Ref. No: MAPL/NMEDT/DPR/26-27/03 Date: 08.05.2026

To,
The Director & HOD
NMEDT Secretariat
Ministry Of Mines
9th Floor,
Jeevan Prakash LIC Building,
Kasturba Gandhi Marg
**NEW-DELHI-110001**

**Subject:** **Submission of Detailed Proposal for Preliminary Exploration (G3 Stage) at Shantipara A Limestone Block in Junagadh District, Gujarat State.**

Respected Sir,

We are pleased to submit the Detailed Project Report (DPR) for Preliminary Exploration (G3 stage) of the Shantipara A Limestone Block (1.49 sq. km) located in Junagadh District, Gujarat. CGM, Gujarat, has accorded No Objection Certificate (NOC) for the project.

The proposal has undergone due appraisal and approvals at various stages. In-principle approval was granted during the 92nd TCC-I meeting. Subsequently, the Detailed Project Report, including the project cost and implementation timeline, was approved in the 94th TCC-I meeting. The project has thereafter received final approval in the 8th Project Sanctioning Committee (PSC) meeting.

We reaffirm our continued commitment to NMEDT and assure diligent and timely execution of the proposed exploration program.

Thanking You,

For Mining Associates Private Limited




Indranil Bhattacharjee
(GM - Projects)

# MINERAL EXPLORATION PROJECT PROPOSAL

# FOR

# PRELIMINARY EXPLORATION (G3) FOR LIMESTONE IN SHANTIPARA A BLOCK NEAR THE VILLAGES JANUDA, SHANTIPARA, KHORASA GIR, DISTRICT- JUNAGADH, STATE - GUJARAT

## (1.49 SQ. KM.)

## UNDER NMEDT

**(T.S. No. 41K/08)**

**Commodity-LIMESTONE**

(Industrial Mineral**)**



**(Date of Submission: 8th May, 2026)**

**Submitted by**:

MINING ASSOCIATES PVT. LTD.
Plot no. 110, Main Dhemo,
Beside Railway Siding,
P.O. Sitarampur, Asansol,
Dist. Paschim Bardhaman,
**WEST BENGAL- 713359.**

**To,**

THE DIRECTOR AND HOD
National Mineral Exploration And Development Trust
Ministry Of Mines
**NEW-DELHI-110001.**

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## SUMMARY OF THE BLOCK FOR G3 STAGE EXPLORATION

| | Features | Details |
|---|---|---|
| | Block ID | Shantipara A Limestone Block |
| | Current Exploration Agency | Mining Associates Pvt. Ltd. |
| | Previous Exploration Agency | Commissioner of Geology and Mining (CGM), Gujarat. |
| | Previous Geological Exploration Report | Based on CGM report:<br>➢ Report on the Investigation carried out For Limestone Around Badalaparajonavia, Mithapur, Mahobatpara Villages of Veraval, Junagadh District (Field Season 1976-77) By Dr. J.P.Patel, Assistant Geologist, Mineral Exploration Circle, Ahmedabad.<br>➢ Geological Report of Solithern Part of Saurashtra Covered Under Toposheet Nos. 41 G/5, G/10+6, 41 K/4, G/15+11, 41 L/5+1. L/9+10 (Based on Interpretation of Satellite Imagery with Limited Field Checks) (Field Season 1995-96 And 1996-97) By S.D. Kapse, Asstt. Geologist. Y.C. Patel, Asstt. Geologist, (F.S. 1995-96), October 1997, Commissioner of Geology and Mining, Government of Gujarat, Gandhinagar.<br>➢ Geological Report of Shantipura, Block (Sukhadev J. Trivedi) Of, Malia Hatina Taluka, Junagadh, District, Gujarat. (Field Season-2018-19) Prepared For, Commissioner of Geology and Mining (CGM), Gandhinagar, Gujarat. Prepared & Investigated By, Vinayak Engimech Pvt. Ltd. |
| | Commodity | Limestone |
| | Mineral Belt | Saurashtra Coastal Miliolitic Limestone Belt |
| | Completion Period with entire Time Schedule to complete the project | 6 Months with review after 3rd and 5th months. |
| | Objectives | 1. Geological mapping in 1:4000 scale to delineate the surface outcrops/disposition, lithological contacts and lateral continuity of limestone bearing formations within the block.<br>2. To undertake systematic collection of Bed Rock samples and their chemical analysis for assessment of grade, quality, and suitability of limestone.<br>3. To drill 7 boreholes (Grid: 800m*800m approx.) in accordance with MEMC Rules, 2015 to establish subsurface continuity, thickness variation, depth persistence of limestone horizons, and to confirm the limestone–basement contact.<br>4. To evaluate grade variability of limestone, including CaO, $SiO_2$ and MgO contents, based on core and bedrock sampling.<br>5. To develop geological sections and a |

<table>
<tr><td></td><td></td><td>conceptual subsurface model of the limestone deposit.<br>6. To generate MEMC-2015 compliant G3 level geological resources (333 – Inferred category) for facilitating auction by the Government of Gujarat.</td></tr>
<tr><td></td><td>Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and Name of the outsource agency</td><td>Drilling and Laboratory analysis works will be outsourced.</td></tr>
<tr><td></td><td>Name/Number of Geoscientists</td><td>1 Geologist (Field) + 1 Geologist (HQ)</td></tr>
<tr><td></td><td>Expected Field days (Geology, Geophysics, Surveyor)</td><td>Shantipara Block A:<br>a. Geologist:70 Field Days+30 HQ Days<br>b. Surveyor:20 Days</td></tr>
<tr><td>1.</td><td>Location</td><td></td></tr>
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<tr><td></td><td>District</td><td>Junagadh</td></tr>
<tr><td></td><td>State</td><td>Gujarat</td></tr>
</table>

| | | |
|---|---|---|
| 2. | **Area (hectares/square kilometers)** | |
| | Block Area | 149 Ha/1.49 sq. km. |
| | Forest Area | -- |
| | Government Land Area | -- |
| | Private Land Area | -- |
| 3. | **Accessibility** | |
| | Nearest Rail Head | Chorvad Road Rail Way Station, Adari Road Rail Way Station are the very nearby railway stations to Shantipara. |
| | Road | Khorasa-Gir Highway then south through Januda |
| | Airport | Keshod Airport ~40 km |
| 4. | **Hydrography** | |
| | Local Surface Drainage Pattern (Channels) | Drainage within the block is poorly developed and ephemeral in nature |
| | Rivers / Streams | No perennial rivers or streams occur within the proposed block. |
| 5. | **Climate** | |
| | Mean Annual Rainfall | 1031 mm |
| | Temperatures (December)(Minimum)<br>Temperatures (June) (Maximum) | Minimum-$12^0$C<br>Maximum-$43^0$C |
| 6. | **Topography** | |
| | Toposheet Number | 41K/08 |

| | | |
|---|---|---|
| | Morphology of the Area | The block area comprises gently undulating plain terrain with low relief, locally covered by soil and calcareous exposures, and minor seasonal drainage channels. |
| 7. | **Availability of baseline geosciences data** | |
| | Geological Map (1:50K) | Attached (refer Plate No.-IV) |
| | Geochemical Map | Available |
| | Geophysical Map (Aerogeophysical, Ground geophysical, Regional as well as local scale GP maps) | Available |
| 8. | Justification for taking up G3 stage mineral exploration | 1. The Shantipara A Limestone Block (area ~1.49 sq km) lies within the Saurashtra Coastal Miliolitic Limestone Belt, a well-established limestone-bearing province of Gujarat. The area consists of Miliolitic Series and Gaj Limestone.<br>2. CGM studied this area and reported that the limestone is exposed at irregular intervals. Surface limestone exposures and proximity to existing limestone mines in the Shantipara area indicate favourable geological continuity and mineral potential within the proposed block.<br>3. Regional investigations by CGM, Gujarat in this belt have reported miliolitic limestone with CaO content ranging from around 41–54%, indicating suitability for cement and industrial applications. CGM report (1995–97) confirms cement-grade miliolitic limestone ($CaCO_3$ 85–92%).<br>4. 14 number of boreholes were reported within the Shantipara Limestone Mine which lies in the vicinity of the proposed block and the average CaO % of limestone reported in the mine was 43.5%. Average SiO2 % was 12.83% (CGM report – 2018).<br>5. The limestone blocks of Junagadh District, including Shantipara A & B Blocks, were identified and invited for exploration by CGM, Gujarat through NPEAs. Subsequently, CGM, Gujarat granted No Objection Certificate (NOC) to MAPL for carrying out exploration in the proposed block under NMEDT, thereby enabling systematic exploration, facilitating future auction of the block.<br>6. Field visit was carried by MAPL in the proposed Shantipara Blocks. **8 samples were collected** and analysed by an **NABL**, accredited Laboratory. **Average CaO% in 8 samples is 51.80% CaO.**<br>Considering the aerial extent of the block, proximity to operating limestone mines indicating geological continuity, and observed grade variability in nearby CGM studies, Preliminary G3 level exploration is technically justified.<br>The proposed G3 exploration will enable generation of **MEMC-2015 compliant** 333 (Inferred) limestone resources, facilitating |

| | | |
|---|---|---|
| | | **scientific evaluation and auction** of the block by the Government of Gujarat. |

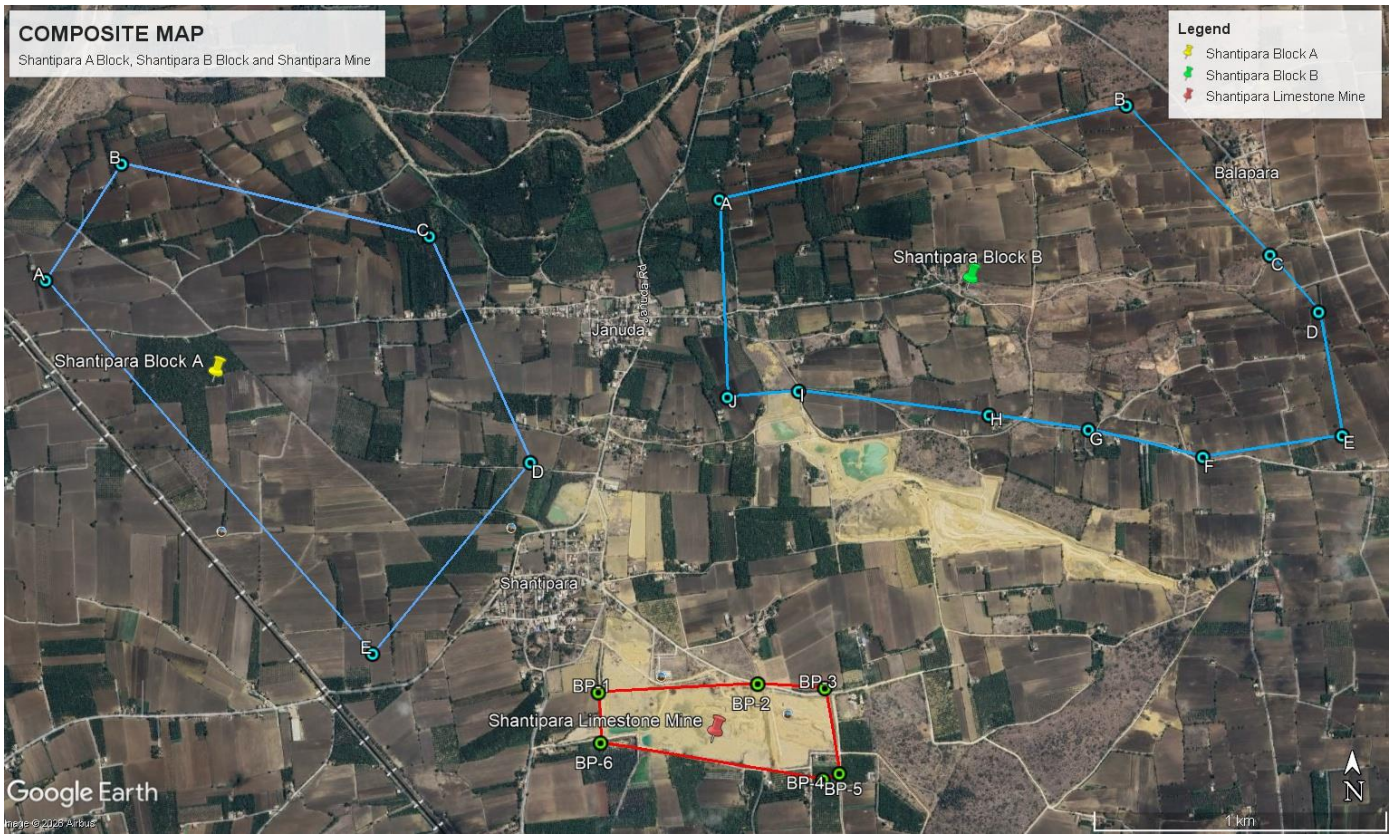



*Figure 1: Composite Map (Shantipara A Block, Shantipara B Block & Shantipara Mine)*

## DETAILED DESCRIPTION OF THE PROJECT

### 1. Block Summary

#### Physiography

The proposed Shantipura A Limestone Block forms part of the low-relief limestone plain of the Saurashtra region and is characterized by a nearly flat to gently undulating terrain. The topography shows only minor elevation variations, largely controlled by the surface expression of miliolitic limestone mounds and shallow intervening depressions.

The physiography of the area is dominantly influenced by the occurrence of miliolitic limestone, which is exposed at the surface as low mounds, discontinuous ridges and hummocky ground. These limestone mounds are interspersed with shallow depressions and flat plains, locally covered by thin soil, calcareous sand or sandy loam, particularly in low-lying areas. No prominent escarpments or steep slopes are observed within the block, and overall ground gradients are very gentle.

Drainage within the block is poorly developed and ephemeral in nature. No perennial streams flow through the area. Surface runoff during the monsoon period is accommodated through shallow, ill-defined drainage courses and natural depressions, indicating limited erosional activity. The absence of deeply incised drainage features reflects a geomorphically stable limestone terrain.

The block is located away from major river systems and is not influenced by active fluvial or marine processes. The combination of gentle relief, sparse vegetation and limited soil cover provides favourable surface conditions for geological mapping, surface sampling, trenching and drilling during the proposed G3 level exploration programme. The elevation ranges from about 31 m to 45 m above mean sea level.

#### Geological Background of the area

**Regional Geology**

The Shantipara A Limestone Block is situated in the coastal Saurashtra region of Junagadh District, Gujarat, where Tertiary marine sedimentary formations overlie the Deccan Trap basaltic basement. A discontinuous horizon of Palaeocene laterite locally intervenes between the Deccan Trap and the overlying sedimentary sequence.

Gaj Formation is mostly argillaceous and partly calcareous, comprising yellow and grey colored clays, variegated clays with gypsum bands and calcareous silt and sandstone along with thin bands of yellow brown colored limestone.

Miliolitic Limestone belonging to Miliolitic Series of Pleistocene age occupy a vast land of this region. Miliolitic Limestone is occasionally underlain by Gaj beds, while Recent to sub-recent alluvium and soil occupy low-lying areas. Miliolitic limestone occurs as outlines in the form of blanket and pockets consisting of limestone with bands of marl and clay. Thus, the Shantipara area forms part of the Saurashtra Coastal Miliolitic Limestone Belt,

The general stratigraphic succession of the region is as follows:

Stratigraphic Sequence of the formations with their geological age are given below:

| Sr No | Period (Age) | | Formation | Rock Type |
|---|---|---|---|---|
| 1 | Quaternary | Holocene | Sub. Recent to Recent | Blown sand, Soils, alluvium, Fluvio-marine deposits |
| 2 | Tertiary | Pleistocene | Milliolitic Formation | Coastal, arenaceous Limestone with Miliolite fossil |
| 3 | | Pliocene to Miocene | Gaj Formation | Argillaceous and calcareous clays, variegated clays with gypsum bands, calcareous silt and sandstone along with yellowish brown Limestone, Marl, Conglomerate |
| | | Lower Eocene | Laterite | Hard and compact Laterite, Bauxite and Clay, Ochreous and Bentonite clays |
| 4 | Tertiary to Upper Mesozoic | Eocene to upper Cretaceous | Deccan Trap | Deccan Traps and associated rocks with intrusive and dykes |

**Sub-Recent to Recent Deposits:** These comprise a thin surface cover of blown sand, soil and minor alluvium, locally developed in low-lying areas. The thickness is limited and discontinuous and does not constitute any significant overburden.

**Milliolitic Formation (Pleistocene):** This formation constitutes the principal lithological unit within the Shantipura A Block. The limestone is light cream to buff coloured, fine-grained, fossiliferous and porous in nature, composed predominantly of miliolite fossils and shell fragments set in a calcitic matrix. The unit occurs as a laterally continuous, sub-horizontal blanket deposit and represents the main target for exploration.

**Gaj Formation (Pliocene–Miocene):** Underlying the miliolitic limestone is the Gaj Formation, represented by calcareous sandstone, marl and clay with occasional variegated clay horizons and gypsum bands. This unit forms the immediate footwall to the limestone and generally shows a gradational contact with the overlying limestone.

**Laterite / Bauxite / Clay (Lower Eocene):** Laterite with associated bauxite and clay horizons is developed locally in the region. These units are not uniformly present within the block area but are included as part of the regional stratigraphic succession.

**Deccan Trap Basalt:** The Deccan Trap basalt forms the regional basement in the area. It is not exposed within the Shantipura A Block but is inferred at depth.

**Geology of the Block**

Miliolitic Limestone belonging to Miliolitic Series of Pleistocene age occupy a vast land of this region. Miliolitic Limestone is occasionally underlain by Gaj beds. Gaj Formation is mostly argillaceous and partly calcareous, comprising of yellow and grey colored clays, variegated clays with gypsum bands and calcareous silt and sandstone along with thin bands of yellow brown colored limestone. Laterites form almost a continuous zone between the Deccan Trap and the Gaj Formations, and occur as discontinuous patches forming colorful ridges. Miliolitic limestone occurs as outlines in the form of blanket and pockets consisting of limestone with bands of marl and clay.

| Local Geology of the Shantipura Limestone Area | | | |
|---|---|---|---|
| **Sr No** | **Period (Age)** | **Formation** | **Rock type** |
| 1 | Quaternary (Recent & Sub-recent) | over burden soil/alluvium | brownish and yellowish color soil |
| | | windblown calcareous sand dunes | calcareous sand, yellow clay with calcareous matter |
| 2 | Tertiary | Miliolitic Formation | pebble and granular limestone |
| | | Gaj Formation | brownish, greyish, whitish and yellowish colour clay, pebble, fine-medium grained limestone |
| 3 | .....Unconformity..... | | |

Thickness of individual litho-units varies from place to place. The field photographs are given in **Annexure-I.**

During field work, 8 samples were collected and analysed for 6 radicals from a NABL accredited laboratory. The Sample Location Map is given below in **Figure 1**.

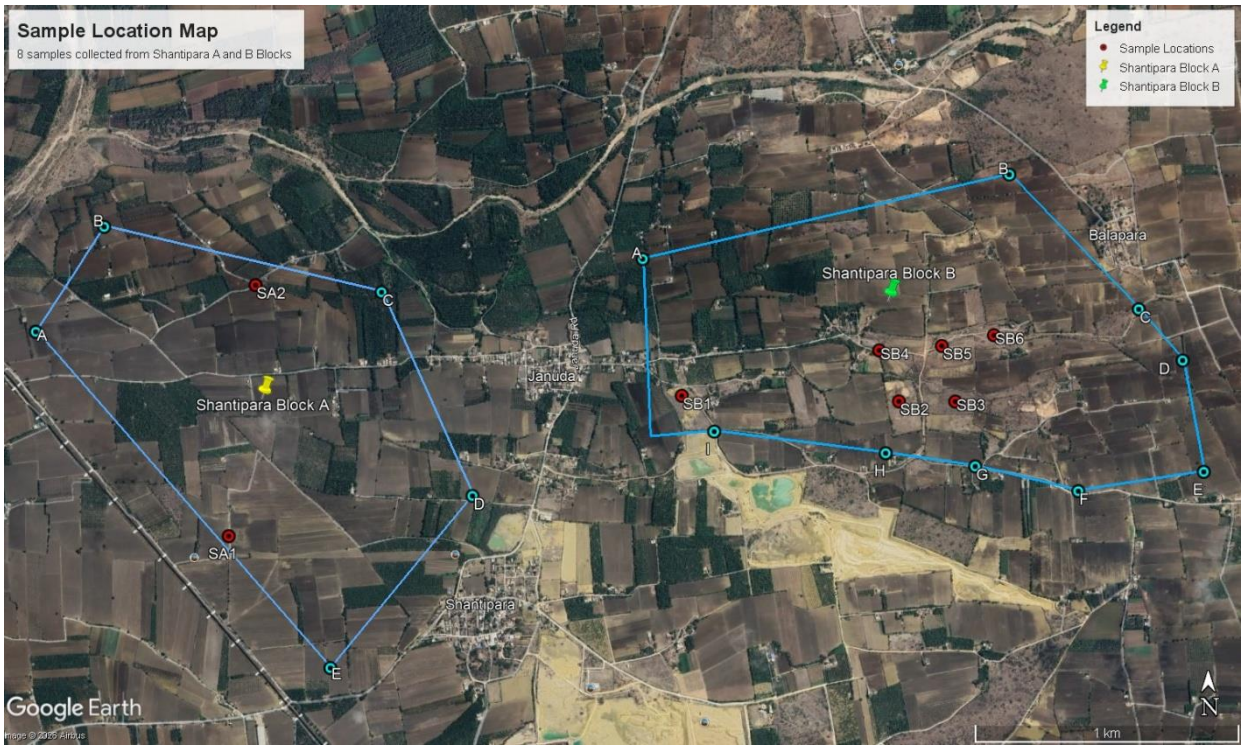



*Figure 2: Sample Location Map*

**Location details of samples collected by MAPL in Shantipara A and B blocks is given below:**

| Sample ID | Latitude | Longitude |
|---|---|---|
| SB1 | 21° 2'1.38"N | 70°19'24.18"E |
| SB2 | 21° 2'0.69"N | 70°19'52.73"E |
| SB3 | 21° 2'0.67"N | 70°20'0.16"E |
| SB4 | 21° 2'6.96"N | 70°19'50.16"E |
| SB5 | 21° 2'7.50"N | 70°19'58.38"E |
| SB6 | 21° 2'8.82"N | 70°20'5.22"E |
| SA1 | 21° 1'44.10"N | 70°18'24.48"E |
| SA2 | 21° 2'15.00"N | 70°18'28.00"E |

The average CaO% reported by the analysis of 8 collected samples is **51.80% CaO.**
The chemical analysis results are given below and the Report is given in **Annexure-II**.

| Sample ID | CaO% |
|---|---|
| SB1 | 48.79 |
| SB2 | 52.15 |
| SB3 | 54.12 |
| SB4 | 53.56 |
| SB5 | 53.84 |
| SB6 | 53.84 |
| SA1 | 44.86 |
| SA2 | 53.28 |

**Mineralization potential of Limestone**

Based on the regional geological setting, proximity to the existing Shantipura limestone mine, and the findings reported in earlier investigations carried out by the Commissioner of Geology and Mining, Gujarat, the Shantipura A Block is considered to be prospective for limestone mineralisation. The block forms part of the miliolitic limestone terrain of the Saurashtra region, where limestone occurs as laterally persistent, near-surface blanket deposits.

Available chemical analysis data from adjacent and nearby limestone workings indicate favourable CaO content suitable for cement and industrial applications. Field observations and geological maps suggest continuity of the limestone horizon into the proposed block area, though systematic subsurface data within the block is presently limited.

In view of the above, the proposed G3 level exploration aims to establish the thickness, quality and lateral continuity of the limestone deposit through systematic large-scale geological mapping, surface sampling, and core drilling on a 800 m × 800 m grid, in accordance with the provisions of MEMC, 2015. The proposed exploration programme is expected to generate reliable geological and analytical data for delineation of Inferred (333) limestone resources, which will support further planning and decision-making for mineral development and auction by the State Government.

**Scope for proposed exploration**

| Sr. No. | Nature of Work | Proposed Work |
|---|---|---|
| 1 | Detailed Mapping in1:4000 scale | 1.49 sq. km |
| 2 | Bed Rock Samples | ~20 |
| 3 | Topographic Survey (2m CI) | 1.49 sq. km |
| 4 | DGPS Survey (7 BH + 5 Block Boundary Points) | 12 No. |
| 5 | Bulk Density Determinations | 2 no. |
| 6 | Sample Analysis (Bed rock samples) | ~20 |
| 7 | Core Drilling | ~210 m |
| 8 | Borehole Depth | ~30m |
| 9 | Drill Core Samples | ~200 No. |
| 10 | Category of Land | -- |
| 11 | Geological Personnel | 01 Nos. (Field) + 01 No. (HQ) |
| 12 | Period of Scheme | 6 months |

**Recommendations by CGM, Gujarat and NMEDT (92nd TCC-I, 94th TCC-I & 8th PSC) :**

CGM, Gujarat invited NPEA's for taking up exploration of certain blocks of limestone. MAPL had applied for 5 limestone blocks. Thereafter, CGM, Gujarat granted NOC to Mining Associates Pvt. Ltd. to take up G4/G3 level explorations in 4 blocks of Junagadh District under NMEDT to facilitate Auction of the blocks. NOC for Shantipara A Limestone Block (one of the 4 blocks) was granted to MAPL by CGM, Gujarat.

NMEDT granted "In-Principle Approval" to MAPL in the 92nd TCC-1 meeting. The Committee also advised to prepare Borehole Plan in (800*800) m grid maintaining 200m distance from block boundary.

A joint field visit was also conducted by CGM-GMRDS's Officials and MAPL's Official in all 4 blocks including the proposed Shantipara A Limestone Block. BH plan was revised as per Committee's instructions. DPR with Project cost and Timeline was approved in 94th TCC-I meeting. Finally, Project was approved in the 8th Project Sanctioning Committee (PSC) meeting.

**Objectives:**

- Geological mapping in 1:4000 scale to delineate the surface outcrops/disposition, lithological contacts and lateral continuity of limestone bearing formations within the block.
- To undertake systematic collection of Bed Rock samples and their chemical analysis for assessment of grade, quality, and suitability of limestone.
- To drill 7 boreholes @ (800*800) m grids in accordance with MEMC Rules, 2015 to establish subsurface continuity, thickness variation, depth persistence of limestone horizons, and to confirm the limestone–basement contact.
- To evaluate grade variability of limestone, including CaO, $SiO_2$ and MgO contents, based on core and bedrock sampling.
- To develop geological sections and a conceptual subsurface model of the limestone deposit.
- To generate MEMC-2015 and subsequent amendments compliant G3 level geological resources (333 – Inferred category) for facilitating auction by the Government of Gujarat.

## 2. Previous Work

**CGM Report (1976-77):** Regional investigations in this belt have reported miliolitic limestone with CaO content ranging from around 41–54%, indicating suitability for cement and industrial applications.

**CGM report (1995–97):** Confirms cement-grade miliolitic limestone ($CaCO_3$ 85–92%). CGM recommended pre-detailed survey in the above-mentioned report.

**CGM Report (2018) of Shantipara Limestone Mine:** Several large scheme areas as well as limestone lease areas are also situated near this block indicating good limestone potential in the block. 14 number of boreholes were reported within the Shantipara Limestone Mine which lies in the vicinity of the proposed block and the average CaO % of limestone reported in the mine was 43.5%. Average SiO2 % was 12.83%.

The above investigations confirm the occurrence and grade suitability of limestone in the region, while no exploratory drilling has been reported in the Shantipara A and B blocks area so far, indicating the need for Preliminary (G3) stage exploration. The area comprises of Limestone of Miliolite, Dwarka and Gaj Formations, which are reported to be of cement grade. **Shantipara Limestone Mine occur in the vicinity of proposed block which is suggestive of high potentiality of the block.**

**Critical Data Gaps in Legacy Work:**

- Absence of GPS-based mapping and precise spatial coordinates of sample locations.
- No subsurface exploration (drilling/trenching) undertaken→ no depth control within the proposed block.
- Grade–thickness relationship of limestone horizons not established.
- MEMC-compliant geological sections, resource blocks or 3D models not available.
- Thickness and quality data cannot be reliably extrapolated at block scale.
- Hence, systematic Preliminary G3 level exploration is required for scientific assessment.

## 3. Block description

| Sr. No. | Block Corner Point | Latitude | Longitude |
|---|---|---|---|
| 1. | A | 21° 2' 9.25"N | 70°17' 58.95"E |
| 2. | B | 21° 2' 22.17"N | 70°18' 8.02"E |
| 3. | C | 21° 2' 14.11"N | 70°18' 44.63"E |
| 4. | D | 21° 1' 49.08"N | 70°18' 56.63"E |
| 5 | E | 21° 1' 27.89"N | 70°18' 37.89"E |

## 4. Proposed/ Planned Methodology

### Detailed Geological Mapping

Geological mapping will be carried out on 1:4,000 scale over the entire 1.49 sq. km block area by systematic traverses using GPS, Brunton compass, and tape. Lithological contacts, structural features, geomorphology, and surface manifestations of limestone observed during field mapping will be incorporated for preparation of the geological map and sections.

### Topographic Survey

A topographic survey shall be undertaken with reference to the triangulation network established by the authorized agencies. Topographic surveys shall be carried out on a 1:4,000 scale and contours shall be generated with 2 m interval. All the surface features such as roads, pits, trenches, borehole collars, streams, village boundaries, etc. shall be brought up on to the map using Electronic Total Station/DGPS survey.

Coordinates and collar RLs of the proposed boreholes and Block boundary corner points shall be surveyed using DGPS.

### Drilling

To understand the subsurface lithological disposition and continuity of limestone horizons, 7 boreholes are proposed with an average depth of ~30 m each. The total cumulative drilling meterage will therefore be ~210 m within the proposed block. Borehole locations will be finalized based on geological mapping results. Borehole depths may vary depending on vertical extent of mineralization.

### Core Logging and Sampling

Recovered cores will be preserved in standard core boxes and logged run-wise for lithology, colour, texture, structures, weathering characteristics, core recovery, and RQD where applicable. Representative core samples from limestone and associated lithologies will be collected following standard sampling procedures for laboratory studies.

After detailed core logging, the drill core will be split into two equal halves, of which one half

will be preserved in the core box as reference. The other half will be pulverized to −200 mesh size and reduced by coning and quartering to obtain four representative parts (~250 g each).

Out of these, one part will be sent for chemical analysis, the second preserved at camp as duplicate, the third may be utilized for preparation of composite samples, and the fourth retained as check/sample for any specific future analysis.

**Chemical Analysis**

The collected surface and core samples i.e. ~220 samples shall be analyzed by XRF for 6 radicals like CaO, MgO, $Al_2O_3$, $SiO_2$, $Fe_2O_3$ and LOI etc. 10% of the primary samples i.e. 22 samples shall be analyzed as check samples.

**Geotechnical and Physical studies**

2 Nos. of Limestone samples will be collected for Bulk Density determination. Thin section will be prepared and complete petrographic studies will be carried out for 5 Nos. of samples.

**Geological Report**

All geological, drilling, sampling, and analytical data generated during G3 exploration will be compiled into a Final G3 Stage Geological Report in accordance with MEMC Rules, 2015 and its subsequent amendments and NMEDT guidelines, establishing the occurrence, quality, preliminary extent of limestone mineralization and estimation of 333 (Inferred) Limestone Resources.

**5. Nature and Quantum of the work**

| **SI. No.** | **Components** | **Unit** | **Quantity** |
|---|---|---|---|
| **A** | **Detailed Geological Mapping** | | |
| 1 | In 1:4000 Scale | Sq. Km. | 1.49 |
| **B** | **Survey work** | | |
| 1 | Demarcation of block boundary, Fixation of Borehole and determination of co-ordinates & Reduced Level (RL) of the borehole by DGPS (7 BH + 5 Block Boundary Points) | Per Point of observation | 12 |
| 2 | Topographic survey with 2m contouring (1:4000 Scale) | Sq. Km. | 1.49 |
| **C** | **Pitting** | | |
| 1 | Pitting (1m length X 1m width X 1 m depth) | Cu.m. | 0 |
| **D** | **Drilling** | | |
| 1 | Core Drilling (~30 m average depth) | m | 210 m |
| 2 | Borehole Pillaring (12"X12"X30") | Nos. | 7 |
| **E** | **Laboratory studies Chemical Analysis** | | |
| 1 | Primary drill core samples for 6 radicals viz. CaO, MgO, $Al_2O_3$, $SiO_2$, $Fe_2O_3$, LOI (XRF) | Nos. | 200 |
| 2 | BRS samples | Nos. | 20 |
| 3 | External Check Samples from NABL Labs for 6 radicals viz CaO, MgO, $Al_2O_3$, $SiO_2$, $Fe_2O_3$, LOI (10% of total samples) | Nos. | 22 |
| | ***TOTAL NUMBER OF SAMPLES*** | Nos. | 242 |
| 6 | Sample preparation | Nos. | 242 |

| | | | |
|---|---|---|---|
| | **Laboratory studies Physical analysis** | | |
| 1 | Preparation of standard thin section of rock | Nos. | 5 |
| 2 | Complete Petrographic Studies along with 5 no. of digital photographs | Nos. | 5 |
| 3 | Bulk Density determination | Nos. | 2 |
| **F** | **Preparation of Exploration Proposal** | Nos. | 1 |
| **G** | **Geological Report preparation (as per MEMC Amendment Rules, 2021/UNFC)** | Nos. | 1 |

## 6. Proposed Exploratory Drilling Plan

The total area of the proposed block is 1.49 sq. km. The block is proposed to be explored by drilling 7 boreholes at (800*800) m grid spacing with a cumulative drilling meterage of ~210 m, each borehole having an approximate vertical depth of ~30 m, in order to assess the subsurface disposition and continuity of bedded limestone deposits, in accordance with the MEMC Rules, 2015 guidelines and its subsequent amendments for G3 stage exploration.

Core drilling by Hydraulic Drilling Rigs. The holes shall be derived in in NQ sizes. While drilling, wherever water table is encountered, depth of the water table should be recorded and to be mentioned in the driller logs. The core recovery in all the formation should be at least 90% except in fault zone, weathered zone, soil, sand and structurally disturbed area.

Collar details of proposed boreholes (UTM Zone: 42Q):

| BH ID | Easting | Northing | Collar RL (m) | Inclination | Depth (m) |
|---|---|---|---|---|---|
| PBH-1 | 635357 | 2326775 | 35 | Vertical | 30 |
| PBH-2 | 635430 | 2326451 | 33 | Vertical | 30 |
| PBH-3 | 635739 | 2326795 | 35 | Vertical | 30 |
| PBH-4 | 635869 | 2326341 | 37 | Vertical | 30 |
| PBH-5 | 636012 | 2325902 | 37 | Vertical | 30 |
| PBH-6 | 636399 | 2326332 | 38 | Vertical | 30 |
| PBH-7 | 636355 | 2325929 | 40 | Vertical | 30 |

**Note:** Proposed borehole coordinates and RLs' may change after detailed Geological mapping and collar survey using DGPS instrument. Borehole depth may also change based on actual depth of mineralization encountered in each borehole.

The proposed borehole locations are shown in Plate–V.

**Expected Outcomes of G3 Program:**

- Establish MEMC-2015 compliant G3 level geological resources (333 – Inferred category).
- Delineate lateral and vertical thickness variation of limestone within the block.
- Generate subsurface geological sections and a conceptual 3D geological model of the deposit.
- Prepare grade distribution maps and thickness (isopach) maps based on drilling and sampling data.
- Generate GIS-based exploration outputs to facilitate further decision-making and auction by the Government of Gujarat.

## 7.0 TIME SCHEDULE

| S. No. | Item of Work | 1 | 2 | 3 | | 4 | 5 | | 6 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Camp Setting | | | | | | | | |
| 2 | Geological Mapping & Sampling | | | | | | | | |
| 3 | Survey Party days | | | | | | | | |
| 4 | Pitting/Trenching | | | | | | | | |
| 5 | Surface Drilling (1 rig) | | | | | | | | |
| 6 | Geologist Man days (Field) | | | | REVIEW | | | REVIEW | |
| 7 | Geologist Man days (HQ) | | | | | | | | |
| 8 | Sampler Man days | | | | | | | | |
| 9 | Camp Winding | | | | | | | | |
| 10 | Chemical Analysis of Surface samples | | | | | | | | |
| 11 | Lab analysis of Drill Core Samples | | | | | | | | |
| 12 | Processing of Analytical Data | | | | | | | | |
| 13 | Report Writing | | | | | | | | |
| Note: | * Commencement of the project may be reckoned from the day exploration agency available with all necessary clearances | | | | | | | | |
| | * Time loss on account of Forest Clearance, Monsoon, local law and order problems if any may be addition to the above timeline. | | | | | | | | |

**Manpower Deployment:**

- **Geologist party:** 1 Geologist (Field) – 70 days + 1 Geologist (HQ) – 30 days
- **2 labours/Geologist** (i.e. 70 days*2 labours = 140 days).
- **Sampler Party:** 1 Sampler – 30 Days and 4 Labours - (30x4) = 120 Days.
- **Survey Party:** 1 Surveyor – 20 Days and 4 Labours – (20x4) = 80 Days.
- **Drilling Party:** 1 Driller, 2 Assistant Driller, 1 Mechanic, 6 labours for Approx. 30 days

## 8.0 BREAK UP OF EXPENDITURE

| SL. No. | Component | Cost in Rs. |
|---|---|---|
| A | Geological Mapping and Other Geological Works | 17,37,327 |
| B | Survey Work | 5,42,480 |
| C | Drilling | 17,67,000 |
| D | Laboratory Studies | 10,37,900 |
| E | Tendering Cost | 23,100 |
| F | Operational charges towards Technical Supervision of outsourced work | 1,15,500 |
| G | ***Total A to F*** | **52,23,307** |
| H | Preparation of Exploration Proposal | 1,04,466 |
| I | Geological Report Preparation | 2,50,000 |
| J | Peer Review | 30,000 |
| K | **Total Estimated Cost without GST** | **56,07,773** |
| L | Provision for GST@18% | **10,09,399** |
| M | **Total estimated cost with GST** | **66,17,172** |
| | **or say Rs. in lakhs** | **~66.17** |

| Preliminary Exploration (G3) for Limestone in Shantipara A Block, Junagadh District, Gujarat (Area 1.49 sq. km), Drilling: 210 m, No. of BH: 7 nos., Average borehole depth range: 30 m, Schedule timeline- 6 months, Review: After 3 and 5 Months | | | | | | | |
|---|---|---|---|---|---|---|---|
| **S. No.** | **Item of Work *** | **Unit *** | **Rates as per NMEDT SoC 2025-26** | | **Estimated Cost of the Proposal** | | **Remarks** |
| | | | **SoC-Item No. *** | **Rates as per SoC * (a)** | **Qty. (b)** | **Total Amount (Rs) (a*b)** | |
| **A** | **Geological Mapping Other Geological Work & Surveying** | | | | | | |
| | Geological mapping, (1:4000 scale) & sampling | Sq. km. | **1.1** | 18,300 | **1.49** | 27,267 | |
| i | a. Charges for Geologist per day for **Field (Total Geo Days = 70 days)** | day | **1.2.1a** | 14,500 | **70** | 10,15,000 | For drilling supervision, core logging and sampling. |
| ii | b. Labours Charges; Base rate | day | **5.8** | 556 | **140** | 77,840 | Amount will be reimbursed as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher. |
| iii | c. Charges for Geologist per day **(HQ)** | day | **1.2.1a** | 10,500 | **30** | 3,15,000 | |
| iv | e. Charges for one Sampler per day | one sampler per day | **1.2.1b** | 7,850 | **30** | 2,35,500 | |
| v | b. Labours Charges; Base rate | day | **5.8** | 556 | **120** | 66,720 | |
| | **Sub Total-A** | | | | | **17,37,327** | |
| **B** | **Survey work** | | | | | | |
| a | Charges for one surveyor per day (topographic survey 1:4000 Scale) | day | **1.3.1** | 10,500 | **20** | 2,10,000 | |
| b | Labour (4 Nos.) per party | day | **5.8** | 556 | **80** | 44,480 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| c | Demarcation of lease boundary, Fixation of Borehole and determination of co-ordinates & Reduced Level (RL) of the boreholes by DGPS | Per Point of observation | **1.3.2** | 24,000 | **12** | 2,88,000 | (5BP+7BH) |
| | **Sub Total-B** | | | | | **5,42,480** | |
| **C** | **DRILLING (Outsource)** | | | | | | (after review) |
| 1 | Drilling (Soft Rock) | Per m | **2.2.1.1c** | 5,500 | **210** | 11,55,000 | No. of BH: 7 nos. with avg. depth of 30 m |
| 2 | Construction of concrete Pillars (12" *12" *30") | Per Borehole | **2.2.7** | 2,000 | **7** | 14,000 | |
| 3 | Borehole plugging by cement. | Per Borehole | **2.2.8** | 10,000 | **7** | 70,000 | Lumpsum |
| 4 | Land/Crop compensation | Per Borehole | **5.6** | 30,000 | **7** | 2,10,000 | As per actuals |
| 5 | Drill Core preservation | Per m | **5.3** | 1,590 | **200** | 3,18,000 | |
| | **Sub Total-C** | | | | | **17,67,000** | |
| **D** | **Laboratory Studies (Outsource)** | | | | | | |
| **1** | **Chemical Analysis** | | | | | | |
| i | Analysis of Major Oxides by XRF | Nos. | **4.1.17a** | 4,200 | **220** | 9,24,000 | 20 BRS + 200 Core samples |
| | External Check samples (10%) | Nos. | **4.1.17a** | 4,200 | **22** | 92,400 | |
| **2** | **Physical, Petrological & Mineralogical studies** | | | | | | |
| i | Preparation of thin section | Nos. | **4.3.1** | 500 | **5** | 2,500 | |
| ii | Complete Petrographic report of rock sample along with digital photographs | Nos. | **4.3.4** | 2800 | **5** | 14,000 | |
| iv | Bulk Density | Nos. | **4.8.1** | 2500 | **2** | 5,000 | |
| | **Sub Total-D** | | | | | **10,37,900** | |
| | **Total Outsourced** | | | | | **11,55,000** | |
| | **Tendering Cost** | | **5.9** | | | **23,100** | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Technical Supervion Cost for outsourced Components** | | **6** | | | **1,15,500** | |
| **F** | **TOTAL** | | | | | **52,23,307** | |
| **G** | **Preparation of Exploration Proposal** | | **5.1** | 2% of approved project cost or 5 lakh whichever is lower | **1** | 1,04,466 | |
| **H** | **Geological Report Preparation** | **5 Hard copies with a soft copy** | **5.2 (ii)** | Total cost exceeding 50 lakh but less than 150 lakh | **1** | 2,50,000 | |
| **I** | **Peer review** | Per review | **--** | | **--** | 30,000 | As per EC decision |
| **K** | **Total Estimated Cost without GST** | | | | | **56,07,773** | |
| **L** | **Provision for GST (18% of M)** | | | | | **10,09,399** | |
| **M** | **Total Estimated Cost with GST** | | | | | **66,17,172** | |
| | **or Say Rs. In Lakhs** | | | | | **~66.17** | |

| | |
|---|---|
| **Note:** | |
| **1** | **Strict adherence to the Ministry of Finance's and GFR guidelines is mandatory. Every transaction must adhere to GFR rule 21.** |
| **2** | **In case of delay/non- performance, the appropriate action will be taken by competent authority against delinquent agency as per prevailing govt. of India rules/guidelines on procurement.** |
| **3** | **If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMEDT SoC and Item no. 6 of NMEDT SoC. In case of execution of the project by NEA on its own, a Certificate regarding non outsourcing of any component/project is required.** |
| **4** | **Necessary efforts should be made to minimize any adverse impact on the environment during exploration activities.** |
| **5** | **Any item of work not mentioned above shall be added as per SoC.** |

**Note:**

**A. Timelines**

Total estimated time period for execution of G3 stage exploration in Shantipara A Limestone Block is 6 months with reviews after 3rd and 5th months. In case, local hindrances, weather, climate etc. results in delay the timeline will undergo changes accordingly.

**B. Total estimated expenditure**

Total estimated cost is **Rs. 66,17,172** including GST.

**C. Terms of payment**

M/s Mining Associates Pvt. Ltd. will raise the invoice for the quantum of work completed in accordance with the approval as per NMEDT rules.

## 9. References:


1. CGM Report: Report on the Investigation carried out For Limestone Around Badalaparajonavia, Mithapur, Mahobatpara Villages of Veraval, Junagadh District (Field Season 1976-77) By Dr. J.P.Patel, Assistant Geologist, Mineral Exploration Circle, Ahmedabad.

2. CGM Report: Geological report of southern part of Saurashtra covered under toposheet nos. 41G/5, G/10+6, 41K/4, G/15+11, 41L/5, L/9+10 (Based on interpretation of satellite imagery with limited field checks) (Field Season 1995-96 and 1996-97) by S. D. Kapse, Asstt. Geologist, Y.C. Patel, Asstt. Geologist (F.S. 1995-96) and S. D. Kapse, Asstt. Geologist (F.S. 1996-97).

3. Geological Report of Shantipura, Block (Sukhadev J. Trivedi) Of, Malia Hatina Taluka, Junagadh, District, Gujarat. (Field Season-2018-19) Prepared For, Commissioner of Geology and Mining (CGM), Gandhinagar, Gujarat. Prepared & Investigated By, Vinayak Engimech Pvt. Ltd.

4. 1:50,000 scale Geological Data obtained from Bhukosh portal (https://bhukosh.gsi.gov.in) of Geological Survey of India.

5. NGDR portal.

6. Revised Schedule of Charges – NMEDT.

# ANNEXURE – I: Field Photographs







**Limestone outcrops within the proposed Shantipara Blocks.**



**Samples Collected by MAPL**



**HCL test showing significant effervesence**



**Limestone boulders within the proposed Shantipara Blocks.**





**Shantipara MINE.**

# ANNEXURE – II: Analysis results of samples collected by MAPL

HORIZON ENVIRONMENT & MINERAL SOLUTION LLP
B/112, THE LANDMARK, OPP. KANSAR GARDEN RESTAURANT,
KUDASAN, GANDHINAGAR – 382421
+91 99798 44388 HORIZONEMSLLP@GMAIL.COM WWW.HEMSLAB.COM
TC-13952

ULR No: - TC13952260000000106 Date: - 23/03/2026

**TEST REPORT**
(Mineral)

| | | | |
|---|---|---|---|
| 1 | Name of Customer | : | **Mining Associates Pvt Ltd** |
| 2 | Customer Contact No. | : | +91 6289339388 |
| 3 | Type of Sample | : | Limestone (As per Party's Letter) |
| 4 | Sample Identification | : | Labeled Samples of Lambora, Mankhetra & Santipura Blocks |
| 5 | Date of Receipt of Sample | : | 17/03/2026, Sample submitter by customer |
| 6 | HEMS Job No. | : | HEMS0326M01 to HEMS0326M17 |
| 7 | Name of work | : | Chemical Analysis of Limestone (IS 1760) |
| 8 | Sample Location | : | Junagadh, Gujarat |
| 9 | Date of Testing | : | 17/03/2026 to 23/03/2026 |

*Test Results:-*

| Sr. No. | HEMS ID. | Sample code | Test Parameter (%) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | CaO | MgO | LOI |
| 1 | HEMS0326M01 | L1 | 0.51 | 0.80 | 0.25 | 53.56 | 0.81 | 43.91 |
| 2 | HEMS0326M02 | L2 | 1.34 | *UDL (DL<2) | 0.51 | 51.31 | 1.21 | 42.39 |
| 3 | HEMS0326M03 | L3 | 1.82 | 1.92 | 0.51 | 53.28 | 0.40 | 41.94 |
| 4 | HEMS0326M04 | L4 | 1.58 | 2.00 | 0.64 | 52.72 | 0.81 | 42.12 |
| 5 | HEMS0326M05 | L5 | 13.23 | *UDL (DL<2) | *UDL (DL<2) | 42.06 | 1.41 | *BDL (DL>40) |
| 6 | HEMS0326M06 | L6 | 13.08 | *UDL (DL<2) | *UDL (DL<2) | 41.78 | 1.81 | *BDL (DL>40) |
| 7 | HEMS0326M07 | M1 | 5.60 | 1.16 | 0.89 | 50.75 | 0.60 | 40.34 |
| 8 | HEMS0326M08 | M2 | 9.32 | 1.16 | 1.02 | 49.07 | 0.60 | *BDL (DL>40) |
| 9 | HEMS0326M09 | M3 | 0.70 | *UDL (DL<2) | 0.76 | 52.15 | 0.81 | 42.73 |
| 10 | HEMS0326M10 | SB1 | 4.87 | *UDL (DL<2) | 1.66 | 48.79 | 1.21 | *BDL (DL>40) |
| 11 | HEMS0326M11 | SB2 | 2.60 | *UDL (DL<2) | 1.15 | 52.15 | 0.40 | 40.95 |
| 12 | HEMS0326M12 | SB3 | 1.11 | 0.40 | 0.25 | 54.12 | 0.20 | 43.12 |
| 13 | HEMS0326M13 | SB4 | 1.56 | 0.32 | 0.51 | 53.56 | 0.20 | 43.27 |
| 14 | HEMS0326M14 | SB5 | 1.34 | 0.80 | 0.38 | 53.84 | 0.40 | 42.42 |
| 15 | HEMS0326M15 | SB6 | 1.71 | 0.60 | 0.51 | 53.84 | 0.40 | 42.07 |
| 16 | HEMS0326M16 | SA1 | 9.60 | *UDL (DL<2) | *UDL (DL<2) | 44.86 | 0.20 | *BDL (DL>40) |
| 17 | HEMS0326M17 | SA2 | 0.67 | 0.68 | 0.51 | 53.28 | 0.40 | 43.83 |

*BDL: Below Detection Limit, DL: Detection Limit, UDL:Upper Detection Limit

Tested By

Nikita Patel
Chemist

Authorized By

Kaushik Shukla
Quality Manager

**Notes:**

- The test results refer only to the samples received in the Laboratory.
- HEMS shall not in any way be involved in any action following the interpretation of test results.
- Any discrepancy in test results should be reported within 15 days.
- This report Is not to be reproduce wholly or in a part and cannot be used as evidence in court of law and shall not be used in advertising media without permission of HEMS in writing.
- The Sample will be destroyed after suitable retaining period, unless otherwise requested by party.
- Subject to Gandhinagar-GJ Jurisdiction only.

End of Report

# ANNEXURE – III:  CGM LEGACY REPORTS

Report No.182

# REPORT ON THE INVESTIGATION CARRIED OUT FOR LIMESTONE AROUND BADALAPARAJONAVIA, MITHAPUR, MAHOBATPARA VILLAGES OF VERAVAL, JUNAGADH DISTRICT

**(Field Season 1976-77)**


**By**

**Dr. J.P.Patel**

**Assistant Geologist**






**Mineral Exploration Circle**

**Ahmedabad**

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1. Summary
2. Introduction
3. Physiography
4. communication
5. Climate
6. Geology
7. short description of the limestone exposures
8. Sampling
9. Reserves
10. Grade of limestone
11. Recommendations
12. Acknowledgement
13. References


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**2.** Map of Bhalpara-chankhal area (Block-I)
**3.** Map of Mithapur area (Block-II)
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2. Specific gravity results of different samples
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5. Average chemical analysis of different blocks.

## SUMMARY:-

Detailed investigations were carried out during the field season 1976-77 to estimate reserves of chemical grade limestone in the area around Veraval and Chorwad of Junagadh district. In all 18.9 million tonnes of chemical grade limestone reserves is estimated. It is very clear from results that only milliolitic limestone of the area under report is of chemical grade.

## INTRODUCTION:-

Investigations for Chemical grade limestone in the area around Chorwad and Veraval of Junagadh district was taken up by the Rajkot circle of the Directorate of Geology and Mining, government of Gujarat, during filed season 1976-77 as per order No. SG/RC/1010 dated 28-10-76.

Accordingly detailed mapping and sampling was started from the eastern part of Veraval and by the end of season 114 sq.kms. area was covered. The detailed mapping was carried out on 1:5000 scales with the help of level, compass and chin.

## PHYSIOGRAPHY:-

The area under investigation constitutes the coastal plains about 19 kms. broad extending towards north from the sea coast and ending rater abruptly against the southern portion of Gir high lands. The area is extensively cultivated among which number of outcrops of Milliolite limestone stand out as small low lying mounds and ridges. The drainage trend is almost N-S to NE-SW. The Hiran and Saraswati rives flow through the Badalpara block area and are for by numberous streams while in the Chorwad block Megal is the only important river.

**COMMUNICATION:-**

The Junagadh Veraval Bhavnagar high way is the important all weather tar road as for as communication is concerned. Chorwad is also connected by Veraval – Porbandar coastal highway. Veraval and Chorwad are both connected by M.G. railway with other important port. Chorwad is a port of considerable importance to the fishing industries.

**CLIMATE:-**

The climate of the area is very pleasant in comparison with the rest of the State. In summer the temperature rises up to $105^0$F and during winter it falls up to $45^0$F. The average annual rainfall is about 50 cms.

**GEOLOGY:-**

Several Geologists have given geological picture of the Saurashtra region. Feddon (1884). Howard Adye (1914). Dr. B.C.Roy (1953), Karunakaran (1950-51) Burjor Mehta, Mathor, Verma, Mehra and others. The geological succession as given by Feddon is as below:-

| | | |
|---|---|---|
| Alluvium | Post-Tertiary | |
| Miliolite series | | |
| Dwarka beds | Post-Pliocene | |
| Gaj beds - - - | Miocene | Tertiary |
| Laterite rocks | Lower Eocene | |
| Traps | Cretaceous to Eocene | |
| Trappean Grits | Cretaceous | Mesozoic |
| Wadhwan Sandstone | -do- | |
| Unia Series | | |

The Stratigraphical succession of the present area is summerised as below:-

| | |
|---|---|
| Alluvium | Recent |
| Miliolite limestone | Pleistocene |
| Dearka beds | Low to Mid. Miocene |
| Gaj beds | Lower Miocene |
| Trap | Cretaceous to Eocene |

The oldest formation is Deccan trap in the present area however; it is exposed only in the northern portion of the area as shown in the map.

**Gaj beds:**

The almost horizontal beds of Gaj group lie unconformably upon the weathered surface of trap rocks or lateritic rocks. The typical yellow colour of these rocks is no doubt due to limonitic staining derived by solution and diffusion from the adjoining lateritic formations. The thickness of these beds increases towards the sea i.e. in south, while decreases in north. The Gaj beds signify the marine transgression over the area where they occur. Limonitic limestone, sandstone, yellowish to white clay and marls are the common rock types. This formation is on the whilo extremely fossiliferous containing fossils of lamellibranches, gastropods, echinoids, bryozoa, corals etc. the cross-bedding is recorded at several places in river cuttings.

**Dwarka beds:**

The Dwarka (?) occurs conformably as lenses over Gaj formation. These beds are very distinct in the area around Sonaria, Mithapur and Mahobatpara villages of Veraval taluka. These beds are characterised by whitish colour and presence of shells of lamellibranches and gastropods in abundance, cemented in a recrystalised matrix of Calcite. Among lamellibranches, pecten shells occur in great abundance in these rocks.

**Milliolite limestone:**

The Dwarka beds are overlained by the younger formation of Miliolite limestone. The exposures of these limestones are also observed to rest directly on Gaj or trap rocks.

Dr. Carter is the first geologist to give nomenclature "Miliolite" to this limestone as they contain foraminifer 'Miliolidae'. Adye (1914) has pointed out that Dr. Carter's name Miliolite still clings tenaciously to this rock when referred to by geologist-in spite of the fact that comparatively few tests of he Miliolite are to be found in the rock. Indeed, the members of this family are more abundantly represented in many of the Tertiaries (Gaj). These rocks are usually white in colour with shades of buff, yellow and grey and brown. The presence of more or less iron gives the colour to the rock. When iron preponderates it is diffused, and the rock has a tendency to shrink in situ into slabs and to become more than ordinarily hard. The typical characteristic of this limestone is solution holes. The soft portions decay and get washed away, making the rock perforated. Such perforation is usually seen only in the upper most portion of the rock. This rock is very valuable among economic rocks of this area being high in Cao content. It is also very extensively used as building stone as it is very soft and easily tooled. The high grade verities of this rock consist almost of entirely of carbonate of lime with only small percentage of silica, iron and occasionally alumina. It is seen that these rock have originated on account of sedimentation and not merely of sub-arieal consolidation. These rocks also very good uniformity in general structure consisting of foraminifers mostly of pelagic hobbit. In addition to the above, grains of quartz and other minerals are also present either uniformly distributed or in linear segregations. All the particles are cemented together by a very fine colour less range in composition from micrite to calcirudite (Verma & Mathur, 1976).

**Petrological description of the Miliolite limestone:**

During the course of the field investigation? Samples of the Miliolite limestone were collected from different exposure and were submitted to the departmental

Petrological laboratory for microscopic studies, as per the study conducted in the laboratory, megascopically they were found to be yellowish white in colour, hard compact and medium grained. With venilets of secondary calcite. The limestones generally show profuse effervence with dilute HCI.

Under the microscope they were generally observed to be medium grained, composed of oval shaped to rounded micro foraminifera fossils and quartz embedded in a calcareous matrix. The calcareous matrix showing crystals of calcite as well as venilets of secondary calcite. Limonite and hematite were also seen in some of the specimen. The calcareous cementing material showed indications of diagenitic recrystallisation of the rock.

**Short Description of the limestone exposures:-**

**(a) Badalpara – Sonaria – Ajotha Block**

The Milliolite limestone occurs in the area around villages of Badalpara, Sonaria and Ajotha. In fact, these villages are situated on the mounds of this limestone. The rock is almost white in colour with solution cavities in the upper most portions. In this block Miliolite limestone is covered by alluvium. The study of well sections reveals that the thickness of the limestone is less towards the margins of the mounds. The maximum thickness of 5.2 meters is recorded in this block in well section near Sonaria. The number of small exposures of Miliolite are seen in the cultivated land as small mounds. The limestone of this area is being used as a building stone by local people.

**Mithapur – Chankthal – Bhalpara Block:**

The exposures which occur at and in north of Mithapur are of very small in extent and the thickness is also very less. The rock is light buff in colour and seems to be siliceous in hand specimen. The maximum thickness of 1.6 meters is recorded in quarry section. The underlying beds of Dwarka (?) formation is very well exposed near pumping station i.e. in N of Mithapur village. These beds are extremely fossiliferous and the

cementing material is white to colour less recrystalised or secondary calcite. The shells of lamelibranchrnd and gastropods are in abundance. The sections of these beds are very ideally exposed in an old well cutting near pumping station. The exposure of small dimension also on the bank of Harna River.

The limestone exposures which occur at Chankthal (old village) are about 23 kms. away from the sea and the thickness recorded here is the maximum measuring 17.42 meters. This is one instance which has showed that the thickness need not necessarily be more only near the coast. The exposures, on which the mosque is situated, form a high hill which is seen from a distance of about 5 kms. The limestone is white to buff in colour with abundant solution cavities.

**Savani-Nawadra Block:**

The limestone occurs in N of Nawadra village is buff in colour and is loosely packed. It is easily tooled therefore extensively used as a building stone. The exposures of Nawadra is biggest among all surveyed during this field season (1.33 sq.kms.) Savani village is situated on a mound. The limestone of Savani area is also used as building stone. The maximum thickness of about 11 meters is recorded in this block. On the way to Savani railway station from Savani, at a distance of about 700 meters, the contact between Miliolite and typical limonitic limestone of Gaj formation is very clearly seen. The Dwarka beds seen to be absent in this area.

**Mahobatpara – sidokar – Kinderwa Block:**

In the area between Mahobatpara and Kinderwa village the exposure of the Miliolite limestone are abundant but they occur as thin layers as out less in Dwarka beds. The average thickness of this limestone is about 0.5 meters. The limestone is white to dirty white in colour, compact and seems to be siliceous in hand specimen, however the solution holes are common.

The exposure which occurs as elongated mound in NW of Sidokar village is quite extensive and shows maximum thickness of 5 meters. The trend of the exposure is almost E-N with 1.7 kms. length and a maximum width of 200 meters.

**Vadodara – Adri Block**

The numbers of exposures have been recorded in the area between Adri and Vadodara villages of Veraval taluka. The limestone occurs as outliers in the Dwarka beds (?) The thickness of limestone is very less, especially these which occurs along sea coast. The maximum thickness of 2.5 meters is recorded in the exposure which occurs at distance of about a kilometer in E of Vadodara village. The colour of the rock is white to dirty white.

**Gadu – Chorwad Block**

In this block the Miliolite exposures have been recorded in the area around village of Gadu, Chorwad, Samadhiala, Khurasha and Simar. The limestone exposures which occur around village of Chorwad, Gadu and Simar are small in extent as well as low in thickness in general. In the area around Gadu below the Miliolite formation, the Gaj formation is clearly seen. Dwarka beds (?) are perhaps absent in this area. The limestone is white to buff in colour with various shades. The thick exposures occur and around Samadhiala village but these areas have been leased out by the Government. In north of Gadu village at a distance of about 800 meters one of limestone is recorded which is buff in colour with maximum thickness of about 6 meters.

**Sampling:-**

In all 304 samples have been collected systematically representing the limestone. The limestone samples are chip samples collected systematically so that it is a true representative of the whole bulk in each patch.

**Reserves:-**

The reserves estimation has been made only for the Miliolite limestone outcrops. These outcrops as indicated earlier occur as discontinuous patches or mounds. The reserves have been calculated outcrop wise which have duly numbered. In calculating reserves, the area of the outcrops has been calculated from the plan and the average thickness of the limestone as measured by actual pitting and as observed in well sections and quarry sections, wherever it was seen, has been taken into consideration. In other places the average thickness of the outcrops has been worked out by taking measurements at various points on the outcrop. The average specific gravity of limestone has been taken 2.08 on the basis of the specific gravity determination carried out on 7 samples. An allowance of 10 5 has been given for the reserves so calculated for the solution holes and cavities that may be found in the limestone. On the basis of above, in all about 18.9 million tonnes of limestone analyzing on an average 53.65 % of Cao has been proved. The details of calculation carried out are indicated below in tabular form for individual block. The details of chemical analysis are given in a separate table appended as appendix. (Table-1)

**10. Grade of limestone:-**

From the perusal of the average chemical composition of the limestone it could be seen, from point of view of Cao, bulk of the reserves obtained from the various outcrops show Cao higher than 50 %, which is far higher than necessary for cement manufacture or for the use as flux in blast furnace. On account of high silica this limestone cannot be used as a chemical grade limestone as per ISI specifications IS 3204 – 1965. Bulk of it therefore could be sued in the manufacture of cement. Outcrops wise, the limestone has been examined as per ISI specifications indicated above and the appropriate grade under which the particular outcrop falls has been indicated block wise in the tables of chemical analysis.

Though the bulk of the limestone reserves do not come under the chemical grade as specified by ISI specifications no. IS 2304 – 1965, it has been observed that considerable quantities of this limestone is being actually mined in this area by the private parties and Dhangradha. M/s. R.J.Trivedi and Co., is actually mining this limestone and supplying the same to Dhangradha chemical, for the manufacture of caustic soda.

## 11. Recommendation:-

As mentioned earlier only Miliolite limestone of chemical grade therefore it is recommended to continue detailed surveys work in the area between Chorwad and Porbandar, or Junagadh district.

In the areas around villages of Waori, Deda, Uba, Inaj, Morad and Umrala Veraval taluka Miliolite occurrence have been repoted. Results of some samples collected from this area reveal that the limestone is of high grade but most of this area is leased out under mining leases, therefore no further work is recommended.

**Table-2**

**Specific gravity of different limestone samples:**

| Sr. No. | Samples No. | Sq. gr. |
|---|---|---|
| 1. | 55 | 2.25 |
| 2. | 63 | 2.00 |
| 3. | 105 | 2.06 |
| 4. | 124 | 2.16 |
| 5. | 188 | 1.83 |
| 6. | 232 | 2.19 |
| 7. | 290 | 2.13 |

Average specific gravity is 2.03

**Acknowledgement:**

The author is thankful to Dr. R.T. Shukla, director of Geology and Mining for taking this scheme in field season 1976-77, and for the keen interest evinces by him during prospecting work.

The author is also thankful to Shri N. Madhukara, Senior Geologist under whose supervision and guidance the work was taken up.

**Block-I**

**Table-1**

**Bhalpara – Chankthal area**

| Exposure number | Area in Sq. meters | Average thickness | Average sp. Gr. | Reserves in metric tonnes | Average percentage of Cao |
|---|---|---|---|---|---|
| 1. | 67500 | 1.0 | 2.08 | 140400 | 49.34 |
| 2. | 12500 | 0.5 | 2.08 | 13000 | 52.96 |
| 3. | 30000 | 1.5 | 2.08 | 93600 | 52.82 |
| 4. | 27500 | 2.5 | 2.08 | 143000 | 51.58 |
| 5. | 12500 | 0.5 | 2.08 | 13000 | 52.59 |
| 6. | 15000 | 0.3 | 2.08 | 9360 | 53.25 |
| 7. | 140000 | 10.00 | 2.08 | 2912000 | 52.57 |
| 8. | 17500 | 3.00 | 2.08 | 109200 | 42.48 |
| 9. | 2500 | 1.00 | 2.08 | 5200 | 52.18 |

Reserves of chemical grade limestone (above 50 % of Cao) = 329360

Average percentage Cao=52.55

(In the above exposure No.1 is not included in the reserves as the same analysis less than 50 % Cao)

**Block No.II**

| Exposure number | Area in Sq. meters | Average thickness | Average sp. Gr. | Reserves in metric tonnes | Average percentage of Cao |
|---|---|---|---|---|---|
| 1. | 12500 | 1.5 | 2.08 | 39000 | 54.39 |
| 2. | 2500 | 0.5 | 2.08 | 2600 | 53.72 |
| 3. | 2500 | 0.5 | 2.08 | 2600 | 53.87 |
| 4. | 3125 | 0.5 | 2.08 | 3250 | 53.87 |
| 5. | 17500 | 0.6 | 2.08 | 21840 | 54.84 |
| 6. | 3125 | 1.00 | 2.08 | 6500 | 54.86 |
| 7. | 3750 | 0.5 | 2.08 | 3900 | 47.71 |
| 8. | 5123 | 0.5 | 2.08 | 5330 | 52.96 |

Reserves of chemical grade limestone (above 50 % Cao) = 85020

Average percentage of Cao = 54.07

(In the above exposure No. 7 is not included in the reserves as the same analyses less then 50 % Cao)

**Block No.III**

**SW of Mahobatpara and Sidokar area**

| Exposure number | Area in Sq. meters | Average thickness in mts. | Average sp. Gr. | Reserves in metric tonnes | Average percentage of Cao |
|---|---|---|---|---|---|
| 1. | 22625 | 2.5 | 2.08 | 117650 | 53.45 |
| 2. | 172500 | 3.00 | 2.08 | 1076400 | 5377 |
| 3. | 10000 | 0.5 | 2.08 | 10400 | 55.17 |
| 8. | 6250 | 0.5 | 2.08 | 6500 | 51.15 |
| 9. | 24000 | 1.00 | 2.08 | 49920 | 55.74 |
| 10. | 1875 | 0.8 | 2.08 | 3120 | 55.74 |
| 11. | 1875 | 1.00 | 2.08 | 3900 | 55.45 |
| 12. | 3750 | 0.8 | 2.08 | 6240 | 55.60 |
| 13. | 33750 | 1.4 | 2.08 | 98280 | 53.47 |
| 14. | 6250 | 1.00 | 2.08 | 13000 | 55.17 |
| 15. | 13750 | 1.1 | 2.08 | 31460 | 54.89 |
| 16. | 3750 | 0.7 | 2.08 | 5460 | 55.17 |
| 17. | 1250 | 0.5 | 2.08 | 1300 | 55.88 |
| 18. | 37500 | 1.2 | 2.08 | 93600 | 55.02 |
| 19. | 1875 | 0.4 | 2.08 | 1560 | 53.88 |
| 20. | 7500 | 0.6 | 2.08 | 9360 | 54.88 |
| 21. | 5625 | 0.5 | 2.08 | 5850 | 54.31 |
| 22. | 2500 | 0.4 | 2.08 | 2080 | 54.45 |
| 23. | 11875 | 0.8 | 2.08 | 19760 | 55.20 |
| 24. | 5625 | 0.5 | 2.08 | 5850 | 55.21 |
| 25. | 9375 | 0.9 | 2.08 | 17550 | 55.08 |
| 26. | 3750 | 0.6 | 2.08 | 4680 | 55.43 |
| 27. | 37625 | 0.5 | 2.08 | 39130 | 55.13 |
| 28. | 21250 | 1.00 | 2.08 | 44200 | 55.34 |
| 29. | 15000 | 1.1 | 2.08 | 34320 | 55.34 |

| | | | | | |
|---|---|---|---|---|---|
| 30. | 3125 | 0.8 | 2.08 | 5200 | 55.34 |
| 31. | 22625 | 1.3 | 2.08 | 61178 | 54.94 |
| 32. | 8125 | 0.7 | 2.08 | 11830 | 54.13 |
| 33. | 56250 | 1.5 | 2.08 | 175500 | 54.60 |
| 34. | 900 | 0.4 | 2.08 | 7488 | 55.35 |
| 35. | 900 | 0.5 | 2.08 | 936 | 55.21 |
| 36. | 31250 | 1.3 | 2.08 | 84500 | 55.14 |
| 37. | 2500 | 1.5 | 2.08 | 2600 | 55.29 |
| 38. | 2500 | 0.4 | 2.08 | 2080 | 55.21 |
| 39. | 4375 | 0.5 | 2.08 | 4550 | 55.21 |
| 40. | 4375 | 0.6 | 2.08 | 5460 | 55.50 |
| 41. | 18750 | 0.8 | 2.08 | 31200 | 54.99 |
| 42. | 4375 | 0.7 | 2.08 | 6370 | 55.07 |
| 43. | 1875 | 0.4 | 2.08 | 1560 | 55.21 |
| 44. | 18750 | 0.8 | 2.08 | 31200 | 55.50 |
| 45. | 37500 | 0.7 | 2.08 | 54600 | 55.27 |
| 46. | 2500 | 0.5 | 2.08 | 2600 | 55.81 |
| 47. | 5625 | 0.4 | 2.08 | 4680 | 55.21 |
| 48. | 5625 | 1.00 | 2.08 | 11700 | 55.21 |
| 49. | 37500 | 1.5 | 2.08 | 117000 | 55.24 |
| 50 | 22500 | 1.00 | 2.08 | 46800 | 54.60 |
| 51. | 8750 | 0.5 | 2.08 | 9100 | 55.17 |
| 52. | 47500 | 0.8 | 2.08 | 79040 | 54.97 |

Reserves of chemical grade limestone (above 50 % Cao) = 2630622.8

Average percentage of Cao = 54.95

Note: - Exposure Nos. 4, 5, 6 and 7 are included in Block No.10.

**Block No.IV**

**Badalpara-Sonaria area**

| Exposure number | Area in Sq. meters | Average thickness in mts. | Average sp. Gr. | Reserves in metric tonnes | Average percentage of Cao |
|---|---|---|---|---|---|
| 1. | 70000 | 2.00 | 2.08 | 291200 | 53.59 |
| 2. | 3750 | 0.6 | 2.08 | 4680 | 54.01 |
| 3. | 1875 | 1.00 | 2.08 | 1875 | 55.58 |
| 4. | 2500 | 1.2 | 2.08 | 6240 | 55.00 |
| 5. | 900 | 2.00 | 2.08 | 3744 | 55.72 |
| 6. | 38750 | 1.3 | 2.08 | 104780 | 54.29 |
| 7. | 37500 | 1.5 | 2.08 | 117000 | 53.93 |
| 8. | 143750 | 2.2 | 2.08 | 657800 | 53.05 |

Reserves of chemical grade limestone (above 50 % Cao) = 1189344

Average percentage of Cao = 54.39

**Block No.V**

**Chorwad area**

| **Exposure number** | **Area in Sq. meters** | **Average thickness in mts.** | **Average sp. Gr.** | **Reserves in metric tonnes** | **Average percentage of Cao** |
|---|---|---|---|---|---|
| 1. | 27500 | 0.5 | 2.08 | 28600 | 54.81 |
| 2. | 8125 | 0.4 | 2.08 | 6760 | 55.32 |
| 3. | 5625 | 0.4 | 2.08 | 4680 | 55.03 |
| 4. | 3750 | 0.5 | 2.08 | 3900 | 55.60 |
| 5. | 10625 | 2.00 | 2.08 | 44200 | 53.04 |

Reserves of chemical grade limestone (above 50 % Cao) = 88140 tonnes

Average percentage of Cao = 54.76

**Block No.VI**

**Gadu Area**

| Exposure number | Area in Sq. meters | Average thickness in mts. | Average sp. Gr. | Reserves in metric tonnes | Average percentage of Cao |
|---|---|---|---|---|---|
| 1. | 17500 | 1.4 | 2.08 | 50960 | 55.73 |
| 2. | 1875 | 0.75 | 2.08 | 2925 | 53.87 |
| 3. | 37500 | 1.2 | 2.08 | 93600 | 53.80 |
| 4. | 55000 | 0.75 | 2.08 | 85800 | 51.39 |
| 5. | 1875 | 0.5 | 2.08 | 1950 | 49.66 |
| 6. | 21250 | 0.5 | 2.08 | 22100 | 52.51 |
| 7. | 8125 | 0.4 | 2.08 | 6760 | 55.10 |

Reserves of chemical grade limestone (above 50 % of Cao) = 262145

Average percentage of Cao = 53.69

(In all the above exposure No.5 is not included in the reserves as the same analysis less than 50 % Cao)

**Block No.VII**

**Samadhiala area**

| Exposure number | Area in Sq. meters | Average thickness in mts. | Average sp. Gr. | Reserves in metric tonnes | Average percentage of Cao |
|---|---|---|---|---|---|
| 1. | 3100 | 0.5 | 2.08 | 3224 | 52.14 |
| 2. | 1250 | 0.3 | 2.08 | 780 | 52.16 |
| 3. | 4375 | 0.4 | 2.08 | 3640 | 53.00 |
| 4. | 117500 | 3.00 | 2.08 | 733200 | 52.97 |
| 5. | 625 | 0.5 | 2.08 | 650 | 54.00 |
| 6. | 7500 | 0.5 | 2.08 | 7800 | 53.94 |
| 7. | 2500 | 0.5 | 2.08 | 2600 | 53.66 |
| 8. | 8125 | 0.7 | 2.08 | 11830 | 54.80 |
| 9. | 31250 | 1.5 | 2.08 | 97500 | 53.73 |
| 10. | 6250 | 1.00 | 2.08 | 13000 | 53.88 |
| 11. | 8750 | 1.5 | 2.08 | 27300 | 45.28 |
| 12. | 13125 | 2.00 | 2.08 | 54600 | 53.25 |
| 13. | 21250 | 2.00 | 2.08 | 88400 | 51.57 |

Reserves of chemical grade limestone (above 50 % of Cao) = 1017224

Average percentage of Cao = 53.25

(In all the above exposure No.11 is not included in the reserves as the same analysis less than 50 % Cao)

**Block No.VIII**

**Navadra area**

| Exposure number | Area in Sq. meters | Average thickness in mts. | Average sp. Gr. | Reserves in metric tonnes | Average percentage of Cao |
|---|---|---|---|---|---|
| 1. | 862000 | 4.5 | 2.08 | 8068320 | 51.54 |
| 2. | 147500 | 2.5 | 2.08 | 76440 | 52.37 |
| 3. | 11250 | 2.00 | 2.08 | 46800 | 51.08 |
| 4. | 10000 | 2.4 | 2.08 | 49920 | 51.36 |
| 5. | 2000 | 2.00 | 2.08 | 8320 | 51.22 |
| 6. | 8750 | 1.5 | 2.08 | 27300 | 50.64 |

Reserves of chemical grade limestone (above 50 % Cao) = 8277100

Average percentage pf Cao = 51.36

* After deduction the excavated area under quarry parwans.

**Block No.IX**

**Savani area**

| Exposure number | Area in Sq. meters | Average thickness in mts. | Average sp. Gr. | Reserves in metric tonnes | Average percentage of Cao |
|---|---|---|---|---|---|
| 1. | 26600 | 1.5 | 2.08 | 82992 | 53.15 |
| 2. | 93750 | 1.8 | 2.08 | 351000 | 52.44 |
| 3. | 40000 | 1.4 | 2.08 | 116480 | 53.27 |
| 4. | 11250 | 1.00 | 2.08 | 23400 | 52.30 |
| 5. | 7625 | 0.5 | 2.08 | 7930 | 53.72 |
| 6. | 1100 | 0.5 | 2.08 | 1144 | 52.01 |
| 7. | 15625 | 2.5 | 2.08 | 81250 | 53.72 |
| 8. | 467500 | 3.00 | 2.08 | 2917200 | 51.69 |

Reserves of chemical grade limestone (above 50 % of Cao) = 3581396

Average percentage of Cao = 52.78

**Block No.X**

**Vadodara – Adri area**

| Exposure number | Area in Sq. meters | Average thickness in mts. | Average sp. Gr. | Reserves in metric tonnes | Average percentage of Cao |
|---|---|---|---|---|---|
| 1. | 5000 | 1 | 2.08 | 10400 | 55.09 |
| 2. | 6100 | 1.2 | 2.08 | 15225.6 | 55.16 |
| 3. | 4550 | 1.3 | 2.08 | 12303.2 | 53.43 |
| 4. | 7225 | 1.5 | 2.08 | 22542 | 53.94 |
| 5. | 13750 | 1.00 | 2.08 | 18969.6 | 52.02 |
| 6. | 43500 | 1.8 | 2.08 | 162864 | 54.51 |
| 7. | 7500 | 1.2 | 2.08 | 19992.96 | 55.02 |
| 8. | 32500 | 1.00 | 2.08 | 89180 | 55.10 |
| 9. | 1125 | 0.4 | 2.08 | 936 | 54.69 |
| 10. | 1175 | 0.5 | 2.08 | 1222 | 54.83 |
| 11. | 925 | 0.4 | 2.08 | 769.6 | 54.55 |
| 12. | 1425 | 0.3 | 2.08 | 889.2 | 54.97 |
| 13. | 1650 | 0.35 | 2.08 | 1201.2 | 55.11 |
| 14. | 2125 | 1.75 | 2.08 | 7735 | 54.89 |
| 15. | 34225 | 0.4 | 2.08 | 28475.2 | 54.89 |
| 16. | 7425 | 0.6 | 2.08 | 9266.4 | 55.16 |
| 17. | 3250 | 1.1 | 2.08 | 7426 | 54.69 |
| 18. | 4525 | 0.8 | 2.08 | 6529.6 | 55.02 |
| 19. | 1850 | 0.6 | 2.08 | 2308.8 | 55.02 |
| 20. | 4275 | 0.45 | 2.08 | 4001.1 | 55.25 |
| 21. | 2250 | 0.6 | 2.08 | 3182.4 | 55.25 |
| 22. | 2525 | 0.4 | 2.08 | 2100.8 | 54.27 |
| 23. | 2350 | 1.00 | 2.08 | 4888 | 53.54 |
| 24. | 28925 | 0.6 | 2.08 | 36098.4 | 54.30 |
| 25. | 3925 | 1.5 | 2.08 | 12246 | 54.50 |

| | | | | | |
|---|---|---|---|---|---|
| 26. | 15125 | 1.5 | 2.08 | 47190 | 54.40 |
| 27. | 3550 | 0.9 | 2.08 | 6645.6 | 54.81 |
| 28. | 12825 | 1.00 | 2.08 | 26676 | 54.47 |
| 29. | 3550 | 0.8 | 2.08 | 5907.2 | 55.11 |
| 30. | 1450 | 0.6 | 2.08 | 1809.6 | 54.67 |
| 31. | 2050 | 0.5 | 2.08 | 2132 | 54.81 |
| 32. | 1125 | 0.7 | 2.08 | 1638 | 55.11 |

The reserves of chemical grade limestone (above 50 % of Cao) = 573761.76

Average percentage of Cao = 54.64

## TOTAL RESERVES AND GRADE OF THE LIMESTONE

| Block | Reserves | Average percentage of Cao |
|---|---|---|
| I. | 3298360 | 52.55 |
| II | 85020 | 54.07 |
| III | 2630622.8 | 54.95 |
| IV | 1189344 | 54.39 |
| V | 88140 | 54.76 |
| VI | 262145 | 53.69 |
| VII | 1017224 | 53.25 |
| VIII | 8277100 | 51.36 |
| IX | 3581396 | 52.78 |
| X | 573761.76 | 54.64 |
| **Total** | 21003112 | Or say 21000000 tonnes |

The Total reserves are 18.9 million after giving 10 % allowance for cavities, solution holes etc. having 53.65 Cao on an average.

**13. RESERVES:-**

| No. | Author | Year | Title |
|---|---|---|---|
| 1. | E. Howard Adye | 1914 | Memoir on the Economic geology of Navanagar state. |
| 2. | Biswas S.K. | 1971 | The Miliolite rocks of Kutch and Kathiawar (western India Sedimentary volume 5 No. pp 147-164 |
| 3. | Bhatt J.V. | | Report on Veraval limestone scheme 1971-72 |
| 4. | Lela V.S. | 1973 | The Miliolite limestone of Saurashtra western India sedimentary Geology Volume 10 pp. 301-310 |
| 5. | Rao U.D.G. | | Report on Veraval limestone scheme 1966-67. |
| 6. | Sperling C.H.B. and Goudie A.S. | 1975 | The Miliolite of western India A discussion of the Aeolian Geology Volume 13 pp. 71-75. |

## SPECITIFATIONS:

## Chemical Is 3204-1965

| S. No. | Characteristic | Requirement | | | |
|---|---|---|---|---|---|
| | | Grade-1 | Grade-2 | Grade-3 | Grade-4 |
| 1. | Loss on ignition % by weight (Max) | 46.00 | 46.00 | 46.00 | 46.00 |
| 2. | Silica % by weight (Max) | 0.75 | - | 1.00 | 2.00 |
| 3. | Cao % by weight (Min) | 54.00 | 53.00 | 54.00 | 50.00 |
| 4. | $Fe_2o_3$ % by weigh | 0.15 | - | 0.25 | - |
| 5. | Mgo % by weight (Max) | 2.00 | 1.00 | 0.8 | 1.00 |
| 6. | $Mo_2o_3$ % by weight (Max) | 0.06 | - | - | - |
| 7. | Cao2 % by weight (Max) | 42.00 | 42.00 | 42.00 | 42.00 |
| 8. | Sulphur % by weight (Max) | - | - | 0.1 | - |
| 9. | Phosphorous | - | - | 0.1 | - |
| 10. | $Al_2o_3$ and $fe_2o_3$ together % by weight | - | - | 0.5 | 4.5 |
| 11. | $Si_2o_3$, $Al_2o_3$ & $fe_2o_3$ together by weight (Max) | - | 3.00 | - | - |

Grade-1 Suitable for bleaching power, bleach liquor, textiles, Vanishes, pulp and papers.

Grade-2 Suitable for the manufacture of soda ash by the Solvay process, caustic soda by lime soda process.

Grade-3 Suitable for the manufacture of calcium carbide.

Grade-4 Suitable for the manufacture.

**TABLES SHOWING GRADE WISE CLASSIFICATION OF LIMESTONE**
**BLOCK NO.I**

| Exposure No. | Reserve M. tonnes | Samples | $Sio_2$ | $So_3$ | $Fe_2o_3$ | $Al_2o_3$ | Tio | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 13000 | 49 | 3.09 | - | 1.22 | 1.68 | - | 55.96 | **Tr.** | 41.43 | Cement grade |
| 3 | 93600 | 50 | 3.34 | - | 0.77 | 1.57 | - | 52.82 | **Tr.** | 41.72 | Cement grade |
| 4 | 143000 | 113 | 6.22 | - | 1.27 | 1.13 | - | 51.58 | 0.32 | 39.05 | Cement grade |
| 5 | 13000 | 117 | 3.34 | - | 1.25 | 0.99 | - | 52.59 | **Tr.** | 40.75 | Cement grade |
| 6 | 9360 | 53 | 3.32 | - | 0.71 | 1.06 | - | 53.25 | 0.12 | 41.96 | Cement grade |
| 7 | 2912000 | (a) 59 to 64<br>(b) 80 to 84 | 3.898 | - | 0.69 | 1.02 | - | 51.57 | 0.09 | 41.79 | Cement grade |
| 8 | 109200 | 65 to 68 | 4.63 | - | 0.72 | 0.99 | - | 52.48 | 0.07 | 41.18 | Cement grade |
| 9 | 5200 | 69 to 70 | 3.135 | - | 0.75 | 0.545 | - | 52.18 | 0.025 | 42.33 | Cement grade |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 13000 | 49 | 40170 | - | 15860 | 21840 | - | 688480 | **Tr.** | 538590 | |
| 3 | 93600 | 50 | 312624 | - | 72077 | 136952 | - | 4943952 | **Tr.** | 3904992 | |
| 4 | 143000 | 113 | 389460 | - | 181610 | 161590 | - | 7375940 | 45760 | 5827250 | |
| 5 | 13000 | 117 | 43420 | - | 16250 | 12870 | - | 683670 | **Tr.** | 529750 | |
| 6 | 9360 | 53 | 31075.2 | - | 6645.6 | 9921.6 | - | 498240 | 1123.2 | 392745.6 | |
| 7 | 2912000 | (a) 59 to 64<br>(b) 80 to 84 | 11350976 | - | 2009280 | 2970240 | - | 150171840 | 262080 | 1216692480 | |
| 8 | 109200 | 65 to 68 | 505596 | - | 78624 | 101108 | - | 5730876 | 7644 | 4496854 | |
| 9 | 5200 | 69 to 70 | 16302 | - | 3900 | 2834 | - | 271336 | 130 | 219596 | |
| | 3298360 | | 12689623.2 | | 2384241.6 | 343435.6 | - | 107364454 | 316737.2 | 137602259 | |
| | | | (3.84) | | (0.72) | (1.04) | - | (51.65) | (0.09) | (41.71) | = 99.05 |

**BLOCK NO.2**

| Exposure No. | Reserve M. tonnes | Samples | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 39000 | 15 | 1.90 | - | 0.19 | 0.81 | - | 54.39 | **Tr.** | 42.87 | 2 |
| 2 | 2600 | 31 | 2.58 | - | 0.43 | 0.26 | - | 53.72 | **Tr.** | 42.70 | Cement grade |
| 3 | 2600 | 44 | 2.85 | - | 1.04 | 0.41 | - | 53.87 | **Tr.** | 41.84 | Cement grade |
| 4 | 3250 | - | 2.85 | - | 1.04 | 0.41 | - | 53.87 | **Tr.** | 41.84 | 2 |
| 5 | 21840 | 46 | 1.77 | - | 0.21 | 0.15 | - | 54.84 | **Tr.** | 43.35 | Cement grade |
| 6 | 6500 | 13 | 1.44 | - | 0.22 | 0.12 | - | 54.86 | **Tr.** | 43.07 | 2 |
| 8 | 5330 | 17 | 3.76 | - | 1.26 | 0.47 | - | 52.96 | **Tr.** | 41.65 | Cement grade |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 39000 | 15 | 74100 | - | 7410 | 31590 | - | 2121210 | **Tr.** | 671930 | |
| 2 | 2600 | 31 | 6708 | - | 1118 | 676 | - | 139672 | **Tr.** | 111020 | |
| 3 | 2600 | 44 | 7410 | - | 2704 | 1066 | - | 145262 | **Tr.** | 108784 | |
| 4 | 3250 | - | 9262.5 | - | 3380 | 1332.5 | - | 175077.5 | **Tr.** | 135980 | |
| 5 | 21840 | 46 | 38656.8 | - | 4586.4 | 3276 | - | 1197705.6 | **Tr.** | 946764 | |
| 6 | 6500 | 13 | 9360 | - | 1430 | 780 | - | 356590 | **Tr.** | 279955 | |
| 8 | 5330 | 17 | 20040.8 | - | 6715.8 | 2402.1 | - | 282276.8 | **Tr.** | 221994.5 | |
| | 81120 | | 165538.1 | | 27345.2 | 41225.6 | - | 4447609.9 | **Tr.** | 3476427.5 | |
| | | | (2.04) | | (0.33) | (0.50) | | (54.82) | | (42.85) | = 100.54 |

**BLOCK NO.3**

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | $So_3$ | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 117650 | 224 & 225 | 1.07 | - | 0.14 | 0.69 | - | 53.45 | 0.15 | 43.42 | 2 |
| 2 | 1076400 | 202 & 207 217 & 222 | 1.28 | - | 0.13 | 0.63 | - | 53.77 | 0.06 | 43.22 | 2 |
| 3 | 10400 | 206 | 1.17 | - | 0.13 | 0.40 | - | 55.17 | - | 43.17 | 2 |
| 8 | 6500 | 200 | 1.75 | - | 0.10 | 0.89 | - | 51.15 | - | 43.05 | 2 |
| 9 | 49920 | 298 | 0.89 | - | 0.23 | 0.24 | - | 55.74 | - | 43.22 | 2 |
| 10 | 3120 | 299 | 0.80 | - | 0.23 | 0.32 | - | 55.74 | - | 43.20 | 2 |
| 11 | 3900 | 287 | 0.82 | - | 0.15 | 0.44 | - | 55.45 | 0.18 | 43.45 | 2 |
| 12 | 6240 | 288 | 0.96 | - | 0.15 | 0.41 | - | 55.60 | 0.13 | 43.45 | 2 |
| 13 | 98280 | 289 & 290 | 1.03 | - | 0.19 | 0.42 | - | 53.47 | 0.09 | 43.30 | 2 |
| 14 | 1300 | 303 | 1.02 | - | 0.15 | 0.33 | - | 55.17 | - | 43.63 | 2 |
| 15 | 31460 | 302 | 1.88 | - | 0.30 | 0.26 | - | 54.89 | - | 42.55 | 2 |
| 16 | 5460 | 301 | 1.52 | - | 0.23 | 0.24 | - | 55.17 | - | 43.20 | 2 |
| 17 | 1300 | 297 | 0.85 | - | 0.23 | 0.44 | - | 55.88 | - | 43.20 | 2 |
| 18 | 93600 | 194 & 195 | 0.79 | - | 0.90 | 0.55 | - | 55.02 | - | 44.52 | 2 |
| 19 | 1560 | 192 | 1.03 | - | 0.15 | 0.66 | - | 53.88 | - | 43.43 | 2 |
| 20 | 9360 | 193 | 0.93 | - | 0.10 | 0.69 | - | 54.88 | - | 45.40 | 2 |
| 21 | 5850 | 191 | 0.97 | - | 0.15 | 0.67 | - | 54.31 | - | 43.22 | 2 |
| 22 | 2080 | 190 | 1.24 | - | 0.20 | 0.71 | - | 54.35 | - | 43.29 | 2 |
| 23 | 19260 | 155 | 0.99 | - | 0.10 | 0.37 | - | 55.20 | - | 43.38 | 2 |
| 24 | 5850 | 153 | 0.96 | - | 0.10 | 0.25 | - | 55.21 | - | 43.37 | 2 |
| 25 | 17550 | 154 | 0.90 | - | 0.10 | 0.35 | - | 55.08 | - | 43.31 | 2 |
| 26 | 4680 | 152 | 0.90 | - | 0.10 | 0.24 | - | 55.43 | - | 43.45 | 2 |
| 27 | 39130 | 150 & 151 | 0.95 | - | 0.15 | 0.06 | - | 55.13 | - | 43.47 | 2 |
| 28 | 44200 | 136 & 137 | 1.03 | - | 0.10 | 0.44 | - | 55.34 | - | 43.34 | 2 |
| 29 | 34320 | 138 | 0.99 | - | 0.10 | 0.45 | - | 55.34 | - | 43.36 | 2 |
| 30 | 5200 | 139 | 1.16 | - | 0.10 | 0.36 | - | 55.34 | - | 43.30 | 2 |
| 31 | 51178 | 140 & 141 | 1.10 | - | 0.12 | 0.19 | - | 54.94 | - | 43.38 | 2 |
| 32 | 11830 | 323 | 1.06 | - | 0.22 | 0.18 | - | 54.13 | 0.35 | 47.67 | 2 |
| 33 | 175500 | 304 | 1.36 | - | 0.30 | 0.28 | - | 54.60 | - | 43.43 | 2 |
| 34 | 7488 | 133 | 0.96 | - | 0.16 | 0.43 | - | 55.35 | - | 53.02 | 2 |
| 35 | 936 | 132 | 0.12 | - | 0.16 | 0.57 | - | 55.21 | - | 43.08 | 2 |
| 36 | 84500 | 130 & 143 | 1.14 | - | 0.12 | 0.39 | - | 55.14 | - | 43.38 | 2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 37 | 2600 | 135 | 1.08 | - | 0.05 | 0.55 | - | 55.29 | - | 43.18 | 2 |
| 38 | 2080 | 134 | 1.24 | - | 0.05 | 0.78 | - | 55.21 | - | 43.01 | 2 |
| 39 | 4550 | 142 | 0.98 | - | 0.10 | 0.10 | - | 55.21 | - | 43.46 | 2 |
| 40 | 5460 | 123 | 1.06 | - | 0.16 | 0.20 | - | 55.50 | - | 43.42 | 2 |
| 41 | 31200 | 119 & 120 | 1.23 | - | 0.19 | 0.39 | - | 54.99 | - | 43.21 | 2 |
| 42 | 6370 | 149 | 0.83 | - | 0.15 | 0.12 | - | 55.07 | - | 43.48 | 2 |
| 43 | 1560 | 121 | 1.07 | - | 0.16 | 0.40 | - | 55.21 | - | 43.11 | 2 |
| 44 | 31200 | 122 | 1.06 | - | 0.16 | 0.34 | - | 55.50 | - | 43.40 | 2 |
| 45 | 54600 | 126 & 127 | 1.03 | - | 0.31 | 0.37 | - | 55.27 | 0.25 | 43.46 | 2 |
| 46 | 3600 | 131 | 1.31 | - | 0.21 | 0.94 | - | 55.81 | - | 42.93 | 2 |
| 47 | 4680 | 128 | 1.24 | - | 0.21 | 5.55 | - | 55.21 | - | 43.20 | 2 |
| 48 | 11700 | 129 | 1.04 | - | 0.11 | 0.72 | - | 55.21 | - | 43.26 | 2 |
| 49 | 117000 | 124 & 125 | 1.15 | - | 0.19 | 0.41 | - | 55.24 | 0.20 | 43.35 | 2 |
| 50 | 46800 | 199 | 1.58 | - | 0.10 | 0.86 | - | 54.60 | - | 44.02 | 2 |
| 51 | 9100 | 196 | 0.92 | - | 0.08 | 0.69 | - | 55.17 | - | 43.44 | 2 |
| 52 | 79040 | 197 ' 198 | 1.87 | - | 0.17 | 0.80 | - | 54.97 | - | 42.92 | 2 |

## BLOCK NO.4

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 291200 | 18 & 23 | 2.62 | - | 0.56 | 0.9 | - | 53.59 | **Tr.** | 42.99 | Cement grade |
| 2 | 4680 | 26 | 1.57 | - | 0.18 | 0.14 | - | 54.01 | 0.22 | 43.10 | 2 |
| 3 | 1875 | 22 | 1.18 | - | 0.17 | 0.05 | - | 55.50 | **Tr.** | 43.39 | 2 |
| 4 | 6240 | 20 | 1.46 | - | 0.22 | 0.36 | - | 55.00 | **Tr.** | 43.20 | 2 |
| 5 | 3744 | 21 | 2.76 | - | 0.74 | 0.51 | - | 53.72 | **Tr.** | 42.34 | Cement grade |
| 6 | 104780 | 5 | 1.23 | - | 0.29 | 0.23 | - | 54.29 | **Nil** | 44.25 | 2 |
| 7 | 117000 | 6 & 7 | 1.95 | - | 0.22 | 0.36 | - | 53.93 | - | 43.31 | 2 |
| 8 | 657800 | 8 & 11 | 3.37 | - | 0.81 | 0.53 | - | 53.05 | - | 42.39 | Cement grade |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 291200 | 18 & 23 | 792944 | - | 171808 | 262080 | - | 15605408 | **Tr.** | 12402208 | |
| 2 | 4680 | 26 | 7374.6 | - | 842.4 | 655.2 | - | 2527668 | 1029.6 | 201708 | |
| 3 | 1875 | 22 | 2212.5 | - | 318.7 | 93.7 | - | 104212.5 | **Tr.** | 81356.25 | |
| 4 | 6240 | 20 | 9910.4 | - | 1372.8 | 2246.4 | - | 343200 | **Tr.** | 269568 | |
| 5 | 4744 | 21 | 10333.40 | - | 2770.5 | 1909.4 | - | 208615.6 | | 158520.9 | |
| 6 | 104780 | 5 | 128879.4 | - | 28290.6 | 24099.4 | - | 5688506.2 | | 4646515 | |
| 7 | 117000 | 6 & 7 | 228150 | - | 25740 | 42120 | - | 6309810 | | 5067270 | |
| 8 | 657800 | 8 & 11 | 2216786 | - | 532818 | 348634 | - | 34896290 | | 27884142 | |
| | 1187319 | | 3365763.3 | | 763961 | 681838.1 | | 63408009 | | 50817768.1 | |
| | | | (2.83) | | (0.64) | (0.57) | | (53.4) | | (42.8) | = 100.24 |

**BLOCK NO.5**

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 28600 | 310 & 311 | 10.4 | - | 0.30 | 0.33 | - | 54.81 | 0.11 | 42.90 | 2 |
| 2 | 6760 | 307 | 0.94 | - | 0.30 | 0.33 | - | 55.32 | **Tr.** | 43.05 | 2 |
| 3 | 4680 | 308 | 1.41 | - | 0.23 | 0.12 | - | 55.03 | 0.50 | 43.17 | 2 |
| 4 | 3900 | 306 | 0.96 | - | 0.15 | 0.13 | - | 55.60 | 0.35 | 43.29 | 2 |
| 5 | 44200 | 312 | 3.87 | - | 1.05 | 0.97 | - | 53.04 | 0.34 | 41.38 | Cement grade |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 28600 | 310 & 311 | 29744 | - | 8580 | 9438 | - | 1567566 | 3146 | 1226940 | |
| 2 | 6760 | 307 | 6354.4 | - | 2028 | 2230.8 | - | 373963.2 | **Tr.** | 291018 | |
| 3 | 4680 | 308 | 6598.8 | - | 1076.4 | 561.1 | - | 257540.4 | 2340 | 202035.6 | |
| 4 | 3900 | 306 | 3744 | - | 585 | 507 | - | 216840 | 1365 | 168831 | |
| 5 | 44200 | 312 | 171054 | - | 46410 | 42874 | - | 2344368 | 15028 | 1828996 | |
| | 88140 | | 217495.2 | | 58679.4 | 55611.4 | | 4760227.8 | 25879 | 3717820.6 | |
| | | | (2.46) | | (0.66) | (0.63) | | (54.00) | (0.29) | (42.18) | =100.22 |

**BLOCK NO.6**

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 50960 | 144 | 3.17 | - | 0.46 | 0.57 | - | 58.73 | 0.19 | 40.86 | Cement grade |
| 2 | 2925 | 145 | 2.94 | - | 0.51 | 0.58 | - | 53.87 | 0.08 | 41.04 | Cement grade |
| 3 | 93600 | 146 & 147 | 3.51 | - | 0.48 | 0.71 | - | 53.80 | 0.18 | 40.85 | Cement grade |
| 4 | 85800 | 156 & 158 | 5.16 | - | 0.50 | 1.59 | - | 51.59 | - | 41.19 | Cement grade |
| 6 | 22100 | 160 & 161 | 3.05 | - | 0.46 | 1.75 | - | 52.51 | **Tr.** | 42.36 | Cement grade |
| 7 | 6760 | 278 | 0.80 | - | 0.15 | 0.21 | - | 55.10 | - | 43.54 | 2 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 50960 | 144 | 161543.2 | - | 23441.6 | 29047.2 | - | 28400008 | 9682.4 | 2082225.6 | |
| 2 | 2925 | 145 | 8599.5 | - | 1491.75 | 1696.5 | - | 163419.7 | 234 | 120042 | |
| 3 | 93600 | 146 & 147 | 3380.13 | - | 44928 | 66456 | - | 5035680 | 16848 | 3823560 | |
| 4 | 85800 | 156 & 158 | 442728 | - | 42900 | 136422 | - | 443582 | - | 3534102 | |
| 6 | 22100 | 160 & 161 | 67405 | - | 10166 | 38675 | - | 1160471 | **Tr.** | 936156 | |
| 7 | 6760 | 278 | 5813.6 | - | 1014 | 1419.6 | - | 372476 | - | 294330.4 | |
| | 262145 | | 1024102.3 | - | 123941.3 | 273716.3 | - | 1401562.5 | 26764.4 | 10790416 | |
| | | | (3.90) | | (0.47) | (1.04) | | (53.46) | (0.10) | (41.16) | =100.09 |

**BLOCK NO.7**

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3224 | 164 | 3.4 | - | 0.87 | 1.61 | - | 52.14 | **Tr.** | 41.74 | Cement grade |
| 2 | 780 | 162 | 3.68 | - | 0.66 | 1.89 | - | 52.16 | **Tr.** | 42.10 | Cement grade |
| 3 | 3640 | 163 | 3.2 | - | 0.66 | 1.88 | - | 53.00 | **Tr.** | 41.63 | Cement grade |
| 4 | 733200 | 168, 170 to 176 | 4.08 | - | 0.49 | 1.18 | - | 52.97 | **Tr.** | 41.84 | Cement grade |
| 5 | 650 | 169 | 2.69 | - | 0.69 | 0.98 | - | 54.00 | **Tr.** | 41.97 | Cement grade |
| 6 | 7800 | 165 | 1.23 | - | 0.15 | 0.77 | - | 53.94 | **Tr.** | 43.06 | Cement grade |
| 7 | 2600 | 166 | 1.55 | - | 0.20 | 0.88 | - | 53.66 | **Tr.** | 43.27 | Cement grade |
| 8 | 11839 | 167 | 1.1 | - | 0.15 | 0.82 | - | 54.80 | **Tr.** | 43.26 | 2 |
| 9 | 97500 | 182 & 183 | 1 | - | 0.15 | 0.66 | - | 53.73 | **Tr.** | 43.32 | 2 |
| 10 | 13000 | 184 | 0.93 | - | 0.10 | 0.51 | - | 53.88 | **Tr.** | 43.37 | 2 |
| 12 | 54600 | 210 & 211 | 2.97 | - | 0.46 | 1.42 | - | 53.25 | **Nil** | 41.98 | Cement grade |
| 13 | 88400 | 212 to 214 | 3.84 | - | 0.48 | 1.49 | - | 51.57 | **Nil** | 41.75 | Cement grade |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3224 | 164 | 10961.9 | - | 2804.8 | 5190.6 | - | 168099.3 | **Tr.** | 134569.7 | |
| 2 | 780 | 162 | 2870.4 | - | 514.8 | 1474.2 | - | 40684.8 | **Tr.** | 32838 | |
| 3 | 3640 | 163 | 1164.8 | - | 2402.4 | 6843.2 | - | 192920 | **Tr.** | 151533.2 | |
| 4 | 733200 | 168, 170 to 176 | 2991456 | - | 359268 | 865176 | - | 38837604 | **Tr.** | 30677088 | |
| 5 | 650 | 169 | 1748.5 | - | 448.5 | 637 | - | 35100 | **Tr.** | 27280.5 | |
| 6 | 7800 | 165 | 9594 | - | 1170 | 6006 | - | 420732 | **Tr.** | 335868 | |
| 7 | 2600 | 166 | 4030 | - | 520 | 2288 | - | 139516 | **Tr.** | 112502 | |
| 8 | 11839 | 167 | 13013 | - | 1774.5 | 9700.6 | - | 648284 | **Tr.** | 5110765.8 | |
| 9 | 97500 | 182 & 183 | 97500 | - | 14265 | 64350 | - | 5238675 | **Tr.** | 4223700 | |
| 10 | 13000 | 184 | 12090 | - | 1300 | 6630 | - | 700440 | **Tr.** | 563810 | |
| 12 | 54600 | 210 & 211 | 162162 | - | 25116 | 77532 | - | 2907450 | **Tr.** | 2292108 | |
| 13 | 88400 | 212 to 214 | 339456 | - | 42432 | 131716 | - | 4558788 | **Tr.** | 3690700 | |
| | 1017224 | | 3644045.3 | - | 52376 | 1177542.6 | - | 5388293.1 | | 42753762.2 | |
| | | | (3.58) | | (0.44) | (1.15) | | (52.97) | | (42.03) | =100.17 |

**BLOCK NO.8**

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 8068320 | 77-80 88-96 98, 99, 101-105-107 | 5.17 | - | 1.18 | 1.30 | - | 51.54 | 0.16 | 42.22 | Cement grade |
| 2 | 76440 | 75 & 76 | 4.43 | - | 1.11 | 0.75 | - | 52.37 | 0.13 | 41.69 | Cement grade |
| 3 | 46800 | 74 | 5.56 | - | 0.93 | 1.60 | - | 51.08 | 0.14 | 41.04 | Cement grade |
| 4 | 49920 | 73 | 4.38 | - | 1.29 | 0.67 | - | 51.36 | **Nil** | 40.60 | Cement grade |
| 5 | 8320 | 72 | 5.44 | - | 1.27 | 0.99 | - | 51.22 | **Nil** | 40.59 | Cement grade |
| 6 | 27300 | 71 | 4.68 | - | 1.28 | 0.76 | - | 50.64 | **Nil** | 40.45 | Cement grade |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| 1 | 8068320 | 77-80 88-96 98, 99, 101-105-107 | 41713214 | - | 9520617.6 | 10488816 | - | 415841212 | 1290931.2 | 340644470.4 | |
| 2 | 76440 | 75 & 76 | 338629.2 | - | 84848.4 | 57330 | - | 4003162.8 | 9937.2 | 3186783.6 | |
| 3 | 46800 | 74 | 260208 | - | 43524 | 74880 | - | **2390544** | 6652 | 1920672 | |
| 4 | 49920 | 73 | 218649.6 | - | 64396.8 | 33446.4 | - | 2563891.2 | **Nil** | 2026752 | |
| 5 | 8320 | 72 | 45260.8 | - | 10566.4 | 8236.8 | - | 426150.4 | **Nil** | 3377088 | |
| 6 | 27300 | 71 | 127764 | - | 34944 | 20748 | - | 1382472 | **Nil** | 1104285 | |
| | 8277100 | | 42603724 (5.14) | - | 9758895 (1.17) | 10683456 (1.29) | - | 423007432.4 (51.19) | 1307420.4 (0.15) | 34922064.8 (42.19) | =101.33 |

**BLOCK NO.9**

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 82992 | 29 | 2.52 | - | 1.22 | 0.81 | - | 53.15 | **Tr.** | 42.28 | Cement grade |
| 2 | 351000 | 25 | 4.23 | - | 0.8 | 0.95 | - | 52.44 | **Tr.** | 41.40 | Cement grade |
| 3 | 116480 | 28 | 2.98 | - | 1.10 | 0.90 | - | 53.15 | **Tr.** | 41.88 | Cement grade |
| 4 | 23400 | 30 | 3.59 | - | 1.13 | 1.15 | - | 52.30 | **Tr.** | 41.44 | Cement grade |
| 5 | 7930 | 31 | 2.58 | - | 0.43 | 0.26 | - | 53.72 | **Tr.** | 42.70 | Cement grade |
| 6 | 1144 | 32 | 4.30 | - | 0.87 | 0.76 | - | 52.01 | **Tr.** | 41.67 | Cement grade |
| 7 | 81250 | 56 | 2.32 | - | 0.41 | 1.07 | - | 53.72 | **Tr.** | 42.61 | 2 |
| 8 | 2917200 | 34 to 43 | 4.82 | - | 0.94 | 0.83 | - | 51.84 | **Tr.** | 40.90 | Cement grade |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 82992 | 29 | 209139.8 | - | 101250.2 | 67223.5 | - | 4411024.8 | **Tr.** | 3508901.7 | |
| 2 | 351000 | 25 | 1484730 | - | 280800 | 333450 | - | 18406440 | **Tr.** | 414531400 | |
| 3 | 116480 | 28 | 347110.4 | - | 128128 | 104832 | - | 6190912 | **Tr.** | 4878182.4 | |
| 4 | 23400 | 30 | 84006 | - | 26442 | 26910 | - | 1223820 | **Tr.** | 969696 | |
| 5 | 7930 | 31 | 20459.4 | - | 3409.9 | 2061.8 | - | 425999.6 | **Tr.** | 338611 | |
| 6 | 1144 | 32 | 4919.2 | - | 995.2 | 869.4 | - | 59499.4 | **Tr.** | 47670.4 | |
| 7 | 81250 | 56 | 188500 | - | 33312.5 | 86937.5 | - | 4364750 | **Tr.** | 3462062.5 | |
| 8 | 2917200 | 34 to 43 | 14060904 | - | 2742168 | 242168 | - | 151227640 | **Tr.** | 119313480 | |
| | 3581396 | | 16399768.8 | | 3316505.8 | 3043560.2 | | 186310085.8 | | 147050004 | |
| | | | (4.5) | | (0.97) | (0.840 | | (52.02) | | (41.52) | =99.81 |

**BLOCK NO.10**

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Grade |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10400 | 246 & 247 | 1.25 | - | 0.30 | 0.33 | - | 55.09 | **Nil** | 43.4 | 2 |
| 2 | 15225.6 | 245 | 1.12 | - | 0.23 | 0.38 | - | 55.16 | **Nil** | 43.51 | 2 |
| 3 | 12303.2 | 244 | 0.90 | - | 0.13 | 0.70 | - | 53.43 | 0.23 | 43.50 | 2 |
| 4 | 22542 | 242 & 243 | 1.25 | - | 0.12 | 0.59 | - | 53.94 | 0.17 | 43.54 | 2 |
| 5 | 18969.6 | 201 | 0.67 | - | 0.17 | 0.62 | - | 52.02 | **Nil** | 43.54 | 2 |
| 6 | 162864 | 237 to 241 | 1.09 | - | 0.23 | 0.55 | - | 54.51 | 0.02 | 43.45 | 2 |
| 7 | 1992.9 | 203 | 0.93 | - | 0.12 | 0.62 | - | 55.02 | **Nil** | 3.52 | 2 |
| 8 | 89180 | 204 & 205 | 1.02 | - | 0.15 | 0.43 | - | 55.10 | **Nil** | 43.48 | 2 |
| 9 | 936 | 250 | 1.12 | - | 0.21 | 0.35 | - | 54.69 | **Tr.** | 43.50 | 2 |
| 10 | 1222 | 251 | 1.02 | - | 0.29 | 0.25 | - | 54.83 | **Tr.** | 43.67 | 2 |
| 11 | 7696 | 252 | 1.04 | - | 0.21 | 0.71 | - | 54.55 | **Tr.** | 43.31 | 2 |
| 12 | 889.2 | 253 | 1.20 | - | 0.15 | 0.52 | - | 54.97 | **Nil** | 43.51 | 2 |
| 13 | 1201.2 | 254 | 1.04 | - | 0.15 | 0.52 | - | 55.11 | **Nil** | 43.48 | 2 |
| 14 | 7735 | 248, 249, 257 | 1.14 | - | 0.25 | 0.40 | - | 54.89 | **Nil** | 43.44 | 2 |
| 15 | 28475.2 | 255 | 1.30 | - | 0.15 | 0.59 | - | 54.89 | **Nil** | 43.47 | 2 |
| 16 | 9266.4 | 259 | 1.31 | - | 0.30 | 0.36 | - | 55.16 | **Nil** | 43.37 | 2 |
| 17 | 7436 | 256 | 1.39 | - | 0.15 | 0.65 | - | 54.69 | **Nil** | 43.35 | 2 |
| 18 | 7529.6 | 258 | 1.19 | - | 0.30 | 0.31 | - | 55.02 | **Nil** | 43.43 | 2 |
| 19 | 2308.8 | 260 | 1.17 | - | 0.23 | 0.45 | - | 55.02 | **Nil** | 43.41 | 2 |
| 20 | 4001.4 | 261 | 0.98 | - | 0.37 | 0.20 | - | 55.05 | **Nil** | 43.56 | 2 |
| 21 | 3182.4 | 262 | 1.03 | - | 0.28 | 0.19 | - | 55.25 | **Nil** | 43.54 | 2 |
| 22 | 2100.8 | 263 | 1.16 | - | 0.75 | 0.39 | - | 54.27 | **Nil** | 42.71 | 2 |
| 23 | 4888 | 267 | 1.75 | - | 0.52 | 0.54 | - | 53.54 | 0.29 | 43.72 | 2 |
| 24 | 36098.4 | 264 & 265 | 1.51 | - | 0.37 | 0.45 | - | 54.30 | 0.12 | 43.13 | 2 |
| 25 | 12246 | 266 | 1.28 | - | 0.22 | 0.29 | - | 54.50 | 0.16 | 43.49 | 2 |
| 26 | 47190 | 268 & 269 | 1.6 | - | 0.30 | 0.31 | - | 54.40 | 0.19 | 43.06 | 2 |
| 27 | 6645.6 | 270 | 1.26 | - | 0.23 | 0.27 | - | 54.81 | 1.10 | 43.38 | 2 |
| 28 | 26676 | 271 & 272 | 2.36 | - | 0.36 | 0.41 | - | 54.47 | 0.06 | 42.67 | 2 |
| 29 | 5907.2 | 273 & 274 | 1.09 | - | 0.30 | 0.23 | - | 55.11 | **Nil** | 43.22 | 2 |
| 30 | 18096 | 276 | 1.56 | - | 0.23 | 0.47 | - | 54.67 | **Nil** | 43.33 | 2 |
| 31 | 2132 | 277 | 1.21 | - | 0.23 | 0.34 | - | 54.81 | **Nil** | 43.31 | 2 |
| 32 | 1638 | 275 | 1.23 | - | 0.23 | 0.67 | - | 55.11 | **Nil** | 43.17 | 2 |

**BLOCK NO.10**

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10400 | 246 & 247 | 13000 | - | 3120 | 3432 | - | 572936 | **Nil** | 451360 | |
| 2 | 15225.6 | 245 | 17052.6 | - | 3105.6 | 57857 | - | 839855.1 | **Nil** | 662465.8 | |
| 3 | 12303.2 | 244 | 11072.9 | - | 1599.4 | 8612.2 | - | 657349.2 | 2829.7 | 538511 | |
| 4 | 22542 | 242 & 243 | 28177.5 | - | 2705 | 13299.8 | - | 1215915.4 | 3232.1 | 980579 | |
| 5 | 18969.6 | 201 | 18400.5 | - | 3224.8 | 11761.1 | - | 986798.6 | **Nil** | 825936.4 | |
| 6 | 162864 | 237 to 241 | 177521.7 | - | 37458.7 | 89575.2 | - | 8877716.6 | 32573 | 7076440.8 | |
| 7 | 1992.9 | 203 | 1853.4 | - | 239.1 | 1235.6 | - | 109649.3 | **Nil** | 86731 | |
| 8 | 89180 | 204 & 205 | 90963.8 | - | 13377 | 38347 | - | 491381 | **Nil** | 3877546.4 | |
| 9 | 936 | 250 | 1048.3 | - | 139.5 | 327.6 | - | 55189.8 | **Tr.** | 40716 | |
| 10 | 1222 | 251 | 1246.4 | - | 354.4 | 305.5 | - | 67002.3 | **Tr.** | 53364.7 | |
| 11 | 769.6 | 252 | 800.4 | - | 161.6 | 546.4 | - | 41981.7 | **Tr.** | 3333.4 | |
| 12 | 889.2 | 253 | 1067 | - | 133.4 | 524.6 | - | 48879.3 | **Nil** | 38689.1 | |
| 13 | 1201.2 | 254 | 1249.2 | - | 180.2 | 624.6 | - | 66198.13 | **Nil** | 52228.1 | |
| 14 | 7735 | 248, 249, 257 | 8819.9 | - | 1933.7 | 3094 | - | 424574.1 | **Nil** | 336008.4 | |
| 15 | 28475.2 | 255 | 37017.8 | - | 4271.3 | 16800.4 | - | 1563003.7 | **Nil** | 1237816.9 | |
| 16 | 9266.4 | 259 | 12139 | - | 2779.9 | 3335.8 | - | 511123.2 | **Nil** | 401883.8 | |
| 17 | 7336 | 256 | 10336 | - | 115.4 | 4833.4 | - | 406674.5 | **Nil** | 322250.6 | |
| 18 | 7529.6 | 258 | 8960.2 | - | 258.9 | 2334.2 | - | 414278.6 | **Nil** | 327010.5 | |
| 19 | 2308.8 | 260 | 2701.3 | - | 531 | 1039 | - | 127030.2 | **Nil** | 100025.5 | |
| 20 | 4001.4 | 261 | 3921.4 | - | 1480.5 | 800.3 | - | 221077.3 | **Nil** | 174301 | |
| 21 | 3182.4 | 262 | 3277.9 | - | 891.0 | 604.6 | - | 175826.6 | **Nil** | 135561.7 | |
| 22 | 2100.8 | 263 | 2477 | - | 1775.6 | 819.3 | - | 114010.4 | **Nil** | 89725.2 | |
| 23 | 4888 | 267 | 8554 | - | 2541.8 | 2639.5 | - | 261703.5 | 1417.5 | 209793 | |
| 24 | 36098.4 | 264 & 265 | 54508.5 | - | 13356.4 | 16244.3 | - | 1969143.1 | 4331.8 | 1556923.9 | |
| 25 | 12246 | 266 | 15674.9 | - | 2694.1 | 3551.3 | - | 667407 | 1951.4 | 532578.5 | |
| 26 | 47190 | 268 & 269 | 75504 | - | 14157 | 18404.1 | - | 2567136 | 8966.1 | 2032001 | |
| 27 | 6645.6 | 270 | 8373.4 | - | 1528.5 | 1794.3 | - | 364245.3 | 7310.1 | 288286.1 | |
| 28 | 26676 | 271 & 272 | 62955.4 | - | 9664.4 | 10937.2 | - | 1453041.7 | 1600.5 | 1138264.9 | |
| 29 | 5907.2 | 273 & 274 | 7029.6 | - | 1772.1 | 1358.6 | - | 325545.8 | **Nil** | 255309.2 | |
| 30 | 18096 | 276 | 2822.9 | - | 416.2 | 850.5 | - | 98930.8 | **Nil** | 78409.9 | |
| 31 | 2132 | 277 | 2579.7 | - | 490.3 | 724.9 | - | 116855 | **Nil** | 92336.9 | |
| 32 | 1638 | 275 | 2014.7 | - | 376.7 | 1097.5 | - | 90270.2 | **Nil** | 70712.5 | |
| | 552161.7 | | 690378 | | 128025.7 | 317711.8 | | 30316156.4 | | 23467396.8 | |
| | | | (1.25) | | (0.23) | (0.57) | | (54.90) | | (43.50) | =100.45 |

**CHEMICAL ANALYSIS OF DIFFERENT BLOCKS.**

| Exposure No. | Reserves | $Sio_2$ | So3 | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3298360 | 3.84 | - | 0.72 | 1.04 | - | 51.65 | 0.09 | 41.71 | 99.05 |
| 2 | 81120 | 2.04 | - | 0.33 | 0.50 | - | 54.82 | **Tr.** | 42.85 | 100.54 |
| 3 | 2458740 | 1.21 | - | 0.15 | 0.58 | - | 54.43 | 0.053 | 43.90 | 100.32 |
| 4 | 1187318 | 2.85 | - | 0.64 | 0.57 | - | 53.40 | - | 42.80 | 100.24 |
| 5 | 88140 | 2.46 | - | 0.66 | 0.63 | - | 54.00 | 0.29 | 42.18 | 100.22 |
| 6 | 262145 | 3.90 | - | 0.47 | 1.04 | - | 54.46 | 0.10 | 41.16 | 100.09 |
| 7 | 1017224 | 3.58 | - | 0.44 | 1.15 | - | 52.97 | - | 42.03 | 100.17 |
| 8 | 8277100 | 5.14 | - | 1.17 | 1.29 | - | 51.19 | 0.15 | 42.19 | 100.13 |
| 9 | 3581396 | 4.5 | - | 0.92 | 0.84 | - | 52.02 | - | 41.52 | 99.81 |
| 10 | 552161.7 | 1.25 | - | 0.23 | 0.57 | - | 54.90 | - | 43.50 | 100.45 |

| Exposure No. | Reserve M. tonnes | Samples No. | $Sio_2$ | $So_3$ | $Fe_2o_3$ | $Al_2o_3$ | $Tio_2$ | Cao | Mgo | LOI |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 117650 | 224 & 225 | 12588.5 | - | 16471 | 81178.5 | - | 6288392.5 | 17647.5 | 5108363 |
| 2 | 1076400 | 202 & 207<br>217 to 222 | 1377792 | - | 1399322 | 741132 | - | 5787180.28 | 70584 | 5084408 |
| 3 | 10400 | 206 | 12168 | - | 1352 | 4160 | - | 573768 | - | 448968 |
| 8 | 6500 | 200 | 1137.5 | - | 650 | 5785 | - | 332475 | - | 279825 |
| 9 | 49920 | 298 | 44428.8 | - | 11481.6 | 11980.8 | - | 2782540 | - | 2157542.4 |
| 10 | 3120 | 299 | 2469 | - | 717.6 | 998.4 | - | 173908.8 | - | 134784 |
| 11 | 3900 | 287 | 3198 | - | 585 | 1716 | - | 216225 | 702 | 169455 |
| 12 | 6240 | 288 | 5990.4 | - | 936 | 2558.4 | - | 346944 | 811.2 | 271128 |
| 13 | 98280 | 289 & 290 | 101228.4 | - | 18673.2 | 41277.6 | - | 5255031.6 | 8845.2 | 425524 |
| 14 | 13000 | 303 | 13260 | - | 1920 | 4290 | - | 717210 | - | 567190 |
| 15 | 31460 | 302 | 59144.8 | - | 9338 | 8179.6 | - | 1726839.4 | - | 1338623 |
| 16 | 5460 | 301 | 8299.2 | - | 1255.8 | 1310.4 | - | 301228.2 | - | 235872 |
| 17 | 1300 | 297 | 1105 | - | 299 | 572 | - | 72644 | - | 56160 |
| 18 | 93600 | 194 & 195 | 73944 | - | 8424 | 51480 | - | 5149872 | - | 4073472 |
| 19 | 1560 | 192 | 1606.8 | - | 234 | 1029.6 | - | 84052.8 | - | 67750.8 |
| 20 | 9360 | 193 | 9266.4 | - | 936 | 6458.4 | - | 513676.8 | - | 424944 |
| 21 | 5850 | 191 | 5675.5 | - | 877.5 | 3919.5 | - | 317713.5 | - | 252837 |
| 22 | 2080 | 190 | 2579.2 | - | 416 | 1476.8 | - | 113256 | - | 90073.2 |
| 23 | 19760 | 155 | 19562.4 | - | 1976 | 7311 | - | 1090752 | - | 857188.9 |
| 24 | 5850 | 153 | 5616 | - | 585 | 1462.5 | - | 322978.5 | - | 253831.5 |
| 25 | 17550 | 154 | 15795 | - | 1775 | 61425 | - | 966654 | - | 760090.5 |
| 26 | 4680 | 152 | 4212 | - | 467 | 1123.2 | - | 242783.4 | - | 203346 |
| 27 | 39130 | 150 & 151 | 37173.5 | - | 5869.5 | 2347.8 | - | 215239.9 | - | 1700981.1 |
| 28 | 44200 | 136 & 137 | 45526 | - | 4420 | 19448 | - | 2446028 | - | 1915628 |
| 29 | 34230 | 138 | 33976.8 | - | 3432 | 15444 | - | 1899268.8 | - | 1488115.2 |
| 30 | 5200 | 139 | 6032 | - | 520 | 1872 | - | 287768 | - | 225160 |
| 31 | 61176 | 140 & 141 | 67295.8 | - | 7341.36 | 11683.82 | - | 336119.3 | - | 2653901.6 |
| 32 | 11830 | 323 | 12539.8 | - | 2002.6 | 2129.4 | - | 540357.9 | - | 563936.1 |
| 33 | 175500 | 304 | 238680 | - | 52650 | 49140 | - | 9582300 | - | 7621865 |
| 34 | 7488 | 133 | 7188.4 | - | 1198 | 3219.8 | - | 414460.8 | - | 322133.7 |
| 35 | 936 | 132 | 1048.3 | - | 149.7 | 533.52 | - | 51676.5 | - | 40322.8 |
| 36 | 84500 | 130 & 143 | 96330 | - | 10140 | 32955 | - | 4569330 | - | 3665610 |
| 37 | 2600 | 135 | 2808 | - | 130 | 1430 | - | 143754 | - | 260043.18 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 38 | 2080 | 134 | 2579.2 | - | 104 | 1622.4 | - | 114836.8 | - | 89460.8 |
| 39 | 4550 | 142 | 4459 | - | 455 | 455 | - | 251205.5 | - | 197743 |
| 40 | 5460 | 123 | 5787.6 | - | 873.6 | 1092 | - | 303030 | - | 237073.2 |
| 41 | 31200 | 119 & 120 | 38376 | - | 5928 | 12168 | - | 1715688 | - | 1348152 |
| 42 | 6370 | 149 | 5287.1 | - | 955.5 | 764.4 | - | 350795.9 | - | 276967.6 |
| 43 | 1560 | 121 | 1669.2 | - | 249.5 | 624 | - | 86127.6 | - | 6725.6 |
| 44 | 31200 | 122 | 33072 | - | 4992 | 10608 | - | 1731600 | - | 1354080 |
| 45 | 54600 | 126 & 127 | 56238 | - | 7098 | 20202 | - | 3017742 | - | 2372916 |
| 46 | 2600 | 131 | 3406 | - | 546 | 2444 | - | 145106 | - | 11618 |
| 47 | 4680 | 128 | 5803.2 | - | 982.8 | 25974 | - | 258382.8 | - | 202176 |
| 48 | 11700 | 129 | 12168 | - | 1287 | 8224 | - | 645957 | - | 506142 |
| 49 | 117000 | 124 & 125 | 134550 | - | 222 30 | 47970 | - | 6463080 | 23400 | 5071950 |
| 50 | 46800 | 199 | 7394 | - | 4680 | 40248 | - | 255280 | - | 201336 |
| 51 | 9100 | 196 | 8372 | - | 728 | 6279 | - | 502047 | - | 395304 |
| 52 | 79040 | 197 & 198 | 147804.8 | - | 13436.8 | 77632 | - | 4354828.8 | - | 3392396.8 |
| **Total** | 2458740 | | 2976494.6 | - | 372412.1 | 1437534.8 | - | 135753245.9 | 139780.4 | 109133310.5 |
| | | | (1.21) | | (0.55) | (0.58) | | (54.43) | (0.05) | (43.90) |
| | | | | | | | | | | =100.32 |

**Copy to copy** **372412.1**

**(0.15)**

**T A B L E N O - 3**

**A N A L Y T I C A L R E P O R T**

**Name of the Mineral:** **Limestone**
**Received from:** **Dr. J.P.Patel**
**Name of the Scheme:** **Veraval limestone scheme**
**Total number of samples:**

| Sr. No. | Ref. No. | Silica $Sio_2$ | $So_3$ | $R_2o_3$ | Ferric oxide $Fe_2o_3$ | Alumina $Al_2o_3$ | Titania $Tio_2$ | Lime Cao | Magnesia Mgo | Loss in ignition | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | VLS-1 | 2.73 | 1.20 | 1.69 | 0.58 | 1.11 | - | 51.69 | 0.45 | 41.12 | 98.88 |
| 2 | VLS-2 | 2.43 | 0.94 | 2.13 | 0.40 | 1.73 | - | 51.69 | 0.20 | 41.77 | 99.16 |
| 3 | VLS-3 | 7.30 | 0.86 | 3.76 | 1.82 | 1.94 | - | 48.51 | 0.39 | 30.06 | 99.02 |
| 4 | VLS-4 | 1.74 | 1.10 | 1.22 | 1.02 | 0.20 | - | 52.27 | 0.50 | 42.40 | 99.23 |
| 5 | VLS-5 | 1.23 | - | 0.50 | 0.27 | 0.33 | - | 54.29 | **Nil** | 44.25 | 100.27 |
| 6 | VLS-6 | 2.28 | - | 0.60 | 0.27 | 0.33 | - | 53.28 | **Nil** | 44.11 | 100.27 |
| 7 | VLS-7 | 1.62 | - | 0.57 | 0.18 | 0.39 | - | 54.58 | **Nil** | 42.52 | 99.29 |
| 8 | VLS-8 | 4.86 | - | 1.91 | 0.92 | 0.99 | - | 51.11 | **Nil** | 42.32 | 100.20 |
| 9 | VLS-9 | 2.02 | - | 0.59 | 0.38 | 0.21 | - | 54.48 | **Tr.** | 43.09 | 100.18 |
| 10 | VLS-10 | 1.26 | - | 0.30 | 0.29 | 0.01 | - | 54.87 | **Tr.** | 43.41 | 99.84 |
| 11 | VLS-11 | 5.37 | - | 2.59 | 1.66 | 0.93 | - | 51.84 | **Tr.** | 40.74 | 100.54 |
| 12 | VLS-12 | 5.29 | - | 1.90 | 1.73 | 0.17 | - | 51.84 | **Tr.** | 40.96 | 99.99 |
| 13 | VLS-13 | 1.44 | - | 0.32 | 0.22 | 0.12 | - | 54.86 | **Tr.** | 43.07 | 100.06 |
| 14 | VLS-14 | 6.80 | - | 3.60 | 0.74 | 2.86 | - | 50.02 | **Tr.** | 39.67 | 100.09 |
| 15 | VLS-15 | 1.90 | - | 1.00 | 0.19 | 0.81 | - | 54.39 | **Tr.** | 42.87 | 100.16 |
| 16 | VLS-16 | 12.46 | - | 2.34 | 1.09 | 1.25 | - | 47.71 | **Tr.** | 37.54 | 100.05 |
| 17 | VLS-17 | 3.76 | - | 1.73 | 1.26 | 0.47 | - | 52.96 | **Tr.** | 41.65 | 100.10 |
| 18 | VLS-18 | 2.50 | - | 1.53 | 0.26 | 1.27 | - | 53.59 | **Tr.** | 42.59 | 100.09 |
| 19 | VLS-19 | 3.07 | - | 1.22 | 0.74 | 0.48 | - | 53.72 | **Tr.** | 42.00 | 100.01 |
| 20 | VLS-20 | 1.46 | - | 0.58 | 0.22 | 0.36 | - | 55.00 | **Tr.** | 43.20 | 100.24 |
| 21 | VLS-21 | 2.76 | - | 1.25 | 0.74 | 0.51 | - | 53.58 | **Tr.** | 42.34 | 100.07 |
| 22 | VLS-22 | 1.18 | - | 0.22 | 0.17 | 0.05 | - | 55.58 | **Tr.** | 43.39 | 100.37 |
| 23 | VLS-23 | 2.74 | - | 1.40 | 0.87 | 0.53 | - | 53.72 | **Tr.** | 42.27 | 100.13 |
| 24 | VLS-24 | 1.00 | - | 0.27 | 0.13 | 0.14 | - | 55.72 | **Tr.** | 43.52 | 100.51 |
| 25 | VLS-25 | 4.23 | - | 1.75 | 0.80 | 0.95 | - | 52.44 | **Tr.** | 41.40 | 99.82 |
| 26 | VLS-26 | 1.57 | - | 0.32 | 0.18 | 0.14 | - | 54.01 | 0.22 | 43.10 | 99.22 |
| 27 | VLS-27 | 2.88 | - | 1.83 | 1.03 | 0.80 | - | 53.43 | **Tr.** | 41.94 | 100.08 |
| 28 | VLS-28 | 2.98 | - | 2.00 | 1.10 | 0.90 | - | 53.27 | **Tr.** | 41.88 | 100.13 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | VLS-29 | 2.52 | - | 2.03 | 1.22 | 0.81 | - | 53.15 | **Tr.** | 42.28 | 99.98 |
| 30 | VLS-30 | 3.59 | - | 2.28 | 1.31 | 1.15 | - | 52.30 | **Tr.** | 41.44 | 99.61 |
| 31 | VLS-31 | 2.58 | - | 0.69 | 0.43 | 0.26 | - | 53.72 | **Tr.** | 42.70 | **99.6** |
| 32 | VLS-32 | 4.30 | - | 1.63 | 0.87 | 0.76 | - | 52.01 | **Tr.** | 41.67 | **99.6** |
| 33 | VLS-33 | 3.00 | - | 1.12 | 0.78 | 0.34 | - | 53.72 | **Tr.** | 42.30 | **100.1** |
| 34 | VLS-34 | 5.72 | - | 1.16 | 0.87 | 0.29 | - | 51.59 | **Tr.** | 40.63 | **99.1** |
| 35 | VLS-35 | 3.88 | - | 1.52 | 1.13 | 0.39 | - | 52.87 | **Tr.** | 40.50 | **99.8** |
| 36 | VLS-36 | 3.00 | - | 1.42 | 1.17 | 0.25 | - | 53.30 | **Tr.** | 42.57 | 100.29 |
| 37 | VLS-37 | 4.75 | - | 2.74 | 1.22 | 1.52 | - | 51.87 | **Tr.** | 40.50 | 99.80 |
| 38 | VLS-38 | 4.60 | - | 2.30 | 0.87 | 1.43 | - | 51.59 | **Tr.** | 41.17 | 99.66 |
| 39 | VLS-39 | 2.73 | - | 1.15 | 0.41 | 0.74 | - | 53.30 | **Tr.** | 42.43 | 99.61 |
| 40 | VLS-40 | 4.46 | - | 2.21 | 0.92 | 1.29 | - | 51.44 | **Tr.** | 41.14 | 99.25 |
| 41 | VLS-41 | 3.56 | - | 1.81 | 0.77 | 1.04 | - | 51.09 | 0.32 | 41.78 | 98.56 |
| 42 | VLS-42 | 16.69 | - | 3.15 | 1.91 | 1.24 | - | 4.75 | **Tr.** | 34.51 | 99.10 |
| 43 | VLS-43 | 4.20 | - | 1.93 | 1.29 | 0.54 | - | 52.44 | **Tr.** | 40.64 | 99.21 |
| 44 | VLS-44 | 2.85 | - | 1.45 | 1.04 | 0.41 | - | 53.87 | **Tr.** | 41.84 | 100.01 |
| 45 | VLS-45 | 1.18 | - | 0.52 | 0.15 | 0.37 | - | 55.29 | **Tr.** | 43.34 | 100.33 |
| 46 | VLS-46 | 1.77 | - | 0.36 | 0.21 | 0.15 | - | 54.84 | **Tr.** | 43.35 | 100.06 |
| 47 | VLS-47 | 4.71 | - | 1.20 | 0.51 | 0.69 | - | 52.29 | **Tr.** | 41.60 | 99.80 |
| 48 | VLS-48 | 3.93 | - | 3.10 | 0.77 | 2.33 | - | 51.66 | **Tr.** | 41.15 | 99.84 |
| 49 | VLS-49 | 3.09 | - | 2.90 | 1.22 | 1.68 | - | 52.96 | **Tr.** | 41.43 | 100.38 |
| 50 | VLS-50 | 3.34 | - | 2.34 | 0.77 | 1.57 | - | 52.82 | **Tr.** | 41.72 | 100.22 |
| 51 | VLS-51 | 2.71 | - | 2.58 | 0.97 | 1.61 | - | 52.96 | **Tr.** | 41.28 | 99.53 |
| 52 | VLS-52 | 4.03 | - | 1.52 | 0.77 | 0.75 | - | 53.54 | 0.06 | 41.18 | 100.33 |
| 53 | VLS-53 | 3.32 | - | 1.77 | 0.71 | 1.06 | - | 53.25 | 0.12 | 41.96 | 100.42 |
| 54 | VLS-54 | 5.72 | - | 2.36 | 2.02 | 1.34 | - | 51.37 | 0.13 | 40.43 | 100.01 |
| 55 | VLS-55 | 4.23 | - | 2.36 | 0.97 | 1.39 | - | 52.09 | 0.03 | 41.63 | 100.34 |
| 56 | VLS-56 | 2.32 | - | 1.48 | 0.41 | 1.07 | - | 53.72 | **Tr.** | 42.61 | 100.13 |
| 57 | VLS-57 | 5.17 | - | 3.00 | 1.48 | 1.52 | - | 51.50 | **Tr.** | 40.50 | 100.17 |
| 58 | VLS-58 | 3.27 | - | 2.20 | 1.17 | 1.03 | - | 53.04 | **Tr.** | 41.68 | 100.19 |
| 59 | VLS-59 | 4.56 | - | 1.61 | 0.66 | 0.95 | - | 52.78 | **Tr.** | 41.48 | 100.43 |
| 60 | VLS-60 | 4.53 | - | 1.91 | 0.41 | 1.50 | - | 42.34 | 0.04 | 41.44 | 100.26 |
| 61 | VLS-61 | 2.85 | - | 1.67 | 0.51 | 1.16 | - | 53.78 | **Tr.** | 41.48 | 100.43 |
| 62 | VLS-62 | 3.55 | - | 1.82 | 0.56 | 1.26 | - | 53.06 | 0.03 | 41.58 | 100.04 |
| 63 | VLS-63 | 3.44 | - | 1.70 | 0.56 | 1.14 | - | 53.21 | 0.03 | 41.76 | 100.14 |
| 64 | VLS-64 | 3.28 | - | 1.60 | 0.61 | 0.99 | - | 53.49 | 0.05 | 41.89 | 100.21 |
| 65 | VLS-65 | 4.36 | - | 1.83 | 0.71 | 1.12 | - | 52.67 | 0.03 | 41.46 | 100.35 |
| 66 | VLS-66 | 5.04 | - | 1.55 | 0.61 | 0.78 | - | 51.94 | 0.10 | 43.21 | 99.74 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 67 | VLS-67 | 4.53 | - | 1.80 | 0.72 | 1.08 | - | 52.33 | 0.10 | 41.29 | 99.95 |
| 68 | VLS-68 | 4.49 | - | 1.83 | 0.84 | 0.99 | - | 53.10 | 0.07 | 40.77 | 100.36 |
| 69 | VLS-69 | 3.31 | - | 1.24 | 0.82 | 0.42 | - | 53.68 | 0.05 | 42.21 | 100.49 |
| 70 | VLS-70 | 2.96 | - | 1.35 | 0.68 | 0.67 | - | 50.68 | **Nil** | 42.26 | 100.26 |
| 71 | VLS-71 | 4.68 | - | 2.04 | 1.28 | 0.76 | - | 50.64 | **Nil** | 40.45 | 99.87 |
| 72 | VLS-72 | 5.44 | - | 2.26 | 1.27 | 0.99 | - | **51.52** | **Nil** | 40.50 | 99.57 |
| 73 | VLS-73 | 4.38 | - | 1.96 | 1.29 | 0.67 | - | 51.36 | **Nil** | 40.60 | 100.37 |
| 74 | VLS-74 | 5.56 | - | 2.53 | 0.93 | 1.60 | - | 51.08 | 0.14 | 41.04 | 100.35 |
| 75 | VLS-75 | 4.47 | - | 1.94 | 1.00 | 0.94 | - | 52.09 | 0.26 | 41.72 | 100.48 |
| 76 | VLS-76 | 4.39 | - | 1.79 | 1.22 | 0.57 | - | 52.66 | **Nil** | 41.67 | 100.51 |
| 77 | VLS-77 | 2.68 | - | 1.37 | 0.71 | 0.66 | - | 53.68 | **Nil** | 41.62 | 99.35 |
| 78 | VLS-78 | 5.21 | - | 1.99 | 1.32 | 0.67 | - | 51.07 | **Nil** | 40.44 | 98.71 |
| 79 | VLS-79 | 4.78 | - | 2.54 | 1.32 | 1.22 | - | 50.93 | **Nil** | 41.12 | 99.37 |
| 80 | VLS-80 | 5.58 | - | 2.40 | 1.23 | 1.17 | - | 51.65 | 0.58 | 40.24 | 100.45 |
| 81 | VLS-81 | 3.23 | - | 1.51 | 0.78 | 0.73 | - | 52.52 | 0.09 | 42.73 | 100.08 |
| 82 | VLS-82 | 3.60 | - | 1.51 | 0.82 | 0.69 | - | 52.38 | 0.06 | 42.59 | 100.14 |
| 83 | VLS-83 | 4.20 | - | 1.65 | 0.96 | 0.69 | - | 52.09 | 0.11 | 42.36 | 100.41 |
| 84 | VLS-84 | 4.06 | - | 1.51 | 0.51 | 1.00 | - | 53.10 | 0.05 | 41.65 | 100.37 |
| 85 | VLS-85 | 6.89 | - | 2.11 | 0.87 | 1.24 | - | 51.08 | 0.05 | 40.18 | 100.31 |
| 86 | VLS-86 | 10.79 | - | 1.92 | 0.92 | 1.00 | - | 49.20 | 0.07 | 38.41 | 100.37 |
| 87 | VLS-87 | 12.11 | - | 2.40 | 1.02 | 1.38 | - | 47.75 | 0.06 | 37.80 | 100.12 |
| 88 | VLS-88 | 4.52 | - | 1.52 | 1.27 | 0.25 | - | 53.24 | **Nil** | 41.51 | 100.38 |
| 89 | VLS-89 | 3.96 | - | 1.78 | 1.02 | 0.76 | - | 52.96 | **Nil** | 41.36 | 100.06 |
| 90 | VLS-90 | 2.74 | - | 1.07 | 0.66 | 0.41 | - | 53.82 | **Nil** | 42.21 | 99.84 |
| 91 | VLS-91 | 8.86 | - | 4.05 | 2.35 | 1.70 | - | 47.75 | **Nil** | 39.09 | 99.75 |
| 92 | VLS-92 | 10.26 | - | 3.15 | 1.80 | 1.35 | - | 47.11 | 0.59 | 38.08 | 99.19 |
| 93 | VLS-93 | 4.70 | - | 3.11 | 1.95 | 1.16 | - | 47.63 | 0.73 | 41.28 | 99.45 |
| 94 | VLS-94 | 7.82 | - | 2.72 | 1.07 | 1.65 | - | 50.21 | 0.13 | 39.08 | 99.96 |
| 95 | VLS-95 | 4.32 | - | 2.10 | 0.87 | 1.23 | - | 52.67 | 0.07 | 41.08 | 100.24 |
| 96 | VLS-96 | 5.32 | - | 2.10 | 0.87 | 1.23 | - | 51.37 | 0.14 | 40.47 | 99.40 |
| 97 | VLS-97 | 4.46 | - | 2.08 | 0.87 | 1.21 | - | 52.38 | 0.23 | 41.18 | 100.33 |
| 98 | VLS-98 | 1.92 | - | 0.33 | 0.20 | 0.13 | - | 54.50 | **Nil** | 42.81 | 99.61 |
| 99 | VLS-99 | 8.20 | - | 3.89 | 2.08 | 1.81 | - | 48.62 | 0.14 | 37.93 | 98.78 |
| 100 | VLS-100 | 7.39 | - | 3.34 | 1.82 | 1.52 | - | 48.65 | 0.64 | 39.49 | 99.51 |
| 101 | VLS-101 | 3.71 | - | 1.20 | 0.61 | 0.59 | - | 52.67 | 0.32 | 41.00 | 98.90 |
| 102 | VLS-102 | 4.33 | - | 3.58 | 1.03 | 2.55 | - | 51.80 | 0.19 | 39.88 | 99.78 |
| 103 | VLS-103 | 4.26 | - | 3.25 | 1.12 | 2.13 | - | 52.38 | 0.02 | 40.10 | 100.01 |
| 104 | VLS-104 | 6.49 | - | 3.40 | 1.02 | 2.38 | - | 49.63 | 0.22 | 39.15 | 98.89 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 105 | VLS-105 | 5.28 | - | 2.79 | 0.92 | 1.87 | - | 51.73 | 0.01 | 40.24 | 100.05 |
| 106 | VLS-106 | 1.26 | - | 1.10 | 0.99 | 0.91 | - | 54.34 | 0.30 | 43.38 | 100.38 |
| 107 | VLS-107 | 3.65 | - | 4.10 | 1.54 | 2.56 | - | 51.00 | 0.32 | 41.00 | 100.07 |
| 108 | VLS-108 | 3.78 | - | 2.02 | 0.87 | 1.15 | - | 52.74 | **Nil** | 41.82 | 100.36 |
| 109 | VLS-109 | 5.88 | - | 3.07 | 1.12 | 1.95 | - | 50.85 | **Nil** | 40.62 | 100.42 |
| 110 | VLS-110 | 5.65 | - | 3.07 | 1.17 | 1.90 | - | 51.00 | **Nil** | 40.61 | 100.33 |
| 111 | VLS-111 | 7.68 | - | 3.10 | 1.22 | 1.88 | - | 49.84 | **Nil** | 39.70 | 100.32 |
| 112 | VLS-112 | 6.22 | - | 2.44 | 1.32 | 1.02 | - | 51.52 | 0.48 | 39.09 | 99.71 |
| 113 | VLS-113 | 6.22 | - | 2.40 | 1.27 | 1.13 | - | 51.58 | 0.32 | 39.05 | 99.57 |
| 114 | VLS-114 | 6.21 | - | 2.40 | 1.27 | 1.13 | - | 51.72 | 0.25 | 39.36 | 99.94 |
| 115 | VLS-115 | 6.40 | - | 1.48 | 1.32 | 1.16 | - | 51.43 | 0.32 | 39.33 | 99.96 |
| 116 | VLS-116 | 3.37 | - | 2.18 | 1.22 | 0.96 | - | 52.31 | 0.36 | 40.73 | 98.95 |
| 117 | VLS-117 | 3.34 | - | 2.23 | 1.25 | 0.99 | - | 52.59 | **Tr.** | 40.75 | 98.92 |
| 118 | VLS-118 | 3.07 | - | 1.64 | 2.58 | 1.06 | - | 53.27 | **Tr.** | 42.28 | 100.26 |
| 119 | VLS-119 | 1.53 | - | 0.66 | 0.22 | 0.44 | - | 54.49 | **Tr.** | 43.04 | 99.72 |
| 120 | VLS-120 | 0.94 | - | 0.50 | 0.16 | 0.34 | - | 55.50 | **Nil** | 43.39 | 100.33 |
| 121 | VLS-121 | 1.07 | - | 0.56 | 0.16 | 0.40 | - | 52.21 | **Nil** | 43.11 | 99.95 |
| 122 | VLS-122 | 1.06 | - | 0.50 | 0.16 | 0.34 | - | 55.50 | **Nil** | 43.40 | 100.46 |
| 123 | VLS-123 | 1.06 | - | 0.36 | 0.16 | 0.20 | - | 55.50 | **Nil** | 43.42 | 100.43 |
| 124 | VLS-124 | 1.11 | - | 0.56 | 0.19 | 0.34 | - | 55.28 | 0.21 | 43.42 | 100.55 |
| 125 | VLS-125 | 1.20 | - | 0.69 | 0.20 | 0.49 | - | 55.21 | 0.19 | 43.29 | 100.58 |
| 126 | VLS-126 | 0.90 | - | 0.50 | 0.11 | 0.39 | - | 55.34 | 0.43 | 43.44 | 100.61 |
| 127 | VLS-127 | 1.16 | - | 0.51 | 0.15 | 0.36 | - | 55.21 | 0.08 | 43.49 | 100.45 |
| 128 | VLS-128 | 1.24 | - | 0.76 | 0.21 | 0.55 | - | 55.21 | **Nil** | 43.20 | 100.41 |
| 129 | VLS-129 | 1.04 | - | 0.83 | 0.11 | 0.72 | - | 55.21 | **Nil** | 43.26 | 100.34 |
| 130 | VLS-130 | 1.20 | - | 0.65 | 0.10 | 0.55 | - | 55.21 | **Nil** | 43.35 | 100.41 |
| 131 | VLS-131 | 1.31 | - | 1.15 | 0.21 | 0.96 | - | 55.81 | **Nil** | 42.93 | 100.20 |
| 132 | VLS-132 | 1.12 | - | 0.73 | 0.16 | 0.57 | - | 55.21 | **Nil** | 43.08 | 100.14 |
| 133 | VLS-133 | 0.96 | - | 0.59 | 0.16 | 0.43 | - | 55.35 | **Nil** | 43.02 | 99.92 |
| 134 | VLS-134 | 1.24 | - | 0.83 | 0.05 | 0.78 | - | 55.21 | **Nil** | 43.01 | 100.29 |
| 135 | VLS-135 | 1.08 | - | 0.66 | 0.05 | 0.55 | - | 55.29 | **Nil** | 43.18 | 100.15 |
| 136 | VLS-136 | 1.03 | - | 0.52 | 0.10 | 0.47 | - | 55.34 | **Nil** | 43.21 | 100.38 |
| 137 | VLS-137 | 1.03 | - | 0.57 | 0.10 | 0.47 | - | 55.34 | **Nil** | 43.36 | 100.15 |
| 138 | VLS-138 | 0.99 | - | 0.55 | 0.10 | 0.36 | - | 55.34 | **Nil** | 43.30 | 100.24 |
| 139 | VLS-139 | 1.16 | - | 0.46 | 0.10 | 0.36 | - | 55.34 | **Nil** | 43.30 | 100.26 |
| 140 | VLS-140 | 1.07 | - | 0.25 | 0.10 | 0.15 | - | 54.95 | **Tr.** | 43.44 | 99.70 |
| 141 | VLS-141 | 1.14 | - | 0.39 | 0.15 | 0.24 | - | 54.94 | **Tr.** | 43.32 | 99.79 |
| 142 | VLS-142 | 0.98 | - | 0.20 | 0.10 | 0.10 | - | 55.21 | **Tr.** | 43.66 | 100.05 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 143 | VLS-143 | 1.09 | - | 0.38 | 0.15 | 0.23 | - | 55.07 | **Tr.** | 43.41 | 99.95 |
| 144 | VLS-144 | 3.17 | - | 1.03 | 0.46 | 0.47 | - | 53.73 | 0.19 | 40.86 | 99.98 |
| 145 | VLS-145 | 2.94 | - | 0.09 | 0.51 | 0.58 | - | 53.87 | 0.08 | 41.04 | 99.02 |
| 146 | VLS-146 | 4.40 | - | 1.39 | 0.56 | 0.83 | - | 53.20 | 0.10 | 40.37 | 99.46 |
| 147 | VLS-147 | 2.62 | - | 1.00 | 0.40 | 0.60 | - | 54.40 | 0.27 | 41.33 | 99.62 |
| 148 | VLS-148 | 2.81 | - | 1.15 | 0.66 | 0.49 | - | 53.60 | **Nil** | 42.36 | 99.65 |
| 149 | VLS-149 | 0.83 | - | 0.27 | 0.15 | 0.12 | - | 55.07 | **Nil** | 43.58 | 99.93 |
| 150 | VLS-150 | 0.97 | - | 0.13 | 0.10 | 0.03 | - | 55.20 | **Nil** | 43.53 | 99.71 |
| 151 | VLS-151 | 0.93 | - | 0.29 | 0.80 | 0.09 | - | 55.07 | **Nil** | 43.42 | 99.71 |
| 152 | VLS-152 | 0.90 | - | 0.34 | 0.10 | 0.24 | - | 55.43 | **Nil** | 43.45 | 100.12 |
| 153 | VLS-153 | 0.96 | - | 0.35 | 0.10 | 0.25 | - | 55.21 | **Nil** | 43.39 | 99.91 |
| 154 | VLS-154 | 0.90 | - | 0.45 | 0.10 | 0.35 | - | 55.08 | **Nil** | 43.31 | 99.74 |
| 155 | VLS-155 | 0.99 | - | 0.47 | 0.10 | 0.37 | - | 55.20 | **Nil** | 43.38 | 100.04 |
| 156 | VLS-156 | 7.69 | - | 2.38 | 0.51 | 1.87 | - | 50.01 | **Nil** | 40.08 | 100.25 |
| 157 | VLS-157 | 4.29 | - | 1.94 | 0.50 | 1.43 | - | 51.87 | **Nil** | 41.54 | 99.64 |
| 158 | VLS-158 | 3.52 | - | 1.98 | 0.51 | 1.47 | - | 52.30 | **Nil** | 41.97 | 99.77 |
| 159 | VLS-159 | 7.20 | - | 2.20 | 0.61 | 1.59 | - | 59.66 | **Nil** | 40.74 | 100.00 |
| 160 | VLS-160 | 3.18 | - | 2.29 | 0.46 | 1.83 | - | 52.44 | **Tr.** | 42.38 | 100.29 |
| 161 | VLS-161 | 2.93 | - | 2.13 | 0.46 | 1.67 | - | 52.58 | **Tr.** | 42.35 | 99.99 |
| 162 | VLS-162 | 3.68 | - | 2.55 | 0.66 | 1.89 | - | 52.16 | **Tr.** | 42.10 | 100.49 |
| 163 | VLS-163 | 3.20 | - | 2.54 | 0.66 | 1.88 | - | 52.00 | **Tr.** | 41.63 | 100.37 |
| 164 | VLS-164 | 3.40 | - | 2.48 | 0.87 | 1.61 | - | 52.14 | **Tr.** | 41.74 | 99.76 |
| 165 | VLS-165 | 1.23 | - | 0.92 | 0.15 | 0.77 | - | 53.84 | **Tr.** | 43.06 | 99.15 |
| 166 | VLS-166 | 1.55 | - | 1.08 | 0.20 | 0.88 | - | 53.66 | **Tr.** | 43.27 | 99.56 |
| 167 | VLS-167 | 1.10 | - | 0.97 | 0.15 | 0.82 | - | 54.80 | **Tr.** | 43.26 | 100.13 |
| 168 | VLS-168 | 3.14 | - | 1.61 | 0.61 | 1.00 | - | 53.59 | **Tr.** | 41.94 | 100.28 |
| 169 | VLS-169 | 2.69 | - | 1.59 | 0.61 | 0.98 | - | 54.00 | **Tr.** | 41.97 | 100.25 |
| 170 | VLS-170 | 4.50 | - | 2.25 | 1.02 | 1.23 | - | 52.30 | **Tr.** | 41.02 | 100.07 |
| 171 | VLS-171 | 2.26 | - | 1.49 | 0.56 | 0.93 | - | 54.14 | **Tr.** | 42.31 | 100.23 |
| 172 | VLS-172 | 3.62 | - | 1.40 | 0.26 | 1.14 | - | 52.97 | **Tr.** | 41.92 | 99.91 |
| 173 | VLS-173 | 3.28 | - | 1.75 | 0.36 | 1.39 | - | 52.55 | **Tr.** | 41.81 | 99.39 |
| 174 | VLS-174 | 9.91 | - | 1.56 | 0.31 | 1.25 | - | 52.55 | **Tr.** | 42.48 | 99.09 |
| 175 | VLS-175 | 2.74 | - | 1.71 | 0.36 | 1.35 | - | 52.55 | **Tr.** | 42.07 | 99.09 |
| 176 | VLS-176 | 3.24 | - | 1.65 | 0.46 | 1.19 | - | 53.12 | **Tr.** | 42.22 | 100.23 |
| 177 | VLS-182 | 2.71 | - | 1.80 | 0.46 | 1.34 | - | 53.73 | **Nil** | 42.30 | 100.54 |
| 178 | VLS-183 | 2.62 | - | 1.65 | 0.46 | 1.19 | - | 53.73 | **Nil** | 42.35 | 100.35 |
| 179 | VLS-184 | 2.65 | - | 1.50 | 0.46 | 1.17 | - | 53.88 | **Nil** | 42.38 | 100.31 |
| 180 | VLS-189 | 3.03 | - | 1.87 | 0.41 | 1.46 | - | 52.59 | **Nil** | 42.16 | 99.65 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 181 | VLS-190 | 1.24 | - | 0.91 | 0.20 | 0.71 | - | 54.45 | **Nil** | 43.29 | 99.80 |
| 182 | VLS-191 | 0.97 | - | 0.82 | 0.15 | 0.67 | - | 54.31 | **Nil** | 43.22 | 99.32 |
| 183 | VLS-192 | 1.03 | - | 0.81 | 0.15 | 0.66 | - | 53.88 | **Tr.** | 43.43 | 99.15 |
| 184 | VLS-193 | 0.93 | - | 0.79 | 0.10 | 0.69 | - | 54.88 | **Tr.** | 43.37 | 100.70 |
| 185 | VLS-194 | 0.90 | - | 0.61 | 0.10 | 0.51 | - | 54.88 | **Tr.** | 43.37 | 99.76 |
| 186 | VLS-195 | 0.68 | - | 0.68 | 0.08 | 0.60 | - | 55.17 | **Tr.** | 43.67 | 100.20 |
| 187 | VLS-196 | 0.92 | - | 0.77 | 0.08 | 0.69 | - | 52.02 | **Tr.** | 43.44 | 100.15 |
| 188 | VLS-197 | 1.70 | - | 1.02 | 0.20 | 0.82 | - | 54.60 | **Tr.** | 43.01 | 100.33 |
| 189 | VLS-198 | 2.05 | - | 0.93 | 0.15 | 0.78 | - | 54.45 | **Tr.** | 42.83 | 100.26 |
| 190 | VLS-199 | 1.58 | - | 0.96 | 0.10 | 0.86 | - | 54.60 | **Tr.** | 43.02 | 100.16 |
| 191 | VLS-200 | 1.75 | - | 0.99 | 0.10 | 0.89 | - | 54.60 | **Tr.** | 43.05 | 100.39 |
| 192 | VLS-201 | 0.97 | - | 0.79 | 0.17 | 0.62 | - | 52.02 | **Nil** | 43.54 | 100.32 |
| 193 | VLS-202 | 1.15 | - | 0.65 | 0.17 | 0.48 | - | 55.02 | **Nil** | 42.39 | 100.21 |
| 194 | VLS-203 | 0.93 | - | 0.74 | 0.12 | 0.52 | - | 55.02 | **Nil** | 43.52 | 100.21 |
| 195 | VLS-204 | 1.06 | - | 0.53 | 0.17 | 0.38 | - | 55.02 | **Nil** | 43.46 | 100.09 |
| 196 | VLS-205 | 0.99 | - | 0.62 | 0.13 | 0.46 | **Tr.** | 55.17 | **Tr.** | 43.44 | 100.22 |
| 197 | VLS-206 | 1.17 | - | 0.53 | 0.13 | 0.40 | **Tr.** | 55.17 | **Tr.** | 43.17 | 100.04 |
| 198 | VLS-207 | 1.20 | - | 0.78 | 0.18 | 0.60 | **Tr.** | 55.02 | **Tr.** | 43.09 | 100.09 |
| 199 | VLS-208 | 14.60 | - | 2.80 | 0.82 | 1.98 | **Tr.** | 45.28 | **Tr.** | 36.55 | 99.23 |
| 200 | VLS-209 | 6.58 | - | 2.2 | 0.56 | 1.64 | - | 51.15 | **Nil** | 40.48 | 100.44 |
| 201 | VLS-210 | 3.02 | - | 1.80 | 0.46 | 1.34 | - | 53.59 | **Nil** | 41.81 | 100.22 |
| 202 | VLS-211 | 2.92 | - | 1.82 | 0.46 | 1.36 | - | 53.30 | **Nil** | 42.16 | 100.20 |
| 203 | VLS-212 | 3.15 | - | 1.94 | 0.46 | 1.48 | - | 53.45 | **Nil** | 41.80 | 100.34 |
| 204 | VLS-213 | 5.85 | - | 2.20 | 0.59 | 1.61 | - | 51.17 | **Nil** | 40.97 | 100.19 |
| 205 | VLS-214 | 2.54 | - | 1.80 | 0.41 | 1.39 | - | 53.24 | **Nil** | 42.48 | 100.06 |
| 206 | VLS-215 | 2.62 | - | 1.74 | 0.41 | 1.33 | - | 53.10 | **Nil** | 42.37 | 99.83 |
| 207 | VLS-216 | 1.10 | - | 0.92 | 0.11 | 0.81 | - | 54.79 | **Nil** | 43.42 | 100.22 |
| 208 | VLS-217 | 1.40 | - | 0.64 | 0.10 | 0.54 | - | 53.38 | **Nil** | 43.51 | 98.93 |
| 209 | VLS-218 | 1.67 | - | 0.63 | 0.12 | 0.51 | - | 53.38 | **Nil** | 43.40 | 99.08 |
| 210 | VLS-219 | 1.34 | - | 0.78 | 0.10 | 0.68 | - | 53.38 | **Nil** | 43.23 | 98.73 |
| 211 | VLS-220 | 1.16 | - | 1.00 | 0.15 | 0.85 | - | 53.38 | **Nil** | 43.22 | 98.76 |
| 212 | VLS-221 | 1.41 | - | 0.81 | 0.13 | 0.68 | - | 53.75 | 0.44 | 43.45 | 99.36 |
| 213 | VLS-222 | 0.94 | - | 0.83 | 0.13 | 0.70 | - | 53.38 | 0.09 | 43.54 | 98.73 |
| 214 | VLS-223 | 1.16 | - | 0.76 | 0.12 | 0.64 | - | 53.18 | 0.16 | 43.57 | 98.83 |
| 215 | VLS-224 | 0.94 | - | 0.73 | 0.13 | 0.60 | - | 53.25 | 0.30 | 43.61 | 98.83 |
| 216 | VLS-225 | 1.21 | - | 0.94 | 0.15 | 0.79 | - | 53.66 | **Nil** | 43.24 | 99.05 |
| 217 | VLS-226 | 1.32 | - | 1.08 | 0.15 | 0.93 | - | 53.38 | **Nil** | 43.07 | 98.85 |
| 218 | VLS-227 | 1.10 | - | 0.92 | 0.12 | 0.80 | - | 52.52 | **Nil** | 43.43 | 98.97 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 219 | VLS-228 | 1.28 | - | 1.04 | 0.15 | 0.89 | - | 53.38 | **Nil** | 43.14 | 98.84 |
| 220 | VLS-229 | 1.12 | - | 0.87 | 0.15 | 0.72 | - | 53.66 | **Nil** | 43.35 | 99.00 |
| 221 | VLS-230 | 1.14 | - | 0.82 | 0.10 | 0.72 | - | 53.66 | **Nil** | 43.32 | 98.94 |
| 222 | VLS-231 | 1.76 | - | 1.23 | 0.20 | 1.03 | - | 43.11 | **Nil** | 42.97 | 99.07 |
| 223 | VLS-232 | 1.58 | - | 1.32 | 0.31 | 1.01 | - | 53.38 | **Nil** | 43.15 | 99.43 |
| 224 | VLS-233 | 1.21 | - | 0.87 | 0.18 | 0.69 | **Tr.** | 53.24 | 0.22 | 43.23 | 98.77 |
| 225 | VLS-234 | 3.89 | - | 2.23 | 0.64 | 1.59 | **Tr.** | 51.58 | 0.13 | 41.65 | 99.58 |
| 226 | VLS-235 | 1.57 | - | 1.28 | 0.33 | 0.95 | **Tr.** | 53.11 | 0.20 | 43.02 | 99.18 |
| 227 | VLS-236 | 1.29 | - | 0.86 | 0.18 | 0.68 | **Tr.** | 53.11 | 0.16 | 43.09 | 98.51 |
| 228 | VLS-237 | 1.12 | - | 0.85 | 0.25 | 0.60 | - | 54.35 | **Nil** | 43.32 | 99.64 |
| 229 | VLS-238 | 1.00 | - | 0.68 | 0.25 | 0.43 | - | 54.77 | **Nil** | 43.51 | 99.96 |
| 230 | VLS-239 | 1.07 | - | 0.77 | 0.25 | 0.52 | - | 54.62 | **Nil** | 43.60 | 100.06 |
| 231 | VLS-240 | 1.23 | - | 0.89 | 0.25 | 0.59 | - | 54.49 | **Nil** | 43.36 | 99.92 |
| 232 | VLS-241 | 1.04 | - | 0.76 | 0.15 | 0.61 | - | 54.35 | 0.12 | 43.49 | 99.76 |
| 233 | VLS-242 | 1.18 | - | 0.73 | 0.13 | 0.60 | - | 54.08 | 0.19 | 43.50 | **99.6** |
| 234 | VLS-243 | 1.32 | - | 0.70 | 0.11 | 0.59 | - | 54.94 | 0.16 | 43.51 | **99.6** |
| 235 | VLS-244 | 0.90 | - | 0.83 | 0.13 | 0.70 | - | 53.43 | 0.23 | 43.77 | **99.1** |
| 236 | VLS-245 | 1.12 | - | 0.61 | 0.23 | 0.38 | - | 55.16 | **Nil** | 43.51 | 100.40 |
| 237 | VLS-246 | 1.19 | - | 0.61 | 0.30 | 0.31 | - | 55.02 | **Nil** | 43.43 | 100.25 |
| 238 | VLS-247 | 1.31 | - | 0.66 | 0.30 | 0.36 | - | 55.16 | **Nil** | 43.37 | 100.50 |
| 239 | VLS-248 | 1.17 | - | 0.68 | 0.23 | 0.45 | - | 55.02 | **Nil** | 43.41 | 100.28 |
| 240 | VLS-249 | 1.14 | - | 0.68 | 0.29 | 0.39 | - | 54.83 | **Tr.** | 43.41 | 100.06 |
| 241 | VLS-250 | 1.12 | - | 0.56 | 0.21 | 0.35 | - | 54.69 | **Tr.** | 43.50 | 99.87 |
| 242 | VLS-251 | 1.02 | - | 0.54 | 0.29 | 0.25 | - | 54.83 | **Tr.** | 43.67 | 100.06 |
| 243 | VLS-252 | 1.04 | - | 0.92 | 0.21 | 0.71 | - | 54.55 | **Tr.** | 43.31 | 99.82 |
| 244 | VLS-253 | 1.20 | - | 0.67 | 0.15 | 0.69 | - | 54.97 | **Nil** | 43.51 | 100.35 |
| 245 | VLS-254 | 1.04 | - | 0.74 | 0.15 | 0.52 | - | 55.11 | **Nil** | 43.48 | 100.37 |
| 246 | VLS-255 | 1.30 | - | 0.70 | 0.15 | 0.59 | - | 54.89 | **Nil** | 44.47 | 100.36 |
| 247 | VLS-256 | 1.39 | - | 0.80 | 0.15 | 0.65 | - | 54.69 | **Nil** | 43.35 | 100.23 |
| 248 | VLS-257 | 1.12 | - | 0.61 | 0.23 | 0.38 | - | 55.16 | **Nil** | 43.51 | 100.40 |
| 249 | VLS-258 | 1.19 | - | 0.61 | 0.30 | 0.31 | - | 55.02 | **Nil** | 43.43 | 100.25 |
| 250 | VLS-259 | 1.31 | - | 0.66 | 0.30 | 0.36 | - | 55.16 | **Nil** | 43.37 | 100.50 |
| 251 | VLS-260 | 1.17 | - | 0.68 | 0.23 | 0.45 | - | 55.02 | **Nil** | 43.41 | 100.28 |
| 252 | VLS-261 | 0.98 | - | 0.57 | 0.37 | 0.20 | - | 55.25 | **Nil** | 43.54 | 100.29 |
| 253 | VLS-262 | 1.03 | - | 0.47 | 0.28 | 0.19 | - | 55.25 | **Nil** | 43.54 | 100.29 |
| 254 | VLS-263 | 1.16 | - | 0.14 | 0.75 | 0.39 | - | 54.27 | **Nil** | 42.71 | 100.28 |
| 255 | VLS-264 | 1.95 | - | 1.28 | 0.60 | 0.68 | - | 54.09 | 0.05 | 42.76 | 100.13 |
| 256 | VLS-265 | 1.07 | - | 0.38 | 0.15 | 0.23 | - | 54.50 | 0.19 | 43.50 | 99.64 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 257 | VLS-266 | 1.28 | - | 0.51 | 0.22 | 0.29 | - | 54.64 | 0.16 | 43.49 | 100.08 |
| 258 | VLS-267 | 1.75 | - | 1.06 | 0.52 | 0.54 | - | 53.54 | 0.29 | 42.92 | 99.56 |
| 259 | VLS-268 | 1.96 | - | 0.94 | 0.45 | 0.49 | - | 54.25 | 0.16 | 42.75 | 100.06 |
| 260 | VLS-269 | 1.24 | - | 0.45 | 0.16 | 0.29 | - | 54.54 | 0.23 | 43.37 | 99.87 |
| 261 | VLS-270 | 1.26 | - | 0.50 | 0.23 | 0.27 | - | 54.81 | 1.10 | 43.38 | 100.02 |
| 262 | VLS-271 | 2.40 | - | 0.98 | 0.45 | 0.53 | - | 54.11 | 0.12 | 42.70 | 100.31 |
| 263 | VLS-275 | 1.23 | - | 0.90 | 0.23 | 0.67 | - | 55.11 | **Nil** | 43.17 | 100.41 |
| 264 | VLS-272 | 2.32 | - | 0.57 | 0.27 | 0.30 | - | 54.83 | **Nil** | 42.64 | 100.36 |
| 265 | VLS-273 | 1.14 | - | 0.42 | 0.27 | 0.15 | - | 55.11 | **Nil** | 43.30 | 99.97 |
| 266 | VLS-274 | 1.05 | - | 0.65 | 0.34 | 0.31 | - | 55.11 | **Nil** | 43.14 | 99.95 |
| 267 | VLS-276 | 1.56 | - | 0.70 | 0.23 | 0.47 | - | 54.67 | **Nil** | 43.33 | 100.26 |
| 268 | VLS-277 | 1.21 | - | 0.57 | 0.23 | 0.34 | - | 54.81 | **Nil** | 43.31 | 99.90 |
| 269 | VLS-278 | 1.96 | - | 0.36 | 0.15 | 0.21 | - | 55.10 | **Nil** | 43.54 | 99.86 |
| 270 | VLS-279 | 1.13 | - | 0.47 | 0.15 | 0.32 | - | 54.95 | **Nil** | 43.66 | 100.21 |
| 271 | VLS-280 | 0.93 | - | 0.31 | 0.22 | 0.09 | - | 55.25 | **Nil** | 43.40 | 99.89 |
| 272 | VLS-281 | 1.02 | - | 0.36 | 0.22 | 0.14 | - | 55.25 | **Nil** | 43.37 | 100.00 |
| 273 | VLS-282 | 1.04 | - | 0.33 | 0.22 | 0.11 | - | 55.25 | **Nil** | 43.57 | 100.19 |
| 274 | VLS-283 | 0.92 | - | 0.29 | 0.22 | 0.07 | - | 55.25 | **Nil** | 43.46 | 99.92 |
| 275 | VLS-284 | 1.01 | - | 0.73 | 0.19 | 0.54 | - | 55.45 | 0.12 | 43.20 | 100.51 |
| 276 | VLS-285 | 1.25 | - | 0.65 | 0.19 | 0.46 | - | 55.45 | 0.16 | 43.23 | 100.74 |
| 277 | VLS-286 | 1.12 | - | 0.61 | 0.27 | 0.34 | - | 55.45 | 0.13 | 43.12 | 100.43 |
| 278 | VLS-287 | 0.82 | - | 0.59 | 0.15 | 0.44 | - | 55.45 | 0.18 | 43.45 | 100.49 |
| 279 | VLS-288 | 0.96 | - | 0.56 | 0.15 | 0.41 | - | 55.60 | 0.13 | 43.45 | 100.70 |
| 280 | VLS-289 | 1.02 | - | 0.58 | 0.15 | 0.43 | - | 53.45 | 0.10 | 43.30 | 100.45 |
| 281 | VLS-290 | 1.05 | - | 0.64 | 0.23 | 0.41 | - | 55.45 | 0.66 | 43.31 | 100.53 |
| 282 | VLS-296 | 1.12 | - | 0.58 | 0.15 | 0.43 | - | 55.45 | 0.11 | 43.32 | 100.58 |
| 283 | VLS-297 | 0.85 | - | 0.67 | 0.23 | 0.44 | - | 55.88 | **Nil** | 43.20 | 100.60 |
| 284 | VLS-298 | 0.89 | - | 0.47 | 0.23 | 0.24 | - | 55.74 | **Nil** | 43.22 | 100.32 |
| 285 | VLS-299 | 0.80 | - | 0.55 | 0.23 | 0.23 | - | 55.74 | **Nil** | 43.20 | 100.29 |
| 286 | VLS-300 | 1.15 | - | 0.59 | 0.27 | 0.32 | - | 55.17 | **Nil** | 43.13 | 100.04 |
| 287 | VLS-301 | 1.52 | - | 0.47 | 0.23 | 0.24 | - | 55.17 | **Nil** | 43.20 | 100.36 |
| 288 | VLS-302 | 1.88 | - | 0.56 | 0.30 | 0.26 | - | 54.89 | **Nil** | 42.55 | 99.88 |
| 289 | VLS-303 | 1.02 | - | 0.48 | 0.15 | 0.33 | - | 55.17 | **Nil** | 43.63 | 100.30 |
| 290 | VLS-304 | 1.36 | - | 0.58 | 0.30 | 0.28 | - | 55.17 | **Nil** | 43.43 | 100.54 |
| 291 | VLS-305 | 2.10 | - | 0.59 | 0.27 | 0.32 | - | 54.46 | **Nil** | 43.08 | 100.51 |
| 292 | VLS-306 | 0.96 | - | 0.28 | 0.15 | 0.13 | - | 55.60 | **0.00** | 43.29 | 100.48 |
| 293 | VLS-307 | 1.30 | - | 0.69 | 0.19 | 0.49 | - | 55.03 | 0.34 | 43.19 | 100.54 |
| 294 | VLS-308 | 1.41 | - | 0.35 | 0.23 | 0.12 | - | 55.03 | 0.51 | 43.17 | 100.47 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 295 | VLS-309 | 0.94 | - | 0.63 | 0.30 | 0.33 | - | 55.32 | **Tr.** | 43.05 | 99.94 |
| 296 | VLS-310 | 1.02 | - | 0.64 | 0.30 | 0.34 | - | 55.46 | 0.23 | 43.20 | 100.55 |
| 297 | VLS-311 | 1.07 | - | 0.62 | 0.30 | 0.32 | - | 55.03 | **Tr.** | 43.05 | 99.94 |
| 298 | VLS-312 | 3.87 | - | 2.02 | 1.05 | 0.97 | - | 53.04 | 0.34 | 41.38 | 100.65 |
| 299 | VLS-313 | 1.27 | - | 0.26 | 0.15 | 0.11 | - | 55.32 | **Nil** | 43.47 | 100.32 |
| 300 | VLS-314 | 1.20 | - | 0.23 | 0.15 | 0.08 | - | 55.32 | **Nil** | 43.38 | 99.93 |
| 301 | VLS-315 | 1.36 | - | 0.52 | 0.15 | 0.37 | - | 55.32 | **Nil** | 43.32 | 100.52 |
| 302 | VLS-316 | 1.39 | - | 0.41 | 0.15 | 0.26 | - | 55.32 | **Nil** | 43.18 | 100.30 |
| 303 | VLS-317 | 1.61 | - | 0.60 | 0.30 | 0.30 | - | 54.88 | **Nil** | 42.13 | 99.22 |
| 304 | VLS-318 | 1.32 | - | 0.51 | 0.15 | 0.36 | - | 54.60 | **Nil** | 43.45 | 99.88 |
| 305 | VLS-319 | 1.64 | - | 0.60 | 0.22 | 0.38 | - | 55.03 | **Nil** | 43.23 | 100.50 |
| 306 | VLS-320 | 7.76 | - | 1.60 | 0.75 | 0.85 | - | 50.33 | **Nil** | 40.14 | 98.83 |
| 307 | VLS-321 | 1.17 | - | 0.43 | 0.22 | 0.21 | - | 54.35 | 0.23 | 43.50 | 99.67 |
| 308 | VLS-322 | 1.54 | - | 0.45 | 0.26 | 0.19 | - | 53.54 | 0.03 | 43.65 | 99.21 |
| 309 | VLS-323 | 1.06 | - | 0.40 | 0.22 | 0.18 | - | 54.13 | 0.35 | 57.67 | 99.61 |

PLATE NO. 2

N

SCALE:- 1:5000

1·00 ⑨ S 70 S 69

S 68 S 67 S 65 S 66 ⑧ 3·00

S 61 S 62 23·19 S 60 22·55 S 63 20·71 25·04 S 53 26·68 S 81 S 83 S 69 S 82 21·14 S 80 S 55 S 59 S 84 ⑦ 10·00

·0·3 ⑥ 21·54 S 53 24·58

S 49 13·42 ② 0·5 20·20

1·5 ③ 20·11 S 50 18·51 16·56

S 113 ④ 2·5

S 548

0·5 ⑤ S 117

TO TALA

TO VERAVAL 13·40 S 85 14·18 S 86 ① 1·00 14·28 S 87

S 547

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- ALLUVIUM
- MILIOLITIC LIMESTONE
- DWARKA BEDS
- GAJ LIMESTONE
- S 86 SAMPLE WITH NUMBER
- 14·28 R.L
- RAILWAY LINE
- ② EXPOSURE NUMBER
- 0·5 AVERAGE THICKNESS IN METRES

• 16·56 R.L

| | | | |
|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG NO. 83 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE 28-9 |
| TRACED BY | | GEOLOGICAL MAP OF THE BHALPARA-CHANKTHAL AREA TAL. VERAVAL, DIST. JUNAGADH. VERAVAL LIMESTONE SCHEME 1976-77. (BLOCK-I) | |
| CHECKED BY | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | SCALE:- 1:500 |

PLATE NO. 3

N

SCALE :- 1:5000

TO TALALA

TO VERAVAL

B546

B547

B548

3 0·5

0·5 4

0·5 2 B531

VILLAGE
MITHPUR

1·5 1 B515

1·2 M

1·7 M

1·5 M

0·6 5 B546

ROAD TO KODINAR

0·5 8 B517

12·93

11·49

0·9 M

0·65 M

0·45 M

0·85 M

0·5 7 B516

1·2 M

0·4 M

11·75

11·71

6 1·00 B513

B514

1·85 M

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- DWARKA BEDS
- GAJ LIMESTONE
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- 11·75 R.L
- RAILWAY LINE
- (2) EXPOSURE NUMBER
- 1·85 M THICKNESS OF LIMESTONE IN WELL SECTION

| | | | | | |
|---|---|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | | DRG NO. | 84 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | | DATE | 29-9-79 |
| TRACED BY | | GEOLOGICAL MAP OF THE MITHAPUR AREA TAL. VERAVAL, DIST. JUNAGADH. VERAVAL LIMESTONE SCHEME 1976 '77. (BLOCK-II) | | | |
| CHECKED BY | | | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | | SCALE:- 1:5000 | |

PLATE NO. 4

112

N

SCALE :- 1:5000

TO GADU

TO GADU

TO AJARI

VILLAGE KINDERWA

VILLAGE SIDOKAR

MILE STONE

MILE STONE

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- MILIOLITIC LIMESTONE
- GAJ LIMESTONE
- S 225 SAMPLE WITH NUMBER
- RAILWAY LINE [3·00] AVERAGE THICKNESS IN METRES
- (2) EXPOSURE NUMBER
- 1·8M THICKNESS OF LIMESTONE IN WELL SECTION
- • 11·45 R.L

(BLOCK-III)

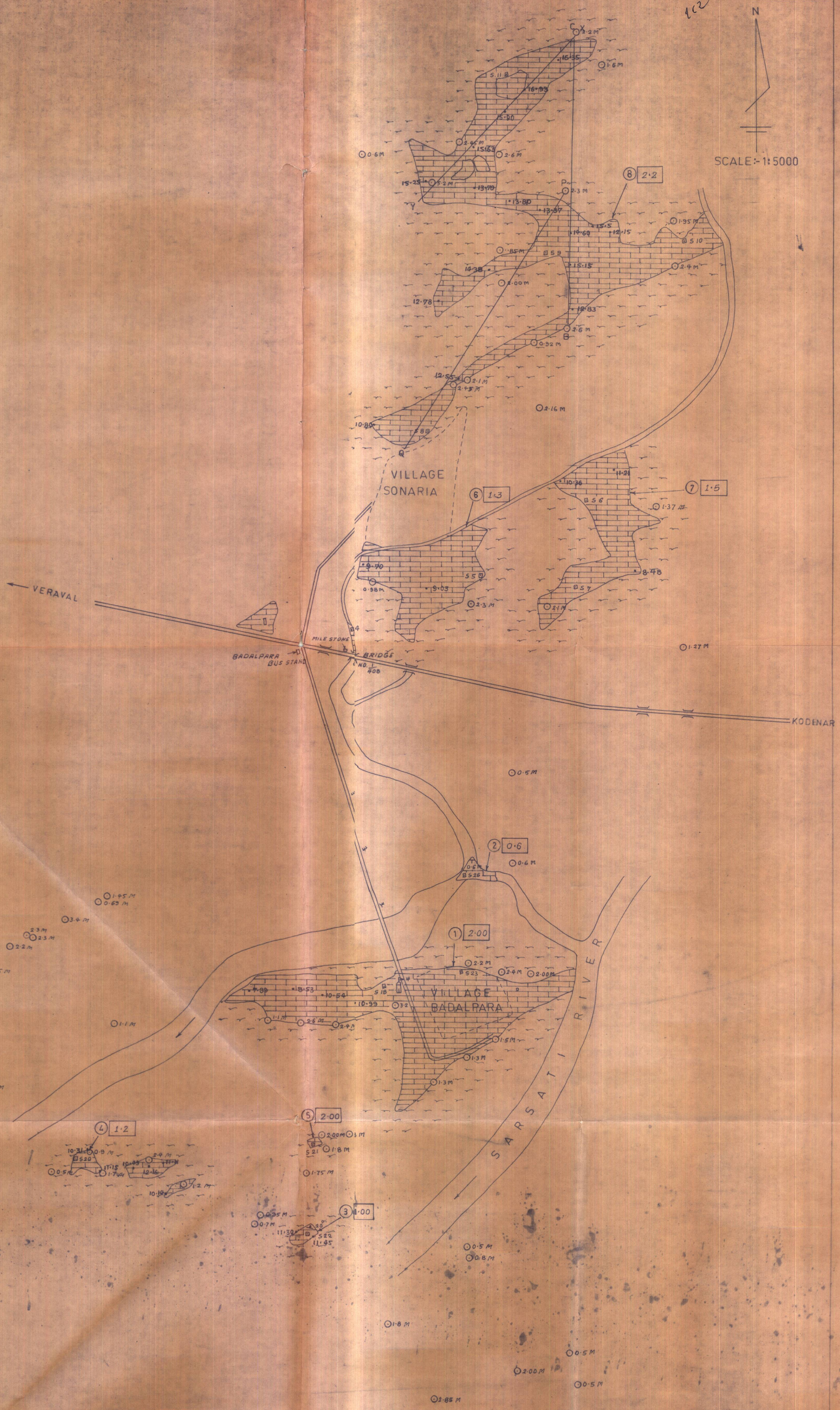
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| SURVEYED BY | M.A.PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG NO | B5 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 28-3-79 |
| TRACED BY | | GEOLOGICAL MAP OF THE SOUTH WEST OF MAHO-BATPARA AND SIDOKAR AREA TALUKA VERAVAL, DIST. JUNAGADH. VERAVAL LIMESTONE SCHEME 1976-77 | | |
| CHECKED BY | | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | SCALE: 1:5000 | |

PLATE NO. 5

112

N

SCALE :- 1:5000




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ALLUVIUM

MILIOLITIC LIMESTONE

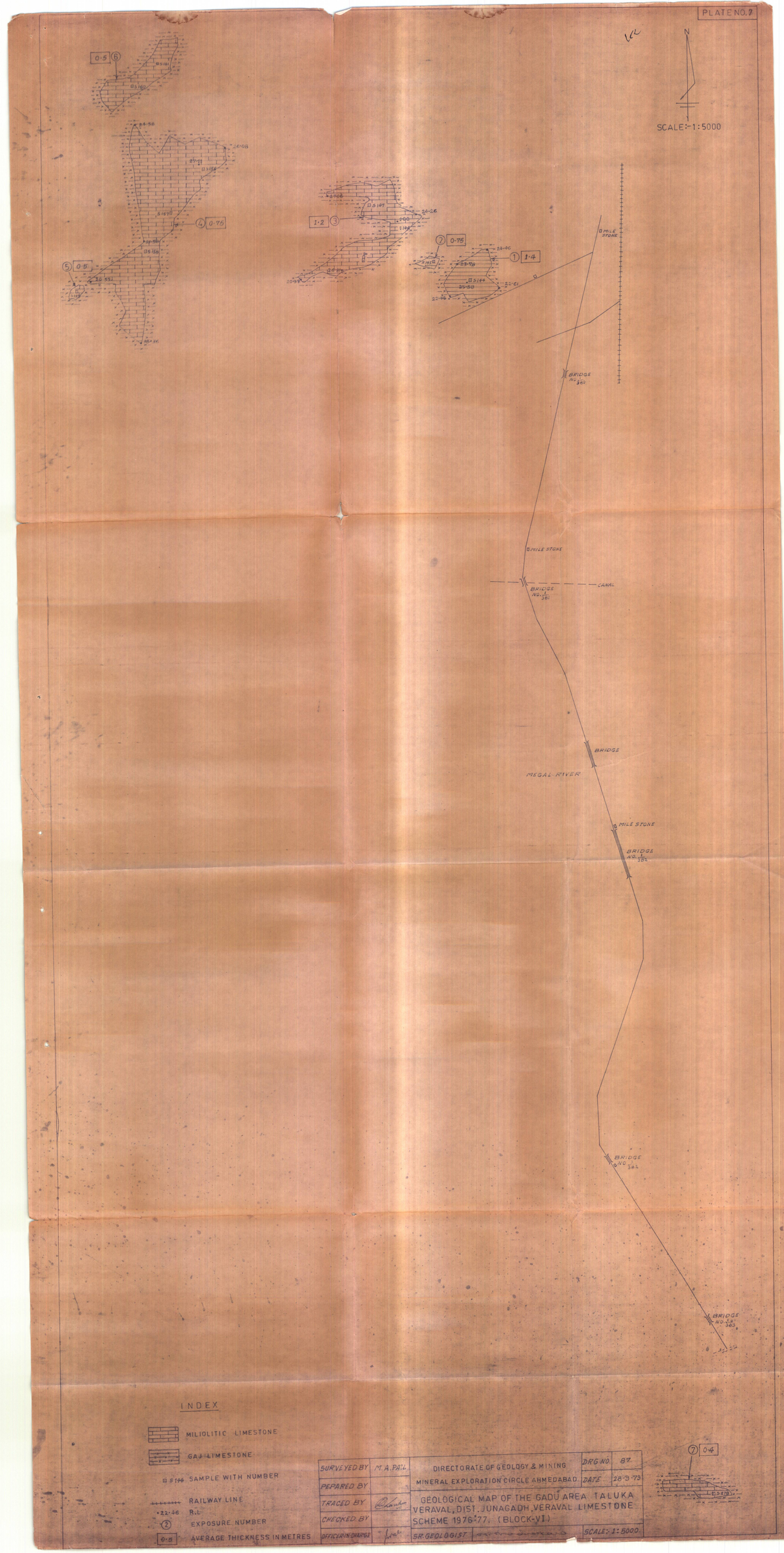
S 22 SAMPLE WITH NUMBER 11·45 R.L

② EXPOSURE NUMBER 2·00 AVERAGE THICKNESS IN METRE

2·00m THICKNESS OF LIMESTONE IN WELL SECTION

| | | | | |
|---|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG NO | 86 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 28-9-79 |
| TRACED BY | | GEOLOGICAL MAP OF THE BADALPARA AND SONARIA AREA TAL. VERAVAL, DIST. JUNAGADH, VERAVAL LIMESTONE SCHEME 1976-77. (BLOCK-IV) | | |
| CHECKED BY | | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | | SCALE :- 1:5000 |

PLATE NO. 7




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- MILIOLITIC LIMESTONE
- GADU LIMESTONE
- S 144 SAMPLE WITH NUMBER
- RAILWAY LINE
- 22·46 R.L
- (2) EXPOSURE NUMBER
- 0·5 AVERAGE THICKNESS IN METRES

| | | | |
|---|---|---|---|
| SURVEYED BY | M. A. PATIL | DIRECTORATE OF GEOLOGY & MINING | DRG NO. 87 |
| PEPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE 28·3·79 |
| TRACED BY | | GEOLOGICAL MAP OF THE GADU AREA TALUKA VERAVAL, DIST. JUNAGADH, VERAVAL LIMESTONE SCHEME 1976-77. (BLOCK-VI) | |
| CHECKED BY | | | |
| OFFICER IN CHARGE | | SR. GEOLOGIST | SCALE: 1:5000 |

PLATE NO.6

42

N

SCALE:-1:5000

MILE STONE

⑤ 2·00

S 312

S 306

S 307

S 308

S 309

S 310

S 311

0·5 ④

0·4 ③

0·4 ②

0·5 ①

LEASED AREA

AMBAJI TEMPLE

AREA OF HOLIDY CAMP

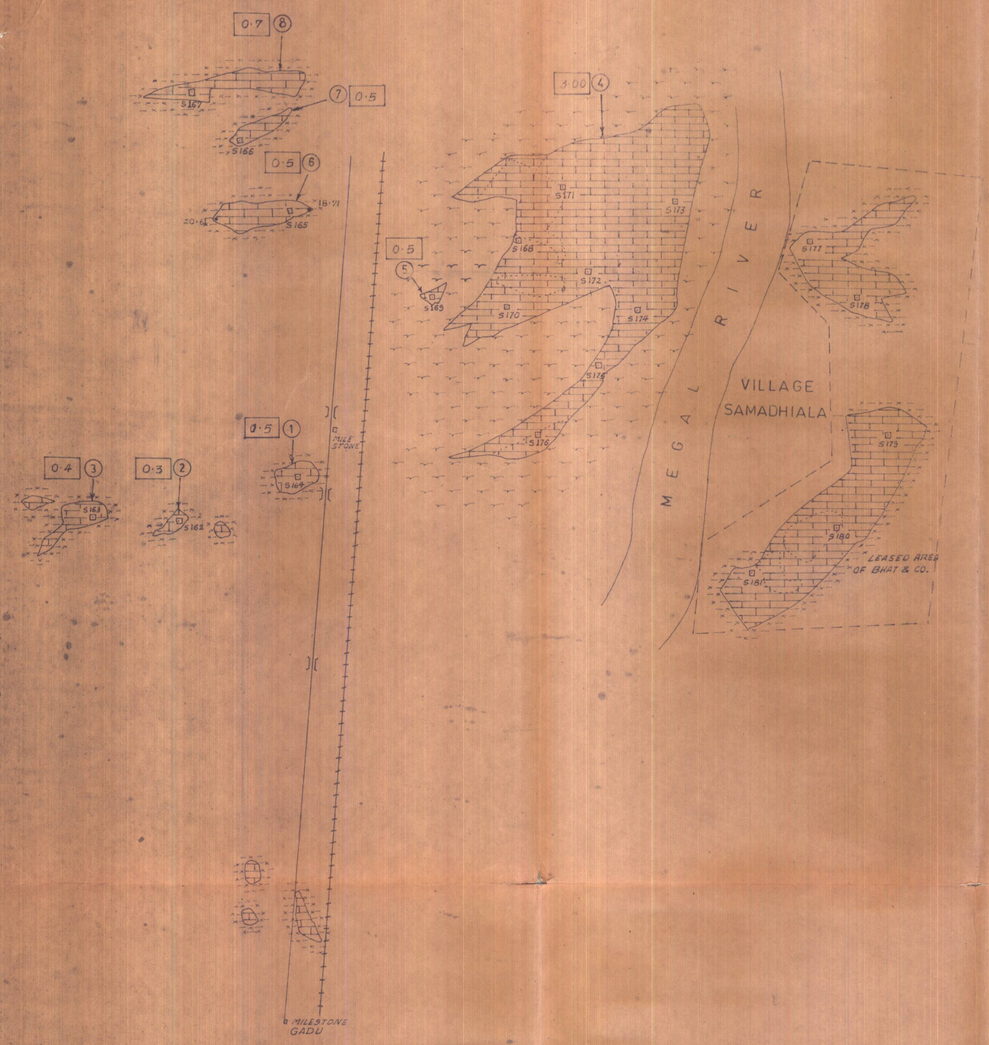
DANDESHWAR

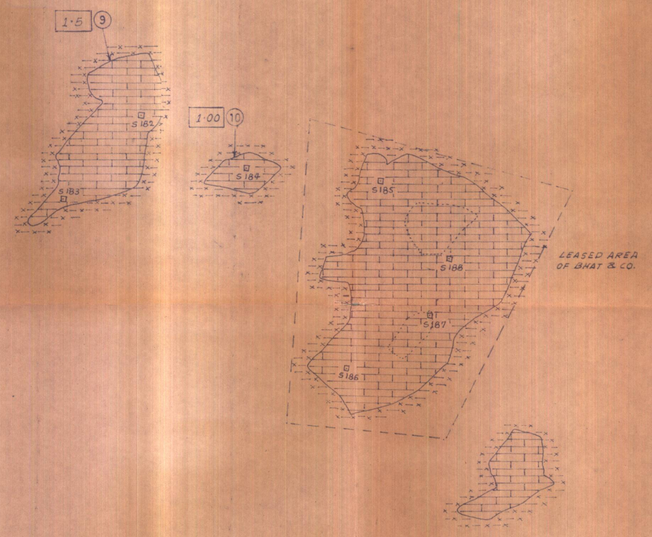
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- ALLUVIUM
- MILIOLITIC LIMESTONE
- DWARKA BEDS
- □ S 310 SAMPLE WITH NUMBER
- 0·5 AVERAGE THICKNESS IN METRES
- • 4·62 R.L
- ② EXPOSURE NUMBER

| | | | | |
|---|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG NO. | 88 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 28-9-79 |
| TRACED BY | | GEOLOGICAL MAP OF THE CHORWAD AREA TALUKA VERAVAL, DIST. JUNAGADH, VERAVAL LIMESTONE SCH-EME 1976-77. (BLOCK-V) | | |
| CHECKED BY | | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | | SCALE:-1:5000 |

PLATE NO.8



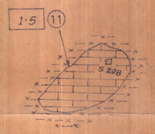


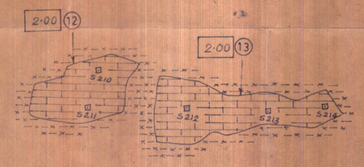


SCALE:- 1:5000

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- ALLUVIUM
- MILIOLITIC LIMESTONE
- GAJ LIMESTONE
- 1 SAMPLE WITH NUMBER
- RAILWAY LINE
- EXPOSURE NUMBER
- .5 AVERAGE THICKNESS IN METRES
- 1·71 R.L




| | | | | |
|---|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG NO | 88 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 28-9-79 |
| TRACED BY | | GEOLOGICAL MAP OF THE SAMADHIALA AREA TAL. VERAVAL DIST. JUNAGADH. VERAVAL LIMESTONE SCHEME 1976-77 (BLOCK-VII) | | |
| CHECKED BY | | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | SCALE:- 1:5000 | |

PLATE NO. 9

N

SCALE:-1:5000

S.99 · 23·34 · S.98 · 4·4 M · 22·84 · 4·3 M · S.101 · 18·54 · 17·7 · 3·8 · 20·64 · 4·6 M · 3 M · 3·0 M · S.32 · 6·4 M · ① 4·5 · 3·2 M. · 8·00 M · S.91 · 23·29 · S.95 · S.94 · 3·7 M · 2·4 M · S.93 · 3·3 M · S.90 · 24·50 · S.96 · S.105 · 4·1 M. · S.79 · S.78 · 3·7 M. · S.102 · S.104 · 3·9 M. · 19·41 · S.107 · 21·49 · S.73 · 20·27 · ④ 2·4 · 1·9 M · QUARRY · S.77 · S.80 · 14·56 · S.75 · 19·89 · 6.74 · ③ 2·00 · S.72 · 5 M · QUARRY · S.71 · 2·0( ⑤ · 2·1 M · 1·5 ⑥ · S.76 · ② 2·5 · S.88 · S.83 · 4·7 M. · 4·2 M

VILLAGE NAWADRA

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- ALLUVIUM
- MILIOLITIC LIMESTONE
- GAJ LIMESTONE
- □ S 76 — SAMPLE WITH NUMBER
- (2) — EXPOSURE NUMBER
- · 14·56 R.L
- O 2·3 M — THICKNESS OF LIMESTOE IN WELL SECTION
- 4·5 — AVERAGE THICKNESS IN METRES

| | | | | |
|---|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG NO. | 90 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 28-9-79 |
| TRACED BY | | GEOLOGICAL MAP OF THE NAWADRA AREA TALUKA VERAVAL, DIST. JUNAGADH. VERAVAL LIMESTONE SCHEME (BLOCK-VIII) 1976-77 | | |
| CHECKED BY | | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | SCALE:- 1:5000 | |

PLATE NO.10

N

SCALE :- 1:5000




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- MILIOLITIC LIMESTONE
- GUJ-LIMESTONE
- ⊡S 26 SAMPLE WITH NUMBER
- (2) EXPOSURE NUMBER
- 3·00 AVERAGE THICKNESS IN METRES
- • 20·13 R.L
- ⊙2·1M THICKNESS OF LIMESTONE IN WELL SECTION
- RAILWAY LINE

| | | | | |
|---|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG NO. | 91 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 28-9-79 |
| TRACED BY | | GEOLOGICAL MAP OF THE SAVANI AREA TALUKA VERAVAL, DIST. JUNAGADH. VERAVAL LIMESTONE SCHEME (BLOCK-IX) 1976-77 | | |
| CHECKED BY | | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | | SCALE:- 1:5000 |

PLATE NO.11

N

SCALE :- 1: 5000

1·00 (1) — 9·20, S 246, S 247, 9·35

1·2 (2) — 8·75, 9·45, S 245

1·3 (3) — 7·70, 7·30, 7·05, S 244

VILLAGE
VADODARA

1·5 (4) — 7·68, 0·9 M, S 243, 6·76, 1·5 M, S 242, 1·2 M, 1·00 M.

1·00 (5) — 8·09, S 201, 9·39, 9·51

1·8 (6) — 1·8 M, S 238, 7·15, S 237, 7·85, 2·00 M, 1·5 M, 1·2 M, 8·10, S 240, S 241, 6·36, 3·10, 0·8 M, 3·00 M, 1·8 M, 1·9 M, 8·87, S 239, 8·02, 1·00 M

1·2 (7) — S 203, 7·32, 9·47

8 1·00 — S 204, 8·15, S 205, 8·55

0·4 (9) — S 250, S 251

0·4 (11) — S 252

(10) 0·5

0·3 (12) — S 253

0·35 (13) — S 254

1·75 (14) — 8·08, S 247, 7·69, S 248, 8·56, S 249, 10·53, 7·98

0·4 (15) — S 255

1·1 (17) — MILE STONE ADRI 2 Km., 7·73, S 256, 6·48, 5·91, 6·46, S 258, 6·66, 6·21

0·8 (18)

7·10, S 239, 8·1, 7·81, 7·46

(16) 0·6

0·6 (19) — 7·30, S 260, 7·19

0·45 (20) — 7·91, 7·1, S 261, 8·11, 7·98, 8·08

0·6 (21) — 0·6 M, 7·96, 8·26, S 262, 8·06

0·4 (22) — 5·66, 5·91, S 263, 5·61

1·00 (23) — S 267

MILE STONE
ADRI 1 Km.

VILLAGE
ADARI

0·6 (24) — 8·20, 5·78, 11·13, S 265, S 266, 6·03, 7·98, 9·75, S 265, 8·53

(25) 1·5

1·5 (26) — 6·64, 10·34, S 269, S 268, 11·83, 6·09, 7·54

0·9 (27) — 6·12, 6·82, 5·80, S 270, 7·32

1·00 (28) — S 271, 8·41, S 272, 8·34, 7·06, 6·60, 7·58, 7·51, S 273, 8·41, S 274, 6·86, 6·78

(29) 0·8

0·6 (30) — S 274

0·7 (32) — S 275, 6·61, 6·46

0·6 (31) — S 277

ARABIAN SEA

INDEX

- ALLUVIUM
- MILIOLITIC LIMESTONE
- DWARKA BEDS
- ⊡ S 265 SAMPLE WITH NUMBER • 8·53 R.L
- (2) EXPOSURE NUMBER 1·5 AVERAGE THICKNESS IN METRES
- ○ 3·00 m THICKNESS OF LIMESTONE IN WELL SECTION

| | | | | |
|---|---|---|---|---|
| SURVEYED BY | M A PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG NO. | 92 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 28-9-79 |
| TRACED BY | | GEOLOGICAL MAP OF THE VADODARA AND ADARI AREA TAL. VERAVAL, DIST. JUNAGADH. VERAVAL LIMESTONE SCHEME 1976-77. (BLOCK-X) | | |
| CHECKED BY | | | | |
| OFFICER-IN-CHARGE | | SR GEOLOGIST | SCALE :- 1:5000 | |

R No. 182

PART OF TOPOSHEET NO 41 L/5 & L/1, K/4 & K/8.

PLATE NO. 1

R No - 182

DGM/ML/93-223

ML/07/1780

DGM/ML/06/1063

CGM/ML/June/06/870

R.NO: 182

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EXPOSURE OF MILIOLITIC LIMESTONE

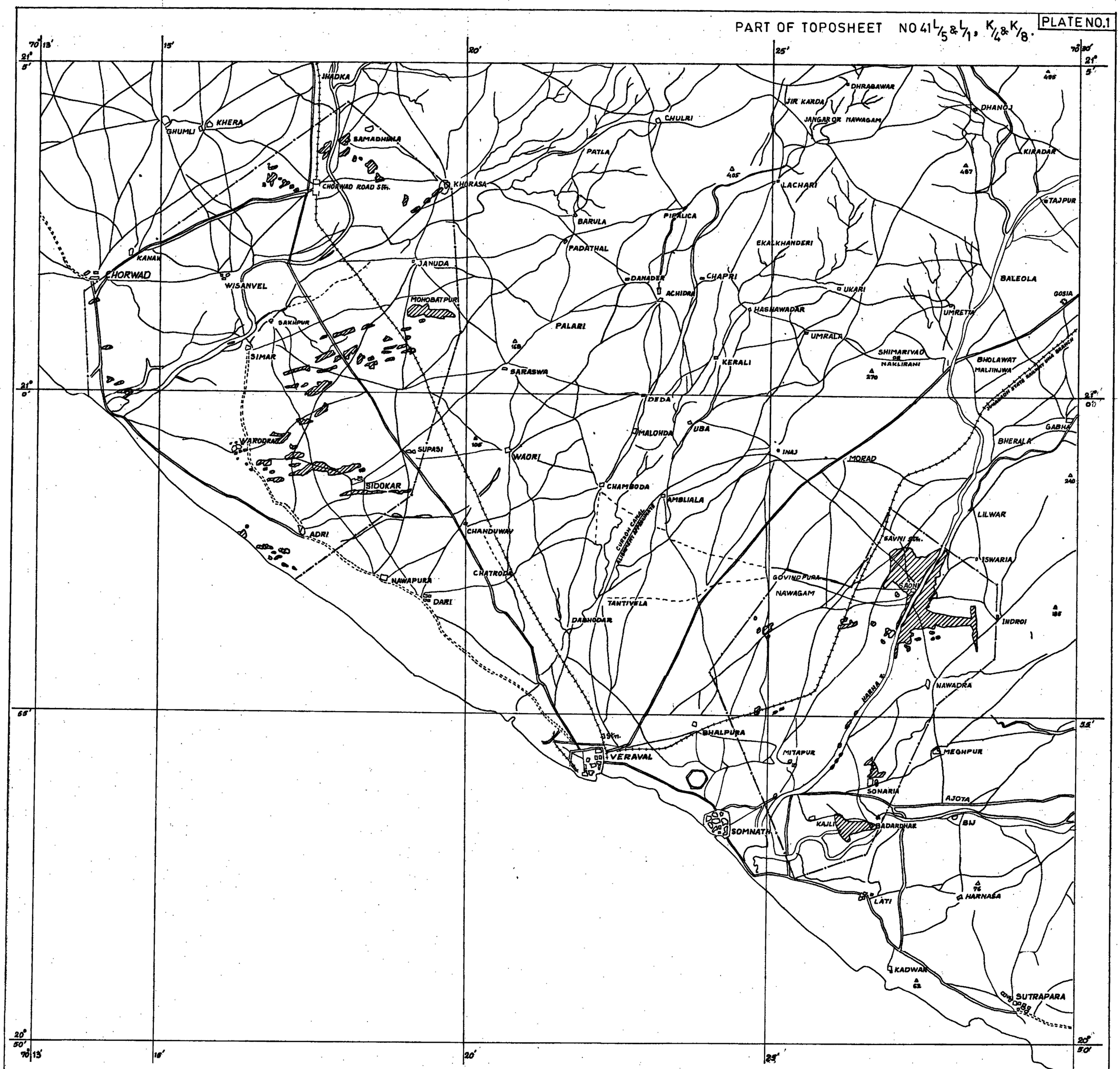
AREA COVERED DURING FIELD SEASON 1976-'77

| | | | | |
|---|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG. No. | 97 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 19-1-80 |
| TRACED BY | | LOCATION MAP AND AREA COVERED UNDER VERAVAL LIMESTONE SCHEME (1976-'77) | | |
| CHECKED BY | | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | SCALE:- 1" = 1 MILE | |

R.M. = 533.54 M22

PART OF TOPOSHEET NO 41 L/5 & L/1, K/4 & K/8.

PLATE NO.1




## INDEX

EXPOSURE OF MILIOLITIC LIMESTONE

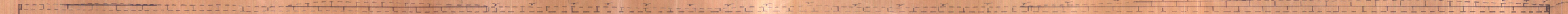
AREA COVERED DURING FIELD SEASON 1976-'77

M.E.C RAJKOT. DRG. NO. 354 DT 26-6-89

R No. 182(X)

| | | | | |
|---|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG. NR | 97 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 19-1-80 |
| TRACED BY | | LOCATION MAP AND AREA COVERED UNDER VERAVAL LIMESTONE SCHEME (1976-'77) | | |
| CHECKED BY | | | | |
| OFFICER-IN-CHARGE | | SR. GEOLOGIST | | SCALE:- 1" = 1 MILE |

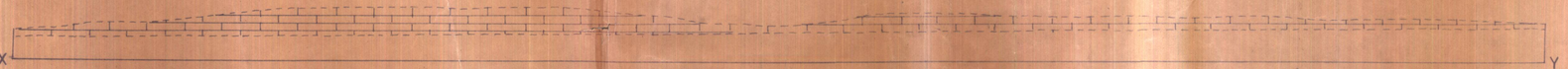
PLATE NO.12




SECTION Q-P




SECTION B-C




SECTION X-Y

INDEX

- ALLUVIUM
- MILLOLITIC LIMESTONE
- DWARKA \ GAJ BEDS

| | | | | |
|---|---|---|---|---|
| SURVEYED BY | M.A. PATEL | DIRECTORATE OF GEOLOGY & MINING | DRG NO. | 98 |
| PREPARED BY | | MINERAL EXPLORATION CIRCLE AHMEDABAD | DATE | 18-2-80 |
| TRACED BY | | GEOLOGICAL SECTIONS OF BADALPARA SONARIA BLOCK (PLATE NO.5) TAL. VERAVAL, DIST. JUNAGADH. VERAVAL LIMESTONE SCHEME 1976-77 | | |
| CHECKED BY | | | | |
| OFFICER IN CHARGE | | SR. GEOLOGIST | SCALE:- | 1:1000 |

R.N. 450

# GEOLOGICAL REPORT OF SOLITHERN PART OF SAURASHTRA COVERED UNDER TOPOSHEET NOS. 41 G/5, G/10+6, 41 K/4, G/15+11, 41 L/5+1. L/9+10 (BASED ON INTERPRETATION OF SATELLITE IMAGERY WITH LIMITED FIELD CHECKS)(FIELD SEASON 1995-96 AND 1996-97)


**By**

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**Y.C. PATEL, ASSTT. GEOLOGIST**

**(F.S. 1995-96)**

**AND**

**S.D. KAPSE, ASSTT. GEOLOGIST**

**(F.S. 1996-97)**



**OCTOBER 1997**

**COMMISSIONER OF GEOLOGY AND MINING**

**GOVERNMENT OF GUJARAT**

**GANDHINAGAR**

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**ABSTRACT**

During the field seasons 1995-96 part of the Junagadh and Jamnagar districts of Saurashtra were taken up for geological mapping on 1:50,000 scales covering an area about 2580 sq. kms. by using Remote Sensing Techniques. The geological maps were prepared using False Colour Composit (F.C.C) OF "LANDSAT" and "SPOT" Satellite data. This aurveyed area falls under the Survey of India topographical map Nos. 41 G/5, 41 G/10 + 6, 41 G/15+11, 41 K/4, small part of 41 K/3, 41 L/5+1 and L/9+10.

The study of imagery revealed that the major part of the surveyed area is covered with trap rocks and miliolitic limestone. The granophyre which is regarded as magmatically differentiated product of basic igneous rock is noticed north of Ranavav. The miliolitic limestone is found throughout all along the coastal tract from kodinar to Miyani exposed intermittently. The other important rock types are Gaj shale and limestone, Dwarka limestone. Weathering of trap rocks has resulted in formation of ferruginous clay and laterites which are found in abundance from North of Miyani to Bhogat. The chalk deposits are noticed near Ranavav.

The other interesting feature of this area is presence of mud flats which are observed within the dissected parts of the coast. These dissected portions act as conduits for the deposition of silt and clay. The silt and clay are deposited in the low lying areas where many small seasonal streams collectively deposit their load during monsoon such areas became liable to flooding and water logging.

Generally along creeks faults are noticed. The marginal shifting of coast are observed at many places such as Madhavpur, Muldwarka, Miyani, Veraval and Porbandar.

During field investigations six samples were collected for Petrographic identifications and were studied at the Petrographic laboratory at Gandhinagar.

Economic minerals in the area are limestone, chalk, coterie, Granophyre & Trap.

## INTRODUCTION

The Department has taken up Saurashtra coast for geological mapping using Remote Sensing Techniques since 1989. The coast from Chara to Bhogat has been mapped during the F.S. 1995-96 and 1996-97. These areas form the part of Junagadh and Jamnagar districts, which falls under Survey of India Toposheet Nos. 41 G/5, 41 G/10+6, 41 G/15+11, 41 K/4, small part of 41 K/3, 41 L/5+1 and L/9+10.

The geology of the area was interpreted with the help of Remote Sensing Techniques using "SPOT" and "LANDSAT" Satellite imagery and thus pre-field maps were prepared at the laboratory. To check accuracy of interpretation field checks were carried out. The necessary corrections were made based on field observations. By incorporating the field details, the maps were finalized. In all 2580 sq. kms. area was covered under geological mapping.

## METHODOLOGY

The base maps were prepared by tracing the details like roads, nallas, villages from topographical maps of Survey of India. These maps were overlain on the False Colour Composit (F.C.C.) of Satellite Imagery and by using Remote Sensing Techniques the lithological boundaries of different litho units and other features were demarcated on the maps. Thus prefield maps were prepared and taken in the field for verification. Based on the field observations and evidences necessary corrections were incorporated and final geological maps were prepared.

## LOCATION AND ACCESSIBILITY

The surveyed area form the Southern and South Western part of Saurashtra and fall in the districts of Junagadh and Jamnagar which are well connected by rail and road. The state coastal highway is passing through these districts. The Taluka places are also well connected

tract important ports such as Kodinar, Chorwad, Madhavpur, Veraval and Porbandar etc. are Present Porbandar and Keshod are important airports which fall under surveyed area.

## PHYSIOGRAPHY

The area in general is flat to undulating. At places, mounds of trap and miliolitic dunes are seen. The area north of Porbandar exhibits rugged topography where hills attaining an elevation of 200 mts. are noticed.

The main rivers flowing through this area are Main, Raval, Machundri, Singoda, Meghal, Madhumati, Bhadar, Orat etc. Since central part of the Saurashtra peninsula forms upland many of these rivers originate in this region and flow radually and most the Arabian Sea. The streams and nallas are ephemeral in nature.

The area experiences hot tropical climate. During summer, i.e. from April to June the climates are very hot and uncomfortable, but nights are pleasant because of cool breeze from sea. The temperature rises up to 42°C during summer whereas in winter it is usually around 12°C. The average rainfall of the area is around 60 cm.

## VEGETATION

The coastal area of Saurashtra is well cultivated. The black cotton soil of trap is very fertile and case crops like cotton are seen along the coast from Chorwad to Madhavpur. The hills in general are barren as at many places the trees are cut.

## PREVIOUS WORK

In this area, the geological investigation has been carried out since last one century. Fedden (1884) gave a generalized account of the regional geology of the Kathiawar Peninsula with some details of unusual rock type like Felsite, diorite, rhyolite, Trachyte and

pitchstone etc. He regarded these extraordinary association of flow and dykes features to have resulted on account of great fissure eruptions.

The officers of Oil and Natural Gas Commission (ONGC) have carried out geological mapping of Saurashtra during 1957-64 with the emphasis on part of coastal tract of Saurashtra, where sedimentary rocks are exposed and hold prospects of containing oil and gas. Shri P.K. Shrivastava of ONGC compiled the information and worked out the stratigraphy of Saurashtra.

Number of workers from Geological Survey of India (GSI) carried out systematic geological mapping along the coast of Saurashtra. Besides preparing geological maps they worked out stratigraphic sequence and structural framework of this region. They also made detailed Petrographic studies based on which they deduced the nature of the eruption and its chronology. Recently, Commissioner of Geology and Mining (CGM) has also initiated systematic geological mapping of the coast to prepare comprehensive maps by using Remote Sensing Techniques. The mapping has brought about the stratigraphic sequence of Saurashtra area besides establishing chronology of basic igneous activity in the region.

## GEOLOGY

Mapping in the parts of coastal Saurashtra from Chara to Bhogat revealed that the Deccan Trap suite of rocks are the dominant and oldest rock unit exposed in the area. The post trappen Tertiary rocks occupying the margin of the trap rocks are noticed along the coast. The younger miliolitic limestones occur as continuous strip overlying Tertaries and traps. The exposures of miliolitic limestone are observed along the coast.

The general stratigraphic sequence as observed in the field is as follows.

Alluvium/ coastal sand/ Mud/ Salt waste Recent to Sub-recent

---------- Unconformity ----------

| | |
|---|---|
| Miliolitic limestone | Pleistocene |
| ---------- Unconformity ---------- | |
| Dwarka limestone | Pliocene to upper Miocene |
| ---------- Unconformity ---------- | |
| Gaj limestone/ shale | Lower Miocane |
| ---------- Unconformity ---------- | |
| Laterite | Palaeocene |
| Basalt/ Granite (Granophyre) | Lower Eocene to Upper Cretaceous |

**Basalt**

Basalt commonly known as Deccan Trap is the oldest rock type noticed in the area. This rock is the most prominantly exposed noticed in the area. This rock is the most prominantly exposed rock type in Saurashtra region covering almost its length and width.

The fine grained basaltic rocks which is seen extensively from Devalia to further NE of paneli, Suryavada area is of the black colour, hard and compact in nature. This rock is fresh and has a thin brown coloured weathering surface. The vesicular fillings are rare in this type of basalt. At few place the basalt is amygdaloidal type.

The trap which is exposed around Tukada - Miyani and its north is highly weathered which at many place changes to laterite. The laterite is reddish, brownish and brick red in colour, sometime it occurs as mound, comprising 3 to 4 meter. thickness. Number of old working for laterite is noticed in this area. The trap rocks are also seen to occur north of Prachi.

On Satellite Imagery grayish - blue tone and fine texture associated with basalt are typically observe. Further, dendritic drainage which is characteristic drainage pattern of basaltic area is also noticed in this region.

## Granite (Granophyre)

The Barda hills 15 km north east of Porbandar essentially expose granophyre. Besides this, felsites and quartz felsites are reported by previous works. It is regarded that differentiation of original basaltic magma has given rise to a vide variety of rock types which are associated with these messes. These felsitic rocks are ash grey to pink colour, medium to coarse grained. Innumerable joints are present in these rocks. These joints are trending in NE-SE and NW-SE directions dipping in SE or NW at high angle or vertical. Along the joints leaching of iron is seen and this has imparted pink and red colour along the joints. In hand specimen feldspar, quartz and pyroxene can be identified. On Satellite imagery it is characterized by yellowish reddish tone and medium texture.

## Laterite

Between Deccan Trap and overlying Gaj beds variegated hard laterite rocks are seen occurring in narrow zone. The sporadic exposures of laterite are seen SW of Palkhada, SW of Hathiani and in Visavadar villages. The high ground near Vadal comprises laterite. ON laterite sometime thin capping of dirty yellow coloured limestone is observed. On the imagery it shows either as greenish or brownish toned feature. From Harshadmata temple towards Lambha NNW-SSE trending linear hillocks also expose laterite. The laterite is also observed at Ashpura Talav and Asphapura Mandir. Here laterite is forming linear mounds and in the saddle portion Dwarka limestone is occuring. The thin laterite cover which is exposed around Babada is extending up to Bhakharla. It is spread over the agricultural fields having about 1 mt. thickness. Laterite rocks by virtue of their resistance to weathering and rich hues of red, brown, yellow stand out prominantly often forming colourful ridges.

## Shales of Gaj Series

The shales and limestone forming this series are occurring along the southern and south-western margin of the Trap/Laterite. The Gaj rocks are resting unconformably over the trap rocks. They are deep yellow to dirty yellow in colour and highly fossiliferous. The

fossils of gastropods and Pelecypods are common. The Gaj limestone/ shale is seen exposed west of Bhetali through kodidra, Padwa, Mantore, Mantore, Bhedala north of Morej, Inej, Umba, Malondha etc Villages. Here width of gastropods and Pelecypods are common. The Gaj limestone/shale is seen exposed west of Bhetali through kodidra, Padwa, Mantore, Bhedala north of Morej, Inej, Umba, Malondha etc. villages. Here width of limestone is varying 2 to 3 km. The terrain exposing the Gaj limestone is monotonously flat, unlike that of rugged topography of miliolitic limestone. The Gaj shales are exposed north east of Bhogat roughly 2 km. Their continuity below the soil cover can be traced. The exposures of these rocks are seen up - to Navagam. The hillocks SE of Navagam are composed of Gaj shales, they are noticed up to Satapar.

**Dwarka Limestone**

The Dwarka rocks are exposed near Baroda Sagar dam. This limestone is of dirty yellow colour and highly fossiliferous. Due to weathering it has become boundary.

The Dwarks rocks are also exposed north west of Miyani, around are Asapura Talav and Ashpura Mandir. Here NNE-SSW trading hills are comprising Dwarka limestone and are forming capping over trap rocks. On the imagery it appears as light yellow to white coloured feature. Since its extent is meager, it is difficult to pick up on the imagery; therefore it is marked based on the field traverses.

**Milliolitic limestone**

The Milliolitic limestone overlies unconformably fossiliferous tertiary rocks and at places it is directly resting over trap. This rock is essentially composed of fossil milliolina (foraminifera) and cemented by calcareous metric. The colour of the rock varies from light buff grey when freshly broken; some time is pinkish or brownish in colour. The brownish tint is due to leaching of iron. The outcrops of miliolitic limestone are highly pitted and porous due to chemical weathering induced by circulating water.

The miliolitic limestone is exposed intermittently throughout the coast (plate No.2) i.e from Sutrapada in south east to Meghal river in the North west.

Number of small dune shaped exposures is seen in plenty spreaded over agricultural fields. The NE-SW trending dunes can be observed 7 to 8 KM. away from coast. Near Adri, sand dunes are observed over the miliolitic limestone. This limestone gives reddish tint due to leaching of iron.

Near Vadodara, in quarry section 4 Mts. thick Milliolitic limestone exposure is observed. The maximum thickness of limestone in Hiran river section near Savani village is about 13 mts. Here the limestone generally occupies valley portion and also along the river bank. The limestone which occurs as crescent shaped dune generally does not have much depth extension and its depth varies from 2 mt to 4 mt. below the ground. The thickness of limestone as observed in the well section around Ajak and Karej (Plate No. 3) is around 15 Mts. Further north from Nagichana the thickness of limestone decreases as observed in the well sections. The limestone is exposed throughout the coastal track of this sheet. The coast, except at Shil village is rocky showing cliff. But at Shil, the coast is sandy. After Mul Madhavpur ( plate No.4) width of limestone band starts decreasing. In this area few out-crop are observed near kadhach and north of kodhach. Most of the northern part of kadhach is liable to flood hence showing thick pile of alluvium cover except at Sharma village where buff grey coloured fossiliferous weathered shale is observed. At Mocha, near Hanuman temple in the well section of Mollusca. Further west of Navibandar, the thickness of limestone observed in well section is about 8 mts.

Around Sirderali and Kantela villages (Plate No.1) soil cover is seen over the miliolitic limestone. The limestone is seen exposed sporadically from kantela to Sungetha, Vithalpur, Jamalpur, Mahabatpar, Khambha and Anida villages. Here thickness of the limestone is meargre as in the road cutting exposures of trap are seen. The stony waste as seen on the toposheet between Bhetali and Rampara are of miliolitic limestone. The road from Khengeri to Bhetali appears to be the boundary between Bhetali and Rampara are of miliolitic limestone. The road from Khengeri to Bhetali appears to be the boundary between

miliolitic limestone and trap. The village Bhetali is on trap. To the south and south west of Bhetali isolated mounds of miliolitic limestone are observed. These mounds attain high up to 2 to 2.5 mts. below this miliolitic, brown coloured unconsolidated calcareous and ferruginous clay material is seen. The saddle portions between these mounds are devoid of miliolitic limestone.

From Harshadmata to Virpur (Gangari) the isolated pocket of miliolitic limestone is seen (plate No.6). This limestone is of buff white colour and surrounded by laterite. On Satellite imagery the Milliolitic limestone exposures appears as whitish, bluish, brownish and even yellowish toned features with smooth texture. At places typical banding nature formed on account of sedimentation of miliolitic limestone could be observed on imagery between Veraval and Porbandar. At places, miliolitic limestone forming mounds could be seen. These mounds are formed as a result of deposition of miliolitic limestone sand on account of SW blowing winds. Thus these mound are Aeolian in origin. The characteristic parabolic and linear shaped dunes are observed on the imagery in support of this view.

In the Porbandar area (Plate No.5), the miliolitic limestone is seen around Pendavada, kantela, Degam, Rinawada, Simani, Lavadia, Bhakharla, Boricha, Dobalia talav, Kajavadari, Digvijaygad villages etc. and also all along the foot hills of Barda from Adityana to Ranavav. Here limestone is pinkish to cream in colour. Some times, it is buff colour. At Places, it is siliceous. It is thinly bedded forming almost horizontal bedded deposit. Numbers of working quarries are observed in this area. The thickness of limestone at Pandavada, Degam and Rinavada is about 4mt. but at the foot hills of Barda, near Adityana it is about 30 mts.

The Milliolitic limestone is seen continuous all along the Porbandar coast ie. from Bosa in south west up to Miyani in the north west. The coast of Porbandar is rocky. The limestone from Porbandar to Gosa is a long narrow strip which extends northwardly up to the muddy areas. In this lying muddy area thick alluvial cover is noticed and no outcrops are visible. The limestone (from Porbandar to Gosa) is mostly sandy and cemented by calcareous matrix forming ridges attain 3 to 5 mts. height.

## STRUCTURE

In-genteral, the surveyed area is plain to undulating terrain and most of horizontal to gently dipping towards sea and do not possess much structural capacity. Few faults are marked based on the interpretation of Satellite imagery. These faults are trending ENE - WSW direction. They are easily identified on imagery because of straight alignment of rivers and shifting/ displacement of coast.

It is also observed that Saurashtra coast is almost straight and at few places it shows zigzag configuration which may be attributed to faulting. As these places form depression, in which mud is deposited. Hence mud flats are seen. The occurrences of these faults along southern coast where Milliolite limestone is exposed indicating prevalence of neo tectonic activity during pleistoane period.

## ECONOMIC MINERALS

### Limestone

The area under survey contains inexhaustible reserves of chemical and cement grade limestone. This limestone contains 85% to 92% of CaCO3. This limestone is seen throughout the southern coastal tract of Saurashtra mainly at Madhavpur, Varaval Porbandar areas etc. This limestone at places attains 3 to 12 mts. thickness and near foot hills of Barda it is 30 mts. thick. But, at places it forms cover or capping having upto 1 mt. thickness. The limestone from thin cover or capping having up to 1 mt. thickness. The limestone from these areas is supplied to M/s. Saurashtra Chemicals, M/s. siddhi Cement, M/s. Tata Chemicals. This limestone is also used in making lime and for dimensional stones in construction of building. Due to its soft nature, it can be cut into required size along the bedding planes.

At places, this limestone forms dune like structure spreaded over the agricultural fields.

## Chalk

The chalk deposits are located around Adityana and Ranavav area near Porbandar. The chalk in Adityana occurs at shallow depth, i.e about one meter to 4 mts. It is quarried by open cast method. Many navigation units are located around Adityana and Ranavav. This chalk contains pebbles of cherty limestone and minute silica particles.

## Laterite

The laterite deposits are seen to occur north of Miyani and around Virpur. It occurs in the form of outlier from Lambha to Bhogat and can be seen up to Jodhapur village in the north. It is also seen north of Babada up to Bhakharla in agricultural fields. Here thickness of laterite is 1 to 3 it. This laterite is used as additive in cement manufacturing industries.

## Granophyre

It is used as construction material for construction of building and road.

## Trap

The trap rocks area used as metal in construction of roads and also used in other constructions.

## CONCLISION AND RECOMMENDATIONS

The Satellite imagery of the area is found extremely useful (i) for delineating geological boundaries of different litho units (ii) It is useful in delineating linear structures like faults/lineaments etc., as it provides synoptic view.

The study of the surveyed area revealed that limestone of Gaj and Dwarka formations are continuing to occur in adjacent sheets along-with laterite patches. So it is recommended to cover these areas under Pre-detailed survey.

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|---|---|---|---|
| 1 | Banerjee A.C | 1988 | Report on systematic geological mapping in parts of T.S.No. 41 J/6 and 41 J/7 in Jamnagar district of Gujarat, January 1988.(Unpublished report of G.S.I) |
| 2 | Mukhopadhyay | 1986 | Report on geological mapping in part of T.S. No. 41 F/8, 41 G/5, 41 G/9 and G/13 Jamnagar and Junagadh district.(Unpublished report of GSI) |
| 3 | Patols B.P. | 1974-75 | Report on the occurrences of chalk around Adityan and Boricha, Ranavav talukas of Junagadh district. (Unpublished report of DGM). |
| 4 | Pathole B.P | 1989-90 1990-91 | Geological report of south eastern Part of Saurashtra. (Unpublished report of DGM). |
| 5 | Shah N.V | 1966-67 | Report on prospecting on bauxite deposits in some of the villages of Jamnagar district. (Unpublished report of DGM). |
| 6 | Rao U.D.G | 1966-67 | Report on limestone deposits in eastern part of Veraval Taluka.(Unpublished report of DGM) |
| 7 | Shrivastav P.K. | 1963 | Geology of Saurashtra. (Unpublished report of ONGC). |

## LIST OF LOCALITY

| VILLAGE | LATITUDE | LONGITUDE |
|---|---|---|
| 1. Adityana | 21° 42' 45" | 69° 41' 30" |
| 2. Digvijaygadh | 21° 40' 30" | 69° 42' 30" |
| 3. Kodinar | 20° 47' 30" | 70° 42' 10" |
| 4. Mangrol | 21° 07' 20" | 70° 06' 50" |
| 5. Miyani | 21° 50' 20" | 69° 23' 00" |
| 6. Navibandar | 21° 27' 00" | 69° 47' 36" |
| 7. Paneli | 21° 53' 30" | 69° 26' 30" |
| 8. Porbandar | 21° 38' 28" | 69° 36' 00" |
| 9. Pranchi | 21° 35' 00" | 70° 36' 30" |
| 10. Ranavav | 21° 40' 57" | 69° 44' 45" |
| 11. Savani | 21° 57' 05" | 70° 27' 20" |
| 12. Veraval | 21° 54' 18" | 70° 00' 00" |
| 13. Visavadar | 21° 20' 30" | 70° 45' 00" |
| 14. Virpur | 21° 53' 30" | 69° 21' 30" |

**PLATES**

**Plate No.** **Description**

1. Geological map of part of Junagadh and Amrali districts covered under T.S. No. 41 L/9 +10

2. Geological map of part of Junagadh district covered under T.S. No. 41 L/5 + 1.

3. Geological map of part of Junagadh district covered under T.S.No. 41 K/4 and 41 G/16

4. Geological map of part of Junagadh district covered under T.S. No. 41 G/15 + 11.

5. Geological map of part of Junagadh district covered under T.S. No. 41 G/10 +6

6. Geological map of part of Junagadh and Jamnagar districts covered under T.S. No 41 G/5 +1.

| **Sample No** | **Petrographic Results** | | **Rock/ Mineral identification** |
|---|---|---|---|
| | **Megascopic study** | **Microscopic study** | |
| 1. | The rock is black in colour. It is fine to medium grained, crystalline granular, hard, massive and compact. At some place black to greenish black, medium sized | The thin section shows ophitic to sub ophitic to sub ophitic texture where the difference in sizes of feldspar (labradorite) and pyroxene (augite) + olivine is quite remarkable. It is mainly | Olivine dolerite |

| | | | |
|---|---|---|---|
| | minerals are observed, the cleaved surface of which are giving vitreous luster. Majority of the grains, as observed are fine in size with vitreous luster at cleaved surface. At some places, a few fine to medium sized grains of pale olive green colour are also noticed, where cleavages are not present. Looking to the colour and Megascopic studies, it is presumed that the rock is basic in nature and intrusive (hypabyssal) in character. | composed of labradorite and augite where labradorite is modality than augite. Olivine is also present in remarkable modality of approximately 15% Opaque present in the form of streaks with modality of almost 2% to 3% have generally occupied the interstitial spaces. | |
| 2. | The rock is light coloured and bended in nature and bended in nature. It is fine grained and porous. Minute pores are observed throughout the sample surface. Coloured bands are almost 1 C.M. in thickness. The rock is compact, massive and considerably hard. It gives perfuse off when treated with dilute Hcl. Also it can be easily scratched by a pen knife. | Thin section shows fine grained equigranular clastic texture. Clasts are sub rounded to rounded. Cementing matrix is very fine grained and almost wholly constituted of carbonates (calcite) and partially by clayey matter. Clasts are also carbonate (calcite). At a few places clasts of free quartz, feldspars and ferruginous matter are also observed in negligible proportion. | Carbonate rock (Lime stone). |

| | | | |
|---|---|---|---|
| 3. | The rock is golden yellow in colour, fine grained, hard, massive and compact with a few minute fossils. At places, fine to medium size calcite grains are observed in the mass. Fine sized black spots are present in the whole mass. It gives perfuse off when treated with dilute Hcl. Solution Cavities are present in the rock. | Thin section shows very fine grained non clastic texture composed almost entirely of carbonate (calcite) material. A few fossil fragments are also observed in thin section. Opaque are neglible modality. | Carbonate rock (Lime stone) |
| 4. | The rock is fine grained light (pinkish white) in colour with numerous minute fossils. The other portion of the rock is conglomeratic types conglomeratic types consisting of rounded pebbles of ferruginous material, mega fossils and other rock fragments. Fossils and other rock fragments. Fossils are observed in one part i.e. in the younger part are settled along the bedding planes.<br>Both the portions give perfuse off. When treated with dilute Hcl and both the | The thin sections shows bio-clastic texture mainly composed of carbonate (calcite), and fossil fragments. Negligible proportion of feldspar, quartz and ferruginous matter is present in the rock. | Fossiliferous (lime stone) |

| | | | |
|---|---|---|---|
| | partings are hard massive and compact. | | |
| 5. | The rock is fine grained fossiliferous and pinkish in colour. It is hard massive and compact. It gives perfuse of when treated with dilute Hcl. | Thin section shows fine grained bio-clastic texture mainly composed of fine grained carbonate (calcite) and some fossils. Accessory minerals are quartz, feldspar and ferruginous matter Cementing matrix is mainly of carbonate (calcite). Clasts are fine in size. | Fossiliferous lime stone) |
| 6. | Polishing Report Sample is medium grained and the polished surface is black in colour. Polished surface is in spotted form (colors). Spotted colors are get-black, black and light black, uniformly scattered throughout the polished face. Jet black spots are nearly 15% in abundance and rest two colors are almost in equal proportion, but the general colour of the polished face is black. A few fine streaks of opaque are also observed, equally distributed throughout the polished face. Also a few blackish white colored spots find to medium size are observed on the polished face, which are randomly scattered. On the whole the sample has received a good polish but light black coloured spots are some what pitted in appearance. | | Dolerite. |

PLATE NO-1

# GEOLOGICAL MAP OF PARTS OF AMRELI DISTRICT COVERED UNDER T.S. NO. 41 L/9+10

## (Based on the Interpretation of IRS and Landsat Satellite imagery with Selective field checks)

## Field Season 1995-96

N

SCALE 1:50000

70° 30' | 35' | 40' | 70° 45' | 21° 0'

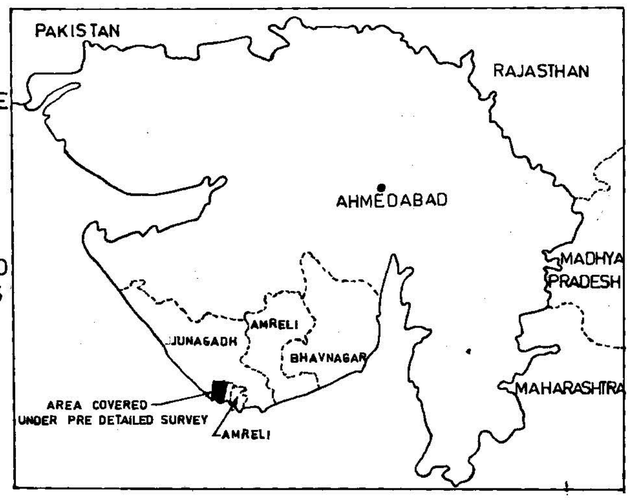
20° 45' | 70° 30' | 35' | 20° 42' 30" | 70° 40' | 70° 45'

GUNVANTPUR
KODIDARA
LUMBHA
ANIDA
JAWANTINES
BHETALI
KHANDHERI
VALADAR
KANKASA
PIKHOR
RAGPUR
PIPALWA
BHUVAWADA
SOMAT NADI
KATELA
GANGETHA
GIRDEVALI
SARASWATI RIVER
SORA
UMBRI
CHOGIYA
SIDDHI CEMENT
ANANDPUR
SINDHEJ
MORASA
MORDIYAR
NAWAGAM
PEDHWADA
W.RAILWAY TO KODINAR
VAWARI
DEWALPUR
VADNAGAR
PASNAWADA
MOTANA
VADODARA
SINGSAR
DUNDANA
RAKHEJ
KODINAR
SOMAT
DHAMLEJ
BARDA
SINGWADA RIVER
DEWALI
KADODARA
DAMLI
PANADAR
PIPLI
CHHARA
MUD
F
ARABIAN SEA

### LEGEND

- ALLUVIUM/SAND/MUD ---------- RECENT
- MILIOLITIC LIMESTONE/AGRICULTURE ON MILIOLITIC LIMESTONE } PLEISTOCENE
- GAJ LIMESTONE & SHALE/AGRICULTURE ON MILIOLITIC LIMESTONE } L. MIOCENE
- TRAP } L.EOCENE TO U.CRETACEOUS
- FORMATION BOUNDARY
- FAULTS
- WATERBODY
- OUT CROP BOUNDARY

### KEY MAP




| | | | |
|---|---|---|---|
| PREPARED BY | | COMMISSIONER OF GEOLOGY & MINING GOVT. OF GUJARAT | DRG. NO. 4140 |
| TRACED BY | | | DATE 17-10-97 |
| CHECKED BY | | | |
| SR. GEOLOGIST | | | |

Report No - 450 (1)

PLATE NO-6

# GEOLOGICAL MAP OF PARTS OF JUNAGADH AND JAMNAGAR DISTRICT COVERED UNDER T.S.NO.-41G/5+1

(Based on the Interpretatation of IRS and Landsat Satellite imagery with Selective field checks)

Field Season 1996-97

N

SCALE:-1:50,000

69° 10' 22° 0'

69° 15'

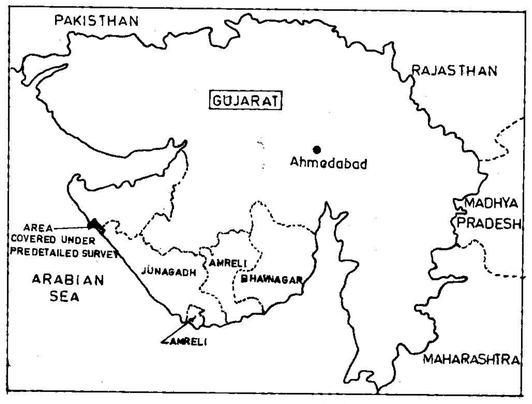
69° 30' 22° 0'

BHOGA
MALETA
PANDI
SATAPAR
SURYADA
NAVADRA
DEVLIA
SANOSRI
ACHLANA
RAVAL
LAMBA
VIRPUR
KAMAN NADI
CHANDRAWADA
GANDHAVI
MIYANI
VADALA
HATHIANI
RABANIWAD
PALKHADA
ARABIAN SEA
MUD
F

## LEGEND

- SAND/MUD ---------- RECENT
- MILIOLITIC LIMESTONE / AGRICULTURE ON MILIOLITIC LIMESTONE } PLEISTOCENE
- DWARKA LIMESTONE ---------- PLIOCENE TO U.MIOCENE
- GAJ SHALE LIMESTONE / AGRICULTURE ON SHALE & LIMESTONE } L MIOCENE
- LATERITE ---------- PALEOCENE
- TRAP ---------- L.EOCENE TO U.CRETACEOUS
- FORMATION BOUNDARY
- FAULT
- WATERBODY

KEYMAP




21° 45' 69° 10'

21° 45' 69° 30'

| | | | |
|---|---|---|---|
| PREPARED BY | | COMMISSIONER OF GEOLOGY & MINING GOVT. OF GUJARAT | DRG.NO 4141 |
| TRACED BY | | | DATE 24-11-97 |
| CHECKED BY | | | |
| SR. GEOLOGIST | | Report No - 450 (4) | |

PLATE NO. 4

# GEOLOGICAL MAP OF PART OF JUNAGADH DISTRICT COVERED UNDER TOPOSHEETS NO. 41G/15+11

## (Based on Interpretation of Landsat Satellite Imagery With Selective Field Checks)

## Field Season 1995-96

SCALE:- 1 : 50 000

N

69° 44' 21° 30'

70° 0' 21° 30'

21° 25' 69° 45'

69° 44' 21° 15'

70° 0' 21° 15'

MUD

Bhadar River

Chikasa

Gorej

MUD

Olat River

Revadra

Mahiyadari

Kadeji

Anipur

Balej

Hatarpur

Ghed Bagasara

Kaddach

Ghodadar

Mander

Chigaria

Padva

Madhuvanti Nadi

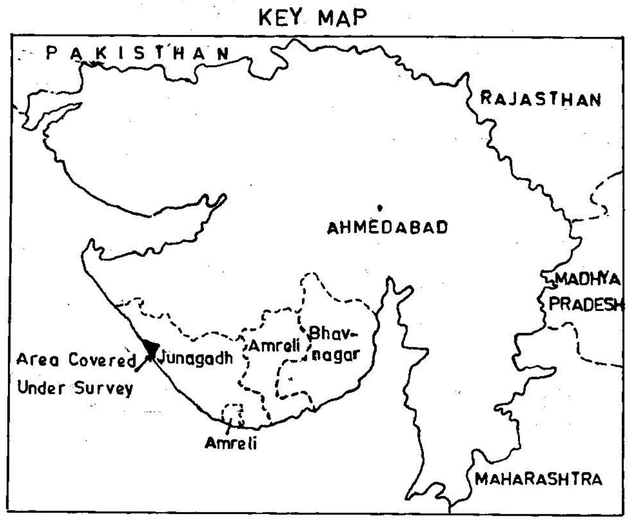
Madhavpur

A R A B I A N S E A

### LEGEND

| | | |
|---|---|---|
| | SAND / ALLUVIUM / MUD | RECENT |
| | MILIOLITIC LIMESTONE<br>AGRICULTURE ON MILIOLITIC LIMESTONE | PLEISTOCENE |
| | FORMATION BOUNDARY | |
| | OUT UOP BOUNDARY | |
| | WATER BODY | |
| | DAM | |

### KEY MAP




| | | | |
|---|---|---|---|
| Prepared by | G.P.Mehta | COMMISSIONER OF GEOLOGY & MINING GOVT. OF GUJARAT | DRG. NO. 4149 |
| Traced by | | | DATE 27-4-98 |
| Checked by | | Report No - 450 (6) | |
| Sr. Geologist | | | |

PLATE NO. 2

# GEOLOGICAL MAP OF PART OF JUNAGADH DISTRICT COVERED UNDER TOPOSHEET NO. 41 L/5 + 1

## (Based on The Interpretation of Landsat Satellite Imagery With Selective Field Checks

FIELD SEASON 1995-96

SCALE:-1:50 000

N

21° 10'

70° 13-26"

70° 30'

Vadodara
Sidokar
Adri
Nawapara
Chhatrada
Dari
Dabhor
Umba
Malan
Inej
Ambliyala
Bherah
TO Talala
Devka Nadi
Tantivela
Govindpura
Hamla R.
Navadra
VERAVAL CITY
Talav
Meghpar
Ajotha
Saraswati R.
Harnasa
GHCL Plant
Sutrapada
ARABIAN SEA
BELT OF TRAP

### LEGEND

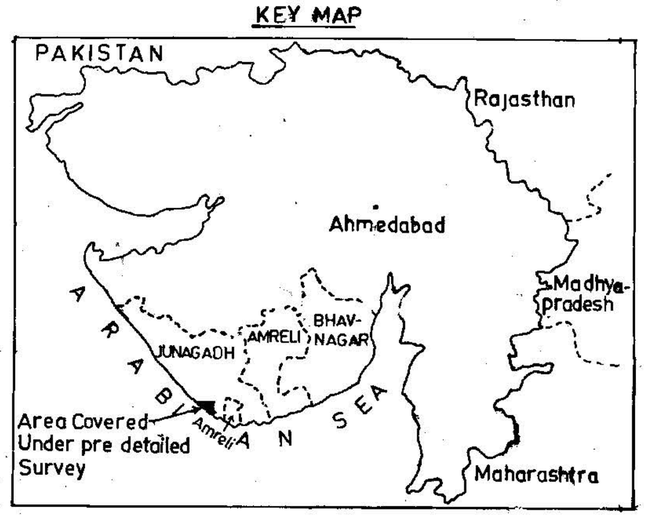
| | | |
|---|---|---|
| SAND / MUD | RECENT |
| MILIOLITIC LIMESTONE / MILIOLITIC LIMESTONE IN THE AGRICULTURAL AREA | PLEISTOCENE |
| GAJ SHALE / LIMESTONE GAJ IN AGRICULTURAL AREA | U. MIOCENE |
| TRAP | L. MIOCENE TO U. CRETACEOUS |

FORMATION BOUNDARY

FAULT

OUT CROP BOUNDARY

### KEY MAP




| | | | | |
|---|---|---|---|---|
| Prepared by | | COMMISSIONER OF GEOLOGY & MINING GOVT. OF GUJARAT | DRG. NO. | 4150 |
| Traced by | | | DATE | 1-5-98 |
| Checked by | | | | |
| Sr. Geologist | | | | |

Report No 450 (2)

20° 45'

70° 13-26"

70° 15'

70° 30'

20° 45'

PLATE NO. 5

# GEOLOGICAL MAP OF PARTS OF JUNAGADH DISTRICT COVERED UNDER T.S.NO.41G 10+6

## (Based on Landsat Satellite Imagery with limited field checks) F.S 1996-97

N

SCALE 1:50,000

69° 27' 69° 30' 69° 35' 69° 40' 69° 45'
21° 45' 21° 40' 21° 35' 21° 30'

SISLI
RATADI
BARDIA
SIMANI
BABDA
BAKHARLAI
LAVADIYA
RINAVADA
SHRINAGAR
PANDAVADAR
RESERVED FOREST
ADITYANA
RANTELA
DEGAM
BARVAN
DHALIYA NES
AMARDAD
KAJAVADARI
RANAVAV
KUCHHADI
KOLIKHADA
CREEK
SUKALA TALAV
DIGVIJAYGADH
SALT PLAN
KALATHANSA
KHAPAT
PIPLA
BOKHIRA
VANANA
CREEK
PORBANDAR
RANGHAVAV
BIRLASAGAR
BATANPAR
DARAR
LIMBADI
GOSA

A R A B I A N S E A

## LEGEND

- ALLUVIUM/MUD/SAND ---------- RECENT/SUBRECENT
- MILIOLITIC LIMESTONE / AGRICULTURE ON MILIOLITIC LIMESTONE ---- PLEISTOCENE
- DWARKA LIMESTONE ---------- PLIOCENE TO U.MIOCENE
- LATRITE ---------- PALEOCENE
- GRANOPHYRE ---------- L.EOCENE TO U.CRETACEOUS

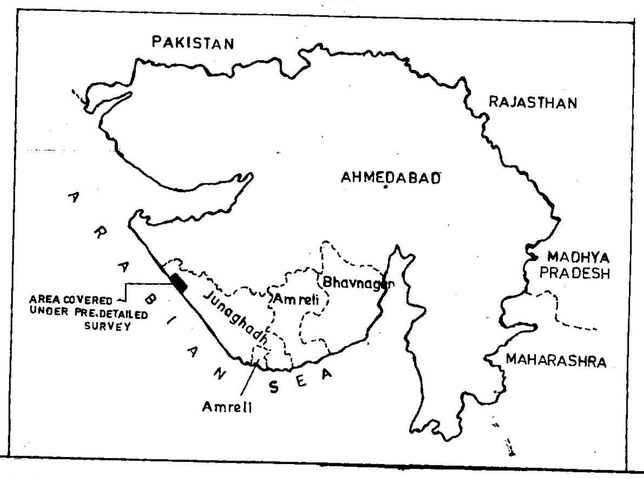
F — F FAULT

JOINT

OUT CROP AREA & FORMATION BOUNDARY

FORMATION BOUNDARY

## KEY MAP




| | | | |
|---|---|---|---|
| PREPARED BY | | COMMISSIONER OF GEOLOGY & MINING GOVT. OF GUJARAT | DRG NO. 4151 |
| TRACED BY | | | DATE 2-5-98 |
| CHECKED BY | | Report No. 45 (3) | |
| SR. GEOLOGIST | | | |

PLATE NO 3

# GEOLOGICAL MAP OF PART OF JUNAGADH DISTRICT COVERED UNDER TOPOSHEETS NO. 41K/4 AND 41G/16

## ( Based On Interpretation Of Landsat Satellite Imagery With Selective Field Checks )

FIELD SEASON 1995-96
SCALE 1: 50,000

N

69° 57'-30"
21° 15'
70° 0'
70° 15'
21° 15'
21° 12'
69° 57'-30"
21° 0'
70° 0'
10'
5'

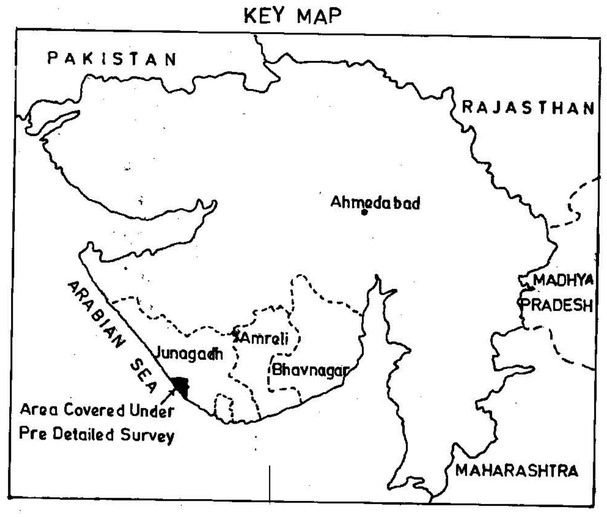
ARABIAN SEA

KAREJ
CHAR
DARSALI
ANTROLI
BAMANVARA
NAGICHANA
BHAT SIMROLI
CHINGARIYA
DIWASA
MANEJ
PIKHOR
BHATGAM
SHIL
KANKASAI
JUTHAT
RAHIJ
DHELANA
MAKTAPUR
MANGROL
SEPA
SHAHPUR
BUDHECHH
GOTNA
AREND
KAKASWADA
JUJARPUR
CHORWAD
CHORWAD BANDAR

## LEGEND

| | |
|---|---|
| ALLUVIUM/ SAND | RECENT |
| MILIOLITIC LIMESTONE/ AGRICULTURE ON MILIOLITIC LIMESTONE | PLEISTOCENE |
| GAJ LIMESTONE / AGRICULTURE ON GAJ LIMESTONE | L. MIOCENE |
| LATERITE | PALEOCENE |
| TRAP | L. EOCENE TO U. CRETACEOUS |
| FORMATION BOUNDARY | |
| OUT UOP BOUNDARY | |

KEY MAP




| | | | |
|---|---|---|---|
| Prepared by | G.P. Mehta | COMMISSIONER OF GEOLOGY & MINING GOVT. OF GUJARAT | DRG.NO. 4152 |
| Traced by | | | DATE 2-5-98 |
| Checked by | | Report No- 450 (5) | |
| Sr.Geologist | | | |

# GEOLOGICAL REPORT OF SHANTIPURA BLOCK (SUKHADEV J. TRIVEDI) OF MALIA HATINA TALUKA, JUNAGADH DISTRICT, GUJARAT. (FIELD SEASON-2018-19)

**Prepared For,**

**COMMISSIONER OF GEOLOGY AND MINING (CGM)**

**Gandhinagar, Gujarat.**

**Prepared & Investigated**

**By,**

**VINAYAK ENGIMECH PVT. LTD.**

**B-404 THE FIRST, Keshavbaugh Party Plot, Vastrapur, Ahmedabad. Gujarat.**

**JULY, 2021.**

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Plate 7: Isopach Maps (Cement Grade Limestone, Limestone & Marl)

Plate 8: Graphic Lithologs

Plate 9: Cross Sections

# Chapter – 1: Introduction

## 1.1 Title and Ownership:

Name of Organisation : Vinayak Engimech Pvt. Ltd.
Address of office : B-404 THE FIRST, Keshavbaugh Party Plot, Vastrapur, Ahmedabad-380015. Gujarat.
Phone : 079 26585650
Fax No. : 079 26585195
Email ID : apurohit@vinayakeng.co.in

Entire drilling work at Shantipura Limestone Mine covered under 2020-Exploration Scheme, was carried out by Vinayak Engimech Pvt. Ltd.-drilling agency having experience of more than 1.50 lakh meters of drilling work and preparing geological report. The agency is consistently working in various projects of Commissioner of Geology and Mining (CGM) & Gujarat Mineral Research & Development Society (GMRDS) since 2009. Total four Geologists are engaged in exploration work having Master's Degree in Geology. The field geologist has experience of 5 years in drilling work of various minerals. The geological report is prepared by geologist having experience of four years.

We have been awarded Work Order dated 20.09.2018 by Commissioner of Geology and Mining for Exploration of Limestone in Junagadh and Gir Somnath District of Gujarat. The drilling work in 2020-Exploration project was initiated on 30.10.2018. The drilling work in Shantipura Limestone Mine was carried out from 30.10.2018 to 06.01.2019. Entire project area falls in Malia-Hatina taluka of Junagadh District, Gujarat. Junagadh District is situated in the Saurashtra region of western Gujarat which is surrounded by Rajkot District (North), Porbandar District (North-West), Amreli District (East) and to the South and West is the Arabian Sea. It is located on the southern corner of the Kathiawar peninsula. After a brief struggle between India and Pakistan, Junagadh voted to join India in a plebiscite held on 20 February 1948. It was a part of Saurashtra state and later Bombay state. In 1960, in consequence of the Maha Gujarat movement, it became part of the newly formed Gujarat state.

## 1.2 Location and Details of the Area:

The Entire study area falls in Malia-Hatina taluka of the Junagadh District, Gujarat. The Junagadh District consists of ten Taluka are Junagadh city, Junagadh Rural, Keshod, Malia-Hatina, Manavadar, Mangrol, Mendarda, Vanthali, Visavadar. The Junagadh District covers an area of 8831 Sq. km and population of District is 27, 43,082 as per 2011 census. Population density of district is 310/ Sq. km. Shantipura village is surrounded by Patan-Veraval Taluka towards South, Talala Taluka towards East, Mendarda Taluka towards North and Mangrol Taluka towards West. It is located 64 Km towards south from District head quater Junagadh, 7 Km from Malia and 397 Km from the state capital Gandhinagar. The geological coordinates of Shantipura Village is latitude 21.374414 N and longitude 70.515447 E.

Shantipura Village, Malia-Hatina taluka is bounded by Gir-Somnath district towards East, Keshod tauka towards North, Veraval taluka towards South and Mangarol-Arabian Sea towards West. Keshod city, Veraval city, Mangrol city and Talala city are nearby cities to Malia taluka. The Shantipura Limestone Mine falls under the Survey of India Toposheet No. F-41 K/8 of the Junagadh District of Gujarat. A map showing area on toposheet can be referred for the same, Scale: 1:25,000 (i.e. Plate-3). The Shantipura Limestone Mine covers an area of 19.96 Ha (Mineralized Zone). A rectangle is made around Shantipura Limestone Mine which has following coordinates:

| Point | Northing | Easting |
|---|---|---|
| A | 21°01'25.11"N | 70°19'04.30"E |
| B | 21°01'25.11"N | 70°19'34.11"E |
| C | 21°01'13.67"N | 70°19'34.11"E |
| D | 21°01'13.67"N | 70°19'04.30"E |

*Table: 1- Coordinates of corner points of rectangle Covering Shantipura Limestone Mine*

The actual block boundary falls within this rectangle and demarcated as polygon. The sheet of coordinates of Shantipura Limestone Mine boundary has given as

separate annexure (i.e. Annexure-6). This report covers all details related to Shantipura Limestone Mine, which is an expiring mining leases (Date of Expire 31.03.2020). The coordinates of Shantipura Limestone Mine boundary has been provided by CGM. The investigation was done for Limestone mineral.

## 1.3 Infrastructure & accessibility:

The Shantipura Limestone Mine is accessible through SH-31 and NH-8D (Junagadh-Somnath Highway) connecting Somnath to Jetpur. A Key and Location plan can be referred for the same. (i.e. Plate-1). Januda (3 Km), Samdhiyala (4 Km), Plaladi (5 Km), Dhandhri (5 Km), Dhanej nani (5 Km) are the nearby village to Shantipura. The nearest railway station from the Shantipura Limestone Mine is Chorvad railway station which is around 9.00 Km away from Shantipura village. The nearest Air-port is the Keshod Airport situated at around 45.00 Km distance from Shantipura village and the Diu Airport which is about 78.00 Km away from Shantipura village. An aerial view of study area map of Shantipura Limestone Mine has also given (i.e. Plate-2).

The highest point in Gujarat, Mt. Girnar is one of the most important pilgrimage sites for both Jains and Hindus, which is around 101 km away from Shantipura village. Another is Somnath temple (Prabhas Patan) near Veraval, is the first among the twelve Jyotirlinga shrines of Shiva, which is around 28 Km away from Shantipura village. In the village of Shantipura large bodies of water available through Arabian Sea. Water and electricity will be drawn from the dugwell and GSEB/DG Set respectively.

The Gir Forest National Park and Wildlife Sanctuary is a forest and wildlife sanctuary, established in 1965, with a total area of 1,412 $Km^2$ (about 258 $Km^2$ fully protected for the national park and 1,153 $Km^2$ for the sanctuary) which is around 76 Km away from Shantipura village.

## 1.4 Physiography & Drainage:

The peninsula of Saurashtra form a rocky table land fringed by coastal plains with a central part made up of an undulating plane broken by hills and

considerably dissected by various rivers that flowing all directions. The area in and around Shantipura village is the part of the Saurashtra coast and has flat topography with gentle slopes. In the study area, Limestone and at some places soil surfaces exhibit calcareous characteristics due to prolonged effects of leaching or weathering. The general slope natural drainage of the area is from East to West direction. Vrajmji is a seasonal river flows nearby the Shantipura village in NE direction. The region is devoid of perennial streams. Overall, the drainage pattern is Sub-dendritic.

The Junagadh district is prosperous in water on account of rivers, reservoirs and lakes. In Junagadh District most of the rivers flow southwards because the general slope of the land is towards the south. The entire area is divided into catchments of the following major rivers, viz. Sonrakh, Shingoda, Machhundri, Shetrunji, Kalwo, Netravati, Uben, Ojat, Hiren and Meghal. Because of the uneven topography, lithological and structural variation, the streams in the hilly terrain are flowing in all directions, forming a radial drainage pattern, whereas the drainage pattern of the streams in the low grounds is dendritic, flowing towards the Arabian sea. All the rivers are non-perennial, rainfed. Junagadh district has many lakes named Narsinh Mehta Sarovar, Damodarji and Sudarshan Lake etc.

## 1.5 Climate & Vegetation:

The summer season is characterized by dry and hot climate. The temperature rises steadily from beginning of March till first week of June. During the months of May-June the temperature reaches up to 35 °C to 43 °C and the mean daily minimum is about 14.7 °C. The onset of south – west monsoon during mid-June, lowers the temperature slightly. In the post-monsoon period, the days are hot and nights are pleasantly cool. During winter, the maximum temperature of about 35 °C and minimum of around 9 °C prevails. The climate in coastal of the study area is moist and warm with average annual rainfall 724.1 mm occurring during 28.21 mm rainy day from the years 1970 to 2000.

Except some bushes and smaller trees, the area is mostly devoid of any vegetation.

## 1.6 Previous Exploration:

The exploration work for Limestone mineral in Shantipura village has not done previously.

## 1.7 Present Exploration:

Drilling work at Shantipura Limestone Mine was carried out by Vinayak Engimech Pvt. Ltd. The work was allocated for exploration of Limestone in Junagadh and Gir Somnath Districts and for Bauxite in Devbhumi Dwarka District, Gujarat with hydraulic core drilling rigs. Total 1559.00 meters of drilling work has been allocated by CGM under this 2020-Exploration Project. Total 15 boreholes were proposed at Shantipura Limestone Mine. The agency has drilled all the 14 boreholes with 410.00 m of total drilling. Borehole location on cadastral map has been given (i.e. Plate-4). Total 91 samples of Limestone has been collected by agency and submitted to Petrography and Mineral Chemistry Lab, Gandhinagar for chemical analysis. Detailed drilling was carried out to understand subsurface mineralisation of Limestone and to evaluate the resources of Limestone in area. Agency has carried out drilling work in accordance with rules, regulations and instructions from authority. Topographical and DGPS survey was also carried out by Vinayak Engimech Pvt. Ltd.

## 1.8 Acknowledgement:

We are grateful to Commissioner of Geology and Mining for giving us such a convenience and providing us continuous and warm response and backing. Under their able guidance and valuable instructions we were able to carry out drilling work. We will always remain indebted to them.

We are also thankful to Scheme Officer of 2020-Exploration Drilling Scheme (Junagadh District) for giving us immense support on field.

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# Chapter – 2: Field Exploration Activity Geological Setting & Mineralization

## 2.1 Regional Geology:

The Saurashtra peninsula is surrounded by the sea water from the three sides, (1) Gulf of Kachchh in the North, (2) Gulf of Khambhat in the East and (3) Arabian sea in SW and SE. The NE portion, which connects the peninsula with the mainland of Gujarat, is also a natural depression, once covered with a shallow sea connecting both the Gulfs. The region has a distinct geological history that has evolved this peninsula quite differently from the neighbouring regions of Kachchh and Mainland Gujarat.

Regional physiographic setting of Saurashtra peninsula is a reflection of its tectonic framework. Saurashtra massif is a horst bounded by Kachchh rift in the North and Cambay rift in the East. Extension of Narmada rift and West Coast Fault are accounted for straight nature of the western and southern coastline of the Saurashtra.

Interactive movements of Indian Plate during Cretaceous after breakup from the Gondwanaland are the major factors responsible for tectonic setup of the Saurashtra. A prominent feature observed offshore Dwarka is the occurrence of Saurashtra Arch trending in NE-SW that separates Saurashtra offshore basin from the Kachchh rift. Almost perpendicular to this, a major fault zone trending NNW-SSE off Porbandar coast defines Saurashtra platform and separates it from the deeper zone due west.

Holocene record of Saurashtra has not been investigated yet with much details. It is characterized by stabilized coastal dunes, raised mudflats, shell beds, dead coral reefs, etc., that can be prominently used to construct the Holocene history of the region. Apart from these, the present day fluvial deposits, pediment debris, beach and tidal clay deposits etc., are considered under the Holocene deposits.

Milliolitic formation-Limestone belonging to Milliolitic series of Pleistocene age occupy a vast land in Gujarat covering the coastal tracts of Saurashtra from North

of Porbandar to South of Bhavnagar. Milliolitic Limestone is occasionally underlain Gaj bed.

Gaj formations are mostly argillaceous and partly calcareous, comprising of yellow and grey coloured clays, variegated clays with gypsum bands and calcareous silt and sandstone along with thin bands of yellow brown coloured Limestone.

Laterites form almost a continuous zone between the Deccan Trap and the Gaj Formations, and occur as discontinuous patches forming colourful ridges, right from the Jamnagar in the north up to Bhavnagar in the South. Laterite exposures along the coastal plain of the Junagadh and Amreli district are fragmentary and highly ferruginous showing poor development of the profile.

A major part of the Saurashtra peninsula is occupied by the magmatic rocks of the Deccan Trap Formation. These rocks constitute elevated table land with an uneven topography. The bulk of the formation is made up of succession of lava flows dominantly of tholeiitic basalt. Common rock type encountered is fine to medium grained grayish black basalt with its variations and amygdaloidal basalt forming marker flows. Thickness of the Deccan Trap Formation in the West of Junagadh to be between 900 to 1300 m whereas, in the East as low as 350 m. The Girnar, Barda, Alech, Osham and Chimardi hills are some of such examples that stand out from the basalt plateau. The inter-trappean beds also occur within the Deccan Trap Formation of Saurashtra.

Stratigraphic Sequence of the formations with their geological age are given below:

| **Period (Age)** | | **Formation** | **Rock Type** |
|---|---|---|---|
| Quaternary | Holocene | Sub. Recent to Recent | Blown sand, Soils, alluvium, Fluvio-marine deposits |
| Tertiary | Pleistocene | Milliolitic Formation | Coastal, arenaceous Limestone with Miliolite fossil |

| | | | |
|---|---|---|---|
| | Pliocene to Miocene | Gaj Formation | argillaceous and calcareous clays, variegated clays with gypsum bands, calcareous silt and sandstone along with yellowish brown Limestone, Marl, Conglomerate |
| | Lower Eocene | Laterite | hard and compact Laterite, Bauxite and Clay, Ochreous and Bentonite clays |
| Tertiary to Upper Mesozoic | Eocene to upper Cretaceous | Deccan Trap | Deccan Traps and associated rocks with intrusive and dykes |

*Table: 2-Regional Geology of the Area,* (Merh, 1995).

## 2.2 Detailed Geological Mapping Local Geology of the Study Area:

Geological mapping of the area was not done by Vinayak Engimech Pvt. Ltd. as it was not part of the scope of the work. Though geological map has been provided, scale 1:2000 (i.e. Plate-6). With the help of core-drilling, sampling and data assessment of the study area the local geological successions of the area are given as below:

| Period (Age) | Formation | Rock type |
|---|---|---|
| Quaternary (Recent & Sub-recent) | over burden soil/alluvium | brownish and yellowish color soil |
| | windblown calcareous sand dunes | calcareous sand, yellow clay with calcareous matter |
| Tertiary | Miliolitic Formation | pebble and granular limestone |
| | Gaj Formation | brownish, greyish, whitish and yellowish colour clay, pebble, fine-medium grained limestone |
| ----------Unconformity---------- | | |

*Table: 3-Local Geology of the Shantipura Limestone Mine*

The Alluvium is surficial features. The Shantipura Limestone Mine is mostly covered by soil/Alluvium and Clay of Recent period. Major Soil type of the area is shallow to medium, blackish to yellowish in nature. The geology of the Shantipura Limestone Mine and its vicinity broadly conforms to the regional geology of the area. In the Shantipura Limestone Mine, limestone occurs on the

surface at some places and is present below overburden. The Limestone belongs to Miliolitic limestone (Pleistocene age) and Gaj Limestone (age from Pliocene to Miocene).

**Local Geology:**

**Soil**

The area is covered with recent to sub recent alluvial deposits. Alluvium is the surficial feature belongs to recent period. The study area is mostly covered by the soil. The soil of the study area is mostly blackish in colour, at some places it shows yellow colour. Soil is composed of clay or finer material like fine grained silty sand. At some places it is mixed with calcareous material. The thickness of soil varies from 0.00 m to 0.45 m in the study area.

**Limestone:**

Limestone is exposed at irregular intervals in the study area. During the logging freshly broken surfaces of Limestone were observed. The Limestone exposed mostly in yellowish to light yellowish, blackish, at some places pinkish and whitish colour. The Limestone is hard and compact. It is generally medium grained in grain size. The Limestone belongs to Pleistocene to Miocene age. Thickness of Limestone ranges from 2.06 m to 5.81 m in drilled boreholes in the study area.

The Gaj limestone pebbles indicate unconformity between Gaj and Miliolitic limestone. Gaj limestone exposed in the study area, is light yellowish to greyish in colour. Miliolitic Limestone appears to have washed away due to cutting action of the rain water. Gaj Formation has been deposited unconformably over Deccan traps. The light yellowish Limestone belonging to Milliolitic Formation of Pleistocene age. Gaj formations are mostly argillaceous and partly calcareous, comprising of yellow and grey coloured clays, variegated clays and along with thin bands of yellow brown coloured Limestone. Gaj Formation Limestone and Milliolite Formation Limestone of Tertiary age were considered for resource estimation, hence limestone of both are the mineralized zone for which resource has been assessed.

**Clay:**

Clay found in the study area also belongs to Gaj formation. It is soft and fine grained in nature. The clay is brownish, greyish and yellowish in colour. At places, it is intermixed with sand, grity material. At some places, calcareous matter is mixed with clay. Variegated clay is also found in mixture of colour like red, brown and yellow. It is fine to medium grained.

## 2.3 Mineralization Details:

Junagadh District is endorsed with mineral deposits. Limestone is the major mineral of the District. Building Limestone, Black trap, Bauxite, Ordinary Clay, Gypsum and Ordinary sand are minor minerals.

Limestone is a sedimentary rock composed primarily of calcium carbonate ($CaCO_3$) in the form of mineral calcite. It most commonly forms in clear, warm, shallow marine waters. It is usually an organic sedimentary rock that forms from the accumulation of shell, coral, algal, and fecal debris. It can also be a chemical sedimentary rock formed by the precipitation of calcium carbonate from lake or ocean water.

The occurrence of the Pleistocene beach limestone all over Tertiary coastal plains fringing the Deccan Trap plateau and deep in the interior of the Deccan Trap country at high elevations tends to lead to the conclusion that during Pleistocene period the sea level stood much higher that at present. This may be true in respect of the areas of the coastal plain and the foothill regions.

But the occurrence of the Miliolite rocks at higher elevation in the interior areas also point to an Aeolian origin indicating that the windblown particles from the fragmented bench sediments might have been deposited in the valleys of the high hills which acted as natural wind barrier and the sea need not have transgressed to such great heights in order to form the thinner layers of the Miliolite rocks at such higher altitudes.

Gaj and Milliolite Formation limestone are mineralized zones found in the Shantipura Limestone Mine. The Limestone deposit is found from the surface of

area. There is soil cover in the form of nodules, grits & small boulders interbedded with soil and clays. Limestone found in bedded form.

Gujarat is richly endowed with limestone of different varieties and constitutes an important mineral resource which finds use in a number of industries. It is the main raw material for the manufacture of Portland cement and almost 75% of the limestone of the state is consumed by the cement industry. High grade limestone is also used in refractory, paper, ceramic, paints, rubber and fertilizer industries. Chemical industries utilize the rock in the manufacture of soda ash, calcium carbide, precipitated calcium carbonate and hydrated lime.

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# Chapter – 3: Exploration

## 3.1 Introduction:

A Borehole Location map has been prepared by Commissioner of Geology and Mining (CGM), Gandhinagar on 200 m grid. To cover the Shantipura Limestone Mine total 15 proposed boreholes were given and out of which 14 boreholes were drilled. The main objective was to evaluate the resources of Limestone in parts of Shantipura village of Malia-Hatina taluka of the Junagadh District of Gujarat with detailed drilling putting boreholes to understand subsurface mineralization of Limestone within the geological formation containing Limestone so as to find the quality and quantity and categorize Limestone of Pleistocene to Miocene age present in the Shantipura Limestone Mine.

The DGPS survey in Shantipura Limestone Mine was carried out by Vinayak Engimech Pvt. Ltd. In the DGPS Survey report, the details of location, identification and demarcation of area, methodology of Topographic Survey and methodology adopted for vectorized cadastral map have been provided. DGPS Survey was carried out by two methods: 1) Rapid Static Mode and 2) Real Time Kinematic mode. To carry out this survey Dual Frequency Sokkia (GSX2) DGPS, Total station Theodolite CHC-NAV Total Station (CTS-112R4 Make) and Electronic Total Station (ETS) Theodolite equipment's were used in various stage of Topographic survey. After topographic survey, draft drawing were generated at site and a complete topographical representation was drafted with the help of AutoCAD.

## 3.2 Drilling:

The Shantipura Limestone Mine covers an area of 19.96 Hectare and it was explored by drilling 14 boreholes. The total meterage drilled for these boreholes is 410.00 m. Part of the area is drilled with borehole spacing of 100-200 m for collecting the information and samples which falls under Detailed Exploration stage of UNFC i.e. G-1 stage and part of the area was drilled with 200-400 m spacing which falls under General Exploration stage of UNFC i.e. G-2 stage for the

strata bound stratified deposits of regular habit as per the Mineral Evidence Rule, 2015, Schedule III. Here, in the Shantipura Limestone Mine drilling has been done with the borehole spacing of 200 m and Limestone is found in all the boreholes. In Shantipura Limestone Mine all borehole are almost near and positive, so it can be said that mode of occurrence of Limestone is of bedded type of deposit. Density of borehole depends upon type of deposit. But, the other details required for the G1 stage has not been obtained. Though as per the information collected from the Shantipura Limestone Mine, it falls under the G-2 stage (i.e. General Exploration) of UNFC classification. Accordingly from the information/data collected during each stage of exploration resource is estimated and classified as per UNFC norms.

The exploratory drilling work was done with help of minimum 2 numbers of Hydraulic core drilling rigs. All boreholes were drilled vertically. No deviation has been measured on field. NQ size core recoveries of minimum 85% was maintained throughout and properly recorded. Geological Core logging was done on all boreholes which included reporting details of lithology, thickness, grain size, colour and megascopic characters. The other necessary details are covered under different annexures, cross sections and graphic lithologs.

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# Chapter – 4: Sample Preparation & Laboratory Studies

## 4.1 Sampling Details:

The selected recovered core was arranged properly in core boxes of 1 m long with 5 riffles covered with lid. All run was marked properly by plastic tag and the core boxes were numbered accurately.

Then core containing mineral was cut vertically from the centre with the help of core splitter dividing it into two equal halves. One half of core was kept aside for preservation purpose and other half was crushed upto desired mesh size of 200 mesh. Then coning and quartering was done for representative sample. Sampling was done to understand the quality of limestone encountered in boreholes as per the instruction given by the authority.

The entire sampling process was carried out in presence of site geologist of CGM and according the suggested procedures of CGM. Samples were collected during this exploratory drilling programme and sent to Petrography and Mineral Chemistry Lab, Gandhinagar for chemical analysis.

## 4.2 Chemical Analysis Details:

Samples were analysed on Axios Advanced PANalytical XRF (X-Ray fluorescence) spectrometer in Petrography and Mineral Chemistry laboratory, Gandhinagar, Government of Gujarat. An Axios Advanced PANalytical XRF uses X-ray for non-destructive analysis wavelength dispersive spectroscopic principles and is good for bulk samples including limestone.

Analysis technique was used as per XRF software. There are different standard samples with lab for calibration and cross checking purpose. The analyses were checked with standard samples result. Some samples were analysed in wet chemical analysis as per ISI technique. In the analysis percentage of elements present in samples were calculated. The elements $SiO_2$, $Al_2O_3$, $Fe_2O_3$, CaO, MgO, $Na_2O$, $K_2O$, $P_2O_5$, $TiO_2$, MnO and $SO_3$ were considered in analysis. Among which percentage of CaO and MgO were considered for categorization of Limestone. The entire chemical analysis of the samples was carried as per the standard methods

in the laboratory. Entire chemical analyses of the samples were done by the qualified staff in the laboratory and during each stage of chemical analyses procedure QA/QC was followed by the higher officials of the Petrography and Mineral Chemistry Lab, Gandhinagar. Core log sample analysis results has been given as separate annexure (i.e. Annexure-5).

For specific gravity of the samples, some representative samples from the various boreholes of different grade were selected after the careful examination of the chemical analyses results. The list of these selected samples were submitted to Petrography and Mineral Chemistry Lab, Gandhinagar, where specific gravity test was done as per the standard methodology. Specific gravity of the sample result provided by the Petrography and Mineral Chemistry Lab, Gandhinagar.

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# Chapter – 5: Data Density, Data Integration & Interpretation

## 5.1 Data density:

To cover the area 14 boreholes were drilled. All 14 boreholes are positive as the limestone mineral is found in all boreholes. Individual Limestone Bed Thickness is given as separate annexure (i.e. Annexure-4). Boreholes were drilled with maintaining accuracy in location with the help of GPS.

## 5.2 Data Evaluation & Correlation of Mineralized zones :

### 5.2.1 Categorization:

Based on chemical analysis results of CaO% and MgO%, Limestone is categorized as Cement Grade, Limestone and Marl. For the categorization of Limestone we have used Threshold value of minerals, Indian Mineral yearbook 2018 and National Mineral Inventory. The Threshold value for Limestone published by Indian Bureau of Mines, Nagpur vide notification no. C284/3/CMG/2017 dated 25th April, 2018. In the above notification the threshold values for Limestone and aluminous laterite are as given below:

CaO% (34% Min.) and MgO% (5% Max.).

Hence, Chemical specification for different grades of limestone are as below:

1. Chemical Grade : >52 % CaO, ≤5% MgO
2. Cement Grade : 40-52 % CaO, ≤5% MgO
3. Limestone : 34-40 % CaO, ≤5% MgO
4. Marl : 20-34 % CaO, ≤5% MgO

### 5.2.2 Correlation of Mineralized zone:

The mineralization of Limestone is under investigation in this exploration work. Three cross sections (E-W direction) and diagonal were prepared for the graphical representation of subsurface mineralization of the area covered by Shantipura Limestone Mine. The Cross Section-1 (diagonal) covers boreholes no. SL-1, SL-3 and SL-5. The Cross Section-2 (E-W) covers boreholes no. SL-1, SL-4,

SL-7, SL-10 and SL-13. The Cross section-3 (E-W) covers boreholes no. SL-2, SL-5 SL-8 and SL-11. Cross sections have been attached (i.e. Refer Plate No. 9).

Thickness of cement grade limestone, limestone and marl varies from borehole to borehole. Graphic lithologs have been provided (i.e. Plate-8).

| Cross-section No. | Total BHs | Thickness of Lst. ranges in various BHs (m) | CGL Thickness (m) | | | Limestone Thickness (m) | | | Marl Thickness (m) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Min. | Max. | Avg. | Min. | Max. | Avg. | Min. | Max. | Avg. |
| 3 | 14 | 2.06 to 5.81 | 0.47 (SL-07) | 4.87 (SL-03) | 1.75 | 0.34 (SL-03) | 3.90 (SL-11) | 1.15 | 0.34 (SL-10) | 2.55 (SL-07) | 0.76 |

*Table: 4 Data Interpretation*

From the above data it can be said that Limestone is found in all the 14 drilled boreholes of Shantipura Limestone Mine. The thickness of Limestone varies from 2.06 m to 5.81 m. Borehole wise & Grade wise thickness has been given as separate annexure (i.e. Annexure-3).

## 5.3 Inference of Isopach Map

Isopach Maps were prepared for Cement Grade Limestone, Limestone and Marl separately (i.e. Plate-7). Isopachs are contour lines of equal thickness over an area. It illustrates the thickness variations within tabular unit. From the Isopach map of Cement Grade Limestone it can be seen that the contour density of Cement Grade Limestone thickness is higher in East and West direction towards boreholes SL-3 and SL-12 and lower in centre and south direction towards boreholes SL-10 and SL-8. So, it can be said that the concentration of Cement Grade Limestone in East and West direction is higher compare to other parts. The same can be inferred for thickness of limestone and Marl after observing the Isopach map for limestone and Marl respectively.

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# Chapter – 6: Mineral Resource

## 6.1 Resource Estimation Technique:

Resource Estimation has been done for Cement Grade Limestone, Limestone and Marl deposits of the Shantipura Limestone Mine by considering area of influence of borehole, thickness of Cement Grade Limestone, Limestone and Marl specific gravity etc. and the classification of the estimated resource was done as per UNFC guidelines.

For the area falls under G2 category, thickness of Limestone is taken differently. In this case, resource estimation was done by taking the average thickness of boreholes which surround particular area (area under G2 category). Resource Estimation map grade wise has been given (i.e. Plate-5).

The area covered by Shantipura Limestone Mine is 19.96 hectare and it covers 14 drilled boreholes. Based on exploration data, resource estimation was done for Cement Grade Limestone, Limestone and Marl. Based on lithologs and lab analysis data, thickness for cement grade limestone, limestone and marl have been calculated. The specific gravity was measured in Petrography and Mineral Chemistry Laboratory, CGM and estimated grade wise. Resource has been estimated by UNFC guidelines for Geological index i.e., detailed exploration (Category G1) and General exploration (Category G2).

**The following parameters and assumptions have been taken into consideration for resource estimation: -**

1. In each borehole area of influence has been considered for resource calculation, as this area is not much undulating and the mineral deposit is of regular habit.
2. Tonnage is estimated on dry basis, after removing moisture content.
3. Average cumulative thickness is taken for each boreholes fall under different category regions, i.e., G1, G2.
4. As per UNFC guidelines for the deposits of Regular habit, the area covered by closed spaced bore holes with bore holes spacing is 200 m are marked for G1 category resource.

5. Beyond the region of G1, where the bore holes are more than 200 m apart up to 400m are put under the region of G2 category.
6. Specific Gravity has been estimated grade wise and average Specific Gravity for Cement Grade Limestone is 2.49, for Limestone is 2.50 and for Marl is 2.47.
7. Recovery loss has not been considered.
8. Total resources estimated here are In-situ resources.
9. To separate out different grades of Limestone CaO% and MgO% values has been considered.
10. The method of chemical analysis of samples and elements to be analyzed were decided by the state government and analysis results were given by State government which is accepted for the estimation of average grade of limestone.

## 6.2 Estimation Method:

For calculation of resources, area of influence of boreholes method has been taken into consideration. Length, width, thickness and the specific gravity of Limestone is taken into consideration. The length, width and thickness of Limestone are considered in meters. The surface area covered by this Shantipura Limestone Mine is 19.96 Hectare. The various terms expressed for computation of resource are mentioned in short term as below:

**A or (L x W) x Th. x Sp. Gr.= R**

Where;

| | | | |
|---|---|---|---|
| L | = Length (in m) | Sp. Gr. | =Specific Gravity |
| W | = Width (in m) | R | = Resources (in Tonnes) |
| A | = Area (in $m^{2)}$ | Th | = Thickness (in m) |

Resources calculation tables have been given as Annexure – 1.

Average grade of different grade of Limestone i.e. Cement Grade Limestone, Limestone and Marl was calculated. In this method the average value of thickness of each grade, $SiO_2$, CaO and MgO values were taken borehole wise. Then average value of these previously taken values was calculated for average grade of cement grade limestone, Limestone and Marl, $SiO_2$, CaO and MgO.

## 6.3 Classification of Mineral Resources:

Considering above factors resources has been estimated grade wise. The calculation sheet for resource estimation has been given as separate annexure (i.e. Annexure -1).

Resource estimation of Shantipura Limestone Mine for Cement Grade Limestone is given in table 5:

| Stage of Exploration | Resource Estimated in (MT) | Classification of resources as per UNFC | UNFC Code | Avg. CaO% | Avg. $SiO_2$% | Avg. MgO% |
|---|---|---|---|---|---|---|
| General Exploration (G2) | 1643866.81 | Indicated resources | 332 | 43.50 | 12.83 | 0.30 |
| **Total** | **1643866.81** | | | | | |

*Table: 5-Classification of estimated resources of Cement Grade Limestone as per UNFC norms*

Resource Estimation of Shantipura Limestone Mine for Limestone is given in table 6:

| Stage of Exploration | Resource Estimated in (MT) | Classification of resources as per UNFC | UNFC Code | Avg. CaO% | Avg. $SiO_2$% | Avg. MgO% |
|---|---|---|---|---|---|---|
| General Exploration (G2) | 1292481.92 | Indicated resources | 332 | 37.03 | 21.81 | 0.43 |
| **Total** | **1292481.92** | | | | | |

*Table: 6 Classification of estimated resources of Limestone as per UNFC norms*

Resource Estimation Shantipura Limestone Mine for Marl is given table 7:

| Stage of Exploration | Resource Estimated in (MT) | Classification of resources as per UNFC | UNFC Code | Avg. CaO% | Avg. $SiO_2$% | Avg. MgO% |
|---|---|---|---|---|---|---|
| General Exploration (G2) | 732040.90 | Indicated resources | 332 | 27.86 | 33.85 | 0.80 |
| **Total** | **732040.90** | | | | | |

*Table: 7 Classification of estimated resources of Marl as per UNFC norms*

Table: 8 Summary of resources of Shantipura Limestone Mine study area is given below:

| Grade | Stage of Expl. | classⁿ of resources as per UNFC | Area (Sq. m.) | Avg. Thickns. (m) | Specific Gravity | Quantity (MT) | Avg. $SiO_2$ % | Avg. CaO % | Avg. MgO % |
|---|---|---|---|---|---|---|---|---|---|
| Cement Grade Limestone | G2 | Indicated (332) | 199600.00 | 1.75 | 2.49 | 1643866.81 | 12.83 | 43.50 | 0.30 |
| Limestone | G2 | Indicated (332) | 199600.00 | 1.15 | 2.50 | 1292481.92 | 21.81 | 37.03 | 0.43 |
| Marl | G2 | Indicated (332) | 199600.00 | 0.76 | 2.47 | 732040.90 | 33.85 | 27.86 | 0.80 |
| **Total Resources** | | | | | | **3668389.63** | | | |

*Table: 8 Summary of resources of Shantipura Limestone Mine*

Above estimation was carried out by considering all maximum possibilities, Field data and Chemical analysis results.

## 6.4 Overburden to Mineral Ratio:

| Cross- section No. | Blocks | Total BHs | OB to Mineral Ratio (Avg.) |
|---|---|---|---|
| 1 | Shantipura Limestone Mine | 14 | 5.00 |

*Table: 9 Overburden to Mineral ratio*

The overburden to mineral ratio is provided with separate annexure (i.e. Annexure-2). After observing the overburden to mineral ratio in all the parts of the mineralized zone it can be said that the overburden ratio is lower for boreholes SL-10, SL-3 and SL-11, which increases in boreholes SL-5 and SL-7. The average OB to Mineral ratio of boreholes drilled in the Shantipura Limestone Mine is 5.00 m.

*********

# Chapter – 7: Conclusion & Recommendation

1. Prospecting and Exploration has been carried out as per Mineral Evidence Rule, 2015 and guide lines for stratified, regular habit mineral.
2. The study area covers bore holes drilled with an average spacing of 100-200 m to understand the subsurface disposition of mineralization. Samples were analyzed by State Government laboratory.
3. Total 14 boreholes were drilled with meterage of 410.00 m which cover an area of 19.96 Hectare in Shantipura Limestone Mine.
4. Total Resources of 3668389.63 metric tonnes. The total resource of Cement Grade Limestone [Cement (Blendable/Beneficiable) grade Limestone] is 1643866.81 metric tonnes which cover mineralize area of 17.6950 Hectare and non-mineralize area of 2.2650 Hectare, resource of Limestone [Limestone (Blendable/Beneficiable) grade] is 1292481.92 metric tonnes which cover mineralize area of 17.0746 Hectare and non-mineralize area of 2.8854 Hectare and of Marl is 732040.90 metric tonnes which cover mineralize area of 16.4105 Hectare and non-mineralize area of 3.5495 Hectare.
5. As per the Annexure-III (copy of end use grade classification of major minerals used for NMI purpose) published by IBM and chemical analysis, in the Shantipura Limestone Mine the Cement Grade Limestone and Limestone categories can be fall in Cement (Blendable/Beneficiable) grade Limestone and Limestone (Blendable/Beneficiable) grade.

*********

## Locality Index

| Name of Village | Latitude | Longitude |
|---|---|---|
| Shantipura | 21°01'35.61"N | 70°18'57.55"E |
| Januda | 21°02'03.74"N | 70°19'06.99"E |
| Gadu | 21°03'13.87"N | 70°17'27.84"E |
| Kindarva | 21°00'16.95"N | 70°19'05.67"E |
| Khorasa | 21°03'06.20"N | 70°19'48.83"E |

*********

## References:


1. Geology of Gujarat by V.N. Kulkarni, Senior Geologist, Engineering Research Institute, P.W.D. Gujarat State.
2. Geology of Gujarat by S.S. Merh, Geological Society of India. Geological Society of India, 1995.
3. Depositional Environment of Mesozoic Sediments of Saurashtra, Revealed by textural Parameters by, D.C. Srivastav, P.V. Rao and M G Hardas, Geological Laboratories, Baroda.
4. Indian Minerals Yearbook, 2013, 52nd Edition – Limestone and Other calcareous minerals, IBM, Ministry of Mines, Govt. Of India, July 2015.
5. 57th Edition, Limestone & Other Calcareous Material, Indian Mineral Yearbook 2018 (Part-III: Mineral Reviews), Govt. of India, Ministry of Mines, Indian Bureau of Mines, Nagpur.
6. Threshold value of Minerals, The gazette of India, Notification, p.g. no.3, Ministry of Mines, Indian Bureau of Mines, Nagpur, 25th April, 2018.
7. Minerals (Evidence of Mineral Contents) Rules, 2015.
8. National Mineral Inventory: An Overview as on 01.04.2015.
9. GWMICC (Ground water & Mineral Investigation Consultancy Centre) report of August, 2014.
10. Final environmental impact assessment & environmental management plan report, study period- October to December 2018.
11. Annexure-III of letter no. 213(1)/Gen. Updation/ME(I)/2020- letter from IBM to CGM date March, 2020.

# GEOLOGICAL REPORT OF SHANTIPURA BLOCK (SUKHADEV J. TRIVEDI) OF MALIA HATINA TALUKA, JUNAGADH DISTRICT, GUJARAT. (FIELD SEASON-2018-19)

## EXECUTIVE SUMMARY

**Prepared for:**

**COMMISSIONER OF GEOLOGY AND MINING (CGM)**

**Gandhinagar, Gujarat.**


**Prepared By:**

**Vinayak Engimech Pvt. Ltd.**

**B-404 THE FIRST, Keshavbaugh Party Plot,**
**Vastrapur, Ahmedabad.**
**Gujarat.**

# Executive Summary

Shantipura Limestone Mine is a part of 2020-Exploration Project. The shantipura Limestone Mine falls in Shantipura village of Malia-Hatina Taluka of Junagadh District. Exploration of Limestone in Shantipura village of Malia-Hatina taluka has been explored by Commissioner of Geology and Mining (CGM), Industries and Mines Department, Gandhinagar through outsourcing. Drilling agency Vinayak Engimech Pvt. Ltd has carried out drilling in this Shantipura Limestone Mine during 2018-2019. This report covers all details related to Shantipura Limestone Mine study area, which is an expiring mining leases (Date of Expire 31.03.2020).

The area includes mainly Limestone deposits of Tertiary period. The mineralized zone belongs to Miliolitic limestone (Pleistocene age) and Gaj Limestone (age from Pliocene to Miocene). At few places, limestone encounter directly at surface. The thickness of limestone varies from 2.06 m to 5.81 m.

Overall topography of area is flat with slight undulation and gently rolling. The study area falls under survey of India toposheet no. 41 K/8 of Malia-Hatina Taluka of Junagadh District. Girnar, the mountain and important pilgrimage site for both Jains and Hindus, which is about 80 Km away from the study area and another is Somnath temple is very important pilgrimage approx. 28.7 Km away from study area. The study area is accessible throughout the year.

There is 410.00 meterage have been drilled by placing 14 diamond core drill boreholes with the interval of 200 m grid spacing. Around 91 nos. of half splitted core samples sent to Petrography and Mineral Chemistry Laboratory, Gandhinagar for sample analysis. Element suit determined at Petrography and Mineral Chemistry Laboratory, Gandhinagar include $SiO_2$, $Al_2O_3$, $Fe_2O_3$, CaO, MgO, $Na_2O$, $K_2O$, $P_2O_5$, $TiO_2$, MnO, $SO_3$ and loss along with specific gravity data.

Vinayak Engimech Pvt. Ltd. has prepared geological report by considering drilling data and analysis provided by Petrography and Mineral Chemistry Laboratory, Gandhinagar. For resource estimation analysis data, grade of

limestone, area of influence method used. The main mineralized body of limestone belonging to Miliolitic Formation and Gaj Formation.

In Shantipura Limestone Mine exploration carried out is G-2 stage (i.e. general exploration). The geological resources of limestone in the study area have been classified based on Mineral (Evidence of Mineral Contents) Rules, 2015 notified by Ministry of Mines.

Total Resources of 3668389.63 metric tonnes. The total resource of Cement Grade Limestone **[**Cement (Blendable/Beneficiable) grade Limestone**]** is 1643866.81 metric tonnes which cover mineralize area of 17.6950 Hectare and non-mineralize area of 2.2650 Hectare, resource of Limestone **[**Limestone (Blendable/Beneficiable) grade**]** is 1292481.92 metric tonnes which cover mineralize area of 17.0746 Hectare and non-mineralize area of 2.8854 Hectare and of Marl is 732040.90 metric tonnes which cover mineralize area of 16.4105 Hectare and non-mineralize area of 3.2795 Hectare.

As per the Annexure-III (copy of end use grade classification of major minerals used for NMI purpose) published by IBM and chemical analysis, in the Shantipura Limestone Mine the Cement Grade Limestone and Limestone categories can be fall in Cement (Blendable/Beneficiable) grade Limestone and Limestone (Blendable/Beneficiable) grade.

The following table summarizes the grade wise indicated geological resource (332) of Shantipura Limestone Mine study area.

| **Summary of the Shantipura Limestone Mine** | | |
|---|---|---|
| **Name of the Study area** | | **Shantipura Limestone Mine** |
| | Features | Details |
| **1** | **Location** | |
| | Village | Shantipura |
| | Tehsil/Taluka | Malia-Hatina |
| | District | Junagadh |
| | State | Gujarat |
| **2** | **Area (hectares/square kilometers)** | 19.96 Hectare |

| | | |
|---|---|---|
| **3** | **Coordinates** | |
| | Coordinates of Rectangle area (Actual auctionable study area falls in this rectangle area and coordinates of study area given in Geological report) | A) 21°01'25.11"N - 70°19'04.30"E |
| | | B) 21°01'25.11"N - 70°19'34.11"E |
| | | C) 21°01'13.67"N - 70°19'34.11"E |
| | | D) 21°01'13.67"N - 70°19'04.30"E |
| **4** | **Exploration** | Commissioner of Geology and Mining (CGM) |
| | Status (G2/G3/G4 etc.) | G2 |
| | Exploration Agency | **Vinayak Engimech Pvt. Ltd.**<br>B-404 THE FIRST, Keshavbaugh Party Plot, Vastrapur, Ahmedabad. Gujarat. |
| | Total Number of Boreholes with meterage | 14 Boreholes with 410.00 m |
| | Borehole spacing | 200 m |
| **5** | **Quantity of Mineral (Grade-wise) (Indicated Resource-332)** | |
| | Cement Grade Limestone- [Cement (Blendable/Beneficiable) grade Limestone] | 1643866.81 metric tonnes |
| | Limestone- [Limestone (Blendable/Beneficiable) grade] | 1292481.92 metric tonnes |
| | Marl | 732040.90 metric tonnes |
| **6** | Total Geological Resources | Total Resources: 3668389.63 metric tonnes<br><br>Cement Grade Limestone- [Cement (Blendable/Beneficiable) grade Limestone]:<br>G2 – 1643866.81 MT<br>Mineralize area- 17.6950 Hectare<br>Non-mineralize area- 2.2650 Hectare<br><br>Limestone- [Limestone (Blendable/Beneficiable) grade]:<br>G2 – 1292481.92 MT<br>Mineralize area- 17.0746 Hectare<br>Non-mineralize area- 2.8854 Hectare<br><br>Marl:<br>G2 – 732040.90 MT<br>Mineralize area- 16.4105 Hectare<br>Non-mineralize area- 3.5495 Hectare |
| **7** | **Accessibility** | |
| | Nearest Rail Head | Chorvad Railway Station (≈9.00 Km) |
| | Road | Accessible through SH-31 |

| | | |
|---|---|---|
| | Airport | Keshod (≈45.00 Km) |
| | Port | Mangrol intermediate type of port |
| **8** | **Hydrography** | |
| | Local Surface Drainage pattern (Channels) | Radial, Dendritic |
| | Rivers/Streams | Seasonal tributaries |
| **9** | **Climate** | |
| | Mean Annual Rainfall | 1000 to 1200 mm |
| | Temperature (December) | Between 9°C - 35°C |
| | Temperature (May-June) | Between 35°C – 43°C |
| **10** | **Topography** | |
| | Toposheet Number | 41 K/8 |
| | Morphology of the Area | Undulatory with small Hillocks |
| **11** | **Cadastral Summary** | |
| | Total study area | 19.96 Hectare |
| **12** | **Resource Summary** | |
| | Resource (UNFC categorisation, tonnage) | G2 (332),<br>3668389.63 metric tonnes |
| | Average Grade | Cement Grade Limestone- [Cement (Blendable/Beneficiable) grade Limestone]: (CaO= 43.50%, SiO2=12.83%, MgO= 0.30%)<br><br>Limestone- [Limestone (Blendable/Beneficiable) grade]: (CaO= 37.03%, SiO2 =21.81%, MgO= 0.43%)<br><br>Marl:<br>(CaO= 27.86%, SiO2 =33.85%, MgO= 0.80%) |
| | Total Average Thickness | Cement Grade Limestone- [Cement (Blendable/Beneficiable) grade Limestone]: 1.75 m<br><br>Limestone- [Limestone (Blendable/Beneficiable) grade]: 1.15 m<br><br>Marl: 0.76 m |

# SUMMARY OF SHANTIPURA BLOCK

## PART A - GENERAL INFORMATION ABOUT SHANTIPURA LIMESTONE MINE STUDY AREA

<table>
<tr><td></td><td>FEATURES</td><td colspan="3">DETAILS</td></tr>
<tr><td>1</td><td>LOCATION</td><td colspan="3"></td></tr>
<tr><td></td><td>MINERAL BLOCK</td><td colspan="3">Shantipura Limestone Mine</td></tr>
<tr><td rowspan="6"></td><td rowspan="6">CORNER POINTS<br>Coordinates of Rectangle area (Actual auctionable block falls in this rectangle area and coordinates of block given in Geological report)</td><td>PILLAR</td><td colspan="2">DGPS COORDINATES</td></tr>
<tr><td></td><td>LATITUDE</td><td>LONGITUDE</td></tr>
<tr><td>A</td><td>21°01'25.11"N</td><td>70°19'04.30"E</td></tr>
<tr><td>B</td><td>21°01'25.11"N</td><td>70°19'34.11"E</td></tr>
<tr><td>C</td><td>21°01'13.67"N</td><td>70°19'34.11"E</td></tr>
<tr><td>D</td><td>21°01'13.67"N</td><td>70°19'04.30"E</td></tr>
<tr><td></td><td>VILLAGE</td><td colspan="3">Shantipura</td></tr>
<tr><td></td><td>TEHSIL/TALUKA</td><td colspan="3">Malia-Hatina</td></tr>
<tr><td></td><td>DISTRICT</td><td colspan="3">Junagadh</td></tr>
<tr><td></td><td>STATE</td><td colspan="3">Gujarat</td></tr>
<tr><td>2</td><td>AREA (HECTARES)</td><td colspan="3">19.96 Hectare</td></tr>
<tr><td></td><td>MINERALISED AREA</td><td colspan="3">19.96 Hectare</td></tr>
<tr><td></td><td>NON-MINERALISED AREA</td><td colspan="3">NIL</td></tr>
<tr><td>3</td><td>EXPLORATION</td><td colspan="3"></td></tr>
<tr><td></td><td>STATUS (G2/G3/G4 ETC.)</td><td colspan="3">G2</td></tr>
<tr><td></td><td>EXPLORATION AGENCY</td><td colspan="3">VINAYAK ENGIMECH PVT. LTD.<br>B-404 The First, Keshavbaugh Party Plot, Vastrapur, Ahmedabad. Gujarat.</td></tr>
<tr><td></td><td>TOTAL NUMBER OF BOREHOLES WITH METERAGE</td><td colspan="3">Total number of boreholes: 14<br>Total meterage: 410.00 m</td></tr>
<tr><td></td><td>BOREHOLE SPACING (DENSITY)</td><td colspan="3">200 m</td></tr>
<tr><td>4</td><td>QUANTITY OF MINERALS (GRADEWISE) (Indicated Resource-332)</td><td colspan="3"></td></tr>
<tr><td></td><td>MINERAL</td><td colspan="3">Limestone & Marl</td></tr>
<tr><td></td><td>TOTAL GEOLOGICAL RESOURCES</td><td colspan="3">Total Resources: 3668389.63 metric tonnes<br><br>Cement Grade Limestone- [Cement (Blendable/Beneficiable) grade Limestone]:<br>G2 – 1643866.81 MT<br>Mineralize area- 17.6950 Hectare<br>Non-mineralize area- 2.2650 Hectare</td></tr>
</table>

| | | |
|---|---|---|
| | | Limestone- [Limestone (Blendable/Beneficiable) grade]:<br>G2 – 1292481.92 MT<br>Mineralize area- 17.0746 Hectare<br>Non-mineralize area- 2.8854 Hectare<br><br>Marl:<br>G2 – 732040.90 MT<br>Mineralize area- 16.4105 Hectare<br>Non-mineralize area- 3.5495 Hectare |
| | GRADE OF LIMESTONE | 1. Cement (Blendable/Beneficiable) grade Limestone.<br>2. Limestone (Blendable/Beneficiable) grade. |
| | AVERAGE GRADE | Cement Grade Limestone- [Cement (Blendable/Beneficiable) grade Limestone]:<br>($CaO$= 43.50%, $SiO_2$=12.83%, $MgO$= 0.30%)<br><br>Limestone- [Limestone (Blendable/Beneficiable) grade]:<br>($CaO$= 37.03%, $SiO_2$ =21.81%, $MgO$= 0.43%)<br><br>Marl:<br>($CaO$= 27.86%, $SiO_2$ =33.85%, $MgO$= 0.80%) |
| **5** | **MINERALISED ZONES** | |
| | NUMBER OF MINERALS ZONES | 01 (Shantipura Limestone Mine with 19.96 Hectare area) |
| | TOTAL AVERAGE THICKNESS | Cement Grade Limestone- [Cement (Blendable/Beneficiable) grade Limestone]: 1.75 m<br><br>Limestone- [Limestone (Blendable/Beneficiable) grade]: 1.15 m<br><br>Marl: 0.76 m |
| **6** | **ACCESSIBILITY** | |
| | **FEATURES** | **DETAILS** |
| | NEAREST RAIL HEAD | Chorvad Railway Station |
| | ROAD | Accessible through SH-31 |
| | AIRPORT | Keshod |
| | PORT | Mangrol intermediate type of port |
| **7** | **HYDROGRAPHY** | |

| | | |
|---|---|---|
| | LOCAL SURFACE DRAINAGE PATTERN (CHANNELS) | Radial, dendritic pattern |
| | RIVERS/STREAMS | Seasonal tributaries |
| **8** | **CLIMATE** | |
| | MEAN ANNUAL RAINFALL | 1000 to 1200 mm |
| | TEMPERATURE (DECEMBER) | between 9°C - 35°C |
| | TEMPERATURE (JUNE) | between 35°C – 43°C |
| **9** | **TOPOGRAPHY** | |
| | TOPOSHEET NUMBER | 41 K/8 |
| | MORPHOLOGY OF THE AREA | Undulatory with small Hillocks |

## PART B-PARTICULARS OF STATUTORY LICENCES, PERMITS, PERMISSIONS, CONCESSIONS, APPROVALS AND CONSENTS RELATED TO MINING OPERATIOS

| | **PARTICULARS** | **DETAILS/STATUS** |
|---|---|---|
| 1 | REVENUE CLEARANCE | N/A |
| 2 | FOREST CLEARANCE | TO BE OBTAINED BY THE PREFERRED BIDDER IF REQUIRED |
| 3 | WILD LIFE CLEARANCE (SANCTUARY, RESERVE OR SPECIAL ZONE CLEARANCE) | TO BE OBTAINED BY THE PREFERRED BIDDER IF REQUIRED |
| 4 | ENVIRONMENT CLEARANCE | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 5 | MINING PLAN APPROVAL | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 6 | CONSENT TO ESTABLISH | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 7 | EXPLOSIVE LICENCE | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 8 | PERMISSION FOR MINE OPENING | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 9 | PERMISSION OF INSTALLATION/TRIAL OPERATION OF EQUIPMENT | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 10 | GROUND WATER CLEARANCE (CENTRE/STATE) | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 11 | RAILWAY SIDING APPROVAL | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 12 | APPROVAL FOR DIESEL STORAGE | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 13 | POWER LINE FROM STATE DISCOM | TO BE OBTAINED BY THE PREFERRED BIDDER |

| | | |
|---|---|---|
| 14 | CLEARANCE RELATING TO WORK UNDER AN EXISTING TRANSMISSION LINE OR SHIFTING OF THE TRANSMISSION LINE | TO BE OBTAINED BY THE PREFERRED BIDDER |
| 15 | GRAM SABHA CONSENT | TO BE OBTAINED BY THE PREFERRED BIDDER IF REQUIRED |
| 16 | ANY OTHER CLEARANCES TO START MINING OPERATION | TO BE OBTAINED BY THE PREFERRED BIDDER |

## PART C-PARTICULARS OF LAND

| Sr. No. | LAND TYPE | AREA (IN HECTARES) |
|---|---|---|
| 1 | TOTAL CONCESSION AREA | 19.96 Hectare |
| 2 | FOREST WITH STATUS | N/A |
| 3 | GOVERNMENT LAND WITH STATUS | 19.96 hectare (100%) |
| 4 | PRIVATE LAND WITH STATUS | N/A |
| 5 | CHARAGAH/PASTURE LAND (*) | N/A |
| 6 | REVENUE SURVEY DETAILS OF THE AREA | SCHEDULE ATTACHED |

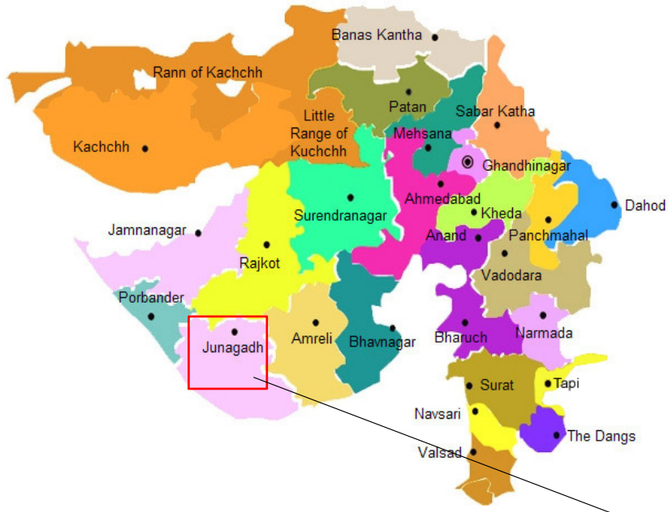
| CO-ORDINATES OF SHANTIPURA LIMESTONE MINE STUDY AREA BOUNDARY | | | | | |
|---|---|---|---|---|---|
| SR. NO. | POINT ID | UTM (WGS84) | | DMS (WGS84) | |
| | | EASTING | NORTHING | LATITUDE | LONGITUDE |
| 1 | BP-1 | 636963 | 2325285 | 21°01'23.68'' | 70°19'04.68'' |
| 2 | BP-2 | 637508 | 2325319 | 21°01'24.62'' | 70°19'23.59'' |
| 3 | BP-3 | 637737 | 2325307 | 21°01'24.15'' | 70°19'31.51'' |
| 4 | BP-4 | 637789 | 2325017 | 21°01'14.72'' | 70°19'33.25'' |
| 5 | BP-5 | 637733 | 2324996 | 21°01'14.04'' | 70°19'31.28'' |
| 6 | BP-6 | 636972 | 2325113 | 21°01'18.10'' | 70°19'04.94'' |

## Khasra Schedule

| Shantipura Village | | | |
|---|---|---|---|
| SR. No. | Survey No. | Area (Hectare) | Type of Land |
| 1 | 78 P (78/1/P9) | 19.96 | Government |

# KEY & LOCATION PLAN

| DISTRICT | TOTAL AREA Sq. Kms. | POPULATION | AVG. LITERACY % |
|---|---|---|---|
| JUNAGADH | 8831.00 | 2743082 | 75.80 |




N

1:50,000

Chorvad Road Railway Station

Barula

Visanvel

Januda

Shantipura

shree ram mandir

School

Sukhpur

Simar

Paldi

Sarasva

Vinoba Vidhya mandir

kindarva

Vavdi Adri

Vadodara Dodiya

Arjun Education campus

Sidokar

Chanduvava

**DRILLING AGENCY:**
**Vinayak Engimech Pvt. Ltd.**

**COMMISSIONER OF GEOLOGY AND MINING (CGM)**
(Block No.1 7th Floor,
Udhyog Bhavan, Sector-11,
Gandhinagar, Gujarat-382010.)

TA: - MALIA DIST.:- JUNAGADH STATE - GUJARAT

**LEGEND**

- Village, Town
- Bus Station
- River
- State, National Highway
- Study Area
- College
- Other Road
- Rail Route
- Temple

# AERIAL VIEW OF STUDY AREA SHANTIPURA LIMESTONE MINE, JUNAGADH.

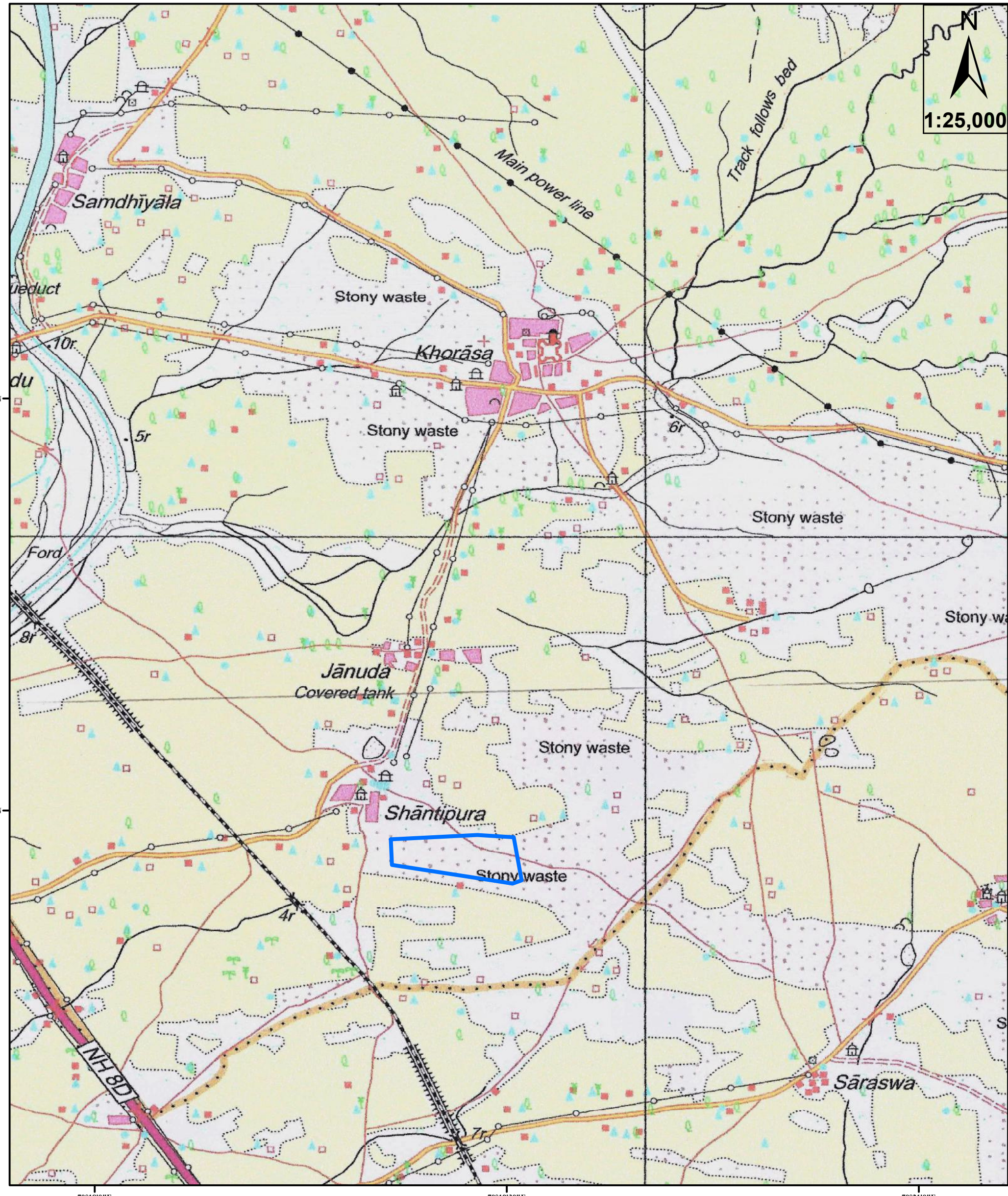



| DRILLING AGENCY: Vinayak Engimech Pvt. Ltd. |
|---|
| COMMISSIONER OF GEOLOGY AND MINING (CGM) (Block No.1 7th Floor, Udhyog Bhavan, Sector-11, Gandhinagar, Gujarat-382010.) |
| TA: - MALIA DIST.:- JUNAGADH STATE - GUJARAT |

## LEGEND

- Study Area Villages
- A — Corner Points with Cordinates
- Study Area

# STUDY AREA LOCATION ON TOPOSHEET - F-41 K/8
# SHANTIPURA LIMESTONE MINE, JUNAGADH.




| DRILLING AGENCY: Vinayak Engimech Pvt. Ltd. |
|---|
| COMMISSIONER OF GEOLOGY AND MINING (CGM) (Block No.1 7th Floor, Udhyog Bhavan, Sector-11, Gandhinagar, Gujarat-382010) |
| TA: - KALYANPUR DIST.:- DEVBHUMI DWARKA STATE - GUJARAT |

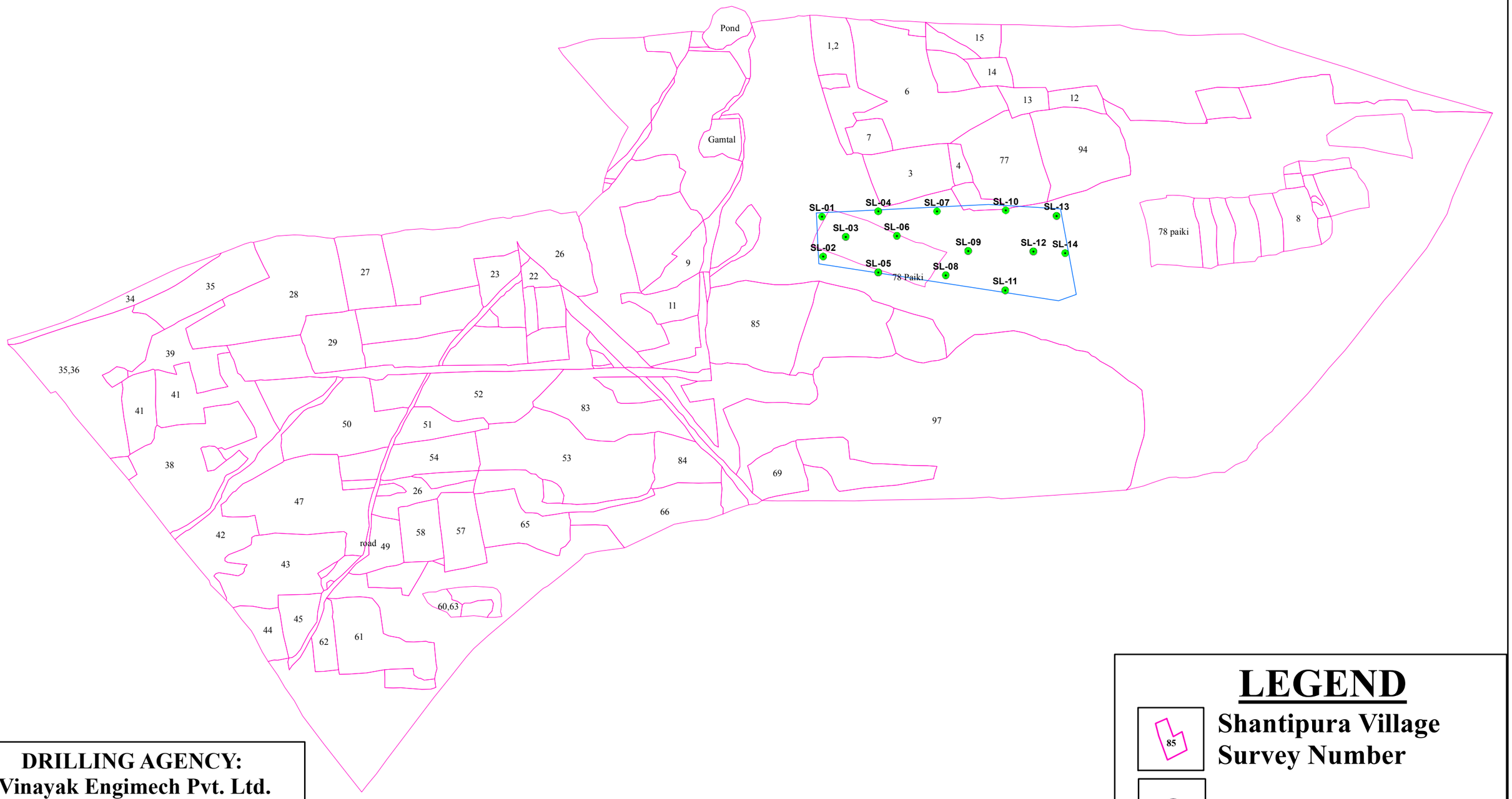
## LEGEND

- TALUKA HEAD QUATER
- STATE HIGHWAY
- WESTERN RAILWAY
- OTHER ROAD
- STUDY AREA
- FAIRLY DESNSED MIXED JUNGLE
- PRIMARY HEALTH CENTRE, TEMPLE
- MUD
- RESERVED FOREST
- STONY WASTE

# CADASTRAL MAP OF STUDY AREA
# SHANTIPURA LIMESTONE MINE, JUNAGADH.

N

1:13,000




## LEGEND

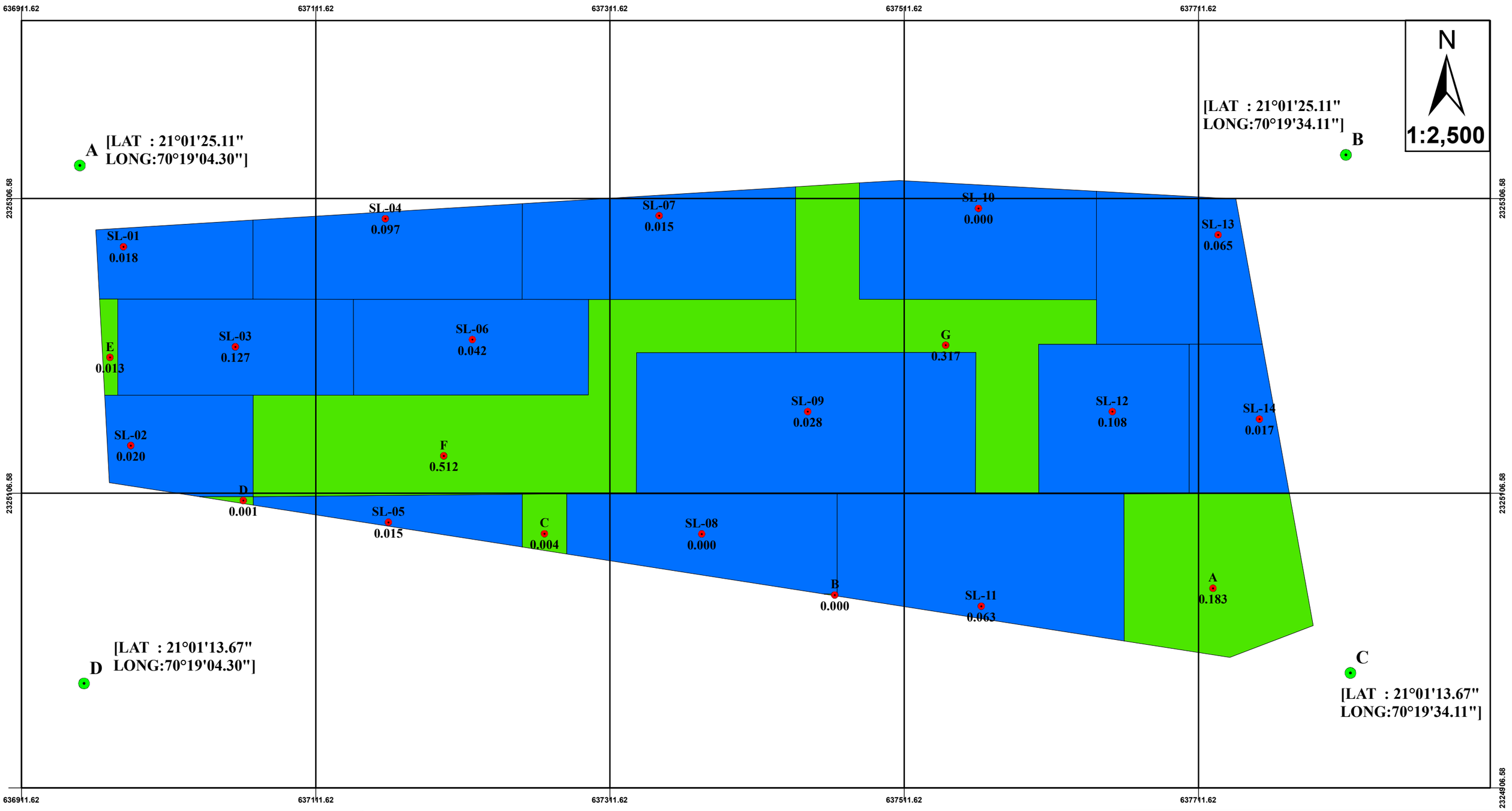
- Shantipura Village Survey Number (85)
- Drilled Bore Holes
- Study Area Boundary

**DRILLING AGENCY:**
**Vinayak Engimech Pvt. Ltd.**

**COMMISSIONER OF GEOLOGY AND MINING (CGM)**
(Block No.1 7th Floor,
Udhyog Bhavan, Sector-11,
Gandhinagar, Gujarat-382010.)

TA: - MALIA DIST.:- JUNAGADH STATE - GUJARAT

# RESOURCE ESTIMATION MAP FOR CEMENT GRADE LIMESTONE, SHANTIPURA LIMESTONE MINE, JUNAGADH.




## INDEX

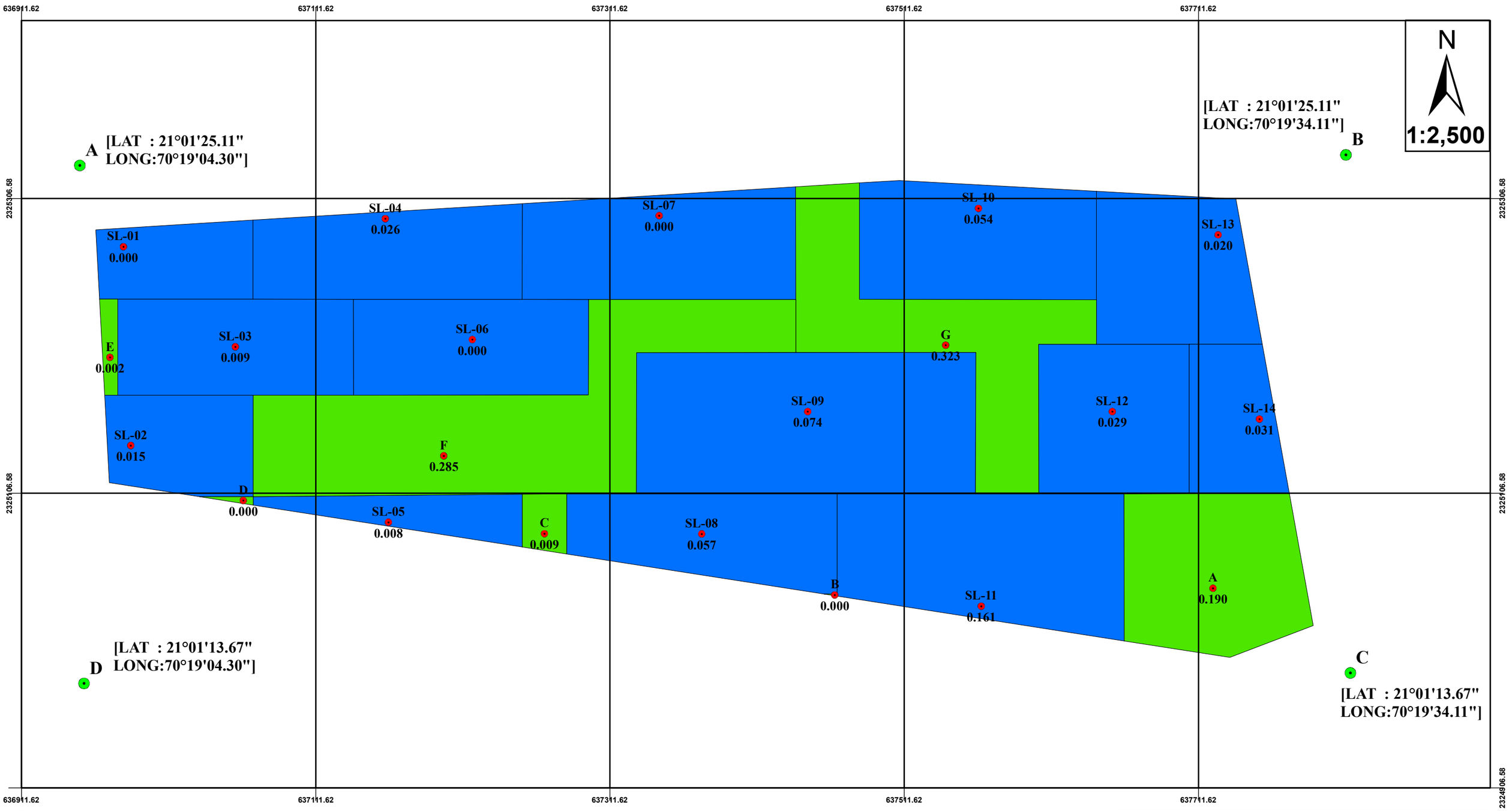
- SL-09 0.028 — BOREHOLES WITH RESOURCE IN MILLION TONNES
- A — CORNER POINTS WITH COORDINATES
- RESOURCE UNDER G-1 CATEGORY
- RESOURCE UNDER G-2 CATEGORY

**DRILLING AGENCY:**
**Vinayak Engimech Pvt. Ltd.**

**COMMISSIONER OF GEOLOGY AND MINING (CGM)**
(Block No.1 7th Floor,
Udhyog Bhavan, Sector-11,
Gandhinagar, Gujarat-382010.)

TA: - MALIA DIST.:- JUNAGADH STATE - GUJARAT

# RESOURCE ESTIMATION MAP FOR LIMESTONE, SHANTIPURA LIMESTONE MINE, JUNAGADH.




## INDEX

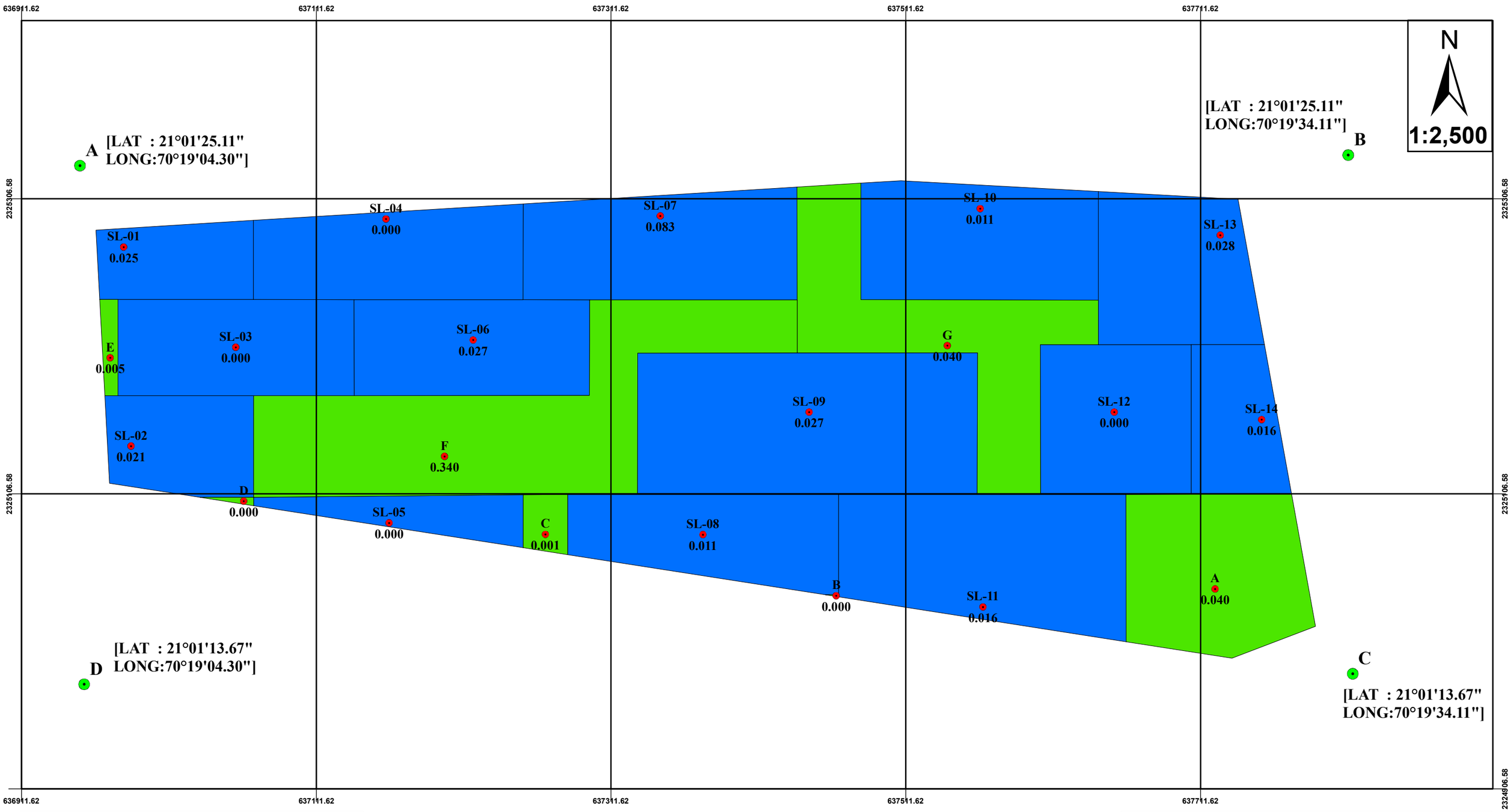
- SL-09 0.074 — BOREHOLES WITH RESOURCE IN MILLION TONNES
- A — CORNER POINTS WITH COORDINATES
- RESOURCE UNDER G-1 CATEGORY
- RESOURCE UNDER G-2 CATEGORY

**DRILLING AGENCY:**
**Vinayak Engimech Pvt. Ltd.**

**COMMISSIONER OF GEOLOGY AND MINING (CGM)**
(Block No.1 7th Floor,
Udhyog Bhavan, Sector-11,
Gandhinagar, Gujarat-382010.)

TA: - MALIA DIST.:- JUNAGADH STATE - GUJARAT

# RESOURCE ESTIMATION MAP FOR MARL, SHANTIPURA LIMESTONE MINE, JUNAGADH.




## INDEX

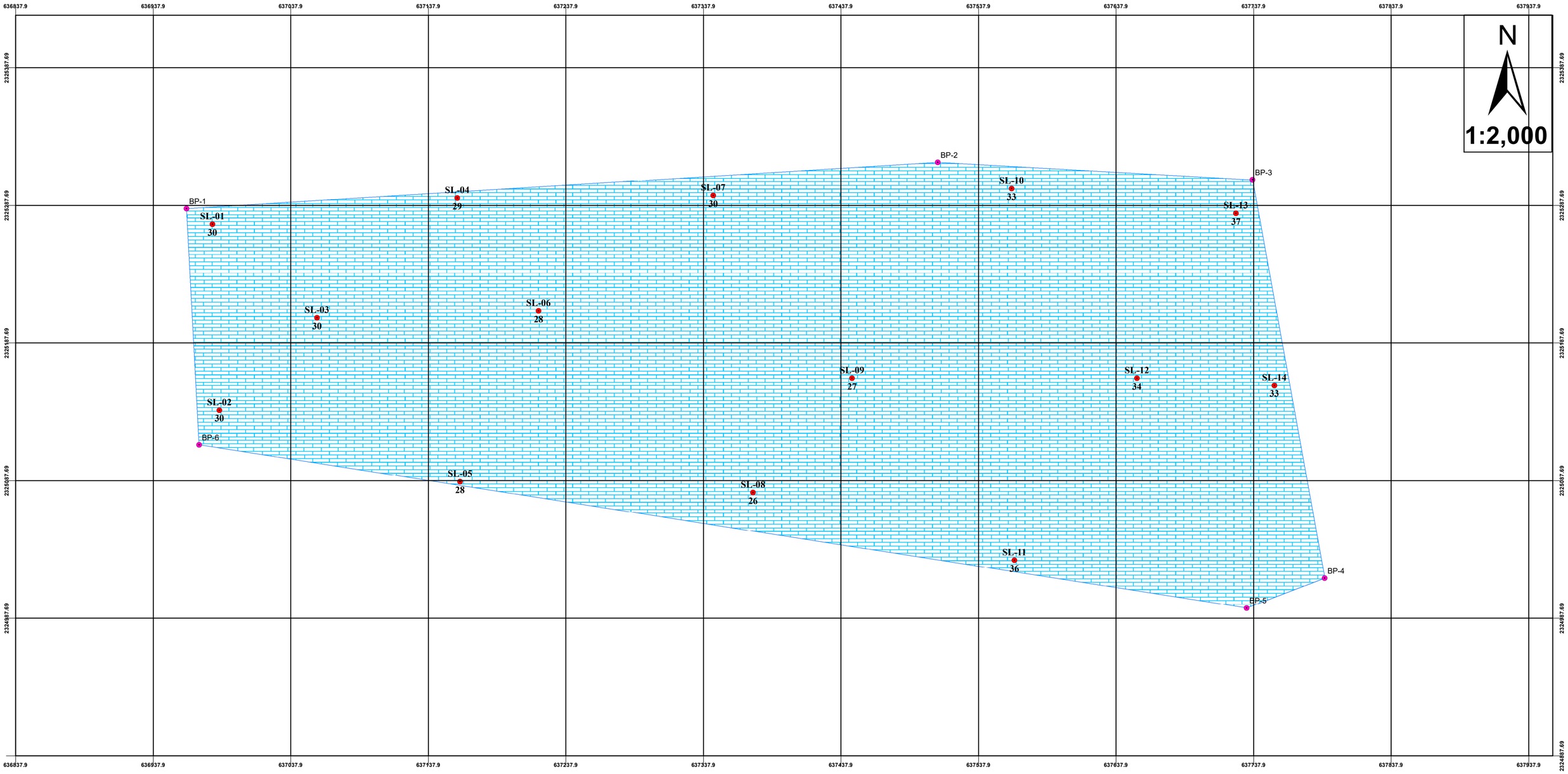
- SL-09 0.027 — BOREHOLES WITH RESOURCE IN MILLION TONNES
- A — CORNER POINTS WITH COORDINATES
- RESOURCE UNDER G-1 CATEGORY
- RESOURCE UNDER G-2 CATEGORY

**DRILLING AGENCY:**
**Vinayak Engimech Pvt. Ltd.**

**COMMISSIONER OF GEOLOGY AND MINING (CGM)**
(Block No.1 7th Floor,
Udhyog Bhavan, Sector-11,
Gandhinagar, Gujarat-382010.)

TA: - MALIA DIST.:- JUNAGADH STATE - GUJARAT

# SURFACE GEOLOGICAL MAP, SHANTIPURA LIMESTONE MINE, JUNAGADH.




| SR. NO. | POINT ID | DMS (WGS84) | |
|---|---|---|---|
| | | LATITUDE | LONGITUDE |
| 1 | BP-1 | 21°01'23.68" | 70°19'04.68" |
| 2 | BP-2 | 21°01'24.62" | 70°19'23.59" |
| 3 | BP-3 | 21°01'24.15" | 70°19'31.51" |
| 4 | BP-4 | 21°01'14.72" | 70°19'33.25" |
| 5 | BP-5 | 21°01'14.04" | 70°19'31.28" |
| 6 | BP-6 | 21°01'18.10" | 70°19'04.94" |

## INDEX

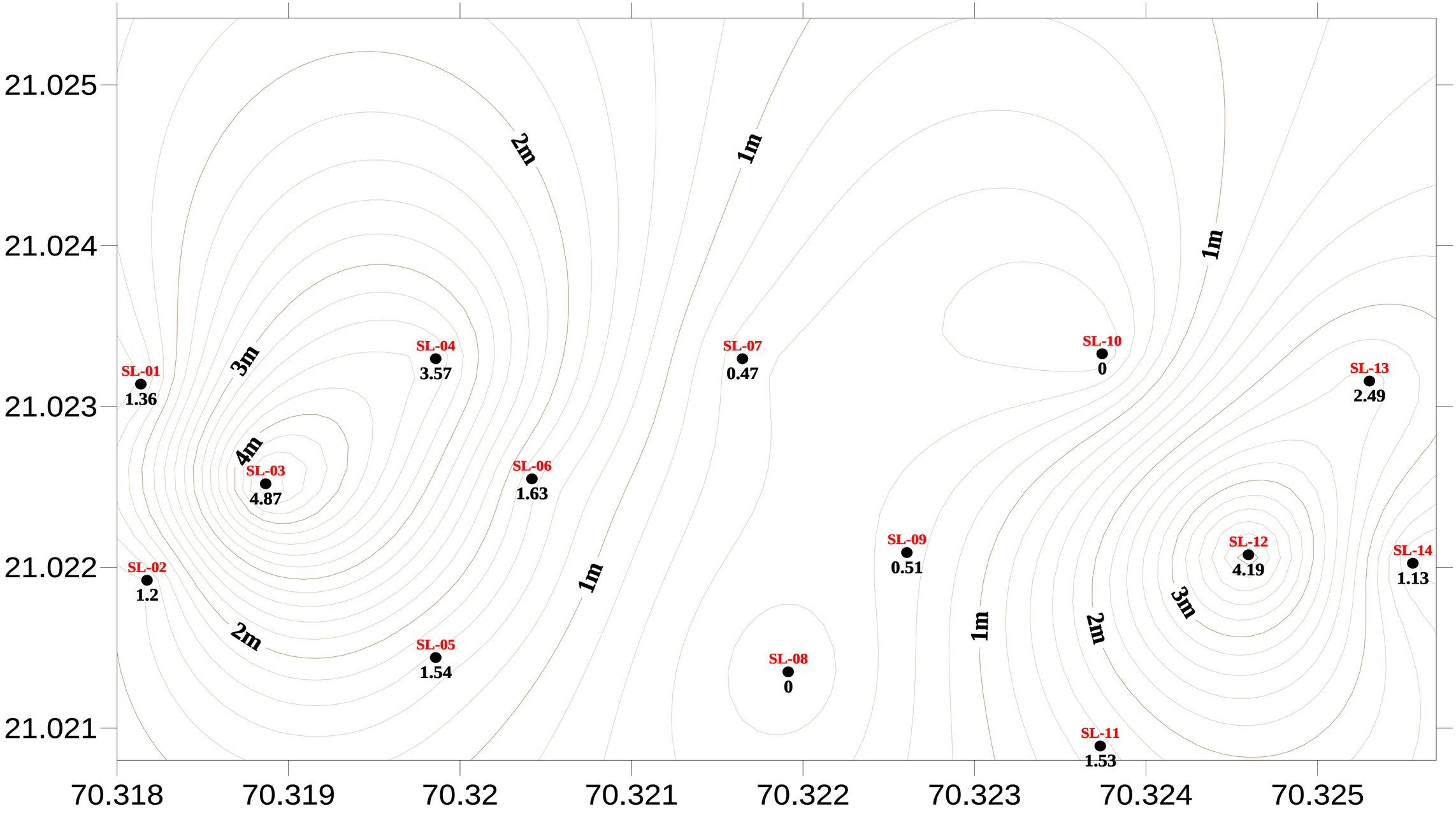
- BOREHOLES WITH R.L.
- BOUNDARY PILLAR
- Shantipura Limestone Mine Boundary
- Miliolitic Limestone

**DRILLING AGENCY:**
**Vinayak Engimech Pvt. Ltd.**

**COMMISSIONER OF GEOLOGY AND MINING (CGM)**
(Block No.1 7th Floor,
Udhyog Bhavan, Sector-11,
Gandhinagar, Gujarat-382010.)

TA: - MALIA DIST.:- JUNAGADH STATE - GUJARAT

# ISOPACH MAP OF CEMENT GRADE LIMESTONE
# SHANTIPURA LIMESTONE MINE, JUNAGADH.




## INDEX

SL-05 1.54 — Borehole with Thickness

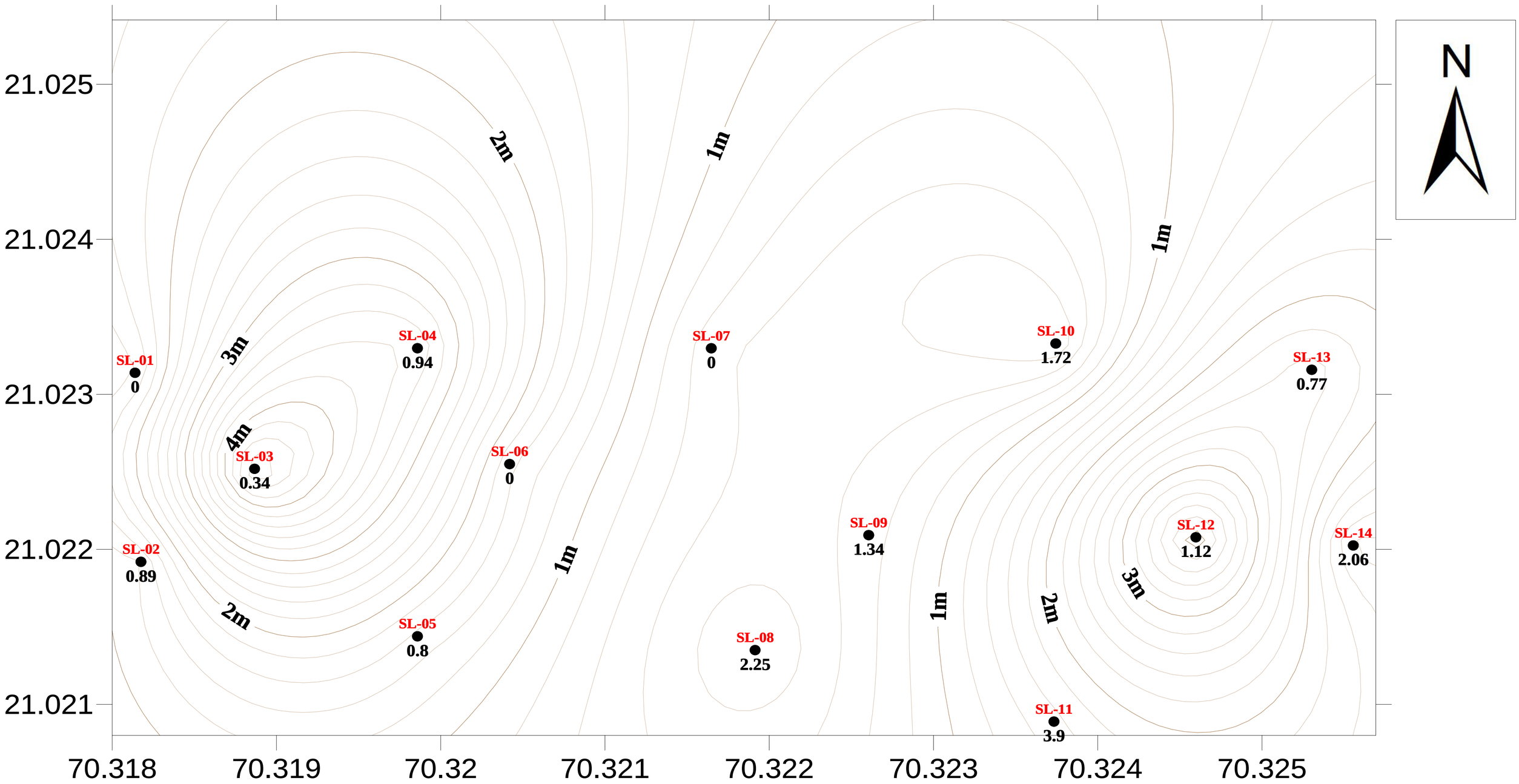
Contour

## Scale

0m 200m 400m 600m 800m

**Drilling Agency:**
**Vinayak Engimech. Pvt. Ltd.**

# ISOPACH MAP OF LIMESTONE
# SHANTIPURA LIMESTONE MINE, JUNAGADH.




## INDEX

SL-05
0.80
Borehole with Thickness

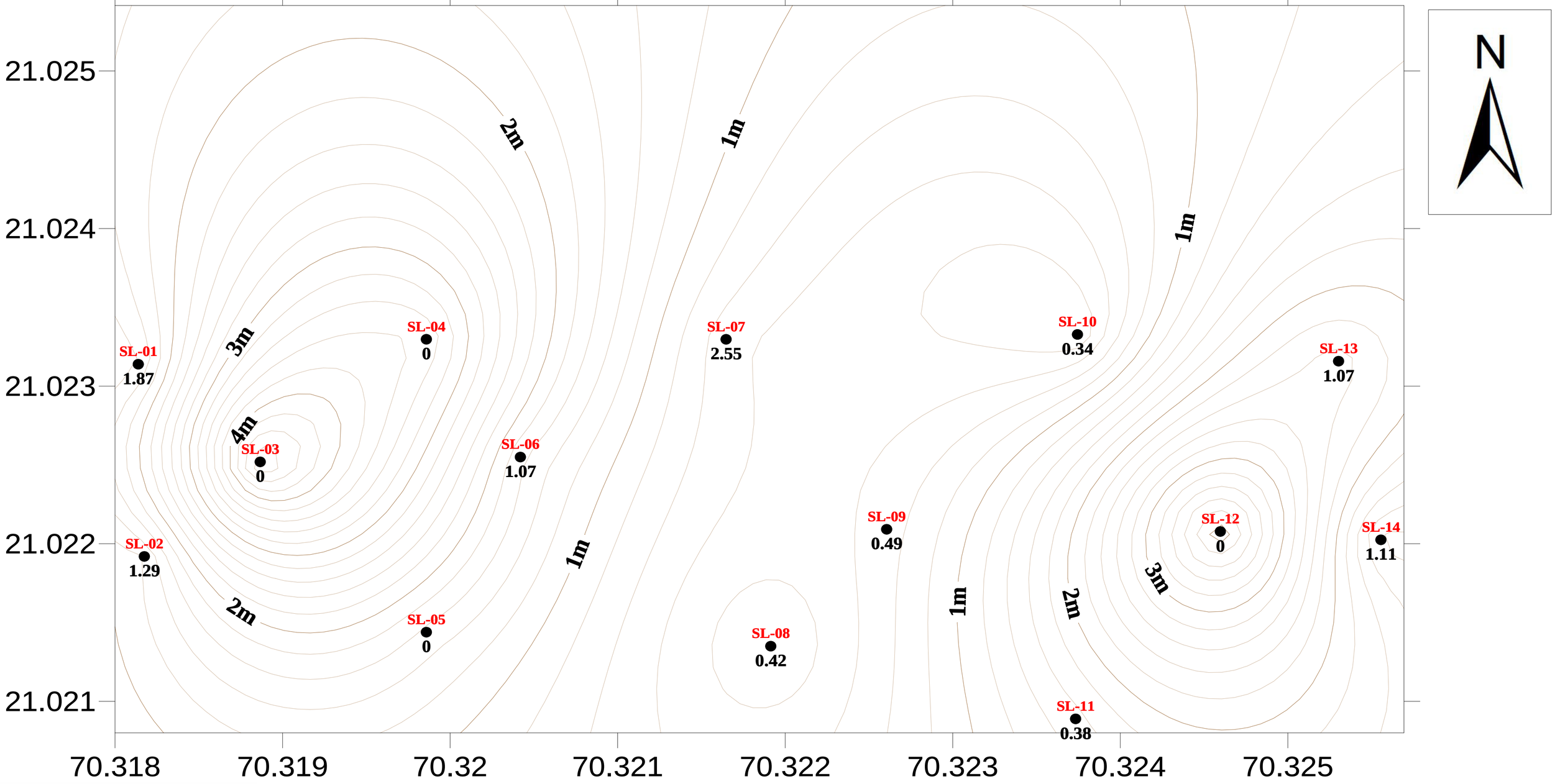
Contour

## Scale

0m 200m 400m 600m 800m

**Drilling Agency:**
**Vinayak Engimech. Pvt. Ltd.**

# ISOPACH MAP OF MARL
# SHANTIPURA LIMESTONE MINE, JUNAGADH.




## INDEX

SL-06 1.07 — Borehole with Thickness

Contour

## Scale

0m — 200m — 400m — 600m — 800m

**Drilling Agency:**
**Vinayak Engimech. Pvt. Ltd.**

# ANNEXURE-1

## RESOURCE ESTIMATION SHEET - 2020 EXPLORATION-SHANTIPURA LIMESTONE MINE, JUNAGDH.

**The specific gravity value is taken as 2.49 for Cement Grade Limestone**

| G2 For Cement Grade Limestone | | | | | | |
|---|---|---|---|---|---|---|
| **SR. No.** | **BH ID** | **Area (In Sq. m.)** | **Thickness (m)** | **Volume (In cubic m)** | **Tonnage (In MT)** | **Tonnage (in million tonnes)** |
| 1 | SL-03 | 10448.1080 | 4.87 | 50882.29 | 126696.89 | 0.127 |
| 2 | SL-12 | 10391.2290 | 4.19 | 43539.25 | 108412.73 | 0.108 |
| 3 | SL-09 | 22117.0732 | 0.51 | 11279.71 | 28086.47 | 0.028 |
| 4 | SL-14 | 5977.5076 | 1.13 | 6754.58 | 16818.91 | 0.017 |
| 5 | SL-04 | 10860.7450 | 3.57 | 38772.86 | 96544.42 | 0.097 |
| 6 | SL-07 | 13165.9336 | 0.47 | 6187.99 | 15408.09 | 0.015 |
| 7 | SL-11 | 16516.3528 | 1.53 | 25270.02 | 62922.35 | 0.063 |
| 8 | SL-05 | 3794.9861 | 1.54 | 5844.28 | 14552.25 | 0.015 |
| 9 | SL-13 | 10471.5225 | 2.49 | 26074.09 | 64924.49 | 0.065 |
| 10 | SL-02 | 6544.5285 | 1.20 | 7853.43 | 19555.05 | 0.020 |
| 11 | SL-06 | 10375.2192 | 1.63 | 16911.61 | 42109.90 | 0.042 |
| 12 | SL-01 | 5313.1302 | 1.36 | 7225.86 | 17992.38 | 0.018 |
| | | **125976.3356** | | | **614023.95** | **0.614** |

| G2 For Cement Grade Limestone | | | | | | |
|---|---|---|---|---|---|---|
| **Point** | **BH ID** | **Area (In Sq. m.)** | **Thickness (m)** | **Volume (In cubic m)** | **Tonnage (In MT)** | **Tonnage (in million tonnes)** |
| A | SL-11<br>SL-12<br>SL-14 | 10755.2630 | 6.85 | 73673.55 | 183447.14 | 0.183 |
| B | SL-08<br>SL-11 | 6.2819 | 1.53 | 9.61 | 23.93 | 0.000 |
| C | SL-05<br>SL-08 | 1155.9443 | 1.54 | 1780.15 | 4432.58 | 0.004 |
| D | SL-05<br>SL-02 | 101.7935 | 2.74 | 278.91 | 694.50 | 0.001 |
| E | SL-01<br>SL-02<br>SL-03 | 693.0829 | 7.43 | 5149.61 | 12822.52 | 0.013 |
| F | SL-02<br>SL-03<br>SL-06<br>SL-07<br>SL-08<br>SL-09 | 23666.8755 | 8.68 | 205428.48 | 511516.91 | 0.512 |
| G | SL-09<br>SL-10<br>SL-11<br>SL-12<br>SL-13 | 14595.3206 | 8.72 | 127271.20 | 316905.28 | 0.317 |
| | | **50974.5617** | | | **1029842.87** | **1.030** |

**The specific gravity value is taken as 2.50 for Limestone**

| G2 For Limestone | | | | | | |
|---|---|---|---|---|---|---|
| **SR. No.** | **BH ID** | **Area (In Sq. m.)** | **Thickness (m)** | **Volume (In cubic m)** | **Tonnage (In MT)** | **Tonnage (in million tonnes)** |
| 1 | SL-03 | 10448.1080 | 0.34 | 3552.36 | 8880.89 | 0.009 |
| 2 | SL-12 | 10391.2290 | 1.12 | 11638.18 | 29095.44 | 0.029 |
| 3 | SL-09 | 22117.0732 | 1.34 | 29636.88 | 74092.20 | 0.074 |
| 4 | SL-14 | 5977.5076 | 2.06 | 12313.67 | 30784.16 | 0.031 |
| 5 | SL-04 | 10860.7450 | 0.94 | 10209.10 | 25522.75 | 0.026 |
| 6 | SL-10 | 12517.6093 | 1.72 | 21530.29 | 53825.72 | 0.054 |
| 7 | SL-11 | 16516.3528 | 3.90 | 64413.78 | 161034.44 | 0.161 |
| 8 | SL-05 | 3794.9861 | 0.80 | 3035.99 | 7589.97 | 0.008 |
| 9 | SL-08 | 10131.4931 | 2.25 | 22795.86 | 56989.65 | 0.057 |
| 10 | SL-13 | 10471.5225 | 0.77 | 8063.07 | 20157.68 | 0.020 |
| 11 | SL-02 | 6544.5285 | 0.89 | 5824.63 | 14561.58 | 0.015 |
| | | **119771.1550** | | | **482534.48** | **0.483** |

| G2 For Limestone | | | | | | |
|---|---|---|---|---|---|---|
| **Point** | **BH ID** | **Area (In Sq. m.)** | **Thickness (m)** | **Volume (In cubic m)** | **Tonnage (In MT)** | **Tonnage (in million tonnes)** |
| A | SL-11<br>SL-12<br>SL-14 | 10755.2630 | 7.08 | 76147.26 | 190368.16 | 0.190 |
| B | SL-08<br>SL-11 | 6.2819 | 6.15 | 38.63 | 96.58 | 0.000 |
| C | SL-05<br>SL-08 | 1155.9443 | 3.05 | 3525.63 | 8814.07 | 0.009 |
| D | SL-05<br>SL-02 | 101.7935 | 1.69 | 172.03 | 430.08 | 0.000 |
| E | SL-01<br>SL-02<br>SL-03 | 693.0829 | 1.23 | 852.49 | 2131.23 | 0.002 |
| F | SL-02<br>SL-03<br>SL-06<br>SL-07<br>SL-08<br>SL-09 | 23666.8755 | 4.82 | 114074.34 | 285185.85 | 0.285 |
| G | SL-09<br>SL-10<br>SL-11<br>SL-12<br>SL-13 | 14595.3206 | 8.85 | 129168.59 | 322921.47 | 0.323 |
| | | **50974.5617** | | | **809947.44** | **0.810** |

**The specific gravity value is taken as 2.47 for Marl**

| G2 For Marl | | | | | | |
|---|---|---|---|---|---|---|
| **SR. No.** | **BH ID** | **Area (In Sq. m.)** | **Thickness (m)** | **Volume (In cubic m)** | **Tonnage (In MT)** | **Tonnage (in million tonnes)** |
| 1 | SL-09 | 22117.0732 | 0.49 | 10837.37 | 26768.29 | 0.027 |
| 2 | SL-14 | 5977.5076 | 1.11 | 6635.03 | 16388.53 | 0.016 |
| 3 | SL-07 | 13165.9336 | 2.55 | 33573.13 | 82925.63 | 0.083 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | SL-10 | 12517.6093 | 0.34 | 4255.99 | 10512.29 | 0.011 |
| 5 | SL-11 | 16516.3528 | 0.38 | 6276.21 | 15502.25 | 0.016 |
| 6 | SL-08 | 10131.4931 | 0.42 | 4255.23 | 10510.41 | 0.011 |
| 7 | SL-13 | 10471.5225 | 1.07 | 11204.53 | 27675.19 | 0.028 |
| 8 | SL-02 | 6544.5285 | 1.29 | 8442.44 | 20852.83 | 0.021 |
| 9 | SL-06 | 10375.2192 | 1.07 | 11101.48 | 27420.67 | 0.027 |
| 10 | SL-01 | 5313.1302 | 1.87 | 9935.55 | 24540.82 | 0.025 |
| | | **113130.3699** | | | **263096.91** | **0.263** |

| **G2 For Marl** | | | | | | |
|---|---|---|---|---|---|---|
| **SR. No.** | **BH ID** | **Area (In Sq. m.)** | **Thickness (m)** | **Volume (In cubic m)** | **Tonnage (In MT)** | **Tonnage (in million tonnes)** |
| A | SL-11<br>SL-12<br>SL-14 | 10755.2630 | 1.49 | 16025.34 | 39582.59 | 0.040 |
| B | SL-08<br>SL-11 | 6.2819 | 0.80 | 5.03 | 12.41 | 0.000 |
| C | SL-05<br>SL-08 | 1155.9443 | 0.42 | 485.50 | 1199.18 | 0.001 |
| D | SL-05<br>SL-02 | 101.7935 | 1.29 | 131.31 | 324.34 | 0.000 |
| E | SL-01<br>SL-02<br>SL-03 | 693.0829 | 3.16 | 2190.14 | 5409.65 | 0.005 |
| F | SL-02<br>SL-03<br>SL-06<br>SL-07<br>SL-08<br>SL-09 | 23666.8755 | 5.82 | 137741.22 | 340220.80 | 0.340 |
| G | SL-09<br>SL-10<br>SL-11<br>SL-12<br>SL-13 | 14595.3206 | 2.28 | 33277.33 | 82195.01 | 0.082 |
| | | **50974.5617** | | | **468943.99** | **0.469** |

## Average Grade of Cement Grade Limestone

| **Sr. No.** | **BH ID** | **Avg. Thickness** | **Avg. $SiO_2$ %** | **Avg. CaO %** | **Avg. MgO %** |
|---|---|---|---|---|---|
| 1 | SL-03 | 0.70 | 12.05 | 44.10 | 0.32 |
| 2 | SL-12 | 0.84 | 13.59 | 43.69 | 0.29 |
| 3 | SL-09 | 0.51 | 14.41 | 42.24 | 0.31 |
| 4 | SL-14 | 0.57 | 17.39 | 40.58 | 0.35 |
| 5 | SL-04 | 3.57 | 13.81 | 43.22 | 0.32 |
| 6 | SL-07 | 0.47 | 8.24 | 47.02 | 0.24 |
| 7 | SL-11 | 0.51 | 11.96 | 43.97 | 0.27 |
| 8 | SL-05 | 0.77 | 12.55 | 43.13 | 0.30 |
| 9 | SL-13 | 0.83 | 10.47 | 45.96 | 0.24 |
| 10 | SL-02 | 1.20 | 13.27 | 42.55 | 0.30 |
| 11 | SL-06 | 0.82 | 11.84 | 43.41 | 0.30 |
| 12 | SL-01 | 0.68 | 14.43 | 42.18 | 0.30 |
| | | | **12.83** | **43.50** | **0.30** |

## Average Grade of Limestone

| Sr. No. | BH ID | Avg. Thickness | Avg. $SiO_2$ % | Avg. CaO % | Avg. MgO % |
|---|---|---|---|---|---|
| 1 | SL-03 | 0.34 | 20.03 | 37.61 | 0.38 |
| 2 | SL-12 | 0.56 | 19.73 | 37.16 | 0.82 |
| 3 | SL-09 | 0.45 | 22.50 | 36.09 | 0.46 |
| 4 | SL-14 | 0.69 | 24.58 | 35.69 | 0.39 |
| 5 | SL-04 | 0.94 | 23.39 | 37.46 | 0.41 |
| 6 | SL-10 | 0.57 | 23.42 | 36.25 | 0.44 |
| 7 | SL-11 | 0.78 | 20.67 | 37.86 | 0.40 |
| 8 | SL-05 | 0.40 | 22.95 | 37.20 | 0.36 |
| 9 | SL-08 | 0.45 | 18.77 | 38.20 | 0.37 |
| 10 | SL-13 | 0.39 | 21.05 | 38.31 | 0.36 |
| 11 | SL-02 | 0.89 | 22.80 | 35.54 | 0.36 |
| | | | **21.81** | **37.03** | **0.43** |

## Average Grade of Marl

| Sr. No. | BH ID | Avg. Thickness | Avg. $SiO_2$ % | Avg. CaO % | Avg. MgO % |
|---|---|---|---|---|---|
| 1 | SL-09 | 0.49 | 36.98 | 23.88 | 2.26 |
| 2 | SL-14 | 0.55 | 33.88 | 28.12 | 0.78 |
| 3 | SL-07 | 0.64 | 36.04 | 26.78 | 0.74 |
| 4 | SL-10 | 0.34 | 43.21 | 21.17 | 0.98 |
| 5 | SL-11 | 0.38 | 26.77 | 33.50 | 0.55 |
| 6 | SL-08 | 0.42 | 31.36 | 29.23 | 0.49 |
| 7 | SL-13 | 0.36 | 30.67 | 30.96 | 0.55 |
| 8 | SL-02 | 0.65 | 27.79 | 32.09 | 0.53 |
| 9 | SL-06 | 0.54 | 36.86 | 26.18 | 0.58 |
| 10 | SL-01 | 0.94 | 34.93 | 26.73 | 0.56 |
| | | | **33.85** | **27.86** | **0.80** |

**ANNEXURE-2**

## OVERBURDEN TO MINERAL RATIO

## OVERBURDEN TO MINERAL RATIO, SHANTIPURA LIMESTONE MINE, JUNAGADH

| BH ID | Overburden (OB) (m) | Total OB | Mineralized Zone Thickness (m) | | | | Interburden Thickness (m) | | | | Total Overburden (O.B.+ I.B.) (m) | Overburden:Mineralized zone Thickness |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | From | To | Thickness | Total Thickness | From | To | Thickness | Total Interburden Thickness | | |
| SL-03 | 0.00 | 0.00 | 0.00 | 4.00 | 4.00 | 5.21 | 4.00 | 9.00 | 5.00 | 11.24 | 11.24 | 2.16 |
| | | | 9.00 | 9.34 | 0.34 | | 9.34 | 10.00 | 0.66 | | | |
| | | | 10.00 | 10.42 | 0.42 | | 10.42 | 16.00 | 5.58 | | | |
| | | | 16.00 | 16.45 | 0.45 | | | | | | | |
| SL-12 | 0.45 | 0.45 | 0.45 | 4.00 | 3.55 | 5.31 | 4.00 | 6.00 | 2.00 | 42.04 | 42.49 | 8.00 |
| | | | 6.00 | 6.32 | 0.32 | | 6.32 | 18.14 | 11.82 | | | |
| | | | 18.14 | 18.78 | 0.64 | | 18.78 | 47.00 | 28.22 | | | |
| | | | 47.00 | 47.80 | 0.80 | | | | | | | |
| SL-09 | 0.00 | 0.00 | 0.00 | 1.00 | 1.00 | 2.34 | 1.00 | 4.23 | 3.23 | 12.22 | 12.22 | 5.22 |
| | | | 4.23 | 4.66 | 0.43 | | 4.66 | 6.38 | 1.72 | | | |
| | | | 6.38 | 6.73 | 0.35 | | 6.73 | 14.00 | 7.27 | | | |
| | | | 14.00 | 14.56 | 0.56 | | | | | | | |
| SL-14 | 0.18 | 0.18 | 0.18 | 0.92 | 0.74 | 4.30 | 0.92 | 1.00 | 0.08 | 16.26 | 16.44 | 3.82 |
| | | | 1.00 | 1.72 | 0.72 | | 1.72 | 2.00 | 0.28 | | | |
| | | | 2.00 | 2.80 | 0.80 | | 2.80 | 3.00 | 0.20 | | | |
| | | | 3.00 | 3.54 | 0.54 | | 3.54 | 3.63 | 0.09 | | | |
| | | | 3.63 | 4.00 | 0.37 | | 4.00 | 15.00 | 11.00 | | | |
| | | | 15.00 | 15.39 | 0.39 | | 15.39 | 20.00 | 4.61 | | | |
| | | | 20.00 | 20.74 | 0.74 | | | | | | | |
| SL-04 | 0.06 | 0.06 | 0.06 | 1.62 | 1.56 | 4.51 | 1.62 | 1.81 | 0.19 | 19.77 | 19.83 | 4.40 |
| | | | 1.81 | 2.81 | 1.00 | | 2.81 | 3.00 | 0.19 | | | |
| | | | 3.00 | 3.30 | 0.30 | | 3.30 | 8.00 | 4.70 | | | |
| | | | 8.00 | 8.36 | 0.36 | | 8.36 | 17.00 | 8.64 | | | |
| | | | 17.00 | 17.63 | 0.63 | | 17.63 | 23.68 | 6.05 | | | |
| | | | 23.68 | 24.34 | 0.66 | | | | | | | |
| SL-07 | 0.21 | 0.21 | 0.21 | 0.68 | 0.47 | 3.02 | 0.68 | 11.13 | 10.45 | 18.43 | 18.64 | 6.17 |
| | | | 11.13 | 11.43 | 0.30 | | 11.43 | 15.34 | 3.91 | | | |
| | | | 15.34 | 16.00 | 0.66 | | 16.00 | 16.07 | 0.07 | | | |
| | | | 16.07 | 17.00 | 0.93 | | 17.00 | 21.00 | 4.00 | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 21.00 | 21.66 | 0.66 | | | | | | |
| SL-10 | 0.23 | 0.23 | 0.23 | 1.55 | 1.32 | 2.06 | 1.55 | 2.00 | 0.45 | 2.46 | 2.69 | 1.31 |
| | | | 2.00 | 2.40 | 0.40 | | 2.40 | 4.41 | 2.01 | | | |
| | | | 4.41 | 4.75 | 0.34 | | | | | | | |
| SL-11 | 0.23 | 0.23 | 0.23 | 3.31 | 3.08 | 5.81 | 3.31 | 4.20 | 0.89 | 17.85 | 18.08 | 3.11 |
| | | | 4.20 | 4.64 | 0.44 | | 4.64 | 5.00 | 0.36 | | | |
| | | | 5.00 | 5.31 | 0.31 | | 5.31 | 9.00 | 3.69 | | | |
| | | | 9.00 | 9.56 | 0.56 | | 9.56 | 12.42 | 2.86 | | | |
| | | | 12.42 | 12.87 | 0.45 | | 12.87 | 17.41 | 4.54 | | | |
| | | | 17.41 | 17.79 | 0.38 | | 17.79 | 23.30 | 5.51 | | | |
| | | | 23.30 | 23.89 | 0.59 | | | | | | | |
| SL-05 | 0.17 | 0.17 | 0.17 | 1.33 | 1.16 | 2.34 | 1.33 | 3.39 | 2.06 | 20.12 | 20.29 | 8.67 |
| | | | 3.39 | 3.77 | 0.38 | | 3.77 | 5.00 | 1.23 | | | |
| | | | 5.00 | 5.39 | 0.39 | | 5.39 | 22.22 | 16.83 | | | |
| | | | 22.22 | 22.63 | 0.41 | | | | | | | |
| SL-08 | 0.00 | 0.00 | 0.00 | 0.43 | 0.43 | 2.67 | 0.43 | 1.00 | 0.57 | 19.05 | 19.05 | 7.13 |
| | | | 1.00 | 1.43 | 0.43 | | 1.43 | 1.66 | 0.23 | | | |
| | | | 1.66 | 2.36 | 0.70 | | 2.36 | 6.86 | 4.50 | | | |
| | | | 6.86 | 7.28 | 0.42 | | 7.28 | 21.03 | 13.75 | | | |
| | | | 21.03 | 21.72 | 0.69 | | | | | | | |
| SL-13 | 0.00 | 0.00 | 0.00 | 2.90 | 2.90 | 4.33 | 2.90 | 3.00 | 0.10 | 14.02 | 14.02 | 3.24 |
| | | | 3.00 | 3.35 | 0.35 | | 3.35 | 8.00 | 4.65 | | | |
| | | | 8.00 | 8.36 | 0.36 | | 8.36 | 14.25 | 5.89 | | | |
| | | | 14.25 | 14.62 | 0.37 | | 14.62 | 18.00 | 3.38 | | | |
| | | | 18.00 | 18.35 | 0.35 | | | | | | | |
| SL-02 | 0.00 | 0.00 | 0.00 | 1.20 | 1.20 | 3.38 | 1.20 | 2.00 | 0.80 | 18.62 | 18.62 | 5.51 |
| | | | 2.00 | 2.42 | 0.42 | | 2.42 | 9.11 | 6.69 | | | |
| | | | 9.11 | 10.00 | 0.89 | | 10.00 | 21.13 | 11.13 | | | |
| | | | 21.13 | 22.00 | 0.87 | | | | | | | |
| SL-06 | 0.38 | 0.38 | 0.38 | 1.40 | 1.02 | 2.70 | 1.40 | 6.39 | 4.99 | 19.66 | 20.04 | 7.42 |
| | | | 6.39 | 7.00 | 0.61 | | 7.00 | 8.33 | 1.33 | | | |
| | | | 8.33 | 8.79 | 0.46 | | 8.79 | 22.13 | 13.34 | | | |
| | | | 22.13 | 22.74 | 0.61 | | | | | | | |
| SL-01 | 0.16 | 0.16 | 0.16 | 1.58 | 1.42 | 3.61 | 1.58 | 6.44 | 4.86 | 13.60 | 13.76 | 3.81 |
| | | | 6.44 | 7.32 | 0.88 | | 7.32 | 16.06 | 8.74 | | | |
| | | | 16.06 | 17.37 | 1.31 | | | | | | | |

**ANNEXURE-3**

| BORHOLEWISE AND GRADEWISE THICKNESS ( in m ) | | | | |
|---|---|---|---|---|
| **SR.NO.** | **BH ID** | **Cement Grade Limestone (m)** | **Limestone (m)** | **Marl (m)** |
| 1 | SL-03 | 4.87 | 0.34 | 0.00 |
| 2 | SL-12 | 4.19 | 1.12 | 0.00 |
| 3 | SL-09 | 0.51 | 1.34 | 0.49 |
| 4 | SL-14 | 1.13 | 2.06 | 1.11 |
| 5 | SL-04 | 3.57 | 0.94 | 0.00 |
| 6 | SL-07 | 0.47 | 0.00 | 2.55 |
| 7 | SL-10 | 0.00 | 1.72 | 0.34 |
| 8 | SL-11 | 1.53 | 3.90 | 0.38 |
| 9 | SL-05 | 1.54 | 0.80 | 0.00 |
| 10 | SL-08 | 0.00 | 2.25 | 0.42 |
| 11 | SL-13 | 2.49 | 0.77 | 1.07 |
| 12 | SL-02 | 1.20 | 0.89 | 1.29 |
| 13 | SL-06 | 1.63 | 0.00 | 1.07 |
| 14 | SL-01 | 1.36 | 0.00 | 1.87 |

**ANNEXURE-4**

| INDIVIDUAL BED THICKNESS FOR CEMENT GRADE LIMESTONE | | | | | |
|---|---|---|---|---|---|
| **SR.No.** | **BH.ID.** | **From** | **To** | **Thickness** | **Total Thickness** |
| 1 | SL-03 | 0.00 | 1.00 | 1.00 | 4.87 |
| | | 1.00 | 2.00 | 1.00 | |
| | | 2.00 | 2.64 | 0.64 | |
| | | 2.64 | 3.40 | 0.76 | |
| | | 3.40 | 4.00 | 0.60 | |
| | | 10.00 | 10.42 | 0.42 | |
| | | 16.00 | 16.45 | 0.45 | |
| 2 | SL-12 | 0.45 | 1.00 | 0.55 | 4.19 |
| | | 1.00 | 2.00 | 1.00 | |
| | | 2.00 | 3.00 | 1.00 | |
| | | 3.00 | 4.00 | 1.00 | |
| | | 18.14 | 18.78 | 0.64 | |
| 3 | SL-09 | 0.00 | 0.51 | 0.51 | 0.51 |
| 4 | SL-14 | 0.18 | 0.92 | 0.74 | 1.13 |
| | | 15.00 | 15.39 | 0.39 | |
| 5 | SL-04 | 1.00 | 1.62 | 0.62 | 3.57 |
| | | 1.81 | 2.81 | 1.00 | |
| | | 3.00 | 3.30 | 0.30 | |
| | | 8.00 | 8.36 | 0.36 | |
| | | 17.00 | 17.63 | 0.63 | |
| | | 23.68 | 24.34 | 0.66 | |
| 6 | SL-07 | 0.21 | 0.68 | 0.47 | 0.47 |
| 7 | SL-11 | 0.23 | 1.00 | 0.77 | 1.53 |
| | | 5.00 | 5.31 | 0.31 | |
| | | 12.42 | 12.87 | 0.45 | |
| 8 | SL-05 | 0.17 | 1.33 | 1.16 | 1.54 |
| | | 3.39 | 3.77 | 0.38 | |
| 9 | SL-13 | 0.00 | 1.00 | 1.00 | 2.49 |
| | | 1.00 | 2.13 | 1.13 | |
| | | 8.00 | 8.36 | 0.36 | |
| 10 | SL-02 | 0.00 | 1.20 | 1.20 | 1.20 |

| | | | | | |
|---|---|---|---|---|---|
| 11 | SL-06 | 0.38 | 1.40 | 1.02 | 1.63 |
| | | 22.13 | 22.74 | 0.61 | |
| 12 | SL-01 | 0.16 | 1.20 | 1.04 | 1.36 |
| | | 7.00 | 7.32 | 0.32 | |

| INDIVIDUAL BED THICKNESS FOR LIMESTONE | | | | | |
|---|---|---|---|---|---|
| **SR.No.** | **BH.ID.** | **From** | **To** | **Thickness** | **Total Thickness** |
| 1 | SL-03 | 9.00 | 9.34 | 0.34 | 0.34 |
| 2 | SL-12 | 6.00 | 6.32 | 0.32 | 1.12 |
| | | 47.00 | 47.80 | 0.80 | |
| 3 | SL-09 | 4.23 | 4.66 | 0.43 | 1.34 |
| | | 6.38 | 6.73 | 0.35 | |
| | | 14.00 | 14.56 | 0.56 | |
| 4 | SL-14 | 1.00 | 1.72 | 0.72 | 2.06 |
| | | 2.00 | 2.80 | 0.80 | |
| | | 3.00 | 3.54 | 0.54 | |
| 5 | SL-04 | 0.06 | 1.00 | 0.94 | 0.94 |
| 6 | SL-10 | 0.23 | 1.00 | 0.77 | 1.72 |
| | | 1.00 | 1.55 | 0.55 | |
| | | 2.00 | 2.40 | 0.40 | |
| 7 | SL-11 | 1.00 | 2.00 | 1.00 | 3.90 |
| | | 2.00 | 3.31 | 1.31 | |
| | | 4.20 | 4.64 | 0.44 | |
| | | 9.00 | 9.56 | 0.56 | |
| | | 23.30 | 23.89 | 0.59 | |
| 8 | SL-05 | 5.00 | 5.39 | 0.39 | 0.80 |
| | | 22.22 | 22.63 | 0.41 | |
| 9 | SL-08 | 0.00 | 0.43 | 0.43 | 2.25 |
| | | 1.00 | 1.43 | 0.43 | |
| | | 1.66 | 2.00 | 0.34 | |
| | | 2.00 | 2.36 | 0.36 | |
| | | 21.03 | 21.72 | 0.69 | |

| | | | | | |
|---|---|---|---|---|---|
| 10 | SL-13 | 2.13 | 2.57 | 0.44 | 0.77 |
| | | 2.57 | 2.90 | 0.33 | |
| 11 | SL-02 | 9.11 | 10.00 | 0.89 | 0.89 |
| 12 | SL-01 | 1.20 | 1.58 | 0.38 | 0.38 |

| INDIVIDUAL BED THICKNESS FOR MARL | | | | | |
|---|---|---|---|---|---|
| **SR.No.** | **BH.ID.** | **From** | **To** | **Thickness** | **Total Thickness** |
| 1 | SL-09 | 0.51 | 1.00 | 0.49 | 0.49 |
| 2 | SL-14 | 3.63 | 4.00 | 0.37 | 1.11 |
| | | 20.00 | 20.74 | 0.74 | |
| 3 | SL-07 | 11.13 | 11.43 | 0.30 | 2.55 |
| | | 15.34 | 16.00 | 0.66 | |
| | | 16.07 | 17.00 | 0.93 | |
| | | 21.00 | 21.66 | 0.66 | |
| 4 | SL-10 | 4.41 | 4.75 | 0.34 | 0.34 |
| 5 | SL-11 | 17.41 | 17.79 | 0.38 | 0.38 |
| 6 | SL-08 | 6.86 | 7.28 | 0.42 | 0.42 |
| 7 | SL-13 | 3.00 | 3.35 | 0.35 | 1.07 |
| | | 14.25 | 14.62 | 0.37 | |
| | | 18.00 | 18.35 | 0.35 | |
| 8 | SL-02 | 2.00 | 2.42 | 0.42 | 1.29 |
| | | 21.13 | 22.00 | 0.87 | |
| 9 | SL-06 | 6.39 | 7.00 | 0.61 | 1.07 |
| | | 8.33 | 8.79 | 0.46 | |
| 10 | SL-01 | 6.44 | 7.00 | 0.56 | 1.87 |
| | | 16.06 | 17.37 | 1.31 | |

**ANNEXURE-5**

| Core Log Sample Analysis Results | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BH ID** | **From** | **To** | **Thickness** | **Lithology** | **Sample No.** | **LAB. Refrance NO.** | **SiO2** | **Al2O3** | **Fe2O3** | **TiO2** | **CaO** | **MgO** | **Na2O** | **K2O** | **P2O5** | **MnO** | **SO3** | **LOI** | **TOTAL** |
| SL-03 | 0.00 | 1.00 | 1.00 | cement grade limestone | SL-03/1 | C/S/18-19/5426 | 10.10 | 3.21 | 1.41 | 0.13 | 45.48 | 0.30 | 0.10 | 0.06 | 0.01 | 0.10 | 0.06 | 38.58 | 99.54 |
| SL-03 | 1.00 | 2.00 | 1.00 | cement grade limestone | SL-03/2 | C/S/18-19/5427 | 7.55 | 2.08 | 2.39 | 0.12 | 46.41 | 0.25 | 0.09 | 0.05 | 0.01 | 0.13 | 0.06 | 40.12 | 99.26 |
| SL-03 | 2.00 | 2.64 | 0.64 | cement grade limestone | SL-03/3 | C/S/18-19/5428 | 18.15 | 5.93 | 1.52 | 0.18 | 40.17 | 0.35 | 0.10 | 0.07 | 0.01 | 0.06 | 0.06 | 33.34 | 99.94 |
| SL-03 | 2.64 | 3.40 | 0.76 | cement grade limestone | SL-03/4 | C/S/18-19/5429 | 12.98 | 3.43 | 1.98 | 0.13 | 43.39 | 0.50 | 0.10 | 0.06 | 0.01 | 0.16 | 0.05 | 36.42 | 99.21 |
| SL-03 | 3.40 | 4.00 | 0.60 | cement grade limestone | SL-03/5 | C/S/18-19/5430 | 17.09 | 5.05 | 1.57 | 0.16 | 41.13 | 0.32 | 0.10 | 0.07 | 0.01 | 0.08 | 0.05 | 34.68 | 100.31 |
| SL-03 | 4.00 | 5.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 5.00 | 5.96 | 0.96 | calcareous clay | SL-03/6 | C/S/18-19/5431 | 46.20 | 8.68 | 6.00 | 0.72 | 19.96 | 0.96 | 0.22 | 0.20 | 0.01 | 0.06 | 0.60 | 16.27 | 99.88 |
| SL-03 | 5.96 | 6.21 | 0.25 | sandy clay | | | | | | | | | | | | | | | |
| SL-03 | 6.21 | 7.46 | 1.25 | calcareous clay | SL-03/7 | C/S/18-19/5432 | 48.93 | 12.80 | 6.88 | 0.72 | 14.67 | 0.88 | 0.24 | 0.21 | 0.01 | 0.06 | 0.05 | 14.12 | 99.57 |
| SL-03 | 7.46 | 7.49 | 0.03 | clay | | | | | | | | | | | | | | | |
| SL-03 | 7.49 | 8.00 | 0.51 | clay | | | | | | | | | | | | | | | |
| SL-03 | 8.00 | 8.77 | 0.77 | clay | | | | | | | | | | | | | | | |
| SL-03 | 8.77 | 9.00 | 0.23 | clay | | | | | | | | | | | | | | | |
| SL-03 | 9.00 | 9.34 | 0.34 | limestone | SL-03/10 | C/S/18-19/5433 | 20.03 | 5.68 | 2.83 | 0.20 | 37.61 | 0.38 | 0.10 | 0.08 | 0.03 | 0.09 | 0.06 | 32.74 | 99.83 |
| SL-03 | 9.34 | 10.00 | 0.66 | clay | | | | | | | | | | | | | | | |
| SL-03 | 10.00 | 10.42 | 0.42 | cement grade limestone | SL-03/11 | C/S/18-19/5434 | 9.41 | 2.49 | 1.71 | 0.12 | 46.76 | 0.28 | 0.10 | 0.05 | 0.05 | 0.07 | 0.06 | 38.01 | 99.11 |
| SL-03 | 10.42 | 10.58 | 0.16 | sandy clay | | | | | | | | | | | | | | | |
| SL-03 | 10.58 | 10.87 | 0.29 | sandy clay | | | | | | | | | | | | | | | |
| SL-03 | 10.87 | 11.00 | 0.13 | sandy clay | | | | | | | | | | | | | | | |
| SL-03 | 11.00 | 11.50 | 0.50 | clay | | | | | | | | | | | | | | | |
| SL-03 | 11.50 | 13.00 | 1.50 | clay | | | | | | | | | | | | | | | |
| SL-03 | 13.00 | 13.59 | 0.59 | clay | | | | | | | | | | | | | | | |
| SL-03 | 13.59 | 14.17 | 0.58 | clay | | | | | | | | | | | | | | | |
| SL-03 | 14.17 | 14.43 | 0.26 | clay | | | | | | | | | | | | | | | |
| SL-03 | 14.43 | 14.66 | 0.23 | clay | | | | | | | | | | | | | | | |
| SL-03 | 14.66 | 14.85 | 0.19 | sandy clay | | | | | | | | | | | | | | | |
| SL-03 | 14.85 | 15.00 | 0.15 | clay | | | | | | | | | | | | | | | |
| SL-03 | 15.00 | 16.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 16.00 | 16.45 | 0.45 | cement grade limestone | SL-03/13 | C/S/18-19/5435 | 9.06 | 2.52 | 2.45 | 0.14 | 45.38 | 0.25 | 0.09 | 0.05 | 0.02 | 0.19 | 0.06 | 38.97 | 99.18 |
| SL-03 | 16.45 | 16.50 | 0.05 | clay | | | | | | | | | | | | | | | |
| SL-03 | 16.50 | 18.00 | 1.50 | clay | | | | | | | | | | | | | | | |
| SL-03 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 20.00 | 21.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 21.00 | 22.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 22.00 | 23.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 23.00 | 24.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 25.00 | 26.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 26.00 | 27.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 27.00 | 28.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 28.00 | 29.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-03 | 29.00 | 30.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 0.00 | 0.45 | 0.45 | soil | | | | | | | | | | | | | | | |
| SL-12 | 0.45 | 1.00 | 0.55 | cement grade limestone | SL-12/1 | C/S/18-19/5436 | 8.12 | 2.23 | 1.25 | 0.12 | 48.00 | 0.21 | 0.09 | 0.04 | 0.05 | 0.07 | 0.05 | 39.72 | 99.95 |
| SL-12 | 1.00 | 2.00 | 1.00 | cement grade limestone | SL-12/2 | C/S/18-19/5437 | 9.32 | 2.65 | 1.37 | 0.12 | 47.02 | 0.23 | 0.09 | 0.04 | 0.05 | 0.08 | 0.06 | 39.13 | 100.16 |
| SL-12 | 2.00 | 3.00 | 1.00 | cement grade limestone | SL-12/3 | C/S/18-19/5438 | 16.94 | 4.27 | 1.67 | 0.18 | 40.79 | 0.32 | 0.11 | 0.06 | 0.02 | 0.14 | 0.06 | 34.87 | 99.43 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL-12 | 3.00 | 4.00 | 1.00 | cement grade limestone | SL-12/4 | C/S/18-19/5439 | 16.62 | 4.79 | 1.77 | 0.16 | 42.18 | 0.30 | 0.10 | 0.06 | 0.01 | 0.08 | 0.06 | 33.24 | 99.37 |
| SL-12 | 4.00 | 5.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 5.00 | 6.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 6.00 | 6.32 | 0.32 | limestone | SL-12/5 | C/S/18-19/5440 | 25.30 | 7.28 | 2.53 | 0.26 | 34.44 | 0.40 | 0.11 | 0.09 | 0.01 | 0.14 | 0.06 | 29.79 | 100.41 |
| SL-12 | 6.32 | 7.00 | 0.68 | clay | | | | | | | | | | | | | | | |
| SL-12 | 7.00 | 8.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 8.00 | 8.47 | 0.47 | clay | | | | | | | | | | | | | | | |
| SL-12 | 8.47 | 8.68 | 0.21 | clay | | | | | | | | | | | | | | | |
| SL-12 | 8.68 | 9.00 | 0.32 | clay | | | | | | | | | | | | | | | |
| SL-12 | 9.00 | 10.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 10.00 | 11.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 11.00 | 12.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 12.00 | 13.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 13.00 | 14.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 14.00 | 15.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 15.00 | 16.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 16.00 | 17.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 17.00 | 18.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 18.00 | 18.05 | 0.05 | clay | | | | | | | | | | | | | | | |
| SL-12 | 18.05 | 18.14 | 0.09 | sandy clay | | | | | | | | | | | | | | | |
| SL-12 | 18.14 | 18.78 | 0.64 | cement grade limestone | SL-12/7 | C/S/18-19/5441 | 16.93 | 4.64 | 2.13 | 0.18 | 40.45 | 0.39 | 0.14 | 0.09 | 0.03 | 0.35 | 0.06 | 33.74 | 99.13 |
| SL-12 | 18.78 | 19.00 | 0.22 | clay | | | | | | | | | | | | | | | |
| SL-12 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 20.00 | 21.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 21.00 | 21.30 | 0.30 | clay | | | | | | | | | | | | | | | |
| SL-12 | 21.30 | 21.51 | 0.21 | clay | | | | | | | | | | | | | | | |
| SL-12 | 21.51 | 22.00 | 0.49 | sandy clay | | | | | | | | | | | | | | | |
| SL-12 | 22.00 | 22.97 | 0.97 | clay | | | | | | | | | | | | | | | |
| SL-12 | 22.97 | 23.00 | 0.03 | clay | | | | | | | | | | | | | | | |
| SL-12 | 23.00 | 24.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 25.00 | 26.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 26.00 | 27.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 27.00 | 28.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 28.00 | 29.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 29.00 | 30.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 30.00 | 31.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 31.00 | 32.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 32.00 | 33.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 33.00 | 34.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 34.00 | 35.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 35.00 | 36.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 36.00 | 37.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 37.00 | 37.10 | 0.10 | clay | | | | | | | | | | | | | | | |
| SL-12 | 37.10 | 38.00 | 0.90 | clay | | | | | | | | | | | | | | | |
| SL-12 | 38.00 | 39.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 39.00 | 39.22 | 0.22 | clay | | | | | | | | | | | | | | | |
| SL-12 | 39.22 | 39.56 | 0.34 | clay | | | | | | | | | | | | | | | |
| SL-12 | 39.56 | 40.00 | 0.44 | clay | | | | | | | | | | | | | | | |
| SL-12 | 40.00 | 41.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 41.00 | 42.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 42.00 | 43.00 | 1.00 | clay | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL-12 | 43.00 | 44.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-12 | 44.00 | 44.18 | 0.18 | clay | | | | | | | | | | | | | | | |
| SL-12 | 44.18 | 45.00 | 0.82 | sandy clay | | | | | | | | | | | | | | | |
| SL-12 | 45.00 | 46.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-12 | 46.00 | 47.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-12 | 47.00 | 47.80 | 0.80 | limestone | SL-12/11 | C/S/18-19/5442 | 14.16 | 4.43 | 1.60 | 0.17 | 39.87 | 1.23 | 0.12 | 0.09 | 0.01 | 0.07 | 0.33 | 37.30 | 99.38 |
| SL-12 | 47.80 | 48.00 | 0.20 | sandy clay | | | | | | | | | | | | | | | |
| SL-12 | 48.00 | 49.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-12 | 49.00 | 50.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 0.00 | 0.51 | 0.51 | cement grade limestone | SL-09/1 | C/S/18-19/5443 | 14.41 | 4.25 | 2.15 | 0.18 | 42.24 | 0.31 | 0.10 | 0.06 | 0.01 | 0.11 | 0.06 | 36.08 | 99.96 |
| SL-09 | 0.51 | 1.00 | 0.49 | marl | SL-09/2 | C/S/18-19/5444 | 36.98 | 8.23 | 5.28 | 0.84 | 23.88 | 2.26 | 0.22 | 0.18 | 0.01 | 0.05 | 0.05 | 21.71 | 99.69 |
| SL-09 | 1.00 | 1.62 | 0.62 | clay | | | | | | | | | | | | | | | |
| SL-09 | 1.62 | 2.00 | 0.38 | clay | | | | | | | | | | | | | | | |
| SL-09 | 2.00 | 3.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 3.00 | 3.56 | 0.56 | siliceous clay | SL-09/3 | C/S/18-19/5445 | 52.11 | 14.69 | 8.64 | 0.72 | 9.86 | 0.77 | 0.26 | 0.19 | 0.01 | 0.05 | 0.05 | 11.86 | 99.21 |
| SL-09 | 3.56 | 4.00 | 0.44 | clay | | | | | | | | | | | | | | | |
| SL-09 | 4.00 | 4.23 | 0.23 | clay | | | | | | | | | | | | | | | |
| SL-09 | 4.23 | 4.66 | 0.43 | limestone | SL-09/4 | C/S/18-19/5446 | 22.53 | 4.90 | 5.04 | 0.36 | 36.38 | 0.45 | 0.41 | 0.39 | 0.01 | 0.05 | 0.14 | 29.64 | 100.30 |
| SL-09 | 4.66 | 4.91 | 0.25 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 4.91 | 5.00 | 0.09 | calcareous clay | | | | | | | | | | | | | | | |
| SL-09 | 5.00 | 6.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 6.00 | 6.25 | 0.25 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 6.25 | 6.38 | 0.13 | clay | | | | | | | | | | | | | | | |
| SL-09 | 6.38 | 6.73 | 0.35 | limestone | SL-09/5 | C/S/18-19/5447 | 24.68 | 8.15 | 2.42 | 0.24 | 34.40 | 0.48 | 0.13 | 0.12 | 0.01 | 0.15 | 0.05 | 28.81 | 99.64 |
| SL-09 | 6.73 | 7.00 | 0.27 | calcareous clay | | | | | | | | | | | | | | | |
| SL-09 | 7.00 | 7.87 | 0.87 | clay | | | | | | | | | | | | | | | |
| SL-09 | 7.87 | 8.00 | 0.13 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 8.00 | 9.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 9.00 | 10.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 10.00 | 11.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 11.00 | 12.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 12.00 | 13.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 13.00 | 13.74 | 0.74 | clay | | | | | | | | | | | | | | | |
| SL-09 | 13.74 | 14.00 | 0.26 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 14.00 | 14.56 | 0.56 | limestone | SL-09/7 | C/S/18-19/5448 | 20.29 | 5.83 | 2.26 | 0.21 | 37.49 | 0.44 | 0.16 | 0.10 | 0.03 | 0.28 | 0.08 | 31.91 | 99.08 |
| SL-09 | 14.56 | 15.00 | 0.44 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 15.00 | 16.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 16.00 | 17.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 17.00 | 18.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 20.00 | 21.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 21.00 | 21.51 | 0.51 | clay | | | | | | | | | | | | | | | |
| SL-09 | 21.51 | 22.00 | 0.49 | clay | | | | | | | | | | | | | | | |
| SL-09 | 22.00 | 22.59 | 0.59 | clay | | | | | | | | | | | | | | | |
| SL-09 | 22.59 | 23.00 | 0.41 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 23.00 | 23.23 | 0.23 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 23.23 | 24.00 | 0.77 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 24.00 | 24.25 | 0.25 | sandy clay | | | | | | | | | | | | | | | |
| SL-09 | 24.25 | 25.00 | 0.75 | clay | | | | | | | | | | | | | | | |
| SL-09 | 25.00 | 26.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 26.00 | 27.00 | 1.00 | clay | | | | | | | | | | | | | | | |

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| SL-09 | 27.00 | 28.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 28.00 | 29.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-09 | 29.00 | 30.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 0.00 | 0.18 | 0.18 | soil | | | | | | | | | | | | | | | |
| SL-14 | 0.18 | 0.92 | 0.74 | cement grade limestone | SL-14/1 | C/S/18-19/5449 | 17.25 | 4.52 | 1.68 | 0.20 | 41.01 | 0.30 | 0.10 | 0.05 | 0.03 | 0.13 | 0.06 | 33.82 | 99.15 |
| SL-14 | 0.92 | 1.00 | 0.08 | calcareous clay | | | | | | | | | | | | | | | |
| SL-14 | 1.00 | 1.72 | 0.72 | limestone | SL-14/3 | C/S/18-19/5450 | 26.21 | 7.11 | 1.70 | 0.27 | 35.22 | 0.42 | 0.15 | 0.07 | 0.03 | 0.13 | 0.05 | 28.23 | 99.59 |
| SL-14 | 1.72 | 2.00 | 0.28 | sludge (limestone) | | | | | | | | | | | | | | | |
| SL-14 | 2.00 | 2.80 | 0.80 | limestone | SL-14/4 | C/S/18-19/5451 | 24.96 | 6.57 | 1.76 | 0.27 | 35.74 | 0.38 | 0.13 | 0.06 | 0.03 | 0.14 | 0.05 | 28.95 | 99.04 |
| SL-14 | 2.80 | 3.00 | 0.20 | calcareous clay | | | | | | | | | | | | | | | |
| SL-14 | 3.00 | 3.54 | 0.54 | limestone | SL-14/6 | C/S/18-19/5452 | 22.57 | 6.33 | 2.26 | 0.23 | 36.12 | 0.37 | 0.11 | 0.08 | 0.01 | 0.15 | 0.05 | 31.55 | 99.83 |
| SL-14 | 3.54 | 3.63 | 0.09 | sandy clay | | | | | | | | | | | | | | | |
| SL-14 | 3.63 | 4.00 | 0.37 | marl | SL-14/7 | C/S/18-19/5453 | 28.64 | 6.33 | 5.36 | 0.36 | 30.31 | 0.92 | 0.31 | 0.68 | 0.01 | 0.15 | 0.28 | 25.92 | 99.27 |
| SL-14 | 4.00 | 4.27 | 0.27 | calcareous clay | | | | | | | | | | | | | | | |
| SL-14 | 4.27 | 4.53 | 0.26 | calcareous clay | | | | | | | | | | | | | | | |
| SL-14 | 4.53 | 4.91 | 0.38 | clay | | | | | | | | | | | | | | | |
| SL-14 | 4.91 | 5.00 | 0.09 | calcareous clay | | | | | | | | | | | | | | | |
| SL-14 | 5.00 | 6.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 6.00 | 7.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 7.00 | 8.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 8.00 | 8.14 | 0.14 | clay | | | | | | | | | | | | | | | |
| SL-14 | 8.14 | 8.16 | 0.02 | clay | | | | | | | | | | | | | | | |
| SL-14 | 8.16 | 8.94 | 0.78 | clay | | | | | | | | | | | | | | | |
| SL-14 | 8.94 | 9.00 | 0.06 | calcareous clay | | | | | | | | | | | | | | | |
| SL-14 | 9.00 | 9.81 | 0.81 | clay | | | | | | | | | | | | | | | |
| SL-14 | 9.81 | 10.00 | 0.19 | clay | | | | | | | | | | | | | | | |
| SL-14 | 10.00 | 11.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 11.00 | 11.86 | 0.86 | clay | | | | | | | | | | | | | | | |
| SL-14 | 11.86 | 12.00 | 0.14 | clay | | | | | | | | | | | | | | | |
| SL-14 | 12.00 | 13.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 13.00 | 13.97 | 0.97 | clay | | | | | | | | | | | | | | | |
| SL-14 | 13.97 | 14.00 | 0.03 | calcareous clay | | | | | | | | | | | | | | | |
| SL-14 | 14.00 | 14.76 | 0.76 | calcareous clay | | | | | | | | | | | | | | | |
| SL-14 | 14.76 | 15.00 | 0.24 | calcareous clay | | | | | | | | | | | | | | | |
| SL-14 | 15.00 | 15.39 | 0.39 | cement grade limestone | SL-14/13 | C/S/18-19/5454 | 17.52 | 4.82 | 2.03 | 0.17 | 40.15 | 0.40 | 0.13 | 0.09 | 0.03 | 0.26 | 0.06 | 33.94 | 99.60 |
| SL-14 | 15.39 | 16.00 | 0.61 | sandy clay | | | | | | | | | | | | | | | |
| SL-14 | 16.00 | 17.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 17.00 | 18.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 18.00 | 18.30 | 0.30 | clay | | | | | | | | | | | | | | | |
| SL-14 | 18.30 | 18.39 | 0.09 | clay | | | | | | | | | | | | | | | |
| SL-14 | 18.39 | 19.00 | 0.61 | clay | | | | | | | | | | | | | | | |
| SL-14 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 20.00 | 20.74 | 0.74 | marl | SL-14/15 | C/S/18-19/5455 | 39.11 | 9.80 | 2.97 | 0.34 | 25.93 | 0.64 | 0.31 | 0.12 | 0.02 | 0.28 | 0.05 | 19.91 | 99.48 |
| SL-14 | 20.74 | 21.27 | 0.53 | siliceous clay | SL-14/16 | C/S/18-19/5456 | 51.24 | 16.96 | 3.87 | 0.72 | 16.75 | 1.15 | 0.49 | 0.23 | 0.02 | 0.14 | 0.05 | 8.10 | 99.72 |
| SL-14 | 21.27 | 22.00 | 0.73 | clay | | | | | | | | | | | | | | | |
| SL-14 | 22.00 | 23.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 23.00 | 24.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 25.00 | 26.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 26.00 | 27.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 27.00 | 28.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-14 | 28.00 | 29.00 | 1.00 | clay | | | | | | | | | | | | | | | |

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| SL-14 | 29.00 | 29.45 | 0.45 | clay | | | | | | | | | | | | | | | |
| SL-14 | 29.45 | 30.00 | 0.55 | clay | | | | | | | | | | | | | | | |
| SL-04 | 0.00 | 0.06 | 0.06 | soil | | | | | | | | | | | | | | | |
| SL-04 | 0.06 | 1.00 | 0.94 | limestone | SL-04/1 | C/S/18-19/5457 | 23.39 | 6.22 | 1.82 | 0.27 | 37.46 | 0.41 | 0.11 | 0.06 | 0.02 | 0.10 | 0.05 | 30.31 | 100.22 |
| SL-04 | 1.00 | 1.62 | 0.62 | cement grade limestone | SL-04/2 | C/S/18-19/5458 | 18.07 | 4.52 | 1.69 | 0.17 | 41.37 | 0.34 | 0.10 | 0.06 | 0.02 | 0.10 | 0.05 | 33.28 | 99.77 |
| SL-04 | 1.62 | 1.81 | 0.19 | calcareous clay | | | | | | | | | | | | | | | |
| SL-04 | 1.81 | 2.81 | 1.00 | cement grade limestone | SL-04/4 | C/S/18-19/5459 | 12.12 | 3.61 | 2.45 | 0.15 | 43.22 | 0.28 | 0.09 | 0.06 | 0.02 | 0.11 | 0.05 | 37.16 | 99.32 |
| SL-04 | 2.81 | 3.00 | 0.19 | calcareous clay | | | | | | | | | | | | | | | |
| SL-04 | 3.00 | 3.30 | 0.30 | cement grade limestone | SL-04/6 | C/S/18-19/5460 | 6.52 | 1.85 | 1.75 | 0.11 | 48.36 | 0.20 | 0.08 | 0.04 | 0.01 | 0.11 | 0.05 | 40.71 | 99.79 |
| SL-04 | 3.30 | 3.49 | 0.19 | sandy clay | | | | | | | | | | | | | | | |
| SL-04 | 3.49 | 4.00 | 0.51 | clay | | | | | | | | | | | | | | | |
| SL-04 | 4.00 | 4.82 | 0.82 | clay | | | | | | | | | | | | | | | |
| SL-04 | 4.82 | 5.00 | 0.18 | sandy clay | | | | | | | | | | | | | | | |
| SL-04 | 5.00 | 5.20 | 0.20 | clay | | | | | | | | | | | | | | | |
| SL-04 | 5.20 | 6.00 | 0.80 | clay | | | | | | | | | | | | | | | |
| SL-04 | 6.00 | 6.25 | 0.25 | sandy clay | | | | | | | | | | | | | | | |
| SL-04 | 6.25 | 6.44 | 0.19 | clay | | | | | | | | | | | | | | | |
| SL-04 | 6.44 | 6.64 | 0.20 | clay | | | | | | | | | | | | | | | |
| SL-04 | 6.64 | 7.00 | 0.36 | clay | | | | | | | | | | | | | | | |
| SL-04 | 7.00 | 7.76 | 0.76 | clay | | | | | | | | | | | | | | | |
| SL-04 | 7.76 | 7.96 | 0.20 | clay | | | | | | | | | | | | | | | |
| SL-04 | 7.96 | 8.00 | 0.04 | clay | | | | | | | | | | | | | | | |
| SL-04 | 8.00 | 8.36 | 0.36 | cement grade limestone | SL-04/8 | C/S/18-19/5461 | 16.18 | 5.35 | 1.35 | 0.16 | 42.42 | 0.32 | 0.10 | 0.06 | 0.01 | 0.05 | 0.05 | 34.27 | 100.32 |
| SL-04 | 8.36 | 8.44 | 0.08 | clay | | | | | | | | | | | | | | | |
| SL-04 | 8.44 | 9.00 | 0.56 | clay | | | | | | | | | | | | | | | |
| SL-04 | 9.00 | 10.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 10.00 | 10.17 | 0.17 | clay | | | | | | | | | | | | | | | |
| SL-04 | 10.17 | 10.32 | 0.15 | sandy clay | | | | | | | | | | | | | | | |
| SL-04 | 10.32 | 11.00 | 0.68 | clay | | | | | | | | | | | | | | | |
| SL-04 | 11.00 | 12.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 12.00 | 13.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 13.00 | 14.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 14.00 | 15.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 15.00 | 16.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 16.00 | 16.78 | 0.78 | clay | | | | | | | | | | | | | | | |
| SL-04 | 16.78 | 17.00 | 0.22 | calcareous clay | | | | | | | | | | | | | | | |
| SL-04 | 17.00 | 17.63 | 0.63 | cement grade limestone | SL-04/11 | C/S/18-19/5462 | 15.48 | 4.59 | 1.89 | 0.16 | 41.64 | 0.39 | 0.12 | 0.08 | 0.01 | 0.14 | 0.05 | 34.66 | 99.21 |
| SL-04 | 17.63 | 17.89 | 0.26 | calcareous clay | | | | | | | | | | | | | | | |
| SL-04 | 17.89 | 18.00 | 0.11 | clay | | | | | | | | | | | | | | | |
| SL-04 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 20.00 | 21.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 21.00 | 22.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 22.00 | 23.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 23.00 | 23.68 | 0.68 | clay | | | | | | | | | | | | | | | |
| SL-04 | 23.68 | 24.34 | 0.66 | cement grade limestone | SL-04/13 | C/S/18-19/5463 | 14.51 | 4.24 | 1.89 | 0.16 | 42.30 | 0.36 | 0.11 | 0.08 | 0.02 | 0.14 | 0.06 | 36.46 | 100.33 |
| SL-04 | 24.34 | 25.00 | 0.66 | clay | | | | | | | | | | | | | | | |
| SL-04 | 25.00 | 26.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 26.00 | 27.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 27.00 | 28.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 28.00 | 29.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-04 | 29.00 | 30.00 | 1.00 | clay | | | | | | | | | | | | | | | |

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| SL-07 | 0.00 | 0.21 | 0.21 | soil | | | | | | | | | | | | | | | |
| SL-07 | 0.21 | 0.68 | 0.47 | cement grade limestone | SL-07/1 | C/S/18-19/5464 | 8.24 | 2.41 | 1.87 | 0.12 | 47.02 | 0.24 | 0.09 | 0.05 | 0.02 | 0.10 | 0.06 | 39.97 | 100.19 |
| SL-07 | 0.68 | 0.86 | 0.18 | sandy clay | | | | | | | | | | | | | | | |
| SL-07 | 0.86 | 1.00 | 0.14 | clay | | | | | | | | | | | | | | | |
| SL-07 | 1.00 | 2.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 2.00 | 2.78 | 0.78 | clay | | | | | | | | | | | | | | | |
| SL-07 | 2.78 | 2.88 | 0.10 | calcareous clay | | | | | | | | | | | | | | | |
| SL-07 | 2.88 | 3.00 | 0.12 | clay | | | | | | | | | | | | | | | |
| SL-07 | 3.00 | 3.20 | 0.20 | clay | | | | | | | | | | | | | | | |
| SL-07 | 3.20 | 3.61 | 0.41 | calcareous clay | | | | | | | | | | | | | | | |
| SL-07 | 3.61 | 4.00 | 0.39 | clay | | | | | | | | | | | | | | | |
| SL-07 | 4.00 | 5.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-07 | 5.00 | 6.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 6.00 | 6.40 | 0.40 | clay | | | | | | | | | | | | | | | |
| SL-07 | 6.40 | 6.91 | 0.51 | clay | | | | | | | | | | | | | | | |
| SL-07 | 6.91 | 7.00 | 0.09 | clay | | | | | | | | | | | | | | | |
| SL-07 | 7.00 | 7.81 | 0.81 | clay | | | | | | | | | | | | | | | |
| SL-07 | 7.81 | 8.00 | 0.19 | calcareous clay | | | | | | | | | | | | | | | |
| SL-07 | 8.00 | 9.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 9.00 | 9.13 | 0.13 | clay | | | | | | | | | | | | | | | |
| SL-07 | 9.13 | 9.34 | 0.21 | clay | | | | | | | | | | | | | | | |
| SL-07 | 9.34 | 9.57 | 0.23 | sandy clay | | | | | | | | | | | | | | | |
| SL-07 | 9.57 | 10.00 | 0.43 | siliceous clay | SL-07/5 | C/S/18-19/5465 | 45.85 | 17.26 | 11.04 | 0.90 | 8.89 | 1.52 | 0.43 | 1.38 | 0.02 | 0.10 | 0.10 | 12.76 | 100.25 |
| SL-07 | 10.00 | 11.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 11.00 | 11.13 | 0.13 | clay | | | | | | | | | | | | | | | |
| SL-07 | 11.13 | 11.43 | 0.30 | marl | SL-07/6 | C/S/18-19/5466 | 39.97 | 13.23 | 2.77 | 0.51 | 23.80 | 0.74 | 0.21 | 0.19 | 0.01 | 0.15 | 0.10 | 18.24 | 99.92 |
| SL-07 | 11.43 | 12.00 | 0.57 | clay | | | | | | | | | | | | | | | |
| SL-07 | 12.00 | 13.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 13.00 | 13.22 | 0.22 | clay | | | | | | | | | | | | | | | |
| SL-07 | 13.22 | 13.38 | 0.16 | clay | | | | | | | | | | | | | | | |
| SL-07 | 13.38 | 14.00 | 0.62 | clay | | | | | | | | | | | | | | | |
| SL-07 | 14.00 | 15.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 15.00 | 15.34 | 0.34 | clay | | | | | | | | | | | | | | | |
| SL-07 | 15.34 | 16.00 | 0.66 | marl | SL-07/8 | C/S/18-19/5467 | 26.05 | 8.18 | 2.48 | 0.27 | 33.10 | 0.57 | 0.17 | 0.13 | 0.02 | 0.25 | 0.06 | 29.17 | 100.45 |
| SL-07 | 16.00 | 16.07 | 0.07 | calcareous clay | | | | | | | | | | | | | | | |
| SL-07 | 16.07 | 17.00 | 0.93 | marl | SL-07/10 | C/S/18-19/5468 | 36.57 | 12.14 | 3.48 | 0.38 | 25.49 | 0.96 | 0.22 | 0.22 | 0.02 | 0.16 | 0.06 | 20.37 | 100.07 |
| SL-07 | 17.00 | 17.58 | 0.58 | clay | | | | | | | | | | | | | | | |
| SL-07 | 17.58 | 17.88 | 0.30 | calcareous clay | SL-07/11 | C/S/18-19/5469 | 43.34 | 13.16 | 6.80 | 0.54 | 15.41 | 2.06 | 0.50 | 1.70 | 0.02 | 0.15 | 0.21 | 16.36 | 100.25 |
| SL-07 | 17.88 | 18.00 | 0.12 | clay | | | | | | | | | | | | | | | |
| SL-07 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 19.00 | 19.73 | 0.73 | clay | | | | | | | | | | | | | | | |
| SL-07 | 19.73 | 20.00 | 0.27 | clay | | | | | | | | | | | | | | | |
| SL-07 | 20.00 | 21.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 21.00 | 21.66 | 0.66 | marl | SL-07/12 | C/S/18-19/5470 | 41.57 | 10.68 | 3.09 | 0.37 | 24.73 | 0.68 | 0.35 | 0.13 | 0.03 | 0.21 | 0.05 | 17.86 | 99.75 |
| SL-07 | 21.66 | 22.00 | 0.34 | siliceous clay | SL-07/13 | C/S/18-19/5471 | 52.44 | 14.22 | 3.68 | 0.50 | 18.30 | 0.82 | 0.49 | 0.16 | 0.03 | 0.15 | 0.05 | 8.39 | 99.23 |
| SL-07 | 22.00 | 23.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 23.00 | 23.85 | 0.85 | clay | | | | | | | | | | | | | | | |
| SL-07 | 23.85 | 23.91 | 0.06 | sandy clay | | | | | | | | | | | | | | | |
| SL-07 | 23.91 | 24.00 | 0.09 | clay | | | | | | | | | | | | | | | |
| SL-07 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 25.00 | 26.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 26.00 | 27.00 | 1.00 | clay | | | | | | | | | | | | | | | |

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| SL-07 | 27.00 | 28.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-07 | 28.00 | 28.32 | 0.32 | clay | | | | | | | | | | | | | | | |
| SL-07 | 28.32 | 29.00 | 0.68 | sandy clay | | | | | | | | | | | | | | | |
| SL-07 | 29.00 | 30.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-10 | 0.00 | 0.23 | 0.23 | clay | | | | | | | | | | | | | | | |
| SL-10 | 0.23 | 1.00 | 0.77 | limestone | SL-10/1 | C/S/18-19/5472 | 22.88 | 6.32 | 1.79 | 0.24 | 37.26 | 0.41 | 0.13 | 0.06 | 0.02 | 0.16 | 0.20 | 30.69 | 100.16 |
| SL-10 | 1.00 | 1.55 | 0.55 | limestone | SL-10/2 | C/S/18-19/5473 | 23.08 | 7.64 | 2.22 | 0.25 | 35.29 | 0.53 | 0.15 | 0.13 | 0.02 | 0.19 | 0.69 | 30.65 | 100.84 |
| SL-10 | 1.55 | 2.00 | 0.45 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 2.00 | 2.40 | 0.40 | limestone | SL-10/3 | C/S/18-19/5474 | 24.29 | 6.46 | 1.91 | 0.29 | 36.21 | 0.39 | 0.12 | 0.06 | 0.02 | 0.18 | 0.05 | 29.79 | 99.77 |
| SL-10 | 2.40 | 2.86 | 0.46 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 2.86 | 2.94 | 0.08 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 2.94 | 3.00 | 0.06 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 3.00 | 3.16 | 0.16 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 3.16 | 3.45 | 0.29 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 3.45 | 4.00 | 0.55 | clay | | | | | | | | | | | | | | | |
| SL-10 | 4.00 | 4.26 | 0.26 | clay | | | | | | | | | | | | | | | |
| SL-10 | 4.26 | 4.41 | 0.15 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 4.41 | 4.75 | 0.34 | marl | SL-10/5 | C/S/18-19/5475 | 43.21 | 13.90 | 3.63 | 0.51 | 21.17 | 0.98 | 0.38 | 0.19 | 0.03 | 0.17 | 0.07 | 15.87 | 100.11 |
| SL-10 | 4.75 | 5.00 | 0.25 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 5.00 | 5.37 | 0.37 | clay | | | | | | | | | | | | | | | |
| SL-10 | 5.37 | 5.71 | 0.34 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 5.71 | 6.00 | 0.29 | clay | | | | | | | | | | | | | | | |
| SL-10 | 6.00 | 7.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-10 | 7.00 | 8.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-10 | 8.00 | 8.29 | 0.29 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 8.29 | 9.00 | 0.71 | clay | | | | | | | | | | | | | | | |
| SL-10 | 9.00 | 9.70 | 0.70 | clay | | | | | | | | | | | | | | | |
| SL-10 | 9.70 | 9.86 | 0.16 | calcareous clay | | | | | | | | | | | | | | | |
| SL-10 | 9.86 | 10.00 | 0.14 | clay | | | | | | | | | | | | | | | |
| SL-10 | 10.00 | 11.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-10 | 11.00 | 11.90 | 0.90 | calcareous clay | | | | | | | | | | | | | | | |
| SL-10 | 11.90 | 12.00 | 0.10 | clay | | | | | | | | | | | | | | | |
| SL-10 | 12.00 | 12.17 | 0.17 | clay | | | | | | | | | | | | | | | |
| SL-10 | 12.17 | 13.00 | 0.83 | clay | | | | | | | | | | | | | | | |
| SL-10 | 13.00 | 14.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-10 | 14.00 | 14.28 | 0.28 | clay | | | | | | | | | | | | | | | |
| SL-10 | 14.28 | 15.00 | 0.72 | clay | | | | | | | | | | | | | | | |
| SL-10 | 15.00 | 15.22 | 0.22 | clay | | | | | | | | | | | | | | | |
| SL-10 | 15.22 | 15.37 | 0.15 | calcareous clay | | | | | | | | | | | | | | | |
| SL-10 | 15.37 | 16.00 | 0.63 | clay | | | | | | | | | | | | | | | |
| SL-10 | 16.00 | 16.20 | 0.20 | clay | | | | | | | | | | | | | | | |
| SL-10 | 16.20 | 16.47 | 0.27 | calcareous clay | | | | | | | | | | | | | | | |
| SL-10 | 16.47 | 17.00 | 0.53 | clay | | | | | | | | | | | | | | | |
| SL-10 | 17.00 | 17.66 | 0.66 | clay | | | | | | | | | | | | | | | |
| SL-10 | 17.66 | 18.00 | 0.34 | clay | | | | | | | | | | | | | | | |
| SL-10 | 18.00 | 18.94 | 0.94 | clay | | | | | | | | | | | | | | | |
| SL-10 | 18.94 | 19.00 | 0.06 | clay | | | | | | | | | | | | | | | |
| SL-10 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-10 | 20.00 | 20.23 | 0.23 | calcareous clay | | | | | | | | | | | | | | | |
| SL-10 | 20.23 | 20.50 | 0.27 | calcareous clay | | | | | | | | | | | | | | | |
| SL-10 | 20.50 | 21.12 | 0.62 | siliceous clay | SL-10/13 | C/S/18-19/5476 | 55.31 | 16.31 | 3.86 | 0.56 | 16.02 | 0.92 | 0.56 | 0.17 | 0.03 | 0.13 | 0.05 | 6.38 | 100.30 |
| SL-10 | 21.12 | 22.00 | 0.88 | clay | | | | | | | | | | | | | | | |

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| SL-10 | 22.00 | 22.29 | 0.29 | calcareous clay | | | | | | | | | | | | | | | |
| SL-10 | 22.29 | 23.00 | 0.71 | clay | | | | | | | | | | | | | | | |
| SL-10 | 23.00 | 23.85 | 0.85 | clay | | | | | | | | | | | | | | | |
| SL-10 | 23.85 | 24.00 | 0.15 | clay | | | | | | | | | | | | | | | |
| SL-10 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-10 | 25.00 | 25.73 | 0.73 | clay | | | | | | | | | | | | | | | |
| SL-10 | 25.73 | 26.00 | 0.27 | clay | | | | | | | | | | | | | | | |
| SL-10 | 26.00 | 26.87 | 0.87 | clay | | | | | | | | | | | | | | | |
| SL-10 | 26.87 | 27.00 | 0.13 | clay | | | | | | | | | | | | | | | |
| SL-10 | 27.00 | 28.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-10 | 28.00 | 29.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-10 | 29.00 | 30.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 0.00 | 0.23 | 0.23 | soil | | | | | | | | | | | | | | | |
| SL-11 | 0.23 | 1.00 | 0.77 | cement grade limestone | SL-11/1 | C/S/18-19/5477 | 17.09 | 4.87 | 1.60 | 0.20 | 41.07 | 0.35 | 0.11 | 0.06 | 0.03 | 0.07 | 0.06 | 34.89 | 100.40 |
| SL-11 | 1.00 | 2.00 | 1.00 | limestone | SL-11/2 | C/S/18-19/5478 | 22.01 | 5.64 | 1.73 | 0.30 | 38.26 | 0.37 | 0.11 | 0.06 | 0.03 | 0.08 | 0.06 | 31.13 | 99.78 |
| SL-11 | 2.00 | 3.31 | 1.31 | limestone | SL-11/3 | C/S/18-19/5479 | 19.85 | 5.47 | 2.34 | 0.23 | 38.61 | 0.39 | 0.11 | 0.06 | 0.03 | 0.10 | 0.50 | 32.36 | 100.05 |
| SL-11 | 3.31 | 4.00 | 0.69 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 4.00 | 4.20 | 0.20 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 4.20 | 4.64 | 0.44 | limestone | SL-11/4 | C/S/18-19/5480 | 18.44 | 5.36 | 2.39 | 0.21 | 39.23 | 0.35 | 0.10 | 0.08 | 0.02 | 0.15 | 0.06 | 33.80 | 100.19 |
| SL-11 | 4.64 | 5.00 | 0.36 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 5.00 | 5.31 | 0.31 | cement grade limestone | SL-11/5 | C/S/18-19/5481 | 12.55 | 3.50 | 1.91 | 0.15 | 43.10 | 0.28 | 0.09 | 0.06 | 0.02 | 0.19 | 0.06 | 37.29 | 99.20 |
| SL-11 | 5.31 | 5.55 | 0.24 | calcareous clay | | | | | | | | | | | | | | | |
| SL-11 | 5.55 | 6.00 | 0.45 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 6.00 | 6.39 | 0.39 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 6.39 | 7.00 | 0.61 | clay | | | | | | | | | | | | | | | |
| SL-11 | 7.00 | 8.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 8.00 | 8.77 | 0.77 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 8.77 | 9.00 | 0.23 | clay | | | | | | | | | | | | | | | |
| SL-11 | 9.00 | 9.56 | 0.56 | limestone | SL-11/7 | C/S/18-19/5482 | 24.97 | 7.66 | 2.30 | 0.26 | 34.53 | 0.43 | 0.12 | 0.11 | 0.02 | 0.12 | 0.05 | 29.72 | 100.29 |
| SL-11 | 9.56 | 10.00 | 0.44 | clay | | | | | | | | | | | | | | | |
| SL-11 | 10.00 | 10.86 | 0.86 | clay | | | | | | | | | | | | | | | |
| SL-11 | 10.86 | 11.00 | 0.14 | clay | | | | | | | | | | | | | | | |
| SL-11 | 11.00 | 12.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 12.00 | 12.42 | 0.42 | clay | | | | | | | | | | | | | | | |
| SL-11 | 12.42 | 12.87 | 0.45 | cement grade limestone | SL-11/8 | C/S/18-19/5483 | 6.25 | 1.31 | 2.45 | 0.11 | 47.74 | 0.19 | 0.08 | 0.04 | 0.03 | 0.25 | 0.05 | 41.23 | 99.73 |
| SL-11 | 12.87 | 13.00 | 0.13 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 13.00 | 14.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 14.00 | 14.24 | 0.24 | clay | | | | | | | | | | | | | | | |
| SL-11 | 14.24 | 14.60 | 0.36 | sandy clay | | | | | | | | | | | | | | | |
| SL-11 | 14.60 | 15.00 | 0.40 | clay | | | | | | | | | | | | | | | |
| SL-11 | 15.00 | 16.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 16.00 | 17.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 17.00 | 17.41 | 0.41 | clay | | | | | | | | | | | | | | | |
| SL-11 | 17.41 | 17.79 | 0.38 | marl | SL-11/9 | C/S/18-19/5484 | 26.77 | 7.48 | 2.29 | 0.25 | 33.50 | 0.55 | 0.19 | 0.11 | 0.02 | 0.19 | 0.06 | 27.66 | 99.07 |
| SL-11 | 17.79 | 18.00 | 0.21 | clay | | | | | | | | | | | | | | | |
| SL-11 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 19.00 | 19.89 | 0.89 | clay | | | | | | | | | | | | | | | |
| SL-11 | 19.89 | 20.00 | 0.11 | clay | | | | | | | | | | | | | | | |
| SL-11 | 20.00 | 21.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 21.00 | 22.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 22.00 | 22.28 | 0.28 | clay | | | | | | | | | | | | | | | |
| SL-11 | 22.28 | 22.80 | 0.52 | sandy clay | | | | | | | | | | | | | | | |

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| SL-11 | 22.80 | 23.00 | 0.20 | clay | | | | | | | | | | | | | | | |
| SL-11 | 23.00 | 23.14 | 0.14 | clay | | | | | | | | | | | | | | | |
| SL-11 | 23.14 | 23.30 | 0.16 | clay | | | | | | | | | | | | | | | |
| SL-11 | 23.30 | 23.89 | 0.59 | limestone | SL-11/10 | C/S/18-19/5485 | 18.10 | 5.16 | 2.36 | 0.20 | 38.65 | 0.48 | 0.14 | 0.10 | 0.03 | 0.23 | 0.12 | 33.52 | 99.09 |
| SL-11 | 23.89 | 24.00 | 0.11 | clay | | | | | | | | | | | | | | | |
| SL-11 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 25.00 | 26.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 26.00 | 27.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 27.00 | 28.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-11 | 28.00 | 28.07 | 0.07 | clay | | | | | | | | | | | | | | | |
| SL-11 | 28.07 | 29.00 | 0.93 | clay | | | | | | | | | | | | | | | |
| SL-11 | 29.00 | 30.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 0.00 | 0.17 | 0.17 | soil | | | | | | | | | | | | | | | |
| SL-05 | 0.17 | 1.33 | 1.16 | cement grade limestone | SL-05/1 | C/S/18-19/5486 | 16.17 | 4.74 | 2.30 | 0.17 | 40.70 | 0.37 | 0.11 | 0.09 | 0.02 | 0.17 | 0.06 | 34.25 | 99.15 |
| SL-05 | 1.33 | 2.00 | 0.67 | sandy clay | | | | | | | | | | | | | | | |
| SL-05 | 2.00 | 2.62 | 0.62 | sludge (sandy clay) | | | | | | | | | | | | | | | |
| SL-05 | 2.62 | 3.00 | 0.38 | sandy clay | | | | | | | | | | | | | | | |
| SL-05 | 3.00 | 3.39 | 0.39 | sandy clay | | | | | | | | | | | | | | | |
| SL-05 | 3.39 | 3.77 | 0.38 | cement grade limestone | SL-05/2 | C/S/18-19/5487 | 8.92 | 2.52 | 2.18 | 0.12 | 45.55 | 0.23 | 0.08 | 0.05 | 0.01 | 0.11 | 0.05 | 39.42 | 99.24 |
| SL-05 | 3.77 | 4.00 | 0.23 | sandy clay | | | | | | | | | | | | | | | |
| SL-05 | 4.00 | 5.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-05 | 5.00 | 5.39 | 0.39 | limestone | SL-05/3 | C/S/18-19/5488 | 22.70 | 5.33 | 1.81 | 0.17 | 37.54 | 0.34 | 0.11 | 0.08 | 0.01 | 0.09 | 0.05 | 30.96 | 99.19 |
| SL-05 | 5.39 | 6.00 | 0.61 | clay | | | | | | | | | | | | | | | |
| SL-05 | 6.00 | 7.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 7.00 | 7.26 | 0.26 | clay | | | | | | | | | | | | | | | |
| SL-05 | 7.26 | 7.37 | 0.11 | sandy clay | | | | | | | | | | | | | | | |
| SL-05 | 7.37 | 8.00 | 0.63 | clay | | | | | | | | | | | | | | | |
| SL-05 | 8.00 | 9.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 9.00 | 10.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 10.00 | 11.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 11.00 | 12.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 12.00 | 12.27 | 0.27 | clay | | | | | | | | | | | | | | | |
| SL-05 | 12.27 | 12.39 | 0.12 | clay | | | | | | | | | | | | | | | |
| SL-05 | 12.39 | 13.00 | 0.61 | clay | | | | | | | | | | | | | | | |
| SL-05 | 13.00 | 14.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 14.00 | 15.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 15.00 | 16.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 16.00 | 17.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 17.00 | 18.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 20.00 | 20.03 | 0.03 | clay | | | | | | | | | | | | | | | |
| SL-05 | 20.03 | 21.00 | 0.97 | clay | | | | | | | | | | | | | | | |
| SL-05 | 21.00 | 22.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 22.00 | 22.22 | 0.22 | clay | | | | | | | | | | | | | | | |
| SL-05 | 22.22 | 22.63 | 0.41 | limestone | SL-05/5 | C/S/18-19/5489 | 23.20 | 5.81 | 1.78 | 0.18 | 36.85 | 0.37 | 0.11 | 0.08 | 0.01 | 0.08 | 0.05 | 30.72 | 99.24 |
| SL-05 | 22.63 | 23.00 | 0.37 | clay | | | | | | | | | | | | | | | |
| SL-05 | 23.00 | 24.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-05 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 0.00 | 0.43 | 0.43 | limestone | SL-08/1 | C/S/18-19/5490 | 16.02 | 4.76 | 2.95 | 0.19 | 39.67 | 0.32 | ..09 | 0.08 | 0.01 | 0.08 | 0.05 | 35.06 | 99.28 |
| SL-08 | 0.43 | 1.00 | 0.57 | sandy clay | | | | | | | | | | | | | | | |
| SL-08 | 1.00 | 1.43 | 0.43 | limestone | SL-08/2 | C/S/18-19/5491 | 21.21 | 5.73 | 2.18 | 0.21 | 37.71 | 0.34 | 0.10 | 0.08 | 0.01 | 0.10 | 0.06 | 31.91 | 99.64 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL-08 | 1.43 | 1.66 | 0.23 | sandy clay | | | | | | | | | | | | | | | |
| SL-08 | 1.66 | 2.00 | 0.34 | limestone | SL-08/3 | C/S/18-19/5492 | 17.67 | 6.03 | 2.89 | 0.26 | 38.09 | 0.35 | 0.10 | 0.08 | 0.01 | 0.08 | 0.06 | 34.78 | 100.40 |
| SL-08 | 2.00 | 2.36 | 0.36 | limestone | SL-08/4 | C/S/18-19/5493 | 18.92 | 6.42 | 2.75 | 0.25 | 38.08 | 0.37 | 0.10 | 0.08 | 0.01 | 0.08 | 0.05 | 33.27 | 100.38 |
| SL-08 | 2.36 | 2.53 | 0.17 | sandy clay | | | | | | | | | | | | | | | |
| SL-08 | 2.53 | 3.00 | 0.47 | clay | | | | | | | | | | | | | | | |
| SL-08 | 3.00 | 4.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 4.00 | 4.15 | 0.15 | clay | | | | | | | | | | | | | | | |
| SL-08 | 4.15 | 4.84 | 0.69 | clay | | | | | | | | | | | | | | | |
| SL-08 | 4.84 | 5.00 | 0.16 | clay | | | | | | | | | | | | | | | |
| SL-08 | 5.00 | 6.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 6.00 | 6.57 | 0.57 | clay | | | | | | | | | | | | | | | |
| SL-08 | 6.57 | 6.86 | 0.29 | clay | | | | | | | | | | | | | | | |
| SL-08 | 6.86 | 7.28 | 0.42 | marl | SL-08/6 | C/S/18-19/5494 | 31.36 | 9.42 | 3.00 | 0.30 | 29.23 | 0.49 | 0.15 | 0.12 | 0.02 | 0.01 | 0.01 | 25.83 | 99.94 |
| SL-08 | 7.28 | 8.00 | 0.72 | clay | | | | | | | | | | | | | | | |
| SL-08 | 8.00 | 8.94 | 0.94 | clay | | | | | | | | | | | | | | | |
| SL-08 | 8.94 | 9.00 | 0.06 | clay | | | | | | | | | | | | | | | |
| SL-08 | 9.00 | 9.42 | 0.42 | clay | | | | | | | | | | | | | | | |
| SL-08 | 9.42 | 9.69 | 0.27 | clay | | | | | | | | | | | | | | | |
| SL-08 | 9.69 | 10.00 | 0.31 | clay | | | | | | | | | | | | | | | |
| SL-08 | 10.00 | 10.79 | 0.79 | clay | | | | | | | | | | | | | | | |
| SL-08 | 10.79 | 10.88 | 0.09 | calcareous clay | | | | | | | | | | | | | | | |
| SL-08 | 10.88 | 11.00 | 0.12 | clay | | | | | | | | | | | | | | | |
| SL-08 | 11.00 | 12.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 12.00 | 13.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 13.00 | 14.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 14.00 | 15.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 15.00 | 16.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 16.00 | 17.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 17.00 | 17.46 | 0.46 | clay | | | | | | | | | | | | | | | |
| SL-08 | 17.46 | 17.60 | 0.14 | clay | | | | | | | | | | | | | | | |
| SL-08 | 17.60 | 18.00 | 0.40 | clay | | | | | | | | | | | | | | | |
| SL-08 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 20.00 | 20.26 | 0.26 | clay | | | | | | | | | | | | | | | |
| SL-08 | 20.26 | 20.35 | 0.09 | sandy clay | | | | | | | | | | | | | | | |
| SL-08 | 20.35 | 21.00 | 0.65 | clay | | | | | | | | | | | | | | | |
| SL-08 | 21.00 | 21.03 | 0.03 | clay | | | | | | | | | | | | | | | |
| SL-08 | 21.03 | 21.72 | 0.69 | limestone | SL-08/10 | C/S/18-19/5495 | 20.04 | 5.95 | 2.08 | 0.20 | 37.44 | 0.49 | 0.14 | 0.11 | 0.02 | 0.21 | 0.06 | 33.40 | 100.14 |
| SL-08 | 21.72 | 22.00 | 0.28 | clay | | | | | | | | | | | | | | | |
| SL-08 | 22.00 | 23.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 23.00 | 24.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-08 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 0.00 | 1.00 | 1.00 | cement grade limestone | SL-13/1 | C/S/18-19/5496 | 9.00 | 2.24 | 1.18 | 0.10 | 47.63 | 0.20 | 0.09 | 0.05 | 0.05 | 0.15 | 0.05 | 38.42 | 99.16 |
| SL-13 | 1.00 | 2.13 | 1.13 | cement grade limestone | SL-13/2 | C/S/18-19/5497 | 12.92 | 3.70 | 1.44 | 0.15 | 44.22 | 0.26 | 0.09 | 0.05 | 0.04 | 0.17 | 0.05 | 36.33 | 99.42 |
| SL-13 | 2.13 | 2.57 | 0.44 | limestone | SL-13/3 | C/S/18-19/5498 | 18.86 | 5.85 | 1.54 | 0.21 | 39.18 | 0.36 | 0.11 | 0.06 | 0.01 | 0.12 | 0.06 | 34.06 | 100.42 |
| SL-13 | 2.57 | 2.90 | 0.33 | limestone | SL-13/4 | C/S/18-19/5499 | 23.24 | 5.97 | 1.77 | 0.25 | 37.43 | 0.35 | 0.13 | 0.06 | 0.01 | 0.18 | 0.05 | 30.02 | 99.46 |
| SL-13 | 2.90 | 3.00 | 0.10 | sandy clay | | | | | | | | | | | | | | | |
| SL-13 | 3.00 | 3.35 | 0.35 | marl | SL-13/5 | C/S/18-19/5500 | 26.78 | 8.88 | 1.77 | 0.29 | 33.51 | 0.52 | 0.16 | 0.08 | 0.01 | 0.05 | 0.05 | 28.25 | 100.35 |
| SL-13 | 3.35 | 3.73 | 0.38 | sandy clay | | | | | | | | | | | | | | | |
| SL-13 | 3.73 | 4.00 | 0.27 | clay | | | | | | | | | | | | | | | |
| SL-13 | 4.00 | 5.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 5.00 | 6.00 | 1.00 | clay | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL-13 | 6.00 | 7.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 7.00 | 8.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 8.00 | 8.36 | 0.36 | cement grade limestone | SL-13/6 | C/S/18-19/5501 | 9.49 | 2.34 | 1.50 | 0.12 | 46.03 | 0.25 | 0.10 | 0.06 | 0.01 | 0.25 | 0.06 | 38.98 | 99.19 |
| SL-13 | 8.36 | 9.00 | 0.64 | clay | | | | | | | | | | | | | | | |
| SL-13 | 9.00 | 10.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 10.00 | 11.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 11.00 | 12.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 12.00 | 13.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 13.00 | 14.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 14.00 | 14.25 | 0.25 | clay | | | | | | | | | | | | | | | |
| SL-13 | 14.25 | 14.62 | 0.37 | marl | SL-13/7 | C/S/18-19/5502 | 27.82 | 8.01 | 1.79 | 0.30 | 32.64 | 0.53 | 0.16 | 0.09 | 0.01 | 0.04 | 0.06 | 28.91 | 100.36 |
| SL-13 | 14.62 | 14.85 | 0.23 | calcareous clay | | | | | | | | | | | | | | | |
| SL-13 | 14.85 | 15.00 | 0.15 | clay | | | | | | | | | | | | | | | |
| SL-13 | 15.00 | 16.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 16.00 | 17.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 17.00 | 18.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 18.00 | 18.35 | 0.35 | marl | SL-13/9 | C/S/18-19/5503 | 37.40 | 9.43 | 2.93 | 0.34 | 26.74 | 0.60 | 0.30 | 0.13 | 0.03 | 0.03 | 0.05 | 21.57 | 99.55 |
| SL-13 | 18.35 | 19.00 | 0.65 | clay | | | | | | | | | | | | | | | |
| SL-13 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 20.00 | 21.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 21.00 | 21.33 | 0.33 | clay | | | | | | | | | | | | | | | |
| SL-13 | 21.33 | 22.00 | 0.67 | clay | | | | | | | | | | | | | | | |
| SL-13 | 22.00 | 23.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-13 | 23.00 | 23.88 | 0.88 | clay | | | | | | | | | | | | | | | |
| SL-13 | 23.88 | 24.00 | 0.12 | clay | | | | | | | | | | | | | | | |
| SL-13 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-02 | 0.00 | 1.20 | 1.20 | cement grade limestone | SL-02/1 | C/S/18-19/5504 | 13.27 | 3.78 | 2.63 | 0.15 | 42.55 | 0.30 | 0.09 | 0.06 | 0.01 | 0.12 | 0.05 | 36.85 | 99.86 |
| SL-02 | 1.20 | 1.43 | 0.23 | calcareous clay | | | | | | | | | | | | | | | |
| SL-02 | 1.43 | 2.00 | 0.57 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 2.00 | 2.42 | 0.42 | marl | SL-02/3 | C/S/18-19/5505 | 25.70 | 7.52 | 2.48 | 0.25 | 33.92 | 0.50 | 0.16 | 0.12 | 0.02 | 0.22 | 0.05 | 28.30 | 99.24 |
| SL-02 | 2.42 | 3.00 | 0.58 | clay | | | | | | | | | | | | | | | |
| SL-02 | 3.00 | 3.54 | 0.54 | clay | | | | | | | | | | | | | | | |
| SL-02 | 3.54 | 4.00 | 0.46 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 4.00 | 5.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 5.00 | 6.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 6.00 | 6.87 | 0.87 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 6.87 | 7.00 | 0.13 | clay | | | | | | | | | | | | | | | |
| SL-02 | 7.00 | 7.39 | 0.39 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 7.39 | 7.81 | 0.42 | clay | | | | | | | | | | | | | | | |
| SL-02 | 7.81 | 8.00 | 0.19 | clay | | | | | | | | | | | | | | | |
| SL-02 | 8.00 | 9.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-02 | 9.00 | 9.11 | 0.11 | clay | | | | | | | | | | | | | | | |
| SL-02 | 9.11 | 10.00 | 0.89 | limestone | SL-02/4 | C/S/18-19/5506 | 22.80 | 6.40 | 2.51 | 0.24 | 35.54 | 0.36 | 0.10 | 0.09 | 0.01 | 0.09 | 0.06 | 31.50 | 99.70 |
| SL-02 | 10.00 | 10.11 | 0.11 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 10.11 | 11.00 | 0.89 | clay | | | | | | | | | | | | | | | |
| SL-02 | 11.00 | 12.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-02 | 12.00 | 12.18 | 0.18 | clay | | | | | | | | | | | | | | | |
| SL-02 | 12.18 | 12.64 | 0.46 | clay | | | | | | | | | | | | | | | |
| SL-02 | 12.64 | 13.00 | 0.36 | clay | | | | | | | | | | | | | | | |
| SL-02 | 13.00 | 13.07 | 0.07 | clay | | | | | | | | | | | | | | | |
| SL-02 | 13.07 | 13.78 | 0.71 | clay | | | | | | | | | | | | | | | |
| SL-02 | 13.78 | 14.00 | 0.22 | calcareous clay | | | | | | | | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL-02 | 14.00 | 14.62 | 0.62 | clay | | | | | | | | | | | | | | | |
| SL-02 | 14.62 | 14.89 | 0.27 | calcareous clay | | | | | | | | | | | | | | | |
| SL-02 | 14.89 | 14.95 | 0.06 | clay | | | | | | | | | | | | | | | |
| SL-02 | 14.95 | 15.00 | 0.05 | clay | | | | | | | | | | | | | | | |
| SL-02 | 15.00 | 16.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-02 | 16.00 | 17.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-02 | 17.00 | 18.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-02 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-02 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-02 | 20.00 | 20.13 | 0.13 | clay | | | | | | | | | | | | | | | |
| SL-02 | 20.13 | 21.00 | 0.87 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 21.00 | 21.13 | 0.13 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 21.13 | 22.00 | 0.87 | marl | SL-02/8 | C/S/18-19/5507 | 29.87 | 9.30 | 2.83 | 0.29 | 30.25 | 0.55 | 0.15 | 0.15 | 0.03 | 0.14 | 0.05 | 26.37 | 99.98 |
| SL-02 | 22.00 | 22.67 | 0.67 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 22.67 | 23.00 | 0.33 | clay | | | | | | | | | | | | | | | |
| SL-02 | 23.00 | 23.27 | 0.27 | clay | | | | | | | | | | | | | | | |
| SL-02 | 23.27 | 23.80 | 0.53 | sandy clay | | | | | | | | | | | | | | | |
| SL-02 | 23.80 | 24.00 | 0.20 | clay | | | | | | | | | | | | | | | |
| SL-02 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 0.00 | 0.38 | 0.38 | soil | | | | | | | | | | | | | | | |
| SL-06 | 0.38 | 1.40 | 1.02 | cement grade limestone | SL-06/1 | C/S/18-19/5508 | 9.90 | 2.76 | 2.88 | 0.14 | 44.46 | 0.26 | 0.09 | 0.05 | 0.02 | 0.14 | 0.06 | 38.48 | 99.24 |
| SL-06 | 1.40 | 2.00 | 0.60 | clay | | | | | | | | | | | | | | | |
| SL-06 | 2.00 | 2.70 | 0.70 | clay | | | | | | | | | | | | | | | |
| SL-06 | 2.70 | 3.00 | 0.30 | clay | | | | | | | | | | | | | | | |
| SL-06 | 3.00 | 4.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 4.00 | 5.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 5.00 | 6.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 6.00 | 6.20 | 0.20 | sandy clay | | | | | | | | | | | | | | | |
| SL-06 | 6.20 | 6.39 | 0.19 | sandy clay | | | | | | | | | | | | | | | |
| SL-06 | 6.39 | 7.00 | 0.61 | marl | SL-06/3 | C/S/18-19/5509 | 33.90 | 9.61 | 2.71 | 0.38 | 28.53 | 0.50 | 0.14 | 0.12 | 0.01 | 0.10 | 0.06 | 23.54 | 99.60 |
| SL-06 | 7.00 | 8.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 8.00 | 8.33 | 0.33 | clay | | | | | | | | | | | | | | | |
| SL-06 | 8.33 | 8.79 | 0.46 | marl | SL-06/4 | C/S/18-19/5510 | 39.81 | 11.69 | 3.45 | 0.51 | 23.83 | 0.65 | 0.19 | 0.17 | 0.02 | 0.16 | 0.06 | 18.87 | 99.41 |
| SL-06 | 8.79 | 9.00 | 0.21 | sandy clay | | | | | | | | | | | | | | | |
| SL-06 | 9.00 | 9.08 | 0.08 | sandy clay | | | | | | | | | | | | | | | |
| SL-06 | 9.08 | 10.00 | 0.92 | clay | | | | | | | | | | | | | | | |
| SL-06 | 10.00 | 11.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 11.00 | 12.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 12.00 | 13.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 13.00 | 14.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 14.00 | 15.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 15.00 | 15.46 | 0.46 | clay | | | | | | | | | | | | | | | |
| SL-06 | 15.46 | 15.69 | 0.23 | clay | | | | | | | | | | | | | | | |
| SL-06 | 15.69 | 16.00 | 0.31 | clay | | | | | | | | | | | | | | | |
| SL-06 | 16.00 | 17.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 17.00 | 18.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 20.00 | 21.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 21.00 | 22.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 22.00 | 22.13 | 0.13 | clay | | | | | | | | | | | | | | | |
| SL-06 | 22.13 | 22.74 | 0.61 | cement grade limestone | SL-06/6 | C/S/18-19/5511 | 13.77 | 3.48 | 1.81 | 0.15 | 42.36 | 0.33 | 0.12 | 0.08 | 0.03 | 0.20 | 0.06 | 38.01 | 100.40 |

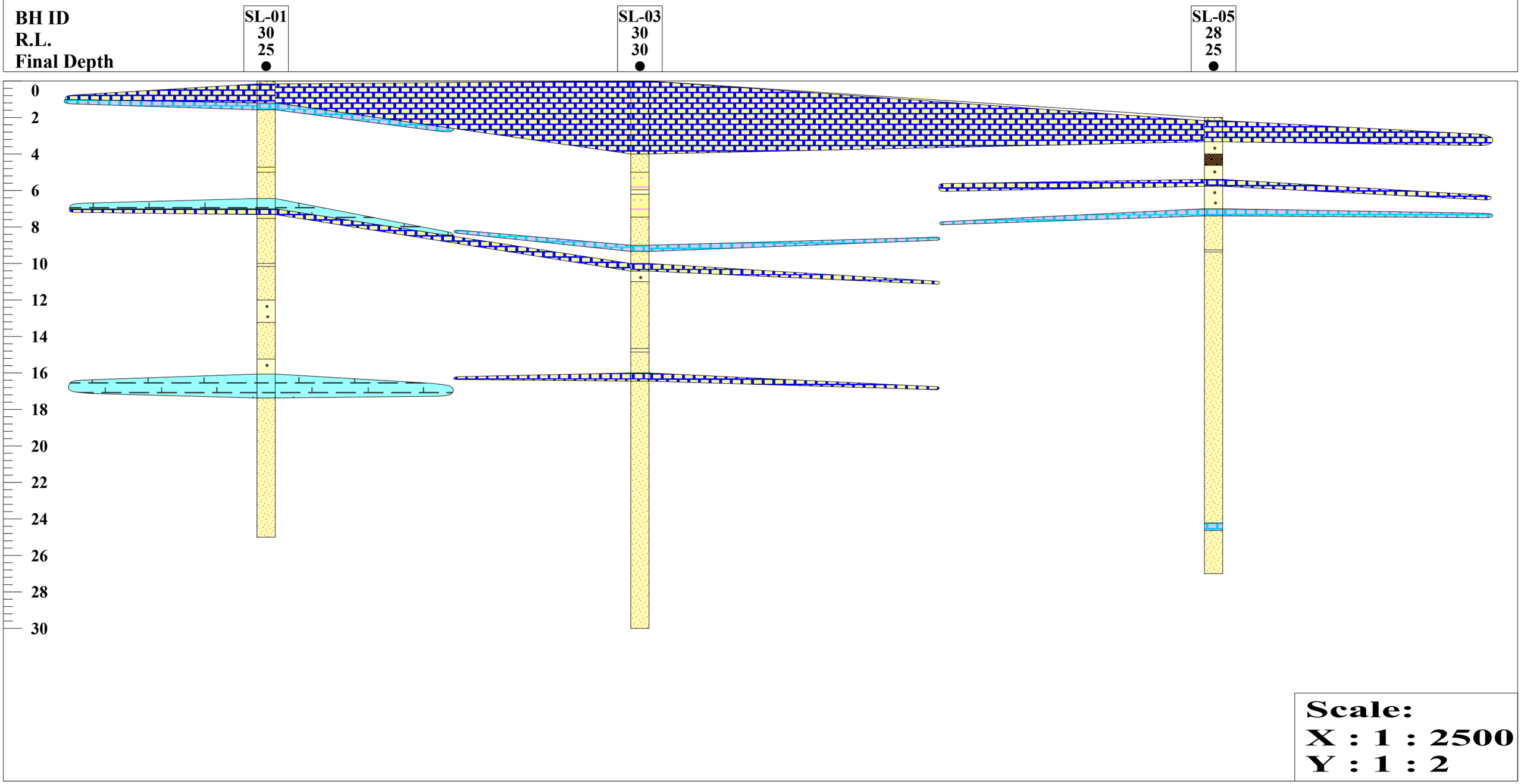
| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SL-06 | 22.74 | 23.00 | 0.26 | clay | | | | | | | | | | | | | | | |
| SL-06 | 23.00 | 24.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-06 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-01 | 0.00 | 0.16 | 0.16 | soil | | | | | | | | | | | | | | | |
| SL-01 | 0.16 | 1.20 | 1.04 | cement grade limestone | SL-01/1 | C/S/18-19/5512 | 18.46 | 4.60 | 1.90 | 0.16 | 40.07 | 0.34 | 0.11 | 0.06 | 0.01 | 0.07 | 0.06 | 33.91 | 99.75 |
| SL-01 | 1.20 | 1.58 | 0.38 | limestone | SL-01/2 | C/S/18-19/5513 | 23.46 | 6.47 | 1.55 | 0.18 | 35.67 | 0.43 | 0.13 | 0.08 | 0.01 | 0.06 | 0.05 | 31.90 | 99.99 |
| SL-01 | 1.58 | 2.00 | 0.42 | clay | | | | | | | | | | | | | | | |
| SL-01 | 2.00 | 2.09 | 0.09 | clay | | | | | | | | | | | | | | | |
| SL-01 | 2.09 | 3.00 | 0.91 | clay | | | | | | | | | | | | | | | |
| SL-01 | 3.00 | 4.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-01 | 4.00 | 4.72 | 0.72 | clay | | | | | | | | | | | | | | | |
| SL-01 | 4.72 | 5.00 | 0.28 | calcareous clay | | | | | | | | | | | | | | | |
| SL-01 | 5.00 | 5.66 | 0.66 | clay | | | | | | | | | | | | | | | |
| SL-01 | 5.66 | 6.00 | 0.34 | clay | | | | | | | | | | | | | | | |
| SL-01 | 6.00 | 6.44 | 0.44 | clay | | | | | | | | | | | | | | | |
| SL-01 | 6.44 | 7.00 | 0.56 | marl | SL-01/4 | C/S/18-19/5514 | 24.74 | 7.30 | 2.78 | 0.27 | 33.41 | 0.40 | 0.11 | 0.09 | 0.01 | 0.08 | 0.06 | 30.65 | 99.90 |
| SL-01 | 7.00 | 7.32 | 0.32 | cement grade limestone | SL-01/5 | C/S/18-19/5515 | 10.40 | 2.84 | 2.30 | 0.14 | 44.29 | 0.25 | 0.09 | 0.06 | 0.02 | 0.11 | 0.06 | 38.78 | 99.34 |
| SL-01 | 7.32 | 7.53 | 0.21 | calcareous clay | | | | | | | | | | | | | | | |
| SL-01 | 7.53 | 8.00 | 0.47 | clay | | | | | | | | | | | | | | | |
| SL-01 | 8.00 | 9.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-01 | 9.00 | 9.34 | 0.34 | clay | | | | | | | | | | | | | | | |
| SL-01 | 9.34 | 10.00 | 0.66 | clay | | | | | | | | | | | | | | | |
| SL-01 | 10.00 | 10.16 | 0.16 | sandy clay | | | | | | | | | | | | | | | |
| SL-01 | 10.16 | 11.00 | 0.84 | clay | | | | | | | | | | | | | | | |
| SL-01 | 11.00 | 11.78 | 0.78 | clay | | | | | | | | | | | | | | | |
| SL-01 | 11.78 | 12.00 | 0.22 | clay | | | | | | | | | | | | | | | |
| SL-01 | 12.00 | 13.00 | 1.00 | sandy clay | | | | | | | | | | | | | | | |
| SL-01 | 13.00 | 13.23 | 0.23 | sandy clay | | | | | | | | | | | | | | | |
| SL-01 | 13.23 | 14.00 | 0.77 | clay | | | | | | | | | | | | | | | |
| SL-01 | 14.00 | 15.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-01 | 15.00 | 15.24 | 0.24 | clay | | | | | | | | | | | | | | | |
| SL-01 | 15.24 | 16.00 | 0.76 | sandy clay | | | | | | | | | | | | | | | |
| SL-01 | 16.00 | 16.06 | 0.06 | sandy clay | | | | | | | | | | | | | | | |
| SL-01 | 16.06 | 17.37 | 1.31 | marl | SL-01/9 | C/S/18-19/5516 | 45.12 | 14.07 | 4.55 | 0.62 | 20.04 | 0.71 | 0.28 | 0.17 | 0.05 | 0.12 | 0.06 | 14.57 | 100.36 |
| SL-01 | 17.37 | 18.00 | 0.63 | clay | | | | | | | | | | | | | | | |
| SL-01 | 18.00 | 19.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-01 | 19.00 | 20.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-01 | 20.00 | 21.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-01 | 21.00 | 21.07 | 0.07 | clay | | | | | | | | | | | | | | | |
| SL-01 | 21.07 | 22.00 | 0.93 | clay | | | | | | | | | | | | | | | |
| SL-01 | 22.00 | 23.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-01 | 23.00 | 24.00 | 1.00 | clay | | | | | | | | | | | | | | | |
| SL-01 | 24.00 | 25.00 | 1.00 | clay | | | | | | | | | | | | | | | |

**ANNEXURE-6**

| CO-ORDINATES OF SHANTIPURA LIMESTONE MINE STUDY AREA BOUNDARY | | | | | |
|---|---|---|---|---|---|
| **SR. NO.** | **POINT ID** | **UTM (WGS84)** | | **DMS (WGS84)** | |
| | | **EASTING** | **NORTHING** | **LATITUDE** | **LONGITUDE** |
| 1 | BP-1 | 636963 | 2325285 | 21°01'23.68" | 70°19'04.68" |
| 2 | BP-2 | 637508 | 2325319 | 21°01'24.62" | 70°19'23.59" |
| 3 | BP-3 | 637737 | 2325307 | 21°01'24.15" | 70°19'31.51" |
| 4 | BP-4 | 637789 | 2325017 | 21°01'14.72" | 70°19'33.25" |
| 5 | BP-5 | 637733 | 2324996 | 21°01'14.04" | 70°19'31.28" |
| 6 | BP-6 | 636972 | 2325113 | 21°01'18.10" | 70°19'04.94" |

# Cross-Section - 1

# GEOLOGICAL CROSS-SECTION OF SHANTIPURA LIMESTONE MINE, JUNAGADH.




## Lithological Index

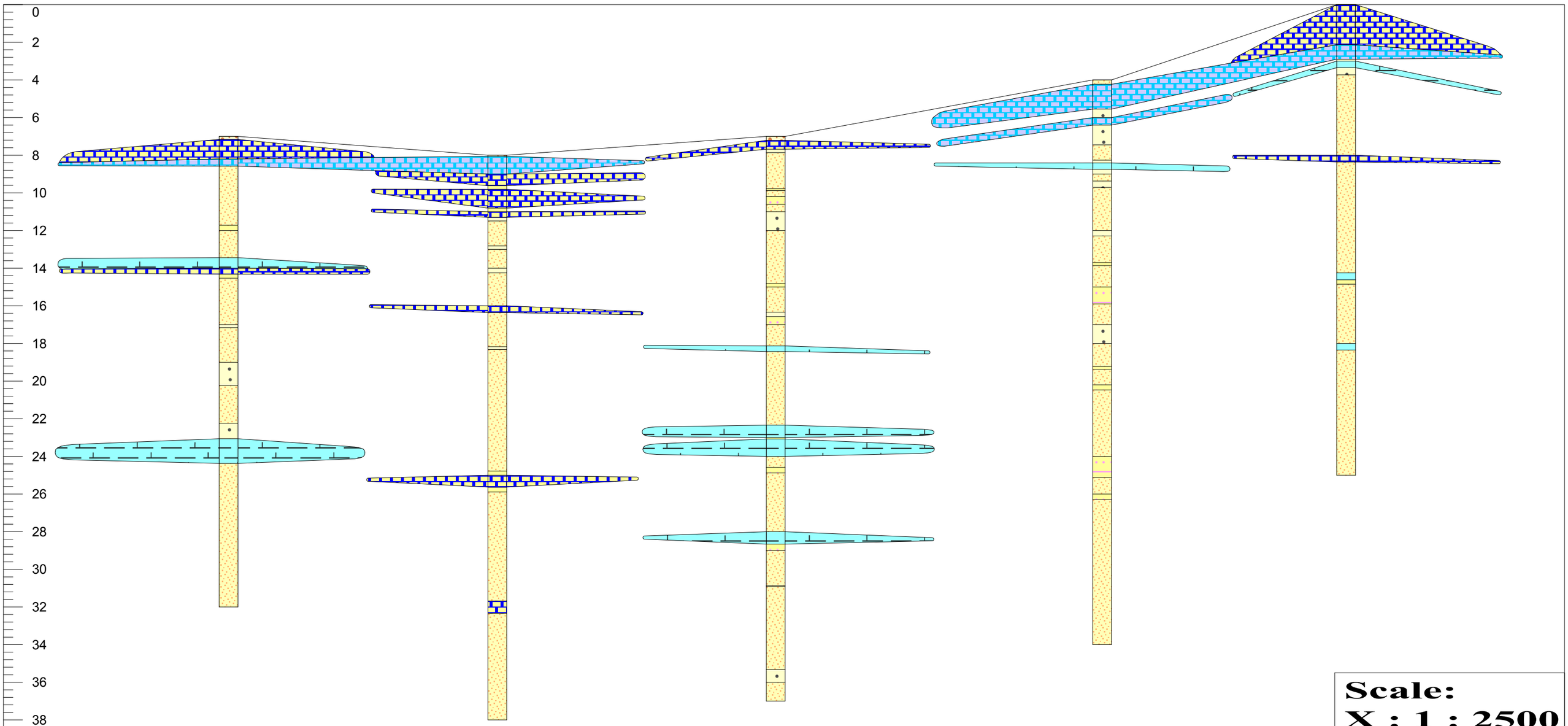
- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

**By,**
**Vinayak Engimech Pvt. Ltd.**

# Cross-Section - 2

# GEOLOGICAL CROSS-SECTION OF SHANTIPURA LIMESTONE MINE, JUNAGADH.

| BH ID | SL-01 | SL-04 | SL-07 | SL-10 | SL-13 |
|---|---|---|---|---|---|
| R.L. | 30 | 29 | 30 | 33 | 37 |
| Final Depth | 25 | 30 | 30 | 30 | 25 |




**Scale:**
**X : 1 : 2500**
**Y : 1 : 2**

## Lithological Index

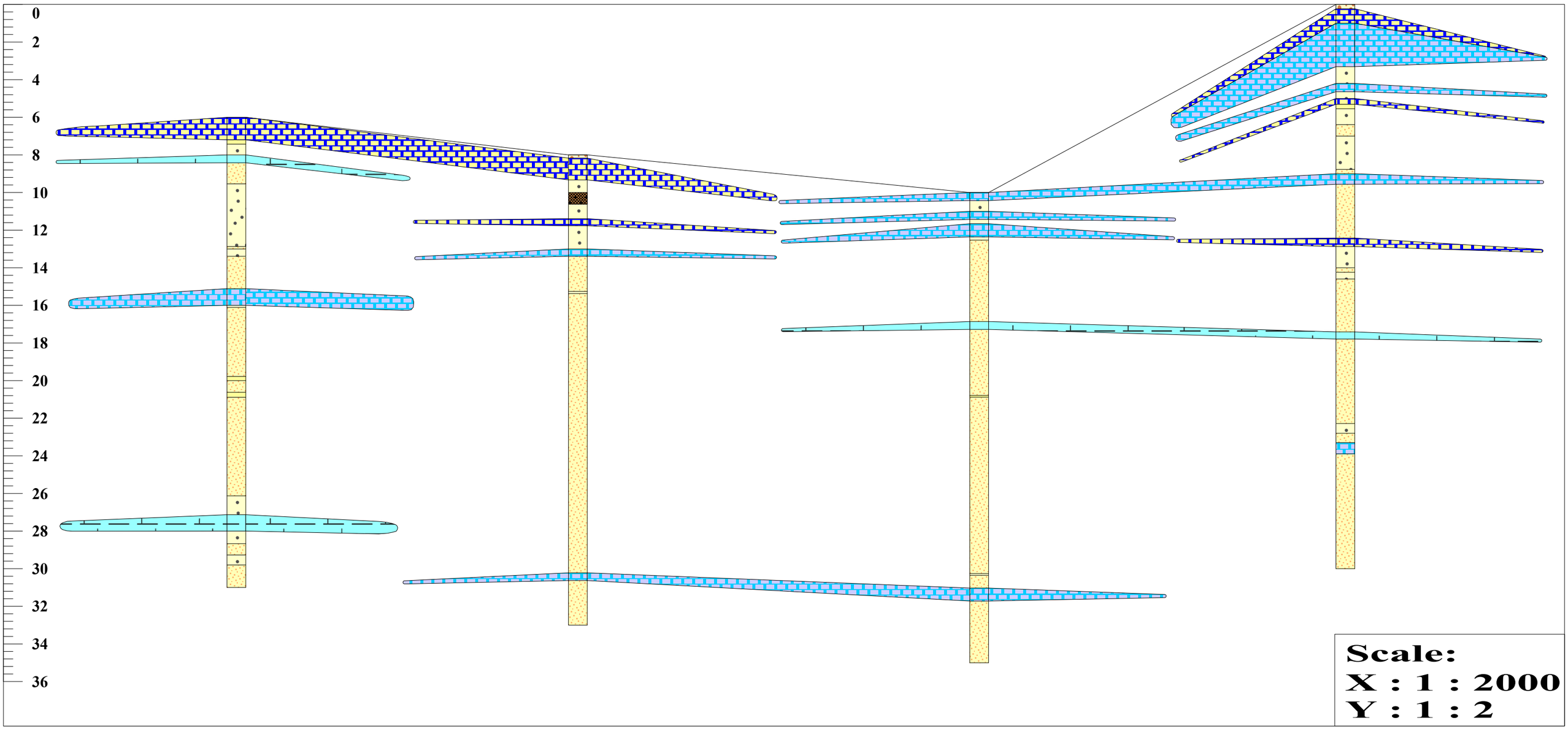
- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

**By,**
**Vinayak Engimech Pvt. Ltd.**

# Cross-Section - 3

# GEOLOGICAL CROSS-SECTION OF SHANTIPURA LIMESTONE MINE, JUNAGADH.

| BH ID | SL-02 | SL-05 | SL-08 | SL-11 |
|---|---|---|---|---|
| R.L. | 30 | 28 | 26 | 36 |
| Final Depth | 25 | 25 | 25 | 30 |




**Scale:**
**X : 1 : 2000**
**Y : 1 : 2**

## Lithological Index

- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

**By,**
**Vinayak Engimech Pvt. Ltd.**

# BH ID : SL-01

**N - 21°01'23.30"**
**E - 70°19'05.30"**
**Altitude(m) - 30**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.16 | | | | | | | | | | | | |
| 0.16 | 1.2 | SL-01/1 | 18.46 | 4.6 | 1.9 | 0.16 | 40.07 | 0.34 | 0.11 | 0.06 | 0.01 | 0.07 | 0.06 |
| 1.2 | 1.58 | SL-01/2 | 23.46 | 6.47 | 1.55 | 0.18 | 35.67 | 0.43 | 0.13 | 0.08 | 0.01 | 0.06 | 0.05 |
| 1.58 | 2 | | | | | | | | | | | | |
| 2 | 2.09 | | | | | | | | | | | | |
| 2.09 | 3 | | | | | | | | | | | | |
| 3 | 4 | | | | | | | | | | | | |
| 4 | 4.72 | | | | | | | | | | | | |
| 4.72 | 5 | | | | | | | | | | | | |
| 5 | 5.66 | | | | | | | | | | | | |
| 5.66 | 6 | | | | | | | | | | | | |
| 6 | 6.44 | SL-01/4 | 24.74 | 7.3 | 2.78 | 0.27 | 33.41 | 0.4 | 0.11 | 0.09 | 0.01 | 0.08 | 0.06 |
| 6.44 | 7 | SL-01/5 | 10.4 | 2.84 | 2.3 | 0.14 | 44.29 | 0.25 | 0.09 | 0.06 | 0.02 | 0.11 | 0.06 |
| 7 | 7.32 | | | | | | | | | | | | |
| 7.32 | 7.53 | | | | | | | | | | | | |
| 7.53 | 8 | | | | | | | | | | | | |
| 8 | 9 | | | | | | | | | | | | |
| 9 | 9.34 | | | | | | | | | | | | |
| 9.34 | 10 | | | | | | | | | | | | |
| 10 | 10.16 | | | | | | | | | | | | |
| 10.16 | 11 | | | | | | | | | | | | |
| 11 | 11.78 | | | | | | | | | | | | |
| 11.78 | 12 | | | | | | | | | | | | |
| 12 | 13 | | | | | | | | | | | | |
| 13 | 13.23 | | | | | | | | | | | | |
| 13.23 | 14 | | | | | | | | | | | | |
| 14 | 15 | | | | | | | | | | | | |
| 15 | 15.24 | | | | | | | | | | | | |
| 15.24 | 16 | | | | | | | | | | | | |
| 16 | 16.06 | SL-01/9 | 45.12 | 14.07 | 4.55 | 0.62 | 20.04 | 0.71 | 0.28 | 0.17 | 0.05 | 0.12 | 0.06 |
| 16.06 | 17.37 | | | | | | | | | | | | |
| 17.37 | 18 | | | | | | | | | | | | |
| 18 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 21 | | | | | | | | | | | | |
| 21 | 21.07 | | | | | | | | | | | | |
| 21.07 | 22 | | | | | | | | | | | | |
| 22 | 23 | | | | | | | | | | | | |
| 23 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | | |

## Lithological Index

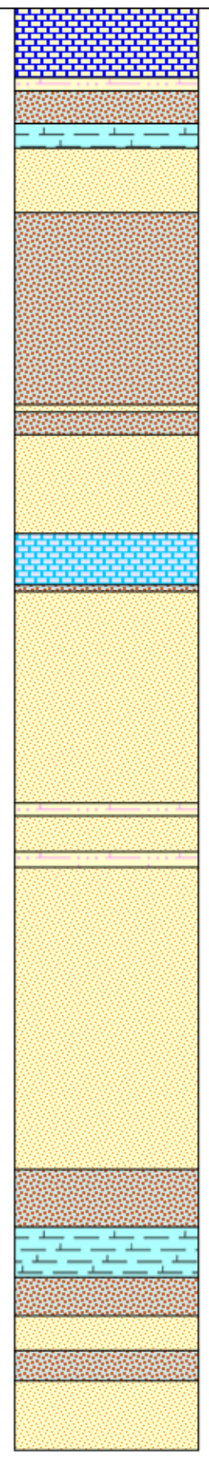
- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 25

# BH ID : SL-02

**N - 21°01'18.91"**
**E - 70°19'05.43"**
**Altitude(m) - 30**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1.2 | SL-02/1 | 13.27 | 3.78 | 2.63 | 0.15 | 42.55 | 0.3 | 0.09 | 0.06 | 0.01 | 0.12 | 0.05 |
| 1.43 | 2 | SL-02/3 | 25.7 | 7.52 | 2.48 | 0.25 | 33.92 | 0.5 | 0.16 | 0.12 | 0.02 | 0.22 | 0.05 |
| 3.54 | 4 | | | | | | | | | | | | |
| 4 | 5 | | | | | | | | | | | | |
| 5 | 6 | | | | | | | | | | | | |
| 6 | 6.87 | | | | | | | | | | | | |
| 7 | 7.39 | | | | | | | | | | | | |
| 7.81 | 8 | | | | | | | | | | | | |
| 8 | 9.11 | SL-02/4 | 22.8 | 6.4 | 2.51 | 0.24 | 35.54 | 0.36 | 0.1 | 0.09 | 0.01 | 0.09 | 0.06 |
| 10 | 10.11 | | | | | | | | | | | | |
| 11 | 12 | | | | | | | | | | | | |
| 12.18 | 12.64 | | | | | | | | | | | | |
| 13 | 13.07 | | | | | | | | | | | | |
| 13.78 | 14 | | | | | | | | | | | | |
| 14.62 | 14.89 | | | | | | | | | | | | |
| 14.95 | 15 | | | | | | | | | | | | |
| 15 | 16 | | | | | | | | | | | | |
| 16 | 17 | | | | | | | | | | | | |
| 17 | 18 | | | | | | | | | | | | |
| 18 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 20.13 | | | | | | | | | | | | |
| 21 | 21.13 | SL-02/8 | 29.87 | 9.3 | 2.83 | 0.29 | 30.25 | 0.55 | 0.15 | 0.15 | 0.03 | 0.14 | 0.05 |
| 22 | 22.67 | | | | | | | | | | | | |
| 23 | 23.27 | | | | | | | | | | | | |
| 23.8 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |



## Lithological Index

- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 25

# BH ID : SL-03

**N - 21°01'21.07"**
**E - 70°19'07.92"**
**Altitude(m) - 30**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | SL-03/1 | 10.1 | 3.21 | 1.41 | 0.13 | 45.48 | 0.3 | 0.1 | 0.06 | 0.01 | 0.1 | 0.06 |
| 1 | 2 | SL-03/2 | 7.55 | 2.08 | 2.39 | 0.12 | 46.41 | 0.25 | 0.09 | 0.05 | 0.01 | 0.13 | 0.06 |
| 2 | 2.64 | SL-03/3 | 18.15 | 5.93 | 1.52 | 0.18 | 40.17 | 0.35 | 0.1 | 0.07 | 0.01 | 0.06 | 0.06 |
| 2.64 | 3.4 | SL-03/4 | 12.98 | 3.43 | 1.98 | 0.13 | 43.39 | 0.5 | 0.1 | 0.06 | 0.01 | 0.16 | 0.05 |
| 3.4 | 4 | SL-03/5 | 17.09 | 5.05 | 1.57 | 0.16 | 41.13 | 0.32 | 0.1 | 0.07 | 0.01 | 0.08 | 0.05 |
| 4 | 5 | | | | | | | | | | | | |
| 5 | 5.96 | SL-03/6 | 46.2 | 8.68 | 6 | 0.72 | 19.96 | 0.96 | 0.22 | 0.2 | 0.01 | 0.06 | 0.6 |
| 5.96 | 6.21 | | | | | | | | | | | | |
| 6.21 | 7.46 | SL-03/7 | 48.93 | 12.8 | 6.88 | 0.72 | 14.67 | 0.88 | 0.24 | 0.21 | 0.01 | 0.06 | 0.05 |
| 7.46 | 7.49 | | | | | | | | | | | | |
| 7.49 | 8 | | | | | | | | | | | | |
| 8 | 8.77 | | | | | | | | | | | | |
| 8.77 | 9 | SL-03/10 | 20.03 | 5.68 | 2.83 | 0.2 | 37.61 | 0.38 | 0.1 | 0.08 | 0.03 | 0.09 | 0.06 |
| 9 | 9.34 | | | | | | | | | | | | |
| 9.34 | 10 | SL-03/11 | 9.41 | 2.49 | 1.71 | 0.12 | 46.76 | 0.28 | 0.1 | 0.05 | 0.05 | 0.07 | 0.06 |
| 10 | 10.42 | | | | | | | | | | | | |
| 10.42 | 10.58 | | | | | | | | | | | | |
| 10.58 | 10.8694736 | | | | | | | | | | | | |
| 10.8694736 | 84211 | | | | | | | | | | | | |
| 84211 | 11 | | | | | | | | | | | | |
| 11 | 11.5 | | | | | | | | | | | | |
| 11.5 | 13 | | | | | | | | | | | | |
| 13 | 13.59 | | | | | | | | | | | | |
| 13.59 | 14.17 | | | | | | | | | | | | |
| 14.17 | 14.43 | | | | | | | | | | | | |
| 14.43 | 14.66 | | | | | | | | | | | | |
| 14.66 | 14.85 | SL-03/13 | 9.06 | 2.52 | 2.45 | 0.14 | 45.38 | 0.25 | 0.09 | 0.05 | 0.02 | 0.19 | 0.06 |
| 14.85 | 15 | | | | | | | | | | | | |
| 15 | 16 | | | | | | | | | | | | |
| 16 | 16.45 | | | | | | | | | | | | |
| 16.45 | 16.5 | | | | | | | | | | | | |
| 16.5 | 18 | | | | | | | | | | | | |
| 18 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 21 | | | | | | | | | | | | |
| 21 | 22 | | | | | | | | | | | | |
| 22 | 23 | | | | | | | | | | | | |
| 23 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |
| 25 | 26 | | | | | | | | | | | | |
| 26 | 27 | | | | | | | | | | | | |
| 27 | 28 | | | | | | | | | | | | |
| 28 | 29 | | | | | | | | | | | | |
| 29 | 30 | | | | | | | | | | | | |

## Lithological Index

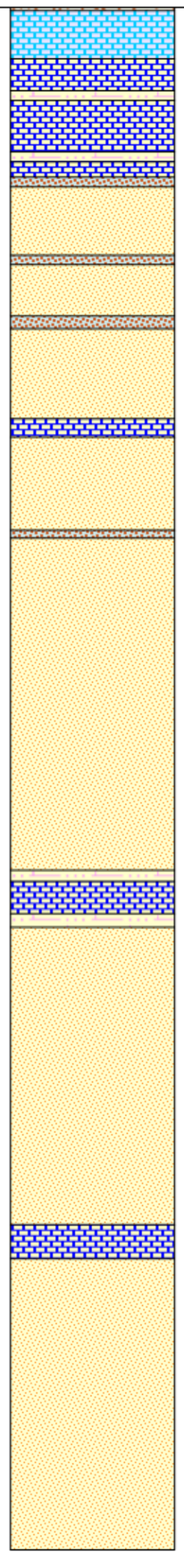
- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 30

# BH ID : SL-04

**N - 21°01'23.87"**
**E - 70°19'11.49"**
**Altitude(m) - 29**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.06 | | | | | | | | | | | | |
| 0.06 | 1 | SL-04/1 | 23.39 | 6.22 | 1.82 | 0.27 | 37.46 | 0.41 | 0.11 | 0.06 | 0.02 | 0.1 | 0.05 |
| 1 | 1.62 | SL-04/2 | 18.07 | 4.52 | 1.69 | 0.17 | 41.37 | 0.34 | 0.1 | 0.06 | 0.02 | 0.1 | 0.05 |
| 1.62 | 1.81 | | | | | | | | | | | | |
| 1.81 | 2.81 | SL-04/4 | 12.12 | 3.61 | 2.45 | 0.15 | 43.22 | 0.28 | 0.09 | 0.06 | 0.02 | 0.11 | 0.05 |
| 2.81 | 3 | SL-04/6 | 6.52 | 1.85 | 1.75 | 0.11 | 48.36 | 0.2 | 0.08 | 0.04 | 0.01 | 0.11 | 0.05 |
| 3 | 3.3 | | | | | | | | | | | | |
| 3.3 | 3.49 | | | | | | | | | | | | |
| 3.49 | 4 | | | | | | | | | | | | |
| 4 | 4.82 | | | | | | | | | | | | |
| 4.82 | 5 | | | | | | | | | | | | |
| 5 | 5.2 | | | | | | | | | | | | |
| 5.2 | 6 | | | | | | | | | | | | |
| 6 | 6.25 | | | | | | | | | | | | |
| 6.25 | 6.44 | | | | | | | | | | | | |
| 6.44 | 6.64 | SL-04/8 | 16.18 | 5.35 | 1.35 | 0.16 | 42.42 | 0.32 | 0.1 | 0.06 | 0.01 | 0.05 | 0.05 |
| 6.64 | 7 | | | | | | | | | | | | |
| 7 | 7.76 | | | | | | | | | | | | |
| 7.76 | 7.96 | | | | | | | | | | | | |
| 7.96 | 8 | | | | | | | | | | | | |
| 8 | 8.36 | | | | | | | | | | | | |
| 8.36 | 8.44 | | | | | | | | | | | | |
| 8.44 | 9 | | | | | | | | | | | | |
| 9 | 10 | | | | | | | | | | | | |
| 10 | 10.17 | | | | | | | | | | | | |
| 10.17 | 10.32 | | | | | | | | | | | | |
| 10.32 | 11 | | | | | | | | | | | | |
| 11 | 12 | | | | | | | | | | | | |
| 12 | 13 | | | | | | | | | | | | |
| 13 | 14 | | | | | | | | | | | | |
| 14 | 15 | | | | | | | | | | | | |
| 15 | 16 | | | | | | | | | | | | |
| 16 | 16.78 | | | | | | | | | | | | |
| 16.78 | 17 | SL-04/11 | 15.48 | 4.59 | 1.89 | 0.16 | 41.64 | 0.39 | 0.12 | 0.08 | 0.01 | 0.14 | 0.05 |
| 17 | 17.63 | | | | | | | | | | | | |
| 17.63 | 17.89 | | | | | | | | | | | | |
| 17.89 | 18 | | | | | | | | | | | | |
| 18 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 21 | | | | | | | | | | | | |
| 21 | 22 | | | | | | | | | | | | |
| 22 | 23 | | | | | | | | | | | | |
| 23 | 23.68 | | | | | | | | | | | | |
| 23.68 | 24.34 | SL-04/13 | 14.51 | 4.24 | 1.89 | 0.16 | 42.3 | 0.36 | 0.11 | 0.08 | 0.02 | 0.14 | 0.06 |
| 24.34 | 25 | | | | | | | | | | | | |
| 25 | 26 | | | | | | | | | | | | |
| 26 | 27 | | | | | | | | | | | | |
| 27 | 28 | | | | | | | | | | | | |
| 28 | 29 | | | | | | | | | | | | |
| 29 | 30 | | | | | | | | | | | | |



## Lithological Index

- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 30

# BH ID : SL-05

**N - 21°01'17.18"**
**E - 70°19'11.49"**
**Altitude(m) - 28**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.17 | | | | | | | | | | | | |
| 0.17 | 1.33 | SL-05/1 | 16.17 | 4.74 | 2.3 | 0.17 | 40.7 | 0.37 | 0.11 | 0.09 | 0.02 | 0.17 | 0.06 |
| 1.33 | 2 | | | | | | | | | | | | |
| 2 | 2.62 | | | | | | | | | | | | |
| 2.62 | 3 | | | | | | | | | | | | |
| 3 | 3.39 | | | | | | | | | | | | |
| 3.39 | 3.77 | SL-05/2 | 8.92 | 2.52 | 2.18 | 0.12 | 45.55 | 0.23 | 0.08 | 0.05 | 0.01 | 0.11 | 0.05 |
| 3.77 | 4 | | | | | | | | | | | | |
| 4 | 5 | | | | | | | | | | | | |
| 5 | 5.39 | SL-05/3 | 22.7 | 5.33 | 1.81 | 0.17 | 37.54 | 0.34 | 0.11 | 0.08 | 0.01 | 0.09 | 0.05 |
| 5.39 | 6 | | | | | | | | | | | | |
| 6 | 7 | | | | | | | | | | | | |
| 7 | 7.26 | | | | | | | | | | | | |
| 7.26 | 7.37 | | | | | | | | | | | | |
| 7.37 | 8 | | | | | | | | | | | | |
| 8 | 9 | | | | | | | | | | | | |
| 9 | 10 | | | | | | | | | | | | |
| 10 | 11 | | | | | | | | | | | | |
| 11 | 12 | | | | | | | | | | | | |
| 12 | 12.27 | | | | | | | | | | | | |
| 12.27 | 12.39 | | | | | | | | | | | | |
| 12.39 | 13 | | | | | | | | | | | | |
| 13 | 14 | | | | | | | | | | | | |
| 14 | 15 | | | | | | | | | | | | |
| 15 | 16 | | | | | | | | | | | | |
| 16 | 17 | | | | | | | | | | | | |
| 17 | 18 | | | | | | | | | | | | |
| 18 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 20.03 | | | | | | | | | | | | |
| 20.03 | 21 | | | | | | | | | | | | |
| 21 | 22 | | | | | | | | | | | | |
| 22 | 22.22 | | | | | | | | | | | | |
| 22.22 | 22.63 | SL-05/5 | 23.2 | 5.81 | 1.78 | 0.18 | 36.85 | 0.37 | 0.11 | 0.08 | 0.01 | 0.08 | 0.05 |
| 22.63 | 23 | | | | | | | | | | | | |
| 23 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |

## Lithological Index

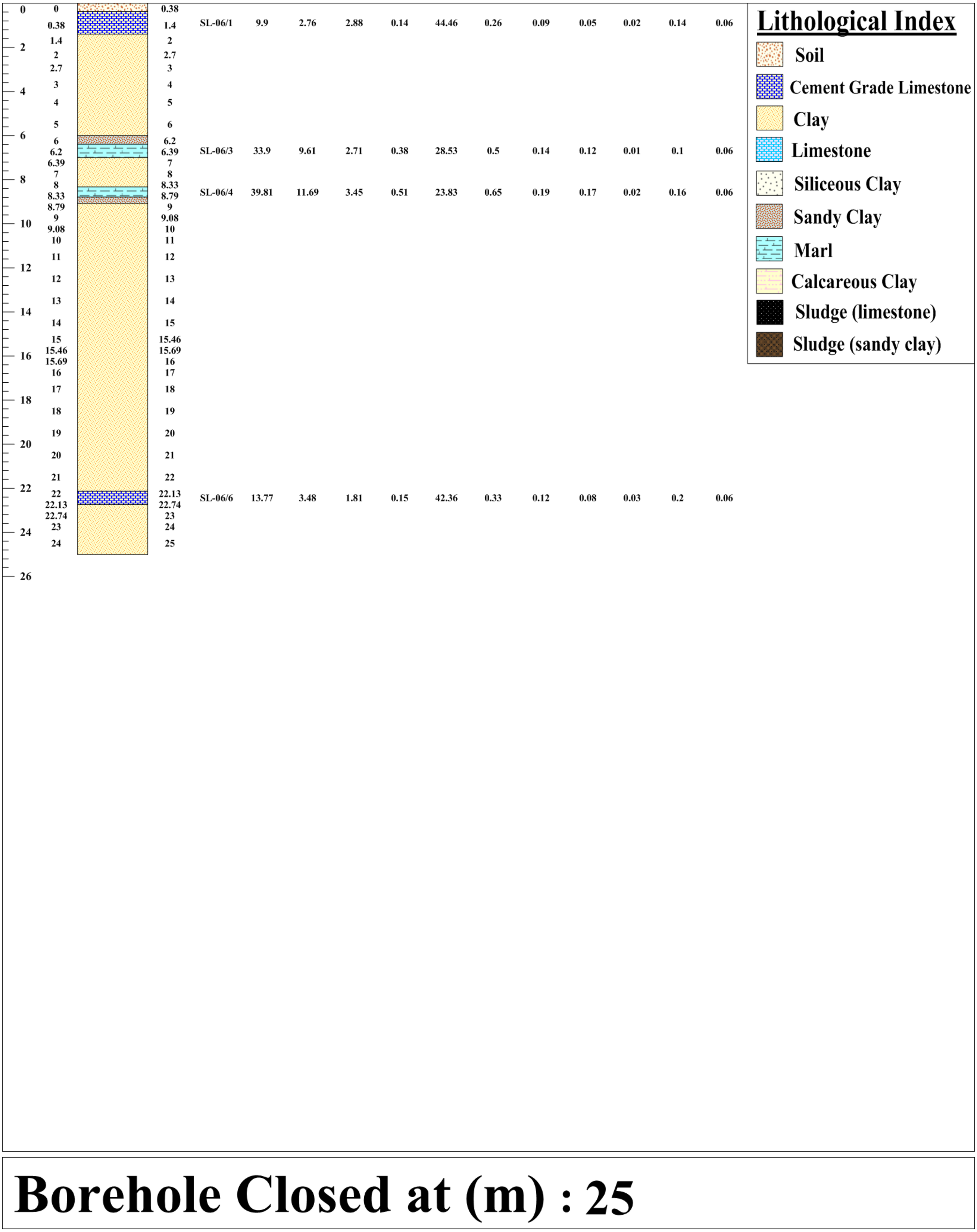
- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 25

# BH ID : SL-06

**N - 21°01'21.18"**
**E - 70°19'13.51"**
**Altitude(m) - 28**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.38 | | | | | | | | | | | | |
| 0.38 | 1.4 | SL-06/1 | 9.9 | 2.76 | 2.88 | 0.14 | 44.46 | 0.26 | 0.09 | 0.05 | 0.02 | 0.14 | 0.06 |
| 1.4 | 2 | | | | | | | | | | | | |
| 2 | 2.7 | | | | | | | | | | | | |
| 2.7 | 3 | | | | | | | | | | | | |
| 3 | 4 | | | | | | | | | | | | |
| 4 | 5 | | | | | | | | | | | | |
| 5 | 6 | | | | | | | | | | | | |
| 6 | 6.2 | | | | | | | | | | | | |
| 6.2 | 6.39 | SL-06/3 | 33.9 | 9.61 | 2.71 | 0.38 | 28.53 | 0.5 | 0.14 | 0.12 | 0.01 | 0.1 | 0.06 |
| 6.39 | 7 | | | | | | | | | | | | |
| 7 | 8 | | | | | | | | | | | | |
| 8 | 8.33 | | | | | | | | | | | | |
| 8.33 | 8.79 | SL-06/4 | 39.81 | 11.69 | 3.45 | 0.51 | 23.83 | 0.65 | 0.19 | 0.17 | 0.02 | 0.16 | 0.06 |
| 8.79 | 9 | | | | | | | | | | | | |
| 9 | 9.08 | | | | | | | | | | | | |
| 9.08 | 10 | | | | | | | | | | | | |
| 10 | 11 | | | | | | | | | | | | |
| 11 | 12 | | | | | | | | | | | | |
| 12 | 13 | | | | | | | | | | | | |
| 13 | 14 | | | | | | | | | | | | |
| 14 | 15 | | | | | | | | | | | | |
| 15 | 15.46 | | | | | | | | | | | | |
| 15.46 | 15.69 | | | | | | | | | | | | |
| 15.69 | 16 | | | | | | | | | | | | |
| 16 | 17 | | | | | | | | | | | | |
| 17 | 18 | | | | | | | | | | | | |
| 18 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 21 | | | | | | | | | | | | |
| 21 | 22 | | | | | | | | | | | | |
| 22 | 22.13 | | | | | | | | | | | | |
| 22.13 | 22.74 | SL-06/6 | 13.77 | 3.48 | 1.81 | 0.15 | 42.36 | 0.33 | 0.12 | 0.08 | 0.03 | 0.2 | 0.06 |
| 22.74 | 23 | | | | | | | | | | | | |
| 23 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |




# Borehole Closed at (m) : 25

# BH ID : SL-07

**N - 21°01'23.87"**
**E - 70°19'17.93"**
**Altitude(m) - 30**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.21 | SL-07/1 | 8.24 | 2.41 | 1.87 | 0.12 | 47.02 | 0.24 | 0.09 | 0.05 | 0.02 | 0.1 | 0.06 |
| 0.21 | 0.68 | | | | | | | | | | | | |
| 0.68 | 0.86 | | | | | | | | | | | | |
| 0.86 | 1 | | | | | | | | | | | | |
| 1 | 2 | | | | | | | | | | | | |
| 2 | 2.78 | | | | | | | | | | | | |
| 2.78 | 2.88 | | | | | | | | | | | | |
| 2.88 | 3 | | | | | | | | | | | | |
| 3 | 3.2 | | | | | | | | | | | | |
| 3.2 | 3.61 | | | | | | | | | | | | |
| 3.61 | 4 | | | | | | | | | | | | |
| 4 | 5 | | | | | | | | | | | | |
| 5 | 6 | | | | | | | | | | | | |
| 6 | 6.4 | | | | | | | | | | | | |
| 6.4 | 6.91 | | | | | | | | | | | | |
| 6.91 | 7 | | | | | | | | | | | | |
| 7 | 7.81 | | | | | | | | | | | | |
| 7.81 | 8 | | | | | | | | | | | | |
| 8 | 9 | | | | | | | | | | | | |
| 9 | 9.13 | SL-07/5 | 45.85 | 17.26 | 11.04 | 0.9 | 8.89 | 1.52 | 0.43 | 1.38 | 0.02 | 0.1 | 0.1 |
| 9.13 | 9.34 | | | | | | | | | | | | |
| 9.34 | 9.57 | | | | | | | | | | | | |
| 9.57 | 10 | SL-07/6 | 39.97 | 13.23 | 2.77 | 0.51 | 23.8 | 0.74 | 0.21 | 0.19 | 0.01 | 0.15 | 0.1 |
| 10 | 11 | | | | | | | | | | | | |
| 11 | 11.13 | | | | | | | | | | | | |
| 11.13 | 11.43 | | | | | | | | | | | | |
| 11.43 | 12 | | | | | | | | | | | | |
| 12 | 13 | | | | | | | | | | | | |
| 13 | 13.22 | | | | | | | | | | | | |
| 13.22 | 13.38 | | | | | | | | | | | | |
| 13.38 | 14 | | | | | | | | | | | | |
| 14 | 15 | SL-07/8 | 26.05 | 8.18 | 2.48 | 0.27 | 33.1 | 0.57 | 0.17 | 0.13 | 0.02 | 0.25 | 0.06 |
| 15 | 15.34 | SL-07/10 | 36.57 | 12.14 | 3.48 | 0.38 | 25.49 | 0.96 | 0.22 | 0.22 | 0.02 | 0.16 | 0.06 |
| 15.34 | 16 | | | | | | | | | | | | |
| 16 | 16.07 | | | | | | | | | | | | |
| 16.07 | 17 | SL-07/11 | 43.34 | 13.16 | 6.8 | 0.54 | 15.41 | 2.06 | 0.5 | 1.7 | 0.02 | 0.15 | 0.21 |
| 17 | 17.58 | | | | | | | | | | | | |
| 17.58 | 17.88 | | | | | | | | | | | | |
| 17.88 | 18 | | | | | | | | | | | | |
| 18 | 19 | | | | | | | | | | | | |
| 19 | 19.73 | | | | | | | | | | | | |
| 19.73 | 20 | | | | | | | | | | | | |
| 20 | 21 | SL-07/12 | 41.57 | 10.68 | 3.09 | 0.37 | 24.73 | 0.68 | 0.35 | 0.13 | 0.03 | 0.21 | 0.05 |
| 21 | 21.66 | SL-07/13 | 52.44 | 14.22 | 3.68 | 0.5 | 18.3 | 0.82 | 0.49 | 0.16 | 0.03 | 0.15 | 0.05 |
| 21.66 | 22 | | | | | | | | | | | | |
| 22 | 23 | | | | | | | | | | | | |
| 23 | 23.85 | | | | | | | | | | | | |
| 23.85 | 23.91 | | | | | | | | | | | | |
| 23.91 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |
| 25 | 26 | | | | | | | | | | | | |
| 26 | 27 | | | | | | | | | | | | |
| 27 | 28 | | | | | | | | | | | | |
| 28 | 28.32 | | | | | | | | | | | | |
| 28.32 | 29 | | | | | | | | | | | | |
| 29 | 30 | | | | | | | | | | | | |

## Lithological Index

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- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 30

# BH ID : SL-08

**N - 21°01'16.86"**
**E - 70°19'18.89"**
**Altitude(m) - 26**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.43 | SL-08/1 | 16.02 | 4.76 | 2.95 | 0.19 | 39.67 | 0.32 | ..09 | 0.08 | 0.01 | 0.08 | 0.05 |
| 1 | 1.43 | SL-08/2 | 21.21 | 5.73 | 2.18 | 0.21 | 37.71 | 0.34 | 0.1 | 0.08 | 0.01 | 0.1 | 0.06 |
| 1.43 | 1.66 | SL-08/3 | 17.67 | 6.03 | 2.89 | 0.26 | 38.09 | 0.35 | 0.1 | 0.08 | 0.01 | 0.08 | 0.06 |
| 1.66 | 2 | SL-08/4 | 18.92 | 6.42 | 2.75 | 0.25 | 38.08 | 0.37 | 0.1 | 0.08 | 0.01 | 0.08 | 0.05 |
| 6.57 | 6.86 | SL-08/6 | 31.36 | 9.42 | 3 | 0.3 | 29.23 | 0.49 | 0.15 | 0.12 | 0.02 | 0.01 | 0.01 |
| 20.35 | 21 | SL-08/10 | 20.04 | 5.95 | 2.08 | 0.2 | 37.44 | 0.49 | 0.14 | 0.11 | 0.02 | 0.21 | 0.06 |

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- Sludge (limestone)
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# Borehole Closed at (m) : 25

# BH ID : SL-09

**N - 21°01'19.53"**
**E - 70°19'21.38"**
**Altitude(m) - 27**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.51 | SL-09/1 | 14.41 | 4.25 | 2.15 | 0.18 | 42.24 | 0.31 | 0.1 | 0.06 | 0.01 | 0.11 | 0.06 |
| 0.51 | 1 | SL-09/2 | 36.98 | 8.23 | 5.28 | 0.84 | 23.88 | 2.26 | 0.22 | 0.18 | 0.01 | 0.05 | 0.05 |
| 1 | 1.62 | | | | | | | | | | | | |
| 1.62 | 2 | | | | | | | | | | | | |
| 2 | 3 | | | | | | | | | | | | |
| 3 | 3.56 | SL-09/3 | 52.11 | 14.69 | 8.64 | 0.72 | 9.86 | 0.77 | 0.26 | 0.19 | 0.01 | 0.05 | 0.05 |
| 3.56 | 4 | | | | | | | | | | | | |
| 4 | 4.23 | SL-09/4 | 22.53 | 4.9 | 5.04 | 0.36 | 36.38 | 0.45 | 0.41 | 0.39 | 0.01 | 0.05 | 0.14 |
| 4.23 | 4.66 | | | | | | | | | | | | |
| 4.66 | 4.91 | | | | | | | | | | | | |
| 4.91 | 5 | | | | | | | | | | | | |
| 5 | 6 | | | | | | | | | | | | |
| 6 | 6.25 | SL-09/5 | 24.68 | 8.15 | 2.42 | 0.24 | 34.4 | 0.48 | 0.13 | 0.12 | 0.01 | 0.15 | 0.05 |
| 6.25 | 6.38 | | | | | | | | | | | | |
| 6.38 | 6.73 | | | | | | | | | | | | |
| 6.73 | 7 | | | | | | | | | | | | |
| 7 | 7.87 | | | | | | | | | | | | |
| 7.87 | 8 | | | | | | | | | | | | |
| 8 | 9 | | | | | | | | | | | | |
| 9 | 10 | | | | | | | | | | | | |
| 10 | 11 | | | | | | | | | | | | |
| 11 | 12 | | | | | | | | | | | | |
| 12 | 13 | | | | | | | | | | | | |
| 13 | 13.74 | | | | | | | | | | | | |
| 13.74 | 14 | | | | | | | | | | | | |
| 14 | 14.56 | SL-09/7 | 20.29 | 5.83 | 2.26 | 0.21 | 37.49 | 0.44 | 0.16 | 0.1 | 0.03 | 0.28 | 0.08 |
| 14.56 | 15 | | | | | | | | | | | | |
| 15 | 16 | | | | | | | | | | | | |
| 16 | 17 | | | | | | | | | | | | |
| 17 | 18 | | | | | | | | | | | | |
| 18 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 21 | | | | | | | | | | | | |
| 21 | 21.51 | | | | | | | | | | | | |
| 21.51 | 22 | | | | | | | | | | | | |
| 22 | 22.59 | | | | | | | | | | | | |
| 22.59 | 23 | | | | | | | | | | | | |
| 23 | 23.23 | | | | | | | | | | | | |
| 23.23 | 24 | | | | | | | | | | | | |
| 24 | 24.25 | | | | | | | | | | | | |
| 24.25 | 25 | | | | | | | | | | | | |
| 25 | 26 | | | | | | | | | | | | |
| 26 | 27 | | | | | | | | | | | | |
| 27 | 28 | | | | | | | | | | | | |
| 28 | 29 | | | | | | | | | | | | |
| 29 | 30 | | | | | | | | | | | | |

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- Limestone
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- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 30

# BH ID : SL-10

**N - 21°01'23.98"**
**E - 70°19'25.48"**
**Altitude(m) - 33**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.23 | | | | | | | | | | | | |
| 0.23 | 1 | SL-10/1 | 22.88 | 6.32 | 1.79 | 0.24 | 37.26 | 0.41 | 0.13 | 0.06 | 0.02 | 0.16 | 0.2 |
| 1 | 1.55 | SL-10/2 | 23.08 | 7.64 | 2.22 | 0.25 | 35.29 | 0.53 | 0.15 | 0.13 | 0.02 | 0.19 | 0.69 |
| 1.55 | 2 | | | | | | | | | | | | |
| 2 | 2.4 | SL-10/3 | 24.29 | 6.46 | 1.91 | 0.29 | 36.21 | 0.39 | 0.12 | 0.06 | 0.02 | 0.18 | 0.05 |
| 2.4 | 2.86 | | | | | | | | | | | | |
| 2.86 | 2.94 | | | | | | | | | | | | |
| 2.94 | 3 | | | | | | | | | | | | |
| 3 | 3.16 | | | | | | | | | | | | |
| 3.16 | 3.45 | SL-10/5 | 43.21 | 13.9 | 3.63 | 0.51 | 21.17 | 0.98 | 0.38 | 0.19 | 0.03 | 0.17 | 0.07 |
| 3.45 | 4 | | | | | | | | | | | | |
| 4 | 4.26 | | | | | | | | | | | | |
| 4.26 | 4.41 | | | | | | | | | | | | |
| 4.41 | 4.75 | | | | | | | | | | | | |
| 4.75 | 5 | | | | | | | | | | | | |
| 5 | 5.37 | | | | | | | | | | | | |
| 5.37 | 5.71 | | | | | | | | | | | | |
| 5.71 | 6 | | | | | | | | | | | | |
| 6 | 7 | | | | | | | | | | | | |
| 7 | 8 | | | | | | | | | | | | |
| 8 | 8.29 | | | | | | | | | | | | |
| 8.29 | 9 | | | | | | | | | | | | |
| 9 | 9.7 | | | | | | | | | | | | |
| 9.7 | 9.86 | | | | | | | | | | | | |
| 9.86 | 10 | | | | | | | | | | | | |
| 10 | 11 | | | | | | | | | | | | |
| 11 | 11.9 | | | | | | | | | | | | |
| 11.9 | 12 | | | | | | | | | | | | |
| 12 | 12.17 | | | | | | | | | | | | |
| 12.17 | 13 | | | | | | | | | | | | |
| 13 | 14 | | | | | | | | | | | | |
| 14 | 14.28 | | | | | | | | | | | | |
| 14.28 | 15 | | | | | | | | | | | | |
| 15 | 15.22 | | | | | | | | | | | | |
| 15.22 | 15.37 | | | | | | | | | | | | |
| 15.37 | 16 | | | | | | | | | | | | |
| 16 | 16.2 | | | | | | | | | | | | |
| 16.2 | 16.47 | | | | | | | | | | | | |
| 16.47 | 17 | | | | | | | | | | | | |
| 17 | 17.66 | | | | | | | | | | | | |
| 17.66 | 18 | | | | | | | | | | | | |
| 18 | 18.94 | SL-10/13 | 55.31 | 16.31 | 3.86 | 0.56 | 16.02 | 0.92 | 0.56 | 0.17 | 0.03 | 0.13 | 0.05 |
| 18.94 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 20.23 | | | | | | | | | | | | |
| 20.23 | 20.5 | | | | | | | | | | | | |
| 20.5 | 21.12 | | | | | | | | | | | | |
| 21.12 | 22 | | | | | | | | | | | | |
| 22 | 22.29 | | | | | | | | | | | | |
| 22.29 | 23 | | | | | | | | | | | | |
| 23 | 23.85 | | | | | | | | | | | | |
| 23.85 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |
| 25 | 25.73 | | | | | | | | | | | | |
| 25.73 | 26 | | | | | | | | | | | | |
| 26 | 26.87 | | | | | | | | | | | | |
| 26.87 | 27 | | | | | | | | | | | | |
| 27 | 28 | | | | | | | | | | | | |
| 28 | 29 | | | | | | | | | | | | |
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- Sandy Clay
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- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 30

# BH ID : SL-11

**N - 21°01'15.20"**
**E - 70°19'25.44"**
**Altitude(m) - 36**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.23 | | | | | | | | | | | | |
| 0.23 | 1 | SL-11/1 | 17.09 | 4.87 | 1.6 | 0.2 | 41.07 | 0.35 | 0.11 | 0.06 | 0.03 | 0.07 | 0.06 |
| 1 | 2 | SL-11/2 | 22.01 | 5.64 | 1.73 | 0.3 | 38.26 | 0.37 | 0.11 | 0.06 | 0.03 | 0.08 | 0.06 |
| 2 | 3.31 | SL-11/3 | 19.85 | 5.47 | 2.34 | 0.23 | 38.61 | 0.39 | 0.11 | 0.06 | 0.03 | 0.1 | 0.5 |
| 3.31 | 4 | | | | | | | | | | | | |
| 4 | 4.2 | SL-11/4 | 18.44 | 5.36 | 2.39 | 0.21 | 39.23 | 0.35 | 0.1 | 0.08 | 0.02 | 0.15 | 0.06 |
| 4.2 | 4.64 | | | | | | | | | | | | |
| 4.64 | 5 | SL-11/5 | 12.55 | 3.5 | 1.91 | 0.15 | 43.1 | 0.28 | 0.09 | 0.06 | 0.02 | 0.19 | 0.06 |
| 5 | 5.31 | | | | | | | | | | | | |
| 5.31 | 5.55 | | | | | | | | | | | | |
| 5.55 | 6 | | | | | | | | | | | | |
| 6 | 6.39 | | | | | | | | | | | | |
| 6.39 | 7 | | | | | | | | | | | | |
| 7 | 8 | | | | | | | | | | | | |
| 8 | 8.77 | | | | | | | | | | | | |
| 8.77 | 9 | SL-11/7 | 24.97 | 7.66 | 2.3 | 0.26 | 34.53 | 0.43 | 0.12 | 0.11 | 0.02 | 0.12 | 0.05 |
| 9 | 9.56 | | | | | | | | | | | | |
| 9.56 | 10 | | | | | | | | | | | | |
| 10 | 10.86 | | | | | | | | | | | | |
| 10.86 | 11 | | | | | | | | | | | | |
| 11 | 12 | | | | | | | | | | | | |
| 12 | 12.42 | | | | | | | | | | | | |
| 12.42 | 12.87 | SL-11/8 | 6.25 | 1.31 | 2.45 | 0.11 | 47.74 | 0.19 | 0.08 | 0.04 | 0.03 | 0.25 | 0.05 |
| 12.87 | 13 | | | | | | | | | | | | |
| 13 | 14 | | | | | | | | | | | | |
| 14 | 14.24 | | | | | | | | | | | | |
| 14.24 | 14.6 | | | | | | | | | | | | |
| 14.6 | 15 | | | | | | | | | | | | |
| 15 | 16 | | | | | | | | | | | | |
| 16 | 17 | | | | | | | | | | | | |
| 17 | 17.41 | | | | | | | | | | | | |
| 17.41 | 17.79 | SL-11/9 | 26.77 | 7.48 | 2.29 | 0.25 | 33.5 | 0.55 | 0.19 | 0.11 | 0.02 | 0.19 | 0.06 |
| 17.79 | 18 | | | | | | | | | | | | |
| 18 | 19 | | | | | | | | | | | | |
| 19 | 19.89 | | | | | | | | | | | | |
| 19.89 | 20 | | | | | | | | | | | | |
| 20 | 21 | | | | | | | | | | | | |
| 21 | 22 | | | | | | | | | | | | |
| 22 | 22.28 | | | | | | | | | | | | |
| 22.28 | 22.8 | | | | | | | | | | | | |
| 22.8 | 23 | | | | | | | | | | | | |
| 23 | 23.14 | SL-11/10 | 18.1 | 5.16 | 2.36 | 0.2 | 38.65 | 0.48 | 0.14 | 0.1 | 0.03 | 0.23 | 0.12 |
| 23.14 | 23.3 | | | | | | | | | | | | |
| 23.3 | 23.89 | | | | | | | | | | | | |
| 23.89 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |
| 25 | 26 | | | | | | | | | | | | |
| 26 | 27 | | | | | | | | | | | | |
| 27 | 28 | | | | | | | | | | | | |
| 28 | 28.07 | | | | | | | | | | | | |
| 28.07 | 29 | | | | | | | | | | | | |
| 29 | 30 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |

## Lithological Index

- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 30

# BH ID : SL-12

**N - 21°01'19.48"**
**E - 70°19'28.55"**
**Altitude(m) - 34**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.45 | | | | | | | | | | | | |
| 0.45 | 1 | SL-12/1 | 8.12 | 2.23 | 1.25 | 0.12 | 48 | 0.21 | 0.09 | 0.04 | 0.05 | 0.07 | 0.05 |
| 1 | 2 | SL-12/2 | 9.32 | 2.65 | 1.37 | 0.12 | 47.02 | 0.23 | 0.09 | 0.04 | 0.05 | 0.08 | 0.06 |
| 2 | 3 | SL-12/3 | 16.94 | 4.27 | 1.67 | 0.18 | 40.79 | 0.32 | 0.11 | 0.06 | 0.02 | 0.14 | 0.06 |
| 3 | 4 | SL-12/4 | 16.62 | 4.79 | 1.77 | 0.16 | 42.18 | 0.3 | 0.1 | 0.06 | 0.01 | 0.08 | 0.06 |
| 4 | 5 | | | | | | | | | | | | |
| 5 | 6 | | | | | | | | | | | | |
| 6 | 6.32 | SL-12/5 | 25.3 | 7.28 | 2.53 | 0.26 | 34.44 | 0.4 | 0.11 | 0.09 | 0.01 | 0.14 | 0.06 |
| 6.32 | 7 | | | | | | | | | | | | |
| 7 | 8 | | | | | | | | | | | | |
| 8 | 8.47 | | | | | | | | | | | | |
| 8.47 | 8.68 | | | | | | | | | | | | |
| 8.68 | 9 | | | | | | | | | | | | |
| 9 | 10 | | | | | | | | | | | | |
| 10 | 11 | | | | | | | | | | | | |
| 11 | 12 | | | | | | | | | | | | |
| 12 | 13 | | | | | | | | | | | | |
| 13 | 14 | | | | | | | | | | | | |
| 14 | 15 | | | | | | | | | | | | |
| 15 | 16 | | | | | | | | | | | | |
| 16 | 17 | | | | | | | | | | | | |
| 17 | 18 | | | | | | | | | | | | |
| 18 | 18.05 | SL-12/7 | 16.93 | 4.64 | 2.13 | 0.18 | 40.45 | 0.39 | 0.14 | 0.09 | 0.03 | 0.35 | 0.06 |
| 18.05 | 18.14 | | | | | | | | | | | | |
| 18.14 | 18.78 | | | | | | | | | | | | |
| 18.78 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 21 | | | | | | | | | | | | |
| 21 | 21.3 | | | | | | | | | | | | |
| 21.3 | 21.51 | | | | | | | | | | | | |
| 21.51 | 22 | | | | | | | | | | | | |
| 22 | 22.97 | | | | | | | | | | | | |
| 22.97 | 23 | | | | | | | | | | | | |
| 23 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |
| 25 | 26 | | | | | | | | | | | | |
| 26 | 27 | | | | | | | | | | | | |
| 27 | 28 | | | | | | | | | | | | |
| 28 | 29 | | | | | | | | | | | | |
| 29 | 30 | | | | | | | | | | | | |
| 30 | 31 | | | | | | | | | | | | |
| 31 | 32 | | | | | | | | | | | | |
| 32 | 33 | | | | | | | | | | | | |
| 33 | 34 | | | | | | | | | | | | |
| 34 | 35 | | | | | | | | | | | | |
| 35 | 36 | | | | | | | | | | | | |
| 36 | 37 | | | | | | | | | | | | |
| 37 | 37.1 | | | | | | | | | | | | |
| 37.1 | 38 | | | | | | | | | | | | |
| 38 | 39 | | | | | | | | | | | | |
| 39 | 39.22 | | | | | | | | | | | | |
| 39.22 | 39.56 | | | | | | | | | | | | |
| 39.56 | 40 | | | | | | | | | | | | |
| 40 | 41 | | | | | | | | | | | | |
| 41 | 42 | | | | | | | | | | | | |
| 42 | 43 | | | | | | | | | | | | |
| 43 | 44 | | | | | | | | | | | | |
| 44 | 44.18 | | | | | | | | | | | | |
| 44.18 | 45 | | | | | | | | | | | | |
| 45 | 46 | | | | | | | | | | | | |
| 46 | 47 | | | | | | | | | | | | |
| 47 | 47.8 | SL-12/11 | 14.16 | 4.43 | 1.6 | 0.17 | 39.87 | 1.23 | 0.12 | 0.09 | 0.01 | 0.07 | 0.33 |
| 47.8 | 48 | | | | | | | | | | | | |
| 48 | 49 | | | | | | | | | | | | |
| 49 | 50 | | | | | | | | | | | | |

## Lithological Index

- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 50

# BH ID : SL-13

**N - 21°01'23.37"**
**E - 70°19'31.09"**
**Altitude(m) - 37**

| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | SL-13/1 | 9 | 2.24 | 1.18 | 0.1 | 47.63 | 0.2 | 0.09 | 0.05 | 0.05 | 0.15 | 0.05 |
| 1 | 2.13 | SL-13/2 | 12.92 | 3.7 | 1.44 | 0.15 | 44.22 | 0.26 | 0.09 | 0.05 | 0.04 | 0.17 | 0.05 |
| 2.13 | 2.57 | SL-13/3 | 18.86 | 5.85 | 1.54 | 0.21 | 39.18 | 0.36 | 0.11 | 0.06 | 0.01 | 0.12 | 0.06 |
| 2.57 | 2.9 | SL-13/4 | 23.24 | 5.97 | 1.77 | 0.25 | 37.43 | 0.35 | 0.13 | 0.06 | 0.01 | 0.18 | 0.05 |
| 2.9 | 3 | SL-13/5 | 26.78 | 8.88 | 1.77 | 0.29 | 33.51 | 0.52 | 0.16 | 0.08 | 0.01 | 0.05 | 0.05 |
| 3 | 3.35 | | | | | | | | | | | | |
| 3.35 | 3.73 | | | | | | | | | | | | |
| 3.73 | 4 | | | | | | | | | | | | |
| 4 | 5 | | | | | | | | | | | | |
| 5 | 6 | | | | | | | | | | | | |
| 6 | 7 | | | | | | | | | | | | |
| 7 | 8 | | | | | | | | | | | | |
| 8 | 8.36 | SL-13/6 | 9.49 | 2.34 | 1.5 | 0.12 | 46.03 | 0.25 | 0.1 | 0.06 | 0.01 | 0.25 | 0.06 |
| 8.36 | 9 | | | | | | | | | | | | |
| 9 | 10 | | | | | | | | | | | | |
| 10 | 11 | | | | | | | | | | | | |
| 11 | 12 | | | | | | | | | | | | |
| 12 | 13 | | | | | | | | | | | | |
| 13 | 14 | | | | | | | | | | | | |
| 14 | 14.25 | SL-13/7 | 27.82 | 8.01 | 1.79 | 0.3 | 32.64 | 0.53 | 0.16 | 0.09 | 0.01 | 0.04 | 0.06 |
| 14.25 | 14.62 | | | | | | | | | | | | |
| 14.62 | 14.85 | | | | | | | | | | | | |
| 14.85 | 15 | | | | | | | | | | | | |
| 15 | 16 | | | | | | | | | | | | |
| 16 | 17 | | | | | | | | | | | | |
| 17 | 18 | | | | | | | | | | | | |
| 18 | 18.35 | SL-13/9 | 37.4 | 9.43 | 2.93 | 0.34 | 26.74 | 0.6 | 0.3 | 0.13 | 0.03 | 0.03 | 0.05 |
| 18.35 | 19 | | | | | | | | | | | | |
| 19 | 20 | | | | | | | | | | | | |
| 20 | 21 | | | | | | | | | | | | |
| 21 | 21.33 | | | | | | | | | | | | |
| 21.33 | 22 | | | | | | | | | | | | |
| 22 | 23 | | | | | | | | | | | | |
| 23 | 23.88 | | | | | | | | | | | | |
| 23.88 | 24 | | | | | | | | | | | | |
| 24 | 25 | | | | | | | | | | | | |

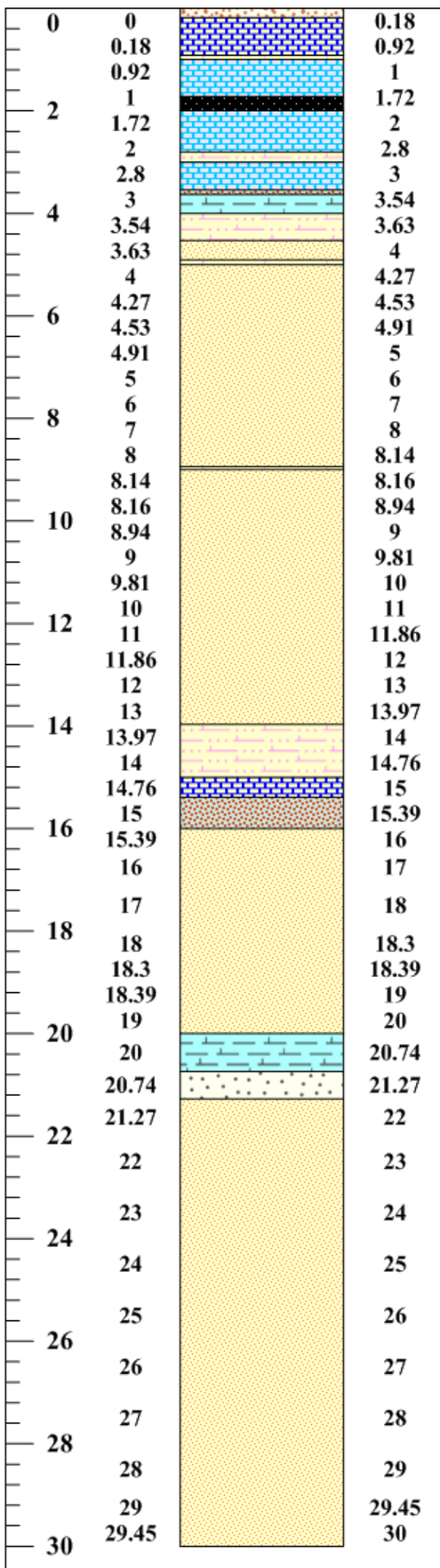
## Lithological Index

- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 25

# BH ID : SL-14

**N - 21°01'19.29"**
**E - 70°19'32.00"**
**Altitude(m) - 33**



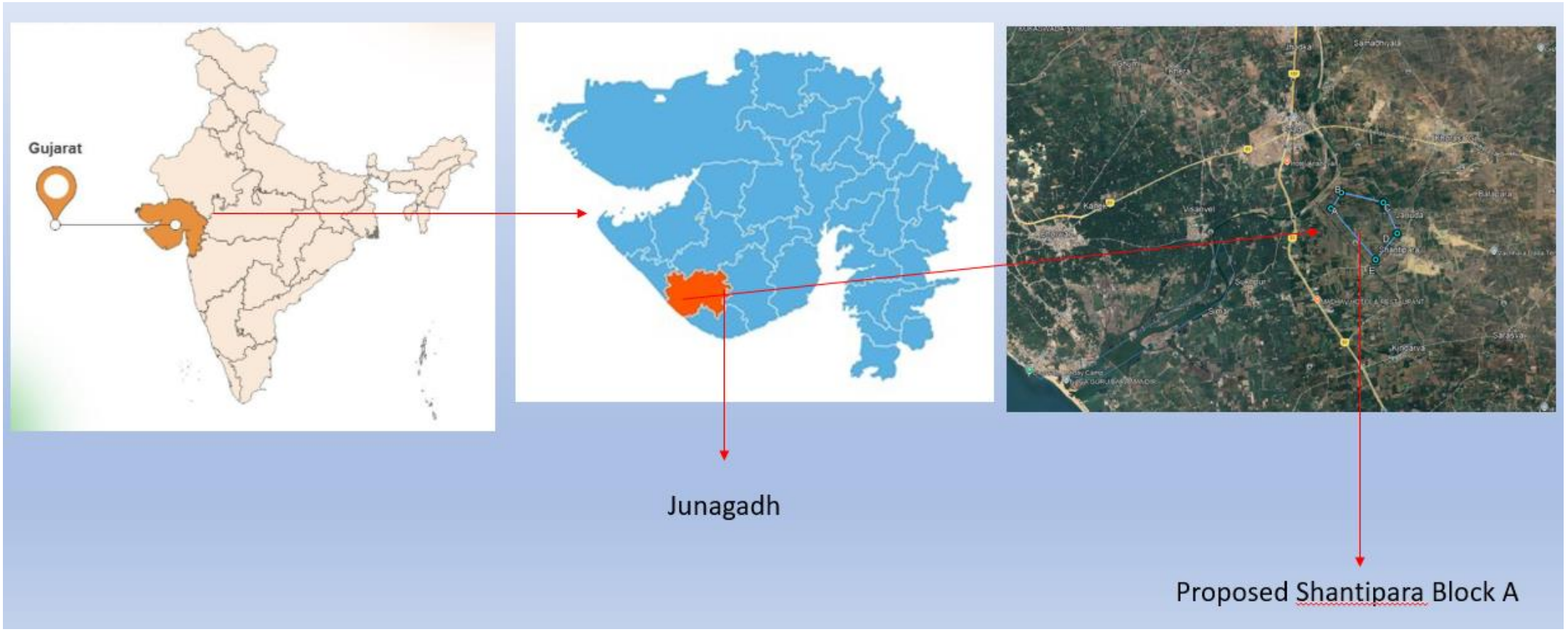
| From | To | Sample No. | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | $TiO_2$ | CaO | MgO | $Na_2O$ | $K_2O$ | $P_2O_5$ | MnO | $SO_3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.18 | SL-14/1 | 17.25 | 4.52 | 1.68 | 0.2 | 41.01 | 0.3 | 0.1 | 0.05 | 0.03 | 0.13 | 0.06 |
| 0.92 | 1 | SL-14/3 | 26.21 | 7.11 | 1.7 | 0.27 | 35.22 | 0.42 | 0.15 | 0.07 | 0.03 | 0.13 | 0.05 |
| 1.72 | 2 | SL-14/4 | 24.96 | 6.57 | 1.76 | 0.27 | 35.74 | 0.38 | 0.13 | 0.06 | 0.03 | 0.14 | 0.05 |
| 2.8 | 3 | SL-14/6 | 22.57 | 6.33 | 2.26 | 0.23 | 36.12 | 0.37 | 0.11 | 0.08 | 0.01 | 0.15 | 0.05 |
| 3.54 | 3.63 | SL-14/7 | 28.64 | 6.33 | 5.36 | 0.36 | 30.31 | 0.92 | 0.31 | 0.68 | 0.01 | 0.15 | 0.28 |
| 14.76 | 15 | SL-14/13 | 17.52 | 4.82 | 2.03 | 0.17 | 40.15 | 0.4 | 0.13 | 0.09 | 0.03 | 0.26 | 0.06 |
| 20 | 20.74 | SL-14/15 | 39.11 | 9.8 | 2.97 | 0.34 | 25.93 | 0.64 | 0.31 | 0.12 | 0.02 | 0.28 | 0.05 |
| 20.74 | 21.27 | SL-14/16 | 51.24 | 16.96 | 3.87 | 0.72 | 16.75 | 1.15 | 0.49 | 0.23 | 0.02 | 0.14 | 0.05 |

## Lithological Index

- Soil
- Cement Grade Limestone
- Clay
- Limestone
- Siliceous Clay
- Sandy Clay
- Marl
- Calcareous Clay
- Sludge (limestone)
- Sludge (sandy clay)

# Borehole Closed at (m) : 30

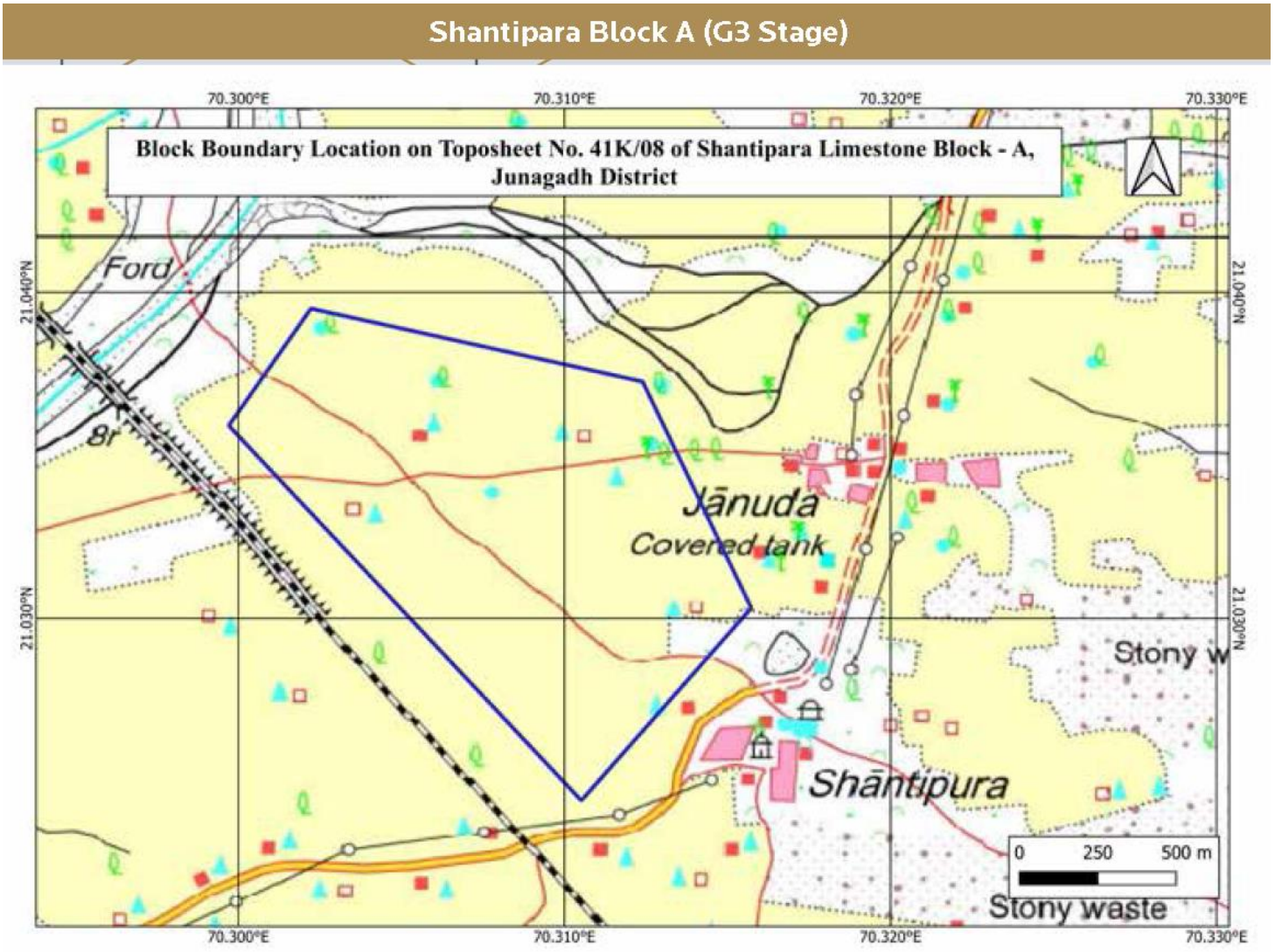
# PLATE – I: Location Map



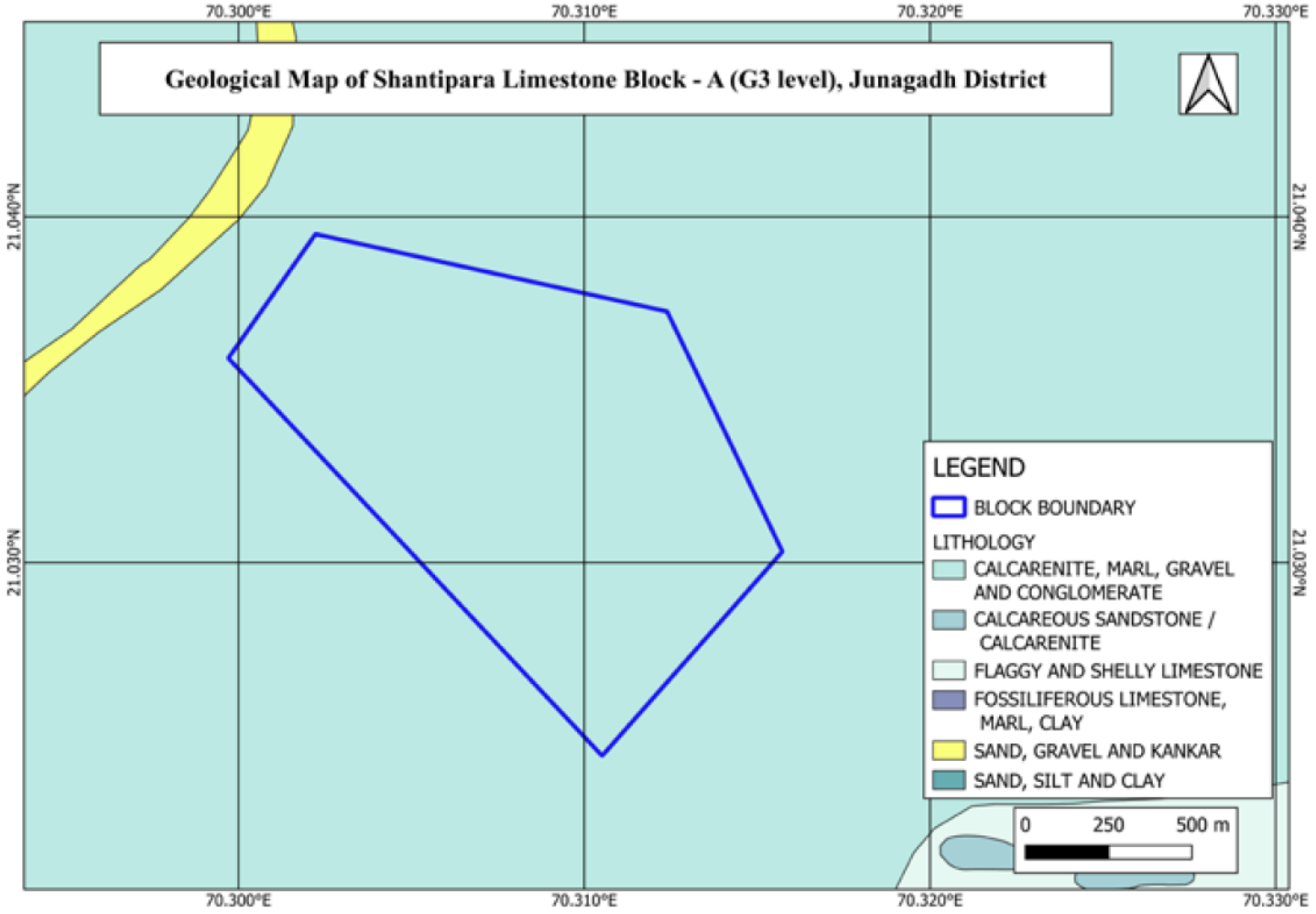
# PLATE – II: Satellite Image Map of Shantipara A Block



# PLATE – III: Proposed Shantipara A Block Superimposed on Toposheet No. 41K/08



# PLATE – IV: Proposed Shantipara A Block Superimposed on Bhukosh Data



# PLATE – V: Proposed Boreholes Plan

