GUYANA SHORE BASE INC.

GEORGETOWN, GY

SCOPE OF WORK DOCUMENT

FOR

SHOREBASE PAVEMENT PROJECT

PREPARED BY:

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.

PH: 504-895-0368

WWW.LANIER-ENGINEERS.COM

TEXAS REGISTERED FIRM: F-2981

OCTOBER 23, 2026

TABLE OF CONTENTS

PART 1 - GENERAL 2
- **A. RELATED DOCUMENTS 2**
- **B. SUMMARY 2**
- **C. PROJECT INFORMATION 2**
- **D. WORK COVERED BY CONTRACT DOCUMENTS 3**
- **E. SUBMITALS 4**
- **F. CONDITIONS ON SITE 4**
- **G. WEATHER 5**
- **H. WORK RESTRICTIONS 5**
- **I. PROJECT DRAWINGS 6**

PART 2 - PRODUCTS 6
- **A. GENERAL 6**

PART 3 - EXECUTION 6
- **A. COORDINATION WITH OWNER 6**
- **B. STANDBY TIME 7**
- **C. SURVEYING AND LAYOUT 7**
- **D. BILLING 7**

APPENDICIES
- **A. CONTRACT DRAWINGS**
- **B. SPECIFICATIONS**

PART 1 - GENERAL

A. RELATED DOCUMENTS

Project Drawings and Specifications, and general provisions of the Contract Documents, apply to this Section.

B. SUMMARY

1. The Scope of Work is defined by the Contract Documents and consists of the following work items.

a) New trenches and bond beams where indicated

b) Fine grading of subbase

c) Bedding sand installation

d) Paver installation

e) Asphalt installation

2. This work includes all that is necessary to provide the Owner with a complete project and thereby includes the procurement, fabrication, transportation, and installation necessary to complete the work unless such items are specifically indicated as Owner furnished.

C. PROJECT INFORMATION

1. Project Name: Shorebase Pavement Project

2. Project Location: Georgetown, GY.

3. Owner: Guyana Shore Base INC.

4. Owner's Representative:

   Mr. Glenn Pasley
   Phone: (592) 227-2380
   Email: Glenn.Pasley@gysbi.com

5. Engineer: Lanier & Associates Consulting Engineers, Inc.

6. Engineer's Representative:

   Mr. Kevin Drouet, P.E.
   Phone: (504) 895-0368
   Email:kdrouet@lanier-engineers.com

7. Document Control:

   Mrs. Maureen Stransky
   Phone: (504) 895-0368
   Email:mstransky@lanier-engineers.com

D. WORK COVERED BY CONTRACT DOCUMENTS

1. New trenches and bond beams

   a) Locations and construction details of future bond beams and trenches

2. Fine grading of subbase

   a) Specifications on subbase type and standards can be found in the attached documents

3. Bedding Sand Installation

   a) Bedding sand standards as well as installation methodology can be found in the contract drawings.

4. Paver Installation

   a) For paver installation methodology, laying pattern, and standards see the construction drawings and attached documents.

5. Asphalt Installation

   a) For asphalt installation methodology, elevations, and standards see the construction drawings and attached documents

E. SUBMITALS

Submittals shall be submitted via email to document control representative who will maintain the project submittal log. A two-week review and approval cycle should be allotted for all submittals. Approval should be received prior to purchase, fabrication or commencement of work. Provide submittals for the following items:

1. Preliminary project schedule (as part of Bid)

2. All submittals specified in the project specification
    a) Mix Designs
    b) Trial Batch Qualification Test Results
    c) Proposed Curing Methods
    d) Reinforcing Bending Schedule & Placing Drawings
    e) Concrete Delivery Ticket
    f) Compression Test Reports
    g) Compression Breaks
    h) Weekly quality control compaction test results (soil and asphalt)

3. Submittals required by GYSBI
    a) Traffic control plan
    b) Work area sequence plan
    c) Any other miscellaneous submittals required by Owner

F. CONDITIONS ON SITE

1. Contractors are to familiarize themselves with the location and conditions under which the work will be performed or any conditions that will affect the work. No additional allowance will be granted due to lack of knowledge of such conditions.

2. The Contractor is to field verify dimensions and identify any interference or limitations. Any additional costs resulting from an incorrectly verified dimensions, undetected interference, or access limitations will be the Contractor's responsibility.

3. The Contractor must take care not to damage coating, existing structures, piping or equipment.

4. During the actual construction period, the Contractor will make every effort to maintain the work site in a clean and safe condition. At the completion of all construction activity, the Contractor shall restore all work areas to, at least, the condition that existed prior to any construction activity. Final cleanup and site restoration will be subject to inspection and acceptance by the Owner.

5. Space will be provided on site for lay down of materials. Laydown area will be limited to 1 – 2 days' worth of production materials at the GSB location. Additional laydown area shall be available at the GCT and/or GIE locations.

6. Field adjustments of the design and lyaout will be required based on above and below grade infrastructure. Contractor to adjustment elevations and highpoints on a case by case basis and in accordance with GYSBI field directions. Technical adjustments can be brought to the Engineer via the RFI process.

G. WEATHER

1. Owner shall not be held accountable for problems or delays which are incurred as a direct result of adverse weather conditions or other acts of God. Downtime due to adverse weather should be estimated and included in the Contractor's schedule and the base bid.

2. The work is located in an area that is occasionally subject to high wind events. The Contractor must prepare a plan to secure his materials and equipment at the work site in the event of an approaching storm.

H. WORK RESTRICTIONS

1. All GYSBI facility safe work practices shall be followed

2. Do not interrupt utilities serving facilities.

3. Owner may choose to require identification tags for Contractor personnel working on Project site.

4. Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site. Maintain list of approved screened personnel with Owner's representative.

5. New road closure must be coordinated with GYSBI at least 96 hours in advance.

I. PROJECT DRAWINGS

1. Only Project Drawings which are stamped "For Construction" and sealed by the Engineer may be used for construction.

2. Contractor shall be responsible to ensure his field crew receives the most current set of Project Drawings, revisions, and addenda.

3. A red-lined "as-built" set shall be maintained by the Contractor and submitted to the Owner prior to demobilization.

PART 2 - PRODUCTS

A. GENERAL

1. Contractor shall be responsible for furnishing all materials necessary to complete the Work Covered by Contract. The Work includes unloading, handling, storing, and protecting Contractor-furnished products as required.

PART 3 - EXECUTION

A. COORDINATION WITH OWNER

1. Contractor shall have restricted use of the Project site for construction operations as indicated in the bid documents.

2. Owner will continue to operate the facility during the entire construction period. It is the Contractors responsibility to have the flexibility to move to areas of the project to avoid interference with the Owner's day-to-day operations.

3. Contractor to plan the work and present the plan for review to Owner during bid process.

4. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage.

5. Contractor to meet at least weekly with the Owner to review the upcoming terminal schedules and adjust their work plan as needed.

6. Contractor downtime rates caused by unscheduled changes in the shipping traffic will be negotiated with the bidders prior to award.

7. Contractor to provide at his cost field quality control compaction testing and submit reports on a weekly basis.

8. Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

9. Roadways, Walkways, Ramps and Entrances: Keep roadways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles to the greatest extent possible.

10. Notify Owner not less than one week in advance of activities that may affect Owner's operations.

11. Do not use roadways, walkways and entrances for parking or storage of materials, unless directed by owner.

12. Schedule deliveries to minimize use of roadways and entrances by construction operations.

13. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

14. Contractor to submit a traffic control plan and work area sequencing plan to the owner for review prior to commencement of work.

15. A Project Manager, HSE Officer, and Quality Control Officer are required to be on site at all times. Field office and break locations will be at the direction of the owner.

B. STANDBY TIME

1. Contractor shall notify Owner immediately upon delay due to Owner operations and only if no other contractual scope of work is available.

C. SURVEYING AND LAYOUT

1. Surveying and layout work for this project will be the responsibility of the Contractor.

D. BILLING

1. Billing will be as indicated in the Contractor’s contract with the Owner.

APPENDIX A

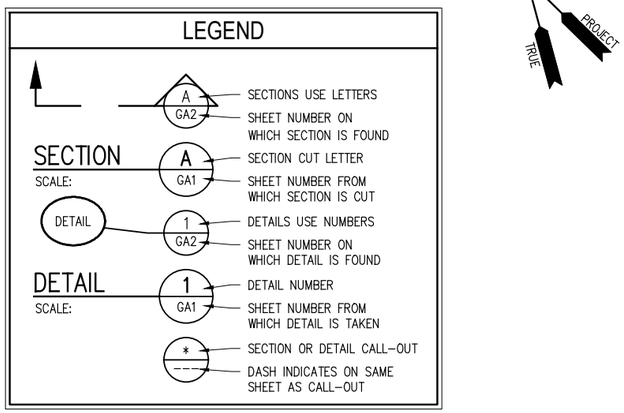
CONTRACT DRAWINGS

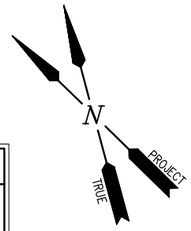
10/23/2026 5:03 PM

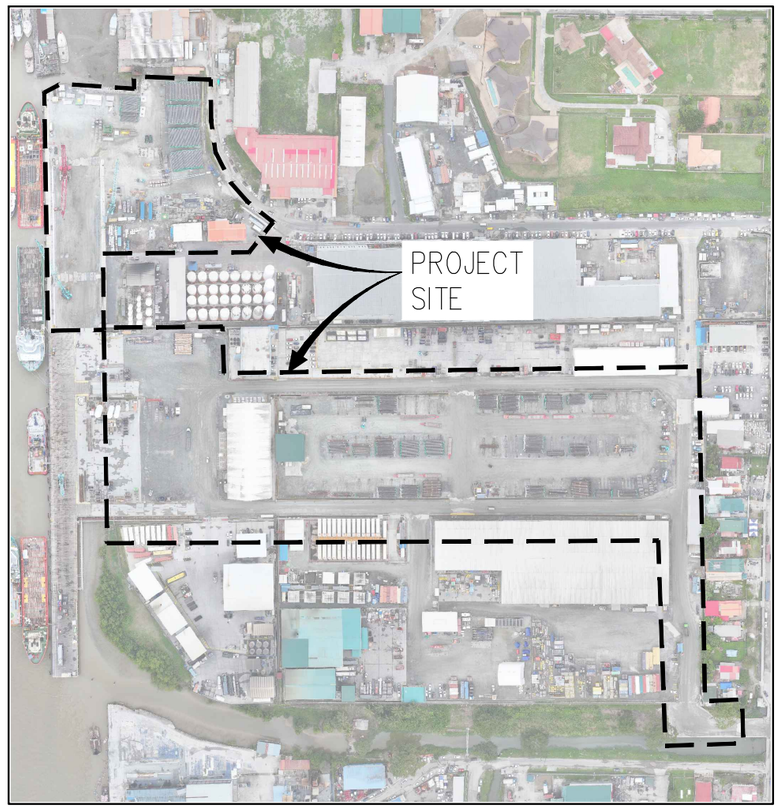
GYSBI

GEORGETOWN, GUYANA

SHORE BASE PAVEMENT PROJECT







DRAWING INDEX		
DWG. NO.	REV.	DRAWING TITLE
CS1	0	TITLE SHEET – VICINITY MAP, LEGEND & DRAWING INDEX
CS2	0	GENERAL NOTES
SP1	0	OVERALL SITE KEY PLAN
SP2	0	OVERALL SITE SEQUENCING PLAN
S1	0	ENLARGED SITE PLAN (1 OF 24) – SEQUENCE 1
S2	0	ENLARGED SITE PLAN (2 OF 24) – SEQUENCE 1
S3	0	ENLARGED SITE PLAN (3 OF 24) – SEQUENCE 2
S4	0	ENLARGED SITE PLAN (4 OF 24) – SEQUENCES 2 & 3
S5	0	ENLARGED SITE PLAN (5 OF 24) – SEQUENCE 4
S6	0	ENLARGED SITE PLAN (6 OF 24) – SEQUENCE 5
S7	0	ENLARGED SITE PLAN (7 OF 24) – SEQUENCES 5 & 6
S8	0	ENLARGED SITE PLAN (8 OF 24) – SEQUENCES 6 & 7
S9	0	ENLARGED SITE PLAN (9 OF 24) – SEQUENCE 8
S10	0	ENLARGED SITE PLAN (10 OF 24) – SEQUENCE 8
S11	0	ENLARGED SITE PLAN (11 OF 24) – SEQUENCE 9
S12	0	ENLARGED SITE PLAN (12 OF 24) – SEQUENCE 10
S13	0	ENLARGED SITE PLAN (13 OF 24) – SEQUENCE 11
S14	0	ENLARGED SITE PLAN (14 OF 24) – SEQUENCE 11
S15	0	ENLARGED SITE PLAN (15 OF 24) – SEQUENCE 12
S16	0	ENLARGED SITE PLAN (16 OF 24) – SEQUENCE 12
S17	0	ENLARGED SITE PLAN (17 OF 24) – SEQUENCE 13
S18	0	ENLARGED SITE PLAN (18 OF 24) – SEQUENCE 14
S19	0	ENLARGED SITE PLAN (19 OF 24) – SEQUENCE 15
S20	0	ENLARGED SITE PLAN (20 OF 24) – SEQUENCE 16
S21	0	ENLARGED SITE PLAN (21 OF 24) – SEQUENCE 17
S22	0	ENLARGED SITE PLAN (22 OF 24) – SEQUENCE 18
S23	0	ENLARGED SITE PLAN (23 OF 24) – SEQUENCE 19
S24	0	ENLARGED SITE PLAN (24 OF 24) – SEQUENCE 20
S25	0	DETAIL SHEET (1 OF 2)
S26	0	DETAIL SHEET (2 OF 2)

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
TITLE SHEET
VICINITY MAP, LEGEND & DRAWING INDEX

SHEET NO.
CS1

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-CS1.DWG

10/23/2026 5:03 PM

GENERAL NOTES

1. CONSTRUCTION SHALL COMPLY WITH THESE GENERAL NOTES, THE CONTRACT DRAWINGS, SPECIFICATIONS, AND ALL APPLICABLE STATE AND LOCAL CODES.
2. EXISTING CONSTRUCTION AND CONDITIONS SHOWN ARE SCHEMATIC. ACTUAL CONDITIONS MAY DIFFER. CONTRACTOR IS FULLY RESPONSIBLE FOR MAKING THEIR OWN SITE EXAMINATION AND DETERMINING THE ACTUAL NATURE AND EXTENT OF EXISTING CONDITIONS AS NEEDED PRIOR TO UNDERTAKING THE WORK.
3. CONTRACTOR SHALL BE REQUIRED TO MAINTAIN COPIES OF OWNER SECURED PERMITS ONSITE FOR THE DURATION OF CONSTRUCTION AND ABIDE BY ALL REQUIREMENTS AND RESTRICTIONS SET FORTH BY THESE PERMITS. ANY ADDITIONAL PERMITS, LICENSES AND NOTIFICATIONS NECESSARY FOR THE PROSECUTION OF WORK SHALL BE SECURED BY THE CONTRACTOR.
4. PORTIONS OF THE FACILITY WILL REMAIN IN OPERATION DURING THE WORK. CONTRACTOR SHALL COORDINATE WORK SCHEDULE WITH THE OWNER. CONTRACTOR SHALL NOT INTERFERE WITH ACTIVITIES AT THE FACILITY TO ALL EXTENTS POSSIBLE.
5. ANY DAMAGE, DISTURBANCE, OR OTHER IMPAIRMENT OF EXISTING FACILITIES SHALL BE PROMPTLY REPAIRED OR REPLACED BY THE CONTRACTOR AS APPROVED BY AND AT NO ADDITIONAL COST TO THE OWNER.
6. CONTRACTOR SHALL REMOVE CONSTRUCTION MATERIAL AND DEBRIS FROM THE WORK SITE DURING AND AT COMPLETION OF THE WORK.
7. STORAGE OF EQUIPMENT AND MATERIAL SHALL BE IN OWNER-DESIGNATED AREAS ONLY.
8. SITE ACCESS SHALL BE AS DIRECTED BY THE OWNER.
9. IT IS SOLELY THE CONTRACTOR'S RESPONSIBILITY TO FOLLOW ALL APPLICABLE SAFETY CODES, PERMIT RESTRICTIONS AND REGULATIONS DURING ALL PHASES OF CONSTRUCTION. CONTRACTOR IS RESPONSIBLE FOR SAFETY PRECAUTIONS, MEANS, METHODS, TECHNIQUES, SEQUENCES OR PROCEDURES REQUIRED FOR PERFORMANCE OF THE WORK INCLUDING, BUT NOT LIMITED TO, SHORING, SCAFFOLDING, UNDERPINNING AND ERECTION.
10. ALL STRUCTURES ARE DESIGNED TO BE SELF-SUPPORTING AND STABLE AFTER ERECTION IS FULLY COMPLETED. IT IS SOLELY THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE ERECTION PROCEDURE AND SEQUENCE AND TO ENSURE THE SAFETY OF THE STRUCTURE AND ITS COMPONENTS DURING ERECTION. THIS INCLUDES THE ADDITION OF ANY SHORING, SHEETING, TEMPORARY BRACING, GUYS, OR TIE DOWNS WHICH MIGHT BE NECESSARY. SUCH MATERIAL SHALL REMAIN THE CONTRACTOR'S PROPERTY AFTER COMPLETION OF THE PROJECT.
11. CONTRACTOR WILL BE RESPONSIBLE FOR ALL LAYOUT AND SURVEYING REQUIRED FOR THE CONSTRUCTION AS SHOWN ON THE DRAWINGS.
12. CONTRACTOR SHALL LOCATE ALL UNDERGROUND PIPING, UTILITIES, AND OTHER OBSTRUCTIONS IN THE VICINITY OF WORK AREA PRIOR TO BEGINNING CONSTRUCTION. OWNER TO SUPPLY CONTRACTOR WITH UNDERGROUND UTILITY SURVEY, CONTRACTOR TO USE CAUTION WHILE PERFORMING WORK IN THESE AREAS. ADJUSTMENT OF THE WORK MAY BE REQUIRED WHERE UTILITIES ARE ENCOUNTERED.
13. ALL EXISTING DIMENSIONS AND ELEVATIONS SHOWN ON DRAWINGS SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO MOBILIZATION. CONTRACTOR SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES.
14. SHOULD ANY OF THE DETAILED INSTRUCTIONS SHOWN ON THE PLANS CONFLICT WITH THE GENERAL STRUCTURAL NOTES, THE SPECIFICATIONS, OR WITH EACH OTHER, THE STRICTEST PROVISION SHALL GOVERN.
15. THE LATEST REVISION OF THE FOLLOWING CODES AND STANDARDS SHALL BE OBSERVED FOR ALL PROJECT RELATED ACTIVITIES:

    ACI 318 AND ACI 315R
    AWS D1.1
16. CONTRACTOR TO DEVELOP AND SUBMIT A TRAFFIC CONTROL PLAN TO THE OWNER FOR REVIEW.
17. SLOPE ARROWS SHOWN IN EXISTING TRENCHES ARE REPRESENTATIVE OF INTENDED FLOW DIRECTION AND NOT A DIFFERENCE IN GRADE.
18. FINAL CONSTRUCTION SEQUENCE TO BE DETERMINED BY OWNER.
19. CONTRACTOR TO PROVIDE NEW CRUSHER RUN MATERIAL AS NEEDED. NEW CRUSHER RUN MATERIAL TO BE SUBMITTED TO OWNER FOR APPROVAL. EXISTING CRUSHER RUN MATERIAL ONSITE MAY BE USED WHERE APPLICABLE.

HANDRAILS

1. EXISTING HANDRAILS NOT ABLE TO BE REUSED SHALL BE REPLACED WITH MATCHING NEW HANDRAILS HOT DIPPED GALVANIZED IN ACCORDANCE WITH ASTM A123 AND THEN PAINTED "SAFETY YELLOW".
2. ALL WELD CONNECTIONS FOR HANDRAILS SHALL BE 3/16" FILLET, UNLESS NOTED OTHERWISE, AND SHALL BE IN ACCORDANCE WITH AWS D1.1, LATEST EDITION.

CONCRETE

1. CONCRETE COMPRESSIVE STRENGTH:
   ALL CONCRETE = 5,000 PSI **CYLINDER STRENGTH** AT TWENTY-EIGHT (28) DAYS, UNLESS OTHERWISE NOTED. CONCRETE SHALL CONFORM WITH THE "BUILDING CODE REQUIREMENTS FOR REINFORCING CONCRETE", ACI 318 (LATEST EDITION). CEMENT SHALL BE TYPE I.
2. CONCRETE WATER/CEMENT RATIO SHALL BE A MAXIMUM OF 0.40.
3. CURING – CONCRETE SHALL BE KEPT IN MOIST CONDITION FOR AT LEAST SEVEN (7) DAYS AFTER PLACEMENT.
4. AT LEAST ONE SET OF EIGHT (8) TEST SPECIMENS SHALL BE COLLECTED FOR EACH 100 CUBIC YARDS OR FRACTIONS THEREOF PLACED IN ANY ONE DAY. TWO (2) TEST SPECIMENS ARE TO BE TESTED AT SEVEN (7) DAYS, TWO (2) AT FOURTEEN (14) DAYS, TWO (2) AT TWENTY-EIGHT (28) DAYS, AND THE OTHER TWO (2) HELD TO BE TESTED AS REQUIRED BY THE ENGINEER.
5. CHAMFER ALL EXPOSED EXTERNAL CORNERS WITH A 3/4" 45° CHAMFER, UNLESS NOTED OTHERWISE.
6. ALL CONCRETE SHALL BE THOROUGHLY COMPACTED BY MECHANICALLY VIBRATING OR HAND POUNDING, AND SHALL BE THOROUGHLY WORKED AROUND THE REINFORCEMENT AND INTO ALL CORNERS OF THE FORMS.
7. CONCRETE TRENCH TO BE PRECAST WHERE FEASIBLE. ADDITIONAL FIELD SPLICES CAN BE ADDED AS REQ'D TO ALLOW TRENCH SLOPING. ADDITIONAL SPLICES CAN BE ADDED AT CONTRACTOR'S DISCRETION AND SHALL HAVE STD ACI REBAR SPLICE LENGTHS PROVIDED.

GRATING

1. ALL TRENCH GRATING SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A123, UNLESS NOTED OTHERWISE.

REINFORCING STEEL

1. REINFORCING BARS SHALL BE NEW DEFORMED BILLET STEEL CONFORMING TO ASTM A615 GRADE 60 OR ASTM A706 GRADE 60. REINFORCING BARS TO BE WELDED SHALL BE ASTM A706 GRADE 60.
2. ALL REBAR SPLICES SHALL COMPLY WITH THE PROVISIONS OF ACI 318-19 AND HAVE A MINIMUM OVERLAP OF FORTY (40) BAR DIAMETERS.
3. BAR SUPPORTS AND SPACERS SHALL COMPLY WITH REQUIREMENTS OF ACI 315R-18.
4. FABRICATION OF BARS, INCLUDING BENDS AND HOOKS, SHALL CONFORM TO ACI 315R-18. ALL BENDS SHALL BE MADE COLD UNLESS NOTED OTHERWISE.
5. BARS SHALL BE SECURELY TIED IN PLACE WITH 16-GAGE BLACK ANNEALED TIE WIRE AND SUPPORTED ON APPROVED STEEL CHAIRS OR PRECAST CONCRETE SADDLES.
6. ADHESIVE FOR POST INSTALLED EPOXY REINFORCEMENT SHALL BE HILTI HIT HY200 OR A-V3.

CIVIL NOTES

1. CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING PROPER ACCESS AND DRAINAGE IN THE WORK AREA AT ALL TIMES DURING CONSTRUCTION.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING THE OWNER OF ENCOUNTERING ANY EXISTING UNDERGROUND OBJECTS.
3. EXISTING DRAINAGE PATTERNS OUTSIDE THE CONSTRUCTION WORK AREA SHALL NOT BE ALTERED WITHOUT PRIOR WRITTEN APPROVAL FROM THE OWNER.
4. SLOPE IS CONSTANT BETWEEN SHOWN ELEVATIONS, UNLESS NOTED OTHERWISE.
5. LAND FEATURES OUTSIDE OF WORK AREA ARE PROVIDED FOR INFORMATION ONLY.
6. ALL EXCAVATIONS SHALL BE MAINTAINED IN ACCORDANCE WITH FEDERAL, STATE AND LOCAL SAFETY REQUIREMENTS.
7. PAVER BEDDING SAND: IN ACCORDANCE WITH ASTM C33, FINE AGGREGATE.
8. ROAD BED BASE COURSE: IN ACCORDANCE WITH ASTM D2940; WITH AT LEAST 95% PASSING A 1 1/2" SIEVE AND NOT MORE THAN 8% PASSING A NO. 200 SIEVE, COMPACTED TO 95% IN ACCORDANCE WITH ASTM D698.
9. PROJECT DESIGN BASED ON SURVEY BY C.B. & ASSOCIATES DATED OCT. 2024.
10. EXISTING SURVEY ELEVATIONS ARE SHOWN ON THE ENLARGED PLANS FOR CONTRACTOR REFERENCE. ALL EXISTING SURVEY ELEVATIONS AND COORDINATES ARE BASED ON CONTROL POINTS LOCATED ON PAGES S7 AND S15. CONTRACTOR TO FIELD VERIFY ELEVATIONS AND COORDINATES AS REQUIRED AND ALERT ENGINEER OF ANY DISCREPANCIES.
11. CONTRACTOR TO SCRAPE OFF EXISTING CRUSHED STONE SURFACING OR ADD COMPACTED CRUSHED STONE TO BASE COURSE TO ACHIEVE DESIRED ELEVATIONS SHOWN IN PLANS.
12. THE INFORMATION IN THIS DESIGN IS BASED ON THE GEOTECHNICAL REPORT FROM VOLHARDEN DATED ON 9/23/2025.

PAVER NOTES

1. PERMEABLE INTERLOCKING CONCRETE PAVERS SHALL MEET ASTM C936.
2. ALL PAVERS WITHIN 6 FT. (2M) OF THE LAYING FACE SHALL BE FULLY COMPACTED AT THE COMPLETION OF EACH DAY.
3. SURFACE TOLERANCE OF COMPACTED PAVERS SHALL DEVIATE NO MORE THAN ±3/8IN. (10MM) UNDER A 10FT. (3M) LONG STRAIGHTEDGE.
4. LIPPAGE: SHALL BE NO GREATER THAN 1/8IN. (3MM) DIFFERENCE IN HEIGHT BETWEEN ADJACENT PAVERS.
5. ALL PAVER WORK TO BE PERFORMED IN ACCORDANCE WITH THE SUPPLIED SPECIFICATIONS IN THE SCOPE OF WORK DOCUMENT.

PAVER DESIGN CRITERIA

1. AN AVERAGE DAILY TRAFFIC (ADT) OF 75 TRUCKS WAS USED (PER PREVIOUS TRAFFIC STUDY).
2. A TRUCK FACTOR OF 1.7 WAS USED.
3. A DESIGN LIFE OF 20 YEARS WAS CONSIDERED ALONG WITH A 2% GROWTH RATE.
4. A 100 PERCENT DIRECTIONAL DISTRIBUTION WAS USED WITH A 90/10 LANE DISTRIBUTION.
5. THE FACTORS LISTED YIELD A DESIGN ESAL VALUE OF 1,000,000.

ASPHALT NOTES

1. ALL ASPHALT MATERIALS TO BE SUBMITTED TO OWNER FOR APPROVAL.
2. SEE SPECIFICATION FOR DETAILS ON MIX CONTENT, TESTING METHODS, TESTING FREQUENCY, AND GENERAL EXECUTION.
3. ASPHALT CONSTRUCTION SHALL OCCUR IN TWO LIFTS. A 4" (100 mm) LIFT OF BASE, FOLLOWED BY A 2" (50 mm) LIFT OF WEARING COURSE.

ASPHALT DESIGN CRITERIA

1. AN AVERAGE DAILY TRAFFIC (ADT) OF 75 TRUCKS WAS USED (PER PREVIOUS TRAFFIC STUDY).
2. A TRUCK FACTOR OF 1.7 WAS USED.
3. A DESIGN LIFE OF 30 YEARS WAS CONSIDERED ALONG WITH A 2% GROWTH RATE.
4. A 100 PERCENT DIRECTIONAL DISTRIBUTION WAS USED WITH A 90/10 LANE DISTRIBUTION.
5. THE FACTORS LISTED YIELD A DESIGN ESAL VALUE OF 1,700,000.

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

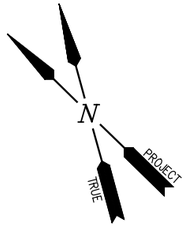
GYSBI
GEORGETOWN GUYANA

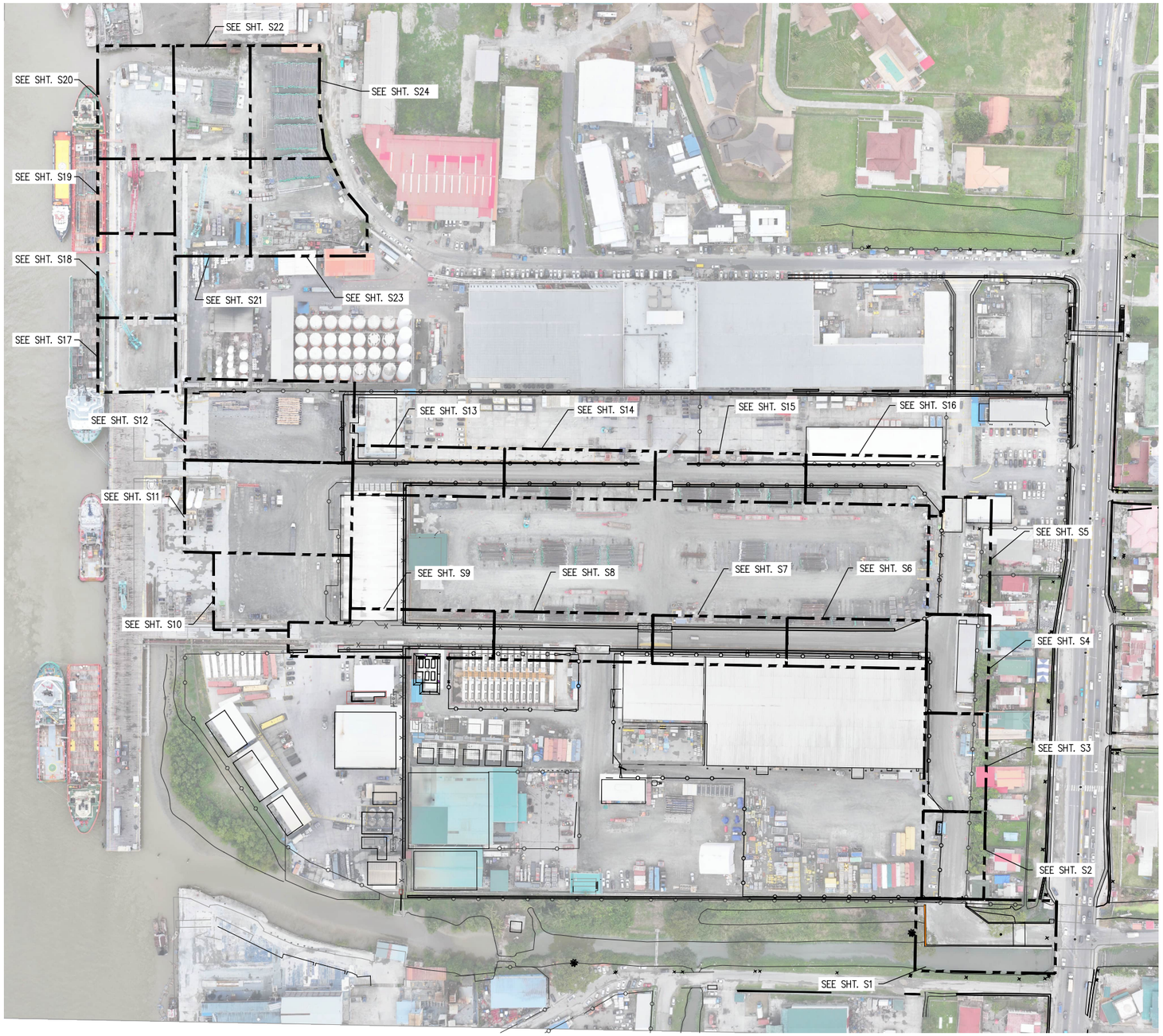
SHORE BASE PAVEMENT PROJECT
GENERAL NOTES

SHEET NO.
CS2

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-CS2.DWG

10/23/2026 5:03 PM





OVERALL SITE KEY PLAN

SCALE = 1:1200

0 60 120 180 240m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

J: \13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-SP1.DWG

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN PJC
CHECK KLD
APPR'D KLD
JOB NO 13582

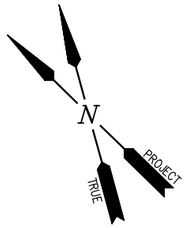
GYSBI
GEORGETOWN GUYANA

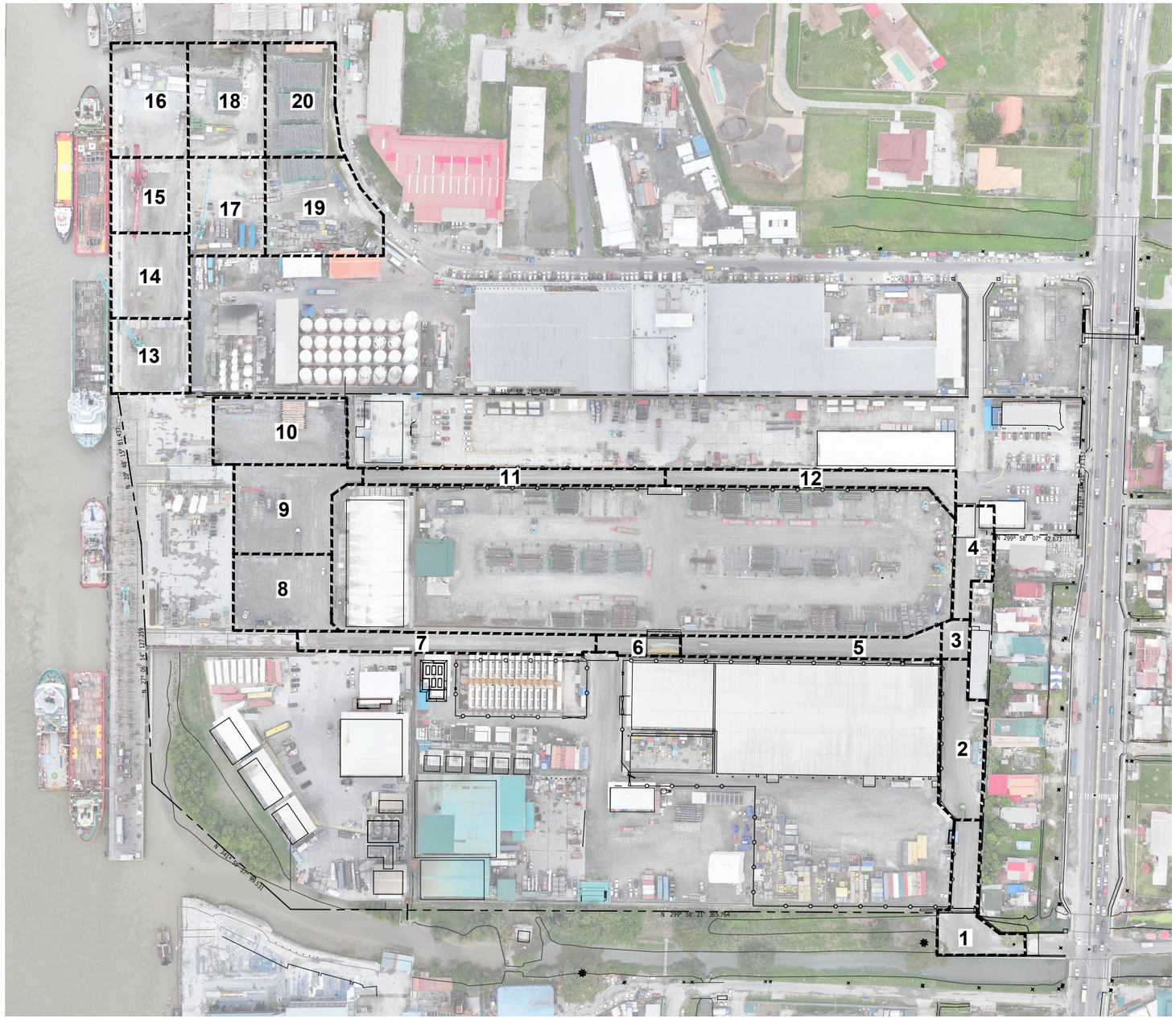
SHORE BASE PAVEMENT PROJECT

OVERALL SITE KEY PLAN

SHEET NO.
SP1

10/23/2026 5:03 PM





PHASE 1 = 1 THROUGH 7
PHASE 2 = 8 THROUGH 12
PHASE 3 = 13 THROUGH 20

OVERALL SITE SEQUENCING PLAN
SCALE = 1:1200

0 60 120 180 240m

NOTES:

1. PROPOSAL SEQUENCING IS SUBJECT TO CHANGE AND SHOULD BE COORDINATED WITH GYSBI PRIOR TO AWARD.

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-SP2.DWG

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

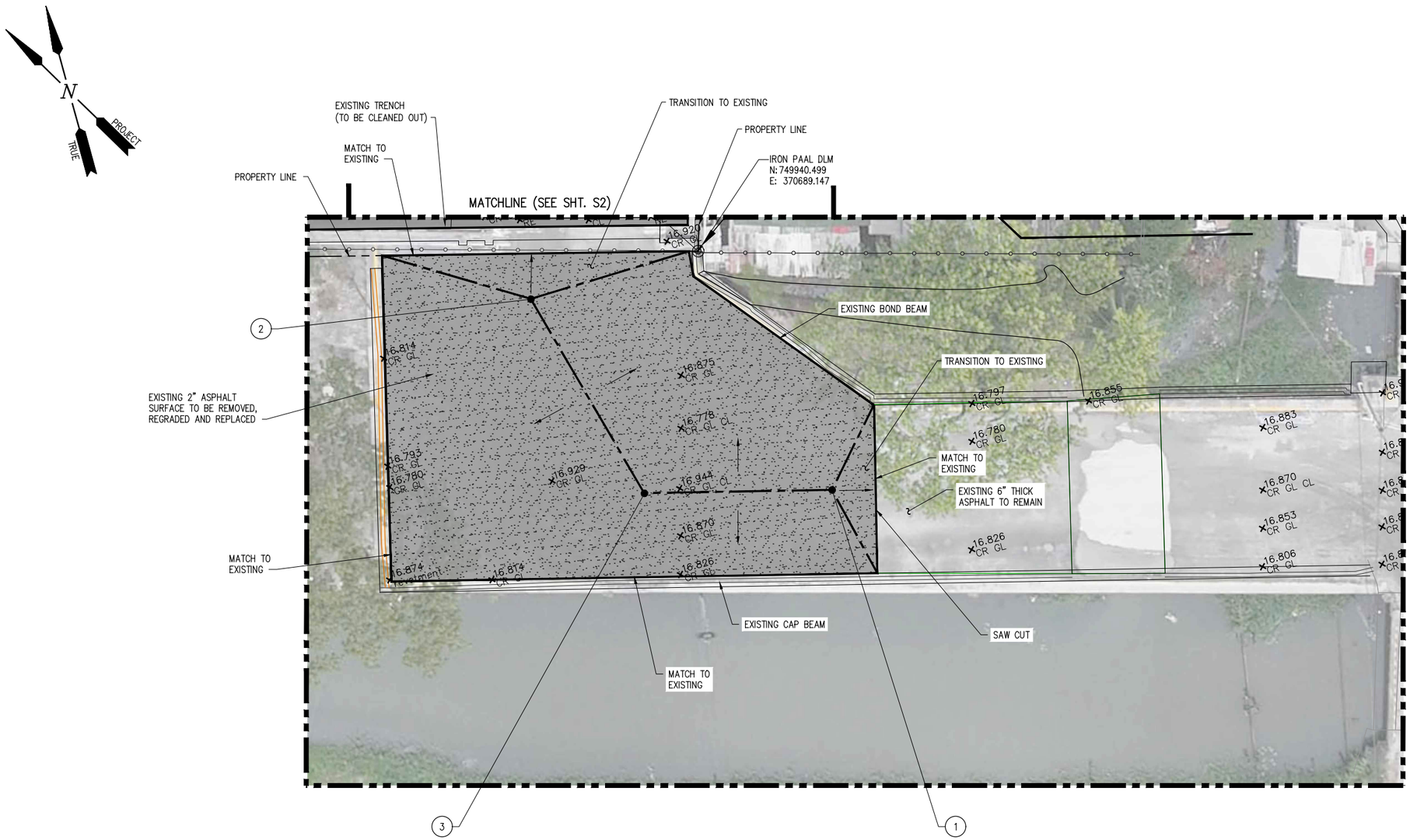
SHORE BASE PAVEMENT PROJECT

OVERALL SITE SEQUENCING PLAN

SHEET NO.
SP2

10/23/2026 5:03 PM

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)17.05	749922.25	370693.72	H.P. OF ASPHALT
2	(+)17.05	749937.62	370673.84	H.P. OF ASPHALT
3	(+)17.05	749925.43	370681.21	H.P. OF ASPHALT



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHALT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	655.69

ENLARGED SITE PLAN (1 OF 24)
SEQUENCE 1

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

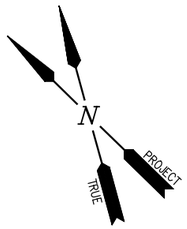
GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (1 OF 24)
SEQUENCE 1

SHEET NO.
S1

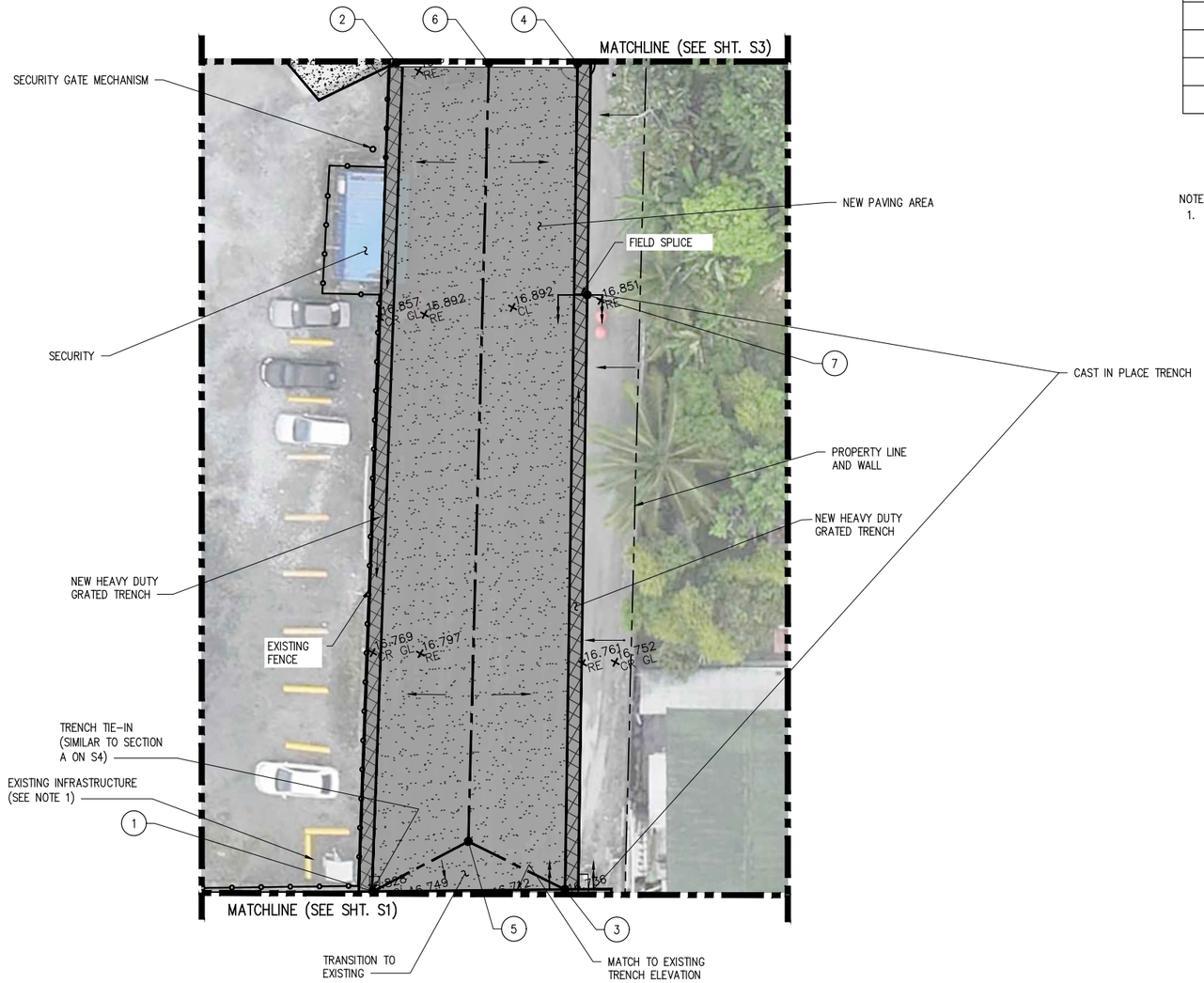
J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PK(G)\13582-PV-S1.DWG

10/23/2026 5:03 PM



POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)16.80	749946.73	370676.03	T.O. TRENCH WALL
2	(+)16.80	749991.86	370689.70	T.O. TRENCH WALL
3	(+)16.75	749943.97	370686.61	T.O. TRENCH WALL
4	(+)16.90	749989.10	370699.63	T.O. TRENCH WALL
5	(+)16.85	749948.04	370682.03	H.P. OF ASPHALT
6	(+)17.00	749990.43	370694.74	H.P. OF ASPHALT
7	(+)16.90	749976.27	370696.71	T.O. TRENCH WALL

NOTES:
1. CONTRACTOR TO WORK WITH GYSBI TO DETERMINE ALLOWABLE FIELD ADJUSTMENTS OF THE EXISTING INFRASTRUCTURE TO FACILITATE TRENCH TIE–IN.



LEGEND	
	– EXISTING HANDRAIL
	– EXISTING CHAINLINK FENCE
	– EXISTING SAFETY ROPE
	– THREADBAR
	– U.G. TRENCH
	– NEW BOND BEAM
	– EXISTING PAVERS
	– NEW PAVERS
	– EXISTING TRENCH
	– NEW TRENCH
	– NEW GRATED TRENCH
	– CONCRETE
	– NEW ASPHALT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	494.30
REINFORCED CONCRETE HEAVY DUTY TRENCH	M	93.92

ENLARGED SITE PLAN (2 OF 24)
SEQUENCE 1

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF–1120 VF–185 TX: F–2981 LSF–10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

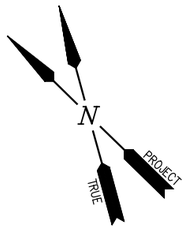
GYSBI
GEORGETOWN GUYANA

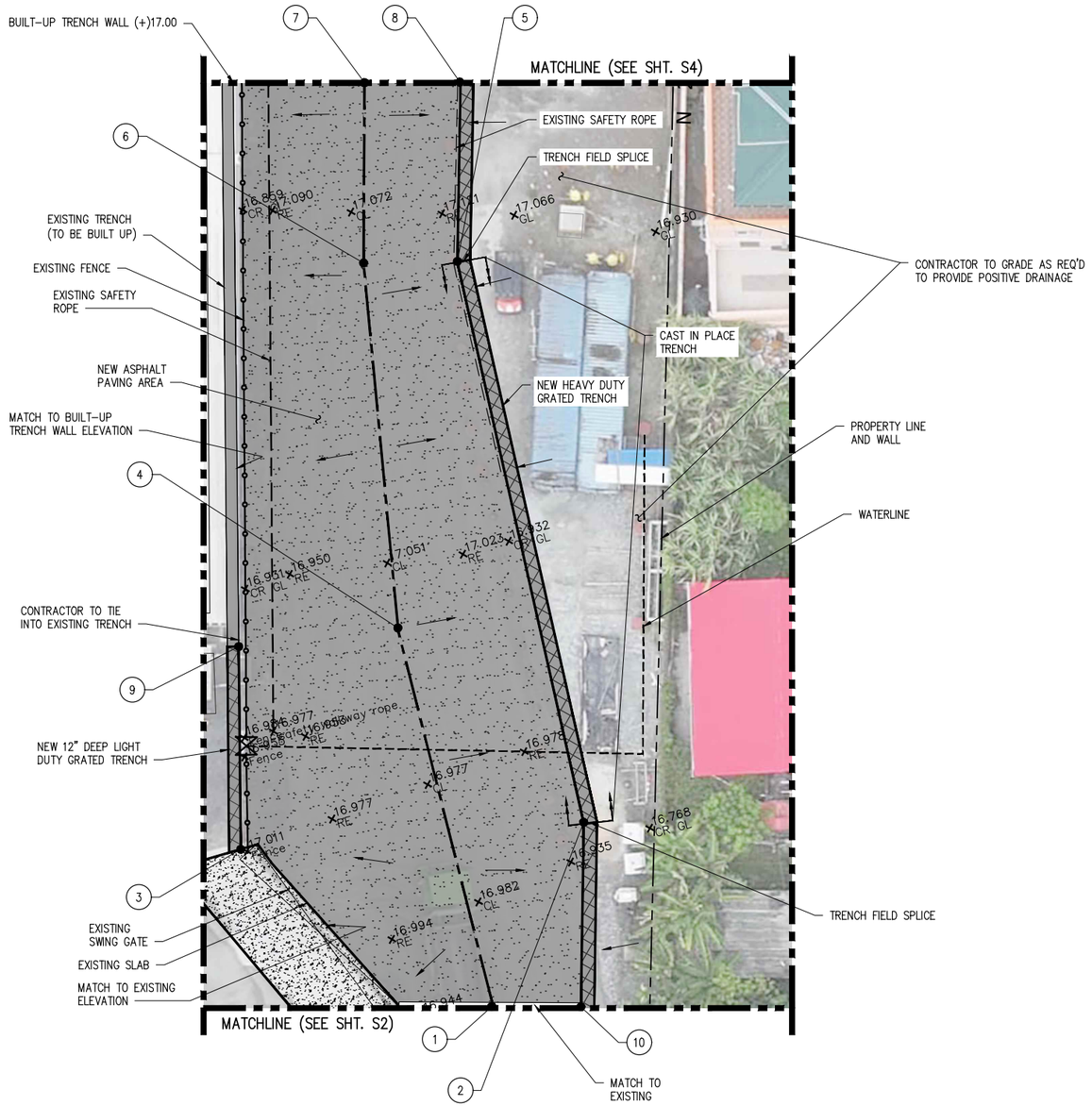
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (2 OF 24)
SEQUENCE 1

SHEET NO.
S2

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC – PAVEMENT PKG\13582–PV–S2.DWG

10/23/2026 5:03 PM





ENLARGED SITE PLAN (3 OF 24)
SEQUENCE 2
SCALE = 1:150

0 3 6 9 12 15 30m

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)17.00	749990.45	370694.77	H.P. OF ASPHALT
2	(+)16.90	749999.15	370702.53	T.O. TRENCH WALL
3	(+)17.00	750002.77	370683.38	T.O. TRENCH WALL
4	(+)17.10	750012.53	370695.26	H.P. OF ASPHALT
5	(+)17.00	750031.64	370703.95	T.O. TRENCH WALL
6	(+)17.10	750032.99	370698.81	H.P. OF ASPHALT
7	(+)17.10	750042.84	370701.54	H.P. OF ASPHALT
8	(+)17.00	750041.45	370706.81	T.O. TRENCH WALL
9	(+)17.00	750013.88	370686.28	T.O. TRENCH WALL
10	(+)16.90	749989.10	370699.63	T.O. TRENCH WALL

LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	733.89
REINFORCED CONCRETE HEAVY DUTY TRENCH	M	53.20
REINFORCED CONCRETE LIGHT DUTY TRENCH	M	11.48

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

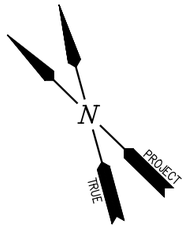
GYSBI
GEORGETOWN GUYANA

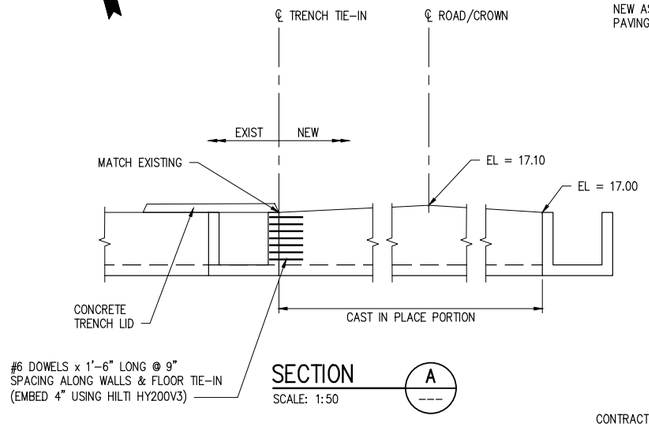
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (3 OF 24)
SEQUENCE 2

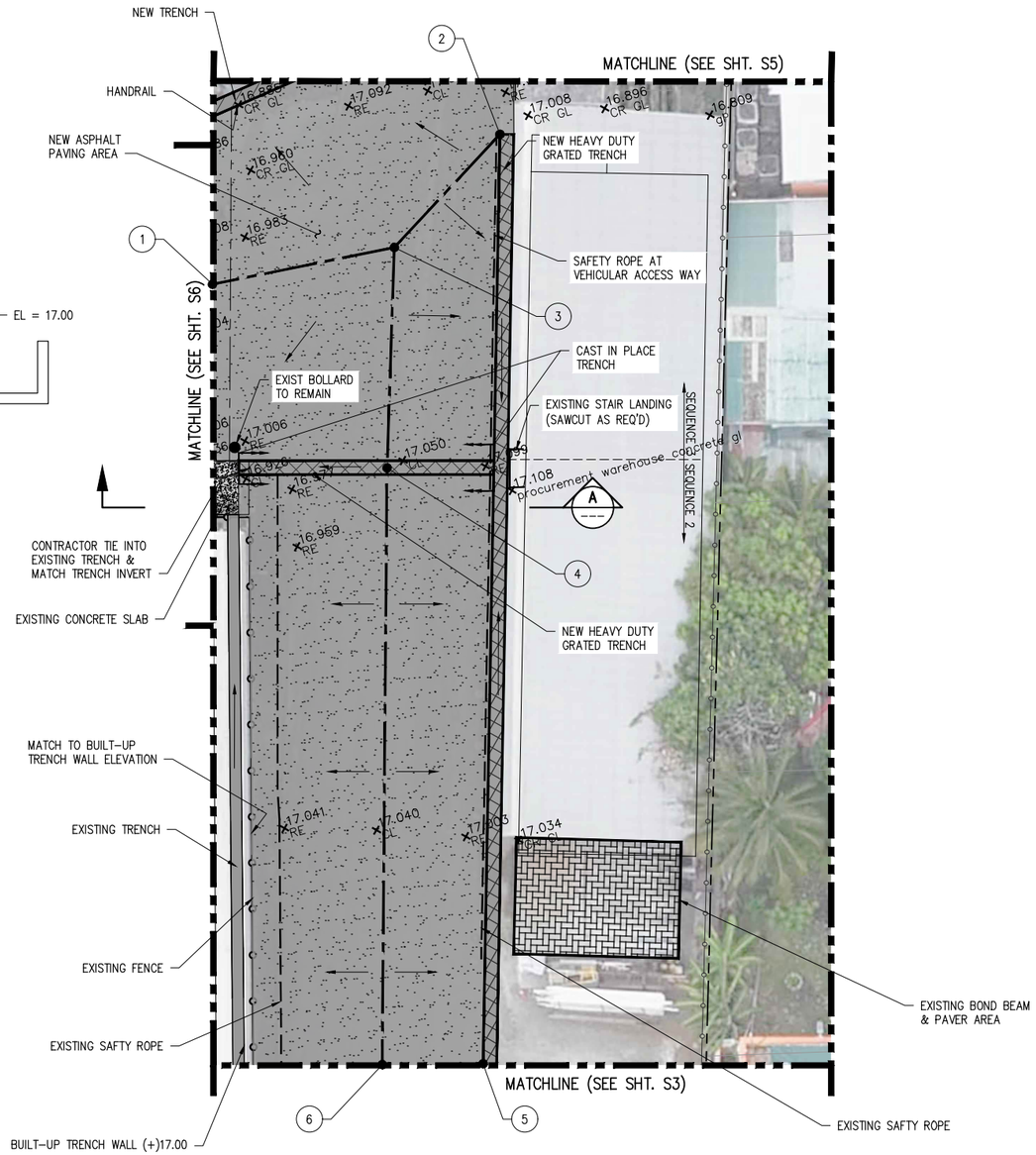
SHEET NO.
S3

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S3.DWG

10/23/2026 5:04 PM







ENLARGED SITE PLAN (4 OF 24)
SEQUENCE 2 & 3
SCALE = 1:150

0 3 6 9 12 15 30m

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)17.10	750085.88	370703.74	H.P. OF ASPHALT
2	(+)17.00	750089.62	370720.85	T.O. TRENCH WALL
3	(+)17.10	750085.23	370713.74	H.P. OF ASPHALT
4	(+)17.10	750073.85	370710.24	H.P. OF ASPHALT
5	(+)17.00	750041.45	370706.81	T.O. TRENCH WALL
6	(+)17.10	750042.84	370701.54	H.P. OF ASPHALT

LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	696.36
REINFORCED CONCRETE HEAVY DUTY TRENCH	M	63.94

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF–1120 TX: F–2981
VF–185 LSF–10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

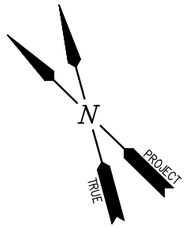
GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (4 OF 24)
SEQUENCE 2 & 3

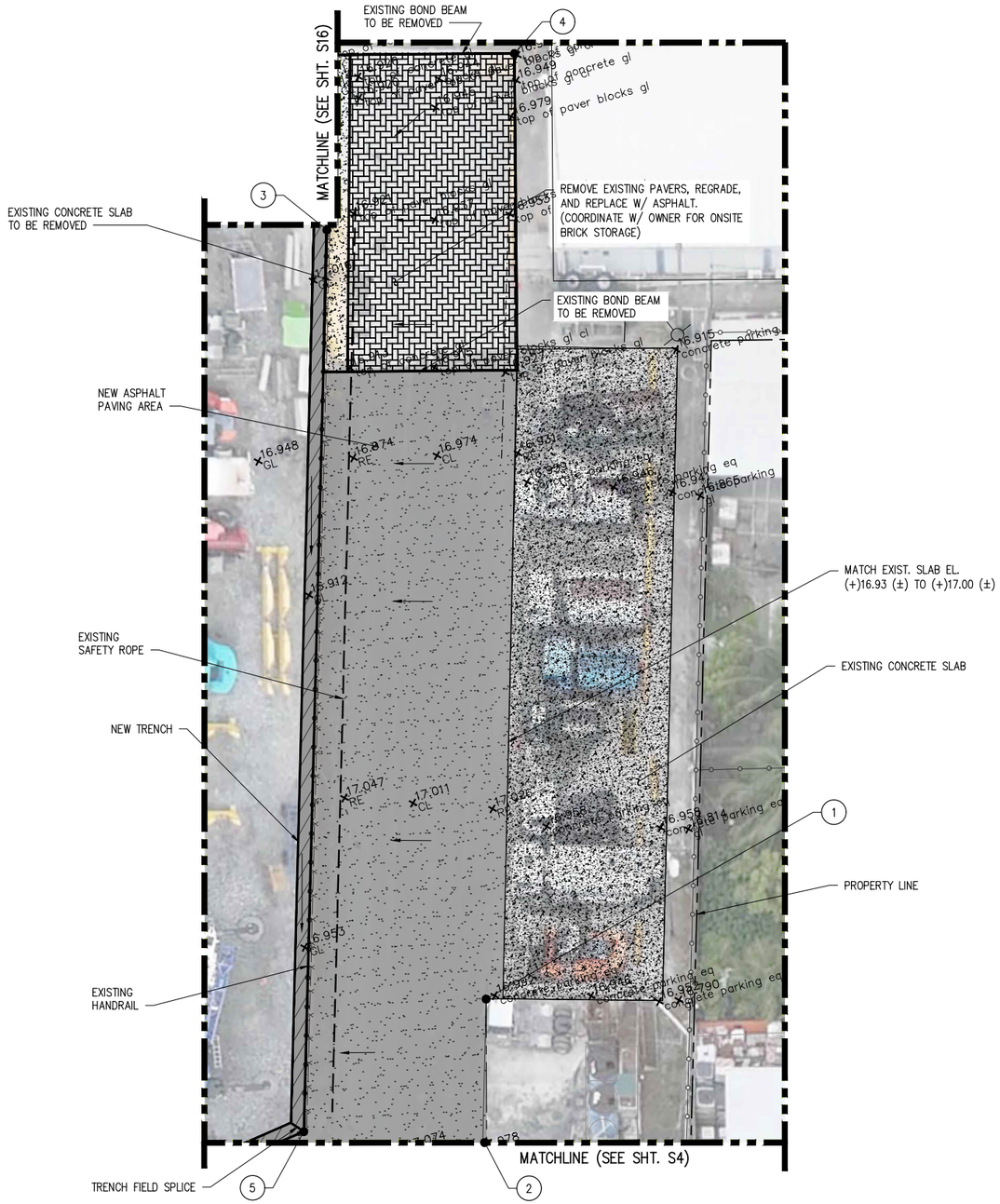
SHEET NO.
S4

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S4.DWG

10/23/2026 5:04 PM



POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)17.00	750100.13	370724.45	H.P. OF ASPHALT
2	(+)17.00	750092.26	370722.12	H.P. OF ASPHALT
3	(+)16.85	750145.14	370727.22	T.O. TRENCH WALL
4	(+)17.00	750152.08	370740.27	H.P. OF ASPHALT
5	(+)16.85	750095.53	370712.36	T.O. TRENCH WALL



ENLARGED SITE PLAN (5 OF 24)
SEQUENCE 4
SCALE = 1:150

0 3 6 9 12 15 30m

LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	668.47
REINFORCED CONCRETE OPEN TRENCH	M	56.32

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

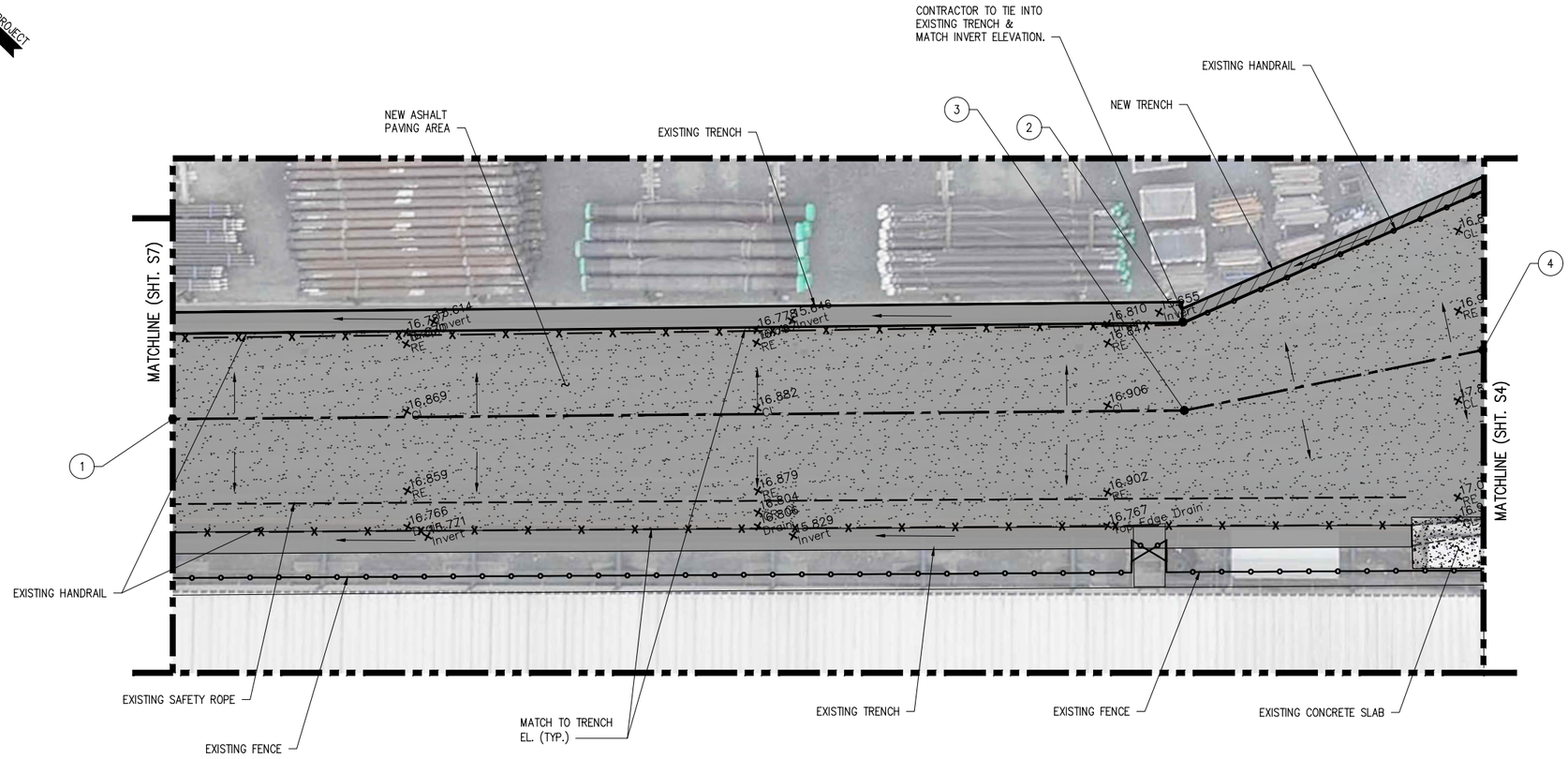
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (5 OF 24)
SEQUENCE 4

SHEET NO.
S5

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S5.DWG

10/23/2026 5:04 PM

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)16.95	750101.70	370630.55	H.P. OF ASPHALT
2	(+)16.80	750091.89	370687.59	T.O. TRENCH WALL
3	(+)16.90	750087.02	370686.39	H.P. OF ASPHALT
4	(+)17.00	750085.88	370703.74	H.P. OF ASPHALT



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	923.97
REINFORCED CONCRETE OPEN TRENCH	M	18.77

ENLARGED SITE PLAN (6 OF 24)
SEQUENCE 5

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

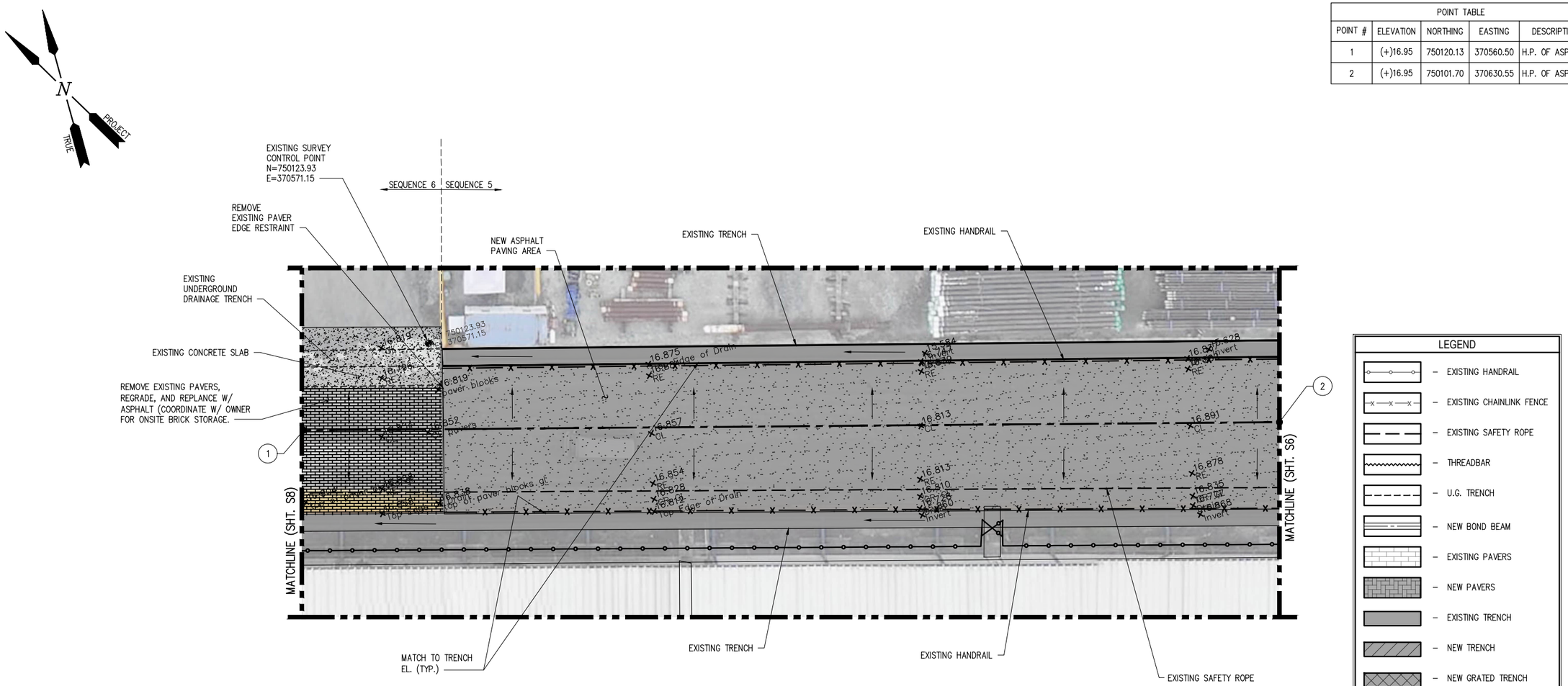
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (6 OF 24)
SEQUENCE 5

SHEET NO.
S6

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PK(G)\13582-PV-S6.DWG

10/23/2026 5:04 PM

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)16.95	750120.13	370560.50	H.P. OF ASPHALT
2	(+)16.95	750101.70	370630.55	H.P. OF ASPHALT



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	784.97

ENLARGED SITE PLAN (7 OF 24)
SEQUENCE 5 & 6

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

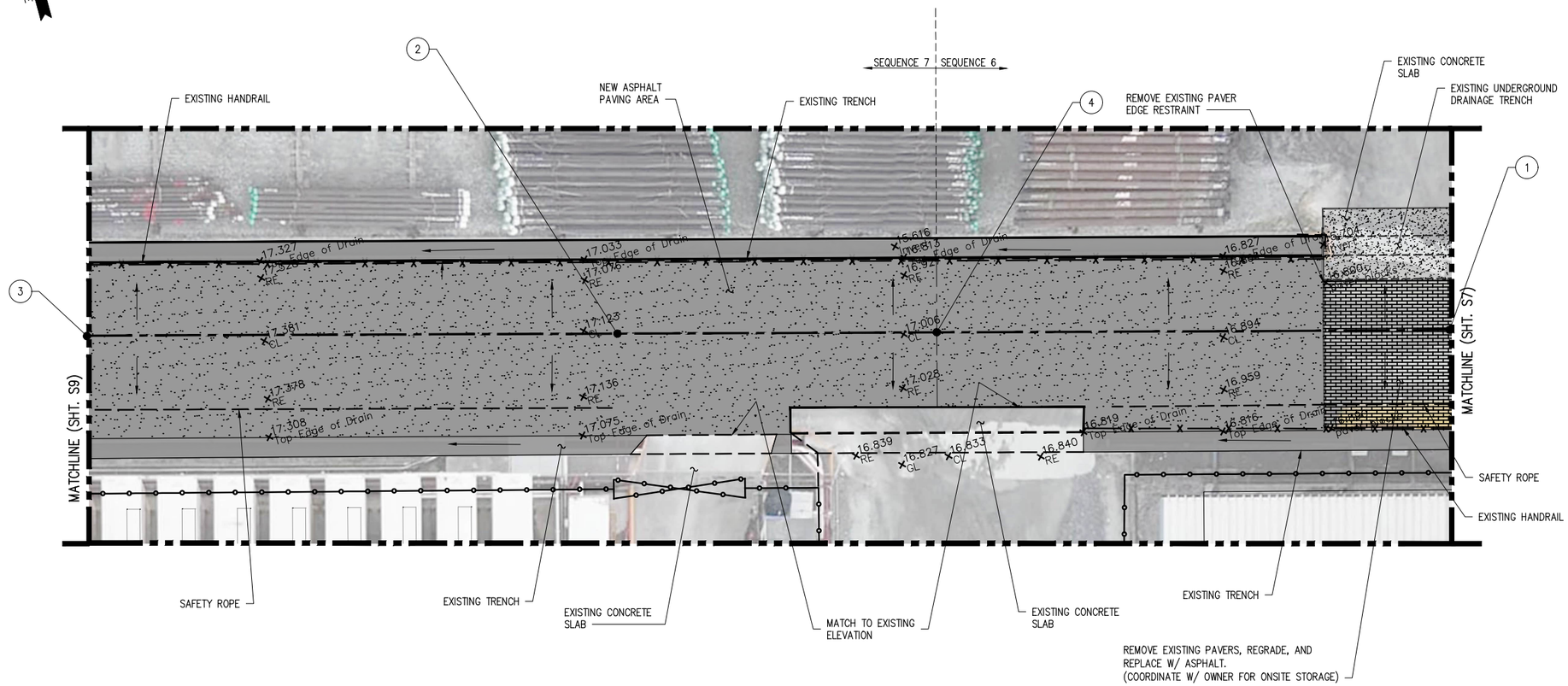
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (7 OF 24)
SEQUENCE 5 & 6

SHEET NO.
S7

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S7.DWG

10/23/2026 5:04 PM

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)16.95	750120.13	370560.50	H.P. OF ASPHALT
2	(+)17.15	750133.56	370510.19	H.P. OF ASPHALT
3	(+)17.55	750142.13	370478.12	H.P. OF ASPHALT
4	(+)16.95	750128.40	370529.49	H.P. OF ASPHALT



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	872.21

ENLARGED SITE PLAN (8 OF 24)
SEQUENCE 6 & 7

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

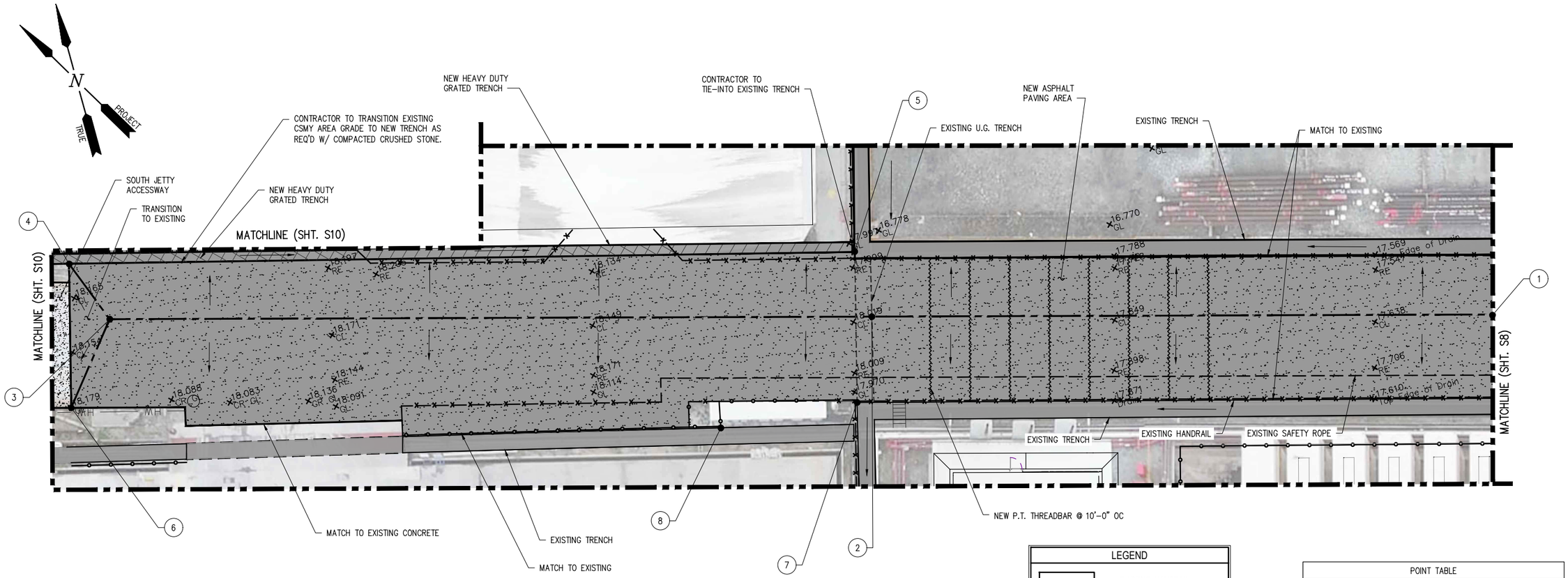
GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (8 OF 24)
SEQUENCE 6 & 7

SHEET NO.
S8

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S8.DWG

10/23/2026 5:04 PM



BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	1275.80
REINFORCED CONCRETE OPEN TRENCH	M	61.58
TENSIONED RODS	EA	8.00

ENLARGED SITE PLAN (9 OF 24)
SEQUENCE 7
SCALE = 1:150

0 3 6 9 12 15 30m

LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)17.55	750142.13	370478.12	H.P. OF ASPHALT
2	(+)18.20	750154.45	370432.27	H.P. OF ASPHALT
3	(+)18.20	750169.59	370375.83	H.P. OF ASPHALT
4	(+)18.10	750174.50	370373.94	T.O. TRENCH WALL
5	(+)18.10	750159.58	370432.30	T.O. TRENCH WALL
6	(+)18.10	750148.40	370429.46	T.O. EXISTING
7	(V.I.F.)	750163.82	370371.20	T.O. EXISTING
8	(V.I.F.)	750149.25	370418.86	T.O. EXISTING

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF–1120 TX: F–2981
VF–185 LSF–10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (9 OF 24)
SEQUENCE 7

SHEET NO.
S9

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S9.DWG

10/23/2026 5:04 PM



POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)18.10	750170.04	370394.44	T.O. TRENCH WALL
2	(+)18.10	750178.45	370361.64	T.O. TRENCH WALL
3	(+)18.40	750183.32	370342.64	C.L. BOND BEAM
4	(+)18.40	750186.93	370343.59	C.L. BOND BEAM
5	(+)18.50	750188.14	370338.69	C.L. BOND BEAM
6	(+)18.10	750214.48	370370.10	T.O. TRENCH WALL
7	(+)18.10	750206.12	370400.70	T.O. TRENCH WALL
8	(+)18.10	750173.65	370392.42	T.O. TRENCH WALL
9	(+)18.30	750179.61	370378.33	H.P. OF PAVERS
10	(+)18.30	750209.98	370386.58	H.P. OF PAVERS
11	(+)18.10	750175.58	370372.84	T.O. TRENCH WALL

LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
REINFORCED CONCRETE BOND BEAM	M	9.41
PAVERS	SQM	2014.16
REINFORCED CONCRETE HEAVY DUTY TRENCH	M	74.14

ENLARGED SITE PLAN (10 OF 24)
SEQUENCE 8

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

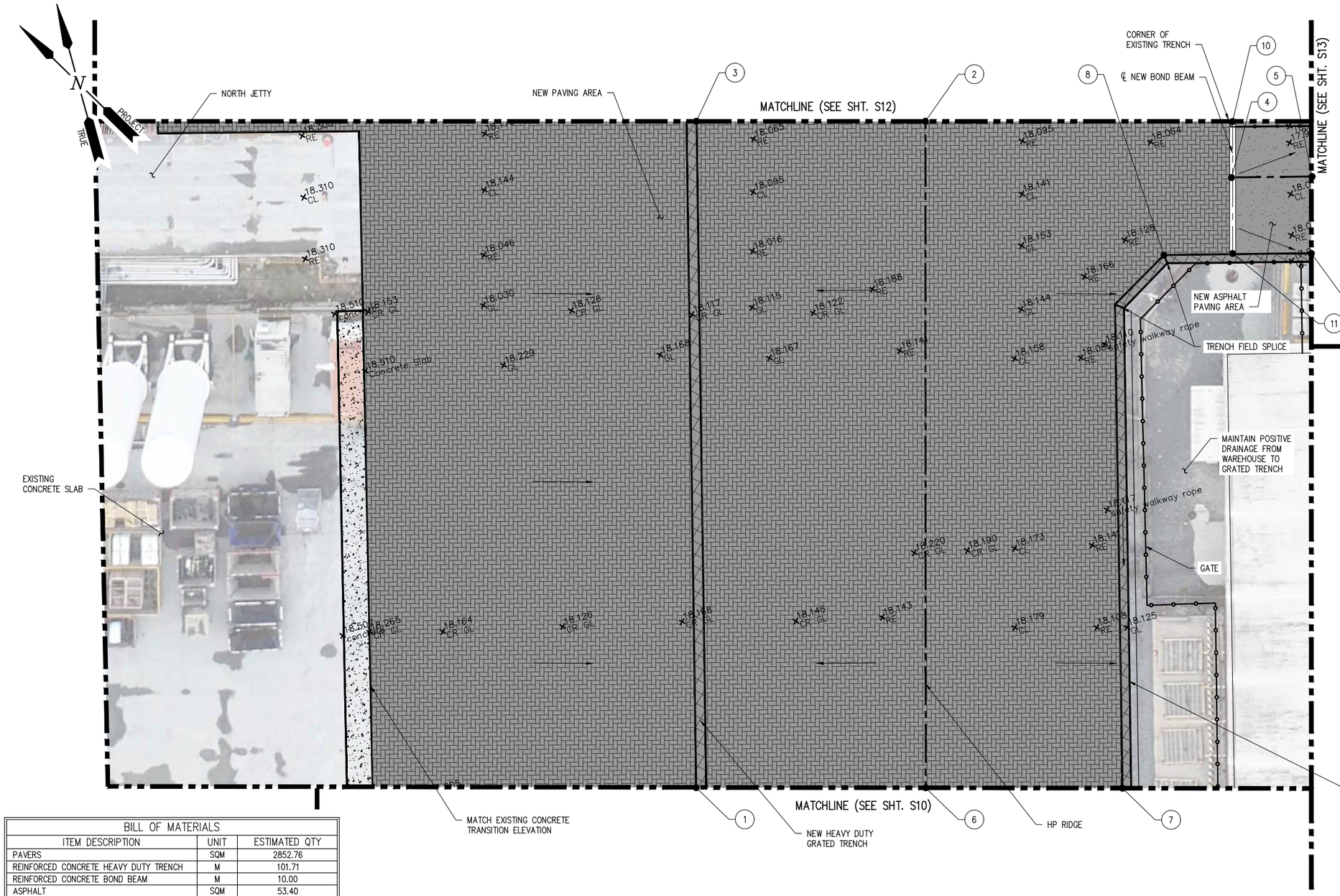
GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (10 OF 24)
SEQUENCE 8

SHEET NO.
S10

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S10.DWG

10/23/2026 5:04 PM



POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)18.10	750214.48	370370.10	T.O. TRENCH WALL
2	(+)18.30	750257.84	370399.57	H.P. OF PAVERS
3	(+)18.10	750262.32	370383.12	T.O. TRENCH WALL
4	(+)18.15	750247.83	370420.45	C.L. BOND BEAM
5	(+)18.15	750246.32	370426.25	H.P. OF ASPHALT
6	(+)18.30	750209.98	370386.58	H.P. OF PAVERS
7	(+)18.10	750206.12	370400.70	T.O. TRENCH WALL
8	(+)18.10	750243.58	370414.08	T.O. TRENCH WALL
9	(+)18.05	750240.82	370424.70	T.O. TRENCH WALL
10	V.I.F.	750251.44	370215.12	C.L. BOND BEAM
11	(+)18.10	750423.43	370419.04	C.L. BOND BEAM

LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
PAVERS	SQM	2852.76
REINFORCED CONCRETE HEAVY DUTY TRENCH	M	101.71
REINFORCED CONCRETE BOND BEAM	M	10.00
ASPHALT	SQM	53.40

ENLARGED SITE PLAN (11 OF 24)
SEQUENCE 9

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

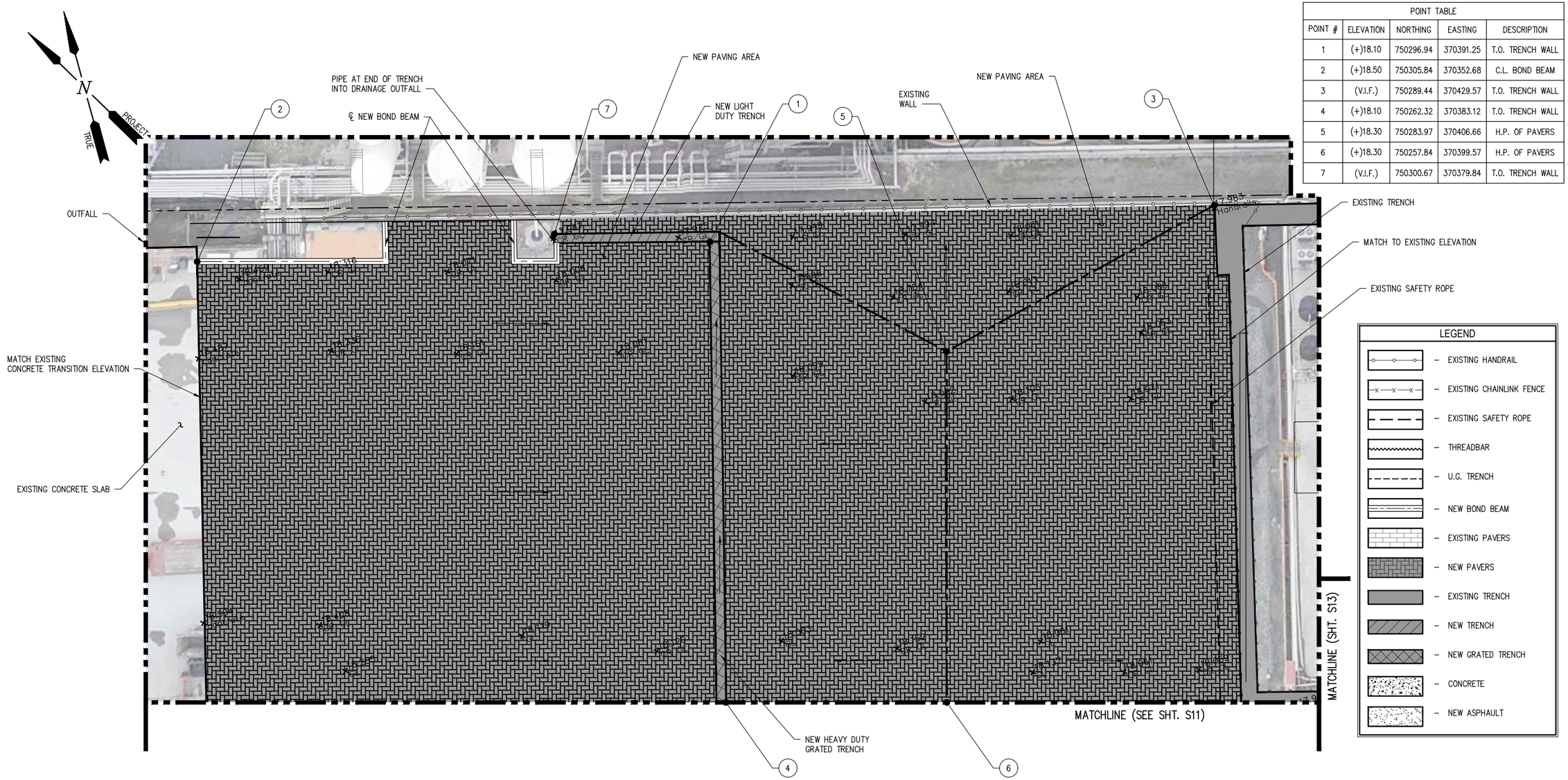
GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (11 OF 24)
SEQUENCE 9

SHEET NO.
S11

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S11.DWG

10/23/2026 5:04 PM



POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)18.10	750296.94	370391.25	T.O. TRENCH WALL
2	(+)18.50	750305.84	370352.68	C.L. BOND BEAM
3	(V.I.F.)	750289.44	370429.57	T.O. TRENCH WALL
4	(+)18.10	750262.32	370383.12	T.O. TRENCH WALL
5	(+)18.30	750283.97	370406.66	H.P. OF PAVERS
6	(+)18.30	750257.84	370399.57	H.P. OF PAVERS
7	(V.I.F.)	750300.67	370379.84	T.O. TRENCH WALL

LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
REINFORCED CONCRETE BOND BEAM	M	25.54
PAVERS	SQM	3015.44
REINFORCED CONCRETE HEAVY DUTY TRENCH	M	34.80
REINFORCED CONCRETE OPEN TRENCH	M	14.50

ENLARGED SITE PLAN (12 OF 24)
SEQUENCE 10

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

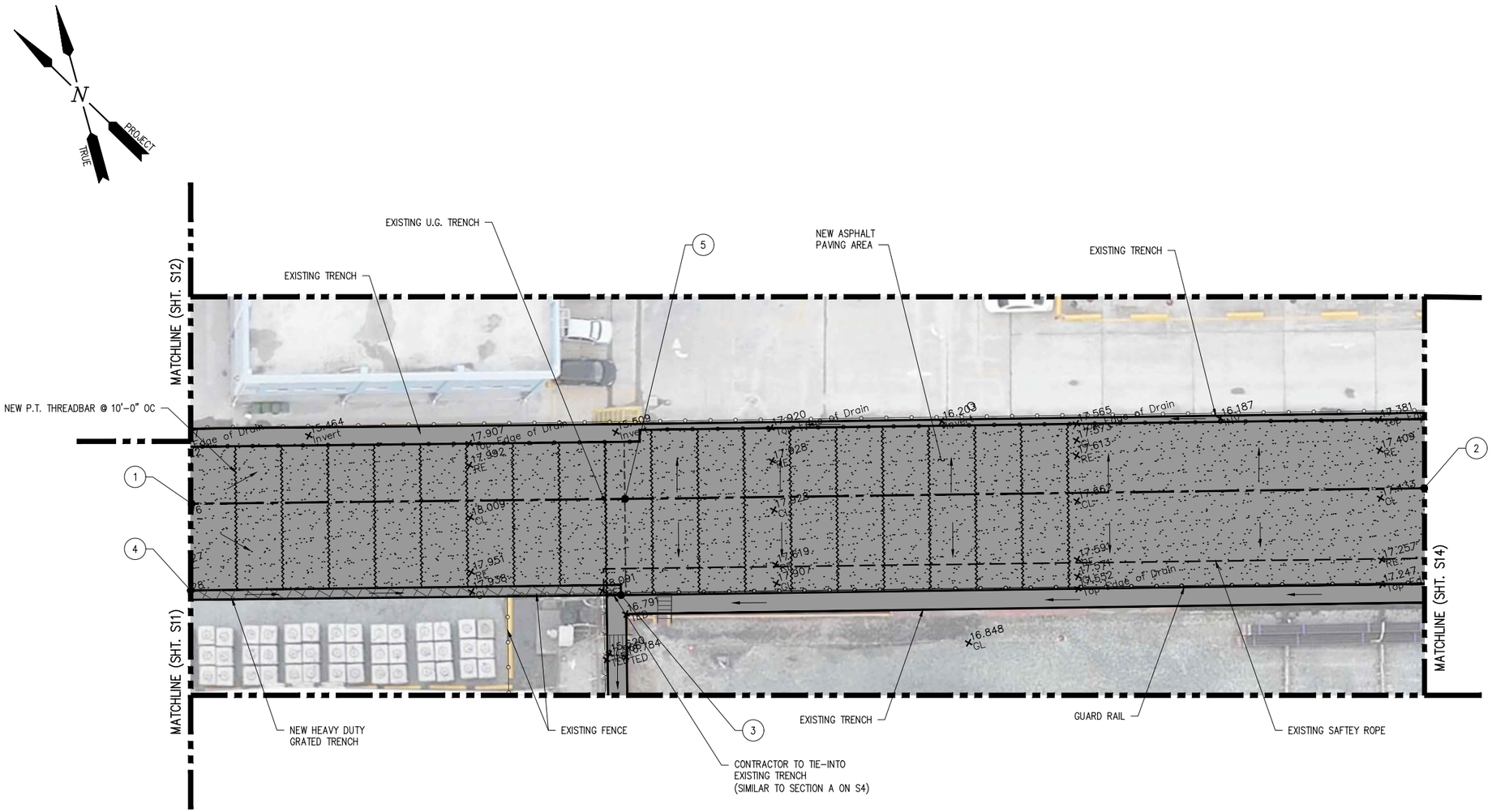
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (12 OF 24)
SEQUENCE 10

SHEET NO.
S12

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S12.DWG

10/23/2026 5:04 PM

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)18.15	750246.32	370426.25	H.P. OF ASPHALT
2	(+)17.40	750225.98	370504.95	H.P. OF ASPHALT
3	(+)18.00	750233.08	370452.00	T.O. OF TRENCH
4	(+)18.05	750240.82	370424.70	T.O. OF TRENCH
5	(+)18.10	750239.13	370453.92	H.P. OF ASPHALT



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	863.20
REINFORCED CONCRETE HEAVY DUTY TRENCH	M	27.30
TENSIONED RODS	EA	18.00

ENLARGED SITE PLAN (13 OF 24)
SEQUENCE 11

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

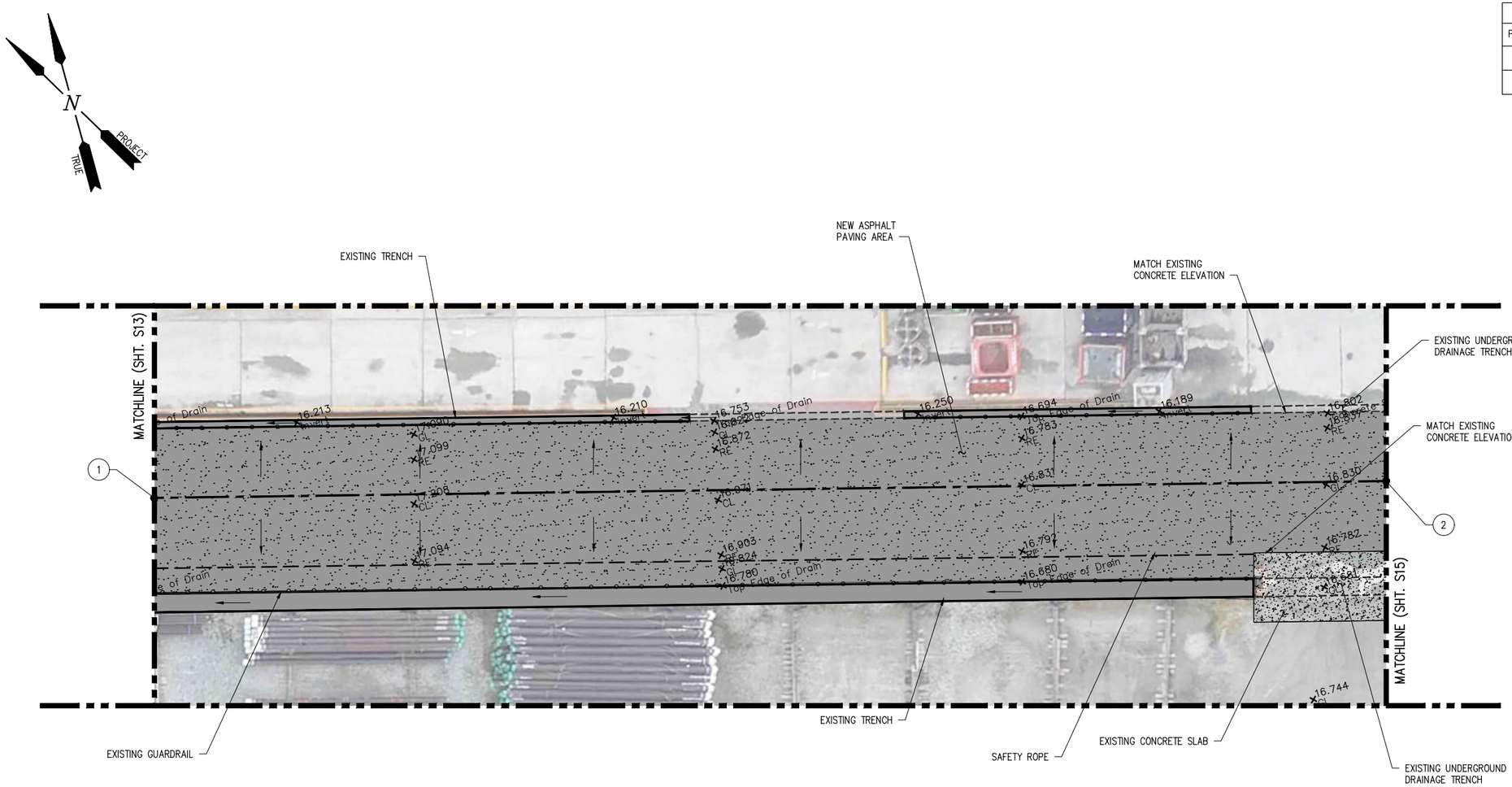
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (13 OF 24)
SEQUENCE 11

SHEET NO.
S13

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S13.DWG

10/23/2026 5:04 PM

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)17.40	750225.98	370504.95	H.P. OF ASPHALT
2	(+)16.90	750205.79	370583.42	H.P. OF ASPHALT



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	865.66

ENLARGED SITE PLAN (14 OF 24)
SEQUENCE 11

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

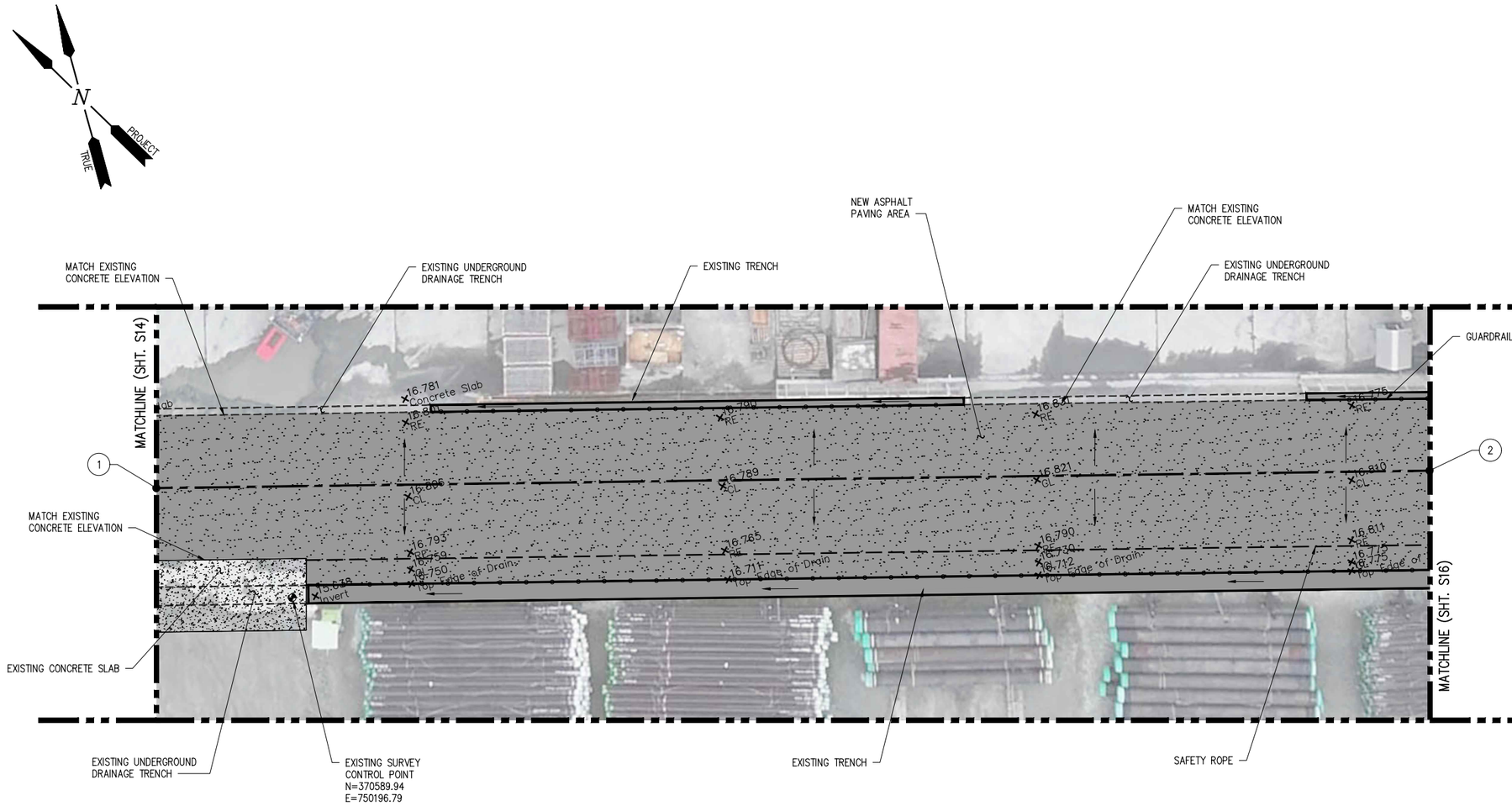
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (14 OF 24)
SEQUENCE 11

SHEET NO.
S14

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S14.DWG

10/23/2026 5:04 PM

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)16.90	750205.79	370583.42	H.P. OF ASPHALT
2	(+)16.90	750185.60	370661.87	H.P. OF ASPHALT



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	886.57

ENLARGED SITE PLAN (15 OF 24)
SEQUENCE 12

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

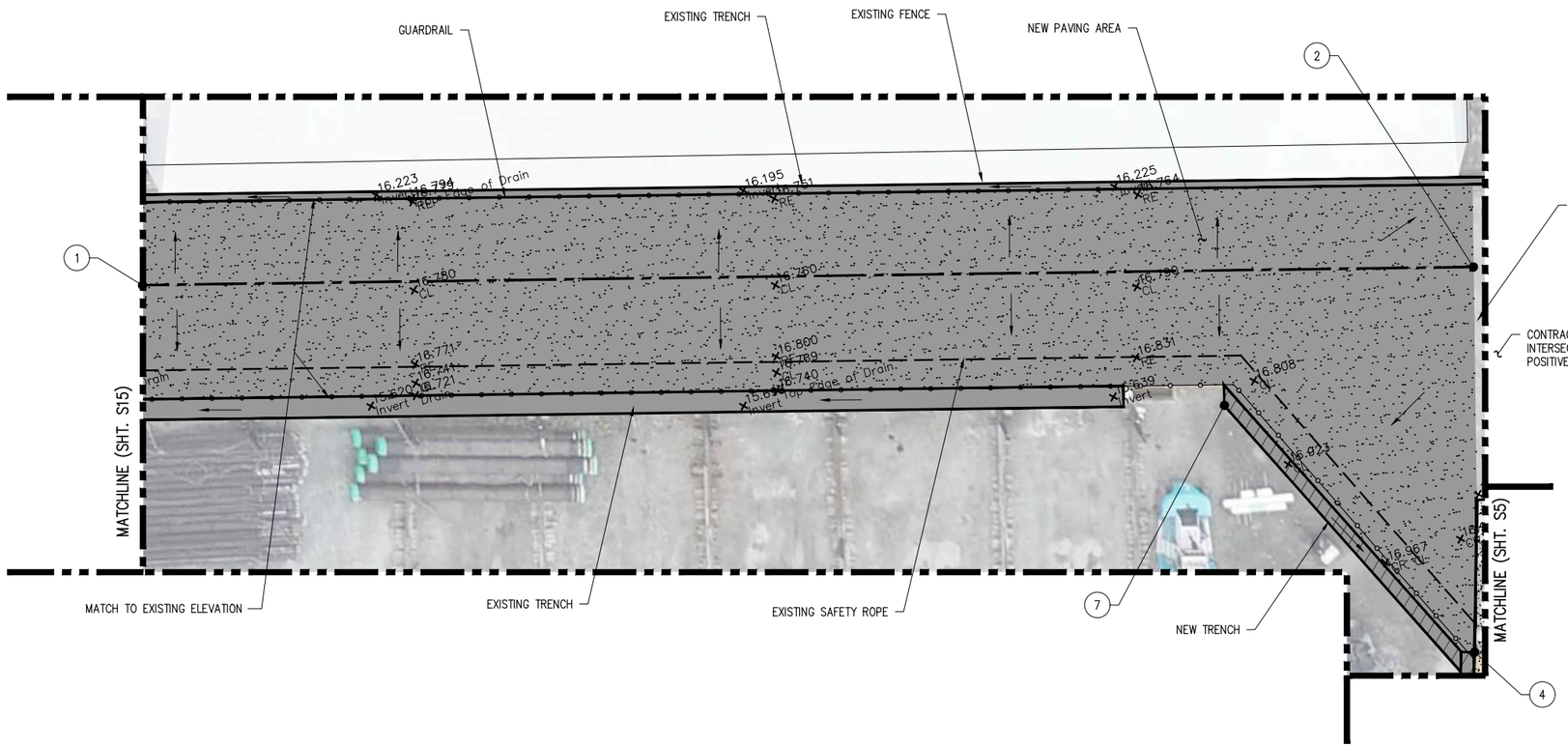
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (15 OF 24)
SEQUENCE 12

SHEET NO.
S15

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S15.DWG

10/23/2026 5:04 PM

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)16.90	750185.60	370661.87	H.P. OF ASPHALT
2	(+)16.90	750167.24	370733.20	H.P. OF ASPHALT
3	(+)16.85	750146.67	370727.68	T.O. TRENCH WALL
4	(+)16.85	750163.47	370717.90	T.O. TRENCH WALL



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
ASPHALT	SQM	903.07
REINFORCED CONCRETE OPEN TRENCH	M	19.70

ENLARGED SITE PLAN (16 OF 24)
SEQUENCE 12

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

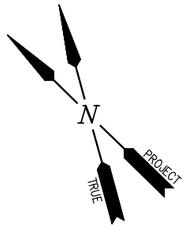
GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (16 OF 24)
SEQUENCE 12

SHEET NO.
S16

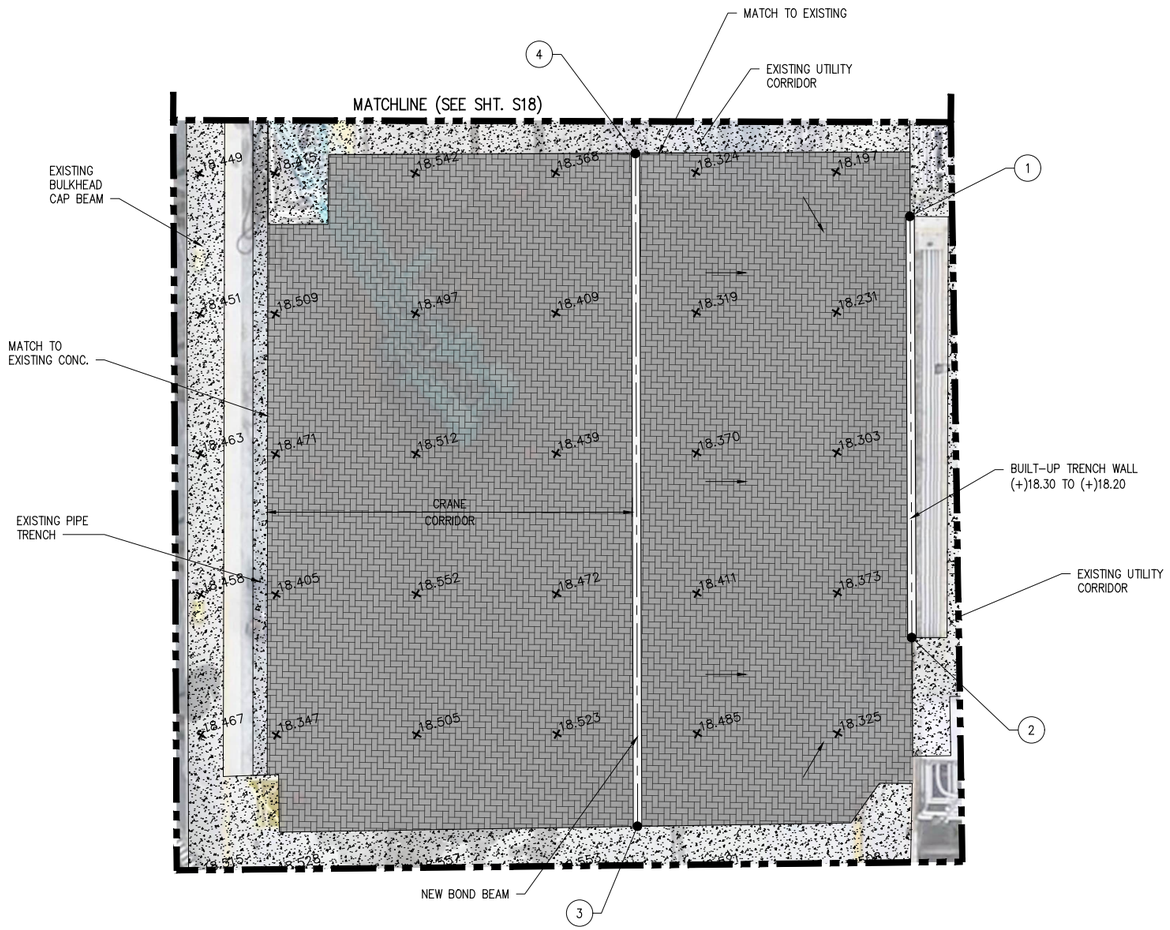
J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PK(G\13582-PV-S16.DWG

10/23/2026 5:05 PM



NOTE:
"CRANE CORRIDOR" AREA SHOULD HAVE AN APPROXIMATE 0% GRADE IN THE EAST/WEST DIRECTION. NORTH/SOUTH SLOPE TO BE UNIFORM BETWEEN EXISTING INFRASTRUCTURE . (I.E. UTILITY TRENCHES AND ADJACENT BERTHS)

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)18.20	750344.79	370350.24	C.L. BOND BEAM
2	(+)18.30	750322.95	370344.76	C.L. BOND BEAM
3	(+)18.537 (V.I.F.)	750316.81	370328.05	C.L. BOND BEAM
4	(+)18.346 (V.I.F.)	750351.69	370336.86	C.L. BOND BEAM



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
REINFORCED CONCRETE BOND BEAM	M	35.97
PAVERS	SQM	1202.93

ENLARGED SITE PLAN (17 OF 24)
SEQUENCE 13

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE JUN. '26
SHT SIZE ISO A1
DESIGN LAR
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (17 OF 24)
SEQUENCE 13

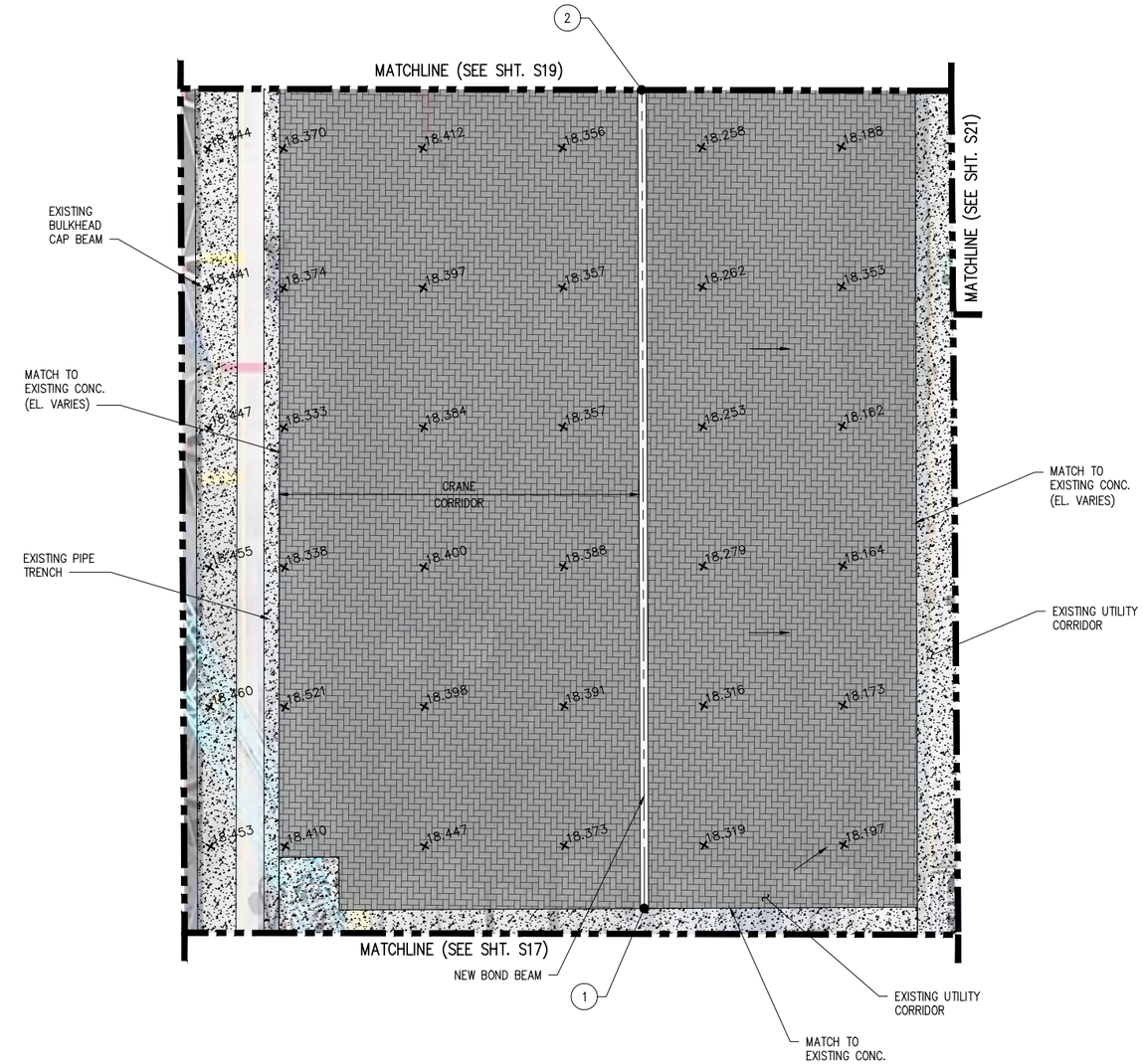
SHEET NO.
S17

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S17.DWG

10/23/2026 5:05 PM

NOTE:
"CRANE CORRIDOR" AREA SHOULD HAVE AN APPROXIMATE 0% GRADE IN THE EAST/WEST DIRECTION. NORTH/SOUTH SLOPE TO BE UNIFORM BETWEEN EXISTING INFRASTRUCTURE . (I.E. UTILITY TRENCHES AND ADJACENT BERTHS)

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)18.346 (V.I.F.)	750354.68	370337.61	C.L. BOND BEAM
2	(+)18.35	750397.34	370348.39	C.L. BOND BEAM



LEGEND	
	– EXISTING HANDRAIL
	– EXISTING CHAINLINK FENCE
	– EXISTING SAFETY ROPE
	– THREADBAR
	– U.G. TRENCH
	– NEW BOND BEAM
	– EXISTING PAVERS
	– NEW PAVERS
	– EXISTING TRENCH
	– NEW TRENCH
	– NEW GRATED TRENCH
	– CONCRETE
	– NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
REINFORCED CONCRETE BOND BEAM	M	44.00
PAVERS	SQM	1477.10

ENLARGED SITE PLAN (18 OF 24)
SEQUENCE 14

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE JUN. '26
SHT SIZE ISO A1
DESIGN LAR
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (2 OF 8)
SEQUENCE 14

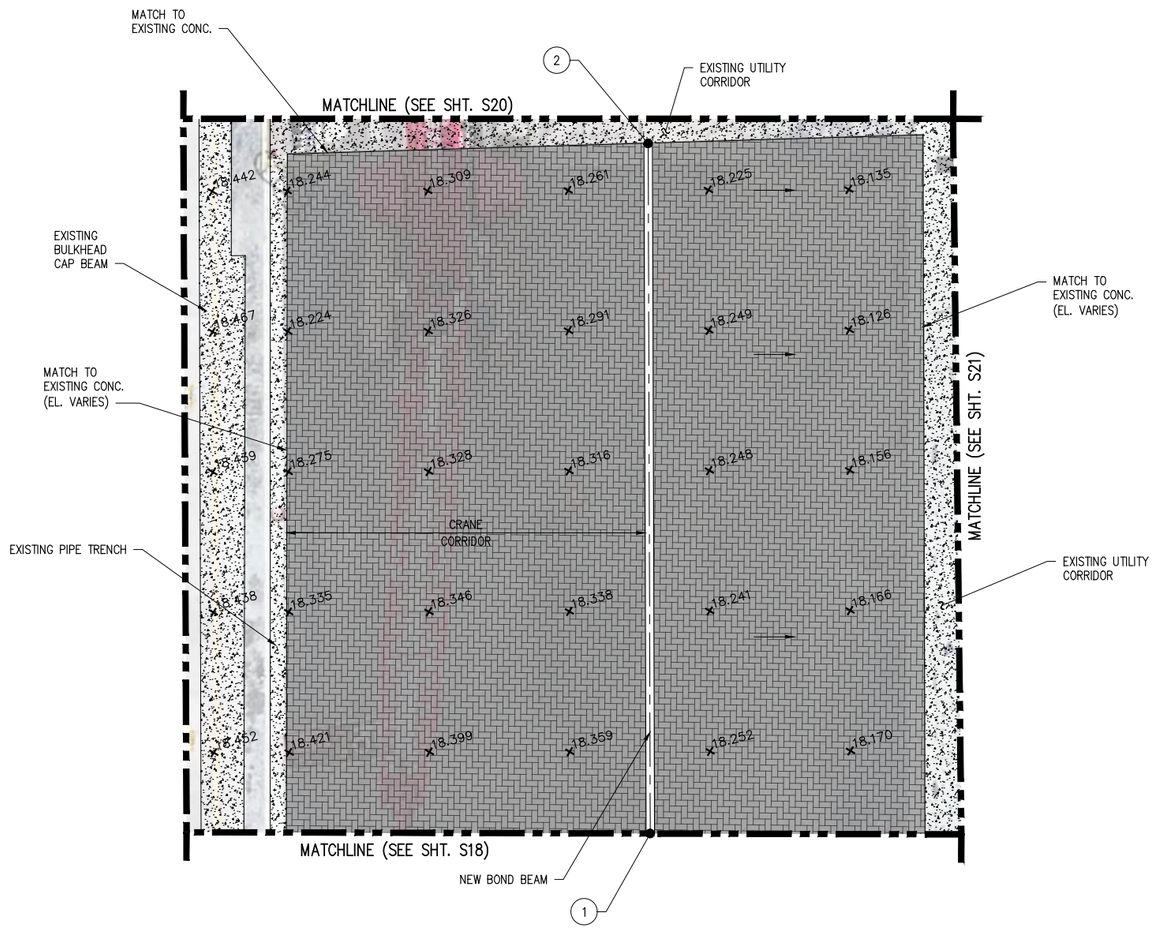
SHEET NO.
S18

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S18.DWG

10/23/2026 5:05 PM

NOTE:
"CRANE CORRIDOR" AREA SHOULD HAVE AN APPROXIMATE 0% GRADE IN THE EAST/WEST DIRECTION. NORTH/SOUTH SLOPE TO BE UNIFORM BETWEEN EXISTING INFRASTRUCTURE . (I.E. UTILITY TRENCHES AND ADJACENT BERTHS)

POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)18.35	750397.33	370348.39	C.L. BOND BEAM
2	(+)18.234 (V.I.F.)	750433.12	370357.43	C.L. BOND BEAM



LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
REINFORCED CONCRETE BOND BEAM	M	36.89
PAVERS	SQM	1236.98

ENLARGED SITE PLAN (19 OF 24)
SEQUENCE 15

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 VF-185 TX: F-2981 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE JUN. '26
SHT SIZE ISO A1
DESIGN LAR
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

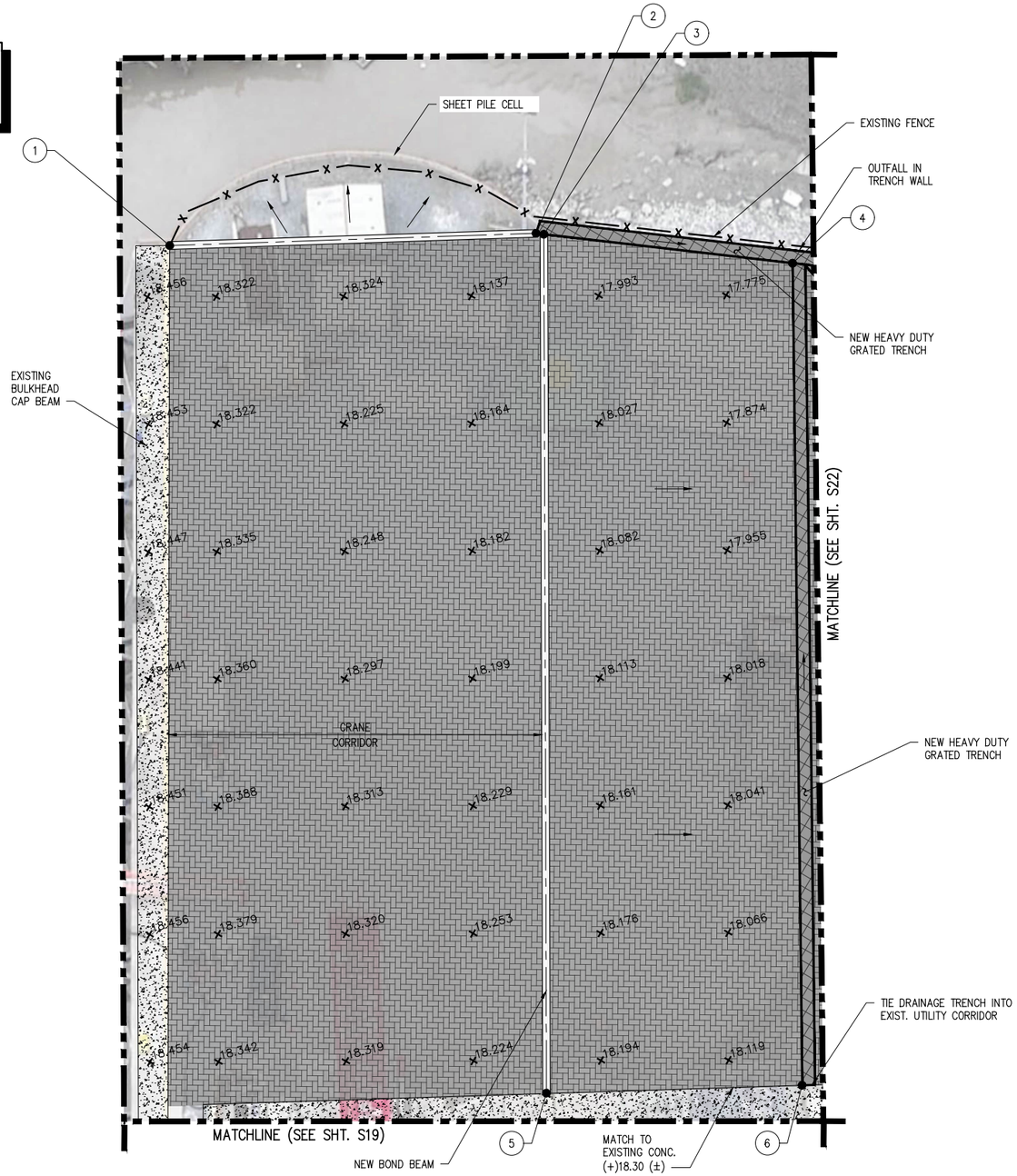
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (3 OF 8)
SEQUENCE 15

SHEET NO.
S19

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S19.DWG

10/23/2026 5:05 PM

NOTE:
"CRANE CORRIDOR" AREA SHOULD HAVE AN APPROXIMATE 0% GRADE IN THE EAST/WEST DIRECTION. NORTH/SOUTH SLOPE TO BE UNIFORM BETWEEN EXISTING INFRASTRUCTURE . (I.E. UTILITY TRENCHES AND ADJACENT BERTHS)



POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)18.20	750489.90	370349.06	C.L. BOND BEAM
2	(+)18.25 (V.I.F.)	750485.26	370370.12	C.L. BOND BEAM
3	(+)18.25 (V.I.F.)	750485.09	370370.55	C.L. BOND BEAM
4	(+)17.90	750479.82	370384.30	T.O. TRENCH WALL
5	(+)18.21 (V.I.F.)	750436.33	370358.24	C.L. BOND BEAM
6	(V.I.F.)	750432.82	370372.86	T.O. TRENCH WALL

LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
REINFORCED CONCRETE BOND BEAM	M	50.54
PAVERS	SQM	1828.20

ENLARGED SITE PLAN (20 OF 24)
SEQUENCE 16

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S20.DWG

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

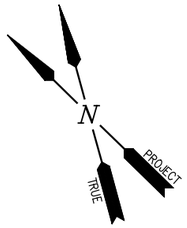
DATE JUN. '26
SHT SIZE ISO A1
DESIGN LAR
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

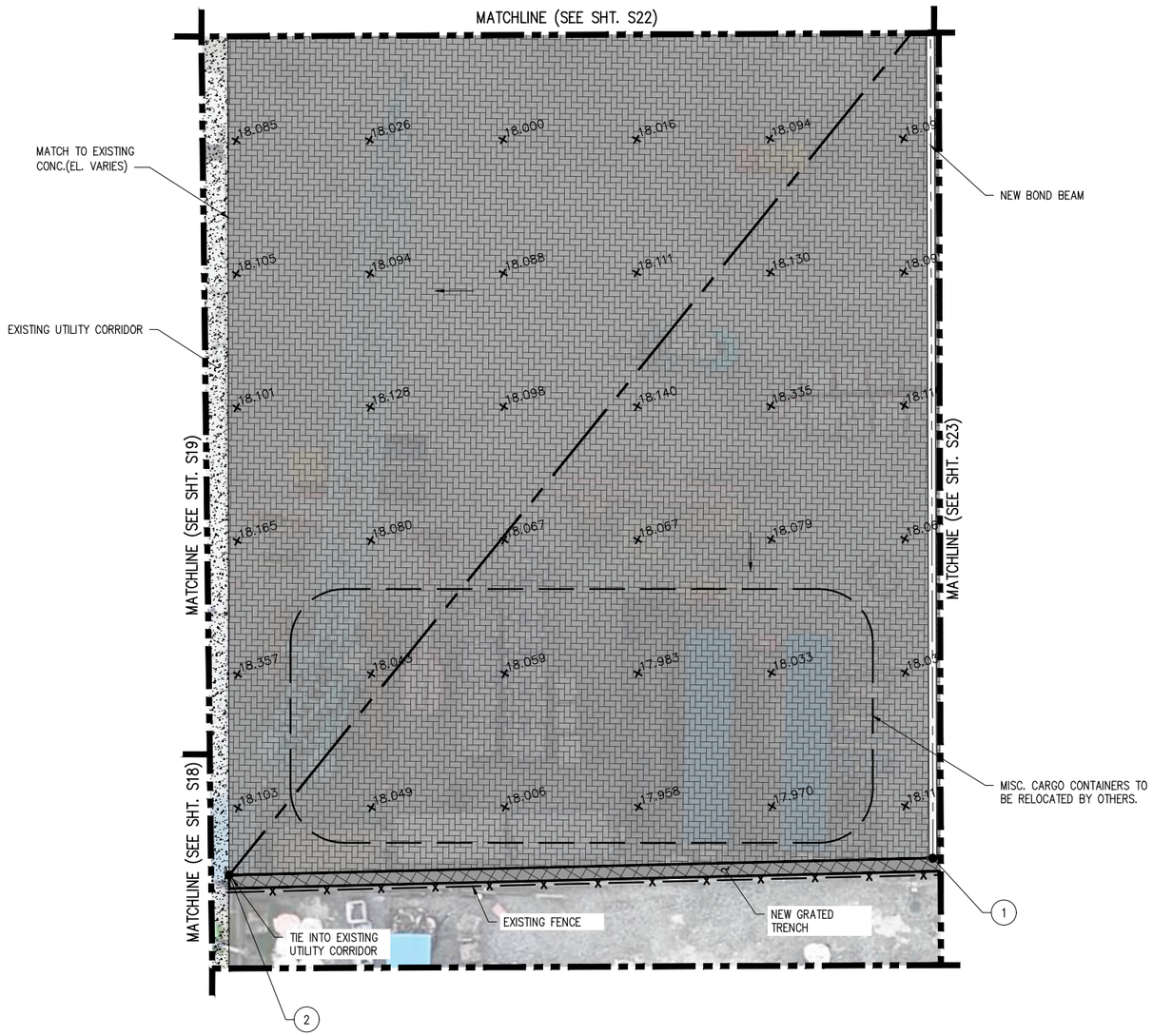
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (20 OF 24)
SEQUENCE 16

SHEET NO.
S20

10/23/2026 5:05 PM



POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)18.00	750377.46	370402.42	C.L. BOND BEAM
2	(V.I.F.)	750386.34	370363.87	T.O. TRENCH WALL



LEGEND	
	– EXISTING HANDRAIL
	– EXISTING CHAINLINK FENCE
	– EXISTING SAFETY ROPE
	– THREADBAR
	– U.G. TRENCH
	– NEW BOND BEAM
	– EXISTING PAVERS
	– NEW PAVERS
	– EXISTING TRENCH
	– NEW TRENCH
	– NEW GRATED TRENCH
	– CONCRETE
	– NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
PAVERS	SQM	1857.40

ENLARGED SITE PLAN (21 OF 24)
SEQUENCE 17

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF–1120 TX: F–2981
VF–185 LSF–10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE JUN. '26
SHT SIZE ISO A1
DESIGN LAR
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

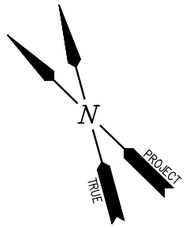
GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (21 OF 24)
SEQUENCE 17

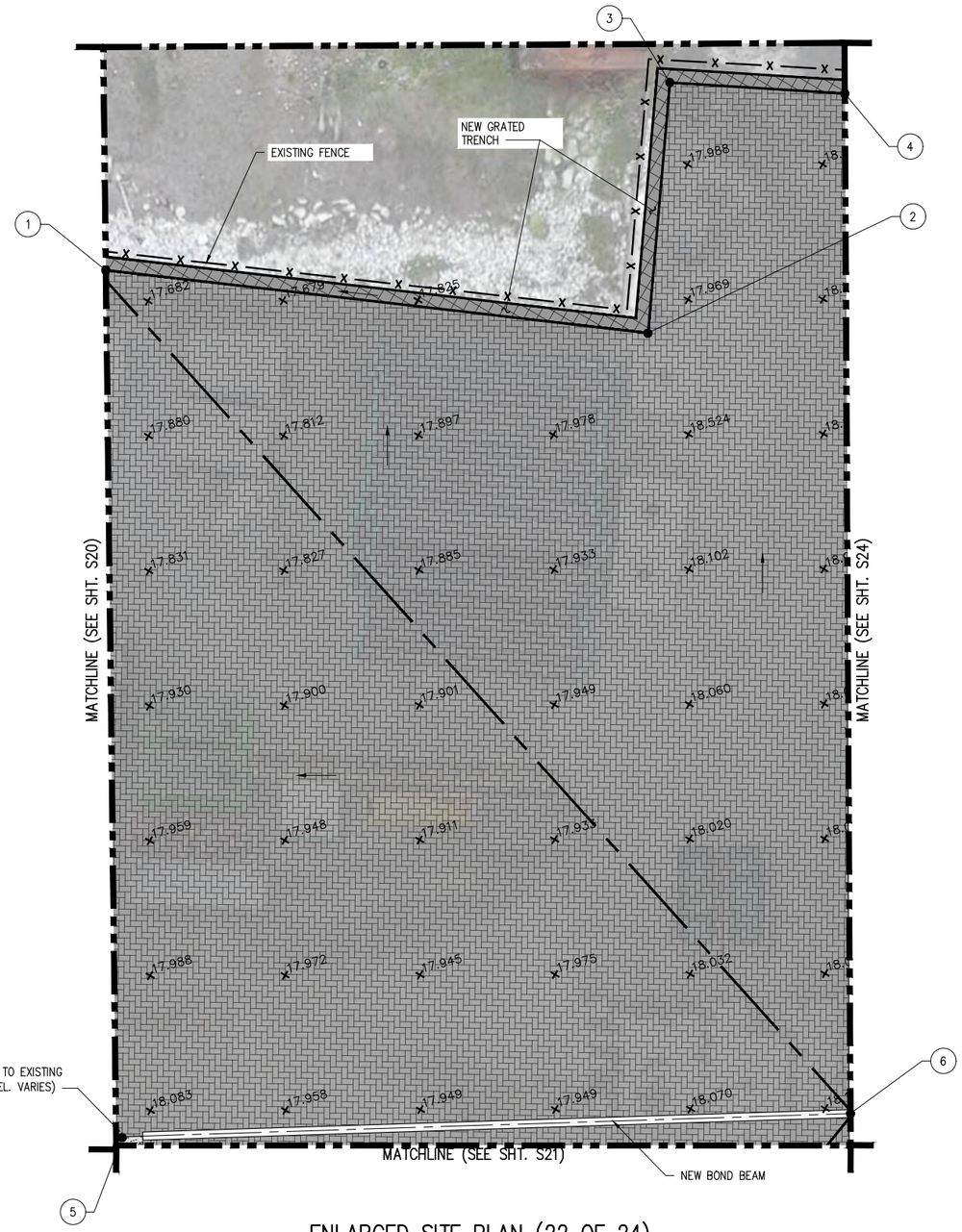
SHEET NO.
S21

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S21.DWG

10/23/2026 5:05 PM



POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)17.90	750479.31	370385.47	T.O. TRENCH WALL
2	(+)17.90	750468.52	370413.80	T.O. TRENCH WALL
3	(+)17.90	750481.71	370418.44	T.O. TRENCH WALL
4	(+)17.90	750478.71	370427.70	T.O. TRENCH WALL
5	(V.I.F.)	750432.23	370375.54	C.L. BOND BEAM
6	(+)18.40	750423.70	370413.96	C.L. BOND BEAM



LEGEND	
	– EXISTING HANDRAIL
	– EXISTING CHAINLINK FENCE
	– EXISTING SAFETY ROPE
	– THREADBAR
	– U.G. TRENCH
	– NEW BOND BEAM
	– EXISTING PAVERS
	– NEW PAVERS
	– EXISTING TRENCH
	– NEW TRENCH
	– NEW GRATED TRENCH
	– CONCRETE
	– NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
REINFORCED CONCRETE BOND BEAM	M	38.48
PAVERS	SQM	2015.79

ENLARGED SITE PLAN (22 OF 24)
SEQUENCE 18

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE	JUN. '26
SHT SIZE	ISO A1
DESIGN	LAR
DRAWN	MEW
CHECK	KLD
APPR'D	KLD
JOB NO	13582

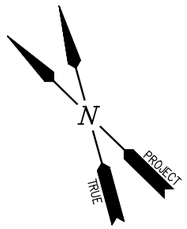
GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (22 OF 24)
SEQUENCE 18

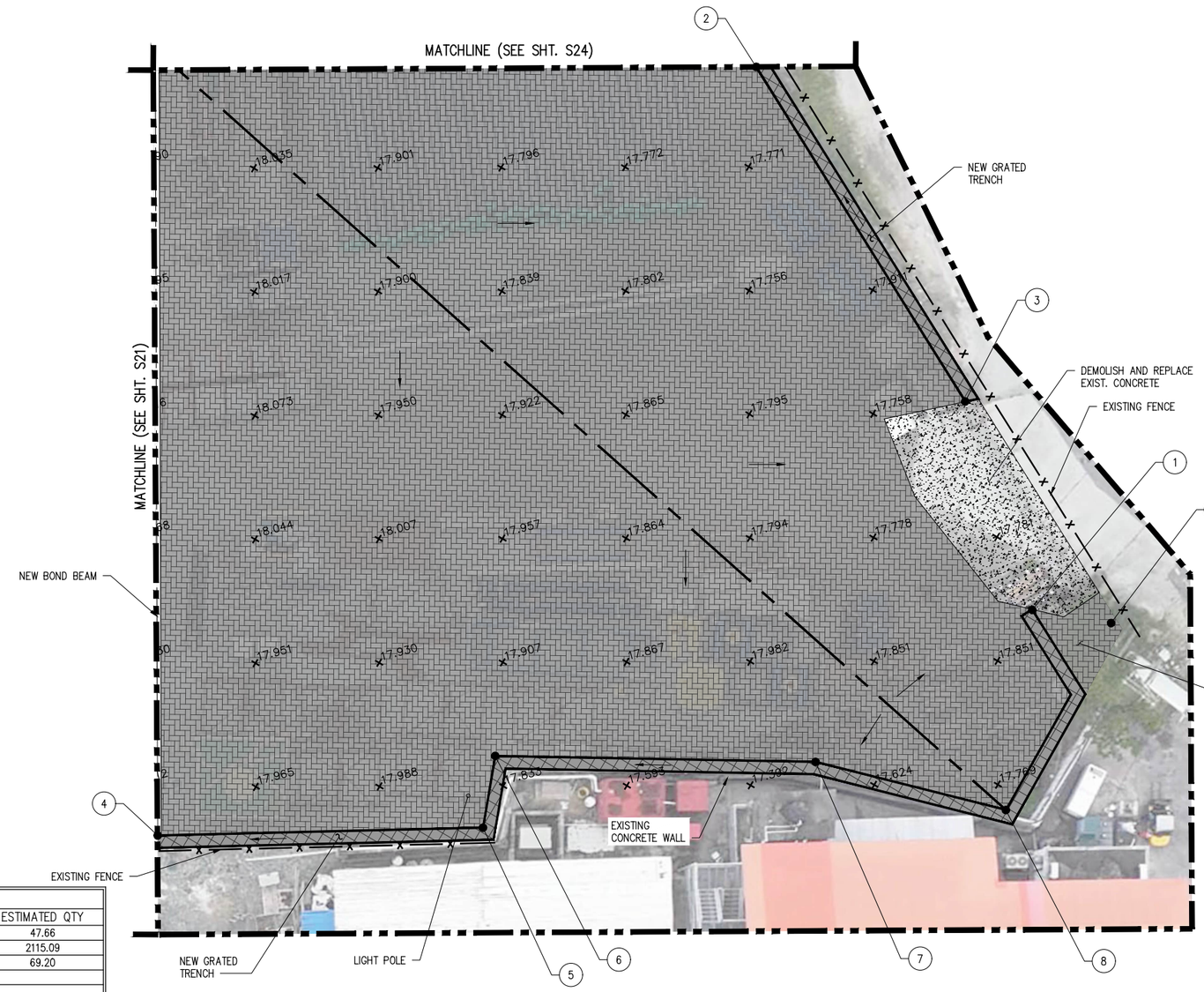
SHEET NO.
S22

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S22.DWG

10/23/2026 5:05 PM



POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)17.80	750377.60	370457.19	T.O. TRENCH WALL
2	(+)17.90	750413.61	370449.13	T.O. TRENCH WALL
3	(+)17.90	750390.82	370456.39	T.O. TRENCH WALL
4	(+)18.00	750377.46	370402.40	C.L. BOND BEAM
5	(+)17.90	750373.03	370421.65	T.O. TRENCH WALL
6	(+)17.80	750377.06	370423.44	T.O. TRENCH WALL
7	(+)17.70	750371.90	370442.18	T.O. TRENCH WALL
8	(+)17.90	750366.21	370452.64	T.O. TRENCH WALL
9	(+)18.00	750375.61	370461.63	T.O. TRENCH WALL



LEGEND	
	– EXISTING HANDRAIL
	– EXISTING CHAINLINK FENCE
	– EXISTING SAFETY ROPE
	– THREADBAR
	– U.G. TRENCH
	– NEW BOND BEAM
	– EXISTING PAVERS
	– NEW PAVERS
	– EXISTING TRENCH
	– NEW TRENCH
	– NEW GRATED TRENCH
	– CONCRETE
	– NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
REINFORCED CONCRETE BOND BEAM	M	47.66
PAVERS	SQM	2115.09
NEW GRATED TRENCH	M	69.20

ENLARGED SITE PLAN (23 OF 24)
SEQUENCE 19

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE	JUN. '26
SHT SIZE	ISO A1
DESIGN	LAR
DRAWN	MEW
CHECK	KLD
APPR'D	KLD
JOB NO	13582

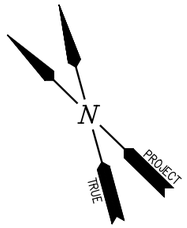
GYSBI
GEORGETOWN GUYANA

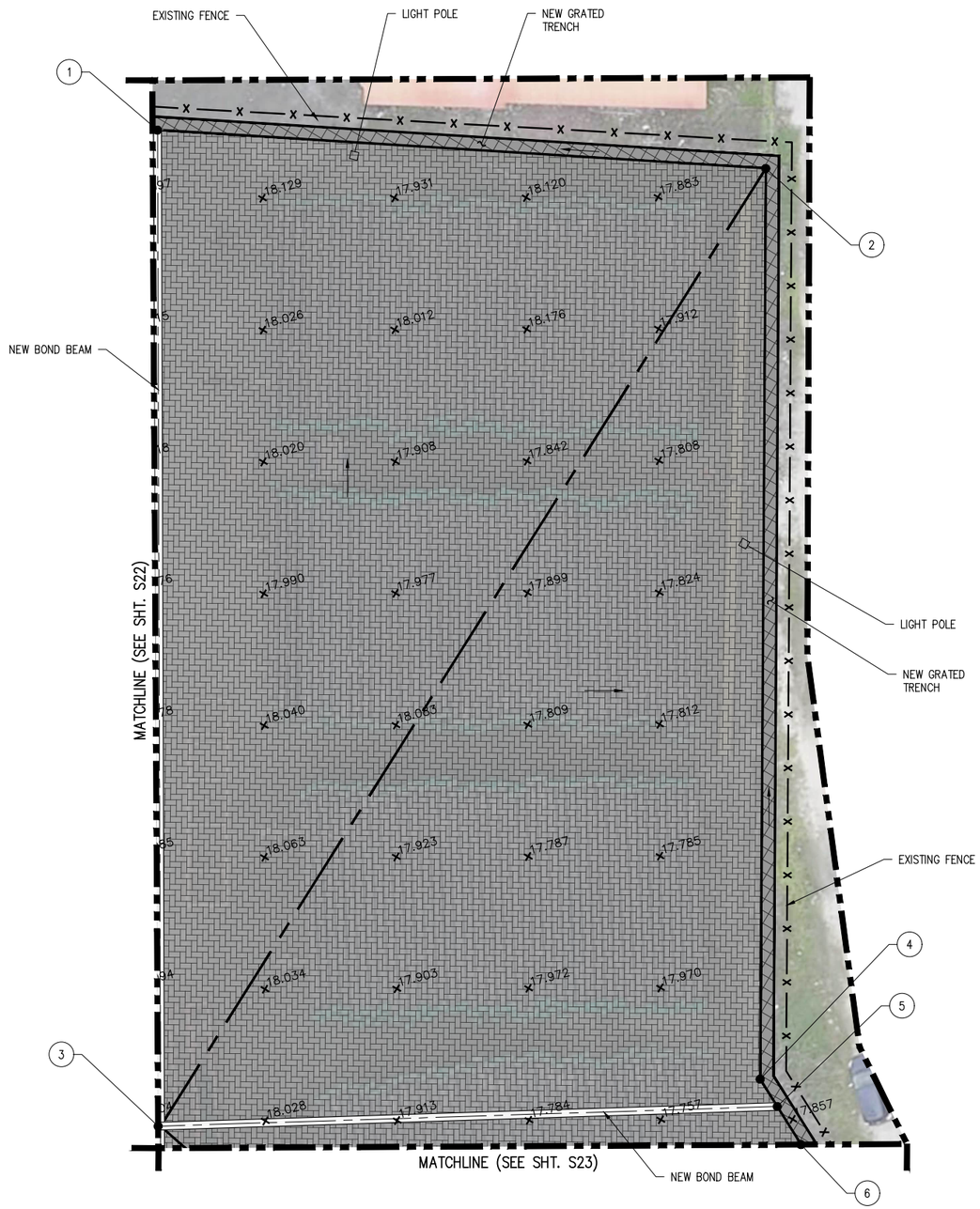
SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (23 OF 24)
SEQUENCE 19

SHEET NO.
S23

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S23.DWG

10/23/2026 5:05 PM





POINT TABLE				
POINT #	ELEVATION	NORTHING	EASTING	DESCRIPTION
1	(+)17.90	750478.62	370427.97	C.L. BOND BEAM
2	(+)17.90	750467.93	370460.96	T.O. TRENCH WALL
3	(+)18.40	750424.14	370411.95	C.L. BOND BEAM
4	(+)17.90	750416.05	370448.36	T.O. TRENCH WALL
5	(+)17.90	750417.80	370447.80	C.L. BOND BEAM
6	(+)17.90	750413.61	370449.13	T.O. TRENCH WALL

LEGEND

- EXISTING HANDRAIL
- EXISTING CHAINLINK FENCE
- EXISTING SAFETY ROPE
- THREADBAR
- U.G. TRENCH
- NEW BOND BEAM
- EXISTING PAVERS
- NEW PAVERS
- EXISTING TRENCH
- NEW TRENCH
- NEW GRATED TRENCH
- CONCRETE
- NEW ASPHAULT

BILL OF MATERIALS		
ITEM DESCRIPTION	UNIT	ESTIMATED QTY
REINFORCED CONCRETE BOND BEAM	M	91.79
PAVERS	SQM	1886.18

ENLARGED SITE PLAN (24 OF 24)
SEQUENCE 20

SCALE = 1:150

0 3 6 9 12 15 30m

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE JUN. '26
SHT SIZE ISO A1
DESIGN LAR
DRAWN MEW
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
ENLARGED SITE PLAN (24 OF 24)
SEQUENCE 20

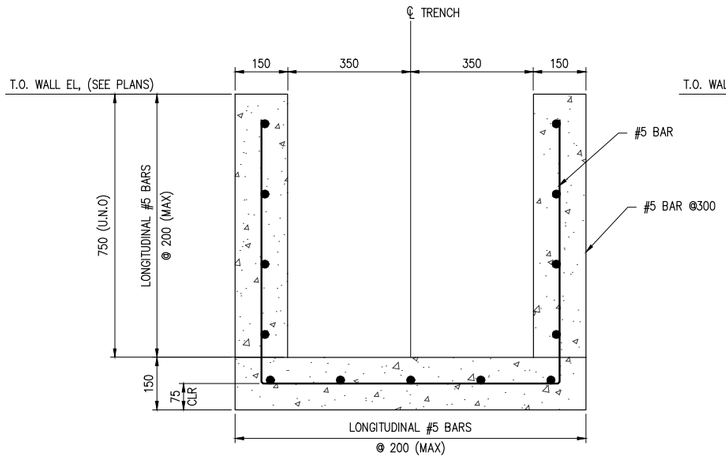
SHEET NO.
S24

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S24.DWG

10/23/2026 5:05 PM

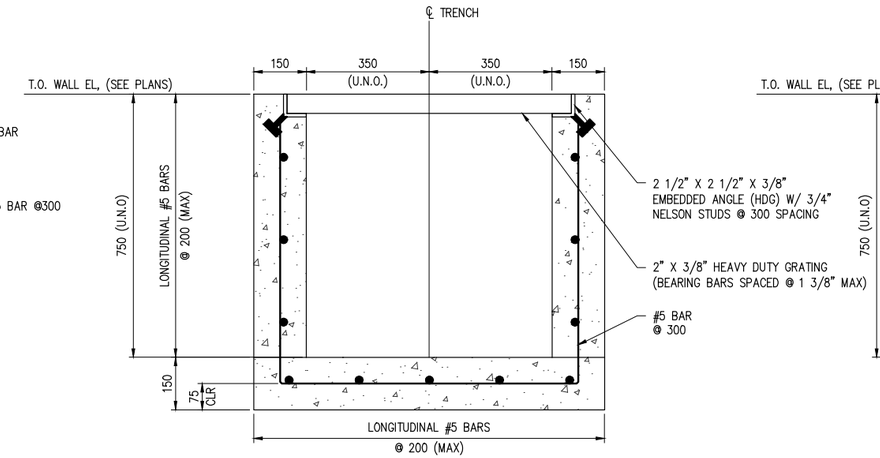
NOTES:

1. ALL DIMENSIONS ARE IN mm U.N.O.



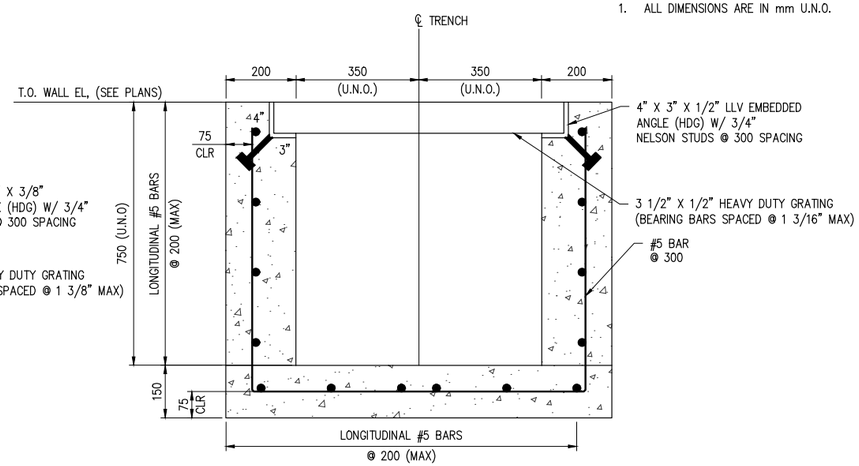
TYPICAL OPEN TRENCH DETAIL

SCALE: 1:8



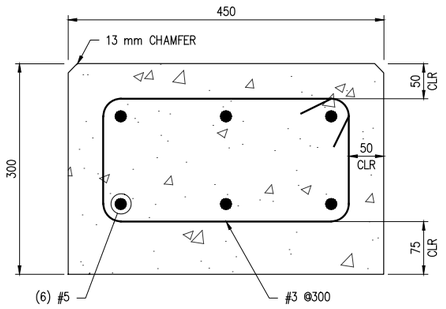
TYPICAL LIGHT DUTY GRATED TRENCH DETAIL

SCALE: 1:8



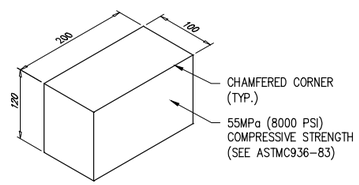
TYPICAL HEAVY DUTY GRATED TRENCH DETAIL

SCALE: 1:8



TYPICAL BOND BEAM DETAIL

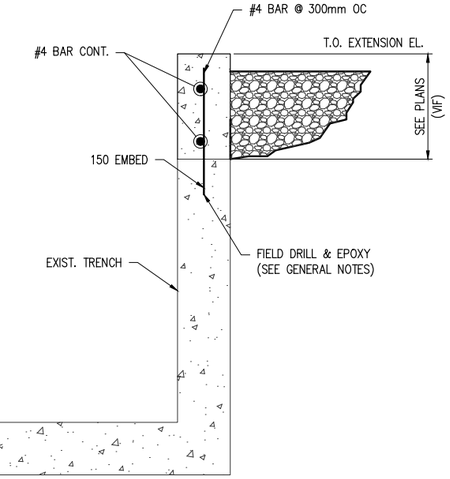
SCALE: 1:4



TYPICAL PAVER BLOCK

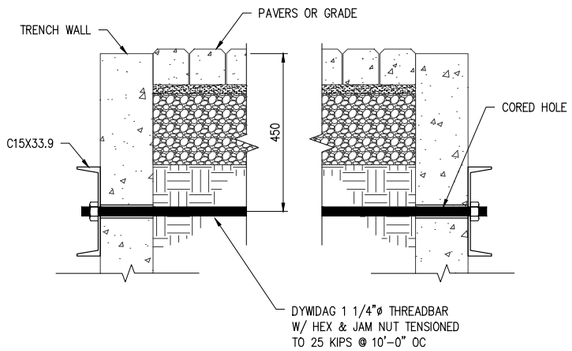
SCALE: 1:4





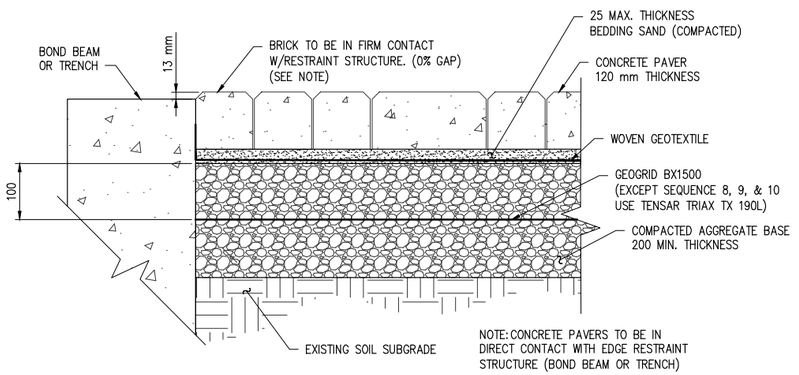
TYPICAL BUILT-UP TRENCH DETAIL

SCALE: 1:8



TYPICAL THREADBAR DETAIL

SCALE: 1:8



CONCRETE PAVER EDGE CONDITION DETAIL

SCALE: N.T.S.

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE NOV '25
SHT SIZE ISO A1
DESIGN KLD
DRAWN JCI
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
DETAIL SHEET
(1 OF 2)

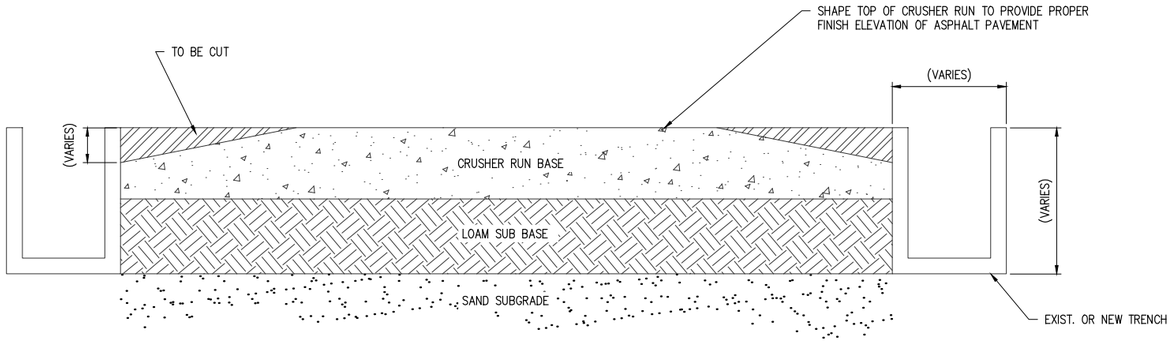
SHEET NO.
S25

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S25.DWG

10/23/2026 5:05 PM

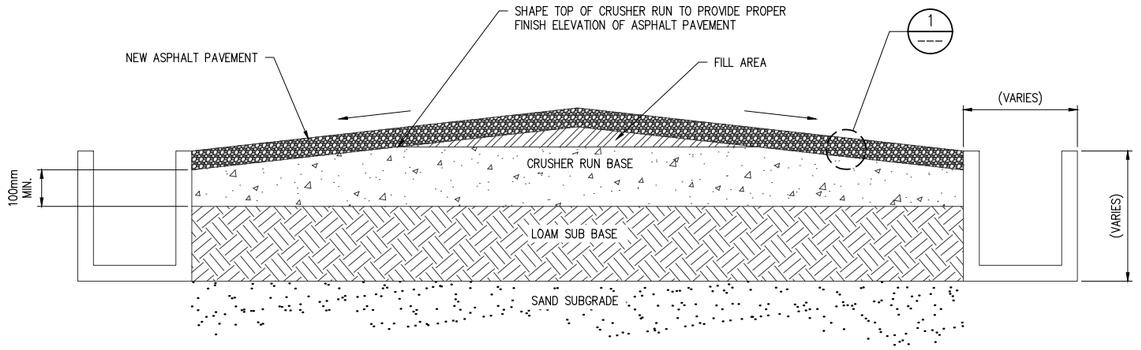
NOTES:

1. ALL DIMENSIONS ARE IN mm U.N.O.



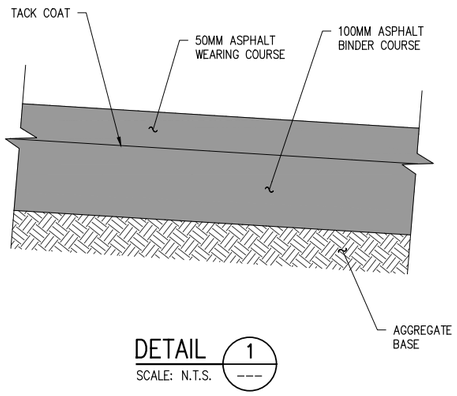
EXISTING ROADWAY & EXCAVATION

SCALE: (N.T.S.)



PROPOSED ROADWAY & FILL

SCALE: (N.T.S.)



DETAIL 1

SCALE: N.T.S.

APPROVED FOR CONSTRUCTION
OCTOBER 22, 2026

J:\13000S\13582 GYSBI SHOREBASE PAVING\DRAWINGS\STRUC - PAVEMENT PKG\13582-PV-S26.DWG

LANIER & ASSOCIATES
CONSULTING ENGINEERS, INC.
LA: EF-1120 TX: F-2981
VF-185 LSF-10194817
NEW ORLEANS • BEAUMONT • CORPUS CHRISTI • HOUSTON • MANDEVILLE

REV	DATE	BY	DESCRIPTION
0	10/22/26	KLD	APPROVED FOR CONSTRUCTION

DATE OCT '26
SHT SIZE ISO A1
DESIGN KLD
DRAWN TMH
CHECK KLD
APPR'D KLD
JOB NO 13582

GYSBI
GEORGETOWN GUYANA

SHORE BASE PAVEMENT PROJECT
DETAIL SHEET
(2 OF 2)

SHEET NO.
S26

APPENDIX B

SPECIFICATIONS

AMENDMENT TO PROCESS INDUSTRY PRACTICE (PIP)

PIP STS03001

Plain and Reinforced Concrete Specification

This document acts as an amendment to, and applies in conjunction with the requirements to the Process Industry Practices (PIP). This document includes additions, deletions, modifications or replacements to the original PIP document. Additions, deletions, modifications and replacements are numbered and formatted with paragraph numbers that correspond to those in the PIP document. A "sticky note" symbol has been added within the body of original PIP document directing the user to this addendum.

1.1 SCOPE

A. The type of requirement is defined below as follows:

1. [ADD] – Signifies content to be added to the PIP specification section.

2. [DELETE] – Signifies content to be deleted from the PIP specification section.

3. [MODIFY] – Signifies the PIP specification section has been modified per the following statement(s).

4. [REPLACE] – Signifies the following statement(s) are revisions to the PIP specification section.

1.2 REQUIREMENTS

4.1.4	DELETE	Entire subparagraph
4.1.5.4	DELETE	Entire subparagraph
4.2.1	DELETE	Entire subparagraph

4.2.2	ADD	Each sample shall consist of 8 specimens, suitable for (2) tests at 7 days, (2) tests at 28 days, and (4) held to be tested as directed by the engineer.
4.5.2.1	MODIFY	Portland cement shall be in accordance with ATSM C150/C150M, Type II or ASTM C-595 Type IL, unless otherwise specified in the contract documents.
4.5.10	ADD	Below floor vapor barriers are only required when indicated in project drawings.
4.6.2.8	DELETE	Entire subparagraph
4.6.5.2.6	DELETE	Entire subparagraph
4.6.6.1	REPLACE	Concrete minimum 28-day compressive strength, f ′c, shall be 5,000 psi.
4.6.6.2	REPLACE	Maximum water-cementitious materials ratio shall be 0.40.
4.6.6.5	REPLACE	Nominal maximum size of coarse aggregate in concrete shall be 1-1/2".

4.6.6.6	DELETE	Concrete mixtures shall be in accordance with the most restrictive requirements of ACI 301-20 IN-LB / ACI 301-20 SI Section 4.2.2.6 for exposure class F1, S1, W2, and C2.
4.6.6.7	REPLACE	Unless otherwise specified in the contract documents, concrete shall be air entrained in accordance with ACI 301-20 IN-LB / ACI 301-20 SI Section 4.2.2.6.c based on the freezing and thawing exposure class F1, with the exception of trowel-finished concrete which shall not be air entrained.
Table 2	DELETE	Supplier's QA Program - For Approval X - With RFQ Submittal X
Table 2	DELETE	Proposed Curing Methods - With RFQ Submittal X

PROCESS INDUSTRY PRACTICES

COMPLETE REVISION
September 2024

Structural

PIP STS03001
Plain and Reinforced Concrete Specification

PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

This Practice has been prepared by harmonizing technical requirements from existing standards of major industrial operators, contractors, and standards development organizations. While this Practice is intended to incorporate the majority of requirements, individual applications may have requirements which take precedence over this Practice. Determinations concerning fitness for purpose or application of this Practice to specific project or engineering situations should not be made solely on information contained in this Practice. All Practices are intended to be consistent with applicable laws and regulations. Should this Practice conflict with applicable laws or regulations, such laws or regulations must be followed. Consult an appropriate professional before applying or acting on any material contained in or suggested by this Practice.

Use of trade names should not be viewed as an expression of preference. Other brands having the same specifications are equally correct and may be substituted for those named.

This Practice is subject to revision at any time. For more information refer to PIP ADG001, *Specification for Developing Practices*.

©1995 Process Industry Practices (PIP), Construction Industry Institute, and The University of Texas at Austin on behalf of the Board of Regents of the University of Texas System

Process Industry Practices
3925 West Braker Lane (R4500)
Austin, Texas 78759

PUBLISHING HISTORY

December 1995	*Issued*	*May 2017*	*Complete Revision*
July 2001	*Complete Revision*	*September 2024*	*Complete Revision*
May 2007	*Complete Revision*		

Not printed with State funds

PIP STS03001
Plain and Reinforced Concrete Specification

Table of Contents

1. Scope 2

2. References 2
2.1 Process Industry Practices 2
2.2 Industry Codes and Standards 2

3. Definitions 4

4. Requirements 5
4.1 General 5
4.2 Quality Control 5
4.3 Quality Assurance 7
4.4 Submittals 8
4.5 Materials 8
4.6 Execution 10

Tables
Table 1 - Tolerances for Embedments ... 14
Table 2 - Supplier Data Requirements ... 19

1. Scope

This Practice provides requirements for furnishing and installing materials and for proportioning, mixing, placing, testing, and curing of cast-in-place plain and reinforced concrete.

This Practice supplements ACI 301-20 IN-LB, *Specifications for Concrete Construction – Inch-Pound Units*, and ACI 301-20 SI, *Specifications for Concrete Construction - International System of Units*.

2. References

Applicable parts of the following Practices and industry codes and standards shall be considered an integral part of this Practice. The edition of references shall be as shown in *ACI 301-20 IN-LB / ACI 301-20 SI* Section 1.4 or, if not listed in *ACI 301-20 IN-LB / ACI 301-20 SI*, shall be the edition in effect on the date of contract award, except as otherwise noted. Short titles are used herein where appropriate.

2.1 Process Industry Practices (PIP)

– PIP STF05121 - *Anchor Fabrication and Installation into Concrete*

2.2 Industry Codes and Standards

- American Concrete Institute (ACI)
  - ACI 117-10 - *Specification for Tolerances for Concrete Construction and Materials and Commentary*
  - ACI 117M-10 - *Specification for Tolerances for Concrete Construction and Materials and Commentary (Metric)*
  - ACI 237R - *Self-Consolidating Concrete*
  - ACI 301-20 IN-LB - *Specifications for Concrete Construction – Inch-Pound Units*
  - ACI 301-20 SI - *Specifications for Concrete Construction – International System of Units*
  - ACI 304R - *Guide for Measuring, Mixing, Transporting, and Placing Concrete*
  - ACI 305.1 IN-LB - *Specification for Hot Weather Concreting – Inch-Pound Units*
  - ACI 305.1M - *Specification for Hot Weather Concreting (Metric)*
  - ACI 306.1 - *Standard Specification for Cold Weather Concreting*
  - ACI SPEC-350.1 IN-LB - *Tightness Testing of Environmental Engineering Concrete Structures – Specification – Inch-Pound Units*
  - ACI SPEC-350.1 SI - *Tightness Testing of Environmental Engineering Concrete Structures – Specification – International System of Units*
  - ACI 350.5-12 - *Specifications for Environmental Concrete Structures*
  - ACI 350.5M-12 - *Specifications for Environmental Concrete Structures (Metric)*
  - ACI MNL-66 - *ACI Detailing Manual*

- ASTM International (ASTM)
  - ASTM A615/A615M - *Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement*
  - ASTM A1064/A1064M - *Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete*
  - ASTM C33/C33M - *Standard Specification for Concrete Aggregates*
  - ASTM C94/C94M - *Standard Specification for Ready-Mixed Concrete*
  - ASTM C150/C150M - *Standard Specification for Portland Cement*
  - ASTM C595/C595M - *Standard Specification for Blended Hydraulic Cements*
  - ASTM C618 - *Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*
  - ASTM C920 - *Standard Specification for Elastomeric Joint Sealants*
  - ASTM C989/C989M - *Standard Specification for Slag Cement for Use in Concrete and Mortars*
  - ASTM C1116/C1116M - *Standard Specification for Fiber-Reinforced Concrete*
  - ASTM C1157/C1157M - *Standard Performance Specification for Hydraulic Cement*
  - ASTM C1567 - *Standard Performance Specification for Hydraulic Cement*
  - ASTM C1602/C1602M - *Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete*
  - ASTM C1610/C1610M - *Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique*
  - ASTM C1611/C1611M - *Standard Test Method for Slump Flow of Self-Consolidating Concrete*
  - ASTM C1621/C1621M - *Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring*
  - ASTM C1712 - *Standard Test Method for Rapid Assessment of Static Segregation Resistance of Self-Consolidating Concrete Using Penetration Test*
  - ASTM D1751 - *Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types)*
  - ASTM D5249 - *Standard Specification for Backer Material for Use with Cold- and Hot-Applied Joint Sealants in Portland Cement Concrete and Asphalt Joints*
  - ASTM E1745 - *Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs*
- Concrete Reinforcing Steel Institute (CRSI)
  - *Manual of Standard Practice (MSP)*

- National Ready Mixed Concrete Association (NRMCA)
  - *Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities – Plant Certification Check List*

3. Definitions

constructor: Party responsible for supplying materials, equipment, tools, supervision, and labor for installation of concrete materials in accordance with contract documents. The term constructor applies also to constructor's subcontractor(s) and vendor(s).

contract documents: All documents, including codes, studies, design drawings, specifications, sketches, practices, and data sheets, that purchaser or engineer of record has transmitted or otherwise communicated, either by incorporation or reference, and made part of the legal contract agreement or purchase order between purchaser and constructor

engineer of record: Purchaser's authorized representative with overall authority and responsibility for engineering design, quality, and performance of civil works, structure, foundations, materials, and appurtenances described in contract documents. Engineer of record is licensed as defined by laws of the locality in which the work is to be constructed and is qualified to practice in the specialty discipline required for the work described in contract documents.

environmental engineering concrete structures: Concrete structures intended for conveying, storing, or treating water, wastewater, or other liquids and non-hazardous materials such as solid waste, and for secondary containment of hazardous liquids

fiber-reinforced concrete (FRC): Concrete containing dispersed, randomly oriented fibers which offers improved long-term serviceability of the structure or product. Fibers are made with different materials and can provide different levels of tensile/flexural capacity for a concrete section, depending on the type, dosage, and geometry.

manufacturer: Party who produces and warrants performance of products, materials, and/or items provided in accordance with contract documents. Products, materials, and/or items are manufactured in a controlled process using standard codes, specifications, tests and possibly include shop drawings to assist in proper application, installation and/or use. The term manufacturer applies also to manufacturer's subcontractor(s) and/or vendor(s).

mass concrete: Any volume of structural concrete in which a combination of dimensions of the member being cast, the boundary conditions, the characteristics of the concrete mixture, and the ambient conditions can lead to undesirable thermal stresses, cracking, deleterious chemical reactions, or reduction in the long-term strength as a result of elevated concrete temperature due to heat from hydration

owner: Party who has authority through ownership, lease, or other legal agreement over site, facility, structure or project wherein concrete materials will be used

purchaser: Party who awards contract to constructor. Purchaser may be owner or owner's authorized agent.

self-consolidating concrete: Fresh concrete that can flow around reinforcement and consolidate within formwork under its own weight without vibration

supplier: Party responsible for supplying concrete materials in accordance with contract documents

4. Requirements

4.1 General

4.1.1 Concrete supply and construction shall be in accordance with all requirements of *ACI 301-20 IN-LB / ACI 301-20 SI*, except as modified or supplemented in this Practice or by contract documents.

4.1.2 Requirements of federal, state, or local agencies that have jurisdiction where concrete is to be placed shall apply.

4.1.3 Any conflicts or inconsistencies between this Practice, design drawings, or other contract documents shall be brought to the attention of purchaser for resolution.

4.1.4 For applications designated as environmental engineering concrete structures in contract documents, concrete supply and construction shall also be in accordance with *ACI 350.5-12 / ACI 350.5M-12.*

4.1.5 Mass Concrete

4.1.5.1 All mass concrete shall be in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* Section 8 and any additional requirements in contract documents.

4.1.5.2 Any concrete designated as mass concrete in contract documents shall be considered mass concrete.

4.1.5.3 Any concrete with a minimum dimension equal to or greater than 4 ft (1200 mm) shall be considered mass concrete unless otherwise specified in contract documents.

4.1.5.4 Any mass concrete in applications designated as environmental engineering concrete structures in contract documents shall also be in accordance with *ACI 350.5-12 / ACI 350.5M-12* Section 8.

4.2 Quality Control

4.2.1 A written quality control program and inspection procedures document shall be submitted to purchaser for approval. These documents shall provide details of how compliance with requirements of this Practice and contract documents shall be achieved.

4.2.2 Samples for testing shall be obtained in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI*. Rate of sampling shall be in

accordance with the following unless otherwise specified in contract documents:

a. For structures, foundations and all other concrete not addressed in Sections 4.4.2b and 4.4.2c, samples shall be obtained in accordance with the following requirements:

(1) One sample minimum per 100 cubic yards (76 cubic meters) of concrete

(2) One sample minimum for each structure or foundation, except if placing a number of items each smaller than 25 cubic yards (19 cubic meters)

(3) One sample minimum per 25 cubic yards (19 cubic meters) if placing a number of items each smaller than 25 cubic yards (19 cubic meters)

b. For paving and slabs on grade, obtain one sample per 75 cubic yards (57 cubic meters) of concrete.

c. For underground pipe or electrical encasements and fireproofing, obtain one sample at beginning of each day of concreting work.

d. Additional samples shall be obtained if observations of tests for slump (except for self-consolidating concrete), temperature, or air content indicate nonconformance with contract documents.

e. For self-consolidating concrete only, additional samples shall be obtained if observations of tests for slump flow, T_{50}, Visual Stability Index (VSI), column segregation or passing ability indicate nonconformance with contract documents.

f. Additional samples shall be obtained for concrete to be placed in service prior to confirmation of 28-day strength tests in accordance with contract documents.

g. For concrete that will have fiber reinforcing, samples shall be obtained for concrete prior to addition of fiber reinforcing unless otherwise specified in contract documents.

4.2.3 For each concrete sample obtained, the following tests shall be conducted in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI*:

a. Compressive strength

b. Slump (except for self-consolidating concrete)

c. Temperature

d. Air content

4.2.4 For each concrete sample obtained for self-consolidating concrete, the following tests shall also be conducted:

a. Slump flow in accordance with *ASTM C1611/C1611M*

b. T_{50} and Visual Stability Index (VSI) in accordance with Appendix of *ASTM C1611/C1611M*

c. Static segregation resistance in accordance with *ASTM C1712*

d. Passing ability in accordance with *ASTM C1621/C1621M*

4.2.5 Test cylinder sets shall be dated and numbered consecutively.

4.2.6 Concrete quality control test reports shall be provided to purchaser weekly unless otherwise specified in contract documents. Data in test report shall include, but not be limited to, the following:

a. Location of concrete on the job and associated design drawing numbers and structure/foundation identification

b. Specified compressive strength (f ′c)

c. Date placed

d. Proportions of concrete mix or mix identification

e. 7- and 28-day compressive strength and compressive strength for any other duration as specified in contract documents

f. Slump (except for self-consolidating concrete), air and concrete temperatures at time of placement, time of day concrete was batched, and time of day concrete was placed

g. For self-consolidating concrete only, slump flow, T_{50}, Visual Stability Index (VSI), column segregation and passing ability

h. Air content

i. Name of inspector making cylinders and cylinder number

4.2.7 Constructor shall notify testing agency when concrete is to be placed.

4.2.8 Ready mixed concrete suppliers shall be certified in accordance with one of the following:

a. Certification by holding a current NRMCA Certificate of Conformance for Concrete Production Facilities

b. Certification from an independent testing agency stating conformance with NRMCA Certification of Ready Mixed Concrete Production Facilities

c. Certification from Department of Transportation or governing authority for the project site location

The certification shall be current for duration of concrete supply.

4.3 Quality Assurance

4.3.1 Purchaser shall be responsible for furnishing a testing agency to act as the “owner’s testing agency” as defined by *ACI 301-20 IN-LB / ACI 301-20 SI,* unless otherwise specified in contract documents.

4.3.2 The purchaser shall have the right to make inspections at any time at the source of supply of materials, at the place of preparation of materials, at the mixing plant if ready mixed concrete is used, and during execution of all concrete work.

4.4 Submittals

4.4.1 The items listed in Table 2 shall be submitted for engineer of record review and approval of items in the approval column. Work shall not proceed without approval.

4.4.2 Trial batch submittal shall include documentation qualifying concrete mixture to reduce the potential of alkali-silica reaction (ASR) in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* Section 4.2.2.6(a).

4.4.3 Additional documentation which is not listed in Table 2 shall be submitted to purchaser if required by contract documents.

4.5 Materials

4.5.1 General

4.5.1.1 Materials shall be in accordance with this Practice and contract documents unless otherwise approved in writing by purchaser.

4.5.1.2 Materials and application thereof shall be in accordance with applicable federal, state and local volatile organic compound regulations.

4.5.2 Cementitious Materials



4.5.2.1 Cementitious materials shall be in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* Section 4.2.1.1. Portland cement shall be in accordance with *ASTM C150/C150M*, Type I or Type II unless otherwise specified in contract documents. Blended hydraulic cement shall be in accordance with *ASTM C595/C595M*. Hydraulic cement shall be in accordance with *ASTM C1157/C1157M*.

4.5.2.2 Only one brand of cement shall be used for a batch of concrete. If brand of cement is changed, constructor shall submit cement certification to purchaser two weeks prior to proposed change of brand. Change of brand shall only occur after the end of a day and completion of the structure/foundation.

4.5.2.3 Fly ash may be used in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* and shall be in accordance with *ASTM C618*, Class F unless otherwise specified in contract documents. Class C fly ash may be used if Class F is not available.

4.5.2.4 Ground Granular Blast Furnace Slag (GGBFS) in accordance with *ASTM C989/C989M* may be used if available.

4.5.2.5 Cementitious materials used for mass concrete applications shall be in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* Section 8.2.1.1. For applications designated as environmental engineering concrete structures in contract documents, cementitious materials used for mass concrete applications shall also be in accordance with *ACI 350.5-12 / ACI 350.5M-12* Section 8.2.1.1.

4.5.3 Admixtures

4.5.3.1 All admixtures shall require engineer of record's authorization for use.

4.5.3.2 Only one manufacturer for each admixture shall be used. Admixtures used together shall be from same manufacturer or documentation of compatibility from manufacturers shall be submitted for approval prior to use.

4.5.3.3 Calcium chloride and admixtures containing soluble chlorides shall not be permitted.

4.5.3.4 For applications designated as environmental engineering concrete structures in contract documents, admixtures used for mass concrete applications shall be in accordance with *ACI 350.5-12 / ACI 350.5M-12* Section 8.2.1.2.

4.5.4 Aggregate

4.5.4.1 Aggregate shall be in accordance with *ASTM C33/C33M.*

4.5.4.2 Aggregate shall be obtained from a single source.

4.5.4.3 Aggregates proposed for use shall be tested in accordance with Appendix of *ASTM C33/C33M*, or a record of satisfactory performance shall be submitted to engineer of record for approval.

4.5.4.4 Fine and coarse aggregate shall meet the restrictions on reactive materials in accordance *ASTM C33/C33M*.

4.5.5 Reinforcement

4.5.5.1 Reinforcing bars shall be deformed billet steel in accordance with *ASTM A615/A615M*, Grade 60 (420) unless otherwise specified in contract documents.

4.5.5.2 Reinforcing shall be uncoated unless otherwise specified in contract documents.

4.5.5.3 Welded wire reinforcement shall be plain wire in accordance with *ASTM A1064/A1064M*. Wire shall be of sufficient size to fabricate in sheets. Rolls of welded wire reinforcement shall not be used.

4.5.5.4 Tie wire shall be black annealed wire, 16 gage (1.29 mm) minimum.

4.5.5.5 Fiber reinforcing shall be in accordance with *ASTM C1116/C1116M* and shall only be used for specific applications as specified in contract documents.

4.5.5.6 Reinforcement supports shall be plastic or plastic-coated standard types and sizes given in *CRSI MSP*.

4.5.6 Water

Water used for mixing water, ice, curing, or any other function relating to placement of concrete shall be in accordance with *ASTM C1602/C1602M*, unless otherwise specified in contract documents.

4.5.7 Accessories

Accessories shall meet the requirements of *ACI 301-20 IN-LB / ACI 301-20 SI*. Use coated or corrosion-resistant material for accessories that remain embedded in concrete with less than two inches (50 mm) cover unless otherwise specified in contract documents.

4.5.8 Joints

4.5.8.1 Joint filler shall be in accordance with *ASTM D1751* unless otherwise specified in contract documents.

4.5.8.2 Backer rod for joint sealant shall be in accordance with *ASTM D5249*. Diameter shall be 1.5 times the width of the joint unless otherwise specified in contract documents.

4.5.8.3 Joint sealant shall be in accordance with *ASTM C920*, unless otherwise specified in contract documents.

4.5.9 Anchorage

Anchorage shall be in accordance with *PIP STF05121*, unless otherwise specified in contract documents.

4.5.10 Vapor Barrier

Below floor vapor barrier shall be in accordance with *ASTM E1745*, Class A, and minimum 10 mil (250 µm) thickness unless otherwise specified in contract documents.

4.6 Execution

4.6.1 General

Storage, handling, measuring, mixing, transporting, and placing of concrete materials shall be in accordance *ACI 301-20 IN-LB / ACI 301-20 SI* and shall comply with manufacturer's written recommendations for handling, storage, and protection.

Comment: *ACI 304R* provides methods and procedures for storage, handling, measuring, mixing, transporting and placing of concrete materials.

4.6.2 Formwork

4.6.2.1 Unless otherwise specified in contract documents, 3/4-inch (20-mm) chamfer strips shall be provided at all corners on permanently exposed surfaces.

4.6.2.2 Form-release agents shall not be applied if concrete surfaces shall receive special finishes or where the agent may affect applied coverings. Alternately, inside surfaces of untreated

formwork shall be soaked with clean water and kept moist before placing concrete.

4.6.2.3 Form removal shall be in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* and the following:

a. For structures for which forms do not provide vertical support or lateral stability (e.g., footings, piers, columns, walls, or sides of beams), the forms may be removed 48 hours after completion of placement if concrete is sufficiently hard to prevent damage by form removal, and if curing starts immediately.

b. Forms for self-supporting members may be removed if concrete compressive strength is at least 80 percent of the specified 28-day compressive strength unless otherwise specified in contract documents. Refer to *ACI 301-20 IN-LB / ACI 301-20 SI*, Section 2.3.4, for determining compressive strength of concrete for removal of formwork.

c. Forms shall not be left permanently in place unless otherwise approved by the purchaser.

4.6.2.4 Form accessories that remain embedded in the concrete (e.g., ties and hangers) shall be a commercially manufactured type and shall be coated or corrosion-resistant if they have less than two inches (50 mm) of cover unless otherwise specified in contract documents.

4.6.2.5 Formed concrete surfaces shall be constructed in accordance with the tolerances shown in *ACI 117 / ACI 117M*.

4.6.2.6 Formwork for columns and walls shall be provided with adequate cleanout openings to permit inspection and easy cleaning after reinforcement has been placed.

4.6.2.7 All side and bottom surfaces of concrete for structures that will be exposed shall be formed. Vertical surfaces of concrete for subgrade structures and pavements shall be formed at least to a depth of 12 inches (300 mm) below grade unless otherwise approved by engineer of record. Concrete below this level may be placed against earth and shall be in accordance with requirements in *ACI 117 / ACI 117M*.



4.6.2.8 Formwork design calculations and drawings shall be sealed by engineer of record for the formwork.

4.6.3 Joints

4.6.3.1 All joints shall be located and constructed in accordance with contract documents. Any variation from the location specified shall be approved by engineer of record.

4.6.3.2 Control joints to be cut with a saw shall be cut as soon as concrete is hard enough to prevent surface raveling and

aggregate dislodging, and within 8 hours after concrete placement.

a. Control joints shall be cut in accordance with saw manufacturer's written recommendations.

b. Sawing sequence shall be based on concrete placement time and size of slab.

4.6.3.3 Control joints in slab toppings shall be located directly above and in line with the control joints in underlying concrete slab.

4.6.3.4 Isolation joints shall be placed where pavement adjoins vertical surfaces (e.g., walls, columns, catch basins, manholes, and equipment foundations). Isolation joints shall be located in accordance with contract documents.

4.6.3.5 Dowels at expansion joints shall be properly aligned to prevent any restraint on expansion movement at the joint.

4.6.3.6 The surface of joints shall be cleaned of scale and laitance and thoroughly wetted, but free of standing water, before placing adjoining concrete.

4.6.4 Waterstops

Waterstops shall be installed in accordance with contract documents and manufacturer's written recommendations.

4.6.5 Reinforcing and Embedments

4.6.5.1 Detailing and Fabrication

1. Reinforcement placing drawings and bending schedules shall be prepared in accordance with *ACI MNL-66* and *CRSI Manual of Standard Practice* and submitted to engineer of record for review and approval.
2. Reinforcement placing drawings and bending schedules shall show number, grade, size, length, mark, location, and bending diagrams for reinforcing bars.
3. Splices in reinforcement shall be detailed, fabricated, and located only as shown on the design drawings.
4. Fabrication drawings shall indicate the related PO number, release number, and design drawing number.
5. Reinforcement shall be tagged with durable weather-resistant tags. Tags shall remain attached and legible throughout transportation, handling and storage.
6. Each bundle of fabricated bars shall be tagged. The tags shall indicate reinforcement placing drawing number, release number, mark number, grade, bar quantity, and bar size.
7. Each bundle of stock-length straight bars shall be tagged to indicate bar quantity, grade, bar size, and bar length.

8. Fabrication tolerances shall be in accordance with *ACI 117 / ACI 117M*.

4.6.5.2 Installation

1. Support and anchorage of reinforcement shall in accordance with *ACI MNL-66* and *ACI 301-20 IN-LB / ACI 301-20 SI*.
2. Embedded aluminum items shall not be permitted.
3. Anchors, inserts, sleeves, drains, curb and seat angles, nosing, and other embedded items shall be installed before placing concrete. Welding of these items to the reinforcing bars shall not be permitted.
4. Embedded portion of anchor rods shall be wrapped with non-bonding tape for the required length and location specified in contract documents if applicable.
5. Anchor threads above the top of concrete elevation specified on the design drawings shall be covered with duct tape or other suitable means to keep the threads clean and to prevent any damage during placement of concrete.
6. Anchor sleeves shall be filled with a nonbonding moldable material or an elastomeric moldable non-hardening material unless otherwise specified in concrete documents. Anchor sleeves shall be capped or plugged to keep out water, concrete, and debris until sleeves are filled with a nonbonding moldable material or an elastomeric moldable non-hardening material, or for sleeves specified in contract documents to be filled with grout (by others).
7. Grout pockets for anchors and shear keys to be grouted in place (by others) shall be capped or plugged to keep out water, concrete, and debris until pockets are filled with grout.
8. Reinforcing bars shall be spliced in accordance with design drawings only. Welded or mechanical splices shall not be permitted unless otherwise approved by engineer of record.

4.6.5.3 Tolerances

Embedments shall be installed in accordance with tolerances shown in Table 1, unless otherwise specified in contract documents. The term “anchor group” used in Table 1 is defined as the set of anchors for a single fabricated steel shipping piece, or a single piece of equipment or skid. Table 1 supersedes Section 2.3.4 in *ACI 117-10 / ACI 117M-10*.

Comment: Tolerances are tighter in Table 1 compared to *ACI 117 / ACI 117M* to align with typical industry practice.

Table 1 – Tolerances for Embedments

Measurement	Tolerance
Anchor projection	+ or – 1/4 inch (6 mm)
Center of anchor group	+ or – 1/4 inch (6 mm)
Center to center of any two anchors within a group	+ or – 1/8 inch (3 mm)
Center to center between anchor groups	+ or – 1/4 inch (6 mm)
Anchor plumbness	1/8 inch in 3 feet (4 mm in 1 meter)
Plate inserts in columns, walls, and beams horizontal and vertical location	+ or – 1/4 inch (6 mm)
Shapes and plate inserts in floor slabs	+ or – 1/4 inch (6 mm) horizontal + or – 1/16 inch (2 mm) elevation

4.6.6 Proportioning and Mixing

4.6.6.1 Concrete minimum 28-day compressive strength, f ′c, shall be 4,000 psi (28 MPa) unless a higher strength is specified for Exposure Class in accordance with *ACI 301-20 (IN-LB) / ACI 301-20 (SI)* or unless otherwise specified in other requirements in this Practice or other contract documents.

4.6.6.2 Maximum water-cementitious materials ratio shall be 0.4 for concrete used for environmental engineering concrete structures. For all other concrete, maximum water-cementitious materials ratio shall be in accordance with the most restrictive requirements of *ACI 301-20 IN-LB / ACI 301-20 SI* Section 4.2.2.6 for the exposure categories and classes specified by engineer of record in contract documents.

4.6.6.3 High early strength concrete or other types of high-performance concrete shall meet the requirements specified in contract documents.

4.6.6.4 Fly ash content exceeding 25% by weight of cementitious material shall be approved by engineer of record.

4.6.6.5 Nominal maximum size of coarse aggregate in concrete shall be in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI,* unless otherwise specified in contract documents.

4.6.6.6 Concrete mixtures shall be in accordance with the most restrictive requirements of *ACI 301-20 IN-LB / ACI 301-20 SI* Section 4.2.2.6 for the exposure categories and classes specified by engineer of record in contract documents.

4.6.6.7 Unless otherwise specified in the contract documents, concrete shall be air entrained in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* Section 4.2.2.6.c based on the freezing and thawing

exposure class specified in contract documents with the exception of trowel-finished concrete which shall not be air entrained.

4.6.6.8 Self-consolidating concrete shall be proportioned to meet slump flow in accordance with *ASTM C1611/C1611M*, T_{50} in accordance with Appendix of *ASTM C1611/C1611M*, and passing ability in accordance with *ASTM C1621/C1621M*, as specified in contract documents for each specific application. Visual stability index (VSI) shall have a rating of 0 (highly stable) or 1 (stable) in accordance with Appendix of *ASTM C1611/C1611M*. Static segregation shall be less than 10% in accordance with *ASTM C1610/C1610M* or *ASTM C1712*.

Comment: ACI 237R provides methods and means for placing self-consolidating concrete.

4.6.6.9 Admixtures and fiber reinforcing shall be added at batch plant unless otherwise directed in contract documents or approved by engineer of record. Fiber reinforcing shall be added in accordance with manufacturer's instructions based on type and dosage of fiber reinforcing specified in contract documents.

4.6.6.10 Concrete envelopes for underground electrical ducts and cover slabs for direct-buried cables shall have a minimum 28-day compressive strength, f ′c, of 3,000 psi (21 MPa) and be colored red by adding 10 pounds of red oxide powder per cubic yard (6 kilograms per cubic meter) of concrete unless otherwise specified in contract documents. Another method of providing red color at the top of the concrete envelope may be used if approved by engineer of record.

4.6.6.11 Concrete envelopes for underground instrument ducts shall have a minimum 28-day compressive strength, f ′c, of 3,000 psi (21 MPa) and be colored yellow by adding 10 pounds of yellow oxide powder per cubic yard (6 kilograms per cubic meter) of concrete unless otherwise specified in contract documents. Another method of providing yellow color at the top of the concrete envelope may be used if approved by engineer of record.

4.6.6.12 On-site mixed concrete shall not be permitted unless otherwise approved by purchaser.

4.6.7 Placing Concrete

4.6.7.1 Inspection and authorization shall be obtained from purchaser before placing concrete.

4.6.7.2 Concrete that has achieved initial set or has been contaminated by foreign matter shall not be deposited in the structure.

4.6.7.3 Addition of water or water-reducing admixture at construction site shall be in accordance with *ASTM C94/C94M* and shall be permitted only if it has been considered in the mix design.

4.6.7.4 Addition of ice at construction site shall be in accordance with *ASTM C94/C94M* and shall be permitted only if it has been considered in the mix design. The concrete manufacturer shall provide written instructions on required amount of ice and mixing procedure.

4.6.7.5 Use of liquid nitrogen to cool freshly mixed concrete shall be permitted only if approved by engineer of record.

4.6.7.6 Materials and equipment for protection, finishing and curing shall be operational at placement site before placement begins.

4.6.7.7 Slabs shall be placed in alternating panels.

4.6.7.8 The interval between concrete deliveries shall be such that no cold joints are created during placement of a single foundation or slab.

4.6.7.9 Time limit from the start of mixing to when the concrete discharge must be completed shall be in accordance with *ASTM C94/C94M* unless otherwise specified by engineer of record.

4.6.8 Curing and Protection

4.6.8.1 Concrete shall be cured and protected in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* unless otherwise specified in this Practice or in contract documents.

4.6.8.2 Concrete not in contact with forms may utilize any of the methods indicated in *ACI 301-20 IN-LB / ACI 301-20 SI* for the preservation of moisture.

4.6.8.3 Liquid membrane curing compounds shall not be used on surfaces that shall receive bonded treatments, tiles, paint or other adhered finishes, epoxy toppings, or additional concrete unless otherwise specified in contract documents.

4.6.8.4 Curing and protection of concrete for environmental engineering concrete structures shall be in accordance with *ACI 350.5-12 / ACI 350.5M-12*. Curing method shall be in accordance with *ACI 350.5-12 / ACI 350.5M-12*, Section 6.3.5.4, methods (a), (b), or (c), unless otherwise approved by engineer of record.

4.6.8.5 Curing and protection of mass concrete shall be in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* Section 8.3.1. For applications designated as environmental engineering concrete structures in contract documents, curing and protection of mass concrete shall also be in accordance with *ACI 350.5-12 / ACI 350.5M-12* Section 8.3.2.

4.6.9 Loading of Self-Supporting Members

No superimposed load shall be applied to self-supporting members before 28-day verification of specified compressive strength, unless

specified 28-day compressive strength has been verified by field-cured cylinders and approved by engineer of record.

4.6.10 Surface Finishing and Tolerances

4.6.10.1 Surface finish and correlating tolerance requirements shall be in accordance with *ACI 301-20 IN-LB / ACI 301-20 SI* Sections 5.3.3 and 5.3.4, *ACI 117 / ACI 117M* and as specified in contract documents.

4.6.10.2 Equipment bases shall be finished with a floated finish. Stairs, steps, ramps, and walks shall be finished with a broom finish.

4.6.11 Repair of Surface Defects

4.6.11.1 Tie holes, honeycombs, and other concrete surface defects shall be repaired promptly after form removal at a time and in a manner that shall not delay, interfere with, or impair the proper curing of the fresh concrete unless otherwise specified or approved by engineer of record.

4.6.11.2 Engineer of record shall be notified before proceeding with repair if the defect is any of the following:

a. Depth is greater than 3 inches (75 mm) at the maximum point and surface area is greater than 150 square inches (100,000 square mm).

b. Depth is greater than 1/4 the thickness of the member and greater than 6 inches (150 mm) in any other direction.

c. Reinforcing steel is exposed.

4.6.11.3 Prepackaged grouts and patching compounds or a patching mortar similar to the concrete mix without coarse aggregate may be used with approval of engineer of record.

4.6.11.4 Out-of-tolerance slabs shall be repaired by grinding down high points and/or raising low points by using a self-leveling compound or repair topping approved by engineer of record and installed in accordance with manufacturer’s recommendation.

4.6.11.5 Critical slab areas, identified in contract documents shall be replaced if out-of-tolerance. A demolition and replacement plan for the slab areas shall be submitted to engineer of record for review and approval before proceeding.

4.6.12 Hot and Cold Weather Concreting

4.6.12.1 Evaporation control measures shall provide adequate protection of, and prevent rapid evaporation from, the fresh concrete surface. Control measures in accordance with *ACI 305.1 IN-LB* / *ACI 305.1M* shall be utilized and remain in place while one or a combination of the concrete and air temperatures, relative humidity of the air, and the wind speed have the capacity to evaporate free water from the fresh concrete surface at a rate

that is equal to or greater than 0.2 pounds per square foot per hour (1 kilogram per square meter per hour).

4.6.12.2 Cold weather concreting shall meet the requirements of *ACI 306.1* for minimum temperatures specified therein.

4.6.13 Architectural and Prestressed Concrete

Architectural and prestressed concrete requirements that are in addition to *ACI 301-20 IN-LB / ACI 301-20 SI* and this Practice shall be in accordance with contract documents.

4.6.14 Tightness Testing of Environmental Engineering Concrete Structures

If specifically required in the contract documents, tightness testing of environmental engineering concrete structures shall be performed in accordance with *ACI SPEC-350.1 IN-LB / ACI SPEC-350.1 SI*.

Table 2 – Supplier Data Requirements

	Type of Submittal		When Required					Remarks
	For Approval	For Record	Weekly	14 Days Before Placement	14 Days Before Fabrication	With RFQ Submittal	Other	
Supplier's QA Program	X					X		
Batch Plant and Truck Mixer Certification		X		X				
Mix Designs	X			X				
Trial Batch Qualification Test Results	X			X				
Cement Certifications		X		X				
Mineral Additive Certifications		X		X				If applicable
Fine and Coarse Aggregate Certifications		X		X				
Admixture Data Sheets and Certifications		X		X				
Material Suppliers, Sources, and Certifications		X		X				
Manufacturer Spec's, Certifications and Installation Instructions		X		X				
Proposed Curing Methods	X					X		
Reinforcing Bending Schedule and Placing Drawings	X				X			
Certified Mill Test Reports for each bar size and heat number		X		X				
Coating Inspection Reports		X	X					If applicable
Concrete Delivery Ticket		X					With delivery	
Compression Test Reports		X	X					
Compression Breaks 500 psi (3.5 MPa) or more below required		X					Same day	Engineer of record needs to review and provide disposition of low strength concrete results
Water Testing Reports		X		X				If applicable
Mass Concrete Thermal Control Plan	X			X				Required for each mass concrete placement

AMENDMENT TO PROCESS INDUSTRY PRACTICE (PIP)

PIP CVS02100

Site Preparation, Excavation, and Backfill Specification

This document acts as an amendment to, and applies in conjunction with the requirements to the Process Industry Practices (PIP). This document includes additions, deletions, modifications or replacements to the original PIP document. Additions, deletions, modifications and replacements are numbered and formatted with paragraph numbers that correspond to those in the PIP document. A "sticky note" symbol has been added within the body of original PIP document directing the user to this addendum.

1.1 SCOPE

A. The type of requirement is defined below as follows:

1. [ADD] – Signifies content to be added to the PIP specification section.

2. [DELETE] – Signifies content to be deleted from the PIP specification section.

3. [MODIFY] – Signifies the PIP specification section has been modified per the following statement(s).

4. [REPLACE] – Signifies the following statement(s) are revisions to the PIP specification section.

1.2 REQUIREMENTS

4.1.1.1	DELETE	Entire subparagraph
4.1.1.6	DELETE	Entire subparagraph
4.1.8.3	DELETE	Entire section

4.3.2.4	DELETE	Entire section
	Select Type	
	Select Type	
	Select Type	
	Select Type	
	Select Type	
	Select Type	
	Select Type	

PIP CVS02100
Site Preparation, Excavation, and Backfill Specification

Table of Contents

1. Scope 2

2. References 2
2.1 Process Industry Practices 2
2.2 Industry Codes and Standards 2
2.3 Government Regulations 3

3. Definitions 3

4. Requirements 4
4.1 General.....4
4.2 Materials – Fill and Backfill 10
4.3. Construction 11

1. Scope

This Practice describes the requirements for excavation, placement, inspection, and management of materials during the site preparation, excavation, and backfill phase of a construction project.

2. References

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 Process Industry Practices (PIP)

- PIP CVS02350 - *Roadway and Area Paving Construction Specification*

2.2 Industry Codes and Standards

- ASTM International (ASTM)
  - ASTM C136/C136M - *Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates*
  - ASTM D698 - *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))*
  - ASTM D1140 - *Standard Test Methods for Determining the Amount of Material Finer Than the 75-µm (No.200) Sieve in Soils by Washing*
  - ASTM D1556/D1556M - *Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method*
  - ASTM D1557 - *Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2700 kN-m/m^3))*
  - ASTM D2167 - *Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method*
  - ASTM D2937 - *Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method*
  - ASTM D3740 - *Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction*
  - ASTM D4253 - *Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table*
  - ASTM D4254 - *Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density*
  - ASTM D4318 - *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*
  - ASTM D5084 - *Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter*
  - ASTM D5268 - *Standard Specification for Topsoil Used for Landscaping Purposes*
  - ASTM D6938 - *Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)*

2.3 Government Regulations

- U.S. Department of Labor, Occupational Safety and Health Administration (OSHA)
  - 29 CFR 1926 - *Safety and Health Regulations for Construction*
- U.S. Environmental Protection Agency (EPA)
  - 40 CFR 122 *National Pollutant Discharge Elimination System (NPDES)* General Permit for Point Source Discharge to Public Waterways (Permit)

3. Definitions

Best Management Practices (BMP): The techniques (e.g., buffers, silt fences, detention ponds, swales, etc.), schedules of activities, prohibitions of practices, and maintenance procedures used to prevent or reduce the discharge of pollutants

constructor: Party responsible for supplying the materials, equipment, tools, supervision, and labor for performing site preparation, excavation, fill, and backfill in accordance with contract documents. The term constructor applies also to constructor's subcontractor(s) and vendor(s).

contract documents: Any and all documents, including codes, studies, design drawings, specifications, sketches, practices, and data sheets that purchaser or engineer of record has transmitted or otherwise communicated, either by incorporation or reference, and made part of the legal contract agreement or purchase order between purchaser and constructor

engineer of record: Purchaser's authorized representative with overall authority and responsibility for engineering design, quality, and performance of civil works, structure, foundations, materials, and appurtenances described in contract documents. Engineer of record is licensed as defined by laws of the locality in which the work is to be constructed, and is qualified to practice in the specialty discipline required for the work described in contract documents.

impermeable fill: Compacted clay fill which has a hydraulic conductivity of less than one foot per year ($1x10^{-6}$ cm/second) using the fluids to be retained

inspector: Party responsible for verifying quality of all materials, installations, and workmanship furnished by constructor. Inspector is qualified by training and experience and holds certifications or documentation of their qualifications. Unless otherwise specified in contract documents, inspector is an independent party retained by purchaser

owner: Party who has authority through ownership, lease, or other legal agreement over project site

professional engineer: An engineer, other than engineer of record licensed as defined by laws of the locality in which the work is to be performed, and qualified to practice in the specialty discipline required for the work described in contract documents

purchaser: The party who awards contract to constructor. Purchaser may be owner or the owner's authorized agent.

Storm Water Pollution Prevention Plan (SWPPP): Written plan that defines erosion and sediment control practices in accordance with the independent requirements of the federal construction general permits

4. Requirements

4.1 General

4.1.1 Quality Control and Submittals

4.1.1.1 A written Quality Control Program document that provides details of how compliance with the requirements of this Practice and contract documents shall be achieved shall be submitted by constructor to purchaser for approval a minimum of 15 days before start of construction.

4.1.1.2 Certified laboratory test data for materials and products to be used in work shall be submitted to purchaser for approval a minimum of 15 days before shipping of materials and products.

4.1.1.3 Results of quality control tests required during performance of work shall be submitted to purchaser within 48 hours of completion.

4.1.1.4 Inspector will provide submittals listed in Section 4.1.2.2 to purchaser and constructor.

4.1.1.5 The following submittals shall be provided to purchaser. Data shall include horizontal dimensions, elevations, size, and slope gradients, as appropriate for the utility and as required by purchaser:

a. Accurately recorded as-built locations of project-installed underground utilities

b. Tie-in points/interferences encountered during project construction

4.1.1.6 Notify purchaser not less than five days in advance of any blasting operation. Blasting shall commence only after owner approval provided by purchaser.

4.1.1.7 If excavation bracing (i.e., shoring and sheeting, manufactured systems) is required, the following submittals shall be provided to purchaser:

a. Plans, sketches, and/or details of the materials and shoring system to be used, including sequence and method of installation

b. Supporting calculations prepared by a professional engineer

c. Identification of any bracing components that shall remain after filling or backfilling

4.1.1.8 If dewatering of an excavation is required, proposed methods and details shall be submitted to purchaser for review before beginning excavation.

4.1.1.9 If required by an authority having jurisdiction, a soil erosion control plan and/or a storm water runoff pollution prevention plan shall be provided to purchaser and the appropriate authority.

4.1.1.10 If completed work is not in accordance with this Practice, constructor shall be responsible for repairing or reconstructing deficiencies to meet this Practice and other contract documents at constructor's expense.

4.1.2 Quality Assurance and Submittals

4.1.2.1 Inspector shall perform field and laboratory testing and/or evaluations in accordance with criteria of *ASTM D3740* to verify compliance of work with requirements of this Practice and to ensure achievement of intents and purposes of the work.

4.1.2.2 Inspector shall provide the following submittals to purchaser and constructor:

a. A statement attesting that constructor's work is in accordance with requirements of this Practice and contract documents

b. Informal daily "pass" or "fail" reports

c. Formal weekly reports including all test logs and comments. These formal reports shall include density and moisture content test logs, indicating location of tests by coordinates and elevation and all appropriate comments.

d. Upon earthwork completion, all density and moisture content test logs and comments compiled and submitted for permanent project records.

e. Sources and test results of all borrow materials used for fill.

4.1.2.3 During construction, purchaser shall have access to all constructor's facilities and records for purpose of conducting performance inspection/audits.

4.1.2.4 During an audit by purchaser, all inspection and test reports, and/or engineering analyses and calculations associated with scope of work shall be provided to purchaser upon request.

4.1.3 Surveying

All lines and grades shall be determined by constructor for constructor's operations from horizontal and vertical control points furnished by purchaser.

4.1.4 Inspection and Testing

4.1.4.1 Unless otherwise specified in contract documents, inspector shall be responsible for quality assurance inspection and testing to ensure that work is in accordance with requirements of this Practice and contract documents.

4.1.4.2 Inspector shall perform tests as outlined in Section 4.1.5 or as otherwise specified in contract documents.

4.1.4.3 Performance or lack of performance of inspections and testing by inspector shall not be construed as granting relief for constructor from meeting requirements of this Practice or other contract documents.

4.1.5 Tests to be Performed

4.1.5.1 Tests of gradation, plasticity, density, and moisture content shall be performed for each type of fill material. These tests shall include the following:

a. One standard sieve analysis in accordance with *ASTM C136/136M* or *ASTM D1140*

b. One liquid and plastic limit determination in accordance with *ASTM D4318*

c. One Modified Proctor Test in accordance with *ASTM D1557* or one Standard Proctor Test in accordance with *ASTM D698*

4.1.5.2 For granular soils that do not exhibit a well-defined moisture-density relationship, index density, unit weight, and relative density shall be determined in accordance with *ASTM D4253* and *ASTM D4254*.

4.1.5.3 If type or source of fill material changes, control tests shall be performed again with the new material.

4.1.5.4 Unless otherwise specified in contract documents, the following in-place dry density and moisture content testing (i.e., field density testing) on compacted fill shall be performed using one of the following methods:

a. Sand-cone method in accordance with *ASTM D1556/D1556M*

b. Nuclear methods in accordance with *ASTM D6938*

c. Rubber balloon method in accordance with *ASTM D2167*

d. Drive-cylinder method in accordance with *ASTM D2937*

4.1.5.5 Unless otherwise specified in contract documents, field density testing shall be performed at the following frequencies:

a. Structural fill under foundations and building slabs – one test every 1000 square feet (90 square meters) of each lift

b. Structural fill under roadways, railroads, area pavement and parking areas – one test every 2000 square feet (180 square meters) of each lift

c. Road base and sub-base – one test every 2000 square feet (180 square meters) of each lift

d. Backfill of trenches – one test for every 150 linear feet (45 linear meters) of each lift and one test within each segment between changes in direction.

e. Backfill over foundations – one test for every 1000 square feet (90 square meters) of each lift.

f. General fill – one test every 5000 square feet (460 square meters) of each lift

4.1.5.6 As a minimum, one in-place moisture content and one density test shall be performed on every lift of fill.

4.1.5.7 Until the required dry density has been achieved, further placement of fill or backfill shall not be permitted.

4.1.5.8 Number of field density tests shall be increased by 50% if more than 4% of tests fail to meet specified dry density. When failed tests become less

than 2%, number of tests shall revert to original specified frequency in Section 4.1.5.5.

4.1.5.9 For impermeable soil a sample shall be taken from each surface (i.e., base, side walls of ponds/ditches). At least one sample shall be taken at 22,500 square feet (2,090 square meters) or less.

4.1.6 Protection

4.1.6.1 Temporary fences, guardrails, barricades, lights, and other protective measures required for safety of personnel and premises shall be installed and maintained in good condition.

4.1.6.2 All reference points (e.g., property markers, benchmarks, etc.) shall be carefully maintained during excavation, backfilling, compaction, and earthwork.

4.1.6.3 If a reference point is damaged during performance of the work, reference point shall be repaired or replaced in accordance with requirements of owner.

4.1.6.4 Unless otherwise specified in contract documents, before earthwork begins, purchaser shall locate and mark all known utilities within project limits or note them in contract documents.

4.1.6.5 If other utility locations become evident as earthwork progresses, work stoppages may be required by owner until utilities are identified and until owner provides specific direction.

4.1.6.6 Utilities scheduled to remain shall be protected and preserved.

4.1.6.7 Bracing and shoring shall be used to protect excavations adjacent to existing underground installations (e.g., foundations, piping manholes, electrical, and duct banks) and personnel performing excavation activities during construction.

4.1.6.8 Unless otherwise specified in contract documents, excavation under foundations shall not be permitted.

4.1.6.9 Damage to structures, utility lines, or graded areas caused by erosion shall be repaired to original condition at constructor's expense. This includes areas that are seeded until such time that vegetation prevents erosion.

4.1.6.10 During performance of the work, constructor shall prevent dust from harming individuals and damaging adjacent properties and equipment.

4.1.7 Environmental

4.1.7.1 Contaminated Soils and Water

1. Known contaminated soils within construction limits shall be managed in accordance with soil management plan and contract documents.
2. If unexpected soil contamination is encountered during the work, work shall be stopped and owner shall be notified immediately.
3. Water to be discharged that is potentially contaminated shall be managed in accordance with contract documents.

4.1.7.2 Erosion/Sediment Control

1. All procedures and work shall be in accordance with local, state, and federal regulations including NPDES General Permit for Point Source Discharge to Public Waterways or project specific permit.
2. Construction affected areas shall be maintained using temporary erosion and sediment control measures, in accordance with Storm Water Pollution Prevention Plan (SWPPP) requirements until permanent measures are completed and functioning.
3. Inspections and reporting shall be performed as specified by SWPPP.
4. If a project specific SWPPP is not required in contract documents, the following minimum prevention measures shall be provided unless otherwise specified by owner:
   a. Silt Fence

      Silt fence shall be installed in accordance with contract documents and on downslope sides of the following areas:

      (1) All disturbed areas

      (2) All stockpile areas

   b. Inspections

      (1) Daily inspections shall be performed in areas of active construction or equipment operation.

      (2) Weekly inspections shall be performed in areas with no construction or equipment operation.

      (3) Area inspections shall be performed within 24 hours of each 0.5-inch (13-mm) or greater rainfall event.

      (4) Inspection reports shall be prepared after each inspection and submitted to purchaser within 2 working days.

   c. Maintenance

      (1) Sediment shall be removed from behind silt fence if it exceeds 6 inches (150 mm) in height. Removed sediment shall be placed in topsoil stockpile areas.

      (2) Any silt fence damaged so it cannot perform its intended function shall be replaced.

      (3) Silt fence shall be removed after area has been surfaced or seeded and has been approved by purchaser.

      (4) Soil that is spilled or washed onto paved areas or streets shall be removed from the surface daily.

      (5) Soil that breaches constructor’s erosion and sediment control measures and spills or washes into drains, pipes, gutters, or ditches or onto adjacent property shall be removed at least daily. Measures shall be provided to prevent recurrence.

(6) Erosion/sediment controls shall be revised as conditions change during construction or if the minimum sediment control measures are not effective in controlling erosion and sediment.

(7) Construction site shall be kept free of trash, and storage bins shall be kept covered.

4.1.8 Safety

4.1.8.1 General

1. Work shall be in accordance with *OSHA 29 CFR 1926* and other applicable federal, state, and local codes and with safety requirements of owner.
2. Unless otherwise specified in the contract documents, a work permit shall be obtained from owner before performing earthwork.

4.1.8.2 Excavation Safety

1. Constructor is solely responsible for designing and constructing stable excavations as mandated by *OSHA29 CFR 1926, Subpart P*.
2. Excavation and trench safety systems include, but are not limited to, sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering or diversion of water to provide adequate drainage.
3. Constructor's "competent" representative, as defined in *OSHA 29 CFR Part 1926.650* to *652* shall evaluate soil exposed in excavations and verify that excavation and trench safety systems, are certified for actual installation conditions as part of constructor's safety procedures.
4. Excavation slope height, slope inclination, and depth, including utility trench excavation depth, shall not be greater than specified in local, state, and federal safety regulations.
5. If evidence of possible cave-ins or slides is apparent, constructor shall immediately stop work in the excavation or trench and move personnel to safe locations until necessary precautions have been taken by Constructor to safeguard personnel entering trench.
6. Confined space entry permits shall be required for trenches and excavations qualifying as OSHA "permit required confined spaces."

4.1.8.3 Blasting

1. If blasting is required, a written blasting safety plan shall be submitted for owner's approval.
2. Permits for blasting shall be obtained by constructor from authorities having jurisdiction.
3. Copies of blasting permits shall be submitted to purchaser.
4. Written permission shall be obtained from owner before explosives are brought to the site and before drilling is started.

5. Explosives shall be stored, handled, and used in accordance with local regulations and owner's safety practices. These criteria shall be addressed in the blasting safety plan.
6. Constructor shall be responsible for all blasting operations.

4.2 Materials – Fill and Backfill

4.2.1 Basic Requirements

4.2.1.1 Fill and backfill materials shall be from either on-site excavation, designated borrow areas, or off-site sources in accordance with requirements of Sections 4.2.1.3, 4.2.3, and 4.2.4.

4.2.1.2 All borrow material and all supply sources shall be submitted to purchaser and approved by engineer of record.

4.2.1.3 Fill and backfill shall contain no rocks or stones larger than 3 inches (75 mm) and shall be free of frozen lumps, organic matter, trash, chunks of highly plastic clay, snow, ice, contamination, or other deleterious material.

4.2.1.4 Liquid limit and plastic limit of materials shall be determined in accordance with *ASTM D4318*.

4.2.2 Topsoil

Topsoil shall conform to *ASTM D5268* or contract documents.

4.2.3 General Fill Material

Fill and backfill to be used as general fill shall be material capable of being compacted to the requirements of Section 4.3.7.8 (b).

4.2.4 Structural Fill Material

4.2.4.1 Fill and backfill to be used as structural fill shall be gravel, sand, clay, or silt, or a mixture of these constituents capable of being compacted to requirements of Section 4.3.7.8 (a).

4.2.4.2 Except for sands or gravels that exhibit no plasticity characteristics, structural fill material shall be in accordance with the following requirements:

a. Liquid limit – 40 maximum

b. Plasticity index – 6 through 20

4.2.5 Controlled Low-Strength Material (CLSM)

4.2.5.1 CLSM may be substituted for either structural fill material or general fill material, if approved by purchaser.

4.2.5.2 Mix design shall be proportioned to produce a 28-day compressive strength between 50 and 100 psi (0.3 and 0.7 MPa) for general fill and 100 and 200 psi (0.7 and 1.4 MPa) for structural fill, pre-tested using actual raw materials and approved by engineer of record before use on project.

4.2.6 Impermeable Fill

4.2.6.1 Earthen dikes, dams, or levees shall use fill material with hydraulic conductivity, liquid limit and plasticity index as specified in contract documents. Channel or pond linings shall have a minimum of 12 inches (300 mm) thick layer of compacted clay unless noted otherwise in contract documents.

4.2.6.2 Unless noted otherwise in design documents, hydraulic conductivity shall be measured in accordance with *ASTM D5084*.

4.3. Construction

4.3.1 Site Preparation

4.3.1.1 Clearing and Grubbing

1. Clearing and grubbing shall consist of removal and disposal of trees, stumps, roots, vegetation, logs, rubbish, and other unsuitable material.
2. Except for trees and shrubs in areas designated in contract documents for preservation, areas designated for clearing and grubbing shall be cleared.
3. During construction operations, trees, shrubs, and other landscape features specifically designated in the contract documents for preservation shall be carefully protected from abuse, marring, or damage.
4. Trees and other vegetation outside the construction area shall not be damaged in any manner.
5. Trees, stumps, and other vegetation in the areas designated for clearing and grubbing shall be removed to the bottom of their root zone.
6. Depressions made by clearing and grubbing operations shall be filled in accordance with Section 4.3.7 and compacted to conform to the adjacent surface of the original ground.

4.3.1.2 Stripping

1. Before any soil is removed, the area shall be cleared of all debris.
2. Stripping shall consist of excavation, removal, and satisfactory disposal of all topsoil and soil containing organic material. Such stripped materials shall not be used as structural fill material under any circumstances.
3. Topsoil shall be removed to full-depth or as specified in contract documents.
4. Reusable materials shall be stockpiled as necessary for constructor's operations in areas approved by purchaser.

4.3.1.3 Rough Grading

1. General area grading shall be completed to within a tolerance of plus or minus 0.20 feet (60 mm) of elevations shown in contract documents but shall not be uniformly high or low.

2. Roads, parking areas, and building areas shall be excavated or filled to subgrade elevations shown in contract documents.
3. Rock encountered through cut sections shall be excavated to 1 foot (300 mm) below subgrade elevation and shall be backfilled to specified elevation.
4. If unsatisfactory field conditions caused by rain, inclement weather, or other circumstances prevent satisfactory performance of work, earthwork operations shall be suspended, and purchaser notified.
5. After completing grading operations and before grassing operations, graded areas that are not to be further improved shall be overlaid with topsoil of a compacted thickness of 4 inches (100 mm) minimum.

4.3.2 Excavation

4.3.2.1 Structural Excavation

1. Structural excavation shall include excavations for area paving, roadways, railways, foundations, grade beams, sumps, basements, retaining walls, manholes, catch basins, trenches, and all other in-ground and below-ground facilities, and areas to be used in the future to support structural loads as specified in contract documents.
2. Structural excavation shall be performed in accordance with contract documents to dimensions, grades, and elevations as noted and as required for formwork.
3. Overexcavation shall not be permitted unless otherwise specified in contract documents or approved by engineer of record.
4. Soils encountered at bottom of excavation elevation specified in contract documents which do not meet compaction requirements of Section 4.3.6.3 or 4.3.6.4 shall be removed and replaced with compacted structural fill or CLSM.

4.3.2.2 Earthen Structures

1. Earthen structures include, but are not limited to, ponds, canals, ditches, retention basins, levees, and dikes.
2. Excavation for earthen structures shall be made to the lines, grades, and cross sections as specified in contract documents.
3. Side slopes of excavations shall be cut and graded to specified cross section.
4. Unstable soil in the slopes shall be removed, and slopes repaired using material and methods in accordance with Sections 4.2 and 4.3.7.
5. Bottoms of excavations shall be graded to elevations and configurations as specified in contract documents.
6. Overexcavation shall be backfilled and compacted in accordance with Sections 4.2 and 4.3.7.

4.3.2.3 Trenching

1. Trenches are excavations made for placement of, but not limited to, underground piping, electrical cables, duct banks, geotextile anchoring, and drainage ditches.
2. Bottom of trenches shall be graded to the elevations as specified in the contract documents.
3. When applicable install shoring in advance of or simultaneously with trench excavation so that soils within full height of trench excavation walls will remain laterally supported at all times.
4. Unstable soil in bottom of trenches shall be removed and replaced using material and methods in accordance with Sections 4.2 and 4.3.7.
5. Overexcavation of trenches shall not be permitted unless otherwise specified in contract documents or approved by engineer of record.

4.3.2.4 Rock Excavation



1. Rock excavation shall consist of excavation of boulders or pieces of detached rock measuring 1 cubic yard (0.76 cubic meter) in volume or greater, or rock in ledges, bedded deposits, and conglomerate deposits so firmly cemented that they present all characteristics of solid rock, which cannot be excavated with earth moving, heavy equipment. All other excavation shall be earth excavation.
2. If blasting is not permitted, rock shall be excavated with mechanical rippers, mechanical breakers, or mechanical drills with non-explosive demolition agents.
3. If blasting is permitted and required, blasting operations shall be managed in accordance with the rock-blasting plan (see Section 4.1.8.3).
4. If unexpected hard rock is encountered during the work, work shall be stopped until a blasting plan is developed or until owner provides specific direction.

4.3.3 Stockpiling

4.3.3.1 Material shall be stockpiled in a location specified by owner.

4.3.3.2 Stockpiles shall be placed, graded, and shaped for drainage.

4.3.3.3 Storage or stockpiling of material shall not be permitted on a completed subgrade.

4.3.3.4 Stockpiling of contaminated soils shall be in accordance with an owner approved contaminated soils management plan or as specified by owner.

4.3.4 Drainage

4.3.4.1 Drainage of cuts, excavations, fills, stockpiles, spoil areas, surcharge embankments, and borrow areas shall be maintained at all times to prevent ponding of surface water because of ground water or rainfall by providing temporary ditches, swales, culverts, and/or pumping systems as required in each respective site area.

4.3.4.2 Temporary drainage facilities shall be removed at completion of project or as specified by owner.

4.3.4.3 A temporary surface seal (e.g., sealing with a smooth drum roller) shall be constructed as required to prevent saturation during wet weather or temporary shutdown of operations.

4.3.4.4 Soil that becomes saturated shall be removed completely or reconditioned in accordance with Section 4.3.7.

4.3.5 Disposal of Excess and Waste Materials

4.3.5.1 If practicable, all suitable materials removed by excavation shall be used as fill.

4.3.5.2 Excavated material, in excess of that required for normal embankment construction, shall be stockpiled within construction limits or shall be placed in a designated spoil area beyond construction limits as specified by owner.

4.3.5.3 Material unsuitable for fill and debris, removed by clearing, grubbing, stripping, and excavation, shall be removed to a disposal area approved by owner.

4.3.5.4 Burning of combustible materials shall be performed only with approval of owner and only if permitted by local authorities.

4.3.6 Preparation of Areas for Structural Fill or Loading

4.3.6.1 Areas of structural excavation to receive structural fill or loading shall be free of frozen subgrade, roots, trash, snow, ice, or other deleterious material.

4.3.6.2 Areas shall be prepared for structural fill or loading as follows:

a. Drained of standing water

b. Proof-rolled by crossing the area repeatedly and methodically with a 10-ton (9-tonne) minimum weight pneumatic tire compactor or a fully loaded dump truck. See *PIP CVS02350* for proof-rolling requirements for roadways and area paving.

c. If proof-rolling demonstrates ruts between 1 and 2 inches (25 and 50 mm) deep after localized soft spots have been repaired, the top 6 inches (150 mm) of the overall area shall be scarified and re-compacted. For areas where ruts exceed 2inches deep, the top 12 inches (300 mm) shall be scarified and re-compacted.

d. For enclosed areas or tightly spaced areas, if access by proof rolling equipment is limited, hand operated rollers or plate compactors may be used if approved by owner.

e. In accordance with any other requirements specified in contract documents including but not limited to overexcavation, moisture conditioning and re-compacting of the upper soils, and chemical stabilization or other methods of improving soil conditions.

4.3.6.3 Density of the top 6 inches (150 mm) in areas for structural fill or loading shall not be less than 90% of the maximum Modified Proctor density in accordance with *ASTM D1557*, or 95% of maximum Standard Proctor density in accordance with *ASTM D698*.

4.3.6.4 Density of the top 6 inches (150 mm) in areas of structural fill or loading, where granular soils exist that do not exhibit well-defined moisture-density relationship, shall be compacted to at least 80% relative density in accordance with *ASTM D4253* and *ASTM D4254*.

4.3.7 Filling and Backfilling

4.3.7.1 Unless otherwise specified in contract documents, the following areas shall be filled or backfilled using structural fill:

a. For foundations that require fill for subgrade improvement or to raise elevation, directly beneath and 3 feet (1meter) beyond perimeter of foundations.

b. Beneath slabs, roadways, railroads, area pavement, and parking areas directly beneath and 3 feet (1meter) beyond the perimeter of improved area.

4.3.7.2 All other areas not designated above may be filled or backfilled using general fill, unless otherwise specified in contract documents.

4.3.7.3 Before placement of structural fill or backfill, the area to receive fill shall be prepared in accordance with Section 4.3.6.

4.3.7.4 Compacting shall begin only after fill or backfill has been properly placed and material is at the specified moisture content.

4.3.7.5 When air temperature is below freezing, earth fill shall not be placed on frozen soil. Earth fill shall be free draining and be placed at temperatures above 35° F (2° C).

4.3.7.6 Unless otherwise specified in contract documents, material shall be placed in loose lifts not exceeding the following criteria, provided that the specified compaction is achieved for the full depth:

a. Structural fill shall be placed in lifts of 8 inches (200 mm) maximum in loose depth.

b. General fill shall be placed in lifts of 12 inches (300 mm) maximum in loose depth.

c. General and structural fill materials placed as backfill and compacted with hand-operated equipment shall be placed in lifts of 4 inches (100 mm) maximum in loose depth unless otherwise approved by purchaser.

4.3.7.7 Compaction shall be performed with equipment compatible with soil type.

4.3.7.8 Unless otherwise specified in contract documents, fill and backfill layers shall be uniformly compacted in accordance with the following density and moisture content requirements:

a. Structural Fill Compaction Densities

(1) Structural fill shall be compacted to at least 90% of maximum Modified Proctor density in accordance with *ASTM D1557*, or 95% of maximum Standard Proctor density in accordance with *ASTM D698*.

(2) Granular soil used as structural fill that does not exhibit well-defined moisture-density relationship shall be compacted to at least 80% relative density in accordance with *ASTM D4253* and *ASTM D4254*.

b. General Fill Compaction Densities

(1) General fill shall be compacted to at least 85% of maximum Modified Proctor density in accordance with *ASTM D1557*, or 90% of the maximum Standard Proctor density in accordance with *ASTM D698*.

(2) Granular soil used as general fill that does not exhibit well-defined moisture-density relationship shall be compacted to 70% to 75% relative density in accordance with *ASTM D4253* and *ASTM D4254*.

c. Moisture content of material being compacted shall be within plus or minus 3% of the optimum moisture content in accordance with applicable *ASTM D1557* or *ASTM D698*. Fill materials shall be conditioned as necessary to achieve required moisture content, without additional cost to purchaser.

d. Chemical stabilization may be used provided the engineer of record approves modifications necessary to obtain satisfactory compaction.

4.3.7.9 Topsoil shall be placed, leveled to grade and lightly rolled to produce a firm surface suitable for landscape purposes.

4.3.7.10 Compaction by water jetting or flooding shall not be permitted.

4.3.7.11 Fill and backfill adjacent to structures (e.g., retaining walls, pits, and basements) shall not be compacted with heavy equipment, but with hand-operated equipment to a distance of 4 feet (1.2 meters) or greater beyond the sides of the structures.

4.3.7.12 To prevent unnecessary eccentric loading on a structure or foundation, every effort shall be made to place backfill materials symmetrically and in uniform layers.

4.3.7.13 Unless otherwise permitted by purchaser, backfill around or over cast-in-place concrete shall not be permitted until the concrete has attained 75% of its specified strength.

4.3.7.14 Compacted surfaces of fill and backfill shall be finish-graded to cross sections, lines, grades, elevations and tolerances specified in contract documents.

4.3.7.15 Where specified by the contract documents, utility warning/marking tape shall be placed continuous during backfill over the utility.

4.3.8 Installation of Base Course

4.3.8.1 Base course for roads, parking areas, and other areas to be surfaced shall be prepared in accordance with this section and *PIP CVS02350*.

4.3.8.2 The existing ground to the toe of fill slopes shall be cleared, grubbed, and stripped in accordance with Sections 4.3.1.1 and 4.3.1.2.

4.3.8.3 Excavation of areas in cut shall be in accordance with Section 4.3.2.

4.3.8.4 Backfill of base course shall be in accordance with Sections 4.3.6 and 4.3.7, with the following exceptions:

a. Compaction shall be to at least 95% of the maximum Modified Proctor density in accordance with *ASTM D1557*, or 100% of maximum Standard Proctor density in accordance with *ASTM D698*.

b. If base course materials are clean granular material, compaction shall be to 85% of relative density in accordance with *ASTM D4253* and *ASTM D4254*.

4.3.8.5 Geosynthetic materials shall be installed in accordance with manufacturer's written instructions and/or as specified in the contract documents.

4.3.8.6 Compacted base course shall be shaped to a smooth and even surface, free of voids, and to the required elevation.

4.3.8.7 Deviation greater than 1/2 inch (12 mm) in cross section or 1/2 inch (12 mm) in length as measured with a 16-foot (5-meter) straightedge shall be corrected by loosening, adding, or removing material and then reshaping and re-compacting by sprinkling and rolling.

4.3.8.8 Base course shall be maintained in a smooth, true-to-grade, compacted condition until it is covered by other construction.

4.3.9 Dewatering

4.3.9.1 All dewatering methods and disposal of water shall be approved by owner.

4.3.9.2 If required for construction, before excavation, an approved dewatering system shall be installed and operated when necessary to lower the groundwater.

4.3.9.3 Design of dewatering system shall be the responsibility of constructor.

4.3.9.4 Constructor shall be responsible for any effects of dewatering on adjacent facilities.

4.3.9.5 Surface water shall be prevented from flowing into excavations by installing ditches, trenches, protective swales, pumps, or other purchaser approved measures.

4.3.9.6 All non-contaminated water shall be diverted or pumped to existing drainage system.

4.3.9.7 Excavations for foundations and other underground installations shall not be used as temporary drainage ditches.

Provided By:

Barnes and Cone, Inc.

Syracuse
315-437-0305
barnesandcone.com

If you have questions about specific products or services we provide, please don't hesitate to contact us.

CONSTRUCTION OF INTERLOCKING CONCRETE PAVEMENTS

PURPOSE

This technical bulletin gives construction guidelines to design professionals and contractors of interlocking concrete pavements. The bulletin reviews the steps in constructing an aggregate base, bedding sand and concrete pavers. This pavement structure is commonly used for pedestrian and vehicular applications. Pedestrian areas, driveways, and areas subject to limited vehicular use are paved with units $2^3/_8$ in. (60 mm) thick. Streets and industrial pavements should be paved with units at least $3^1/_8$ in. (80 mm) thick.

It is recommended that CMHA Certified Concrete Paver Installers be utilized for the construction of interlocking concrete pavement. These individuals have attended training and have demonstrated their knowledge of the guidelines, materials and techniques specific to interlocking concrete pavement. CMHA maintains a list of Certified Concrete Paver Installers on www.masonryandhardscapes.org.

Aggregate bases stabilized with asphalt or cement are recommended under very heavy loads, and over weak or saturated soil subgrades. These are sometimes used when adequate aggregates are not available or when a stabilized base is more economical than unstabilized aggregate. Refer to *Tech Note PAV-TEC 004–Structural Design of Interlocking Concrete Pavement for Roads and Parking Lots* when looking for additional information regarding the structural design of the base and subbase. *Tech Note PAV-TEC 004* is based on the design methods detailed in ASCE 58-16 *Structural Design of Interlocking Concrete Pavements for Municipal Streets and Roadways* (ASCE 2016).

Concrete pavers made in the U.S. should meet the requirements established in the American Society for Testing and Materials ASTM C936, *Standard Specification for Solid Interlocking Concrete Paving Units.* Requirements of this standard include a minimum average compressive strength of 8,000 psi (55 MPa) and average absorption no greater than 5%. Samples must conform to dimensional tolerances for length and width at ±1/16 in. (±1.6 mm), and height at ±1/8 in. (±3 mm). Freeze-thaw durability should be tested while immersed in tap water using ASTM C1645 *Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units*. The average mass loss from all samples tested should be no greater than 225 g/m^2 when subject to 28 freeze-thaw cycles, or no greater than 500 g/m^2 when subject to 49 freeze-thaw cycles. For applications where the pavers will be subject to deicers, the tap water is replaced with a 3% saline solution.

Concrete pavers made in Canada are required to meet requirements set forth by the Canadian Standards Association CSA-A231.2 *Precast Concrete Pavers*. This standard requires a minimum average cube compressive strength of 7,250 psi (50 MPa) or 5,800 psi (40 MPa) at delivery. Samples must meet dimensional tolerances for length and width of –1 to +2 mm and height at ±3.0 mm. Freeze-thaw durability is tested while samples are immersed in a 3% saline solution and subject to -15 degrees C as the lowest temperature. Samples must have



Figure 1. Excavation of the soil subgrade and placing grade stakes.

Revised March 2022



Figure 2. Compacting the soil subgrade.



Figure 3. Application of the geotextile under aggregate base.

an average mass loss no greater than 225 g/m^2 when subject to 28 freeze-thaw cycles, or no greater than 500 g/m^2 when subject to 49 freeze-thaw cycles.

Installation steps include job planning, layout, excavating and compacting the soil subgrade, applying geotextiles (optional), spreading and compacting the sub-base and/or base aggregates, constructing edge restraints, placing and screeding the bedding sand, and placing concrete pavers. For larger installations mechanical placement of pavers may be more economical. Refer to *Tech Note PAV-TEC-011 Mechanical Installation of Interlocking Concrete Pavements* for additional information.

JOB PLANNING

Prior to excavating, check with the local utility companies to ensure that digging does not damage underground pipes or wires. Many localities have one telephone number to call at least two days before excavation for marking utility line locations. Overhead clearances should be checked so that equipment does not interfere with wires. Site access by vehicles and equipment should be established so that the job can be built without delays.

LAYOUT

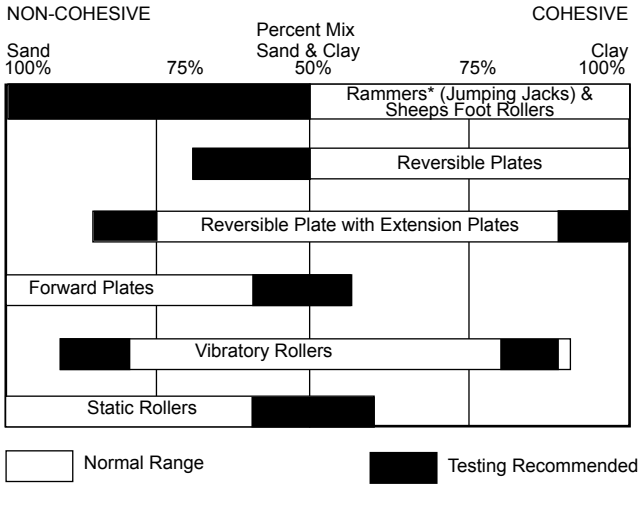
In preparing for excavation, the area to be removed should be marked with stakes. See Figure 1. The stakes should be a slight distance away from the area to be removed so that they are not removed during excavation. The stakes should be marked to establish grades, or have string lines pulled and tied to them. Slopes should be a minimum of 1.5%. In the case of roads, the minimum longitudinal slope should be 1% with a minimum cross slope of 2%. Grade stakes should be checked periodically during the job to be sure that they have not been disturbed.

EXCAVATING, DRAINAGE AND COMPACTING THE SOIL SUBGRADE

During and after excavation, the soil should be inspected for organic materials or large rocks. If organic materials, roots, debris, or rocks remain, they should be removed and replaced with clean, compacted aggregate backfill material. Free-standing water saturating the soil should be removed. After it is removed, low, wet areas can be stabilized with a layer of crushed stone and/or cement.

Typical 4 in. (100 mm) diameter perforated drainage pipes surrounded with minimum 3 in. (75 mm) of No. 57 or similar open-graded stone is wrapped in woven or non-woven geotextile as specified by the designer. The surface of the stone is even with the top of the compacted soil subgrade. The stone and geotextile pipe assembly is placed along the pavement perimeter to remove excess water in the subgrade soil and base. The perforated pipe should be sloped and directed to outlets at the sides or ends of the pavement. The pipe outlets should be

Table 1. Guide to the Application of Compaction Equipment to Various Soils (Courtesy of Vibromax 2000 Co.)



*Rammers work very well in sand if confined, as around abutments, foundations, etc.

Table 2. Geotextile Requirements for Separation per AASHTO M288

Geotextile Class		Class I [a]		Class II [a]		Class III [a]	
Elongation	**ASTM D4632**	**< 50%**	**> 50%**	**< 50%**	**> 50%**	**< 50%**	**> 50%**
Grab Strength [b]	ASTM D4632	315 lb [1400 N]	202 lb [900 N]	247 lb [1100 N]	157 lb [700 N]	180 lb [800 N]	112 lb [500 N]
Sewn Seam Strength [b,c]	ASTM D4632	283 lb [1260 N]	182 lb [810 N]	223 lb [990 N]	142 lb [630 N]	162 lb [720 N]	101 lb [450 N]
Tear Strength [b]	ASTM D4533	112 lb [500 N]	79 lb [350 N]	90 lb [400 N] [d]	56 lb [250 N]	67 lb [300 N]	40 lb [180 N]
Puncture Strength [b]	ASTM D6241	618 lb [2750 N]	433 lb [1925 N]	495 lb [2200 N]	309 lb [1375 N]	371 lb [1650 N]	223 lb [990 N]
Permittivity [b,e]	ASTM D4491	0.02 sec^{-1}					
Apparent Opening Size	ASTM D4751	0.024 in [0.60 mm] maximum average roll value					
Ultraviolet Stability	ASTM D4355	> 50% after 500 hr exposure					

[a] The severity of the installation conditions generally dictates the required geotextile class. Class I is the most severe and Class III is the least severe.
[b] All numeric values represent MARV in the weaker principal direction.
[c] When sewn seams are required.
[d] The required tear strength for woven monofiliment geotextiles if 250 N.
[e] Default Value. Permittivity of the geotextile should be greater than the soil.

covered with screens to prevent animal ingress. Drain pipes are recommended in clay soils or other slow draining soils subject to vehicular traffic. Soil subgrade drainage extends pavement performance to the extent that the small additional investment is returned many times in additional pavement service years.

Compaction of the soil subgrade is critical to the performance of interlocking concrete pavements. See Figure 2. Adequate compaction will minimize settlement. Compaction should be at least 98% of standard Proctor density as specified in ASTM D698. However, modified Proctor density (ASTM D1557) is preferred, especially for areas under constant vehicular traffic. This compaction standard may not be achievable in extremely saturated or very fine soils. Stabilization of the soil subgrade may be necessary in these situations.

Compaction equipment varies with the type of subgrade soil. Manufacturers of compaction equipment can provide guidance on which machines should be applied to various types of soil. Table 1 gives general guidance on applying the right machines to various soil types.

Monitoring soil moisture content is important to reaching the compaction levels described above. Soil moisture and density measurements should be taken to control and verify the degree of compaction. Soil should be moist, without visible signs of water, stick together as a ball when squeezed by hand and break into a few pieces when dropped from 6 to 12 inches as indicated in *CMHA Concreter Paver Course Manual* The moisture content and compacted density of the subgrade soil should be checked for compliance to specifications before installing geotextiles.

APPLYING GEOTEXTILES (OPTIONAL)

Geotextile may be used in areas where soil remains saturated part of the year, where there is freeze and thaw, or over clay and moist silty subgrade soils. See Figure 3. As a separation layer,

Table 3. Geotextile Overlap Requirements

Soil CBR	Overlap
> 3.0	1.0 ft [0.3 m] to 1.5 ft [0.45 m]
1.0 to 3.0	2.0 ft [0.6 m] to 3.0 ft [1.0 m]
0.5 to 1.0	3.0 ft [1.0 m] or sewn
< 0.5	Sewn
All roll ends	3.0 ft [1.0 m]

Table 4. Grading Reqirements for Dense Graded Aggregate per ASTM D2940

Sieve Size (Square Openings)	Design Range[(a)] Mass % Passing		Job Mix Tolerance Mass % Passing	
	Bases	**Subbases**	**Bases**	**Subbases**
2 in. (50 mm)	100	100	–2	–3
1 1/2 in. (37.5 mm)	95-100	90-100	±5	±5
3/4 in. (19 mm)	70-92	—	±8	—
3/8 in. (9.5 mm)	50-70	—	±8	—
No. 4 (4.75 mm)	35-55	30-60	±8	±10
No. 30 (600 µm)	12-25	—	±5	—
No. 200 (75 µm)	0-8[(b)]	0-12[(b)]	±3	±5

(a) Select the Job Mix Formula with due regard to the availability of materials and service requirements of project. Test results outside the design range are not prohibited, provided they are within the job mix tolerances.

(b) Determine by wet sieving. Where local environmental conditions (temperature and availability of free moisture) indicate that in order to prevent damage by frost action it is necessary to have lower percentages passing the No. 200 (0.075 mm) sieve than permitted in Table 4, appropriate lower percentages shall be specified. When specified, the material having a diameter smaller than 0.020 mm shall not exceed 3% mass.



Figure 4. Base compaction with a reversible plate compactor.

geotextiles prevent the migration of soil into the aggregate base under loads, especially when saturated, thereby reducing the likelihood of rutting. When geotextiles are used they preserve the load bearing capacity of the base over a greater length of time than placement without them. Woven or non-woven fabric may be used under the base with a maximum apparent opening size of 0.60 mm as testing using ASTM D4751. Table 2 lists minumum requirements of geotextiles for soil separation. These requirements are from AASHTO M288 Standard Specification for Geotextile Specification for Highway Applications (AASHTO 2015). The minimum down slope overlap should be at least 12 in. (300 mm). Overlap requirements for low strength subgrades are detailed in Table 3.

When the fabric is placed in the excavated area, it should be turned up along the sides of the opening, covering the sides of the base layer. There should be no wrinkles on the bottom. When the aggregate is dumped on the fabric, the tires from trucks should be kept off the fabric to prevent wrinkling.

SPREADING AND COMPACTING THE SUBBASE AND/OR BASE AGGREGATES

Specifications typically used by cities, states, or provinces for aggregate base materials under flexible asphalt pavements are adequate for interlocking concrete pavements. If no specifications are available use the recommended grading for the aggregate base shown in Table 4. Spread and compact the base in 4 to 6 in. (l00 to 150 mm) lifts using 7,000 lbf (31 kN) reversible plate compactors. Thinner lifts will be required for compactors in the 5,000 lbf (22 kN) range. High force compaction equipment can compact thicker lifts. Consult with compaction equipment manufacturer for guidance. Frozen base material should not be installed, nor should material be placed over a frozen soil subgrade.

Recycled concrete aggregates (RCA) used with interlocking concrete pavement in vehicular areas should be from crushed sources certified by a state or provincial department of transportation as meeting specifications for gradation and hardness. These typically include limits on the percent passing the No. 200 (0.075 mm) sieve (generally <12%) and abrasion durability tests such as Los Angeles abrasion resistance or micro-Deval loss. No more than 50% RCA mixed with non-recycled (quarried/crushed) dense-graded aggregates are recommended for vehicular applications. For pedestrian interlocking concrete pavements, up to 100% RCA can be used. However, there is an increased risk of efflorescence passed to the concrete paver surface. While not affecting structural performance, efflorescence may be unsightly and difficult to remove. Recycled asphalt materials should follow the aforementioned guidelines.

The thickness of the base is determined by traffic, soil type, subgrade soil drainage and moisture, and climate. Sidewalks, patios and pedestrian areas should have a minimum base thickness (after compaction) of 4 in. (100 mm) over well-drained soils. Residential driveways on well-drained soils should be at least 6 in. (150 mm) thick. In colder climates, continually wet or weak soils will require that bases be thicker.

Local, state or provincial engineering standards for base thickness can be applied to streets constructed with interlocking concrete pavers. Non freeze-thaw areas with well-drained soils should have at least a 6 in. (150 mm) thick base. Minimum base thicknesses for residential streets are 8 to 10 in. (200 to 250 mm). Greater thicknesses are often used in regions



Figure 5. Density testing of the aggregate base with a nuclear density gauge.





Figure 6a & 6b. Screeding the bedding sand.

with numerous freeze-thaw cycles, expansive soils, or very cold climates. A qualified civil engineer familiar with local soils and traffic conditions should be consulted to determine the appropriate base thickness for streets and heavy-duty, industrial pavements.

Many localities determine base thickness with the 1993 *Guide for the Design of Pavement Structures* published by the American Association of State Highway and Transportation Officials (AASHTO). The AASHTO procedure calculates the structural number (SN) of the strength coefficients of each base and pavement layer. The SN is determined by assessing the traffic loads, soils, and environmental factors (e.g., drainage, freeze-thaw). The layer coefficient recommended for $3^1/_8$ in. (80 mm) thick pavers on 1 in. (25 mm) bedding sand is 0.44 per inch (25 mm), i.e., the SN = $4^1/_8$ x 0.44 = 1.82. Base thicknesses can be readily determined by using the charts in *Tech Note PAV-TEC-004–Structural Design of Interlocking Concrete Pavement for Roads and Parking Lots* or CMHA Structural Design Software. This software is available for free download on www.masonryandhardscapes.org.

Like compaction of the soil subgrade, adequate compaction of the base is critical to minimizing settlement of interlocking concrete pavements. See Figure 4. Special attention should be given to achieving compaction standards adjacent to edge restraints, catch basins and utility structures. When spread and compacted, the aggregate base should be at its optimum moisture. Bases for pedestrian areas and residential driveways should be compacted a minimum 98% of standard Proctor density. For vehicular areas, compaction should be at least 98% of modified Proctor density as determined by ASTM D1557, or AASHTO T180. While the highest percentage compaction (100%) is preferred, it may not be achievable on weak or saturated soils. Density measurements of the compacted base should be made with a nuclear density gauge or other methods approved by the local, state or provincial transportation department. See Figure 5. Unless otherwise specified, the compacted thickness of individual lifts should be +3/4 in. to –1/2



Figure 7. Placing the concrete pavers.



Figure 8. Saw cutting pavers.



Figure 9. Compacting the pavers and bedding sand.



Figure 10. Spreading the joint sand.

in. (+19 mm to –13 mm). Maintaining consistent lift thickness during compaction will help achieve consistent density. Variation in final base surface elevations should not exceed ±3/8 in. (± 10 mm) when tested with a 10 ft. (3 m) straightedge.

The finished surface of a compacted aggregate base should not allow bedding sand to migrate into it. If the surface will allow ingress of bedding sand, a choke course of fine material can be spread and compacted into the surface, or a bitumen tack coat can be applied. The surface of the base course and its perimeter around the edge restraints should be inspected for areas that might allow sand to migrate after installation. Such locations can be joints in curbs, around utility structures or catch basins. These areas should be covered with a geotextile fabric to prevent loss of the bedding sand.

CONSTRUCTING EDGE RESTRAINTS

Edge restraints are a key part of interlocking concrete pavements. By providing lateral resistance to loads, they maintain continuity and interlock among the paving units. Aluminum, steel, plastic, or concrete are typical edge restraints. Consult *CMHA Tech Note PAV-TEC-003* on edge restraints for recommendations on applications and construction.

Edge restraints must be set at the correct level, especially if the tops of the restraints are used for screeding the bedding sand. Their elevations should be checked prior to placing the sand and pavers. A minimum of 1 in. (25 mm) vertical restraining surface should be in contact with the side of the paver to adequately restrain it. For heavy duty application a greater restraining surface may be warranted. Edge restraints are typically installed before the bedding sand and pavers are laid. However, some restraints can be secured into the base as the laying progresses.

Table 5. Grading Requirements for Bedding Sand

Gradation for Bedding Sand			
ASTM C33		**CSA A23.1 FA1**	
Sieve Size	Percent Passing	Sieve Size	Percent Passing
3/8 in.(9.5 mm)	100	10.0 mm	100
No. 4 (4.75 mm)	95 to 100	5.0 mm	95 to 100
No. 8 (2.36 mm)	80 to 100	2.5 mm	80 to 100
No. 16 (1.18 mm)	50 to 85	1.25 mm	50 to 90
No. 30 (0.6 mm)	25 to 60	630 µm	25 to 65
No. 50 (0.3 mm)	5 to 30	315 µm	10 to 35
No. 100 (0.15 mm)	0 to 10	160 µm	2 to 10
No. 200 (0.075 mm)	0 to 1	80 µm	0 to 1

Note: Bedding sands should conform to ASTM C33 or CSA A23.1 FA1 gradations for concrete sand. For ASTM C33, CMHA recommends the additional limitations on the No. 200 (0.075 mm) sieve as shown. For CSA A23.1 FA1, CMHA recommends reducing the maximum passing the 80 µm sieve from 3% to 1%.



Figure 11. Vibrating sand into the joints.

PLACING AND SCREEDING THE BEDDING SAND

Bedding sand under concrete pavers should conform to ASTM C33 or CSA A23.1. This material is often called concrete sand. Masonry sand for mortar should never be used for bedding, nor should limestone screenings or stone dust. The bedding sand should have symmetrical particles, generally sharp, washed, with no foreign material. Waste screenings and stone dust should not be used, as they often do not compact uniformly and can inhibit lateral drainage of moisture in the bedding layer. *CMHA Tech Note PAV-TEC-017—Bedding Sand Selection for Interlocking Concrete Pavements in Vehicular Applications* provides additional guidance on selecting bedding sand and gradations including limits on material passing the No. 200 (0.075 mm) seive. See Table 5.

Bedding sand should be spread and screeded to an uncompacted nominal 1 in. (25 mm) thickness. Frozen or saturated sand should not be installed. If there is an uneven base (due to inconsistent compaction or improper grading), the bedding sand should not be used to compensate for it. Over time, unevenness in the bedding sand will reflect through to the surface. Uneven areas on the base surface must be made even prior to placing the bedding sand.

Once the base is complete, screed pipes or rails are placed on it and the bedding sand spread over them. The sand is screeded or smoothed across the pipes with a straight and true strike board. See Figure 6. Screed pipes are removed and the resulting void filled with bedding sand. After the sand is screeded it should not be disturbed. Sufficient sand is placed and screeded to stay ahead of the placed pavers. Powered screeding machines that roll on rails and asphalt spreading machines adapted for screeding sand have been successfully used on larger installations to increase productivity.

PLACING THE CONCRETE PAVERS

Concrete pavers can be placed in many patterns depending on the shapes. Herringbone patterns (45 or 90 degree) are recommended in all street applications, as these interlocking patterns provide the maximum load bearing support, and resist creep from starting, braking and turning tires. See Figure 7. CMHA takes a conservative approach by not recognizing differences among paver shapes with respect to structural and functional performance. Certain manufacturers may have materials and data that discuss the potential benefits of shapes on functional and structural performance in vehicular applications. Chalk lines snapped on the bedding sand or string lines pulled across the surface of the pavers are used as a guide to maintain straight joint lines. Buildings, concrete collars, inlets, etc., are generally not straight and should not be used for establishing straight joint lines.

Paving units arrive at the job site packaged in bundles that are often strapped and/or wrapped to a wooden shipping pallet. Paving units should be taken from 3 or 4 bundles and not from a single one. Mixing the pavers ensures a visually consistent blend of the colors. If there's only one color of pavers on the job, installing pavers from several bundles at the same time will diminish the appearance of slight variations in that color.



Figure 12. Removing excess sand from the finished surface will make the pavement ready for traffic.

Joint widths between the pavers should be consistent and be between $^{1}/_{16}$ and $^{3}/_{16}$ in. (2 and 5 mm). Most pavers are made with spacer bars on their sides. These maintain a minimum joint width, allowing the sand to enter between each unit. Pavers without spacers are generally not placed snug against each other since string lines guide consistent joint spacing.

Cut pavers should be used to fill gaps along the edge of the pavement. Pavers are cut with a double bladed splitter or a masonry saw. See Figure 8. A saw gives a smooth cut. All saws should have equipment to reduce the dust created, since it is know to contain high level of respirable crystaline

Table 6. Grading Requirements for Joint Sand

Gradation for Joint Sand			
ASTM C144		CSA A179	
Sieve Size	Percent Passing	Sieve Size	Percent Passing
No. 4 (4.75 mm)	100	5.0 mm	100
No. 8 (2.36 mm)	95 to 100	2.5 mm	90 to 100
No. 16 (1.18 mm)	70 to 100	1.25 mm	85 to 100
No. 30 (0.6 mm)	40 to 75	630 µm	65 to 95
No. 50 (0.3 mm)	10 to 35	315 µm	15 to 80
No. 100 (0.15 mm)	2 to 15	160 µm	0 to 35
No. 200 (0.075 mm)	0 to 5	80 µm	0 to 10

silica. Gaps greater than $^3/_8$ in. (10 mm) should be filled with cut pavers. For street applications do not cut pavers to less than $^1/_3$ their original size. Instead fill voids with two cut pavers.

After an area of pavers is placed, it should be compacted with a vibrating plate compactor, which should be capable of exerting a minimum of 5,000 lbf. (22 kN) of centrifugal compaction force and operate at 75-90 hertz. See Figure 9. At least two passes should be made across the pavers to seat the pavers in the bedding sand and force it into the joints at the bottom of the pavers.

Dry joint sand is spread into the joints and the pavers compacted again until the joints are full. See Figures 10 and 11. This may require two or three passes of the plate compactor. If the sand is wet, it should be spread on a clean, hard surface to dry before being spread on the pavers and compacted into the joints. Joint sand may be finer than the bedding sand to facilitate filling of the joints like a sand meeting ASTM C144 or CSA A179 requirements. See Table 6. Bedding sand also can be used to fill the joints, but it may require extra effort in spreading and compacting. Compaction should be within 6 ft (2 m) of an unrestrained edge or laying face. All pavers within 6 ft (2 m) of the laying face should have the joints filled and be compacted at the end of each day. Excess sand is then removed. See Figure 12. The remaining uncompacted edge can be covered with a waterproof covering if there is a threat of rain. This will prevent saturation of the bedding sand, minimizing removal and replacement of the bedding sand and pavers.



Figure 13. The completed paved area from Figure 12 receives tank traffic at the U.S. Army Proving Grounds in Aberdeen, Maryland.

Final surface elevations should not vary more than $\pm^3/_8$ in. ($\pm$10 mm) under a 10 ft (3 m) straightedge, unless otherwise specified. Bond or joint lines should not vary $\pm^1/_2$ in. (13 mm) over 50 ft (15 m) from taut string lines. The top of the pavers should be $^1/_8$ to $^3/_8$ in. (3 to 10 mm) above adjacent catch basins, utility covers, or drain channels, with the exception of areas required to meet ADA design guideline tolerances. Lippage between individual pavers should be a maximum $^1/_8$ in. (3 mm) for pedestrian access routes. The top of the installed pavers may be $^1/_8$ to $^1/_4$ in. (3 to 6 mm) above the final elevations to compensate for possible minor settling. A small amount of settling is typical of all flexible pavements. Optional sealers or joint sand stabilizers may be applied. Using stabilized sand may have advantages in areas prone to joint sand loss. See *CMHA Tech Note PAV-TEC-005–Cleaning, Sealing and Joint Sand Stabilization of Interlocking Concrete Pavement* for further guidance.

CMHA Tech Note PAV-TEC-009–A Guide Specification for the Construction of Interlocking Concrete Pavement helps translate construction methods and procedures described here into a construction document. *Tech Note PAV-TEC-009* provides a template for developing project-specific materials and installation specifications for the bedding and joint sand, plus the concrete pavers. Consult the *Construction Tolerances and Recommendations for Interlocking Concrete Pavements* for the list of recommended tolerances. Additional guide specifications and detail drawings for varioius applications are available at www.masonryandhardscapes.org as well as CMHA Tech Notes. Other CMHA Tech Notes and technical manuals should be referenced for information on design, detailing, construction and maintenance.

MAINTENANCE OF INTERLOCKING CONCRETE PAVEMENT

Occasionally interlocking concrete pavements will require maintenance for them to deliver peak performance. Refer to *Tech Note PAV-TEC-006–Operation and Maintenance Guide for Interlocking Concrete Pavement* for information on preventative maintenance, identifying and remedying aesthetic and structural distresses and best practices for the disassembly and reinstatement of interlocking concrete pavement.

REFERENCES

1. Refer to the latest published ASTM and CSA standards and CMHA Tech Notes.
2. ASTM–American Society for Testing and Materials International, Conshocken, PA. www.astm.org
3. CSA–Canadian Standards Association, Rexdale, ON. www.csagroup.org
4. CMHA– Concrete Masonry and Hardscapes Association, Herndon VA. www.MasonryandHardscapes.org
5. ASCE 2016– American Society of Civil Engineers, *Structural Design of Interlocking Concrete Pavements for Municipal Streets and Roadways*. Reston, VA. www.ASCE.org
6. CSA–CAASHTO 2015–American Association of State Highway and Transportation Officials, *Standard Specification for Geotextile Specification for Highway Applications M288-15*, Washington, D.C., 2006

Figures 1, 6a, 7, 10, 12, 13 are courtesy of the Waterways Experiment Station, U.S. Army Corps of Engineers. Figure 5 is courtesy of the Portland Cement Association.

ABOUT CMHA

The Concrete Masonry & Hardscapes Association (CMHA) represents a unification of the Interlocking Concrete Pavement Institute (ICPI) and National Concrete Masonry Association (NCMA). CMHA is a trade association representing US and Canadian producers and suppliers in the concrete masonry and hardscape industry, as well as contractors of interlocking concrete pavement and segmental retaining walls. CMHA is the authority for segmental concrete products and systems, which are the best value and preferred choice for resilient pavement, structures, and living spaces. CMHA is dedicated to the advancement of these building systems through research, promotion, education, and the development of manufacturing guides, design codes and resources, testing standards, and construction practices.

Disclaimer:
The content of this CMHA Tech Note is intended for use only as a guideline and is made available “as is.” It is not intended for use or reliance upon as an industry standard, certification or as a specification. CMHA and those companies disseminating the technical information contained in the Tech Note make no promises, representations or warranties of any kind, expressed or implied, as to the accuracy or completeness of content contained in the Tech Note and disclaim any liability for damages or injuries resulting from the use or reliance upon the content of Tech Note. Professional assistance should be sought with respect to the design, specifications, and construction of each project.

BEDDING SAND SELECTION FOR INTERLOCKING CONCRETE PAVEMENTS IN VEHICULAR APPLICATIONS

Bedding sands are a critical component of all sand-set segmental concrete paving systems. Especially for vehicular applications, specifiers and contractors need to consider bedding sand selection. While gradation is an important consideration, other characteristics should be assessed in order to ensure long-term pavement performance. This technical bulletin examines these characteristics and provides guidance to specifiers and contractors.

BACKGROUND

Bedding sand provides four main functions. It beds the pavers during installation; helps initialize interlock among the pavers; provides a structural component for the system (as described in *CMHA Tech Note PAV-TEC-004–Structural Design of Interlocking Concrete Pavement for Roads and Parking Lots*) and facilitates drainage of water that infiltrates through the joints. Typical specifications require bedding sands to conform to ASTM C33 *Standard Specification for Concrete Aggregates* and CSA A23.1 *Concrete materials and methods of concrete construction* FA1 gradation for concrete sands with an additional limit of 1% passing the No. 200 (0.075 mm*) sieve (See Table 1). To achieve this low percentage of fines, washing the sand is typically required. A common name for the recommended bedding material is washed concrete sand. In vehicular applications, experience and research have shown that other factors besides gradation contribute to the successful function of the bedding layer in vehicular applications. Knapton (1994) notes that since 1980 the amount of material passing

Table 1. Gradation for Bedding Sand

ASTM C33		CSA A23.1 FA1	
Sieve Size	Percent Passing	Sieve Size	Percent Passing
3/8 in.(9.5 mm)	100	10.0 mm	100
No. 4 (4.75 mm)	95 to 100	5.0 mm	95 to 100
No. 8 (2.36 mm)	80 to 100	2.5 mm	80 to 100
No. 16 (1.18 mm)	50 to 85	1.25 mm	50 to 90
No. 30 (0.6 mm)	25 to 60	630 µm	25 to 65
No. 50 (0.3 mm)	5 to 30	315 µm	10 to 35
No. 100 (0.15 mm)	0 to 10	160 µm	2 to 10
No. 200 (0.075 mm)	0 to 1[1]	80 µm	0 to 1[1]

Note 1: Bedding sands should conform to ASTM C33 or CSA A23.1 FA1 gradations for concrete sand. For ASTM C33, CMHA recommends the additional limitations on the No. 200 (0.075 mm) sieve as shown. For CSA A23.1 FA1, CMHA recommends reducing the maximum passing the 80 µm sieve from 3% to 1%.

**Although the ASTM equivalent for the No. 200 sieve size is 75 micron (.075 mm), CSA standards use the German (DIN) and French (ANFOR) standard equivalent sieve size of 80 micron (0.080 mm)*

Revised March 2022

the No. 200 (0.075 mm) sieve has been reduced in the British Standard BS 7533-1 *Pavements constructed with clay, concrete or natural stone paving units. Code of practice for the structural design of pavements using modular paving units.* He notes that fines have reduced from 10% in 1980, to 3% in 1991, to 1% for heavily trafficked pavements, further reducing to 0.1% for bus stations. North American standards currently limit the amount of allowable material passing these sieves to 1%.

Other studies (Lilley and Dowson 1988) (Beaty 1996) have investigated failures of segmental concrete pavements subjected to channelized vehicular traffic. They have also concluded that more comprehensive specifications are required. Lilley and Dowson (1988) suggested that bedding sands in segmental concrete pavements designed to carry more than 1.5 million equivalent standard axle loads, ESALs (18 kip/80 kN), should be subjected to grading and degradation tests. *For the purposes of this Tech Note, vehicular traffic is defined as roads exposed to a minimum of 1.5 million lifetime ESALs and axle loads up to 24,250 lbs (11,000 kg).*



Figure 1. The Micro-Deval test apparatus.
Source: Gilson Company

FAILURE MECHANISMS

Failure of the bedding sand layer occurs in channelized vehicular loads from two main actions; structural failure through degradation and saturation due to inadequate drainage. Since bedding sands are located high in the pavement structure, they are subjected to repeated applications of high stress from the passage of vehicles over the pavement (Beaty 1996). This repeated action, particularly from higher bus and truck axle loads, will degrade the bedding sand and cause failure. For these applications sand should be selected based on their ability to withstand long-term degradation.

Bedding sand permeability also is a significant factor in the selection process. Wherever difficulties have been experienced with laying course materials in heavily trafficked pavements, water has been a major factor (Knapton 1994). As they approach higher moisture levels in service, bedding sands may become unstable. Smaller particle sizes (fines) become suspended in water, forming slurry that lubricates the entire bedding layer. Choosing bedding sand with a gradation as shown in Table 1 will help to reduce the risk of poor drainage and instability. However, these sands will be susceptible to drainage problems if they do not have the hardness to withstand long term degradation from vehicular wheel loads.

SELECTION AND PERFORMANCE DESIGN PRINCIPLES—GOING BEYOND GRADATION

Selecting Durable Bedding Sands—Durability of aggregates has long been understood to be a major factor in pavement performance. ASTM C88 *Soundness of Aggregate by use of Sodium Sulfate or Magnesium Sulfate* is an example of a typical test method used by road agencies to assess aggregate durability. The test involves soaking an aggregate in a solution of magnesium or sulfate salts and oven drying. This is repeated for a number of cycles, with each cycle causing salt crystals to grow and degrade the aggregate. The test method takes a minimum of 6 days to complete. The percent loss is then calculated on individual size fractions. This test method, however, is considered highly variable. Jayawickrama, Hossain and Phillips (2006) note that when ASTM initially adopted this test method they recognized the lack of precision, saying, “it may not be suitable for outright rejection of aggregates without confirmation from other tests more closely related to the specific service intended.” CMHA recommends using ASTM C88 as a measure of aggregate durability as long as other material properties described in this bulletin are also considered.

The Micro-Deval test is evolving as the test method of choice for evaluating durability of aggregates in North America. Defined by CSA A23.2-23A, *The Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus* and ASTM D7428 *Standard Test Method for Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval*

Apparatus, the test method involves subjecting aggregates to abrasive action from steel balls in a laboratory rolling jar mill. In the CSA test method a 1.1 lb (500 g) representative sample is obtained after washing to remove the No. 200 (0.080 mm) material. The sample is saturated for 24 hours and placed in the Micro-Deval stainless steel jar with 2.75 lb (1250 g) of steel balls and 750 mL of tap water (See Figure 1). The jar is rotated at 100 rotations per minute for 15 minutes. The sand is separated from the steel balls over a sieve and the sample of sand is then washed over an 80 micron (No. 200) sieve. The material retained on the 80 micron sieve is oven dried. The Micro-Deval loss is then calculated as the total loss of original sample mass expressed as a percentage. ASTM and the American Association of State Highway Transportation Officials have both adopted the coarse aggregate version of the Micro-Deval test, ASTM D6928 and AASHTO TP 58. Both are also considering a version for fine aggregates. Since the test apparatus uses the same size drum and rotates at the same speed, no modifications to the apparatus are required to perform the fine aggregate test in laboratories currently equipped to perform the coarse aggregate test procedure.

A study conducted by the Interlocking Concrete Pavement Institute (ICPI 2004) investigated nine sands from across the United States reported by contractors to have "good to excellent" serviceability in vehicular applications. The results of this study indicated that eight of these sands had Micro-Deval degradation losses less than 8% when measured according to CSA A23.2-23A. The same study subjected these sands to the ASTM C88 soundness loss and found that no sample had greater than 6% loss. The Micro-Deval test is recommended as the primary means to characterize bedding sand durability (See Table 3) and the magnesium or sulfate soundness should be considered when the Micro-Deval test is not locally available. The variability of the soundness test method should always be a consideration unless measured in relation to other material properties.

A test method similar in nature to Micro-Deval is the Lilley and Dowson test (Lilley Dowson 1998). This test method specifically developed for bedding sands is recognized internationally and is referenced in CMHA manuals *Port and Industrial Pavement Design with Concrete Pavers* and *Airfield Pavement Design with Concrete Pavers*. This test method is performed on 3 lbs (1.4 kg) randomly selected, oven-dried sand samples with two 1 in. (25 mm) diameter steel balls together weighing 0.3 lb (135 g). Three sub-samples each weighing 0.5 lbs (0.2 kg) are derived from the main sample. Each sub-sample is sieved according to ASTM C136 then re-mixed and placed in a nominal liter capacity porcelain jar with the two steel balls. The three jars are rotated at 50 rpm for six hours and sieved again. Sand durability is assessed from resulting increases in the percent passing the No. 50, 100 and 200 (0.300, 0.150, and 0.075 mm) sieves. Developed in the UK, the test is not readily available at laboratories in North America. The CSA and ASTM Micro-Deval tests may be more available.

Beaty (1996) demonstrated a correlation between the two tests with a correlation coefficient greater than 0.99. The relationship between the two tests is:

$$L = 1.97 + 1.21\,M$$

Where:

M = CSA Micro-Deval Degradation Loss (%)

L = Lilley and Dowson Degradation Loss (%)

Beaty's correlation involved a modification to the test procedure by reconstituting the test aggregates into a standard gradation shown in Table 2 and performing the Micro-Deval and Lilley Dowson tests on the re-graded aggregate. In this modified version of the Lilley Dowson test procedure the loss (L) is measured as the total increase in percentage of fines passing the No. 200 (0.075 mm) sieve at the completion of the test. Using the correlation described above, an 8% Micro Deval degradation (See Table 3) would have a corresponding Lilley and Dowson degradation of 12%.

Bedding Layer Drainage—Bedding layer drainage is important for early and long term performance of a pavement. One failure documented by Knapton (1993) describes a segmental pavement that was opened to bus traffic and within hours of construction subjected to continuous heavy rain. The bedding sand in this case had a high percentage of fines. As a result of the continuous rainfall, finer sieve fractions in the sand were transported into the drain holes of the underlying concrete slab. With the drainage compromised the bedding sand liquefied and was pumped through the joints of the pavement, resulting in immediate rutting and failure of the system. The pavement was subsequently reconstructed with bedding sand that had 0% material passing the No. 200 (0.075 mm) sieve and reported excellent performance. Although gradation is an important factor in drainage (since it affects permeability) eliminating all of the fines can sometimes be impractical. Therefore, CMHA recommends up to 1% passing the No. 200 (0.075 mm) sieve.

Another important material property is permeability. Even specifications that allow up to 3% of fines can result in a five fold decrease in permeability from the lowest to highest percentage passing (Bullen 1998). In research conducted by the Interlocking Concrete Pavement Institute (ICPI 2004) the permeability of "very good to excellent" bedding sands was

Sieve Size	Percent Passing
4.75 mm	100
2.36 mm	90
1.18 mm	70
0.600 mm	47
0.300 mm	20
0.150 mm	7
0.075 mm	0

Table 2. Modified Gradation or Reconstituted Aggregates According to Beaty (1996)

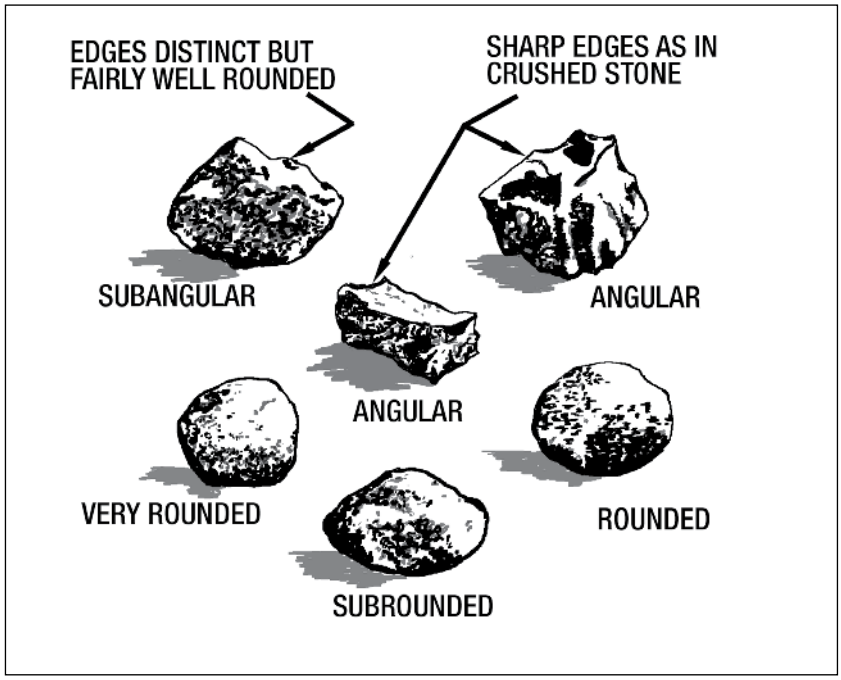


Figure 2. Typical description of coarse grains according to ASTM D2488

measured. Using the test method described by ASTM D2434 *Standard Test Method for Permeability of Granular Soils (Constant Head)* the permeabilities ranged from 2.8 in./hr (2.1 x 10^{-3} cm/second) to 15.6 in./hr (1.1 x 10^{-2} cm/second). These values correspond to fines that range from 2.5% to 0% passing the No. 200 (0.075 mm) sieve but, more importantly they also are associated with Micro-Deval maximum degradation values of 8%. Table 3 indicates a minimum permeability of 2.8 in./hr (2.1 x 10^{-3} cm/second) that should also be considered at the same time as the other primary properties listed.

Other Material Properties—Studies have indicated that bedding sand shape plays a role in bedding sand performance. (Knapton 1993) notes that rounded or cubic grains lead to stable sands, whereas more angular grains are frequently associated with sands that fail. The sands tested by ICPI (ICPI 2004) showed that eight of the nine "good to excellent" performing sands were characterized by having a predominance of sub-angular to sub-rounded particle shapes when tested according to ASTM D2488 *Description and Identification of Soils (Visual-Manual Procedure)*. Specifiers and contractors should consider bedding sand angularity using Figure 2 as a guide. Figure 3 shows a photograph of one of the ICPI test sands at high magnification. Table 3 suggests that a combined percentage of sub-angular to sub-rounded particles should be a minimum of 60%.

Geology—Geology of bedding sands has been noted by a number of studies to play an important role in their performance. For example, bedding sand with quartz mineralogy is preferred over crushed sandstones (Knapton 1993). In the study by the Interlocking Concrete Pavement Institute (ICPI 2004), eight of the nine "good to excellent" performing sands were noted to consist predominately of silica minerals with over 80% of the material either quartz or quartzite. Table 3 recommends a minimum 80/20 ratio of silica/carbonate mineralogy. A tenth sample, included in the study (and noted as poor performing in the field) was characterized as having up to 50% carbonate content. Petrographic analysis was conducted according to the Ministry of Transportation of Ontario laboratory method MTO LS-616 P*rocedure for the Petrographic Analysis of Fine Aggregate* (MTO 1996). ASTM C295 *Standard Guide for Petrographic Examination of Aggregates for Concrete* offers an alternative test method.

Limestone screenings and stone dust are not recommended for bedding sand. In addition to being unevenly graded and having excessive material passing the No. 200 (0.075 mm) sieve, screenings and stone dust will break down over time from wetting and abrasion due to vehicular loads. Unlike soft limestone screenings and stone dust, hard, durable concrete sand meeting the requirements in Table 3 will not break down easily. Limestone screenings also tend to break down during pavement construction under initial paver compaction. Depressions will eventually appear in the pavement surface with limestone screenings or stone dust.

Recommended Material Properties—Table 3 lists the primary and secondary material properties that should be considered when selecting bedding sands for vehicular applications. Bedding sands may exceed the gradation requirement for the maximum amount passing the No. 200 (0.075 mm) sieve as long as the sand meets degradation and permeability recommendations in Table 3. Micro-Deval degradation testing can be replaced with sodium sulfate or magnesium soundness testing as long as this test is accompanied by the other primary material property tests listed in Table 3. Other material



Figure 3. Example of sand from the ICPI bedding sand test program with a total combined percentage of sub-angular and sub-rounded particles equal to 65% according to ASTM D2488



Figure 4. A two-man hand pulled screed



Figure 5. Mechanical screeding is the most efficient method of bedding sand installation

properties listed, such as petrography and angularity testing ``content range of 6% to 8% has been shown to be optimal for most sands (Beaty 1992). Contractors can assess moisture content by squeezing a handful of sand in their hand. Sand at optimal moisture content will hold together when the hand is re-opened without shedding excess water. Although it can be difficult to control the exact moisture content on the job site, uniformity of moisture content can be maintained by covering stock piles with tarps. Digging into sand piles at mid-height to avoid saturated material that may be at the bottom of the pile is also recommended.

While on the job site, a contractor should check the hardness of the bedding sand particles. Particles of sufficient hardness will not break under the pressure of a Swiss Army pocket knife. This field test, although not recommended for pre-selection of bedding sands, helps assess a material at the time of delivery. Table 4 lists the recommended bedding sand properties that need to be considered by a contractor during installation.

Interlocking concrete pavements should also be designed and constructed such that the bedding sand should not be able to migrate into the base, or laterally through the edge restraints. Dense-graded base aggregates with 5% to 12% fines (the amount passing the No. 200 or 0.075 mm sieve), will ensure that the bedding sand does not migrate down into the base surface. For pavements built over asphalt or concrete bases, it is necessary to provide adequate drainage

Table 3. Recommended Laboratory Material Properties for Bedding and Joint Sands in Vehicular Applications [1,2]

Material Properties	Test Method	Recommended Maximum or Minimum
Primary Properties		
Gradation	ASTM C33 CSA A23.1 (FA1)	Maximum 1 % passing No. 200 (0.075 or 0.080 mm) sieve
Micro-Deval Degradation	CSA A23.2-23A ASTM D7428	Maximum 8%
Constant Head Permeability	ASTM D2434	Minimum 2 x 10^{-3} cm/second (2.83 in/hr)
Secondary Properties		
Soundness – Sodium Sulfate or Magnesium Sulfate	ASTM C88	Maximum 7%
Silica (Quartz and Quartzite)/ Carbonate Ratio	MTO LS-616 ASTM C295	Minimum 80/20 ratio
Angularity and Particle Shape	ASTM D2488	Minimum 60% combined sub- angular and sub- rounded

Note 1: See "Recommended Material Properties" on page 5 of CMHA Tech Note PAV-TEC-017

Note 2: Bedding sand may also be selected based on field performance. Field performance is selected when the specifier or contractor assumes responsibility for the selection and performance of bedding sand not conforming to the properties in Table 3. Field performance as a selection criteria is suggested when the available local materials do not meet the primary material properties suggested in Table 3, but the specifier or contractor can demonstrate to the satisfaction of the owner (or owner's representative), successful historical field performance. In this case the owner should specify the class of vehicular traffic, and the contractor should verify past field performance of the bedding sand under similar vehicular traffic.

Primary Properties	Test	Recommended Maximum or Minimum	Construction Tolerance	Frequency of Field Test
Gradation	ASTM C33 and CSA A23.1 (FA1)	See Table 1	Not Applicable	Provided by aggregate supplier every 25,000 sf (2,500 m^2)
Bedding Layer Thickness	Check with ruler	Nominal 1 in. (25 mm)	± 3/8 in. (10 mm)	By contractor every 5,000 to 10,000 sf (500 to 1000 m^2)
Hardness	Test with Swiss army pocket knife blade	No broken particles	Not Applicable	By contractor every 25,000 sf (2,500 m^2)
Secondary Properties	Test	Recommended Maximum or Minimum	Construction Tolerance	Frequency of Field Test
Moisture content at time of installation	Hand test	Holds together without shedding water	Not applicable	While screeding

Table 4. Recommended Installation Properties for Bedding Sands in Vehicular Applications

by providing 2 in. (50 mm) diameter weep holes around the perimeter on 10 ft (3 m) centers and at the low points in the concrete base to drain excess water from the bedding layer. Holes should be filled with washed angular gravel and covered with geotextile to prevent the loss of bedding sand. Figure 6 on the next page shows a detail. Specifiers can visit the CMHA website to download similar details for use in specifications from www.masonryandhardscpes.org. To control lateral loss of bedding sand, Figure 7 shows geotextile installed at the interface of a concrete curb. To ensure that the sand cannot migrate through the joints in the curb woven geotextile is placed on top of the aggregated base, extending approximately 1 ft. (300 mm) into the pavement and wrapped up the sides of the curb to fully contain the bedding sand.



Figure 7. Woven geotextile used to contain bedding sand from migrating laterally.
Visit www.masonryandhardscpes.org for detail drawings.

ROLE OF JOINTING SAND

Jointing sand provides two primary functions in a segmental concrete pavement; it creates interlock and helps seal the pavement. CMHA recommends that the same material properties listed in Table 3 also apply to jointing sand. Panda and Ghosh (2002) describe laboratory research on pavements using fine and coarse joint sands. Simulated loading consisted of 11-kip (51 kN) over 80 mm pavers with varying joint widths and joint sand gradations. Deflection of the pavement was then measured with coarser sand exhibiting lower deflections. The study concluded that "the coarser the sand, the better the performance." The coarser sands used in the study correspond to the gradations for Joint Sand listed in Table 1 and the study recommended joint widths up to 3/16 in. (5mm). CMHA recommends joint widths of 1/16 to 3/16 (2 mm to 5 mm).

Contractors can benefit from using one sand source. There are advantages to using the bedding material for the jointing sand during construction. Using one material allows the contractor to monitor and control one sand product on the job site. Over time the joints become filled with detritus, providing some degree of sealing. Regardless of the sand used, segmental concrete pavements will always allow some water penetration through the joints.

Coarse bedding sand may require additional effort to place it in the joints. In some cases, smaller joint widths may require the use of finer graded sand. In this case, the use of mortar sand is recommended. Mortar sand should conform to the gradations of either ASTM C144 or CSA A179 but should also meet the material property requirements of Table 3.

Although joint sand selection is an important factor, design and construction play a more important role. Considerations such as joint width, ensuring that the sand is swept in dry, degree of compaction, and ensuring the joints are completely filled, are just as critical to the long term success of pavement performance. Information on joint sand installation can be found in *CMHA Tech Note PAV-TEC-002—Construction of Interlocking Concrete Pavements*).

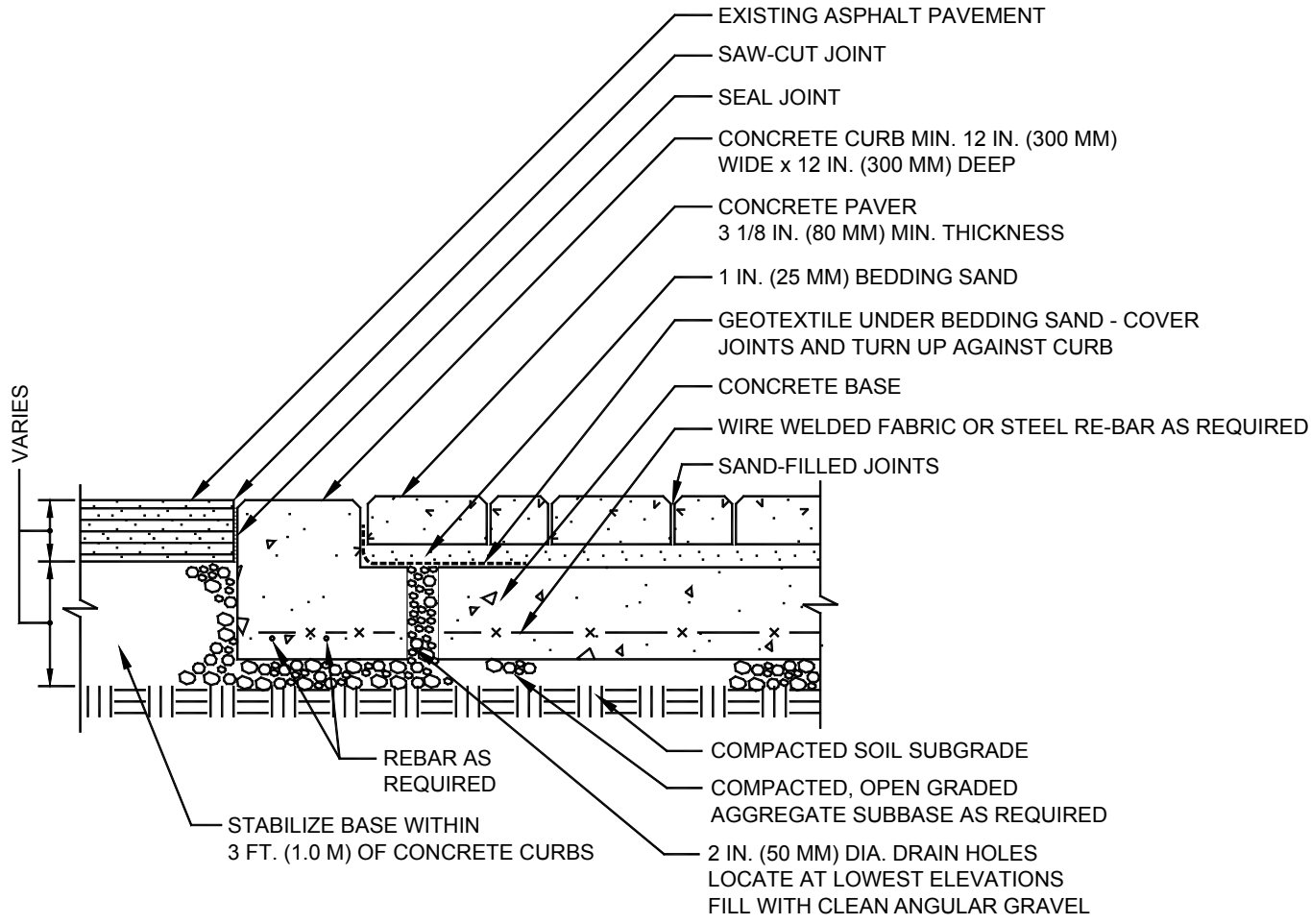


Figure 6. Recommended detail for sand set pavers over a concrete base. Drainage holes provide drainage for water that enters the bedding layer through the joints. The same detail applies for paver overlays on asphalt.

MAINTENANCE OF INTERLOCKING CONCRETE PAVEMENT

Occasionally interlocking concrete pavements will require maintenance for them to deliver peak performance. Refer to *Tech Note PAV-TEC-006–Operation and Maintenance Guide for Interlocking Concrete Pavement* for information on preventative maintenance, identifying and remedying aesthetic and structural distresses and best practices for the disassembly and reinstatement of interlocking concrete pavement.

REFERENCES

Refer to the latest published ASTM and CSA standards and CMHA Tech Notes and manuals

ASTM–American Society for Testing and Materials International, Conshocken, PA. www.astm.org

CSA–Canadian Standards Association, Rexdale, ON. www.csagroup.org

CMHA-Concrete Masonry and Hardscapes Association, Herndon, VA. www.MasronyandHardscapes.org

Knapton J., "Paver Laying Course Materials – State of the Art" in *Proceedings* of the 2nd International Workshop on Concrete Block Paving, Oslo, Norway, pp. 246 – 264, 1994.

BS 7533-101: *Pavements constructed with clay, concrete or natural stone paving units*. Code of practice for the structural design of pavements using modular paving units. British Standards Institution, London, UK, 2021

Lilley A.A. and Dowson A.J., "Laying Course Sand for Concrete Block Paving" in *Proceedings* of the 3rd International Conference on Concrete Block Paving, Rome, Italy, pp. 457-462, 1988.

Beaty A.N.S. "Laying Course Materials: Specification and Performance," in *Proceedings* of the 5th International Conference on Concrete Block Paving, Tel Aviv, Israel, pp. 129-139, 1996.

Jayawickrama, Hossain and Phillips, *Evaluation of Aggregate Durability Using Micro-Deval Test*, Transportation Research Board 2006 Annual Meeting, 2006.

ICPI Bedding Sand Laboratory Testing, File no. L04-0127AT, DAVROC Testing Laboratories, ICPI Herndon, VA, USA 2004.

Knapton J., *The Nature and Classification of Bedding Sand*, Proc. BIBM 1993, pp 135-141, Washington, DC, 1993.

Bullen F. and Knapton J., "The Role of Bedding Sands in Segmental Paving Instability," in *Proceedings* of the 3rd International Workshop on Concrete Block Paving, Cartagena, Colombia, May 10-13, 1998 pp. 36-1 to 36-4, 1998.

MTO LS – 616 *Procedure for the Petrographic Analysis of Fine Aggregate*, Ministry of Transportation Ontario, Downsview Ontario, Canada, 2005.

Beaty, A., "Predicting the Performance of Bedding Sands," in *Proceedings* of the 4th International Conference on Concrete Block Paving, Auckland, New Zealand, pp. 273-284, 1992.

Panda and Ghosh, "Structural Behavior of Concrete Block Paving—Sand in Bed and Joints," *Journal of Transportation Engineering*, March 2002.

ABOUT CMHA

The Concrete Masonry & Hardscapes Association (CMHA) represents a unification of the Interlocking Concrete Pavement Institute (ICPI) and National Concrete Masonry Association (NCMA). CMHA is a trade association representing US and Canadian producers and suppliers in the concrete masonry and hardscape industry, as well as contractors of interlocking concrete pavement and segmental retaining walls. CMHA is the authority for segmental concrete products and systems, which are the best value and preferred choice for resilient pavement, structures, and living spaces. CMHA is dedicated to the advancement of these building systems through research, promotion, education, and the development of manufacturing guides, design codes and resources, testing standards, and construction practices.

Disclaimer:
The content of this CMHA Tech Note is intended for use only as a guideline and is made available "as is." It is not intended for use or reliance upon as an industry standard, certification or as a specification. CMHA and those companies disseminating the technical information contained in the Tech Note make no promises, representations or warranties of any kind, expressed or implied, as to the accuracy or completeness of content contained in the Tech Note and disclaim any liability for damages or injuries resulting from the use or reliance upon the content of Tech Note. Professional assistance should be sought with respect to the design, specifications, and construction of each project.

SECTION 32 12 16 – ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt repairs.

2. Hot-mix asphalt paving.

3. Asphalt surface treatments.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Guyana Shore Base.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.

b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.

2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

3. Job-Mix Designs: For each job mix proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each paving material.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F.

2. Tack Coat: Minimum surface temperature of 60 deg F.

3. Slurry Coat: Comply with weather limitations in ASTM D 3910.

4. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.

5. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073 sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242/D 242M, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: ASTM D6373, PG 64-22.

B. Asphalt Cement: [ASTM D 3381/D 3381M for viscosity-graded material] [ASTM D 946/D 946M for penetration-graded material].

C. Cutback Prime Coat: ASTM D 2027, medium-curing cutback asphalt, MC-30 or MC-70.

D. Emulsified Asphalt Prime Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

E. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

F. Fog Seal: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.

G. Water: Potable.

H. Undersealing Asphalt: ASTM D 3141/D 3141M; pumping consistency.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires, asphalt shingles, or glass from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Sand: ASTM D 1073, Grade No. 2 or No. 3.

C. Joint Sealant: ASTM D 6690, Type I, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes.

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.

2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted Base as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.

2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.

C. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.

2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 PAVING GEOTEXTILE INSTALLATION

A. Apply tack coat uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd..

B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.5 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.

2. Place hot-mix asphalt surface course in single lift.

3. Spread mix at a minimum temperature of 250 deg F.

4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.

5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.

2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.

2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.

3. Offset transverse joints, in successive courses, a minimum of 24 inches.

4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent or greater than 100 percent.

2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.

2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch

2. Surface Course: 1/8 inch

3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.9 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.

1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.

b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 32 12 16