ltd, Gurgaon. **Any tender document not accompanied with the required earnest money (in an acceptable form) and Cost of Tender documents (through Demand Draft/Pay Order of a Scheduled Bank issued up to last date of purchase of Tender documents) when it is downloaded from RITES website, will be summarily rejected**. The EMD of unsuccessful bidder shall be refunded after the finalization of contract and issuance of work order to successful bidder. The EMD of successful bidder to whom work is awarded shall be adjusted in S.D.

3.3 OTHER TERMS AND CONDITIONS

3.3.1 The tender should be duly signed on each page by bidder & shall be submitted in sealed cover. **EMD including the Cost of Tender Document if the Bid is submitted on the document downloaded from RITES website must be enclosed in separate envelop (Envelop-1).** The Technical bid and Financial bid should be enclosed and sealed in same envelope **(Envelop-2)** super scribed with the name of the work and name of bidder**.** These two envelopes should then be submitted in a sealed cover super scribed with the name of the work, date and time of opening of the tender and name of bidder. Please note that all documents other than financial bid should be submitted with Technical Bid only.

3.3.2 RITES reserve the right to split the work and award the job to one or more agencies without assigning any reason whatsoever. Time is essence of the contract and GM/UT, RITES reserves the right to award and/or split the work to other tenderers at the least quoted rates for that segment.

3.3.3 The acceptance of the tender will rest with GM/UT who does not bind himself to accept the lowest tender and reserves the right to reject any or all the tenders received, without assigning any reason. All tenders in which any of the prescribed conditions are not fulfilled or which are incomplete in any respect are liable to be rejected.

3.3.4 Last date for submission of the tender/Bid in the office of the General Manager/UT is **11.09.13.**

3.3.5 **The tenderers are advised to satisfy themselves by visiting the site to confirm about the prevalent site conditions, topography of the area, Geological formations etc. before quoting and submitting the tender to RITES.**

3.3.6 In the event of a discrepancy between description of rates or amount **in words & figures** quoted by a tenderer, the description in **words** shall prevail.

3.3.7 RITES reserve the right to accept or reject any or all tenders without assigning any reason thereof.

3.3.8 **Party should submit the following latest and valid documents in duplicate**

a) Attested Photocopies of affidavit from the Court regarding proof of Proprietorship (For Proprietary concern/firm).

b) Attested Photocopies of Partnership deed in case of Partnership firm.

c) Attested Photocopies of Memorandum and Articles of Association for firms not covered under para a and b above.

d) Attested Photocopies of Power of Attorney in favor of the party's representative authorized to sign the documents.

e) Self Attested Photocopies of PAN/TAN issued by Income tax Department

3.4 VALIDITY OF OFFER

Your offer should be valid for a period of **90 days** from date of opening of the tender.

3.5 Earnest Money is liable to be forfeited in case of the following:

i) On revocation of tender due to increase in rates after opening of tenders but before the validity of the tender expires.

ii) On refusal to accept the work order after award of contract.

iii) If the work is not commenced on the stipulated date of start of the work in case the work is awarded to the tenderer.

iv) In account of non-mobilization of prescribed drilling rigs and accessories within stipulated time.

v) On non-submission of Additional Performance guarantee, if required, on account of unbalanced bid.

3.6 Tenderers are requested to give unconditional offers. A conditional offer, having financial repercussions, is liable to be rejected. Unconditional rebate/discounts in the financial offer will, however, be accepted. RITES LTD reserve the right to accept or reject any conditional rebate/discounts. While evaluating the Bid price, the conditional rebate/discounts which are in excess of the requirements of the bidding documents or otherwise result in accrual of unsolicited benefits to the RITES LTD, shall not be taken in to account.

ANNEXURE – I

LIST OF SIMILAR WORKS SATISFYING QUALIFICATION CRITERIA COMPLETED DURING THE LAST 5 YEARS

S. No.	Client's Name and Address	Name of the Work & Location	Scope of work carried out by the Bidder	Agreement /Letter of Award No. and date	Contract Value (Rs. in Lakhs)		Value of Materials supplied free by the Client	Date of Start	Date of Completion			Ref. of Documents (with page no.) in support of meeting Qualification Criteria.
					Awarded	Actual on completion			As per LOA/ Agreement	Actual	Reasons for delay in completion if any	

SEAL AND SIGNATURE OF THE BIDDER

Note:

1. **In support of having completed above works, attach self attested copies of the completion certificate from the owner/client or Executing Agency / Consultant appointed by owner / Client indicating the name of work, the description of work done by the Bidder, date of start, date of completion (contractual & actual), value of contract as awarded and as executed by the Bidder and value of material supplied free by the client.**

2. Such Credential certificates issued by Govt. Organizations/ Semi Govt. Organizations / Public Sector Undertakings / Autonomous bodies of Central or State Government / Municipal Bodies / Public Ltd. Co. listed on BSE/NSE shall only be accepted for assessing the eligibility of a Tenderer.

In case of a Certificate from a Public Limited Co., the Bidder should also submit documentary proof that the Public Ltd. Co. was listed on BSE or NSE when the work was executed for it.

3. In case of false submission by Agency, the contract will be terminated at the risk and cost of the Agency and further necessary action will be initiated as required.

4. Information must be furnished for works carried out by the Bidder in his own name or proportionate share as member of a Joint Venture. In the latter case details of contract value including extent of financial participation by partners in that work should be furnished.

5. If a Bidder has got a work executed through a Subcontractor on a back to back basis, the Bidder cannot include such a work for his satisfying the Qualification Criterion even if the Client has issued a Completion Certificate in favour of that Bidder.

6. Use a separate sheet for each partner in case of a Joint Venture.

7. Only similar works completed during the last 5 years prior to the last stipulated date for submission of Bid, which meet the Qualification Criterion need be included in this list.

ANNEXURE – II

Performa for Submission of Past Contractual Performance

(Affidavit on non-judicial stamp paper of ` 10/- duly attested by Notary/ Magistrate)

This is to certify that We, M/s_____, in submission of this offer confirms that:

i) We have not made any misleading or false representation in the forms, statements and attachments in proof of the qualification requirements.

ii) We do not have records of poor performance such as abandoning the work, not properly completing the contract, inordinate delay in completion, litigation history or financial failures.

iii) Business has never been banned with us by the central / State Government Department/ Public Sector Undertaking or Enterprise of Central / State Government.

iv) We have submitted all the supporting documents and furnished all the relevant details as per prescribed format.

v) The information and documents submitted with the tender by us are correct and we are fully responsible for the correctness of the information and documents submitted by us.

vi) We understand that in case any statement/information/document furnished by us is found to be incorrect or false, our EMD in full will be forfeited.

SEAL, SIGNATURE AND NAME OF THE BIDDER SIGNING THE DOCUMENT

SECTION 4
SCOPE OF WORK

4. SCOPE OF WORK

4.1 INTRODUCTION

It is proposed to do **32 nos. bore holes** including the bore holes in depot area, overburden down to maximum depth of 30 meter & rock down to maximum depth of 5m, conducting In-situ permeability test and other in-situ tests for Detailed Geotechnical Investigation for Technical Feasibility and Detailed Project Report for Patna Metro Rail System in Patna for the proposed metro corridors in Patna City.

Note: The whole work can be converted into stages as per requirement of the Project. No extra claims by Agency against remobilization of staff and equipments will be entertained.

4.2 SCOPE OF WORK

GENERAL

The work mainly comprises of Geo-Technical Investigation along the proposed Metro corridors and depot areas for Patna Metro Rail System. Details of tentative corridors are as under as shown in the key plan enclosed as Figure 4.1 (Key plan).

S.no.	Description of Corridor
1	Digha to High court along Railway line
2	Gandhi Maidan to Rajendra Nagar
3	Gandhi Setu to ISBT & Depot
4	Gandhi Setu to Patna Sahib
5	Any other corridor as per project requirement

The above corridors are given just for tentative idea and so are likely to change. The work will be done at site for the corridors as per instruction of RITES/Engineer.

The Geo-Technical Investigation shall be carried out along the alignment at every 500m. Nothing extra shall be paid for making any arrangement for carrying out the bore holes on above locations. The depth of bore holes shall be 30 m or refusal level, whichever is reached earlier.

Activities to be performed are as follows:

i) Conducting the bore holes upto a maximum depth of 30 metres in soil (RQD<= 20%) or 10 m in weathered rock (RQD > 20% & CR<=20%) or upto a maximum depth of 5 metres in intact Hard Rock (CR >20%) using diamond bits and hydraulic / calyx rig by wash boring method as per the directions of Engineer-in-charge and as detailed in Technical Specifications and Schedule.

ii) Conducting Standard Penetration Tests in bore holes at regular intervals of 3.0 metre or as per I.S. Code of practice and also in-situ tests as per Schedule.

iii) Collecting undisturbed soil samples from bore holes at every 3.0 m interval or change of strata subject to a minimum of two per bore hole as per I.S. Code of practice.

iv) Recording of water table level in the bore holes after completion of boring.

v) Conducting in-situ permeability tests in Rocky strata and tests in labs in all other types of soils.

vi) Collecting rock core samples from bore holes and record the RQD/CR values.

vii) Conduct all necessary laboratory tests on samples collected as per Schedule and Technical Specifications.

viii) Marking the bore hole location on ground as per survey plan and plotting the same in alignment plan.

ix) Plotting the soil strata profile.

x) Preparation of report summarizing the details of soil/rock classifications, analysis of test data and recommending the type of foundations to be adopted with design calculations for the proposed Elevated corridor duly highlighting the design criteria and design methodology and different groups of soil strata encountered.

xi) Contractor will show all the borehole locations on the Topo survey plan provided by RITES.

4.3 MATERIALS

4.3.1 Quality

All materials used in the works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Engineer and shall comply strictly with the tests prescribed in the Technical Specifications / Code of Practice.

4.3.2 Rejection

Any material found not to conform to the specifications shall be rejected forthwith and shall have to be removed from the site by the contractor at his own cost.

Any work not to the satisfaction of the engineer or his representative will be rejected and same shall be rectified, or removed and replaced with work of required standard of workmanship at no extra cost.

4.3.3 TIME SCHEDULE

The Contractor shall complete field work within one and half month and submit all deliverables/reports within **8 weeks** as per the tenderer "Time Schedule" for completion of various items of work. This schedule is to be within the overall completion period of 8 weeks. The detailed programme in the form of a quantified bar chart or CPM network shall include all activities starting from beginning to completion.

Note: The contractor shall strictly follow the timeline mentioned in the contract and therefore, deploy sufficient number of machinery and staff to complete the work within the time frame.

4.3.4 VARIATION IN QUANTITIES

Quantities provided in BOQ are tentative. Overall variation may be up to +50%. Variation will be calculated on total amount. No compensation will be payable on this account. No compensation will be paid for reduction in quantities also. In case of overall variation beyond +50%, the rates for the additional quantities shall be negotiated on mutually accepted terms.

4.3.5 SPECIAL TECHNICAL SPECIFICATIONS

Drilling of boreholes is required to be carried out in accordance with specifications of relevant codes of Bureau of Indian Standard as given below:
IS: 4078 Code of practice for indexing & storage of drill cores.
IS: 2131 Method for standard penetration test
IS: 1892 Code of practice for sub surface investigation for foundations
IS: 6926 Diamond core drilling site investigation for river valley projects.
IS: 5313 Guide for core drilling observation.
IS: 4464 Code of practice for presentation of drilling information and core description in foundation investigation.
IS: 5529 (Part – I & Part - II) Code of practice for in – situ permeability tests in overburden and rock respectively.
Any other relevant codes & specifications as decided by RITES Engineer in charge.

4.4 FIELD INVESTIGATIONS – IN SOIL

4.4.1 BORING

i) General Requirements

b) Boreholes shall be taken at specified locations to obtain information about the sub-soil profile, its nature and strength and to collect soil samples for strata identification and conducting laboratory tests. The minimum diameter of the bore shall be 150 mm and boring shall be carried out in accordance with the provisions of IS: 1892 as per this specification.

c) All bore holes shall extend up to depths as directed by the Engineer. If the strata with Standard Penetration Test (SPT) `N' value greater than 100 with characteristics of rock

is met with, prior to the specified depth, the bore hole shall be advanced further by chiseling. Chiseling shall be continued for a maximum depth of 20 cm or up to 2 hours whichever is earlier. During chiseling rock fragments shall be collected. Identification of rock strata shall be on the basis of visual examination of SPT sample and rock fragments. After it is established that rock is met with, borehole shall be advanced further by drilling in rock and core shall be collected. When the bore hole is terminated in soil strata, an additional Standard Penetration Test shall be carried out at the termination depth.

d) Casing pipe shall be used in the borehole to support its sides when a side fall is suspected to occur inside the borehole. When casing pipe is used, it shall be ensured that its bottom end is at all times less than 15 cm above the bottom of the borehole and not below the level at whim the test has to be conducted or sampling has to be done. In case of cohesion less soils the advancement of the casing pipe shall be sum that it does not disturb the soil to be tested or sampled. The casing shall be advanced by slowly turning the casing pipe and not by driving.

e) In-situ tests shall be conducted or undisturbed samples (UDS) shall be collected in the bore holes at regular intervals and at change of strata or as decided by the Engineer. Representative disturbed samples shall be preserved for conducting various identification tests in the laboratory. Water table in the borehole shall be carefully recorded and reported No water /drilling mud shall be added while boring above ground water table. For cohesion less soil below water table, the water level in the bore hole shall at all times be maintained slightly above the water table.

f) The bore hole shall be cleaned using suitable tools up to the depth of testing or sampling, ensuring that there is minimum disturbance of the soil at the bottom of the bore hole. The process of jetting through an open tube sampler shall not be permitted. In cohesive soils, the bore hole may be cleaned using a bailer with a flap valve. Gentle circulation of drilling fluid shall be done when rotary mud circulation boring is adopted.

g) **On completion of the bore hole, including the borehole in which special tests are conducted, contractor shall backfill all the bore holes upto complete satisfaction of client/RITES. If the contractor does not backfill the bore hole within desired period to avoid any mishap, an amount of Rs. 1500/- per bore hole subject to minimum Rs 25000/- will be deducted as penalty. The contractor shall also submit photo of each bore hole after its completion.**

h) Contractor shall be responsible for safety of road users too.

ii) Rotary Mud Circulation Boring

This method can be used in all types of soil below water table. In this method boring shall be done by rotating the bit fixed at the bottom of the drill rod. Proper care shall be taken to keep firm contact between the bit and the bottom of the bore hole. Bentonite mud shall be used as the drilling fluid to prevent caving in of the bore hole sides. Use of percussion tool shall be permitted in hard clays and dense sandy deposits.

4.4.2 STANDARD PENETRATION TEST

This test shall be conducted in all types of soil deposits met within a bore hole, to find the variation in the soil stratification by correlating with the number of blows required for unit penetration of standard penetrometer. This test shall be conducted at 3.0m intervals and every change of strata and as per the direction of the Engineer. The starting depth of performing SPT shall be between 1.0 and 2.0 m depth below ground level. This depth shall be staggered in alternate boreholes. The depth interval between the top levels of Standard Penetration Test and next undisturbed sampling shall not be less than 1.0m. The specifications for the equipments and other accessories, procedure for conducting the test, presentation of test results and collection of the disturbed soil samples shall conform to IS: 2131.

This test shall be carried out by driving a standard split spoon sampler in the bore hole by means of a 63.5 kg hammer having a free tall of 0.75m. The sampler shall be driven using the hammer and for 450mm. While driving the number of blows for every 150 mm penetration and the penetration for every 50 blows shall be recorded. The number of blows for the last 300 mm drive shall be reported as N value. This test shall be discontinued when the blows count is equal to 100 at the penetration shall be recorded. Refusal shall be considered to be met with when the blow count is equal to or greater than 100. At the location where the test is discontinued the penetration and the number of blows shall also be reported. Sufficient quantity of disturbed soil samples shall be collected from the split spoon sampler for identification, and laboratory testing. The sample shall be visually classified and recorded at the site and shall be properly preserved and labeled for future identification.

It may not be possible to conduct SPT test wherever boulders/cobbles/ pebbles/gravels are encountered in bore holes drilled in top overburden debris. However attempt will be made to get SPT values wherever soil is encountered up to the required depth.

4.4.3 SAMPLING

i) General

a) Sufficient number of soil samples shall be collected for reliable estimation of soil properties. The samples collected shall be either disturbed or undisturbed. Disturbed soil samples shall be collected for field identification and conducting tests such as sieve analysis, index properties, specific gravity, chemical analysis, etc. Undisturbed samples shall be collected to estimate the strength and settlement properties of the soil.

b) All the accessories required for sampling and the method of sampling shall conform to IS: 2132. All the disturbed and undisturbed samples collected in the field shall be classified at the site as per IS: 1498.

c) All the samples shall be identified with date, bore hole or trial pit number, depth of sampling, etc. It is also essential to mark an arrow pointing towards the top surface of the sample. Care shall be taken to keep the undisturbed soil samples and box samples vertically with the arrow directing upwards. The tube samples shall be properly

trimmed at both ends and sealed with molten paraffin wax at both ends immediately after extracting the samples from the bore hole and suitably capped on both sides.

d) When contractor fails to collect the undisturbed soil sample at specified depth the reason for the same shall be indicated in the bore log and the bore hole shall be advanced by 0.5m. Subsequently for cohesion less soil Standard Penetration Test shall be performed and for very soft cohesive soil field vane shear test shall be performed.

e) Precaution shall be taken to ensure that there shall not be any change in moisture content and disturbance of the soil samples and they shall be placed in a temporary store at the end of the day's work. All the samples shall be kept over a bed of sand, jute bags, saw dust, etc. and covered over on top with similar material. The bed and top cover shall be kept moist till they are properly packed in wooden boxes. Contractor shall be responsible for packing and transporting of all the samples from site to the laboratory at **Patna/Gurgaon** within seven days after sampling with proper protection against loss and damage.

f) All the samples shall be packed in wooden boxes using sand, saw dust etc. all around the samples before transportation to laboratory for testing.

ii) Disturbed sample

a) Disturbed soil samples shall be collected in bore holes at regular intervals to provide complete description of soil profile and its variation. Jar samples weighing approximately 10 N shall be collected in bore holes at 0.5 m intervals starting from a depth of 0.5m below ground level and at every identifiable change of strata to supplement the boring records. Samples shall be immediately stored in air tight or polythene bags and labeled with bore hole number and depth.

b) In elevated areas, if superficial material is available in plenty, then bulk samples from a depth of about 0.5m below ground level shall be collected to establish all the required properties to use it as a fill material. Disturbed samples weighing about 250 N shall be collected at shallow depths and immediately stored in polythene bags as per IS: 1892. The bags shall be sealed properly and they shall be kept, in wooden boxes.

iii) Undisturbed Samples

In each bore hole undisturbed sample shall be collected at every change of strata and at regular intervals of 3.0 m and as directed by the Engineer. The starting depth of collection of UDS shall be between ground level and 1.0 m below ground level and as decided by the Engineer. The starting depth shall be staggered in alternate boreholes. In cohesive soils collection of UDS shall be preferred in place of SPT. The depth interval between the top level of undisturbed sampling and standard penetration test shall be at least 0.5m. Undisturbed samples shall be 100 mm dia. and 450 mm length. Samples shall be collected in such a manner that the structure of the soil and its moisture content do not get altered. The specifications for the accessories required for sampling and the sampling procedure shall conform to IS: 1892 and IS: 2132. Undisturbed sampling in sand shall be done using compressed air technique mentioned in IS: 8763. Thin walled sampler shall be used to collect undisturbed samples by pushing the tube into the soil. The sampling tube shall

have a smooth finish on both surfaces and minimum effective length of 450 mm. The area ratio of sampling tubes shall be less than 12.5%. However, in case of very stiff soils, area ratio up to 20% shall be permitted.

a) Undisturbed Sampling in cohesive soil

Undisturbed samples in soft to stiff cohesive soils shall be obtained using thin walled sampler. In order to reduce the wall friction, suitable precautions such as oiling the surfaces shall be taken. The bore hole shall be cleaned and the depth of sampling below the ground level shall be noted. The sampler shall then the attached to the bottom of the boring rods and lowered into the borehole. The sampler shall be pushed into the clay layer by hand or by jacking and soil sample of specified length shall be collected without disturbing the soil. The distance by which the sampler penetrates into the soil strata shall be checked. Care being taken to ensure that the sampler is not driven too far as this will compress the soil. The sampler shall be rotated to break the core at the bottom of the sample and then steadily drawn up.

b) Undisturbed sampling using Piston sampler

Undisturbed samples in very loose saturated sandy and silty soils and very soft clays shall be obtained by using a piston sampler consisting of a sampling cylinder and piston system. In soft clays and silty clays, with water standing in the casing pipe, piston sampler shall be used to collect undisturbed samples. During this method of sampling expert supervision is called for.

The interior surface of the sampler shall be smooth, clean and corrosion resistant. Its cutting edge and the ring seals shall be inspected for wear and rejected if worm. Check shall be done to ensure that the moving parts of the sampler function freely before the sampler is lowered into the bore hole. While pushing the system into the soil and till the beginning of the sampling operations, the bottom of the piston shall be flush with the cutting edge of the sampler. At the depth of sampling, the piston should be fixed relative to the ground and the sampler cylinder shall be independently pressed down smoothly and continuously into the ground. If an obstruction is met, the sampler shall be withdrawn and another sample taken after the obstruction is removed.

Accurate measurements of the depth of sampling, height of sampler, stroke and length of sample recovery shall be recorded. After the sampler is pushed to the required depth, both the sampler cylinder and piston system shall be drawn up together ensuring that there shall not be any disturbance to the sample which shall then be protected from changes in moisture content.

c) Undisturbed sampling in Cohesion less Soils

Undisturbed samples in cohesion less soil shall be obtained as per the procedure given in IS: 8763. Compressed air sampler shall be used to take samples of cohesion less soil below water table. Precautions shall be taken to clear the bore hole before sampling. Thin walled tube samples of 60 mm internal diameter shall be used. The height and other dimensions of the sampler shall be recorded before use. Proper care shall be taken to maintain the water level slightly above the ground water table before and

during sampling operations. Immediately after the sample is obtained, the ends of the sample shall be waxed and capped to avoid moisture content changes.

iv) Relaxation During Sampling

a) The Sampler shall be pushed into the soil and driving of sampler shall be resorted to only when it cannot be pushed into the soil. This half be done only with the permission of the Engineer and all the details about the same shall be recorded into the bore logs.

b) In clays when N value is above 50, undisturbed samples may be replaced by standard penetration test.

4.4.4 GROUND WATER

i) The methods as per IS: 6935 shall be adopted for determining the ground water table in bore holes and as per the instructions of the Engineer.

ii) In case any variation in the ground water level is observed in any specific boreholes, then the water level in these bore holes shall be recorded daily during the course of the field investigation. Levels in nearby wells, streams, etc. if any shall be noted whenever these readings are taken.

iii) Sub-Soil Water Samples

a) Sub-soil water samples shall be collected for carrying out chemical analysis. Representative samples of ground water shall be addition of water to aid boring or drilling. Water samples shall not be collected when bentonite slurry or mud has been used for drilling operations. If water has been added for drilling purpose of if ground water has been diluted by surface rain water, then the bore hole shall be dewatered and water allowed to rise from which the sample may be taken.

b) The sampling apparatus shall be such that the water at the desired depth can be collected directly without any disturbance and any change in the concentration of the constituents like dissolved gases, etc. Under agitation shall be avoided. An ordinary suction pump with its suction end inserted up to the required depth in the bore hole shall be used for this purpose.

c) The sample shall be collected in a clean vessel and allowed to settle so that the supematural liquid can be poured into a clean well raised glass or polythene bottle. Sufficient quantity and number of samples shall be collected to carry out the chemical analysis and sent to a laboratory in airtight bottles with proper labeling. Chemical analysis of water samples shall include determination of pH value, turbidity; sulphate, carbonate, nitrate and chloride, presence of organic matter and suspended solids.

d) In some cases constituents may be mixed and analyzed later as specified in file specific test methods. Chemical preservatives may be added to the sample for cases as specified in the test method/IS codes. This shall only be done if analysis cannot be conducted within an hour of collection and shall have the prior written permission and approval of the Engineer.

4.4.5 IN-SITU PERMEABILITY TEST

i) In-situ permeability test shall be conducted to determine the water percolation capacity of overburden soil. This test shall be performed inside the bore hole at specified depths or in each layer or as per the directions of the Engineer. The type of test shall be either pump in or pump-out test depending on the subsoil and ground water conditions. Pump in test shall be conducted whether ground water in borehole exist or not. Pump-out test (optional) shall be conducted to obtain data for dewatering purposes when ground water is met in the bore hole. The specifications for the equipments required for the test and the procedure of testing shall be in accordance with ARE: 5529, Part-I. When it is required to carry out the permeability test for a particular section of the strata above the ground water table, betonies slurry shall not be used while boring.

ii) Pump-in-Test

Pump-in test shall be conducted in the bore hole by allowing water to percolate into tile soil. Choice of the method of testing shall depend on the soil permeability and prevailing ground water level. Only clear water shall be used for conducting the test before conducting the test, the bore hole shall be cleaned. Water shall be allowed to percolate through the test section for sufficient period of time to saturate the soil before starting the observation.

a) Constant Head Method (in bore hole)

This test shall be conducted in bore holes where soil has a high permeability; water shall be allowed into the bore hole through a metering system ensuring gravity flow at constant head so as to maintain a steady water level in the bore hole. A reference mark shall be made at convenient level which can be easily seen the casing pipe to note down the fluctuations of water level. The fluctuations shall be counteracted by varying the quantity of water flowing into the bore hole. The elevation of water shall be observed at every 5 minute interval. When three consecutive readings show constant value, the necessary observations such as flow rate, elevation of water surface above test depth, diameter of casing pipe, etc. shall be made and recorded as per the proforma recommended in IS: 5529, Part-I, Appendix-A.

b) Falling Head Method (in bore hole)

This method shall be adopted for soils of low permeability and when can stand without casing. The test section shall be sealed by the bottom of the bore hole and a packer at the top of the test section. If the test has to be conducted at an intermediate section of a prebored hole then, double packers shall be used. Access to the test section through the packer shall be by means of a pipe which shall extend to above the ground level. Water shall be filled into the pipe upto the level marked just below the top of the pipe and water allowed to drain into the test section. The water level in the pipe shall be recorded at regular intervals as

mentioned in IS: 5529, Part-I, Appendix-B. The test shall be repeated till Constar it records of water level are achieved.

4.5 FIELD INVESTIGATION- ROCK

4.5.1 ROCK DRILLING

i) General Requirements

Conventional Diamond core drilling equipment may be used for drilling vertical holes up to a maximum depth of 200 m each (actual depth to be ascertained based on foundation size, formation level and ground conditions). The size of core in the upper portion of rock shall be HX/HQ if required, which should be continued to as much depth as possible. But it may be required to be reduced to NX/NQ after certain depth. Unlike some types of drilling, the aim of core drilling is not to make a hole, but to retrieve a core sample- a long solid cylinder of rock that geologists can analyze to determine the composition of rock under the ground.

Rock drilling shall be carried out as per BIS-6926 and/or ASTM D2113. Quality drilling is important in maintaining a reasonable straight vertical hole and nearly circular cross-section. The rotary drilling machine shall also be capable of drilling angular holes where required by the prevailing geological site conditions. For meaningful interpretation of the orientation of the geological features, suitable core orientation procedures shall be employed during investigation. Only hydraulically operated drilling rigs shall be used with good quality compatible drill rods. Sufficient number of spare parts shall be readily available at the site for maintenance of drilling rig, drilling rods, pump sets etc.
The core barrel employed for rock drilling shall be HX/HQ or NX/NQ Size double tube, longitudinally split inner tube for good rock and triple tube, longitudinally split inner tube for poor rock with diamond core bit.

ASTM D5434 shall be broadly used for the preparation of field logs providing the following minimum information:

a) Project identification, borehole number, location, start and end dates of boring completed, drill rate and elevation of the location.

b) Rock type with description of colour, texture/structure, rock strength, change in rock stratum, ground water level.

c) Core Recovery, RQD, discontinuities spacing, joint condition, orientation, dip of strata, cavities, fissures, the occurrence of seams, gouge material.

Orientation of Joints in recovered cores from inclined holes shall be reported w.r.t core axis. Rock Quality Designation (RQD) measurement shall be done as per BIS 11315 part XI and/or ASTM D6032. Core recovered from the borehole shall be appropriately marked, photographed and carefully preserved in core boxes and transportation of the same shall be as per ASTM D 5079.

A core drill string is a series of connected long hollow tubes (called rods or pipes), with a barrel at the end connected to a special cutting bit at the bottom of the hole. As the drill moves further into the earth, the driller adds rods onto the end, lengthening the drill string.

Fig. 1 Diamond-impregnated core bits are the most commonly-used bits in core drilling because they are powerful and long-wearing

Different bits are used depending on the type of rock to be drilled. There are two characteristics of bits- the pieces of cutting material and the surrounding material, called the matrix. Bits are self-sharpening; as a bit is used, the matrix gradually wears away to expose more of the cutting material.

For hard rock, diamonds are used in a soft matrix, so that plenty of cutting material is exposed. For softer rock, a less expensive cutting material (e.g. tungsten carbide chips) can be used, with a harder matrix so that the bit lasts longer. The driller determines the type of bit to be used depending on the drilling conditions.

Fig.2 The photograph shows drilling mud being mixed ready to use

As the driller rotates the drill string, downward pressure and abrasion from the bit cuts into the rock, pushing core into the core barrel. This process creates a lot of friction and heat, so a flushing medium is used to cool the bit, lubricate the core, remove the loose bits of rock (called the cuttings), and help stabilize the hole. Water, soluble oil or drilling mud can be used.

Fig.3 The driller is lifting the inner tube out of the hole using the lifting device

Drilling in rock shall be done it specified locations or as per the directions of the Engineer. Before commencing drilling, it shall be proved that characteristics of rock have been met with. The starting depth of drilling in rock shall be certified by the Engineer. The portion drilled in rock shall be backfilled with cement and sand (1:3) grout. The drilling information shall be recorded in proper proforma.

ii) Equipment

For conventional drilling, VOL 35/VOL 90 or equivalent hydraulic rigs suitable for appropriate depth may be used up to a depth of 200 m.

a) Core drilling shall be done by rotary motion using diamond bit. The feed or thrust to the drilling bit shall be actuated by hydraulic type. The equipment or set up shall be capable of recovering 75% of the drilled volume. The rotary core drilling equipment and procedure for drilling shall conform to IS: 6926. The equipment shall be provided with necessary facilities to regulate the spindle speed bit pressure and water pressure during core drilling to get good core recovery.

b) Drilling shall be carried out with HX/HQ or NX/NQ size diamond tipped drill bits or impregnated diamond bit depending on the type of rock encountered. Double tube swivel core barrel of Type B conforming to IS: 6926 shall be used to ensure good core recovery and to pick up cores from all layers of rock. Suitable core catches shall be used to ensure continuous and good core recovery. For ensuring maximum core recovery in weak rocky formation, triple tube core barrel including split type core barrel shall be used.

iii) Procedure

a) The drilling fluid shall be clean water. Circulation of the drilling fluid shall be started before the core barrel reaches the bottom of the hole to prevent cuttings or sludge from entering the core barrel at the start of coring. Drilling fluid shall be circulated continuously down the hollow rods and the sludge conveying the rock cuttings to the surface shall be collected. Bentonite as drilling fluid will be used only when warranted with the specific approval of the Engineer in charge.

b) When drilling through soft/weathered/fractured rock water circulation must be reduced so as to avoid shattering/breaking the core.

c) The rotational speed of the bit (spindle speed) the amount of downward pressure applied on the bit (bit pressure) and water pressure shall be suitably adjusted and properly monitored so that the core is collected with least disturbance and avoid shearing of the Core from its base Bit-speed, bit pressure, water pressure for the type of bit for various rocks type shall be as given in Appendix A of IS: 6926.

d) In general, the drilling run shall be of 1.5 m length, however this can be increased to 3.0m provided the core recovery is observed more than 80% in two successive 1.5m drill runs and on approval from Engineer. In exceptional cases where core recovery is poor, drill run shall be of 0.75 m in length. If the core recovery is less than 20% then SPT shall be performed before commencing the next drill run.

e) If at any time a blocking of the bit or grinding of the core is indicated, the core barrel shall be immediately withdrawn from the borehole regardless of the length of drill run completed.

iv) Observations

a) As drilling is a very costly process, it is of utmost importance that complete observation should be made during a drilling operation. Accurate record of progress of drilling shall be kept by the drilling in-charge.

b) The colour of return water at regular intervals, the depth of which any change of colour of return water is observed; the depth of occurrence and amount of flow of hot water, if encountered, shall be recorded.

c) The depths through which a uniform rate of penetration was maintained, the depth at which marked change in rate of penetration or sudden fall of drill rod occurs, the depth of which any blockage of drill bit causing core loss, if any shall be recorded.

d) Any heavy vibration or torque noticed during drilling should be recorded together with the depth of Occurrence.

e) Special conditions like the depth at which grouting was done during drilling, presence of artesian conditions, loss of drilling fluid observation of gas discharge with return water etc., shall also be observed and recorded.

f) During drilling operation, observation on return water rate of penetration etc. shall be recorded in the proforma as given in IS: 5313, Appendix-A.

g) The sludge obtained during each run shall be collected separately, dried and packed in polythene bags with proper numbering.

h) Causes of poor core recovery shall be carefully examined and correlated with speed of drilling, excessively mud laden return drill water, shear zones, clay seams etc.

i) Data from the driller's daily records and geologist's field log shall be edited interactively for preparation of graphical log.

j) Results of in-situ permeability tests etc. shall be furnished in log sheet for each individual hole in specified standard format of Bureau of Indian Standards.

k) Other special conditions, which may be peculiar to individual cases during drilling operation, shall be recorded.

v) Core Samples

a) The field logging of rock core samples obtained from the borehole will be done by competent professional engineering geologist.

b) Core samples shall be extracted by the application of a continuous pressure at one end of the core with the barrel held horizontally without vibration. Friable cores shall be extracted from the barrel directly into a suitable sized half round plastic channel section. Care shall be taken to maintain the direction of extrusion of sample same as that while coring to avoid stress reversal.

c) Immediately after withdrawal from the core barrel the Cores shall be placed in a tray and transferred into boxes specially prepared for the purpose. The boxes shall be made from seasoned timber or any other durable material and shall be indexed on top of the lid as per IS: 4078. The cores shall be numbered serially and arranged in the boxes in a sequential order. The description of the core samples shall be recorded as per IS: 4464. Where no core is recovered. It shall be recorded as specified in the continuous record of core recovery and RQD to be mentioned in the bore log as per IS: 11315 Part-II.

d) The basic information for the standard basic geo-technical description of rocks shall cover a) degree of weathering b) discontinuity spacing c) strength d) colour e) grain size f) texture g) structural condition, the mineralogy of the grains and cementing material h) rock name and supplementary adjectives, if any, special features like major joint planes fractures/laminations, faults, etc. shall also be indicated.

4.5.2 PERMEABILITY TEST

Lugeon Test

The test setup of Lugeon Test is similar to Injection Fall off test, except that there is no fall off phase. The test section shall be isolated with set of packer and pressurized by a series of rising pressure steps followed by a series of symmetrical decreasing pressure steps. During each pressure step, the pressure must be kept as constant as possible. The duration of each step of stabilized pressure shall be 10 min. The injected volume of water must be recorded precisely every minute for each stabilized pressure.

In–situ permeability / Lugeon test will be conducted in the boreholes at desired interval of 3 metres in each borehole. The examination of cores from holes gives only a general idea

of the physical condition of the rocks constituting the foundation media. Water percolation tests/Lugeon tests if performed in the boreholes are of significance in interpreting the drilling data and in supplementing the information with regard to permeability characteristics. Determination of permeability or rock mass is of greatest significance in assessing the problem of seepage. It is therefore considered necessary to perform the Lugeon/permeability tests. These tests shall be performed in bedrock as outlined in I.S. 5529 (part – II for rock) (1983). The Lugeon test comprises the measurement of the volume of water that can escape from an uncased section of boreholes in a given time under a pressure. The flow is confined between two packers in the double packer test or between one packer and bottom of the borehole in a single packer test. For computing Equivalent Permeability in Lugeons, the water percolation test in each test section of 3m will be carried out at five test pressures, three in increasing order and two in decreasing order. These tests can be used to assess the amount of grout that rock will accept and to obtain a measure of the amount of fracturing of rock and to decide on the seepage control measures.

Permeability test shall be conducted in bed rock inside the drilled hole by pumping in water under pressure to determine the percolation capacity of the rock strata. This test shall be conducted in encased and ungrouted sections of the drill hole and the use of bentonite slurry drilling is strictly prohibited. Clear and clean water shall be used for the purpose of both drilling and testing. The equipments required and the procedure to be followed for conducting the test shall be either 1.5m or 3.0m as per field conditions and the directions of the Engineer. The levels of water table, if any, in the drill hole shall be recorded and the drill hole shall be cleaned before starting the test. Depending upon the depth of the test section, single packer or double packer method shall be adopted. Care shall be taken to see that all joints and connections are water tight during the test.

***Single Packer Method*:**

This method shall be adopted when the bottom elevation of the test section is the same as the bottom of the drill hole and where it is considered necessary to know the permeability value during drilling itself. This test shall be useful where the full length of the hole cannot stand encased or up ground. The packer shall be fixed at the top level of test section such that only the test section lies below the packer. Water shall then be pumped through a pipe into the test section under a required pressure and maintaining it till a constant quantity of water intake is observed. The amount of water percolating through the hole shall be recorded at every 5 minutes intervals. The test shall be repeated by increasing the pressure at regular intervals upto a pressure limit as specified in IS: 5529, Part-II. The details and observations during the test shall be suitably recorded in a proforma recommended in IS: 5529, Part-II, Appendix-B.

Double Packer Method:

This method shall be used when the permeability of an isolated section inside a drill hole is to be determined. Packers shall be fixed both at the top and bottom of the test section such that their spacing is exactly equal to the length of the test section. The test shall then be conducted as specified in clause 6.2 (a).

FORM OF AGREEMENT

(ON NON JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)

Agreement No: dated-------

Name of work: Detailed Geotechnical Investigation for Technical Feasibility and Detailed Project Report for Patna Metro Rail System in Patna

THIS AGREEMENT is made on ----- day of --- Two thousand ----- between RITES Ltd. a Government of India Enterprise a company registered under companies Act,1956 having registered office at SCOPE MINAR, Laxmi Nagar, Delhi-110092 and its Corporate office at RITES Bhawan Plot No.-1, Sector 29, Gurgaon (Haryana) representing through General Manager (C/UT), RITES LIMITED hereinafter called RITES LIMITED (which expression shall, wherever the context so demands or require, include their successors in office and assigns) on one part and M/s--------- hereinafter called the Contractor (which expression shall, wherever the context so demands or require, include their successors in office and assigns) of the other part.

Whereas the RITES LIMITED is desirous that certain works be executed viz.------- (brief description of work) and has by Letter of Acceptance dated---- accepted a tender submitted by the Contractor for execution , completion, remedying of any defects therein and maintenance of such works at a total Contract price of Rs._____/- (Rupees---------- only)

NOW THIS AGREEMENT WITNESSETH as follows

1. In this Agreement words and expression shall have the same meaning as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The following documents in conjunction with addendam /corrigendam to Tender Documents shall deemed to form and be read and construed as part of this Agreement viz

   - The Letter of Acceptance dated-----
   - Priced Schedule (Bill) of Quantities
   - Notice Inviting of Tender
   - Instruction to Tenderers
   - General terms
   - Scope of Work
   - Special Conditions and Specifications
   - Schedule A to F
   - Amendments to Tender Documents (if any, list enclosed)
   - General Conditions of Contract comprising of
     i) Conditions of Contract

ii) Clauses of Contract
iii) RITES safety of code
iv) RITES- Model Rules for the protection of Health and Sanitary arrangements for workers
v) RITES-Contractor's labour regulations

3. In consideration of payment to be made by the RITES LIMITED to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the RITES LIMITED to execute, complete, remedy defects therein and maintain the works in conformity in all respects with the provision of Contract.

4. RITES LIMITED hereby covenants to pay to the Contractor in consideration of the execution, completion, remedying of any defects therein and maintenance of the, works the contract price or such other sum as may become payable under the provisions of the contract at the time and in the manner prescribed by the contract.

IN WITNESS where of the parties hereto have caused their respective common seals to be hereinto affixed (or have herewith set their respective hands and seals) the day and year first above written.

For and on behalf of the RITES	**For and on behalf of the Agency**
Signature of the authorized Official	Signature of the authorized Official
Name of the official Stamp/Seal of the RITES SIGNED, SEALED AND DELIVERED	Name of the official Stamp/Seal of the Agency
By the said	By the said
---------- Name ---------- On behalf of the RITES in the Presence of ----------	---------- Name ---------- On behalf of the Agency in the presence of ----------
Witness Name Address	Witness Name Address

SECTION 5

SPECIAL CONDITIONS OF CONTRACT AND SPECIFICATIONS

5. SPECIAL CONDITIONS OF CONTRACT AND SPECIFICATIONS

5.1 SPECIAL CONDITIONS OF CONTRACT

5.1.1 Conditions of Contract will form an integral part of the NIT and contract, which is enclosed along with the tender documents.

5.1.2 In case of any deviation between conditions of contract, RITES GCC and any other special condition & specifications of contract of this NIT, the special condition & specifications of contract of this NIT shall prevail.

5.2 TIME EXTENSION

5.2.1 Time allowed for the work is **8 weeks** including mobilization of Man Power and Machineries etc. at site. Total bore holes are **32 nos** including bore holes in depot area, which shall be reckoned from the day of the issue of LOI/LOA. Tenderers must satisfy that they would be able to complete the drilling and other works within stipulated period.

5.2.2 Time is the essence of contract. The contractor shall make all efforts to complete the work within the validity of the contract. However, if because of some reason it is expected that the work will not be completed in time, the contractor shall apply for time-extension in writing one month before the expiry of the validity of the contract, which will be considered on the merit of the case.

5.3 Schedule of payment.

Payment shall be made as per the following schedule:

- 15% of the total remuneration on acceptance of methodology and mobilization/inspection of instruments at site, start of field work and submission of inception report.
- 60% of the quoted item rates as per accepted schedule of rates on completion of field work and submission of bore logs details and its accepted by RITES
- 15% of the quoted item rates as per accepted schedule of rates on submission of draft report for acceptance.
- 10 % of total remuneration on submission of final reports and acceptance by RITES.

5.4 DELIVERABLES

The following drawings, reports, documents etc. shall be submitted by the Contractor/Sub-consultant as per time frame indicated below:

a) Inception report	10 days from the date of award of work
b) Completion of field work and submission of bore log details	6 weeks from the date of award of work
c) Submission of Draft reports.	8 weeks from the date of award of work
c) Submission of Draft reports.	Within 1 week from the date of award of work

5.5 Security deposit, at rate of **10%** shall be deducted from each of the running payment. This will be refunded after **180 days** of the satisfactory completion of the work. In this connection Clause-1 of General Conditions of Contract may be referred to.

5.6 The payment made for successful bidder shall be through ECS/EFT. The successful bidder should give the details i.e. Account Number (Type), Bank name and code, Branch name, Address and code (as appearing on MICR cheque issued by bank).

5.7 TERMS AND CONDITIONS

5.7.1 The Contractor shall deploy** adequate number of tools, plan, equipment and competent personnel within 15 days from the date of the issue of Letter of Acceptance to complete the work within the completion time stipulated in the Contract subjected to minimum **4 nos. of Hydraulic feed rotary drilling rigs** and suitable accessories capable for drilling through soil overburden/ boulder/rocky strata down to depths as described in the Schedule of Quantities. All the machines and allied accessories deployed shall be in perfect working order and preferably not more than 5 years old. If the equipment deployed shows frequent failure or its condition is poor, the Engineer-in-charge at his sole discretion may ask the contractor to replace them. The contractor is bound to replace them within the time period reasonably specified by the Engineer-in-charge/Representative. Any additional cost incurred in this process will be on contractor account. Equipment older than that specified above may be used subject to written approval/permission accorded by RITES Engineer-in-charge at his sole discretion and conditions duly certified by the site Engineer. Such permission accorded by the site Engineer shall not in any way relieve the Contractor of any of his responsibilities under the Contract.

Details of deployment of machine for the execution of the Works should be submitted in following Performa within 15 days of issue of letter of Acceptance.

(In Days reckoned from the date of issue of LOA)

S. No.	Description	Capacity (Output/ day)	Vintage (Year of manufacturer)	Date of Deployment**	Working days++	Total Expected Progress (Col. 3 x Col. 6)	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1							
2							
TOTAL PROGRESS							

** Date of deployment will be date of start of work of the machine

++ Working days shall be the days between date of start to Date of completion.

5.7.2 The contractor has to ensure deployment of a minimum of **4 Hydraulic feed rotary drilling rigs** and accessories suitable as well as capable for drilling through soil

overburden/boulder/rocky strata down to depths as described in the Schedule of Quantities.

5.7.3 The contractor has to ensure the complete mobilization of necessary equipment and personnel at site within **15 days from the date of issue of LOI/LOA.**

5.7.4 The contractor, within 7 days from issue date of Letter pf Acceptance, shall submit the programme in the form of bar chart or Microsoft Project in sufficient detail showing item wise rate of progress to adhere to the timeline as asked by the Engineer-in-charge.

5.7.5 The Contractor shall ensure that the progress of work is as per programme given above and a monthly review will be done at site by the Contractor with site representative and a report shall be submitted to the Engineer-in-charge duly endorsed by the Site Representative of RITES Ltd.

5.7.6 After subsequent review of the work if it appears that the actual progress of the Works does not conform to the programme, the Contractor shall take immediate action, at their expenses, to ensure completion of the works within the Time for Completion by deployment of more machines, manpower and/or increase working shifts. A revised programme showing these modifications should be submitted for approval of the Engineer-in-charge.

5.7.7 Amount of Mobilization/demobilization, wherever it is a separate items of BOQ, is considered as a full compensation for mobilization/demobilization of tools, plants & equipment in minimum quantity as specified in tender document to complete the work in originally stipulated time for completion. The value will be proportionally reduced automatically in case of insufficient mobilization and/or in case of extension of time with Liquidated Damages and/or reduction of scope of work due to default of the contractor without affecting any other remedies specified in the contract.

5.7.8 If the Contractor fails to take necessary action as per approved revised program or the Engineer-in-charge is of the opinion that with the revised programme submitted by Contractor, the work cannot be completed in stipulated time, the scope may be reduced by the Engineer-in-charge in addition to other action deemed fit as per the contract. RITES Ltd. will be at liberty to get the balance work executed by any other agencies or departmentally. The contractor shall have no claim for such actions by RITES Ltd.

5.7.9 The contractor shall depute two qualified and experienced Geologist/Geotechnical Engineer acceptable to the RITES LTD throughout the contract period to supervise the work in field, prepare Geological bore logs and got checked/approved by the Representative/Geologist of RITES. For the period of non-deployment of the qualified and experienced Geologist/Geotechnical Engineer, recovery of Rs. 40,000/- per month per Geologist/Geotechnical Engineer or part thereof shall be made from the running bills of the contractor.

5.7.10 Rates mentioned in the schedule of quantities shall be valid for a variation of the quantity up to maximum of (±) 50% for each item. In case of variation in quantities beyond + 50%,

the rates for the additional quantities beyond +50% variations shall be negotiated/decided on mutually acceptable terms, provided the rate so arrived does not exceed the originally accepted rate as per agreement.

5.7.11 In case of any unforeseen development as per technical requirement, drilling has to be carried out beyond the limits prescribed in the BOQ. No additional payment shall be made to the contractor for any additional depth up to 10m beyond the upper limit of the depth prescribed in the BOQ. For any further depth beyond 10m as indicated above, the rate shall be negotiated/mutually decided depending upon actual lithological condition and rate analysis.

5.7.12 Engineer or representative of RITES shall have the power to make any alternation, deletion, addition or substitution in the original scope and specification of work and no claim whatsoever on account of the above shall be entertained except for the payment for the actual work done on agreemental rates for original items of the contract and negotiated and approved rates for new item.

5.7.13 Taxes and Levies

Sales tax, works tax, consignment tax, purchase tax & other taxes and levies as applicable to site will borne by contractor. However, **service tax as per prevailing rates shall be paid extra**. Income tax as per rules shall be deducted from each bill.

5.7.14 The contractor shall have to follow all rules and regulations pertaining to payment of Minimum Wages Act as notified by State Government applicable for Project Site i.e. **Bihar State**. The contractor shall also be responsible for observance of labour regulations in respect of labour welfare PF & ESI.

5.7.15 It shall be the sole responsibility of the contractor to ensure accuracy of work alignment and level of works awarded to him.

5.8 PERFORMANCE GUARANTEE

5.8.1 The Contractor shall submit an irrevocable **PERFORMANCE GUARANTEE of 5%** (Five Per cent) of the tendered value in addition to other deposits mentioned elsewhere in the Contract for his proper performance of the Contract agreement, (not withstanding and/ or without prejudice to any other provisions in the Contract) within **15 days** from the date of issue of Letter of Acceptance. This period can be further extended as specified by the Engineer-in-Charge on written request of the Contractor stating the reason for delays in procuring the Bank Guarantee, to the satisfaction of the Engineer-in-Charge. This guarantee shall be in the form of fixed deposit receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the form given at Annexure 'A' in GCC. In case a fixed deposit receipt of any Bank is furnished by the Contractor to the RITES LTD as part of the performance guarantee and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the Contractor and the Contractor shall forthwith on demand furnish additional security to the RITES LTD to make good the deficit.

The rates quoted by Tenderer shall be reasonable and not unbalanced. If RITES Ltd. comes across any unbalanced rates, RITES may require the Tenderer to furnish detailed analysis to justify workability of the rates. If the Tenderer fails to justify this, RITES will ask bidder to furnish additional BG to the extent total quoted cost lower than 75% of Tender estimate within advised time by RITES for contract period, otherwise, his tender shall be liable to be rejected by RITES Ltd. forfeiting the EMD and award the contract to any next lowest bidder.

5.8.2 The Performance Guarantee shall be initially valid up to the stipulated date of completion plus 60 days beyond that. In case the time for completion of work gets enlarged, the Contractor shall get the validity of Performance Guarantee extended to cover such enlarged time for completion of work plus 60 days. After recording of the completion certificate for the work by the competent authority, the performance guarantee shall be returned to the Contractor, without any interest.

5.8.3 The Engineer-in-charge shall not make a claim under the Performance Guarantee except for amounts to which the RITES LTD is entitled under the Contract (notwithstanding and/or without prejudice to any other provisions in the Contract agreement) in the event of:

a) Failure by the Contractor to extend the validity of the Performance Guarantee as described herein above, in which event the Engineer-in-charge may claim the full amount of the Performance Guarantee.
b) Failure by the Contractor to pay the RITES LTD any amount due, either as agreed by the Contractor or determined under any of the Clauses/ Conditions of the agreement, within 30 days of the service of notice to this effect by Engineer-in-charge.

5.8.4 In the event of the Contract being determined or rescinded under provisions of any of the clause/condition of the agreement, the performance guarantee shall stand forfeited in full and shall be absolutely at the disposal of the RITES LTD.

5.9 FORCE MAJEURE

If at any time, during the continuance of this contract, the performance in whole or in part by either party of any obligation under this contract shall be prevented or delayed by reason of any war, hostility, acts of public enemy, civil commotion, sabotage, serious loss or damage by fire, explosions, epidemics, strikes, lockouts or acts of God (hereinafter, referred to events) provided, notice of the happening of any such event is given by either party to the other within 30 days from the date of occurrence thereof, neither party shall by reason of such event, be entitled to terminate this contract nor shall either party have any claim for damages against the other in respect of such non-performance of delay in performance, and works under the contract shall be resumed as soon as practicable after such event has come to an end or ceased to exist, and the decision of the Engineer-in-charge as to whether the works have been so resumed or not shall be final and conclusive, PROVIDED FURTHER that if the performance in whole or in part of any obligation under this contract is prevented or delayed by reason of any such event for a period exceeding 60 days, either party may at its option terminate the contract by giving notice to the other party.

5.10 LIQUIDATED DAMAGE & PENALTY

In case of any delay not attributed to RITES in the execution of the work beyond the stipulated time schedule, RITES shall recover as liquidated damages from contractor at the rate of one percent of total contract value per week or part thereof subject to maximum of 10% of contract value. Clause-2 of General Conditions of Contract may be referred to in this connection.

SECTION 6
SCHEDULE A TO F

PROFORMA OF SCHEDULES

(Operative Schedules to be supplied separately to each intending Tenderer)

SCHEDULE 'A'
Schedule of quantities (As per Bill of Quantities attached), (BOQ to be attached with Financial Bid)

SCHEDULE 'B'
Schedule of materials to be issued to the contractor. (Refer Clause 10 of Clauses of Contract)

S. No	Description of items	Quantity	Rates in Figures & words at which the material will be charged to the contractor	Place of Issue
1	2	3	4	5

- Not Applicable -

SCHEDULE 'C'
Tools and plants to be hired to the contractor. (Refer clause 34 of Clauses of Contract).

S. No	Description	Hire charges per day	Place of Issue
1	2	3	4

- Not Applicable -

SCHEDULE 'D'
Extra schedule for specific requirements/Documents for the work, if any
- Not Applicable: -

SCHEDULE 'E' –
Schedule of components of Cement, Steel, other materials, POL, Labour etc, for price escalation. (Refer Clause 10CC of Clauses of Contract).

SCHEDULE 'F'
Reference to General Conditions of Contract

Name of Work: Detailed Geotechnical Investigation for Technical Feasibility and Detailed Project Report for Patna Metro Rail System in Patna

Estimated cost of work	Rs. 9,81,354/-
Earnest money	Rs. 10000/-
Performance Guarantee	5% of Tendered value.
Security Deposit	10% of Tendered value

Notice Inviting Tender and Instruction to Tenderers

Officer inviting tender: General Manager/C (UT)/RITES

PART II – FINANCIAL BID

GUIDELINES FOR FILLING UP THE PRICE BID DOCUMENT

1. The schedule of quantities shall be read in conjunction with the instruction to tenderers, General and special conditions of contract, specifications.

2. The quantities given in the schedule of quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the contractor and verified by the engineer and valued at the rates and prices tendered in the priced schedule of quantities ,where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of contract.

3. The rates and prices tendered in the priced Bill of Quantities shall except in so far as it is otherwise provided under the contract include all constructional plants, Labor, supervision, materials, transportation, erection, maintenance, insurance, profit, taxes and duties, together with general risks, liabilities and obligations set out or implied in the contract. However, the service tax as per prevailing rates shall be paid extra.

4. Nothing extra shall be paid for mobilization, setting up boring rig from one location to another as specified in B.O.Q location, demobilization the same at site.

5. The tenderer should quote rates in figures as well as in words for items given in Bill of Quantities. The tenderer shall also work out the total amount of his offer and the same should be written in figures as well as in words.

6. A rate or price shall be entered in indelible ink against each item in figures as well as in words and the amount against each item is to be worked out. The cost of items against which the tenderer has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the schedule of quantities.

7. The method of measurement of completed work for payment shall be in accordance with the specifications.

8. **Service Tax as per prevailing rates shall be paid extra.**

9. Necessary barricading with 2.4mx1.8m metallic/wooden boards with necessary fixing/supporting arrangements shall be made around the work area .The barricades shall be provided as per drawing attached. The cost of providing, maintaining, shifting etc. of barricading shall be borne by the agency.

Name of work: Detailed Geotechnical Investigation for Technical Feasibility and Detailed Project Report for Patna Metro Rail System in Patna

BILL OF QUANTITIES

ITEM NO.	DESCRIPTION	QTY.	UNIT	Estimated Rates	Estimated Amount
A	**FIELD WORK**				
1	Vertical Boring 150mm dia. through all kinds of soils and weathered/soft rock with adequate / suitable equipment for depths measured below existing ground level including mobilization, setting up boring rig, demobilization the same (CR<=20%).				
	From 0 – 30m	910	Mtr.	682	620901
2	Drilling NX size through Hard Rock using diamond bit (CR >20%) upto 30m depth.	50	Mtr.	812	40580
3	Collecting undisturbed soil samples in 100mm dia. 450mm long thin walled tube sampler at every 3m interval or at change of strata whichever occurs earlier from boreholes and sealing the container.	256	No.	178	45656
4	Conducting standard penetration tests as per IS: 2131-1981 at 3m interval or at change of strata and collecting the disturbed sample. Packaging and labeling the same.	256	No.	141	36216
B	**LABORATORY TESTS**				
1	**Grain size analysis**				
	(a) Hydrometer analysis	172	No.	105	17990
	(b) Sieve analysis	340	No.	48	16202
2	Bulk and dry density and moisture content on UD samples.	256	No.	63	16247
3	Specific gravity of soil.	256	No.	71	18135
4	Chemical analysis of soil giving contents of sulphates, chlorides, pH value, etc.	32	No.	341	10912
5	Atterbergs limits	512	No.	78	40046
6	Consolidation test on clay samples giving relevant information as per IS: 2720 – XV –1986.	32	No.	158	5048
7	Collection of water samples and testing the same for pH value, sulphates, chlorides etc.	32	No.	532	17030
8	Direct shear test	32	No.	146	4665
9	Triaxial compressive strength test giving full test results including mohr circle, stress – strain curve etc.				
	a) Un-consolidation undrained test.	16	No.	153	2451
	b) Consolidation test on clay samples giving	16	No.	111	1770

ITEM NO.	DESCRIPTION	QTY.	UNIT	Estimated Rates	Estimated Amount
	relevant information as per IS: 2720 – XV –1986.				
10	Unconfined compressive strength test on clay soil samples as per IS: 2720 – X - 1973	32	No.	63	2009
11	Testing of hard rock for Crushing strength, Density, Water Absorption Test and rock cutting etc.	16	No.	171	2729
C	Preparation and submission of final report in four copies giving recommendations for type of foundation, analysis of borelogs & tests results along with SBC values.	1	Per Job	82768	82768
Total Amount		**Rs. 981354**			
Quoted % Below (-)/Above(+)	**In Figures**				
	In Words				
Quoted Amount	**In Figures**				
	In Words				

Seal and signature of the Bidder
Name of Signing Authority:
Contact No.:

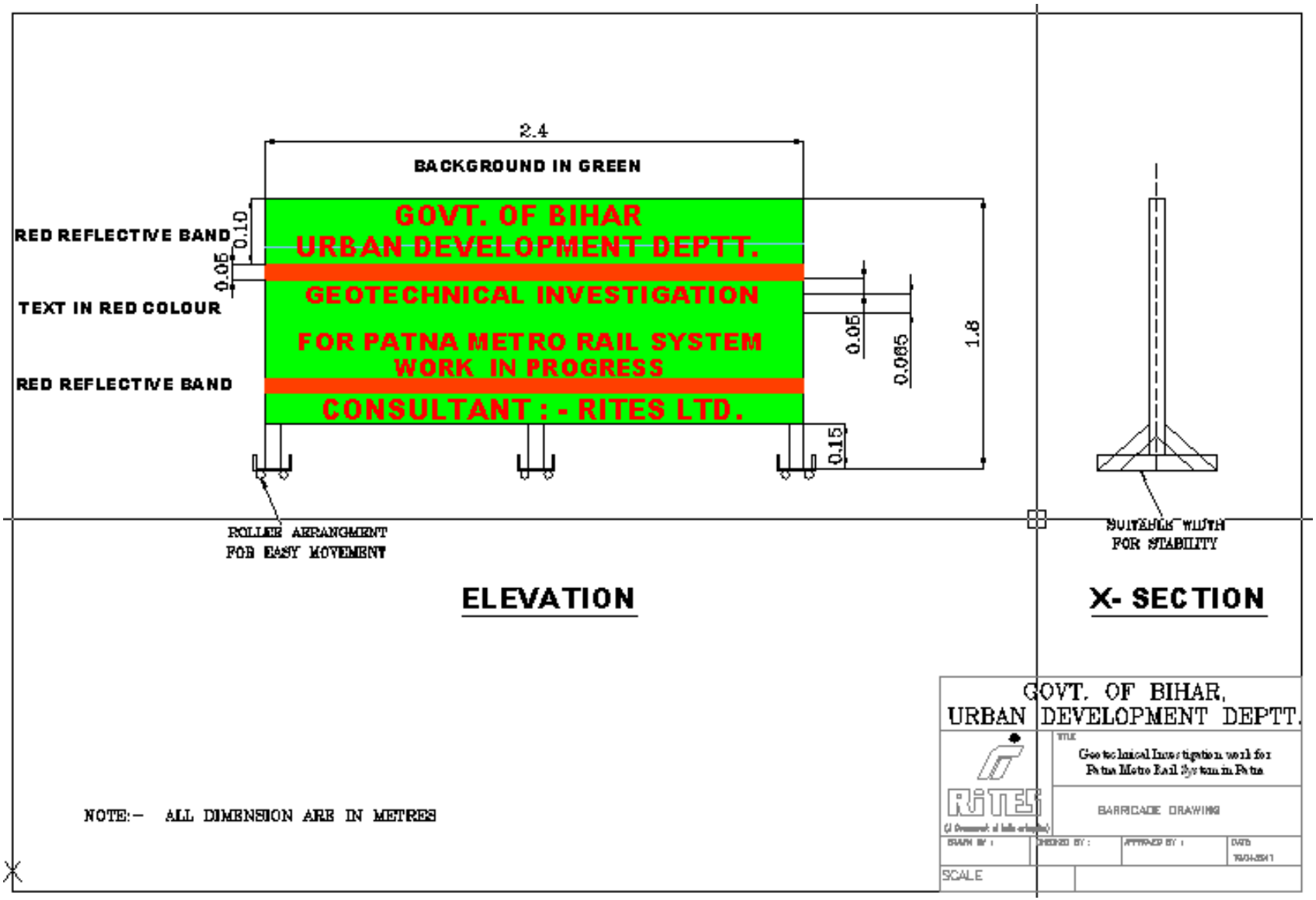
2.4
BACKGROUND IN GREEN
RED REFLECTIVE BAND
0.10
0.05
TEXT IN RED COLOUR
GOVT. OF BIHAR
URBAN DEVELOPMENT DEPTT.
GEOTECHNICAL INVESTIGATION
FOR PATNA METRO RAIL SYSTEM
WORK IN PROGRESS
CONSULTANT : - RITES LTD.
RED REFLECTIVE BAND
0.05
0.065
1.8
0.15
ROLLER ARRANGMENT
FOR EASY MOVEMENT
SUITABLE WIDTH
FOR STABILITY
ELEVATION
X- SECTION
NOTE:- ALL DIMENSION ARE IN METRES
GOVT. OF BIHAR,
URBAN DEVELOPMENT DEPTT.
Geotechnical Investigation work for
Patna Metro Rail System in Patna
BARRICADE DRAWING
SCALE

Fig 4.1: Key plan