

Solicitation No.
VA-101-12-RP-0140
Project No. 640-424



**Department of
Veterans Affairs**

Specifications

Vol. 4 and 5 Addendum No. 04

For: Loop Road and Site Utilities
Radiology Consolidation
Parking Structure 2

At: VA Medical Center – Palo Alto
3801 Miranda Avenue
Palo Alto, California 94304

Issue:

Open Bids:

Amendment

No.	Date

TABLE OF CONTENTS

VOLUME 1: DIVISION 01 - GENERAL REQUIREMENTS
VOLUME 2: LOOP ROAD AND SITE UTILITIES
VOLUME 3: LOOP ROAD AND SITE UTILITIES (CONTINUED)
VOLUME 4: RADIOLOGY CONSOLIDATION
VOLUME 5: RADIOLOGY CONSOLIDATION (CONTINUED)
VOLUME 6: PARKING STRUCTURE 2
VOLUME 7: APPENDICES

VOLUME 1 OF 7 DIVISION 01 - GENERAL REQUIREMENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 010000 - GENERAL REQUIREMENTS *(Add#02)*10/07/2013
SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION
SECTION 013216.13 - NETWORK ANALYSIS SCHEDULES
SECTION 013323 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
SECTION 014219 - REFERENCE STANDARDS
SECTION 015719 - TEMPORARY ENVIRONMENTAL CONTROLS
SECTION 015816 - TEMPORARY INTERIOR SIGNAGE
SECTION 016000 - PRODUCT REQUIREMENTS
SECTION 017000 - EXECUTION REQUIREMENTS
SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT
SECTION 017700 - CLOSEOUT PROCEDURES

VOLUME 4 OF 7 RADIOLOGY CONSOLIDATION

DIVISION 00 - SPECIAL SECTIONS

SECTION 000115.02 - LIST OF DRAWING SHEETS
- RADIOLOGY CONSOLIDATION *(Add#01)* *(Add#04)*10/28/2013

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 014339.13 - VISUAL MOCKUPS *(Add#01)*09/18/2013
SECTION 014529.02 - TESTING LABORATORY SERVICES - RADIOLOGY CONSOLIDATION
SECTION 018111.02 - SUSTAINABLE DESIGN REQUIREMENTS - RADIOLOGY
CONSOLIDATION *(Add#01)*09/18/2013
LEED PRODUCT DATA SUBMITTAL FORM
LEED REQUIREMENTS SCORECARD
SECTION 019100.02 - GENERAL COMMISSIONING REQUIREMENTS - RADIOLOGY
CONSOLIDATION

DIVISION 02 - EXISTING CONDITIONS

SECTION 024100 - DEMOLITION (Add#01)09/18/2013
SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION (Add#01)09/18/2013
SECTION 028213.13 - GLOVEBAG ASBESTOS ABATEMENT (Add#01)09/18/2013
SECTION 028213.31 - ASBESTOS TRANSITE ABATEMENT

DIVISION 03 - CONCRETE

SECTION 033000 - CAST-IN-PLACE CONCRETE (Add#01)09/18/2013
SECTION 033300 - ARCHITECTURAL CONCRETE
SECTION 034100 - PRECAST STRUCTURAL CONCRETE FOR STEAM TRENCHES AND
VAULTS (Add#01)09/18/2013
SECTION 035200 - LIGHTWEIGHT INSULATING CONCRETE

DIVISION 04 - MASONRY

SECTION 042513.13 - TERRACOTTA RAINSCREEN PANELS (Add#01)09/18/2013
SECTION 047210 - STONE VENEER WALL (Add#01)09/18/2013

DIVISION 05 - METALS

SECTION 051200 - STRUCTURAL STEEL FRAMING (Add#01)09/18/2013
SECTION 051250 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL
SECTION 053100 - STEEL DECKING
SECTION 053600 - COMPOSITE METAL DECKING
SECTION 054000 - COLD-FORMED METAL FRAMING
SECTION 055000 - METAL FABRICATIONS (Add#01)09/18/2013
SECTION 055100 - METAL STAIRS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

SECTION 061000 - ROUGH CARPENTRY
SECTION 062000 - FINISH CARPENTRY

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 070800 - FACILITY EXTERIOR CLOSURE COMMISSIONING
SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING
SECTION 071352 - MODIFIED BITUMINOUS SHEET WATERPROOFING
SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING
SECTION 072113 - THERMAL INSULATION (Add#01)09/18/2013
SECTION 072613.13 - CONCRETE SLAB APPLIED VAPOR RETARDER

SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS (Add#01)09/18/2013
SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS
SECTION 074213.13 - FORMED METAL WALL PANELS
SECTION 074213.16 - METAL PLATE WALL PANELS (Add#01)09/18/2013
SECTION 075216.13 - STYRENE-BUTADIENE-STYRENE MODIFIED BITUMINOUS MEMBRANE
ROOFING, COLD-APPLIED (Add#01)09/18/2013
SECTION 076000 - FLASHING AND SHEET METAL
SECTION 077100 - ROOF SPECIALTIES
SECTION 078100 - APPLIED FIREPROOFING
SECTION 078400 - FIRESTOPPING
SECTION 079200 - JOINT SEALANTS
SECTION 079513 - EXPANSION JOINT COVER ASSEMBLIES

DIVISION 08 - OPENINGS

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES (Add#01)09/18/2013
SECTION 081400 - INTERIOR WOOD DOORS (Add#01)09/18/2013
SECTION 081710 - INTEGRATED DOOR ASSEMBLIES (Add#01)09/18/2013
SECTION 083113 - ACCESS DOORS AND FRAMES
SECTION 083473 - SOUND CONTROL DOOR ASSEMBLIES
SECTION 083513.23 - ACCORDION FOLDING FIRE DOORS (Add#01)09/18/2013
SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS (Add#01)09/18/2013
SECTION 086300 - METAL-FRAMED SKYLIGHTS
SECTION 087100 - DOOR HARDWARE (Add#01)09/18/2013
SECTION 087113 - AUTOMATIC DOOR OPERATORS (Add#01)09/18/2013
SECTION 087113.11 - LOW ENERGY POWER ASSIST DOOR
OPERATORS (Add#01)09/18/2013
SECTION 088000 - GLAZING (Add#01)09/18/2013

DIVISION 09 - FINISHES

SECTION 090600 - SCHEDULE FOR FINISHES (Add#01)09/18/2013
SECTION 092216 - NON-STRUCTURAL METAL FRAMING (Add#01)09/18/2013
SECTION 092400 - PORTLAND CEMENT PLASTERING
SECTION 092900 - GYPSUM BOARD
SECTION 093013 - CERAMIC/PORCELAIN TILING (Add#01)09/18/2013
SECTION 095100 - ACOUSTICAL CEILINGS (Add#01)09/18/2013
SECTION 095426 - LINEAR WOOD CEILINGS (Add#01)09/18/2013
SECTION 095429 - WOOD PANEL CEILINGS
SECTION 096513 - RESILIENT BASE AND ACCESSORIES (Add#01)09/18/2013
SECTION 096516 - RESILIENT SHEET FLOORING
SECTION 096516.13 - LINOLEUM FLOORING
SECTION 096519 - RESILIENT TILE FLOORING
SECTION 096536 - STATIC-CONTROL RESILIENT FLOORING (Add#01)09/18/2013

SECTION 096800 - CARPETING (Add#01)09/18/2013
SECTION 098433 - SOUND-ABSORBING WALL UNITS
SECTION 099100 - PAINTING (Add#01)09/18/2013
SECTION 099600 - HIGH-PERFORMANCE COATINGS
SECTION 099654 - POLYVINYLIDENE DIFLUORIDE (PVDF)
COATING SYSTEM (Add#01)09/18/2013
SECTION 099659 - HIGH-BUILD GLAZED COATINGS (Add#01)09/18/2013

DIVISION 10 - SPECIALTIES

SECTION 101400 - SIGNAGE
SIGNAGE SCHEDULE (Add#01)09/18/2013
SECTION 102113 - TOILET COMPARTMENTS (Add#01)09/18/2013
SECTION 102123 - CUBICLE CURTAIN TRACKS
SECTION 102600 - WALL AND DOOR PROTECTION (Add#01)09/18/2013
SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES
SECTION 104413 - FIRE EXTINGUISHER CABINETS
SECTION 105116 - WOOD LOCKERS
SECTION 108113 - BIRD CONTROL DEVICES

DIVISION 11 - EQUIPMENT

SECTION 11 23 43 - HANGING GARMENT CONVEYORS (Add#01)09/18/2013
SECTION 112443.13 - WINDOW WASHING SYSTEMS SAFETY TIE-BACK ANCHOR
SECTION 117000 - HEALTHCARE EQUIPMENT

DIVISION 12 - FURNISHINGS

SECTION 122400 - WINDOW SHADES (Add#01)09/18/2013
SECTION 123200 - MANUFACTURED WOOD CASEWORK
SECTION 123600 - COUNTERTOPS
SECTION 124813 - ENTRANCE FLOOR MATS (Add#01)09/18/2013

DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 130541 - SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL
COMPONENTS (Add#01)09/18/2013
SECTION 134900 - RADIATION PROTECTION (Add#01)09/18/2013
WEST PHYSICS CONSULTING SHIELDING DESIGN LETTER
SECTION 134927 - MAGNETIC RESONANCE IMAGING (MRI) SHIELDED
ENCLOSURES (Add#01) (Add#02)10/07/2013

VOLUME 5 OF 7

RADIOLOGY CONSOLIDATION (CONTINUED)

DIVISION 21 - FIRE SUPPRESSION

SECTION 210512 - MOTOR REQUIREMENTS FOR FIRE-SUPPRESSION
EQUIPMENT ^(Add#01)09/18/2013

SECTION 210511 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS ^(Add#01)09/18/2013

SECTION 213000 - FIRE PUMPS ^(Add#01)09/18/2013

DIVISION 22 - PLUMBING

SECTION 220511 - COMMON WORK RESULTS FOR PLUMBING ^(Add#01)09/18/2013

SECTION 220512 - GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

SECTION 220711 - PLUMBING INSULATION

SECTION 221100 - FACILITY WATER DISTRIBUTION

SECTION 221300 - FACILITY SANITARY AND VENT PIPING ^(Add#01)09/18/2013

SECTION 221400 - FACILITY STORM DRAINAGE ^(Add#01)09/18/2013

SECTION 221436 - PACKAGED, SUBMERSIBLE, DRAINAGE PUMP UNITS

SECTION 224000 - PLUMBING FIXTURES ^(Add#01)09/18/2013

SECTION 226200 - VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

SECTION 226300 - GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

SECTION 230130.51 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

SECTION 230511 - COMMON WORK RESULTS FOR HVAC ^(Add#01)09/18/2013

SECTION 230512 - GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION
EQUIPMENT

SECTION 230541 - NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

SECTION 230711 - HVAC AND BOILER PLANT INSULATION ^(Add#01)09/18/2013

SECTION 230923 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC ^(Add#01) ...09/18/2013

SECTION 232113 - HYDRONIC PIPING ^(Add#01)09/18/2013

SECTION 232123 - HYDRONIC PUMPS

SECTION 232213 - STEAM AND CONDENSATE HEATING PIPING

SECTION 232223 - STEAM CONDENSATE PUMPS

SECTION 232300 - REFRIGERANT PIPING

SECTION 232500 - HVAC WATER TREATMENT

SECTION 233100 - HVAC DUCTS AND CASINGS ^(Add#01)09/18/2013

SECTION 233400 - HVAC FANS

SECTION 233600 - TERMINAL UNITS

SECTION 233700 - OUTLETS AND INLETS

- SECTION 234000 - HVAC AIR CLEANING DEVICES
- SECTION 236400 - PACKAGED WATER CHILLERS (Add#01)09/18/2013
- SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION
AIR-HANDLING UNITS (Add#01)09/18/2013
- SECTION 238100 - DECENTRALIZED UNITARY HVAC EQUIPMENT
- SECTION 238200 - CONVECTION HEATING AND COOLING UNITS
- SECTION 238216 - AIR COILS

DIVISION 26 - ELECTRICAL

- SECTION 260511 - REQUIREMENTS FOR ELECTRICAL INSTALLATIONS
- SECTION 260521 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS
AND BELOW)
- SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS (Add#01) ..09/18/2013
- SECTION 260536 - WIREWAYS FOR RADIOLOGY EQUIPMENT
- SECTION 260541 - UNDERGROUND ELECTRICAL CONSTRUCTION
- SECTION 260571 - ELECTRICAL SYSTEM PROTECTIVE DEVICE STUDY
- SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS
- SECTION 260923 - LIGHTING CONTROLS
- SECTION 262200 - LOW-VOLTAGE TRANSFORMERS
- SECTION 262411 - DISTRIBUTION SWITCHBOARDS
- SECTION 262416 - PANELBOARDS
- SECTION 262419 - MOTOR-CONTROL CENTERS
- SECTION 262511 - BUSWAYS
- SECTION 262713 - ELECTRIC METERING
- SECTION 262726 - WIRING DEVICES
- SECTION 262911 - MOTOR STARTERS
- SECTION 262921 - DISCONNECT SWITCHES
- SECTION 263005 - PHOTOVOLTAIC SYSTEMS
- SECTION 264200 - CATHODIC PROTECTION (Add#01)09/18/2013
- SECTION 265100 - INTERIOR LIGHTING
- SECTION 265600 - EXTERIOR LIGHTING

DIVISION 27 - COMMUNICATIONS

- SECTION 270511 - REQUIREMENTS FOR COMMUNICATIONS INSTALLATIONS
- SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS
- SECTION 270533 - RACEWAYS AND BOXES FOR COMMUNICATIONS SYSTEMS
- SECTION 270543 - UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS
- SECTION 270811 - TESTING FOR COMMUNICATIONS
- SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS (Add#01) ...09/18/2013
- SECTION 271313 - TELECOMMUNICATION BACKBONE TWISTED PAIR CABLING
- SECTION 271323 - TELECOMMUNICATION BACKBONE ISP FIBER CABLING
- SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING (Add#01)09/18/2013

- SECTION 274116 - INTEGRATED AUDIOVISUAL SYSTEMS
- SECTION 274131 - MASTER ANTENNA TELEVISION EQUIPMENT AND SYSTEMS
- SECTION 275116 - PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS
- SECTION 275123 - INTERCOMMUNICATIONS AND PROGRAM SYSTEMS
- SECTION 275223 - TELECOMMUNICATION NURSE CALL SYSTEMS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

- SECTION 280000 - BASIC SECURITY REQUIREMENTS (Add#01)09/18/2013
- SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY
- SECTION 280553 - SECURITY SYSTEM LABELING
- SECTION 280800 - SECURITY SYSTEM ACCEPTANCE TESTING
- SECTION 281300 - ACCESS AND ALARM MONITORING SYSTEM (Add#01)09/18/2013
- SECTION 283100 - DETECTION AND ALARM

DIVISION 31 - EARTHWORK

- SECTION 312000 - EARTH MOVING
- SECTION 312319 - DEWATERING
- SECTION 312323.33 - FLOWABLE FILL
- SECTION 315100 - EXCAVATION SUPPORT AND PROTECTION

DIVISION 32 - EXTERIOR IMPROVEMENTS

- SECTION 320523 - CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS (Add#01) (Add#02)10/07/2013
- SECTION 321216 - ASPHALT PAVING
- SECTION 321413 - TURF BLOCK PAVERS (Add#01)09/18/2013
- SECTION 321723 - PAVEMENT MARKINGS
- SECTION 328400 - PLANTING IRRIGATION (Add#01)09/18/2013
- SECTION 329000 - PLANTING (Add#01) (Add#02)10/07/2013
- SECTION 329453 - TREE SOIL CELLS (Add#01)09/18/2013

DIVISION 33 - UTILITIES

- SECTION 331000 - WATER UTILITIES
- SECTION 333000 - SANITARY SEWERAGE UTILITIES (Add#01)09/18/2013
- SECTION 334000 - STORM DRAINAGE UTILITIES (Add#01) (Add#04)10/28/2013
- SECTION 334716.17 - BIORETENTION AREA, SWALE, AND PERMEABLE PAVEMENT DRAINAGE
- SECTION 336300 - STEAM AND CHILLED WATER SITE DISTRIBUTION (Add#01)09/18/2013

DIVISION 34 - TRANSPORTATION

- SECTION 347513.13 - ACTIVE VEHICLE BARRIERS

VOLUME 7 OF 7

APPENDICES

Appendix A - Geotechnical Investigation: Phase 2 Improvements - Packages 1, 2, 3, and 5

Appendix B - Facilities Protection Plan for Hillview-Porter Regional Program
Groundwater Remediation Facilities at the Veterans
Administration Hospital Property, Palo Alto, Ca.

Appendix C - Stormwater Pollution Prevention Plan

- - - E N D - - -

(Add#01) 18 SEP 2013, Addendum No. 1
(Add#02) 07 OCT 2013, Addendum No. 2
(Add#04) 28 OCT 2013, Addendum No. 4

SECTION 00 01 15.02

LIST OF DRAWING SHEETS - RADIOLOGY CONSOLIDATION

(RE-ISSUED FOR ADDENDUM NO. 04) (Add#04)

The drawings listed below accompanying this specification form a part of the contract.

Sheet Number	Sheet Name
VOLUME 1	
GENERAL	
GI0.0.1	COVER SHEET
GI0.1.1	INDEX OF DRAWINGS
GI0.1.3	SAMPLE CPM NETWORK
GI0.2.1	PROJECT INFORMATION AND APPLICABLE CODES
CIVIL	
CS0.1.1	CIVIL NOTES, LEGEND AND ABBREVIATIONS
CS1.1.1	EXISTING CONDITIONS PLAN
CD1.1.2	EXISTING CONDITIONS PLAN
CD1.2.1	CIVIL DEMOLITION PLAN
CD1.2.2	CIVIL DEMOLITION PLAN
CS1.3.0	HORIZONTAL CONTROL PLAN
CS1.3.1	LAYOUT PLAN
CS1.3.2	LAYOUT PLAN
CS1.4.1	GRADING PLAN
CS1.4.2	GRADING PLAN
CS1.5.1	UTILITY PLAN
CS1.5.2	UTILITY PLAN
CS1.5.3	UTILITY PLAN
CS1.5.4	ED ROAD PROFILE 25+73 TO 30+29 STEAM TRENCH PROFILE
CS1.5.5	ED ROAD PROFILE 10+00 TO 11+60 RADIOLOGY SEWER PROFILE
CS1.6.1	EROSION CONTROL PLAN
CS1.6.2	EROSION CONTROL PLAN
CS1.7.1	SIGNAGE AND STRIPING PLAN
CS1.7.2	SIGNAGE AND STRIPING PLAN

CS1.8.1 DETAILS
CS1.8.2 DETAILS
CS1.8.3 DETAILS
CS1.8.4 DETAILS
CS1.8.5 DETAILS
CS1.8.6 DETAILS
CS1.8.7 DETAILS

LANDSCAPE

LP1.1.0 SCHEDULES, NOTES AND LEGENDS
LP1.1.1 OVERALL LANDSCAPE SITE PLAN
LP2.1.0 LAYOUT PLAN
LP3.1.0 CONSTRUCTION PLAN
LP4.1.0 ENLARGED PLANS
LP3.1.1 ENLARGED PLANS
LP5.1.0 CONSTRUCTION DETAILS
LP5.1.1 CONSTRUCTION DETAILS
LP7.1.0 PLANTING PLAN
LP7.2.0 PLANTING DETAILS
LI1.1.0 IRRIGATION PLAN
LI1.2.0 IRRIGATION DETAILS

STRUCTURAL

SF0.1.1 GENERAL NOTES
SF0.1.2 SYMBOLS AND ABBREVIATIONS
SF1.1.1 TYPICAL CONCRETE DETAILS
SF1.1.2 TYPICAL CONCRETE DETAILS
SF1.2.1 TYPICAL STEEL DETAILS
SF1.2.2 TYPICAL STEEL DETAILS
SF1.3.1 TYPICAL METAL DECK DETAILS
SF2.1.0 OVERALL FOUNDATION PLAN LEVEL B
SF2.1.0A FOUNDATION PLAN LEVEL B AREA A
SF2.1.1 OVERALL FLOOR FRAMING PLAN LEVEL 1
SF2.1.1A FLOOR FRAMING PLAN LEVEL 1 AREA A
SF2.1.2 OVERALL FRAMING PLAN ROOF LEVEL
SF2.1.2A FRAMING PLAN ROOF LEVEL AREA A

SF2.1.3	FRAMING PLAN UPPER ROOF AREA A
SF2.1.4	MECHANICAL SCREEN FRAMING PLAN AREA A
SF2.2.1	PARTIAL STAIR FRAMING PLANS
SF2.2.2	STAIR DETAILS
SF3.1.1	BRACED FRAME ELEVATIONS
SF4.2.1	DESIGN LOAD & VIBRATION CRITERIA
SF5.1.1	CONCRETE DETAILS
SF5.1.2	CONCRETE DETAILS
SF5.1.3	CONCRETE DETAILS
SF5.1.4	CONCRETE DETAILS
SF7.1.1	STEEL COLUMN SCHEDULE
SF7.2.1	STEEL DETAILS
SF7.2.2	STEEL DETAILS
SF7.2.3	STEEL DETAILS
SF7.3.1	BRACED FRAME DETAILS
ARCHITECTURAL	
GI1.1.1	<i>(Add#01)</i> ARCHITECTURAL OVERALL SITE PLAN
GI1.1.2	<i>(Add#01)</i> TYPICAL MOUNTING HEIGHTS AND CONFIGURATION DIAGRAMS
A0.1.1	ABBREVIATIONS, GENERAL NOTES AND DIMENSIONING CONVENTIONS
A0.1.2	ARCHITECTURAL SYMBOLS
A0.2.5	LIFE SAFETY DIAGRAM LEVEL B
A0.3.5	LIFE SAFETY DIAGRAM LEVEL 1
A0.5.1	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL B
A0.5.2	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL B
A0.5.3	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL B
A0.5.4	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL B
A0.5.5	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL B
A0.5.6	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL B
A0.5.7	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL B
A0.6.1	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A0.6.2	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A0.6.3	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A0.6.4	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A0.6.5	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A0.6.6	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1

A0.6.7	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A0.6.8	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A0.6.9	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A0.6.10	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A0.6.11	SEQUENCE OF CONSTRUCTION ACTIVITY LEVEL 1
A1.1.1	ARCHITECTURAL SITE PLAN
A1.2.1	CONNECTOR PLANS LEVEL B
AD2.1.0	DEMOLITION PLAN LEVEL B AREA B
AD2.1.1	DEMOLITION PLAN LEVEL 1 AREA B
AD3.1.0	DEMOLITION REFLECTED CEILING PLAN LEVEL B
AD3.1.1	DEMOLITION REFLECTED CEILING PLAN LEVEL 1
AD5.1.1	DEMOLITION EXTERIOR WALL DETAILS
AE2.1.0	OVERALL FLOOR PLAN LEVEL B
AE2.1.0A	FLOOR PLAN LEVEL B AREA A
AE2.1.0B	FLOOR PLAN LEVEL B AREA B
AE2.1.1	OVERALL FLOOR PLAN LEVEL 1
AE2.1.1A	FLOOR PLAN LEVEL 1 AREA A
AE2.1.1B	FLOOR PLAN LEVEL 1 AREA B
AE2.1.2	OVERALL ROOF PLAN
AE2.1.3	OVERALL UPPER ROOF PLAN
AE3.1.0	OVERALL REFLECTED CEILING PLAN LEVEL B
AE3.1.0A	REFLECTED CEILING PLAN LEVEL B AREA A
AE3.1.0B	REFLECTED CEILING PLAN LEVEL B AREA B
AE3.1.1	OVERALL REFLECTED CEILING PLAN LEVEL 1
AE3.1.1A	REFLECTED CEILING PLAN LEVEL 1 AREA A
AE3.1.1B	REFLECTED CEILING PLAN LEVEL 1 AREA B
AE3.1.2	REFLECTED CEILING PLAN ROOF PLAN
AE4.1.0	EXISTING BUILDING 100 SOUND MITIGATION ELEVATIONS
AE4.1.1	EXTERIOR ELEVATIONS
AE4.1.2	EXTERIOR ELEVATIONS
AE4.1.3	EXTERIOR ELEVATIONS
AE4.1.4	EXTERIOR WINDOW SCHEDULE
AE4.1.5	EXTERIOR WINDOW SCHEDULE
AE4.1.6	EXTERIOR MOCKUP
AE4.2.1	BUILDING SECTIONS
AE4.2.2	BUILDING SECTIONS

AE4.3.1	EXTERIOR WALL PLANS / SECTIONS / ELEVATIONS
AE4.3.2	EXTERIOR WALL PLANS / SECTIONS / ELEVATIONS
AE4.3.3	EXTERIOR WALL PLANS / SECTIONS / ELEVATIONS
AE4.3.4	EXTERIOR WALL PLANS / SECTIONS / ELEVATIONS
AE4.3.5	EXTERIOR WALL PLANS / SECTIONS / ELEVATIONS
AE4.3.6	EXTERIOR WALL PLANS / SECTIONS / ELEVATIONS
AE4.4.1	TYPICAL WALL SECTIONS
AE5.1.1	EXTERIOR WALL DETAILS
AE5.1.2	EXTERIOR WALL DETAILS
AE5.1.3	EXTERIOR WALL DETAILS
AE5.1.4	EXTERIOR WALL DETAILS
AE5.1.5	EXTERIOR WALL DETAILS
AE5.2.1	ENLARGED EXTERIOR DETAILS
AE5.2.2	ENLARGED EXTERIOR DETAILS
AE5.3.1	ROOF AND WATERPROOFING DETAILS
AE5.4.1	EXPANSION JOINT DETAILS
AE6.1.1	STAIR PLANS AND SECTIONS
AE6.1.2	STAIR DETAILS
AE7.0.1	ENLARGED PLANS - LOCKERS, TOILETS AND SHOWERS
AE7.1.1	ENLARGED PLANS - MRI SUITE
AE7.1.2	ENLARGED PLANS - CT SUITE
AE7.1.3	ENLARGED PLANS - ULTRASOUND
AE7.1.4	ENLARGED PLANS - WAITING AREA
AE7.1.5	ENLARGED RCP - WAITING AREA
AE7.1.6	ENLARGED PLANS - PATIENT HOLDING BAY
AE7.1.7	ENLARGED RCP - PATIENT HOLDING BAY
AE8.0.1	INTERIOR ELEVATIONS
AE8.0.2	INTERIOR ELEVATIONS
AE8.0.3	INTERIOR ELEVATIONS
AE8.0.4	INTERIOR ELEVATIONS
AE8.0.5	INTERIOR ELEVATIONS
AE8.0.6	INTERIOR ELEVATIONS
AE8.0.7	INTERIOR ELEVATIONS
AE8.0.8	INTERIOR ELEVATIONS
AE8.0.9	INTERIOR ELEVATIONS
AE8.0.10	INTERIOR ELEVATIONS

AE8.0.11	INTERIOR ELEVATIONS
AE8.0.12	INTERIOR ELEVATIONS
AE8.6.1	INTERIOR DETAILS CORNER GUARDS, HANDRAILS AND MISCELLANEOUS
AE8.7.1	MODULAR CASEWORK SCHEDULE
AE8.7.2	MODULAR CASEWORK DETAILS
AE8.7.3	CUSTOM CASEWORK ENLARGED PLANS, ELEVATIONS AND DETAILS
AE8.7.4	CUSTOM CASEWORK ENLARGED PLAN, ELEVATIONS AND DETAILS
AE8.7.5	CUSTOM CASEWORK ENLARGED PLANS, ELEVATIONS AND DETAILS
AE9.0.1	FINISH SCHEDULE LEVEL B
AE9.0.2	FINISH SCHEDULE LEVEL 1
AE9.0.3	EXISTING FINISH SCHEDULE LEVEL B & 1
AE9.1.0A	FINISH PLAN LEVEL B AREA A
AE9.1.0B	FINISH PLAN LEVEL B AREA B
AE9.1.1A	FINISH PLAN LEVEL 1 AREA A
AE9.1.1B	FINISH PLAN LEVEL 1 AREA B
AE9.2.1	PARTITION SCHEDULE AND DETAILS
AE9.2.2	PARTITION SCHEDULE AND DETAILS
AE9.2.3	PARTITION SCHEDULE AND DETAILS
AE9.2.4	PARTITION SCHEDULE AND DETAILS
AE9.2.5	PARTITION SCHEDULE AND DETAILS
AE9.2.6	PARTITION SCHEDULE AND DETAILS
AE9.3.1	DOOR SCHEDULE
AE9.4.1	DOOR STANDARDS AND DETAILS
AE9.4.2	DOOR DETAILS
AE9.5.1	TYPICAL CEILING DETAILS
AE9.5.2	TYPICAL CEILING DETAILS
AE9.5.3	TYPICAL REFLECTED CEILING PLAN LOCATIONS AND CONFIGURATIONS
AE9.5.4	CEILING DETAILS
AE9.5.5	CEILING DETAILS
AE9.5.6	CEILING DETAILS
AE9.6.1	INTERIOR DETAILS
AE9.6.2	INTERIOR DETAILS
AE9.6.3	INTERIOR DETAILS
AE9.7.1	INTERIOR GLAZING TYPES

SIGNAGE

AG1.1.0A SIGN LOCATION PLAN LEVEL B AREA A
AG1.1.0B SIGN LOCATION PLAN LEVEL B AREA B
AG1.1.1A SIGN LOCATION PLAN LEVEL 1 AREA A
AG1.1.1B SIGN LOCATION PLAN LEVEL 1 AREA B
AG1.1.2 SIGN LOCATION PLAN OVERALL ROOF
AG1.2.1 INTERIOR SIGNS WAYFINDING & IDENTIFICATION
AG1.2.2 INTERIOR SIGNS WAYFINDING & IDENTIFICATION
AG1.2.3 INTERIOR SIGNS IDENTIFICATION & CODE
AG1.2.4 INTERIOR SIGNS ELEVATIONS

EQUIPMENT

QH2.1.0A EQUIPMENT PLAN LEVEL B AREA A
QH2.1.0B EQUIPMENT PLAN LEVEL B AREA B
QH2.1.1A EQUIPMENT PLAN LEVEL 1 AREA A
QH2.1.1B EQUIPMENT PLAN LEVEL 1 AREA B
QH7.1.1 EQUIPMENT PLAN - EMS AND PHARMACY CACHE
QH7.1.2 EQUIPMENT PLAN - EMS/NFS OFFICES, STORAGE AND STAFF SUPPORT
AREA
QH7.1.3 EQUIPMENT PLAN - RADIOLOGY - OFFICES, READING ROOM, STAFF
AREA AND ULTRASOUND
QH7.1.4 EQUIPMENT PLAN - RADIOLOGY - MRI AND CT SCANNING ROOMS
QH7.1.5 EQUIPMENT PLAN - RADIOLOGY - PATIENT HOLDING BAY AND
ULTRASOUND
QH7.1.6 EQUIPMENT RCP - RADIOLOGY - PATIENT HOLDING BAY AND
ULTRASOUND
QH7.1.7 EQUIPMENT PLAN - RADIOLOGY - MAIN WAITING AND RECEPTION
QH7.1.8 EQUIPMENT PLAN - RADIOLOGY - STAFF SUPPORT AREAS

VOLUME 2

GENERAL

GI0.0.2 COVER SHEET
GI0.1.2 INDEX OF DRAWINGS

MECHANICAL

M0.1.1	TITLE PAGE, SYMBOLS AND ABBREVIATIONS
MS1.1.1	MECHANICAL PLAN SITE
MS1.1.2	OVERALL MECHANICAL SITE - CHILLER RELOCATION - DEMO WORK
MS1.1.3	OVERALL MECHANICAL SITE - CHILLER RELOCATION - NEW WORK
MS1.1.4	ENLARGED MECHANICAL SITE - CHILLER RELOCATION - DEMO WORK
MS1.1.5	OVERALL AND ENLARGED MECH SITE - AIR HANDLER UNIT AIR INTAKE FILTRATION PLAN FOR BUILDING 5
MS1.1.6	ENLARGED MECHANICAL SITE PLAN - CHILLER RELOCATION BUILDING 100
MD2.1.0	HVAC DEMOLITION PLAN LEVEL B
MD2.1.1	HVAC DEMOLITION PLAN LEVEL 1
MD2.1.2	HVAC DUCT CLEANING PLAN LEVEL B
MD2.1.3	HVAC DUCT CLEANING PLAN LEVEL 1
MH1.1.0	OVERALL HVAC AHU ZONING FLOOR PLAN LEVEL B
MH1.1.1	OVERALL HVAC AHU ZONING FLOOR PLAN LEVEL 1
MH1.2.0	OVERALL HVAC EF ZONING FLOOR PLAN LEVEL B
MH1.2.1	OVERALL HVAC EF ZONING FLOOR PLAN LEVEL 1
MH1.3.0	OVERALL HVAC TERMINAL UNIT ZONING PLAN LEVEL B
MH1.3.0A	HVAC TERMINAL UNIT ZONING PLAN LEVEL B AREA A
MH1.3.0B	HVAC TERMINAL UNIT ZONING PLAN LEVEL B AREA B
MH1.3.1	OVERALL HVAC TERMINAL UNIT ZONING PLAN LEVEL 1
MH1.3.1A	HVAC TERMINAL UNIT ZONING PLAN LEVEL 1 AREA A
MH1.3.1B	HVAC TERMINAL UNIT ZONING PLAN LEVEL 1 AREA B
MH2.1.0	OVERALL HVAC MECHANICAL FLOOR PLAN LEVEL B
MH2.1.0.1	HVAC ROOM AIR BALANCE SCHEDULE LEVEL B
MH2.1.0A	HVAC MECHANICAL FLOOR PLAN LEVEL B AREA A
MH2.1.0B	HVAC MECHANICAL FLOOR PLAN LEVEL B AREA B
MH2.1.1	OVERALL HVAC MECHANICAL FLOOR PLAN LEVEL 1
MH2.1.1.1	HVAC ROOM AIR BALANCE SCHEDULE LEVEL 1
MH2.1.1A	HVAC MECHANICAL FLOOR PLAN LEVEL 1 AREA A
MH2.1.1B	HVAC MECHANICAL FLOOR PLAN LEVEL 1 AREA B
MH2.1.2	OVERALL HVAC MECHANICAL FLOOR PLAN ROOF LEVEL
MH3.1.1	HVAC SECTIONS
MH3.1.2	HVAC SECTIONS
MH3.1.3	MECH ENLARGED PLANS AND SECTIONS

MH5.1.1	MECHANICAL DETAILS
MH5.1.2	MECHANICAL DETAILS
MH5.1.3	MECHANICAL DETAILS
MH5.1.4	MECHANICAL DETAILS
MH5.1.5	MECHANICAL DETAILS
MH5.1.6	MECHANICAL DETAILS
MH5.1.7	MECHANICAL DETAILS
MH5.1.8	MECHANICAL DETAILS
MH5.1.9	MECHANICAL DETAILS
MH6.1.1	MECHANICAL EQUIPMENT SCHEDULES
MH6.1.2	MECHANICAL EQUIPMENT SCHEDULES
MH6.1.3	MECHANICAL EQUIPMENT SCHEDULES
MH6.1.4	MECHANICAL EQUIPMENT SCHEDULES
MH7.1.1	AIR FLOW EQUIPMENT DIAGRAMS - AHUS, EFS
MH7.1.2	EF DIAGRAMS
MH8.1.1	MECHANICAL CONTROLS
MH8.1.2	MECHANICAL CONTROLS
MH8.1.3	MECHANICAL CONTROLS
MH8.1.4	MECHANICAL CONTROLS
MH8.1.5	MECHANICAL CONTROLS
MH8.1.6	MECHANICAL CONTROLS
MP2.1.0	OVERALL HVAC PIPING FLOOR PLAN LEVEL B
MP2.1.0A	HVAC PIPING FLOOR PLAN LEVEL B AREA A
MP2.1.1	OVERALL HVAC PIPING FLOOR PLAN LEVEL 1
MP2.1.1A	HVAC PIPING FLOOR PLAN LEVEL 1 AREA A
MP2.1.2	HVAC MECHANICAL PIPING PLAN ROOF LEVEL
MP4.1.1	ENLARGED MECHANICAL ROOM PLAN LEVEL B AND SECTIONS
MP7.1.1	MECH PIPING FLOW DIAGRAMS - BUILDING CHILLED AND HEATING HOT WATER
MP7.1.2	MECH PIPING FLOW DIAGRAMS - BUILDING STEAM
PLUMBING	
P0.1.1	TITLE PAGE, SYMBOLS AND ABBREVIATIONS
PD2.1.0	PLUMBING DEMOLITION PLAN LEVEL B
PD2.1.1	PLUMBING DEMOLITION PLAN LEVEL 1

PS1.1.1	ENLARGED PLUMBING SITE PLAN - DOMESTIC WATER CONNECTION TO BLDG 5
PP2.1.0	OVERALL COLD & HOT WATER FLOOR PLAN LEVEL B
PP2.1.0A	COLD & HOT WATER FLOOR PLAN LEVEL B AREA A
PP2.1.0B	COLD & HOT WATER FLOOR PLAN LEVEL B AREA B
PP2.1.1	OVERALL COLD & HOT WATER FLOOR PLAN LEVEL 1
PP2.1.1A	COLD & HOT WATER FLOOR PLAN LEVEL 1 AREA A
PP2.1.1B	COLD & HOT WATER FLOOR PLAN LEVEL 1 AREA B
PP2.1.2	OVERALL COLD & HOT WATER PLAN ROOF LEVEL
PP2.2.1	OVERALL MEDICAL GAS FLOOR PLAN LEVEL 1
PP2.2.1A	MEDICAL GAS FLOOR PLAN LEVEL 1 AREA A
PP2.2.1B	MEDICAL GAS FLOOR PLAN LEVEL 1 AREA B
PP2.3.1	ENLARGED PLUMBING PLAN LOCKERS, TOILETS AND SHOWERS
PP2.3.2	ENLARGED MEDICAL GAS FLOOR PLAN LEVEL 1
PP3.1.1	PLUMBING DOMESTIC WATER PIPING RISER DIAGRAM
PP3.1.2	PLUMBING WASTE, VENT STORM DRAIN PIPING RISER DIAGRAM
PP3.1.3	PLUMBING WASTE, VENT & STORM DRAIN PIPING RISER DIAGRAM
PP3.1.4	PLUMBING WASTE, VENT & STORM DRAIN PIPING RISER DIAGRAM
PP3.1.5	MEDICAL GAS DIAGRAM
PP4.1.1	PLUMBING DETAILS
PP4.1.2	PLUMBING DETAILS
PP5.1.1	PLUMBING EQUIPMENT SCHEDULES
PL2.1	OVERALL WASTE, VENT & STORM DRAIN FOUNDATION PLAN
PL2.1-A	WASTE, VENT & STORM DRAIN FOUNDATION LEVEL AREA A
PL2.1.0	OVERALL WASTE, VENT & STORM DRAIN FLOOR PLAN LEVEL B
PL2.1.0A	WASTE, VENT & STORM DRAIN FLOOR PLAN LEVEL B AREA A
PL2.1.0B	WASTE, VENT & STORM DRAIN FLOOR PLAN LEVEL B AREA B
PL2.1.1	OVERALL WASTE, VENT & STORM DRAIN FLOOR PLAN LEVEL 1
PL2.1.1A	WASTE, VENT & STORM DRAIN FLOOR PLAN LEVEL 1 AREA A
PL2.1.1B	WASTE, VENT & STORM DRAIN FLOOR PLAN LEVEL 1 AREA B
PL2.1.2	OVERALL WASTE, VENT & STORM DRAIN PLAN ROOF LEVEL
FIRE PROTECTION	
FX2.0.0	FIRE SPRINKLER PLAN BASEMENT
FX2.0.1	FIRE SPRINKLER PLAN BASEMENT CONNECTOR
FX2.1.0	FIRE SPRINKLER PLAN LEVEL 1

FX6.0.0	FIRE SPRINKLER DETAILS
ELECTRICAL	
ES0.1.0	SYMBOLS, ABBREVIATIONS AND GENERAL NOTES
ES1.1.0	OVERALL SITE PLAN
ES1.1.1	ENLARGED SITE PLAN - ELECTRICAL FEEDERS - EXISTING/DEMO
ES1.1.2	ENLARGED SITE PLAN - ELECTRICAL FEEDERS - FINAL CONDITION
ES1.2.1	ENLARGED SITE PLAN - LIGHTING AND POWER - EXISTING/DEMO
ES1.2.2	ENLARGED SITE PLAN - LIGHTING AND POWER - FINAL CONDITION
ES1.3.1	ENLARGED SITE PLAN - BLDG 5
ES2.0.0	BLDG 100 LEVEL B - EXISTING PLAN
ES2.0.1	BLDG 100 LEVEL 1 - EXISTING PLAN
EDL2.1.0	DEMOLITION PLAN LEVEL B AREA B LIGHTING
EDL2.1.1	DEMOLITION PLAN LEVEL 1 AREA B LIGHTING
EDP2.1.0	DEMOLITION PLAN LEVEL B AREA B POWER
EDP2.1.1	DEMOLITION PLAN LEVEL 1 AREA B POWER
EL1.0.0	LUMINAIRE SCHEDULE
EL1.0.1	LUMINAIRE SCHEDULE
EL1.0.2	LUMINAIRE SCHEDULE
EL1.0.3	LUMINAIRE SCHEDULE
EL1.1.0	LIGHTING CONTROL DETAILS
EL2.1.0	OVERALL LIGHTING FLOOR PLAN LEVEL B
EL2.1.0A	LIGHTING FLOOR PLAN LEVEL B AREA A
EL2.1.0B	LIGHTING FLOOR PLAN LEVEL B AREA B
EL2.1.1	OVERALL LIGHTING FLOOR PLAN LEVEL 1
EL2.1.1A	LIGHTING FLOOR PLAN LEVEL 1 AREA A
EL2.1.1B	LIGHTING FLOOR PLAN LEVEL 1 AREA B
EL2.1.2	LIGHTING FLOOR PLAN ROOF LEVEL
EP1.0.0	EQUIPMENT SCHEDULE
EP2.1.0	OVERALL POWER FLOOR PLAN LEVEL B
EP2.1.0A	POWER FLOOR PLAN LEVEL B AREA A
EP2.1.0B	POWER FLOOR PLAN LEVEL B AREA B
EP2.1.1	OVERALL POWER FLOOR PLAN LEVEL 1
EP2.1.1A	POWER FLOOR PLAN LEVEL 1 AREA A
EP2.1.1B	POWER FLOOR PLAN LEVEL 1 AREA B
EP2.1.2	POWER FLOOR PLAN - ROOF LEVEL

EP3.1.0	PV SYSTEM ROOF PLAN
EP3.2.0	PV SYSTEM DETAILS
EP4.1.1	ENLARGED PLANS - ELECTRICAL ROOMS
EP4.1.2	ENLARGED PLANS - MAIN ELECTRICAL ROOMS AND MECHANICAL ROOM M-04
EP4.2.1	CT ROOM G1-305 FLOOR PLANS AND ELEVATIONS
EP4.2.2	CT ROOM G1-305 SCHEDULES
EP4.2.3	CT ROOM G1-307 FLOOR PLANS AND ELEVATIONS
EP4.2.4	CT ROOM G1-307 SCHEDULES
EP4.3.1	MRI ROOM G1-105A FLOOR PLANS AND ELEVATIONS
EP4.3.2	MRI ROOM G1-105A SCHEDULES
EP4.3.3	MRI ROOM G1-105C FLOOR PLANS AND ELEVATIONS
EP4.3.4	MRI ROOM G1-105C SCHEDULES
EP4.3.5	MRI DETAILS
EP4.4.1	CHILLER FLOOR PLANS - BUILDING 5
EP4.4.2	CHILLER FLOOR PLAN - BUILDING 5
EP4.4.3	MAIN ELECTRICAL AREA - BUILDING 5
EP4.4.4	CRAWL SPACE FEEDER PLANS - BUILDING 5
EP4.5.1	MAIN ELECTRICAL ROOMS - BUILDINGS 102 & 103
<u>EP5.0.0</u> <i>(Add#02)</i>	<u>SHUTDOWN SCHEDULE AND NOTES</u>
EP5.1.0	SINGLE LINE DIAGRAM - SITE NORMAL POWER SS-2 SUBSTATION
EP5.1.1	SINGLE LINE DIAGRAM - EMERGENCY POWER - BUILDING 103
EP5.1.2	SINGLE LINE DIAGRAM - NORMAL POWER
EP5.1.3	SINGLE LINE DIAGRAM - EMERGENCY POWER
EP5.1.4	SINGLE LINE DIAGRAM - EMERGENCY POWER
EP5.1.5	SINGLE LINE DIAGRAM - EMERGENCY POWER
<u>EP5.1.6</u> <i>(Add#02)</i>	<u>SINGLE LINE DIAGRAM - BUILDING 5 & 102</u>
EP5.2.1	ELECTRICAL RISER DIAGRAM
EP6.1.1	TYPICAL CONDUITS AND BOX SUPPORT DETAILS
EP6.1.2	TYPICAL GROUNDING DETAILS AND SIGN DETAILS
EP6.1.3	TYPICAL EQUIPMENT ANCHORING DETAILS
EP6.1.4	DETAILS
EP7.1.1	PANEL SCHEDULES - LIFE SAFETY EMERGENCY
EP7.2.1	PANEL SCHEDULES - CRITICAL EMERGENCY
EP7.2.2	PANEL SCHEDULES - CRITICAL EMERGENCY
EP7.2.3	PANEL SCHEDULES - CRITICAL EMERGENCY

EP7.3.1	PANEL SCHEDULES - EQUIPMENT EMERGENCY
EP7.3.2	PANEL SCHEDULES - EQUIPMENT EMERGENCY
EP7.3.3	PANEL SCHEDULES - EQUIPMENT EMERGENCY
EP7.4.1	PANEL SCHEDULES - NORMAL
FIRE ALARM	
F0.1.0	GENERAL NOTES, SYMBOLS AND SCHEDULES
FD2.1.0	FIRE ALARM DEMOLITION PLAN LEVEL B AREA B
FD2.1.1	FIRE ALARM DEMOLITION PLAN LEVEL 1 AREA B
FA1.1.1	ENLARGED FIRE ALARM SITE PLAN
FA2.1.0	FIRE ALARM ZONING FLOOR PLAN LEVEL B
FA2.1.1	FIRE ALARM ZONING FLOOR PLAN LEVEL 1
FA3.1.0	OVERALL FIRE ALARM FLOOR PLAN LEVEL B
FA3.1.0A	FIRE ALARM FLOOR PLAN LEVEL B AREA A
FA3.1.0B	FIRE ALARM FLOOR PLAN LEVEL B AREA B
FA3.1.1	OVERALL FIRE ALARM FLOOR PLAN LEVEL 1
FA3.1.1A	FIRE ALARM FLOOR PLAN LEVEL 1 AREA A
FA3.1.1B	FIRE ALARM FLOOR PLAN LEVEL 1 AREA B
FA3.1.2	FIRE ALARM FLOOR PLAN ROOF LEVEL
FA5.1.1	FIRE ALARM RISER DIAGRAM
FA6.1.1	FIRE ALARM DETAILS
TELECOM	
T0.0.1	SYMBOLS LIST AND GENERAL NOTES
TD2.1.0B	TELECOM DEMO PLAN LEVEL B AREA B
TD2.1.1B	TELECOM DEMO PLAN LEVEL 1 AREA B
TN0.0.2	DEVICE SCHEDULE
TN0.1.0	RISER DIAGRAM - PATHWAYS
TN0.1.1	RISER DIAGRAM - GROUNDING
TN0.1.2	RISER DIAGRAM - CABLING
TN0.1.3	NURSE CALL DIAGRAM
TN0.1.4	PAGING SYSTEM DIAGRAM
TN0.1.5	INTERCOM SYSTEM DIAGRAM
TN0.2.0	AUDIO VISUAL SYSTEM DIAGRAM LEARNING CENTER
TN0.2.1	AUDIO VISUAL SYSTEM DIAGRAM SHARED CONFERENCE ROOM
TN1.0.1	SITE PLAN

TN2.1.0A	TELECOM PLAN LEVEL B AREA A
TN2.1.0B	TELECOM PLAN LEVEL B AREA B
TN2.1.1A	TELECOM PLAN LEVEL 1 AREA A
TN2.1.1B	TELECOM PLAN LEVEL 1 AREA B
TN3.1.0A	RCP LEVEL B AREA A
TN3.1.0B	RCP LEVEL B AREA B
TN3.1.1A	RCP LEVEL 1 AREA A
TN3.1.1B	RCP LEVEL 1 AREA B
TN4.0.1	NEW AND EXISTING TELECOM ROOM PLANS
TN4.0.2	MDF FB-370 ROOM PLANS
TN4.1.1	AUDIO VISUAL ENLARGED PLANS CONFERENCE ROOM
TN4.1.2	AUDIO VISUAL ENLARGED PLANS LEARNING CENTER
TN5.0.1	INSTALLATION DETAILS
TN5.0.2	INSTALLATION DETAILS
TN5.0.3	INSTALLATION DETAILS
TN5.0.4	INSTALLATION DETAILS
TN5.0.5	INSTALLATION DETAILS
TN5.0.6	TELECOM DETAILS
TN5.1.1	INSTALLATION DETAILS
SECURITY	
TY0.0.1	SECURITY SYMBOLS LIST AND GENERAL NOTES
TY0.1.0	SECURITY RISER DIAGRAM
TY0.1.1	SECURITY ACAMS BLOCK DIAGRAM
TY2.1.0A	SECURITY FLOOR PLAN LEVEL B AREA A
TY2.1.0B	SECURITY FLOOR PLAN LEVEL B AREA B
TY2.1.1A	SECURITY FLOOR PLAN LEVEL 1 AREA A
TY2.1.1B	SECURITY FLOOR PLAN LEVEL 1 AREA B
TY4.0.1	SECURITY ROOM PLAN AND EQUIPMENT ELEVATION
TY5.0.1	SECURITY INSTALLATION DETAILS
TY5.0.2	SECURITY INSTALLATION DETAILS
SHIELDING	
XS1.0.1A	MAGNETIC SHIELD FOUNDATION PLAN
XS1.0.2A	RF SHIELD FOUNDATION PLAN
XS1.1.0A	CEILING SUPPORT LAYOUT

XS1.2.0A	FLOOR PLAN
XS1.3.0A	SILICON STEEL FLOOR
XS1.4.0A	SILICON STEEL BELOW MRI LEVEL
XS2.0.0A	ELEVATIONS
XS2.1.0A	SILICON STEEL ELEVATION
XS1.0.1B	MAGNETIC SHIELD FOUNDATION PLAN
XS1.0.2B	RF SHIELD FOUNDATION PLAN
XS1.1.0B	CEILING SUPPORT LAYOUT
XS1.2.0B	FLOOR PLAN
XS1.3.0B	SILICON STEEL FLOOR
XS1.4.0B	SILICON STEEL BELOW MRI LEVEL
XS2.0.0B	ELEVATIONS
XS2.1.0B	SILICON STEEL ELEVATION
XS3.0.0	DETAILS
XS3.1.0	DETAILS
XS3.1.1 (Add#01)	DETAILS
XS3.2.0	WIRING DIAGRAM FOR EMERGENCY FAN
XS4.0.0	SHIELDED AUTO-SEALING RF DOOR

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(Add#01) 18 SEP 2013, Addendum No. 01

(Add#04) 28 OCT 2013, Addendum No. 04

SECTION 33 40 00

STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. This section specifies construction of outside, underground storm sewer systems. The storm sewer systems shall be complete and ready for operation, including all drainage structures, frames, grate and covers, connections to new buildings, structure service lines, existing storm sewer lines and existing drainage structures and all required incidentals.

1.2 RELATED WORK:

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Sustainable design requirements and procedures including submittal requirements: Section 01 81 11.02, SUSTAINABLE DESIGN REQUIREMENTS.
- C. Procedures and requirements for managing and disposing construction and demolition waste: Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT.
- D. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 00, EARTH MOVING.
- E. Concrete Work, Reinforcing, Placement and Finishing: Section 03 30 00, CAST-IN-PLACE CONCRETE.
- F. Fabrication of Steel Ladders: Section 05 50 00, METAL FABRICATIONS.
- G. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 QUALITY ASSURANCE

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to public storm sewer lines and the extension, and/or modifications to Public Utility systems.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
 - 1. Piping.
 - 2. Jointing material.
 - 3. Manhole, inlet, catch basin, and area drain material.
 - 4. Frames and covers.
 - 5. Steps.
 - 6. Resilient connectors and downspout boots.
- C. LEED Submittals: Submit in accordance with Section 01 81 11.02.
 - 1. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.
 - 2. LEED Product Data Submittal Form: Submit completed product data form provided by the Contracting Officer's Representative; certified by vendor, installer, subcontractor, and/or manufacturer as appropriate.

1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - 1. A48-03/A48M-03 Gray Iron Castings
 - 2. A536-84(2004) Ductile Iron Castings
 - 3. A615-05/A615M-05 Deformed and Plain-Billet Steel Bars for Concrete Reinforcement
 - 4. A655-04e1/A655M-04e1... Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
 - 5. A742-03/A742M-03 Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
 - 6. A760-01a/A760M-01a Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
 - 7. A762-00/A762M-00 Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
 - 8. A798-01/M798M-01 Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
 - 9. A849-00 Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe

10. A929-01/A929M-01 Steel Sheet, Metallic Coated by the Hot Dip Process for Corrugated Steel Pipe
11. C76-05a/C76M-05a Reinforced Concrete Culvert, Storm Drain and Sewer Pipe
12. C139-03 Concrete Masonry Units for Construction of Catch Basins and Manholes
13. C150-04ae1 Portland Cement
14. C443-05/C443M-05 Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
15. C478-03a/C478M-03a Precast Reinforced Concrete Manhole Sections
16. C506-05/C506M-05 Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe
17. C507-05a/C507M-05a Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
18. C655-04e1/C655M-04e1 Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
19. C1433-04e1/C1433M-04e1 Precast Reinforced Concrete Box Sections for Culverts, Storm Drains and Sewers
20. C828-03 Low-Pressure Air Test of Vitrified Clay Pipe Lines
21. C857-95(2001) Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
22. C923-02/C923M-02 Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Materials
23. C924-02/C924M-02 Testing Concrete Pipe Sewer Lines by Low Pressure Air Test Method
24. C1103-03/C1103M-03 Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
25. D698-00ae1 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
26. D1056-00 Flexible Cellular Materials-Sponge or Expanded Rubber
27. D2412-02 Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading
28. D2321-04e1 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications .
29. D3034-04a Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
30. D3212-96a(2003)e1 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
31. D3350-04 Polyethylene Plastics Pipe and Fittings Materials

32. D4101-05a Polypropylene Injection and Extrusion Materials
33. F477-02e1 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
34. F679-03 Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
35. F714-05 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
36. F794-03 Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
37. F894-98a Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
38. F949-03 Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with Smooth Interior
39. F1417-92 (2005) Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

C. American Association of State Highway and Transportation Officials (AASHTO) :

1. Standard Specifications for Highway Bridges
2. M190-04 Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
3. M198-05 Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
4. M294-04 Corrugated Polyethylene Pipe, 300-1500 mm (12 to 60 inches) Diameter

PART 2 - PRODUCTS

2.1 PIPING:

A. Gravity Lines (Pipe and Appurtenances):

1. Concrete:
 - a. Reinforced pipe, ASTM C76. Class III . Reinforced arch culvert and storm drainpipe shall comply with ASTM C506, Class A-IV. Joints shall be watertight flexible joints made with rubber-type gaskets conforming to ASTM C443.
2. Polyvinyl Chloride (PVC):
 - a. Pipe and Fittings, Type PSM PVC Pipe, shall conform to ASTM D3034, Type PSM, SDR 35. Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D 3212. Gaskets shall conform to ASTM F 477. Solvent welded joints shall not be permitted.

- b. Pipe and fittings, smooth wall, corrugated or ribbed PVC, shall conform to the following:
- 1) Pipe and fittings shall conform to ASTM F949 corrugated sewer pipe with a smooth interior. The corrugated outer wall shall be fused to the smooth interwall at the corrugation valley. Pipe and fitting shall have a smooth bell, elastomeric joints conforming to ASTM D 3212, and shall have a minimum pipe stiffness of 345 kPa (50 psi) at 5 percent deflection, when tested in accordance with ASTM D 2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be installed on field cut sections of pipe without the requirement for special fittings.
 - 2) Ribbed wall PVC pipe and fittings shall conform to ASTM F794, Series 46. Ribbed sewer pipe with smooth interior pipe and fittings shall have a smooth bell, elastomeric joints conforming to ASTM D 3212, and shall have a minimum pipe stiffness of 320 kPa (46 psi) when tested in accordance with ASTM D 2412, at 5 percent vertical deflection. Joints shall not leak at 7.6 m (25 feet) of head under 5 percent deflection.
 - 3) Solid wall pipe and fittings shall conform to ASTM F 679, SDR 35 pipe and fittings shall gaskets conforming to ASTM F 477, and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi). *(Add#01)*
3. High Density Polyethylene (HDPE):
- a. Smooth Wall PE Pipe: Shall comply with ASTM F714, DR 21 for pipes 75 to 600 mm (3 to 24 inches), and SDR 26 for pipes 650 to 1200 mm (26 to 48 inches). Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.
 - b. Corrugated PE Pipe: Shall comply with AASHTO M294, Type S for pipes 300 to 1500 mm (12 to 60 inches). Pipe walls shall have following minimum properties:

Nominal Size	Minimum Wall Area	Min. Moment of Inertia mm ⁴ /mm (in ⁴ /in)
300 mm (12 in)	3200 mm ² /m (1.50 in ² /ft)	390 (.024)
375 mm (15 in)	4000 mm ² /m (1.91 in ² /ft)	870 (.053)
450 mm (18 in)	4900 mm ² /m (2.34 in ² /ft)	1020 (.062)
600 mm (24 in)	6600 mm ² /m (3.14 in ² /ft)	1900 (.116)
750 mm (30 in)	8300 mm ² /m (3.92 in ² /ft)	2670 (.163)

900 mm (36 in)	9500 mm ² /m (4.50 in ² /ft)	3640 (.222)
1050 mm (42 in)	9900 mm ² /m (4.69 in ² /ft)	8900 (.543)
1200 mm (48 in)	10900 mm ² /m (5.15 in ² /ft)	8900 (.543)
1350 mm (54 in)	12000 mm ² /m (5.67 in ² /ft)	13110 (.800)
1500 mm (60 in)	13650 mm ² /m (6.45 in ² /ft)	13110 (.800)

- c. Profile Wall PE Pipe: Shall comply with ASTM F894, Class 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, Minimum cell class 334433C. Pipe walls shall have following minimum properties:

Nominal Size	Minimum Wall Area	Min. Moment of Inertia mm ⁴ /mm (in ⁴ /in)
450 mm (18 in)	6300 mm ² /m (2.96 in ² /ft)	850 (.052)
525 mm (21 in)	8800 mm ² /m (4.15 in ² /ft)	1150 (.070)
600 mm (24 in)	9900 mm ² /m (4.66 in ² /ft)	1330 (.081)
675 mm (27 in)	12500 mm ² /m (5.91 in ² /ft)	2050 (.125)
750 mm (30 in)	12500 mm ² /m (5.91 in ² /ft)	2050 (.125)
825 mm (33 in)	14800 mm ² /m (6.99 in ² /ft)	2640 (.161)
900 mm (36 in)	17100 mm ² /m (8.08 in ² /ft)	3310 (.202)
1050 mm (42 in)	16500 mm ² /m (7.81 in ² /ft)	4540 (.277)
1200 mm (48 in)	18700 mm ² /m (8.82 in ² /ft)	5540 (.338)

d.

B. Pressure (Force) Lines (Pipe and Fittings):

1. All pipe and fittings used in the construction of force mains shall be rated for a minimum of 1035 kPa (150 psi).
2. Ductile Iron: Pipe shall conform to AWWA C151 and C111 with polyethylene lining. Flange joints shall conform to AWWA C115. Lining shall be heat-fused mechanical bond polyethylene having a dielectric strength of 250 volts per mil when fully cured. Lining shall be holiday tested in accordance with AWWA C116. The lining shall be a minimum of 1 mm (40 mil) in the barrel of the pipe, and a minimum of 0.25 mm (10 mil) on the bell and spigot area of the pipe. The lining shall be repaired at all field cuts per the manufacturer's recommendations. Joints shall be conformed to AWWA C116. Pipe shall be polyethylene encased per AWWA C105.

3. Ductile iron fittings shall comply with AWWA C110 and AWWA C111. Fittings shall be polyethylene line, as specified for ductile iron pipe. Ductile iron fittings shall be polyethylene encased per AWWA C105.
4. Polyvinyl Chloride (PVC): (Add#04)
 - a. PVC pipe less than 4 inches shall conform to ASTM D1785, Schedule 80. PVC socket fittings shall be ASTM D2464, Schedule 80. Solvent cements for joining PVC piping shall be ASTM D2564, with primer according to ASTM F656.
 - b. PVC pipe 100 mm to 300 mm (4 to 12 inches) shall conform to AWWA C900, ~~Class 200 (DR 14)~~ Class 235 (DR 18). Fittings for PVC pipe shall be ductile iron. See 2.2.D.6 for restrained joints.

2.2 JOINTING MATERIAL:

- A. Concrete Pipe: Rubber gasket ASTM C443.
- B. Polyvinyl Chloride (PVC) Pipe:
 1. PVC Plastic Pipe: Joints shall comply with ASTM D3212, Elastomeric Gaskets shall comply with ASTM F477 and as recommended by the manufacturer.
- C. PE Plastic Pipe:
 1. Smooth Wall PE Plastic Pipe: Pipe shall be joined using butt fusion as recommended by the manufacturer.
 2. Corrugated PE Plastic Pipe: Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.
 3. Profile Wall PE Plastic Pipe: Joints shall be gasket or thermal weld type with integral bell in accordance with ASTM F894.
- D. Pressure (Force) Main:
 1. All joints indicated on the drawings as being "restrained" shall be fully restrained and capable of restraining 50 percent above all loads acting on the joint, but not less than 1035 kPa (150 psi). Thrust blocks shall not be permitted.
 2. Ductile iron pipe and fittings, mechanical or push-on, conforming to AWWA C110 and C111. Restrained joints shall meet the following requirements:
 - a. Push-on joints shall be restrained by a mechanical locking slot cast integrally in the bell of the pipe or fitting. The spigot shall have a retainer weldment or band. Locking segments, placed in the slots in the bell, shall form a mechanical restraint and prevent the opening of the joint.
 3. Mechanical joint restraint shall be incorporated into the design of the follower gland. The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The device shall

be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be made of Grade 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell conforming to AWWA C111 and AWWA C153 of the latest revision. Torque limiting twist-off nuts shall be used to insure proper actuation of the restraining wedges. The gland shall be specifically designed for the type of pipe (DIP or PVC) connected to the fitting. Polyvinyl Chloride (PVC) Pipe (Pressure Use):

- a. Push-on joints shall conform to AWWA C900, C905.
- b. Push-on gaskets for pipe, ASTM F477.
- c. Restrained joints shall comply with one of the following:
 - 1) Joints to mechanical ductile iron fittings shall comply with the requirements for ductile iron pipe, except the mechanical joint restraint gland shall be specifically designed for use with PVC pipe.
 - 2) Push-on bell and spigot joints shall be retained with retaining rings and thrust rods. The rings shall be ductile iron conforming to ASTM A536. The rings shall be split style with serrated inside face which grips the pipe when the halves of the ring is assembled together. The ring shall not bear directly on the back of the bell. The rods shall be of adequate size and number to resist all axial movement of the joint.
4. All joints indicated on the drawings as being "restrained" shall be fully restrained and capable of restraining 50 percent above all loads acting on the joint, but not less than 1035 kPa (150 psi). Thrust blocks shall not be permitted.
5. Ductile iron pipe and fittings, mechanical or push-on, conforming to AWWA C110 and C111. Restrained joints shall meet the following requirements:
 - a. Push-on joints shall be restrained by a mechanical locking slot cast integrally in the bell of the pipe or fitting. The spigot shall have a retainer weldment or band. Locking segments, placed in the slots in the bell, shall form a mechanical restraint and prevent the opening of the joint.
 - b. Mechanical joint restraint shall be incorporated into the design of the follower gland. The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be made of Grade 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell conforming to AWWA C111 and AWWA C153 of the latest revision. Torque limiting twist-off nuts shall be used to insure proper actuation of the restraining wedges. The

gland shall be specifically designed for the type of pipe (DIP or PVC) connected to the fitting.

6. Polyvinyl Chloride (PVC) Pipe (Pressure Use):
 - a. Push-on joints shall conform to AWWA C900, C905.
 - b. Push-on gaskets for pipe, ASTM F477.
 - c. Restrained joints shall comply with one of the following:
 - 1) Joints to mechanical ductile iron fittings shall comply with the requirements for ductile iron pipe, except the mechanical joint restraint gland shall be specifically designed for use with PVC pipe.
 - 2) Push-on bell and spigot joints shall be retained with retaining rings and thrust rods. The rings shall be ductile iron conforming to ASTM A536. The rings shall be split style with serrated inside face which grips the pipe when the halves of the ring is assembled together. The ring shall not bear directly on the back of the bell. The rods shall be of adequate size and number to resist all axial movement of the joint.

2.3 MANHOLES, INLETS AND CATCH BASINS:

- A. Manholes, inlets and catch basins shall be constructed of precast concrete segmental blocks, precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. Manholes, inlets and catch basins shall be in accordance with State Department of Transportation standard details, and the following VA requirements, in case of variance, VA requirements supersede:
 1. Precast Concrete Segmental Blocks: Blocks shall conform to ASTM C139 and shall not be less than 150 mm (6 inches) thick for manholes to a depth of 3.6 m (12 feet); not less than 200 mm (8 inches) thick for manholes deeper than 3.6 m (12 feet) deep. Blocks shall be not less than 200 mm (8 inches) in length. Blocks shall be shaped so that joints seal and bond effectively with cement mortar. Parge structure interior and exterior with 15 mm (1/2 inch) of cement mortar applied with a trowel and finished to an even glazed surface.
 2. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 4. Flat top manhole tops shall be reinforced concrete as detailed on the drawings.
 5. Precast Catch Basins: Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM

- A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C-857.
6. Mortar:
 - a. Precast Concrete Segmental Block Structures: By volume, 1 part of Portland cement, 1/4 part lime hydrate, and 3 parts sand.
 - b. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21L (5-1/2 gallons) per sack of cement.
 7. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M-198B.
 8. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "storm sewer". The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
 9. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 250 mm (10 inches) wide and project a minimum of 125 mm (5 inches) away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.
 10. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 9 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 180 mm (7 inches) from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).
- B. Prefabricated Corrugated Metal Manholes: Manholes shall be the type and design as indicated on the drawings and as recommended by the manufacturer.
- C. Prefabricated Plastic Manholes and Drain Basins: Plastic manholes and drain basins shall be as indicated on the drawings.
- D. Frame and Cover for Gratings:
1. Galvanized steel: conforming to ASTM A123.
 2. Cast iron: conforming to ASTM A48
 3. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the drawings.

2.4 DRAINS

- A. Area Drains:

- B. Cast iron grate with reinforced square or rectangular concrete box, light duty, size as noted on plans
 - a. Small area drains: 10"x17", nominal dimension
 - b. Large area drains: 19"x21", nominal dimension
- C. Structural foam polyolefin round grate, with UV inhibitor. 8" nominal diameter. Connects to 6" HDPE pipe riser. Use only where noted on the utility plan.

2.5 HEADWALLS:

- A. Headwalls shall be cast-in-place concrete and in accordance with State Department of Transportation standard details. Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

2.6 CONCRETE:

- A. Concrete shall have a minimum compressive strength of 20 MPa (3000 psi) at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform to the provisions of Division 03 of these specifications.

2.7 REINFORCING STEEL:

- A. Reinforcing steel shall be deformed bars, ASTM A615, Grade 40 unless otherwise noted.

2.8 FLARED END SECTIONS:

- A. Flared End Sections: Sections shall be of standard design fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929.

2.9 PRECAST REINFORCED CONCRETE BOX.

- A. Precast Reinforced Concrete Box: For highway loadings with 600 mm (2 feet) of cover or more subjected to dead load only, conform to ASTM C1433; For less than 600 mm (2 feet) of cover subjected to highway loading, conform to ASTM C1433.

2.10 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS:

- A. Resilient Connectors: Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.
- B. Downspout Boots: Boots used to connect exterior downspouts to the storm drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B.

2.11 WARNING TAPE:

- A. Standard, 4-Mil polyethylene 76 mm (3 inch) wide tape detectable type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 EXCAVATION FOR STORM DRAINS AND DRAINAGE STRUCTURES:

- A. Excavation of trenches and for appurtenances and backfilling for storm drains, shall be in accordance with the applicable portions of Section 31 20 00, EARTH MOVING.

3.2 PIPE BEDDING:

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform with the lowest one-fourth of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798.

3.3 GENERAL PIPING INSTALLATION:

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.
- G. Do not lay sewer pipe in same trench with another pipe or other utility.

- H. Do not walk on pipe in trenches until covered by layers of shading to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. Reinforced Concrete Pipe: Comply with manufacturer's recommendations.
 - 2. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
 - 3. High Density Polyethylene (HDPE) Piping: Comply with manufacturer's recommendations.
- J. Installation of Pressure (Force) Mains:
 - 1. Sections of piping listed on the drawings shall be fully restrained using approved joint restraint devices. Joint restraint devices shall be installed in accordance with the manufacturer's recommendations. For devices with twist of nuts, the twist of nuts shall be placed on top of the fitting for the Engineer's inspection. The Contractor shall torque test all bolts, set screws, identified by the Contracting Officer's Representative.
 - 2. Thrust blocks shall not be permitted.
 - 3. Install pressure (force) mains in accordance with the provisions of these specifications and the following standards:
 - a. Ductile Iron Piping: AWWA C111 and C600.
 - b. Polyvinyl Chloride (PVC) Piping: AWWA C605.
- K. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.

3.4 REGRADING:

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.
- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES:

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable

requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.6 MANHOLES, INLETS AND CATCH BASINS:

A. General:

1. Circular Structures:

- a. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
- b. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
- c. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

2. Rectangular Structures:

- a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE of these specifications.
 - b. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on a 200 mm (8 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D 698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
 4. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
 - a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
 5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (25mm per 300mm, 1-inch per foot) nor more than 1:6 (50mm per 300mm, 2 inches per foot). Bottom slab and benches shall be concrete.
 6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
 7. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.

8. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.7 CURB INLETS, CATCH BASINS, AND AREA DRAINS:

- A. Reinforced concrete as shown or precast concrete.

3.8 INSPECTION OF SEWERS:

- A. Inspect and obtain the Resident Engineer's approval. Thoroughly flush out before inspection. Lamp between structures and show full bore indicating sewer is true to line and grade. Lip at joints on inside of sewer is prohibited.

3.9 TESTING OF STORM SEWERS:

- A. Gravity Sewers (Select one of the following):
 1. Air Test: Concrete Pipes conform to ASTM C924, Plastic Pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
 2. Exfiltration Test:
 - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During 1 hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11L (3.0 gallons) per hour per 30 m (100 feet).
 - b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.

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(Add#01) 18 SEP 2013, Addendum No. 1
(Add#04) 28 OCT 2013, Addendum No. 4

