## Humboldt County Resource Conservation District
**Wadulh Lagoon Tidal Wetland Enhancement Project**

# Addendum #1

The purpose of this Addendum is to modify the Contract Documents for the subject project.

This Addendum shall become part of said Contract Documents.

Each bidder shall acknowledge receipt of this addendum in his/her bid proposal.

**CLARIFICATIONS:**

Item 1. CLARIFICATION: The earthwork volumes shown on sheet 7 of the contract design plans are based on the difference of the existing ground surface from the proposed design surface. The existing surface model was developed from LIDAR data. The LIDAR data was compared with RTK survey data. In the open pasture areas where the majority of excavation will occur, the LIDAR data appear to be biased high by approximately +0.3 to +0.5 feet relative to the ground survey. Overall, the calculated earthwork balance has an estimated excess cut of 8,600 CY (See Design Plans Sheet 7). It is anticipated that there will be sufficient sediment to construct levees. Plans identify areas that may be used to place excess spoil.

The earthwork quantities include an unknown quantity of vegetation, which may be incorporated into landscape fill. Borings show that dense rooting does not extend more than approximately 0.5 feet below the ground surface, see the Geotechnical Investigation Report (March 6, 2024) and Addendum 1 to the Geotechnical Report (February 18, 2025) prepared by SHN and attached for reference.

Item 2. CLARIFICATION: Nuisance water shall be contained and managed within the project limits of disturbance. The volume of nuisance water encountered and the extent for which it will need to be pumped / discharged will be subject to seasonal groundwater fluctuations, site soil characteristics, contractor's means / methods and regulatory permit compliance. This is further described in Technical Specification Section 01 57 00 and the Contractor is responsible for developing a water management plan that allows efficient grading operations. The approximate groundwater elevations are shown on the boring logs contained in the Geotechnical Investigation Report (March 6, 2024) and Addendum 1 to the Geotechnical Report (February 18, 2025) prepared by SHN and attached for reference.

Item 3. CLARIFICATION: Seeding and mulching are limited to the surface areas of the LV-1 Lanphere Road Levee and LV-2 South Levee (Bid Item 9). Specific placement of silt fences, fiber rolls and other erosion / sediment control BMPs are not shown on the contract plans, however the awarded contractor is responsible to place temporary erosion / sediment control BMPs subject to site conditions, compliance with regulatory permits and in accordance with Bid Item 3, Stormwater Pollution Control requirements on Sheet 3 of the contract plans and the contractor provided erosion / sediment control plan.

**SPECIFICATIONS:**

Item 4. The unit for Bid Item 8 should be updated to Square Yards (SY) in the Bid Schedule (Page 13) and Measurement & Payment section, see red below.

**BASE BID**

| BID ITEM NO. | ITEM DESCRIPTION | EST. QTY. | UNIT | UNIT COST | EXTENDED TOTAL AMOUNT |
|---|---|---|---|---|---|
| 1 | Project Area Mobilization and Demobilization | 1 | LS | $ | $ |
| 2 | Install Stabilized Construction Entrance | 1 | LS | $ | $ |
| 3 | Erosion Control, Water Management and Environmental Protection | 1 | LS | $ | $ |
| 4 | Construction Staking and Survey Control | 1 | LS | $ | $ |
| 5 | Phase 1 Earthwork | 1 | LS | $ | $ |
| 6 | Phase 2 Earthwork | 1 | LS | $ | $ |
| 7 | Phase 3 Earthwork | 1 | LS | $ | $ |
| 8 | Geogrid and Granular Backfill | 3,250 | ~~SF~~ SY | $ | $ |
| 9 | Seed and Straw Mulch | 1 | LS | $ | $ |
| 10 | Class II Aggregate Base | 205 | CY | $ | $ |
| 11 | 18-inch HDPE Culvert Pipe | 110 | LF | $ | $ |
| 12 | 18-inch Flap-gate | 1 | EA | $ | $ |
| 13 | Disposal | 1 | LS | $ | $ |

TOTAL BASE BID: Items 1 through 13 inclusive: $_____

*Note: The amount entered as the "Total Base Bid" should be identical to the Base Bid amount entered in Section 1 of the Bid Proposal form.*

Item 8. Geogrid and Granular Backfill

Measurement and payment for this item shall be on a ~~SQUARE FOOT~~ SQUARE YARD basis. Payment shall include full compensation for all materials, labor, equipment and supervision necessary to install Geogrid and granular backfill as indicated on Plans and as described in the Specifications. Payment shall also include full compensation for all materials, labor, equipment and supervision necessary to complete all ground preparation, installation of Geogrid and granular backfill to achieve the required lines and grades shown on the Plans as required by the Specifications. Additional Geogrid beyond the quantities shown on Plans that are installed at the direction of the Project Engineer shall be paid on the same basis as above.

Item 9. Seed and Straw Mulch

Measurement for this item shall be on a LUMP SUM basis. Payment shall include full compensation materials, labor, equipment and supervision necessary to install seed and mulch on flood control levees.

Item 10. Class 2 Aggregate Base

Measurement and payment for this item shall be on a CUBIC YARD basis. Payment shall include full compensation for all materials, labor, equipment and supervision necessary to complete all



**Attachments:**

- Geotechnical Investigation Report (March 6, 2024) and Addendum 1 to the Geotechnical Report (February 18, 2025) prepared by SHN.

**END OF ADDENDUM NO. 1**

May 27, 2025

Jeremy Svehla, P.E. Date

**Phone:** (707) 441-8855 **Email:** info@shn-engr.com **Web:** shn-engr.com
812 W. Wabash Avenue, Eureka, CA 95501-2138

Reference: 023156

March 6, 2024

Jill Demers
Executive Director
Humboldt County Resource Conservation District
5630 South Broadway St
Eureka, CA 95503

**Subject: Geotechnical Investigation Report for Wadulh Lagoon Tidal Wetland Enhancement Project**

Humboldt County Resource Conservation District:

# Introduction

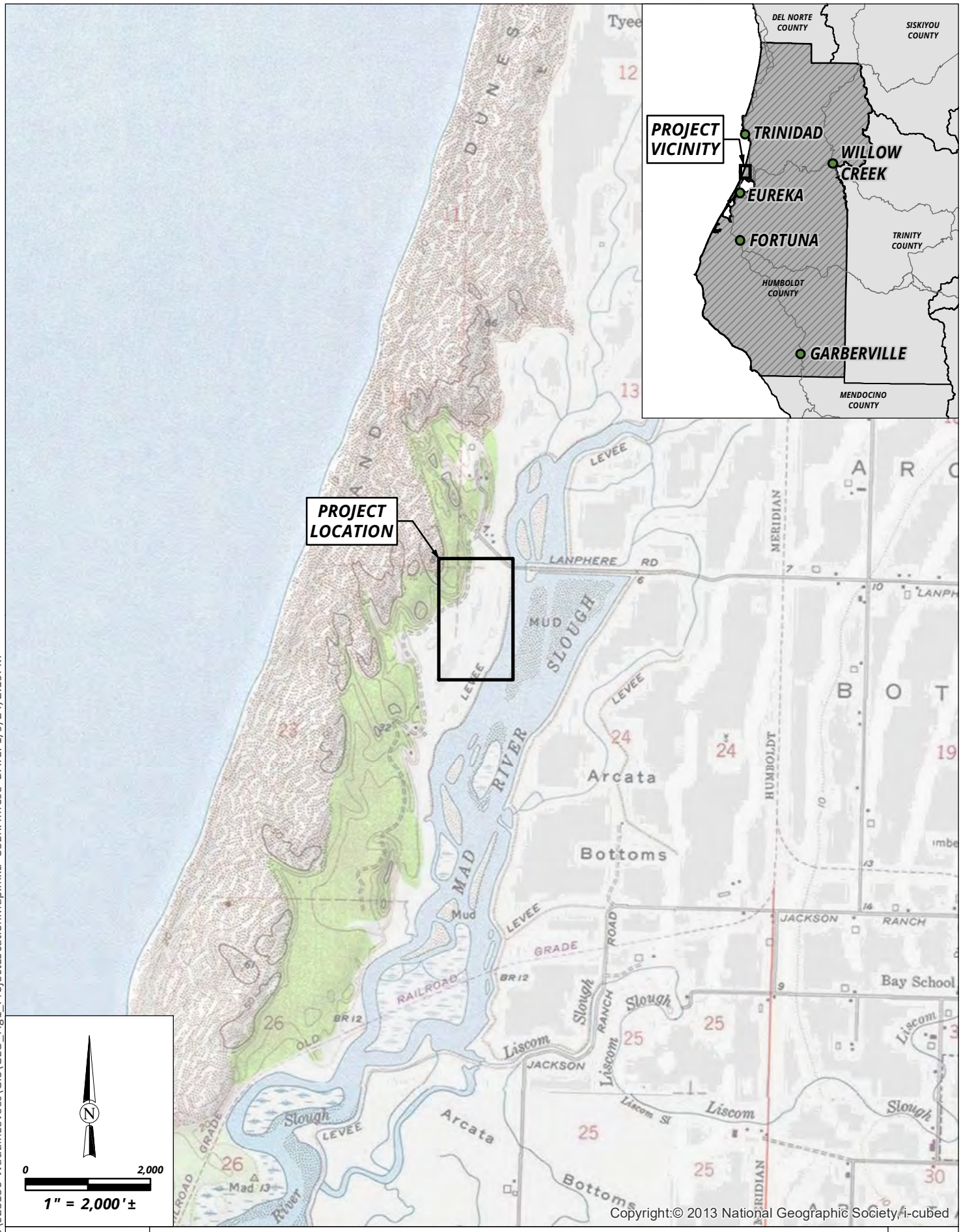
This report provides the results of SHN's geotechnical investigation at Humboldt County Assessor's parcel number (APN) 506-291-014, located adjacent to the Mad River Slough near Arcata, California (Figure 1). We understand that the U.S. Fish and Wildlife Service (Arcata office) is developing plans for a tidal wetland enhancement project for the Humboldt Bay National Wildlife Refuge.

Preliminary project plans at the time of this writing propose to open the property to tidal influence by breaching and lowering the existing Mad River Slough levee along the east side of the property. A representative plan sheet from the 30% plan set is provided as Figure 2. The project also includes the excavation of a network of channels, the construction of salt marsh ridges, the filling of legacy drainage ditches, and the construction of two new/expanded levees at the south and north ends of the project (see Figure 2). We understand that the intent is to use onsite materials excavated from the channels to construct the levees.

The focus of our investigation was to characterize shallow subsurface conditions within the excavation areas and to develop recommendations for construction of the levees. Our scope of work included a subsurface investigation including seven hand-auger borings, laboratory testing of selected soils samples, and the preparation of this report. Below, we provide our findings, conclusions, and soils-related recommendations for construction of the levees.

# Site Description

The project site includes historic grazing land adjacent to the Mad River Slough (to the east) and Lanphere Dunes Road (to the west) and associated drainage control features. The site is accessed through the "Arcata Bottoms" by a combination of paved and unpaved roads. The project area is



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Humboldt County Resource Conservation District
Wadulh Lagoon Enhancement Project - Geotechnical Study
Arcata, California

**Project Location Map**

January 2024 - 023156

**Figure 1**

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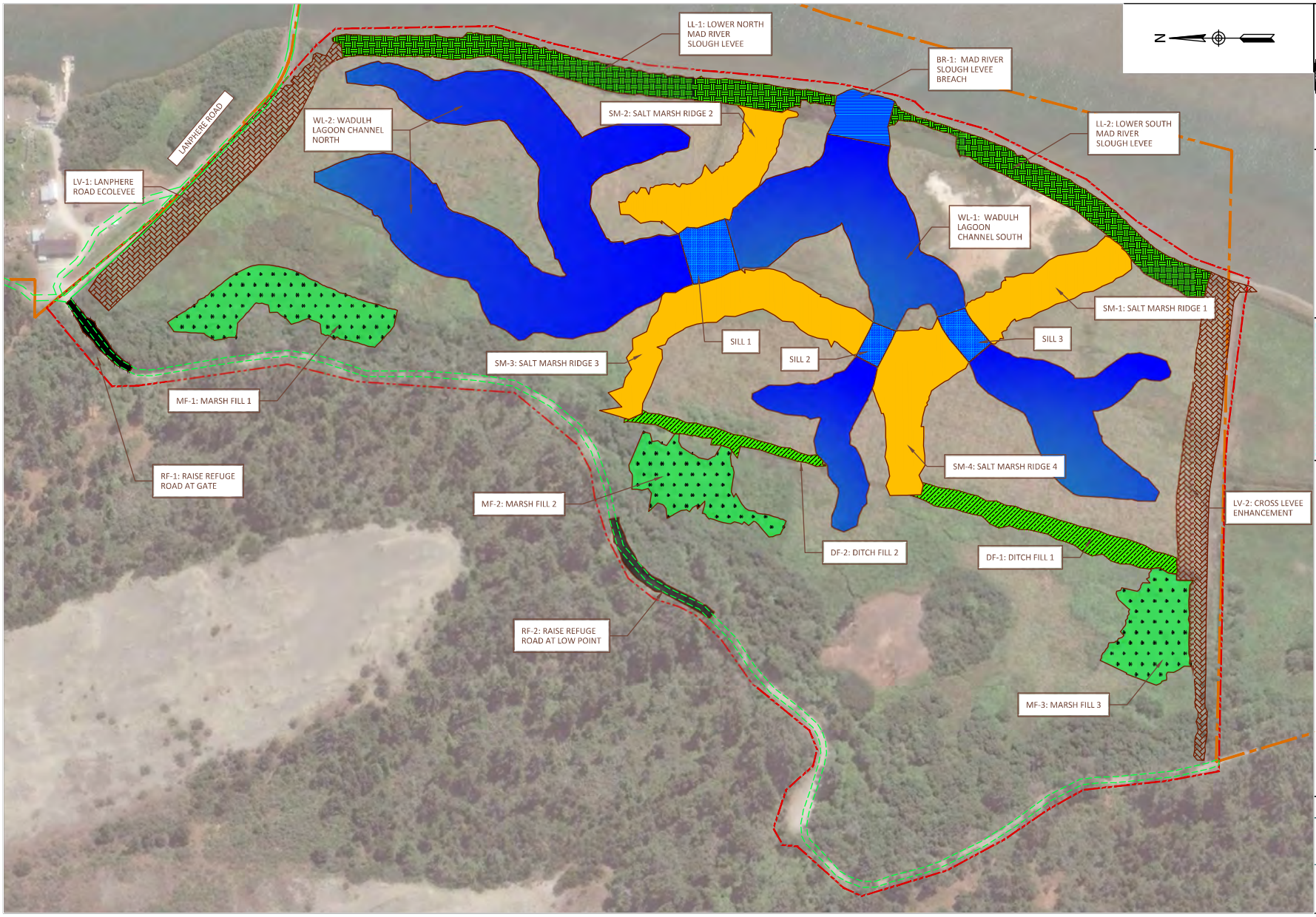



REGISTERED PROFESSIONAL ENGINEER COLMAN SHEA C71483 CIVIL STATE OF CALIFORNIA

U.S. FISH AND WILDLIFE SERVICE
COASTAL PROGRAM
1655 HEINDON ROAD
ARCATA, CA 95521
(707) 822-7201

PREPARED FOR:
HUMBOLDT BAY NATIONAL WILDLIFE REFUGE
1020 RANCH ROAD
LOLETA, CA 95551

U.S. Fish and Wildlife Service Coastal Program

WADULH LAGOON TIDAL WETLAND ENHANCEMENT PROJECT
30% DESIGN PLANS (NOT FOR CONSTRUCTION)

PROJECT GRADING ELEMENTS

DATE: 8/28/2023

SHEET NUMBER: 6

SCALE: 0 200'

Humboldt County Resource Conservation District
Wadulh Lagoon Enhancement Project - Geotechnical Study
Arcata, California

**Project Grading Elements**

January 2023 - 023156

**Figure 2**

generally flat to gently sloping (towards the slough) and vegetated with wetland forest and dense grasses. Ground surface elevations are approximately 3 to 4 feet within the lowland area and from 10 to 45 feet (North American vertical datum, 1988 [NAVD88]) on the western slope. There are currently two existing levees at the site: the Mad River Slough Levee along the eastern edge bordering Mad River Slough, and a cross-levee oriented east to west connecting the Mad River Slough Levee to the access road at the west end of the parcel.

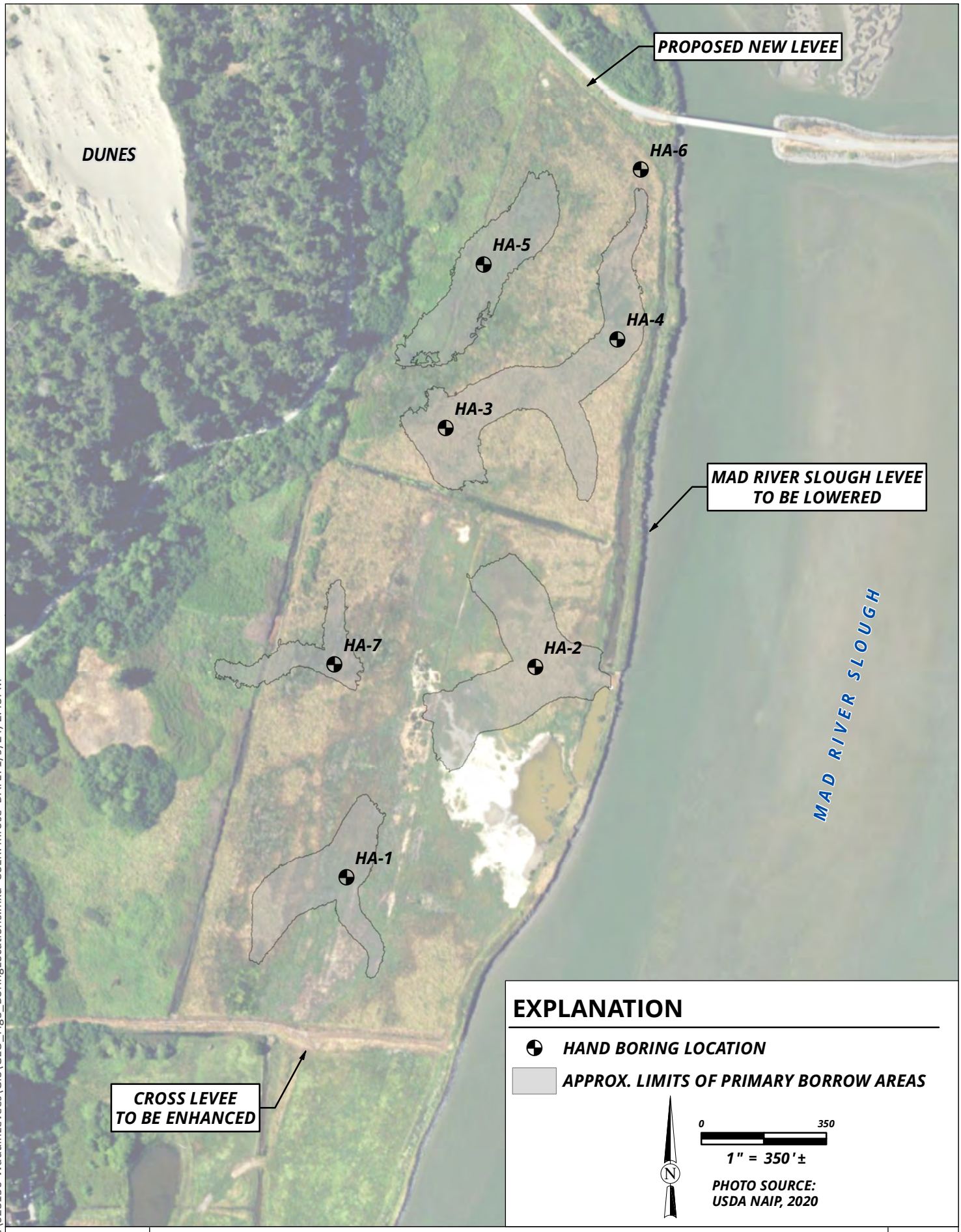
The property was diked off in the 1930s and has been historically used as grazing land. A number of small drainage ditches and small swales drain the property though a culvert with a tide gate. The Lanphere Dunes are situated immediately to the west. Springs along the base of the dunes supply water to a wetland forest along the western edge of the property. The existing Mad River Slough Levee is partially compromised by heavy erosion on the slough side, with nearly half of the levee fill prism missing in some areas. Those areas are generally unvegetated and exhibit vertical (to undercut) outboard slope faces.

The existing cross-levee on the south side of the project was constructed by the adjacent property owner using a mix of materials supplied by the California Department of Transportation (Caltrans), which included large cobble-sized rock. The levee is relatively narrow with 2:1 side slopes.

# Field Investigation and Laboratory Testing

SHN conducted field investigations on October 13 and 20, 2023, to review existing surficial conditions, advance hand-auger borings, and collect soil samples for laboratory testing. Seven hand-auger borings (HA-1 through HA-7) were advanced across the site. The boring locations were selected to generally characterize soils conditions in proposed new lagoon channel/borrow areas, and to evaluate groundwater conditions. The borings were advanced to depths ranging from 3 to 5 feet below grade using a 3-inch auger bucket. Figure 3 shows approximate locations of the hand-auger borings. Boring logs are included as Appendix 1.

Soils encountered in our borings were logged and described in the field in general accordance with ASTM-International (ASTM) standard D 2488. Soil samples were collected at regular intervals throughout the soil profile in each boring and returned to SHN's lab in Eureka for geotechnical index testing. In-place soil samples were obtained by hand-driving a 2.5-inch-inside-diameter (ID), 3.0-inch-outside-diameter (OD) Modified California Sampler (MCS) containing steel liners; bulk soil samples were collected from the auger bucket. Laboratory tests included moisture content and density, percent passing the No. 200 sieve, Atterberg limits, and organic content. Additionally, we collected two 5-gallon bucket samples for the development of compaction curves on soil materials likely to be used to construct the new levees. Results of laboratory testing are shown on Table 1 below, included on the boring logs in Appendix 1, and attached as Appendix 2.

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Humboldt County Resource Conservation District
Wadulh Lagoon Enhancement Project - Geotechnical Study
Arcata, California

**Hand-Boring Locations**

January 2024 - 023156

**Figure 3**

**Table 1. Laboratory Test Results**

| Sample Location | In-situ Dry Density (pcf)[a] | In-situ Moisture Content | Organic Content | Liquid Limit | Plastic Index | Optimum Moisture Content | Maximum Dry Density (pcf) | Percent Fines (Passing No. 200 sieve) |
|---|---|---|---|---|---|---|---|---|
| HA-1 0-1' | | | | | | 21.6% | 99.2 | |
| HA-1 2.5-3' | 64 | 49% | | | | | | |
| HA-1 3-3.5' | | | 10% | 83 | 39 | | | |
| HA-2 0.5-1' | 81 | 18% | | | | | | 62% |
| HA-2 2-2.5' | | | | | | | | 95% |
| HA-3 0.5-1' | 54 | 66% | | 124 | 37 | | | |
| HA-3 1-1.5' | | | 12% | | | | | |
| HA-4 0-1' | | | | | | | | |
| HA-4 0.5-1' | 50 | 61% | | | | 24.9% | 90.1 | |
| HA-5 0.8-1' | 69 | 49% | | | | | | |
| HA-5 0-1' | | | 13% | | | | | |
| HA-5 3-3.5' | | | | 56 | 23 | | | |
| HA-7 0.25-0.75' | | | | | | | | 95% |
| HA-7 1-1.5' | 61 | 40% | 15% | 58 | 22 | | | |

[a] pcf: pounds per cubic foot

# Findings

## Soil Conditions

Soils observed in the hand-auger borings consist primarily of fine-grained alluvium interpreted to be intertidal bay margin and overbank flood deposits. The organic-rich topsoil encountered in each boring was generally thin (1 to 2 inches) and contained an abundance of very fine roots gradually decreasing

with depth. Below the topsoil, we encountered highly organic silt varying in consistency from soft to medium stiff at all seven boring locations. Laboratory testing indicates the fine-grained soils encountered in the borings are predominantly organic silts (OH). One notable difference in stratigraphy was in borings HA-3 and -4, where we encountered loose, saturated fine sand at 2 feet and 1.5 feet below the ground surface (BGS). The sand was loose enough that it tended to collapse in the borehole, but the sand extended to the bottom of each boring (4.5 feet and 3 feet BGS). In HA-2, we encountered loose, dry silty sand from 0.5 to 2.3 feet.

Laboratory test results on six samples indicate that the dominant materials within the proposed borrow areas consist of highly plastic/organic silt (OH). The in-situ dry density of these borrow soils ranged from 50 to 81 pounds per cubic foot (pcf) with an average of 63 pcf. The moisture contents of the six in-situ soil samples range from 18% to 66%, with an average of 47%. Two laboratory compaction tests on the organic silts yielded maximum dry densities of 90 and 99 pcf, with an average of 95 pcf. Optimum moisture contents for the two samples were approximately 22% and 25%, with an average of 23%. The in-situ moisture content results reported in Table 1 on the previous page were specific to the location, depth, and time of sampling. Actual moisture conditions at other times and locations should be expected to vary.

## Groundwater Conditions

Groundwater elevations at the time of our investigation ranged from -0.4 feet (HA-2) to 2.9 feet (HA-5) NAVD88 using the publicly available 2019 light detection and ranging (LiDAR) dataset as a ground surface reference. Groundwater elevations are presented in Table 2. Mottling was observed in the fine-grained materials above the water table in each boring. Groundwater is anticipated to fluctuate seasonally and be higher during the wettest portion of the season and following periods of persistent precipitation. Groundwater appears to be highest along the west edge of the project, presumably being recharged by groundwater within the dunes. Minor tidal influence of groundwater is expected in areas along the eastern edge of the project, closest to the slough, though we did not investigate this condition.

**Table 2. Groundwater Elevations**

| Boring ID | Date Measured | Ground Surface Elevation (feet NAVD88[a]) | Groundwater Elevation (feet NAVD88) | Depth to Water (feet BGS[b]) |
|---|---|---|---|---|
| HA-1 | 10/13/2023 | 2.9 | 0.1 | 2.8 |
| HA-2 | 10/13/2023 | 3.6 | -0.4 | 4.0 |
| HA-3 | 10/13/2023 | 4.0 | 2.6 | 1.4 |
| HA-4 | 10/20/2023 | 3.2 | 1.2 | 2.0 |
| HA-5 | 10/20/2023 | 4.1 | 2.9 | 1.2 |
| HA-6 | 10/20/2023 | 3.5 | 2.0 | 1.5 |
| HA-7 | 10/20/2023 | 2.3 | 0.9 | 1.4 |

[a] NAVD88: North American vertical datum, 1988
[b] BGS: below ground surface

# Conclusions

## Suitability of Existing Soils for Levee Construction

Preliminary grading estimates by others (at the time of this writing) indicate that the proposed borrow areas (primarily lagoon channels) will provide sufficient fill material for construction of the levees. We understand that excess and/or unsuitable materials for levee construction will be used as non-structural fill in areas planned to support the development of marsh plains. Planned excavations that will generate the most material for reuse include the lagoon itself and the upper portions of the Mad River Slough levee along the eastern edge of the project. We understand that the majority of the fill for levee construction will be from the portions of the channels that will be excavated to an elevation of negative 2 feet (shown on Figure 3).

From these borrow areas, we anticipate that the most suitable materials for use as levee fill will be found just below the thin organic-rich topsoil, but above the groundwater table. Soils below the water table are likely to be difficult to manage and will likely need to be dried out prior to placement as structural fill.

Using comparisons of our in-situ density testing and the results from our laboratory compaction curves, we anticipate that there will be a net volume reduction of soils between the in-situ condition and the compacted condition. As an example, the average in-situ dry density of native organic silt soils collected above the October 2023 water table is 63 pcf and the average maximum dry density of similarly high compacted soils is 95 pcf. Assuming a range of 80 to 90 percent relative compaction of these soils, the range of compacted dry densities would be 76 pcf to 85 pcf, which calculates to a shrinkage of 17% to 26%, respectively.

It is important to point out that the six moisture/density samples primarily represent upper portions of the soil profile in proposed borrow areas. Deeper portions may well have higher moisture contents, particularly those portions below the water table. Considering that the vast majority of available proposed borrow material will have moisture contents of 50% or more, for the project (as envisioned) to proceed, we must conclude that all onsite borrow is suitable for levee construction. It is just a matter of what provisions must be employed to produce appropriate strategies for accessing, handling, and placing these materials in the proposed levee structures. It is likely that different strategies will be needed for the loose, saturated clean sand materials encountered in test borings HA-3 and HA-4.

## Issues Related to Construction Operations

The combination of relatively shallow groundwater and the low-density/high water content nature of the majority of site soils will have a substantial impact on determining appropriate construction means and methods and the related construction equipment. As examples, heavy equipment traffic will quickly break through the ground surface and “liquefy” the subsoil to the point that ingress/egress will be compromised. Even repeated traffic below low ground pressure equipment is likely to be similarly problematic. Borrow area cut slopes will be subject to “slumping” unless they are at a gentle gradient and minimally disturbed during the excavation process. Areas where the loose sand is encountered

below the water table will be partially sensitive and may tend to "run" into the excavation as soon as they are exposed. Depending on soil moisture content, low angle fill slopes may be required for long term stability.

# Recommendations

Based on the observations made in the field and the results of laboratory testing, there is a relatively small section of the soil profile that is unsaturated. As discussed above, these are the materials below the topsoil and above the groundwater table. It will be important to carefully plan the excavation activities to successfully remove these "target soils." We provide the following recommendations for removal and management of material from borrow areas intended for use as levee fills.

1. As much as feasible, avoid travel on the surface of the borrow areas until the driest materials have been removed. Excessive traffic can contaminate the target soils with surface organics and/or increase saturation by pumping or "punching" the soils into the water table.
2. Carefully scrape off the organic-rich topsoil to avoid over-excavation. In most borings, only a few inches of topsoil exist. Stockpile topsoil separately.
3. Carefully excavate and stockpile the driest materials (below topsoil and above groundwater) separately from other materials. If possible, spread the soils out in a thin layer so that they can dry.
4. Materials excavated from below the water table will be saturated and should be stockpiled separately from the drier materials. This material may be usable for levee fills if sufficient time and management is allowed for drying them out.

We provide the following recommendations for construction of the levees.

1. To prepare the subgrade surface to support structural fill, the footprint of the levee should be stripped of all existing vegetation and major root systems. This material should be stockpiled for later use (see #8, below).
2. Equipment with relatively low ground pressure should be used as much as feasible and the number of trips necessary to prepare the subgrade should be minimized to avoid causing pumping soil conditions.
3. With the exception of vertical sides or steps, subgrade surfaces to receive levee fill should be cut-graded to slope no steeper than 15 percent.
4. A representative of SHN should conduct a review of the exposed subgrade surface that will support the levee. This evaluation may include in-place soil density testing, as well as proofrolling as described in the following paragraph. If necessary, the SHN representative will recommend that remaining unsuitable soils (such as overly weak, compressible, or disturbed soils) be additionally stripped.
5. Scarify and compact (90% minimum ASTM 1557) the upper 6 inches of exposed subgrade soils that are to receive levee fills. Alternatively, the subgrade surface may be proofrolled using a loaded 10-wheel, 10-cubic-yard dump truck, or equivalent. The proofrolling should be

accomplished under the observation of the representative from SHN with the soil damp or moist (not wet or dry), and a firm, non-yielding surface should be evident during the proofrolling. If a yielding surface is observed (pumping, weaving under wheel loads), the yielding area may need to be additionally excavated and the over-excavated material replaced with Caltrans specification Class 2 baserock (or an approved alternative), in a manner that will result in a stable subgrade surface under the proofrolling, following the over-excavation and replacement.

6. Levee fills should be placed in loose, horizontal lifts not exceeding 8 inches and compacted to a minimum of 90% of the maximum relative dry density as determined by the current ASTM D1557 test method.
7. The levee side slopes should be placed no steeper than 3:1 (horizontal to vertical).
8. Following levee construction to the desired height and width, the stockpiled topsoil should be spread over the levee, wheel-rolled into place, and seeded to provide erosion control and promote the establishment of vegetative cover.

## Alternative Options

Conventional structural fill placement specifications as described above will only be achievable with ambitious soil drying and/or treatment operations prior to placement. This will require substantial time and handling effort and, therefore, may be contradictory to project goals. With an acceptance of lower-level performance expectations, a much less intensive and time-consuming levee construction process could be developed and implemented. These methods would reflect successful levee construction practices in low-impact environments over the years in the local area. With your direction and input, we can provide a set of specific recommendations for a selected option.

# Closure

The analyses, conclusions, and recommendations contained in this report are based on site conditions that we observed at the time of our investigation, data from our subsurface explorations and laboratory tests, our current understanding of proposed project elements, and on our experience with similar projects in similar geotechnical environments. We have assumed that the information obtained from our limited subsurface explorations is representative of subsurface conditions throughout the site.

We recommend a representative of our firm confirm site conditions during the construction phase. If subsurface conditions differ significantly from those disclosed by our investigation, we should be given the opportunity to re-evaluate the applicability of our conclusions and recommendations. Some alteration of recommendations may be appropriate.

If the scope of the proposed construction changes from that described in this report, our recommendations should also be reviewed.

If there is a substantial lapse of time between the submission of our report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, we should review our report to determine the applicability of the conclusions and

recommendations considering the changed conditions and time lapse. This report is applicable only to the project and site studied.

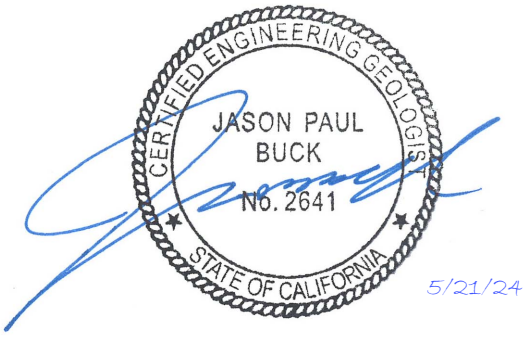
The conclusions and recommendations presented in this report are professional opinions derived in accordance with current standards of professional practice. Our recommendations are tended on the assumption that design of the improvements will conform to their intent. No warranty is expressed or implied.

The field and laboratory work was conducted to investigate the site characteristics specifically addressed by this report. Assumptions about other site characteristics, such as hazardous materials contamination, or environmentally sensitive or culturally significant areas, should not be made from this report.

Please call me at 707-441-8855 if you have any questions.

Sincerely,

**SHN**




Jason Buck
Principal Engineering Geologist

JPB:ame

Appendices
1. Boring Logs
2. Laboratory Test Results

# Boring Logs

1

# BORING LOG KEY

## SAMPLE TYPES

HAND DRIVEN TUBE SAMPLE

GRAB SAMPLE FROM AUGER BUCKET

## SYMBOLOGY

STABILIZED WATER LEVEL

INITIAL WATER LEVEL

APPROXIMATE CONTACT

WELL-DEFINED CONTACT

## ABBREVIATIONS

| | |
|---|---|
| PP | Pocket Penetrometer |
| MC | Moisture Content |
| DD | Dry Density |
| LL | Liquid Limit |
| PL | Plastic Limit |

# BORING NUMBER HA-1



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/13/23 **COMPLETED** 10/13/23
**GROUND ELEVATION** 2.9 ft NAVD88 **HOLE SIZE** 4"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.75 ft / Elev 0.15 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | ML | | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL) |
| | GB | | | | 0.3 ft 2.7 |
| | | | | | (OH) ORGANIC SILT, medium stiff, dry, brownish gray, high plasticity, low dry strength, slightly mottled/FeO staining, many very fine roots. |
| 1 | | | | | |
| | | | | | Becomes slightly moist |
| 2 | | | | | |
| | MC | PP = 1.3 tsf<br>MC = 49%<br>DD = 64 pcf | | | Slight decrease in organics/root content. |
| | | | OH | | ▽ |
| | | | | | ▽ |
| 3 | | | | | Becomes wet, soft. |
| | GB | % Organics = 9.6 | | | |
| 4 | | | | | Becomes dark gray. |
| | GB | | | | |
| | | | | | Layer of dark brown and black, stratified, organic-rich deposits. |
| 5 | | | | | 5.0 ft -2.1 |

Bottom of borehole at 5.0 feet.

# BORING NUMBER HA-2



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/13/23 **COMPLETED** 10/13/23
**GROUND ELEVATION** 3.6 ft NAVD88 **HOLE SIZE** 4"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 4.00 ft / Elev -0.40 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | ML | | 0.1 ft (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL) 3.5 |
| | | | ML | | (ML) SILT with SAND, soft, dry, light grayish brown, very fine sand. |
| | | | | | 0.5 ft 3.1 |
| 1 | MCS | MC = 18%<br>DD = 81 pcf<br>Fines = 62% | ML | | (ML) SANDY SILT, soft, dry, grayish brown to brownish gray, very fine roots, weak mottling with FeO staining. |
| 2 | | | | | Becomes plastic. |
| | | | | | 2.0 ft 1.6 |
| | GB | Fines = 95% | OH | | (OH) ORGANIC SILT, soft, slightly moist, grayish brown to brownish gray, medium to high plasticity, 5% very fine sand. |
| | | | | | Attempted slide hammer mod-cal sample from 2.5 to 3' with approx. 4" recovery. |
| 3 | | | | | Becomes medium stiff. |
| | | | | | ▽ Becomes moist, contains FeO stains, trace very fine sand. |
| 4 | | | | | ▽ Becomes wet. |
| 5 | | | | | 5.0 ft -1.4 |

Bottom of borehole at 5.0 feet.

# BORING NUMBER HA-3



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/13/23 **COMPLETED** 10/13/23
**GROUND ELEVATION** 4 ft NAVD88 **HOLE SIZE** 4"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.35 ft / Elev 2.65 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | ML | 0.1 ft | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL). 3.9 |
| | | | | | (OH) ORGANIC SILT, dry, grayish brown, fine roots/organics, low dry strength, high plasticity. |
| 1 | GB | MC = 66%<br>DD = 54 pcf<br>LL = 124<br>PL = 87 | | | |
| | | | OH | | Becomes moist. |
| 2 | GB | PP = 1.5 tsf<br>% Organics = 11.8 | | | ▽<br>Organic rich, dark brown horizon.<br>Grades to gray. |
| | | | | 2.0 ft | 2.0 |
| | | | | | (SP) POORLY GRADED SAND, loose, wet, brownish gray, trace silt, quartz rich, fine sand. |
| 3 | GB | | | | Grades to dark gray. |
| | | | SP | | |
| 4 | | | | | Wet, loose sand. |
| | | | | 4.5 ft | -0.5 |

Bottom of borehole at 4.5 feet.

# BORING NUMBER HA-4



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/20/23 **COMPLETED** 10/20/23
**GROUND ELEVATION** 3.2 ft NAVD88 **HOLE SIZE** 4"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.00 ft / Elev 1.20 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | GB | | ML | | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL). |
| | | | | | 0.3 ft 2.9 |
| | MC | PP = 1.3 tsf<br>MC = 61%<br>DD = 50 pcf | OH | | (OH) ORGANIC SILT, soft to medium stiff, dry to slightly moist, high plasticity, low toughness, low dry strength, fine roots/organics, slightly mottled with FeO stains near organics. |
| 1 | GB | | | | Becomes moist to wet at 1'. |
| | | | | | 1.5 ft ▽ 1.7 |
| | | | SP | | (SP) POORLY GRADED SAND, loose, wet, gray to bluish gray, trace silt, quartz rich, fine (beach/dune) sand. |
| 2 | | | | | ▽ |
| | | | | | Grades to dark gray.<br>Hole caving due to loose, wet sand. |
| 3 | | | | | 3.0 ft 0.2 |
| | | | | | Bottom of borehole at 3.0 feet. |

# BORING NUMBER HA-5



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/20/23 **COMPLETED** 10/20/23
**GROUND ELEVATION** 4.1 ft NAVD88 **HOLE SIZE** 4"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.20 ft / Elev 2.90 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | | | ML | | 0.1 ft (ML) SILT, wet, dark brown, abundant organics, fine roots, low plasticity, (TOPSOIL). 4.0 |
| | GB | PP = 1.3 tsf<br>MC = 49%<br>DD = 69 pcf<br>% Organics = 13.3 | | | (OH) ORGANIC SILT, soft, wet, dark gray to dark grayish brown, high plasticity. |
| 1 | MC | | | | ▽ Becomes wet. |
| | GB | | | | |
| 2 | | | OH | | Becomes medium stiff. |
| 3 | | LL = 56<br>PL = 33 | | | Grades to dark gray with fine roots. |
| | | | | | 3.5 ft 0.6 |

Bottom of borehole at 3.5 feet.

# BORING NUMBER HA-6



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/20/23 **COMPLETED** 10/20/23
**GROUND ELEVATION** 3.5 ft NAVD88 **HOLE SIZE** 4"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.50 ft / Elev 2.00 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0 | | ML | | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL). |
| | | | | 0.2 ft |
| | | | | (OH) ORGANIC SILT, soft, dry to moist, high plasticity, brownish gray, FeO stains near organics (fine roots). 3.3 |
| 1 | | | | ▽ |
| | GB | OH | | Organic-rich layer, very dark brown. |
| | | | | ▽ |
| 2 | | | | Grades to dark gray, decrease in organic content. |
| | GB | | | |
| 3 | | | | Grades to dark gray; some fine roots. |
| | | | | Bottom of borehole at 3.0 feet. |

# BORING NUMBER HA-7



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/20/23 **COMPLETED** 10/20/23
**GROUND ELEVATION** 2.3 ft NAVD88 **HOLE SIZE** 4"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.35 ft / Elev 0.95 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0 | GB | Fines = 95% | ML | | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL). |
| | | | | | 0.3 ft 2.0 |
| | MC | | OH | | (OH) ORGANIC SILT, soft to medium stiff, dry, brownish gray, moderate cementation, high plasticity, organic rich (very fine roots). |
| 1 | GB | PP = 4.3 tsf<br>MC = 40%<br>DD = 61 pcf<br>LL = 58<br>PL = 36<br>% Organics = 14.7 | | | ▽ Becomes moist, soft, low toughness, grades to gray-dark gray. |
| | GB | | | | Becomes wet. |
| 2 | GB | | | | |
| | GB | | | | |
| 3 | | | | | 3.2 ft -0.9 |

Bottom of borehole at 3.2 feet.

# Laboratory Test Results

2

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# DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

| | | | |
|---|---|---|---|
| **Project Name:** | **Wadulh** | **Project Number:** | **023156** |
| **Performed By:** | **JMA** | **Date:** | **11/27/23** |
| **Checked By:** | **KEW** | **Date:** | **12/5/2023** |
| **Project Manager:** | **AT** | | |

| **Lab Sample Number** | 23-1069 | 23-1072 | 23-1075 | 23-1079 | 23-1083 |
|---|---|---|---|---|---|
| **Boring Label** | HA-1 | HA-2 | HA-3 | HA-4 | HA-5 |
| **Sample Depth (ft)** | 2-2.5' | 0.5-1.0' | 0.5-1.0' | 0.5-1.0' | 0.5-1.0' |
| **Diameter of Cylinder, in** | 2.42 | 2.42 | 2.42 | 2.42 | 2.42 |
| **Total Length of Cylinder, in.** | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 |
| **Length of Empty Cylinder A, in.** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Length of Empty Cylinder B, in.** | 1.85 | 0.88 | 1.60 | 0.82 | 0.73 |
| **Length of Cylinder Filled, in** | 4.15 | 5.12 | 4.40 | 5.18 | 5.27 |
| **Volume of Sample, $in^3$** | 19.09 | 23.55 | 20.24 | 23.83 | 24.24 |
| **Volume of Sample, cc.** | 312.80 | 385.91 | 331.64 | 390.44 | 397.22 |

| **Pan #** | a6 | A9 | a7 | a2 | a1 |
|---|---|---|---|---|---|
| **Weight of Wet Soil and Pan** | 560.2 | 677.7 | 559.3 | 585.9 | 737.2 |
| **Weight of Dry Soil and Pan** | 405.9 | 589.6 | 371.0 | 397.6 | 521.1 |
| **Weight of Water** | 154.3 | 88.1 | 188.3 | 188.3 | 216.1 |
| **Weight of Pan** | 87.5 | 88.1 | 86.7 | 87.5 | 81.6 |
| **Weight of Dry Soil** | 318.4 | 501.5 | 284.3 | 310.1 | 439.5 |
| **Percent Moisture** | 48.5 | 17.6 | 66.2 | 60.7 | 49.2 |
| **Dry Density, g/cc** | 1.02 | 1.30 | 0.86 | 0.79 | 1.11 |
| **Dry Density, $lb/ft^3$** | 63.5 | 81.1 | 53.5 | 49.6 | 69.1 |

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# DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

| | | | |
|---|---|---|---|
| **Project Name:** | **Wadulh** | **Project Number:** | **023156** |
| **Performed By:** | **JMA** | **Date:** | **11/27/23** |
| **Checked By:** | **KEW** | **Date:** | **12/5/2023** |
| **Project Manager:** | **AT** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Lab Sample Number** | 23-1089 | | | | |
| **Boring Label** | HA-7 | | | | |
| **Sample Depth (ft)** | 0.5-1.0' | | | | |
| **Diameter of Cylinder, in** | 2.42 | | | | |
| **Total Length of Cylinder, in.** | 6.00 | | | | |
| **Length of Empty Cylinder A, in.** | 0.00 | | | | |
| **Length of Empty Cylinder B, in.** | 0.00 | | | | |
| **Length of Cylinder Filled, in** | 6.00 | | | | |
| **Volume of Sample, $in^3$** | 27.60 | | | | |
| **Volume of Sample, cc.** | 452.24 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Pan #** | A5 | | | | |
| **Weight of Wet Soil and Pan** | 707.9 | | | | |
| **Weight of Dry Soil and Pan** | 529.5 | | | | |
| **Weight of Water** | 178.4 | | | | |
| **Weight of Pan** | 86.9 | | | | |
| **Weight of Dry Soil** | 442.6 | | | | |
| **Percent Moisture** | 40.3 | | | | |
| **Dry Density, g/cc** | 0.98 | | | | |
| **Dry Density, $lb/ft^3$** | 61.1 | | | | |

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# PERCENT PASSING # 200 SIEVE (ASTM - D1140)

| | | | |
|---|---|---|---|
| **Project Name:** | **Wadulh** | **Project Number:** | **023156** |
| **Performed By:** | **JMA** | **Date:** | **11/29/2023** |
| **Checked By:** | **KEW** | **Date:** | **12/5/2023** |
| **Project Manager:** | **AT** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Lab Sample Number** | 23-1073 | 23-1074 | 23-1088 | | |
| **Boring Label** | HA-2 | HA-2 | HA-7 | | |
| **Sample Depth** | 0.5-1.0' | 2-2.5' | 0-0.5' | | |
| **Pan Number** | ss2 | ss3 | ss11 | | |
| **Dry Weight of Soil & Pan** | 388.5 | 371.5 | 426.4 | | |
| **Pan Weight** | 193.4 | 197.1 | 192.8 | | |
| **Weight of Dry Soil** | 195.1 | 174.4 | 233.6 | | |
| **Soil Weight Retained on #200&Pan** | 268.5 | 206.3 | 205.3 | | |
| **Soil Weight Passing #200** | 120.0 | 165.2 | 221.1 | | |
| **Percent Passing #200** | **62** | **95** | **95** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Lab Sample Number** | | | | | |
| **Boring Label** | | | | | |
| **Sample Depth** | | | | | |
| **Pan Number** | | | | | |
| **Dry Weight of Soil & Pan** | | | | | |
| **Pan Weight** | | | | | |
| **Weight of Dry Soil** | | | | | |
| **Soil Weight Retained on #200&Pan** | | | | | |
| **Soil Weight Passing #200** | | | | | |
| **Percent Passing #200** | | | | | |

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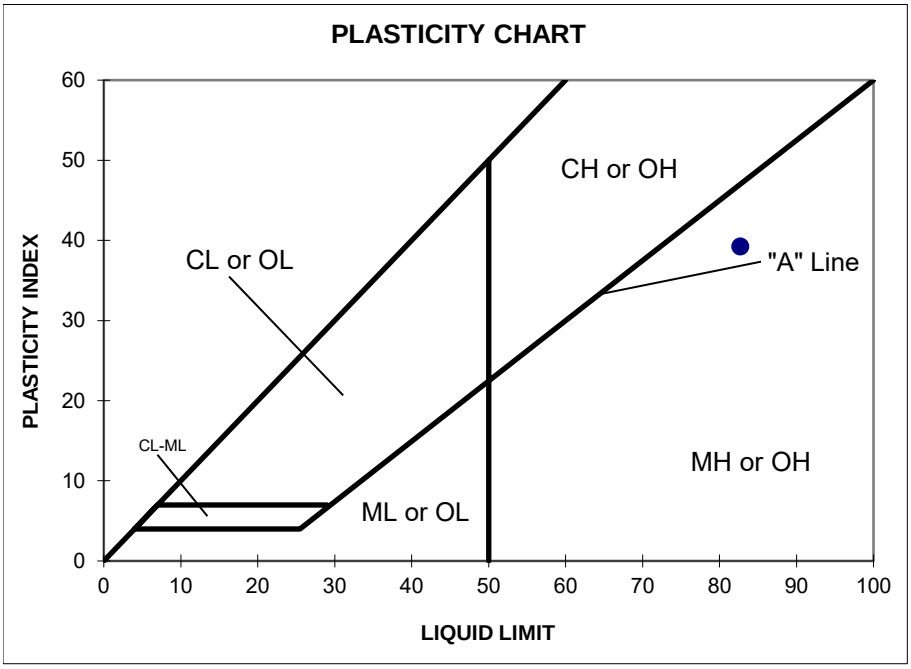
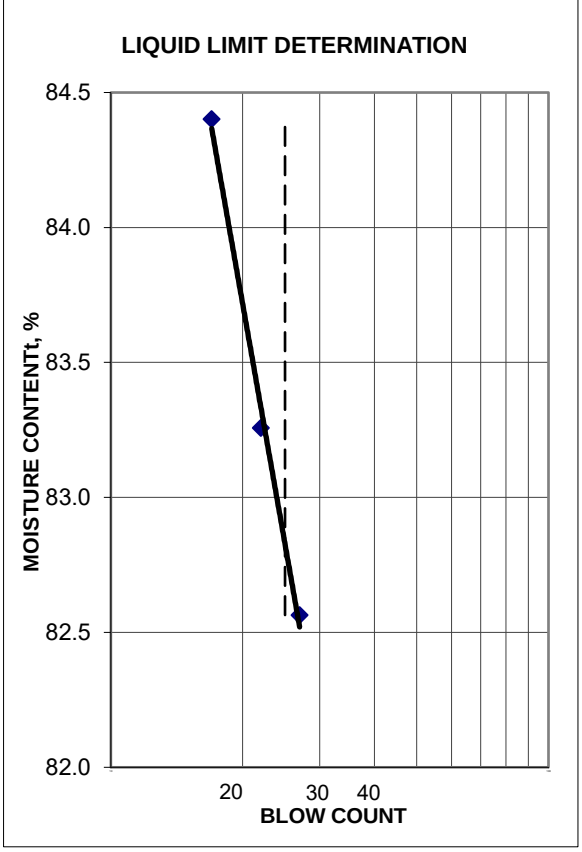
# LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

| | | | | | |
|---|---|---|---|---|---|
| JOB NAME: | **Wadulh** | JOB #: | **023156** | LAB SAMPLE #: | **23-1070** |
| SAMPLE ID: | **HA-1 @ 3-3.5'** | PERFORMED BY: | **JMA** | DATE: | **11/30/2023** |
| PROJECT MANAGER: | **AT** | CHECKED BY: | **KEW** | DATE: | **12/5/2023** |

| LINE NO. | | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 3 |
|---|---|---|---|---|---|---|
| A | PAN # | 19 | 20 | 10 | 11 | 12 |
| B | PAN WT. (g) | 16.870 | 17.140 | 29.590 | 28.670 | 29.340 |
| C | WT. WET SOIL & PAN (g) | 23.010 | 23.410 | 36.710 | 36.770 | 37.970 |
| D | WT. DRY SOIL & PAN (g) | 21.160 | 21.500 | 33.490 | 33.090 | 34.020 |
| E | WT. WATER (C-D) | 1.850 | 1.910 | 3.220 | 3.680 | 3.950 |
| F | WT. DRY SOIL (D-B) | 4.290 | 4.360 | 3.900 | 4.420 | 4.680 |
| G | BLOW COUNT | -- | -- | 27 | 22 | 17 |
| H | MOISTURE CONTENT (E/F*100 | 43.1 | 43.8 | 82.6 | 83.3 | 84.4 |

| LIQUID LIMIT | **PLASTIC INDEX** | PLASTIC LIMIT |
|---|---|---|
| 83 | **39** | 43 |



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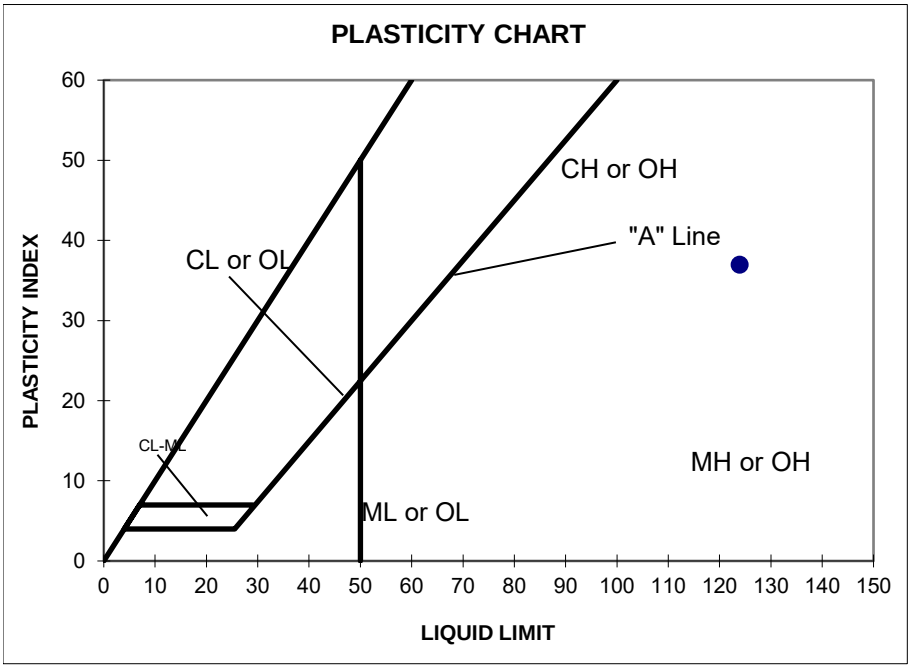
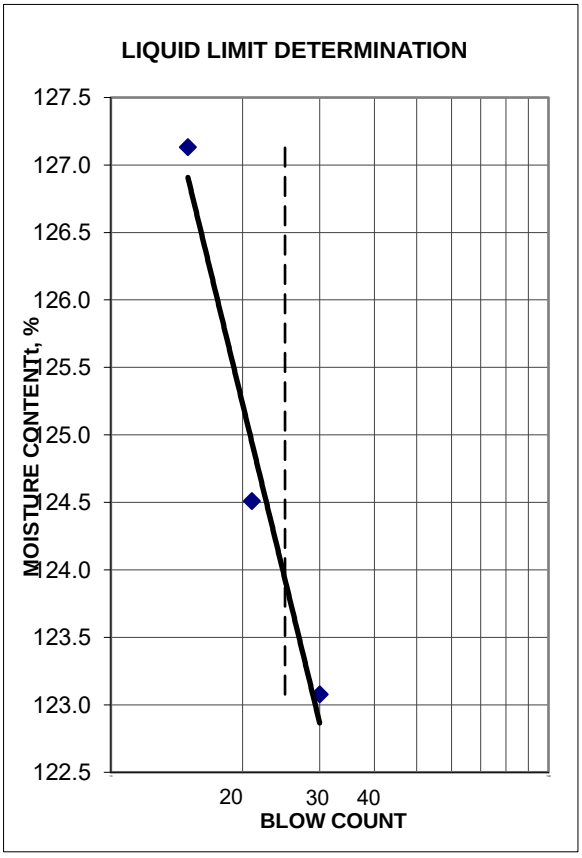
# LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

| | | | | | |
|---|---|---|---|---|---|
| JOB NAME: | **Wadulh** | JOB #: | **023156** | LAB SAMPLE #: | **23-1075** |
| SAMPLE ID: | **HA-3 @ 0.5-1.0'** | PERFORMED BY: | **JMA** | DATE: | **12/1/2023** |
| PROJECT MANAGER: | **AT** | CHECKED BY: | **KEW** | DATE: | **21/5/23** |

| LINE NO. | | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 3 |
|---|---|---|---|---|---|---|
| A | PAN # | 17 | 18 | 7 | 8 | 9 |
| B | PAN WT. (g) | 20.210 | 20.140 | 28.880 | 29.020 | 28.580 |
| C | WT. WET SOIL & PAN (g) | 26.350 | 27.450 | 34.970 | 35.890 | 34.440 |
| D | WT. DRY SOIL & PAN (g) | 23.470 | 24.080 | 31.610 | 32.080 | 31.160 |
| E | WT. WATER (C-D) | 2.880 | 3.370 | 3.360 | 3.810 | 3.280 |
| F | WT. DRY SOIL (D-B) | 3.260 | 3.940 | 2.730 | 3.060 | 2.580 |
| G | BLOW COUNT | -- | -- | 30 | 21 | 15 |
| H | MOISTURE CONTENT (E/F*100 | 88.3 | 85.5 | 123.1 | 124.5 | 127.1 |

| LIQUID LIMIT | **PLASTIC INDEX** | PLASTIC LIMIT |
|---|---|---|
| 124 | **37** | 87 |



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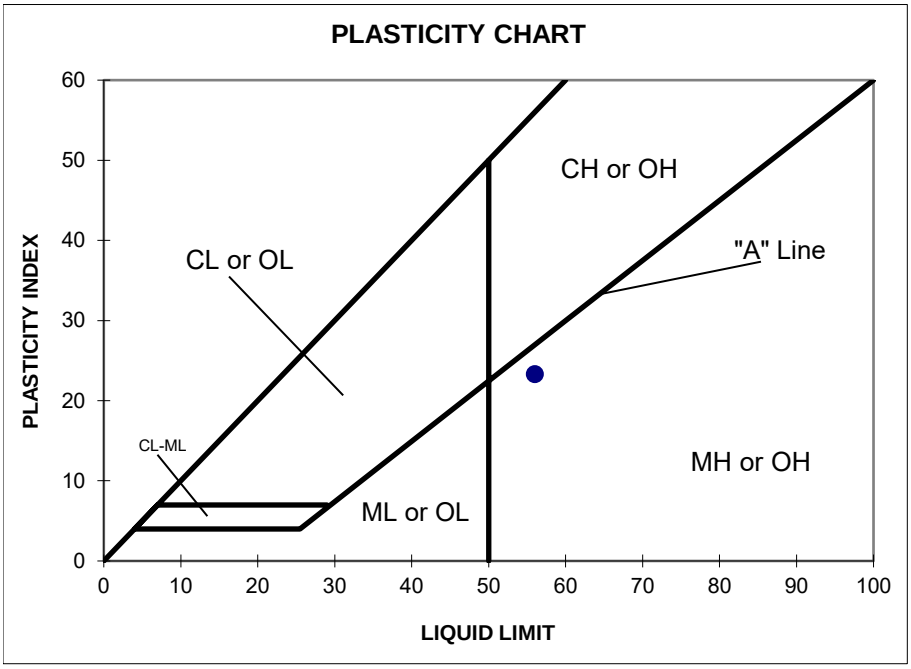
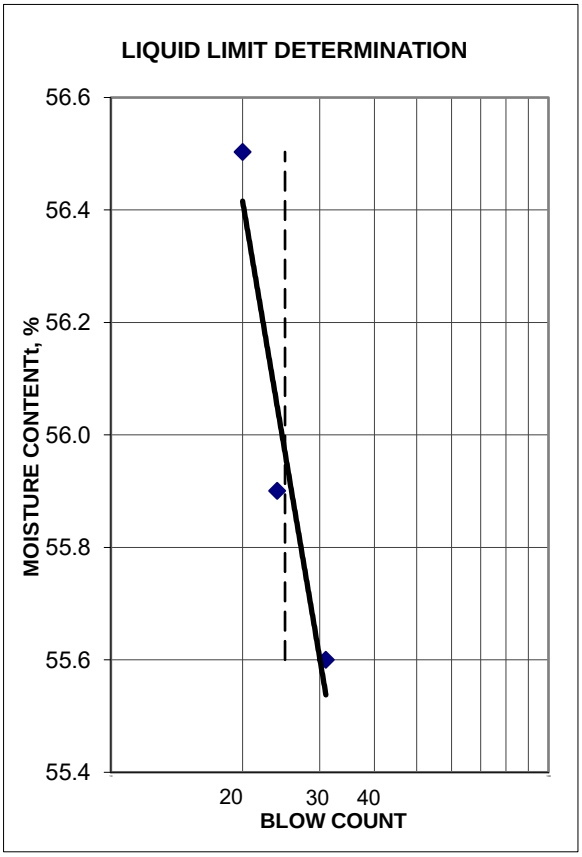
# LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

| | | | | | |
|---|---|---|---|---|---|
| JOB NAME: | **Wadulh** | JOB #: | **023156** | LAB SAMPLE #: | **23-1085** |
| SAMPLE ID: | **HA-5 @ 3-3.5'** | PERFORMED BY: | **JMA** | DATE: | **11/30/2023** |
| PROJECT MANAGER: | **AT** | CHECKED BY: | **KEW** | DATE: | **12/5/2023** |

| LINE NO. | | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 3 |
|---|---|---|---|---|---|---|
| A | PAN # | 13 | 14 | 1 | 2 | 3 |
| B | PAN WT. (g) | 22.000 | 20.120 | 29.590 | 28.920 | 28.990 |
| C | WT. WET SOIL & PAN (g) | 28.030 | 26.710 | 37.370 | 36.450 | 36.330 |
| D | WT. DRY SOIL & PAN (g) | 26.550 | 25.080 | 34.590 | 33.750 | 33.680 |
| E | WT. WATER (C-D) | 1.480 | 1.630 | 2.780 | 2.700 | 2.650 |
| F | WT. DRY SOIL (D-B) | 4.550 | 4.960 | 5.000 | 4.830 | 4.690 |
| G | BLOW COUNT | -- | -- | 31 | 24 | 20 |
| H | MOISTURE CONTENT (E/F*100 | 32.5 | 32.9 | 55.6 | 55.9 | 56.5 |

| LIQUID LIMIT | **PLASTIC INDEX** | PLASTIC LIMIT |
|---|---|---|
| 56 | **23** | 33 |



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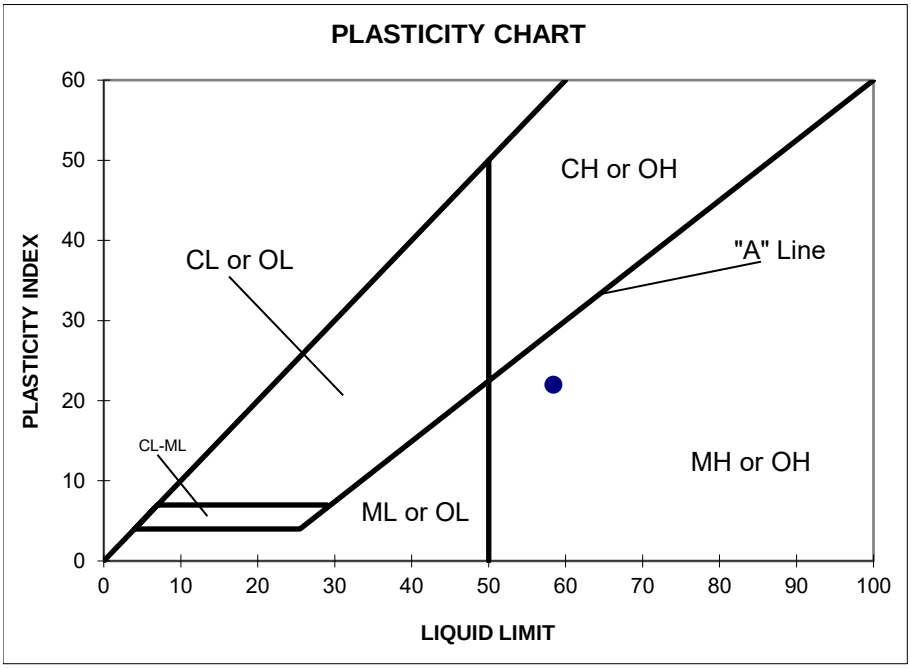
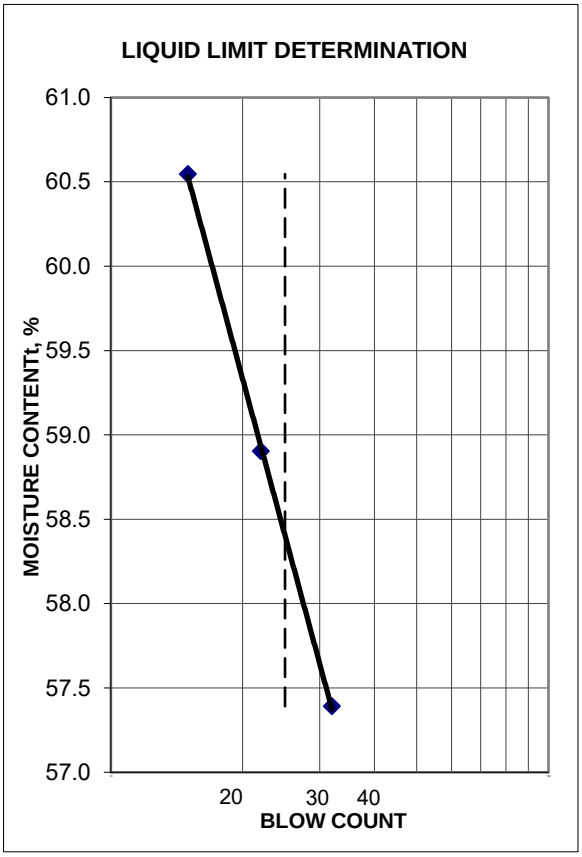
# LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

| | | | | | |
|---|---|---|---|---|---|
| JOB NAME: | **Wadulh** | JOB #: | **023156** | LAB SAMPLE #: | **23-1090** |
| SAMPLE ID: | **HA-7 @ 1-1.5'** | PERFORMED BY: | **JMA** | DATE: | **12/1/2023** |
| PROJECT MANAGER: | **AT** | CHECKED BY: | **KEW** | DATE: | **12/5/2023** |

| LINE NO. | | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 3 |
|---|---|---|---|---|---|---|
| A | PAN # | 19 | 20 | 10 | 11 | 12 |
| B | PAN WT. (g) | 16.880 | 17.140 | 29.580 | 28.670 | 29.360 |
| C | WT. WET SOIL & PAN (g) | 22.880 | 23.320 | 36.820 | 35.630 | 35.830 |
| D | WT. DRY SOIL & PAN (g) | 21.290 | 21.660 | 34.180 | 33.050 | 33.390 |
| E | WT. WATER (C-D) | 1.590 | 1.660 | 2.640 | 2.580 | 2.440 |
| F | WT. DRY SOIL (D-B) | 4.410 | 4.520 | 4.600 | 4.380 | 4.030 |
| G | BLOW COUNT | -- | -- | 32 | 22 | 15 |
| H | MOISTURE CONTENT (E/F*100 | 36.1 | 36.7 | 57.4 | 58.9 | 60.5 |

| LIQUID LIMIT | **PLASTIC INDEX** | PLASTIC LIMIT |
|---|---|---|
| 58 | **22** | 36 |



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# COMPACTION TEST DATA SHEET

| | | | | | |
|---|---|---|---|---|---|
| Job Name: | **Wadulh Geotech** | | Lab Sample Number: | **23-1050** | |
| Job Number: | **023156** | | Tested By: **ZA** | Date Tested: | **11/8/23** |
| Sample ID: | **HA-1 @ 0-1'** | | Checked By: **KEW** | Date Checked: | **12/5/23** |
| Sample Description: | **Subgrade Soil** | | | | |
| Initial Gradation: | + 3/4"= **0.0** % | + 3/8"= **0.0** % | + No.4= **0.0** % | | |
| Moisture Correction | Gauge Number: | | Corection Factor: | | |

## TEST DATA

| | | | | | |
|---|---|---|---|---|---|
| Mold + Wet Soil, lb | 13.264 | 12.897 | 13.038 | 13.135 | 13.251 |
| Mold, lbs | 9.229 | 9.229 | 9.229 | 9.229 | 9.229 |
| Moist Soil, lbs | 4.035 | 3.668 | 3.809 | 3.906 | 4.022 |
| Factor (1/Vol.), cu. ft | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 |
| WET DENSITY, pcf | 121.0 | 110.0 | 114.3 | 117.2 | 120.7 |
| Drying Dish No. | t9 | t7 | t11 | t2 | t8 |
| Wet Soil and Dish | 805.9 | 503.6 | 567.1 | 640.0 | 603.5 |
| Dry Soil and Dish | 668.1 | 456.3 | 505.3 | 559.3 | 516.8 |
| Moisture, g. | 137.8 | 47.3 | 61.8 | 80.7 | 86.7 |
| DIsh, grams | 114.1 | 113.0 | 113.3 | 112.5 | 115.4 |
| Dry Soil, g. | 554.0 | 343.3 | 392.0 | 446.8 | 401.4 |
| MST. CONTENT, % | **24.9** | **13.8** | **15.8** | **18.1** | **21.6** |
| DRY DENSITY, pcf | **96.9** | **96.7** | **98.7** | **99.2** | **99.2** |
| % Moist. Added | | | | | |

## TEST METHOD

[ ] STANDARD ASTM D 698

5.5 lb hammer, 12" drop, 3 layers

[x ] MODIFIED ASTM D 1557

10 lb hammer, 18" drop, 5 layers

[x ] Manual hammer [ ] Mechanical hammer

| ASTM | Soil | Mold, in. | Blows | Mold Wt. |
|---|---|---|---|---|
| A | SW | 4 | 25 | 9.229 |

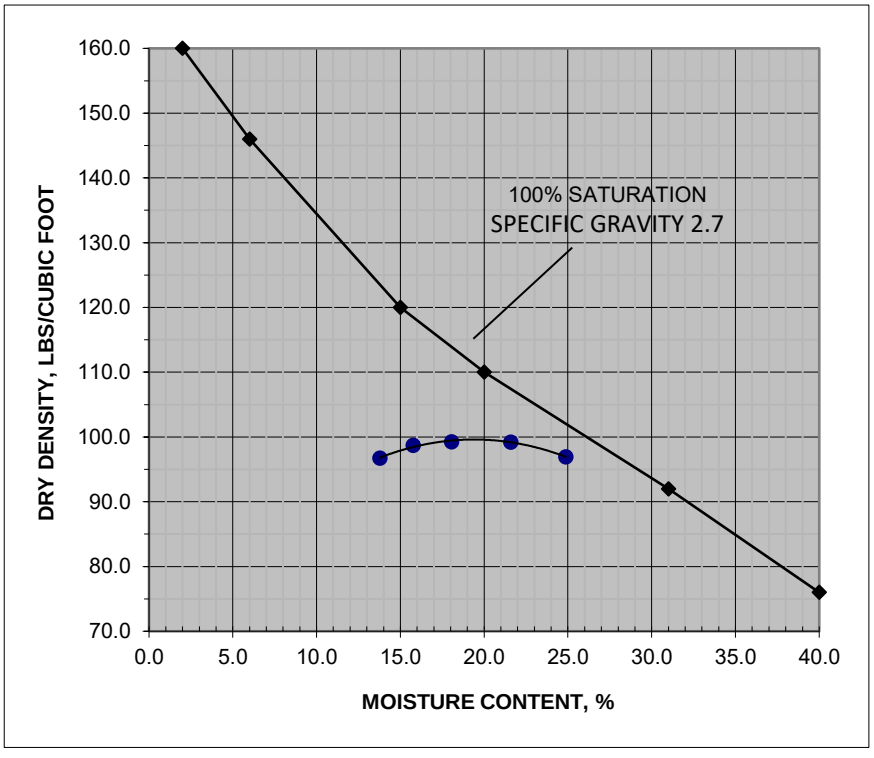
| | | |
|---|---|---|
| A | Retained on No.4 ≤ 25% | 4" Mold use passing No.4 |
| B | No.4 ≥ 25% & 3/8" <25% | 4" Mold use passing 3/8" |
| C | 3/8" ≥25% & 3/4" ≤30% | 6" Mold use passing 3/4" |

| | | |
|---|---|---|
| MAXIMUM DRY DENSITY (pcf) | **99.2** | **NA** Rock Corr. |
| OPTIMUM MOISTURE CONTENT (%) | **21.6** | |

## INITIAL GRADATION

| | |
|---|---|
| Total Weight (gm) | 15846 |

| Screen size | Wt. Screen | Wt. Cumulat |
|---|---|---|
| + 3/4" screen | 0 | 0 |
| + 3/8" screen | 0 | 0 |
| + No.4 screen | 0 | 0 |



CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash Eureka, CA 95501-2138 Tel: 707/441-8855 FAX: 707/441-8877 E-mail: shninfo@shn-engr.com

# COMPACTION TEST DATA SHEET

| | | | | | |
|---|---|---|---|---|---|
| Job Name: | **Wadulh Geotech** | | Lab Sample Number: | **23-1051** | |
| Job Number: | **023156** | | Tested By: **ZA** | Date Tested: | **11/8/23** |
| Sample ID: | **HA-4 @ 0-1'** | | Checked By: **KEW** | Date Checked: | **12/5/23** |
| Sample Description: | **Subgrade Soil** | | | | |
| Initial Gradation: | + 3/4"= **0.0** % | + 3/8"= **0.0** % | + No.4= **0.0** % | | |
| Moisture Correction | Gauge Number: | | Corection Factor: | | |

## TEST DATA

| | | | | | |
|---|---|---|---|---|---|
| Mold + Wet Soil, lb | 12.828 | 12.944 | 12.983 | 13.067 | 13.009 |
| Mold, lbs | 9.23 | 9.23 | 9.23 | 9.23 | 9.23 |
| Moist Soil, lbs | 3.598 | 3.714 | 3.753 | 3.837 | 3.779 |
| Factor (1/Vol.), cu. ft | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 |
| WET DENSITY, pcf | 107.9 | 111.4 | 112.6 | 115.1 | 113.4 |
| Drying Dish No. | ss5 | ss10 | t9 | t8 | t3 |
| Wet Soil and Dish | 785.2 | 719.1 | 698.1 | 650.1 | 595.5 |
| Dry Soil and Dish | 684.2 | 620.5 | 581.8 | 530.6 | 478.1 |
| Moisture, g. | 101.0 | 98.6 | 116.3 | 119.5 | 117.4 |
| DIsh, grams | 195.5 | 195.4 | 115.1 | 115.4 | 114.7 |
| Dry Soil, g. | 488.7 | 425.1 | 466.7 | 415.2 | 363.4 |
| MST. CONTENT, % | **20.7** | **23.2** | **24.9** | **28.8** | **32.3** |
| DRY DENSITY, pcf | **89.4** | **90.4** | **90.1** | **89.4** | **85.7** |
| % Moist. Added | | | | | |

## TEST METHOD

[ ] STANDARD ASTM D 698

5.5 lb hammer, 12" drop, 3 layers

[x ] MODIFIED ASTM D 1557

10 lb hammer, 18" drop, 5 layers

[x ] Manual hammer [ ] Mechanical hammer

| ASTM | Soil | Mold, in. | Blows | Mold Wt. |
|---|---|---|---|---|
| A | ML | 4 | 25 | 9.23 |

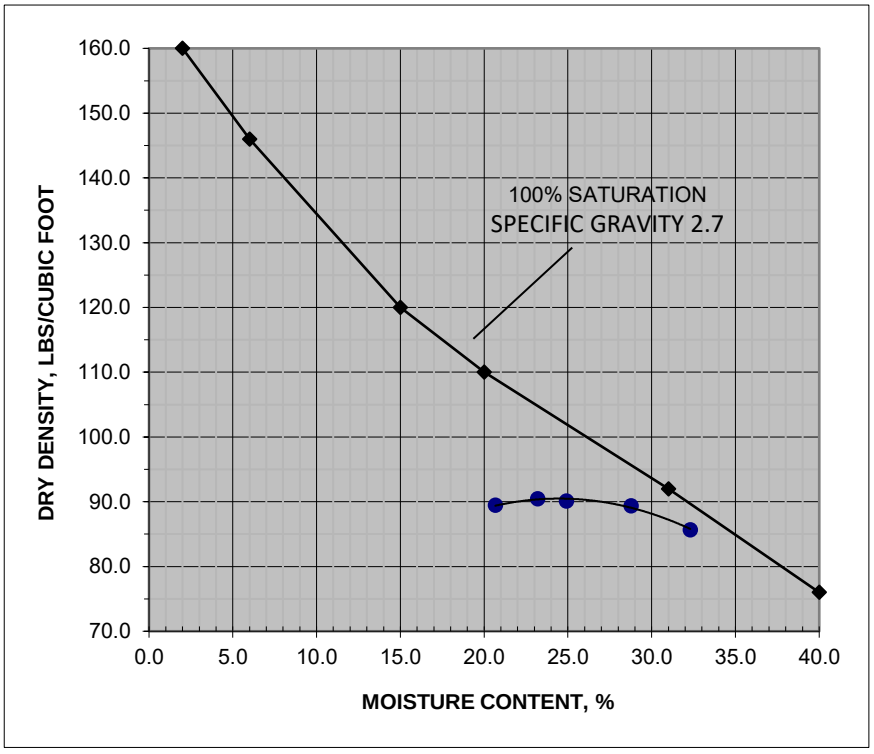
| | | |
|---|---|---|
| A | Retained on No.4 ≤ 25% | 4" Mold use passing No.4 |
| B | No.4 ≥ 25% & 3/8" <25% | 4" Mold use passing 3/8" |
| C | 3/8" ≥25% & 3/4" ≤30% | 6" Mold use passing 3/4" |

| | | |
|---|---|---|
| MAXIMUM DRY DENSITY (pcf) | **90.1** | **NA** Rock Corr. |
| OPTIMUM MOISTURE CONTENT (%) | **24.9** | |

## INITIAL GRADATION

| | |
|---|---|
| Total Weight (gm) | 15400 |

| Screen size | Wt. Screen | Wt. Cumulat |
|---|---|---|
| + 3/4" screen | 0 | 0 |
| + 3/8" screen | 0 | 0 |
| + No.4 screen | 0 | 0 |



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# PERCENT ORGANICS (ASTM D2974)

**Project Name:** Waduhl Geotech
**Project Manager:** AT

**Project Number:** 023156
**Performed By:** JMA **Date:** 12/1/2023
**Checked By:** KEW **Date:** 12/5/2023

| Lab Sample # | Project Sample # | Pan # | Weight of Dry Soil and Pan | Pan Weight | Weight of Dry Soil | Weight of Burned Soil and Pan | Weight of Burned Soil | Weight of Organics | % Organics |
|---|---|---|---|---|---|---|---|---|---|
| 23-1070 | HA-1 @ 3-3.5' | TEX | 37.28 | 18.98 | 18.3 | 35.53 | 16.55 | 1.75 | **9.56** |
| 23-1076 | HA-3 @ 1-2' | USA | 38.98 | 16.01 | 22.97 | 36.27 | 20.26 | 2.71 | **11.80** |
| 23-1081 | HA-5 @ 0-1' | TES | 40.79 | 18.98 | 21.81 | 37.9 | 18.92 | 2.89 | **13.25** |
| 23-1089 | HA-7 @ .5-1.0' | USA | 38.52 | 16.02 | 22.50 | 35.21 | 19.19 | 3.31 | **14.71** |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

**Phone:** (707) 441-8855 **Email:** info@shn-engr.com **Web:** shn-engr.com
812 W. Wabash Avenue, Eureka, CA 95501-2138

Reference: 023156

February 18, 2025

Jill Demers, Executive Director
Humboldt County Resource Conservation District
5630 South Broadway St.
Eureka, CA 95503

**Subject: Addendum 1 to Geotechnical Investigation Report for Wadulh Lagoon Tidal Wetland Enhancement Project**

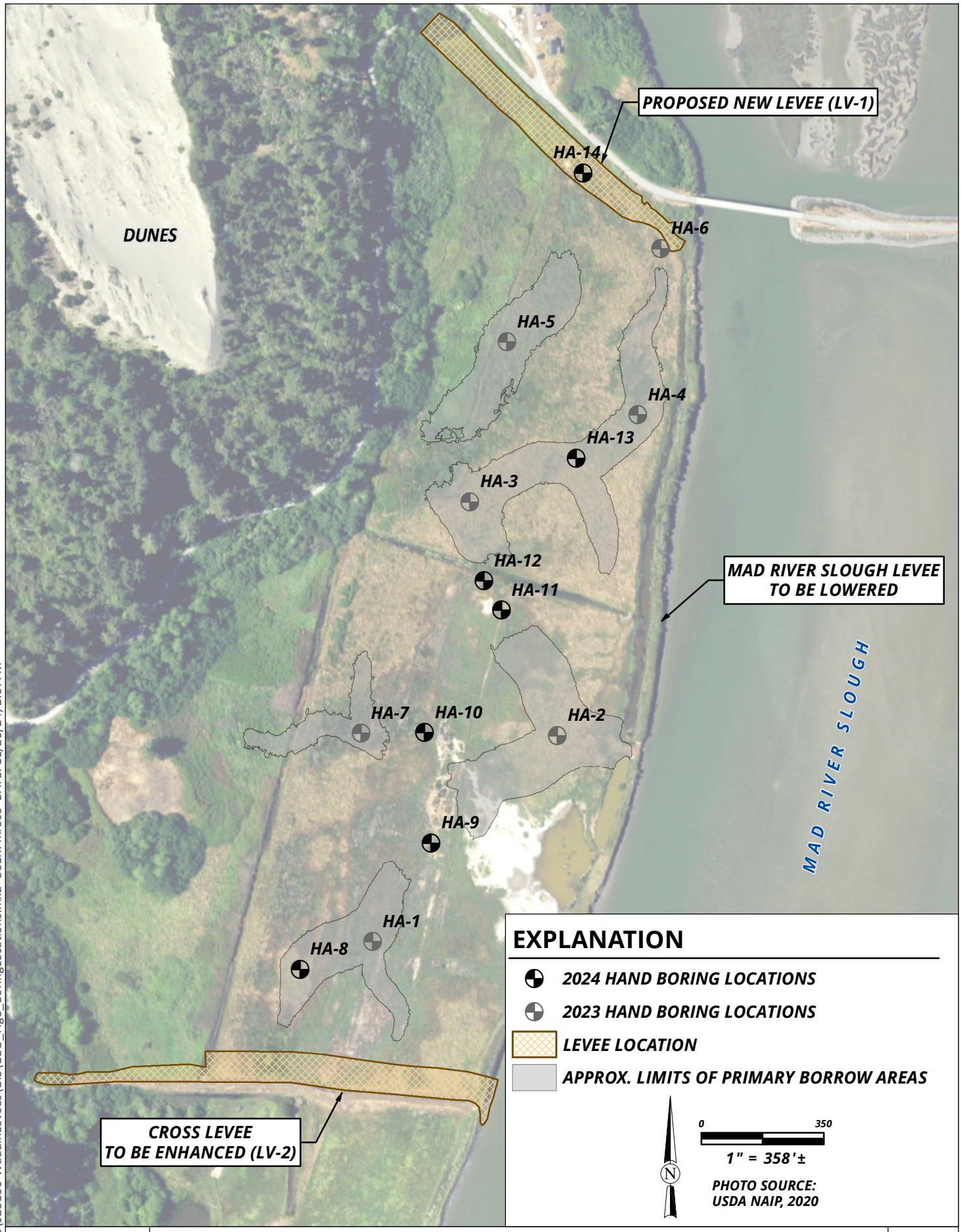
SHN previously completed a geotechnical investigation report for the Wadulh Lagoon Tidal Wetland Enhancement Project (dated March 6, 2024), which characterized existing soil and groundwater conditions and provided construction considerations and recommendations for levee construction. In our report we identified and discussed some of the challenges of working with the existing onsite soils. Loose, saturated sands identified in some areas present issues for the stability of planned features such as the sills. The organic-rich silts found in most other areas will be relatively wet and challenging to compact without extreme measures to moisture condition. This addendum provides the results of additional field and laboratory testing, and recommendations for alternative methods of levee construction.

The focus of our supplemental field and laboratory investigation was to further characterize shallow subsurface conditions within the excavation areas, evaluate the extent of the loose sands encountered in the previous hand borings, and develop alternative recommendations for construction of the project. Our scope of work included a subsurface investigation, laboratory testing of selected soils samples, and preparation of this addendum. Below, we provide our findings, conclusions, and soils-related recommendations for construction of the project.

# Field Investigation and Laboratory Testing

Seven hand-auger borings (HA-8 through HA-14) were advanced across the site on July 10, 2024, to characterize soils and collect soil samples for laboratory testing. The boring locations were selected to evaluate the extent of loose sands initially encountered in HA-3 and HA-4, and to further characterize the organic silts encountered in the new lagoon and borrow areas. The borings were advanced to depths ranging from 3.75 to 6.5 feet below grade using a 3-inch auger bucket. An amended Figure 3 shows the locations of all borings, including those from our previous study. Boring logs are included as Appendix 1. Groundwater elevations encountered in the field are provided in a Table as Appendix 2.

Soil samples were collected by hand-driving a 2.5-inch-inside-diameter (ID), 3.0-inch-outside-diameter (OD) Modified California Sampler (MCS) containing steel liners; bulk soil samples were collected from the auger bucket. Samples were delivered to SHN's lab in Eureka for laboratory testing of moisture content and density, percent passing the No. 200 sieve, and Atterberg limits. Results of laboratory testing from both the 2023 and 2024 investigations are shown on the boring logs in Appendix 1 and attached as a summary table in Appendix 3.

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Humboldt County Resource Conservation District
Wadulh Lagoon Enhancement Project - Geotechnical Study
Arcata, California

**Hand-Boring Locations**

November 2024 - 023156

**Figure 3**

# Soil and Groundwater Conditions

Soils observed in the hand-auger borings (HA-8 through HA-14) are generally consistent with conditions encountered in the 2023 borings (HA-1 through HA-7; SHN, 2024), composed predominantly of fine-grained, overbank flood deposits (highly organic silt beneath a thin layer of topsoil). Loose, saturated fine sand was encountered at 2 feet below the ground surface (BGS) in HA-13, extending to the maximum depth explored (4.5 feet BGS), similar to previous borings nearby (HA-3 and HA-4). Poorly graded loose sands identified in our 2023 investigation were not found in the sill locations. Instead, in HA-10 and HA-12, we encountered loose, wet, cohesive silty sand at 2.75 feet and 2 feet, respectively, extending to 4 feet BGS in both borings.

# Alternative Options for Levee Construction

In our initial report we provided recommendations for levee construction that follow generally accepted engineering practices for placement and compaction of fill materials. The reuse of native materials in intertidal environments like the Wadulh Lagoon project is complicated by the fine-grained nature of the existing soils, high moisture content and shallow groundwater. The time and effort necessary to moisture condition the soils to accommodate standard methods for fill placement and monitoring is not often practical on projects like this. Below we provide alternative recommendations for working with the soil conditions as they are. The use of these alternatives is meant to improve the constructability of the project.

It's important to note that the recommendations provided in our initial report for removal and management of the "target soils" (unsaturated material above the groundwater table) remain appropriate and will be important for consideration by the contractor in planning the work sequencing.

The primary challenge in constructability of the project is maintaining the stability of the subgrade below the levee, and along paths of travel for transporting and placing fill materials. The utilization of geosynthetics has proven to be useful on other local projects with similar challenges. Below, we provide specifications for two methods for developing a stabilized surface using geosynthetics;

1) using a **geogrid** with a well-graded granular material to form a mechanically stabilized layer, or
2) using a **geotextile fabric** to reinforce the subgrade.

## Mechanically Stabilized Layer Using Geogrid

The use of a geogrid placed directly on the subgrade along with a granular material to interlock with the geogrid is what forms the mechanically stabilized layer from which equipment can work and to build up the fill prism. The following recommendations are made for this option:

1. Instead of removing all the vegetation from the footprint, we recommend leaving the surface layer of organics; this has been proven to improve performance and stabilization. The grasses should be cut/mowed, but the basal layer of the vegetation and root structures can be left in

place. Preparation of the subgrade for placement of the geogrid should include developing a relatively flat surface. Drainage swales or other irregularities should be filled in or otherwise smoothed out.

2. Once the subgrade is prepared, place a single layer of geogrid at the necessary width and length. We recommend using Tensar InterAx 750 Geogrid (or equivalent). Where more than one roll width (12 feet) of geogrid is necessary, the geogrid should be overlapped a minimum of 12 inches. We expect that the footprint of the northern levee will require a reinforced section two rolls wide.
3. Place 12 inches of granular material over the geogrid starting at one end, working in one direction so that the geogrid remains flat and no wrinkles are formed. Equipment should not be permitted to drive directly on the geogrid. The optimal granular material is well graded angular rock or recycled concrete with particle sizes no more than 3.5 inches in diameter and fines contents less than 15%. Poorly graded sand or other available granular material (although not as ideal) may also be suitable to achieve the stabilization objective.
4. The granular material should be carefully compacted into place. Static rolling is preferred. No vibratory action should be applied to achieve compaction.

## Subgrade Reinforcement Using Geotextile

Subgrade reinforcement using a geotextile fabric generally doesn't provide the same level of benefit as a geogrid, but the benefits it does provide can be realized without the use of a granular soil. The following recommendations are made for this option:

1. Similar to preparation for the use of geogrid, some of the vegetative mat on the surface can be left in place, but more attention should be paid to achieving a flat prepared surface.
2. Lay out the geotextile fabric directly on the subgrade surface. We recommend using Mirafi® H2Ri (or equivalent). The layer must extend laterally far enough beyond the working surface to be attached or pinned at the edges such that any slack between the edges is minimized. This is to prevent sagging in the middle. The Mirafi® H2Ri comes in 15-foot-wide rolls.
3. Once the geotextile is laid out and pinned tightly at the edges, borrow soils may be placed directly on top and pushed out in one direction so that the fabric is put under tension. A first lift of approximately 18 inches is recommended.

### Fill Placement

Once a stabilization layer has been established, fill placement can continue using borrow materials. We recommend that fills be placed in thin lifts (less than 12-inch loose lifts) to promote drying of soils during placement activities and improve compaction. Recommendations associated with monitoring field densities through standard compaction testing will not be applicable with this approach. Instead, a "performance" specification will need to be developed in the field based on site conditions and equipment. A representative of SHN should provide oversight and field recommendations, as necessary to ensure the means and methods will meet the objectives of the project. Lightweight equipment should

be used to spread and compact soils. Tracked equipment may be necessary. Rollers should not be used in vibratory mode. Soils should be allowed to dry or mixed with drier soils if they are too wet to be effectively spread and tracked/rolled into place.

### Additional Stabilization Layer

If equipment access and/or fill placement becomes difficult due to the stability of the placed fill, then an additional stabilization layer can be developed. This will likely be a decision made in the field based on the success of the means and methods and the weather conditions at the time of construction.

Soils placed at over-optimum conditions can be expected to dry and consolidate over time. The levee should be slightly overbuilt to accommodate settlement over time. If long-term accessibility for equipment on the levee crest is required, a layer of geotextile fabric could be placed approximately 18 inches below finished grade to help maintain longevity of the levee crest surface.

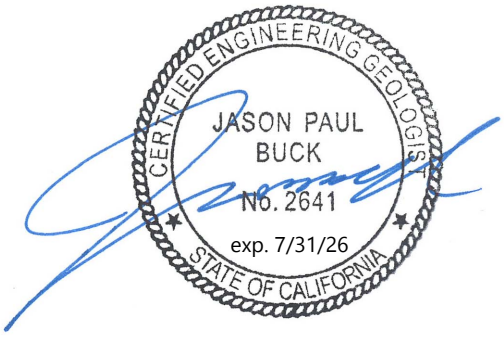
## Closure

The analyses, conclusions, and recommendations contained in this report are based on site conditions that we observed at the time of our investigation, data from our subsurface explorations and laboratory tests, our current understanding of proposed project elements, and on our experience with similar projects in similar geotechnical environments. Limitations associated with the use of this information provided in our original report remain applicable to this document.

Please call me at (707) 441-8855 if you have any questions.

Sincerely,

**SHN**




signed 2-18-2025

Jason Buck
Principal Engineering Geologist

JPB:lam
Appendices 1. Boring Logs
2. Groundwater Elevations
3. Laboratory Test Results and Table

## Reference Cited

SHN. (March 6, 2024). "Geotechnical Investigation Report for Wadulh Lagoon Tidal Wetland Enhancement Project." Eureka, CA:SHN.

# Hand Boring Logs

1

# KEY TO SOIL PROFILE LOG

## SAMPLE TYPES

HAND DRIVEN TUBE SAMPLE

BULK (GRAB) SAMPLE

## SYMBOLOGY

STABILIZED WATER LEVEL

INITIAL WATER LEVEL

APPROXIMATE CONTACT

WELL-DEFINED CONTACT

## ABBREVIATIONS

| | |
|---|---|
| PP | Pocket Pen |
| MC | Moisture Content |
| DD | Dry Density |
| LL | Liquid Limit |
| PL | Plastic Limit |

# BORING NUMBER HA-1



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/13/23 **COMPLETED** 10/13/23
**GROUND ELEVATION** 2.9 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.75 ft / Elev 0.15 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | GB | | ML | 0.3 | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL) 2.7 |
| | | | | | (OH) ORGANIC SILT, medium stiff, dry, brownish gray, high plasticity, low dry strength, slightly mottled/FeO staining, many very fine roots. |
| | | | | | Becomes slightly moist |
| | | | | | Slight decrease in organics/root content. |
| 2.5 | MC | PP = 1.3 tsf<br>MC = 49%<br>DD = 64 pcf | OH | | ▽ |
| | GB | % Organics = 9.6 | | | Becomes wet, soft. |
| | | | | | Becomes dark gray. |
| | GB | | | | Layer of dark brown and black, stratified, organic-rich deposits. |
| 5.0 | | | | 5.0 | -2.1 |

Bottom of borehole at 5.0 feet.

# BORING NUMBER HA-2



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/13/23 **COMPLETED** 10/13/23
**GROUND ELEVATION** 3.6 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 4.00 ft / Elev -0.40 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | |
|---|---|---|---|---|---|---|
| 0.0 | | | ML | | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL) | 3.5 |
| | | | ML | | (ML) SILT with SAND, soft, dry, light grayish brown, very fine sand. | |
| 0.5 | | | | | | 3.1 |
| | MCS | MC = 18%<br>DD = 81 pcf<br>Fines = 62% | ML | | (ML) SANDY SILT, soft, dry, grayish brown to brownish gray, very fine roots, weak mottling with FeO staining. | |
| | | | | | Becomes plastic. | |
| 2.0 | | | | | | 1.6 |
| 2.5 | GB | Fines = 95% | OH | | (OH) ORGANIC SILT, soft, slightly moist, grayish brown to brownish gray, medium to high plasticity, 5% very fine sand. | |
| | | | | | Attempted slide hammer mod-cal sample from 2.5 to 3' with approx. 4" recovery. | |
| | | | | | Becomes medium stiff. | |
| | | | | | ▽ Becomes moist, contains FeO stains, trace very fine sand. | |
| | | | | | ▽ Becomes wet. | |
| 5.0 | | | | 5.0 | | -1.4 |

Bottom of borehole at 5.0 feet.

# BORING NUMBER HA-3



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/13/23 **COMPLETED** 10/13/23
**GROUND ELEVATION** 4 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.35 ft / Elev 2.65 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | ML | | 0.1 (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL). 3.9 |
| | | | | | (OH) ORGANIC SILT, dry, grayish brown, fine roots/organics, low dry strength, high plasticity. |
| | GB | MC = 66%<br>DD = 54 pcf<br>LL = 124<br>PL = 87 | OH | | |
| | | | | | Becomes moist. ▽ |
| | GB | PP = 1.5 tsf<br>% Organics = 11.8 | | | Organic rich, dark brown horizon.<br>Grades to gray. |
| | | | | | 2.0 2.0 |
| 2.5 | GB | | SP | | (SP) POORLY GRADED SAND, loose, wet, brownish gray, trace silt, quartz rich, fine sand. |
| | | | | | Grades to dark gray. |
| | | | | | Wet, loose sand. |
| | | | | | 4.5 -0.5 |

Bottom of borehole at 4.5 feet.

# BORING NUMBER HA-4



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/20/23 **COMPLETED** 10/20/23
**GROUND ELEVATION** 3.2 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.00 ft / Elev 1.20 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | GB | | ML | | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL). |
| | | | | 0.3 | 2.9 |
| | MC | PP = 1.3 tsf<br>MC = 61%<br>DD = 50 pcf | OH | | (OH) ORGANIC SILT, soft to medium stiff, dry to slightly moist, high plasticity, low toughness, low dry strength, fine roots/organics, slightly mottled with FeO stains near organics. |
| | GB | | | | Becomes moist to wet at 1'. |
| | | | | 1.5 ▽ | 1.7 |
| 2.5 | | | SP | | (SP) POORLY GRADED SAND, loose, wet, gray to bluish gray, trace silt, quartz rich, fine (beach/dune) sand. |
| | | | | | Grades to dark gray.<br>Hole caving due to loose, wet sand. |
| | | | | 3.0 | 0.2 |

Bottom of borehole at 3.0 feet.

# BORING NUMBER HA-5



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/20/23 **COMPLETED** 10/20/23
**GROUND ELEVATION** 4.1 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.20 ft / Elev 2.90 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | ML | | (ML) SILT, wet, dark brown, abundant organics, fine roots, low plasticity, (TOPSOIL). 0.1 — 4.0 |
| | GB<br>MC | PP = 1.3 tsf<br>MC = 49%<br>DD = 69 pcf<br>% Organics = 13.3 | | | (OH) ORGANIC SILT, soft, wet, dark gray to dark grayish brown, high plasticity. |
| | GB | | | | ▽ Becomes wet. |
| 2.5 | | LL = 56<br>PL = 33 | OH | | Becomes medium stiff.<br>Grades to dark gray with fine roots. |
| | | | | | 3.5 — 0.6 |

Bottom of borehole at 3.5 feet.

# BORING NUMBER HA-6



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/20/23 **COMPLETED** 10/20/23
**GROUND ELEVATION** 3.5 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.50 ft / Elev 2.00 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | ML | | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL). |
| 0.2 | | | | 3.3 |
| | | | | (OH) ORGANIC SILT, soft, dry to moist, high plasticity, brownish gray, FeO stains near organics (fine roots). |
| | | | | ▽ |
| | GB | | | Organic-rich layer, very dark brown. |
| | | OH | | ▽ |
| | | | | Grades to dark gray, decrease in organic content. |
| | GB | | | |
| 2.5 | | | | Grades to dark gray; some fine roots. |

Bottom of borehole at 3.0 feet.

# BORING NUMBER HA-7



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 10/20/23 **COMPLETED** 10/20/23
**GROUND ELEVATION** 2.3 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.35 ft / Elev 0.95 ft
**LOGGED BY** A. Troia **CHECKED BY** R. Johnson
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | GB | Fines = 95% | ML | | (ML) SILT, soft, moist, dark brown, abundant organics, dense mat of very fine roots, (TOPSOIL). |
| | | | | 0.3 | 2.0 |
| | MC | PP = 4.3 tsf<br>MC = 40%<br>DD = 61 pcf<br>LL = 58<br>PL = 36<br>% Organics = 14.7 | OH | | (OH) ORGANIC SILT, soft to medium stiff, dry, brownish gray, moderate cementation, high plasticity, organic rich (very fine roots). |
| | GB | | | | ▽ Becomes moist, soft, low toughness, grades to gray-dark gray. |
| | GB | | | | Becomes wet. |
| 2.5 | GB | | | | |
| | GB | | | | |
| | | | | 3.2 | -0.9 |

Bottom of borehole at 3.2 feet.

# BORING NUMBER HA-8



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 7/10/24 **COMPLETED** 7/10/24
**GROUND ELEVATION** 3 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 3.50 ft / Elev -0.50 ft
**LOGGED BY** A. Troia **CHECKED BY**
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | ML | | (ML) TOPSOIL, many fine roots. |
| 0.3 | | | | | 2.7 |
| | | | | | (OH) ORGANIC SILT, medium stiff, dry, gray, mottled, medium to high plasticity, many fine roots, organic rich. |
| | MCS | MC = 44%<br>DD = 71 pcf | | | Becomes moist |
| | | | OH | | |
| 2.5 | | | | | Becomes soft |
| | | | | | ▽ Becomes wet |
| 3.8 | | | | | -0.8 |
| | | | | | Bottom of borehole at 3.8 feet. |

# BORING NUMBER HA-9



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 7/10/24 **COMPLETED** 7/10/24
**GROUND ELEVATION** 2.3 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.00 ft / Elev 0.30 ft
**LOGGED BY** A. Troia **CHECKED BY**
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | ML | | (ML) TOPSOIL, many fine roots. 2.2 |
| | | | ML | | (ML) SANDY SILT, moist, gray, fine sand, cohesive, low plasticity, some organics. 1.8 |
| | | | | | (OH) ORGANIC SILT, medium stiff, dark gray, mottled, medium to high plasticity, fine to medium roots. |
| | MCS | MC = 52%<br>DD = 67 pcf | | | ▽ Becomes wet and soft with decreased mottling. |
| 2.5 | | | | | |
| | GB | LL = 61<br>PL = 33 | OH | | |
| | GB | | | | Moderate to strong sulfuric odor (decaying organics). |
| 5.0 | | | | | |
| | | | | | 6.5 -4.2 |

Bottom of borehole at 6.5 feet.

# BORING NUMBER HA-10



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 7/10/24 **COMPLETED** 7/10/24
**GROUND ELEVATION** 3 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.00 ft / Elev 1.00 ft
**LOGGED BY** A. Troia **CHECKED BY**
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION | |
|---|---|---|---|---|---|---|
| 0.0 | | | ML | | (ML) TOPSOIL, many fine roots. | 2.9 |
| | | | OH | | (OH) ORGANIC SILT, medium stiff, dry to moist, gray with brown mottling, fine roots, organic rich, moderate toughness. | |
| | | | | | ▽ Becomes wet and soft. | |
| 2.5 | | | | | | 0.5 |
| | | | ML | | (ML) SILT, soft, wet, brown, organic-rich, (BURIED TOPSOIL?) | 0.3 |
| | | | SM | | (SM) SILTY SAND, loose, wet, dark brownish gray, fine sand, cohesive, few fine roots. | |
| | | GB Fines = 37% | | | Sand occurs as thin lenses from 3.5 to 4' | |
| | | | OL | | (OL) ORGANIC SILT with SAND and SHELLS, soft, gray, wet, cohesive, medium plasticity. | -1.0 |
| 5.0 | | | | | | -2.0 |
| | | | OH | | (OH) ORGANIC SILT, soft, gray, wet, organic rich, decaying orgaics, trace sand. | -2.3 |

Bottom of borehole at 5.3 feet.

# BORING NUMBER HA-11



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 7/10/24 **COMPLETED** 7/10/24
**GROUND ELEVATION** 2.5 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 1.25 ft / Elev 1.25 ft
**LOGGED BY** A. Troia **CHECKED BY**
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | OH | | (OH) ORGANIC SILT, medium stiff, gray with brown mottling, organic rich, many fine roots. |
| | | | | | ▽ Becomes wet |
| | | | | 2.0 | 0.5 |
| 2.5 | MCS | MC = 107%<br>DD = 41 pcf<br>Fines = 58% | ML | | (ML) Grades to SANDY SILT, soft, wet, gray, cohesive, few organics, wood fragments at 2'. |
| | GB | | | | sand occurs as thin lenses |
| | | | | 3.0 | -0.5 |
| | | | OH | | (OH) ORGANIC SILT, soft, wet, brownish gray, high plasticity. |
| | | | | 3.8 | -1.3 |

Bottom of borehole at 3.8 feet.

# BORING NUMBER HA-12



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 7/10/24 **COMPLETED** 7/10/24
**GROUND ELEVATION** 2.7 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.40 ft / Elev 0.30 ft
**LOGGED BY** A. Troia **CHECKED BY**
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | | | TOPSOIL, many fine roots. 2.6 |
| | | | OH | | (OH) ORGANIC SILT, medium stiff, dry, gray and brown, lenses of hard silt with organics and fine roots. |
| | | | | | Grades slightly sandy (~5%). |
| 2.0 | | | | | 0.7 |
| 2.5 | GB | Fines = 44% | SM | | (SM) SILTY SAND, loose, moist, gray, fine sand, cohesive, trace organics. ▽ |
| | | | | | Grades to dark bluish gray. |
| | | | | | No auger bucket retention at 3.5'; silt content increasing at 4' |
| 4.0 | | | | | -1.3 |

Bottom of borehole at 4.0 feet.

# BORING NUMBER HA-13



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 7/10/24 **COMPLETED** 7/10/24
**GROUND ELEVATION** 3.6 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.50 ft / Elev 1.10 ft
**LOGGED BY** A. Troia **CHECKED BY**
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|
| 0.0 | | ML | | (ML) TOPSOIL, many fine roots |
| 1.0 | | | | 2.6 |
| | | ML | | (ML) SILT, soft, dark brownish gray, fine roots. |
| | | | | grades to gray, becomes moist |
| 2.0 | | | | 1.6 |
| | GB | SP | | (SP) POORLY GRADED SAND, loose, moist, gray with brown mottling, <10% fines. |
| 2.5 | | | | ▽ Becomes wet |
| | | | | Silt/clay layer from 3 to 3.25' |
| | | | | Becomes bluish gray |
| 4.5 | | | | -0.9 |

Bottom of borehole at 4.5 feet.

# BORING NUMBER HA-14



**CLIENT** Humboldt County Resource Conservation District
**PROJECT NAME** Wadulh Lagoon Tidal Wetland Enhancement
**PROJECT NUMBER** 023156
**PROJECT LOCATION** APN 506-291-014
**DATE STARTED** 7/10/24 **COMPLETED** 7/10/24
**GROUND ELEVATION** 3.2 ft NAVD88 **HOLE SIZE** 3"
**DRILLING CONTRACTOR**
**GROUNDWATER DEPTH**
**DRILLING METHOD** Hand Auger
▽ **AT TIME OF DRILLING** 2.70 ft / Elev 0.50 ft
**LOGGED BY** A. Troia **CHECKED BY**
**NOTES**

| DEPTH (ft) | SAMPLE TYPE NUMBER | TESTS | U.S.C.S. | GRAPHIC LOG | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| 0.0 | | | | | (OH) ORGANIC SILT, medium stiff, gray with brown mottling, medium to high plasicity. |
| | | | OH | | Thin lenses of SANDY SILT |
| | | | | 1.0 | 2.2 |
| | MCS | MC = 63%<br>DD = 59 pcf | | | (OH) Grades to ORGANIC SILT, soft, moist, gray, medium to high plasticity. |
| 2.5 | | | OH | | Brown, organic rich layer with odor of decayed organics, abundant woody material. |
| | | | | | ▽ Lamination of LEAN CLAY (4 mm thick), gray. |
| | | | | | Decreased wood content |
| | | | | 4.0 | -0.8 |

Bottom of borehole at 4.0 feet.

# Groundwater Elevations

2

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# Appendix 2

## Groundwater Elevations

| Boring ID | Date Measured | Ground Surface Elevation (feet NAVD88[i]) | Groundwater Elevation (feet NAVD88) | Depth to Water (feet BGS[ii]) |
|---|---|---|---|---|
| HA-1 | 10/13/2023 | 2.9 | 0.1 | 2.8 |
| HA-2 | 10/13/2023 | 3.6 | -0.4 | 4.0 |
| HA-3 | 10/13/2023 | 4.0 | 2.6 | 1.4 |
| HA-4 | 10/20/2023 | 3.2 | 1.2 | 2.0 |
| HA-5 | 10/20/2023 | 4.1 | 2.9 | 1.2 |
| HA-6 | 10/20/2023 | 3.5 | 2.0 | 1.5 |
| HA-7 | 10/20/2023 | 2.3 | 0.9 | 1.4 |
| HA-8 | 7/10/2024 | 3.0 | -0.5 | 3.5 |
| HA-9 | 7/10/2024 | 2.3 | 0.3 | 2.0 |
| HA-10 | 7/10/2024 | 3.0 | 1.0 | 2.0 |
| HA-11 | 7/10/2024 | 2.5 | 1.3 | 1.3 |
| HA-12 | 7/10/2024 | 2.7 | 0.3 | 2.4 |
| HA-13 | 7/10/2024 | 3.6 | 1.1 | 2.5 |
| HA-14 | 7/10/2024 | 3.2 | 0.5 | 2.7 |

[i] NAVD88: North American vertical datum, 1988
[ii] BGS: below ground surface

# Laboratory Test Results

3

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# Appendix 3

## Laboratory Test Results

| Sample Location | In-situ Dry Density (pcf)[i] | In-situ Moisture Content | Organic Content | Liquid Limit | Plastic Index | Optimum Moisture Content | Maximum Dry Density (pcf) | Percent Fines (Passing No. 200 sieve) |
|---|---|---|---|---|---|---|---|---|
| HA-1 0-1' | | | | | | 21.6% | 99.2 | |
| HA-1 2.5-3' | 64 | 49% | | | | | | |
| HA-1 3-3.5' | | | 10% | 83 | 39 | | | |
| HA-2 0.5-1' | 81 | 18% | | | | | | 62% |
| HA-2 2-2.5' | | | | | | | | 95% |
| HA-3 0.5-1' | 54 | 66% | | 124 | 37 | | | |
| HA-3 1-1.5' | | | 12% | | | | | |
| HA-4 0-1' | | | | | | | | |
| HA-4 0.5-1' | 50 | 61% | | | | 24.9% | 90.1 | |
| HA-5 0.8-1' | 69 | 49% | | | | | | |
| HA-5 0-1' | | | 13% | | | | | |
| HA-5 3-3.5' | | | | 56 | 23 | | | |
| HA-7 0.25-0.75' | | | | | | | | 95% |
| HA-7 0.5-1' | 61 | 40% | 15% | 58 | 22 | | | |
| HA-8 1-1.5′ | 71 | 44% | | | | | | |
| HA-9 1.5-2′ | 67 | 52% | | | | | | |

| Sample Location | In-situ Dry Density (pcf)[i] | In-situ Moisture Content | Organic Content | Liquid Limit | Plastic Index | Optimum Moisture Content | Maximum Dry Density (pcf) | Percent Fines (Passing No. 200 sieve) |
|---|---|---|---|---|---|---|---|---|
| HA-9 3.5-4′ | | | | 61 | 28 | | | |
| HA-10 3-3.5′ | | | | | | | | 37% |
| HA-11 2-2.5′ | 41 | 107% | | | | | | 58% |
| HA-12 2-2.5′ | | | | | | | | 44% |
| HA-14 1.25-1.75′ | 59 | 63% | | | | | | |

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# DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

| | | | |
|---|---|---|---|
| **Project Name:** | **Wadulh** | **Project Number:** | **023156** |
| **Performed By:** | **JMA** | **Date:** | **11/27/23** |
| **Checked By:** | **KEW** | **Date:** | **12/5/2023** |
| **Project Manager:** | **AT** | | |

| **Lab Sample Number** | 23-1069 | 23-1072 | 23-1075 | 23-1079 | 23-1083 |
|---|---|---|---|---|---|
| **Boring Label** | HA-1 | HA-2 | HA-3 | HA-4 | HA-5 |
| **Sample Depth (ft)** | 2-2.5' | 0.5-1.0' | 0.5-1.0' | 0.5-1.0' | 0.5-1.0' |
| **Diameter of Cylinder, in** | 2.42 | 2.42 | 2.42 | 2.42 | 2.42 |
| **Total Length of Cylinder, in.** | 6.00 | 6.00 | 6.00 | 6.00 | 6.00 |
| **Length of Empty Cylinder A, in.** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Length of Empty Cylinder B, in.** | 1.85 | 0.88 | 1.60 | 0.82 | 0.73 |
| **Length of Cylinder Filled, in** | 4.15 | 5.12 | 4.40 | 5.18 | 5.27 |
| **Volume of Sample, $in^3$** | 19.09 | 23.55 | 20.24 | 23.83 | 24.24 |
| **Volume of Sample, cc.** | 312.80 | 385.91 | 331.64 | 390.44 | 397.22 |

| **Pan #** | a6 | A9 | a7 | a2 | a1 |
|---|---|---|---|---|---|
| **Weight of Wet Soil and Pan** | 560.2 | 677.7 | 559.3 | 585.9 | 737.2 |
| **Weight of Dry Soil and Pan** | 405.9 | 589.6 | 371.0 | 397.6 | 521.1 |
| **Weight of Water** | 154.3 | 88.1 | 188.3 | 188.3 | 216.1 |
| **Weight of Pan** | 87.5 | 88.1 | 86.7 | 87.5 | 81.6 |
| **Weight of Dry Soil** | 318.4 | 501.5 | 284.3 | 310.1 | 439.5 |
| **Percent Moisture** | 48.5 | 17.6 | 66.2 | 60.7 | 49.2 |
| **Dry Density, g/cc** | 1.02 | 1.30 | 0.86 | 0.79 | 1.11 |
| **Dry Density, $lb/ft^3$** | 63.5 | 81.1 | 53.5 | 49.6 | 69.1 |

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# DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

| | | | |
|---|---|---|---|
| **Project Name:** | **Wadulh** | **Project Number:** | **023156** |
| **Performed By:** | **JMA** | **Date:** | **11/27/23** |
| **Checked By:** | **KEW** | **Date:** | **12/5/2023** |
| **Project Manager:** | **AT** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Lab Sample Number** | 23-1089 | | | | |
| **Boring Label** | HA-7 | | | | |
| **Sample Depth (ft)** | 0.5-1.0' | | | | |
| **Diameter of Cylinder, in** | 2.42 | | | | |
| **Total Length of Cylinder, in.** | 6.00 | | | | |
| **Length of Empty Cylinder A, in.** | 0.00 | | | | |
| **Length of Empty Cylinder B, in.** | 0.00 | | | | |
| **Length of Cylinder Filled, in** | 6.00 | | | | |
| **Volume of Sample, $in^3$** | 27.60 | | | | |
| **Volume of Sample, cc.** | 452.24 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **Pan #** | A5 | | | | |
| **Weight of Wet Soil and Pan** | 707.9 | | | | |
| **Weight of Dry Soil and Pan** | 529.5 | | | | |
| **Weight of Water** | 178.4 | | | | |
| **Weight of Pan** | 86.9 | | | | |
| **Weight of Dry Soil** | 442.6 | | | | |
| **Percent Moisture** | 40.3 | | | | |
| **Dry Density, g/cc** | 0.98 | | | | |
| **Dry Density, $lb/ft^3$** | 61.1 | | | | |

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# DENSITY BY DRIVE- CYLINDER METHOD (ASTM D2937)

| | | | |
|---|---|---|---|
| **Project Name:** | **Wadulh** | **Project Number:** | **023156** |
| **Performed By:** | **JMA** | **Date:** | **8/20/2024** |
| **Checked By:** | **DJG** | **Date:** | **9/12/2024** |
| **Project Manager:** | **AT** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Lab Sample Number** | 24-837 | 24-839 | 24-842 | 24-847 | |
| **Boring Label** | HA-8 | HA-9 | HA-11 | HA-14 | |
| **Sample Depth (ft)** | 1-1.5 | 1.5-2 | 2-2.5 | 1.25-1.75 | |
| **Diameter of Cylinder, in** | 2.42 | 2.42 | 2.42 | 2.42 | |
| **Total Length of Cylinder, in.** | 6.00 | 6.00 | 6.00 | 6.00 | |
| **Length of Empty Cylinder A, in.** | 0.00 | 0.00 | 1.08 | 0.85 | |
| **Length of Empty Cylinder B, in.** | 0.89 | 0.90 | 0.00 | 0.00 | |
| **Length of Cylinder Filled, in** | 5.11 | 5.10 | 4.92 | 5.15 | |
| **Volume of Sample, $in^3$** | 23.50 | 23.46 | 22.63 | 23.69 | |
| **Volume of Sample, cc.** | 385.16 | 384.41 | 370.84 | 388.17 | |

| | | | | | |
|---|---|---|---|---|---|
| **Pan #** | s27 | ss22 | s25 | ss26 | |
| **Weight of Wet Soil and Pan** | 778.1 | 776.5 | 648.9 | 764.5 | |
| **Weight of Dry Soil and Pan** | 587.2 | 561.4 | 388.3 | 532.4 | |
| **Weight of Water** | 190.9 | 215.1 | 260.6 | 232.1 | |
| **Weight of Pan** | 151.6 | 149.4 | 144.7 | 163.8 | |
| **Weight of Dry Soil** | 435.6 | 412.0 | 243.6 | 368.6 | |
| **Percent Moisture** | **43.8** | **52.2** | **107.0** | **63.0** | |
| **Dry Density, g/cc** | 1.13 | 1.07 | 0.66 | 0.95 | |
| **Dry Density, $lb/ft^3$** | **70.6** | **66.9** | **41.0** | **59.3** | |

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# PERCENT PASSING # 200 SIEVE (ASTM - D1140)

| | | | |
|---|---|---|---|
| **Project Name:** | **Wadulh** | **Project Number:** | **023156** |
| **Performed By:** | **JMA** | **Date:** | **11/29/2023** |
| **Checked By:** | **KEW** | **Date:** | **12/5/2023** |
| **Project Manager:** | **AT** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Lab Sample Number** | 23-1073 | 23-1074 | 23-1088 | | |
| **Boring Label** | HA-2 | HA-2 | HA-7 | | |
| **Sample Depth** | 0.5-1.0' | 2-2.5' | 0-0.5' | | |
| **Pan Number** | ss2 | ss3 | ss11 | | |
| **Dry Weight of Soil & Pan** | 388.5 | 371.5 | 426.4 | | |
| **Pan Weight** | 193.4 | 197.1 | 192.8 | | |
| **Weight of Dry Soil** | 195.1 | 174.4 | 233.6 | | |
| **Soil Weight Retained on #200&Pan** | 268.5 | 206.3 | 205.3 | | |
| **Soil Weight Passing #200** | 120.0 | 165.2 | 221.1 | | |
| **Percent Passing #200** | **62** | **95** | **95** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Lab Sample Number** | | | | | |
| **Boring Label** | | | | | |
| **Sample Depth** | | | | | |
| **Pan Number** | | | | | |
| **Dry Weight of Soil & Pan** | | | | | |
| **Pan Weight** | | | | | |
| **Weight of Dry Soil** | | | | | |
| **Soil Weight Retained on #200&Pan** | | | | | |
| **Soil Weight Passing #200** | | | | | |
| **Percent Passing #200** | | | | | |

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# PERCENT PASSING # 200 SIEVE (ASTM - D1140)

| | | | |
|---|---|---|---|
| **Project Name:** | **Wadulh** | **Project Number:** | **023156** |
| **Performed By:** | **JMA** | **Date:** | **8/23/2024** |
| **Checked By:** | **DJG** | **Date:** | **9/3/2024** |
| **Project Manager:** | **AT** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Lab Sample Number** | 24-841 | 24-842 | 24-844 | | |
| **Boring Label** | HA-10 | HA-11 | HA-12 | | |
| **Sample Depth (ft)** | 3-3.5 | 2-2.5 | 2-2.5 | | |
| **Pan Number** | ss1 | ss11 | ss8 | | |
| **Dry Weight of Soil & Pan** | 344.2 | 306.3 | 465.6 | | |
| **Pan Weight** | 194.8 | 192.7 | 192.9 | | |
| **Weight of Dry Soil** | 149.4 | 113.6 | 272.7 | | |
| **Soil Weight Retained on #200&Pan** | 288.9 | 240.3 | 345.6 | | |
| **Soil Weight Passing #200** | 55.3 | 66.0 | 120.0 | | |
| **Percent Passing #200** | **37** | **58** | **44** | | |

| | | | | | |
|---|---|---|---|---|---|
| **Lab Sample Number** | | | | | |
| **Boring Label** | | | | | |
| **Sample Depth** | | | | | |
| **Pan Number** | | | | | |
| **Dry Weight of Soil & Pan** | | | | | |
| **Pan Weight** | | | | | |
| **Weight of Dry Soil** | | | | | |
| **Soil Weight Retained on #200&Pan** | | | | | |
| **Soil Weight Passing #200** | | | | | |
| **Percent Passing #200** | | | | | |

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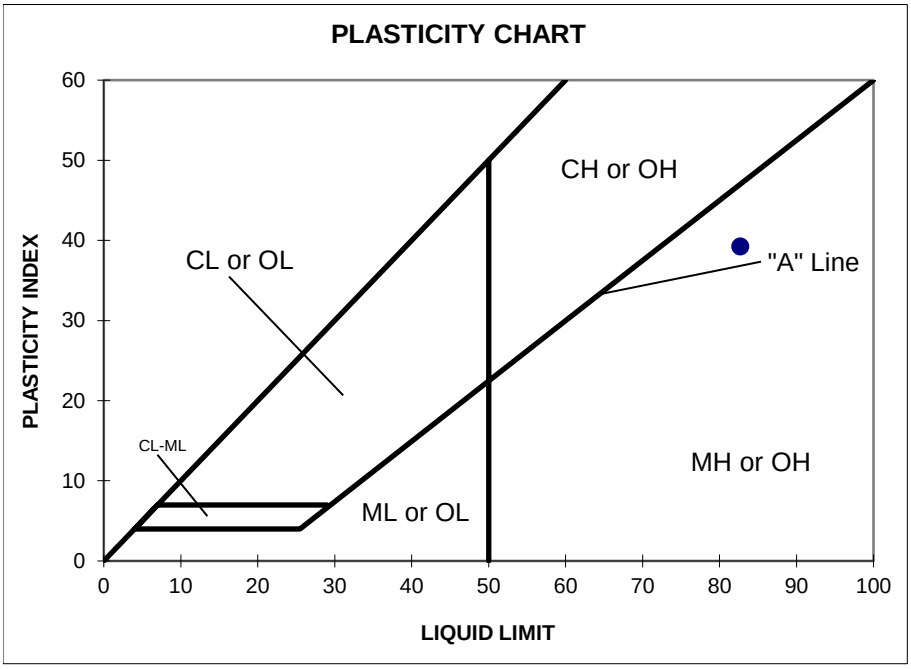
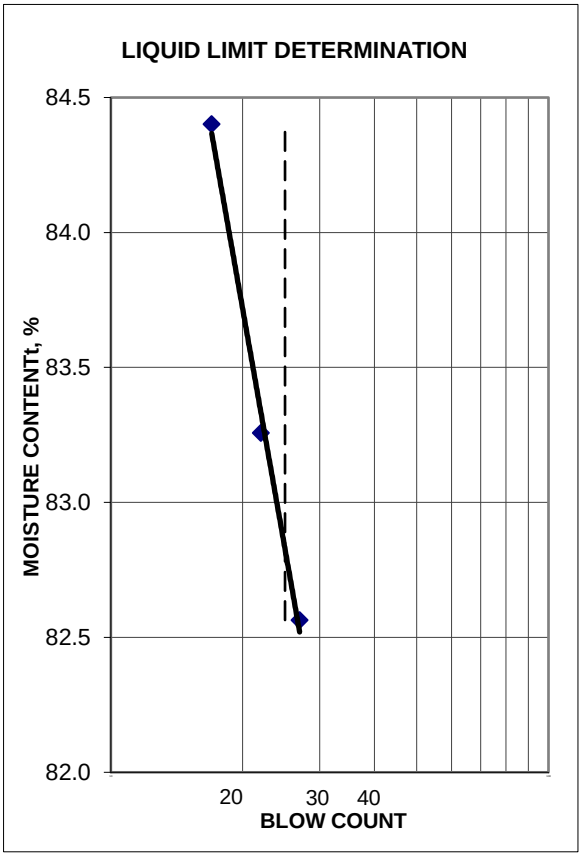
# LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

| | | | | | |
|---|---|---|---|---|---|
| JOB NAME: | **Wadulh** | JOB #: | **023156** | LAB SAMPLE #: | **23-1070** |
| SAMPLE ID: | **HA-1 @ 3-3.5'** | PERFORMED BY: | **JMA** | DATE: | **11/30/2023** |
| PROJECT MANAGER: | **AT** | CHECKED BY: | **KEW** | DATE: | **12/5/2023** |

| LINE NO. | | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 3 |
|---|---|---|---|---|---|---|
| A | PAN # | 19 | 20 | 10 | 11 | 12 |
| B | PAN WT. (g) | 16.870 | 17.140 | 29.590 | 28.670 | 29.340 |
| C | WT. WET SOIL & PAN (g) | 23.010 | 23.410 | 36.710 | 36.770 | 37.970 |
| D | WT. DRY SOIL & PAN (g) | 21.160 | 21.500 | 33.490 | 33.090 | 34.020 |
| E | WT. WATER (C-D) | 1.850 | 1.910 | 3.220 | 3.680 | 3.950 |
| F | WT. DRY SOIL (D-B) | 4.290 | 4.360 | 3.900 | 4.420 | 4.680 |
| G | BLOW COUNT | -- | -- | 27 | 22 | 17 |
| H | MOISTURE CONTENT (E/F*100) | 43.1 | 43.8 | 82.6 | 83.3 | 84.4 |

| LIQUID LIMIT | **PLASTIC INDEX** | PLASTIC LIMIT |
|---|---|---|
| 83 | **39** | 43 |



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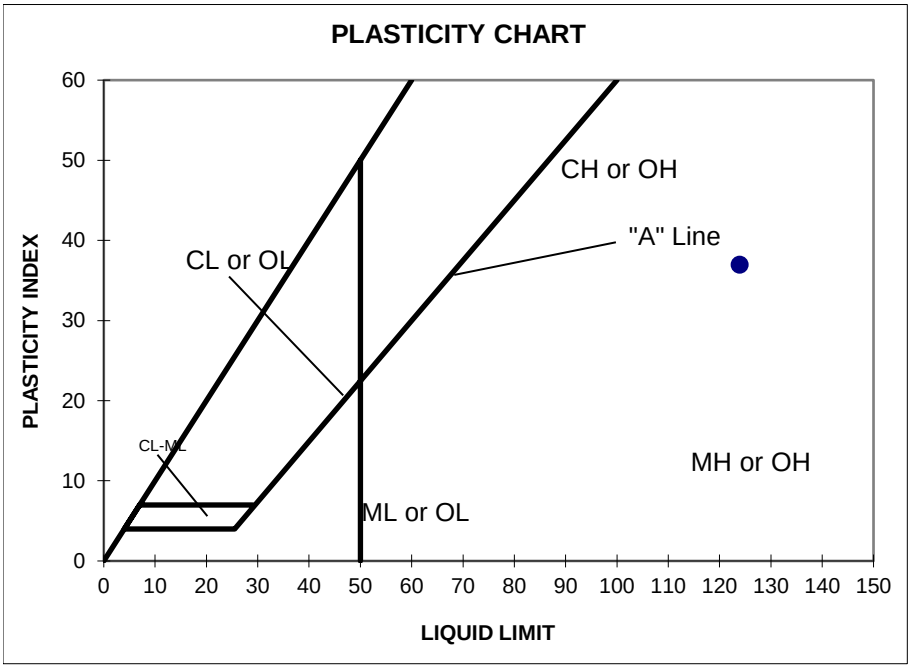
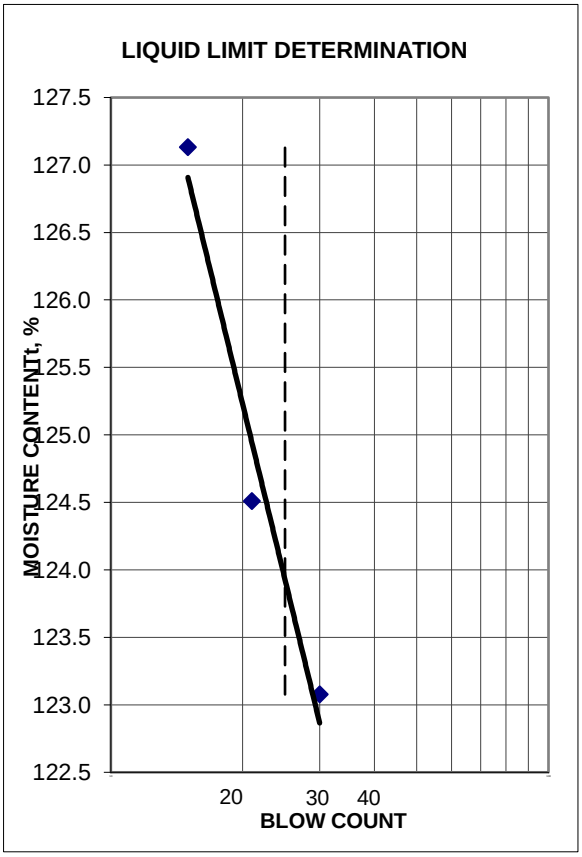
# LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

| | | | | | |
|---|---|---|---|---|---|
| JOB NAME: | **Wadulh** | JOB #: | **023156** | LAB SAMPLE #: | **23-1075** |
| SAMPLE ID: | **HA-3 @ 0.5-1.0'** | PERFORMED BY: | **JMA** | DATE: | **12/1/2023** |
| PROJECT MANAGER: | **AT** | CHECKED BY: | **KEW** | DATE: | **21/5/23** |

| LINE NO. | | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 3 |
|---|---|---|---|---|---|---|
| A | PAN # | 17 | 18 | 7 | 8 | 9 |
| B | PAN WT. (g) | 20.210 | 20.140 | 28.880 | 29.020 | 28.580 |
| C | WT. WET SOIL & PAN (g) | 26.350 | 27.450 | 34.970 | 35.890 | 34.440 |
| D | WT. DRY SOIL & PAN (g) | 23.470 | 24.080 | 31.610 | 32.080 | 31.160 |
| E | WT. WATER (C-D) | 2.880 | 3.370 | 3.360 | 3.810 | 3.280 |
| F | WT. DRY SOIL (D-B) | 3.260 | 3.940 | 2.730 | 3.060 | 2.580 |
| G | BLOW COUNT | -- | -- | 30 | 21 | 15 |
| H | MOISTURE CONTENT (E/F*100) | 88.3 | 85.5 | 123.1 | 124.5 | 127.1 |

| LIQUID LIMIT | **PLASTIC INDEX** | PLASTIC LIMIT |
|---|---|---|
| 124 | **37** | 87 |



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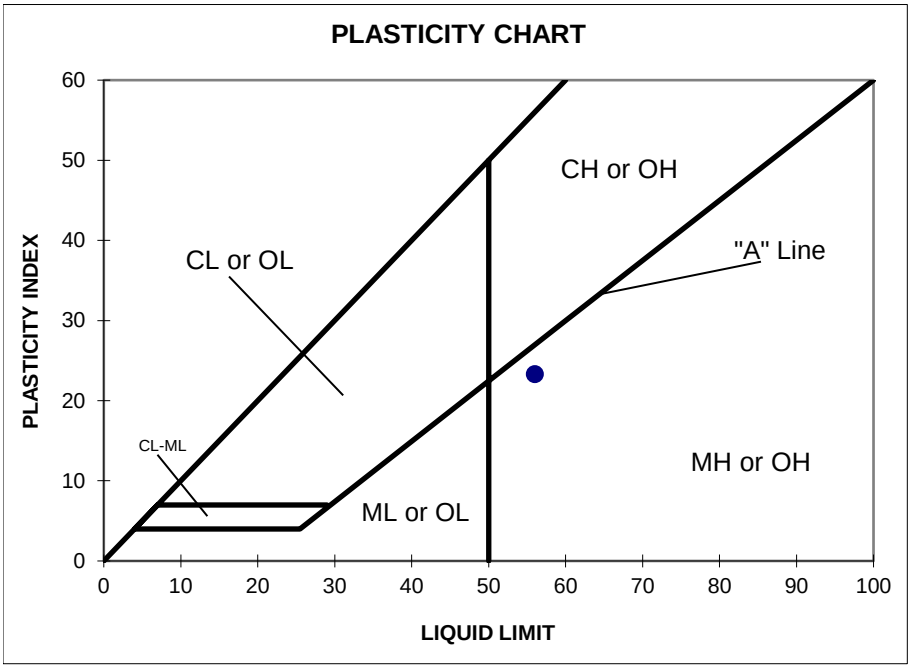
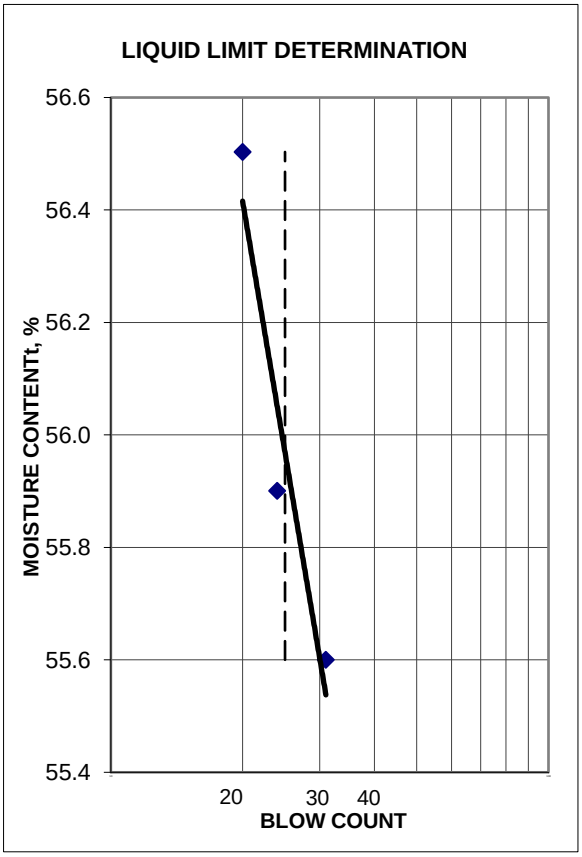
# LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

| | | | | | |
|---|---|---|---|---|---|
| JOB NAME: | **Wadulh** | JOB #: | **023156** | LAB SAMPLE #: | **23-1085** |
| SAMPLE ID: | **HA-5 @ 3-3.5'** | PERFORMED BY: | **JMA** | DATE: | **11/30/2023** |
| PROJECT MANAGER: | **AT** | CHECKED BY: | **KEW** | DATE: | **12/5/2023** |

| LINE NO. | | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 3 |
|---|---|---|---|---|---|---|
| A | PAN # | 13 | 14 | 1 | 2 | 3 |
| B | PAN WT. (g) | 22.000 | 20.120 | 29.590 | 28.920 | 28.990 |
| C | WT. WET SOIL & PAN (g) | 28.030 | 26.710 | 37.370 | 36.450 | 36.330 |
| D | WT. DRY SOIL & PAN (g) | 26.550 | 25.080 | 34.590 | 33.750 | 33.680 |
| E | WT. WATER (C-D) | 1.480 | 1.630 | 2.780 | 2.700 | 2.650 |
| F | WT. DRY SOIL (D-B) | 4.550 | 4.960 | 5.000 | 4.830 | 4.690 |
| G | BLOW COUNT | -- | -- | 31 | 24 | 20 |
| H | MOISTURE CONTENT (E/F*100) | 32.5 | 32.9 | 55.6 | 55.9 | 56.5 |

| LIQUID LIMIT | **PLASTIC INDEX** | PLASTIC LIMIT |
|---|---|---|
| 56 | **23** | 33 |



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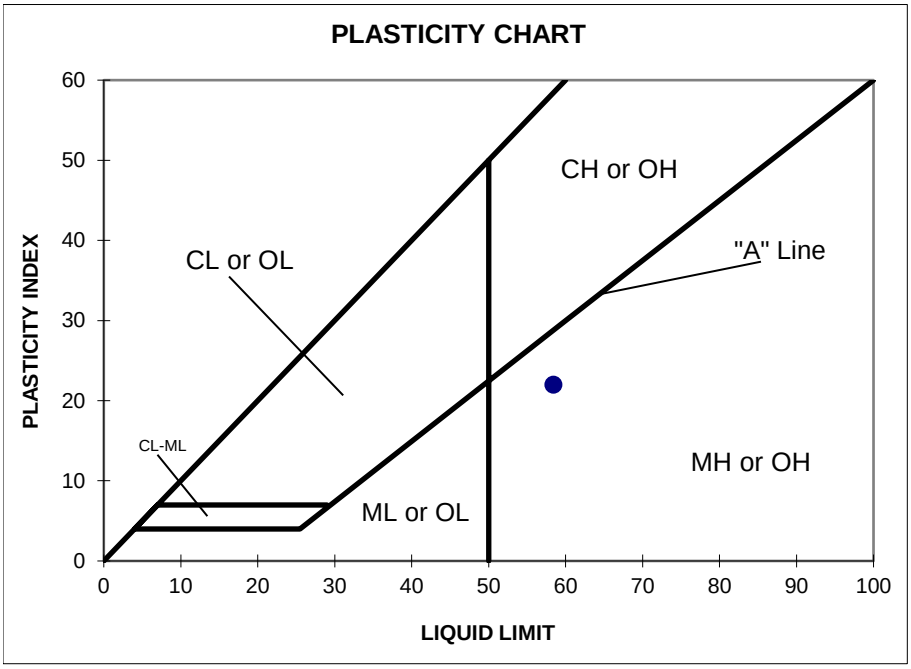
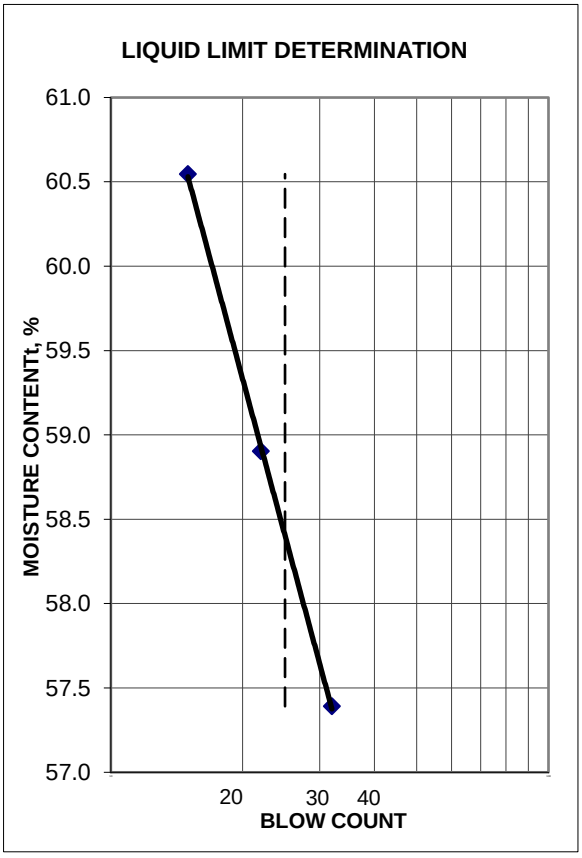
# LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM-D4318)

| | | | | | |
|---|---|---|---|---|---|
| JOB NAME: | **Wadulh** | JOB #: | **023156** | LAB SAMPLE #: | **23-1090** |
| SAMPLE ID: | **HA-7 @ 1-1.5'** | PERFORMED BY: | **JMA** | DATE: | **12/1/2023** |
| PROJECT MANAGER: | **AT** | CHECKED BY: | **KEW** | DATE: | **12/5/2023** |

| LINE NO. | | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 3 |
|---|---|---|---|---|---|---|
| A | PAN # | 19 | 20 | 10 | 11 | 12 |
| B | PAN WT. (g) | 16.880 | 17.140 | 29.580 | 28.670 | 29.360 |
| C | WT. WET SOIL & PAN (g) | 22.880 | 23.320 | 36.820 | 35.630 | 35.830 |
| D | WT. DRY SOIL & PAN (g) | 21.290 | 21.660 | 34.180 | 33.050 | 33.390 |
| E | WT. WATER (C-D) | 1.590 | 1.660 | 2.640 | 2.580 | 2.440 |
| F | WT. DRY SOIL (D-B) | 4.410 | 4.520 | 4.600 | 4.380 | 4.030 |
| G | BLOW COUNT | -- | -- | 32 | 22 | 15 |
| H | MOISTURE CONTENT (E/F*100) | 36.1 | 36.7 | 57.4 | 58.9 | 60.5 |

| LIQUID LIMIT | **PLASTIC INDEX** | PLASTIC LIMIT |
|---|---|---|
| 58 | **22** | 36 |



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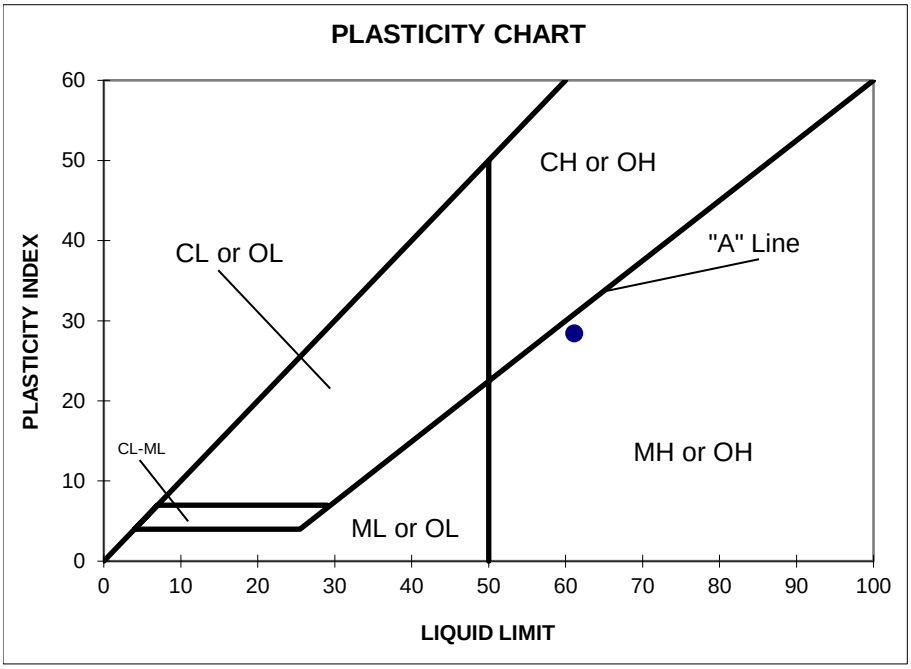
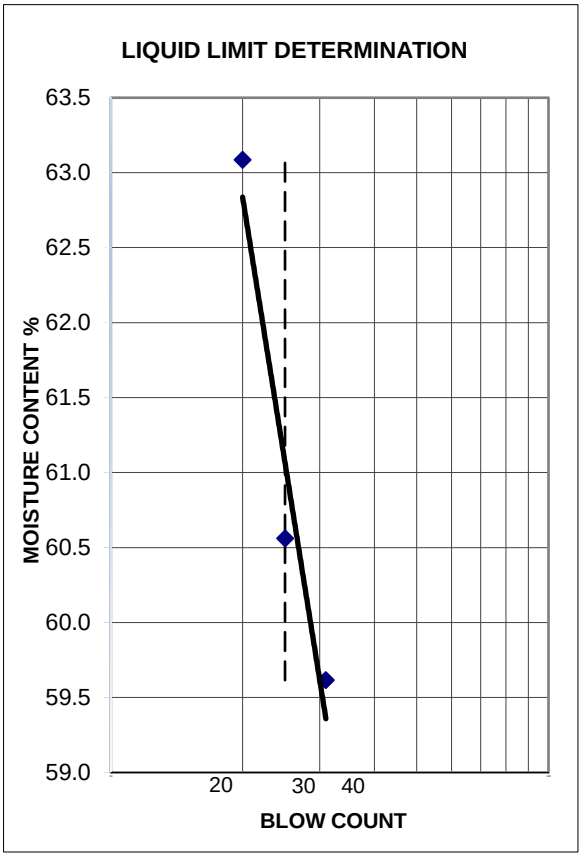
# LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX (ASTM D4318)

| | | | | | |
|---|---|---|---|---|---|
| PROJECT NAME: | **Wadulh** | PROJECT NUMBER: | **023156** | LAB SAMPLE ID: | **24-840** |
| SAMPLE ID: | **HA-9 3.5-4.0'** | PERFORMED BY: | **JMA** | DATE: | **8/28/2024** |
| PROJECT MANAGER: | **AT** | CHECKED BY: | **DJG** | DATE: | **9/3/2024** |

| LINE NO. | | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 1 | TRIAL NO. 2 | TRIAL NO. 3 |
|---|---|---|---|---|---|---|
| A | PAN # | 17 | 18 | 7 | 8 | 9 |
| B | PAN WT. (g) | 20.20 | 20.18 | 28.83 | 28.96 | 28.55 |
| C | WT. WET SOIL & PAN (g) | 27.28 | 26.45 | 36.30 | 36.41 | 34.47 |
| D | WT. DRY SOIL & PAN (g) | 25.52 | 24.92 | 33.51 | 33.60 | 32.18 |
| E | WT. WATER (C-D) | 1.76 | 1.53 | 2.790 | 2.81 | 2.29 |
| F | WT. DRY SOIL (D-B) | 5.32 | 4.74 | 4.68 | 4.64 | 3.63 |
| G | BLOW COUNT | -- | -- | 31 | 25 | 20 |
| H | MOISTURE CONTENT (E/F*100) | 33.1 | 32.3 | 59.6 | 60.6 | 63.1 |

| LIQUID LIMIT | **PLASTIC INDEX** | PLASTIC LIMIT |
|---|---|---|
| 61 | **28** | 33 |



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# COMPACTION TEST DATA SHEET

| | | | | | |
|---|---|---|---|---|---|
| Job Name: | **Wadulh Geotech** | | Lab Sample Number: | **23-1050** | |
| Job Number: | **023156** | | Tested By: **ZA** | Date Tested: | **11/8/23** |
| Sample ID: | **HA-1 @ 0-1'** | | Checked By: **KEW** | Date Checked: | **12/5/23** |
| Sample Description: | **Subgrade Soil** | | | | |
| Initial Gradation: | + 3/4"= **0.0** % | + 3/8"= **0.0** % | + No.4= **0.0** % | | |
| Moisture Correction | Gauge Number: | | Corection Factor: | | |

## TEST DATA

| | | | | | |
|---|---|---|---|---|---|
| Mold + Wet Soil, lb | 13.264 | 12.897 | 13.038 | 13.135 | 13.251 |
| Mold, lbs | 9.229 | 9.229 | 9.229 | 9.229 | 9.229 |
| Moist Soil, lbs | 4.035 | 3.668 | 3.809 | 3.906 | 4.022 |
| Factor (1/Vol.), cu. ft | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 |
| WET DENSITY, pcf | 121.0 | 110.0 | 114.3 | 117.2 | 120.7 |
| Drying Dish No. | t9 | t7 | t11 | t2 | t8 |
| Wet Soil and Dish | 805.9 | 503.6 | 567.1 | 640.0 | 603.5 |
| Dry Soil and Dish | 668.1 | 456.3 | 505.3 | 559.3 | 516.8 |
| Moisture, g. | 137.8 | 47.3 | 61.8 | 80.7 | 86.7 |
| DIsh, grams | 114.1 | 113.0 | 113.3 | 112.5 | 115.4 |
| Dry Soil, g. | 554.0 | 343.3 | 392.0 | 446.8 | 401.4 |
| MST. CONTENT, % | **24.9** | **13.8** | **15.8** | **18.1** | **21.6** |
| DRY DENSITY, pcf | **96.9** | **96.7** | **98.7** | **99.2** | **99.2** |
| % Moist. Added | | | | | |

## TEST METHOD

[ ] STANDARD ASTM D 698

5.5 lb hammer, 12" drop, 3 layers

[x ] MODIFIED ASTM D 1557

10 lb hammer, 18" drop, 5 layers

[x ] Manual hammer [ ] Mechanical hammer

| ASTM | Soil | Mold, in. | Blows | Mold Wt. |
|---|---|---|---|---|
| A | SW | 4 | 25 | 9.229 |

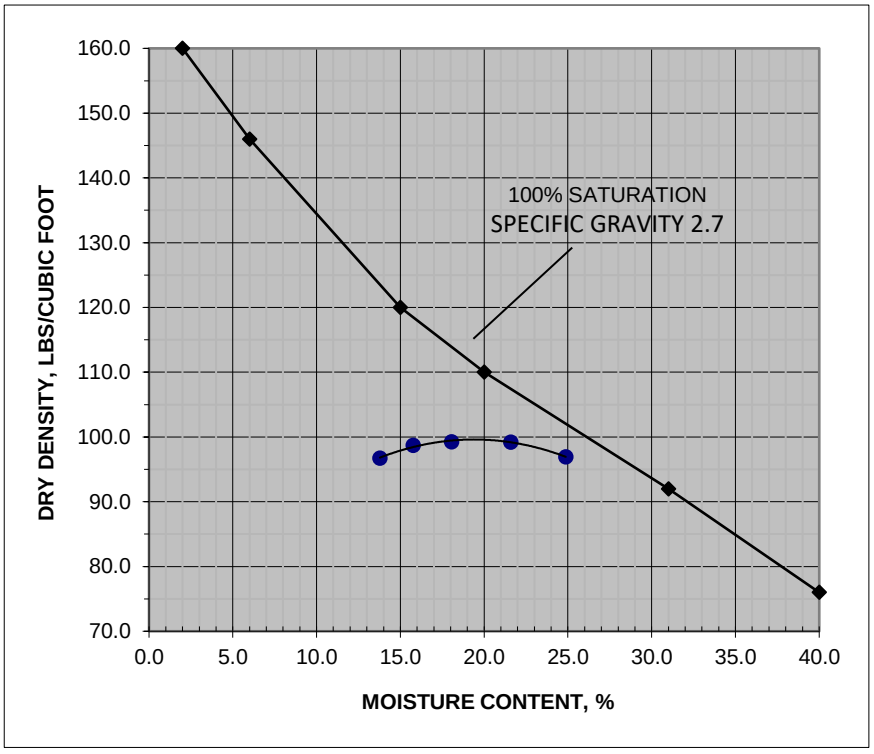
| | | |
|---|---|---|
| A | Retained on No.4 ≤ 25% | 4" Mold use passing No.4 |
| B | No.4 ≥ 25% & 3/8" <25% | 4" Mold use passing 3/8" |
| C | 3/8" ≥25% & 3/4" ≤30% | 6" Mold use passing 3/4" |

| | | |
|---|---|---|
| MAXIMUM DRY DENSITY (pcf) | **99.2** | **NA** Rock Corr. |
| OPTIMUM MOISTURE CONTENT (%) | **21.6** | |

## INITIAL GRADATION

| | |
|---|---|
| Total Weight (gm) | 15846 |

| Screen size | Wt. Screen | Wt. Cumulat |
|---|---|---|
| + 3/4" screen | 0 | 0 |
| + 3/8" screen | 0 | 0 |
| + No.4 screen | 0 | 0 |



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# COMPACTION TEST DATA SHEET

| | | | | | |
|---|---|---|---|---|---|
| Job Name: | **Wadulh Geotech** | Lab Sample Number: | **23-1051** | | |
| Job Number: | **023156** | Tested By: | **ZA** | Date Tested: | **11/8/23** |
| Sample ID: | **HA-4 @ 0-1'** | Checked By: | **KEW** | Date Checked: | **12/5/23** |
| Sample Description: | **Subgrade Soil** | | | | |
| Initial Gradation: | + 3/4"= **0.0** % | + 3/8"= **0.0** % | + No.4= **0.0** % | | |
| Moisture Correction | Gauge Number: | Corection Factor: | | | |

## TEST DATA

| | | | | | |
|---|---|---|---|---|---|
| Mold + Wet Soil, lb | 12.828 | 12.944 | 12.983 | 13.067 | 13.009 |
| Mold, lbs | 9.23 | 9.23 | 9.23 | 9.23 | 9.23 |
| Moist Soil, lbs | 3.598 | 3.714 | 3.753 | 3.837 | 3.779 |
| Factor (1/Vol.), cu. ft | 30.00 | 30.00 | 30.00 | 30.00 | 30.00 |
| WET DENSITY, pcf | 107.9 | 111.4 | 112.6 | 115.1 | 113.4 |
| Drying Dish No. | ss5 | ss10 | t9 | t8 | t3 |
| Wet Soil and Dish | 785.2 | 719.1 | 698.1 | 650.1 | 595.5 |
| Dry Soil and Dish | 684.2 | 620.5 | 581.8 | 530.6 | 478.1 |
| Moisture, g. | 101.0 | 98.6 | 116.3 | 119.5 | 117.4 |
| DIsh, grams | 195.5 | 195.4 | 115.1 | 115.4 | 114.7 |
| Dry Soil, g. | 488.7 | 425.1 | 466.7 | 415.2 | 363.4 |
| MST. CONTENT, % | **20.7** | **23.2** | **24.9** | **28.8** | **32.3** |
| DRY DENSITY, pcf | **89.4** | **90.4** | **90.1** | **89.4** | **85.7** |
| % Moist. Added | | | | | |

## TEST METHOD

[ ] STANDARD ASTM D 698

5.5 lb hammer, 12" drop, 3 layers

[x ] MODIFIED ASTM D 1557

10 lb hammer, 18" drop, 5 layers

[x ] Manual hammer [ ] Mechanical hammer

| ASTM | Soil | Mold, in. | Blows | Mold Wt. |
|---|---|---|---|---|
| A | ML | 4 | 25 | 9.23 |

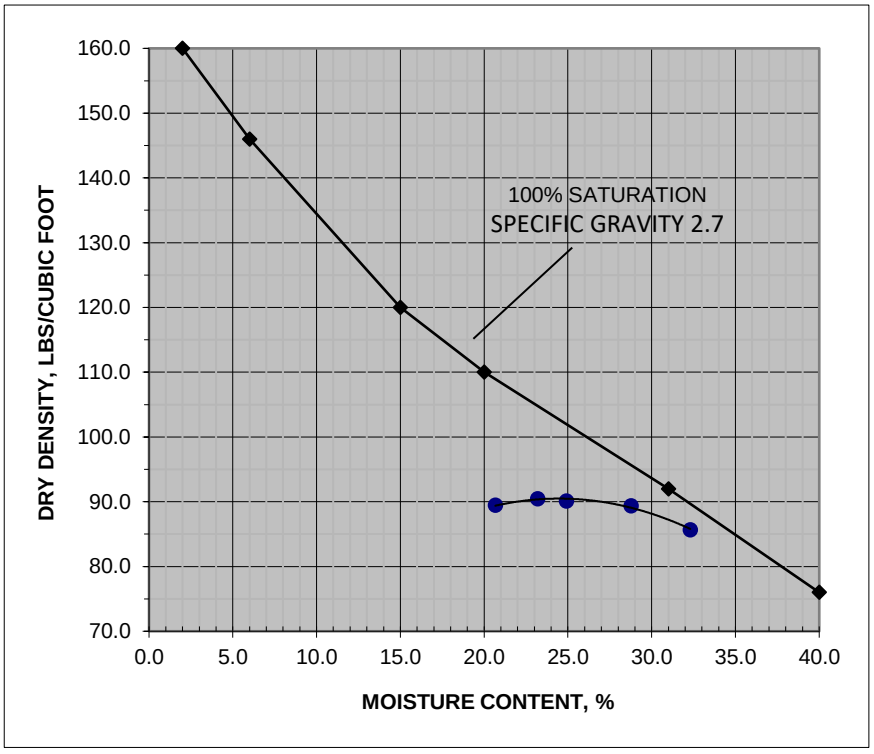
| | | |
|---|---|---|
| A | Retained on No.4 ≤ 25% | 4" Mold use passing No.4 |
| B | No.4 ≥ 25% & 3/8" <25% | 4" Mold use passing 3/8" |
| C | 3/8" ≥25% & 3/4" ≤30% | 6" Mold use passing 3/4" |

| | | |
|---|---|---|
| MAXIMUM DRY DENSITY (pcf) | **90.1** | **NA** Rock Corr. |
| OPTIMUM MOISTURE CONTENT (%) | **24.9** | |

## INITIAL GRADATION

| | |
|---|---|
| Total Weight (gm) | 15400 |

| Screen size | Wt. Screen | Wt. Cumulat |
|---|---|---|
| + 3/4" screen | 0 | 0 |
| + 3/8" screen | 0 | 0 |
| + No.4 screen | 0 | 0 |



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# PERCENT ORGANICS (ASTM D2974)

| | | | |
|---|---|---|---|
| **Project Name:** | **Waduhl Geotech** | **Project Number:** | **023156** |
| **Project Manager:** | **AT** | **Performed By:** | **JMA** |
| | | **Checked By:** | **KEW** |

**Date:** 12/1/2023
**Date:** 12/5/2023

| Lab Sample # | Project Sample # | Pan # | Weight of Dry Soil and Pan | Pan Weight | Weight of Dry Soil | Weight of Burned Soil and Pan | Weight of Burned Soil | Weight of Organics | % Organics |
|---|---|---|---|---|---|---|---|---|---|
| 23-1070 | HA-1 @ 3-3.5' | TEX | 37.28 | 18.98 | 18.3 | 35.53 | 16.55 | 1.75 | **9.56** |
| 23-1076 | HA-3 @ 1-2' | USA | 38.98 | 16.01 | 22.97 | 36.27 | 20.26 | 2.71 | **11.80** |
| 23-1081 | HA-5 @ 0-1' | TES | 40.79 | 18.98 | 21.81 | 37.9 | 18.92 | 2.89 | **13.25** |
| 23-1089 | HA-7 @ .5-1.0' | USA | 38.52 | 16.02 | 22.50 | 35.21 | 19.19 | 3.31 | **14.71** |
| | | | | | | | | | |
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