APPLICATION OF BORING AND TUNNELING METHODS TO INSTALL A 6" DIAMETER COLLECTOR SEWER SYSTEM UNDER A BUILDING

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UCT
Underground Construction Technology
International Conference & Exhibition

WHO WE ARE:

- UNDERGROUND CONSTRUCTION SPECIALIST
- IN BUSINESS SINCE 1976
- 120 EMPLOYEES
- PROVIDE SERVICE FOR NATURAL GAS, WATER, SEWER, AND ELECTRIC POWER INDUSTRIES

Aaron Enterprises-York Pennsylvania

WHAT WE DO:

- Jack and bore
- Horizontal directional drilling
- Tunneling
- Vertical shafts
- Guided pilot tube
- Pipe ramming
- Trenchless pipe replacement
- Soil stabilization
- Design and consulting

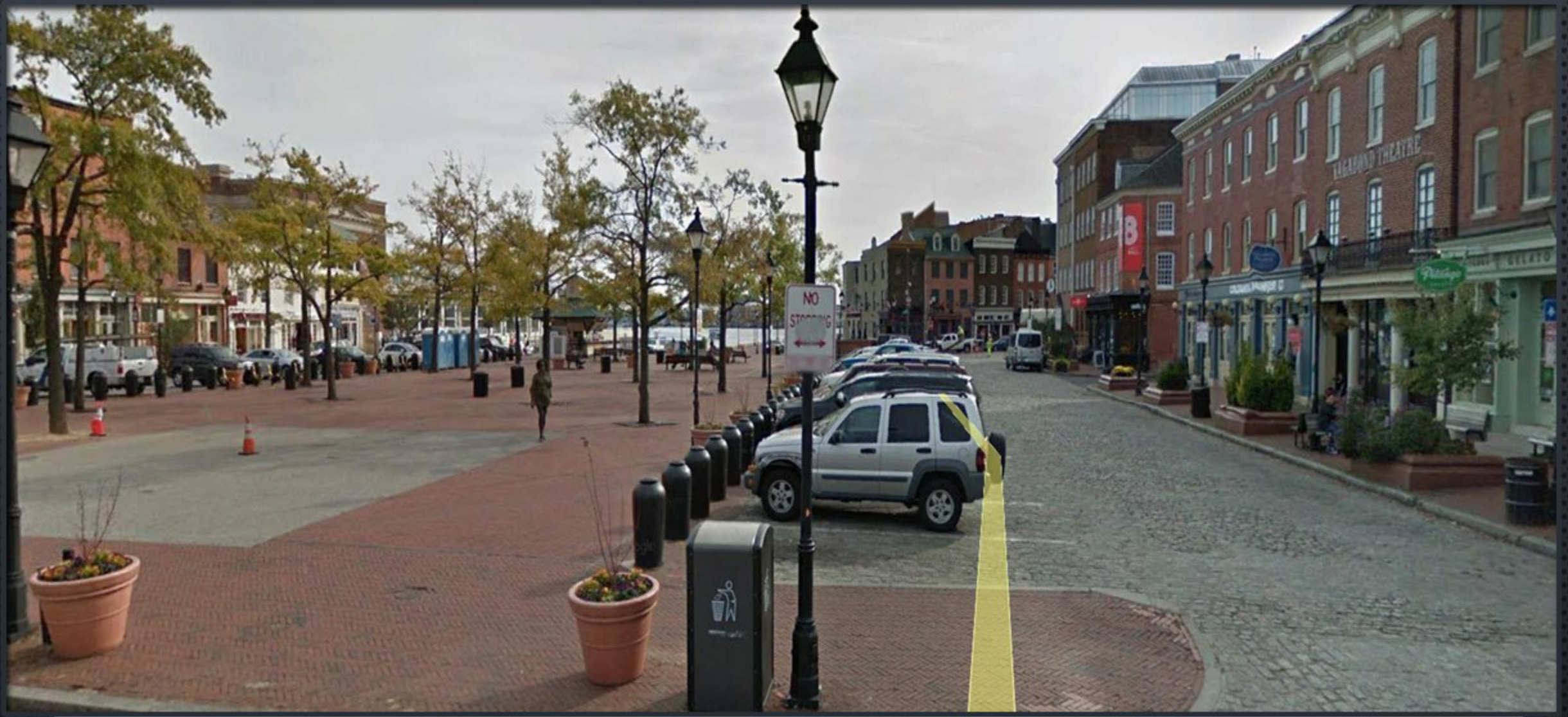
WHY THIS PROJECT IS SPECIAL:

- CREATIVE USE OF TRENCHLESS EQUIPMENT
- UNORTHODOX METHODS NEEDING A MIX OF DISCIPLINES TO BE SUCCESSFUL
- APPLICATION OF SIMILAR TECHNIQUE APPLIED LOCALLY
- 18 YEARS OLD WHEN I WORKED PROJECT

Project Background

A developer wanted to install a sanitary sewer system beneath the concrete floor of a large, vacant waterfront warehouse in Baltimore, MD

- Near historic Fells Point neighborhood
- Project would Continue to improve the neighborhood and enrich economic viability of the city
- Project took place almost 20 years ago



FELLS POINT, BALTIMORE MARYLAND

Project Location

PROJECT GOALS:

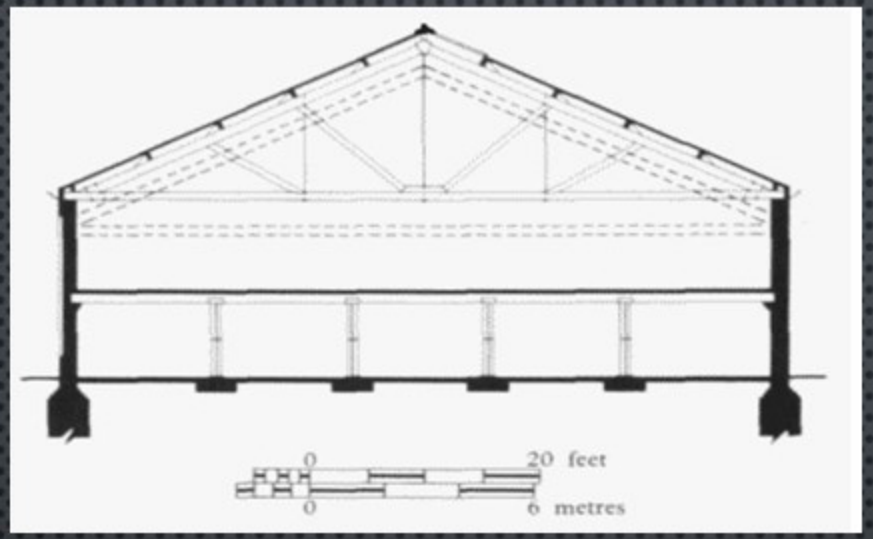
- CONVERT THE BUILDING INTO A RESEARCH LABORATORY
- ENGINEER AND BUILT EXTENSIVE SUBFLOOR 6" GRAVITY DRAIN PIPE COLLECTOR SYSTEM
- TIE IN TO MUNICIPAL SEWER SYSTEM AT THE STREET

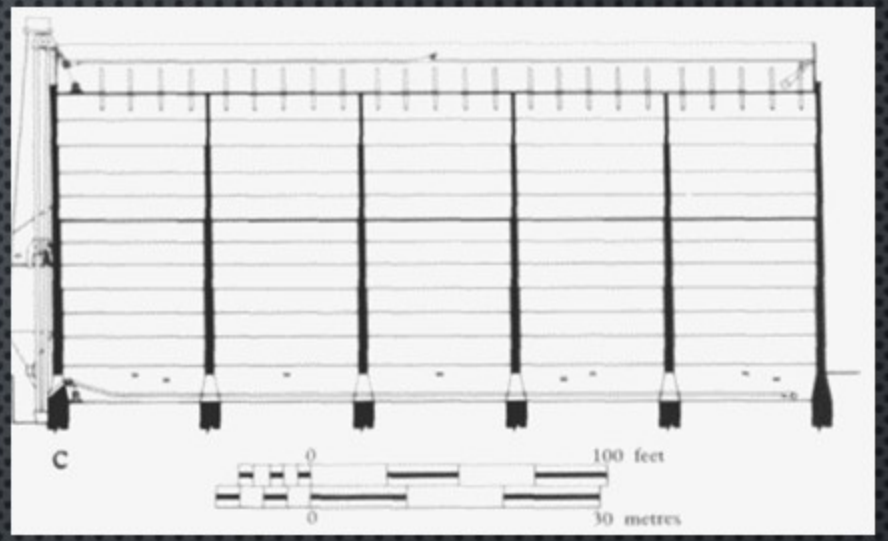
CHALLENGES 1 SITE

- HARBOR WATERFRONT
- EXISTING EARTHEN MATERIALS SETTLING UNDER BUILDING
  - CONVENTIONAL TRENCH SIMPLY WOULD NOT WORK

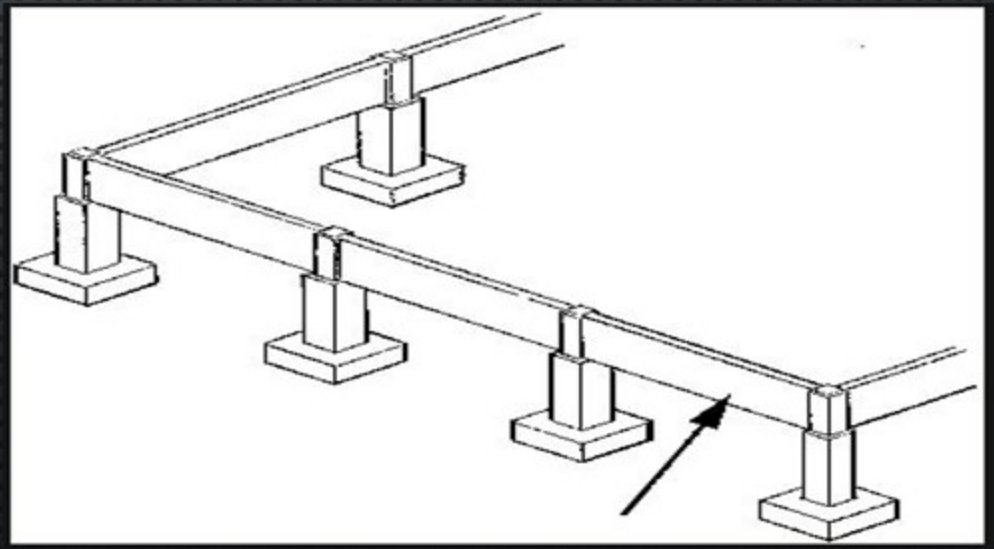
CHALLENGES 2 BUILDING

- BUILDING WAS BUILT ON PILES
  - SUPPORTS LOCATED 25' ON CENTER THROUGHOUT STRUCTURES FOOTPRINT





- CONCRETE GRADE BEAM GOING AROUND PERIMETER OF STRUCTURE SUPPORTED EXTERIOR WALLS AND TIED ALL PILES TOGETHER



CHALLENGES 3 BUILDING

- 12" THICK REINFORCED CONCRETE FLOORS
  - FINISHED FLOOR ELEVATION 4 FEET ABOUT STREET GRADE

CHALLENGES 4

- ELABORATE PLUMBING NETWORK NECESSARY TO SERVE NUMEROUS PROPOSED LABS

PROPOSED SOLUTIONS 1:

- **FEASIBILITY** OF CONSTRUCTION FOR 6" DIAMETER GRAVITY PLUMBING SYSTEM BENEATH FLOOR

- **MEANS** OF CONSTRUCTION
  - MINIMIZE FLOOR CUTS
  - NO DISTURBANCE TO BUILDING FOUNDATIONS GRADE BEAM

- **TIME SAVINGS**-OVERALL CONSTRUCTION SCHEDULE.
  - ALLOW FOR WORK ON LABS AT THE SAME TIME AS WORK BELOW

PROPOSED SOLUTION 2:

ENGINEERING

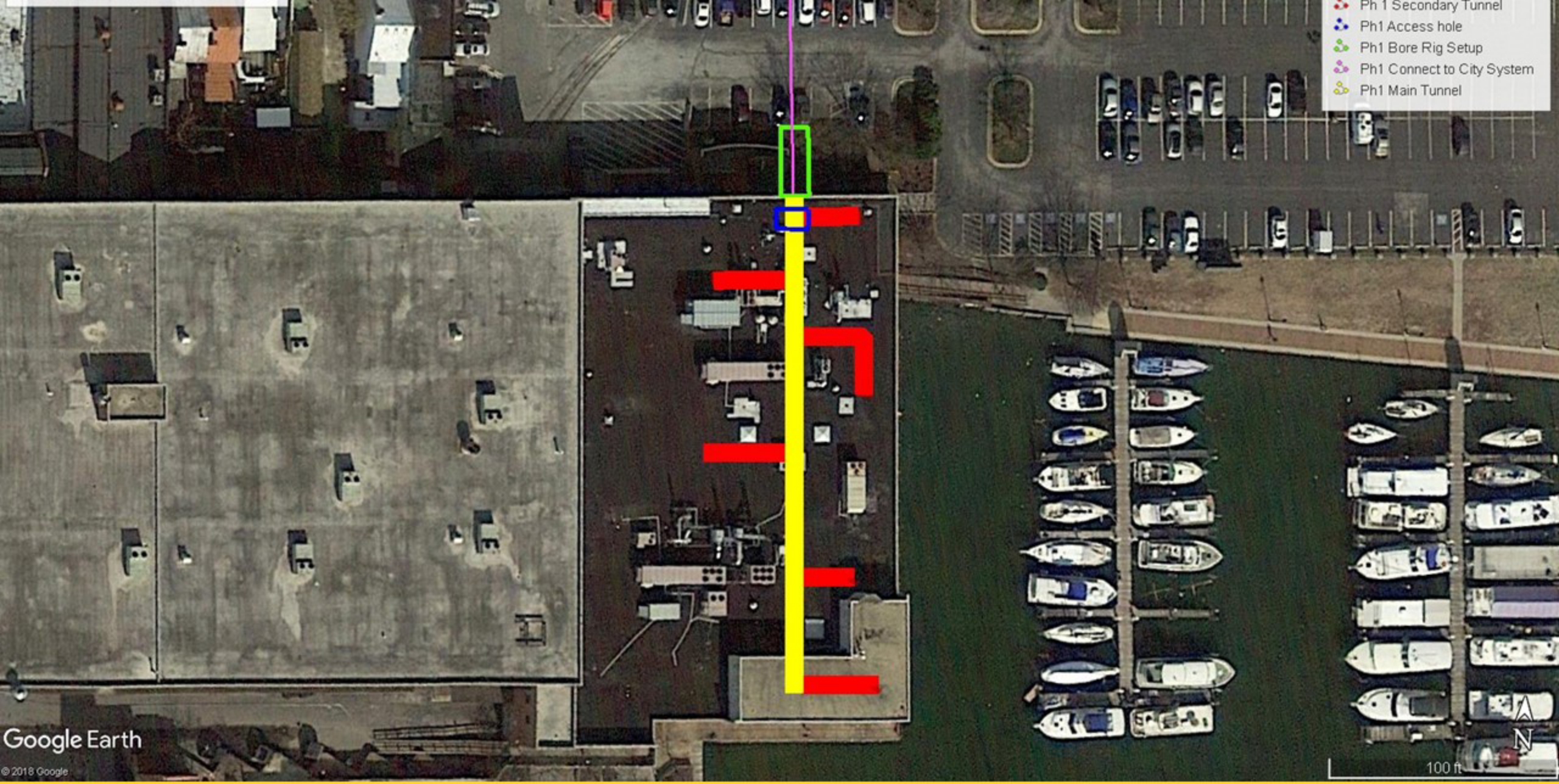
- DESIGN GRAVITY SEWER SYSTEM
- DRAWING AND PLANS
- JUNCTION POINTS FOR VARIOUS DRAINS
- COMMON DRAIN GOING TO CITY SEWER SYSTEM

DETERMINATIONS NEEDED PRIOR TO CONSTRUCTION

- ESTABLISH EXISTING ELEVATIONS OF EXISTING CITY SEWER
  - DETERMINE WE HAD SUFFICIENT DEPTH TO SERVE THE BUILDING WITH GRAVITY SEWER
- CONFIRM TIDAL DATA OF THE PORT
  - DETERMINE TIDAL INFLUENCE ON PROPOSED METHOD
  - CHANGING TIDE ELEVATIONS AND DEPTH OF PROPOSED GRAVITY SEWER
  - HIGH TIDE WOULD SOME DAY GET WATER IN BOTTOM OF EXCAVATION
  - LOWEST POINT OF SEWER SYSTEM WAS APPROXIMATELY 6" BELOW HIGH TIDE MARK

AEI PROPOSED SOLUTION 3:

CONSTRUCT SERIES OF V SHAPED DITCH TUNNELS BENEATH THE FLOOR


Ph 1 Secondary Tunnel
Ph1 Access hole
Ph1 Bore Rig Setup
Ph1 Connect to City System
Ph1 Main Tunnel
Google Earth
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N
100 ft

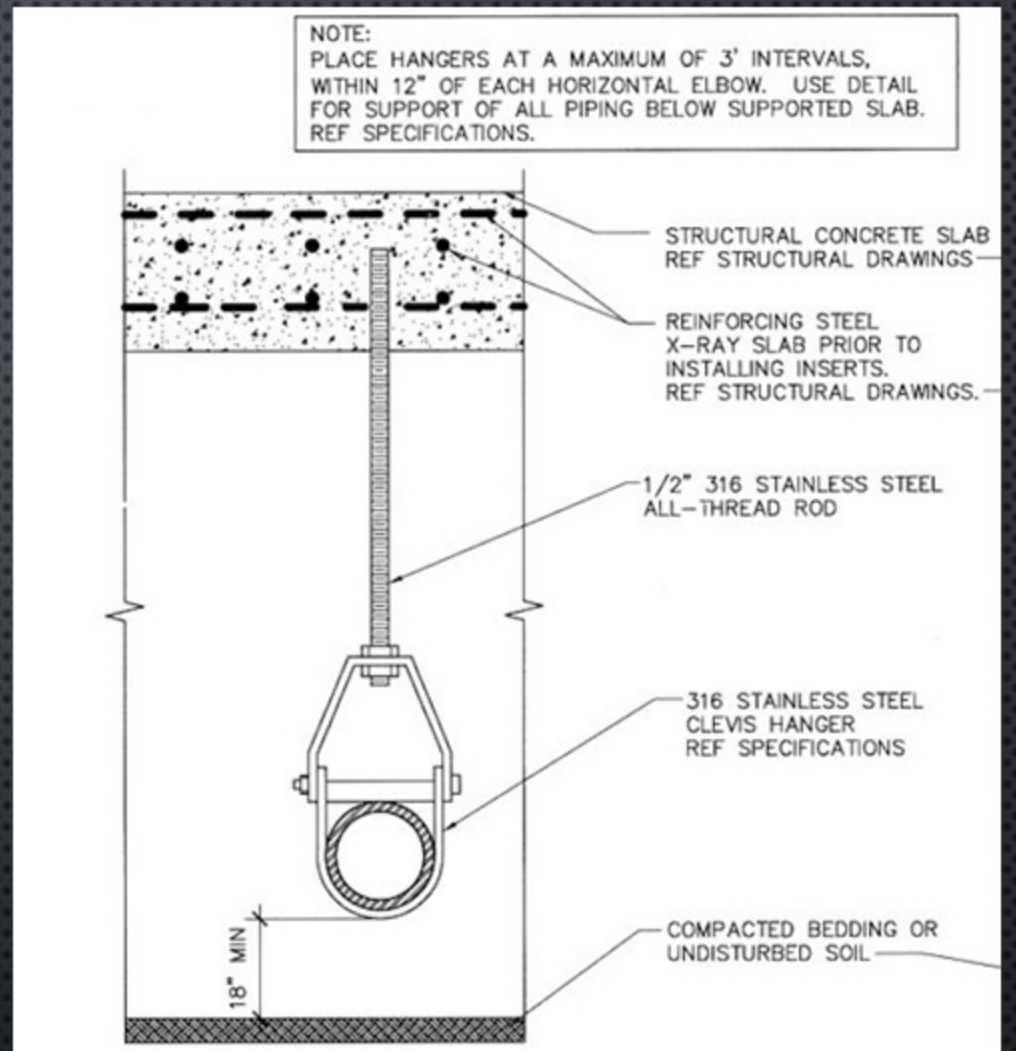
AEI PROPOSED SOLUTION 4:

SUSPEND GRAVITY SEWER PLUMBING NETWORK FROM FLOOR

AEI PROPOSED CONSTRUCTION 4:

USE STAINLESS STEEL PIPE HANGERS AND HARDWARE

ANCHORED THROUGH DRILLED HOLES IN CONCRETE FLOOR SLAB



SAFETY CONCERNS

- CONFINED SPACE
- AIR MONITORING
- LIGHTING
- EMERGENCY EVACUATION PLAN
- COMMUNICATIONS
- EXCAVATION SLOPES

PREP WORK FOR TRENCHLESS 1

LAYOUT PIPE NETWORK ON FLOOR OF SITE

- PAINT MARKS 10' ON CENTER FOR ALIGNMENT OF SEWER SYSTEM
- LASER
  - WHEN SETTING RODS/SYSTEM ALIGNMENT
  - ADJUST SLOPE OF SEWER PIPE

PREP WORK FOR TRENCHLESS 2

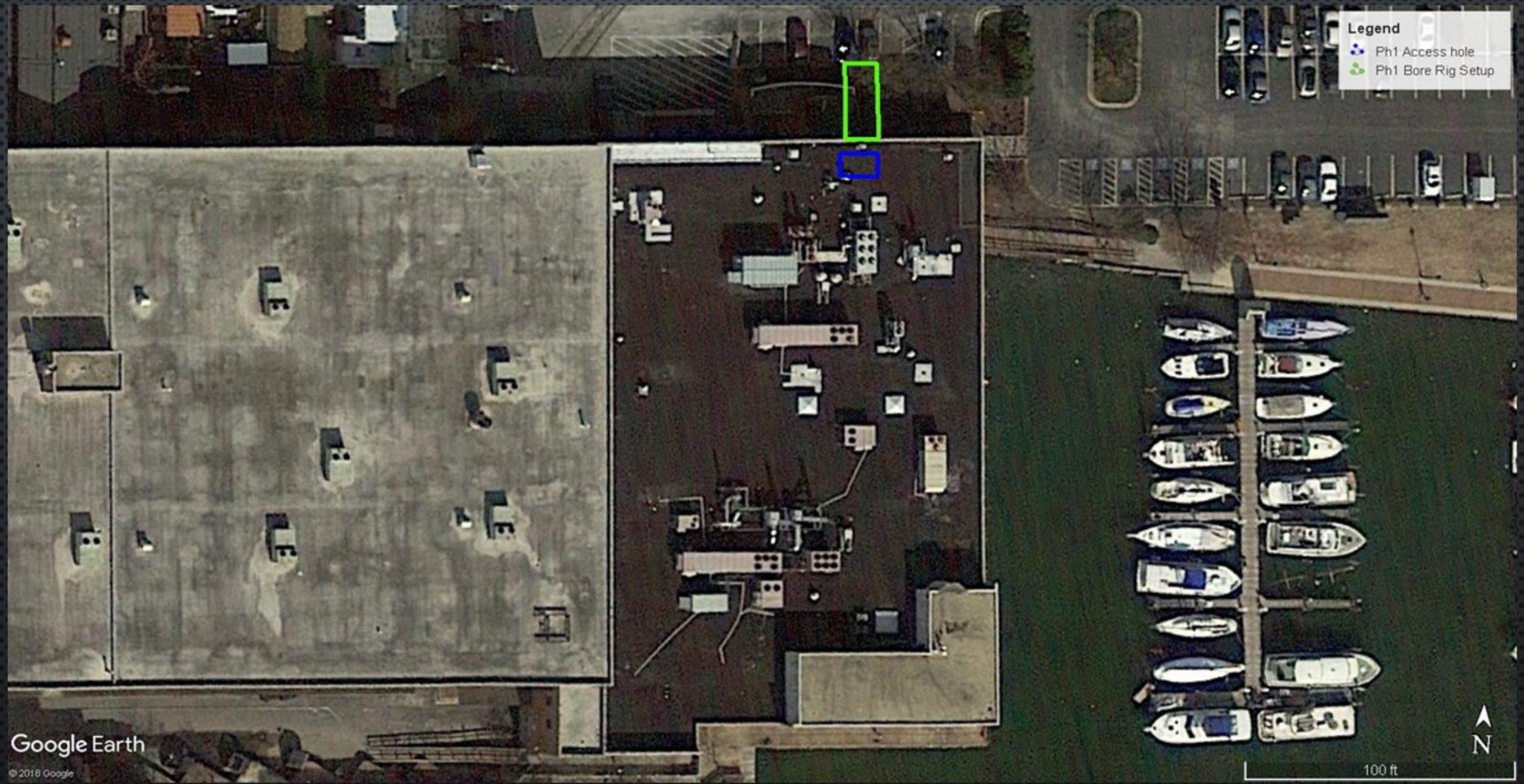
- DRILL HOLES 1.5"HOLES THROUGH CONCRETE FLOOR AT ALIGNMENT MARK
  - PILOT HOLES SERVED 2 PURPOSES
    - USED AS SITE POINT FOR THE TUNNEL ALIGNMENT DURING EXCAVATION
    - HOUSE THE SUSPENSION RODS FOR PIPE HANGERS
- DRILL 6" DIAMETER X 2" DEEP RECESS HOLES AT MARKS
  - HOUSED HARDWARE SUSPENSION FOR RODS, NUTS AND WASHERS BELOW FINISHED FLOOR
  - LATER THESE HOLES WERE GROUTED OVER FOLLOWING ESTABLISHMENT OF PIPE GRADES

ACCESS PIT 1

- 10’ x10’ CUT OUT OF FLOOR
- TUNNEL JUNCTION
  - ACCESS TO SYSTEM
  - LATER METAL DOORS TO BE INSTALLED TO ALLOW FUTURE ACCESS TO THE SYSTEM

ACCESS PIT 2

BOBCAT WITH BACKHOE ATTACHMENT


Legend
Ph1 Access hole
Ph1 Bore Rig Setup
Google Earth
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100 ft

BORING MACHINE SETUP OUTSIDE BUILDING

BORING MACHINE SETUP OUTSIDE BUILDING 2

CUT ACCESS WAY THROUGH FOUNDATION GRADE BEAM

BORED INTO THE ACCESS PIT

MAIN TUNNEL EXCAVATION

LEAD IN ACCESS PIT

- ATTACH "V" WING TO CASING LEAD

- BEGIN HAND TUNNEL EXCAVATION OF MAIN TUNNEL

V-WING

ATTACH "V" WING TO LEAD

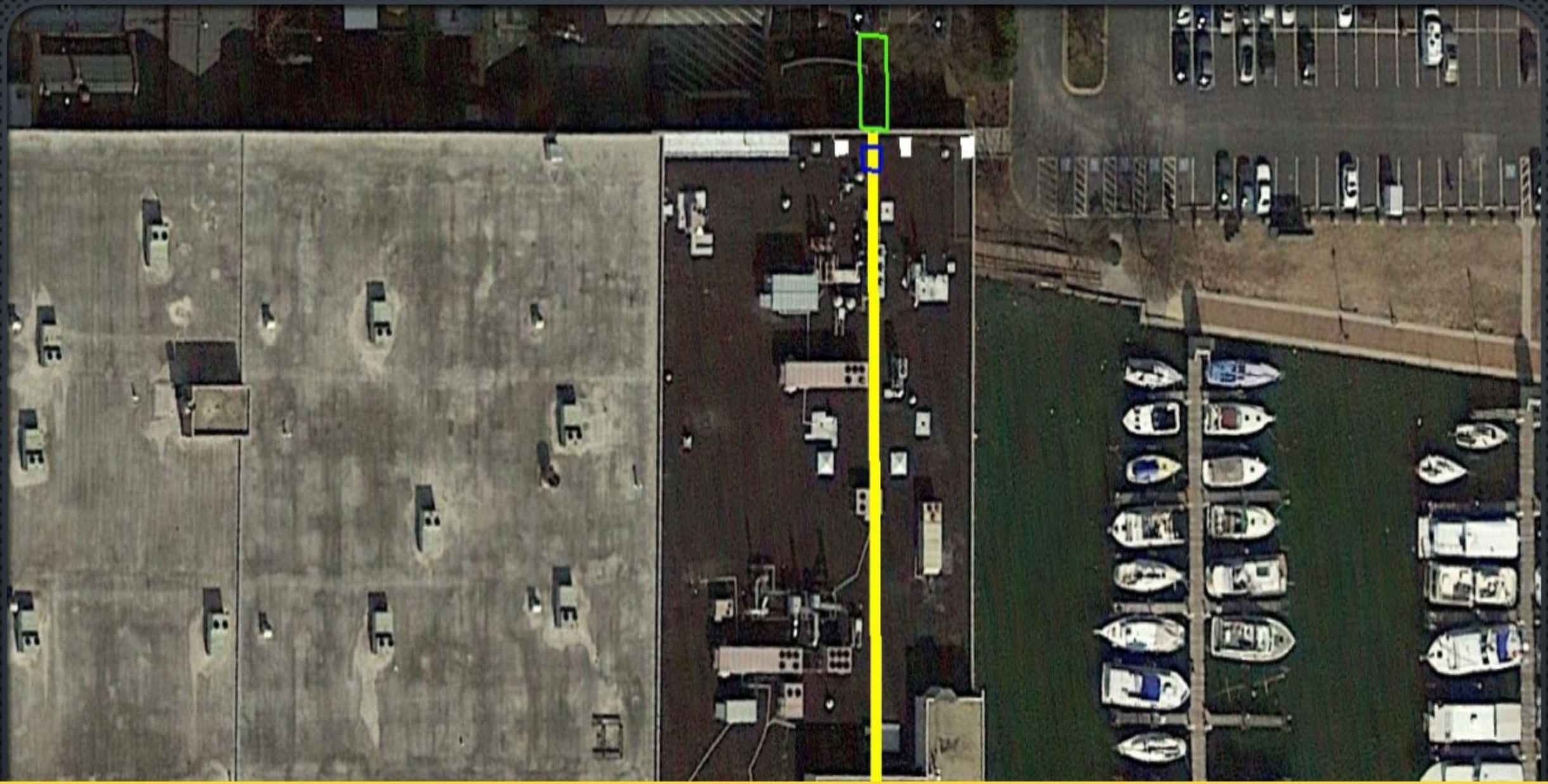
- ACT AS STABALIZER
- PREVENT CASING FROM "ROLLING" WHILE AUGER ROTATES WITHIN THE PIPE
- ACT AS CUTTER BLADES FORMING "V" DITCH
  - KNOCK DOWN EARTHEN MATERIAL TO A 1 TO 1 SLOPE
- SOIL MATERIALS CUT BY THE "V" WING WOULD FALL DOWN ON TOP THE CASING AND INTO GRATE
- BOTTOM OF CONCRETE FLOOR ACTED AS TOP GUIDE OF V SHAPED TUNNEL

MAIN TUNNEL EXCAVATION

- 16" STEEL CASING CUT LOWER PORTION OF THE TUNNEL
- PREFABRICATED GRATE WELDED AROUND TOP OF STEEL CASING
- ROTATING AUGER ACTED AS SPOILS CONVEYOR TO OUTSIDE THE BUILDING

EXCAVATED A NEARLY 200 LF LONG V DITCH

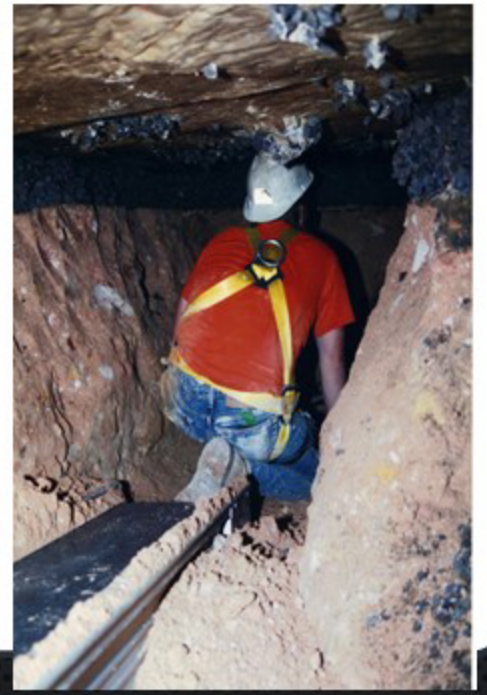
- AS THE DITCH WAS BORED A WORKMAN SAT ATOP THE ADVANCING CASING
- OBSERVED FORWARD SITE RODS COMING THROUGH FLOOR PENETRATIONS
- CLEAN UP OVERFLOW MATERIALS AND DEBRIS INTO THE GRATE

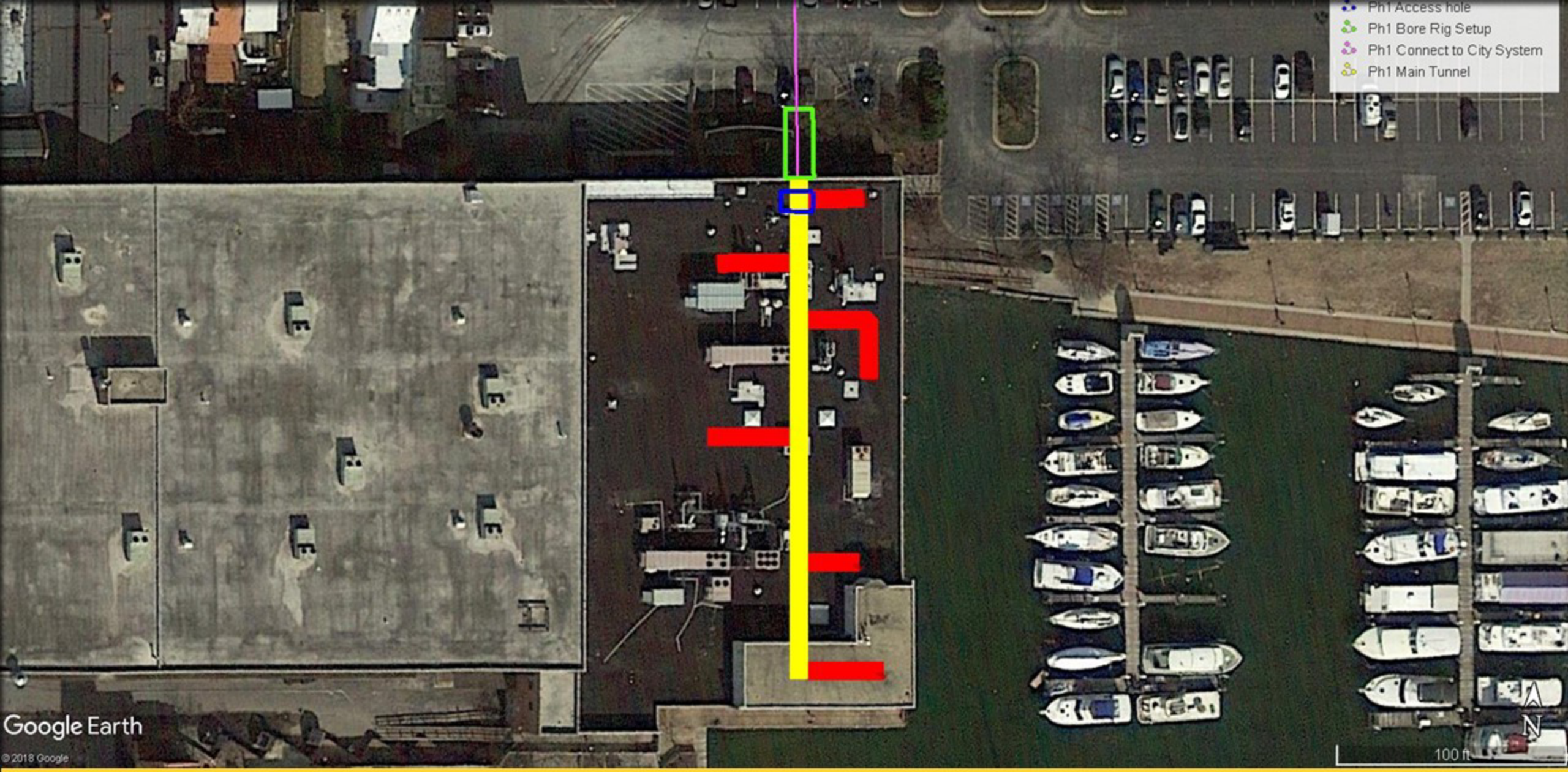


SECONDARY TUNNELS

- HAND TUNNEL EXCAVATION
- UTILIZED FLOOR PILOT HOLES FOR ALIGNMENT
- PULLED LEAD CASING BACK TO FIRST INTERSECTING TUNNEL ALIGNMENT
- UTILIZED MINI-CONVEYORS FOR SPOILS REMOVAL BETWEEN (WORKING FACE) HAND MINING EXCAVATION AND CASING(GRATE)
- MATERIALS DISCHARGED FROM CONVEYOR WOULD FALL INTO GRATE AND TAKEN AWAY BY THE BORING MACHINE AUGER

USE OF MINI-CONVEYORS FOR SPOILS REMOVAL

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PLUMBING AND HARDWARE INSTALL

Pipe foreman and crew installed pipe network from beneath building

PLUMBING AND HARDWARE 2

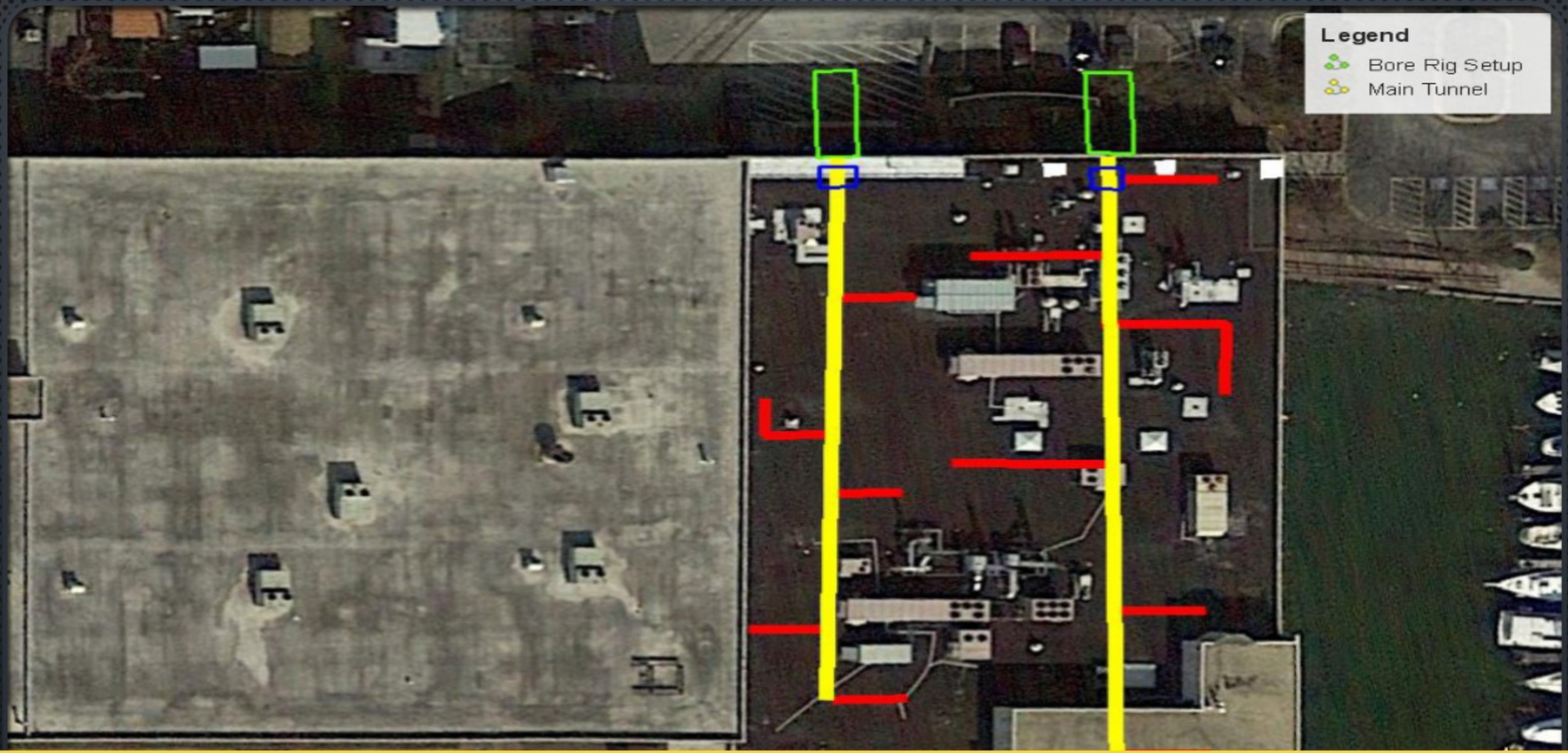
ALLOWED FOR FINAL PIPE GRADIENT TO BE ADJUSTED BY TIGHTENING OR LOOSING NUT ON "ALL THREAD ROD"

ANTI-FLOTATION –ONE NUT AND WASHER PLACED ON ROD BOTTOM TO PREVENT FLOAT

GRADIENT ADJUSTER-ONE NUT AND WASHER PLACE ON FLOOR

PROJECT SUCCESS

- 2 YEARS LATER REQUEST TO REPEAT THE TECHNIQUE TO FACILITATE AN EXPANSION FOR ADDITIONAL LABS (PHASE 2)


Legend
Bore Rig Setup
Main Tunnel

BUILDING CURRENTLY

- BUILDING IS EMPTY-
- BUILDING IS TO BE REDEVELOPED AND REBUILT AS APARTMENTS OR PARKING AREA

Any Questions

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