

VICINITY MAP

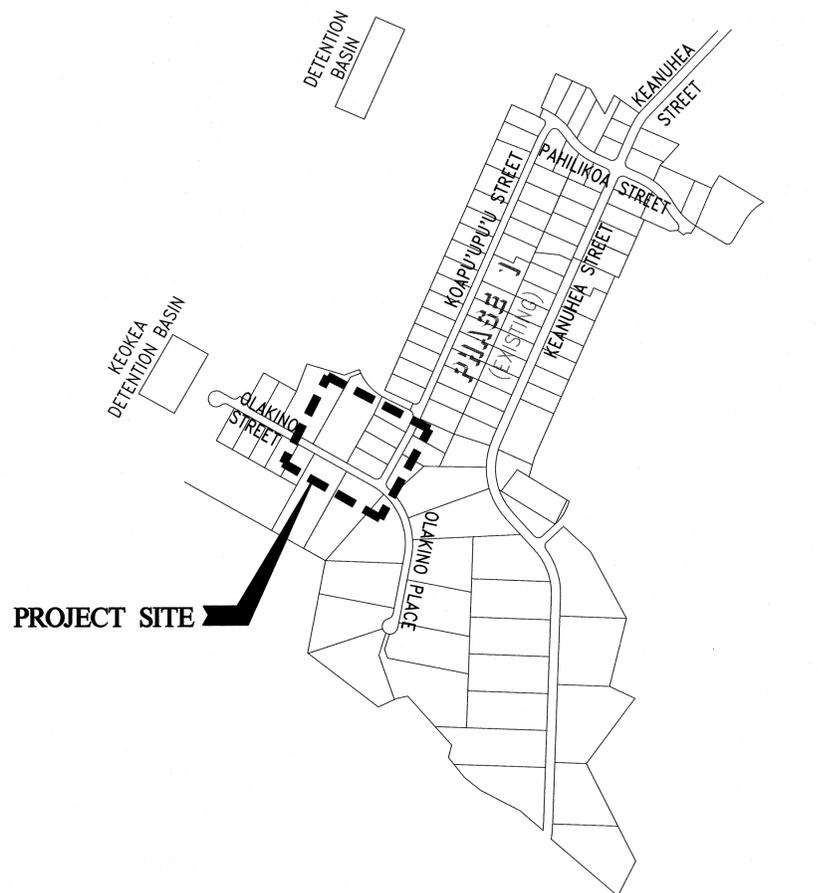
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CONSTRUCTION PLANS FOR OLAKINO STREET DRAINAGE IMPROVEMENTS

KEOKEA & WAIOHULI, MAKAWAO, MAUI

OWNER AND DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011



LOCATION MAP

NOT TO SCALE



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APPROVED

CHAIRMAN, HAWAIIAN HOMES COMMISSION
DEPARTMENT OF HAWAIIAN HOME LANDS
STATE OF HAWAII

DATE

DIRECTOR, DEPARTMENT OF PUBLIC WORKS
COUNTY OF MAUI

DATE

GENERAL NOTES

- LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE BASED ON AVAILABLE "AS-BUILT" OR RECORD CONSTRUCTION PLANS AND ARE APPROXIMATE ONLY AND THEIR ACCURACY IS NOT GUARANTEED.
- ELEVATIONS SHOWN ARE BASED ON PROJECT BENCHMARK - 1/2" INCH PIPE FOUND ON SOUTH SIDE OF KULA HIGHWAY AND SOUTHERLY SIDE OF PROJECT SITE. ELEVATION = 2,752.73 FEET.
- EXISTING GRADES SHALL BE VERIFIED BY THE CONTRACTOR BEFORE PROCEEDING WITH GRADING WORK. SHOULD ANY DISCREPANCIES BE DISCOVERED IN THE EXISTING GRADES OR DIMENSIONS GIVEN ON THE PLANS, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER BEFORE PROCEEDING ANY FURTHER WITH THE WORK, OTHERWISE HE WILL BE HELD RESPONSIBLE FOR ANY COST INVOLVED IN THE CORRECTION OF CONSTRUCTION PLACED DUE TO SUCH DISCREPANCIES.
- THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF EXISTING UTILITIES WITHIN PROJECT LIMITS BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR DAMAGES DUE TO THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ALL UNDERGROUND UTILITIES.
- THE CONTRACTOR SHALL REPORT ANY INCONSISTENCIES WITH THE PROPOSED PLAN TO THE OWNER'S REPRESENTATIVE AND SHALL DEMOLISH, REMOVE, OR RELOCATE ALL EXISTING UTILITIES, IMPROVEMENTS, ETC. INCONSISTENT WITH THE PROPOSED PLAN AS DIRECTED BY THE OWNER'S REPRESENTATIVE AND AT THE CONTRACTOR'S EXPENSE.
- THE LATEST REVISIONS OF THE "STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION," SEPTEMBER 1984 AND THE "HAWAII STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND PUBLIC WORKS CONSTRUCTION," (2005) SHALL BE INCLUDED AS PART OF THESE CONSTRUCTION PLANS. THE CONTRACTOR SHALL OBTAIN THE LATEST REVISIONS BEFORE COMMENCING CONSTRUCTION. THE FOLLOWING DETAILS SHOWN IN "STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION," DATED SEPTEMBER 1984, AS AMENDED, SHALL BE APPLICABLE TO THIS PROJECT:
R-9 CONCRETE PAVEMENT
R-10 CONCRETE PAVEMENT JOINT DETAILS
R-11 CONCRETE PAVEMENT JOINT DETAILS
R-55 ROADWAY SWALE
D-31 PAYMENT TRENCH WIDTH AND REPAVING FOR DRAIN PIPES
- IF HISTORIC SITES SUCH AS WALLS, PLATFORMS, PAVEMENTS AND MOUNDS OR REMAINS SUCH AS ARTIFACTS, BURIALS, CONCENTRATION OF CHARCOAL OR SHELLS ARE ENCOUNTERED DURING CONSTRUCTION WORK, WORK SHALL CEASE IN THE IMMEDIATE VICINITY OF THE FIND AND THE FIND SHALL BE PROTECTED FROM FURTHER DAMAGE. THE CONTRACTOR SHALL IMMEDIATELY CONTACT THE STATE HISTORIC PRESERVATION DIVISION (243-5169), WHICH WILL ASSESS THE SIGNIFICANCE OF THE FIND AND RECOMMEND MITIGATION MEASURES, IF NECESSARY.
- PURSUANT TO CHAPTER 6E OF THE HAWAII REVISED STATUTES, ALL CONTRACTORS SHALL ENSURE THAT IN THE EVENT THAT ANY HUMAN SKELETAL REMAINS ARE INADVERTENTLY DISCOVERED DURING CONSTRUCTION, THE REMAINS SHALL NOT BE MOVED AND ANY ACTIVITY IN THE IMMEDIATE AREA THAT COULD DAMAGE THE REMAINS OR THE POTENTIAL HISTORIC SITE SHALL CEASE AND THE DEPARTMENT OF LAND AND NATURAL RESOURCES' HISTORIC PRESERVATION DIVISION (TELEPHONE: 243-1285), THE APPROPRIATE MEDICAL EXAMINER OR CORONER, AND THE POLICE DEPARTMENT (TELEPHONE: 244-6400), SHALL BE CONTACTED.
- ALL LESSEES USING EXISTING DIRT ROADS TO ACCESS THEIR PROPERTY SHALL CONTINUE TO BE PROVIDED ACCESS TO THEIR PROPERTY AT ALL TIMES DURING CONSTRUCTION ACTIVITIES BY THE CONTRACTOR.
- PRIOR TO ANY LAND ALTERATION, ALL TASKS OF THE HISTORIC SITES INTERIM PROTECTION PLAN MUST BE IN PLACE FOR THE ISOLATED NON-BURIAL SITES TO BE PRESERVED AND THE HISTORIC PRESERVE. ISOLATED SIGNIFICANT HISTORIC SITES AND THE HISTORIC PRESERVE MUST HAVE PROTECTION MEASURES IN PLACE PRIOR TO ANY LAND ALTERATION. SUCH PROTECTION SHALL INCLUDE PERMANENT FENCING AND TEMPORARY PLASTIC CONSTRUCTION FENCING. THE CONSTRUCTION CREWS MUST BE BRIEFED ON THE IMPORTANCE OF THESE PROTECTIVE MEASURES.
- CONTRACTOR TO ENSURE THAT EXISTING DRAINAGE PATTERNS REMAIN UNCHANGED UNTIL ALL PROPOSED DRAINAGE STRUCTURES ARE CONSTRUCTED AND OPERATIONAL.

NOTES FOR CONSTRUCTION WITHIN COUNTY RIGHT-OF-WAY

- THE CONTRACTOR SHALL OBTAIN A PERMIT TO PERFORM WORK ON COUNTY HIGHWAYS FROM THE DEVELOPMENT SERVICES ADMINISTRATION TWO WEEKS PRIOR TO THE COMMENCEMENT OF WORK.
- STANDARD DETAIL DRAWINGS AND STANDARD SPECIFICATIONS OF THE DEPARTMENT OF PUBLIC WORKS SHALL BE INCLUDED AS PART OF THE CONSTRUCTION PLANS.
- ALL CONSTRUCTION WORK SHALL STRICTLY CONFORM TO THE APPLICABLE SECTIONS OF THE HAWAII STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND PUBLIC WORKS CONSTRUCTION, AND THE SEPTEMBER 1984 "STANDARD DETAILS" FOR PUBLIC WORKS CONSTRUCTION OF THE DEPARTMENT OF PUBLIC WORKS, AS AMENDED.
- IF EXISTING UTILITIES, WHETHER OF NOT SHOWN ON PLANS, ARE DAMAGED DURING CONSTRUCTION, THE CONTRACTOR SHALL AT HIS OWN EXPENSE BE REQUIRED TO REPAIR SUCH UTILITIES.
- THE CONTRACTOR SHALL PROVIDE, INSTALL AND MAINTAIN ALL NECESSARY SIGNS, LIGHTS, FLARES, BARRICADES, AND OTHER PROTECTIVE DEVICES FOR THE PROTECTION, SAFETY AND CONVENIENCE OF THE PUBLIC, ACCORDING TO THE LATEST VERSIONS OF "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICE FOR STREETS AND HIGHWAYS", AND TO THE RULES AND REGULATIONS GOVERNING THE USE OF TRAFFIC CONTROL DEVICES AT WORKSITES AND/OR ADJACENT TO THE PUBLIC STREETS AND HIGHWAYS ADOPTED BY THE HIGHWAY SAFETY COORDINATOR AND THE U.S. FEDERAL HIGHWAY ADMINISTRATION "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR HIGHWAY CONSTRUCTION AND MAINTENANCE OPERATIONS", DATED 2009.
- THE DIRECTOR OF PUBLIC WORKS AND/OR THE DIRECTOR OF THE DEPARTMENT OF WATER SUPPLY HAS THE RIGHT TO STOP CONSTRUCTION SHOULD ANY WORK BE FOUND CONTRARY TO THE APPROVED CONSTRUCTION PLAN OR DETRIMENTAL TO THE PUBLIC'S INTEREST.

NOTES FOR CONSTRUCTION WITHIN COUNTY RIGHT-OF-WAY (CONT'D)

- THE CONTRACTOR SHALL SCHEDULE A PRE-CONSTRUCTION MEETING WITH THE DEVELOPMENT SERVICES ADMINISTRATION FIVE (5) DAYS PRIOR TO COMMENCEMENT OF CONSTRUCTION.
- THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, KEEP THE PROJECT AREA AND SURROUNDING AREA FREE FROM DUST NUISANCE. THE WORK SHALL BE IN CONFORMANCE WITH AIR POLLUTION CONTROL STANDARDS AND REGULATIONS OF THE STATE DEPARTMENT OF HEALTH AND COUNTY GRADING ORDINANCE.
- THE CONTRACTOR SHALL REMOVE ALL SILT AND DEBRIS RESULTING FROM HIS WORK AND DEPOSITED IN DRAINAGE FACILITIES, ROADWAYS AND OTHER AREAS. THE COST INCURRED FOR ANY NECESSARY REMEDIAL ACTION ORDERED BY THE DIRECTOR OF PUBLIC WORKS SHALL BE PAID BY THE CONTRACTOR.
- CONSTRUCTION DEBRIS AND WASTES SHALL BE DEPOSITED AT AN APPROPRIATE WORK SITE. THE CONTRACTOR SHALL INFORM THE DIRECTOR OF PUBLIC WORKS OF THE LOCATION OF THE DISPOSAL SITES. THE DISPOSAL SITE MUST FULFILL THE REQUIREMENTS OF THE GRADING ORDINANCES.
- THE CONTRACTOR SHALL SUBMIT A TIF AND FIVE (5) COPIES OF THE "AS-BUILT" DRAWINGS PRIOR TO THE FINAL APPROVAL OF THE IMPROVEMENTS.
- IF THE CLEARANCE BETWEEN A WASTEWATER LINE AND A NEW OR EXISTING WATERLINE IS EIGHTEEN INCHES (18") OR LESS, THE WASTEWATER LINE SHALL BE CONCRETE-JACKETED IN ACCORDANCE WITH THE STANDARD DETAILS OF PUBLIC WORKS CONSTRUCTION DATED SEPTEMBER 1984.
- SHOULD HISTORIC SITES SUCH AS WALLS, PLATFORMS, PAVEMENTS, OR MOUNDS, OR REMAINS SUCH AS ARTIFACTS BURIALS, CONCENTRATION OF SHELL OR CHARCOAL BE ENCOUNTERED DURING CONSTRUCTION ACTIVITIES, WORK SHALL CEASE IMMEDIATELY IN THE IMMEDIATE VICINITY OF THE FIND AND THE FIND SHALL BE PROTECTED FROM FURTHER DAMAGE. THE CONTRACTOR AND/OR LANDOWNER SHALL IMMEDIATELY CONTACT THE STATE HISTORIC PRESERVATION DIVISION @ 243-5169 WHICH WILL ASSESS THE SIGNIFICANCE OF THE FIND AND RECOMMEND AN APPROPRIATE MITIGATION MEASURE, IF NECESSARY.

DEPARTMENT OF PUBLIC WORKS NOTES

- THE CONTRACTOR SHALL ALLOW FOUR WEEKS TO OBTAIN A GRADING PERMIT FROM THE DSA PRIOR TO COMMENCEMENT OF ANY CLEARING AND GRUBBING. A SATISFACTORY DRAINAGE AND EROSION CONTROL PLAN SHALL BE SUBMITTED IN THE EVENT THE GRUBBING AREA EXCEEDS ONE ACRE OR THE PROPOSED CUT OR FILL IS GREATER THAN 15 FEET IN HEIGHT. THE CONTRACTOR SHALL PROVIDE, INSTALL AND MAINTAIN ALL BEST MANAGEMENT PRACTICE MEASURES.
- THE CONTRACTOR SHALL PROVIDE, INSTALL AND MAINTAIN ALL NECESSARY SIGNS, LIGHTS, FLARES, BARRICADES, AND OTHER PROTECTIVE DEVICES FOR THE PROTECTION, SAFETY AND CONVENIENCE OF THE PUBLIC AND IN ACCORDANCE WITH THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS, 2009." THE CONTRACTOR SHALL PREPARE AND OBTAIN NECESSARY APPROVALS OF TRAFFIC CONTROL PLANS IF REQUIRED BY THE DSA.
- STANDARD DETAIL DRAWINGS OF THE DEPARTMENT OF PUBLIC WORKS AND THE HAWAII STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND PUBLIC WORKS CONSTRUCTION (2005) AS AMENDED, SHALL BE INCLUDED AS PART OF THE CONSTRUCTION PLANS.
- ALL CONSTRUCTION WORK SHALL STRICTLY CONFORM TO THE APPLICABLE SECTIONS OF THE 2005 HAWAII STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND PUBLIC WORKS CONSTRUCTION, AS AMENDED, AND THE SEPTEMBER 1984 "STANDARD DETAILS" FOR PUBLIC WORKS CONSTRUCTION OF THE DEPARTMENT OF PUBLIC WORKS, AS AMENDED.
- THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, KEEP THE PROJECT AREA AND SURROUNDING AREA FREE FROM DUST NUISANCE. THE WORK SHALL BE IN CONFORMANCE WITH AIR POLLUTION CONTROL STANDARDS AND REGULATIONS OF THE STATE DEPARTMENT OF HEALTH AND COUNTY GRADING ORDINANCE.
- THE CONTRACTOR SHALL REMOVE ALL SILT AND DEBRIS RESULTING FROM HIS WORK AND DEPOSITED IN DRAINAGE FACILITIES, ROADWAYS AND OTHER AREAS. THE COSTS INCURRED FOR ANY NECESSARY REMEDIAL ACTION ORDERED BY THE DIRECTOR OF PUBLIC WORKS SHALL BE PAID BY THE CONTRACTOR.
- PURSUANT TO MAUI COUNTY CODE SECTION 3.44.015(C), THE COUNTY OF MAUI IS NOT RESPONSIBLE FOR ANY PARK, ROADWAY, EASEMENT (INCLUDING BUT NOT LIMITED TO DRAINAGE, SEWER, ACCESS, RECLAIMED WATER, OR IRRIGATION EASEMENT), OR ANY OTHER INTEREST IN REAL PROPERTY SHOWN ON THIS MAP OR SHOWN ON THESE PLANS, UNLESS THE MAUI COUNTY COUNCIL HAS ACCEPTED ITS DEDICATION BY A RESOLUTION APPROVED BY A MAJORITY OF COUNCIL'S MEMBERS AT A REGULAR OR SPECIAL MEETING OF THE MAUI COUNTY COUNCIL.

DISABILITY AND COMMUNICATION ACCESS BOARD (DCAB) REQUIREMENTS

- WHERE PEDESTRIAN WALKWAYS EXIST, THEY SHALL BE MAINTAINED IN PASSABLE CONDITION OR OTHER FACILITIES FOR PEDESTRIANS SHALL BE PROVIDED. PASSAGE BETWEEN WALKWAYS AT INTERSECTIONS SHALL LIKEWISE BE PROVIDED. TEMPORARY PEDESTRIAN PASSAGES SHALL BE ACCESSIBLE PER ADAAG 201.3 AND SHALL COMPLY W/ADAAG 206.1.

GRADING NOTES

- FINISH SPOT ELEVATIONS AND FINISH CONTOURS, AS SHOWN ON PLAN REPRESENTS FINISH GRADING. THE SITEMARK CONTRACTOR SHALL COORDINATE WITH THE LANDSCAPE CONTRACTOR THE LOCATION AND DEPTH OF TOPSOIL. THE FINISH SUBGRADE SHALL REFLECT THE FINISH GRADE LESS SPECIFIED TOPSOIL DEPTH.
- ALL GRADING OPERATIONS SHALL BE PERFORMED IN CONFORMANCE WITH THE APPLICABLE PROVISIONS OF THE WATER POLLUTION CONTROL AND WATER QUALITY STANDARDS CONTAINED IN THE PUBLIC HEALTH REGULATIONS, STATE DEPARTMENT OF HEALTH, ON WATER POLLUTION CONTROL AND WATER QUALITY STANDARDS.
- THE CONTRACTOR SHALL REMOVE ALL SILT AND DEBRIS RESULTING FROM HIS WORK AND DEPOSITED IN DRAINAGE FACILITIES, ROADWAYS, AND OTHER AREAS. THE COSTS INCURRED FOR ANY NECESSARY REMEDIAL ACTION BY THE STATE DEPARTMENT OF HEALTH SHALL BE PAYABLE BY THE CONTRACTOR.
- THE CONTRACTOR, AT HIS EXPENSE, SHALL KEEP THE PROJECT AREA AND SURROUNDING AREA FREE OF DUST NUISANCE. THE WORK SHALL BE IN CONFORMANCE WITH THE AIR POLLUTION CONTROL STANDARDS AND REGULATIONS OF THE STATE DEPARTMENT OF HEALTH.
- CONSTRUCTION DEBRIS, ASH MATERIAL, AND WASTES SHALL BE DEPOSITED AT AN APPROPRIATE SITE. THE CONTRACTOR SHALL INFORM THE ENGINEER OF THE LOCATION OF DISPOSAL SITES. THE DISPOSAL SITE MUST ALSO FULFILL REQUIREMENTS OF THE GRADING ORDINANCES.
- THE CONTRACTOR SHALL NOT DEMOLISH OR CLEAR ANY STRUCTURE, SITE OR VACANT LOT WITHOUT FIRST ASCERTAINING THE PRESENCE OR ABSENCE OF RODENTS WHICH MAY ENDANGER THE PUBLIC HEALTH BY DISPERSAL FROM SUCH PREMISES. SHOULD SUCH INSPECTION REVEAL THE PRESENCE OF SUCH RODENTS, THE CONTRACTOR SHALL ERADICATE SUCH RODENTS BEFORE DEMOLISHING OR CLEARING SAID STRUCTURE, SITE OR VACANT LOT.
- ALL SLOPES AND EXPOSED AREAS SHALL BE SODDED OR PLANTED IMMEDIATELY AFTER THE GRADING WORK HAS BEEN COMPLETED.
- THE FOLLOWING MEASURES SHALL BE TAKEN TO CONTROL DUST AND EROSION DURING THE SITE DEVELOPMENT PERIOD:
 - MINIMIZE TIME OF CONSTRUCTION.
 - RETAIN EXISTING GROUND COVER UNTIL THE LATEST DATE TO COMPLETE CONSTRUCTION.
 - CONSTRUCT REMAINING PERMANENT EROSION AND DRAINAGE CONTROL FEATURES AS EARLY AS POSSIBLE.
 - USE TEMPORARY AREA SPRINKLERS IN NON-ACTIVE CONSTRUCTION AREAS WHEN GROUND COVER IS REMOVED.
 - STATION WATER TRUCK ON-SITE DURING CONSTRUCTION PERIOD TO PROVIDE FOR IMMEDIATE SPRINKLING, AS NEEDED, IN ACTIVE CONSTRUCTION AREAS (WEEKENDS AND HOLIDAYS INCLUDED).
 - USE TEMPORARY BERMS AND CUT-OFF DITCHES, WHERE NEEDED, FOR CONTROL OF EROSION. IMPLEMENT AND MAINTAIN THE MEASURES OF THE BMP PLAN.
 - GRADED AREAS SHALL BE THOROUGHLY WATERED AFTER CONSTRUCTION ACTIVITY HAS CEASED FOR THE DAY AND ON WEEKENDS.
 - ALL CUT AND FILL SLOPES SHALL BE SODDED OR PLANTED IMMEDIATELY AFTER GRADING WORK HAS BEEN COMPLETED.

COMPACTION REQUIREMENTS

- TESTING OF MATERIALS SHALL BE CONDUCTED BY AN APPROVED INDEPENDENT TESTING AGENCY IN ACCORDANCE WITH ASTM STANDARD METHODS OR AS SPECIFIED BY THE DEPARTMENT OF PUBLIC WORKS, ENGINEERING DIVISION, AS FOLLOWS:
 - EMBANKMENT/SELECT BORROW AND SUBGRADE MATERIALS: ONE (1) COMPACTION TEST PER 600 SQUARE YARDS PER LIFT;
 - AGGREGATE SUBBASE COURSE: ONE (1) COMPACTION TEST PER 400 SQUARE YARDS; ONE (1) GRADATION AND SAND EQUIVALENT TEST PER PROJECT;
 - AGGREGATE BASE COURSE: ONE (1) COMPACTION TEST PER 300 SQUARE YARDS; ONE (1) GRADATION AND SAND EQUIVALENT TEST PER PROJECT;
 - ASPHALT CONCRETE PAVEMENT OR ASPHALT TREATED BASE COURSE; THREE (3) A.C. CORES FOR THICKNESS AND DENSITY TESTS PER PROJECT;
 - TRENCH BACKFILL MATERIAL: ONE (1) TEST FOR EACH 300 LINEAL FEET OF TRENCH PER LIFT OF MATERIAL.
 - CONTRACTOR SHALL SUBMIT ALL TESTING REPORTS INCLUDING RESULTS TO THE COUNTY'S INSPECTION AGENCY FOR REVIEW AND APPROVAL PRIOR TO COUNTY'S ACCEPTANCE OF WORK.
 - THE CONTRACTOR SHALL BE REQUIRED TO NOTIFY THE COUNTY OF ANY TESTING FAILURES AND CORRECT EACH FAILURE PRIOR TO PROCEEDING TO THE NEXT PHASE OF CONSTRUCTION.
- BEST MANAGEMENT PRACTICES NOTES**
- ALL GRADED AREAS SHALL BE PROTECTED FROM EROSION BY HYDROMULCHING EXPOSED AREAS AS SOON AS GRADES ARE ATTAINED.
 - ALL TEMPORARY EROSION CONTROL MEASURES, SUCH AS SILT FENCES, STABILIZED CONSTRUCTION ENTRANCE, AND HYDROMULCHING SHALL BE INSTALLED AND MAINTAINED UNTIL SUCH TIME PERMANENT EROSION CONTROL MEASURES ARE ESTABLISHED.
 - HYDROMULCHING AREAS SHALL BE MAINTAINED UNTIL GRASS HAS BEEN ESTABLISHED.
 - THE CONTRACTOR SHALL COMPLY WITH THE CONDITIONS OF THE BEST MANAGEMENT PRACTICE PLAN AND GENERAL PERMIT COVERING DISCHARGE OF STORM WATER ASSOCIATED WITH CONSTRUCTION ACTIVITIES.
15. NON-COMPLIANCE TO ANY OF THE ABOVE REQUIREMENTS SHALL MEAN IMMEDIATE SUSPENSION OF ALL WORK, AND REMEDIAL WORK SHALL COMMENCE IMMEDIATELY. ALL COSTS INCURRED SHALL BE BILLED TO THE VIOLATOR. FURTHERMORE, VIOLATORS SHALL BE SUBJECT TO ADMINISTRATIVE, CIVIL AND/OR CRIMINAL PENALTIES.

TEMPORARY EROSION CONTROL NOTES

- FOLLOW SEQUENCE OF OPERATION AS RECOMMENDED BY THE "RULES RELATING TO WATER QUALITY," DEPARTMENT OF PUBLIC WORKS, CITY AND COUNTY OF HONOLULU, DEC. 2018.
- THE CONTRACTOR SHALL PROVIDE A STABILIZED CONSTRUCTION ENTRANCE FOR INGRESS AND EGRESS.
- SILT FENCING SHALL BE USED AS SHOWN AND AT SELECTED LOCATIONS, AS SHOWN ON PLANS. ADDITIONAL SILT FENCING SHALL BE INSTALLED AS DIRECTED BY THE OFFICER-IN-CHARGE.
- THE CONTRACTOR SHALL MINIMIZE THE AMOUNT OF LAND TO BE EXPOSED AT ANY ONE TIME.
- ALL GRADED AREAS SHALL BE HYDROMULCHED IN ORDER TO PREVENT EROSION AND SILT RUNOFF. TWO APPLICATIONS OF HYDROMULCHING SHALL BE PROVIDED DURING THE DURATION OF CONSTRUCTION.
- THE ABOVE PROCEDURE FOR EROSION AND SEDIMENT CONTROL MAY BE REVISED BY THE CONTRACTOR TO CONFORM TO HIS GRADING OPERATION PROCEDURE. HOWEVER, ANY REVISIONS TO THE ABOVE SHALL BE SUBMITTED TO THE DEPARTMENT OF PUBLIC WORKS' (DPW) CHIEF ENGINEER FOR APPROVAL, BY THE CONTRACTOR. A COPY OF THE APPROVED PLAN SHALL BE SUBMITTED TO THE OFFICER-IN-CHARGE PRIOR TO STARTING WORK.

GRUBBING

- ALL GRUBBING WORK SHALL BE DONE IN ACCORDANCE WITH THE SOILS REPORTS BY PSC DATED MARCH 2005 AND APRIL 2013.
- NO CONTRACTOR SHALL PERFORM ANY GRUBBING OPERATION SO AS TO CAUSE FALLING ROCKS, SOIL OR DEBRIS IN ANY FORM TO FALL, SLIDE OR FLOW ONTO ADJOINING PROPERTIES, STREETS OR NATURAL WATERCOURSES. SHOULD SUCH VIOLATIONS OCCUR, THE CONTRACTOR MAY BE CITED AND THE CONTRACTOR SHALL IMMEDIATELY MAKE ALL REMEDIAL ACTIONS NECESSARY.
- THE CONTRACTOR, AT HIS OWN EXPENSE, SHALL KEEP THE PROJECT AREA AND SURROUNDING AREA FREE FROM DUST NUISANCE. THE WORK SHALL BE IN CONFORMANCE WITH THE AIR POLLUTION CONTROL STANDARDS CONTAINED IN THE HAWAII ADMINISTRATIVE RULES, CHAPTER 11-60, "AIR POLLUTION CONTROL."
- ADEQUATE PROVISIONS SHALL BE MADE TO PREVENT SURFACE WATERS FROM DAMAGING THE CUT FACE OF AN EXCAVATION OR THE SLOPED SURFACES OF A FILL. FURTHERMORE, ADEQUATE PROVISIONS SHALL BE MADE TO PREVENT SEDIMENT-LADEN RUNOFF FROM LEAVING THE SITE.
- ALL GRUBBED AREAS SHALL BE SODDED OR PLANTED IMMEDIATELY AFTER THE GRUBBING WORK HAS BEEN COMPLETED.
- THE COUNTY SHALL BE INFORMED OF THE LOCATION OF THE DISPOSAL SITE FOR THE PROJECT WHEN THE APPLICATION FOR A GRUBBING PERMIT IS MADE. THE DISPOSAL SITE MUST ALSO FULFILL THE REQUIREMENTS OF THE GRADING ORDINANCE.
- NO GRUBBING WORK SHALL BE DONE ON SATURDAYS, SUNDAYS AND HOLIDAYS AT ANY TIME WITHOUT PRIOR NOTICE TO THE DIRECTOR, DHHL, PROVIDED SUCH GRUBBING WORK IS ALSO IN CONFORMANCE WITH THE COMMUNITY NOISE CONTROL STANDARDS CONTAINED IN THE HAWAII ADMINISTRATIVE RULES, CHAPTER 11-43, "COMMUNITY NOISE CONTROL FOR OAHU."
- THE LIMITS OF THE AREA TO BE GRUBBED SHALL BE FLAGGED BEFORE THE COMMENCEMENT OF THE GRUBBING WORK.
- ALL GRUBBING OPERATIONS SHALL BE PERFORMED IN CONFORMANCE WITH THE APPLICABLE PROVISIONS OF THE WATER QUALITY AND WATER POLLUTION CONTROL STANDARDS CONTAINED IN HAWAII ADMINISTRATIVE RULES, CHAPTER 11-54, "WATER QUALITY STANDARDS" AND CHAPTER 11-55, "WATER POLLUTION CONTROL", AND IF APPLICABLE, THE NPDES PERMIT FOR THE PROJECT.
- WHERE APPLICABLE AND FEASIBLE, THE MEASURES TO CONTROL EROSION AND OTHER POLLUTANTS SHALL BE IN PLACE BEFORE ANY GRUBBING WORK IS INITIATED.
- TEMPORARY EROSION CONTROLS SHALL NOT BE REMOVED BEFORE PERMANENT EROSION CONTROLS ARE IN-PLACE AND ESTABLISHED.
- TEMPORARY EROSION CONTROL PROCEDURES SHALL BE SUBMITTED FOR APPROVAL PRIOR TO APPLICATION FOR GRUBBING PERMIT.
- IF THE GRUBBING WORK INVOLVES CONTAMINATED SOIL, THEN ALL GRUBBING WORK SHALL BE DONE IN CONFORMANCE WITH APPLICABLE STATE AND FEDERAL REQUIREMENTS.
- THE CONTRACTOR SHALL NOTIFY THE CIVIL ENGINEERING BRANCH, DEPT. OF PUBLIC WORKS TO ARRANGE FOR INSPECTIONAL SERVICES AND SUBMIT THREE (3) SETS OF APPROVED CONSTRUCTION PLANS SEVEN (7) DAYS PRIOR TO COMMENCEMENT OF CONSTRUCTION WORK.
- NON-COMPLIANCE TO ANY OF THE ABOVE REQUIREMENTS SHALL MEAN IMMEDIATE SUSPENSION OF ALL WORK, AND REMEDIAL WORK SHALL COMMENCE IMMEDIATELY. ALL COSTS INCURRED SHALL BE BILLED TO THE VIOLATOR. FURTHERMORE, VIOLATORS SHALL BE SUBJECT TO ADMINISTRATIVE, CIVIL AND/OR CRIMINAL PENALTIES.



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION. CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION. LICENSE EXPIRATION DATE: 04/30/20

REVISION DATE	DESCRIPTION	MADE BY	APPROVED								
Community Planning and Engineering, Inc. Engineering Design Construction Management Infrastructure Planning 1286 Queen Emma Street, Third Floor Honolulu, Hawaii											
OLAKINO STREET DRAINAGE IMPROVEMENTS KEOKEA & WAIHOLI, MAKAWAO, MAUI OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011											
GENERAL NOTES - 1											
DRAWN BY: GM	ENGINEER: GM	CHECKED BY: AM									
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WATER POLLUTION AND EROSION CONTROL NOTES

A. GENERAL:

1. SEE SPECIAL PROVISION SECTION 209 – WATER POLLUTION AND EROSION CONTROL. SECTION 209 DESCRIBES BUT IS NOT LIMITED TO: SUBMITTAL REQUIREMENTS; SCHEDULING OF A WATER POLLUTION AND EROSION CONTROL CONFERENCE WITH THE ENGINEER; CONSTRUCTION REQUIREMENTS; METHOD OF MEASUREMENT; AND BASIS OF PAYMENT. IN ADDITION, APPENDIX A LISTS POTENTIAL POLLUTANT SOURCES AND CORRESPONDING BMPs USED TO MITIGATE THE POLLUTANTS.
2. FOLLOW THE GUIDELINES IN THE CURRENT HDOT CONSTRUCTION BEST MANAGEMENT PRACTICES FIELD MANUAL IN DEVELOPING, INSTALLING AND MAINTAINING THE BEST MANAGEMENT PRACTICES (BMP) FOR THE PROJECT. FOR ANY CONFLICTING REQUIREMENTS BETWEEN THE MANUAL AND APPLICABLE BID DOCUMENTS, THE APPLICABLE BID DOCUMENTS WILL GOVERN. SHOULD A REQUIREMENT NOT BE CLEARLY DESCRIBED WITHIN THE APPLICABLE BID DOCUMENTS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY FOR INTERPRETATION. FOR THE PURPOSES OF CLARIFICATION UNDER NOTE A.2, "APPLICABLE BID DOCUMENTS" INCLUDE THE CONSTRUCTION PLANS, STANDARD SPECIFICATIONS, SPECIAL PROVISIONS, PERMITS, AND THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) WHEN APPLICABLE.
3. FOLLOW THE GUIDELINES IN THE HONOLULU'S CITY & COUNTY "RULES RELATING TO SOIL EROSION STANDARDS AND GUIDELINES" ALONG WITH APPLICABLE SOIL EROSION GUIDELINES FOR PROJECTS ON MAUI, MOLOKAI, KAUAI, AND HAWAII.
4. THE ENGINEER MAY ASSESS LIQUIDATED DAMAGES OF UP TO \$27,500 FOR NON-COMPLIANCE OF EACH BMP REQUIREMENT AND EACH REQUIREMENT STATED IN SECTION 209 AND SPECIAL PROVISIONS, FOR EVERY DAY OF NON-COMPLIANCE. THERE IS NO MAXIMUM LIMIT ON THE AMOUNT OF ASSESSED PER DAY.
5. THE ENGINEER WILL DEDUCT THE COST FROM THE PROGRESS PAYMENT FOR ALL CITATIONS RECEIVED BY THE DEPARTMENT FOR NON-COMPLIANCE, OR THE CONTRACTOR SHALL REIMBURSE THE STATE FOR THE FULL AMOUNT OF THE OUTSTANDING COST INCURRED BY THE STATE.
6. IF NECESSARY, INSTALL A RAIN GAGE PRIOR TO ANY FIELD WORK INCLUDING THE INSTALLATION OF ANY SITE-SPECIFIC BEST MANAGEMENT PRACTICES. THE RAIN GAGE SHALL HAVE A TOLERANCE OF AT LEAST 0.05 INCHES OF RAINFALL. INSTALL THE RAIN GAGE ON THE PROJECT SITE IN AN AREA THAT WILL NOT DETER RAINFALL FROM ENTERING THE GAGE OPENING. DO NOT INSTALL IN A LOCATION WHERE RAIN WATER MAY SPLASH INTO RAIN GAGE. THE RAIN GAGE INSTALLATION SHALL BE STABLE AND PLUMBED. DO NOT BEGIN FIELD WORK UNTIL THE RAIN GAGE IS INSTALLED AND SITE-SPECIFIC BEST MANAGEMENT PRACTICES ARE IN-PLACE.
7. SUBMIT SITE-SPECIFIC BMP PLAN TO THE ENGINEER ALONG WITH A COMPLETED SITE-SPECIFIC BMP REVIEW CHECKLIST WITHIN 30 CALENDAR DAYS OF CONTRACT EXECUTION. THE SITE-SPECIFIC BMP REVIEW CHECKLIST MAY BE OBTAINED FROM [HTTP://WWW.STORMWATERHAWAII.COM](http://www.stormwaterhawaii.com).

B. WASTE DISPOSAL:

1. WASTE MATERIALS:
COLLECT AND STORE ALL WASTE MATERIALS IN A SECURELY LIDDED METAL DUMPSTER OR ROLL OFF CONTAINER WITH COVER TO KEEP RAIN OUT OR LOSS OF WASTE DURING WINDY CONDITIONS. THE DUMPSTER SHALL MEET ALL LOCAL AND STATE SOLID WASTE MANAGEMENT REGULATIONS. DEPOSIT ALL TRASH AND CONSTRUCTION DEBRIS FROM THE SITE IN THE DUMPSTER. EMPTY THE DUMPSTER WEEKLY OR WHEN THE CONTAINER IS TWO-THIRDS FULL, WHICHEVER IS SOONER. DO NOT BURY CONSTRUCTION WASTE MATERIALS ONSITE. THE CONTRACTOR'S SUPERVISORY PERSONNEL SHALL BE INSTRUCTED REGARDING THE CORRECT PROCEDURE FOR WASTE DISPOSAL. POST NOTICES STATING THESE PRACTICES IN THE OFFICE TRAILER, ON A WEATHERPROOF BULLETIN BOARD, OR OTHER ACCESSIBLE LOCATION ACCEPTABLE TO THE ENGINEER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SEEING THAT THESE PROCEDURES ARE FOLLOWED. SUBMIT THE SOLID WASTE DISCLOSURE FORM FOR CONSTRUCTION SITES TO THE ENGINEER WITHIN 30 CALENDAR DAYS OF CONTRACT EXECUTION. PROVIDE A COPY OF ALL THE DISPOSAL RECEIPTS FROM THE FACILITY PERMITTED BY THE DEPARTMENT OF HEALTH TO RECEIVE SOLID WASTE TO THE ENGINEER MONTHLY. THIS SHOULD ALSO INCLUDE DOCUMENTATION FROM ANY INTERMEDIARY FACILITY WHERE SOLID WASTE IS HANDLED OR PROCESSED.
2. HAZARDOUS WASTE:
DISPOSE ALL HAZARDOUS WASTE MATERIALS IN THE MANNER SPECIFIED BY LOCAL OR STATE REGULATIONS AND BY THE MANUFACTURER. THE CONTRACTOR'S SITE PERSONNEL SHALL BE INSTRUCTED IN THESE PRACTICES AND SHALL BE RESPONSIBLE FOR SEEING THAT THESE PRACTICES ARE FOLLOWED.
3. SANITARY WASTE:
COLLECT ALL SANITARY WASTE FROM THE PORTABLE UNITS A MINIMUM OF ONCE PER WEEK, OR AS REQUIRED. POSITION SANITARY FACILITIES WHERE THEY ARE SECURE AND WILL NOT BE TIPPED OVER OR KNOCKED DOWN.

C. EROSION AND SEDIMENT CONTROL INSPECTION AND MAINTENANCE PRACTICES:

1. FOR PROJECTS WITH AN NPDES PERMIT FOR CONSTRUCTION ACTIVITIES, INSPECT AT THE FOLLOWING INTERVALS. FOR CONSTRUCTION AREAS DISCHARGING TO NUTRIENT OR SEDIMENT IMPAIRED WATERS, INSPECT ALL CONTROL MEASURES AT LEAST ONCE EACH WEEK AND WITHIN 24 HOURS OF ANY RAINFALL EVENT OF 0.25 INCHES OR GREATER WITHIN A 24 HOUR PERIOD. FOR CONSTRUCTION AREAS DISCHARGING TO WATERS NOT IMPAIRED FOR NUTRIENT OR SEDIMENTS, INSPECT ALL CONTROL MEASURES WEEKLY. INSPECTIONS ARE ONLY REQUIRED DURING THE PROJECT'S NORMAL WORKING HOURS. THE DISCHARGE POINT WATER CLASSIFICATION MAY BE FOUND IN THE SWPPP.
2. FOR PROJECTS WITHOUT AN NPDES PERMIT FOR CONSTRUCTION ACTIVITIES, INSPECT ALL CONTROL MEASURES WEEKLY.
3. REMOVE BUILT-UP SEDIMENT FROM THE SILT FENCE WHEN IT HAS REACHED ONE-THIRD THE HEIGHT OF THE FENCE. REMOVE SEDIMENT FROM THE OTHER PERIMETER SEDIMENT CONTROL DEVICES WHEN IT HAS REACHED ONE-HALF THE HEIGHT OF THE DEVICE.
4. INSPECT SILT SCREEN OR FENCE FOR DEPTH OF SEDIMENT, TEARS, TO VERIFY THAT THE FABRIC IS SECURELY ATTACHED TO THE FENCE POSTS OR CONCRETE SLAB AND TO VERIFY THAT THE FENCE POSTS ARE FIRMLY IN THE GROUND. INSPECT AND VERIFY THE BOTTOM OF THE SILT SCREEN IS BURIED A MINIMUM OF 6 INCHES BELOW THE EXISTING GROUND.
5. INSPECT TEMPORARY AND PERMANENT SEEDING AND PLANTING FOR BARE SPOTS, WASHOUTS AND HEALTHY GROWTH.
6. COMPLETE AND SUBMIT TO THE ENGINEER A MAINTENANCE INSPECTION REPORT WITHIN 24 HOURS AFTER EACH INSPECTION.
7. PROVIDE A STABILIZED CONSTRUCTION ENTRANCE AT ALL POINTS OF EXIT ONTO PAVED ROADS TO REDUCE VEHICLE TRACKING OF SEDIMENTS. INCLUDE STABILIZED CONSTRUCTION ENTRANCE IN THE WATER POLLUTION, DUST, AND EROSION CONTROL SUBMITTALS. MINIMUM LENGTH SHOULD BE 50 FEET. MINIMUM WIDTH SHOULD BE 30 FEET. MINIMUM DEPTH SHOULD BE 12 INCHES OR AS RECOMMENDED BY THE SOILS ENGINEER AND UNDERLAIN WITH GEO-TEXTILE FABRIC. IF MINIMUM DIMENSIONS CANNOT BE MET, PROVIDE OTHER STABILIZATION TECHNIQUES THAT REMOVE SEDIMENT PRIOR TO EXIT. CLEAN THE PAVED STREET ADJACENT TO THE SITE ENTRANCE DAILY OR AS REQUIRED TO REMOVE ANY EXCESS MUD, COLD-PLAINED MATERIALS, DIRT OR ROCK TRACKED FROM THE SITE. DO NOT HOSE DOWN THE STREET WITHOUT CONTAINING OR VACUUMING WASH WATER. COVER DUMP TRUCKS HAULING MATERIAL FROM THE CONSTRUCTION SITE WITH A TARP/AULIN. REMOVE SEDIMENT TRACKED ONTO THE STREET, SIDEWALK, OR OTHER PAVED AREA BY THE END OF THE DAY IN WHICH THE TRACK-OUT OCCURS.
8. INCLUDE DESIGNATED CONCRETE WASHOUT AREA(S) IN THE WATER POLLUTION, DUST, AND EROSION CONTROL SUBMITTALS.
9. SUBMIT THE NAME OF A SPECIFIC INDIVIDUAL DESIGNATED RESPONSIBLE FOR INSPECTIONS, MAINTENANCE AND REPAIR ACTIVITIES AND FILLING OUT THE INSPECTION AND MAINTENANCE REPORT.
10. PERSONNEL SELECTED FOR THE INSPECTION AND MAINTENANCE RESPONSIBILITIES SHALL RECEIVE TRAINING FROM THE CONTRACTOR. THEY SHALL BE TRAINED IN ALL THE INSPECTION AND MAINTENANCE PRACTICES NECESSARY FOR KEEPING THE EROSION AND SEDIMENT CONTROLS USED ONSITE IN GOOD WORKING ORDER.
11. CONTAIN, REMOVE, AND DISPOSE SLURRY GENERATED FROM SAW CUTTING OF PAVEMENT IN ACCORDANCE WITH APPROVED BMP PRACTICES. DO NOT ALLOW DISCHARGE INTO THE DRAINAGE SYSTEM OR STATE WATERS.
12. FOR PROJECTS WITH AN NPDES PERMIT FOR CONSTRUCTION ACTIVITIES, IMMEDIATELY INITIATE STABILIZING EXPOSED SOIL AREAS UPON COMPLETION OF EARTH-DISTURBING ACTIVITIES FOR AREAS WHERE EARTH-DISTURBING ACTIVITIES HAVE PERMANENTLY OR TEMPORARILY CEASED. EARTH-DISTURBING ACTIVITIES HAVE PERMANENTLY CEASED WHEN CLEARING AND EXCAVATION WITHIN ANY AREA OF THE CONSTRUCTION SITE THAT WILL NOT INCLUDE PERMANENT STRUCTURES HAS BEEN COMPLETED. EARTH-DISTURBING ACTIVITIES HAVE TEMPORARILY CEASED WHEN CLEARING, GRADING, AND EXCAVATION WITHIN ANY AREA OF THE SITE THAT WILL NOT INCLUDE PERMANENT STRUCTURES WILL NOT RESUME (I.E., THE LAND WILL BE IDLE) FOR A PERIOD OF 14 OR MORE CALENDAR DAYS, BUT SUCH ACTIVITIES WILL RESUME IN THE FUTURE. FOR CONSTRUCTION AREAS DISCHARGING INTO WATERS NOT IMPAIRED FOR NUTRIENTS SEDIMENTS, COMPLETE INITIAL STABILIZATION WITHIN 14 CALENDAR DAYS AFTER THE TEMPORARY OR PERMANENT CESSATION OF EARTH-DISTURBING ACTIVITIES. FOR CONSTRUCTION AREAS DISCHARGING INTO NUTRIENT OR SEDIMENT IMPAIRED WATERS, COMPLETE INITIAL STABILIZATION WITHIN 7 CALENDAR DAYS AFTER THE TEMPORARY OR PERMANENT CESSATION OF EARTH-DISTURBING ACTIVITIES. CLASSIFICATION OF WATER AT THE DISCHARGE POINT MAY BE FOUND IN THE SWPPP.
13. FOR PROJECTS WITHOUT AN NPDES PERMIT FOR CONSTRUCTION ACTIVITIES, COMPLETE INITIAL STABILIZATION WITHIN 14 CALENDAR DAYS AFTER THE TEMPORARY OR PERMANENT CESSATION OF EARTH-DISTURBING ACTIVITIES.

D. GOOD HOUSEKEEPING, BEST MANAGEMENT PRACTICES:

1. MATERIALS POLLUTION PREVENTION PLAN
 - A. APPLICABLE MATERIALS OR SUBSTANCES LISTED BELOW ARE EXPECTED TO BE PRESENT ONSITE DURING CONSTRUCTION. OTHER MATERIALS AND SUBSTANCES NOT LISTED BELOW SHALL BE ADDED TO THE INVENTORY.

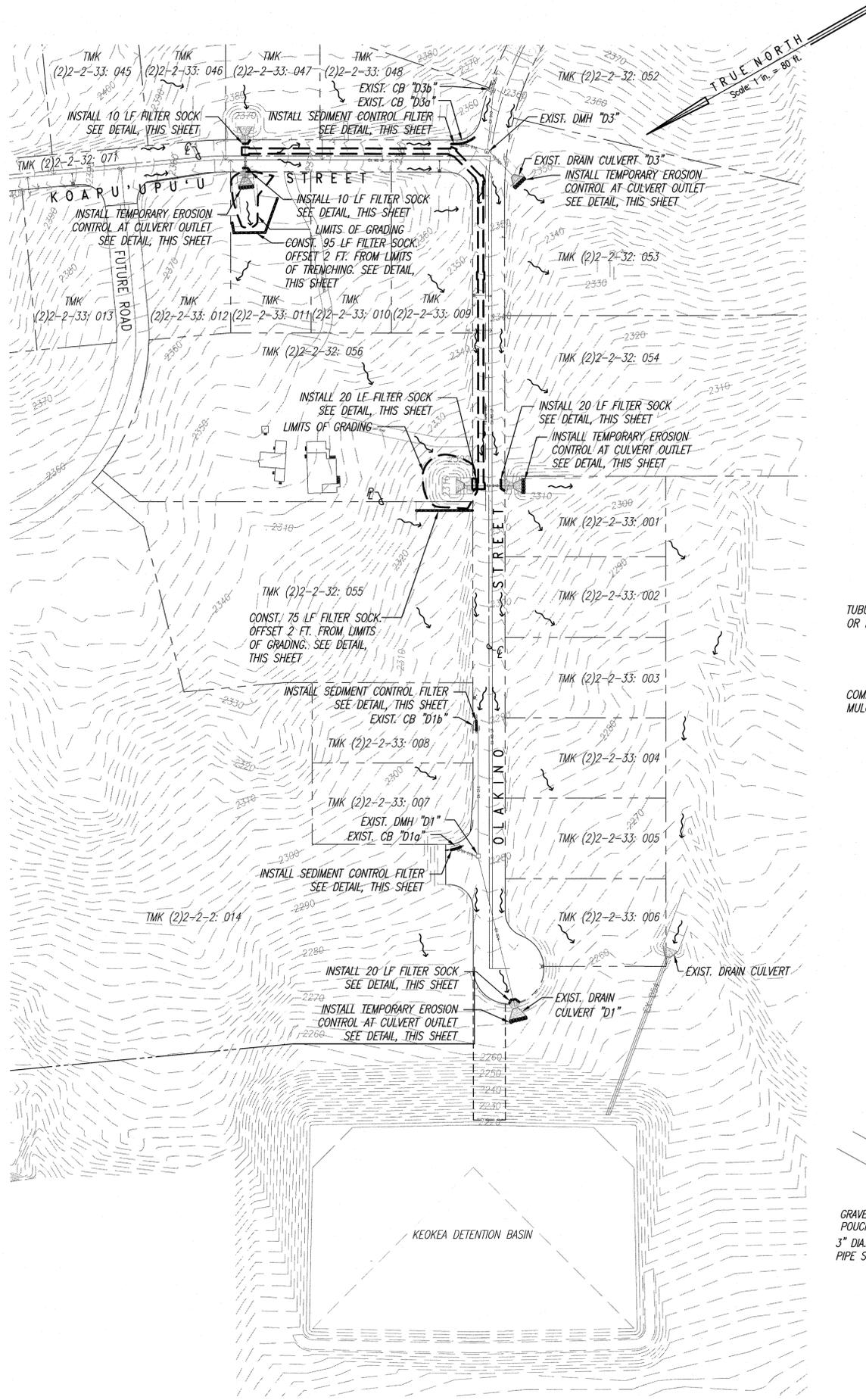
<ul style="list-style-type: none"> CONCRETE DETERGENTS PAINTS (ENAMEL AND LATEX) METAL STUDS FERTILIZERS PETROLEUM BASED PRODUCTS 	<ul style="list-style-type: none"> CLEANING SOLVENTS WOOD MASONRY BLOCK HERBICIDES AND PESTICIDES CURING COMPOUNDS ADHESIVES
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 - B. USE MATERIAL MANAGEMENT PRACTICES TO REDUCE THE RISK OF SPILLS OR OTHER ACCIDENTAL EXPOSURE OF MATERIALS AND SUBSTANCES TO STORM WATER RUNOFF. MAKE AN EFFORT TO STORE ONLY ENOUGH PRODUCT AS IS REQUIRED TO DO THE JOB.
 - C. STORE ALL MATERIALS STORED ONSITE IN A NEAT, ORDERLY MANNER IN THEIR APPROPRIATE CONTAINERS AND IF POSSIBLE, UNDER A ROOF OR OTHER ENCLOSURE.
 - D. KEEP PRODUCTS IN THEIR ORIGINAL CONTAINERS WITH THE ORIGINAL MANUFACTURER'S LABEL.
 - E. DO NOT MIX SUBSTANCES WITH ONE ANOTHER UNLESS RECOMMENDED BY THE MANUFACTURER.
 - F. WHENEVER POSSIBLE, USE A PRODUCT UP COMPLETELY BEFORE DISPOSING OF THE CONTAINER.
 - G. FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR PROPER USE AND DISPOSAL.
 - H. CONDUCT A DAILY INSPECTION TO ENSURE PROPER USE AND DISPOSAL OF MATERIALS ONSITE.
2. HAZARDOUS MATERIAL POLLUTION PREVENTION PLAN
 - A. KEEP PRODUCTS IN ORIGINAL CONTAINERS UNLESS THEY ARE NOT RESEALABLE.
 - B. RETAIN ORIGINAL LABELS AND MATERIAL SAFETY DATA SHEETS (MSDS) FORMERLY MATERIAL SAFETY DATA SHEETS (MSDS).
 - C. DISPOSE OF SURPLUS PRODUCTS ACCORDING TO MANUFACTURER'S INSTRUCTIONS AND LOCAL AND STATE REGULATIONS.
3. ONSITE AND OFFSITE PRODUCT SPECIFIC PLAN
THE FOLLOWING PRODUCT SPECIFIC PRACTICES SHALL BE FOLLOWED ONSITE:
 - A) PETROLEUM BASED PRODUCTS:
MONITOR ALL ONSITE VEHICLES FOR LEAKS AND PERFORM REGULAR PREVENTIVE MAINTENANCE TO REDUCE THE CHANCE OF LEAKAGE. STORE PETROLEUM PRODUCTS IN TIGHTLY SEALED CONTAINERS WHICH ARE CLEARLY LABELED. APPLY ASPHALT SUBSTANCES USED ONSITE ACCORDING TO THE MANUFACTURER'S RECOMMENDATION.
 - B) FERTILIZERS:
APPLY FERTILIZERS USED ONLY IN THE MINIMUM AMOUNTS RECOMMENDED BY THE MANUFACTURER AND FEDERAL, STATE, AND LOCAL REQUIREMENTS. AVOID APPLYING JUST BEFORE A HEAVY RAIN EVENT. APPLY AT THE APPROPRIATE TIME OF YEAR FOR THE LOCATION, AND PREFERABLY TIMED TO COINCIDE AS CLOSELY AS POSSIBLE TO THE PERIOD OF MAXIMUM VEGETATION UPTAKE AND GROWTH. ONCE APPLIED, WORK FERTILIZER INTO THE SOIL TO LIMIT EXPOSURE TO STORM WATER. DO NOT APPLY TO STORM CONVEYANCE CHANNELS WITH FLOWING WATER. STORAGE SHALL BE IN A COVERED SHED OR IN AN AREA WHERE FERTILIZER WILL NOT COME INTO CONTACT WITH PRECIPITATION OR STORMWATER. TRANSFER THE CONTENTS OF ANY PARTIALLY USED BAGS OF FERTILIZER TO A SEALABLE PLASTIC BIN TO AVOID SPILLS.
 - C) PAINTS:
SEAL AND STORE ALL CONTAINERS WHEN NOT REQUIRED FOR USE. DO NOT DISCHARGE EXCESS PAINT TO THE DRAINAGE SYSTEM, SANITARY SEWER SYSTEM, OR STATE WATERS. DISPOSE PROPERLY ACCORDING TO MANUFACTURERS' INSTRUCTIONS AND STATE AND LOCAL REGULATIONS.
 - D) CONCRETE TRUCKS:
WASHOUT OR DISCHARGE CONCRETE TRUCK DRUM WASH WATER ONLY AT A DESIGNATED SITE AS FAR AS PRACTICABLE FROM STORM DRAIN INLETS OR STATE WATERS. DO NOT DISCHARGE WATER IN THE DRAINAGE SYSTEM OR STATE WATERS. CLEAN DISPOSAL SITE AS REQUIRED OR AS REQUESTED BY THE ENGINEER.
4. SPILL CONTROL PLAN
 - A. POST A SPILL PREVENTION PLAN TO INCLUDE MEASURES TO PREVENT AND CLEAN UP EACH SPILL.
 - B. THE CONTRACTOR SHALL BE THE SPILL PREVENTION AND CLEANUP COORDINATOR. DESIGNATE AT LEAST THREE SITE PERSONNEL WHO SHALL RECEIVE SPILL PREVENTION AND CLEANUP TRAINING. THESE INDIVIDUALS SHALL EACH BECOME RESPONSIBLE FOR A PARTICULAR PHASE OF PREVENTION AND CLEANUP. POST THE NAMES OF RESPONSIBLE SPILL PERSONNEL IN THE MATERIAL STORAGE AREA ON A WEATHERPROOF BULLETIN BOARD OR OTHER ACCESSIBLE LOCATION ACCEPTABLE TO THE ENGINEER AND IN THE OFFICE TRAILER ONSITE.
 - C. CLEARLY POST MANUFACTURERS' RECOMMENDED METHODS FOR SPILL CLEANUP. MAKE SITE PERSONNEL AWARE OF THE PROCEDURES AND THE LOCATION OF THE INFORMATION AND CLEANUP SUPPLIES.
 - D. KEEP AMPLE MATERIALS AND EQUIPMENT NECESSARY FOR SPILL CLEANUP IN THE MATERIAL STORAGE AREA ONSITE.
 - E. CLEAN UP ALL SPILLS IMMEDIATELY AFTER DISCOVERY.
 - F. KEEP THE SPILL AREA WELL VENTILATED. PERSONNEL SHALL WEAR APPROPRIATE PROTECTIVE CLOTHING TO PREVENT INJURY FROM CONTACT WITH A HAZARDOUS SUBSTANCE.

D. GOOD HOUSEKEEPING, BEST MANAGEMENT PRACTICES CONT'D:

- G. REPORT SPILLS OF TOXIC HAZARDOUS MATERIAL TO THE APPROPRIATE STATE OR LOCAL GOVERNMENT AGENCY, REGARDLESS OF THE SIZE. WHERE A LEAK, SPILL, OR OTHER RELEASE CONTAINING A HAZARDOUS SUBSTANCE OR OIL IN AN AMOUNT EQUAL TO OR IN EXCESS OF A REPORTABLE QUANTITY ESTABLISHED UNDER EITHER 40 CFR PART 110, 40 CFR PART 117, OR 40 CFR PART 302 OCCURS DURING A 24-HOUR PERIOD, THE CONTRACTOR SHALL NOTIFY THE ENGINEER AS SOON AS THE CONTRACTOR HAS KNOWLEDGE OF THE DISCHARGE. THE ENGINEER SHALL NOTIFY THE NATIONAL RESPONSE CENTER (NRC) AT (800) 424-8802, THE CLEAN WATER BRANCH DURING REGULAR BUSINESS HOURS AT 586-4309, AND THE HAWAII STATE HOSPITAL OPERATOR AT 247-2191 AND THE CLEAN WATER BRANCH (CWB-CWB) VIA EMAIL AT CleanWaterBranch@doh.hawaii.gov DURING NON-BUSINESS HOURS IMMEDIATELY. THE CONTRACTOR SHALL ALSO PROVIDE TO THE ENGINEER, WITHIN 7 CALENDAR DAYS OF KNOWLEDGE OF THE RELEASE, A DESCRIPTION OF THE RELEASE, THE CIRCUMSTANCES LEADING TO THE RELEASE, AND DATE OF THE RELEASE. THE ENGINEER WILL PROVIDE THIS INFORMATION TO THE CWB-CWB. THE ENGINEER WILL PROVIDE INFORMATION TO THE NRC IF REQUESTED.

REVISION DATE	DESCRIPTION	MADE BY	APPROVED
			
<p>OLAKINO STREET DRAINAGE IMPROVEMENTS KEOKEA & WAIHOLI, MAKAWAO, MAUI OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011</p>			
<p>GENERAL NOTES - 2</p>			
DRAWN BY: GM	ENGINEER: GM	CHECKED BY: AM	
			
<p>THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION. CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION. LICENSE EXPIRATION DATE: 04/30/20</p>			

FILE	POCKET	FOLDER	NO.
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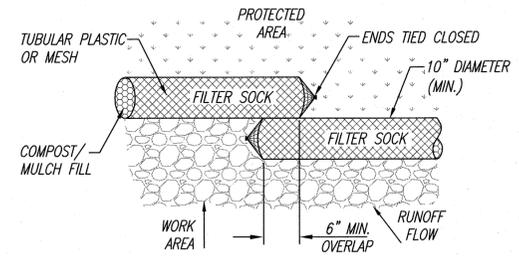
EROSION CONTROL PLAN
SCALE: 1" = 80'

CONSTRUCTION BMPs

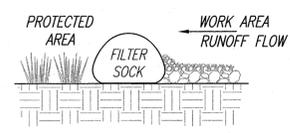
- A. CONSTRUCTION MANAGEMENT TECHNIQUES INCLUDE:
- CLEARING AND GRUBBING SHALL BE HELD TO THE MINIMUM NECESSARY FOR GRADING AND EQUIPMENT OPERATION (15 ACRES MAX.).
 - CONSTRUCTION SHALL BE SEQUENCED TO MINIMIZE THE EXPOSURE TIME OF CLEARED SURFACE AREA. (15 ACRES MAX.).
 - CONSTRUCTION SHALL BE STAGED OR PHASED FOR LARGE PROJECTS. AREAS OF ONE PHASE SHALL BE IN PLACE AND FUNCTIONAL PRIOR TO THE START OF THE NEXT PHASE. STABILIZATION CAN BE ACCOMPLISHED BY TEMPORARILY OR PERMANENTLY PROTECTING THE DISTURBED SOIL SURFACE FROM RAINFALL IMPACTS AND RUNOFF.
 - EROSION AND SEDIMENT CONTROL MEASURES, INCLUDING BERMS IN DRAINAGE WAYS SHALL BE IN PLACE AND FUNCTIONAL PRIOR TO THE START OF THE GRADING WORK AND SHALL BE MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD. TEMPORARY MEASURES MAY BE REMOVED AT THE BEGINNING OF THE WORK DAY, BUT SHALL BE REPLACED AT THE END OF THE WORK DAY.
 - ALL CONTROL MEASURES SHALL BE CHECKED AND REPAIRED, AS NECESSARY, FOR EXAMPLE, WEEKLY IN DRY PERIODS AND WITHIN 24-HOURS AFTER ANY RAINFALL OF 0.5 INCHES OR GREATER WITHIN A 24-HOUR PERIOD. DURING PROLONGED RAINFALL, DAILY CHECKING IS NECESSARY. THE PERMITTEE SHALL MAINTAIN RECORDS OF CHECKS AND REPAIRS.
 - THE PERMITTEE SHALL MAINTAIN RECORDS OF THE DURATION AND ESTIMATED VOLUME OF STORM WATER DISCHARGE(S).
 - A SPECIFIC INDIVIDUAL SHALL BE DESIGNATED TO BE RESPONSIBLE FOR EROSION AND SEDIMENT CONTROLS ON EACH PROJECT SITE.
 - THE CONTRACTOR SHALL HAVE PERSONNEL INSPECT, REPAIR AND MAINTAIN THE INGRESS/EGRESS FILTER BERM FOR THE DURATION OF THE PROJECT. THIS SHALL INCLUDE BUT NOT BE LIMITED TO ANY SWEEPING OF GRAVEL, SAND AND DUST THAT MAY DISPERSE FROM THE BERM WITH AN INSPECTION AT THE BEGINNING OF THE DAY AND A FINAL INSPECTION AT THE END OF THE DAY.

CONSTRUCTION BMPs (CONT'D)

- B. VEGETATION CONTROLS INCLUDE:
- PRE-CONSTRUCTION VEGETATIVE GROUND COVER SHALL NOT BE DESTROYED, REMOVED OR DISTURBED MORE THAN 20 CALENDAR DAYS PRIOR TO SITE DISTURBANCE.
 - TEMPORARY SOIL STABILIZATION WITH APPROPRIATE VEGETATION SHALL BE APPLIED ON AREAS THAT WILL REMAIN UNFINISHED FOR MORE THAN 30 CALENDAR DAYS.
 - PERMANENT SOIL STABILIZATION WITH PERENNIAL VEGETATION SHALL BE APPLIED AS SOON AS PRACTICABLE AFTER FINAL GRADING.
- C. STRUCTURAL CONTROLS INCLUDE:
- STORM WATER FLOWING TOWARD THE CONSTRUCTION AREA SHALL BE DIVERTED BY USING APPROPRIATE CONTROL MEASURES, AS PRACTICAL.
 - EROSION CONTROL MEASURES SHALL BE DESIGNED ACCORDING TO THE SIZE OF DISTURBED OR DRAINAGE AREAS, TO DETAIN RUNOFF AND TRAP SEDIMENT.
 - WATER MUST BE DISCHARGED THROUGH A PIPE OR LINED CHANNEL SO THAT THE DISCHARGE DOES NOT CAUSE EROSION.
 - MUDDY WATER TO BE PUMPED FROM EXCAVATION AND WORK AREAS MUST BE HELD IN SETTLING BASINS OR TREATED BY FILTRATION OR OTHER APPROPRIATE MEASURES PRIOR TO ITS DISCHARGE INTO STATE WATERS. WATER MUST BE DISCHARGED THROUGH A PIPE OR LINED CHANNEL SO THAT THE DISCHARGE DOES NOT CAUSED EROSION AND SEDIMENTATION.
 - STORM DRAIN INLET PROTECTION.
 - CONTRACTOR SHALL CLEAN OUT ALL ACCUMULATED SILT AND DEBRIS IN EXISTING DRAINAGE DITCHES AND INLETS. FLUSHING IS PROHIBITED.

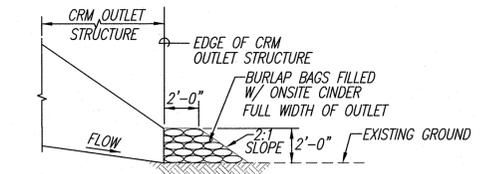


PLAN



SECTION

DETAIL - FILTER SOCK
NOT TO SCALE



TYPICAL SECTION

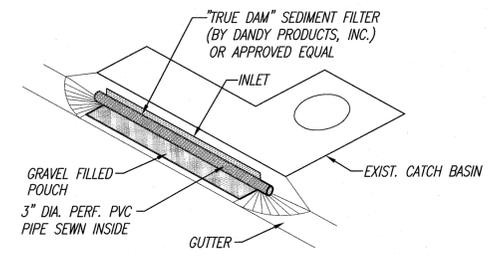
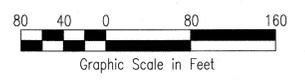
TEMPORARY EROSION CONTROL @ CULVERT OUTLETS
NOT TO SCALE

EARTHWORK QUANTITIES (FOR PERMIT PURPOSES ONLY)

AREA TO BE GRADED	0.14 ACS.
AREA OF DISTURBANCE	0.14 ACS.
PER DOH DEFINITION	
EXCAVATION	1.11 C.Y.
EMBANKMENT	807.10 C.Y.

LEGEND

- LIMITS OF TRENCHING
- - - - - EXISTING CONTOUR
- - - - - EXISTING DRAIN PIPE
- - - - - EXISTING LOT LINE
- ===== BURLAP BAGS OR APPROVED EQUAL @ CULVERT INLET/OUTLET
- ===== FILTER SOCK
- ~~~~~ DIRECTION OF STORM SURFACE RUNOFF FLOW



DETAIL - SEDIMENT CONTROL FILTER AT CATCH BASIN
NOT TO SCALE

- NOTES:**
- SEDIMENT AND DEBRIS AT THE SEDIMENT CONTROL FILTER AT CATCH BASINS SHALL BE CLEANED AND REMOVED WEEKLY IN DRY PERIODS AND WITHIN 24 HR PERIOD DURING RAINFALL. DAILY CHECKING IS NECESSARY. THE PERMITTEE SHALL MAINTAIN RECORDS OF CHECKS AND REMOVAL OF SEDIMENT AND DEBRIS.
 - DURING AN EVENT OF ABOVE NORMAL RAINFALL, THE CONTRACTOR SHALL REMOVE SEDIMENT FILTER AND REPLACE AFTER EVENT HAS PASSED.



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION. CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION. LICENSE EXPIRATION DATE: 04/30/20

REVISION DATE	DESCRIPTION	MADE BY	APPROVED
Community Planning and Engineering, Inc. Engineering Design Construction Management Infrastructure Planning 1286 Queen Emma Street, Third Floor Honolulu, Hawaii			
OLAKINO STREET DRAINAGE IMPROVEMENTS KEOKEA & WAIHOLI, MAKAWAO, MAUI OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011			
EROSION CONTROL PLAN & DETAILS			
DRAWN BY: GM	ENGINEER: GM	CHECKED BY: AM	

HYDROLOGIC DESIGN DATA

$Q = C I A$
 $i =$ RAINFALL INTENSITY FOR 1 HR. (IN./HR.)
 $Q =$ DISCHARGE QUANTITY (CFS)
 $I =$ RAINFALL INTENSITY FOR T_c DURATION (IN./HR.)
 $C =$ RUNOFF COEFFICIENT
 $A =$ AREA IN ACRES (AC)

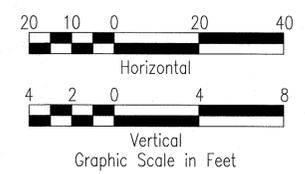
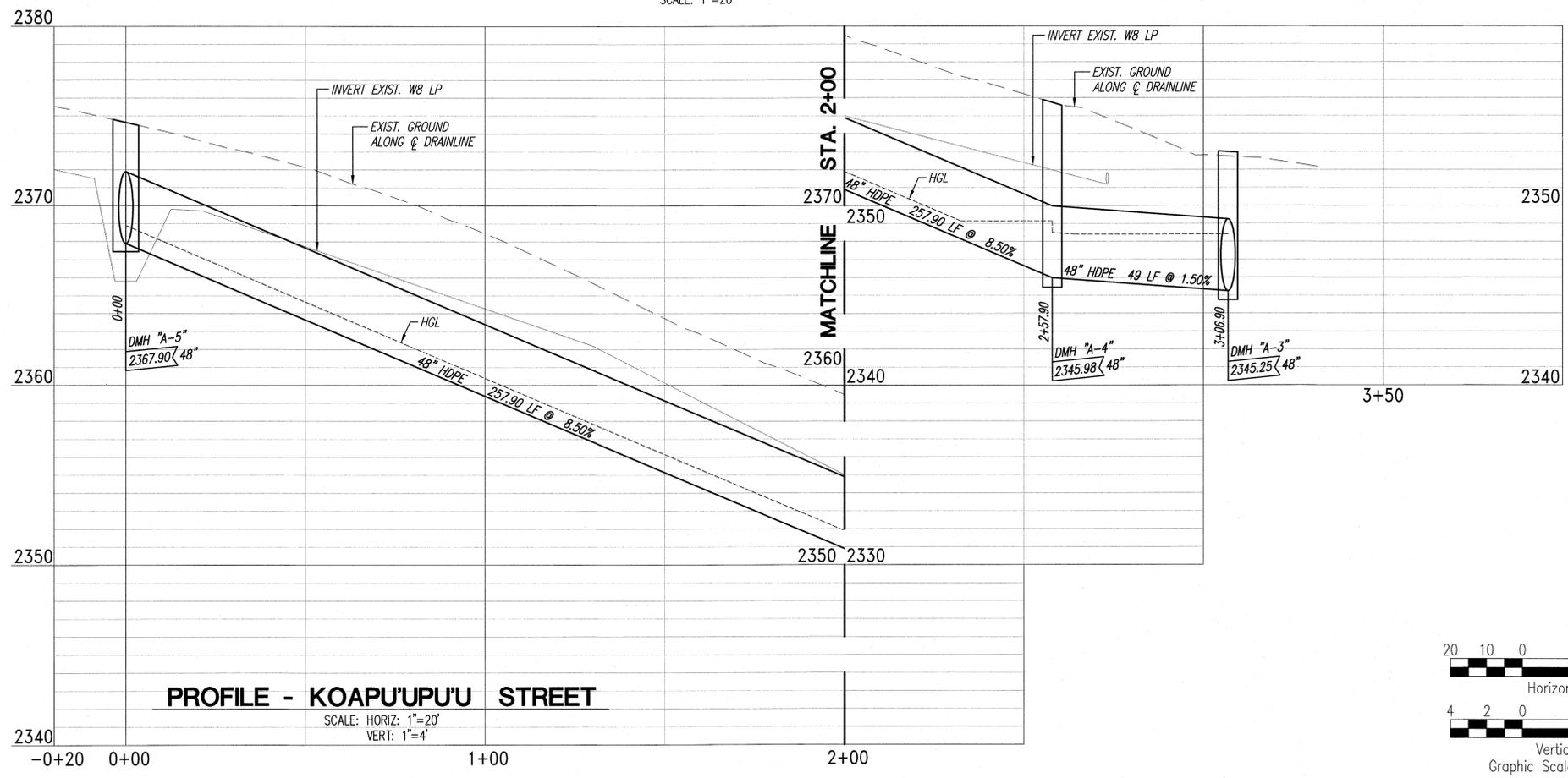
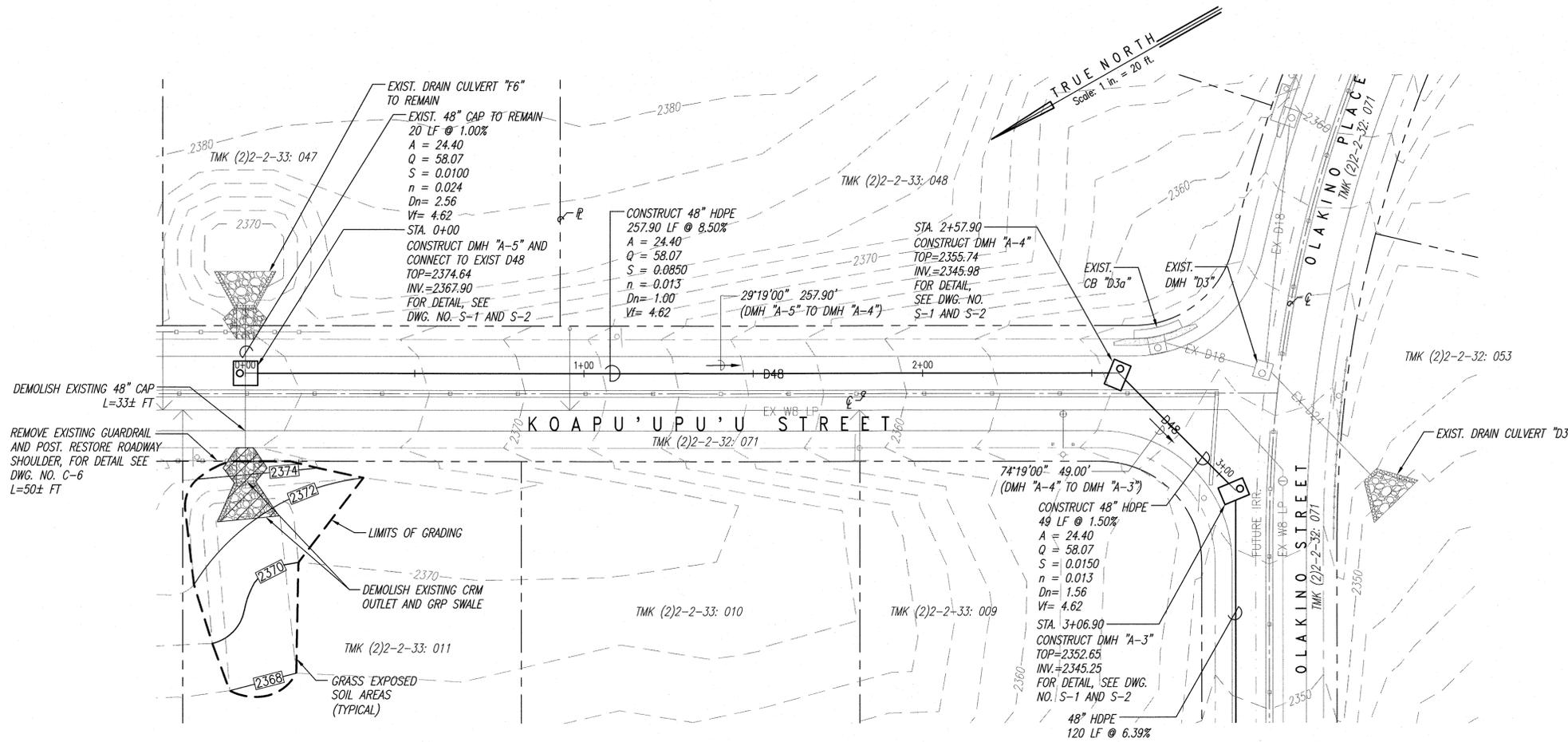
KEOKEA AGRICULTURAL LOTS (2 ACRES MIN.)	WAIHOLI RESIDENTIAL LOTS (20,000 SF MIN.)
$T_m = 50$ YRS	$T_m = 50$ YRS
$i = 2.9$ IN/HR	$i = 2.9$ IN/HR
$T_c = 15.5$ MINS.	$T_c = 9$ MINS.
$I(50) = 5.2$ IN./HR.	$I(50) = 6.8$ IN./HR.
$C = 0.32$	$C = 0.39$
$CI(50) = 1.66$ CFS/AC.	$CI(50) = 2.65$ CFS/AC.

LEGEND

	LIMITS OF GRADING
	EXISTING CONTOUR
	EXISTING DRAIN PIPE
	EXISTING WATERLINE
	FINISHED CONTOUR
	NEW DRAIN PIPE
	EXISTING LOT LINE
	DEMOLISH AND REMOVE
	EXISTING GUARDRAIL
	CORRUGATED ALUMINUM PIPE
	HIGH DENSITY POLYETHYLENE PIPE
	CATCH BASIN
	DRAIN MANHOLE
	AREA, ACS
	DRAIN RUNOFF, CFS
	SLOPE OF PIPE, FT/FT
	NORMAL DEPTH OF FLOW, FT
	FULL FLOW VELOCITY, FPS

NOTE:

- FOR TRENCHING WIDTH AND PAVEMENT RESTORATION DETAIL, SEE STANDARD DETAIL D-31.
- HYDROLOGIC DESIGN DATA BASED ON DRAINAGE MASTER PLAN, "DRAINAGE REPORT FOR KEOKEA-WAIHOLI DEVELOPMENT," MAY 2006.
- CONTRACTOR TO RESTRIPE ANY PAVEMENT MARKINGS AND REPLACE ANY PAVEMENT MARKERS REMOVED DURING TRENCHING OF NEW DRAINLINE IN ROADWAY.



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION. CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION. LICENSE EXPIRATION DATE: 04/30/20

REVISION DATE	DESCRIPTION	MADE BY	APPROVED

Community Planning and Engineering, Inc.
 Engineering Design | Construction Management | Infrastructure Planning
 1286 Queen Emma Street, Third Floor | Honolulu, Hawaii

OLAKINO STREET DRAINAGE IMPROVEMENTS
 KEOKEA & WAIHOLI, MAKAWAO, MAUI
 OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
 TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011

PLAN AND PROFILE CULVERT "F6" & KOAPU'UPU'U STREET DRAINLINE "A"

DRAWN BY: JSO	ENGINEER: FJC	CHECKED BY: AMM
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HYDROLOGIC DESIGN DATA

$Q = C I A$
 $i =$ RAINFALL INTENSITY FOR 1 HR. (IN./HR.)
 $Q =$ DISCHARGE QUANTITY (CFS)
 $I =$ RAINFALL INTENSITY FOR T_c DURATION (IN./HR.)

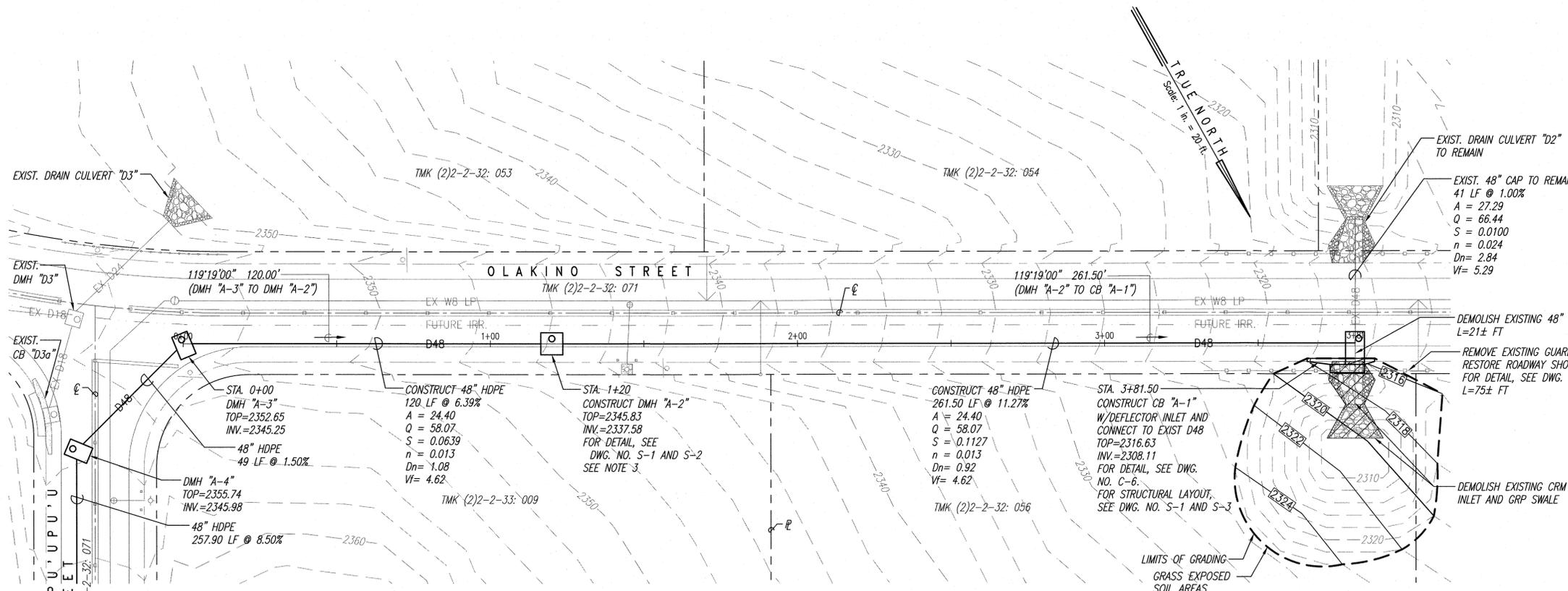
$C =$ RUNOFF COEFFICIENT
 $A =$ AREA IN ACRES (AC)

KEOKEA AGRICULTURAL LOTS (2 ACRES MIN.) $T_m = 50$ YRS $i = 2.9$ IN./HR $T_c = 15.5$ MINS. $I(50) = 5.2$ IN./HR. $C = 0.32$ $C I(50) = 1.66$ CFS/AC.	WAIHOLI RESIDENTIAL LOTS (20,000 SF MIN.) $T_m = 50$ YRS $i = 2.9$ IN./HR $T_c = 9$ MINS. $I(50) = 6.8$ IN./HR. $C = 0.39$ $C I(50) = 2.65$ CFS/AC.
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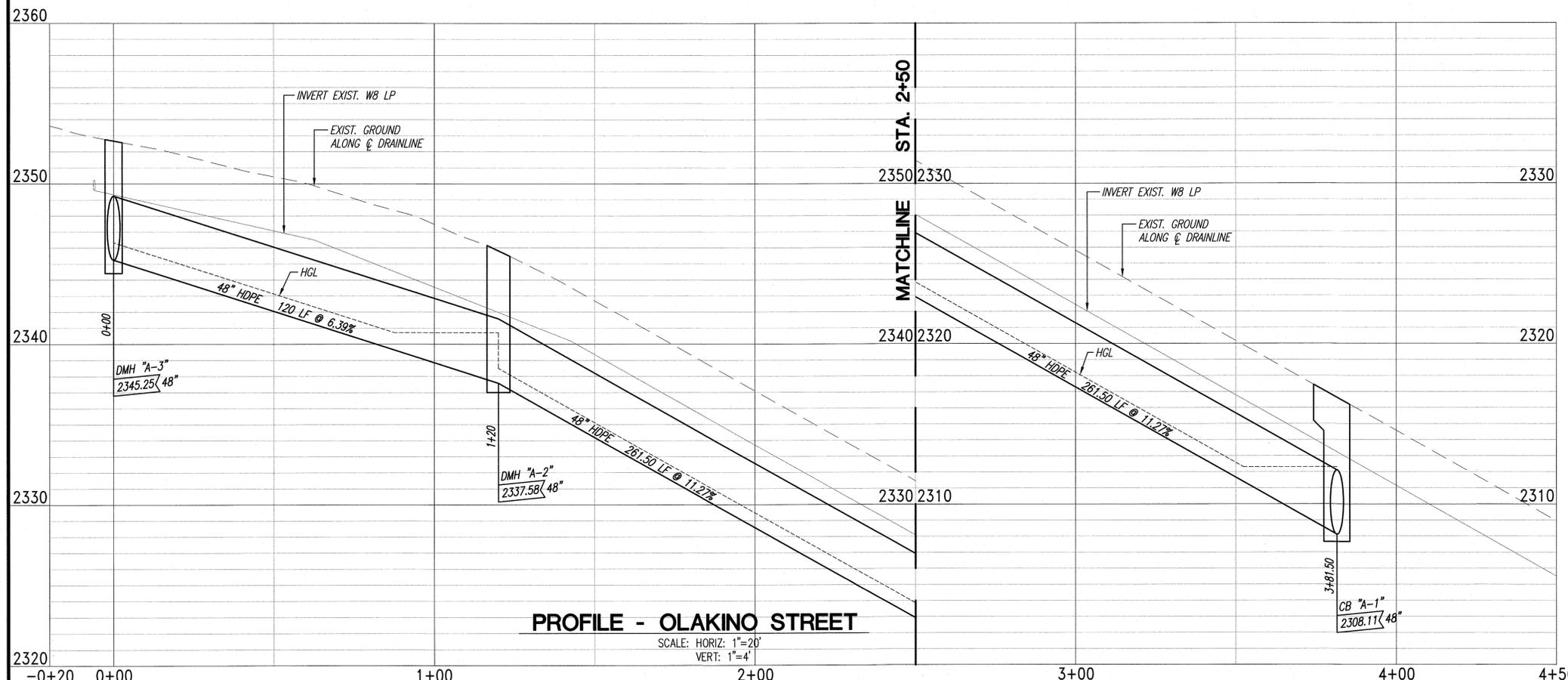
LEGEND

- LIMITS OF GRADING
- EXISTING CONTOUR
- EXISTING DRAIN PIPE
- EXISTING WATERLINE
- FINISHED CONTOUR
- NEW DRAIN PIPE
- EXISTING LOT LINE
- DEMOLISH AND REMOVE
- EXISTING GUARDRAIL
- CORRUGATED ALUMINUM PIPE
- HIGH DENSITY POLYETHYLENE PIPE
- CATCH BASIN
- DRAIN MANHOLE
- AREA, ACS
- DRAIN RUNOFF, CFS
- SLOPE OF PIPE, FT/FT
- NORMAL DEPTH OF FLOW, FT
- FULL FLOW VELOCITY, FPS

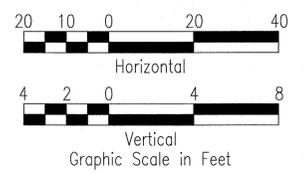
- NOTE:**
1. FOR TRENCHING WIDTH AND PAVEMENT RESTORATION DETAIL, SEE STANDARD DETAIL D-31.
 2. HYDROLOGIC DESIGN DATA BASED ON DRAINAGE MASTER PLAN, "DRAINAGE REPORT FOR KEOKEA-WAIHOLI DEVELOPMENT," MAY 2006.
 3. CONTRACTOR TO ENSURE SPECIAL DMH "A-2" PROVIDES SUFFICIENT VERTICAL CLEARANCE FROM EXISTING SWALE SECTION.
 4. CONTRACTOR TO RESTRIPE ANY PAVEMENT MARKINGS AND REPLACE ANY PAVEMENT MARKERS REMOVED DURING TRENCHING OF NEW DRAINLINE IN ROADWAY.



PLAN - OLAKINO STREET
SCALE: 1"=20'



PROFILE - OLAKINO STREET
SCALE: HORIZ: 1"=20'
VERT: 1"=4'



REVISION DATE	DESCRIPTION	MADE BY	APPROVED

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 1288 Queen Emma Street, Third Floor Honolulu, Hawaii

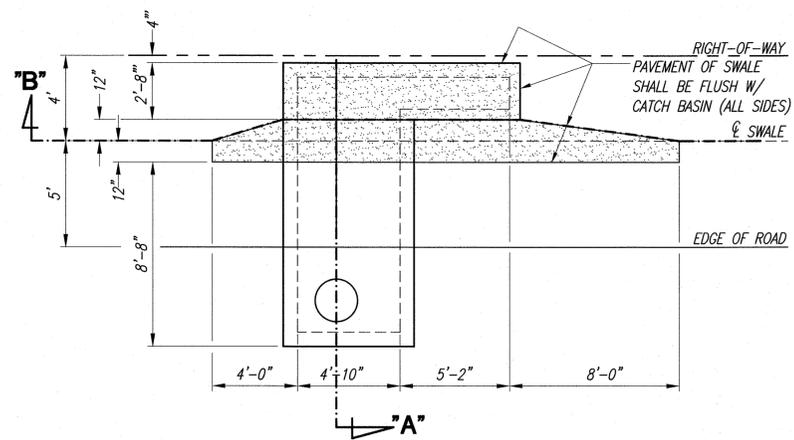
**OLAKINO STREET
DRAINAGE IMPROVEMENTS**
 KEOKEA & WAIHOLI, MAKAWAO, MAUI
 OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
 TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011

**PLAN AND PROFILE
OLAKINO STREET & CULVERT "D2"
DRAINLINE "A"**

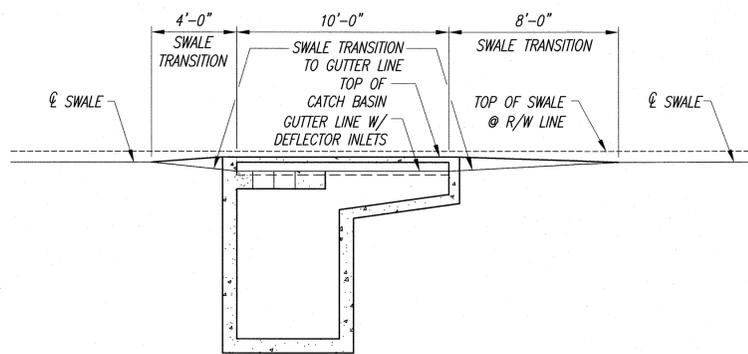
DRAWN BY: JSO	ENGINEER: FJC	CHECKED BY: AMM
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ANSON M. MURAYAMA
 LICENSED PROFESSIONAL ENGINEER
 No. 6975-C
 HAWAII, U.S.A.

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PLAN



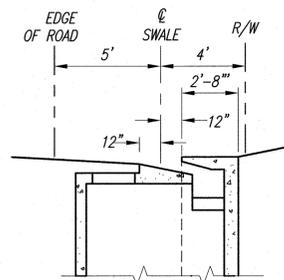
SECTION "B"

DETAIL - TRANSITION GUTTER FOR CATCH BASINS

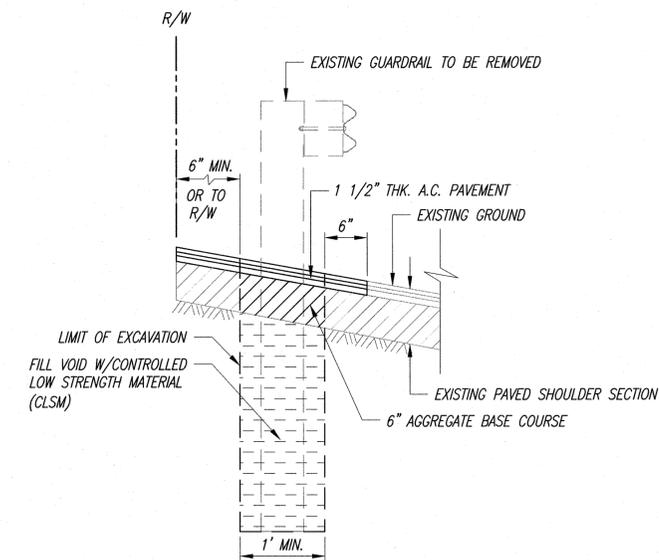
SCALE : 1/4" = 1'-0"

NOTES:

1. SEE STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION STORM DRAINS, SHEETS D-1 THRU D-31. FOR ADDITIONAL DETAILS, SEE LATEST EDITION.
2. FOR CATCH BASIN DETAILS, SEE DWG. NO. S-3.

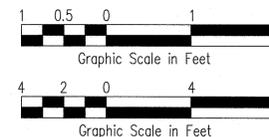


SECTION "A"



SHOULDER RESTORATION DETAIL

SCALE: 1" = 1'-0"



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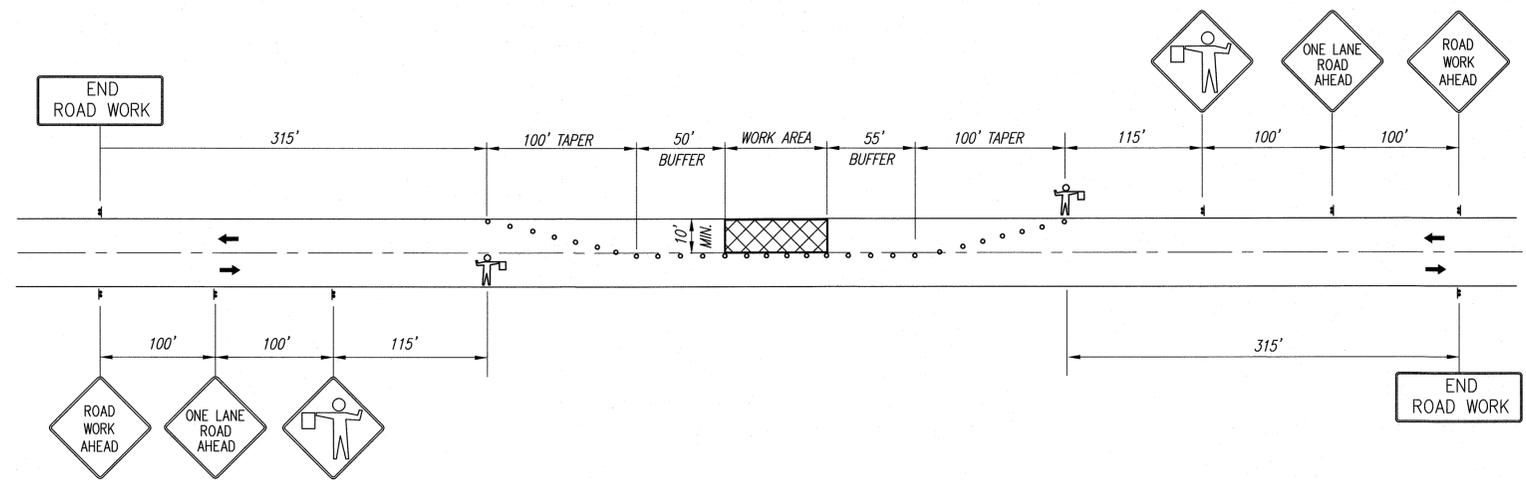
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 Engineering Design | Construction Management | Infrastructure Planning
 1286 Queen Emma Street, Third Floor Honolulu, Hawaii

OLAKINO STREET DRAINAGE IMPROVEMENTS
 KEOKEA & WAIHOLI, MAKAWAO, MAUI
 OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
 TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011

DRAINAGE DETAILS

DRAWN BY: GM	ENGINEER: GM	CHECKED BY: AM
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FILE	PROJECT	FOLDER	NO.
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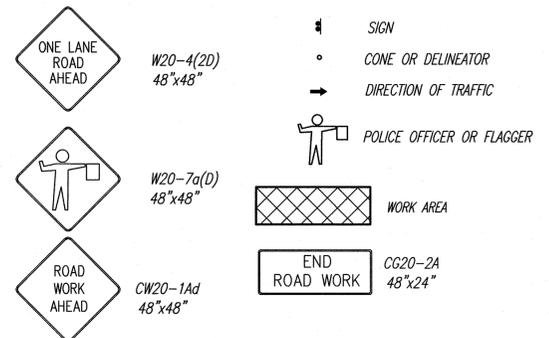
**TYPICAL TRAFFIC CONTROL PLAN
(TWO FLAGGER OPERATION)**

NOT TO SCALE

GENERAL NOTES FOR TRAFFIC CONTROL PLAN

1. THE PERMITTEE SHALL MAKE MINOR ADJUSTMENTS AT INTERSECTIONS, DRIVEWAYS, BRIDGES, STRUCTURES, ETC., TO FIT FIELD CONDITIONS.
2. CONES OR DELINEATORS SHALL BE EXTENDED TO A POINT WHERE THEY ARE VISIBLE TO APPROACHING TRAFFIC.
3. TRAFFIC CONTROL DEVICES SHALL BE INSTALLED SUCH THAT THE SIGN OR DEVICE FARTHEST FROM THE WORK AREA SHALL BE PLACED FIRST. THE OTHERS SHALL THEN BE PLACED PROGRESSIVELY TOWARD THE WORK AREA.
4. REGULATORY AND WARNING SIGNS WITHIN THE CONSTRUCTION ZONE THAT ARE IN CONFLICT WITH THE TRAFFIC CONTROL PLANS SHALL BE REMOVED OR COVERED. ALL SIGNS SHALL BE RESTORED UPON COMPLETION OF THE WORK.
5. FLAGGERS AND/OR POLICE OFFICERS SHALL BE IN SIGHT OF EACH OTHER OR IN DIRECT COMMUNICATION AT ALL TIMES.
6. WHEN REQUIRED BY THE ISSUING OFFICE, THE PERMITTEE SHALL INSTALL A FLASHING ARROW SIGNAL AS SHOWN ON THE TRAFFIC CONTROL PLANS.
7. ALL TRAFFIC LANES SHALL BE A MINIMUM OF 10 FEET WIDE.
8. ALL CONSTRUCTION WARNING SIGNS SHALL BE PROMPTLY REMOVED OR COVERED WHENEVER THE MESSAGE IS NOT APPLICABLE OR NOT IN USE.
9. THE BACKS OF ALL SIGNS USED FOR TRAFFIC CONTROL SHALL BE APPROPRIATELY COVERED TO PRECLUDE THE DISPLAY OF INAPPLICABLE SIGN MESSAGES (I.E., WHEN SIGNS HAVE MESSAGES ON BOTH FACES).
10. AT THE END OF EACH DAY'S WORK OR AS SOON AS THE WORK IS COMPLETED, THE PERMITTEE SHALL REMOVE ALL TRAFFIC CONTROL DEVICES NO LONGER NEEDED TO PERMIT FREE AND SAFE PASSAGE OF PUBLIC TRAFFIC. REMOVAL SHALL BE IN THE REVERSE ORDER OF INSTALLATION. EXISTING FADED OR OBLITERATED PAVEMENT MARKINGS THAT ARE NECESSARY FOR SAFE TRAFFIC FLOW IN THE CONSTRUCTION AREA SHALL BE REPLACED WITH TEMPORARY OR PERMANENT MARKINGS BEFORE OPENING THE ROADWAY TO PUBLIC TRAFFIC EACH DAY.
11. PERMANENT PAVEMENT MARKINGS AND TRAFFIC SIGNS SHALL BE REPLACED UPON COMPLETION OF EACH PHASE OF WORK.
12. DRIVEWAYS SHALL BE KEPT OPEN UNLESS THE OWNERS OF THE PROPERTY USING THE RIGHT-OF-WAY ARE OTHERWISE PROVIDED FOR SATISFACTORILY. FURTHER, THE PERMITTEE SHALL CONTROL TRAFFIC GOING IN AND OUT OF DRIVEWAYS.
13. ALL CONES SPACED AT 10' O.C.

LEGEND



REVISION DATE	DESCRIPTION	MADE BY	APPROVED
Community Planning and Engineering, Inc. Engineering Design Construction Management Infrastructure Planning 1289 Queen Emma Street, Third Floor Honolulu, Hawaii			
OLAKINO STREET DRAINAGE IMPROVEMENTS KEOKEA & WAIOHULI, MAKAWAO, MAUI OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011			
TRAFFIC CONTROL PLAN			
DRAWN BY: JSO	ENGINEER: FJC	CHECKED BY: AMM	
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DRAINAGE STRUCTURE NOTES

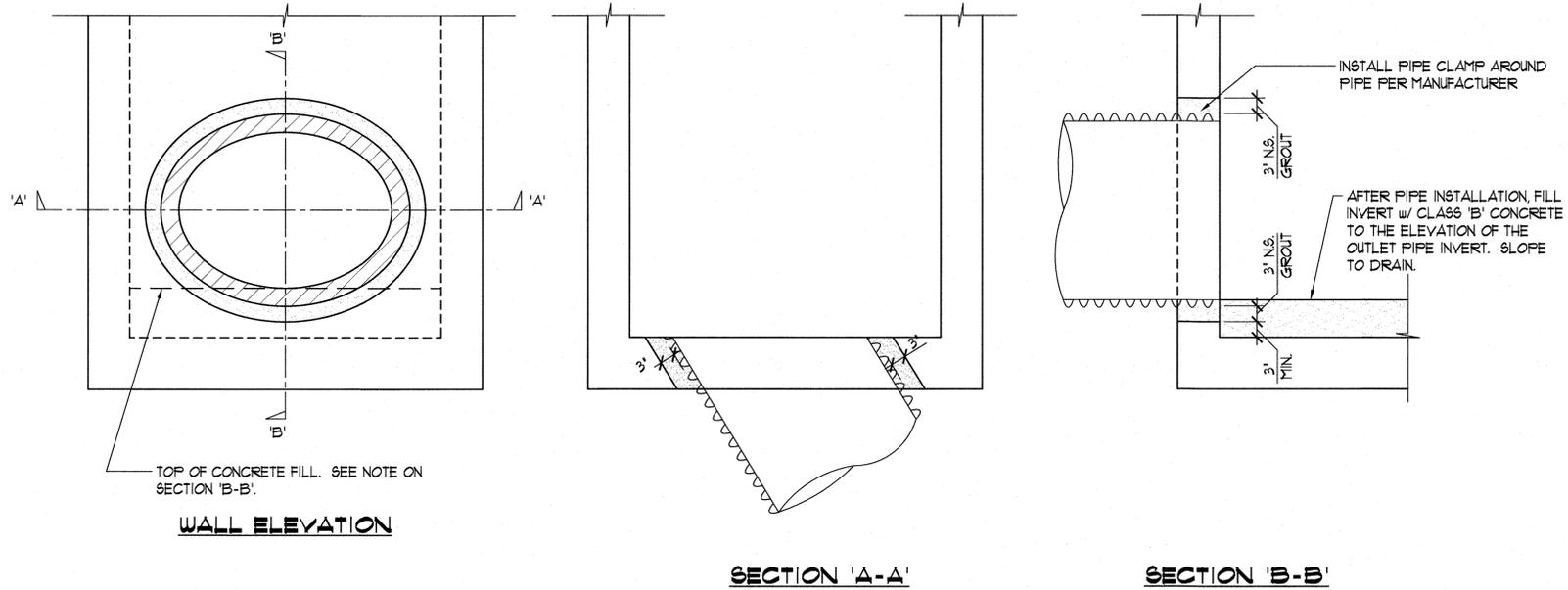
1. ALL WORK SHALL CONFORM TO THE 'STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION' (LATEST).
2. CONCRETE SHALL HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH & A MAXIMUM WATER TO CEMENT RATIO AS FOLLOWS:

	STRENGTH	W/C RATIO
DMH 4 DI	4,000 PSI	0.48
3. ALL REINFORCING STEEL SHALL CONFORM TO ASTM A615 GRADE 60.
4. MINIMUM COVER IN INCHES FOR REBARS FOR CAST-IN-PLACE AND PRECAST CONCRETE EXCEPT AS NOTED:

CONCRETE CAST AGAINST EARTH (C.I.P.)	3"
FORMED CONCRETE EXPOSED TO EARTH OR WEATHER	2"
5. UNLESS OTHERWISE NOTED, SPLICES, LAPS, DOVEL EXTENSIONS AND EMBEDMENTS SHALL BE 40 BAR DIAMETERS MINIMUM.
6. ALL REINFORCING BARS MARKED 'CONT.' OR 'TEMP.' SHALL BE LAPPED 40 BAR DIAMETERS MINIMUM.
 1. STAGGER ALL SPLICES WHERE POSSIBLE.
 2. REBARS SHALL BE SUPPORTED, BENT AND PLACED AS PER 'MANUAL OF STANDARD PRACTICE FOR DETAILING CONCRETE STRUCTURES' ACI 315 (LATEST).
 3. AT TIME CONCRETE IS PLACED, REINFORCING SHALL BE FREE FROM MUD, OIL, LAITANCE OR OTHER SUBSTANCES ADVERSELY AFFECTING BOND CAPACITY.
 4. FOR REINFORCING NOT SHOWN ON THE PLANS, FOLLOW LATEST APPROVED VERSION OF THE 'STANDARD DETAILS FOR PUBLIC WORK CONSTRUCTION' (STANDARD DETAILS).
 5. REINFORCEMENT, ANCHOR BOLTS, DOVELS AND ALL OTHER EMBEDDED ITEMS SHALL BE POSITIVELY SECURED BEFORE POURING.

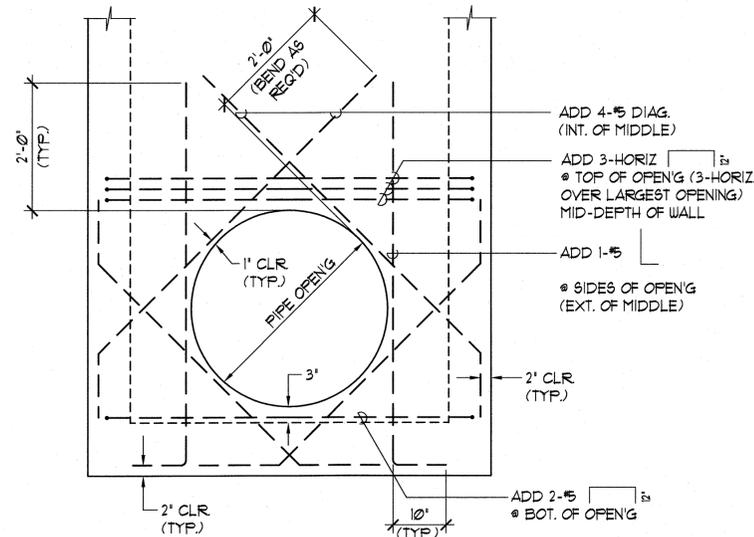
DESIGN CRITERIA

1. AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS BRIDGES SIXTH EDITION.
 - LIVE LOAD: HL-93
 - EARTH LOAD: 60 PCF AT-REST PRESSURE



PIPE OPEN'G LIMITATIONS FOR BOXES

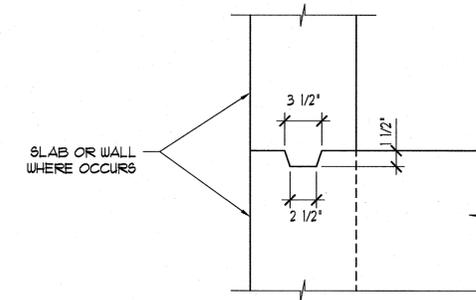
N.T.S.



ELEVATION

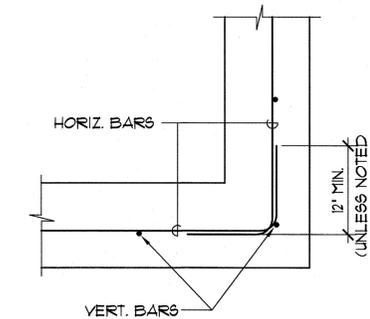
TYP. ADDED REINF. AT PIPES

N.T.S.



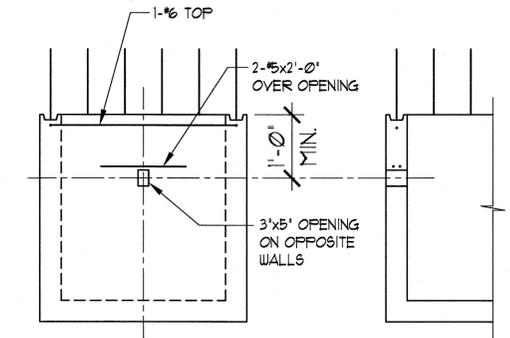
TYPICAL KEY DETAIL

N.T.S.



PLAN - TYP. CORNER REINFORCEMENT LAPPING

N.T.S.



TYPICAL LIFTING EYE DETAIL FOR P.C.B.

N.T.S.



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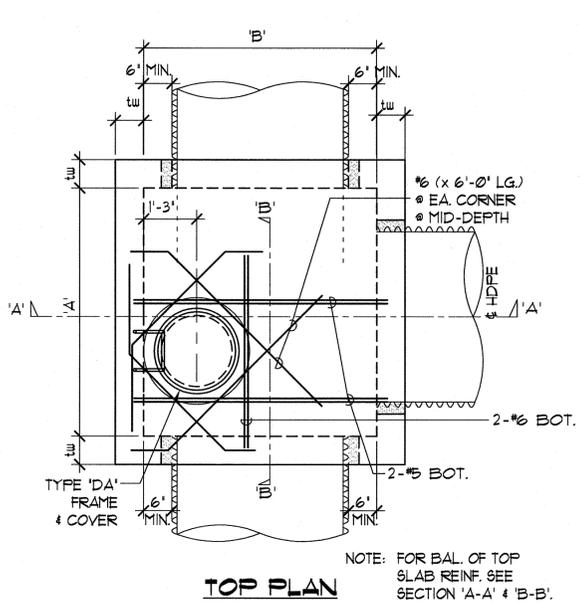
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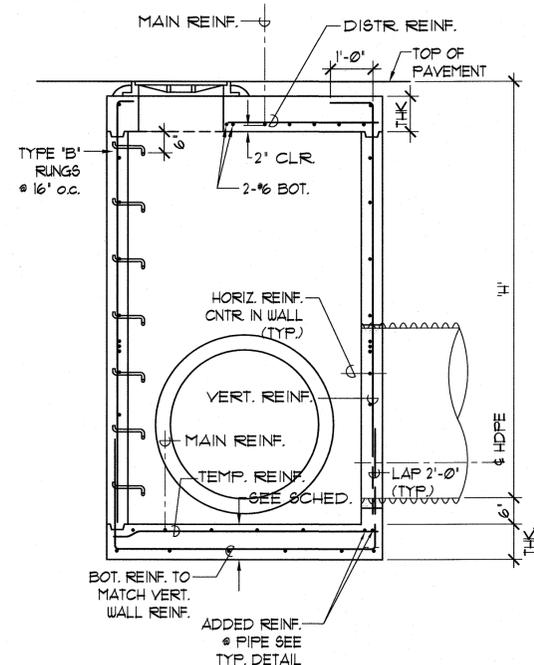
OLAKINO STREET DRAINAGE IMPROVEMENTS
 KEOKEA & WAIHOHULI, MAKAWAO, MAUI
 OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
 TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011

GENERAL NOTE & TYP. DETAILS

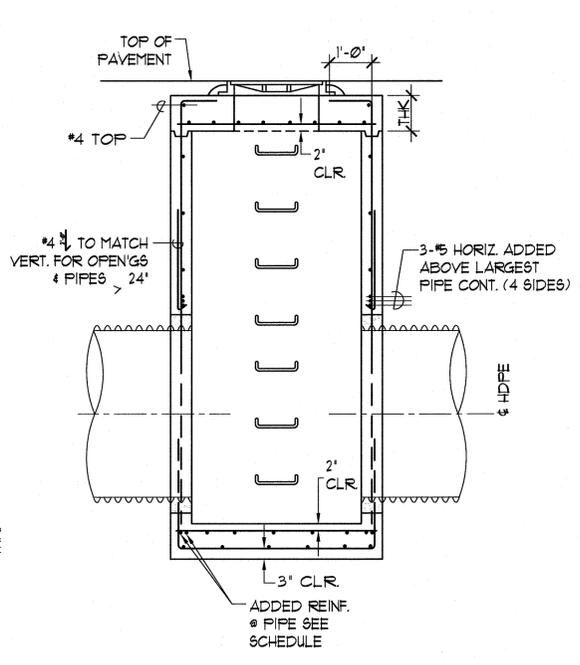
DRAWN BY: ENGINEER: CHECKED BY:



TOP PLAN



SECTION 'A-A'



SECTION 'B-B'

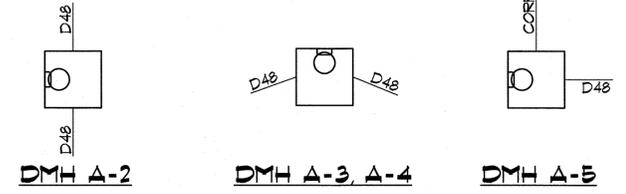
SLAB REINFORCING SCHEDULE										SDMH TRAFFIC	
MARK	"H" MAX	"A"	"B"	tw	THK.	TOP SLAB REINF.			INVERT SLAB REINF.		
						MAIN	REINF. DISTRIB.	THK.	MAIN	TEMP.	
A-2, A-5	8'	5'-10"	5'-10"	8"	10"	5#5'o.c.	5#10'o.c.	10"	4#9'o.c.	4#9'o.c.	
A-3, A-4	10'	4'-0"	6'-6"	8"	10"	5#5'o.c.	5#10'o.c.	10"	4#9'o.c.	4#9'o.c.	

WALL REINFORCING SCHEDULE				
MARK	A-2, A-5	A-3, A-4	MARK	
tw	8"	8"	tw	
VERT. REINF.	5#4'o.c.	6#4'o.c.	VERT. REINF.	
"H"	HORIZ. REINF. (CENTERED IN WALL)		"H"	
0'-0" TO 2'-0"	4#1'o.c.	4#1'o.c.	0'-0" TO 2'-0"	
2'-0" TO 3'-0"			2'-0" TO 3'-0"	
3'-0" TO 4'-0"			3'-0" TO 4'-0"	
4'-0" TO 5'-0"		4#5'o.c.	4'-0" TO 5'-0"	
5'-0" TO 6'-0"			5'-0" TO 6'-0"	
6'-0" TO 9'-0"			6'-0" TO 9'-0"	
9'-0" TO 10'-0"			9'-0" TO 10'-0"	

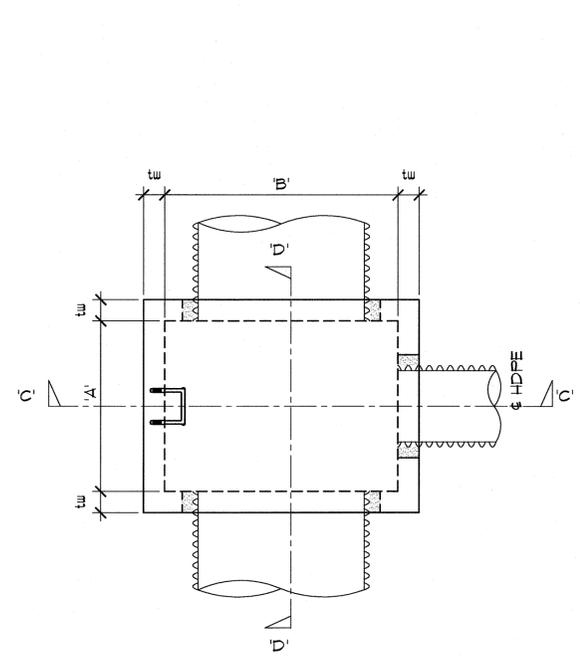
ADDED REINF. @ PIPE	
PIPE SIZE	REINF.
48"	2-5

SPECIAL DRAIN MANHOLE DETAIL
SC: 1/2"=1'-0"

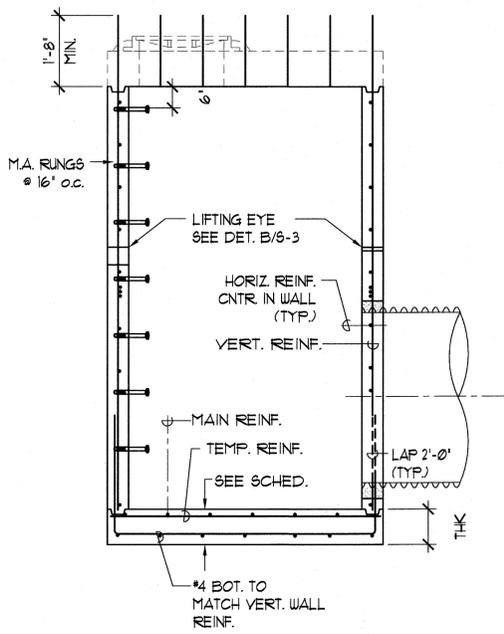
6-2



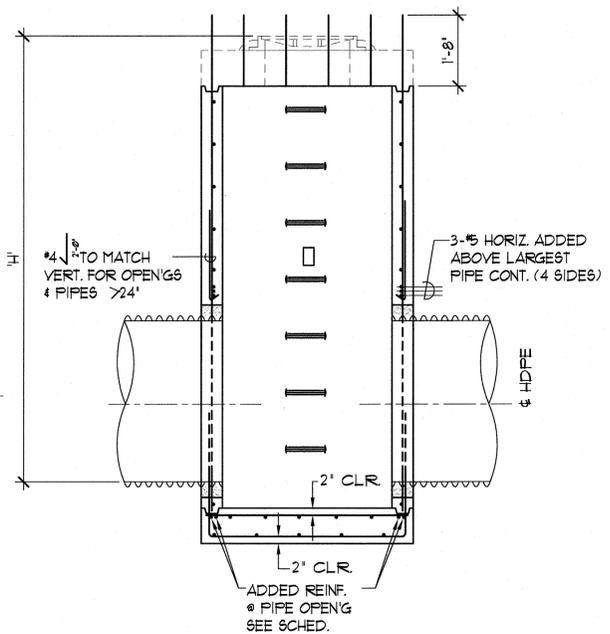
DRAIN MANHOLE SCHEMATICS
N.T.S. C 6-2



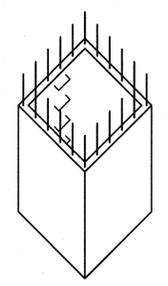
TOP PLAN (RUNGS CENTERED)



SECTION 'C-C'



SECTION 'D-D'

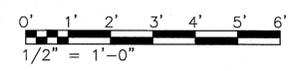


ISOMETRIC
N.T.S.

- PRECAST NOTES:**
- TOP SLAB TO BE CAST-IN-PLACE IN FIELD. FOLLOW REINF. & DETAILS SHOWN ON DET. A/6-2.
 - FOR DIMENSIONS & REINF. FOLLOW SCHEDULES SHOWN ON ABOVE.
 - SEE SHEET S-1 FOR GENERAL NOTES & TYPICAL DETAILS.
 - DRAIN MANHOLES SHALL KEEP CLEAR OF THE CONCRETE CURB AND GUTTER.

PRECAST SPECIAL DRAIN MANHOLE DETAIL
SC: 1/2"=1'-0"

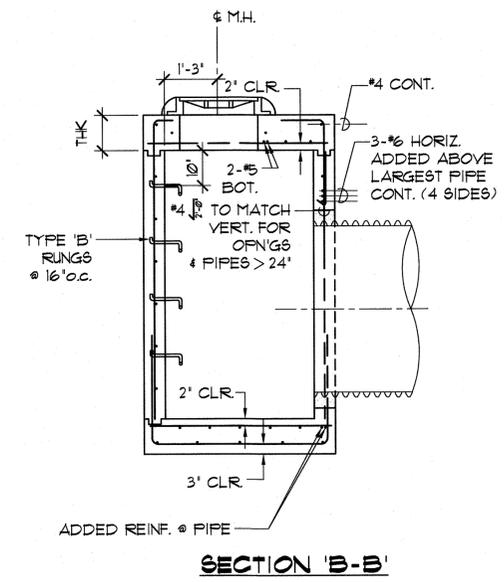
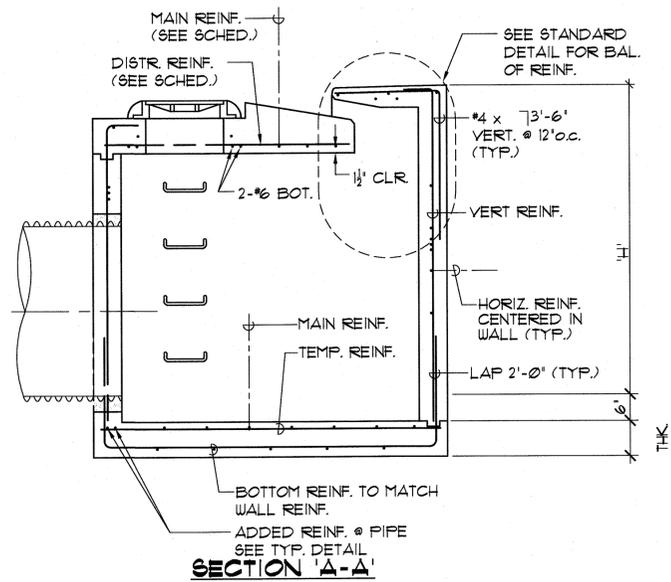
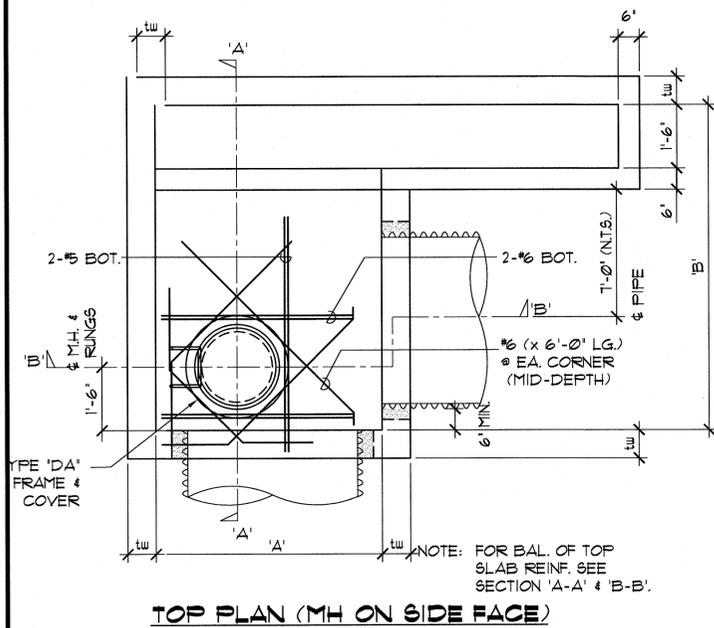
6-2



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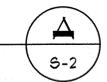
REVISION DATE	DESCRIPTION	MADE BY	APPROVED
Community Planning and Engineering, Inc. Engineering Design Construction Management Infrastructure Planning 1285 Queen Emma Street, Third Floor Honolulu, Hawaii			
OLAKINO STREET DRAINAGE IMPROVEMENTS KEOKEA & WAIHOLI, MAKAWAO, MAUI OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011			
DMH C.I.P. & PRECAST DETAILS			
DRAWN BY:	ENGINEER:	CHECKED BY:	



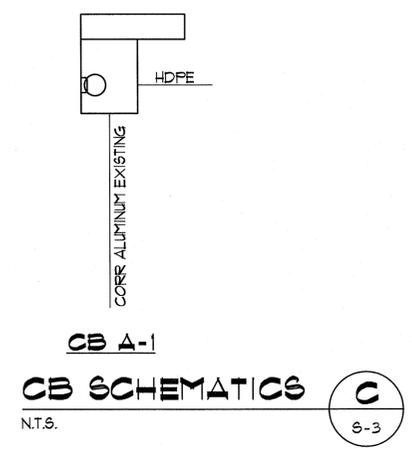
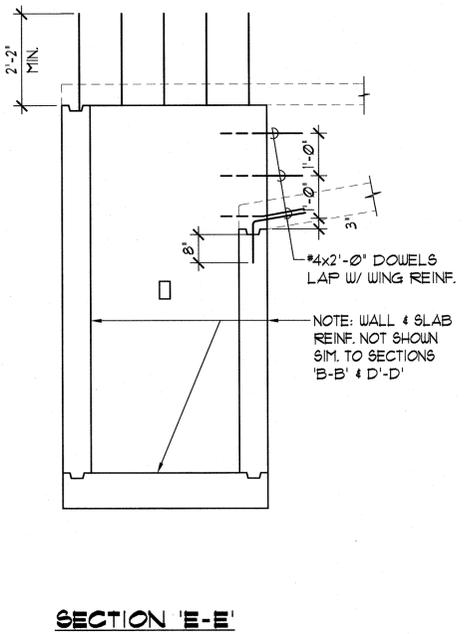
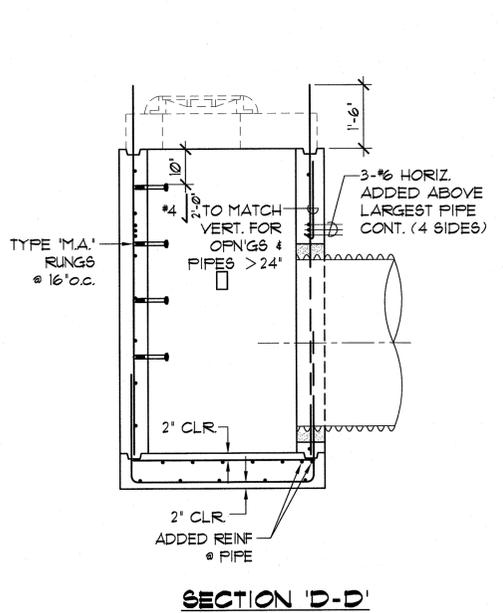
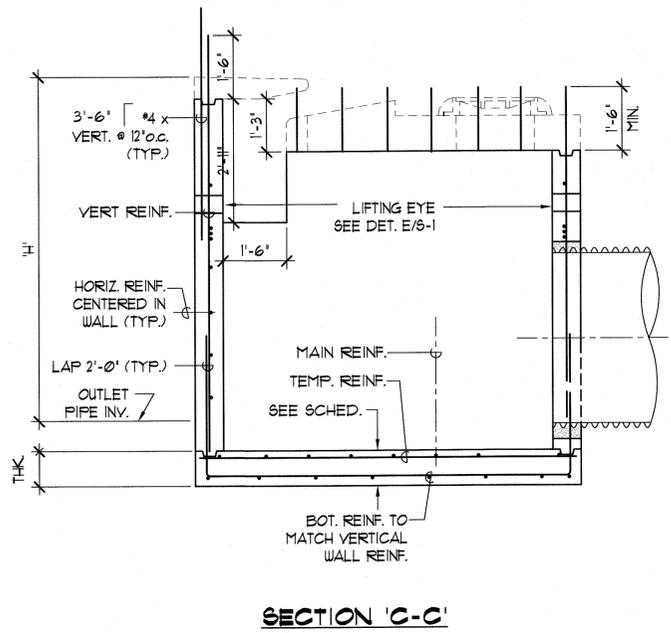
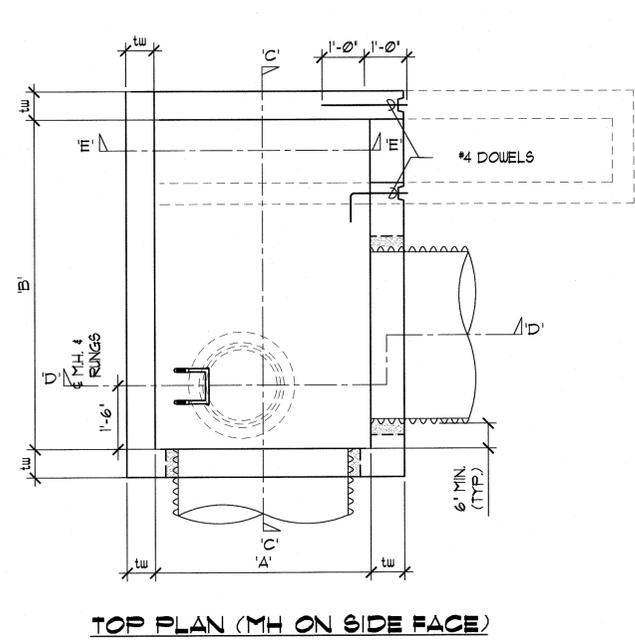
SLAB REINFORCING SCHEDULE										
MARK	"H" MAX.	"A"	"B"	tw	THK	TOP SLAB REINF.		INVERT SLAB REINF.		
						MAIN	REINF. DISTRIB.	THK.	MAIN	TEMP.
A-1	8.56'	5'-1"	12'-0"	8'	10'	5 # 5'oc.	5 # 10'oc.	12'	5 # 12'oc.	5 # 14'oc.

WALL REINFORCING SCHEDULE				ADDED REINF. @ PIPE	
MARK	A-4	MARK	PIPE SIZE	REINF.	
tw	8"	tw	48"	2-#5	
VERT. REINF.	#5 @ 4'oc.	VERT. REINF.			
"H"	HORIZ. REINF. (CENTERED IN WALL)	"H"			
0'-0" to 2'-0"	#6 @ 6'oc.	0'-0" to 2'-0"			
2'-0" to 3'-0"		2'-0" to 3'-0"			
3'-0" to 4'-0"	#6 @ 4'oc.	3'-0" to 4'-0"			
4'-0" to 5'-0"		4'-0" to 5'-0"			
5'-0" to 7'-0"		5'-0" to 7'-0"			
7'-0" to 9'-0"		7'-0" to 9'-0"			
9'-0" to 12'-0"		9'-0" to 12'-0"			

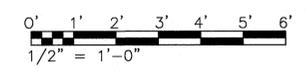
SPECIAL TYPE 'B' CATCH BASIN DETAILS
SC: 1/2" = 1'-0"



- PRECAST NOTES:**
- TOP SLAB TO BE CAST-IN-PLACE IN FIELD. FOLLOW REINF. & DETAILS SHOWN ON DET. A/6-3.
 - FOR DIMENSIONS & REINF. FOLLOW SCHEDULES SHOWN ABOVE.
 - SEE SHEET S-1 FOR GENERAL NOTES & TYPICAL DETAILS.



SPECIAL TYPE 'B' PRECAST CATCH BASIN DETAILS
SC: 1/2" = 1'-0"



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REVISION DATE	DESCRIPTION	MADE BY	APPROVED

Community Planning and Engineering, Inc.
Engineering Design | Construction Management | Infrastructure Planning
1286 Queen Emma Street, Third Floor Honolulu, Hawaii

OLAKINO STREET DRAINAGE IMPROVEMENTS
KEOKEA & WAIHOHULI, MAKAWAO, MAUI
OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
TAX MAP KEYS: (2) 2-2-032: 056 & 071 AND (2) 2-2-033: 011

CATCH BASIN C.I.P. & PRECAST DETAILS

DRAWN BY:	ENGINEER:	CHECKED BY:

GENERAL NOTES

- LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE BASED ON AVAILABLE "AS-BUILT" OR RECORD CONSTRUCTION PLANS AND ARE APPROXIMATE ONLY AND THEIR ACCURACY IS NOT GUARANTEED.
- EXISTING CONTOURS AND FEATURES ARE BASED ON "TOPOGRAPHIC SURVEY OF KEOKEA FARM LOTS" PREPARED BY AUSTIN TSUTSUMI & ASSOCIATES, INC. DATED MAY 18, 2001.
- ELEVATIONS SHOWN ARE BASED ON PROJECT BENCHMARK - 1/2 INCH PIPE FOUND ON SOUTH SIDE OF KULA HIGHWAY AND SOUTHERLY SIDE OF PROJECT SITE ELEVATION = 2,752.73 FEET.
- EXISTING GRADES SHALL BE VERIFIED BY THE CONTRACTOR BEFORE PROCEEDING WITH GRADING WORK. SHOULD ANY DISCREPANCIES BE DISCOVERED IN THE EXISTING GRADES OR DIMENSIONS GIVEN ON THE PLANS, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER BEFORE PROCEEDING ANY FURTHER WITH THE WORK, OTHERWISE HE WILL BE HELD RESPONSIBLE FOR ANY COST INVOLVED IN THE CORRECTION OF CONSTRUCTION PLACED DUE TO SUCH DISCREPANCIES.
- THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF EXISTING UTILITIES WITHIN PROJECT LIMITS BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR DAMAGES DUE TO THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ALL UNDERGROUND UTILITIES.
- THE CONTRACTOR SHALL REPORT ANY INCONSISTENCIES WITH THE PROPOSED PLAN TO THE OWNER'S REPRESENTATIVE AND SHALL DEMOLISH, REMOVE, OR RELOCATE ALL EXISTING UTILITIES, IMPROVEMENTS, ETC. INCONSISTENT WITH THE PROPOSED PLAN AS DIRECTED BY THE OWNER'S REPRESENTATIVE AND AT THE CONTRACTOR'S EXPENSE.
- THE LATEST REVISIONS OF THE "STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION," SEPTEMBER 1984 AND THE "HAWAII STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND PUBLIC WORKS CONSTRUCTION," 1994 SHALL BE INCLUDED AS PART OF THESE CONSTRUCTION PLANS. THE CONTRACTOR SHALL OBTAIN THE LATEST REVISIONS BEFORE COMMENCING CONSTRUCTION. THE FOLLOWING DETAILS SHOWN IN "STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION," DATED SEPTEMBER 1984, AS AMENDED, SHALL BE APPLICABLE TO THIS PROJECT:
- IF HISTORIC SITES SUCH AS WALLS, PLATFORMS, PAVEMENTS AND MOUNDS OR REMAINS SUCH AS ARTIFACTS, BURIALS, CONCENTRATION OF CHARCOAL OR SHELLS ARE ENCOUNTERED DURING CONSTRUCTION WORK, WORK SHALL CEASE IN THE IMMEDIATE VICINITY OF THE FIND AND THE FIND SHALL BE PROTECTED FROM FURTHER DAMAGE. THE CONTRACTOR SHALL IMMEDIATELY CONTACT THE STATE HISTORIC PRESERVATION DIVISION (243-5169), WHICH WILL ASSESS THE SIGNIFICANCE OF THE FIND AND RECOMMEND MITIGATION MEASURES, IF NECESSARY.
- PURSUANT TO CHAPTER 6E OF THE HAWAII REVISED STATUTES, ALL CONTRACTORS SHALL ENSURE THAT IN THE EVENT THAT ANY HUMAN SKELETAL REMAINS ARE INADVERTENTLY DISCOVERED DURING CONSTRUCTION, THE REMAINS SHALL NOT BE MOVED AND ANY ACTIVITY IN THE IMMEDIATE AREA THAT COULD DAMAGE THE REMAINS OR THE POTENTIAL HISTORIC SITE SHALL CEASE AND THE DEPARTMENT OF LAND AND NATURAL RESOURCES' HISTORIC PRESERVATION DIVISION (TELEPHONE : 243-1285), THE APPROPRIATE MEDICAL EXAMINER OR CORONER, AND THE POLICE DEPARTMENT (TELEPHONE:244-6400), SHALL BE CONTACTED.
- ALL LESSEES USING EXISTING DIRT ROADS TO ACCESS THEIR PROPERTY SHALL CONTINUE TO BE PROVIDED ACCESS TO THEIR PROPERTY AT ALL TIMES DURING CONSTRUCTION ACTIVITIES BY THE CONTRACTOR.
- PRIOR TO ANY LAND ALTERATION, ALL TASKS OF THE HISTORIC SITES INTERIM PROTECTION PLAN MUST BE IN PLACE FOR THE ISOLATED NON-BURIAL SITES TO BE PRESERVED AND THE HISTORIC PRESERVE. ISOLATED SIGNIFICANT HISTORIC SITES AND THE HISTORIC PRESERVE MUST HAVE PROTECTION MEASURES IN PLACE PRIOR TO ANY LAND ALTERATION. SUCH PROTECTION SHALL INCLUDE PERMANENT FENCING AND TEMPORARY PLASTIC CONSTRUCTION FENCING. THE CONSTRUCTION CREWS MUST BE BRIEFED ON THE IMPORTANCE OF THESE PROTECTIVE MEASURES.

NOTES FOR CONSTRUCTION WITHIN COUNTY RIGHT-OF-WAY

- THE CONTRACTOR SHALL OBTAIN A PERMIT TO PERFORM WORK ON COUNTY HIGHWAYS FROM THE DEVELOPMENT SERVICES ADMINISTRATION TWO WEEKS PRIOR TO THE COMMENCEMENT OF WORK.
- STANDARD DETAIL DRAWINGS AND STANDARD SPECIFICATIONS OF THE DEPARTMENT OF PUBLIC WORKS SHALL BE INCLUDED AS PART OF THE CONSTRUCTION PLANS.
- ALL CONSTRUCTION WORK SHALL STRICTLY CONFORM TO THE APPLICABLE SECTIONS OF THE HAWAII STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND PUBLIC WORKS CONSTRUCTION, AND THE SEPTEMBER 1984 "STANDARD DETAILS" FOR PUBLIC WORKS CONSTRUCTION OF THE DEPARTMENT OF PUBLIC WORKS, AS AMENDED.
- IF EXISTING UTILITIES, WHETHER OF NOT SHOWN ON PLANS, ARE DAMAGED DURING CONSTRUCTION, THE CONTRACTOR SHALL AT HIS OWN EXPENSE BE REQUIRED TO REPAIR SUCH UTILITIES.
- THE CONTRACTOR SHALL PROVIDE, INSTALL AND MAINTAIN ALL NECESSARY SIGNS, LIGHTS, FLARES, BARRICADES, AND OTHER PROTECTIVE DEVICES FOR THE PROTECTION, SAFETY AND CONVENIENCE OF THE PUBLIC, ACCORDING TO THE LATEST VERSIONS OF "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICE FOR STREETS AND HIGHWAYS", AND TO THE RULES AND REGULATIONS GOVERNING THE USE OF TRAFFIC CONTROL DEVICES AT WORKSITES AND/OR ADJACENT TO THE PUBLIC STREETS AND HIGHWAYS ADOPTED BY THE HIGHWAY SAFETY COORDINATOR AND THE U.S. FEDERAL HIGHWAY ADMINISTRATION "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR HIGHWAY CONSTRUCTION AND MAINTENANCE OPERATIONS", DATED 2003.
- THE DIRECTOR OF PUBLIC WORKS AND/OR THE DIRECTOR OF THE DEPARTMENT OF WATER SUPPLY HAS THE RIGHT TO STOP CONSTRUCTION SHOULD ANY WORK BE FOUND CONTRARY TO THE APPROVED CONSTRUCTION PLAN OR DETRIMENTAL TO THE PUBLIC'S INTEREST.

NOTES FOR CONSTRUCTION WITHIN COUNTY RIGHT-OF-WAY: CONT'D

- THE CONTRACTOR SHALL SCHEDULE A PRE-CONSTRUCTION MEETING WITH THE DEVELOPMENT SERVICES ADMINISTRATION FIVE (5) DAYS PRIOR TO COMMENCEMENT OF CONSTRUCTION.
- THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, KEEP THE PROJECT AREA AND SURROUNDING AREA FREE FROM DUST NUISANCE. THE WORK SHALL BE IN CONFORMANCE WITH AIR POLLUTION CONTROL STANDARDS AND REGULATIONS OF THE STATE DEPARTMENT OF HEALTH AND COUNTY GRADING ORDINANCE.
- THE CONTRACTOR SHALL REMOVE ALL SILT AND DEBRIS RESULTING FROM HIS WORK AND DEPOSITED IN DRAINAGE FACILITIES, ROADWAYS AND OTHER AREAS. THE COST INCURRED FOR ANY NECESSARY REMEDIAL ACTION ORDERED BY THE DIRECTOR OF PUBLIC WORKS SHALL BE PAID BY THE CONTRACTOR.
- CONSTRUCTION DEBRIS AND WASTES SHALL BE DEPOSITED AT AN APPROPRIATE WORK SITE. THE CONTRACTOR SHALL INFORM THE DIRECTOR OF PUBLIC WORKS OF THE LOCATION OF THE DISPOSAL SITES. THE DISPOSAL SITE MUST FULFILL THE REQUIREMENTS OF THE GRADING ORDINANCES.
- THE CONTRACTOR SHALL SUBMIT A TIF AND FIVE (5) COPIES OF THE "AS-BUILT" DRAWINGS PRIOR TO THE FINAL APPROVAL OF THE IMPROVEMENTS.

DEPARTMENT OF PUBLIC WORKS NOTES

- THE CONTRACTOR SHALL ALLOW FOUR WEEKS TO OBTAIN A GRADING PERMIT FROM THE DSA PRIOR TO COMMENCEMENT OF ANY CLEARING AND GRUBBING. A SATISFACTORY DRAINAGE AND EROSION CONTROL PLAN SHALL BE SUBMITTED IN THE EVENT THE GRUBBING AREA EXCEEDS ONE ACRE OR THE PROPOSED CUT OR FILL IS GREATER THAN 15 FEET IN HEIGHT. THE CONTRACTOR SHALL PROVIDE, INSTALL AND MAINTAIN ALL BEST MANAGEMENT PRACTICE MEASURES.
- THE CONTRACTOR SHALL PROVIDE, INSTALL AND MAINTAIN ALL NECESSARY SIGNS, LIGHTS, FLARES, BARRICADES, AND OTHER PROTECTIVE DEVICES FOR THE PROTECTION, SAFETY AND CONVENIENCE OF THE PUBLIC AND IN ACCORDANCE WITH THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREET AND HIGHWAY, 2003." THE CONTRACTOR SHALL PREPARE AND OBTAIN NECESSARY APPROVALS OF TRAFFIC CONTROL PLANS IF REQUIRED BY THE DSA.
- STANDARD DETAIL DRAWINGS OF THE DEPARTMENT OF PUBLIC WORKS AND THE HAWAII STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND PUBLIC WORKS CONSTRUCTION (2005) AS AMENDED, SHALL BE INCLUDED AS PART OF THE CONSTRUCTION PLANS.
- ALL CONSTRUCTION WORK SHALL STRICTLY CONFORM TO THE APPLICABLE SECTIONS OF THE 2005 HAWAII STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND PUBLIC WORKS CONSTRUCTION, AS AMENDED, AND THE SEPTEMBER 1984 "STANDARD DETAILS" FOR PUBLIC WORKS CONSTRUCTION OF THE DEPARTMENT OF PUBLIC WORKS, AS AMENDED.
- THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, KEEP THE PROJECT AREA AND SURROUNDING AREA FREE FROM DUST NUISANCE. THE WORK SHALL BE IN CONFORMANCE WITH AIR POLLUTION CONTROL STANDARDS AND REGULATIONS OF THE STATE DEPARTMENT OF HEALTH AND COUNTY GRADING ORDINANCE.
- THE CONTRACTOR SHALL REMOVE ALL SILT AND DEBRIS RESULTING FROM HIS WORK AND DEPOSITED IN DRAINAGE FACILITIES, ROADWAYS AND OTHER AREAS. THE COSTS INCURRED FOR ANY NECESSARY REMEDIAL ACTION ORDERED BY THE DIRECTOR OF PUBLIC WORKS SHALL BE PAID BY THE CONTRACTOR.
- PURSUANT TO MAUI COUNTY CODE SECTION 3.44.015(C), THE COUNTY OF MAUI IS NOT RESPONSIBLE FOR ANY PARK, ROADWAY, EASEMENT (INCLUDING BUT NOT LIMITED TO DRAINAGE, SEWER, ACCESS, RECLAIMED WATER, OR IRRIGATION EASEMENT), OR ANY OTHER INTEREST IN REAL PROPERTY SHOWN ON THIS MAP OR SHOWN ON THESE PLANS, UNLESS THE MAUI COUNTY COUNCIL HAS ACCEPTED ITS DEDICATION BY A RESOLUTION APPROVED BY A MAJORITY OF COUNCIL'S MEMBERS AT A REGULAR OR SPECIAL MEETING OF THE MAUI COUNTY COUNCIL.

GRADING NOTES

- FINISH SPOT ELEVATIONS AND FINISH CONTOURS, AS SHOWN ON PLAN REPRESENTS FINISH GRADING. THE SITEWORK CONTRACTOR SHALL COORDINATE WITH THE LANDSCAPE CONTRACTOR THE LOCATION AND DEPTH OF TOPSOIL. THE FINISH SUBGRADE SHALL REFLECT THE FINISH GRADE LESS SPECIFIED TOPSOIL DEPTH.
- THE CONTRACTOR SHALL IMPLEMENT AND MAINTAIN THE MEASURES OF THE BEST MANAGEMENT PRACTICE (BMP) PLAN. ALL GRADING OPERATIONS SHALL BE PERFORMED IN CONFORMANCE WITH THE APPLICABLE PROVISIONS OF THE WATER POLLUTION CONTROL AND WATER QUALITY STANDARDS CONTAINED IN THE PUBLIC HEALTH REGULATIONS, STATE DEPARTMENT OF HEALTH, ON WATER POLLUTION CONTROL AND WATER QUALITY STANDARDS.
- THE CONTRACTOR SHALL REMOVE ALL SILT AND DEBRIS RESULTING FROM HIS WORK AND DEPOSITED IN DRAINAGE FACILITIES, ROADWAYS, AND OTHER AREAS. THE COSTS INCURRED FOR ANY NECESSARY REMEDIAL ACTION BY THE STATE DEPARTMENT OF HEALTH SHALL BE PAYABLE BY THE CONTRACTOR.
- THE CONTRACTOR, AT HIS EXPENSE, SHALL KEEP THE PROJECT AREA AND SURROUNDING AREA FREE OF DUST NUISANCE. THE WORK SHALL BE IN CONFORMANCE WITH THE AIR POLLUTION CONTROL STANDARDS AND REGULATIONS OF THE STATE DEPARTMENT OF HEALTH.
- CONSTRUCTION DEBRIS, ASH MATERIAL, AND WASTES SHALL BE DEPOSITED AT AN APPROPRIATE SITE. THE CONTRACTOR SHALL INFORM THE ENGINEER OF THE LOCATION OF DISPOSAL SITES. THE DISPOSAL SITE MUST ALSO FULFILL REQUIREMENTS OF THE GRADING ORDINANCES.
- THE CONTRACTOR SHALL NOT DEMOLISH OR CLEAR ANY STRUCTURE, SITE OR VACANT LOT WITHOUT FIRST ASCERTAINING THE PRESENCE OR ABSENCE OF RODENTS WHICH MAY ENDANGER THE PUBLIC HEALTH BY DISPERSAL FROM SUCH PREMISES. SHOULD SUCH INSPECTION REVEAL THE PRESENCE OF SUCH RODENTS, THE CONTRACTOR SHALL ERADICATE SUCH RODENTS BEFORE DEMOLISHING OR CLEARING SAID STRUCTURE, SITE OR VACANT LOT.
- THE FOLLOWING MEASURES SHALL BE TAKEN TO CONTROL DUST AND EROSION DURING THE SITE DEVELOPMENT PERIOD:
 - MINIMIZE TIME OF CONSTRUCTION.
 - RETAIN EXISTING GROUND COVER UNTIL THE LATEST DATE TO COMPLETE CONSTRUCTION.
 - CONSTRUCT REMAINING PERMANENT EROSION AND DRAINAGE CONTROL FEATURES AS EARLY AS POSSIBLE.
 - USE TEMPORARY AREA SPRINKLERS IN NON-ACTIVE CONSTRUCTION AREAS WHEN GROUND COVER IS REMOVED.
 - STATION WATER TRUCK ON-SITE DURING CONSTRUCTION PERIOD TO PROVIDE FOR IMMEDIATE SPRINKLING, AS NEEDED, IN ACTIVE CONSTRUCTION AREAS (WEEKENDS AND HOLIDAYS INCLUDED).
 - USE TEMPORARY BERMS AND CUT-OFF DITCHES, WHERE NEEDED, FOR CONTROL OF EROSION. IMPLEMENT AND MAINTAIN THE MEASURES OF THE BMP PLAN.
 - GRADED AREAS SHALL BE THOROUGHLY WATERED AFTER CONSTRUCTION ACTIVITY HAS CEASED FOR THE DAY AND ON WEEKENDS.
 - ALL CUT AND FILL SLOPES SHALL BE SODDED OR PLANTED IMMEDIATELY AFTER GRADING WORK HAS BEEN COMPLETED.

COMPACTION REQUIREMENTS

- TESTING OF MATERIALS SHALL BE CONDUCTED BY AN APPROVED INDEPENDENT TESTING AGENCY IN ACCORDANCE WITH ASTM STANDARD METHODS OR AS SPECIFIED BY THE DEPARTMENT OF PUBLIC WORKS, ENGINEERING DIVISION, AS FOLLOWS:
 - EMBANKMENT/SELECT BORROW AND SUBGRADE MATERIALS: ONE (1) COMPACTION TEST PER 600 SQUARE YARDS PER LIFT;
 - TRENCH BACKFILL MATERIAL: ONE (1) TEST FOR EACH 300 LINEAL FEET OF TRENCH PER LIFT OF MATERIAL.
- CONTRACTOR SHALL SUBMIT ALL TESTING REPORTS INCLUDING RESULTS TO THE COUNTY'S INSPECTION AGENCY FOR REVIEW AND APPROVAL PRIOR TO COUNTY'S ACCEPTANCE OF WORK.
- THE CONTRACTOR SHALL BE REQUIRED TO NOTIFY THE COUNTY OF ANY TESTING FAILURES AND CORRECT EACH FAILURE PRIOR TO PROCEEDING TO THE NEXT PHASE OF CONSTRUCTION.

DISABILITY AND COMMUNICATION ACCESS BOARD (DCAB) REQUIREMENTS

- WHERE PEDESTRIAN WALKWAYS EXIST, THEY SHALL BE MAINTAINED IN PASSABLE CONDITION OR OTHER FACILITIES FOR PEDESTRIANS SHALL BE PROVIDED. PASSAGE BETWEEN WALKWAYS AT INTERSECTIONS SHALL LIKEWISE BE PROVIDED. TEMPORARY PEDESTRIAN PASSAGES SHALL BE ACCESSIBLE PER ADAAG 201.3 AND SHALL COMPLY W/ADAAG 206.1.

BEST MANAGEMENT PRACTICES NOTES

- ALL GRADED AREAS SHALL BE PROTECTED FROM EROSION BY HYDROMULCHING EXPOSED AREAS AS SOON AS GRADES ARE ATTAINED.
- ALL TEMPORARY EROSION CONTROL MEASURES, SUCH AS SILT FENCES, STABILIZED CONSTRUCTION ENTRANCE, AND HYDROMULCHING SHALL BE INSTALLED AND MAINTAINED UNTIL SUCH TIME PERMANENT EROSION CONTROL MEASURES ARE ESTABLISHED.
- HYDROMULCHING AREAS SHALL BE MAINTAINED UNTIL GRASS HAS BEEN ESTABLISHED.

TEMPORARY EROSION CONTROL NOTES

- FOLLOW SEQUENCE OF OPERATION AS RECOMMENDED BY THE "SOIL EROSION STANDARDS AND GUIDELINES," DEPARTMENT OF PUBLIC WORKS, CITY AND COUNTY OF HONOLULU, NOV. 1975.
- SILT FENCING SHALL BE USED AS SHOWN AND AT SELECTED LOCATIONS, AS SHOWN ON PLANS. ADDITIONAL SILT FENCING SHALL BE INSTALLED AS DIRECTED BY THE OFFICER-IN-CHARGE.
- THE CONTRACTOR SHALL MINIMIZE THE AMOUNT OF LAND TO BE EXPOSED AT ANY ONE TIME.
- ALL GRADED AREAS SHALL BE HYDROMULCHED IN ORDER TO PREVENT EROSION AND SILT RUNOFF. TWO APPLICATIONS OF HYDROMULCHING SHALL BE PROVIDED DURING THE DURATION OF CONSTRUCTION.
- THE ABOVE PROCEDURE FOR EROSION AND SEDIMENT CONTROL MAY BE REVISED BY THE CONTRACTOR TO CONFORM TO HIS GRADING OPERATION PROCEDURE. HOWEVER, ANY REVISIONS TO THE ABOVE SHALL BE SUBMITTED TO THE DEPARTMENT OF PUBLIC WORKS' (DPW) CHIEF ENGINEER FOR APPROVAL, BY THE CONTRACTOR. A COPY OF THE APPROVED PLAN SHALL BE SUBMITTED TO THE OFFICER-IN-CHARGE PRIOR TO STARTING WORK.

GRUBBING

- ALL GRUBBING WORK SHALL BE DONE IN ACCORDANCE WITH THE SOILS REPORTS BY PSC DATED MARCH 2005 AND APRIL 2013.
- NO CONTRACTOR SHALL PERFORM ANY GRUBBING OPERATION SO AS TO CAUSE FALLING ROCKS, SOIL OR DEBRIS IN ANY FORM TO FALL, SLIDE OR FLOW ONTO ADJOINING PROPERTIES, STREETS OR NATURAL WATERCOURSES. SHOULD SUCH VIOLATIONS OCCUR, THE CONTRACTOR MAY BE CITED AND THE CONTRACTOR SHALL IMMEDIATELY MAKE ALL REMEDIAL ACTIONS NECESSARY.
- THE CONTRACTOR, AT HIS OWN EXPENSE, SHALL KEEP THE PROJECT AREA AND SURROUNDING AREA FREE FROM DUST NUISANCE. THE WORK SHALL BE IN CONFORMANCE WITH THE AIR POLLUTION CONTROL STANDARDS CONTAINED IN THE HAWAII ADMINISTRATIVE RULES, CHAPTER 11-60, "AIR POLLUTION CONTROL."
- ADEQUATE PROVISIONS SHALL BE MADE TO PREVENT SURFACE WATERS FROM DAMAGING THE CUT FACE OF AN EXCAVATION OR THE SLOPED SURFACES OF A FILL. FURTHERMORE, ADEQUATE PROVISIONS SHALL BE MADE TO PREVENT SEDIMENT-LADEN RUNOFF FROM LEAVING THE SITE.
- ALL GRUBBED AREAS SHALL BE SODDED OR PLANTED IMMEDIATELY AFTER THE GRUBBING WORK HAS BEEN COMPLETED.
- THE COUNTY SHALL BE INFORMED OF THE LOCATION OF THE DISPOSAL SITE FOR THE PROJECT WHEN THE APPLICATION FOR A GRUBBING PERMIT IS MADE. THE DISPOSAL SITE MUST ALSO FULFILL THE REQUIREMENTS OF THE GRADING ORDINANCE.
- NO GRUBBING WORK SHALL BE DONE ON SATURDAYS, SUNDAYS AND HOLIDAYS AT ANY TIME WITHOUT PRIOR NOTICE TO THE DIRECTOR, DHHL, PROVIDED SUCH GRUBBING WORK IS ALSO IN CONFORMANCE WITH THE COMMUNITY NOISE CONTROL STANDARDS CONTAINED IN THE HAWAII ADMINISTRATIVE RULES, CHAPTER 11-43, "COMMUNITY NOISE CONTROL FOR OAHU."
- THE LIMITS OF THE AREA TO BE GRUBBED SHALL BE FLAGGED BEFORE THE COMMENCEMENT OF THE GRUBBING WORK.
- ALL GRUBBING OPERATIONS SHALL BE PERFORMED IN CONFORMANCE WITH THE APPLICABLE PROVISIONS OF THE WATER QUALITY AND WATER POLLUTION CONTROL STANDARDS CONTAINED IN HAWAII ADMINISTRATIVE RULES, CHAPTER 11-54, "WATER QUALITY STANDARDS" AND CHAPTER 11-55, "WATER POLLUTION CONTROL", AND IF APPLICABLE, THE NPDES PERMIT FOR THE PROJECT.
- WHERE APPLICABLE AND FEASIBLE, THE MEASURES TO CONTROL EROSION AND OTHER POLLUTANTS SHALL BE IN PLACE BEFORE ANY GRUBBING WORK IS INITIATED.
- TEMPORARY EROSION CONTROLS SHALL NOT BE REMOVED BEFORE PERMANENT EROSION CONTROLS ARE IN-PLACE AND ESTABLISHED.
- TEMPORARY EROSION CONTROL PROCEDURES SHALL BE SUBMITTED FOR APPROVAL PRIOR TO APPLICATION FOR GRUBBING PERMIT.
- IF THE GRUBBING WORK INVOLVES CONTAMINATED SOIL, THEN ALL GRUBBING WORK SHALL BE DONE IN CONFORMANCE WITH APPLICABLE STATE AND FEDERAL REQUIREMENTS.
- THE CONTRACTOR SHALL NOTIFY THE CIVIL ENGINEERING BRANCH, DEPT. OF PUBLIC WORKS TO ARRANGE FOR INSPECTIONAL SERVICES AND SUBMIT THREE (3) SETS OF APPROVED CONSTRUCTION PLANS SEVEN (7) DAYS PRIOR TO COMMENCEMENT OF CONSTRUCTION WORK.
- NON-COMPLIANCE TO ANY OF THE ABOVE REQUIREMENTS SHALL MEAN IMMEDIATE SUSPENSION OF ALL WORK, AND REMEDIAL WORK SHALL COMMENCE IMMEDIATELY. ALL COSTS INCURRED SHALL BE BILLED TO THE VIOLATOR. FURTHERMORE, VIOLATORS SHALL BE SUBJECTED TO ADMINISTRATIVE, CIVIL AND/OR CRIMINAL PENALTIES.



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION. CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION. LICENSE EXPIRATION DATE: 04/30/20

REVISION DATE	DESCRIPTION	MADE BY	APPROVED
Community Planning and Engineering, Inc. Engineering Design Construction Management Infrastructure Planning 1286 Queen Emma Street, Third Floor Honolulu, Hawaii			
LOT 59 & 60 DRAINAGE IMPROVEMENTS KEOKEA & WAIHOHULI, MAKAWAO, MAUI OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS TAX MAP KEYS: (2) 2-2-032: 059 & 060			
GENERAL NOTES - 1			
DRAWN BY: CO	ENGINEER: CO	CHECKED BY: ANM/FJC	
APPROVED:			

FILE	POCKET	FOLDER	NO.

WATER POLLUTION AND EROSION CONTROL NOTES

A. GENERAL:

- SEE SPECIAL PROVISION SECTION 209 – WATER POLLUTION AND EROSION CONTROL. SECTION 209 DESCRIBES BUT IS NOT LIMITED TO: SUBMITTAL REQUIREMENTS; SCHEDULING OF A WATER POLLUTION AND EROSION CONTROL CONFERENCE WITH THE ENGINEER; CONSTRUCTION REQUIREMENTS; METHOD OF MEASUREMENT; AND BASIS OF PAYMENT. IN ADDITION, APPENDIX A LISTS POTENTIAL POLLUTANT SOURCES AND CORRESPONDING BMPs USED TO MITIGATE THE POLLUTANTS.
- FOLLOW THE GUIDELINES IN THE CURRENT HDOT CONSTRUCTION BEST MANAGEMENT PRACTICES FIELD MANUAL IN DEVELOPING, INSTALLING AND MAINTAINING THE BEST MANAGEMENT PRACTICES (BMP) FOR THE PROJECT. FOR ANY CONFLICTING REQUIREMENTS BETWEEN THE MANUAL AND APPLICABLE BID DOCUMENTS, THE APPLICABLE BID DOCUMENTS WILL GOVERN. SHOULD A REQUIREMENT NOT BE CLEARLY DESCRIBED WITHIN THE APPLICABLE BID DOCUMENTS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY FOR INTERPRETATION. FOR THE PURPOSES OF CLARIFICATION UNDER NOTE A.2, "APPLICABLE BID DOCUMENTS" INCLUDE THE CONSTRUCTION PLANS, STANDARD SPECIFICATIONS, SPECIAL PROVISIONS, PERMITS, AND THE STORM WATER POLLUTION PREVENTION PLAN (SWPPP) WHEN APPLICABLE.
- FOLLOW THE GUIDELINES IN THE HONOLULU'S CITY & COUNTY "RULES RELATING TO SOIL EROSION STANDARDS AND GUIDELINES" ALONG WITH APPLICABLE SOIL EROSION GUIDELINES FOR PROJECTS ON MAUI, MOLOKAI, KAUAI, AND HAWAII.
- THE ENGINEER MAY ASSESS LIQUIDATED DAMAGES OF UP TO \$27,500 FOR NON-COMPLIANCE OF EACH BMP REQUIREMENT AND EACH REQUIREMENT STATED IN SECTION 209 AND SPECIAL PROVISIONS, FOR EVERY DAY OF NON-COMPLIANCE. THERE IS NO MAXIMUM LIMIT ON THE AMOUNT OF ASSESSED PER DAY.
- THE ENGINEER WILL DEDUCT THE COST FROM THE PROGRESS PAYMENT FOR ALL CITATIONS RECEIVED BY THE DEPARTMENT FOR NON-COMPLIANCE, OR THE CONTRACTOR SHALL REIMBURSE THE STATE FOR THE FULL AMOUNT OF THE OUTSTANDING COST INCURRED BY THE STATE.
- IF NECESSARY, INSTALL A RAIN GAGE PRIOR TO ANY FIELD WORK INCLUDING THE INSTALLATION OF ANY SITE-SPECIFIC BEST MANAGEMENT PRACTICES. THE RAIN GAGE SHALL HAVE A TOLERANCE OF AT LEAST 0.05 INCHES OF RAINFALL. INSTALL THE RAIN GAGE ON THE PROJECT SITE IN AN AREA THAT WILL NOT DETER RAINFALL FROM ENTERING THE GAGE OPENING. DO NOT INSTALL IN A LOCATION WHERE RAIN WATER MAY SPLASH INTO RAIN GAGE. THE RAIN GAGE INSTALLATION SHALL BE STABLE AND PLUMBED. DO NOT BEGIN FIELD WORK UNTIL THE RAIN GAGE IS INSTALLED AND SITE-SPECIFIC BEST MANAGEMENT PRACTICES ARE IN-PLACE.
- SUBMIT SITE-SPECIFIC BMP PLAN TO THE ENGINEER ALONG WITH A COMPLETED SITE-SPECIFIC BMP REVIEW CHECKLIST WITHIN 30 CALENDAR DAYS OF CONTRACT EXECUTION. THE SITE-SPECIFIC BMP REVIEW CHECKLIST MAY BE OBTAINED FROM [HTTP://WWW.STORMWATERHAWAII.COM](http://www.stormwaterhawaii.com).

B. WASTE DISPOSAL:

- WASTE MATERIALS:**
COLLECT AND STORE ALL WASTE MATERIALS IN A SECURELY LIDDED METAL DUMPSTER OR ROLL OFF CONTAINER WITH COVER TO KEEP RAIN OUT OR LOSS OF WASTE DURING WINDY CONDITIONS. THE DUMPSTER SHALL MEET ALL LOCAL AND STATE SOLID WASTE MANAGEMENT REGULATIONS. DEPOSIT ALL TRASH AND CONSTRUCTION DEBRIS FROM THE SITE IN THE DUMPSTER. EMPTY THE DUMPSTER WEEKLY OR WHEN THE CONTAINER IS TWO-THIRDS FULL, WHICHEVER IS SOONER. DO NOT BURY CONSTRUCTION WASTE MATERIALS ONSITE. THE CONTRACTOR'S SUPERVISORY PERSONNEL SHALL BE INSTRUCTED REGARDING THE CORRECT PROCEDURE FOR WASTE DISPOSAL. POST NOTICES STATING THESE PRACTICES IN THE OFFICE TRAILER, ON A WEATHERPROOF BULLETIN BOARD, OR OTHER ACCESSIBLE LOCATION ACCEPTABLE TO THE ENGINEER. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SEEING THAT THESE PROCEDURES ARE FOLLOWED. SUBMIT THE SOLID WASTE DISCLOSURE FORM FOR CONSTRUCTION SITES TO THE ENGINEER WITHIN 30 CALENDAR DAYS OF CONTRACT EXECUTION. PROVIDE A COPY OF ALL THE DISPOSAL RECEIPTS FROM THE FACILITY PERMITTED BY THE DEPARTMENT OF HEALTH TO RECEIVE SOLID WASTE TO THE ENGINEER MONTHLY. THIS SHOULD ALSO INCLUDE DOCUMENTATION FROM ANY INTERMEDIARY FACILITY WHERE SOLID WASTE IS HANDLED OR PROCESSED.
- HAZARDOUS WASTE:**
DISPOSE ALL HAZARDOUS WASTE MATERIALS IN THE MANNER SPECIFIED BY LOCAL OR STATE REGULATIONS AND BY THE MANUFACTURER. THE CONTRACTOR'S SITE PERSONNEL SHALL BE INSTRUCTED IN THESE PRACTICES AND SHALL BE RESPONSIBLE FOR SEEING THAT THESE PRACTICES ARE FOLLOWED.
- SANITARY WASTE:**
COLLECT ALL SANITARY WASTE FROM THE PORTABLE UNITS A MINIMUM OF ONCE PER WEEK, OR AS REQUIRED. POSITION SANITARY FACILITIES WHERE THEY ARE SECURE AND WILL NOT BE TIPPED OVER OR KNOCKED DOWN.

C. EROSION AND SEDIMENT CONTROL INSPECTION AND MAINTENANCE PRACTICES:

- FOR PROJECTS WITH AN NPDES PERMIT FOR CONSTRUCTION ACTIVITIES, INSPECT AT THE FOLLOWING INTERVALS. FOR CONSTRUCTION AREAS DISCHARGING TO NUTRIENT OR SEDIMENT IMPAIRED WATERS, INSPECT ALL CONTROL MEASURES AT LEAST ONCE EACH WEEK AND WITHIN 24 HOURS OF ANY RAINFALL EVENT OF 0.25 INCHES OR GREATER WITHIN A 24 HOUR PERIOD. FOR CONSTRUCTION AREAS DISCHARGING TO WATERS NOT IMPAIRED FOR NUTRIENT OR SEDIMENTS, INSPECT ALL CONTROL MEASURES WEEKLY. INSPECTIONS ARE ONLY REQUIRED DURING THE PROJECT'S NORMAL WORKING HOURS. THE DISCHARGE POINT WATER CLASSIFICATION MAY BE FOUND IN THE SWPPP.
- FOR PROJECTS WITHOUT AN NPDES PERMIT FOR CONSTRUCTION ACTIVITIES, INSPECT ALL CONTROL MEASURES WEEKLY.
- MAINTAIN ALL EROSION AND SEDIMENT CONTROL MEASURES PER SPECIFICATION SECTIONS 3.02 FIELD QUALITY CONTROL AND 3.03 INSPECTIONS. IF REPAIR IS NECESSARY, INITIATE REPAIR IMMEDIATELY AND COMPLETE BY THE CLOSE OF THE NEXT WORK DAY IF THE PROBLEM DOES NOT REQUIRE SIGNIFICANT REPAIR OR REPLACEMENT, OR IF THE PROBLEM CAN BE CORRECTED THROUGH ROUTINE MAINTENANCE. WHEN INSTALLATION OF A NEW EROSION OR SEDIMENT CONTROL OR A SIGNIFICANT REPAIR IS NEEDED, INSTALL THE NEW OR MODIFIED CONTROL OR COMPLETE THE REPAIR NO LATER THAN 7 CALENDAR DAYS FROM THE TIME OF DISCOVERY. "IMMEDIATELY" MEANS THE CONTRACTOR SHALL TAKE ALL REASONABLE MEASURES TO MINIMIZE OR PREVENT DISCHARGE OF POLLUTANTS UNTIL A PERMANENT SOLUTION IS INSTALLED AND MADE OPERATIONAL. IF A PROBLEM IS IDENTIFIED AT A TIME IN THE DAY IN WHICH IT IS TOO LATE TO INITIATE REPAIR, INITIATION OF REPAIR SHALL BEGIN ON THE FOLLOWING WORK DAY.
- REMOVE BUILT-UP SEDIMENT FROM THE SILT FENCE WHEN IT HAS REACHED ONE-THIRD THE HEIGHT OF THE FENCE. REMOVE SEDIMENT FROM THE OTHER PERIMETER SEDIMENT CONTROL DEVICES WHEN IT HAS REACHED ONE-HALF THE HEIGHT OF THE DEVICE.
- INSPECT SILT SCREEN OR FENCE FOR DEPTH OF SEDIMENT, TEARS, TO VERIFY THAT THE FABRIC IS SECURELY ATTACHED TO THE FENCE POSTS OR CONCRETE SLAB AND TO VERIFY THAT THE FENCE POSTS ARE FIRMLY IN THE GROUND. INSPECT AND VERIFY THE BOTTOM OF THE SILT SCREEN IS BURIED A MINIMUM OF 6 INCHES BELOW THE EXISTING GROUND.
- INSPECT TEMPORARY AND PERMANENT SEEDING AND PLANTING FOR BARE SPOTS, WASHOUTS AND HEALTHY GROWTH.
- COMPLETE AND SUBMIT TO THE ENGINEER A MAINTENANCE INSPECTION REPORT WITHIN 24 HOURS AFTER EACH INSPECTION.
- PROVIDE A STABILIZED CONSTRUCTION ENTRANCE AT ALL POINTS OF EXIT ONTO PAVED ROADS TO REDUCE VEHICLE TRACKING OF SEDIMENTS. INCLUDE STABILIZED CONSTRUCTION ENTRANCE IN THE WATER POLLUTION, DUST, AND EROSION CONTROL SUBMITTALS. MINIMUM LENGTH SHOULD BE 50 FEET. MINIMUM WIDTH SHOULD BE 30 FEET. MINIMUM DEPTH SHOULD BE 12 INCHES OR AS RECOMMENDED BY THE SOILS ENGINEER AND UNDERLAIN WITH GEO-TEXTILE FABRIC. IF MINIMUM DIMENSIONS CANNOT BE MET, PROVIDE OTHER STABILIZATION TECHNIQUES THAT REMOVE SEDIMENT PRIOR TO EXIT. CLEAN THE PAVED STREET ADJACENT TO THE SITE ENTRANCE DAILY OR AS REQUIRED TO REMOVE ANY EXCESS MUD, COLD-PLANED MATERIALS, DIRT OR ROCK TRACKED FROM THE SITE. DO NOT HOSE DOWN THE STREET WITHOUT CONTAINING OR VACUUMING WASH WATER. COVER DUMP TRUCKS Hauling MATERIAL FROM THE CONSTRUCTION SITE WITH A TARPULIN. REMOVE SEDIMENT TRACKED ONTO THE STREET, SIDEWALK, OR OTHER PAVED AREA BY THE END OF THE DAY IN WHICH THE TRACK-OUT OCCURS.
- INCLUDE DESIGNATED CONCRETE WASHOUT AREA(S) IN THE WATER POLLUTION, DUST, AND EROSION CONTROL SUBMITTALS.
- SUBMIT THE NAME OF A SPECIFIC INDIVIDUAL DESIGNATED RESPONSIBLE FOR INSPECTIONS, MAINTENANCE AND REPAIR ACTIVITIES AND FILLING OUT THE INSPECTION AND MAINTENANCE REPORT.
- PERSONNEL SELECTED FOR THE INSPECTION AND MAINTENANCE RESPONSIBILITIES SHALL RECEIVE TRAINING FROM THE CONTRACTOR. THEY SHALL BE TRAINED IN ALL THE INSPECTION AND MAINTENANCE PRACTICES NECESSARY FOR KEEPING THE EROSION AND SEDIMENT CONTROLS USED ONSITE IN GOOD WORKING ORDER.
- CONTAIN, REMOVE, AND DISPOSE SLURRY GENERATED FROM SAW CUTTING OF PAVEMENT IN ACCORDANCE WITH APPROVED BMP PRACTICES. DO NOT ALLOW DISCHARGE INTO THE DRAINAGE SYSTEM OR STATE WATERS.
- FOR PROJECTS WITH AN NPDES PERMIT FOR CONSTRUCTION ACTIVITIES, IMMEDIATELY INITIATE STABILIZING EXPOSED SOIL AREAS UPON COMPLETION OF EARTH-DISTURBING ACTIVITIES FOR AREAS WHERE EARTH-DISTURBING ACTIVITIES HAVE PERMANENTLY OR TEMPORARILY CEASED. EARTH-DISTURBING ACTIVITIES HAVE PERMANENTLY CEASED WHEN CLEARING AND EXCAVATION WITHIN ANY AREA OF THE CONSTRUCTION SITE THAT WILL NOT INCLUDE PERMANENT STRUCTURES HAS BEEN COMPLETED. EARTH-DISTURBING ACTIVITIES HAVE TEMPORARILY CEASED WHEN CLEARING, GRADING, AND EXCAVATION WITHIN ANY AREA OF THE SITE THAT WILL NOT INCLUDE PERMANENT STRUCTURES WILL NOT RESUME (I.E., THE LAND WILL BE IDLE) FOR A PERIOD OF 14 OR MORE CALENDAR DAYS, BUT SUCH ACTIVITIES WILL RESUME IN THE FUTURE. FOR CONSTRUCTION AREAS DISCHARGING INTO WATERS NOT IMPAIRED FOR NUTRIENTS SEDIMENTS, COMPLETE INITIAL STABILIZATION WITHIN 14 CALENDAR DAYS AFTER THE TEMPORARY OR PERMANENT CESSATION OF EARTH-DISTURBING ACTIVITIES. FOR CONSTRUCTION AREAS DISCHARGING INTO NUTRIENT OR SEDIMENT IMPAIRED WATERS, COMPLETE INITIAL STABILIZATION WITHIN 7 CALENDAR DAYS AFTER THE TEMPORARY OR PERMANENT CESSATION OF EARTH-DISTURBING ACTIVITIES. CLASSIFICATION OF WATER AT THE DISCHARGE POINT MAY BE FOUND IN THE SWPPP.
- FOR PROJECTS WITHOUT AN NPDES PERMIT FOR CONSTRUCTION ACTIVITIES, COMPLETE INITIAL STABILIZATION WITHIN 14 CALENDAR DAYS AFTER THE TEMPORARY OR PERMANENT CESSATION OF EARTH-DISTURBING ACTIVITIES.

D. GOOD HOUSEKEEPING, BEST MANAGEMENT PRACTICES:

- MATERIALS POLLUTION PREVENTION PLAN**
 - APPLICABLE MATERIALS OR SUBSTANCES LISTED BELOW ARE EXPECTED TO BE PRESENT ONSITE DURING CONSTRUCTION. OTHER MATERIALS AND SUBSTANCES NOT LISTED BELOW SHALL BE ADDED TO THE INVENTORY.
 - CONCRETE
 - DETERGENTS
 - PAINTS (ENAMEL AND LATEX)
 - METAL STUDS
 - FERTILIZERS
 - PETROLEUM BASED PRODUCTS
 - CLEANING SOLVENTS
 - WOOD
 - MASONRY BLOCK
 - HERBICIDES AND PESTICIDES
 - CURING COMPOUNDS
 - ADHESIVES
 - USE MATERIAL MANAGEMENT PRACTICES TO REDUCE THE RISK OF SPILLS OR OTHER ACCIDENTAL EXPOSURE OF MATERIALS AND SUBSTANCES TO STORM WATER RUNOFF. MAKE AN EFFORT TO STORE ONLY ENOUGH PRODUCT AS IS REQUIRED TO DO THE JOB.
 - STORE ALL MATERIALS STORED ONSITE IN A NEAT, ORDERLY MANNER IN THEIR APPROPRIATE CONTAINERS AND IF POSSIBLE, UNDER A ROOF OR OTHER ENCLOSURE.
 - KEEP PRODUCTS IN THEIR ORIGINAL CONTAINERS WITH THE ORIGINAL MANUFACTURER'S LABEL.
 - DO NOT MIX SUBSTANCES WITH ONE ANOTHER UNLESS RECOMMENDED BY THE MANUFACTURER.
 - WHENEVER POSSIBLE, USE A PRODUCT UP COMPLETELY BEFORE DISPOSING OF THE CONTAINER.
 - FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR PROPER USE AND DISPOSAL.
 - CONDUCT A DAILY INSPECTION TO ENSURE PROPER USE AND DISPOSAL OF MATERIALS ONSITE.
- HAZARDOUS MATERIAL POLLUTION PREVENTION PLAN**
 - KEEP PRODUCTS IN ORIGINAL CONTAINERS UNLESS THEY ARE NOT RESEALABLE.
 - RETAIN ORIGINAL LABELS AND MATERIAL SAFETY DATA SHEETS (SDS) FORMERLY MATERIAL SAFETY DATA SHEETS (MSDS).
 - DISPOSE OF SURPLUS PRODUCTS ACCORDING TO MANUFACTURER'S INSTRUCTIONS AND LOCAL AND STATE REGULATIONS.
- ONSITE AND OFFSITE PRODUCT SPECIFIC PLAN**
THE FOLLOWING PRODUCT SPECIFIC PRACTICES SHALL BE FOLLOWED ONSITE:
 - PETROLEUM BASED PRODUCTS:**
MONITOR ALL ONSITE VEHICLES FOR LEAKS AND PERFORM REGULAR PREVENTIVE MAINTENANCE TO REDUCE THE CHANCE OF LEAKAGE. STORE PETROLEUM PRODUCTS IN TIGHTLY SEALED CONTAINERS WHICH ARE CLEARLY LABELED. APPLY ASPHALT SUBSTANCES USED ONSITE ACCORDING TO THE MANUFACTURER'S RECOMMENDATION.
 - FERTILIZERS:**
APPLY FERTILIZERS USED ONLY IN THE MINIMUM AMOUNTS RECOMMENDED BY THE MANUFACTURER AND FEDERAL, STATE, AND LOCAL REQUIREMENTS. AVOID APPLYING JUST BEFORE A HEAVY RAIN EVENT. APPLY AT THE APPROPRIATE TIME OF YEAR FOR THE LOCATION, AND PREFERABLY TIMED TO COINCIDE AS CLOSELY AS POSSIBLE TO THE PERIOD OF MAXIMUM VEGETATION UPTAKE AND GROWTH. ONCE APPLIED, WORK FERTILIZER INTO THE SOIL TO LIMIT EXPOSURE TO STORM WATER. DO NOT APPLY TO STORM CONVEYANCE CHANNELS WITH FLOWING WATER. STORAGE SHALL BE IN A COVERED SHED OR IN AN AREA WHERE FERTILIZER WILL NOT COME INTO CONTACT WITH PRECIPITATION OR STORMWATER. TRANSFER THE CONTENTS OF ANY PARTIALLY USED BAGS OF FERTILIZER TO A SEALABLE PLASTIC BIN TO AVOID SPILLS.
 - PAINTS:**
SEAL AND STORE ALL CONTAINERS WHEN NOT REQUIRED FOR USE. DO NOT DISCHARGE EXCESS PAINT TO THE DRAINAGE SYSTEM, SANITARY SEWER SYSTEM, OR STATE WATERS. DISPOSE PROPERLY ACCORDING TO MANUFACTURERS' INSTRUCTIONS AND STATE AND LOCAL REGULATIONS.
 - CONCRETE TRUCKS:**
WASHOUT OR DISCHARGE CONCRETE TRUCK DRUM WASH WATER ONLY AT A DESIGNATED SITE AS FAR AS PRACTICABLE FROM STORM DRAIN INLETS OR STATE WATERS. DO NOT DISCHARGE WATER IN THE DRAINAGE SYSTEM OR STATE WATERS. CLEAN DISPOSAL SITE AS REQUIRED OR AS REQUESTED BY THE ENGINEER.
- SPILL CONTROL PLAN**
 - POST A SPILL PREVENTION PLAN TO INCLUDE MEASURES TO PREVENT AND CLEAN UP EACH SPILL.
 - THE CONTRACTOR SHALL BE THE SPILL PREVENTION AND CLEANUP COORDINATOR. DESIGNATE AT LEAST THREE SITE PERSONNEL WHO SHALL RECEIVE SPILL PREVENTION AND CLEANUP TRAINING. THESE INDIVIDUALS SHALL EACH BECOME RESPONSIBLE FOR A PARTICULAR PHASE OF PREVENTION AND CLEANUP. POST THE NAMES OF RESPONSIBLE SPILL PERSONNEL IN THE MATERIAL STORAGE AREA ON A WEATHERPROOF BULLETIN BOARD OR OTHER ACCESSIBLE LOCATION ACCEPTABLE TO THE ENGINEER AND IN THE OFFICE TRAILER ONSITE.
 - CLEARLY POST MANUFACTURERS' RECOMMENDED METHODS FOR SPILL CLEANUP. MAKE SITE PERSONNEL AWARE OF THE PROCEDURES AND THE LOCATION OF THE INFORMATION AND CLEANUP SUPPLIES.
 - KEEP AMPLE MATERIALS AND EQUIPMENT NECESSARY FOR SPILL CLEANUP IN THE MATERIAL STORAGE AREA ONSITE.
 - CLEAN UP ALL SPILLS IMMEDIATELY AFTER DISCOVERY.
 - KEEP THE SPILL AREA WELL VENTILATED. PERSONNEL SHALL WEAR APPROPRIATE PROTECTIVE CLOTHING TO PREVENT INJURY FROM CONTACT WITH A HAZARDOUS SUBSTANCE.

D. GOOD HOUSEKEEPING, BEST MANAGEMENT PRACTICES CONT'D:

- REPORT SPILLS OF TOXIC HAZARDOUS MATERIAL TO THE APPROPRIATE STATE OR LOCAL GOVERNMENT AGENCY, REGARDLESS OF THE SIZE. WHERE A LEAK, SPILL, OR OTHER RELEASE CONTAINING A HAZARDOUS SUBSTANCE OR OIL IN AN AMOUNT EQUAL TO OR IN EXCESS OF A REPORTABLE QUANTITY ESTABLISHED UNDER EITHER 40 CFR PART 110, 40 CFR PART 117, OR 40 CFR PART 302 OCCURS DURING A 24-HOUR PERIOD, THE CONTRACTOR SHALL NOTIFY THE ENGINEER AS SOON AS THE CONTRACTOR HAS KNOWLEDGE OF THE DISCHARGE. THE ENGINEER SHALL NOTIFY THE NATIONAL RESPONSE CENTER (NRC) AT (800) 424-8802, THE CLEAN WATER BRANCH DURING REGULAR BUSINESS HOURS AT 586-4309, AND THE HAWAII STATE HOSPITAL OPERATOR AT 247-2191 AND THE CLEAN WATER BRANCH (DOH-CWB) VIA EMAIL AT CleanWaterBranch@doh.hawaii.gov DURING NON-BUSINESS HOURS IMMEDIATELY. THE CONTRACTOR SHALL ALSO PROVIDE TO THE ENGINEER, WITHIN 7 CALENDAR DAYS OF KNOWLEDGE OF THE RELEASE, A DESCRIPTION OF THE RELEASE, THE CIRCUMSTANCES LEADING TO THE RELEASE, AND DATE OF THE RELEASE. THE ENGINEER WILL PROVIDE THIS INFORMATION TO THE DOH-CWB. THE ENGINEER WILL PROVIDE INFORMATION TO THE NRC IF REQUESTED.

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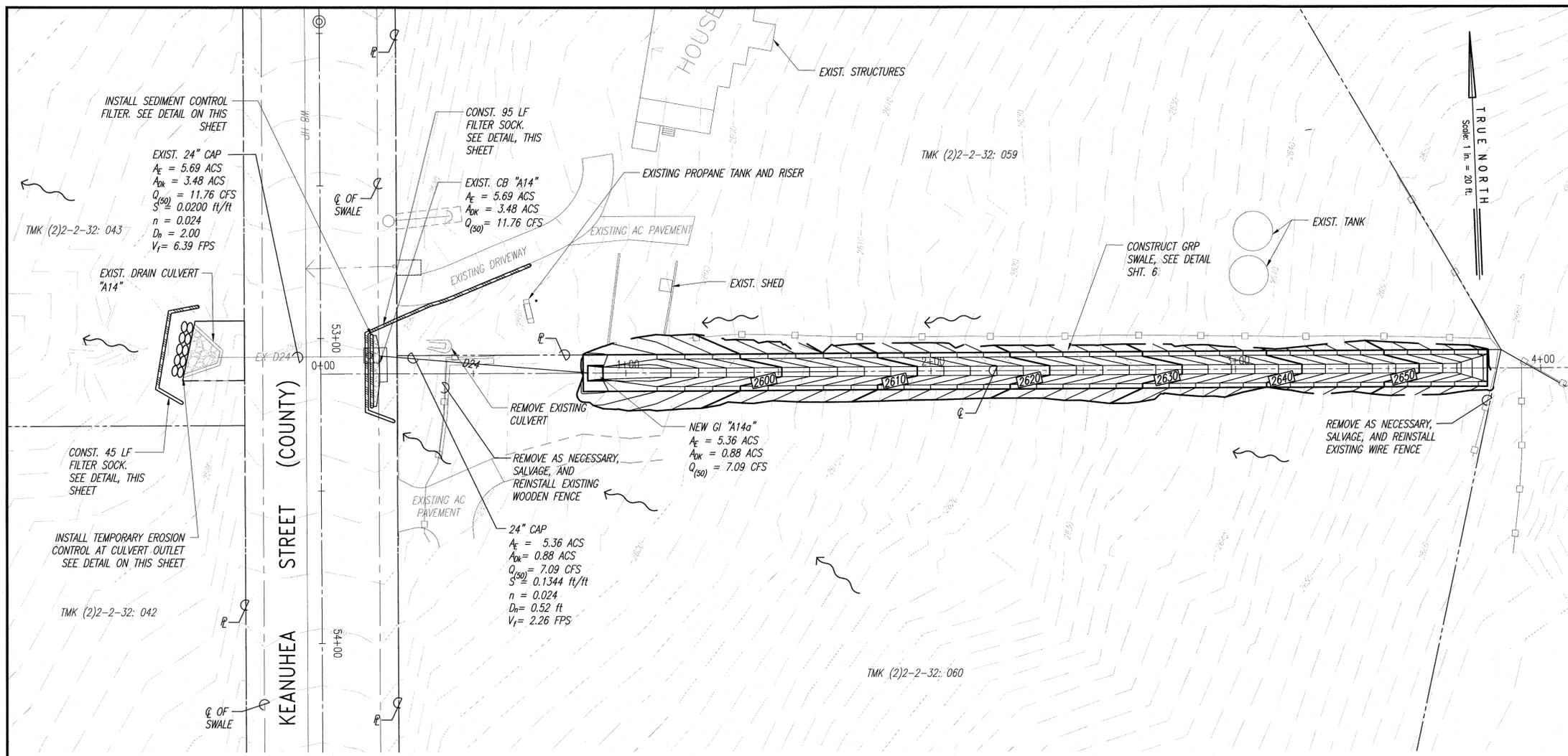
LOT 59 & 60
DRAINAGE IMPROVEMENTS
 KEOKEA & WAIHOLI, MAKAWAO, MAUI
 OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
 TAX MAP KEYS: (2) 2-2-032: 059 & 060



GENERAL NOTES - 2

DRAWN BY: CO	ENGINEER: CO	CHECKED BY: AMM/FJC
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CONSTRUCTION BMPs

- A. CONSTRUCTION MANAGEMENT TECHNIQUES INCLUDE:
- CLEARING AND GRUBBING SHALL BE HELD TO THE MINIMUM NECESSARY FOR GRADING AND EQUIPMENT OPERATION (15 ACRES MAX.).
 - CONSTRUCTION SHALL BE SEQUENCED TO MINIMIZE THE EXPOSURE TIME OF CLEARED SURFACE AREA. (15 ACRES MAX.).
 - CONSTRUCTION SHALL BE STAGED OR PHASED FOR LARGE PROJECTS. AREAS OF ONE PHASE SHALL BE IN PLACE AND FUNCTIONAL PRIOR TO THE START OF THE NEXT PHASE. STABILIZATION CAN BE ACCOMPLISHED BY TEMPORARILY OR PERMANENTLY PROTECTING THE DISTURBED SOIL SURFACE FROM RAINFALL IMPACTS AND RUNOFF.
 - EROSION AND SEDIMENT CONTROL MEASURES, INCLUDING BERMS IN DRAINAGE WAYS SHALL BE IN PLACE AND FUNCTIONAL PRIOR TO THE START OF THE GRADING WORK AND SHALL BE MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD. TEMPORARY MEASURES MAY BE REMOVED AT THE BEGINNING OF THE WORK DAY, BUT SHALL BE REPLACED AT THE END OF THE WORK DAY.
 - ALL CONTROL MEASURES SHALL BE CHECKED AND REPAIRED, AS NECESSARY, FOR EXAMPLE, WEEKLY IN DRY PERIODS AND WITHIN 24-HOURS AFTER ANY RAINFALL OF 0.5 INCHES OR GREATER WITHIN A 24-HOUR PERIOD. DURING PROLONGED RAINFALL, DAILY CHECKING IS NECESSARY. THE PERMITEE SHALL MAINTAIN RECORDS OF CHECKS AND REPAIRS.
 - THE PERMITEE SHALL MAINTAIN RECORDS OF THE DURATION AND ESTIMATED VOLUME OF STORM WATER DISCHARGE(S).
 - A SPECIFIC INDIVIDUAL SHALL BE DESIGNATED TO BE RESPONSIBLE FOR EROSION AND SEDIMENT CONTROLS ON EACH PROJECT SITE.
- B. VEGETATION CONTROLS INCLUDE:
- PRE-CONSTRUCTION VEGETATIVE GROUND COVER SHALL NOT BE DESTROYED, REMOVED OR DISTURBED MORE THAN 20 CALENDAR DAYS PRIOR TO SITE DISTURBANCE.
 - TEMPORARY SOIL STABILIZATION WITH APPROPRIATE VEGETATION SHALL BE APPLIED ON AREAS THAT WILL REMAIN UNFINISHED FOR MORE THAN 30 CALENDAR DAYS.
 - PERMANENT SOIL STABILIZATION WITH PERENNIAL VEGETATION SHALL BE APPLIED AS SOON AS PRACTICABLE AFTER FINAL GRADING.
- C. STRUCTURAL CONTROLS INCLUDE:
- STORM WATER FLOWING TOWARD THE CONSTRUCTION AREA SHALL BE DIVERTED BY USING APPROPRIATE CONTROL MEASURES, AS PRACTICAL.
 - EROSION CONTROL MEASURES SHALL BE DESIGNED ACCORDING TO THE SIZE OF DISTURBED OR DRAINAGE AREAS, TO DETAIN RUNOFF AND TRAP SEDIMENT.
 - WATER MUST BE DISCHARGED THROUGH A PIPE OR LINED CHANNEL SO THAT THE DISCHARGE DOES NOT CAUSE EROSION.
 - MUDDY WATER TO BE PUMPED FROM EXCAVATION AND WORK AREAS MUST BE HELD IN SETTLING BASINS OR TREATED BY FILTRATION OR OTHER APPROPRIATE MEASURES PRIOR TO ITS DISCHARGE INTO STATE WATERS. WATER MUST BE DISCHARGED THROUGH A PIPE OR LINED CHANNEL SO THAT THE DISCHARGE DOES NOT CAUSED EROSION AND SEDIMENTATION.
 - STORM DRAIN INLET PROTECTION.
 - CONTRACTOR SHALL CLEAN OUT ALL ACCUMULATED SILT AND DEBRIS IN EXISTING DRAINAGE DITCHES AND INLETS. FLUSHING IS PROHIBITED.
- D. REMOVAL OF TEMPORARY SILT FENCE:
- REMOVAL OF TEMPORARY SILT FENCE SHALL BE DONE AFTER PERMANENT VEGETATIVE GROUND COVER HAS BEEN ACCEPTED BY THE GOVERNING AGENCY.

GENERAL LAYOUT & EROSION CONTROL PLAN

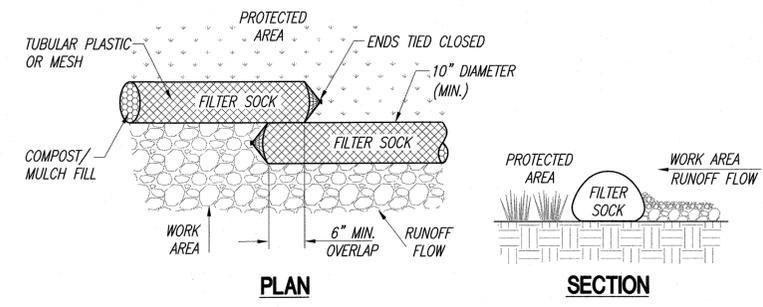
SCALE: 1"=20'

HYDROLOGIC DESIGN DATA

$Q = C I A$
 i = RAINFALL INTENSITY FOR 1 HR. (IN./HR.)
 Q = DISCHARGE QUANTITY (CFS)
 C = RUNOFF COEFFICIENT
 I = RAINFALL INTENSITY FOR T_c DURATION (IN./HR.)
 A = AREA IN ACRES (AC)

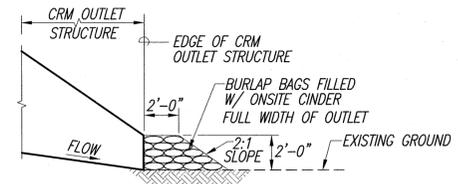
NOTE:
 1. HYDROLOGIC DESIGN DATA BASED ON DRAINAGE MASTER PLAN, "DRAINAGE REPORT FOR KEOKEA-WAIOHULI DEVELOPMENT," AUGUST 2013

EXISTING OR PREDEVELOPMENT	KEOKEA AGRICULTURAL LOTS (2 ACRES MIN.)
$T_m = 50$ YRS	$T_m = 50$ YRS
$i = 2.9$ IN/HR	$i = 2.9$ IN/HR
$T_c = 35$ MINS.	$T_c = 15.5$ MINS.
$I(50) = 3.75$ IN./HR.	$I(50) = 5.2$ IN./HR.
$C = 0.28$	$C = 0.32$
$C I(50) = 1.05$ CFS/AC.	$C I(50) = 1.66$ CFS/AC.



DETAIL - FILTER SOCK

NOT TO SCALE



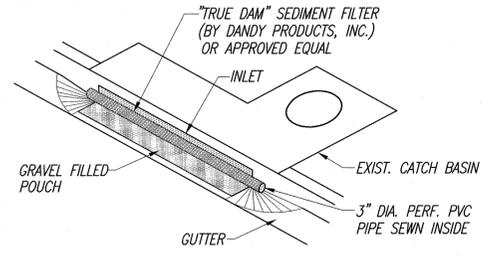
TYPICAL SECTION

TEMPORARY EROSION CONTROL @ CULVERT OUTLETS

NOT TO SCALE

LEGEND

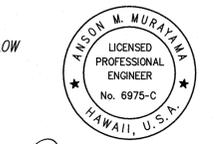
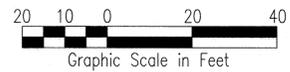
- 2360--- EXISTING CONTOUR
- EX D24--- EXISTING DRAIN PIPE
- D24--- DRAIN PIPE
- --- EXISTING LOT LINE
- CAP CORRUGATED ALUMINUM PIPE
- GI GRATED INLET
- A AREA, ACS
- Q DRAIN RUNOFF, CFS
- S SLOPE OF PIPE, FT/FT
- Dn NORMAL DEPTH OF FLOW, FT
- Vf FULL FLOW VELOCITY, FPS
- --- LIMITS OF GRADING
- BURLAP BAGS OR APPROVED EQUAL @ CULVERT INLET/OUTLET
- FILTER SOCK
- --- DIRECTION OF STORM SURFACE RUNOFF FLOW
- --- EXISTING WIRE/WOODEN FENCE



DETAIL - SEDIMENT CONTROL FILTER AT CATCH BASIN

NOT TO SCALE

- NOTES:**
- SEDIMENT AND DEBRIS AT THE SEDIMENT CONTROL FILTER AT CATCH BASINS SHALL BE CLEANED AND REMOVED WEEKLY IN DRY PERIODS AND WITHIN 24 HR PERIOD DURING RAINFALL. DAILY CHECKING IS NECESSARY. THE PERMITEE SHALL MAINTAIN RECORDS OF CHECKS AND REMOVAL OF SEDIMENT AND DEBRIS.
 - DURING AN EVENT OF ABOVE NORMAL RAINFALL, THE CONTRACTOR SHALL REMOVE SEDIMENT FILTER AND REPLACE AFTER EVENT HAS PASSED.



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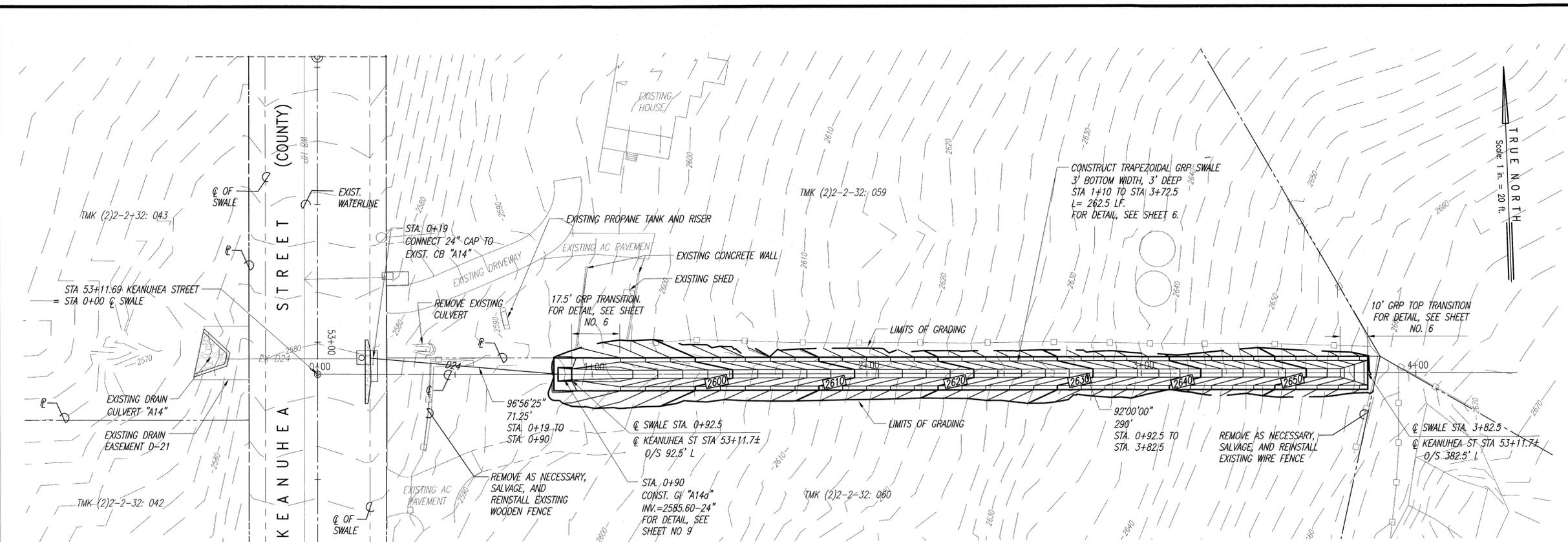
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LOT 59 & 60 DRAINAGE IMPROVEMENTS
 KEOKEA & WAIOHULI, MAKAWAO, MAUI
 OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
 TAX MAP KEYS: (2) 2-2-032: 059 & 060

GENERAL LAYOUT & EROSION CONTROL PLAN

DRAWN BY: CO ENGINEER: CO CHECKED BY: AMM/FJC APPROVED:

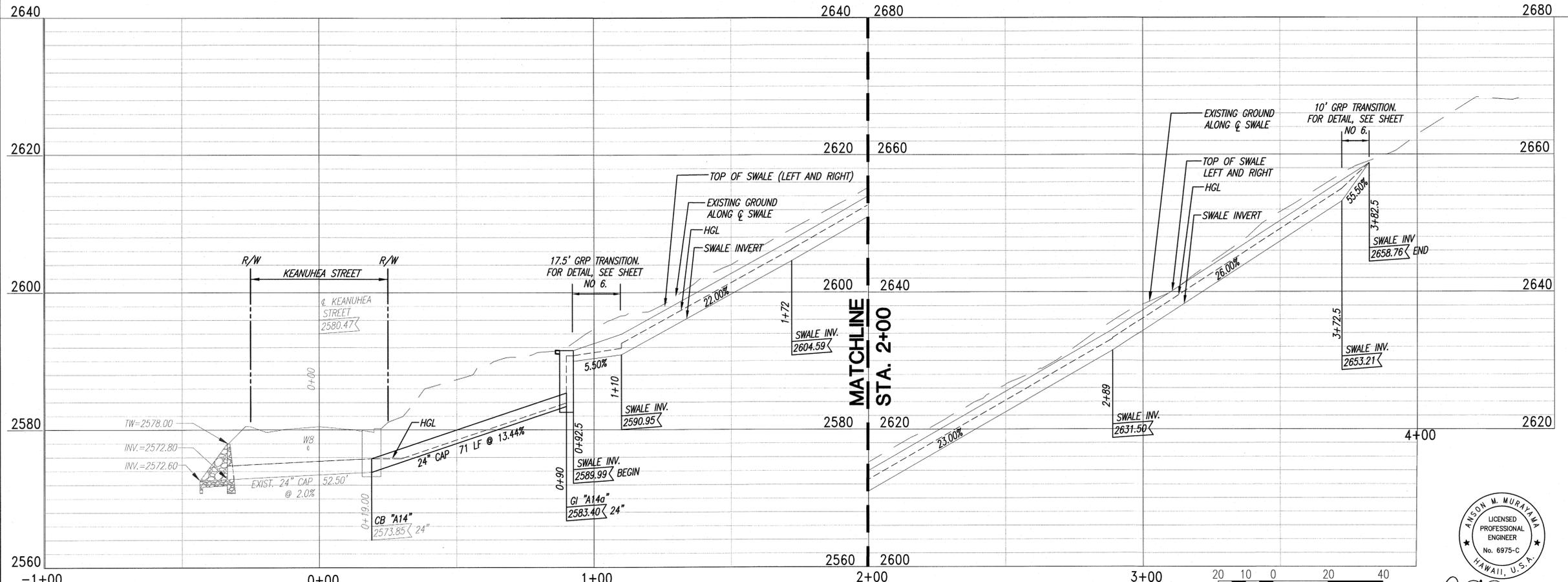
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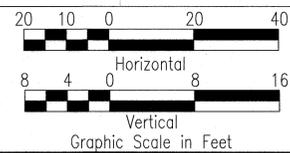
PLAN - GRP SWALE BETWEEN LOT 59 & 60
SCALE: 1"=20'

LEGEND

---	LIMITS OF GRADING
- - - -	EXISTING CONTOUR
EX D24	EXISTING DRAIN PIPE
- [] -	FINISHED CONTOUR
- [] -	DRAIN PIPE
- - - -	EXISTING LOT LINE
[]	EXISTING WIRE/WOODEN FENCE



PROFILE - GRP SWALE BETWEEN LOT 59 & 60
SCALE: HORIZ: 1"=20'
VERT: 1"=8'



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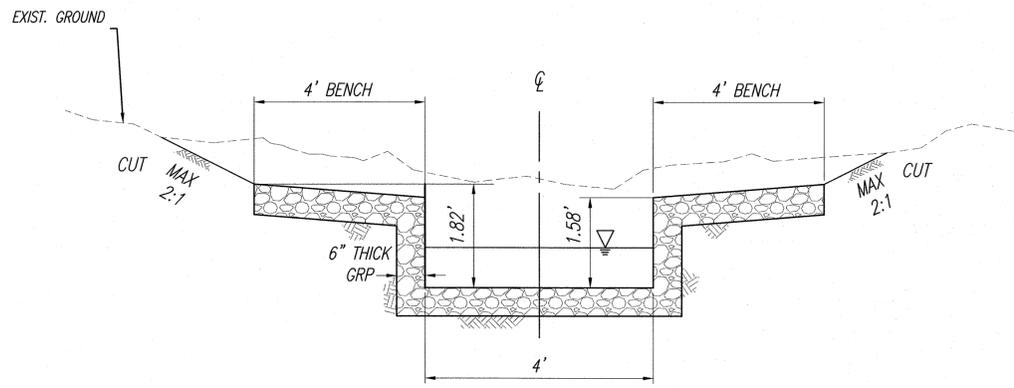
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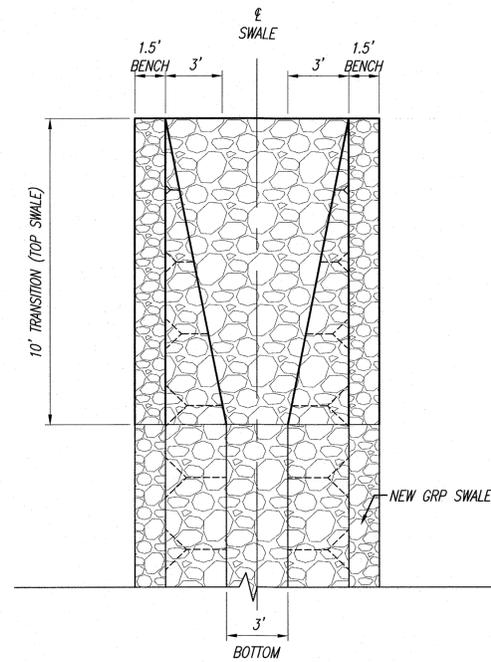
LOT 59 & 60 DRAINAGE IMPROVEMENTS
KEOKEA & WAIHOHULI, MAKAWAO, MAUI
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PLAN AND PROFILE GRATED INLET "A14A" & SWALE

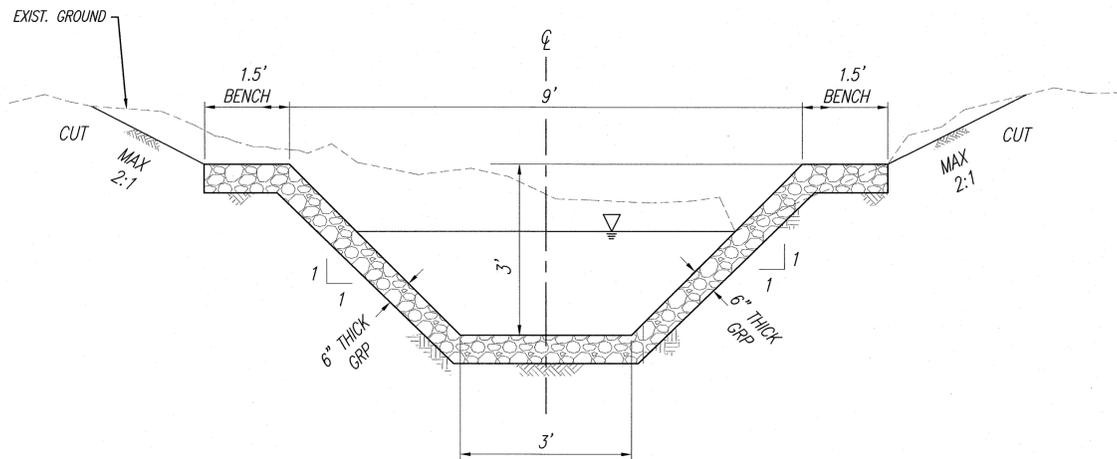
DRAWN BY: CO	ENGINEER: CO	CHECKED BY: AMM/FJC
APPROVED:		



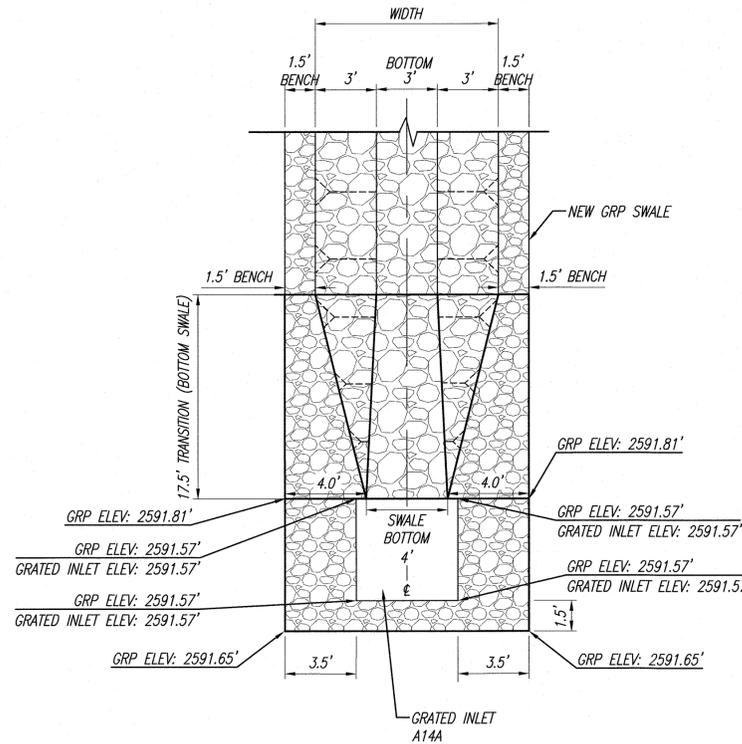
GRP SWALE SECTION STA 0+92.5
NOT TO SCALE



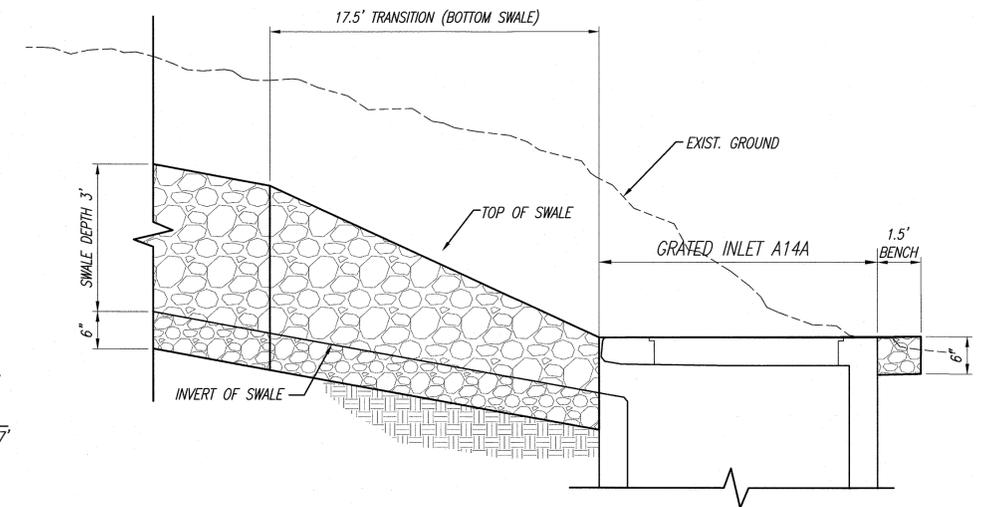
GRP SWALE TRANSITION DETAILS STA 3+72.5 TO STA 3+82.5
NOT TO SCALE



GRP SWALE SECTION STA 1+10 TO STA 3+72.5
NOT TO SCALE



GRP SWALE TRANSITION DETAILS STA 0+92.5 TO STA 1+10
NOT TO SCALE



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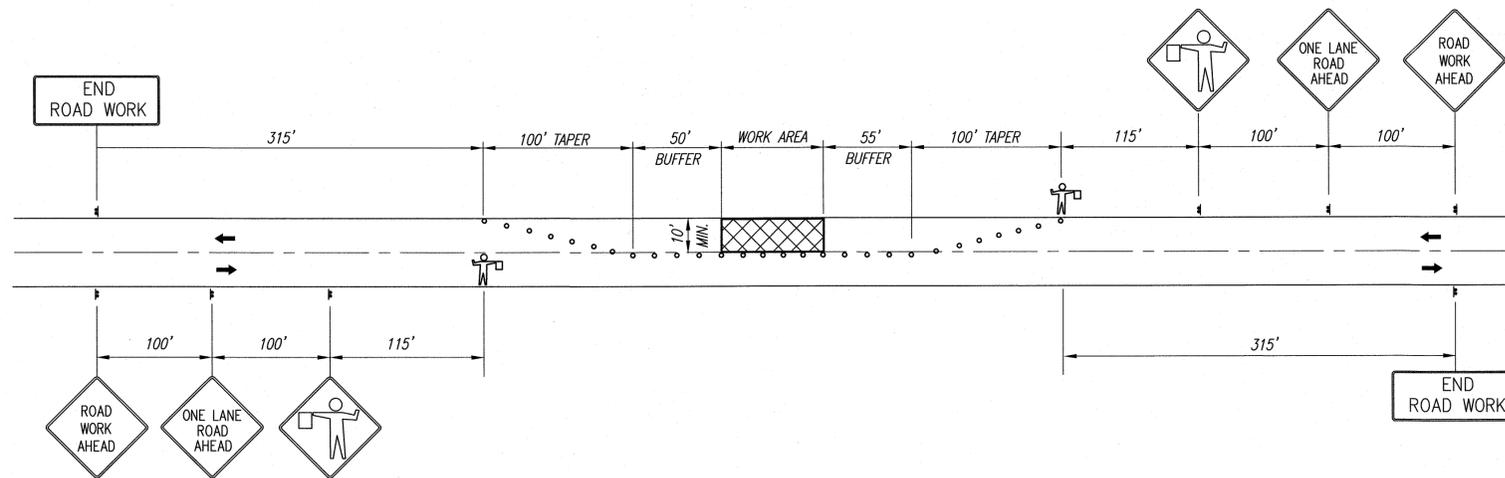
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LOT 59 & 60
DRAINAGE IMPROVEMENTS
KEOKEA & WAIHOLI, MAKAWAO, MAUI
OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
TAX MAP KEYS: (2) 2-2-032: 059 & 060

SWALE DETAIL

DRAWN BY: CO	ENGINEER: CO	CHECKED BY: AMM/FJC
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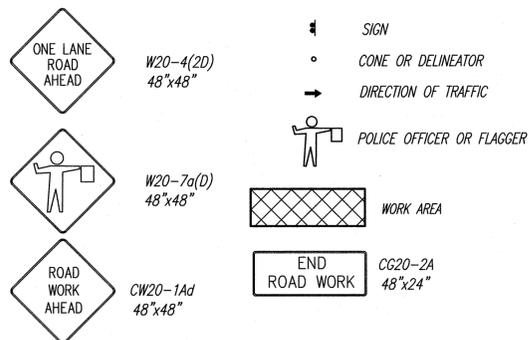
**TYPICAL TRAFFIC CONTROL PLAN
(TWO FLAGGER OPERATION)**

NOT TO SCALE

GENERAL NOTES FOR TRAFFIC CONTROL PLAN

1. THE PERMITTEE SHALL MAKE MINOR ADJUSTMENTS AT INTERSECTIONS, DRIVEWAYS, BRIDGES, STRUCTURES, ETC., TO FIT FIELD CONDITIONS.
2. CONES OR DELINEATORS SHALL BE EXTENDED TO A POINT WHERE THEY ARE VISIBLE TO APPROACHING TRAFFIC.
3. TRAFFIC CONTROL DEVICES SHALL BE INSTALLED SUCH THAT THE SIGN OR DEVICE FARTHEST FROM THE WORK AREA SHALL BE PLACED FIRST. THE OTHERS SHALL THEN BE PLACED PROGRESSIVELY TOWARD THE WORK AREA.
4. REGULATORY AND WARNING SIGNS WITHIN THE CONSTRUCTION ZONE THAT ARE IN CONFLICT WITH THE TRAFFIC CONTROL PLANS SHALL BE REMOVED OR COVERED. ALL SIGNS SHALL BE RESTORED UPON COMPLETION OF THE WORK.
5. FLAGGERS AND/OR POLICE OFFICERS SHALL BE IN SIGHT OF EACH OTHER OR IN DIRECT COMMUNICATION AT ALL TIMES.
6. WHEN REQUIRED BY THE ISSUING OFFICE, THE PERMITTEE SHALL INSTALL A FLASHING ARROW SIGNAL AS SHOWN ON THE TRAFFIC CONTROL PLANS.
7. ALL TRAFFIC LANES SHALL BE A MINIMUM OF 10 FEET WIDE.
8. ALL CONSTRUCTION WARNING SIGNS SHALL BE PROMPTLY REMOVED OR COVERED WHENEVER THE MESSAGE IS NOT APPLICABLE OR NOT IN USE.
9. THE BACKS OF ALL SIGNS USED FOR TRAFFIC CONTROL SHALL BE APPROPRIATELY COVERED TO PRECLUDE THE DISPLAY OF INAPPLICABLE SIGN MESSAGES (I.E., WHEN SIGNS HAVE MESSAGES ON BOTH FACES).
10. AT THE END OF EACH DAY'S WORK OR AS SOON AS THE WORK IS COMPLETED, THE PERMITTEE SHALL REMOVE ALL TRAFFIC CONTROL DEVICES NO LONGER NEEDED TO PERMIT FREE AND SAFE PASSAGE OF PUBLIC TRAFFIC. REMOVAL SHALL BE IN THE REVERSE ORDER OF INSTALLATION. EXISTING FADED OR OBLITERATED PAVEMENT MARKINGS THAT ARE NECESSARY FOR SAFE TRAFFIC FLOW IN THE CONSTRUCTION AREA SHALL BE REPLACED WITH TEMPORARY OR PERMANENT MARKINGS BEFORE OPENING THE ROADWAY TO PUBLIC TRAFFIC EACH DAY.
11. PERMANENT PAVEMENT MARKINGS AND TRAFFIC SIGNS SHALL BE REPLACED UPON COMPLETION OF EACH PHASE OF WORK.
12. DRIVEWAYS SHALL BE KEPT OPEN UNLESS THE OWNERS OF THE PROPERTY USING THE RIGHT-OF-WAY ARE OTHERWISE PROVIDED FOR SATISFACTORILY. FURTHER, THE PERMITTEE SHALL CONTROL TRAFFIC GOING IN AND OUT OF DRIVEWAYS.
13. ALL CONES SPACED AT 10' O.C.

LEGEND



REVISION DATE	DESCRIPTION	MADE BY	APPROVED
<p align="center">Community Planning and Engineering, Inc. Engineering Design Construction Management Infrastructure Planning 1288 Queen Emma Street, Third Floor Honolulu, Hawaii</p>			
<p>LOT 59 & 60 DRAINAGE IMPROVEMENTS KEOKEA & WAIHOLI, MAKAWAO, MAUI OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS TAX MAP KEYS: (2) 2-2-032: 059 & 060</p>			
<p>TRAFFIC CONTROL PLAN</p>			
DRAWN BY: CO	ENGINEER: CO	CHECKED BY: AMM/FJC	
<p align="center"> THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION. CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION. LICENSE EXPIRATION DATE: 04/30/20 </p>			

GENERAL NOTES

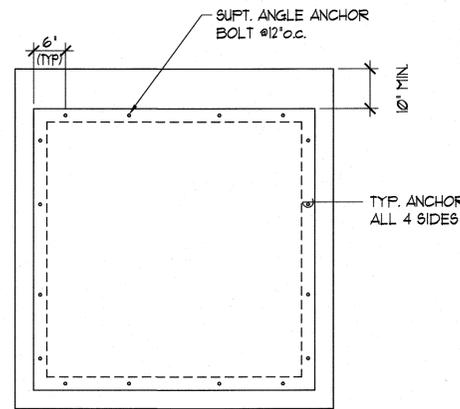
1. ALL WORK SHALL CONFORM TO THE 2006 INTERNATIONAL BUILDING CODE AS AMENDED AND ADOPTED BY THE CITY AND COUNTY OF HONOLULU.
2. ALL MATERIALS AND WORKMANSHIP SHALL CONFORM TO THE DRAWINGS AND SPECIFICATIONS.
3. THE GENERAL NOTES AND TYPICAL DETAILS SHALL APPLY UNLESS OTHERWISE SHOWN.
4. DIMENSIONS SHALL TAKE PRECEDENCE OVER SCALES SHOWN ON DRAWINGS.
5. DRAWINGS INDICATE GENERAL AND TYPICAL DETAILS OF CONSTRUCTION. WHERE CONDITIONS ARE NOT SPECIFICALLY INDICATED BUT ARE OF SIMILAR CHARACTER TO DETAILS SHOWN, SIMILAR DETAILS OF CONSTRUCTION SHALL BE USED, SUBJECT TO REVIEW BY THE ENGINEER.
6. ALL INFORMATION SHOWN ON THE DRAWINGS RELATIVE TO EXISTING CONDITIONS IS GIVEN AS THE BEST PRESENT KNOWLEDGE, BUT WITHOUT GUARANTEE OF ACCURACY. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CONDITIONS PRIOR TO THE START OR THE JOB AND NOTIFY ALL DISCREPANCIES TO THE ENGINEER.
7. ALL OMISSIONS OR CONFLICTS BETWEEN THE VARIOUS ELEMENTS OF THE WORKING DRAWINGS SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER BEFORE PROCEEDING WITH ANY WORK SO INVOLVED.
8. DURING THE CONSTRUCTION PERIOD THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SAFETY OF THE BUILDING/ STRUCTURE AND THE PROTECTION OF ADJACENT PROPERTIES, STRUCTURES, STREETS AND UTILITIES FROM DAMAGE. THE CONTRACTOR SHALL PROVIDE ADEQUATE SHORING, BRACING AND GUYS IN ACCORDANCE WITH ALL NATIONAL, STATE AND LOCAL SAFETY ORDINANCES.
9. ALL ERECTION PROCEDURES SHALL CONFORM TO OSHA STANDARDS. ANY DEVIATION MUST BE APPROVED BY OSHA.
10. THE CONTRACTOR SHALL NOTIFY ENGINEERING (PHONE 536-1692) TWO WORKING DAYS PRIOR TO BEGINNING ANY WORK WHICH WILL CONCEAL STRUCTURAL ELEMENTS SUCH AS POURING CONCRETE (CONCEALING REINFORCING) OR SHEATHING WALLS (CONCEALING HOLD DOWN ANCHORS).

DRAINAGE STRUCTURE NOTES

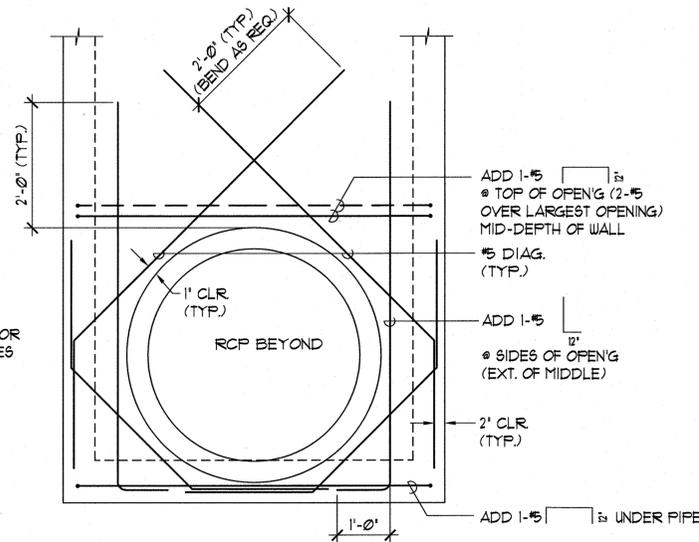
1. ALL WORK SHALL CONFORM TO THE 'STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION' (LATEST).
2. CONCRETE SHALL HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH & A MAXIMUM WATER TO CEMENT RATIO AS FOLLOWS:

	STRENGTH	W/C RATIO
DRAIN INLET	4,000 PSI	0.48
DRAIN MANHOLE	4,000 PSI	0.48
3. ALL REINFORCING STEEL SHALL CONFORM TO ASTM A615 GRADE 60.
4. MINIMUM COVER IN INCHES FOR REBARS FOR CAST-IN-PLACE AND PRECAST CONCRETE EXCEPT AS NOTED:

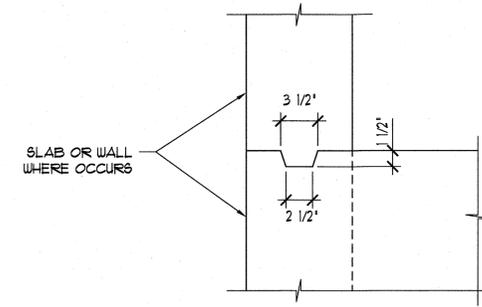
CONCRETE CAST AGAINST EARTH (C.I.P.)	3"
FORMED CONCRETE EXPOSED TO EARTH OR WEATHER	2"
5. UNLESS OTHERWISE NOTED, SPLICES, LAPS, DOVEL EXTENSIONS AND EMBEDMENTS SHALL BE 40 BAR DIAMETERS MINIMUM.
6. ALL REINFORCING BARS MARKED 'CONT.' OR 'TEMP.' SHALL BE LAPPED 48 BAR DIAMETERS MINIMUM.
7. STAGGER ALL SPLICES WHERE POSSIBLE.
8. REBARS SHALL BE SUPPORTED, BENT AND PLACED AS PER 'MANUAL OF STANDARD PRACTICE FOR DETAILING CONCRETE STRUCTURES' ACI 315 (LATEST).
9. AT TIME CONCRETE IS PLACED, REINFORCING SHALL BE FREE FROM MUD, OIL, LAITANCE OR OTHER SUBSTANCES ADVERSELY AFFECTING BOND CAPACITY.
10. FOR REINFORCING NOT SHOWN ON THE PLANS, FOLLOW LATEST APPROVED VERSION OF THE 'STANDARD DETAILS FOR PUBLIC WORK CONSTRUCTION' (STANDARD DETAILS).
11. REINFORCEMENT, ANCHOR BOLTS, DOWELS AND ALL OTHER EMBEDDED ITEMS SHALL BE POSITIVELY SECURED BEFORE POURING.



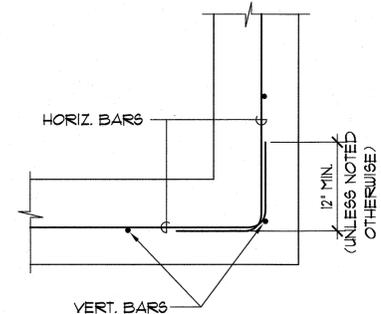
NOTE: WELD ANGLES ON FOUR SIDES TOGETHER
PLAN - GRATING BOLT DOWN LOCATION PLAN **A**
 N.T.S. 5-1



ELEVATION
TYP. ADDED REINF. AT PIPES FOR C.I.P. BOXES **B**
 N.T.S. 5-1



TYPICAL KEY DETAIL **C**
 N.T.S. 5-1



PLAN - TYP. CORNER REINFORCEMENT LAPPING **D**
 N.T.S. 5-1



Adrian Lee
 04/30/20
 Expiration Date of the License
 THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION.

REVISION DATE	DESCRIPTION	MADE BY	APPROVED

Community Planning and Engineering, Inc.
 Engineering Design | Construction Management | Infrastructure Planning
 1286 Queen Emma Street, Third Floor Honolulu, Hawaii

LOT 59 & 60 DRAINAGE IMPROVEMENTS
 KEOKEA & WAIHOLI, MAKAWAO, MAUI
 OWNER & DEVELOPER: DEPARTMENT OF HAWAIIAN HOME LANDS
 TAX MAP KEYS: (2) 2-2-032: 059 & 060

GENERAL NOTES & TYPICAL DETAILS

DRAWN BY: JM	ENGINEER: RR	CHECKED BY: AL
APPROVED:		

TECHNICAL SPECIFICATIONS

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 <u>DIVISION 7 - THERMAL AND MOISTURE PROTECTION</u>		(NOT USED)
 <u>DIVISION 8 - DOORS, WINDOWS, GLASS</u>		(NOT USED)
 <u>DIVISION 9 - FINISHES</u>		(NOT USED)
 <u>DIVISION 10 - SPECIALTIES</u>		(NOT USED)
 <u>DIVISION 11 - EQUIPMENT</u>		(NOT USED)
 <u>DIVISION 12 - FURNISHINGS</u>		(NOT USED)
 <u>DIVISION 13 - SPECIAL CONSTRUCTION</u>		(NOT USED)
 <u>DIVISION 14 - CONVEYING SYSTEMS</u>		(NOT USED)
 <u>DIVISION 15 - MECHANICAL</u>		(NOT USED)
 <u>DIVISION 16 - ELECTRICAL</u>		(NOT USED)

DIVISION 2 – SITE WORK

SECTION 02100 – CLEARING AND GRUBBING

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions, DHHL Construction General Conditions and Special Conditions in this bid package shall govern this section of the work.
- 1.02 WORK INCLUDED
- A. Furnish all labor, materials, equipment and tools necessary to accomplish all clearing and grubbing work as indicated on the plans and as specified herein.
 - B. It shall be the responsibility of the Contractor to examine the project site and determine for himself the existing conditions.
 - C. Obvious conditions of the site existing on the date of the bid opening shall be accepted as part of the work, even though they may not be clearly indicated on the plans and/or described herein or may vary there from.
 - D. All debris of any kind accumulated from clearing or grubbing shall be disposed of off-site weekly and the whole area left clean. The Contractor shall be required to make all necessary arrangements related to the proposed place of disposal.
 - E. Burning onsite will not be permitted.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

- 3.01 SEQUENCE OF WORK: All sequence of work shall be subject to the approval of the Construction Manager.
- 3.02 PROTECTION
- A. Adequate precautions shall be taken before commencing and during the course of the work to insure the protection of life, limb and property.
 - B. The Contractor shall protect from damage all surrounding structures, trees, plants, grass, walks, pavements, utility boxes, etc. Any damages will be repaired or replaced by the Contractor to the satisfaction of the Construction Manager.
- 3.03 PERMITS: The Contractor shall apply for and obtain the necessary permits prior to the commencement of work. The Contractor shall pay for all fees.
- 3.04 MAINTAINING TRAFFIC
- A. The Contractor shall conduct operations with minimum interference to streets, driveways, sidewalks, etc. in accordance with the Traffic Control Plan in the contract documents.

- B. When necessary, the Contractor shall provide, erect and maintain lights, barriers, etc., as required by traffic and safety regulations with special attention to protection of life.

3.05 CONSTRUCTION LINES, LEVELS AND GRADES

- A. The Contractor shall verify all lines, levels and elevations indicated on the plans before any clearing, excavation or construction begins. Any discrepancy shall be immediately brought to the attention of the Construction Manager and any change shall be made in accordance with his instruction. The Contractor shall not be entitled to extra payment if he fails to report the discrepancies before proceeding with any work whether within the area affected or not.
- B. All lines and grades shall be established by a Surveyor licensed in the State of Hawaii.

3.06 CLEARING AND GRUBBING

- A. The Contractor shall clear off and remove from the entire area within the area to be graded, all rubbish, grass and weeds, stumps, large roots, buried logs, garbage, boulders and other unsuitable material. Where soft wet soils are encountered, light equipment should be used.
- B. The Contractor shall grub the ground surface within the area to be graded of all grass and weeds to 6 inches below present grades. This material shall be disposed off site properly.
- C. Any stumps and roots larger than 3 inches in diameter shall be removed to a depth not less than 18 inches below the original grade level. Fill voids with onsite material to maintain indicated grade.
- D. No excavation or filling shall be undertaken until area has been cleared and grubbed.

3.07 CONTRACT ZONE LIMITS:

- 3.07.1 The Contract Zone Limits shall coincide with the limits of disturbance as shown on the plans. These limits indicate only in general the limits of the work involved. The Contractor, however, is required to perform any and all necessary and incidental work which may fall outside of these demarcation lines.

- 3.08 VERIFICATION OF EXISTING GRADES: Verify existing grades, inverts, and improvements before any clearing and grubbing work is done. Immediately bring to the attention of the Construction Manager any discrepancy, and make any changes in accordance with his instructions. Starting of clearing and grubbing operations will be construed to mean that the Contractor agrees that the existing grades, inverts, and improvements are essentially correct as indicated. No extra compensation will be allowed if existing grades, inverts, and improvements are in error after verification thereof or if he fails to report the discrepancies before proceeding with any work.

- 3.09 CLEAN-UP: Clean up and remove all debris accumulated from construction operations from time to time, when and as directed by the Construction Manager. Upon completion of the construction work and before final acceptance of work, remove all surplus materials, equipment, etc., and leave entire job site clean and neat.

END OF SECTION

SECTION 02210 – SITE EARTHWORK

PART 1 – GENERAL

1.01 GENERAL CONDITIONS: The General Conditions, DHHL Construction General Conditions and Special Conditions in this bid package shall govern this section of the work.

1.02 WORK INCLUDED: Furnish all labor, materials, services, equipment and related items necessary to excavate, fill, remove, transport, stockpile and dispose of all materials within the limits of the project required to construct the site work improvements in accordance with these specifications, dimensions, sections and details shown on the plans, and the approval of the Department.

1.03 RELATED WORK IN OTHER SECTIONS

Temporary Soil Erosion Control..... Section 02270

1.04 SUBSURFACE SOIL DATA: Subsurface soil investigations have been made at the project site. A copy of the complete reports entitled “Preliminary Geotechnical Exploration Report, Keokea-Waiohuli Development Project, Kula, Keokea, Maui, Hawaii”, dated March 31, 2005 “Preliminary Geotechnical Exploration Report, Keokea-Waiohuli Subdivision Phases 1, 2 and 4A, Kula, Makawao, Maui, Hawaii”, dated April 5, 2013 and all supplemental revisions to these reports prepared by PSC Consultants LLC are available on the compact disc (CD) provided with these bid documents. Test pit and boring logs are shown in the soils report.

The Contractor is expected to examine the site and the record of soil investigation and decide for himself the character of materials to be encountered. The Engineer will not assume responsibility for variations of subsoil quality or condition at locations other than places shown and at the time investigations were made.

The soils report and its recommendations are made part of these specifications.

1.05 PROTECTION

A. Erosion Control: The Contractor shall incorporate into his work schedule the Temporary Erosion Control Measures and the Permanent Erosion Control procedures indicated on the plans and as specified in the contract.

B. Dust Control: Every effort shall be made by the Contractor to keep dust to a minimum. Spraying the ground with water or other means of control shall be used wherever possible. The Contractor shall have an adequate supply of water for moisture conditioning of fill material.

Without limiting the generality or applicability of other indemnity provisions of the contract, the Contractor agrees that he shall indemnify and hold harmless the Department from and against all suits, actions, claims, demands, damages, costs and expenses (including but not limited to attorney’s fees) arising out of any damage to any property whatsoever or injury to any person whomsoever, in any way caused or contributed to by dust from the Contractor’s operations.

- C. Existing Utilities and Work Areas: The Contractor shall be responsible for the protection of existing surface and subsurface utilities and poles within and abutting the project site, trench excavations and other work areas.
- D. Finished Grades: All finished grades shall be kept moist until grassing is established. Where shrinkage cracks are noted after compaction of the finished grade, finished grade shall be re-scarified, moisture-conditioned to above the optimum moisture content, and re-compacted to the specified requirement at no additional cost to the Department. During construction, the Contractor shall properly grade and maintain all excavated surfaces to provide positive drainage and prevent ponding of water. In the event that ponding of water caused softening of the subgrades, the Contractor shall remove the soft soils and shall backfill the excavation with compacted fill at no additional cost to the Department.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. General Fill: Materials for general fill purposes should be well-graded, granular soils with no rocks greater than 12 inches in size in the deeper portion of the fill, at least 5 feet below the final grade or below any planned utilities. Materials ranging from 6 to 12 inches should be limited to less than 15 percent of the total general fill. The excavated materials, if less than 12 inches in maximum dimension, may be used as a source of general fill, provided these are processed to meet the gradation requirements for general fill. If the excavated materials do not contain a sufficient amount of fines to produce the desired gradation for general fill, offsite borrow or crusher-run onsite materials may be added to produce a well graded material.

Boulders, cobbles, or fractured rock fragment over 6 inches in size may be used in deeper portions of fills providing they are not nested, and sufficient soils are placed adjacent to them in such a manner that voids are properly filled and compacted, and are below the depths of utility installations.

The onsite soils may be used as general fill and backfill where structural fills are not specifically required, provided that it does not contain organics, debris, and other deleterious materials.

- B. Structural Fill. Structural fill shall be granular, free of organic debris, deleterious substances, and particles larger than 3 inches. Structural fill shall be classified as GP, GW, GM, GP-GM, SP, SW, SM, SP-SM and SW-SM, in accordance with ASTM D 2487. Where fill material is used in confined areas such as utility trenches and behind walls, the particles should be less than 2 inches in maximum dimensions. The material shall have a plasticity index less than 12 (ASTM 4318), a liquid limit less than 35, a CBR (ASTM D 1883) of at least 20 when compared to 95% relative compaction at optimum moisture content, and not more than 30% by weight passing the No. 200 sieve (ASTM D 1140).

The onsite basaltic rock may be crushed to meet the above recommendations for use as structural fill.

- C. Boulder Fills. A large quantity of boulders will be generated from excavation operations. Boulders at the surface and in the excavations may be used in the deeper fills, provided that the following recommendations are followed:
1. Boulders must not be nested together and shall be placed so that compaction equipment is able to suitably compact the soil around them. Boulder placement and compaction shall be reviewed and monitored by a Geotechnical Engineer.
 2. Boulders, 6-inch plus size rocks, can be used below 5 feet from finish grade or below utility lines whichever is at the greater depth; and
- Care shall be exercised to avoid placement of boulders in proposed utility alignments to prevent difficulty in later excavations of utility trenches.
- D. Imported Borrow: Additional general fill material needed for general filling shall consist of imported borrow materials that have the same general properties as on-site material described above. Borrow material shall be tested by the geotechnical engineer to evaluate its stability for use as general fill and shall be approved by the Engineer.
- E. Non-Expansive Select Material: Non-expansive select material to be used for this project shall consist of shall be crushed coral, basalt gravel, or cinder sand. The non-expansive select material shall be well-graded from coarse to fine with no particles larger than 3 inches in largest dimension. It shall have a plasticity index not exceeding 15 as determined by ASTM D-4318-84; and have maximum 20 percent particles passing the No. 200 sieve. The material shall have a laboratory CBR value of 25 or higher. Free draining materials and highly permeable materials shall not be used as select material. Select material shall be tested by the Geotechnical Engineer for conformance with these requirements prior to delivery to the project site for the intended use.
- F. Rocks: Rocks greater than 6 inches in diameter may be used at the bottom of deep fills or may be placed in areas suitable for rock disposal in accordance with the recommendations of the Geotechnical Engineer. Rocks not used in an engineered fill shall be disposed of as directed by the Engineer.
- G. Organic Topsoil (Stripped Material): Subsequent to acceptable clearing and grubbing, remove the top 8 inches of organic material laden topsoil as required and disposed of properly off-site.
- H. Ash Material): Ash material shall be removed and disposed of properly off-site prior to construction of the new improvements as specified by the Geotechnical Engineer.

PART 3 – EXECUTION

3.01 SITE GRADING

- A. Notification of Schedule: The Construction Manager shall be notified by the Contractor after clearing and grubbing and before any fill is placed; and also at least two weeks in advance before grading operations are scheduled to begin. Further, the Contractor shall advise the Construction Manager of the proposed overall schedule for earthwork operations.

B. General: All cuts and fills to be constructed shall be monitored by a licensed geotechnical consultant (Geotechnical Engineer) retained by the Contractor, who shall approve all fill material, methods of placing and compaction and perform field density tests during the grading. No deviation from these specifications shall be made except upon the written approval of the Construction Manager and/or other public agencies having jurisdiction.

C. General Fill. Materials for general fill purposes should be well-graded, granular soils with no rocks greater than 12 inches in size in the deeper portion of the fill, at least 5 feet below the final grade or below any planned utilities. Materials ranging from 6 to 12 inches should be limited to less than 15 percent of the total general fill. The excavated materials, if less than 12 inches in maximum dimension, may be used as a source of general fill, provided these are processed to meet the gradation requirements for general fill. If the excavated materials do not contain a sufficient amount of fines to produce the desired gradation for general fill, offsite borrow or crusher-run onsite materials may be added to produce a well graded material.

Boulders, cobbles, or fractured rock fragment over 6 inches in size may be used in deeper portions of fills providing they are not nested, and sufficient soils are placed adjacent to them in such a manner that voids are properly filled and compacted, and are below the depths of utility installations.

The onsite soils maybe used as general fill and backfill where structural fills are not specifically required, provided that it does not contain organics, debris, and other deleterious materials. Between 2 feet and 5 feet on-site soil, except ash, can be used.

D. Site Preparation:

1. Site Preparation. At the onset of earthwork, the area within the contract grading limits shall be cleared of trees, vegetation, debris, rubbish, boulders, and other deleterious materials. These materials shall be removed and properly disposed of off-site.

2. Competent Soils. Areas to receive fill shall be over-excavated down 2 feet, and shall be scarified to a depth of 6 inches, moisture-conditioned to at least 2 percent above the optimum moisture content, and compacted to a minimum of 90 percent relative compaction. Relative compaction refers to the in-place, dry density of soil expressed as percentage of the maximum dry density of the same soil established in accordance with ASTM Test designation D 1557-78. The optimum moisture content is the moisture content corresponding to the maximum compacted dry density. Soft, yielding areas encountered during site preparation shall be over-excavated to expose firm soil surface and stabilized by backfilling with select material placed in 8-inch thick, loose, lifts and compacted to 90 percent relative compaction or 95 percent of its maximum dry density.

E. Site Grading:

1. General. Boulders may be stockpiled for future use, such as rip rap, gravity walls, landscaping and other purposes.

Materials used for fills placed within the upper 2 feet of the embankments shall be select non-expansive material less than 3 inches in maximum dimension. If additional off site borrow soil is required, it shall be tested and approved by a Geotechnical Engineer prior to its delivery to the project site.

2. Earthwork and Grading. Soft or loose unsuitable silt/volcanic ash soils encountered within the roadways and driveways shall be stripped to a depth of at least 2 feet below grade or until very stiff or gravelly materials are encountered, and replaced with select granular material. Where the design subgrade encounters silty gravel, gravelly silt with cobbles, and boulders or weathered basalt, over excavation will not be necessary. After grading, scarification and proof rolling, the subbase and base course may be placed directly on top of these gravelly insitu materials. If the clinker gravel is covered in volcanic ash matrix, the use of a geofabric, such as Mirafi 140, is recommended to prevent contamination of the select borrow fill or subbase. Where fresh basalt rocks are encountered, the subbase course may be placed directly over the basalt rocks after grading.
3. Over Excavation. Some of the existing upper silt/volcanic ash soils do not contain, or have very little percentage of coarse material and are not suitable for support of structures such as roadways, house pads, driveways, access/service roads, drainage swales and berms. These soils are porous (susceptible to collapse/settle with increased water content), have a relatively low dry density, are prone to erosions, and should be over-excavated and replaced with select onsite granular soils or borrow. The silt/volcanic ash shall be over-excavated down to at least 2 feet or until very stiff or dense gravelly materials are encountered, replaced with select granular materials.
4. Fill Placement and Compaction. The fill shall be placed in level lifts with a maximum loose thickness of 8-inches and compacted to a minimum of 90 percent at house pads and 95 percent at driveways and access/service roads. Each layer shall be spread uniformly and processed to attain uniformity of the material and water content. Additional fill material shall not be placed on any fill layer which has not been properly compacted and tested.

Lava tubes, if encountered, shall be filled with select granular material.

- F. Slopes. Cut and fill slopes of 2H:1V (horizontal to vertical) may be used.

Steeper cut slopes ratios up to 1H:1V may be used in weathered basalt formations.

Fill slopes shall be constructed by overfilling 2 to 3 feet, then cutting back to the design slope to obtain a well-compacted slope face.

Where the existing ground is steeper than 5H:1V, keying and benching are required to properly bond the new fill to the slope. The filling operations should start at the lowest point up in level compacted layers, as recommended above.

Water shall be diverted away from the top of slopes and slope planting shall be implemented to minimize surface erosion.

- G. Excavations: All excavation shall be made to the lines and grades as shown on the project plans. All excavation shall be inspected and approved by the geotechnical engineer. Where conditions encountered require, he shall direct the necessary modifications to be made.

Suitable material from excavation shall be used in the fill, and unsuitable material free of organic material from excavation shall be disposed of offsite.

- H. Drainage: Care shall be exercised during grading so that areas involved will drain properly. Water shall be prevented from running over the slopes by the temporary berms or drainage swales. Runoff diversion by ditches shall be completed in the time specified in the bid form.

- I. Field Testing: The Construction Manager shall be notified seven (7) days prior to the start of grading. A pre-grading conference shall be held between the parties involved so as to discuss methods of operations, site problems and scheduling. Field density tests shall be taken by the Geotechnical Engineer retained by the Contractor.

- K. Supervision: At all times, the Contractor shall have a responsible field superintendent on the project in full charge of the work with authority to make decisions. He shall cooperate with the Construction Manager in carrying out the work. Any instructions given to him by the Construction Manager shall be considered to have been given to the Contractor personally.

- L. Rainy Weather: No fill shall be placed, spread or rolled during unfavorable weather. When the work is interrupted by rain, operations shall not be resumed until field tests by the Construction Manager indicate that conditions will permit satisfactory results.

- M. Unforeseen Conditions: If unforeseen or undetected soil conditions such as soft spots, existing utility trenches, structure foundations, voids or cavities, boulders, seepage water or expansive soil pockets, etc. are encountered, the Contractor at his sole expense shall make all necessary corrective measures in the field as such conditions are detected.

- 3.02 UNSUITABLE EXCAVATED MATERIAL: The Contractor shall remove from the site all unsuitable excavated material unless specified otherwise by the Construction Manager. The unsuitable material not containing organic material shall be hauled and disposed of offsite. Unsuitable material containing organic material shall be disposed of off-site, unless otherwise specified.

Removal, including hauling and disposal, of the unsuitable material will not be paid for directly, but shall be considered incidental to the project.

END OF SECTION

SECTION 02221 – TRENCH EXCAVATION AND BACKFILL

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions, DHHL Construction General Conditions and Special Conditions in this bid package shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary for excavating and backfilling trench for drainlines and appurtenances in conformity with the dimensions, profiles, section and details shown on the plans. Work shall be governed by Section 11 of the Standard Specifications as amended herein. The Contractor shall be solely responsible for the means, techniques, procedures, and sequences for dewatering and bracing and shoring the excavation as required.
- 1.03 SUPPLEMENTS: All excavated material shall be unclassified regardless of its composition, whether soil, solid rock, asphalt pavement, concrete, rubbish or other material.

The installation and removal of sheeting shall be done in a manner that will not cause settlement or disturbance of the pipe cradle material.

All existing ground, roadways and other improvements damaged, destroyed or disturbed shall be, at the Contractor’s expense, replaced, reconstructed and restored in kind to an equal or better condition satisfactory to the Engineer.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Materials for roads shall be in accordance with the following sections of the Standard Specifications, as revised, except as amended on the plans and/or in the specifications herewith:

Trench Excavation and Backfill..... Section 11
- B. Trench Backfill: Trench backfill shall consist of free draining granular materials, such as No. 3B fine gravel (ASTM C33, No. 67 gradation), up to about 12 inches above the pipes. The upper portion of the trench backfill from 1 foot above the pipe to the top of the subgrade or finished grade shall consist of select granular material.
- C. Pipe Cushion: Pipe cushion shall consist of No. 3B fine gravel as described by ASTM C33 (No. 67 gradation).

PART 3 – EXECUTION

- 3.01 TRENCH BOTTOM: Should the trench bottom be within 2 feet of the unsuitable material, the trench shall be over-excavated to provide 2 feet of select granular material under the bottom of the trench. Suitable material shall be select granular material or crushed rock required by the particular utility company and installed as specified herein.
- 3.02 PLACEMENT AND COMPACTION: Trench backfill shall be moisture-conditioned to above the optimum moisture, placed in level lifts not exceeding 8 inches in loose thickness and

compacted to a minimum of 90 percent maximum dry density. In pavement areas the upper 2 feet of trench backfill below the pavement subgrade shall be compacted to 95 percent maximum dry density. Compaction shall be in accordance with ASTM D1557-91.

Compaction shall be performed by rolling with equipment well-suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the optimum moisture content that will readily facilitate obtaining the specified compaction with the equipment used. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 6 inches and compacted as specified for the adjacent fill. Each layer shall be compacted as specified for the adjacent fill.

END OF SECTION

SECTION 02270 – TEMPORARY SOIL EROSION CONTROL

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions, DHHL Construction General Conditions and Special Conditions in this bid package shall govern this section of the work.
- 1.02 WORK INCLUDED: Submit three (3) sets of the erosion control materials for approval by the Engineer. Furnish all labor, materials, services, equipment and related items necessary to implement the temporary erosion control measures, submitted separately, as required by these specifications and as ordered by the Engineer during the life of the contract to control water pollution through the use of berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.
- A. Temporary erosion and siltation control measures as described herein shall be applied to any erodible material within this project, including local material sources and work areas.
 - B. The Contractor shall be responsible for providing the necessary erosion control measures which are shown on the plans or which may be ordered by the Engineer. All grading operations shall be performed in conformance with the applicable provisions of the “Water Pollution Control and Water Quality Standards” contained in the “Public Health Regulations,” State Department of Health.
 - C. The Contractor shall be responsible for promptly (next day after storms) removing all silt and debris resulting from his work and deposited in drainage facilities, roadways, neighboring lands, and other areas.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Mulches: To be bagasse, hay, straw, fiber mats, netting, wood cellulose, bark, wood chips, or other suitable material acceptable to the Engineer and shall be reasonably clean and free of noxious weeds and deleterious materials.
- B. Slope Drains: To be constructed of fiber mats, plastic sheets, or other materials acceptable to the Engineer.
- C. Catch Basin Inlet Filters: “True Dam” sediment filter (by Dandy Products, Inc.) or approved equal, acceptable to the Engineer.
- D. Filter Sock: “BioSock” compost filter sock (by EnviroTech Solutions) or approved equal, acceptable to the Engineer. For filter socks on steep slopes, wooden stakes shall be installed to hold filter sock in-place. Contractor shall submit to Engineer for approval.

PART 3 – EXECUTION

3.01 TEMPORARY EROSION CONTROL

- A. The Construction Manager has the authority to limit the surface area exposed by clearing and grubbing and to limit the surface area exposed by excavation, borrow and fill operations. The Construction Manager may also direct the Contractor to provide immediate, permanent, or temporary pollution control measures to prevent contamination of streams, drainage channels and pipes, roads, neighboring lands, and other areas.

Except for specified measures which may be shown on the plans, the Contractor shall determine the appropriate erosion control measures to use. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, and slope drains, and the use of temporary mulches, mats, and grassing, or the construction and use of other control devices or methods as necessary to control erosion.

- B. The Contractor shall incorporate all erosion control measures shown in the plans. The erosion controls may be modified as necessary to adjust to conditions that develop during construction. All modifications are subject to approval by the Construction Manager.
- C. The Contractor shall limit the surface area exposed by grubbing, stripping of topsoil, and grading to that which is necessary for him to perform the next operation and which is within his capability and progress in keeping the finish grading, mulching, grassing, and other such pollution control measures current.

The grubbing of the vegetative root mat and stumps and the stripping of topsoil shall be confined within the limits of grading which can be actively and continuously prosecuted within 15 calendar days. The area to be graded shall be limited to the minimum area necessary to accommodate the Contractor's equipment and work force and shall not at any time exceed 15 acres, unless otherwise stated on plans, without prior approval of the Construction Manager.

Any area remaining bared or cleared for more than 10 calendar days and which is not within the limits of active construction shall be immediately hydro-mulch seeded or remedied as directed by the Construction Manager at the Contractor's expense without cost to the Department. All areas where finish grading has been completed shall be grassed within three calendar days after the completion of grading for that area.

- D. The Contractor shall, at the end of each work operation in any one day, shape the earthwork in such a manner as to control and direct the runoff to minimize the erosion of soils. He shall construct earth berms along the top edges of embankments or along the property line with adjacent properties, streams and water channels, to intercept any runoff. Temporary slope drains shall be provided to carry runoff from the top of cuts and fills. Temporary facilities for controlled discharges shall be provided for runoff impounded, directed, or controlled by project activities or by any erosion control measure employed.
- E. Cut slopes shall be shaped, topsoil added if necessary, and planted as the work progresses. In no case shall the exposed surface be greater than 15 feet in height. Whenever major excavation is suspended or halted and the slope is bared for more than 15 consecutive days, the exposed surfaces shall be hydro-mulch seeded or protected as

directed by the Construction Manager at the Contractor's expense without cost to the Department of Hawaiian Home Lands.

Fill slopes shall be finished as specified and in accordance with the requirements outlined for cut slopes above.

- F. Construction of berms, cofferdams, or other such construction in or near the vicinity of streams, ponds, waterways, or other bodies of water shall be with approved materials.
- G. The temporary erosion and siltation control measures outlined in these specifications are minimum requirements and shall not preclude the provision of any additional measures which the Contractor may deem necessary. Damages caused by the erosion of soils and the pollution of downstream areas shall be the responsibility of the Contractor and all costs for repairing, correcting, replacing and cleaning damaged or polluted facilities shall be borne by the Contractor.

END OF SECTION

SECTION 02510 – ASPHALT CONCRETE PAVEMENT

PART 1 – GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions, DHHL Construction General Conditions and Special Conditions in this bid package shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary to complete, in place, asphalt concrete pavement for roads in conformity with the dimensions, profiles, sections and details shown on the plans.
- 1.03 SUBMITTALS: The Contractor shall submit for approval, the job mix formula for the asphalt concrete to be supplied for the project. The job mix formula shall indicate the source of aggregates and grades of bituminous material to be used in the mix. The total amount of bituminous binder in the mix shall be between 4.5 percent to 8.0 percent by weight depending on the specified Asphalt Concrete Mix. All test data used to develop the job mix formula shall also be submitted. The job mix formula for the mixture shall be in effect until modified in writing by the Engineer. Should a change in sources of materials be made, a new job mix formula shall be established and approved before the new material is used.

The bituminous mixtures shall be designed using procedures contained in Chapter III, Marshall Method of Mix Design, of the Asphalt Institute’s Manual Series No. 2 (MS-2), current edition, and shall meet the requirements of Table I below:

TABLE I
REQUIREMENTS FOR MARSHALL METHOD OF MIX DESIGN

Test Property	Mix #2	Mix #3	Mix #4	Mix #5
Number of Blows	75	75	75	75
Stability, lb (minimum number)	2,000	2,000	2,000	2,000
Flow, 0.01 in.	8 - 16	8 - 16	8 - 16	8 - 16
Percent air voids	4 - 6	4 - 6	4 - 6	4 - 6
Percent air voids in mineral aggregate (min.)	13	14	16	18

The job-mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size and a single percentage of bituminous material to be added to the aggregate.

After the job-mix formula is established, all mixtures furnished for the project shall conform thereto within the following ranges of tolerances in Table II below:

TABLE II
RANGE OF TOLERANCES FOR JOB-MIX FORMULA

Passing No. 4 and larger sieves	± 7 percent
Passing No. 8 to No. 100 sieves (inclusive)	± 4 percent
Passing No. 200 sieve	± 2 percent
Bitumen	± 0.4 percent

Acceptance Sampling and Testing of the Bituminous Mixture.

- A. The Contractor shall provide laboratory testing for control and acceptance functions during periods of mixture productions: One (1) field Marshall Test, asphalt content test, gradation analysis, and specific gravity test for each mixture.
- B. The compacted mixtures of the in-place pavement shall not be less than 91 percent of the specific gravity (ASTM D2041, commonly called the Rice Method) of the combined mixture without voids.
- C. Two (2) core or cut samples per street for the determination of the thickness and density of the completed pavements (or using nuclear gauge for determination of density) shall be obtained and/or tested by the Contractor at no extra cost (including that to restore the affected area). The size and locations of the samples will be directed by the Engineer.
- D. All data for the control and the acceptance testing shall be submitted.

PART 2 – PRODUCTS

2.01 MATERIALS: Materials for roads shall be in accordance with the following sections of the Standard Specifications, except as amended on the plans and/or in the specifications herewith:

Roadway Excavation	Section 12
Subgrade	Section 29
Aggregate Subbase Course	Section 30
Aggregate Base Course.....	Section 31
Asphalt Surface Treatments.....	Section 33
Asphalt Concrete Pavement, Mix No. 3 or 4	Section 34

Asphalt cement grade shall be PG 64-16.

PART 3 – EXECUTION

- 3.01 INSTALLATION: Stake out the areas to be paved using wooden stakes on which the final finish elevations, base course and subgrade elevations are clearly marked. All stakes and elevations shall be approved by the Construction Manager before any work is done.

Contractor shall fine grade the subgrade under the pavement and swales by bringing the subgrade to the proper grade from the mass grade elevations to the proper shape before installing the subbase course.

Install roadways in accordance with the applicable sections noted hereinbefore.

- 3.02 COMPACTION TESTING: The Contractor shall notify the Construction Manager at least 5 days prior to the start of fine grading for the roadway subgrade. Field density tests will be taken on the roadway subgrade, and aggregate subbase and base course by the Geotechnical Engineer retained by the Contractor. The Contractor shall be responsible for any corrective measures required as a result of inadequate compaction.

- 3.03 CLEANING OF SURFACES: Immediately before applying the prime coat or tack coat, the surface to be treated shall be swept clean of all loose material, dirt, excess dust or other objectionable material. No application shall be permitted when the surface to be treated is appreciably damp or when weather conditions are unsuitable.

Apply asphalt surface treatments at the rates specified in Section 33 of the Standard Specifications.

- 3.04 ADJUSTMENT OF EXISTING UTILITY STRUCTURES TO FINISHED GRADE: Adjust existing utility structures to finished grade in accordance with Section 36 of the Standard Specifications.

- 3.05 REPAIRS OF EXISTING ASPHALT CONCRETE PAVEMENTS: Repair to the original conditions and to the satisfaction of the Construction Manager all existing asphaltic concrete pavements that have been damaged by construction activities, including damage done by heavy equipment.

- 3.06 PLACING ASPHALT CONCRETE PAVEMENT: Install asphalt concrete pavement as specified in Section 34 of the Standard Specifications.

END OF SECTION

SECTION 02577 - PAVEMENT MARKERS, STRIPING AND MARKINGS

PART 1 - GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions, DHHL Construction General Conditions and Special Conditions in this bid package shall govern this section of the work.
- 1.02 WORK INCLUDED: Furnish all labor, materials and equipment required to accomplish the installation of all pavement markers, reflectorized white and yellow traffic pavement striping and other markings in conformance to the “Manual on Uniform Traffic Control Devices for Streets and Highways,” dated 2009, and these plans and specifications. This work shall also include the removing of existing pavement markers and removing or eradicating of existing pavement striping and markings when called for in the plans and/or directed by the Traffic Engineer.
- 1.03 SUBMITTALS: Submit material certifications, test results and brochures for all pavement markers and traffic paint materials to the Department of Public Works, County of Maui. A copy of the submittal shall be submitted to the Construction Manager.

PART 2 - PRODUCTS

- 2.01 GENERAL: Materials shall conform to the requirements of Pavement Markers, Adhesives for Pavement Markers, and Pre-Mixed Reflectorized White and Yellow Traffic Paint, as specified in these specifications.

2.02 MATERIALS

A. Pavement Markers

1. Description of Markers: The markers shall have the shape, dimensions and tolerances as shown on the plans. The markers shall be of uniform composition and free from surface irregularities, cracks, checks, chipping and other physical damage interfering with appearance or application.
2. Type of Markers
 - a. Type “D” – Two-Way Yellow Reflective Markers
3. Markers
 - a. Reflective Pavement Markers: Reflective pavement markers shall be of the prismatic reflector type consisting of a methyl methacrylate or suitably compounded acrylonitrile butadiene styrene (ABS) shell filled with a mixture of an inert thermosetting compound and filler material. The exterior surface of the shell shall be smooth and contain one or two methyl methacrylate prismatic reflector faces of the color specified.

The reflective lens shall not contain any voids or air space, and the back of the lens shall be metalized.

The shell shall be fabricated in a manner that will provide a mechanical interlock between the thermosetting compound and the shell. The thermosetting compound shall bond directly to the backside of the metallized lens surface.

The base of the marker shall be flat (the deviation from a flat surface shall not exceed 0.050 inch), rough textured and free from gloss or substances which may reduce its bond to the adhesive. The presence of a soft or resin-rich film on the surface of the base will be cause for rejection.

Reflective markers shall conform to the following requirements:

- 1) **Optical Performance:** The specific intensity of each reflective surface, when tested at 0.2 degree angle of divergence, shall not be less than the following specified values:

Specific Intensity			
	Clear	Yellow	Red
0° Incidence Angle	3.0	1.5	0.75
20° Incidence Angle	1.2	0.60	0.30

NOTE:

- a) **Angle of Incidence.** The angle formed by a ray from the light source to the marker and the normal to the leading edge of the marker face.
- b) **Angle of Divergence.** The angle formed by a ray from the light source to the marker and the returned ray from the marker to the measuring receptor.
- c) **Specific Intensity.** The mean candle power of the reflected light at a given incidence and divergence angle for each foot candle at the reflector on a plane perpendicular to the incidence light.

$$\frac{(R_L)(D^2)}{I_L} SI =$$

Where: SI = Specific Intensity

R_L = Reflected Light

I_L = Incident Light

D = Test Distance

- d) Test Method: The markers to be tested shall be located with the center of the reflecting face at a distance of 5 feet from a uniformly bright light source having an effective diameter of 0.2 inch. The photocell receptor width shall be 0.05 inch and shall be shielded to eliminate stray light. The distance from the center of the light source aperture to the center of the photocell shall be 0.21 inch. If a test distance of other than 5 feet is used, the source and receptor shall be modified in the same proportion as the test distance.
- 2) Color: The color of the reflectors when illuminated by an automobile headlight shall be an approved clear, yellow or red color as required. Off-color reflection will constitute grounds for rejection.
- 3) Strength Requirements: A random sample of 3 markers shall be selected for the load test. The marker shall support a minimum load of 2,000 pounds as applied in the following manner: The marker shall be centered, base down, over the open end of a vertically positioned hollow metal cylinder. The cylinder shall be 1-inch high, with an internal diameter of 3 inches and a wall thickness of 1/4 inch. A load necessary to break the marker shall be applied at a speed of 0.2 inch per minute to the top of the marker through a 1-inch diameter solid metal cylinder centered on the top of the marker. Failure shall consist of either:
 - a) Breakage or significant deformation of the marker at load of less than 2,000 pounds, or
 - b) Significant delamination of the shell and the filler material regardless of the load required to break the marker.
- 4) Sampling: Six markers will be selected at random from each batch for testing. However, if a batch represents less than 100 markers, the Engineer may delete sampling and may accept the markers based on certification of compliance and certified test results.
- 5) Tolerances: Should any one of the samples selected for strength testing fail to comply with the strength requirements of these specifications, six (6) additional samples will be tested. The failure of any of these additional six (6) samples will be cause for rejection of the entire lot or shipment represented by the samples.
- 6) Packaging: Shipments shall be made in containers which are acceptable to common carriers and packaged in such a manner as to insure delivery in perfect condition. Any damaged shipments shall be replaced by the Contractor. Each package shall be clearly marked as to the name of the manufacturer, color, type, lot number, quantity enclosed, and date of manufacture.

B. Adhesive for Pavement Markers

1. General: The adhesives shall be furnished as two components. The adhesives are described as Standard Set Type and Rapid Set Type.

All adhesives shall have a white "A" epoxy component and a black "B" curing agent component, each packaged separately. The mixing ratio of Component A to Component B shall be one-to-one by volume. The color of the material when mixed shall be approximately that of Color Nos. 26132 to 21652 of Federal Standard No. 595-A. The Standard Set Type is a compositional specification, together with test requirements. The Rapid Set Type is based on laboratory test requirements only. No volatile solvents or thinners shall be present in the epoxy adhesives requirements.

2. Properties of the Adhesives: The adhesive shall have the following properties:

- a. Pot Life: The pot life shall be 12 minutes maximum and 7 minutes minimum for Standard Set Type and 5 minutes minimum for Rapid Set Type when tested as follows at $77^{\circ}\text{F} \pm 3^{\circ}\text{F}$: Mix equal volumes of Components A and B in an 8-ounce, unwaxed paper cut 2 inches \pm 1/4 inch at base to give a 170 grams \pm 10 grams total mass. Mix 60 seconds \pm 5 seconds before timing for pot life. Test with a tongue depressor with minimum stirring. Record the time the material becomes unusable as the pot life. With most materials this shall be approximately the time a hard lump forms in the center.

- b. Shear Strength: When tested as follows, the shear strength shall be not less than 1,000 psi for Standard Set Type and 900 psi for Rapid Set Type.

Bond three concrete blocks 2 inch x 3-1/2 inch x 7 inch of 7-sack concrete together with the 7-inch sides parallel forming two areas of contact 3-1/2 inch x 3-1/2 inch by overlapping the blocks. The test specimen then has a base of two blocks and a second surface formed by the center block. Apply the adhesive to the contact surfaces and allow to cure for 24 hours at $77^{\circ}\text{F} \pm 3^{\circ}\text{F}$. Cap the base of the specimen with an approved capping compound and test at a load rate of 10,000 pounds per minute. A swivel type head must be used at the top of the testing press. Computations are based on a total area of 24.5 square inches (shear strength = total load/24.5).

- c. Viscosity: The viscosity of each component when measured in a three-fourths filled standard round quart paint can shall be between 1.0×10^5 and 3.0×10^5 centipoises for Standard Set Type and 0.8×10^5 and 2.2×10^5 centipoises for Rapid Set Type when measured as follows: Stir the components vigorously for 30 seconds with a spatula. Remove entrained air by vigorously tamping and measure viscosity within 10 minutes after stirring. Use Brookfield Viscometer, Model RVT at 5.0 RPM with a Model C Brookfield Helipath Stand and Helipath TD Spindle having a crossarm length of 0.804 inch for Standard Set Type and T.E. Spindle for Rapid Set Type. Use weight included in spindle set. Component and ambient temperature is to be $77^{\circ}\text{F} \pm 3^{\circ}\text{F}$ at time of measurement. Reading shall be taken at approximately the center of the vertical travel of the spindle.

d. Viscosity--Shear Ratio:

$$\frac{\text{Viscosity at 0.5 RPM}}{\text{Viscosity at 2.5 RPM}}$$

This ratio shall be 2.0 minimum for Standard Set Type and 1.8 minimum for Rapid Set Type for Component A and 1.9 minimum for Component B. Take the above viscosities at the same time and conditions as in subsection (C) above.

e. Bond Strength

- 1) Clean a 4 inch x 4 inch area on a flat surface of a concrete block made with 7-sack concrete and having a tensile strength in excess of 250 psi.
- 2) Use the equipment and load described in California Test Method No. 420. Condition test equipment, concrete and epoxy at test temperature for 24 hours before test.
- 3) Mix adhesive on a tin plate with a trowel or spatula for 60 seconds ± 5 seconds. Immediately start timing, place adhesive on pipe cap and press firmly in place on concrete. Just before the required test time, insert the dynamometer hook into pipe cap.
- 4) After curing 3-1/3 hours for Standard Set Type and 25 minutes for Rapid Set Type at $77^{\circ}\text{F} \pm 3^{\circ}\text{F}$ measured from the end of the mixing period, the bond strength shall be at least 200 psi.

f. Weight per Gallon, Pounds at $77^{\circ}\text{F} \pm 3^{\circ}\text{F}$ (Standard Set Type).

Component A 11.5 - 11.8
Component B 11.7 - 12.1

Composition:

STANDARD SET TYPE	
Component A	Parts by Weight
Epoxy Resin ¹	100
Titanium Dioxide, TT-P-422, Type III or IV	7.31
Resin Grade Asbestos ²	5.00
Talc ³	37.64
Component B	
N-Aminoethyl Piperazine ¹	23.16
Nonylphenol ⁵	52.00
Carbon Black, TT-P-343, Form 1, Class B	0.22
Talc ³	77.37
Resin Grade Asbestos ²	1.00

¹Viscosity, 5-7 poises at 25°C (77°F); epoxide equivalent 175-195; Color (Gardner), 5 maximum; manufactured from epichlorohydrin and bisphenol A. The reactive diluent shall be butyl glycidyl ether.

²Specific gravity, grams per ml., 2.45; moisture content, % by weight, 2.0 maximum; surface area, square meters per gram, 60 approximately; reflectance, G.E. brightness, 72-76; nature of surface charge, electropositive (cationic); Ph in water, 9.5; bulking value, gallons per 100 lbs., 4.8; oil absorption (DOP), pound per 100 lbs., 120; refractive index, n_d 25°C (77°F), 1.54-1.56; wet bulk density in water, after dispersion, 2 grams per liter, settling after 1 hr., 100 ml. clear maximum; dry bulk density, pounds per cubic foot, 4.

³Percent passing U.S. No. 325 sieve, 94-96; maximum particle size, 70microns, oil absorption (Gardner-Coleman), 6-7 ml. per 20 grams; fineness in oil (Hegman) 1-2; specific surface, 0.5-0.6 square meter per gram; consistency (40% suspension in linseed oil) 55-60 KU.

⁴Color (ALPHA) 50 maximum; amine value 1250-1350 based on titration which reacts with the three nitrogens in the molecule; appearance clear and substantially free of suspended matter.

⁵Color (ALPHA) 50 maximum; hydroxyl number 245-255; distillation range, °C at 760 mm first drop 295 minimum, 5% 298 minimum, 95% 325 maximum; water, % (K.F.) 0.05 maximum.

g. Directions for use.

Any settling of fillers or pigments in Components A or B shall be completely re-dispersed to provide a homogeneous mix before the components are used. Just before use, Components A and B shall be mixed in a one-to-one ratio by volume.

When the Rapid Set Type adhesive is used, the components shall be mixed by a 2-component type automatic mixing and extrusion apparatus. The temperature of the Rapid Set Type adhesive shall be maintained at 65°F to 85°F before mixing. The temperature of the Standard Set Type adhesive shall be maintained at 60°F to 100°F before mixing. Any heating of epoxy adhesive shall be done by the application of indirect heat.

Packaging and Labeling of Adhesive: Each adhesive component shall be packaged in containers not larger than 5 gallons in volume. The containers shall be new steel, not less than No. 24 gage and shall otherwise meet Interstate Commerce shipping standards. Each container shall be clearly labeled with designation (Component A or B), type (Standard or Rapid Set), manufacturer's name, date of manufacture, batch number (a batch shall consist of a single charge of all components in a mixing chamber), directions for mixing, and the following warning:

CAUTION

This material will cause severe dermatitis if it is allowed to come in contact with the skin or eyes. Use gloves and protective creams on the hands. Should this material contact the skin, wash thoroughly with soap and water. Do not attempt to remove this material from the skin with solvents. If any gets in the eyes, flush for 10 minutes with water and secure immediate medical attention.

Sampling: One quart sample of each of the components (A and B) from each batch will be sampled for testing.

Certification: The Contractor shall submit to the Engineer a certificate of compliance indicating that all types of adhesives conform to the requirements of the specifications.

C. Pre-Mixed Reflectorized White and Yellow Traffic Paint

1. General: Qualification of Reflectorized Traffic Paint: Only those traffic paints which have qualified in the latest completed prequalification tests conducted by the State Department of Transportation and having a Weighted Rating (W) of at least 6.5 for reflectorized white and 7.0 for reflectorized yellow at the completion of the road test will be permitted for use on this project. Quick dry paints shall not be used.

The phrase "latest completed prequalification tests" shall mean either those traffic paints which have been prequalified by the State Department of Transportation at the time this contract becomes effective or those traffic paints which have been listed by

the State Department of Transportation as meeting the prequalification tests of the State Department of Transportation at the time the Contractor is doing pavement striping. The Traffic Engineer will furnish a list of prequalified traffic paints upon the request of the Contractor.

The Contractor may use other materials designed for pavement striping, such as adhesive striping, on temporary detours with the approval of the Traffic Engineer. Such materials shall meet the color and reflection requirements for traffic paints.

2. Pre-Mixed ReflectORIZED White and Yellow Traffic Paint

- a. General: The pre-mixed reflectORIZED white and yellow traffic paints shall be composed of a pigment binder and glass spheres and shall be suitable for use as traffic markings on concrete, bituminous macadam and asphalt concrete pavements. These paints shall be ready for use without any subsequent addition of glass spheres or solvent. The white paint shall be pure white and free from tint. The yellow paint shall be within the green and red tolerance limits when compared with U.S. Federal Highways Administration's "Standard Color Chips for Highways Signs."

The term "pre-mixed reflectORIZED" shall refer to the finished mixture of pigmented binder and glass spheres. The terms "pre-mixed compound" and "compound" shall mean the same thing. The term "binder" shall refer to the pigment and vehicle alone (not including glass spheres). The term "spheres" shall refer only to the glass spheres incorporated in the compound.

The pre-mixed reflectORIZED white and yellow traffic paints shall be mixed at the factory ready for immediate application, using spray machines without thinning, at the normal rate of application used for these purposes by the Department of Transportation Services.

The traffic paints shall be well-ground and mixed. The paints shall not exhibit any characteristics of skinning, settling, thickening, or living. The paints shall be readily mixed to a uniform consistency, capable of being applied through the spray machine without clogging or causing other operational difficulties. The mixing of the paint shall be performed in the normal manner followed by the Department of Transportation Services.

The paint shall be capable of drying to an elastic adherent finish and shall not show appreciable discoloration with age. The volatile material shall have a minimum solvent action on asphalt and be of such character that any gums and nonvolatile components of the vehicle will entirely dissolve therein and not precipitate from the solution on standing. The paints shall be of such quality that a dry film thereof will not darken or otherwise discolor excessively when exposed to sunlight.

- b. Tests: In addition to the above-mentioned requirements, the pre-mixed reflectORIZED white and yellow traffic paints shall conform to the following requirements:

- 1) Composition: The composition, formulation, and milling of the paints shall in all respect be identical to the sample and manufacturer's certificate of formulation thereof submitted in accordance with the Department of Transportation Services' requirements.
- 2) Consistency: This test shall be performed in accordance with ASTM D562. The paint, as received, shall have a consistency as determined by the Stormer Viscosimeter and expressed as Krebs units at 77°F between 75 and 90.
- 3) Wet Hiding Power: When applied with a 0.008 inch Bird Film Applicator on Standard Mostest Black and White Hiding Power Chart, Form 05, as supplied by the Leneta Company, P.O. Box 86, Ho-ho-kus, New Jersey 07423, the paint shall completely hide black.
- 4) No Pickup Time: The paint shall be tested in accordance with ASTM D711, except that the wet film shall be applied to the glass with a 0.005 inch Bird Film Applicator. The drying time for no pickup shall be not less than 5 minutes or more than 40 minutes.)
- 5) Chemical Analysis: The Department of Transportation Services shall have the option to perform a chemical analysis of said paints to determine if the paints conform with the manufacturer's certificate of formulation and that they are identical with the sample of paint submitted for prequalification test under the latest "Notice to Prospective Bidders for Furnishing Traffic Paint." (The Department of Transportation Services retains the right to check formulation by any approved method.
- 6) Weight per Gallon: The paint supplied by the successful bidder shall be within ± 0.5 Department of Transportation Services prior to installation of materials.
- 7) Glass Spheres: The glass spheres used in the compound shall be colorless, clean and transparent, free from milkiness and air bubbles. Not more than 20 percent of the glass spheres shall be irregular or fused spheroids when tested in accordance with the method used by the Department of Transportation Services.
- 8) Glass Spheres Content: There shall not be less than 4.00 pounds of glass spheres per gallon of finished pre-mixed reflectorized traffic paint.
- 9) Gradation of Spheres: Glass spheres shall meet the following gradation when tested in accordance with ASTM D1214, using U. S. Standard Sieves:

Sieve Size	Percent Passing
#40	100
#50	90 - 100
#100	20 - 75
#200	0 - 15

- c. **Packing: Marking and Batching:** The paints shall be delivered in clean open-head steel drums. Each container shall bear a label with the following information shown thereon: Name and address of the manufacturer, shipping point, trademark or trade name, kind of paint, formula, number of gallons, date of manufacture and batch number.

All paint pails shall have a positive and permanent seal.

- d. **Sampling and Testing:** The Contractor shall furnish paint samples from each paint batch to an independent testing laboratory. At least two samples from each batch consisting of one quart each in sealed containers will be used for testing.

No paint shall be used or paid for except as authorized by the Traffic Engineer until laboratory tests (excluding the laboratory test for settling) are completed, or if the paint fails to meet the requirements of these specifications.

D. Preformed Pavement Markings

1. **General:** The preformed pavement marking tape shall consist of a film with glass beads on a conformable backing precoated with a pressure sensitive adhesive. The tape shall be capable of being adhered to asphalt concrete or Portland cement concrete without the use of heat, solvents or other additional adhesive means, and shall be immediately ready for traffic after application.

The size, quality and refractive index of the glass beads shall be such that the performance requirements as specified herein are met. The beads shall not be easily removed when the material surface is scratched with a thumbnail.

The preformed pavement marking tape shall contain selected pigments blended to provide standard highway colors of white or yellow. The tape shall maintain a uniform color under both daylight and night lighting conditions throughout its expected life.

Preformed works and symbols shall conform to the applicable shapes and sizes outlined in the latest edition of the FHWA publication, "Manual on Uniform Traffic Control Devices for Streets and Highways" (MUTCD), as amended.

When stored in a cool, dry area indoors, the tape shall be suitable for use a minimum of one year after the date of purchase.

2. Classification: Preformed pavement marking tape shall be of various types and compositions and for applications as specified as follows:
- a. Temporary Preformed Pavement Marking Tape: Temporary tape shall be capable of performing for the duration of a normal construction period and shall then be capable of being removed intact or in large pieces.
 - b. Permanent Preformed Pavement Marking Tape
 - 1) Type I permanent tape shall be durable and capable of performing as specified herein when subjected to a high traffic volume and severe wear conditions such as repeated shear action from crossover and stop, start, or turn movements. Removal should not be easy.
 - 2) Type II permanent tape shall be used for highway edge of pavement lines. The tape shall be capable of performing satisfactorily when subjected to low traffic volumes, less severe wear action than for Type I, and primarily free rolling traffic.
 - 3) Type III permanent tape shall be used for symbols, legends and intersection markings such as stopbars and crosswalks in areas of high wear or as needed.
3. Reflectance: The films shall have the following initial minimum reflectance value of 0.2 degree and 0.5 degree observation angles and at an entrance angle of 86 degrees as measured in accordance with the testing procedure of Federal Test Method Standard 370. The photometric quantity to be measured shall be specific luminance (SL), and shall be expressed as millicandelas per square foot per foot candle (mcd/ft.²/fc).

INITIAL MINIMUM REFLECTANCE VALUE

		Specific Luminance (mcd/ft. ² /fc)			
		White		Yellow	
Observation Angle Classification		0.26°	0.5°	0.2°	0.5°
Temporary		1770	1270	1310	810
Permanent	Type I	550	380	410	250
	Type II	960	760	680	510
	Type III	550	380	410	250

The sample size shall be 2.0 feet x 2.5 feet and the test distance shall be 50 feet. The angular aperture of both the photoreceptor and light projector shall be 6 minutes of arc. The reference center shall be the geometric center of the sample, and the reference axis shall be taken perpendicular to the test sample.

4. Skid Resistance: The surface of the preformed pavement marking tapes shall provide an initial minimum skid resistance value of 45 BPN when tested in accordance with ASTM E303.

5. Temporary Preformed Pavement Marking Tape

a. Composition: The tape shall be a highly reflective, conformable, pliant polymer material intended for marking applications where removability is required.

The tape shall consist of a mixture of high quality polymer materials and pigments and shall not contain metallic foil. Glass beads shall be distributed throughout the pigmented area and in a reflective layer bonded to the top surface. The performance of the glass beads shall meet the durability and reflectance criteria specified herein.

The tape shall be reinforced with a non-metallic medium and shall be pre-coated with a pressure sensitive adhesive.

The tape shall be capable of adhering to roadway surfaces under climatic and traffic conditions normally encountered in the construction work zone. Newly applied tape shall be capable of being immediately exposed to traffic without pickup or distortion by vehicles.

b. Thickness: The film without adhesive shall have a minimum thickness of 0.03 inch (0.76 mm).

c. Removability: The tape shall be removable from asphalt cement concrete or Portland cement concrete, either manually or with a roll-up device, at temperatures about 40°F (4°C), and without the use of heat, solvents, grinding or sandblasting. The tape shall meet this requirement even after traffic exposure on transverse applications in accordance with the following:

- 1) Time in place - 632 days
- 2) ADT per lane - 9,000 (23% trucks, 3.5 axles/unit)
- 3) Minimum axle hits - 13,000,000

6. Permanent Preformed Pavement Marking Tape

a. Type I

1) Composition: Tape shall consist of a mixture of high quality polymeric materials, pigments and glass beads, with a reflective layer of beads bonded to the top surface.

2) Thickness: The film without adhesive shall have a minimum thickness of 0.06 inch (1.52 mm).

- 3) Conformability and Patchability: The tape shall be conformable to pavement contours, breaks, faults, etc., through the action of traffic at normal pavement temperatures. Worn or missing areas shall be repairable with butt spliced patches of the same material.
- 4) Tensile Strength and Elongation: The tape shall have a minimum tensile strength of 40 pounds per square inch and minimum elongation of 75 percent at break when tested in accordance with ASTM D638. The sample size shall be 6 inches x 1 inch and shall be tested at a temperature between 70°F and 80°F with a jaw speed of 10 to 12 inches per minute.
- 5) Reflectivity Retention: Glass beads shall be strongly bonded and not easily removed by traffic. The tape shall be tested for reflectivity retention as follows:
 - (a) A sample 2 inches x 6 inches shall be bent around a 1/2-inch diameter mandrel with the 2-inch dimension perpendicular to the mandrel axis. Examination of the area with 5x magnifier shall show less than 10 percent of the beads with 40 percent or less embedment in the binder.
 - (b) Taber Abraser Simulation Test: Using a Taber Abraser with an H-18 wheel and a 125 gram load, a sample shall be tested for 200 cycles and then inspected with a magnifier of 5-power or larger.

No more than 15 percent of the beads shall be lost due to popout and bead erosion shall be the major mode of failure.
- 6) Effective Performance: The tape shall be neat and durable and shall not flow or distort due to temperature or vehicle impacts. The pliant polymer shall provide a cushioned, resilient substrate that shall reduce bead crushing and loss for the life of the marking. The film shall be weather resistant and shall show no appreciable fading, lifting or shrinkage throughout its usage. The tape shall show no significant tearing, roll back, or other signs of poor adhesion during its useful life which shall be a minimum of one year from the date of installation.

Immediately after application, the tape shall be capable of being impacted by vehicles without being picked up or distorted.

b. Type II

- 1) Composition: The retroreflective pavement marking material shall consist of glass beads embedded in a white or yellow film with a thin, flexible conformable backing which is precoated with a pressure sensitive adhesive.

- 2) Thickness: The film with adhesive shall have a minimum thickness of 0.025 inch (0.64 mm).
- 3) Abrasive Resistance: Samples of test material shall not wear through to the conformable backing surface in less than 400 cycles when tested in accordance to Federal Test Method Standard 141, Method 6192, except using an H-22 wheel and a 250 gm load.
- 4) Acid Resistance: The beads shall show resistance to etching, hazing or delamination of bead surface after exposure to a 1 percent solution of sulfuric acid. The test shall be performed as follows:

Soak one gram of beads in 100 cc of a 1 percent H₂SO₄ solution for 100 hours. Then decant the acid solution and dry the beads at 100°C. Microscopic examination of a sample of the beads shall show no more than 5 percent of the beads altered by the acid.
- 5) Reflectivity Retention: The requirements shall be as described in 6.a.5).
- 6) Effective Performance: The requirements shall be as described in 6.a.6).

c. Type III

- 1) Composition: The retroreflective pavement marking film shall consist of a mixture of high quality polymeric materials, pigments and glass beads distributed throughout its base cross sectional area, with a reflective layer of beads bonded to the top urethane wear surface. The edges of the preformed tape shall be clean cut and true.
- 2) Thickness: The film without adhesive shall have a minimum thickness of 0.06 inch (1.52 mm).
- 3) Conformability and Patchability: The tape shall be conformable to pavement contours, breaks, faults, etc., and worn or missing areas shall be repairable with the same materials in accordance with the manufacturer's instructions.
- 4) Tensile Strength and Elongation. The material shall have a minimum tensile strength of 350 pounds per square inch and a minimum elongation of 50 percent at break when tested in accordance to the provisions of ASTM D638. The sample size shall be 6 inches x 1 inch and shall be tested between 70-80°F with a jaw speed of 10 to 12 inches per minute.
- 5) Reflectivity Retention: The glass beads shall be strongly bonded and not be easily removed by traffic wear.

The predominant mode of failure shall be “wear down” of the beads at 200 cycles when no more than 15 percent of the beads shall be lost due to popout using a Taber Abraser with an H-18 wheel and a 125 gram load.

- 6) Glass Bead Retention: When a 2-inch x 6-inch (5.08 x 15.24 cm) sample is bent over a 1/2-inch diameter mandrel (with a 2-inch dimension perpendicular to the mandrel axis), microscopic examination of the area on the mandrel shall show no more than 10 percent of the beads with entrapment by the binder of less than 40 percent.
- 7) Installation: The markings shall be applied and tamped in accordance with the manufacturer’s recommendations.

E. Reflective Thermoplastic Compound Pavement Markings

1. General: Reflective thermoplastic compound pavement markings shall be a substance, free of volatiles, which is machine applied to the pavement surface in a hot molten state and which, after cooling to the ambient temperature, and without polymerization or other chemical change, forms a traffic marking stripe of the quality and appearance as specified herein.

The material used shall be a product especially compounded for traffic markings.

The installed stripe shall not be slippery when wet.

The compound shall not deteriorate by contact with sodium chloride, calcium chloride, oil content of pavement materials, or from oil droppings from traffic.

In the plastic state, the material shall not give off fumes which are toxic or otherwise injurious to persons or property. The material shall not break down or deteriorate if held at the plastic temperature for a period of 4 hours, or by reason of four reheatings to the plastic temperature.

There shall be no obvious change in color of the material as a result of up to four reheatings, or from batch to batch.

To insure the best possible adhesion, the compound shall be installed in a melted state of a minimum temperature of 375°F, and the material shall not scorch or discolor if kept at temperatures between 380°F to 450°F for up to 4 hours.

The pigmented binder shall be well-dispersed and free from all skins, dirt, foreign objects, or such ingredients as will cause bleeding, staining, or discoloration.

After application and proper drying time, the material shall show no appreciable deformation or discoloration under local traffic conditions, and in an air and/or road temperature ranging from 0° to 120°F.

Under this specification, the term “drying time” shall be defined as the minimum elapsed time, after application, when the stripe shall have and retain the characteristics required by the preceding sections. In addition, the drying time shall be established by the minimum elapsed time after application, after which normal local traffic will leave no impression or imprint on the applied marking.

The drying time shall not exceed a characteristic straight line curve, the lower limits of which are 2 minutes at 50°F, the upper limits of which are 15 minutes of 90°F, both temperatures measured at a maximum relative humidity of 70 percent.

The stripe shall maintain its original dimensions and placement. The exposed surface shall be free from tack. Cold ductility of the material shall be such as to permit normal movement with the road surface without chipping.

The marking shall have a uniform cross section. Pigment shall be evenly dispersed throughout the material. The density and character of the material shall be uniform throughout its thickness.

The material shall not smear or spread under normal traffic conditions at temperatures below 120°F.

The filler to be incorporated with the resins or binders shall be a white calcium carbonate or equivalent filler.

The white thermoplastic shall have a pigment containing not less than 6 percent per Titanium Dioxide, and, after setting, shall be pure white, free from dirt or tint.

Yellow reflectorized thermoplastic compound shall be “Federal Yellow”.

The binder shall consist of a mixture of non-drying synthetic resins at least one of which is solid at room temperature. The total binder content of the thermoplastic compound shall be not less than 15 percent nor more than 35 percent by weight.

The material shall not change in its color and brightness characteristics after prolonged exposure to sunlight.

During manufacture, reflectorizing beads shall be mixed into the material to the extent of not less than 20 percent nor more than 50 percent by weight of the material. The beads that are applied to the surface of the material shall be automatically applied at a uniform rate of approximately 3 pounds of glass beads to every 100 square feet of line.

The glass beads used in the formulation shall have a refractive index of not less than 1.51 when tested by the liquid immersion method at 25°C (77°F) shall consist of 70 percent minimum by count of true spheres; shall be free from air inclusions; and shall have the following graduation:

U. S. Sieve Number	Percent Passing
30	90 -100
40	35 - 100
100	0 -10

Not less than 70 percent of the spheres shall meet the following requirements:

- a. The surface of the spheres shall be smooth, lustrous, and free from film scratch and pits.
- b. The spheres shall be clear and transparent and shall not be ovoid in shape or fused spheroids.

- b. The spheres shall show high autocollimating efficiency. Not more than 1 percent shall be black, amber, or milky.

The glass beads dropped on the applied marking shall have a refractive index of not less than 1.51 when tested by the liquid immersion method of 25°C (77°F) shall consist of 70 percent min. by count of true spheres; shall be free from air inclusion; and shall have the following gradation:

U. S. Sieve Number	Percent Passing
20	90 - 100
80	0 - 10

Not less than 70 percent of the spheres shall meet the following requirements:

- a. The surface of the spheres shall be smooth, lustrous, and free from film scratch and pits.
- b. The spheres shall be clear and transparent and shall not be ovoid in shape or fused spheroids.
- c. The spheres shall show high autocollimating efficiency. Not more than 1 percent shall be black, amber, or milky.

2. Specifications and Tests

a. Color

- 1) White: Initially white; as demonstrated by a standard color difference meter such as the Gardner Color Difference Meter manufactured by Gardner Laboratories, Inc., Bethesda, Maryland, the material shall show deviations from a magnesium oxide standard not greater than the following:

Scale Definition	Mag Oxide Standard Sample	
Rd Reflectance	100	70 minimum
a Redness-Greenness	0	-5 to +5
b Yellowness-Blueness	0	-10 to +10

- 2) Yellow: Initially yellow; equal to standard color chips using Federal test method standard 141 Method 4252.

- b. Color Retention: The retention of the initial color shall be determined as follows: Specimens shall be prepared and tested from the samples submitted

in accordance with ASTM D620-57T, "Tentative Method of Test for Colorfastness of Plastics." The ultraviolet light source shall be as specified from the test procedure or optionally may be a General Electric 275 watt sunlamp bulb, type RS, with built-in reflector. After 100 hours of exposure, specimens shall show no perceptible color change when compared visually with an unexposed specimen.

- c. Water Absorption: Material shall have not more than 0.5 percent by weight of retained water, when tested by ASTM D570, procedure a.
- d. Softening Point: Material shall have a softening point of not less than 90°C (194°F), as determined by ASTM E28.
- e. Specific Gravity: Specific gravity of compound at 25°C (77°F) shall be from 1.9 to 2.5.
- f. Impact Resistance: The impact resistance shall not be less than 15-inch-pounds at 77°F after the material has been heated for 4 hours at 400°F and cast into bars of 1-inch cross sectional area and 3 inches long and placed with 1-inch extending above the vise in a cantilever beam (Izod Type) tester using the 25-inch pound scale. See ASTM D256 for description of this instrument.
- g. Bond Strength: When two concrete blocks 2 inches by 3-1/2 inches by 7 inches are cemented together on the 3-1/2 inch by 7-inch faces with a 1/16 to 1/8-inch layer of the thermoplastic traffic line material and tested according to ASTM C321, the bond strength shall not be less than 150 pounds square inch.
- h. Indentation Resistance: The reading of the Shore Durometer, Type A, as described in ASTM D2240 after 15 seconds shall not be less than the amounts herein designated when the material is tested after heating for 4 hours at 400°F, and cooled to the following temperatures:

Temperature	Reading
115°F	65
77°F	95
40°F	95

- 3. Packaging: Each unit container shall be clearly and adequately marked to indicate the color of the material, the process batch number or similar manufacturer's identification, the manufacturer's name and location of plant, and the date of manufacture.

The material shall be delivered to a designated area in unit containers as processed by the manufacturer. Each unit container when filled shall weigh no less than 24 lbs. or more than 52 lbs.

4. Warranty: Thermoplastic compound pavement marking material furnished and installed under this specification shall be guaranteed by the Contractor against failure due to poor adhesion resulting from defective materials or methods of application.

For approved pavements carrying 30,000 vehicles per day or less, the successful bidder shall guarantee to replace, without cost to the Department, that part of the pavement markings installed under this contract which, in the opinion of the Construction Manager, has not remained to perform useful service as follows:

- a. Stop Lines:

90 percent of the total of any one intersection for one year.
75 percent of the total of any one intersection for 2 years.
50 percent of the total of any one intersection for less than 3 years.

- b. Lane Lines, Edge Lines, and Center Lines:

90 percent of a unit for one year.
80 percent of a unit for 2 years.
60 percent of a unit for 3 years.

(A "Unit" is defined as any length of highway having installed thereon 2,000 linear feet of line of specified width in any combination or pattern.)

The replacement material installed under this guarantee shall be guaranteed the same as the original material, from the date of the original installation.

5. Equipment: The material shall be applied to the pavement by an extrusion method wherein one side of the shaping die is the pavement and the other three sides are part of the equipment.

The equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment shall be constructed to pavement accumulation and clogging. All parts of the equipment which come in contact with the material shall be easily accessible and exposable for cleaning and maintenance.

All mixing and conveying parts including the shaping die shall maintain the material at the plastic temperature.

The equipment shall assure continuous uniformity in the dimensions of the stripe. The thickness of the material on the pavement shall be no less than 3/32 inch and no more than 3/16 inch measured as an average in any 3-foot length.

The applicator shall cleanly cut off square stripe ends and shall be capable of applying "skip" lines. The use of pans, aprons or similar appliances which the die overruns will not be permitted.

Beads applied to the surface of the completed stripe shall be applied by an automatic bead dispenser attached to the liner in such a manner that the beads are dispensed almost instantly upon the completed line. The bead dispenser shall be equipped with an automatic cutoff control synchronized with the cutoff of the thermoplastic material.

The equipment shall be constructed to provide for varying die widths to produce varying widths of traffic markings.

A special kettle shall be provided for melting and heating the composition. The kettle shall be equipped with an automatic thermostatic control device so that heating can be done by controlled heat transfer liquid rather than direct flame, to provide positive temperature control and prevent overheating of the composition.

The applicator and kettle must be equipped and arranged to satisfy the requirements of the National Fire Underwriters.

The applicator shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

The applicator shall be capable of containing a minimum of 125 pounds of molten material.

6. Application: The Contractor shall clean off dirt, blaze, paint, tape and grease where necessary and as directed by the Engineer.

The material may be installed in variable widths from 2 inches to 12 inches.

On pavements containing less than 6 percent bituminous asphalt and on all concrete pavements, the Contractor shall prestripe the application area with a binder material as recommended by the manufacturer.

The compound shall be installed in a melted state at temperatures of 380°F to 450°F.

The minimum installed thickness of the line as viewed from a lateral cross section shall be not less than 3/32nds of an inch at the edges, nor less than 1/8th of an inch in the center. The measures shall be taken as an average throughout any 36-inch section of the line.

The new line when applied over an old line of compatible material shall bond itself to the old line in such a manner that no splitting or separation takes place during its useful life.

The finished lines shall have well-defined edges and be free of waviness.

PART 3 - EXECUTION

- 3.01 GENERAL: Pavement markers and markings shall be applied to surfaces that have been thoroughly cleaned and are free of dirt, dust, curing compound, grease, oil, moisture, loose aggregates, unsound layers and any other material which would adversely affect the bond of the adhesive or paint.

In the installation of pavement markers, the cleaning of asphalt concrete surfaces shall be by blast cleaning. Clean, newly placed asphalt concrete need not be blast cleaned unless the surface contains an abnormal amount of asphalt or the surface is contaminated with dirt, grease, oil or any other material which would adversely affect bonding.

Unless otherwise specified, the Contractor shall establish control points, satisfactory to the Construction Manager, spaced at intervals that will insure accurate location of pavement markers and striping. Markers, paints and tape shall not be applied when moisture or foreign matter is present on the pavement surface or when wind conditions are such as to cause dust to be deposited on the prepared areas or to prevent satisfactory application of the marker adhesive or paint.

The Contractor shall paint temporary guidelines and outline of arrows, legends and crosswalks with a 2-inch wide brushed line on the day the roadway is opened to traffic which shall be approved by the Construction Manager before permanent lines are painted.

The Contractor shall furnish and place all warning and directional signs necessary to direct and control the traffic during marker installation or the striping operations. Warning signs shall be set up before the beginning of each operation and extra signs shall be kept well ahead of the marking or painting equipment.

The Contractor shall install all markers and apply all pavement striping before opening roadways to public traffic except that when connections to existing pavements are made or when temporary detours carry public traffic, the Contractor shall mark or stripe the connecting pavements on the day that the roadway is open to traffic.

If it is necessary to run public traffic over roadways soon after paving, the Contractor shall paint, on the day of each day's paving, temporary guide dashes at the traffic stripe or marker location on the pavement, as guidance for drivers, until the permanent markings can be placed. The Contractor shall maintain and repaint, if necessary, all temporary markings until the permanent striping and/or markers are installed. This work shall be considered incidental to the items of paving, pavement markers and/or pavement striping, and no separate payment will be made thereof.

Permanent pavement markers, striping and markings shall be applied no sooner than 7 calendar days nor later than 14 calendar days after completion of the pavement.

- 3.02 PAVEMENT MARKERS: Unless otherwise ordered in writing by the Construction Manager, markers shall be cemented to the pavement with Standard Set Type adhesive. If ordered by the Construction Manager, the Contractor shall use Rapid Set Type adhesive for the Standard Set Type adhesive at no extra cost to the Department.

If the Contractor uses Rapid Set Type adhesive, he shall submit samples of the markers and Rapid Set Type adhesive proposed for use to the Construction Manager, for testing and approval, at least 10 days before the date of its intended use.

The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the marker in a quantity sufficient to result in complete coverage of the area of contact of the marker with no voids present and with a slight excess after the marker has been pressed in place. The marker shall be placed in position and pressure applied until firm contact is made with the pavement. Excess adhesive around the edge of the marker, excess adhesive on the pavement, and adhesive on the exposed surfaces of the markers shall be immediately removed. Soft rags moistened with mineral spirits conforming to Federal Specification TT-T-291E or kerosene may be used, if necessary, to remove adhesive from exposed faces of pavement markers. No other solvent shall be used. The marker shall be protected against impact until the adhesive has hardened to the degree designated by the Construction Manager.

The adhesive requires that the mixing operation and placing of the markers be done rapidly. When hand mixing or machine mixing the Standard Set Type adhesive, all markers shall be aligned and pressed into place within 5 minutes after mixing is started. When hand mixing Standard Set Type adhesive, not more than one quart shall be mixed at one time. Any mixed batch which becomes viscous so that the adhesive cannot be readily extruded from under the marker on application of slight pressure shall not be used.

When the Rapid Set Type adhesive is used, the components shall be mixed by a two component type automatic mixing and extrusion apparatus, the markers shall be placed within 60 seconds after the adhesive has been mixed and extruded and no further movement of the marker will be allowed.

Automatic mixing equipment for the epoxy adhesive shall use positive displacement pumps and shall properly meter the components in the specific ratio, ± 5 percent by volume of either component. At the beginning of each day and at any other time ordered by the Construction Manager, the ratio shall be checked by the Contractor in the presence of the Construction Manager. This check shall be made by disconnecting the mixing heads, or using suitable bypass valves, and filling two suitable containers with the unmixed components. The mixing head shall properly mix two components so that there is no trace of black or white streaks in the mixed material.

The Standard Set Type adhesive shall not be used when either the pavement or the air temperature is less than 50°F. The Rapid Set Type adhesive shall not be used when either the pavement or the air temperature is less than 30°F. No markers shall be installed if the relative humidity of the air is greater than 80 percent or if the pavement is not surface dry. The Construction Manager shall be the judge as to when the adhesive has set sufficiently to bear traffic. The following table (next page) may be used as a guide; however, the times shown may vary, depending upon field conditions:

TIME TO BEAR TRAFFIC		
Temperature* (°F)	Standard Set Type (Hours)	Rapid Set Type (Minutes)
100	1-1/2	15
90	2	20
80	3	25
70	4	30
60	5	35
50	7	45
40	No Application Below 50°F	65
30		85
		No Application Below °F

*The temperature indicated is either pavement surface or air temperature, whichever is lower. The hardness of the rim of epoxy around the marker shall not be used as an indication of the degree of cure of the epoxy under the marker.

No pavement markers shall be installed over longitudinal or transverse joints of the pavement surface.

3.03 PAVEMENT STRIPING AND MARKINGS: Pavement striping and markings shall be of the length, width and placement specified and shall conform to the Department of Transportation Services' Standards.

Traffic paint shall be applied at a nominal film thickness of 0.015 inch, utilizing a wheeled, hand or self-propelled applicator machine. The traffic paint applicator machine shall have appropriate shields of nozzle controls which will permit sharp pavement stripe definition. The traffic paint applicator machine shall have an air stream nozzle which can direct compressed air immediately before the area of paint application for the purpose of cleaning the pavement prior to paint application.

Pavement arrows, legends, and crosswalks shall be applied with appropriate templates (refer to "Traffic Standards Manual" of the Department of Transportation Services, dated July 1976).

No stripe shall be less than the specified width. No stripe shall exceed the specified width by more than 1/2 inch. The length of the 10-foot painted segment for skip stripe may vary ± 1 foot and the 30-foot gap between segments may vary ± 1 foot. The alignment of the stripe shall not deviate from the intended alignment by more than 1 inch on tangents and on curves up to and including one degree. On curves exceeding one degree, the alignment of the stripe shall not deviate from the intended alignment by more than 2 inches.

When necessary to correct a deviation which exceeds the permissible tolerance in alignment, that portion of the stripe so affected shall be removed plus an additional 30 feet in each direction, and a new stripe then provided in accordance with these specifications.

All stripes, segments of stripes and markings shall present a clean cut, uniform appearance. All striping and markings which fail to meet the requirements specified herein, or are marred or damaged by traffic or from other causes, shall be corrected prior to acceptance by the City at the Contractor's expense. All misted areas, dripped and spattered paint shall be removed to the satisfaction of the Construction Manager.

The freshly painted stripe shall be protected by cones or other satisfactory devices until the traffic paint is dry and will not transfer to car tires. All stripes damaged by traffic, or pavements marked by traffic crossing wet paint, shall be repaired or corrected as specified below.

The Contractor shall submit to the Construction Manager test specimens as requested. Test films shall be applied to a suitable plane rigid surface. The area shall be of sufficient size to permit film thickness measurement to be made at least 1 inch from any edge.

- 3.04 REMOVING EXISTING PAVEMENT MARKERS, STRIPING AND MARKINGS: Existing pavement markers shall be removed by methods that cause the least possible damage to the pavement or surfacing.

Where specified on the plans and/or directed by the Construction Manager, existing pavement striping and markings shall be removed to the fullest extent possible by methods that will not materially damage the surface or texture of the pavement, or leave impressions on the roadway that could be confused with permanent striping during inclement weather or night driving conditions. Any damage to the pavement or surfacing caused by the removal operations shall be repaired by the Contractor at his expense by methods acceptable to the Construction Manager.

Painting over the existing striping and markings will not be permitted. Burning off existing striping and markings will be permitted using an approved method using excess oxygen.

Sand or other material deposited on the pavement as a result of removing pavement markers, traffic striping and markings shall be removed as the work progresses. Accumulation of sand or other material which may constitute a hazard to traffic will not be permitted.

Extraneous traffic striping and markings shall be removed before any change is made in the traffic pattern.

- 3.05 PREFORMED PAVEMENT MARKING TAPE: Preformed pavement marking tape may be applied manually or with the tape applicators approved by the tape manufacturer. All markings shall be applied in accordance with the tape manufacturer's recommendations and as specified herein.

The Contractor shall install permanent preformed pavement marking tape only at the locations shown on the plans and as specified herein.

Preformed pavement marking tape shall not be applied over other markings or old paint. The Contractor shall remove all old markings and otherwise prepare the surface for tape application as specified.

The minimum temperatures for the application of preformed pavement marking tape shall be 60° F (15°C) for air and 70°F (21°C) for roadway surfaces, with both temperatures rising. The maximum temperature shall be 150° F (66°C) for roadway surfaces.

The Contractor shall prime existing roadway surfaces with an approved primer immediately prior to the application of permanent preformed pavement marking tape. The Contractor shall apply the primer as recommended by the tape manufacturer and as directed by the Construction Manager.

The Contractor may use tapes of different widths to form a specified stripe width (i. e., two 4-inch wide tapes may be used to form an 8-inch wide stripe); however, 12-inch wide stripe shall be of a single width and payment shall be made for the specified stripe width as shown on the plans and called for in the bid form.

The Contractor shall use butt splices only and shall not overlap the tape material.

All markings shall be thoroughly tamped with approved mechanical tampers. Additionally, the Contractor shall slowly drive on the newly applied markings several times with a truck.

All areas marked with preformed pavement marking tape shall be ready for traffic immediately after application.

3.06 REMOVAL OF TEMPORARY TAPE TRAFFIC MARKINGS: The Contractor shall remove all temporary tape striping placed to delineate traffic lanes, crosswalks, stop bars, etc., prior to the laydown of the finish asphalt concrete mix #4 layer.

3.07 METHOD OF MEASUREMENT: Pavement markings, including lane striping, will not be measured.

Pavement markers will not be measured.

Pavement arrows, legends and words will be measured as complete units of the type and design specified on the plans and in the bid form.

3.08 BASIS OF PAYMENT: The accepted quantities of the various types of pavement markers will be paid for at the contract lump sum price complete in place. The price includes full compensation for furnishing all labor, materials, tools, equipment and incidentals, and for doing all the work involved, in furnishing and placing pavement markers complete in place, as shown on the plans, as specified herein or as directed by the Construction Manager.

Pavement striping, including pavement markings such as stop lines (or stop bars), will be paid for at the lump sum price bid in the bid form which price shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved in furnishing and installing traffic pavement striping complete in place as shown on the plans, including the removal of existing extraneous paint or paint stripe, as specified herein or as directed by the Construction Manager.

The quantity of pavement striping noted in the bid form is based on the striping plan. If the completed work deviates from the striping plan, the unit price for the adjusted striping work will be determined by dividing the lump sum price bid in the bid form by the quantity noted in the bid form. The lump sum price bid will be adjusted by the amount determined by multiplying the above unit price by the length of striping added or deleted. The adjusted striping work will be measured as follows: pavement stripes 12 inches or less in width (including between line spacing) will be measured as a single stripe; pavement stripes over 12 inches wide will be measured as two stripes; and the unpainted spaces, up to 25 feet, between painted stripe segments will be included in the measurement.

The accepted quantities of pavement arrows, legend and words will be paid for at the contract unit price per each as indicated in the bid form, in place complete.

The contract price shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved as shown on the plans, as specified herein or as directed by the Construction Manager.

Removal of existing pavement markings and markers shall be considered incidental to the various payment items.

Removal of existing pavement markings and markers shall be paid for at the lump sum price bid in the bid form which price shall be full compensation for furnishing all labor, materials, tools, equipment and incidentals and for doing all the work involved in removal in place as shown on the plans.

END OF SECTION

SECTION 02721 – STORM DRAINAGE SYSTEM

PART 1 – GENERAL

1.01 GENERAL CONDITIONS: The General Conditions, DHHL Construction General Conditions and Special Conditions in this bid package shall govern this section of the work.

1.02 WORK INCLUDED: Furnish all labor, materials, tools, equipment and related items necessary to complete, in place, the storm drainage system in conformity with the dimensions, profiles, sections, and details shown on the plans. Work relating to drainpipes and drainage structures shall be governed by the following sections of the Standard Specifications:

Trench Excavation and Backfill.....	Section 11
Drain Pipes.....	Section 24
Drain Manholes.....	Section 25
Catch Basins and Storm Water Inlets	Section 26
Concrete Structures.....	Section 40

1.03 CONTRACTOR SUBMITTALS: Shop drawings shall be submitted for precast manholes, catch basins and storm water inlets.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Storm Drain Line:

- a. High Density Polyethylene (HDPE) Pipe, AASHTO M294.
- b. Corrugated Aluminum Pipe (CAP) Pipe, AASHT M196

B. Materials for the storm drainage system shall be in accordance with the sections of the Standard Specifications noted hereinbefore.

PART 3 – EXECUTION

3.01 INSTALLATION: Install the storm drainage system in accordance with applicable sections of the Standard Specifications noted hereinbefore and the Section 603 – Culverts and Storm Drains, Standard Specifications for Road, Bridge, and Public Works Construction.

3.02 The Contractor shall be responsible for precisely laying out the storm drain lines and culverts shown on the contract plans. The location shown on the contract plans of the various existing utility lines which the new lines are to cross over or under or connect to were determined on the basis of the best information available; however, no assurance can be provided that the actual locations will be precisely as shown on the contract plans.

3.03 In performing all work, the Contractor shall exercise due care and caution necessary to avoid any damage to and impairment in the use of any existing utility lines. Any damage inflicted on existing lines resulting from the Contractor’s operations shall be immediately repaired and restored as directed by the Construction Manager at the Contractor’s expense.

END OF SECTION

DIVISION 3 - CONCRETE

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions, DHHL Construction General Conditions and Special Conditions in this bid package shall govern this section of the work.
- 1.02 WORK INCLUDED: Cast-in-place concrete and reinforcing steel for concrete slabs and footings. Work shall be in conformance to Section 39 - Portland Cement Concrete and Section 48 - Reinforcing Steel of the Standard Specifications.
- 1.03 QUALITY ASSURANCE
- A. Codes: Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified.
1. Concrete Reinforcing Steel Institute, "Manual of Standard Practice"
 2. ACI 318 "Building Code Requirements for Reinforced Concrete"
 3. ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete"
 4. ACI 311, "Recommended Practice for Concrete Inspection"
- B. Concrete Testing Service
1. The Contractor will employ, at his own expense, a testing laboratory experienced in the testing of concrete materials and mixes to perform material evaluation tests. This laboratory shall be the official testing agency for this project.
 2. Materials and installed work may require testing and retesting, as directed by the Engineer, at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times. Test, if not specifically indicated to be done at the Department's expense, including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.
 3. Tests shall comply with ASTM Standards whenever applicable.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type I
- B. Aggregates: ASTM C33
1. Fine Aggregates: Clean, sharp, natural sand or rocksand as manufactured locally

free from loam, clay, lumps or other deleterious substances.

2. Coarse Aggregates: Clean, uncoated, processed aggregate containing no clay, mud loam or foreign matter.

C. Reinforcing:

1. ASTM A615-51, Grade 60
2. ASTM A185, galvanized welded wire fabric

2.02 CONCRETE ADMIXTURES

- A. Air-Entraining Admixtures: ASTM C260
- B. Water-Reducing Admixtures: ASTM C494, Type D
- C. Set Control Admixtures: ASTM C494, as follows:
 1. Type B, retarding
 2. Type D, water-reducing and retarding
- D. Calcium Chloride: Do not use calcium chloride in concrete.

2.03 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type of concrete; 28-day compressive strengths shall be 3,000 psi (Class A); 2,500 psi (Class B); 2,000 psi (Class C) and in the Standard Specifications.
- B. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete required.
- C. Unless otherwise noted, Class A concrete shall be used for all electrical ducts, reaction blocks, slabs and walls; Class B concrete for curb and gutter, and sidewalk applications.

2.04 JOINT MATERIALS

- A. Premolded Joint Fillers: Premolded material of specified thickness composed of fiberboard impregnated with asphalt.
- B. Joint Sealing Compound: Tremco Butyl Sealant or approved equal.
- C. Epoxy-Resin Bonding Agent: Two component, mineral filled epoxy polysulfide polymer complying with FS MMM-G-650, Type I or Type II, Grade A.

- 2.05 MOISTURE BARRIER: Provide moisture barrier over prepared base material where shown on plans. Use only materials which are resistant to decay when tested in accordance with ASTM E154, as follows: Polyethylene sheet not less than 6 mils thick.

2.06 CURING MATERIALS

- A. Curing compounds for membrane curing shall conform to ASTM C309.
- B. Liquid Curing - Hardening Compound: Aqueous solution of sodium silicate with non-acid penetrating agent, reacting chemically with free lime in concrete to form a hard, non-dusting surface which will not inhibit bonding with future finishes. Products offered by manufacturers to comply with the requirements for liquid curing hardening compounds include the following:
 - 1. Demicon: Castle Chemical Corp.
 - 2. Eucosil: Euclid Chemical Co.
 - 3. Chem Hard: L&M Construction Chemicals

2.07 EPOXY GROUT: Manufactured grout with built-in bonding material subject to approval of the Engineer.

PART 3 - EXECUTION

3.01 PREPARATION: Pre-Placement Inspection -- Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts involved in ample time to permit the installation of their work; cooperate with other trades in setting such work, as required.

3.02 CONCRETE PLACEMENT

- A. General: Place concrete in compliance with the practices and recommendations of ACI 304 and as herein specified.
 - 1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.
 - 2. Screen concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.
 - 3. Do not use concrete which becomes non-plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the project site and dispose of it in an acceptable location.
- B. Concrete Conveying
 - 1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practicable by

methods which will prevent segregation and loss of concrete mix materials.

2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris water, and other deleterious materials.

C. Placing Concrete Slabs

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Bring slab surfaces to the correct level with a straightedge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.
4. Maintain reinforcing steel in the proper position continuously during concrete placement operations.

- D. Dowel installation where shown. Prepare for bonding of dowels and anchors to existing concrete by using drilled holes and a two-component epoxy which is manufactured for this specific purpose. Install in accordance with manufacturer's requirements to develop strength of dowels.

3.03 CONCRETE CURING AND PROTECTION

A. General

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.
2. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.
3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

B. Curing Methods

1. Perform curing of concrete by moist curing, or by moisture retaining cover curing, by membrane curing, or by combinations thereof, as herein specified for a continuous period of 14 days.
2. Liquid Curing-Hardening Compound: Apply to horizontal surfaces when concrete is dry to touch by means of power spray, hand spray, or hair broom in accordance with manufacturer's directions.

C. Curing Unformed Surfaces

1. Initially cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moist curing, whenever possible.
2. Moist cure surfaces to receive fluid applied waterproof membranes and composition flooring. Do not cure by membrane curing or curing compounds.
3. All slabs not receiving a finish floor material shall receive a liquid curing-hardening compound in accordance with the manufacturer's recommendations.
4. Final cure unformed surfaces, unless otherwise specified, by any of the methods specified above, as applicable.

D. Protection from Mechanical Injury: During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.04 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures from the passage of work by other trades, unless otherwise shown or directed, after the work or other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the work.
- B. Epoxy Adhesive: For application on corrective work where the ordinary methods of remedy are deemed inadequate by the Construction Manager. Type of adhesive shall be subject to the approval of the Construction Manager.

3.05 CONCRETE SURFACE REPAIRS

A. Repair of Unformed Surfaces

1. Test unformed surfaces such as monolithic slabs, for smoothness and to verify surface plane to the tolerance specified for each surface and finish. Correct low and high areas as herein specified.

2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
3. Repair finish unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects, as such, include cracks in excess of 0.03 inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
4. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
5. Correct low areas in unformed surfaces during, or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Construction Manager.

B. Finishing of Formed Surfaces

1. Joint marks and fins shall be removed and surfaces left smooth and dense. Tieholes and honeycombing shall be repaired with cement and sand mortar.
2. Exposed concrete surfaces shall be vigorously and thoroughly rubbed with a sand cement mortar the consistency of a thick paint to fill all voids and provide a smooth surface. There shall be no discernible thickness of mortar on the surface.

END OF SECTION

DIVISION 4 - MASONRY

SECTION 04230 – GROUTED RIPRAP

PART 1 - GENERAL

- 1.01 GENERAL CONDITIONS: The General Conditions, DHHL Construction General Conditions and Special Conditions in this bid package shall govern this section of the work.
- 1.02 DELIVERY, STORAGE AND HANDLING:
- A. Mortar and Grout Materials: Portland cement, masonry cement, mortar cement, lime and admixtures shall be stored in such a manner as to prevent deterioration or contamination with foreign matter. Cement which has become caked, partially set or otherwise deteriorated, or any material which becomes damaged or contaminated, shall be rejected.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Stone shall be clean, durable, free from seams or other imperfection. When tested under AASHTO Test Method T96, it shall show a wear not to exceed 50%. It shall have a minimum specific gravity of 2.4. Stone shall be at least 1/8 cubic foot in volume and have a minimum unit weight of 155 pounds per cubic foot.
- Stones generated from on-site grading operations shall be initially used as long as it conforms to the criteria hereinabove. If on-site grading operations do not generate an adequate quantity of stones for the grouted rip rap work, stones shall be imported as required. Stones to be used for this purpose shall be approved by the Geotechnical Engineer; to be retained by the Contractor.
- B. Mortar shall consist of one part cement to three parts fine aggregate and shall meet the requirements as provided in Section 39 “Portland Cement Concrete”.
- C. Hydrated Lime shall conform to the ASTM C207, Type S. Hydrated lime shall be added to the mortar and the quantity shall not exceed the recommendations of the manufacturer.
- D. Water used in mixing mortar or grout shall be clean and free from injurious amounts of oils, acids, alkalis, salts, organic materials or other substances that may be deleterious to either the mortar or reinforcement. Non-potable water shall not be used.

PART 3 - EXECUTION

- 3.01 GENERAL: The Contractor shall use stones that are available from on-site grading operations, if available and in accordance with Section 612 – Grouted rubble Paving, Standard Specifications for Road, Bridge, and Public works construction. Stones shall be grouted in place.

The proportioning of materials for grout shall be by volume and done in such a manner that the specified proportions can be controlled and accurately maintained. Fine aggregate shall be

measured in a damp loose condition. Mixing shall be by a mechanical batch mixer for at least 5 minutes for grout, but for not more than 10 minutes. Hand mixing shall be permitted only for small batches of 3 cubic feet or less.

- 3.02 RIPRAP: Riprap shall be placed in a manner to produce a well-graded mass of rock with minimum practicable percentage of voids and shall be constructed to the lines and grades shown on the plans. Work around drainage structure shall be done carefully so as to not damage structure. Structure that is damaged during construction shall be replaced at the contractor's expense.

Riprap shall be placed to its full course thickness in one operation and in such a manner as to avoid displacing the filter material. Placement shall begin at the bottom of the areas to be covered and continue up slope. Subsequent loads of material shall be placed against previously placed material in such a manner as to ensure a relatively homogenous mass. The finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Placing riprap in layers will not be permitted. Placing riprap by dumping it at the top of the slope and pushing it down the slope will not be permitted. No equipment shall be operated directly on the complete stone protection system. The Contractor shall maintain the stone protection until accepted by the Construction Manager and any material displaced prior to acceptance and due to the Contractor's negligence shall be replaced at no cost to the Department.

- 3.03 GROUTING OF RIPRAP: Grout shall be batched and mixed in sufficient quantities to prevent cold joints. Rock shall be flushed with water to remove fines from the rock prior to placing the grout. Rock shall be kept moist just ahead of the actual placing, but no flowing or standing water shall be present during the grouting operation.

Grout placement shall not be permitted when weather conditions prevent proper placement.

Grout placed on inverts or other nearly level areas may be placed on one course. On slopes, the grout shall be placed in two (2) courses in successive lateral strips approximately thirteen (13) feet in width starting at the toe of the slope and progressing to the top. The flow of the grout shall be directed with brooms, spades or baffles to prevent it from flowing excessively along the same path and to assure that all intermittent spaces are filled. Sufficient barring shall be done to loosen tight pockets of riprap and otherwise aid the penetration of grout so that all voids shall be filled and the grout fully penetrates the riprap. All brooming shall be uphill and after the grout has stiffened, the entire surface shall be rebroomed to eliminate runs, to fill voids caused by sloughing, and to remove grout from the top surface and pockets or depressions of the upper stones.

Beginning immediately after placement and continuing for at least 7 days, all grout shall be cured and protected from premature drying, mechanical damage and exposure to rain or flowing water. All materials and equipment needed for adequate curing and protection shall be available at the site. After completion of any strip or panel, no workman or other load shall be permitted on the grouted surface for a period of 24 hours. Exposed surfaces shall be kept continuously moist for the entire period, or until curing compound is applied.

END OF SECTION

**PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
KEOKEA-WAIOHULI DEVELOPMENT PROJECT
KULA, KEOKEA, MAUI, HAWAII**

For

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By:



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March, 2005

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PSC Job No. 24304.10

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**PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
KEOKEA-WAIOHULI DEVELOPMENT PROJECT
KULA, KEOKEA, MAUI, HAWAII**

March 31, 2005

PSC Job No. 24304.10

SUMMARY OF FINDINGS AND RECOMMENDATIONS

The project site is located on the western slopes of Mount Haleakala. It is underlain mainly by volcanic flows of basaltic andesite, andesitic basalt, and picritic basalt geologically termed as the Kula volcanic series. Sections of the road passing over the Kula Volcanic series will encounter volcanic ash generally intermixed with vitric tuffaceous gravels, cobbles and boulders of varying proportions (vitric) on top of the andesitic basalts. The surface soils range in thickness from 0 to more than 8 feet in one location. The Kula volcanic ash by itself is not suitable for engineered fills due to its low density and strength, high natural moisture content, and characteristically difficult to compact. The surface soils are generally classified as silt (MH) based on the Unified Soil Classification System. This soil acts like silt when dry and is prone to wind and water erosion. Some of these surface soil materials can be replaced or capped with borrow fill to provide adequate support for the proposed road network development. Laboratory tests show that the near surface, silt/volcanic ash derived soils generally have relatively low dry densities and high insitu moisture contents. Special attention should therefore be given to the preparation of subgrade and design of pavement for this road network project.

To achieve a relatively uniform support under the proposed roadway pavement structure, it is recommended that the soft or loose ash soil be removed down to at least 2 feet below the design/finish sub grade or until stiff to very stiff silt or gravelly materials are exposed, up to 2 feet below the design/finish subgrade. It should then be replaced with non-expansive, select borrow fill material (or an approved mixture of the insitu silts/volcanic ash with at least 60 percent of crusher-run basaltic aggregates), which may be obtained from the proposed project/borrow sites or other sources. Where fresh to slightly weathered basalt rocks are encountered, the basaltic base course may be placed directly over this after grading. If the grading works for the road involve extensive cutting through fresh or slightly weathered basalt, the use of embankment fill may be considered. For the Keokea site, volcanic ash materials generally range in thickness from 3/4 feet to 7.5 feet, except where the rocks are exposed at the surface. We recommend the removal of the near-surface soft volcanic ash materials in this area until stiff to very stiff soils are exposed and replacing them with select borrow material, except in the area bounded by TP-6 to TP-10 in Road A, TP-11 to TP-13 in future road and TP-14 in Road C. For the Waiohuli site, volcanic ash covered most of the road network, (except in the area bound by TP-24 through TP-27, in Road J, TP-29 through TP-30 in Road H, TP-31 through TP-32 in Road F, TP-36 in Road M, and TP-35 in Road A.) In this area, volcanic ash materials range from about 2.5 feet to 7.5 feet. We recommend the removal of the soft or loose near-surface ash materials encountered in this area, as described, and replacing them with select borrow material (or a mixture of ash and crusher-run basaltic aggregates).



Basaltic rock formations were observed at the proposed bridge and reservoir sites. It is our opinion, from a geotechnical standpoint, that it is feasible to build these structures at these selected sites.

Community Planning and Engineering, Inc. (CP&E) proposes to source borrow material from a parcel at the lower northwestern end of the proposed subdivision (Plate No. 2-A). Based on our field exploration in this area, the borrow site will have adequate borrow material consisting of basaltic/andesitic gravels, as shown in Boring Nos. B-1 to B-10. Some of the topsoils found in the borrow area, particularly in the vicinity of boring B-3, which consists of sandy, clayey silt, may be used as subbase fill material. Preliminary laboratory tests indicate that reconstituting the native volcanic ash silts with crusher run basaltic gravels also found at the site, with properly mixed portions, would considerably improve the soil strength characteristics.

We believe that a grading scheme to strip about 2 feet of the soft or loose volcanic ash soils (or until stiff to very stiff or dense materials are encountered), where these are encountered below the design/finish subgrade elevation along the road right-of-way, and replacing with select borrow material will provide long-term stability. The text of this report should be referred to for detailed and special design recommendations.

INTRODUCTION

This report presents the results of our preliminary geotechnical exploration for the proposed road network of the Keokea-Waiohuli Agricultural Lots project located at Keokea and Waiohuli, Maui, Hawaii. The study also includes the proposed water reservoir and bridge crossing on the Waiohuli side of the subdivision per our proposal of March 2005. The general location and vicinity of the project site is shown on the Project Location Map, Plate No. 1.

Our work on the project was performed generally in accordance with our proposal dated March 2, 2004, except where modified by CP&E and PSC as to the exploration method based on actual site conditions for the borrow and other site areas. This report summarizes our findings and recommendations.

PROJECT CONSIDERATIONS

The proposed Keokea-Waiohuli Agricultural Lots subdivision is located along the western slopes of Mount Haleakala west of Kula Highway Route 37 opposite Keokea Park. The terrain is steep to moderate and rough with boulders, cinder flows and rock outcrops. The majority of the study area, particularly the southern half of the site, is covered with vegetation consisting of groves of trees, Giant Cacti, and grass. The northern half contains less of the trees found at the southern



portion. The site generally slopes downward in a westerly direction from Kula Highway. The proposed subdivision road network will provide access to the proposed 400-Lot Keokea-Waiohuli Subdivision of the Department of Hawaiian Homelands (DHHL). The proposed alignment of the road network, bridge and reservoir sites, are shown in the Site Plan, Plate No. 2.

Geotechnical studies and field explorations were also conducted in the general area of the project site in 1995 by Ernest Hirata & Associates and by Dames & Moore in 1998. The studies revealed that the surface soil in the areas studied consisted of light brown to brown clayey silt with gravel and cobbles. Both studies also revealed that the surface soils are derived from volcanic ash. It was also found that this particular type of soil has high insitu moisture content and low dry density. In the dry and uncompacted state the soil exhibits little or no cohesion and becomes highly susceptible to erosion from both wind and water. Similarly, the dense and weathered basalt formation was reportedly encountered under the surface soils.

The volcanic ash derived soil in its pure form, is not recommended for structural fill, or for road embankment unless it is reconstituted with granular material. Based on these, a proposed grading scheme will consist of removing 2 feet of the soft or loose surface (volcanic ash) soil material below the design subgrade where these are encountered (or until stiff to very stiff or dense materials are encountered) and replacing these with borrow fill of non-expansive granular capping material which will support the pavement structure of the proposed subdivision road network project.

To define the extent of the fill and to obtain samples for index property tests, 50 test pits were excavated at approximately 500-foot intervals along the proposed road system by PSC Consultants, LLC, for this current study.

A borrow area is proposed at the northwestern lower end of the property (Plate No. 2-A). It is being contemplated as a source of fill material and may also serve as disposal area for the unsuitable soils and other debris that will be removed from the roadway construction site. Ten (10) borings (Boring Nos. B-1 through B-10) were excavated, with a Hoeram, by PSC from 10 to 20 feet deep at the proposed borrow area (Plate 2-B) to delineate the depths of the topsoil and to determine the engineering properties of the underlying soil/rock formation intended for borrow material.

We anticipate that asphaltic concrete pavements and or concrete pavements will be required for the roadways in the subdivision and while specific traffic loading has not been specified, we anticipate a medium vehicle loading for the project consisting primarily of passenger vehicles and delivery trucks.



The structural information for the reservoir and bridge sites were provided by Tanimura and Associates, Inc., Consulting Structural Engineers.

PURPOSE AND SCOPE

The purpose of our geotechnical exploration is to gather information on the nature, distribution, and characteristics of the subsurface earth materials encountered on the proposed project site and borrow area, and to provide specific recommendations pertinent to the proposed road network development. The scope of our exploration consisted of the following tasks and work efforts:

1. Review of the existing available data from published and unpublished sources pertaining to the geology and soil conditions at the site and its vicinity and conducting a reconnaissance survey of the project site;
2. Scheduling the field exploration and coordinating with CP&E and Land Surveyors for the test pit/boring locations and site access;
3. Scheduling the field walkover survey and coordinating with CP&E and Site Archeologist for the reservoir and bridge site locations in the Waiohuli area and site access;
4. Mobilization and demobilization of drilling/excavating equipment and operators;
5. Coordination of the field exploration, and logging of the borings and test pits by a field engineer from our firm;
6. Excavating 50 test pits, 1 to 8 feet deep, each, with the use of a Backhoe or Hoe Ram equipment, approximately 500 feet apart along the pre-surveyed road network alignment, and collecting surface bulk samples for classification and CBR testing for pavement design. The depth of the underlying rock limited the depths of the test pits.
7. Excavating 10 borings to depths of about 15 to 20 feet below the existing ground surface at the proposed borrow area;
8. Laboratory testing of selected soil samples obtained from the field exploration to classify the materials encountered and to evaluate their engineering properties relative to their intended use. In addition, mixed design of ash and granular materials and CBR tests were performed to determine their suitability for pavement support.
9. Analyzing the field and laboratory data for the formulation of preliminary geotechnical engineering recommendations pertinent to the road and pavement design, the reservoir, and the bridge at the Wiaohuli site, including but not limited to foundations, engineered fills, and site grading for the proposed subdivision road development;



10. Coordinating with and providing preliminary geotechnical recommendations to the structural designers for the reservoir and bridge sites at Waiohuli area; and
11. Preparation of this report summarizing our work on the project and presenting our findings and recommendations.

Detailed descriptions of our field exploration and laboratory testing are presented in the plates of this report.

SITE DESCRIPTION

The project site is located in the western slopes of Mount Haleakala, along the Kula Highway Route 37 opposite Keokea Park in Keokea, on the island of Maui, Hawaii. The terrain in the general area of the project site slopes downward to the west with grades ranging from moderate to steep. Occasional basaltic rock outcrops and boulders were also observed. Vegetation consisting of grass, groves of trees, and giant Cacti abounds at the site, particularly on the southern half of the property.

The proposed subdivision road network will have an estimated total length of approximately 36,000 feet or about 6.82 miles, providing access to some 400 agricultural lots. At the writing of this report, only the road profiles and cross sections for Roads A, B, D, and Bridge Abutments and a topographic map of the proposed subdivision and Reservoir site are available. The proposed road profiles and sections of the other roads of the subdivision road network were not provided.

SUBSURFACE CONDITIONS

Project Site Geology

The project site is underlain mainly by volcanic flows of basaltic andesite, andesitic basalt and picritic basalt, geologically termed as the Kula volcanic series as shown in the Geologic Map of the Project Site and Vicinity (Plate No. 1-A). These volcanic flows are covered with a surface layer of volcanic ash derived silt sometimes intermixed with tuffaceous gravels, cobbles, and boulders (weathered tuff) in the majority of the study area. These surface soils range in thickness from about 1 foot to more than 8 feet in one location. The ash material is generally not suitable for pavement and foundation support or embankment fill.



Subsurface Exploration

Road Network

Subsurface conditions along the proposed subdivision road network were explored by excavating and sampling 50 test pits spaced at approximately 500 feet on centers. The depth of excavation ranged between 4 to 8 feet except in places where the basaltic/andesitic volcanic rock occur very close to the ground surface. The approximate locations of the test pits are shown on Site Plan, Plate No. 2.

Borrow Area

The proposed borrow area was explored by digging with a hoe ram and sampling 10 borings to depths ranging between 15 to 18 feet below the existing ground surface. The approximate locations of the borings and test pits are shown in the Site Plan of the Proposed Borrow Area, Plate No. 2B.

Subdivision Road Alignment

The proposed road network will generally traverse over volcanic ash derived silt materials (silt), with varying amounts of gravels, cobbles, and boulders. The thickness of the surface soil layer ranges in the order of 1 foot to about 8 feet.

Road "A"

This proposed road alignment runs along the middle central portion of the subdivision from the southern most lots to its northern limits. Eighteen (18) test pits were excavated along this road alignment as shown in the Site Plan, Plate No. 2. The depth to the basaltic rock from the surface ranges from 2 feet in Test Pit TP-6 to about 7.5 feet in Test Pit TP-46. Silt materials were encountered in Test Pits, TP-4, TP-5, TP-34, TP-45, and TP-46. The silt materials encountered in the rest of the test pits contained varying amounts of tuffaceous gravels, cobbles and boulders.

Road "B"

Proposed Road "B", approximately 1,500 feet in length, is the main access road to the subdivision connecting Kula Highway to Road "A". Test Pits TP-1 through TP-4 are located along this proposed road alignment. The thickness of the overburden soils range from 4-feet in Test Pit TP-4 to about 8 feet in Test Pit TP-3. With the exception of Test Pit TP-4 (at the Road "A" and Road "B" junction), where the materials encountered are predominantly silt, the soils encountered in Test Pits TP-1 to TP-3 are either silty gravels or gravelly silts with tuffaceous cobbles and boulders.



Road "C"

Road "C" is a road extension that will run perpendicular to Road "B" (Plate No.2). It is about 1500 feet in length and is aligned in a west-southwest direction. Test Pit TP-14 was excavated approximately near the central portion of this road, which revealed overburden soils consisting of about 4 feet thick of silty gravel underlain with Basaltic rocks. Additional exploration should be performed in other portions of the road alignment to confirm the subsurface soil information.

Road "D"

Road "D" is a lateral road in the mid-western section of the subdivision connecting to Roads "F" and J. Three (3) test pits (TP-21 to TP-23) were excavated along this road. The depth to volcanic rock from the surface is about 5 feet in Test Pit TP-21 to about 1-foot in Test Pit TP-23, near its intersection with Road "J". The overburden soils encountered in Test Pits TP-21 are predominantly silt (MH). The same types of soils are also present in Test Pit TP-22 but contains considerable amount of gravel. A thin layer (about 1-foot) of stones and boulders in a silt matrix were encountered in Test Pit TP-23.

Road "G"

Proposed Road "G" makes a loop originating from and terminating in Road A at the northwestern side of the subdivision. It has an approximate length of about 3,225 feet. Auxilliary roads, G1 and G2 parallel to each other traverse the area bounded by the loop formed by Road G in a north-northeast orientation. Five (5) test pits, namely; TP-40 to TP-44, are located in the vicinity of Road G. The thickness of the overburden soils range from about 4-feet in Test Pits TP-42 and 43 to about 8 feet in Test Pit TP-44. The overburden materials encountered in these Test Pits are predominantly silts and gravelly silts. Additional test pits may be made to confirm the subsurface soil information in other parts of Road G.

Road "H"

Road "H" is a lateral road in the mid-western section of the subdivision connecting Roads F and E. Three test pits TP-28 through TP-30, were excavated along this road. The depth to volcanic rock from the surface is about 1 foot in Test Pit TP-30 to about 4.5 feet in Test Pit TP-28. The overburden soils encountered are predominantly silty gravels and gravelly silts.

Road "K"

Road "K" is a service road that runs perpendicular to both Roads A and E at the northeastern section of the subdivision. It is about 3,225 feet long. Test pits TP-39, 48, 49, and 50 were excavated in the general vicinity of this road. The overburden soil in this road alignment consists of silty gravels and gravelly silts ranging in thickness from 3 to 4.5 feet.



Road "F"

Road "F" is aligned parallel to Road "A" to the west of Road "A". It stretches about 2,400 feet from Road "D" in its southern end and connects with Road E to the north. Test Pits TP-31 through TP-33 were excavated along the general vicinity of this road. The depth to volcanic rock from the surface ranges from about 5 feet in Test Pit TP-32 to about 1.5 and 2.5 feet in Test Pits TP-31 and TP-33, respectively. A thin layer (about 1 foot) of cobbles and boulders in a silt matrix were encountered in Test Pit TP-31. Overburden materials encountered in Test Pit, TP-32 and TP-33 consisted of silty gravel (GM-GW).

Road "M"

Road "M" connects with Road "A" at its southern end and terminates to the north at its intersection with Road "E". It runs parallel to the east side of Road "A" and is about 1,900 feet in length. Test Pits TP-36 and TP-37 are located within this road alignment. The near-surface soils consisted of silt (MH) occurring to a depth of about 4 feet and 2 feet in Test Pits TP-36 and TP-37, respectively. Silty gravel (GM) was also encountered under the surface silt layer in TP-37, occurring down to about 7.5 feet, where it interfaces with the underlying basalt rock.

Roads "L and L-1"

Roads "L and L-1" provide access to the lots bounded by Roads A and K on the northeast side of the subdivision. Road L is approximately 1,125 feet and Road L-1, which branches perpendicular to Road L is about 375 feet. Test Pit TP-47 was excavated in the vicinity of this road. The depth to rock from the surface is about 6 feet in Test Pit TP-47. The overburden materials encountered in this test pit consisted of gravelly silt. Additional test pits can be made in the areas which are more than 500 feet apart, to confirm the subsurface soil conditions.

Road "E"

Road "E" is a header road that traverses across the northern half of the subdivision from east to west with a length of about 2,900 feet. It connects the northern ends of Roads "J", "H", "F", "A", "M" and the southern end of Road "K". Test Pits TP-26, TP-29, TP-33, TP-35, and TP-39 are approximately aligned within the path of this road. The depth to volcanic rock from the surface ranges from 1 foot in the westernmost end at Test Pit TP-26 and appear to thicken to 5 feet toward the other end at Test Pit TP-39. The overburden materials encountered along this road alignment, at the test pit locations, consisted of silty gravel. These near surface soils are generally underlain with basaltic rock of the Kula Volcanic Series.

Additional field exploration may be performed in the eastern end of Road "E" to confirm the subsurface soil information.



Proposed Borrow Site

The designated borrow site is located in a property adjacent to the northwestern side of the subdivision (Plate No. 2-A). Ten (10) borings (B-1 to B-10) were excavated, using a Hoeram, within the proposed borrow area (Plate No. 2-B), to explore the type of materials available at this site and to determine their relevant engineering properties. The borings encountered a surface soil of predominantly silt materials ranging in thickness from 0 (Boring B-5) to about 5.5 feet in Boring B-1. The surface soils are underlain with volcanic flows of basaltic/andesitic rocks with intermediate layers/lenses of tuffaceous gravels (clinker), cobbles, and boulders. A void of about 4.5 feet in vertical dimension, probably originating from a lava tube, was encountered in Boring B-2 between depths of 8 to 12.5 feet. Groundwater was not encountered in any of the borings during the time of our exploration. All borings/test pits were properly backfilled after completion of our field exploration work.

DISCUSSION AND RECOMMENDATIONS

Our field exploration indicated that volcanic ash derived silt soil with varying amounts of gravel, cobbles and boulders generally cover the project site with occasional basaltic rock outcrops. The thickness of the surface soil ranges from about 1 foot to more than 8 feet (Test Pit TP-44). These silt soils contain relatively high amounts of moisture. In the dry state it loses cohesive strength and becomes prone to wind and water erosion. Our field exploration also showed that a large part of the soil overburden within the study area contained considerable amounts of coarse materials such as tuffaceous/basaltic gravels, cobbles and boulders. In some areas the coarse materials exceeded that of the fines, as reflected in the logs of borings. These overburden materials are underlain with fresh to moderately weathered andesitic, basaltic flows also known as the Kula volcanic series.

Keokea Site

The field exploration along Roads A, B, and D, within the Keokea side of the subdivision, indicated overburden soils generally comprising of silty gravels and gravelly silts with varying amounts of cobbles and boulders. Embankment fills may be laid directly over these materials (after clearing, grubbing and scarifying) without over-excavation. Undercutting below subgrade will not be necessary when these gravelly silt and silty gravels with cobbles and boulders are encountered. In this area, volcanic ash materials generally range in thickness from 3/4 feet to 7.5 feet, except where the rocks are exposed at the surface. If road grading encounters loose volcanic ash below finish subgrade level, we recommend the removal of the upper 2 feet, or more if necessary, until stiff to very stiff or dense materials are encountered or until gravelly silt material is exposed, except in the area bounded by TP-6 to TP-10 in Road A, TP-11 to TP-13 in future road and TP-14 in Road C. We further recommend replacing these with select borrow compacted to 95 percent of relative compaction, to improve the stability of the proposed subdivision road. The removed surface silt/volcanic ash soils may be buried in the borrow pits and covered with 1 foot of the excavated borrow material to limit erosion potential, particularly if future developments are planned.



It should be noted that actual ground conditions or materials within the approximately 500-foot spacing between test pits may vary and should be verified during actual grading operations. In Road A, for instance, a berm-like natural feature rising to about 8 feet from the proposed road cut stands between TP-5 and TP-6, particularly between stations 80+00 through 82+00 in profile of Road A, Plate No. 86 (Sheet 3 of 5 of the provided road profiles). This may be rock, soil, or a combination thereof and therefore the grading method in between the test pits will be dictated, in part, by what is actually encountered in the unexplored portions of the road development.

Waiohuli Site

In this area, volcanic ash materials generally range in thickness from 2.5 feet to 7.5 feet, except where the rocks are exposed at the surface, such as at the proposed bridge crossing. We also recommend the removal of the near-surface soft volcanic ash materials in this area until stiff to very stiff soils are exposed and replacing them with select borrow material, except in the area bounded by TP-24 through TP-27, in Road J, TP-29 and TP-30 in Road H, TP-31 and TP-32 in Road F, TP-36 in Road M and TP-35 in Road A.

At the proposed borrow area, the thickness of the overburden soil is on the order of 2 to 17 feet. The overburden materials encountered in this area are mostly gravelly silts and silty gravels with cobbles and buried boulders. Detailed descriptions of the materials encountered in this site can be referred to the Logs of Borings (Plate No. 53 through 62), Boring Nos. B-1 to B-10.

Bridge Site at Waiohuli

Site Description

The approximate location of the bridge, site contains gray, basaltic rock outcrops on both the left and right abutments. The rock surfaces at the central part of the dry stream channel appear smoother, as compared to the rocks exposed higher up the banks, indicating an intermittent stream flow. Pools of water trapped in small depressions in the rock were also observed along the central portion of the channel. At the approximate location of the bridge site, the upstream channel (eastern portion of the site) is relatively shallower than the western section, where a sudden drop occurs to an estimated depth of about 10 feet, forming a narrow channel at the downstream side of the crossing about 5 wide. Visibility range at the site is limited due to the dense growth of secondary forest cover consisting of native trees and brush. Access to the site is also hampered by the abundance of dead tree debris.

The approximate site of the abutments generally consists of hard, strong, slightly weathered, fractured, basaltic rock exposures.



From our preliminary survey of the project site, it is our opinion that the project is feasible for construction from a geotechnical engineering standpoint, with the following design parameters:

Foundation Design

The proposed single span, 60-foot long bridge abutments may be supported on spread footing foundations initially designed for an allowable bearing pressure of 6000 psf (287 kPa). This allowable bearing capacity may be increased or decreased depending on the geotechnical conditions at the exact bridge locations, which will be determined from an additional field exploration prior to final design. Other geotechnical design parameters are as follows:

Seismic Data

- Shear wave velocity 2,500 fps
- Peak Rock Acceleration 0.2 g (From UBC)

Lateral Soil Forces

Seismic Soil Pressure	33 percent increase over active and passive cases
Active Case: Design Value	36 pcf equivalent fluid pressure for pre-approved backfill material
At Rest Case: Design Value	55 pcf equivalent fluid pressure for pre-approved backfill material
Passive Resistance: Design Value	400 pcf equivalent fluid pressure for pre-approved backfill material. Maximum value 4000 psf.

The above foundation recommendations and design parameters are based on surface site observations only for use in the preliminary design of the structure. These design parameters will be subject to change if the engineering properties of the underlying materials are different from what we have anticipated and should be verified by actual field exploration.

Reservoir Site

Site Description

The general location of the proposed reservoir is undulating ground containing low-lying ridges and valleys. The proposed water storage structure will be set on the ridge about 300 feet northwest of the intersection of Roads K and E. The



ridge area is generally covered with grass and contains gray, basaltic rock outcrops. The exposed rocks were observed to be hard, strong, and massive. The rock surfaces are sharp and rough.

From our preliminary survey of the project site, it is our opinion that the project is feasible for construction from a geotechnical engineering standpoint. The following recommendations may be used for preliminary design of the reservoir

Based on our preliminary field observations, the proposed reservoir tank may bear on the underlying hard basaltic rock formation or properly compacted pre-approved fill material, with the following design parameters:

Foundation Design

For preliminary design purposes, an allowable bearing pressure of 3000 psf (145 kPa) may be used for the onsite materials or on properly compacted, pre-approved select borrow. The minimum footing embedment depth shall be 18 inches (1.5 feet) below the lowest adjacent finished grade. An allowable bearing pressure of 6,000 (287kPa) may be used, tentatively, for footings bearing on the basaltic rock. These allowable bearing capacities may be increased or decreased depending on the actual geotechnical conditions at the exact reservoir locations which will be determined from future exploration data.

The bearing values are for dead plus live loads and may be increased by 1/3 for transient loads due to wind or seismic forces.

For footings adjacent to slopes, the footing must be deepened such that there is a minimum distance of 6 feet from the edge of the footing to the slope face.

Conditions where the footing will rest partially on rock and partially on fill should be avoided. Foundation fills over cut rock should be more or less uniform in thickness to limit differential settlement. Other geotechnical design parameters are as follows.

Lateral Resistance

For resistance of lateral loads, such as wind or seismic forces, an allowable passive earth resistance equivalent to that exerted by fluid weighing 300 pcf may be used for footings, provided that the vertical surface is in direct contact with undisturbed soil, or properly compacted fill.



Frictional resistance between footings or slabs and the underlying soil may be assumed as 0.3 times the dead load for properly compacted, pre-approved structural fill or 0.5 times the dead load for footings resting on basaltic rock.

Slab on Grade

For the preliminary design of concrete slab on grade, a modulus of subgrade reaction of 300 pci maybe used for the structural fill of select granular borrow materials.

Slopes

Permanent fill or cut slopes of soil type materials shall not exceed 2H:1V (horizontal to vertical). Exposed soil slopes must be covered immediately after construction to limit erosion. Cut slopes into the basaltic rock formation may be made at 1H:1V.

The above recommendations and design parameters are based on surface site observations only for use in the preliminary design of the structure. These design parameters will be subject to change if the engineering properties of the underlying materials are different from what we have anticipated and should be verified by actual field exploration.

Earthwork and Grading

The following sections present guidelines for the design and construction of the earthwork and grading for the subject subdivision road development and appurtenant structures.

Our field exploration indicates that under the silt (volcanic ash) surface soils, the site is generally underlain with competent basaltic/andesitic rocks and deposits of tuffaceous gravels (clinker), cobbles, and boulders. These underlying materials have good strength characteristics and, if excavated and properly processed, could meet the requirements for select borrow for subbase course, as stipulated in Section 16 of the Standard Specifications for Public Works Construction.



Therefore, the recommended grading concept would involve utilization of the suitable overburden soils and the weathered basaltic/andesitic gravels and rocks in the designated borrow site as replacement fill and select material. These materials could be quarried, processed, and classified according to aggregate sizes and stockpiled for use as capping, subbase, basecourse, and paving material. After sufficient quantities of borrow material is excavated, processed, and stockpiled, the soft or loose unsuitable silt (volcanic ash) soils that are encountered within the subdivision road right-of-way will be stripped to a depth of at least 2 feet below the finish subgrade where applicable, or until stiff to very stiff or gravelly materials are encountered. The unsuitable materials should be disposed of, properly, off-site or in the borrow area excavation and capped with 1-foot of the excavated borrow granular material to limit erosion and downhill siltation. Where the design subgrade encounters silty gravel, gravelly silt with cobbles, and boulders or weathered basalt, over excavation and replacement with borrow or embankment fill will not be necessary. After grading, scarification, and proof rolling, the subbase course may be placed directly on top of these gravelly insitu materials. Where fresh basalt rocks are encountered, the basaltic base course may be placed directly over this, after grading. If the grading works for the road involve extensive cutting through slightly weathered to fresh basalt, the use of embankment fill may be considered. In this case, benching is required for slopes that are steeper than 5H:1V, where daylight sections are encountered. Additional recommendations should be provided for areas where ash and granular/basaltic materials are involved. This usually involves the over-excavation of up to 2 feet for an area of several feet to create the same material within the daylight section for uniform support.

Borrow Pit Operation

To generate sufficient select fill materials for the required road grading, a borrow pit operation may be considered as a supplementary or main source of fill and paving materials. Based on field observations, it is our opinion that the weathered subsurface basaltic/andesitic rock formations at the borrow site can be quarried using controlled blasting, if permitted. After blasting, these may be further reduced with rock-breakers (Hoe Ram), and excavated with bucket type excavators. The resulting excavation area could be utilized as a disposal site to contain the stripped unsuitable silt/volcanic ash soils to limit downstream siltation. Any silt soils placed in the borrow pits should be laid in controlled lifts and properly compacted and capped with non-expansive material, if future developments are planned.



As discussed above, the basaltic andesite from the borrow site may be considered comparable to select fill material when properly processed and are suitable for road embankment and capping fill within the upper 1.5 feet below the proposed finished subgrade of the subdivision road.

Site Grading

Currently, numerous boulders and rock outcrops and groves of trees are present at the site and along the proposed road right-of-way and bridge site. The boulders encountered may be processed for aggregates or select fill material, if they can meet the grading specifications and requirements contained in this report. Otherwise, these can be stockpiled for future use such as rip rapping, landscaping, and other purposes, or disposed of in the borrow pits. This can be determined during the construction and grading operations.

Fill embankments and cuts are anticipated in the subdivision road network development. Therefore, proper site preparation and compaction of the new fills and bonding of the new fills to the existing ground surface will be required to provide a stable fill mass. As discussed above, 2 feet of the soft or loose surface silt (volcanic ash derived soils) should be stripped below the design subgrade of the road development where these are encountered. These ash soils should be disposed of off-site or be placed in the borrow pits. However, if the insitu soils contain considerable amounts of gravels, boulders, and cobbles, as encountered in many of the test pits, stripping and replacement of the soft or loose ash soils with select borrow will not be necessary, provided that the volcanic ash soils are properly blended with granular/oversize materials to form a uniform matrix. The basaltic/andesitic materials such as those found at the proposed borrow area, if properly processed, are considered suitable as replacement fill for the stripped ash soils and for road embankment fill.

We recommend that the road grading operations be observed by a representative of PSC Consultants, LLC. It is important that a representative from our office observe the road grading to evaluate whether any undesirable materials are encountered during the excavation and scarification process and whether the exposed soil/rock conditions are similar to those anticipated in our engineering analysis.



Site Preparation

At the onset of earthwork, the area within the contract grading limits of the road right-of-way should be cleared of trees, vegetation, debris, rubbish, boulders, and other deleterious materials. These materials should be removed and properly disposed of off-site.

In areas to receive fill, such as the silt layers that are over excavated down to 2 feet or the insitu silty gravels and gravelly silts, should be scarified to a depth of 6 inches, moisture-conditioned to at least 2 percent above the optimum moisture content, and compacted to a minimum of 90 percent relative compaction. Relative compaction refers to the in-place dry density of soil expressed as percentage of the maximum dry density of the same soil established in accordance with ASTM Test designation D 1557-91. The optimum moisture content is the moisture content corresponding to the maximum compacted dry density. Soft or yielding areas encountered during site preparation should be over-excavated to expose firm soil surface and stabilized by backfilling with select material placed in 8-inch thick, loose, lifts and compacted to 90 percent relative compaction or 95 percent for fills 2 feet below the proposed road subgrade.

Over-Excavation

Some of the existing upper clayey silt (volcanic ash) that do not contain or have very little percentage of coarse material may not be suitable for support of the proposed pavement. These are porous (susceptible to collapse/settlement with increased water content), have a relatively low dry density, and are prone to erosion and should be over excavated and replaced with select onsite/borrow fill. These materials are generally from 0.75 to 8 feet in depth and their limits within the project site were mentioned in the Summary Section and Discussion and Recommendation Section of this report. If these upper clayey silt (volcanic ash) materials are also encountered in areas between test pits or areas outside the aforementioned limits during the grading of the proposed road right-of-way, they should be over-excavated down to at least 2 feet or until stiff to very stiff or dense gravelly materials are encountered and replaced with select granular materials. A minimum of 2 feet of select granular materials should be provided underneath the pavement section along the road right-of-way and compacted to 95 percent relative compaction under the section headed, "Pavements". It is important that a PSC representative be present during the site grading work to determine which areas need to be over excavated or retained. A separating geotextile should be used between the remaining in-place porous volcanic ash materials and select granular fill materials. Adequate sub-drains should also be installed in the areas of deeper porous deposits to prevent surface runoff entering into the porous volcanic ash layer.



The excavated volcanic ash/silt materials can be mixed with onsite granular/basaltic materials for reuse as select/engineering fill, when properly mixed and processed. Some laboratory tests (CBR and compaction tests) were performed on trial mixtures of onsite samples to determine the engineering properties and appropriate proportions of components for possible select fill.

Fill Materials and Placement

Borrow Pit Backfill and Compaction

It is anticipated that the soft or loose silt/volcanic ash soils that will be removed from the subdivision road right-of-way and placed in the borrow pits will be prone to erosion due to its relative lightness and very low to zero cohesive strength when dried. In order to reduce the erosion potential of this soil, the disposed soft or loose silt (ash) backfill material should be moisture conditioned to at least 3 percent above the optimum moisture content and compacted to 85 to 90 percent relative compaction. The final layer of backfill should be placed at a minimum of 12 inches below the finished subgrade in the borrow pits to allow the placement of at least 12 inches of capping material composed of granular select borrow.

Onsite Fills/Backfills and Compaction

Road Embankment and Replacement Fills

Materials used for road embankment filling and the replacement fills placed within the top 2 feet of finished subgrade within the road right-of-way area should be non-expansive, select material, generally less than 3 inches in maximum dimension, should have a plasticity index not exceeding 15, as determined in accordance with ASTM Test Method D 4318-84, and should have a maximum of 40 percent of particles passing the No. 200 sieve. The onsite tuffaceous, basaltic/andesitic materials, if properly processed after excavation, are suitable for this purpose.

Trial Mix of Fill Materials

Preliminary California Bearing Ratio (CBR) tests conducted indicate that the volcanic ash when mixed with 50 percent (by volume) of the onsite basaltic gravel passing Sieve No. 4 would result in a General Rating of Fair to Good. This mixture may be suitable for subbase or base material. Similarly, on site silts mixed with approximately 50 percent (by volume) of the basaltic gravels retained



in sieve No. 4 indicated a General Rating of Fair to Good, which is likewise suitable for use as subbase or base material. Another test was conducted using a mixture of about 25 percent (by volume) of the basalt gravel passing the No. 4 sieve with approximately 75 percent of the onsite silt resulting in a general rating of Poor to Fair.

This type of mixture may only be used as subgrade. On the other hand, CBR tests conducted on purely volcanic ash silt, such as samples from Test Pits TP-4, 18, and 28, resulted in a General Classification Rating of Very Poor (CBR No.<3). The tests indicate that the soil strength characteristics can be improved with the addition of coarse gravelly materials. Based on the above tests, we recommend gravel content of at least 60 percent (by volume) or greater for the replacement and road embankment fills; that is, if a mix-design is to be adopted. Further tests should be conducted during actual construction to insure the consistency of the mix design is satisfied.

Compaction

Fill material should be placed in level lifts with maximum loose thickness of 8 inches; moisture conditioned to least 2 percent above optimum, and properly compacted to a minimum of 90 percent relative compaction. In roadway areas, the minimum degree of compaction within the upper 2 feet of the finished pavement subgrade level should be 95 percent. Each layer should be spread uniformly and blade-mixed to attain uniformity of the material and even distribution of water content. Additional fill material should not be placed on any fill layer that has not been properly compacted.

If additional offsite borrow material is required, it should be tested by PSC Consultants, LLC to evaluate its suitability for use as select fill prior to its delivery to the project site.

Slopes

In cases where sloping fills are required, such as at the edge of fill embankments consisting of select material, these may be designed at 2H:1V or flatter. Fill slopes should be constructed by overfilling 2 to 3 feet, then cutting back to the design slope to expose a well-compacted face.



Water should be diverted away from the slopes by diversion ditches at their tops and surface drains on slope surface and subdrains may be used to provide adequate drainage. Slope planting should be utilized to limit erosion.

Pavements

We anticipate that asphaltic concrete pavements will be required for the roadways in the subdivision. While traffic loading has not been specified, we anticipate a medium vehicle loading for the project consisting primarily of passenger vehicles and delivery trucks. We have made our preliminary pavement design assuming the pavement subgrade soil will consist of compacted tuffaceous, basaltic/andesitic fill materials with a minimum CBR value of 25. The fill material within 2 feet below the pavement subgrade should be compacted to 95 percent relative compaction. Based on the above assumptions, we recommend the following flexible and rigid pavement sections be used for preliminary design purposes:

Flexible Pavement Section

2-Inches	Asphaltic Concrete
6-Inches	Aggregate Base Course
<u>6-Inches</u>	<u>Aggregate Subbase Course</u>
14-Inches	Total Pavement thickness on a minimum of 2 feet of properly compacted select borrow material or insitu basaltic/andesitic rock formation.

Rigid Pavement Section

6-Inches	Concrete
<u>6-Inches</u>	<u>Aggregate Subbase Course</u>
12-Inches	Total Thickness

The recommended section considers medium subdivision traffic. In areas with heavier traffic, such as at main collector roads like Road "A" and Road "B", the section should be thickened with an additional 1/2-inch asphaltic concrete to provide adequate support for the anticipated increased traffic loading.

The base course should be compacted to 95 percent of its maximum dry density, as determined in accordance with ASTM Test Method D 1557-91.



CBR and density test and/or field observations should be performed on the actual subgrade used for the road construction to confirm the adequacy of the above pavement sections. The recommended section assumes that adequate drainage will be provided.

Road Drainage

Subdrains should be provided where there is a possibility that runoff from rainfall or irrigation could saturate the subsurface soils. Exposed surface soils should be protected from erosive runoff by providing surface drains, diversion berms, and other flood control devices. The access of water into the roadbed soil under the pavement should be minimized in order to stabilize the moisture content as by incorporating water inhibiting membrane into the design, as described in Item 1.21.1-d of the DOT Pavement Design Manual (Rev. March 2002).

Utility Trenches

We envision that utility lines will be required for the proposed subdivision road project. A granular bedding consisting of 6 inches of No. 3B Fine gravel is recommended under the pipes. Free draining granular materials, such as No. 3B Fine gravel (ASTM C 33, No. 67 gradation), should also be used for the trench backfill, up to about 12 inches above the pipes to provide adequate support around the pipes and to reduce compaction of the backfill, thus reducing the potential for damaging the pipes.

The upper portion of the trench backfill from 1 foot above the pipes to the top of the subgrade or finished grade should consist of select granular material. The backfill should be moisture conditioned, placed in maximum 8-inch, level, loose lifts and mechanically compacted to not less than 90 percent relative compaction to reduce the potential for future ground subsidence. Where trenches are below pavement areas, the upper 2 feet of the trench backfill below the pavement subgrade should be compacted to 95 percent relative compaction.

Design Review

Drawings and specifications for the proposed construction should be submitted to PSC Consultants, LLC, as geotechnical consultant, for review and written comments prior to construction. This review is needed to evaluate adherence of the plans to the recommendations provided herein. If this review is not made, PSC cannot assume responsibility for the interpretations made by others, or errors resulting there from.



Construction Observation and Testing

The recommendations provided in this report are based on subsurface conditions disclosed by widely spaced exploratory borings and excavations. The geotechnical consultant should check the interpolated subsurface conditions during construction. The geotechnical consultant should attend the pre-construction meeting between the contractors and owners/designers.

During grading, the geotechnical consultant should:

- ❖ Observe excavation, placement, and compaction of engineered fill for the road pavement structures;
- ❖ Observe preparation and compaction of aggregate base for asphalt/concrete pavement and flatwork subgrade;
- ❖ Check and test any imported materials prior to their use as fill;
- ❖ Perform field tests to evaluate fill compaction;
- ❖ Observe subgrade conditions at the bottom of pipeline trenches;
- ❖ Observe fill placement and compaction around the pipes in the utility trenches;
- ❖ Observe the fine-grading and exterior drainage improvements constructed around the finished structures; and
- ❖ Perform and check the foundation excavations for the Bridge and Reservoir sites.

The recommendations provided in this report assume that PSC will be retained as the geotechnical consultant during the construction phase of the project. If another geotechnical consultant is selected, we request that the selected consultant provide a letter to the architect/designer and owner/client (with a copy to PSC and Maui County) indicating that they fully understand our recommendations and that they are in full agreement with the recommendations contained in this report and will take over as the Geotechnical Consultant of Record for this project. If deviations from soil conditions and recommendations presented in this report occur, they should provide amended recommendations as new geotechnical consultants of record for the project.



LIMITATIONS

The analyses and recommendations submitted in this report are based, in part, upon information obtained from field borings and visual observations. Variations of subsoil conditions between the borings may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to reevaluate the recommendations provided in this report.

The test pits and boring locations in this report were selected by PSC Consultants LLC, based on the previous boring information done by others and our scope of work. The field locations for the borings and test pits were located by the client's surveyor and modified based on actual site conditions during field exploration work. The physical locations and elevations of the borings should be considered accurate only to the degree implied by the methods used.

The stratification lines shown on graphic representations of the borings depict the approximate boundaries between soil/rock types and, as such, may denote a gradual transition.

This report has been prepared for the exclusive use of Community Planning and Engineering, Inc., their client, and their consultants for specific application to the proposed Keokea-Waiohuli development in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

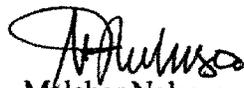
This report has been prepared solely for the purpose of assisting the architect/engineer in the design evaluation of the proposed project. Therefore, it may not contain sufficient data, or proper information to serve as the basis for preparation of construction cost estimates. A contractor wishing to bid on this project is urged to retain a competent geotechnical engineer to assist in the interpretation of this report and/or in the performance of additional site-specific exploration for bid estimating purposes.

The owner/client should be aware that unanticipated soil/rock conditions are commonly encountered. Unforeseen soil/rock conditions, such as perched ground water, soft deposits, hard layers, or cavities, may occur in localized areas and may require probing or corrections in the field (which may result in construction delays) to attain a properly constructed project. Therefore, a sufficient contingency fund is recommended to accommodate these extra costs.



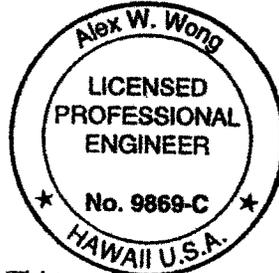
The findings in this report are valid as of the present date. However, changes in the soil conditions can occur with the passage of time, whether they be due to natural processes, or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation, or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control. Therefore, this report is subject to review by the controlling agencies and is valid for a period of 2 years.

Respectfully submitted,
PSC CONSULTANTS, LLC

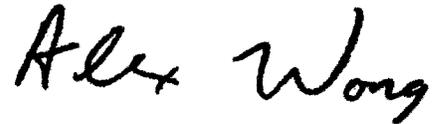

Melchor Nolasco
Office Engineer

MGN/ASW/PSC:ch

- Enc.: Plate No. 1
Plate No. 1-A
Plate No. 2
Plate No. 2-A
Plate No. 2-B
Plate No. 3 through 52
Plate No. 53 through 62
Plate No. 63
Plate No. 64
Plate No. 65 through 72
Plate No. 73 through 78
Plate No. 79
Plate Nos. 80 through 82
Plate Nos. 83 through 85
Plate No. 86



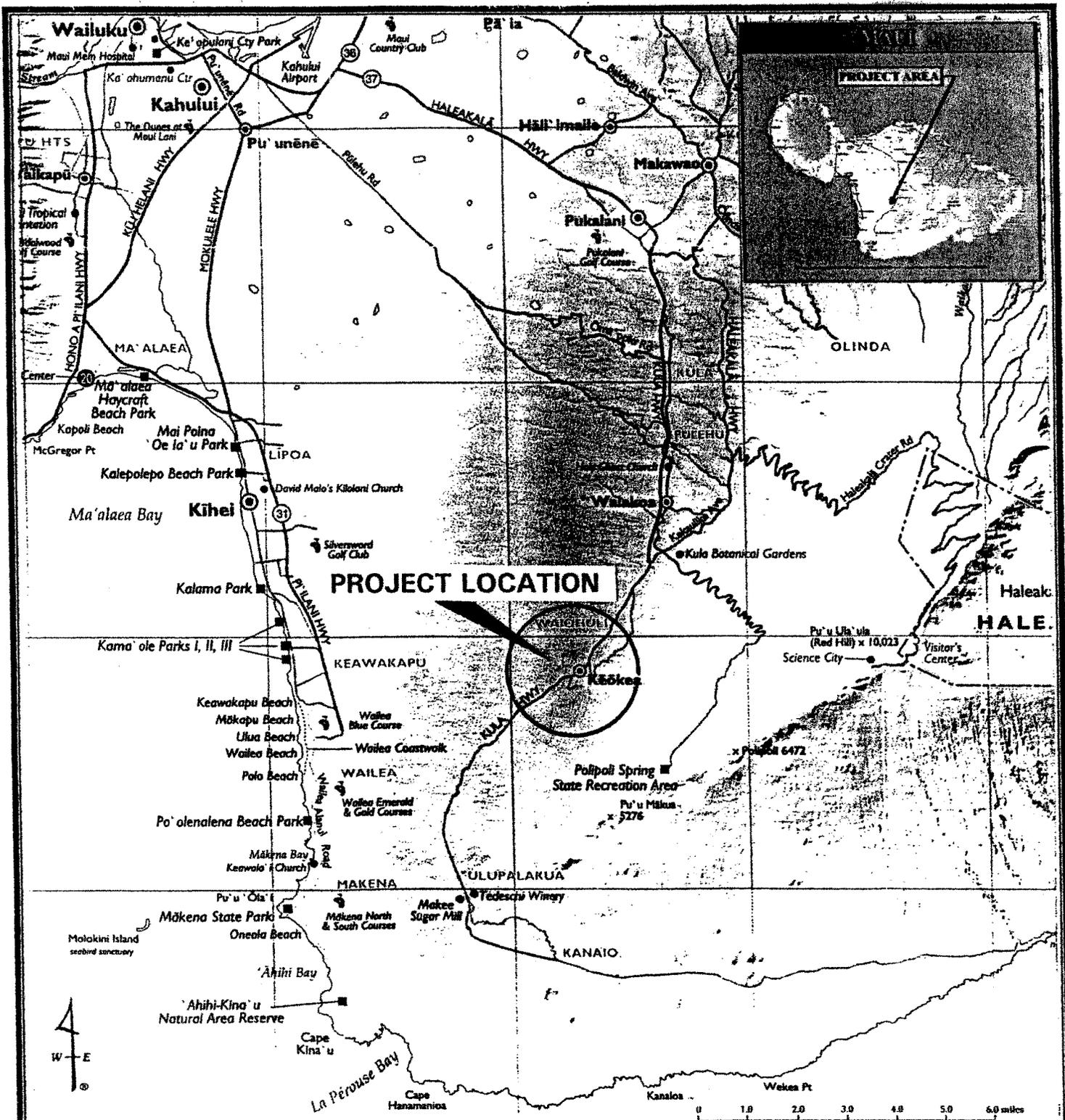
This work was prepared by
me or under my supervision
(License Expires April 30, 2006)



Alex W. Wong, P.E.
Senior Engineer

- Project Location Map
Geologic Map of Project Site
Site Plan
Location Map of Proposed Borrow Area
Site Plan of Proposed Borrow Area
Logs of Test Pits (Road Network)
Logs of Borings/Test Pits (Borrow Area)
Soil/Rock Classification Chart
Rock Classification System
Laboratory Compaction Curves (Road Network)
California Bearing Ratio Data (Road Network)
Atterberg Limits Test Results (Road Network)
Laboratory Compaction Curves (Borrow Site)
California Bearing Ratio Data (Experimental Mix)
Segment of Road "A" Profile





Reference: Island Map of Maui , Pacific Travelogue Inc. (2000)

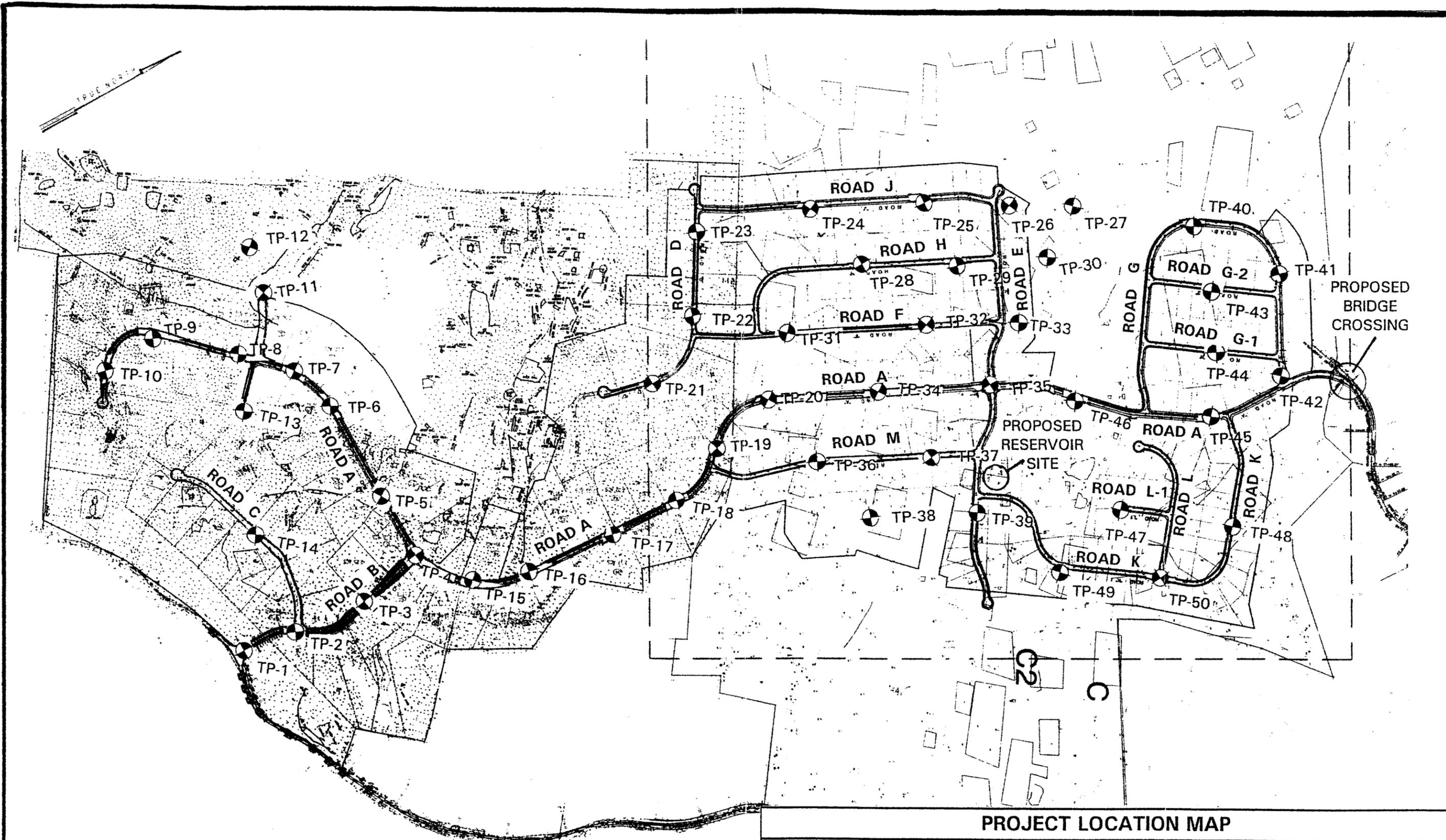
PROJECT LOCATION MAP

RSC CONSULTANTS, LLC
 SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
 Proposed DHHL Agricultural Subdivision Road System
 Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10



LEGEND:
 ● Approximate Test Pit Location

APPROXIMATE MAP SCALE: 1" = 600'

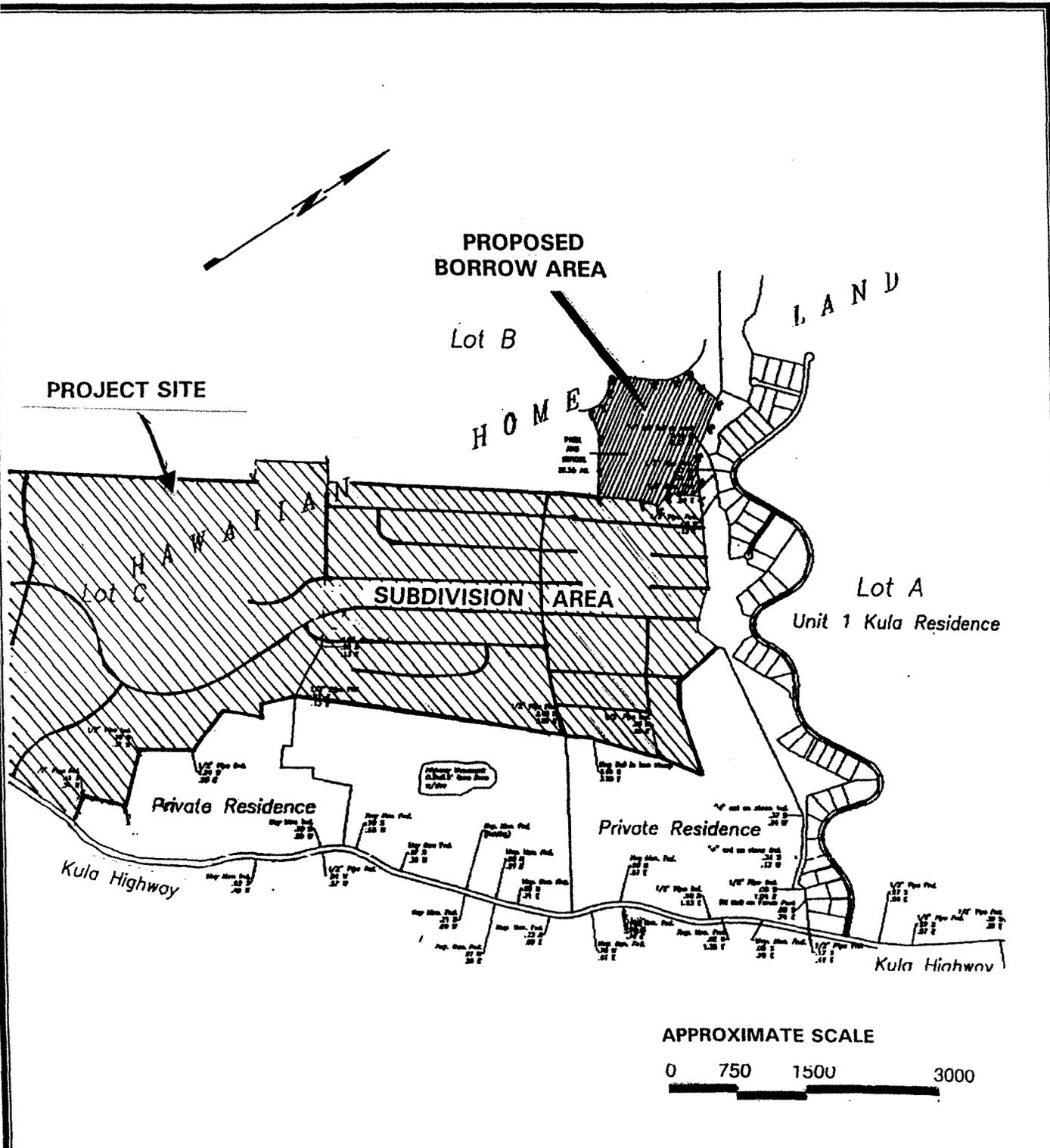
PROJECT LOCATION MAP

PSC CONSULTANTS, LLC
 SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
 Subdivision Road Network, Bridge, and Water
 Reservoir Project
 Keokea, Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO. 24304.10



Reference: Location Map of Proposed Borrow Site (ACE LAND SURVEYING. Dated 07/22/04)

LOCATION MAP OF PROPOSED BORROW AREA

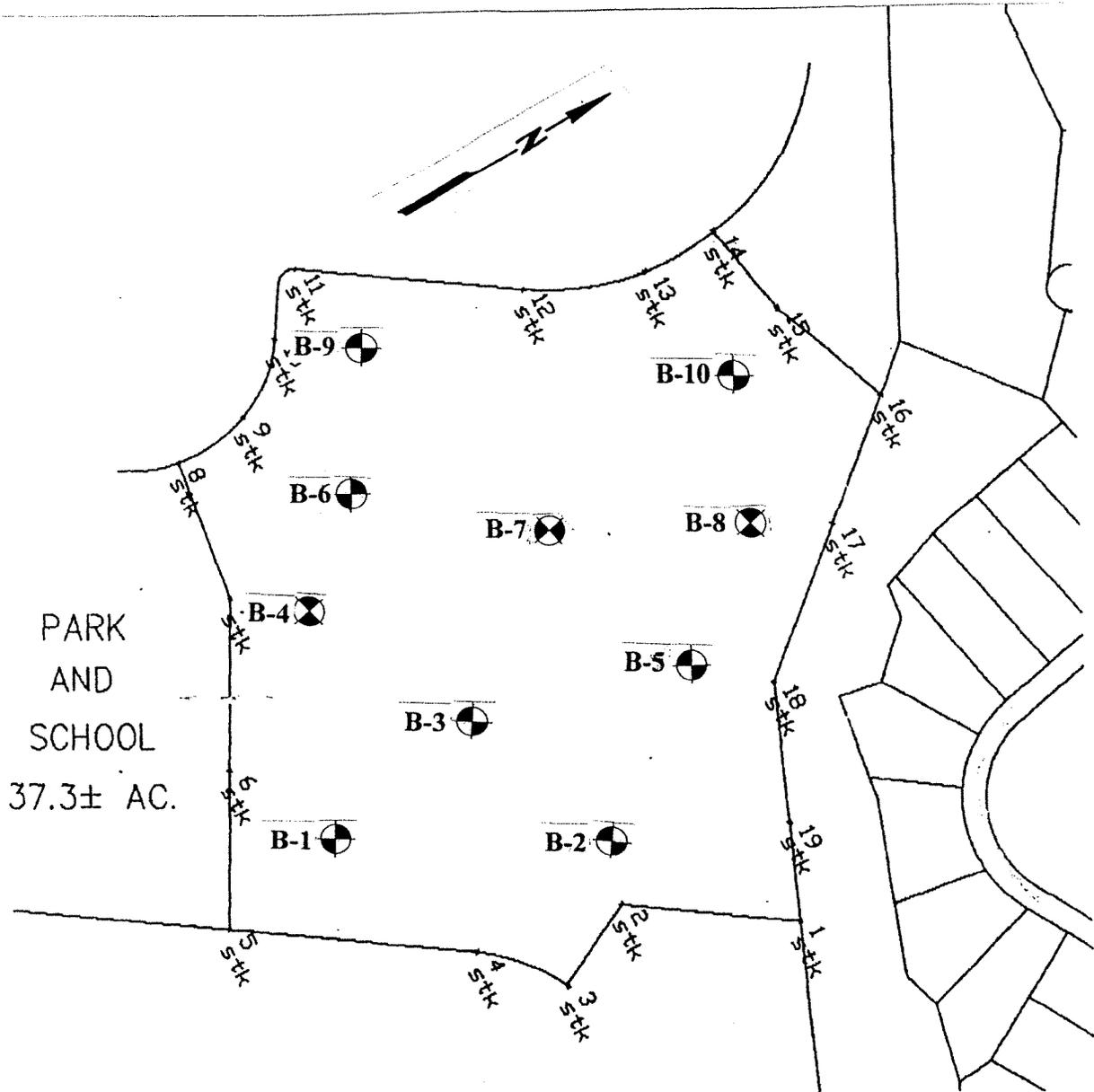


CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
Proposed DHHL Agricultural Subdivision Road Network
Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO. 24304.10



LEGEND:

 Approximate Boring/Test Pit Location

APPROXIMATE SCALE



Reference: Site Plan of Borrow Site (ACE LAND SURVEYING. Dated 07/28/04)

SITE PLAN OF PROPOSED BORROW AREA

PSC
CONSULTANTS, LLC
 SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
 Proposed DHHL Agricultural Subdivision Road Network
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO. 24304.10

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-1
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
MD=88 pcf						BS-1				Gravelly SILT/Silty GRAVEL , dark brown, medium stiff to stiff, with sub-angular tuffaceous cobbles and boulders, traces of sand, clay, and rootlets. Moist.
		19.7					1			
							2			
							3			
							4			
							5			BASALT , dark gray, moderately weathered to fresh, strong
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered

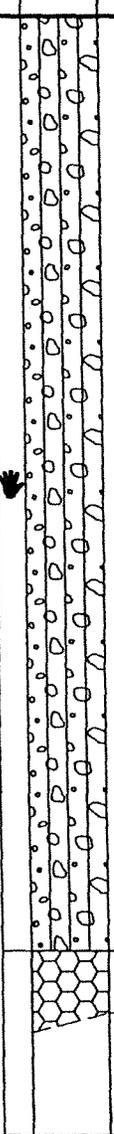
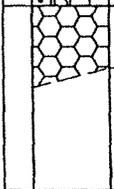
SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-2
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-2				Silty GRAVEL , gray tuffaceous subangular gravel, cobbles and boulders in a brown, moist, silt (volcanic ash) matrix with traces of rootlets.
							1			
							2			
							3			
							4		GM	
							5			
							6			
							7			
							8			BASALT , gray, moderately weathered to fresh, vesticated, strong
							9			Test pit terminated at about 8.0 ft. Groundwater was not encountered

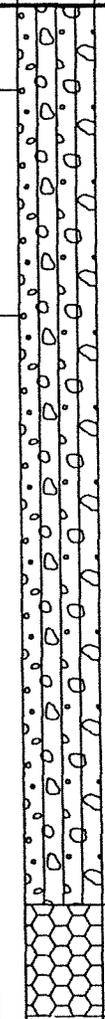
SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 8/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-3
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		43.9				BS-3	1	 MH		Gravelly SILT, with sub-angular basaltic cobbles and boulders, trace clay and rootlets, dark brown, moist
							2			
							3			
							4			
							5			
							6			
							7			
							8			
							9			
							10			BASALT, dark gray, moderately weathered, strong Test pit terminated at about 9 ft. Groundwater was not encountered

SAMPLE TYPE MC - Modified California SPT - Standard Penetration CB - Core Barrel AUG - Auger Cuttings		OTHER LABORATORY TESTS MD - Moisture/Density CON - Consolidation Test PI - Atterberg Limits		UC - Unconfined Compression SG - Specific Gravity SA - Sieve Analysis	
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LOG OF BORING



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Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING: KEOKEA.GPJ BORING.GDT 11/2/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-4
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION	
PI=12						BS-4				SILT with angular basalt cobbles and boulders, dark brown, moist	
CBR=0.80							1				
		35.5					2			MH	
							3				
							4				
							5			BASALT, dark gray, very hard, massive, strong	
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered	

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING



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Keokea/Waiohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-6
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		32.5				BS-6	1		GM MH	Gravelly SILT/Silty GRAVEL with basaltic cobbles and boulders, trace of clay and rootlets, brown, moist
							2			BASALT, gray, fresh to moderately weathered, vesticated, strong
							3			Test pit terminated at about 2.5 ft. Groundwater was not encountered

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-7
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-7				Silty GRAVEL, gray subangular basaltic gravel with cobbles and boulders with silt matrix, trace rootlets, brown, moist
							1			
							2		GM	
							3			
							4			BASALT, dark gray, moderately weathered, strong
							5			
							6			Test pit terminated at about 4 ft. Groundwater was not encountered

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING



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**Keokea/Walohuli Development
Kula, Makawao, Maui, Hawaii**

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-8
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-8				Silty GRAVEL, gray, subangular basaltic gravel, cobbles, and boulders with silt matrix, trace rootlets, brown, moist
							1			
							2		GM	
							3			
							4			
							5			BASALT, gray, moderately weathered, strong
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered.

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING



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Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-9
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-9			GM	Silty GRAVELvessicated, subangular, tuffaceous gravels, cobbles and boulders with silt matrix, trace rootlets, dark gray to black, moist
						1				
						2				
							3			BASALT, dark gray, moderately weathered, strong.
						4				Test pit terminated at about 3.75 ft. Groundwater was not encountered
							5			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING



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Keokea/Waiohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-10
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-10				Silty GRAVEL, gray, tuffaceous, subangular gravels, cobbles and boulders in a brown, moist, silt matrix with trace rootlets.
		49.2					1		GM	BASALT, gray, moderately weathered to fresh, strong.
							2			
							3			Test pit terminated at about 2.5 ft. Groundwater was not encountered.
							4			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING



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Keokea/Waiohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-11
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-11			GM	Silty GRAVEL, gray, subangular, vesticated basaltic gravels, cobbles and boulders in a brown, medium stiff, moist silt matrix with trace rootlets.
							1			BASALT, dark gray, moderately weathered, strong
							2			Test pit terminated at about 1.75 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel
 AUG - Auger Cuttings
 SH - Shelby Tube
 D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
 CON - Consolidation Test
 PI - Atterberg Limits
 UC - Unconfined Compression
 SG - Specific Gravity
 SA - Sieve Analysis

LOG OF BORING



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 Consultants
 Construction Management,
 Testing & Inspection

Keokea/Waiohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-12
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		30.9				BS-12			GM	Silty GRAVEL, dark gray, moderately weathered, dense, subangular, vesticated, tuffaceous gravels, cobbles and boulders, in a brown, fine grained, medium stiff, moist, silt (volcanic ash) matrix. Trace rootlets.
							1			BASALT, dark gray basaltic rock, slightly to moderately weathered, vesticated, strong.
							2			
							3			Test pit terminated at about 2.5 ft. Groundwater was not encountered

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING



Geotechnical & Environmental
Consultants
Construction Management,
Testing & Inspection

Keokea/Waiohuli Development
Kula, Makawao, Maui, Hawaii

DATE: March 2005	PROJECT NO.: 24304.10
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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-13
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-13				Silty GRAVEL, gray, subangular, vessicated, medium dense to dense, basaltic gravels, cobbles and boulders in a brown, medium stiff, moist silt (volcanic ash) matrix with trace rootlets.
							1			
							2		GM	
							3			
							4			
							5			BASALT, gray, moderately weathered to fresh, strong, basaltic rock
							6			Test pit terminated at about 5.0 ft. Groundwater was not encountered.

SAMPLE TYPE MC - Modified California SPT - Standard Penetration CB - Core Barrel AUG - Auger Cuttings		OTHER LABORATORY TESTS MD - Moisture/Density CON - Consolidation Test PI - Atterberg Limits		UC - Unconfined Compression SG - Specific Gravity SA - Sieve Analysis	
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LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9704

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-14
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		30.5				BS-14	1		GM	Silty GRAVEL, dark gray, subangular, vessicated, dense, basaltic gravels, cobbles and boulders in a brown to dark brown, medium stiff, fine grained, moist silt (volcanic ash) matrix with trace rootlets. T
						2				
						3				
						4				
						5				
							6			BASALT dark gray basaltic rock, moderately weathered, strong
										Test pit terminated at about 5 ft. Groundwater was not encountered

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 97/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-15
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		44.7				BS-15				Silty GRAVEL , gray, subangular, dense, basaltic gravels, cobbles and boulders in a brown, medium stiff, moist silt matrix with trace rootlets.
							1			
							2		GM	
							3			
							4			
							5			BOULDERS , gray, subangular, lava boulders, moderately weathered, dense, strong
							6			
							7			
							8			BASALT gray, slightly to moderately weathered, strong, massive.
							9			Test pit terminated at about 8.5 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel
 AUG - Auger Cuttings
 SH - Shelby Tube
 D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
 CON - Consolidation Test
 PI - Atterberg Limits
 UC - Unconfined Compression
 SG - Specific Gravity
 SA - Sieve Analysis

LOG OF BORING



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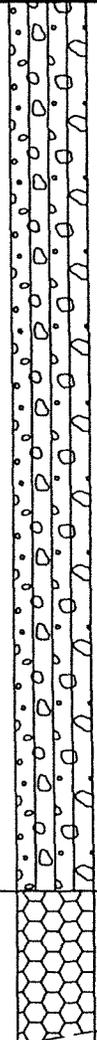
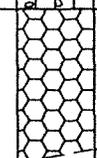
Keokea/Waiohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-16
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-16				<p>Gravelly SILT, brown, medium stiff, moist, with gray, subangular, tuffaceous gravels, cobbles and boulders. With trace rootlets.</p>
							1			
		41.5					2		MH	
							3			
							4			
							5		<p>BASALT, gray basaltic rock, moderately weathered, strong, massive</p>	
							6		<p>Boring terminated at about 5.5 ft. Groundwater was not encountered</p>	

SAMPLE TYPE MC - Modified California SPT - Standard Penetration CB - Core Barrel AUG - Auger Cuttings		OTHER LABORATORY TESTS MD - Moisture/Density CON - Consolidation Test PI - Atterberg Limits		UC - Unconfined Compression SG - Specific Gravity SA - Sieve Analysis	
SH - Shelby Tube D&M - Dames & Moore					

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-17
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		26.7				BS-17			MH	Gravelly SILT, brown, medium stiff, moist, with loose clinker, cobbles and boulders.
							1			
							2			
							3			
							4			BASALT, gray, moderately weathered, strong
							5			Test pit terminated at about 4.5 ft. Groundwater was not encountered
							6			

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-18
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
PI=7.5 CBR=0.35		28.8				BS-18	1			Gravelly SILT , dark brown, medium stiff, moist (volcanic ash), with lava cobbles and boulders, trace rootlets.
						2				
						3			MH	
						4				
						5				
							6			BASALT , gray, moderately weathered, strong
							7			Test pit terminated at about 6.0 ft. Groundwater was not encountered
							8			

SAMPLE TYPE	OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits
		SA - Sieve Analysis

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<p>Geotechnical & Environmental Consultants Construction Management, Testing & Inspection</p>	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-19
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG:	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		24.8				BS-19				Gravelly SILT, brown, medium stiff, with basalt cobbles, and boulders, trace clay and rootlets, moist (volcanic ash).
							1			
							2			
							3	MH		
							4			
							5			
							6			BASALT, gray, moderately weathered, strong
							7			
							8			Test pit terminated at about 7.0 ft Groundwater was not encountered

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-20 <i>WHEELES?</i>
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
MD=83.25		0.3				BS-20				Silty GRAVEL, gray, basaltic gravels, cobbles, and boulders in a brown, medium stiff, moist silt matrix with trace rootlets.
		22.0					1			
							2		GM	
							3			
							4			
							5			BASALT, gray, moderately weathered, fractured, vesticated strong.
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered.

SAMPLE TYPE			OTHER LABORATORY TESTS		
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits			SG - Specific Gravity
					SA - Sieve Analysis

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BORING - KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan.	DRILLER: PSC	BORING NO. TP-21
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		49.7				BS-21	1			<p>SILT, brown, medium stiff, with some gray, subangular basaltic gravels and cobbles, traces of clay and rootlets. Moist (volcanic ash).</p> <p>MH</p>
							2			
							3			
							4			
							5			
							6			
							7		<p>BASALT, gray, fractured, slightly to moderately weathered, strong</p> <p>Test pit terminated at about 5.25 ft. Groundwater was not encountered</p>	

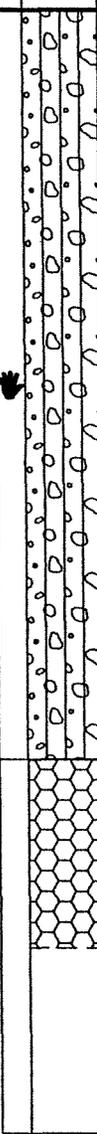
SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

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Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-22
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-22				Gravelly SILT, brown, medium stiff, with basalt boulders, traces of clay and rootlets, moist (volcanic ash).
							1			
							2			
							3			
							4			BASALT, moderately weathered, fractured, strong
							5			Test pit terminated at about 5 ft. Groundwater was not encountered.
							6			

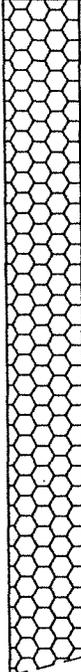
SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

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 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Walohuli Development Kula, Makawao, Maui, Hawaii	
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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-23
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		39.4				BS-23	0		GW GM	BASALT, boulders with silt matrix, traces of clay and rootlets, brown, moist
							1			BASALT gray, slightly to moderately weathered, fractured with vesicles, stong
							2			
							3			Test pit terminated at about 2.75 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING



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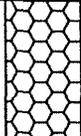
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BORING - KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-24
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-24				Silty GRAVEL basaltic gravels, cobbles, and boulders with silt matrix, trace rootlets, brown, moist
		33.1					1		GW GM	BASALT gray, slightly to moderately weathered, strong, fractured
							2			Test pit terminated at about 1.75 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING



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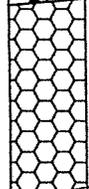
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DATE: March 2005

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BORING KEOKEA.GPJ BORING.GDT 97/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-25
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-25			GW GM	Silty GRAVEL, gray tuffaceous gravel (clinker); cobbles and boulders with silt (volcanic ash), trace rootlets, brown, moist
							1			BASALT, dark gray, slightly to moderately weathered, strong
							2			Test pit terminated at about 1.75 ft. Groundwater was not encountered
							3			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING



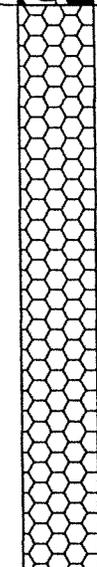
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BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-26
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		10.4				BS-26			GM	Silty GRAVEL, gray vitric tuff/lava gravels (clinker), cobbles and boulders with silt, trace rootlets, brown, moist
							1			BASALT dark gray, moderately weathered, strong to very strong
							2			Test pit terminated at about 1.75 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel
 AUG - Auger Cuttings
 SH - Shelby Tube
 D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
 CON - Consolidation Test
 PI - Atterberg Limits
 UC - Unconfined Compression
 SG - Specific Gravity
 SA - Sieve Analysis

LOG OF BORING



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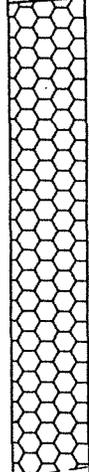
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BORING KEOKEA, GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-27
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-27			GM	Silty GRAVEL, gray, sub-angular vitric tuff/lava gravels cobbles and boulders with silt matrix, with trace clay and rootlets, brown, moist
							1			BASALT, gray, moderately weathered to fresh, fractured, strong to very strong
							2			
							3			Test pit terminated at about 2.5 ft. Groundwater was not encountered.

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-28
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe Excavator	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-28				SILT, brown, medium stiff, moist with traces of gravel and rootlets.
PI=2							1		MH	
BR=1.9		27.9					2			Gravelly SILT with basaltic cobbles and boulders, traces of clay and rootlets, dark brown, moist
							3		MH	
							4			
							5			BASALT, dark gray, fresh to moderately weathered, strong, fractured
							6			Test pit terminated at about 5.25 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

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DATE: March 2005

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-29
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-29				Silty GRAVEL, gray tuffaceous gravels, cobbles and boulders with a clayey silt matrix, trace rootlets, brown, moist
							1		GW GM	
							2			
							3			BASALT dark gray, slightly to moderately weathered, strong to very strong.
							4			Test pit terminated at about 3.5 ft. Groundwater was not encountered

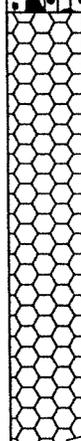
SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING: KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-30
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/24/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-30				Silty GRAVEL, gray sub-angular to angular tuffaceous gravels, cobbles and boulders, with clayey silt matrix with trace rootlets, brown, moist
							1		GW GM	BASALT, dark gray, moderately weathered, strong
							2			Test pit terminated at about 1.75 ft. Groundwater was not encountered.

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING



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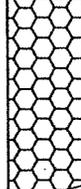
**Keokea/Walohuli Development
Kula, Makawao, Maui, Hawaii**

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-31
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 6/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-31				Basaltic BOULDERS, gray, moderately weathered, vesticated, with silt (volcanic ash) matrix, brown, moist
							1			BASALT, gray, moderately weathered to fresh, strong
		28.2					2			Test pit terminated at about 1.75 ft. Groundwater was not encountered.
							3			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING



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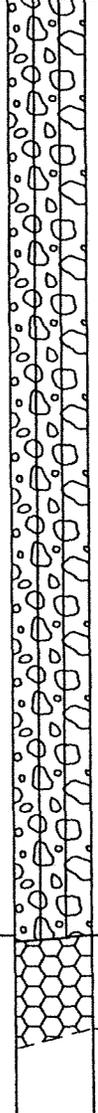
Keokea/Waiohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING - KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan		DRILLER: PSC	BORING NO. TP-32
BORING ELEVATION:		LOGGED BY: JGN	
DATE (S) DRILLED: 6/04		TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-32			GW GM	Silty GRAVEL, gray, subangular basaltic gravels, cobbles, and boulders with silt matrix, trace rootlets, brown, moist
						1				
						2				
						3				
						4				
							5		BASALT, dark gray, moderately weathered to fresh, strong	
							6			Test pit terminated at about 5 ft. Groundwater was not encountered.

SAMPLE TYPE	OTHER LABORATORY TESTS
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density
CB - Core Barrel	UC - Unconfined Compression
AUG - Auger Cuttings	CON - Consolidation Test
SH - Shelby Tube	SG - Specific Gravity
D&M - Dames & Moore	PI - Atterberg Limits
	SA - Sieve Analysis

LOG OF BORING

 <p>Geotechnical & Environmental Consultants Construction Management, Testing & Inspection</p>	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING - KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-33
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-33				Silty GRAVEL, gray tuffaceous gravels, cobbles and boulders with silt (volcanic ash) matrix, trace rootlets, brown, moist
							1		GM GW	
							2			
										BASALT, dark gray, moderately weathered to fresh, strong.
							3			Test pit terminated at about 3.0 ft. Groundwater was not encountered.
							4			

SAMPLE TYPE				OTHER LABORATORY TESTS			
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression		CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis				

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waihuli Development Kula, Makawao, Maui, Hawaii
	DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-34
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-34				SILT, with basalt boulders, traces of clay and rootlets, brown, moist (volcanic ash)
							1			
							2			grades with more basaltic boulders
							3			
							4			
							4			BASALT, dark gray, moderately weathered to fresh, strong
							5			
							6			Test pit excavation terminated at about 5.0 ft. Groundwater was not encountered.

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING_KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-35
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/2/04	TYPE RIG:	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-35				Silty GRAVEL, gray tuffaceous gravels, cobbles and boulders with silt matrix, trace rootlets, brown, moist
							1			
							2		GM	
							3			BASALT, dark gray, slightly to moderately weathered, strong.
							4			Test pit terminated at about 3.5 Groundwater was not encountered

SAMPLE TYPE	OTHER LABORATORY TESTS		
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-36
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-36				SILT, with some basaltic gravel and cobbles, trace of clay and rootlets, brown to dark brown, moist
		38.1					1			
							2		MH	
							3			
							4			BASALT, dark gray, with coarse sand to pea-sized vesicles, slightly to moderately weathered, strong
							5			
							6			Test pit terminated at about 5.25 ft. Groundwater was not encountered

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel
 AUG - Auger Cuttings
 SH - Shelby Tube
 D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
 CON - Consolidation Test
 PI - Atterberg Limits
 UC - Unconfined Compression
 SG - Specific Gravity
 SA - Sieve Analysis

LOG OF BORING



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Keokea/Walohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-37
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-37				SILT with some lava cobbles and boulders, trace of clay and rootlets, brown, moist
							1		MH	
							2			
							3			Silty GRAVEL, gray lava gravels, cobbles, and boulders with silt matrix, trace rootlets, brown, moist
							4			
							5		GM	
							6			
							7			
							8			BASALT, dark gray, moderately weathered, vesticated, strong
							9			Test pit excavation terminated at about 8.0 ft. Groundwater was not encountered.
							10			

SAMPLE TYPE	OTHER LABORATORY TESTS		
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING: KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-38
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-38			MH	SILT with traces of gravel and rootlets, brown, moist (volcanic ash).
							1			
							2			
							3			
							4		MH	Gravelly SILT with some basaltic cobbles, brown, moist
							5			
							6			BASALT, gray to dark gray, moderately weathered, strong
							7			Test pit terminated at about 6.25 ft. Groundwater was not encountered

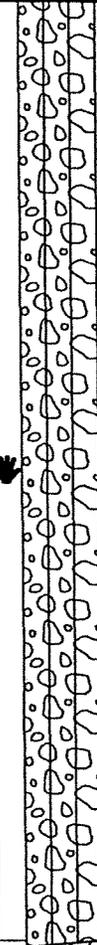
SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii
	DATE: March 2005.

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-39
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/2/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						B9-39				Silty GRAVEL, gray lava gravels, cobbles and boulders with silt matrix, trace rootlets, brown, moist
							1			
							2			
							3		GM	
							4			
							5			BASALT, dark gray, slightly to moderately weathered, strong to very strong
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered

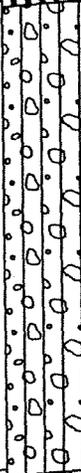
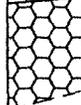
SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-40
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-40				SILT with some basaltic gravel and cobbles, trace of clay and rootlets, brown to dark brown moist. (volcanic ash)
							1		MH	
							2			
							3			Gravelly SILT with basaltic gravels, cobbles and boulders, brown, moist
							4		MH	
							5			BASALT, dark gray, slightly to moderately weathered, strong, elongated pea to coarse sand-sized vesicles
							6			Test pit terminated at about 5.5 ft. Groundwater was not encountered

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEUKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-41
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-41				SILT with vesicated basaltic boulders and cobbles, trace of clay and rootlets, brown to dark brown, moist (volcanic ash)
MD=84.5 pcf		0.3					1			
CMC=36%							2			
		30.1					3			
							4			
							5			
							6			BASALT , dark gray, moderately weathered, strong. Test pit terminated at about 5.5 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING



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Keokea/Waiohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-42
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-42				Gravelly Silt with basaltic gravels, cobbles and boulders, trace of clay and rootlets, dark brown to brown, moist (volcanic ash)
							1			
							2			
							3			
							4			
										BASALT, dark gray, slightly to moderately weathered, strong
							5			Test pit terminated at about 4.75 ft. Groundwater was not encountered.
							6			

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING: KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-43
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		37.9				BS-43	0		MH	SILT with basaltic gravel, cobbles and boulders, brown, moist
							1			
							2			
							3			
							4			
							5			
							6			
							7			BASALT, dark gray, moderately weathered, strong
							8			
							9			Test pit terminated at about 8 ft. Groundwater was not encountered
							10			

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 11/2/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-44
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION	
		37.7				BS-44	1		MH	SILT with traces of gravel, brown to dark brown, moist (volcanic ash)	
							2				
							3				
							4				
							5				
							6				
							7				
							8				
							9			Test pit terminated at about 8 feet Groundwater was not encountered	
							10				

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING: KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Suite Plan	DRILLER: PSC	BORING NO. TP-45
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/07	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-45				Clayey SILT with trace gravel, sand and rootlets, dark brown, moist
							1			
							2			
							3		MH	
							4			
							5			
							6			Gravelly SILT with angular to sub-angular basaltic boulders, trace of clay and rootlets, brown to dark brown, moist (volcanic ash)
							7		MH	
							8			BASALT, dark gray, moderately weathered, strong
							9			Test pit terminated at about 8.5 ft. Groundwater was not encountered
							10			

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Walohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-46
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/07	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-46				SILT with some gravels, cobbles and boulders, trace rootlets, brown, moist
							1			
							2			
							3			
							4	MH		
							5			
							6			
							7			
							8			BASALT, dark gray, moderately weathered, strong
							9			Test pit terminated at about 8.0 ft. Groundwater was not encountered.

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

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 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea/Waihohuli Development Kula, Makawao, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-47
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		36.7				BS-47	1		MH	SILT with sub-rounded to basaltic cobbles, trace rootlets and clay, amber brown, moist (volcanic ash)
						2				
						3				
						4				
						5				
						6				
							7			BASALT, dark gray, slightly to moderately weathered, fractured, strong.
							8			Test pit excavation terminated at about 6.5 ft. Groundwater was not encountered

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression	
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

	Keokea/Waiohuli Development Kula, Makawao, Maui, Hawaii	
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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-48
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-48				Gravelly SILT with basaltic cobbles and boulders, trace of clay and rootlets, brown, moist (volcanic ash)
							1			
							2		MH	
							3			
							4			
							5			BASALT, Dark gray, moderately weathered to fresh, strong
							6			Test pit excavation terminated at about 5.5 ft. Groundwater was not encountered

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel
 AUG - Auger Cuttings
 SH - Shelby Tube
 D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
 CON - Consolidation Test
 PI - Atterberg Limits
 UC - Unconfined Compression
 SG - Specific Gravity
 SA - Sieve Analysis

LOG OF BORING



Geotechnical & Environmental
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Keokea/Waiohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO.: 24304.10

BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-49
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-49			MH	Gravelly SILT with sub-angular basaltic gravel and cobbles, trace of clay and rootlets, brown to dark brown, moist (volcanic ash)
							1			
							2			
							3			
							4			
										BASALT gray, slightly to moderately weathered, strong
										Test pit excavation terminated at about 4.75 ft Groundwater was not encountered
							5			
							6			

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel
 AUG - Auger Cuttings
 SH - Shelby Tube
 D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density
 CON - Consolidation Test
 PI - Atterberg Limits
 UC - Unconfined Compression
 SG - Specific Gravity
 SA - Sieve Analysis

LOG OF BORING



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Keokea/Waiohuli Development
 Kula, Makawao, Maui, Hawaii

DATE: March.2005

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BORING: KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. TP-50
BORING ELEVATION:	LOGGED BY: JGN	
DATE (S) DRILLED: 7/04	TYPE RIG: Backhoe	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-50				SILT with some cobbles and boulders, trace of clay and rootlets, brown, moist (volcanic ash)
							1			
		37.4					2		MH	
							3			
							4			BASALT, dark gray, slightly to moderately weathered, strong
										Test pit excavation terminated at about 3.75 ft. Groundwater was not encountered.

SAMPLE TYPE

MC - Modified California SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings D&M - Dames & Moore

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

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 Kula, Makawao, Maui, Hawaii

DATE: March 2005

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BORING KEOKEA.GPJ BORING.GDT 9/7/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-1
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/26	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-B1	1		MH	SILT, brown, medium stiff, moist with some basaltic gravel, trace rootlets
						2				
						3				
						4				
						5				
						6		GM	BASALT, blue-black, slightly weathered, very strong, massive	
						7				
						8				
						9				
						10		GM	GRAVEL, gray vitric tuff gravels, cobbles and boulders intersticed with brown, moist, clayey silt.	
						11				
						12				
						13				
						14				
						15		GM	BASALT, gray, slightly weatered, very strong, massive	
						16				
						17				
						18				
						19			Boring terminated at about 18 feet Groundwater was not encountered	
						20				

SAMPLE TYPE	OTHER LABORATORY TESTS
MC - Modified California SPT - Standard Penetration	MD - Moisture/Density UC - Unconfined Compression
CB - Core Barrel SH - Shelby Tube	CON - Consolidation Test SG - Specific Gravity
AUG - Auger Cuttings D&M - Dames & Moore	PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING

Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea Waiohuli Development Proposed Borrow Site Waiohuli, Maui, Hawaii	
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BORING - KEOKS.GPJ BORING.GDT 8/10/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-2
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/27	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		31.2				BS-B2	1		MH	SILT, brown, medium stiff, moist with basaltic gravels, cobbles and boulders, trace rootlets
							2			Basaltic BOULDERS, bluish brown, slightly to moderately weathered, very strong
							3			
							4			
							5			
							6			
							7			
							8			
							9			Cavity, (possibly lava tube)
							10			
							11			
							12			
							13			BASALT, gray, slightly to moderately weathered, venticular, strong
							14			
							15			
							16			
							17			Boring terminated at about 16.5 feet Groundwater was not encountered
							18			

SAMPLE TYPE			OTHER LABORATORY TESTS		
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression		
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity		
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis		

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Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea Waiohuli Development Proposed Borrow Site Waiohuli, Maui, Hawaii	
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BORING KEOKS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-3
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/28	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
MDD=105 PCF	16.6					BS-B3	1		MH	Clayey SILT dark brown to gray, medium stiff to stiff with basaltic gravels, cobbles and boulders, trace sand, rootlets. Moist.
							2			Tuffaceous cobbles and boulders in a clayey silt matrix
							3			BASALT, bluish gray, slightly weathered, very strong
							4			Brown tuffaceous cobbles with clayey silt and some boulders
							5			
							6			
							7			
							8			
							9			
							10			
							11			
							12			
							13			
							14			
							15			
							16			
							17			
							18			

SAMPLE TYPE MC - Modified California SPT - Standard Penetration MD - Moisture/Density CB - Core Barrel SH - Shelby Tube CON - Consolidation Test AUG - Auger Cuttings D&M - Dames & Moore PI - Atterberg Limits			OTHER LABORATORY TESTS UC - Unconfined Compression SG - Specific Gravity SA - Sieve Analysis		
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LOG OF BORING

 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea Waiohuli Development Proposed Borrow Site Waiohuli, Maui, Hawaii	
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BORING KE0BS.GPJ BORING.GDT 8/10/04

BORING LOCATION: See Site Plan		DRILLER: PSC	BORING NO. B-4
BORING ELEVATION:		LOGGED BY: JAGN	
DATE (S) DRILLED: 7/28		TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-B4	1		MH	SILT, brown, medium stiff, moist, with tuffaceous gravels and cobbles, trace rootlets. Moist
						2				
						3				
						4				
							5			BASALT, bluish gray, fresh, massive, very strong
						6				
						7				
						8				
							9			Tuffaceous cobbles and boulders in a brown clayey silt matrix
						10				
						11				
						12				
							13			BASALT, gray, slightly to moderately weathered, vesticated, strong
						14				
						15				
						16				
							17			Boring terminated at about 16 feet Groundwater was not encountered
							18			

SAMPLE TYPE			OTHER LABORATORY TESTS		
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression		
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity		
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis		

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 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea Waiohuli Development Proposed Borrow Site Waiohuli, Maui, Hawaii	
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BORING KEOKS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-5
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/29	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
						BS-B5	1			Tuffaceous boulders, gravel and cobbles, gray, vesticated, sub-angular, dense, conglomeratic rocks in a clayey silt matrix
							2			
							3			
							4			
							5			BASALT, gray, fresh to slightly weathered, very strong
							6			
							7			
							8			Boulders & Cobbles, vitric, tuffaceous rocks in a brown silty soil (volcanic ash) matrix
							9			
							10			
							11			
							12			BASALT, blue gray, fresh, very strong, massive
							13			
							14			
							15			
							16			Boring terminated at about 15.5 feet Groundwater was not encountered
							17			
							18			

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea Waiohuli Development Proposed Borrow Site Waiohuli, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.11

BORING KE085.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-6
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/29	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION	
MDD=88.13 pcf						BS-B6	1		MH	Gravelly SILT, brown, medium stiff, moist with subangular tuffaceous gravels and boulders, trace rootlets.	
	2										
	3										
	4										
								5			BASALT, bluish gray, slightly weathered, very strong
	6										
								7			Basaltic GRAVEL (clinker), dark gray, dense to very dense, dry
	8										
								9			BASALT, gray, slightly to moderately weathered, strong
	10										
	11										
	12										
								13			Basaltic GRAVEL (clinker), dark gray, subangular, dense to very dense
	14										
								15			Boring terminated at about 16 feet Groundwater was not encountered
	16										
	17										
								18			

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

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Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea Waiohuli Development Proposed Borrow Site Waiohuli, Maui, Hawaii	
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BORING KEOKS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-7
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/30	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
							1		MH	SILT, brown, medium stiff, moist, with tuffaceous gravels, cobbles and boulders, trace rootlets
						2				
						3				
							4			Basalt BOULDERS, grayish black, slightly to moderately weathered, very strong
						5				
						6				
						7				
						8				
						9				
						10				
						11			Tuffaceous ROCKS, gray, tuffaceous cobbles and boulders in a silty, volcanic ash matrix	
						12				
						13				
						14				
							15			Basalt BOULDERS, gray, slightly weathered, very strong
						16				
						17				
						18				
										Boring terminated at about 15 feet Groundwater was not encountered

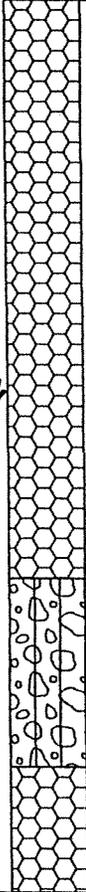
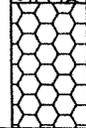
SAMPLE TYPE				OTHER LABORATORY TESTS			
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression				
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity				
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis				

LOG OF BORING

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BORING KEOKS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-8
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/30	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
MDD=86.2 pcf	86.2	27.7				BS-B8	1		MH	Clayey SILT, brown, with subangular tuffaceous gravel, cobbles and boulders, trace rootlets. Moist
							2			BASALT, gray to black, slightly weathered, very strong
							3			
							4			
							5			
							6			
							7			
							8			
							9			
							10			
							11			Vitric TUFF, black to gray subangular tuffaceous gravel (clinker) and cobbles, dense to very dense
							12			
							13			
							14			BASALT, gray, slightly to moderately weathered, strong
							15			
							16			Boring terminated at about 16 feet Groundwater was not encountered
							17			
							18			

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

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Keokea Waiohuli Development
Proposed Borrow Site
Waiohuli, Maui, Hawaii

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BORING KEOKS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-9
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/31	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
		21.3				BS-B9	1		MH	Gravelly SILT, brown, medium stiff, moist with tuffaceous gravel, cobbles and boulders, trace rootlets
						2				
						3				
						4				
							5			Basalt ROCK, bluish gray, slightly weathered, very strong
						6				
						7				
							8			GRAVEL, gray tuffaceous gravels (clinker) with cobbles and boulders
						9				
						10				
						11				
							12			Boring terminated at about 12 feet Groundwater was not encountered
							13			
							14			

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

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BORING KE0BS.GPJ BORING.GDT 8/11/04

BORING LOCATION: See Site Plan	DRILLER: PSC	BORING NO. B-10
BORING ELEVATION:	LOGGED BY: JAGN	
DATE (S) DRILLED: 7/31	TYPE RIG: Hoe Ram	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLE NUMBER	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION	
		21.8				BS-B10	1		MH	Gravelly SILT, brown, medium stiff, moist, with tuffaceous subangular cobbles and boulders, trace rootlets	
						2					
						3					
							4			BASALT, bluish gray, slightly to moderately weathered, very strong	
						5					
						6					
						7					
							8			Vitric TUFF, gray tuffaceous gravels (clinker), cobbles and boulders. Dense to very dense	
						9					
						10					
						11					
							12			BASALT, bluish gray, slightly to moderately weathered, strong.	
						13					
						14					
						15					
							16			Boring terminated at about 16 feet Groundwater was not encountered	
							17				
							18				

SAMPLE TYPE		OTHER LABORATORY TESTS	
MC - Modified California	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	D&M - Dames & Moore	PI - Atterberg Limits	SA - Sieve Analysis

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 Geotechnical & Environmental Consultants Construction Management, Testing & Inspection	Keokea Waiohuli Development Proposed Borrow Site Waiohuli, Maui, Hawaii	
	DATE: March 2005	PROJECT NO.: 24304.11

BORING KE0BS.GPJ BORING.GDT 8/11/04

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	FINE GRAINED SOILS 50% OR MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
		SILTS AND CLAYS LIQUID LIMIT GREATER THAN OR EQUAL TO 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
ROCKS					VOLCANIC BASALT / ANDESITE

UNIFIED SOIL CLASSIFICATION SYSTEM



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Proposed DHHL Agricultural Subdivision Road Network
Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO. 24304.10

I **CONSOLIDATION OF SEDIMENTARY ROCKS;** usually determined from unweathered samples. Largely dependent on cementation.

U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

II **BEDDING OF SEDIMENTARY ROCKS**

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	very thick bedded
Blocky	2.0 to 4.0 ft.	thick-bedded
Slabby	0.2 to 2.0 ft.	thin-bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01 ft.	thinly laminated

III **FRACTURING**

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

IV **HARDNESS**

1. **Soft** – reserved for plastic material alone.
2. **Low hardness** – can be gouged deeply or carved easily with a knife blade.
3. **Moderately hard** – can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** – can be scratched with difficulty; scratch produces little powder and is often faintly visible.
5. **Very hard** – cannot be scratched with a knife blade; leaves a metallic streak.

V **STRENGTH**

1. **Plastic or very low strength.**
2. **Friable** - Crumbles easily by rubbing with fingers.
3. **Weak** – An unfractured specimen of such material will crumble under light hammer blows.
4. **Moderately strong** – Specimen will withstand a few heavy hammer blows before breaking.
5. **Strong** – Specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. **Very strong** – Specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

VI **WEATHERING** – The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation and freezing and thawing.

- D. **Deep** – Moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.
- M. **Moderate** – Slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.
- L. **Little** - No megascopic decomposition of minerals; little or no affect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.
- F. **Fresh** – Unaffected by weathering agents. No disintegration or discoloration. Fractures usually less numerous than joints.

ROCK CLASSIFICATION SYSTEM



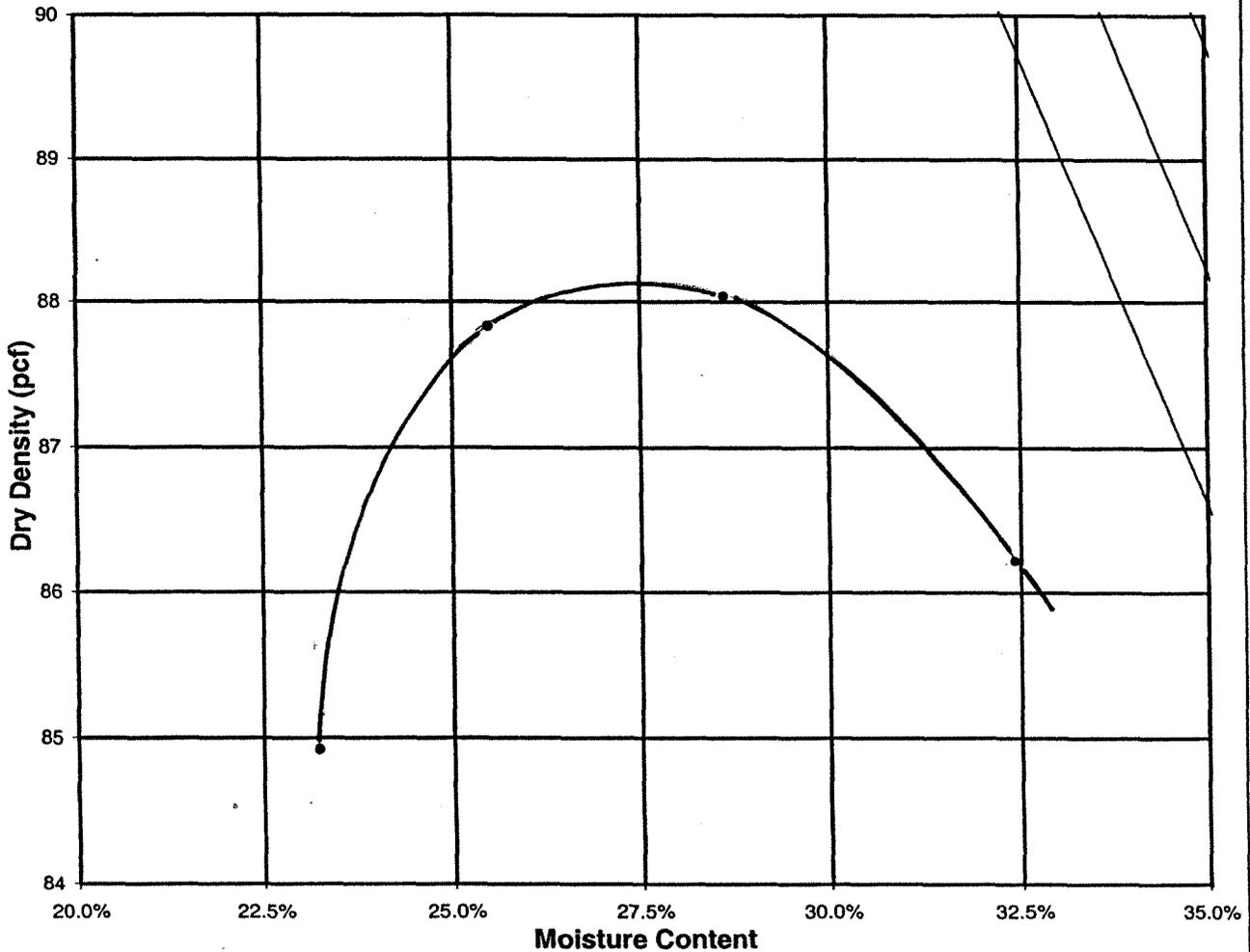
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Proposed DHHL Agricultural Subdivision Road Network
Kula, Makawao, Maui, Hawaii

DATE: March 2005

PROJECT NO. 24304.10

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-1 Road Alignment

Description: Dark Brown Clayey SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	104.65	110.2	113.24	114.17
Moisture Content	23.23%	25.48%	28.63%	32.42%
Dry Density (pcf)	84.92	87.83	88.04	86.22

Maximum Dry Density (pcf): 88.0
 Optimum Moisture Content (%): 28.6
 Test Method: ASTM D-1557

Atterberg Limits
 LL PL PI

COMPACTION TEST RESULTS ASTM D-1557



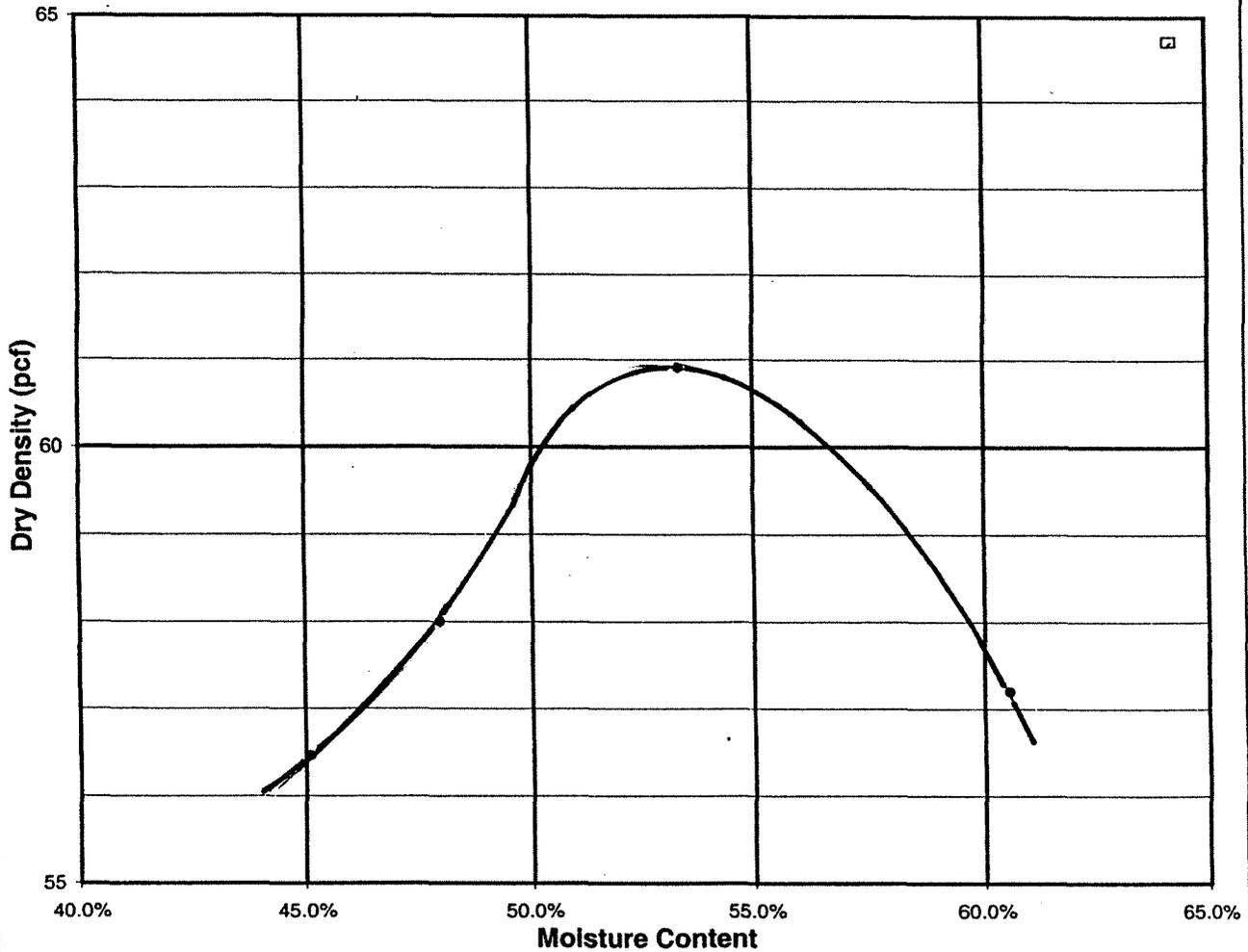
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Date: March 2005 PROJECT NO. 24304.10

A:\Labshots\Compaction BS-1 Keokea\Points Only

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-4 Road Alignment

Description: Dark Brown Volcanic Ash

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	81.98	85.78	93.42	91.86
Moisture Content	45.1%	47.9%	53.4%	60.6%
Dry Density (pcf)	56.5	58.0	60.9	57.2

Maximum Dry Density (pcf): 60.9
 Optimum Moisture Content (%) : 53.4

Test Method: ASTM D-1557-91C

Atterberg Limits

<u>LL</u>	<u>PL</u>	<u>PI</u>
82	70	12

COMPACTION TEST RESULTS ASTM D-1557



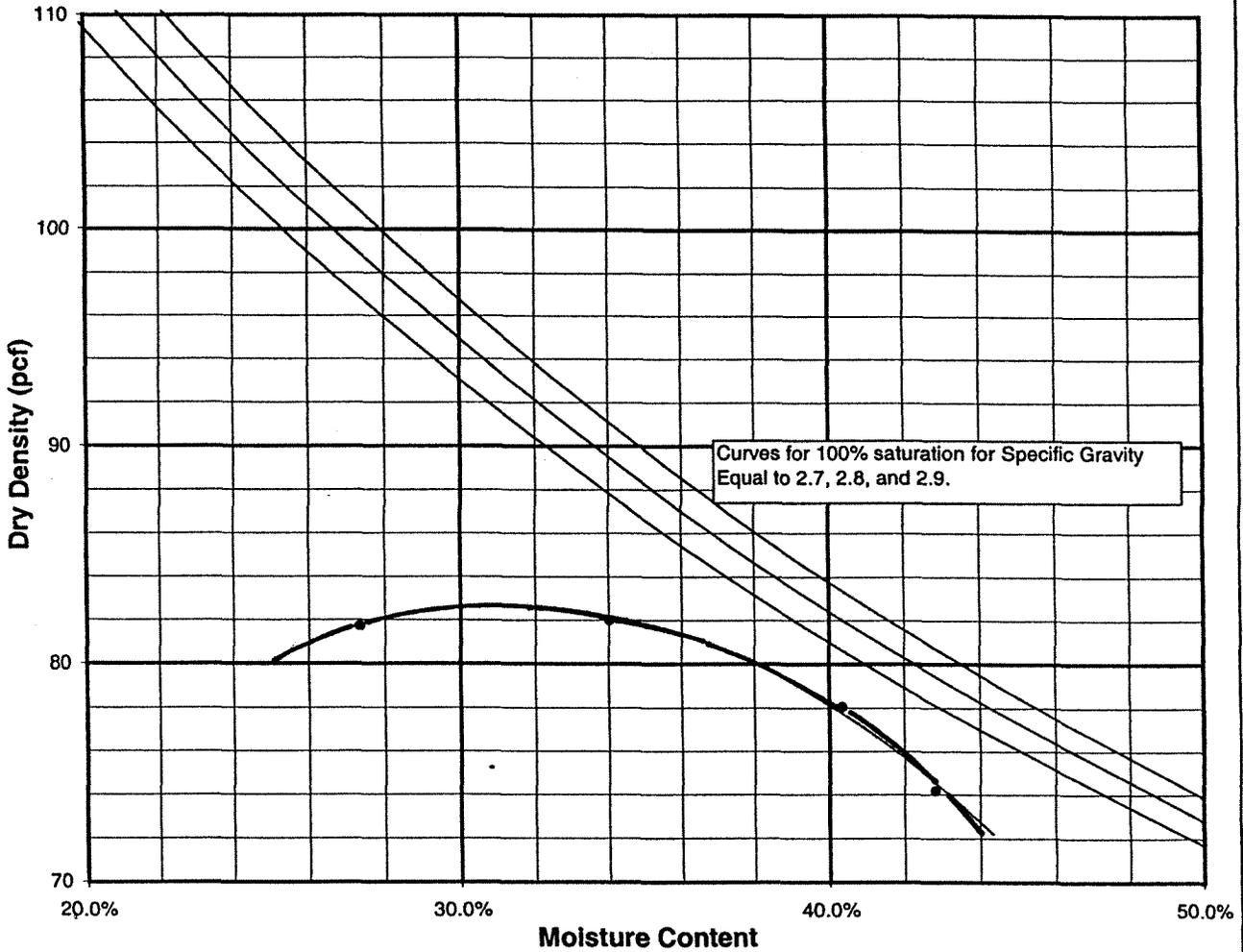
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 Kula, Makawao, Maui, Hawaii

Date: March 2005

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MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-18 Prop.Rd. Alignment

Description: Brown Volcanic Ash

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	104	109.88	109.65	105.95
Moisture Content	27.3%	34.0%	40.4%	42.8%
Dry Density (pcf)	81.7	82.0	78.1	74.2

Maximum Dry Density (pcf): 82.0
 Optimum Moisture Content (%) : 34

Test Method: ASTM D-1557-91C

Atterberg Limits

<u>LL</u>	<u>PL</u>	<u>PI</u>
69	68	1

COMPACTION TEST RESULTS

ASTM D-1557



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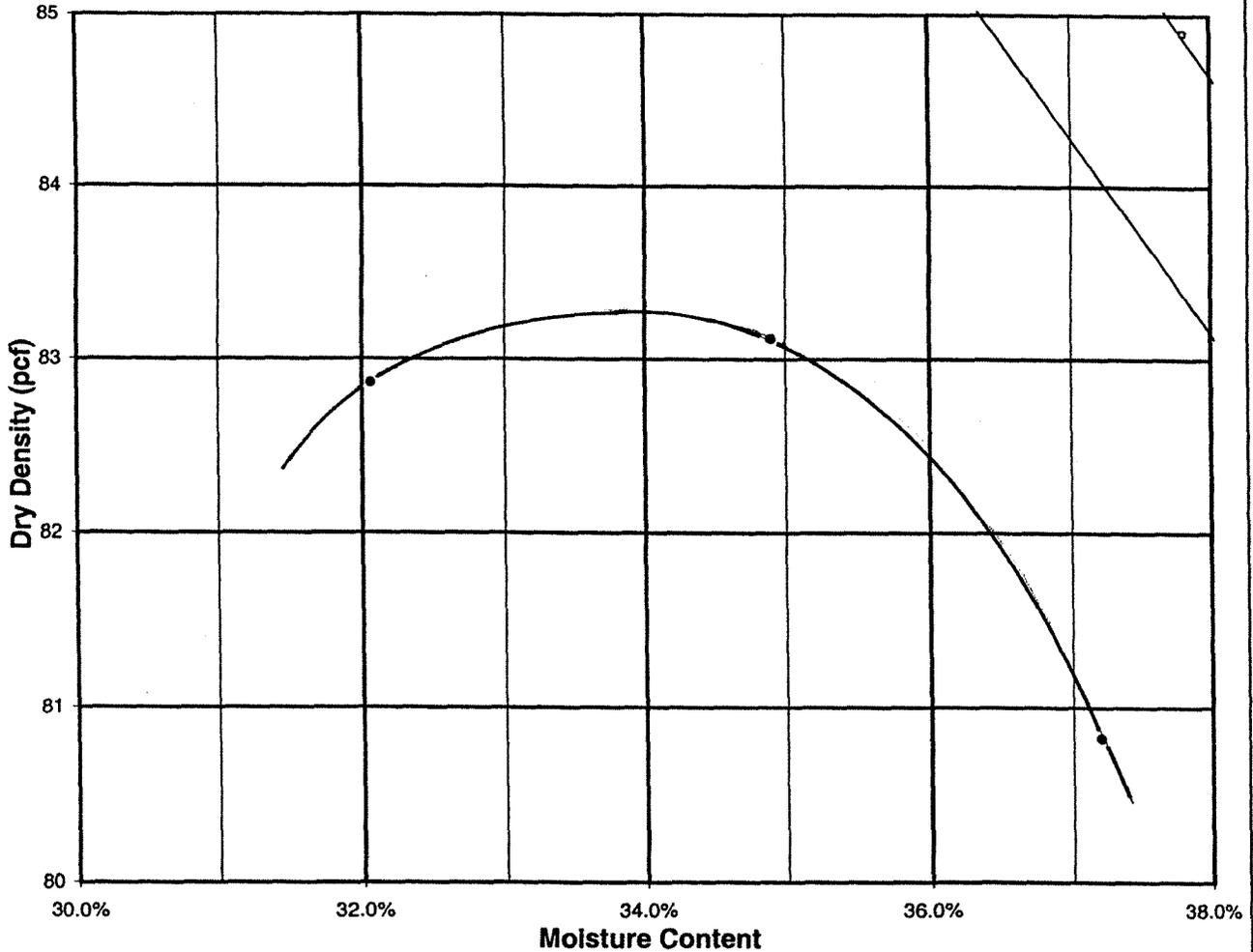
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 Proposed Agricultural Subdivision Road Network
 Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

PLATE NO: 67

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-20 Road Alignment

Description: Brown SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	109.42	112.12	110.88	
Moisture Content	32.06%	34.90%	37.20%	
Dry Density (pcf)	82.86	83.12	80.82	

Maximum Dry Density (pcf): 83.25
 Optimum Moisture Content (%): 34
 Test Method: ASTM D-1557

Atterberg Limits

LL

PL

PI

COMPACTION TEST RESULTS

ASTM D-1557



PSC Consultants, LLC

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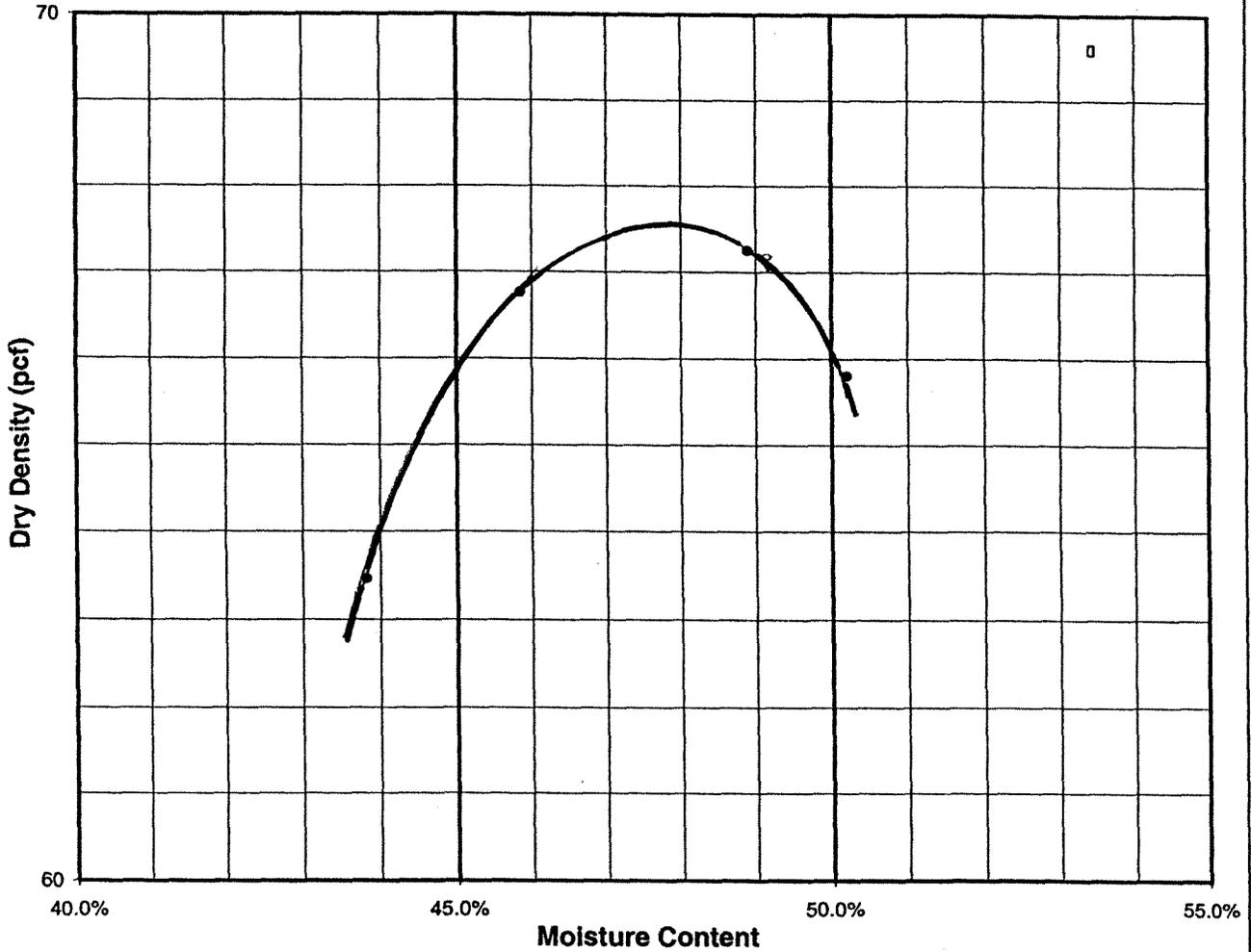
Proposed Agricultural Subdivision Borrow Site

Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.11

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-28 Prop. Rd. Alignment

Description: Brown Volcanic Ash

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	91.31	97.46	100.2	98.83
Moisture Content	43.8%	45.9%	48.9%	50.2%
Dry Density (pcf)	63.5	66.8	67.3	65.8

Maximum Dry Density (pcf): 67.3
 Optimum Moisture Content (%) : 48.9

Test Method: ASTM D-1557-91C

Atterberg Limits

<u>LL</u>	<u>PL</u>	<u>PI</u>
62	60	2

COMPACTION TEST RESULTS

ASTM D-1557



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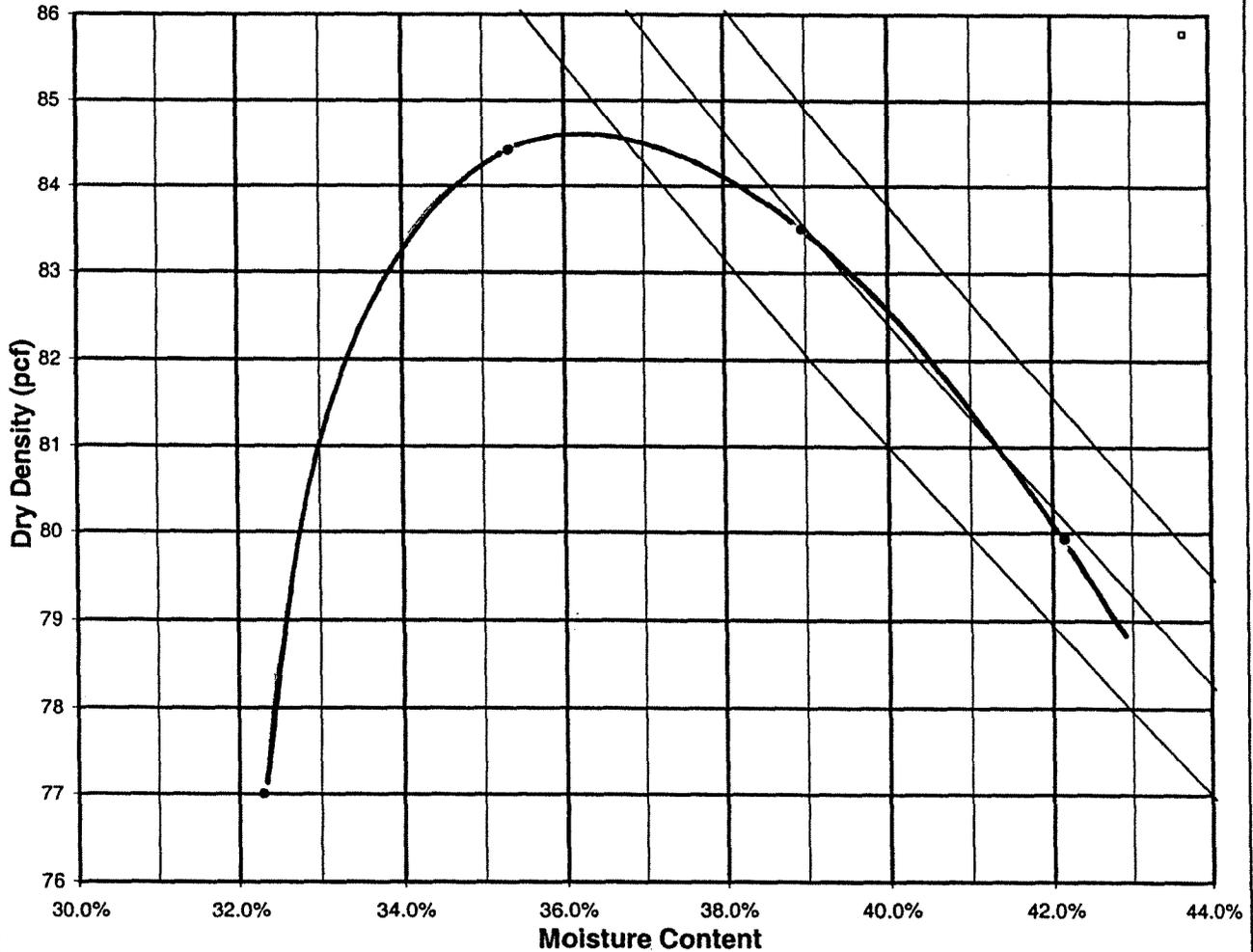
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Keokea/Waiohuli Development
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 Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-41 Road Alignment

Description: Brown SILT (ML) trace of gravel and clay

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	101.87	114.24	116.03	113.62
Moisture Content	32.30%	35.32%	38.96%	42.15%
Dry Density (pcf)	77.00	84.42	83.50	79.93

Maximum Dry Density (pcf): 84.50
 Optimum Moisture Content (%): 36
 Test Method: ASTM D-1557

Atterberg Limits
 LL PL PI

COMPACTION TEST RESULTS ASTM D-1557



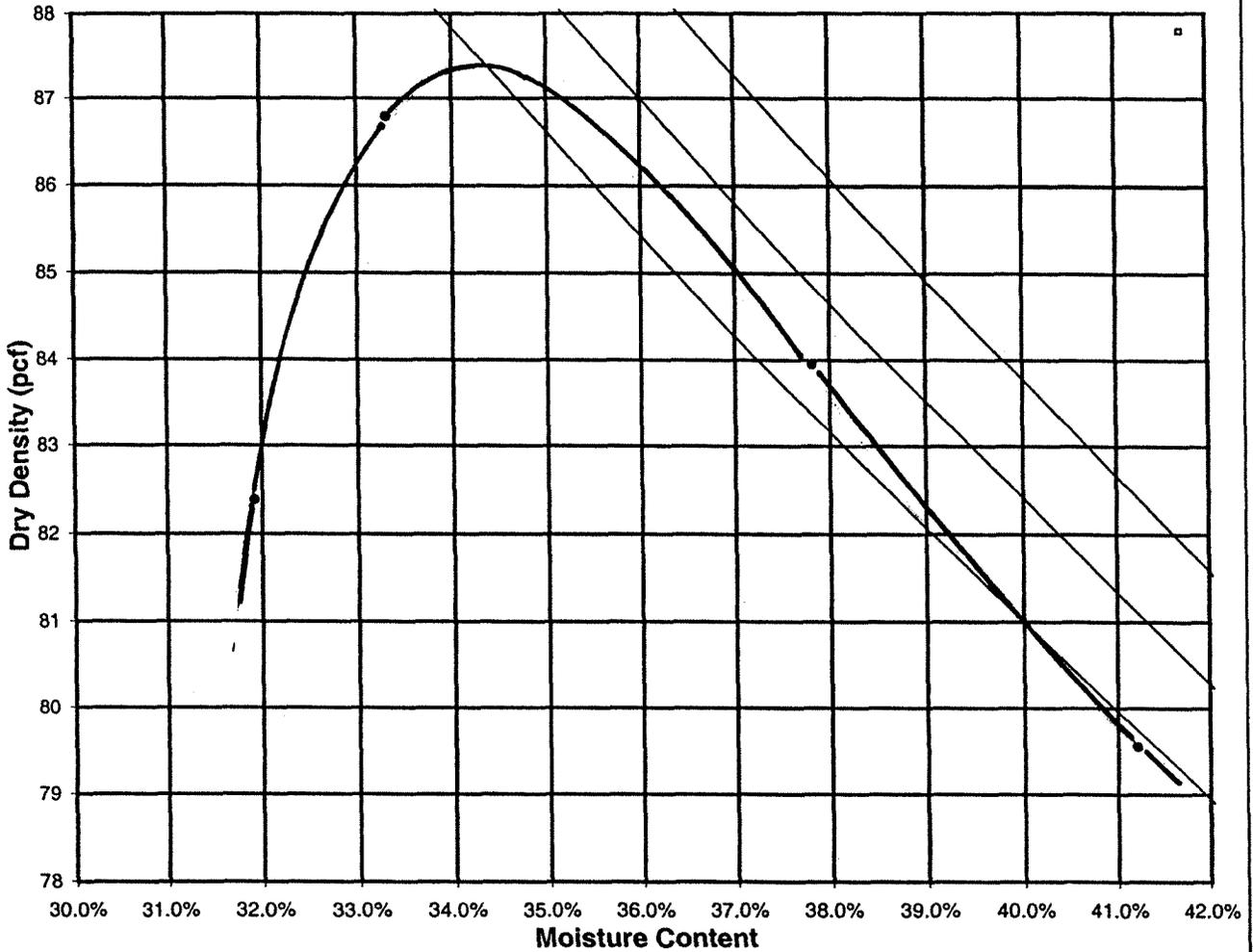
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 Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.11

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-45 Road Alignment

Description: Dark Brown Clayey SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	108.68	115.7	115.69	112.33
Moisture Content	31.92%	33.31%	37.82%	41.21%
Dry Density (pcf)	82.38	86.79	83.95	79.55

Maximum Dry Density (pcf): about 87.3
 Optimum Moisture Content (%): about 34.5
 Test Method: ASTM D-1557

Atterberg Limits
 LL PL PI

COMPACTION TEST RESULTS ASTM D-1557



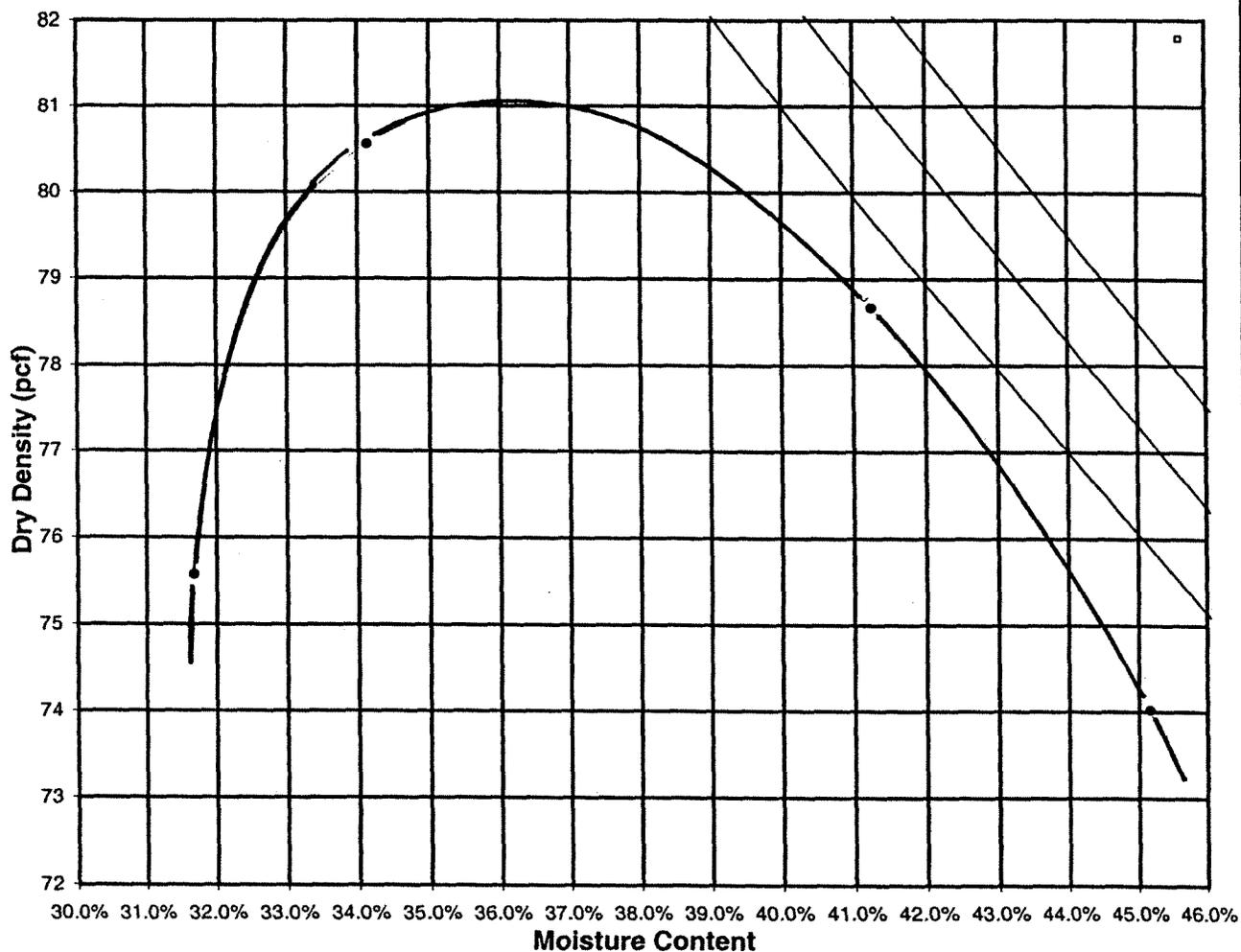
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Keokea/Waiohuli Development
 Proposed Agricultural Subdivision Road Network
 Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-47 Road Alignment

Description: Amber Brown Clayey SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	99.51	108.06	111.12	107.44
Moisture Content	31.68%	34.14%	41.25%	45.16%
Dry Density (pcf)	75.57	80.56	78.67	74.02

Maximum Dry Density (pcf): 81

Optimum Moisture Content (%): 36

Test Method: ASTM D-1557

Atterberg Limits

LL

PL

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COMPACTION TEST RESULTS

ASTM D-1557



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Keokea/Walohuli Development

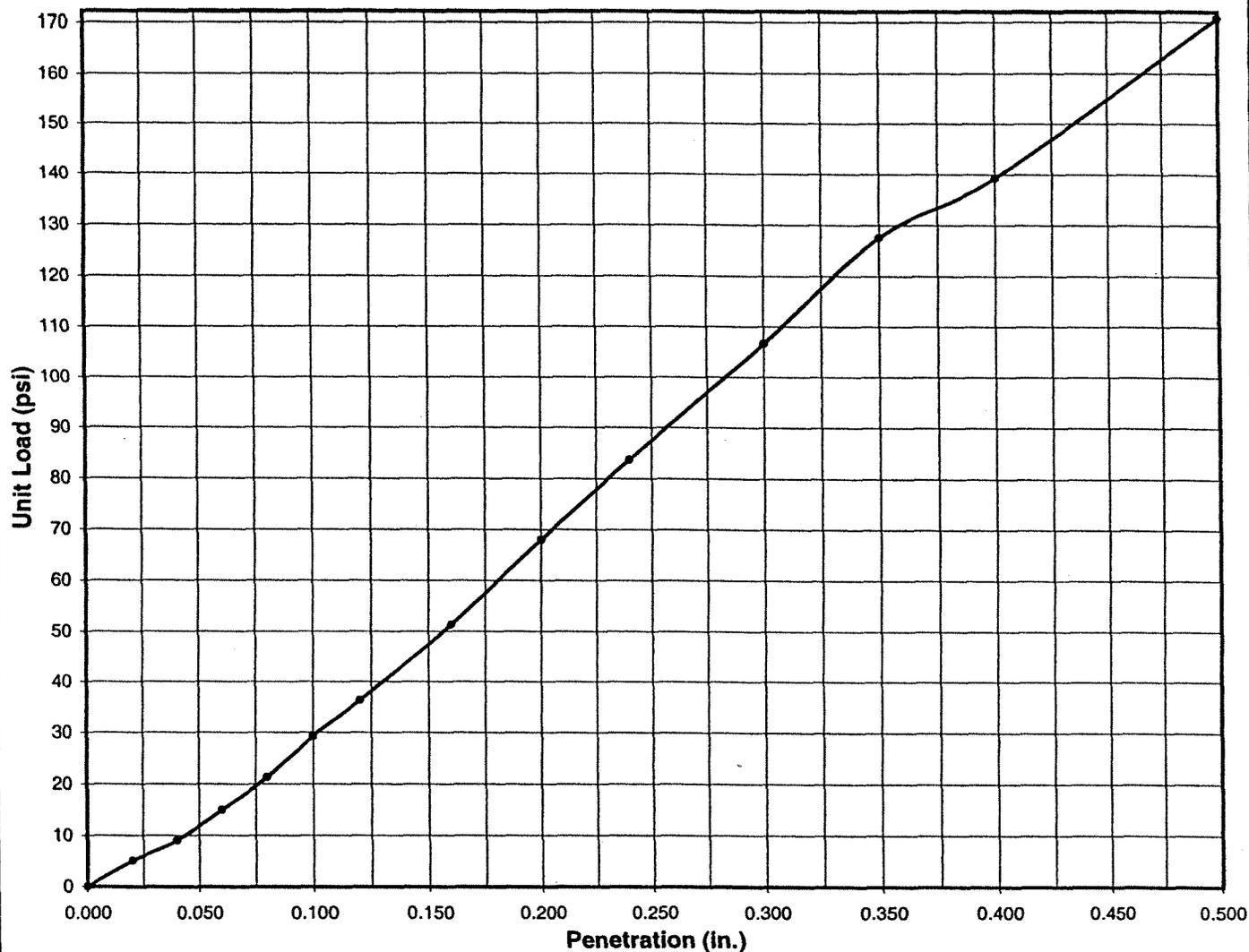
Proposed Agricultural Subdivision Road Network

Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

CBR CURVE



Sample Source: TP-1

Depth: 0-5

Description: Brown Clayey Silt (MH)

	Before Expansion	After Expansion
Relative Compaction (%):	90.93%	90.20%
Moisture Content (%):	37.66%	38.66%
Dry Density (pcf):	80.00	79.41
Percent Swell or Expansion Value (%):	0.80%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	3	
CBR Value @ 0.2" Corrected:	4.5	

Atterberg Limits

LL PL PI

CALIFORNIA BEARING RATIO ASTM D-1883-94



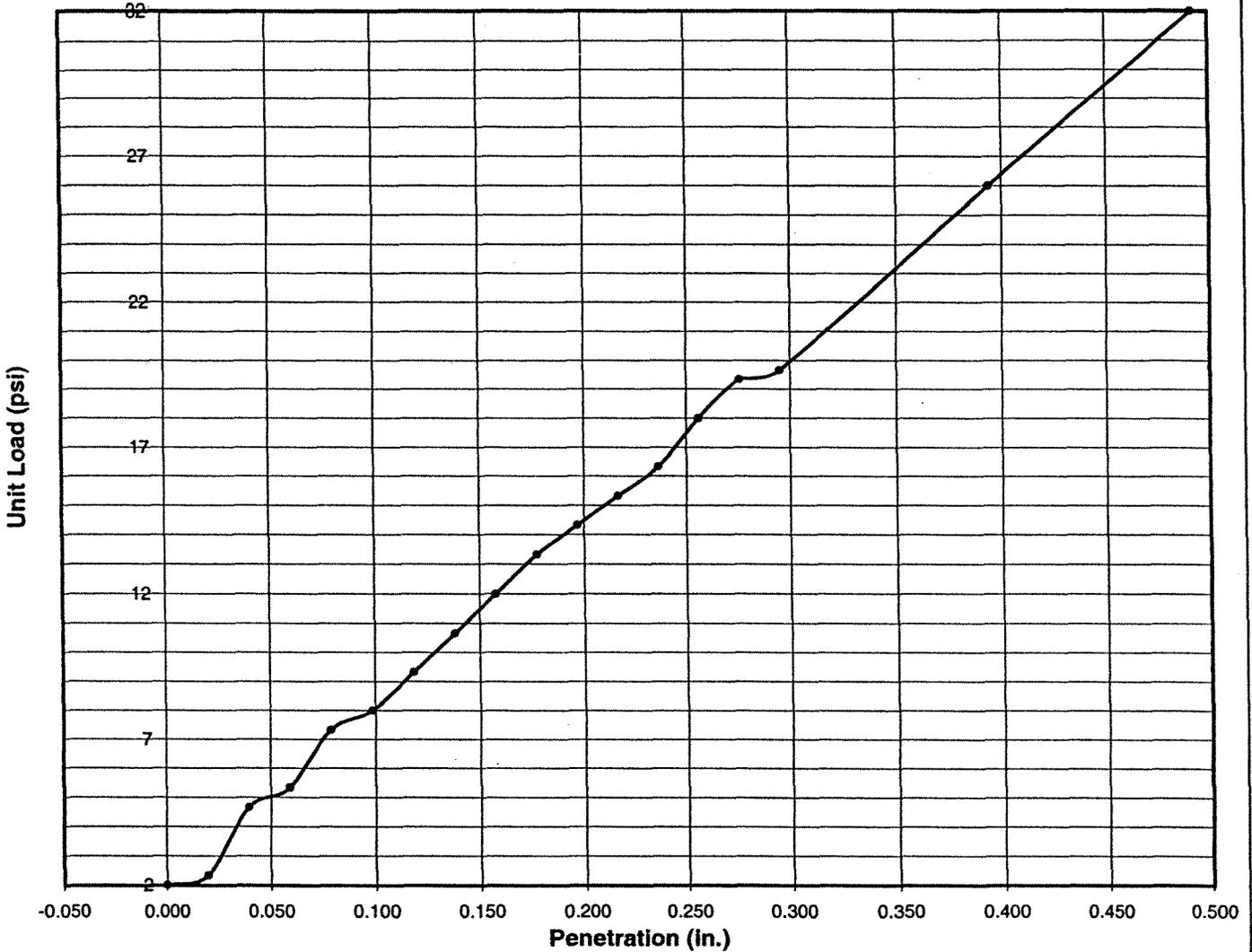
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Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.12

CBR CURVE



Sample Source: TP-4

Depth: 0-2 ft

Description: Brown Silt (MH)
volcanic ash

	Before Expansion	After Expansion
Relative Compaction (%):	94.55%	94.48%
Moisture Content (%):	60.35%	61.74%
Dry Density (pcf):	57.63	57.54
Percent Swell or Expansion Value (%):	1.65%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	0.8	
CBR Value @ 0.2" Corrected:	0.95	

Atterberg Limits

LL	PL	PI
82.00	70	12

**CALIFORNIA BEARING RATIO
ASTM D-1883-94**

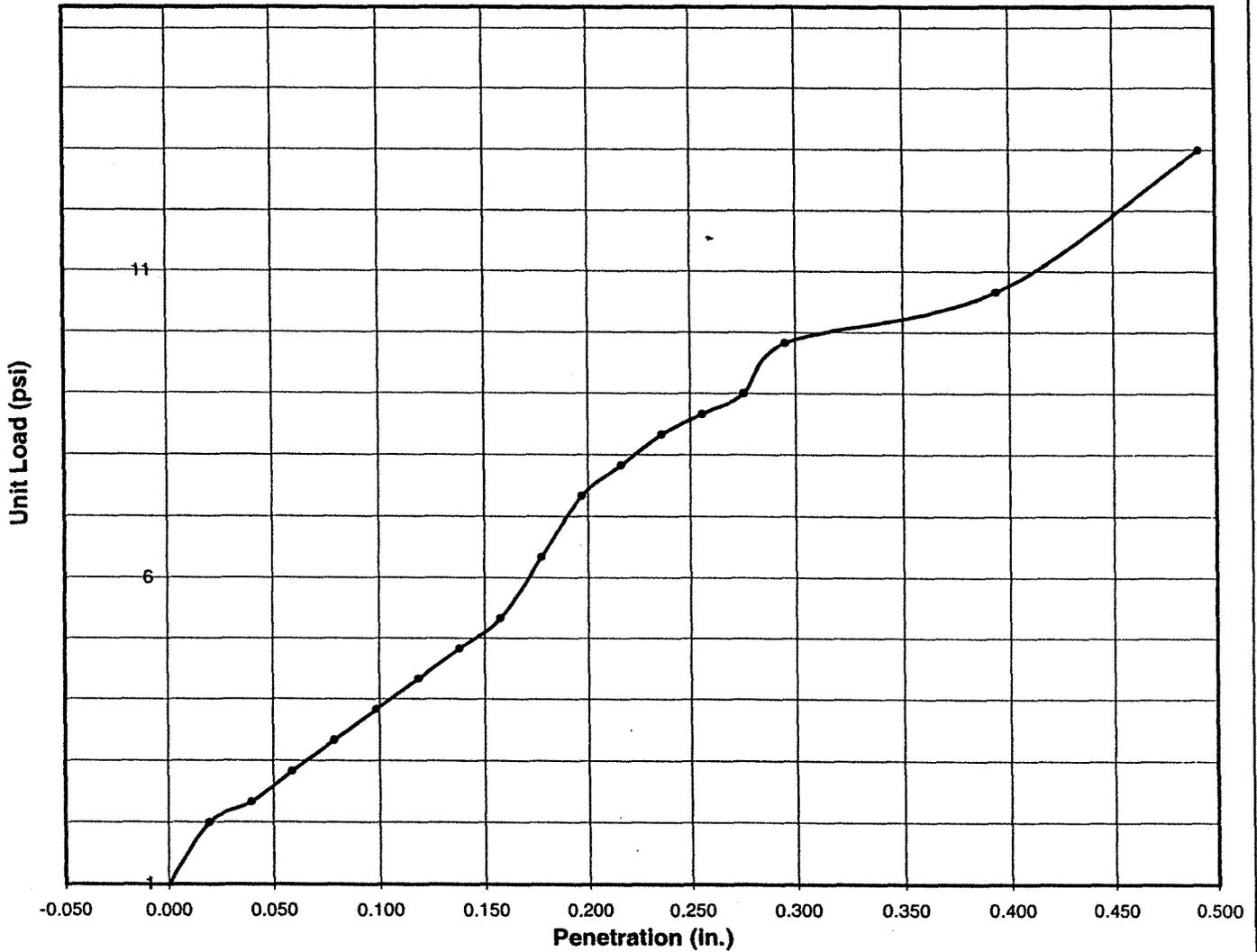


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Keokea Waiohuli Development
DHHL Agricultural Lots Subdivision Road Project
Keokea, Kula, Makawao, Maui, Hawaii

Date: July 2004 PROJECT NO. 24304.10

CBR CURVE



Sample Source: TP-18

Depth: 0-2

Description: Brown Silt (MH)
volcanic ash

	Before Expansion	After Expansion
Relative Compaction (%):	85.00%	85.09%
Moisture Content (%):	47.88%	49.03%
Dry Density (pcf):	69.73	69.77
Percent Swell or Expansion Value (%):	-0.06%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	0.35	
CBR Value @ 0.2" Corrected:	0.46	

Atterberg Limits

<u>LL</u>	<u>PL</u>	<u>PI</u>
51.50	44	7.5

CALIFORNIA BEARING RATIO ASTM D-1883-94



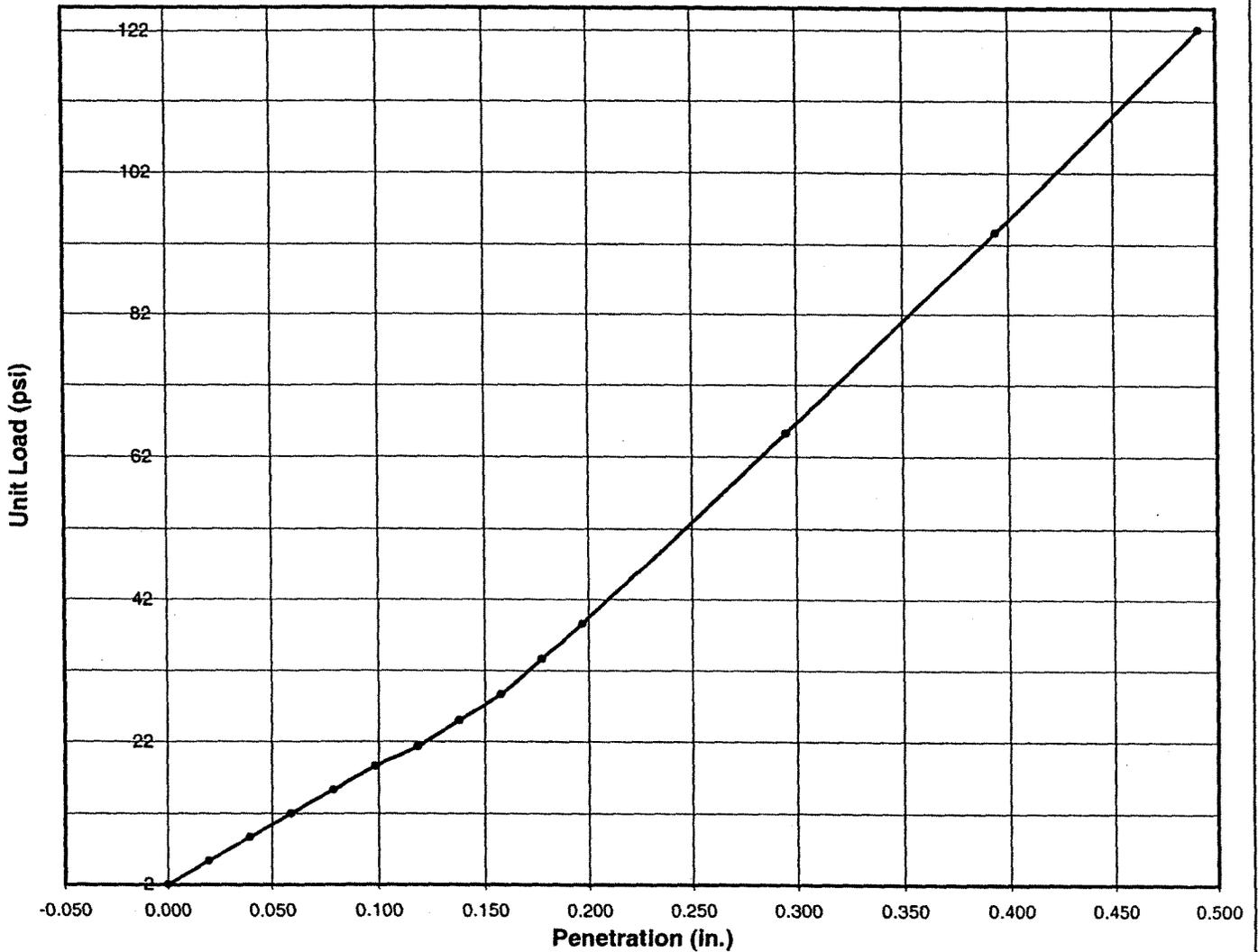
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DHHL Agricultural Lots Subdivision Road Project
Keokea, Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

CBR CURVE



Sample Source: TP-28

Depth: 0-2

Description: Brown Silt (MH)
volcanic ash

	Before Expansion	After Expansion
Relative Compaction (%):	94.60%	93.00%
Moisture Content (%):	52.72%	56.92%
Dry Density (pcf):	63.61	62.61
Percent Swell or Expansion Value (%):	1.69%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	1.9	
CBR Value @ 0.2" Corrected:	2.6	

Atterberg Limits

<u>LL</u>	<u>PL</u>	<u>PI</u>
62.00	60	2

**CALIFORNIA BEARING RATIO
ASTM D-1883-94**



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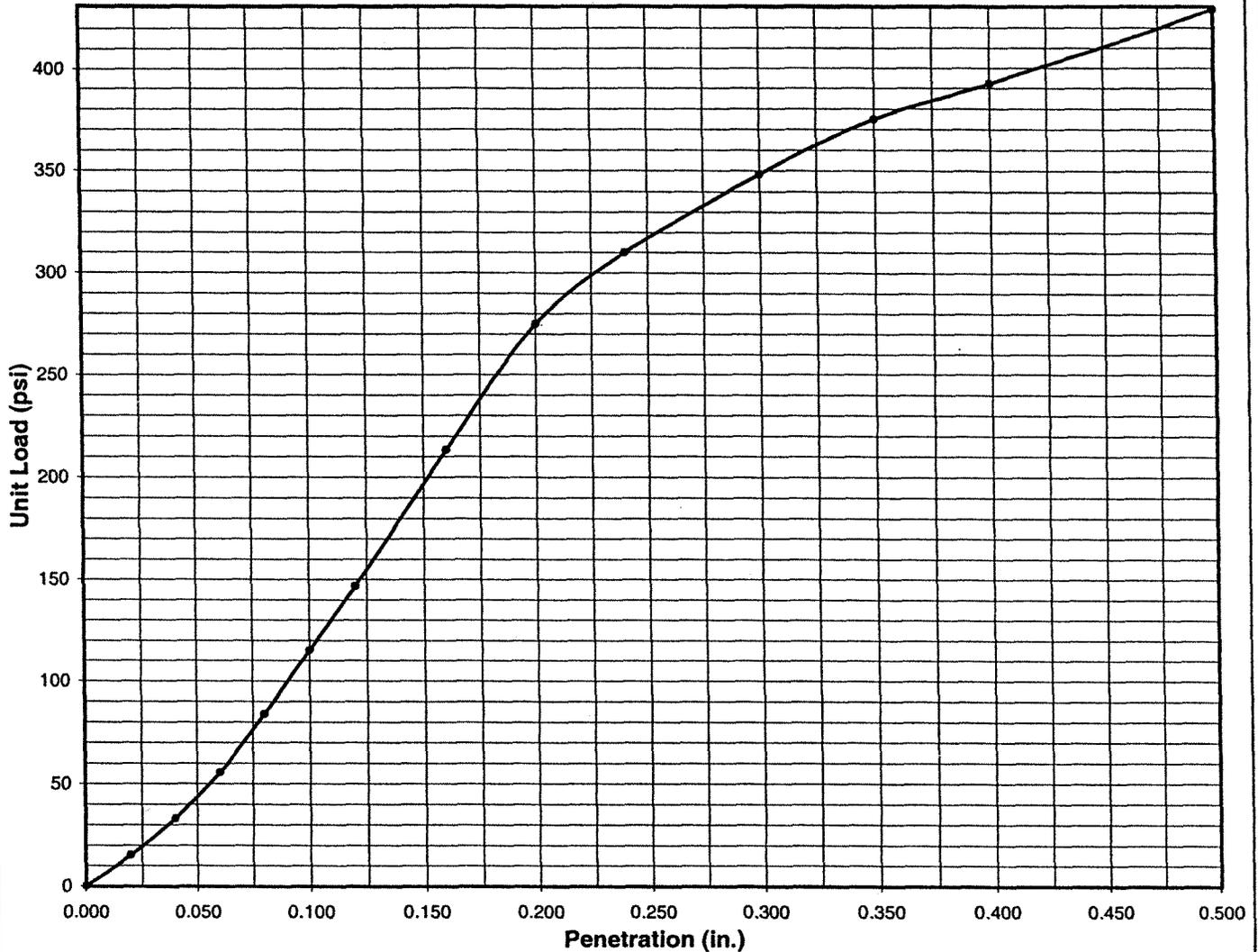
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DHHL Agricultural Lots Subdivision Road Project
Keokea, Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

CBR CURVE



Sample Source: TP-45

Depth: 0-5

Description: Brown Clayey Silt (MH)
with gravel, trace sand

	Before Expansion	After Expansion
Relative Compaction (%):	92.48%	92.34%
Moisture Content (%):	42.26%	43.42%
Dry Density (pcf):	80.27	80.14
Percent Swell or Expansion Value (%):	0.17%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	11.53	
CBR Value @ 0.2" Corrected:	18.33	

Atterberg Limits

LL PL PI

CALIFORNIA BEARING RATIO ASTM D-1883-94



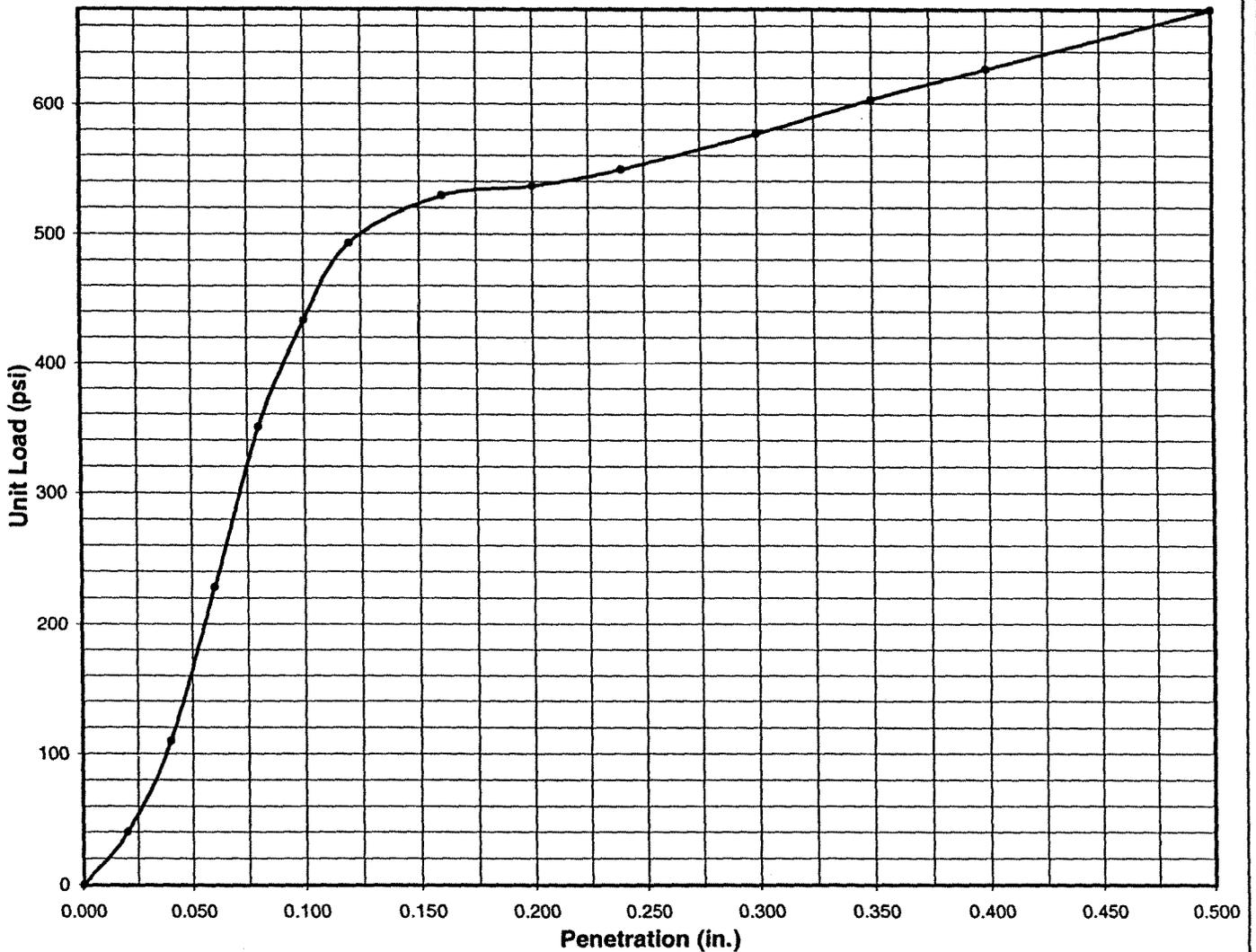
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Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

CBR CURVE



Sample Source: TP-47

Depth: 0-6

Description: Amber brown Silty Clay (CL-ML), with cobbles

	Before Expansion	After Expansion
Relative Compaction (%):	97.85%	97.44%
Moisture Content (%):	42.00%	43.69%
Dry Density (pcf):	78.83	78.50
Percent Swell or Expansion Value (%):	0.48%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	43.3	
CBR Value @ 0.2" Corrected:	35.77	

Atterberg Limits

LL PL PI

CALIFORNIA BEARING RATIO ASTM D-1883-94



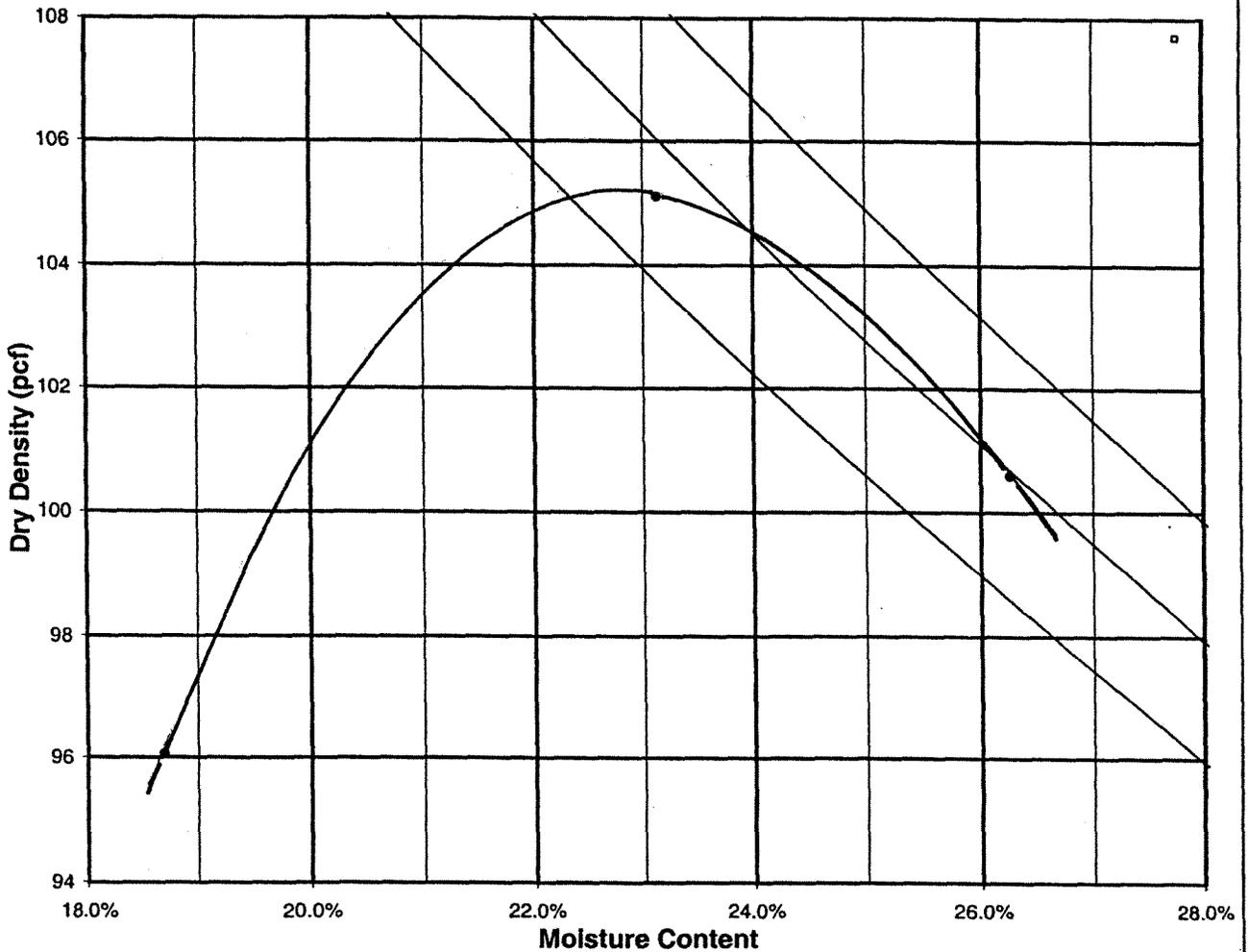
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Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-3 Borrow Area

Description: Dark brown to gray clayey SILT with tuffaceous gravel, cobbles, trace sand

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	114.01	129.4	127	
Moisture Content	18.69%	23.13%	26.26%	
Dry Density (pcf)	96.06	105.10	100.59	

Maximum Dry Density (pcf): 105.1
 Optimum Moisture Content (%): 23
 Test Method: ASTM D-1557

Atterberg Limits

LL

PL

PI

COMPACTION TEST RESULTS

ASTM D-1557



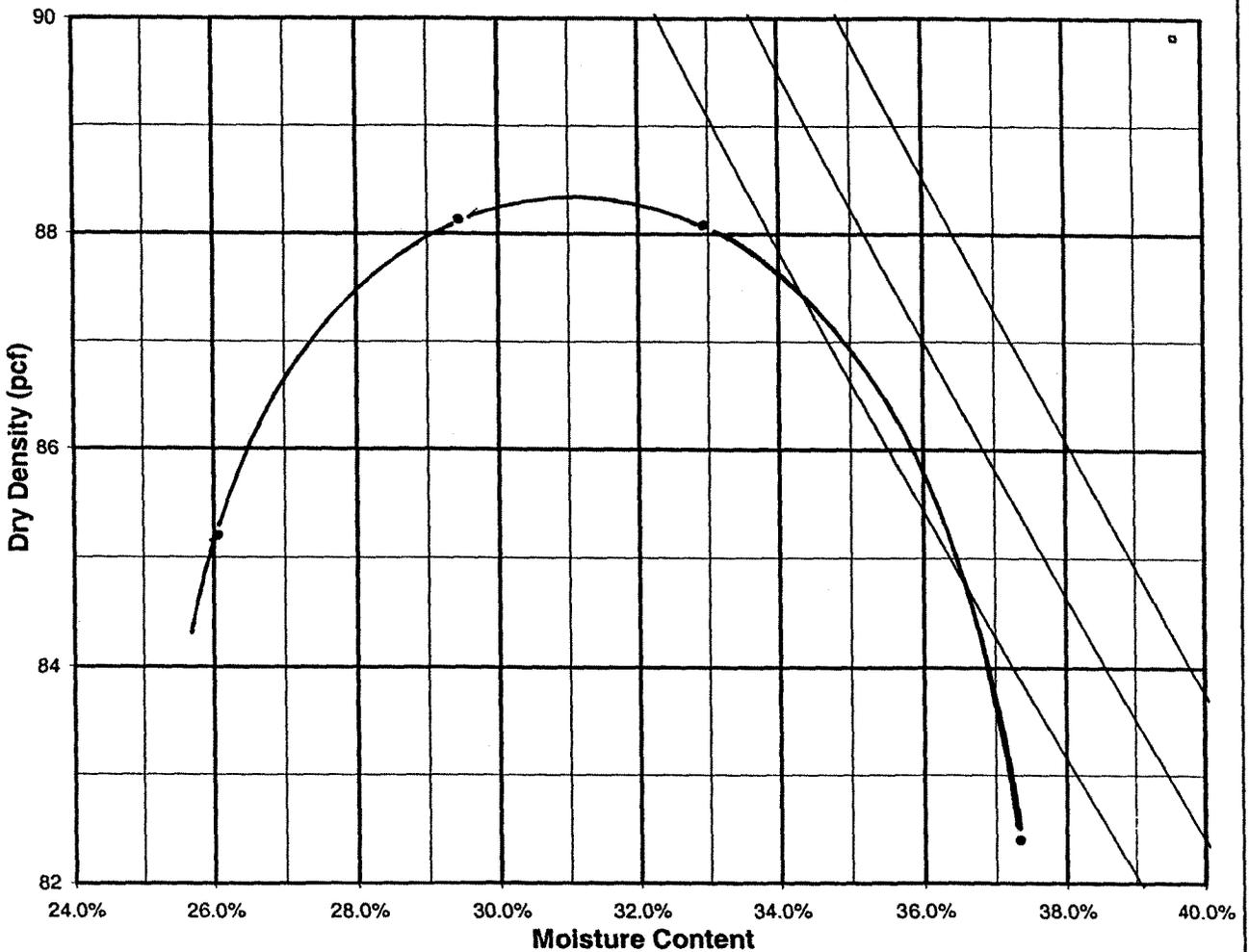
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Keokea/Waiohuli Development
 Proposed Agricultural Subdivision Borrow Site
 Kula, Makawao, Maui, Hawaii

Date: March 2005

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MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-6 Borrow Area

Description: Brown clayey SILT with cobbles

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	107.4	114.07	117.08	113.16
Moisture Content	26.06%	29.44%	32.93%	37.34%
Dry Density (pcf)	85.20	88.13	88.08	82.40

Maximum Dry Density (pcf): 88.1
 Optimum Moisture Content (%): 29.44
 Test Method: ASTM D-1557

Atterberg Limits
 LL PL PI

COMPACTION TEST RESULTS ASTM D-1557



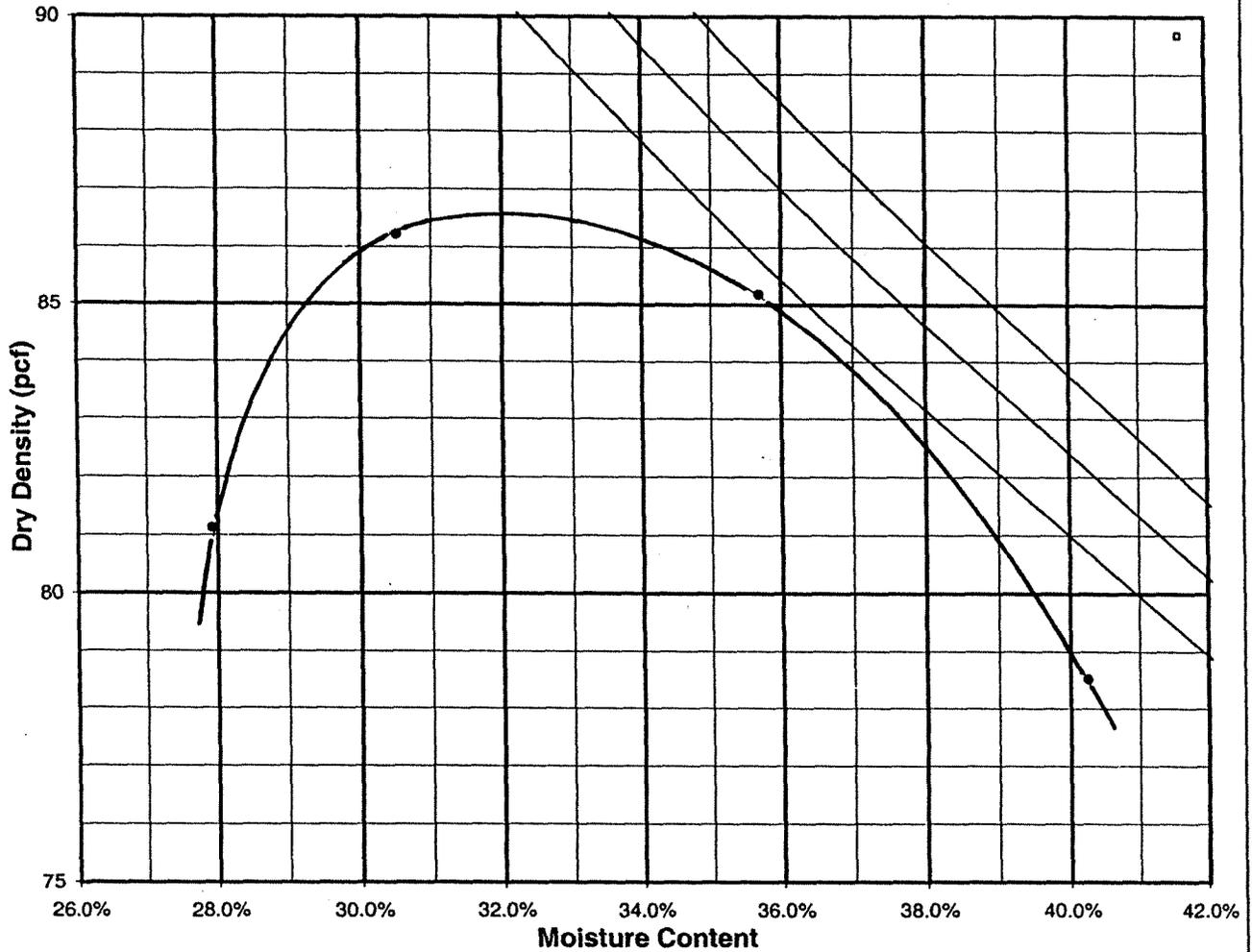
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 Proposed Agricultural Subdivision Bor. Site
 Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.11

MOISTURE-DENSITY RELATIONSHIP



Sample Source: TP-8 Borrow Area

Description: Brown clayey SILT with basaltic gravel and cobbles

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	103.78	112.51	115.58	110.12
Moisture Content	27.92%	30.51%	35.69%	40.25%
Dry Density (pcf)	81.13	86.21	85.18	78.52

Maximum Dry Density (pcf): 86.2
 Optimum Moisture Content (%): 30.5

Atterberg Limits

LL

PL

PI

Test Method: ASTM D-1557

COMPACTION TEST RESULTS ASTM D-1557



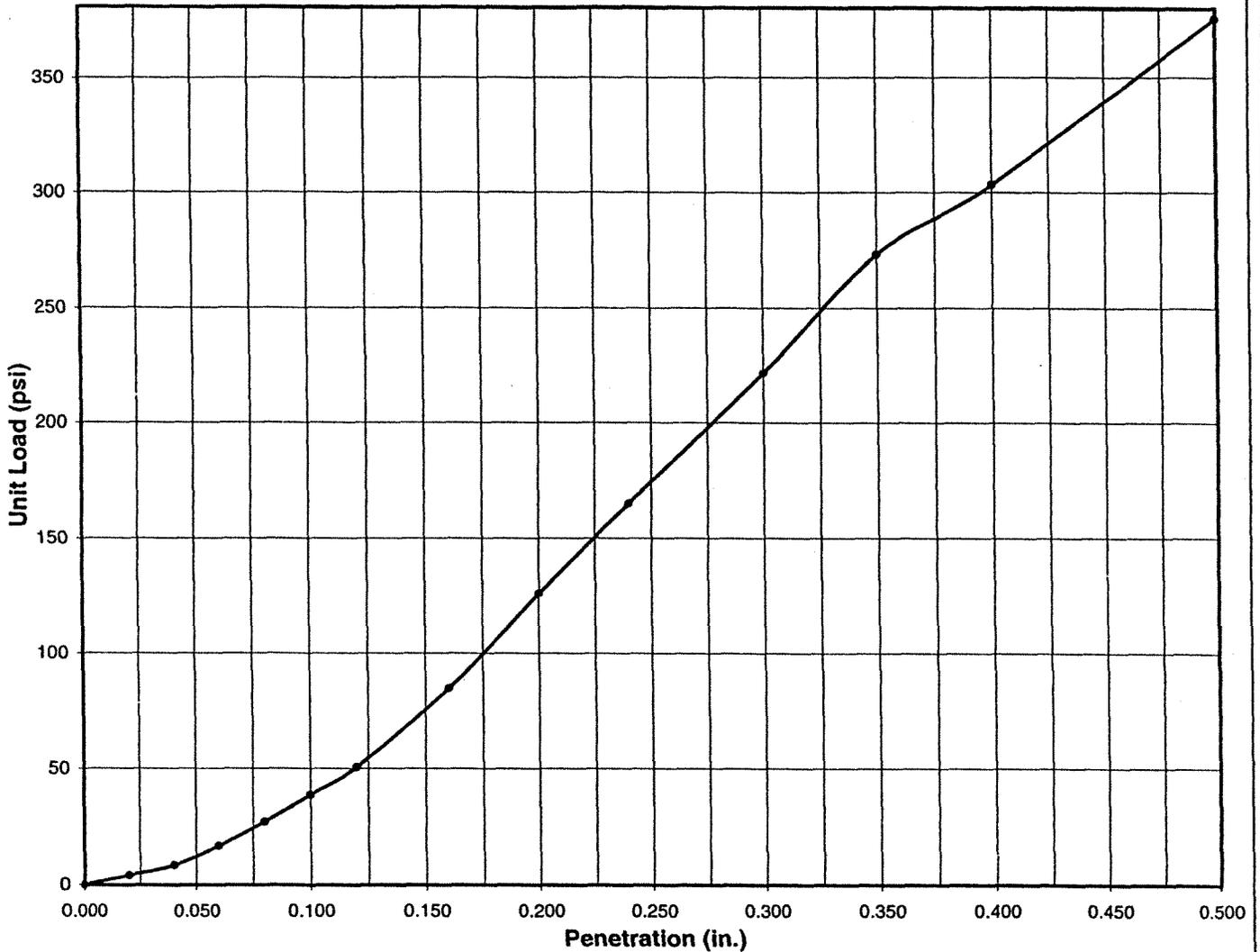
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Keokea/Waiohuli Development
 Proposed Agricultural Subdivision Borrow Site
 Kula, Makawao, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.11

CBR CURVE



Sample Source: Borrow Area

Depth: 0-6

Description: Brown silt with approx. 25% sandy gravel

	Before Expansion	After Expansion
Relative Compaction (%):		
Moisture Content (%):	28.21%	29.21%
Dry Density (pcf):	92.35	90.64
Percent Swell or Expansion Value (%):	0.76%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	3.867	
CBR Value @ 0.2" Corrected:	8.4	

Atterberg Limits

LL PL PI

CALIFORNIA BEARING RATIO ASTM D-1883-94



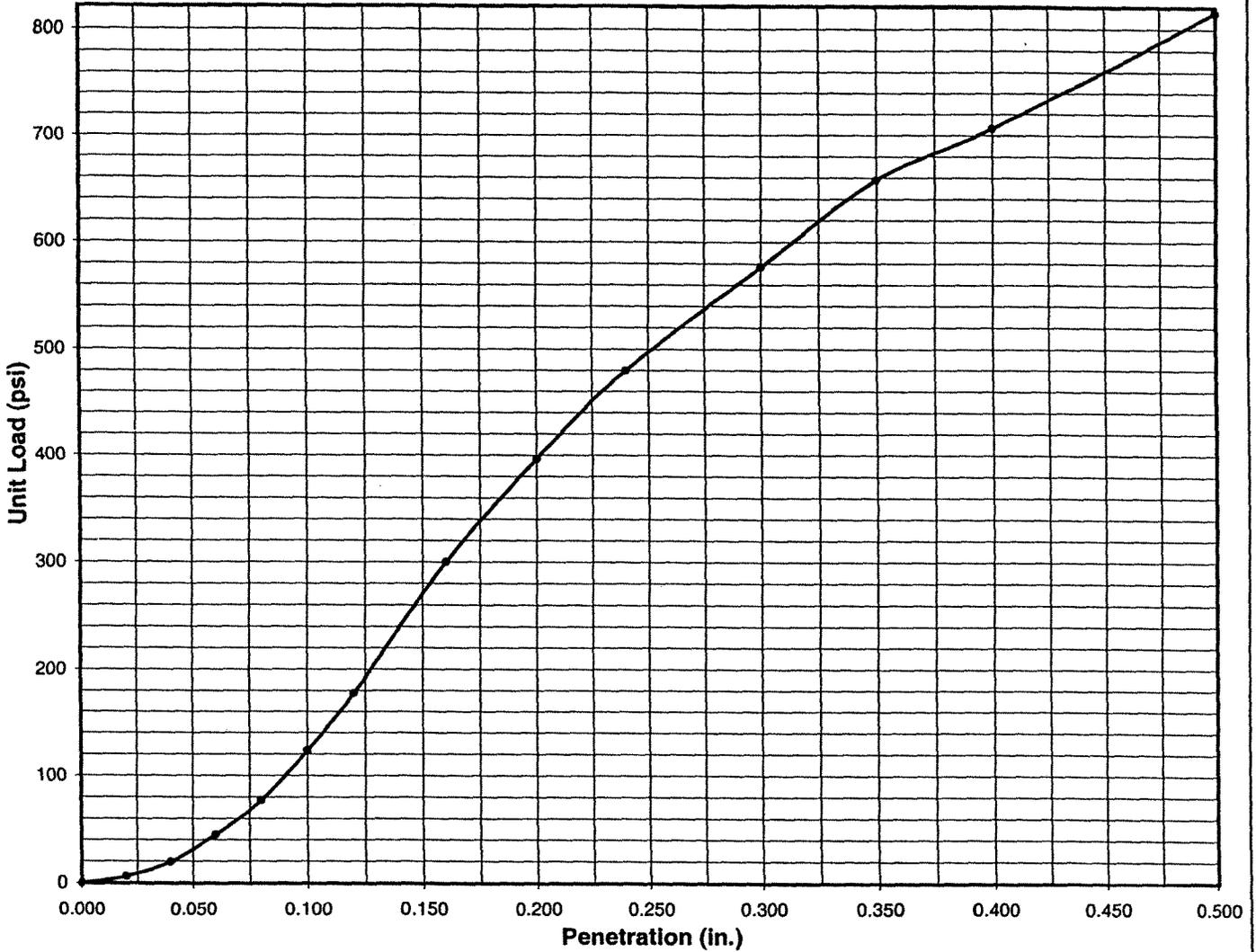
PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

CBR CURVE



Sample Source: Borrow Area

Depth: 0-6

Description: Brown silt with approx. 50% gravel and sand (ML-GW)

	Before Expansion	After Expansion
Relative Compaction (%):		
Moisture Content (%):	17.38%	22.85%
Dry Density (pcf):	105.03	104.15
Percent Swell or Expansion Value (%):	0.91%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	12.33	
CBR Value @ 0.2" Corrected:	26.44	

Atterberg Limits

LL PL PI

**CALIFORNIA BEARING RATIO
ASTM D-1883-94**



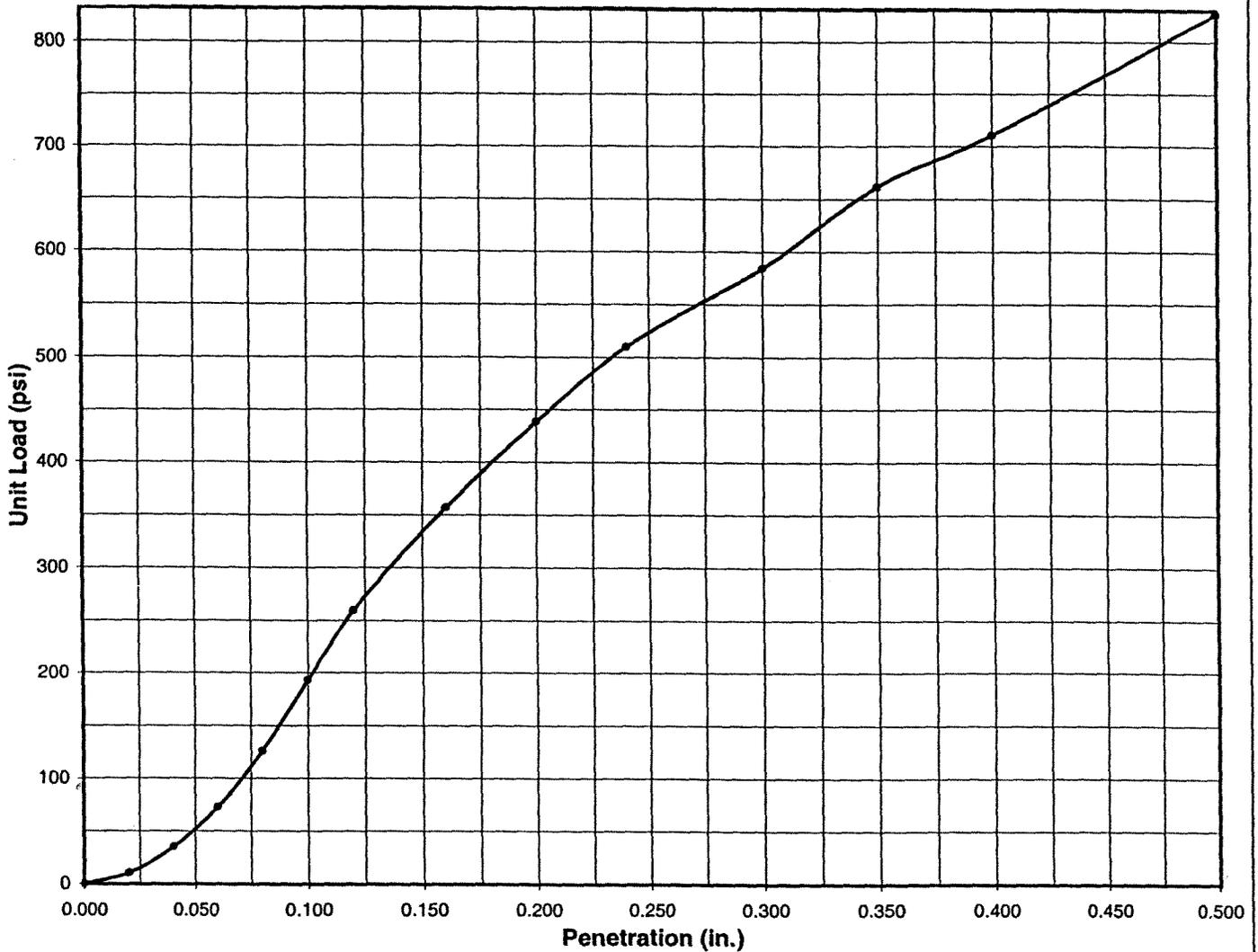
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Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005

PROJECT NO. 24304.10

CBR CURVE



Sample Source: Borrow Area

Depth: 0-6

Description: 50% Silt with approx. 50% gravel (ML-GP) Gravel > #4 and less than 3/4"

	Before Expansion	After Expansion
Relative Compaction (%):		
Moisture Content (%):	18.02%	23.52%
Dry Density (pcf):	102.20	101.44
Percent Swell or Expansion Value (%):	0.74%	
Compaction Test Method:	ASTM D-1557 A	
CBR Value @ 0.1" Corrected:	19.33	
CBR Value @ 0.2" Corrected:	29.22	

Atterberg Limits

LL PL PI

CALIFORNIA BEARING RATIO ASTM D-1883-94



PSC Consultants, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Development
DHHL Agricultural Subdivision Road System
Keokea, Maui, Hawaii

Date: March 2005

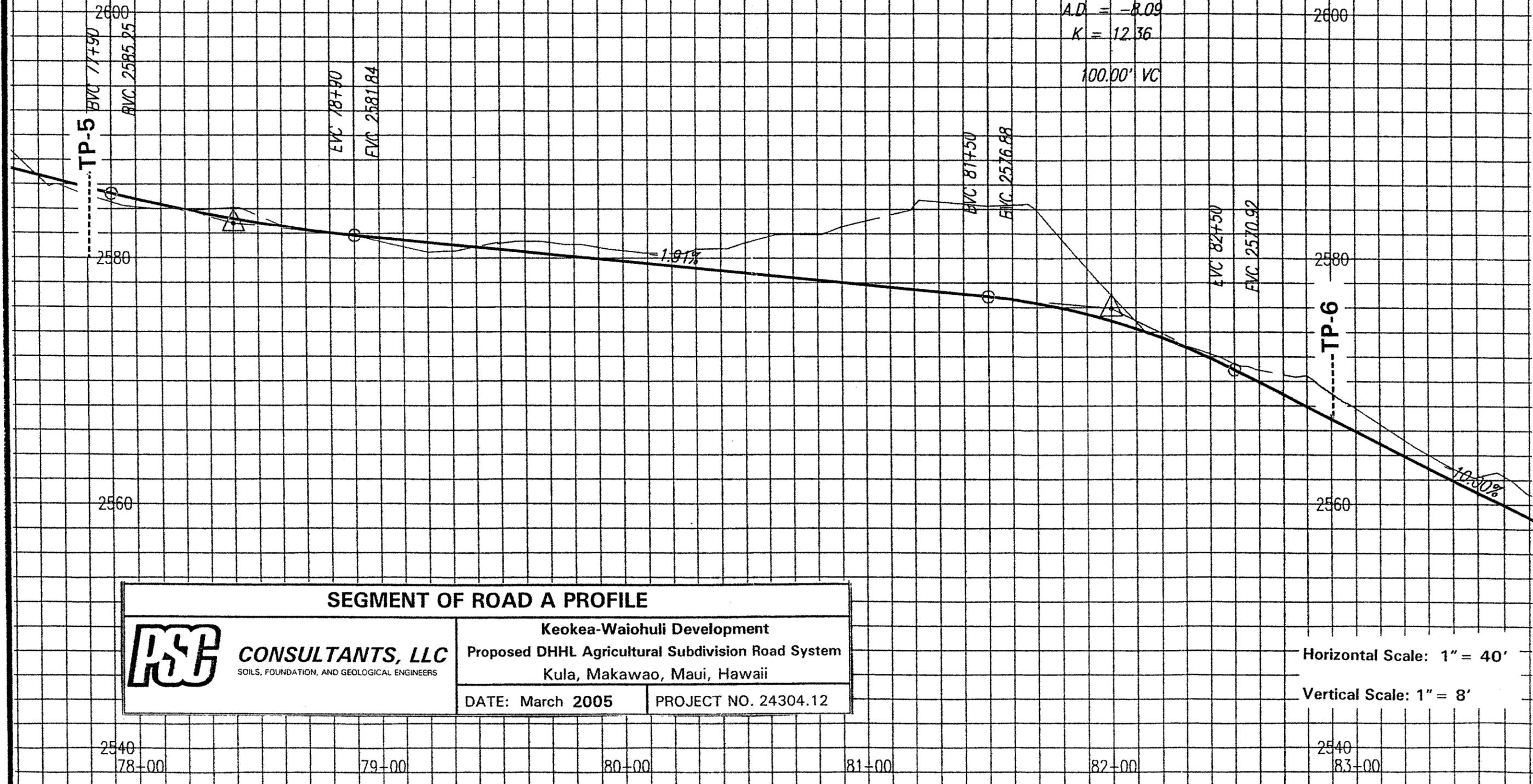
PROJECT NO. 24304.10

PVC STA = 78+40
 PVI ELEV = 2582.80
 A.D. = 2.99
 K = 33.49

100.00' VC

PVC STA = 82+00
 PVI ELEV = 2575.92
 A.D. = -8.09
 K = 12.36

100.00' VC



SEGMENT OF ROAD A PROFILE



Keokea-Waiohuli Development
 Proposed DHHL Agricultural Subdivision Road System
 Kula, Makawao, Maui, Hawaii
 DATE: March 2005 PROJECT NO. 24304.12

Horizontal Scale: 1" = 40'

Vertical Scale: 1" = 8'

Reference: Revised Road A Profile by CP&E (10/22/04)

**PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
KEOKEA-WAIOHULI SUBDIVISION PHASES 1, 2, and 4A
KULA, MAKAWAO, MAUI, HAWAII
TMK: (2) 2-2-002:14, 55 AND 71**

For:

Community Planning and Engineering, Inc.
1286 Queen Emma Street
Honolulu, Hawaii 96813

By:



Geotechnical • Environmental • Construction Management
Testing • Inspection • Drilling & Sampling

CORPORATE HEADQUARTERS
94-547 Ukee Street, Suite No. 210
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www.pscconsultants.com

**PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
KEOKEA-WAIOHULI SUBDIVISION PHASES 1, 2 AND 4A
KULA, MAKAWAO, MAUI, HAWAII
TMK: (2) 2-2-002:14, 55 and 71**

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**PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
KEOKEA-WAIOHULI SUBDIVISION PHASES 1, 2 and 4A
KULA, MAKAWAO, MAUI, HAWAII
TMK: (2) 2-2-002:14, 55 and 71**

April 05, 2013

PSC Job No. 212302.20

SUMMARY OF FINDINGS AND RECOMMENDATIONS

The project site includes the future construction at Phases 1, 2 and 4A within the Keokea-Waiohuli Development on the western slopes of Mount Haleakala. Phase 1 has been constructed and the future construction will cover grading work for drainage and lot boundary shifts at some lots. Phase 2 covers construction at Roads H, J and extension of Road E, and includes about 70 lots. Phase 4A covers Road M and includes about 25 lots.

The area is underlain by volcanic flows of basaltic andesite, andesitic basalt and picritic basalt geologically termed as the Kula volcanic series. Sections of the subdivision within the Kula Volcanic series will encounter volcanic ash generally intermixed with vitric tuffaceous gravels, cobbles and boulders of varying proportions (vitric) on top of the andesitic basalts. The surface soils range in thickness from 0 to more than 8 feet in some locations. The Kula volcanic ash by itself is not suitable for engineered fills due to its low density, weak strength and high natural moisture content. The surface soils are generally classified as silt (MH) based on the Unified Soil Classification System, and when dry are prone to wind and water erosion. Laboratory tests from the previous preliminary geotechnical exploration for roadways show that these silts near ground surface, a silt/volcanic ash soil, generally have relatively low dry densities and do not provide adequate support for the proposed road.

To achieve a relatively uniform support under the roadway and culvert foundations, it is recommended that the soft or loose silt/ash soils be excavated down to 2 feet below the design/finish subgrade or until stiff to very stiff silt or gravelly materials are exposed. The silt/ash soils should then be replaced with non-expansive, select fill material.

This report supplements the Geotechnical Exploration Report of Typical Foundations on Certain Lots at Keokea-Waiohuli Development dated April 30, 2007, and Preliminary Geotechnical Exploration Report for the Keokea-Waiohuli Development dated March 31, 2005 by PSC Consultants, LLC.

INTRODUCTION

This report presents the results of our geotechnical exploration and survey to develop typical roadway, general grading and drainage recommendations for the proposed Keokea-Waiohuli Development for Phases 1, 2 and 4A located at Keokea and Waiohuli, Maui, Hawaii. The general location and vicinity of the project site is shown on the Project Location Map, Plate 1.



Our work on the project was performed in general accordance with our proposal and scope of work dated May 4, 2012. This report summarizes our findings and recommendations.

PROJECT CONSIDERATIONS

The project site is within the partially completed Keokea-Waiohuli Development located along the western slopes of Mount Haleakala west of Kula Highway Route 37 opposite Keokea Park. The terrain within the undeveloped area is steep to moderate and rough with boulders, cinder flows and rock outcrops. The majority of the study area, particularly the southern half of the site, is covered with vegetation consisting of groves of haole koa trees, giant cacti and grass. The northern half of the site contains fewer trees and was previously used as pasture or graze land. The site generally slopes downward in a western direction from Kula Highway. The proposed new construction includes approximately 95 lots and Roads H, J and M, and extension of Road E. Roads A, D and most of Road E were completed by a previous construction contract. This area is shown in Plate 3, Site Plan - Roads.

The previous reports by PSC Consultants revealed that the surface soil in the areas studied consisted of light brown to brown clayey silt with gravel and cobbles. This soil has high insitu moisture content and low dry density, and in the dry and uncompacted state, exhibits little or no cohesion and becomes highly susceptible to erosion from both wind and water. A dense and weathered basalt formation is present as occasional outcroppings and under the surface soils. Volcanic ash pockets are present, and this ash is characterized by poor workability, and in its dry state, becomes very loose.

The volcanic ash derived soil, in its pure form, is not recommended for engineered fill or for road embankment unless it is reconstituted with granular material. A recommended grading scheme consists of removing 2 feet of the surface volcanic ash soil material below the design subgrade where ash is encountered and replacing these with borrow fill of non-expansive granular capping material to support the roadway pavement structure.

A borrow area designated as a stockpile site is located at the northwestern lower end of the construction site. This area was a former borrow site (Plate 2) and will be used as a source of general fill material and as disposal area for the unsuitable soils that will be removed from the roadway construction site.

The excavation and embankment quantities for the new construction were not available but is expected to balance. We anticipate that asphaltic concrete pavements and or concrete pavements will be required for Roads H, J and M, and Road E extension. While specific traffic loading has not been specified, we anticipate a medium vehicle loading for the project consisting primarily of passenger vehicles and delivery trucks.



PURPOSE AND SCOPE

The purpose of our geotechnical exploration and survey is to gather information on the nature, distribution and characteristics of the near surface soils encountered for the new roads and to provide grading and pavement recommendations for the proposed roads. The scope of our exploration consisted of the following tasks and work efforts:

1. Review of the existing available data from published and unpublished sources pertaining to the geology and soil conditions at the site and conduct a reconnaissance survey of the project site;
2. Schedule the field exploration and coordinate with Community Planning and Engineering, Inc. (CPE) for the test pit locations and site access;
3. Coordinate field exploration and logging of the test pits by a field engineer;
4. Excavate 9 test pits, 1 to 5 feet deep, with use of backhoe, approximately 400 feet apart (including test pits and borings under the March 2005 report) along Roads H, J and M, Road E extension and at the stockpile site, and collect surface bulk samples for classification and CBR tests for pavement design;
5. Classify the materials encountered and to evaluate their engineering properties relative to their intended use by laboratory testing of select soil samples obtained from the field. Also conduct CBR tests to determine their suitability for pavement support;
6. Mobilization and demobilization of drilling/excavating equipment and operators; and
7. Preparation of this report summarizing our work on the project and presenting our findings and recommendations.

SUBSURFACE CONDITIONS

Project Site Geology

The project site is underlain mainly by volcanic flows of basaltic andesite, andesitic basalt and picritic basalt, geologically termed as the Kula volcanic series. These volcanic flows are covered with a surface layer of volcanic ash derived silt sometimes intermixed with tuffaceous gravels, cobbles and boulders (weathered tuff) generally described as Kula Loam in the majority of the study area. These surface soils range in thickness from surface outcroppings of basaltic rock to more than 4 feet in some locations. The ash material is generally not suitable for pavement and foundation support, and for embankment fill.

Subdivision Road Alignment

The proposed road network will generally traverse over volcanic-ash derived silt materials with varying amounts of gravels, cobbles and boulders. The thickness of the surface soil layer ranges from 1- to about 8-feet deep.



Plate 3 shows location of existing roads adjoining the proposed roads.

Road H

Road "H" is about 2,000 feet in length and connects Road E extension to existing Road F. Two test pits, TP-4 and TP-9 (Plates 8 and 13), were excavated along this road and encountered a basalt layer at about 4 feet and 2 feet below ground elevation, respectively.

Road J

Road J runs parallel to existing Road F and is located at the west side of subdivision, about 1900 feet in length, connecting Road E extension with existing Road D. Test pits 5 and 6 (Plates 9 and 10) encountered a basalt layer at about 2 feet and 4 feet below ground level, respectively.

Road M

Road M is located at the east side of subdivision about 2500 feet in length, connects to Road E at the north side of Road M and connects to Road A at the south side. Test pits 1 and 2 (Plates 5 and 6), both encountering basalt layers at about 4 feet below ground level.

Road E Extension

Road E extension is located at the west side of the subdivision and extends west from existing Road E approximately 600 feet. Test pit 3 (Plate 7) at intersection of Road E and H shows a basalt layer at 2 feet below ground level.

Borrow/Stockpile Site

The designated borrow/stockpile site is located in an area about 1600 feet north of proposed Road J. This site was a former borrow area covered in PSC report dated March 2005 with ten borings and was used as a borrow area for engineered fill material during the construction of Keokea-Waiohuli Development in 2006-2008. Test pits 7 and 8 (Plates 11 and 12) were excavated in the stockpile area.

Currently, this area is a stockpile area about 10 feet high. Test Pits 7 and 8 were excavated to observe the type of material within the stockpile area. Test Pit 7 was dug at the southern corner below Waiohuli Detention Basin No. 1 and encountered 6.5 feet of gravelly silt over basalt. Test Pit 8 was dug on the northern corner of the Borrow/Stockpile site and encountered about 7 feet of silty gravel underlain by basalt. Based on the materials encountered at the test pits, the materials at the stockpile area are suitable for use as general fill. Any unsuitable materials, if encountered, should not be used as general fill.

DISCUSSION AND RECOMMENDATIONS

General

Our field exploration and visual mapping indicated that volcanic ash derived silt soil, also known as Kula Loam, generally cover the project site, occasionally with varying amounts of gravel, cobbles and boulders. Occasional basaltic rock outcrops are also common. The thickness of surface soil ranges from approximately a few inches to more than 8 feet in some locations



throughout the project site. These silt soils contain relatively high amounts of moisture. In a dry state, it loses cohesive strength and becomes prone to wind and water erosion. Our field exploration also showed that a large part of the soil overburden within the study area contained considerable amounts of coarse materials such as tuffaceous/basaltic gravels, cobbles and boulders. In some areas the coarse materials exceeded the fines. These overburden materials are underlain with fresh to moderately weathered andesitic basaltic flows known as Kula volcanic series.

Site Preparation

At the onset of earthwork, the area within the contract grading limits should be cleared of trees, vegetation, debris, rubbish, boulders and other deleterious materials. These materials should be removed and properly disposed of off-site.

Areas to receive fill (such as at silt, silty gravels and gravelly silt areas) are to be over-excavated down 2 feet, and scarified to a depth of 6 inches. The subgrade should then be moisture conditioned to about 2 percent above optimum moisture content and recompacted to a minimum of 90 percent of its maximum dry density as determined in accordance with ASTM Test Method D1557-78. Soft or yielding areas should be over-excavated to expose firm soil surface and stabilized by backfilling with select material placed in 8-inch thick loose lifts and compacted to 90 percent of its maximum dry density.

Site Grading

General

Currently, numerous boulders, rock outcrops and groves of haole koa trees abound at the site. The boulders may be stockpiled for future use, such as for rip rap, gravity walls, landscaping and other such purposes.

Materials used for fills placed within the upper 2 feet of the embankments should be select non-expansive material less than 3 inches in maximum dimension. If additional off site borrow soil is required, it should be tested and approved by a geotechnical engineer prior to its delivery to the project site.

Earthwork and Grading

Soft or loose unsuitable silt/volcanic ash soils encountered within the roadways should be stripped to a depth of at least 2 feet below grade or until stiff to very stiff or gravelly materials are encountered, and replaced with select granular material. Where the design subgrade encounters silty gravel, gravelly silt with cobbles, and boulders or weathered basalt, over excavation will not be necessary. After grading, scarification and proof rolling, the subbase and base course may be placed directly on top of these gravelly insitu materials. If the clinker gravel is covered in volcanic ash matrix, the use of a geofabric, such as Mirafi 140, is recommended to prevent contamination of the select borrow fill or subbase. Where fresh basalt rocks are encountered, the subbase course may be placed directly over the basalt rocks after grading.



Over Excavation

Some of the existing upper silt/volcanic ash soils do not contain, or have very little percentage of coarse material and are not suitable for support of roadways, house pads and driveways. These soils are porous (susceptible to collapse/settle with increased water content), have a relatively low dry density, are prone to erosion, and should be over-excavated and replaced with select onsite granular soils or borrow. The silt/volcanic ash should be over excavated down to at least 2 feet or until stiff to very stiff or dense gravelly materials are encountered, and replaced with select granular materials.

Fill Placement and Compaction

The fill should be placed in level lifts with a maximum loose thickness of 8-inches and compacted to a minimum of 90 percent at house pads and 95 percent at driveways. Each layer should be spread uniformly and processed to attain uniformity of the material and water content. Additional fill material should not be placed on any fill layer which has not been properly compacted and tested.

Lava tubes, if encountered, should be filled with select granular material.

Boulder Fills

Many surface boulders were noted around the site. In addition, a large quantity of boulders will be generated from excavation operations. Boulders at the surface and in the excavations may be used in the deeper fills, provided that the following recommendations are followed:

1. Boulders must not be nested together and should be placed so that compaction equipment is able to suitably compact the soil around them. Boulder placement and compaction should be reviewed and monitored by a geotechnical engineer;
2. Boulders, 6" plus size rocks, can be used below 5 feet from finish grade or below utility lines whichever is at the greater depth; and
3. Care must be exercised to avoid placement of boulders in proposed utility alignments to prevent difficulty in later excavations of utility trenches.

Slopes

Cut and fill slopes of 2H:1V (horizontal to vertical) may be used. This is based on the assumption that cut slopes have a high percentage of gravels and cobbles and the fill slopes will be constructed of select material.

Steeper cut slope ratios up to 1H:1V may be used in weathered basalt formations.

Fill slopes should be constructed by overfilling 2 to 3 feet, then cutting back to the design slope to obtain a well-compacted slope face.

Where the existing ground is steeper than five horizontal to one vertical (5H:1V), keying and benching are required to properly bond the new fill to the slope. The filling



operations should start at the lowest point and continue up in level compacted layers, as recommended above.

Water should be diverted away from the tops of slopes and slope planting should be implemented to minimize surface erosion.

Pavements

We anticipate that asphaltic concrete pavements will be required for the roadways in the subdivision and while specific traffic loading has not been specified, we anticipate a medium vehicle loading for the project consisting primarily of passenger vehicles and delivery trucks. We have made our preliminary pavement design assuming the pavement subgrade soil will consist of compacted tuffaceous, basaltic/andesitic fill materials with a minimum CBR value of 25. The fill material within 2 feet below the pavement subgrade should be compacted to 95 percent relative compaction. Based on the above assumptions, we recommend the following flexible and rigid pavement sections be used for preliminary design purposes:

Flexible Pavement Section

2-Inches	Asphaltic Concrete
6-Inches	Aggregate Base Course
<u>6-Inches</u>	<u>Aggregate Subbase Course</u>
14-Inches	Total Pavement thickness on a minimum of 2 feet of properly compacted select borrow material or insitu basaltic/andesitic rock formation.

Rigid Pavement Section

6-Inches	Concrete
<u>6-Inches</u>	<u>Aggregate Subbase Course</u>
12-Inches	Total Thickness

The base course should be compacted to 95 percent of its maximum dry density as determined in accordance with ASTM Test Method D 1557-91.

CBR and density test and/or field observations should be performed on the actual subgrade used for the road construction to confirm the adequacy of the above pavement sections. The recommended pavement sections assume that adequate drainage will be provided.

Service Roads

Surface topping will be 3" minus select material. Where dense rocks and cobbles are present, the select material will be placed on the rock/cobble surface. If silt is present on dense rocks and cobbles, the silt should be cleaned from the rocks and cobbles. At silt areas, roadway should be cleared to 12" below service road finish grade and select material placed to 12" thickness. Select material should be rolled to provide a compacted smooth surface.



Road Drainage

Subdrains should be provided where there is a possibility that runoff from rainfall or irrigation could saturate the subsurface soils. Exposed surface soils should be protected from erosive runoff by providing surface drains, diversion berms and other flood control devices. The access of water into the roadbed soil under the pavement should be minimized in order to stabilize the moisture content as by incorporating water inhibiting membrane into the design as described in Item 1.21.1-d of the DOT Pavement Design Manual (Rev. March 2002).

Utility Trenches

We envision that utility lines will be required for the proposed subdivision road project. A granular bedding consisting of 6 inches of No. 3B Fine gravel is recommended under the pipes. Free draining granular materials, such as No. 3B Fine gravel (ASTM C 33, No. 67 gradation), should also be used for the trench backfill, up to about 12 inches above the pipes to provide adequate support around the pipes and compaction of the No. 3B fine gravel should be lowered to reduce potential for damage to the pipes.

The upper portion of the trench backfill from 1-foot above the pipes to the top of the subgrade or finished grade should consist of select granular material. The backfill should be moisture conditioned, placed in maximum 8-inch, level, loose lifts and mechanically compacted to not less than 90 percent relative compaction to reduce the potential for future ground subsidence. Where trenches are below pavement areas, the upper 2 feet of the trench backfill below the pavement finish grade should be compacted to 95 percent relative compaction.

Design Review

Drawings and specifications for the proposed construction should be submitted to PSC Consultants, LLC, as geotechnical consultant, for review and written comments prior to construction. This review is needed to evaluate adherence of the plans to the recommendations provided herein. If this review is not made, PSC cannot assume responsibility for the interpretations made by others or errors resulting there from.

Construction Observation and Testing

The recommendations provided in this report are based on subsurface conditions disclosed by widely spaced exploratory borings and excavations. The geotechnical consultant should check the interpolated subsurface conditions during construction. The geotechnical consultant should attend the pre-construction meeting between the contractors and owners/designers.

During grading, the geotechnical consultant should;

- ❖ Observe excavation, placement and compaction of engineered fill for the road pavement structures;
- ❖ Observe preparation and compaction of aggregate base for asphalt/concrete pavement and flatwork subgrade;
- ❖ Check and test any imported materials prior to their use as fill;



- ❖ Perform field tests to evaluate fill compaction;
- ❖ Observe subgrade conditions at the bottom of pipeline trenches;
- ❖ Observe fill placement and compaction around the pipes in the utility trenches; and
- ❖ Observe the fine-grading and exterior drainage improvements constructed around the finished structures.

The recommendations provided in this report assume that PSC will be retained as the geotechnical consultant during the construction phase of the project. If another geotechnical consultant is selected, we request that the selected consultant provide a letter to the architect/designer and owner/client (with a copy to PSC) indicating that they fully understand our recommendations and that they are in full agreement with the recommendations contained in this report. If deviations from soil conditions and recommendations presented in this report occur, they should provide amended recommendations as new geotechnical consultants of record for the project.

LIMITATIONS

The analyses and recommendations submitted in this report are based, in part, upon information obtained from field test pits and visual observations. Variations of subsoil conditions between the test pits may occur, and the nature and extent of these variations may not become evident until construction is underway. If variations then appear evident, it will be necessary to reevaluate the recommendations provided in this report.

The test pit locations were selected by PSC Consultants LLC, by taping existing features and structures shown on the plans available. The physical locations and elevations should be considered accurate only to the degree implied by the method used.

This report has been prepared for the exclusive use of Community Planning and Engineering, Inc., their client and their consultants for specific application to the proposed Keokea-Waiohuli Development Phases 1, 2 and 4A in accordance with generally accepted geotechnical engineering principles and practices. No warranty is expressed or implied.

This report has been prepared solely for the purpose of assisting Community Planning and Engineering, Inc. in the design evaluation of the proposed project. Therefore, it may not contain sufficient data or proper information to serve as the basis for preparation of construction documents and cost estimates for a roadway or lot construction. A contractor wishing to bid on this project is urged to retain a competent geotechnical engineer to assist in the interpretation of this report and/or in the performance of additional site-specific exploration for bid estimating purposes.



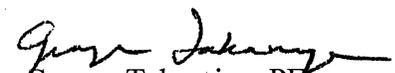
The owner/client should be aware that unanticipated soil/rock conditions are commonly encountered. Unforeseen soil/rock conditions, such as soft deposits, hard layers or cavities, may occur in localized areas and may require probing or corrections in the field (which may result in construction delays) to attain a properly constructed project. Therefore, a sufficient contingency fund is recommended to accommodate these extra costs.

The findings in this report are valid as of the present date. However, changes in the soil conditions can occur with the passage of time whether they are due to natural processes or to the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards occur, whether they result from legislation, or from the broadening of knowledge. Accordingly, the findings in this report might be invalidated, wholly or partially, by changes outside of our control. Therefore, this report is subject to review by the controlling agencies and is valid for a period of 2 years.

Respectfully submitted,
PSC CONSULTANTS, LLC


Derrick Chan
Project Engineer



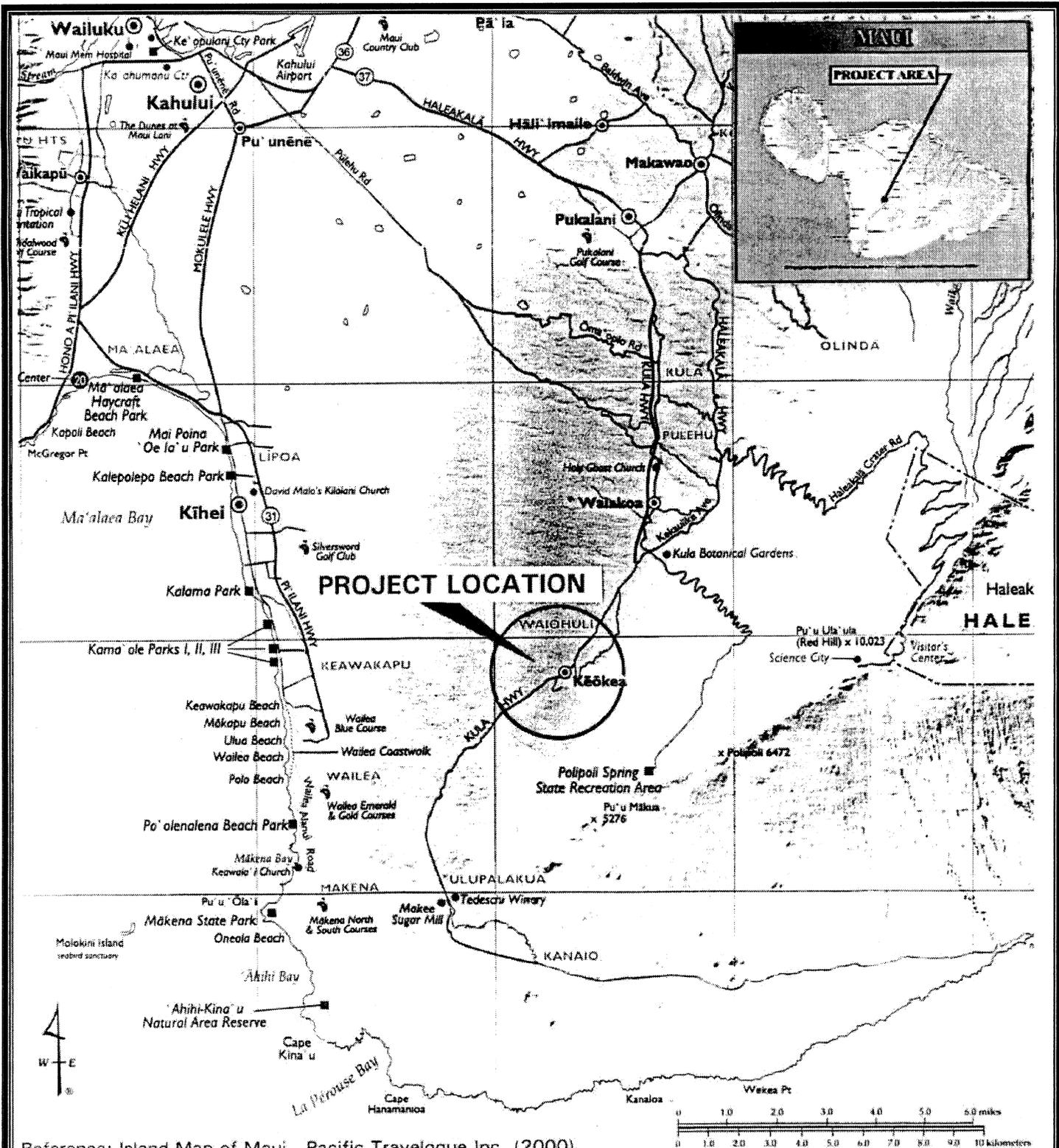

George Takamiya, PE
Senior Engineer

This work was prepared by
me or under my supervision
(License Expires April 2014)

DC/GT/PSC:lk

Enclosures:	Plate 1	Project Location Map
	Plate 2	Site Plan
	Plate 3	Site Plan - Roads
	Plate 4	Site Plan - Borrow/Stockpile Site
	Plates 5 through 13	Log of Boring (TP1 through TP9)
	Plate 14	Unified Soil Classification System
	Plate 15	Rock Classification System
	Plates 16 through 19	Compaction Test Results – ASTM D1557
	Plate 20	California Bearing Ratio – ASTM D1883
	Plates 20A through 20C	California Bearing Ratio – ASTM D1883-94
	Plate 21	Grain Size Distribution
	Plates 22 through 25	Sieve Analysis – ASTM D422-63
	Plate 26	Atterberg Limits Data





Reference: Island Map of Maui, Pacific Travelogue Inc. (2000)

PROJECT LOCATION MAP

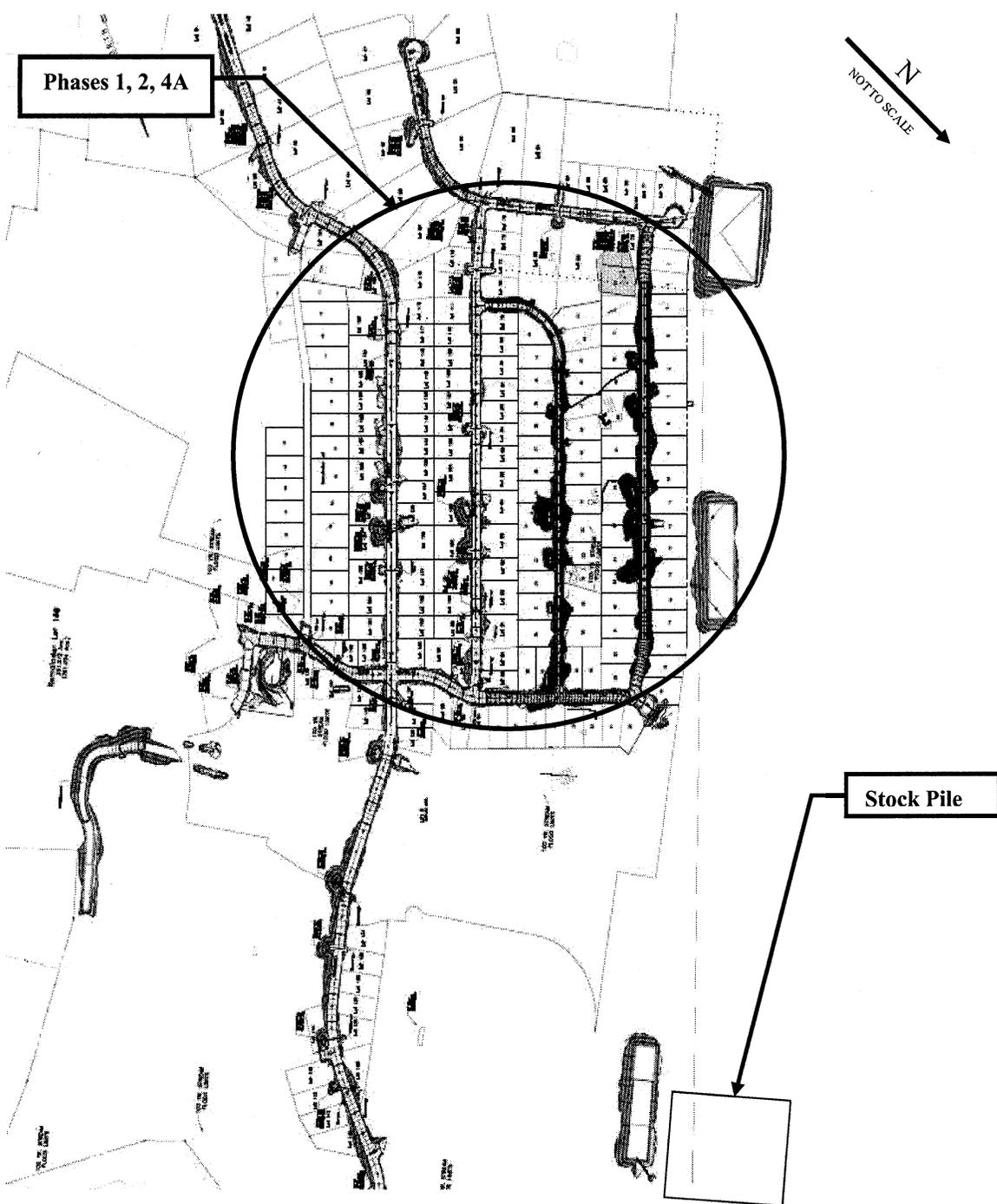


CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013

PROJECT NO. 212302.20



Reference: CPE Site plan of Phases 1, 2, 4A

SITE PLAN

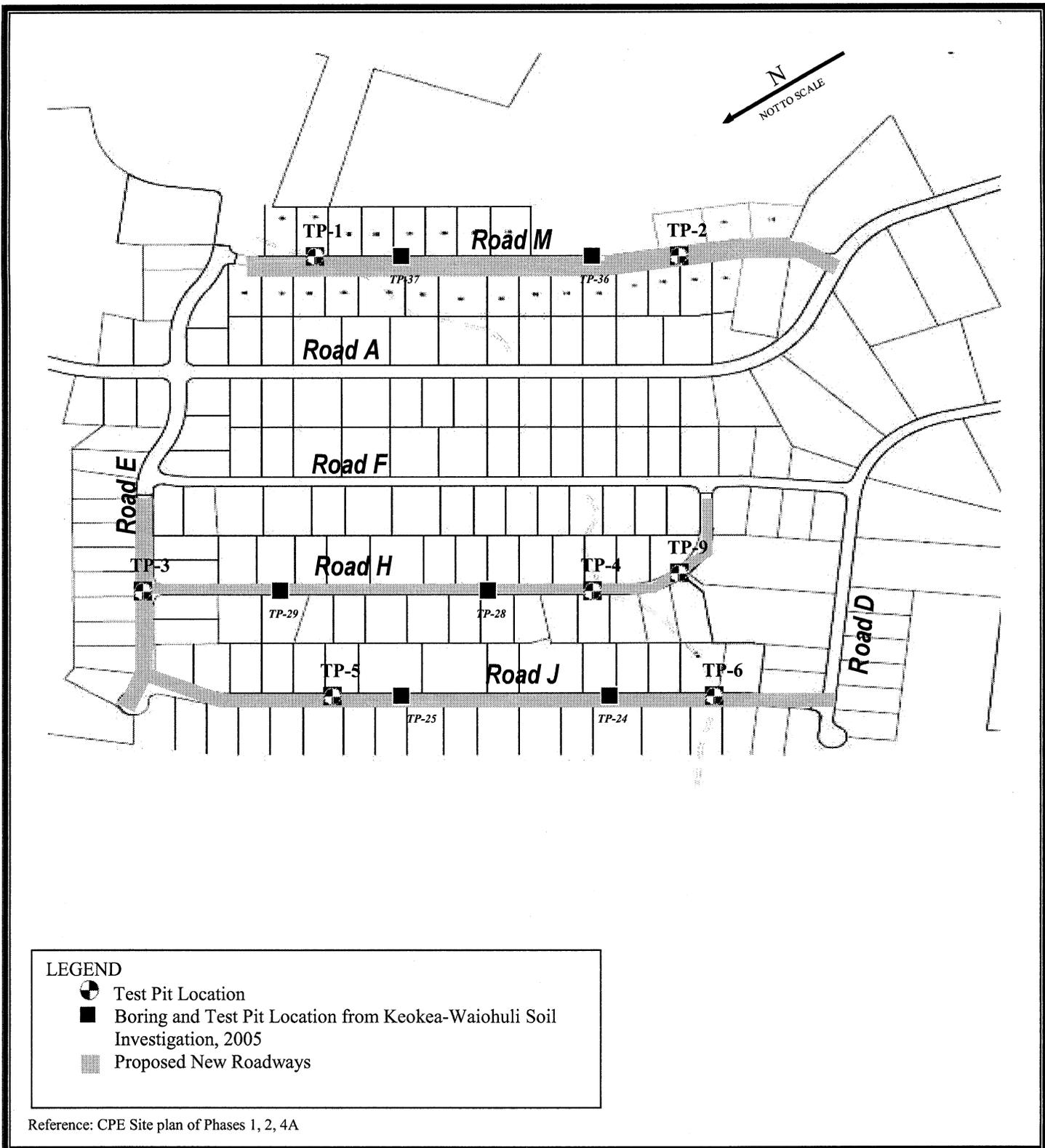


CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013

PROJECT NO. 212302.20



LEGEND

-  Test Pit Location
-  Boring and Test Pit Location from Keokea-Waiohuli Soil Investigation, 2005
-  Proposed New Roadways

Reference: CPE Site plan of Phases 1, 2, 4A

SITE PLAN - ROADS

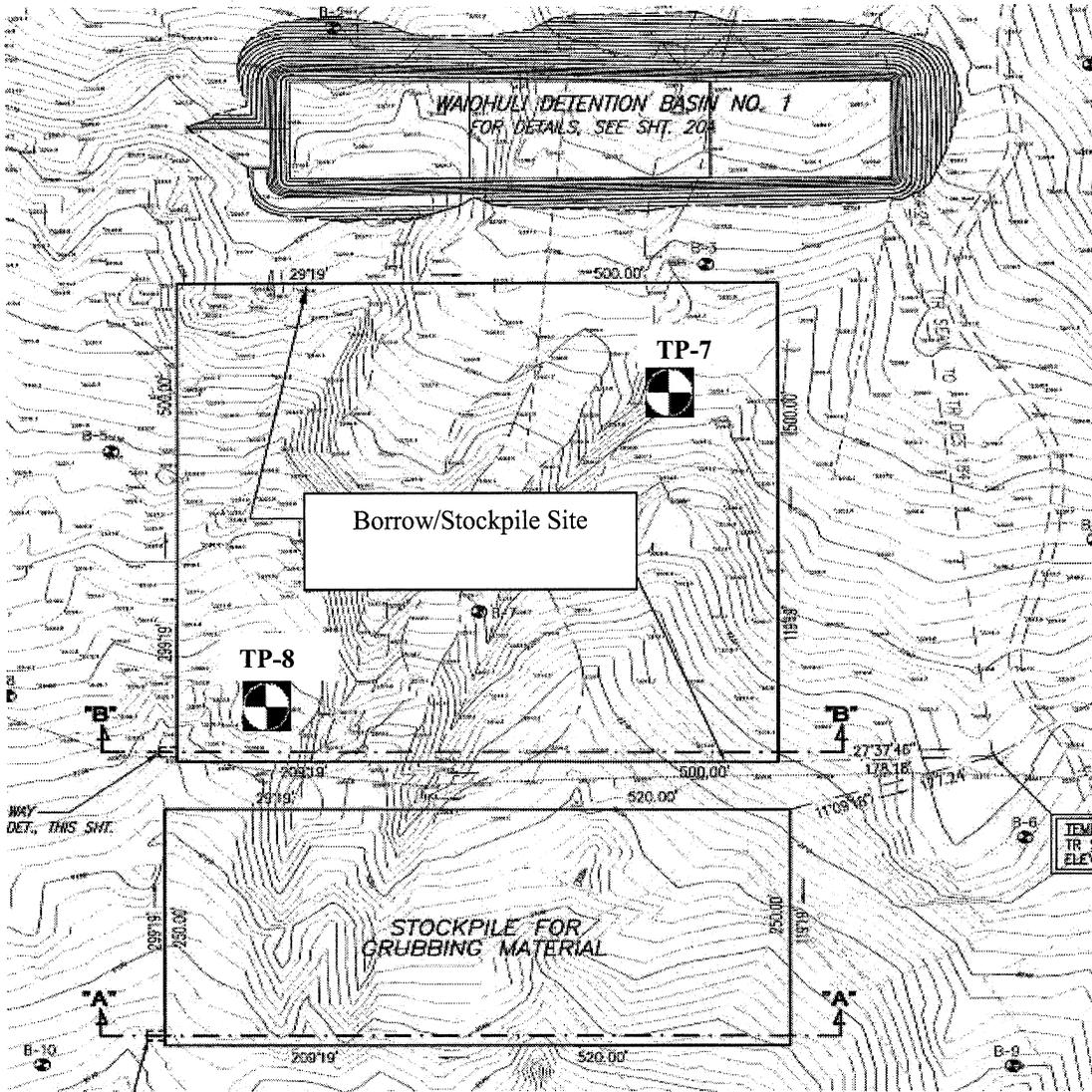


CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013

PROJECT NO. 212302.20



LEGEND
 Test Pit Location

Reference: Construction Plans for Keokea-Waiohuli Development Phase 1

SITE PLAN - BORROW/STOCKPILE SITE



CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013

PROJECT NO. 212302.20

BORING LOCATION: See Plate 3

DRILLER: Ed Gaynor

BORING ELEVATION (ft):

LOGGED BY: DSC

BORING TP-1

DATE (S) DRILLED: 03/08/13

TYPE RIG: Bobcat 325

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION	
										Dry Vegetation, tall grass	
MD/CBR	83	32.7				Grab 1-1	1		MH	SILT, dark brown, trace of clay, rootlets, basaltic gravel and cobbles, moist	
						2					
						3					
						4					
										BASALT, dark gray, moderately weathered, strong	
										Test pit terminated at about 4.5 ft (Refusal). Ground water was not encountered.	
							5				
							6				
							7				
							8				

SAMPLE TYPE

OTHER LABORATORY TESTS

- | | | | |
|----------------------|----------------------------|--------------------------|-----------------------------|
| D&M - Dames & Moore | SPT - Standard Penetration | MD - Moisture/Density | UC - Unconfined Compression |
| CB - Core Barrel | SH - Shelby Tube | CON - Consolidation Test | SG - Specific Gravity |
| AUG - Auger Cuttings | NR - No Recovery | PI - Atterberg Limits | SA - Sieve Analysis |

LOG OF BORING



CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013

PROJECT NO.: 212302.20

210301 MAMALAOHOA RD W/ROD A. 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	BORING TP-2
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/07/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
SAPI	7.4					GRAB 2-1	1		GP GM	Dry Vegetation, Tall Grass
						2				Poorly Graded GRAVEL with SILT and SAND, gray lava gravel, cobbles and boulders with silt matrix, trace roots, dark brown, moist
						3				BASALT, dark gray, strong, weathered
							4			Test pit terminated at about 3.5 ft (Refusal). Ground water was not encountered.
							5			
							6			
							7			
							8			

SAMPLE TYPE	OTHER LABORATORY TESTS
D&M - Dames & Moore SPT - Standard Penetration MD - Moisture/Density UC - Unconfined Compression	
CB - Core Barrel SH - Shelby Tube CON - Consolidation Test SG - Specific Gravity	
AUG - Auger Cuttings NR - No Recovery PI - Atterberg Limits SA - Sieve Analysis	

LOG OF BORING

	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii	
	DATE: April 2013	PROJECT NO.: 212302.20

210301 MAMALAOHOA RD W/ROD A. 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	BORING TP-3
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/07/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
MD/CBR	96	14.8				GRAB 3-1	1		GM	Heavy Vegetation Silty GRAVEL, dark brown, very stiff, 1"-3" subangular vesticate gray basalt, boulders, moist
							2			BASALT Test pit terminated at about 2 ft (Refusal). Ground water was not encountered.
							3			
							4			
							5			
							6			
							7			
							8			

SAMPLE TYPE	OTHER LABORATORY TESTS
D&M - Dames & Moore	SPT - Standard Penetration
CB - Core Barrel	SH - Shelby Tube
AUG - Auger Cuttings	NR - No Recovery
MD - Moisture/Density	UC - Unconfined Compression
CON - Consolidation Test	SG - Specific Gravity
PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii	
	DATE: April 2013	PROJECT NO.: 212302.20

210301 MAMALAOHUA RD W/ROD A. 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	BORING TP-4
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/08/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
SAPI		3.2				GRAB 4-1	1		GW GM	Light Brush, bushes Well-Graded GRAVEL with SILT and SAND, brown, boulders, cobbles, gray, strong, trace rootlets, trace red clay, dry
							2			BASALT Test pit terminated at about 1.75 ft (Refusal). Ground water was not encountered.
							3			
							4			
							5			
							6			
							7			
							8			

SAMPLE TYPE			OTHER LABORATORY TESTS		
D&M - Dames & Moore	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression		
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity		
AUG - Auger Cuttings	NR - No Recovery	PI - Atterberg Limits	SA - Sieve Analysis		

LOG OF BORING

	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii	
	DATE: April 2013	PROJECT NO.: 212302.20

210301 MAMALAOHOA RD W/IRQD A. 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A, GPJ TEST PIT, GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	BORING TP-5
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/08/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
							0			DRY GRASS VEGETATION
							1		ML SM	Sandy SILT, brown, soft, with gravel cobbles and boulders, dry
						2				
SA/PI		15.9				3	GRAB 5-1			
							4			BASALT, vesticate, strong, gray
							5			Test pit terminated at about 4.5 ft (Refusal). Ground water was not encountered.
							6			
							7			
							8			

SAMPLE TYPE			OTHER LABORATORY TESTS		
D&M - Dames & Moore	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression		
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity		
AUG - Auger Cuttings	NR - No Recovery	PI - Atterberg Limits	SA - Sieve Analysis		

LOG OF BORING

	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii	
	DATE: April 2013	PROJECT NO.: 212302.20

210301 MAMALAOHOA RD W/ROD A. 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	BORING TP-6
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/08/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
										DRY VEGETATION GRASS
MD/CBR	73	37.0				GRAB 6-1	1		MH	SILT, brown, stiff, trace rootlets and clay, with basalt cobbles and boulders, dry
							2			
							3			
							4			BASALT, strong, weathered, gray, dry
							5			Test pit terminated at about 4 ft (Refusal). Ground water was not encountered.
							6			
							7			
							8			

SAMPLE TYPE		OTHER LABORATORY TESTS	
D&M - Dames & Moore	SPT - Standard Penetration	MD - Moisture/Density	UC - Unconfined Compression
CB - Core Barrel	SH - Shelby Tube	CON - Consolidation Test	SG - Specific Gravity
AUG - Auger Cuttings	NR - No Recovery	PI - Atterberg Limits	SA - Sieve Analysis

LOG OF BORING

	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii	
	DATE: April 2013	PROJECT NO.: 212302.20

210301 MAMALAOHOA RD W/ROD A. 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 4	DRILLER: Ed Gaynor	BORING TP-7
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/07/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
							0			OVERGROWN VEGETATION
							1			Gravelly SILT, brown, medium stiff, with basalt, boulders, trace of clay and rootlets, dry (volcanic ash)
MD/CBR	99	21.2				GRAB 7-1	2			
							3			
							4		ML	
							5			
							6			
							7			Test pit terminated at about 6.5 ft (Refusal). Ground water was not encountered.
							8			

SAMPLE TYPE	OTHER LABORATORY TESTS
D&M - Dames & Moore	SPT - Standard Penetration
CB - Core Barrel	SH - Shelby Tube
AUG - Auger Cuttings	NR - No Recovery
	MD - Moisture/Density
	CON - Consolidation Test
	PI - Atterberg Limits
	UC - Unconfined Compression
	SG - Specific Gravity
	SA - Sieve Analysis

LOG OF BORING

	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii	
	DATE: April 2013	PROJECT NO.: 212302.20

210301 MAMALAOHOA RD W/RQD A. 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A.GPJ TEST PIT.GDT 4/4/13

BORING LOCATION: See Plate 4	DRILLER: Ed Gaynor	BORING TP-8
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/07/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
							1			GRASSY BRUSH
							2			Silty GRAVEL with SAND, dark brown silt, stiff, gray subangular basalt, moist
SA/PI		7.4				GRAB 8-1	3			
							4		GM	
							5			
							6			
							7			BASALT
							8			Test pit terminated at about 7 ft (Refusal). Ground water was not encountered.

SAMPLE TYPE

D&M - Dames & Moore SPT - Standard Penetration
 CB - Core Barrel SH - Shelby Tube
 AUG - Auger Cuttings NR - No Recovery

OTHER LABORATORY TESTS

MD - Moisture/Density UC - Unconfined Compression
 CON - Consolidation Test SG - Specific Gravity
 PI - Atterberg Limits SA - Sieve Analysis

LOG OF BORING

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
 Kula, Makawao, Maui, Hawaii



CONSULTANTS, LLC
 SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

DATE: April 2013

PROJECT NO.: 212302.20

210301 MAMALAOHOA RD W/IRQD A. 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A, GPJ TEST PIT, GDT 4/4/13

BORING LOCATION: See Plate 3	DRILLER: Ed Gaynor	BORING TP-9
BORING ELEVATION (ft):	LOGGED BY: DSC	
DATE (S) DRILLED: 03/08/13	TYPE RIG: Bobcat 325	

OTHER LAB TESTS	DRY UNIT WEIGHT (pcf)	MOISTURE CONTENT (%)	CORE RECOVERY (%)	R.Q.D. (%)	NUMBER OF BLOWS/12"	SAMPLER TYPE	DEPTH IN FEET	GRAPHIC SYMBOL	U.S.C.S.	GEOTECHNICAL DESCRIPTION
							1		MH	DRY VEGETATION GRASS Clayey SILT, brown, soft/stiff, trace rootlets, moist
						GRAB 9-1	2		GP	BASALT Test pit terminated at about 2 ft (Refusal). Ground water was not encountered.
							3			
							4			
							5			
							6			
							7			
							8			

210301 MAMALAOHOA RD W/ROAD A. 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A GPJ TEST PIT.GDT 4/4/13

SAMPLE TYPE	OTHER LABORATORY TESTS
D&M - Dames & Moore	SPT - Standard Penetration
CB - Core Barrel	SH - Shelby Tube
AUG - Auger Cuttings	NR - No Recovery
	MD - Moisture/Density
	CON - Consolidation Test
	PI - Atterberg Limits
	UC - Unconfined Compression
	SG - Specific Gravity
	SA - Sieve Analysis

LOG OF BORING

	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii	
	DATE: April 2013	PROJECT NO.: 212302.20

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS 50% OR MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		CLEAN SANDS (LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			SM	SILTY SANDS, SAND - SILT MIXTURES	
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES		
FINE GRAINED SOILS 50% OR MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY	
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY	
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN OR EQUAL TO 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY	
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS	
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

UNIFIED SOIL CLASSIFICATION SYSTEM



CONSULTANTS, LLC
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013

PROJECT NO. 212302.20

I. CONSOLIDATION OF SEDIMENTARY ROCKS; usually determined from unweathered samples. Largely dependent on cementation.

- U = unconsolidated
- P = poorly consolidated
- M = moderately consolidated
- W = well consolidated

II. BEDDING OF SEDIMENTARY ROCKS

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	Very Thick-Bedded
Blocky	2.0 to 4.0 ft.	Thick-Bedded
Slabby	0.2 to 2.0 ft.	Thin-Bedded
Flaggy	0.05 to 0.2 ft.	Very Thin-Bedded
Shaly or Platy	0.01 to 0.05 ft.	Laminated
Papery	Less than 0.01 ft.	Thinly Laminated

III. FRACTURING

Intensity	Size of Pieces in Feet
Very Little Fractured	Greater than 4.0
Occasionally Fractured	1.0 to 4.0
Moderately Fractured	0.5 to 1.0
Closely Fractured	0.1 to 0.5
Intensely Fractured	0.05 to 0.1
Crushed	Less than 0.05

IV. HARDNESS

1. Soft – reserved for plastic material alone.
2. Low Hardness – can be gouged deeply or carved easily with a knife blade.
3. Moderately Hard – can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. Hard – can be scratched with difficulty; scratch produces little powder and is often faintly visible.
5. Very Hard – cannot be scratched with a knife blade; leaves a metallic streak.

V. STRENGTH

1. Plastic or very low strength.
2. Friable – crumbles easily by rubbing with fingers.
3. Weak – an unfractured specimen of such material will crumble under light hammer blows.
4. Moderately Strong – specimen will withstand a few heavy hammer blows before breaking.
5. Strong – specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. Very Strong – specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

VI. WEATHERING – The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation and freezing and thawing.

- D. Deep – moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.
- M. Moderate – slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected; moderate to occasionally intense discoloration; moderately coated fractures.
- L. Little – no megascopic decomposition of minerals; little or no effect on normal cementation; slight and intermittent, or localized discoloration; few stains on fracture surfaces.
- F. Fresh – unaffected by weathering agents; no disintegration or discoloration; fractures usually less numerous than joints.

ROCK CLASSIFICATION SYSTEM



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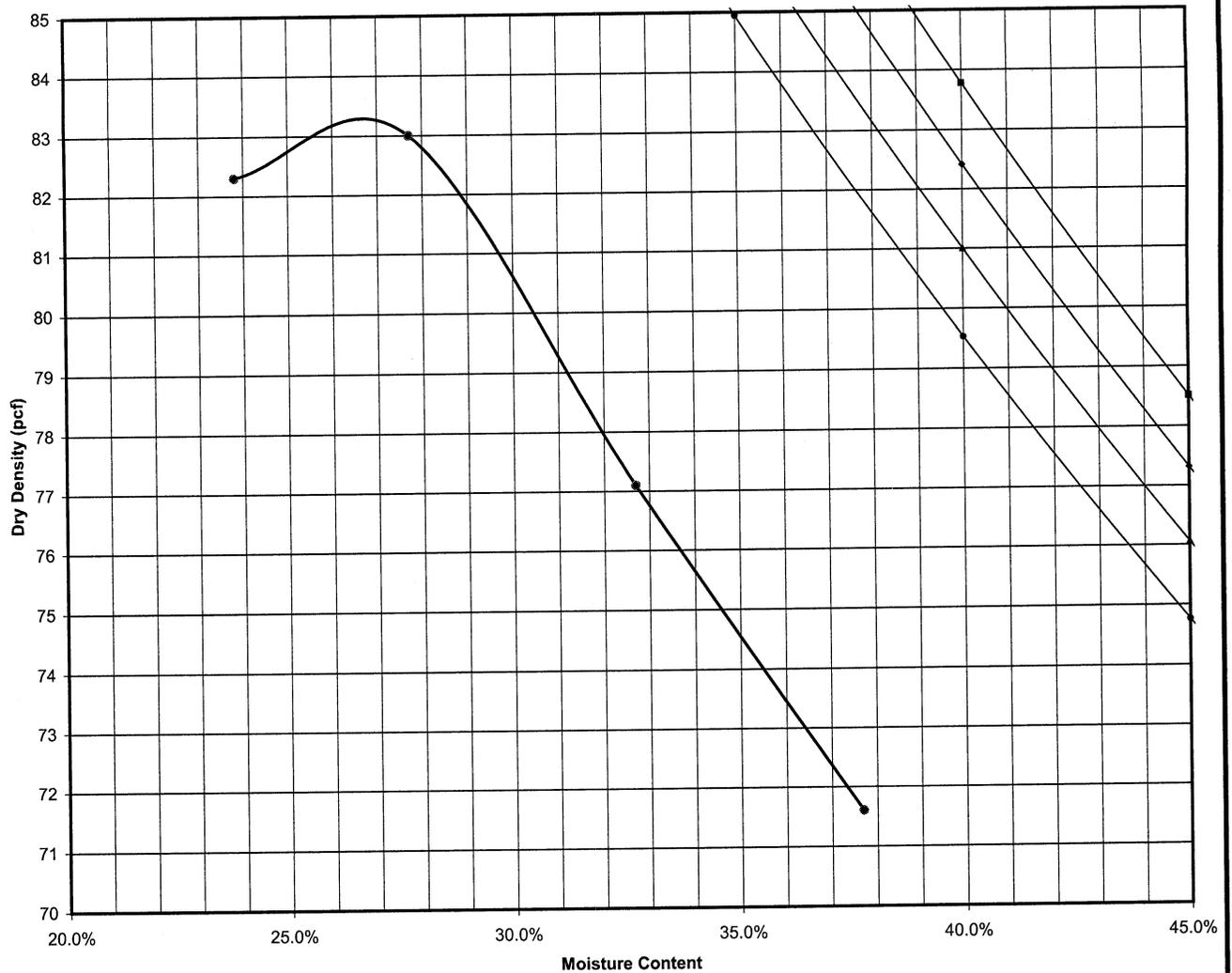
Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

DATE: April 2013

PROJECT NO. 212302.20

Curves for
100%
saturation

MOISTURE-DENSITY RELATIONSHIP



Sample Source: 1-1(TP-1)/Road M

Description: Dark Brown (MH) Silt w/ Basaltic Gravel

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	101.86	105.99	102.4	98.54
Moisture Content	23.80%	27.70%	32.70%	37.70%
Dry Density (pcf)	82.30	83.00	77.10	71.60

Maximum Dry Density (pcf): 83.4
 Optimum Moisture Content (%) : 27
 Test Method: ASTM D-1557

Atterberg Limits

LL

PL

PI

COMPACTION TEST RESULTS

ASTM D-1557



PSC Consultants, LLC

SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A

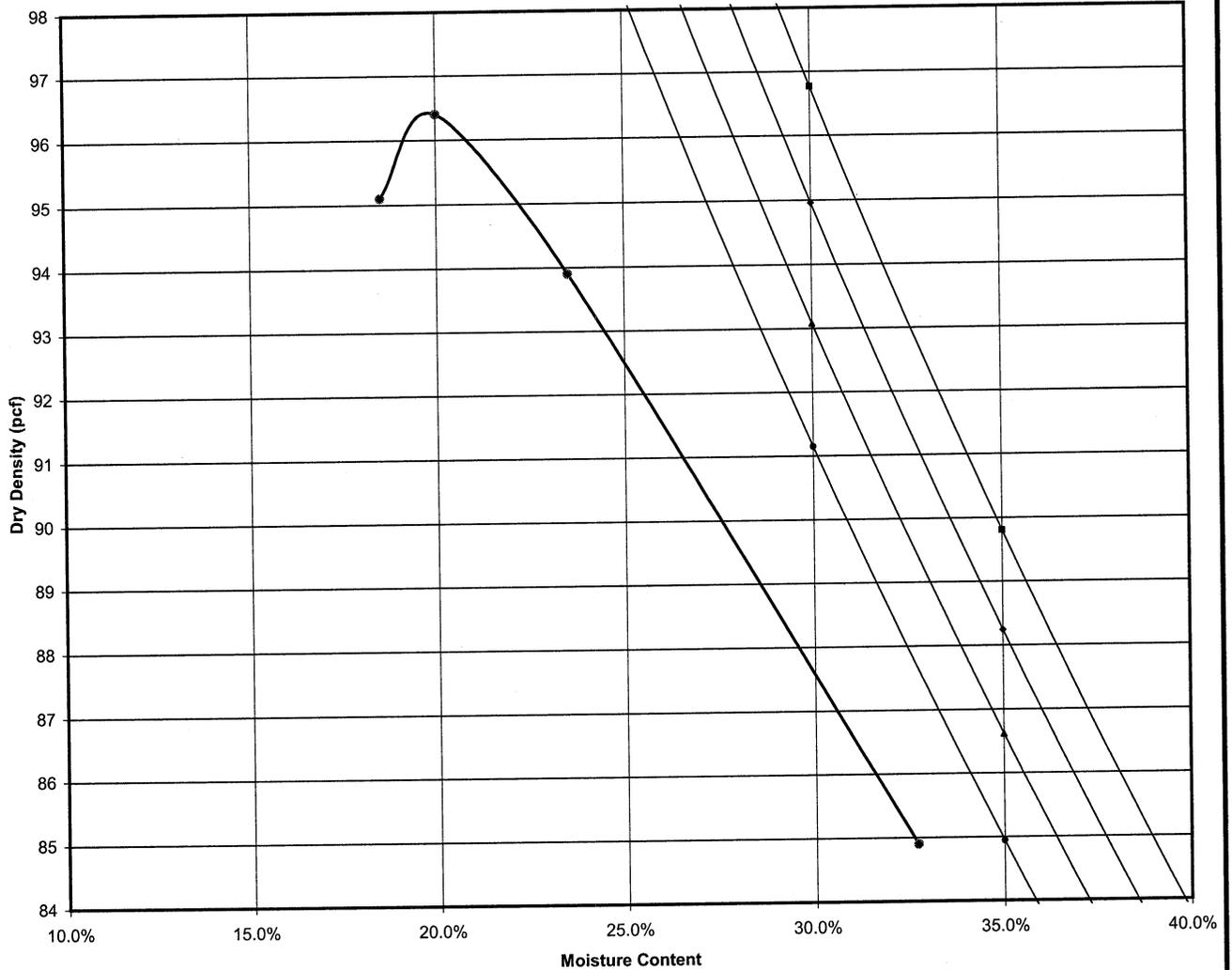
Kula, Makawao, Maui, Hawaii

Date: April 2013

Project No. 212302.20

Curves for
100%
saturation

MOISTURE-DENSITY RELATIONSHIP



Sample Source: 3-1 (TP-3)/Road E/RoadH

Description: Dark Brown (GM) Silty GRAVEL

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	112.65	115.71	115.98	112.65
Moisture Content	18.50%	20.00%	23.50%	32.70%
Dry Density (pcf)	95.10	96.40	93.90	84.90

Maximum Dry Density (pcf): 96.4
 Optimum Moisture Content (%): 20
 Test Method: ASTM D-1557

Atterberg Limits

LL PL PI

COMPACTION TEST RESULTS

ASTM D-1557



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SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

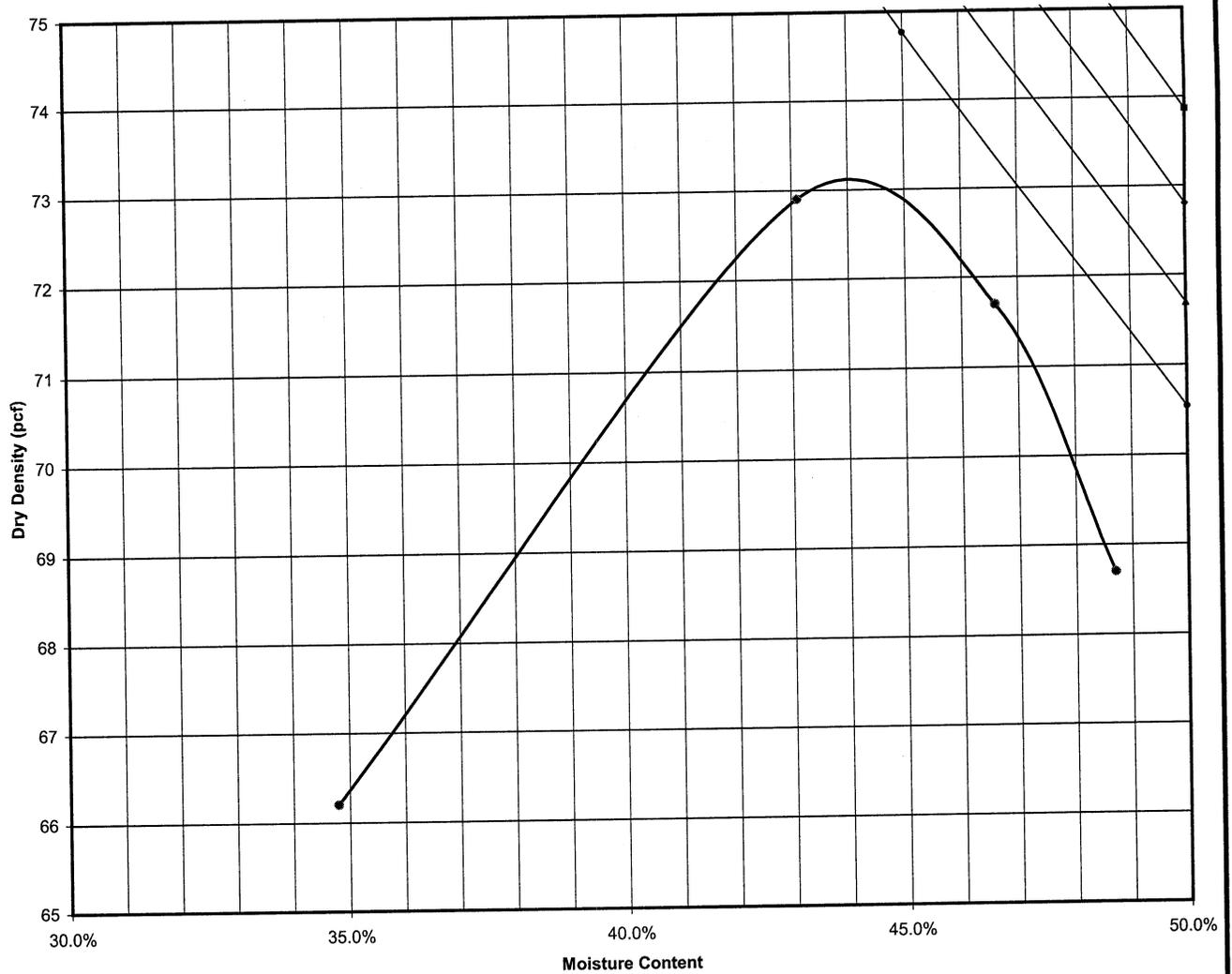
Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
 Kula, Makawao, Maui, Hawaii

Date: April 2013

Project No. 212302.20

Curves for
100%
saturation

MOISTURE-DENSITY RELATIONSHIP



Sample Source: 6-1 (TP-6)/Road J

Description: Brown (MH) SILT w/ Basalt Cobbles

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	89.23	104.39	105.05	102.13
Moisture Content	34.80%	43.10%	46.60%	48.70%
Dry Density (pcf)	66.20	72.90	71.70	68.70

Maximum Dry Density (pcf): 73
 Optimum Moisture Content (%): 44
 Test Method: ASTM D-1557

Atterberg Limits

LL PL PI

COMPACTION TEST RESULTS

ASTM D-1557



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SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

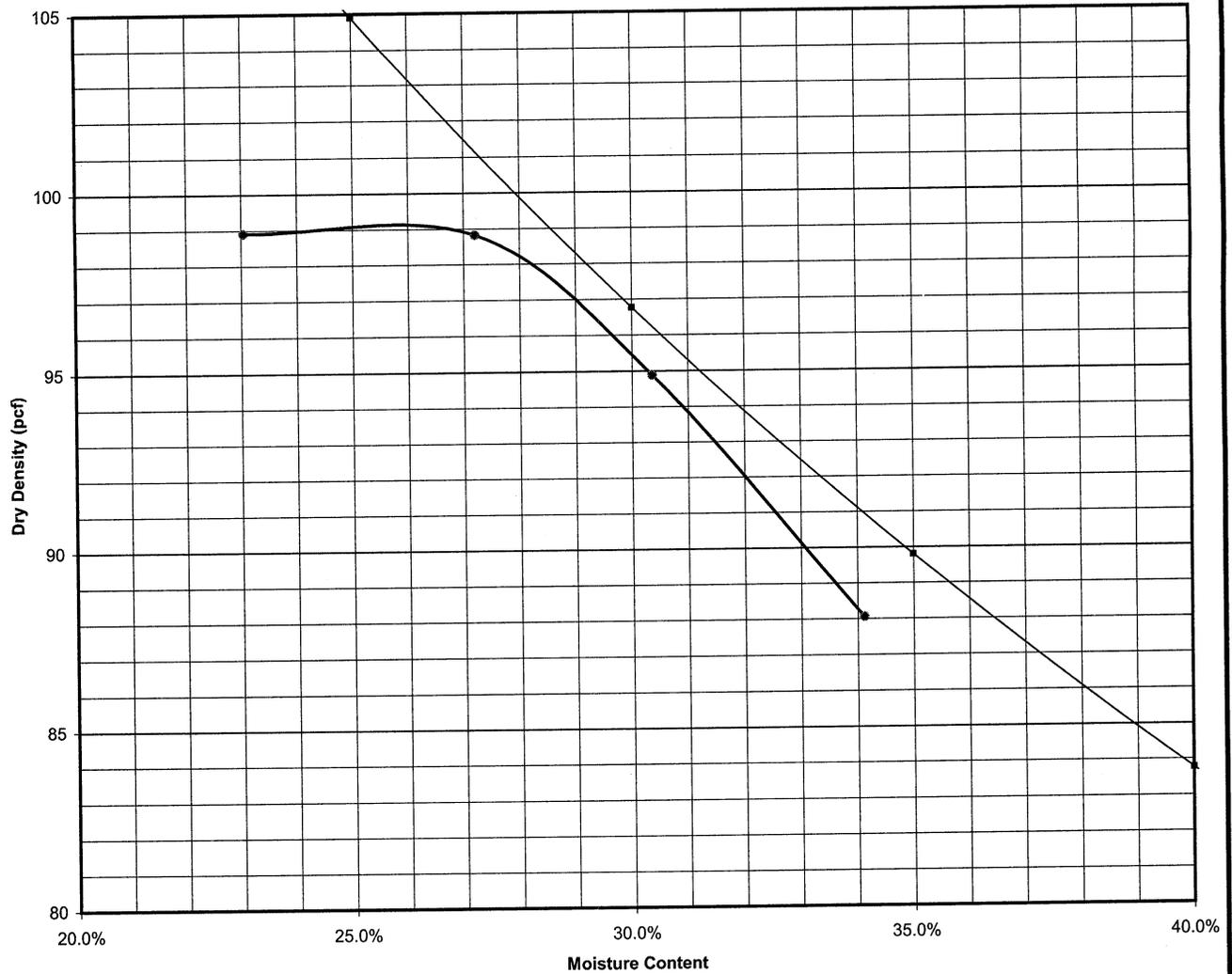
Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
 Kula, Makawao, Maui, Hawaii

Date: April 2013

Project No. 212302.20

Curves for
100%
saturation

MOISTURE-DENSITY RELATIONSHIP



Sample Source: 7-1 (TP-7)/Stock Pile

Description: Brown (MH) Gravelly SILT

	Test Point 1	Test Point 2	Test Point 3	Test Point 4
Wet Density (pcf)	121.7	125.7	123.7	118.1
Moisture Content	23.04%	27.20%	30.36%	34.12%
Dry Density (pcf)	98.91	98.82	94.89	88.06

Maximum Dry Density (pcf): 99
 Optimum Moisture Content (%) : 23
 Test Method: ASTM D-1557

Atterberg Limits

LL PL PI

COMPACTION TEST RESULTS

ASTM D-1557



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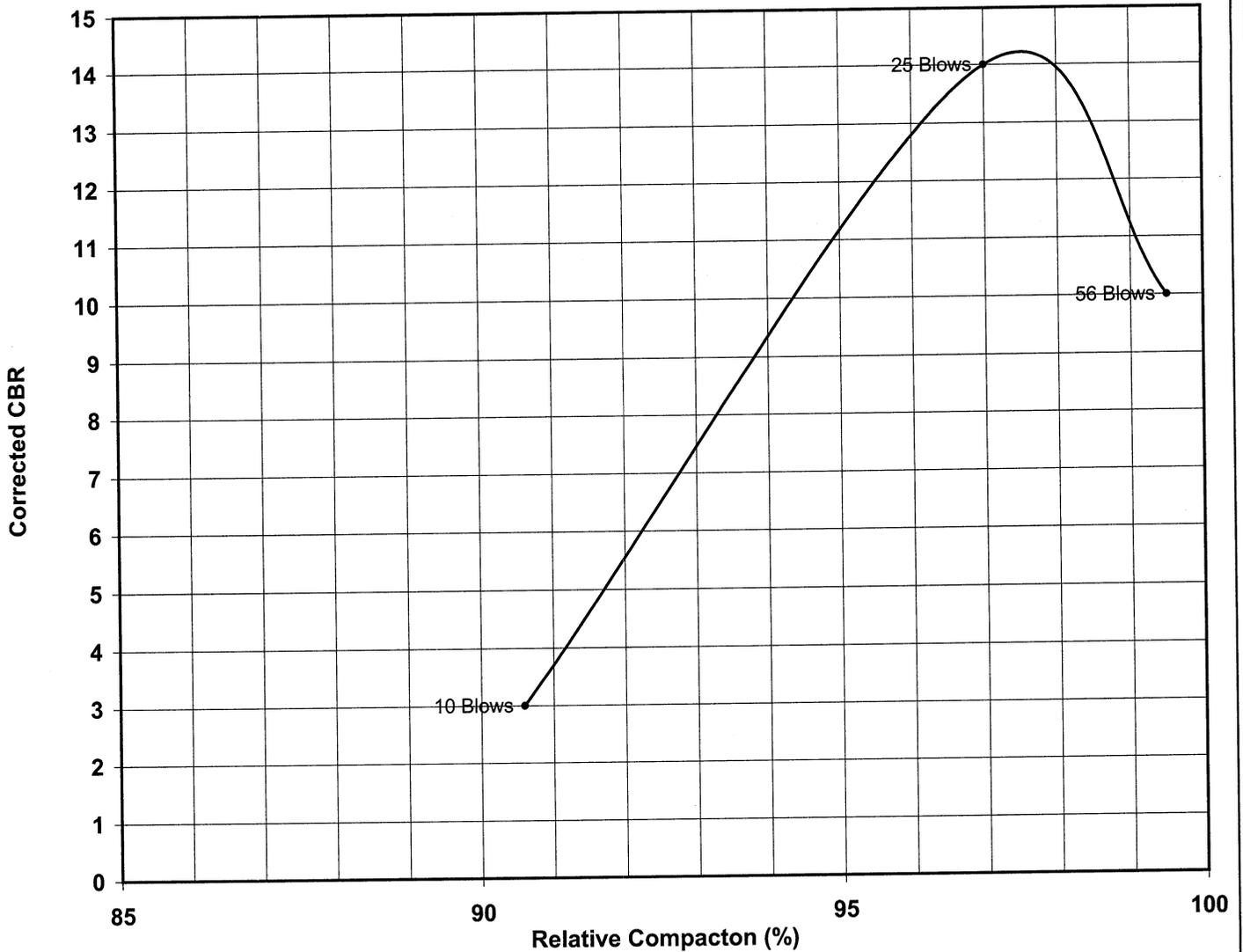
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
 Kula, Makawao, Maui, Hawaii

Date: April 2013

Project No. 212302.20

Dry Density vs. CBR



Sample Source: 6-1(TP-6)/Road J

Depth: Grab

Description: Brown Silt w/ Basalt Gravel

Blows/Lift	Dry Density (pcf)	CBR	Relative comp. %
10	66.1	3	91
25	70.9	14	97
56	72.5	10	99.5

CBR for at 95% Relative Compaction :	11
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**CALIFORNIA BEARING RATIO
ASTM D-1883**



PSC Consultants, LLC

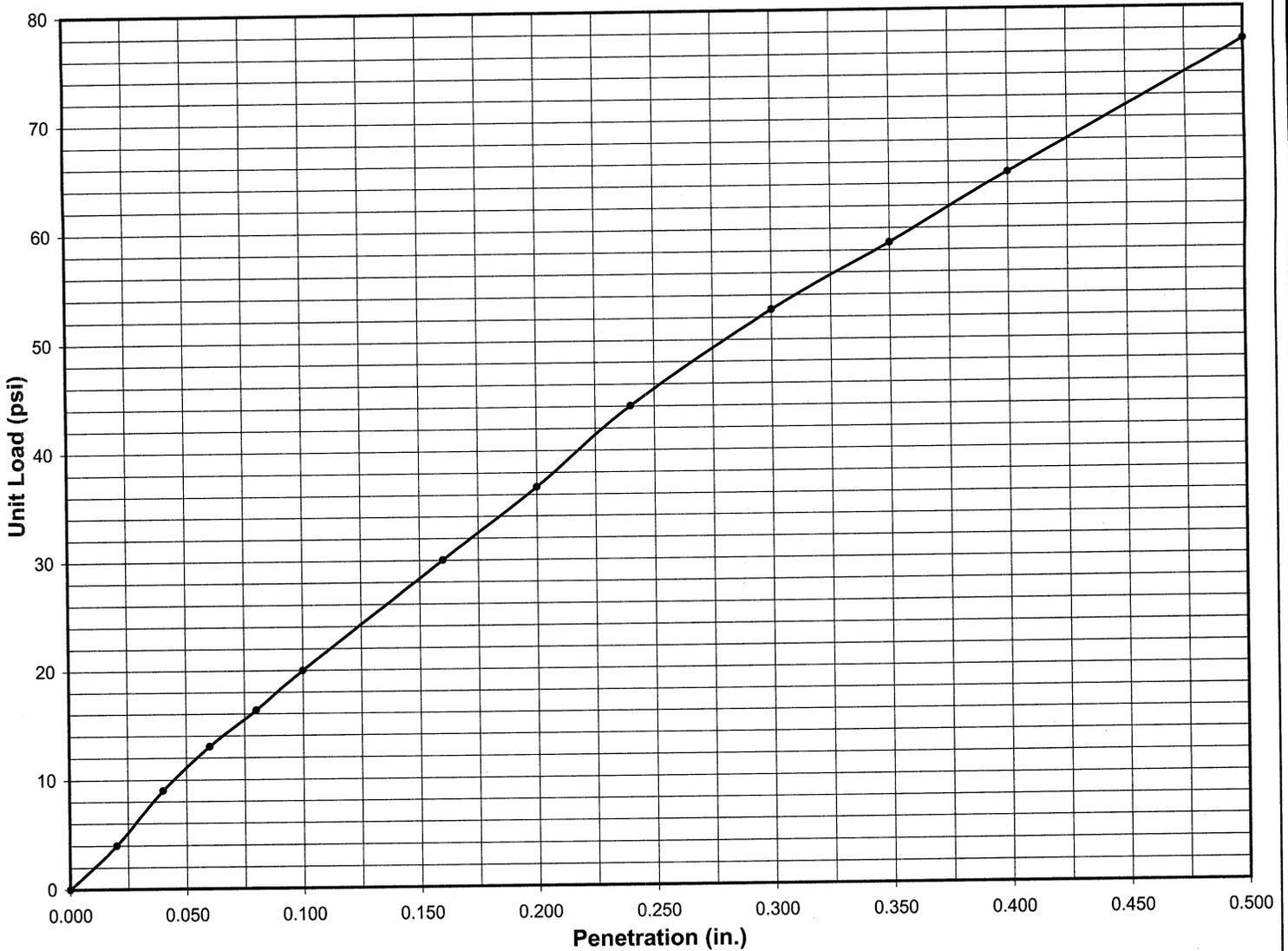
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii**

Date: April 2013

Project No. 212302.20

CBR CURVE



Sample Source: 6-1(TP-6)/Road J
Blows/lift: 10

Depth: Grab

Description: Brown Silt w/ Basalt Gravel

	Before Expansion	After Expansion
Relative Compaction (%)	93.70%	90.59%
Moisture Content (%)	43.40%	48.23%
Dry Density (pcf)	68.40	66.13
Percent Swell or Expansion Value (%)	1.27%	
Compaction Test Method	ASTM D-1557	
Corr. CBR Value @ 0.1" :	3	
Corr. CBR Value @ 0.2" :	2	

Atterberg Limits
LL PL PI

CALIFORNIA BEARING RATIO
ASTM D-1883-94



PSC Consultants, LLC

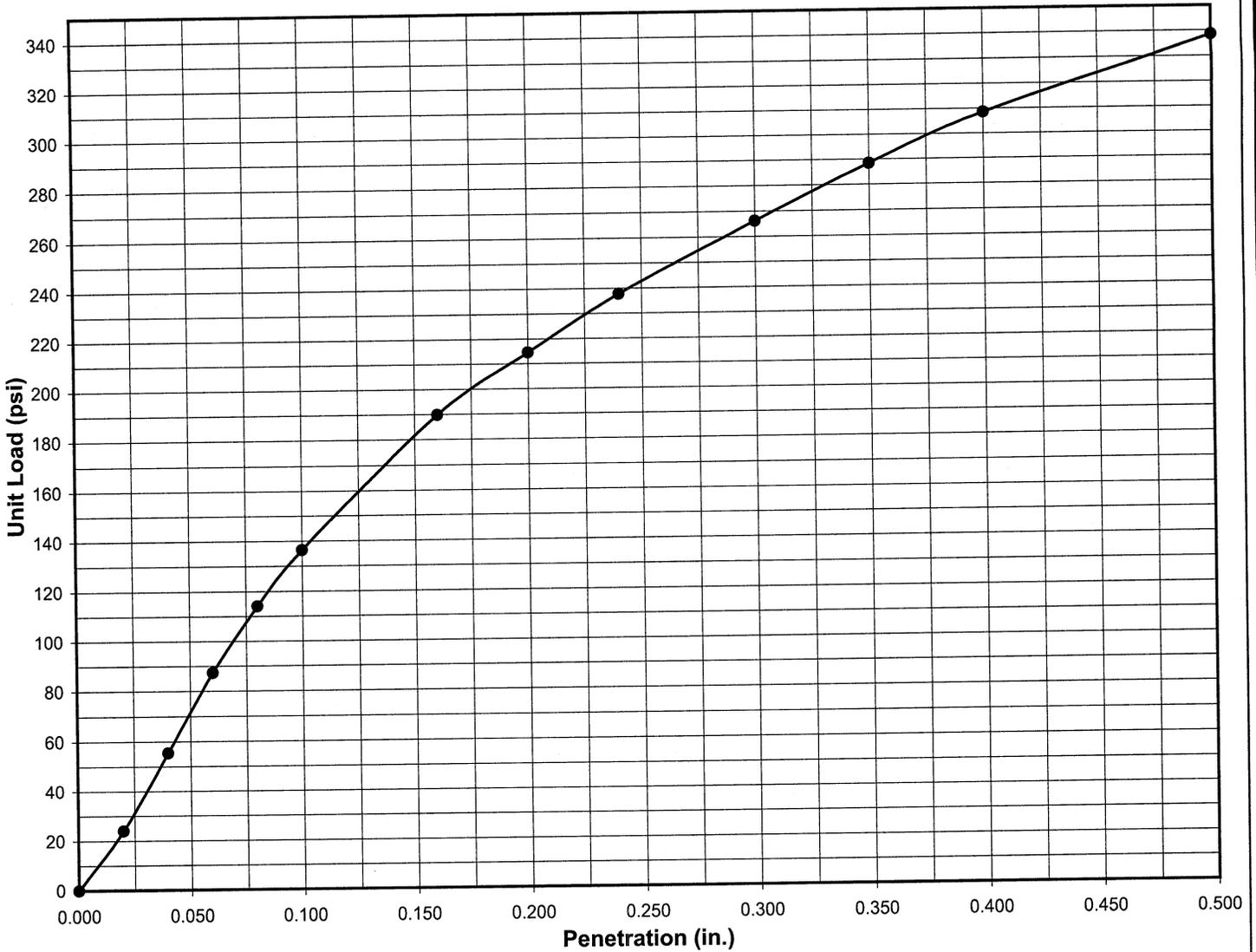
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
 Kula, Makawao, Maui, Hawaii

Date: April 2013

Project No. 212302.20

CBR CURVE



Sample Source: 6-1(TP-6)/Road J
Blows/lift: 25

Depth: Grab

Description: Brown Silt w/ Basalt Gravel

	Before Expansion	After Expansion
Relative Compaction (%):	99.59%	97.12%
Moisture Content (%):	41.10%	44.70%
Dry Density (pcf):	72.70	70.90
Percent Swell or Expansion Value (%):	0.98%	
Compaction Test Method:	ASTM D-1557	
Corr. CBR Value @ 0.1" :	17	
Corr. CBR Value @ 0.2" :	14	

Atterberg Limits

LL PL PI

CALIFORNIA BEARING RATIO
ASTM D-1883-94



PSC Consultants, LLC

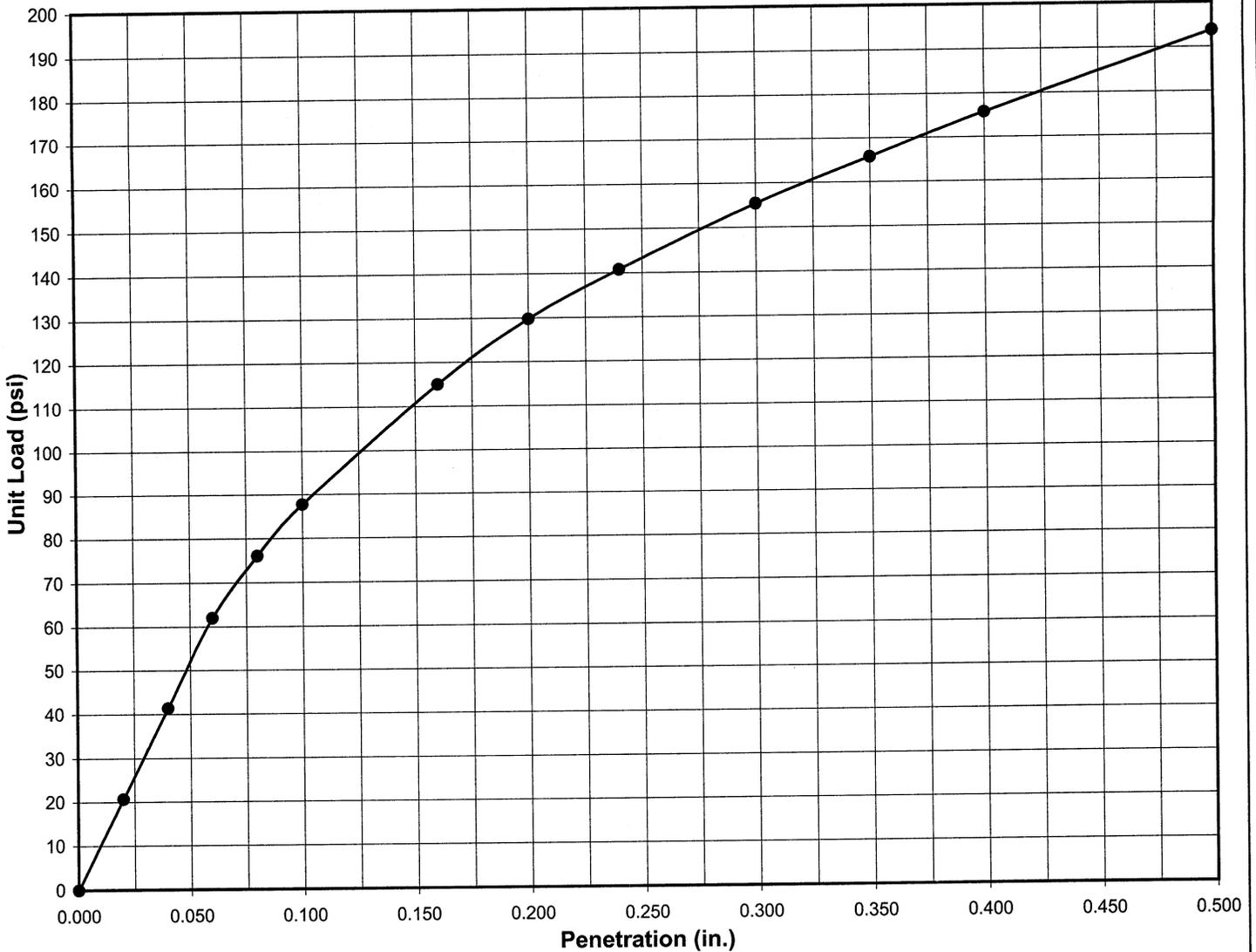
SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

Date: April 2013

Project No. 212302.20

CBR CURVE



Sample Source: 6-1(TP-6)/Road J
Blows/lift: 56

Depth: Grab

Description: Brown Silt w/ Basalt Gravel

	Before Expansion	After Expansion
Relative Compaction (%):	100.00%	99.45%
Moisture Content (%):	43.80%	44.70%
Dry Density (pcf):	73.00	72.60
Percent Swell or Expansion Value (%):	0.47%	
Compaction Test Method:	ASTM D-1557	
Corr. CBR Value @ 0.1" :	10	
Corr. CBR Value @ 0.2" :	9	

Atterberg Limits

LL PL PI

CALIFORNIA BEARING RATIO ASTM D-1883-94



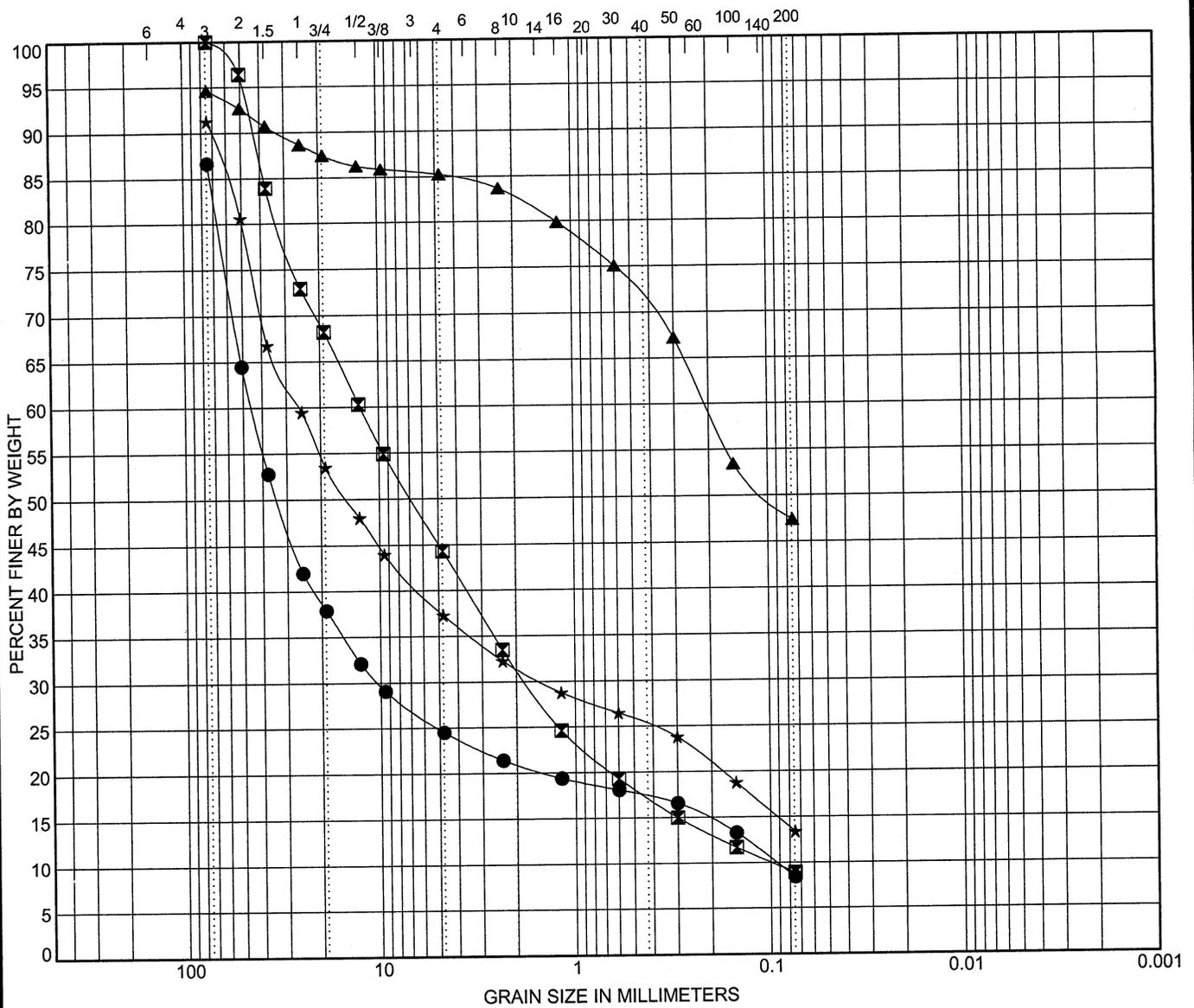
PSC Consultants, LLC

SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS

**Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
 Kula, Makawao, Maui, Hawaii**

Date: April 2013

Project No. 212302.20



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● TP-2 @ DEPTH 1ft.	POORLY GRADED GRAVEL with SILT and SAND GP-GM	NP	NP	NP	25.27	480.62
☒ TP-4 @ DEPTH 1ft.	WELL-GRADED GRAVEL with SILT and SAND GW-GM	NP	NP	NP	2.62	126.90
▲ TP-5 @ DEPTH 3ft.	SANDY SILT ML-SM	NP	NP	NP		
★ TP-8 @ DEPTH 3ft.	SILTY GRAVEL with SAND GM	NP	NP	NP		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● TP-2 @ DEPTH 1ft.	75	45.202	10.364	0.094	62.2	16.1	8.4	
☒ TP-4 @ DEPTH 1ft.	75	12.497	1.797	0.098	55.7	35.4	8.9	
▲ TP-5 @ DEPTH 3ft.	75	0.208			9.4	37.9	47.4	
★ TP-8 @ DEPTH 3ft.	75	25.704	1.497		54.0	23.9	13.4	

GRAIN SIZE DISTRIBUTION

 <p>CONSULTANTS, LLC SOILS, FOUNDATION, AND GEOLOGICAL ENGINEERS</p>	Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii	
	Date: April 2013	Project No.: 212302.20

210301 SIEVE - MAMALAHOA 212302.20 CPE KEOKEA-WAIOHULI PH. 1, 2, 4A.GPJ TEST PIT.GDT 4/4/13

SIEVE ANALYSIS (ASTM D422-63 Re- Approved 2002)

Project	<u>Keokea-Waiohuli Subdivision Phases 1, 2 and 4A</u>	Job No.	<u>212302.20</u>
Sample Source	<u>Test Pit 2 (Road M)</u>	Purpose	<u>Classification</u>
Soil Description	<u>POORLY GRADED GRAVEL with SILT and SAND (GP-GM)</u>	Sample No.	<u>2-1</u>
Tested by	<u>DP</u>	Test Date(s)	<u>3/12/2013</u>

Wt of wet sample & tare (g)	<u>15150.2</u>	-200 Wash	
Wt of dry sample and tare (g)	<u>14165.9</u>	Before Wash	
Moisture (g)	<u>984.3</u>	Wt of dry sample and tare (g)	<u>14165.9</u>
Wt of tare (g)	<u>926.5</u>	After Wash	
Wt of dry sample (g)	<u>13239.4</u>	Wt of dry sample and tare (g)	<u>13236.0</u>
Moisture content	<u>7.4%</u>	Wt. Passing -200 (g)	<u>929.9</u>
		% Passing -200	<u>7.0%</u>

Sieve no.	Diameter (mm)	Cumulative Weight Retained (gm)	% Retained	% Passing
3"	75	1763.00	13.32%	86.68%
2"	50.8	4699.90	35.50%	64.50%
1-1/2"	37.5	6254.60	47.24%	52.76%
1"	25	7685.20	58.05%	41.95%
3/4"	19	8221.50	62.10%	37.90%
1/2"	12.7	8995.60	67.95%	32.05%
3/8"	9.5	9382.20	70.87%	29.13%
#4	4.75	9995.50	75.50%	24.50%
#8	2.36	10403.20	78.58%	21.42%
#16	1.18	10669.90	80.59%	19.41%
#30	0.6	10837.60	81.86%	18.14%
#50	0.3	11035.40	83.35%	16.65%
#100	0.15	11479.60	86.71%	13.29%
#200	0.075	12133.40	91.65%	8.35%
Pan				

SIEVE ANALYSIS (ASTM D422-63 Re- Approved 2002)

Project	<u>Keokea-Waiohuli Subdivision Phases 1, 2 and 4A</u>	Job No.	<u>212302.20</u>
Sample Source	<u>Test Pit 4 (Road H)</u>	Purpose	<u>Classification</u>
Soil Description	<u>WELL-GRADED GRAVEL w/ SILT and SAND (GW-GM)</u>	Sample No.	<u>4-1</u>
Tested by	<u>DP</u>	Test Date(s)	<u>3/12/2013</u>

Wt of wet sample & tare (g)	<u>12151.9</u>	-200 Wash	
Wt of dry sample and tare (g)	<u>11807.2</u>	Before Wash	
Moisture (g)	<u>344.7</u>	Wt of dry sample and tare (g)	<u>11807.2</u>
Wt of tare (g)	<u>928.5</u>	After Wash	
Wt of dry sample (g)	<u>10878.7</u>	Wt of dry sample and tare (g)	<u>10859.2</u>
Moisture content	<u>3.2%</u>	Wt. Passing -200 (g)	<u>948.0</u>
		% Passing -200	<u>8.7%</u>

Sieve no.	Diameter (mm)	Cumulative Weight Retained (gm)	% Retained	% Passing
3"	75	0.00	0.00%	100.00%
2"	50.8	394.00	3.62%	96.38%
1-1/2"	37.5	1750.80	16.09%	83.91%
1"	25	2952.50	27.14%	72.86%
3/4"	19	3458.80	31.79%	68.21%
1/2"	12.7	4318.10	39.69%	60.31%
3/8"	9.5	4904.80	45.09%	54.91%
#4	4.75	6061.70	55.72%	44.28%
#8	2.36	7232.20	66.48%	33.52%
#16	1.18	8199.20	75.37%	24.63%
#30	0.6	8782.40	80.73%	19.27%
#50	0.3	9251.40	85.04%	14.96%
#100	0.15	9600.70	88.25%	11.75%
#200	0.075	9907.70	91.07%	8.93%
Pan				

SIEVE ANALYSIS (ASTM D422-63 Re- Approved 2002)

Project	<u>Keokea-Waiohuli Subdivision Phases 1, 2 and 4A</u>	Job No.	<u>212302.20</u>
Sample Source	<u>Test Pit 5 (Road J)</u>	Purpose	<u>Classification</u>
Soil Description	<u>Orange-Brown Sandy SILT (ML-SM)</u>	Sample No.	<u>5-1</u>
Tested by	<u>DP</u>	Test Date(s)	<u>3/11/2013</u>

Wt of wet sample & tare (g)	<u>10568.9</u>	-200 Wash	
Wt of dry sample and tare (g)	<u>9248.9</u>	Before Wash	
Moisture (g)	<u>1320.0</u>	Wt of dry sample and tare (g)	<u>9248.9</u>
Wt of tare (g)	<u>929.5</u>	After Wash	
Wt of dry sample (g)	<u>8319.4</u>	Wt of dry sample and tare (g)	<u>5347.9</u>
Moisture content	<u>15.9%</u>	Wt. Passing -200 (g)	<u>3901.0</u>
		% Passing -200	<u>46.9%</u>

Sieve no.	Diameter (mm)	Cumulative Weight Retained (gm)	% Retained	% Passing
3"	75	446.80	5.37%	94.63%
2"	50.8	608.80	7.32%	92.68%
1-1/2"	37.5	772.20	9.28%	90.72%
1"	25	942.30	11.33%	88.67%
3/4"	19	1042.80	12.53%	87.47%
1/2"	12.7	1142.00	13.73%	86.27%
3/8"	9.5	1173.30	14.10%	85.90%
#4	4.75	1224.70	14.72%	85.28%
#8	2.36	1359.00	16.34%	83.66%
#16	1.18	1673.50	20.12%	79.88%
#30	0.6	2074.20	24.93%	75.07%
#50	0.3	2727.00	32.78%	67.22%
#100	0.15	3870.80	46.53%	53.47%
#200	0.075	4375.80	52.60%	47.40%
Pan				

SIEVE ANALYSIS (ASTM D422-63 Re- Approved 2002)

Project	<u>Keokea-Waiohuli Subdivision Phases 1, 2 and 4A</u>	Job No.	<u>212302.20</u>
Sample Source	<u>Test Pit 8 (Borrow/Stockpile Site)</u>	Purpose	<u>Classification</u>
Soil Description	<u>Brown Silty GRAVEL with SAND (GM)</u>	Sample No.	<u>8-1</u>
Tested by	<u>DP</u>	Test Date(s)	<u>3/11/2013</u>
Wt of wet sample & tare (g)	<u>10714.0</u>	-200 Wash	
Wt of dry sample and tare (g)	<u>10042.7</u>	Before Wash	
Moisture (g)	<u>671.3</u>	Wt of dry sample and tare (g)	<u>10042.7</u>
Wt of tare (g)	<u>923.6</u>	After Wash	
Wt of dry sample (g)	<u>9119.1</u>	Wt of dry sample and tare (g)	<u>9031.2</u>
Moisture content	<u>7.4%</u>	Wt. Passing -200 (g)	<u>1011.5</u>
		% Passing -200	<u>11.1%</u>

Sieve no.	Diameter (mm)	Cumulative Weight Retained (gm)	% Retained	% Passing
3"	75	793.30	8.70%	91.30%
2"	50.8	1768.80	19.40%	80.60%
1-1/2"	37.5	3023.40	33.15%	66.85%
1"	25	3690.40	40.47%	59.53%
3/4"	19	4243.50	46.53%	53.47%
1/2"	12.7	4738.40	51.96%	48.04%
3/8"	9.5	5105.80	55.99%	44.01%
#4	4.75	5720.20	62.73%	37.27%
#8	2.36	6174.80	67.71%	32.29%
#16	1.18	6496.60	71.24%	28.76%
#30	0.6	6703.40	73.51%	26.49%
#50	0.3	6948.10	76.19%	23.81%
#100	0.15	7400.30	81.15%	18.85%
#200	0.075	7901.40	86.65%	13.35%
Pan				



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www.pscconsultants.com

LETTER OF TRANSMITTAL

TO: Community Planning & Engineering, Inc.
1286 Queen Emma Street
Honolulu, Hawaii 96813

DATE:	May 29, 2013
PSC JOB NO.:	212302.20
SUBJECT:	Report Addendum
Keokea-Waiohuli Subdivision Phases 1, 2 and 4A	
Kula, Makawao, Maui, Hawaii	

ATTENTION: Mr. Richard Santo, P.E.

We ARE SENDING YOU Attached Under separate cover via USPS the following items:

Invoice Samples Prints Plans Other: _____

Letter Proposal Report Specifications

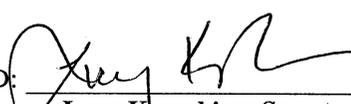
COPIES	DATE	DESCRIPTION
1 Original	May 28, 2013	Supplementary Recommendations Preliminary Geotechnical Exploration Report Keokea-Waiohuli Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii TMK: (2) 2-2-002:14, 55 and 71

For approval For information Submit ___ copies for distribution For your use For review & comment

Return ___ corrected prints As requested Resubmit ___ copies for approval Other _____

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SIGNED: 
Lucy Kaneshiro, Secretary



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Mr. Richard Santo
Community Planning and Engineering, Inc.
1286 Queen Emma Street
Honolulu, Hawaii 96813

May 28, 2013
PSC Job No. 212303.20

Subject: Addendum to Preliminary Geotechnical Exploration Report
Keokea-Waiohuli Subdivision Phases 1, 2 and 4A
Kula, Makawao, Maui, Hawaii

Reference: Preliminary Geotechnical Exploration Report, Proposed Keokea-Waiohuli
Subdivision Phases 1, 2 and 4A Kula, Makawao, Maui, Hawaii dated April 5,
2013 prepared by PSC Consultants, LLC

Dear Mr. Santo:

We are pleased to provide our supplementary recommendations to the above-referenced report to address Service Roads:

The following is our revised paragraph on "Service Roads" (pg 7, last paragraph);

1.) "Service Roads"

Surface topping will be 2" asphalt concrete with 2" minimum base thickness of 3" minus select material. Where dense rocks and cobbles are present, the select material will be placed on the rock/cobble surface. If silt is present on dense rocks and cobbles, the silt should be cleaned from the rocks and cobbles. At silt areas, roadway should be cleared to 12" below service road finish grade or till silt pockets are removed, and select material placed where silt was removed. Select material should be rolled to 95 percent compaction and to a smooth surface for the AC topping."

2.) For concern on word "subdrain" at report paragraph on "Road Drainage" (pg 8, first paragraph), we would like to change "Subdrains" to "Drains and culverts" at first line of paragraph.

Standard of Care

The above recommendations are provided in accordance with currently accepted standards of geotechnical engineering principles and practices. No warranty, expressed or implied, or merchantability or fitness is made or intended in connection with our work by furnishing of oral or written reports or findings.

We appreciate this opportunity to be of continued service to you. Should you have any questions, please give us a call.

Respectfully submitted,
PSC CONSULTANTS, LLC



Derrick Chan
Project Engineer

DSC/GT/PSC: lk



This work was prepared by
me or under my supervision
(License Expires April 30, 2014)



George Takamiya, P.E.
Senior Engineer

