IDAHO
DEPARTMENT OF ENVIRONMENTAL QUALITY

HWMA STORAGE and TREATMENT PERMIT for the

IDAHO NUCLEAR TECHNOLOGY and ENGINEERING CENTER and the RADIOACTIVE WASTE MANAGEMENT COMPLEX

on the

IDAHO NATIONAL LABORATORY

EPA ID NO. ID4890008952

Effective Date: April 27, 2009
Revision Date: December 20, 2019
Book 3B of 3

APPENDIX 1

DRAWINGS AND EXHIBITS FOR WMF-1617,

WMF-698 AND WMF-1619

APPENDIX 1.

DRAWINGS AND EXHIBITS FOR WMF-1617 AND WMF-698

DRAWING NUMBER	REVISION NUMBER	DRAWING DESCRIPTION
761186	3	Phase V of the Accelerated Retrieval Project WMF-1617 Retrieval Enclosure 5 and Airlock 5 Site Grading Plan
761187	2	Phase V of the Accelerated Retrieval Project WMF-1617 Retrieval Enclosure 5 and Airlock 5 Grading Sections and Details
761193	4	Phase V of the Accelerated Retrieval Project WMF-1617 RE5/AL5 Building Elevations
761194	4	Phase V of the Accelerated Retrieval Project WMF-1617 AL5 Airlock 5 Interior Wall Plan
761195	4	Phase V of the Accelerated Retrieval Project WMF-1617 AL5 Airlock 5 Interior Elevations
761196	5	Phase V of the Accelerated Retrieval Project WMF-1617 AL5 Airlock 5 Interior Elevations
761207	2	Phase V of the Accelerated Retrieval Project WMF-1617 Airlock 5 & Retrieval Enclosure 5 Foundation and Legend
761210	2	Phase V of the Accelerated Retrieval Project WMF-1617 Airlock 5 Foundation Slab Pan, Legend and Sections
762023	3	Phase V of the Accelerated Retrieval Project RE5/AL5 WMF-1617 Equipment Location Plan
762024	4	Phase V of the Accelerated Retrieval Project WMF-1617 AL5 Airlock 5 Equipment Location Plan
762067	3	Phase V of the Accelerated Retrieval Project RE5/AL5 WMF-1617 DPS Fire Protection System Dry Chemical Diagram
762114	4	Phase V of the Accelerated Retrieval Project RE5/AL5 WMF-1617 RE5 Lighting Plan

DRAWING NUMBER	REVISION NUMBER	DRAWING DESCRIPTION
762115	3	PHASE V OF THE ACCELERATED RETRIEVAL PROJECT RE5/AL5 WMF-1617 AL5 LIGHTING PLAN
762141	3	PHASE V OF THE ACCELERATED RETRIEVAL PROJECT RE5/AL5 WMF-1617 FIRE ALARM PLAN
762142	5	PHASE V OF THE ACCELERATED RETRIEVAL PROJECT RE5/AL5 WMF-1617 AIRLOCK 5 FIRE ALARM PLAN
762153	4	PHASE V OF THE ACCELERATED RETRIEVAL PROJECT WMF-1617 RETRIEVAL ENCLOSURE 5 DATA/DATA CCTV FLOOR PLAN
762154	6	PHASE V OF THE ACCELERATED RETRIEVAL PROJECT RE5/AL5 WMF-1617 DATA/DATA CCTV AND INTERCOM FLOOR PLAN
177425	20	RWMC SDA FIREWATER PIPING PLOT PLAN
631228	3	RWMC TARGETED WASTE REMOVAL AND DISPOSITION PROJECT STORAGE ENCLOSURE VENTILATION PLAN, SECTIONS AND DETAIL
631225	4	RWMC TARGETED WASTE REMOVAL AND DISPOSITION PROJECT STORAGE ENCLOSURE PLAN
631233	5	RWMC TARGETED WASTE REMOVAL & DISPOSITION PROJECT WMF-698 STORAGE ENCLOSURE NORMAL POWER AND LIGHTING PLAN
631234	2	RWMC TARGETED WASTE REMOVAL AND DISPOSITION PROJECT STORAGE ENCLOSURE STORAGE ENCLOSURE GROUNDING PLAN
631237	2	RWMC TARGETED WASTE REMOVAL AND DISPOSITION PROJECT STORAGE ENCLOSURE FIRE ALARM PLAN
631238	2	RWMC TARGETED WASTE REMOVAL AND DISPOSITION PROJECT STORAGE ENCLOSURE FIRE ALARM SECTION AND DETAILS
631130	2	RWMC TARGETED WASTE REMOVAL AND DISPOSITION PROJECT STORAGE ENCLOSURE FOUNDATION PLAN

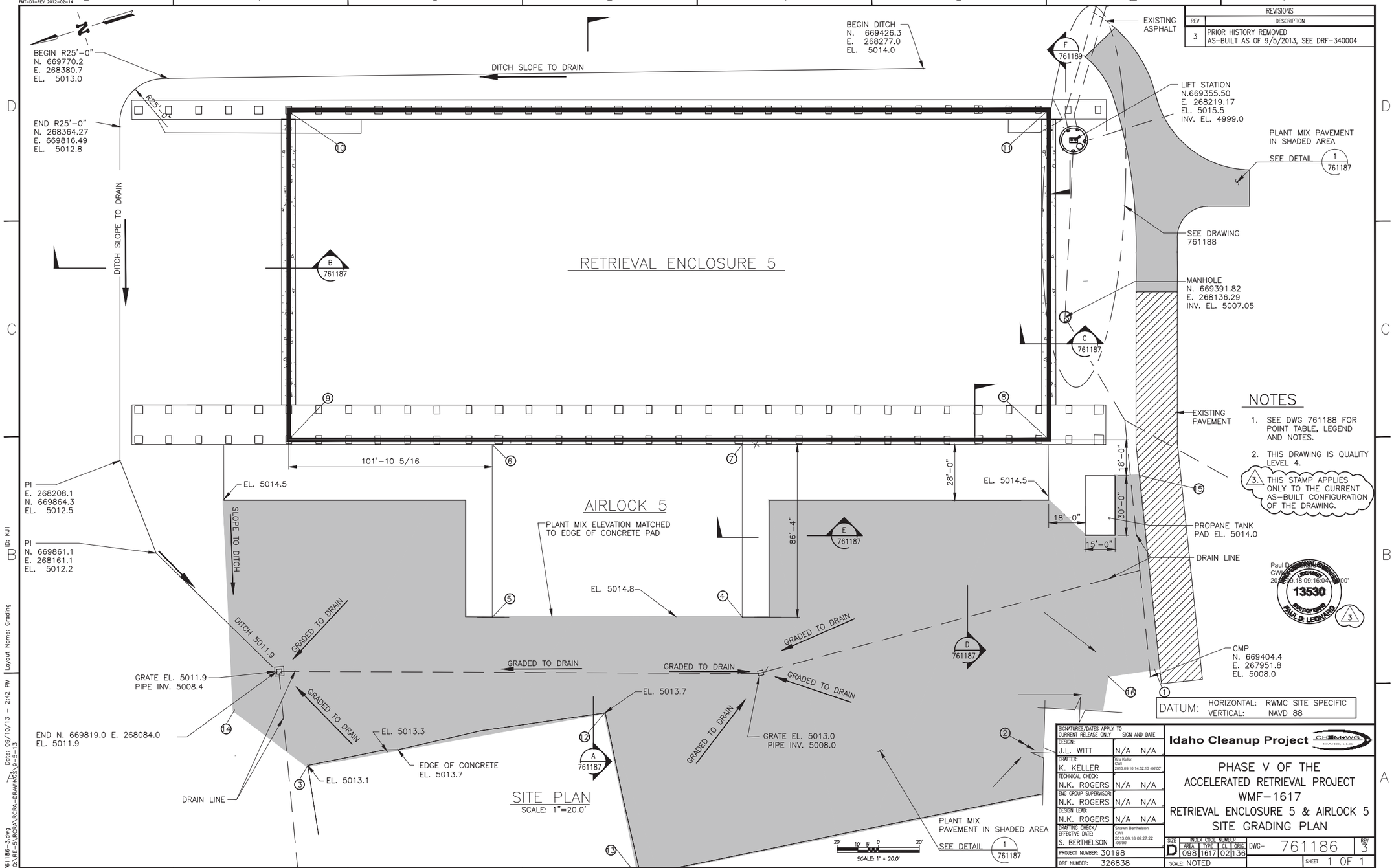
DRAWING NUMBER	REVISION NUMBER	DRAWING DESCRIPTION
627752	2	RWMC TARGETED WASTE REMOVAL AND DISPOSITION PROJECT STORAGE ENCLOSURE STORAGE ENCLOSURE PLAN AND SECTIONS
627917	2	RWMC TARGETED WASTE REMOVAL AND DISPOSITION PROJECT STORAGE ENCLOSURE PAD PLAN, SECTIONS, AND DETAILS
783977	1	PHASE V OF THE ACCELERATED RETRIEVAL PROJECT RE5/AL5 WMF-1617 RE5 VENTILATION 3D VIEW AND EAST VIEW
Exhibit 1	N/A	RWMC WMF-1617 RE5/AL5 AIRLOCK 5 DRUM OUT ENCLOSURE VIEWS
Exhibit 2	N/A	RWMC WMF-1617 RE5/AL5 AIRLOCK 5 SERVICE BAY EQUIPMENT LAYOUT
Exhibit 3	N/A	RWMC WMF-1617 RE5/AL5 AIRLOCK 5 DRUM-OUT ACCESS PLATFORM AND COMPACTOR CONTAINMENT PAN DETAILS
Exhibit 4	N/A	RWMC WMF-1617 RE5/AL5 AIRLOCK 5 DRUM-OUT HOPPER AND DETAILS
Exhibit 5	N/A	DRUM STORAGE SECONDARY CONTAINMENT
Exhibit 6	N/A	TYPICAL WASTE TRAY
Exhibit 7	N/A	WASTE TRAY SECONDARY CONTAINMENT
Exhibit 8	4-12-17	WASTE TRAY SUPPORT TABLE ENGINEERING SKETCH #4
WMF-1619		
765045	1	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 SITE GRADING PLAN
765048	2	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 GRADING SECTIONS
765049	2	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 GRADING SECTIONS AND DETAILS

DRAWING NUMBER	REVISION NUMBER	DRAWING DESCRIPTION
766857	1	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 FOUNDATION PLAN
766858	1	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 FOUNDATION SLAB PLAN
766859	1	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 FOUNDATION SECTIONS
767855	2	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 EQUIPMENT LOCATION PLAN
767856	1	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 (AL6) EQUIPMENT LOCATION PLAN
767863	2	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 BUILDING ELEVATIONS
767864	3	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 FLOOR PLAN
767867	2	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK BUILDING SECTIONS
767868	1	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 BUILDING SECTION
767869	2	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 INTERIOR ELEVATIONS
767870	1	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 INTERIOR ELEVATIONS

DRAWING NUMBER	REVISION NUMBER	DRAWING DESCRIPTION
767935	2	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 DRUM PACKAGING STATION DRY CHEMICAL P & ID
767979	3	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 RETRIEVAL ENCLOSURE 7 LIGHTING PLAN
767980	3	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 LIGHTING PLAN
768004	3	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 RE7 FIRE ALARM PLAN
768005	2	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 FIRE ALARM PLAN
768016	3	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 RETRIEVAL ENCLOSURE 7 DATA/DATA CCTV PLAN
768017	5	PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 DATA/DATA CCTV PLAN AND INTERCOM WIRING DIAGRAM

FMT-D1-REV 2012-02-14

REVISIONS	
REV	DESCRIPTION
3	PRIOR HISTORY REMOVED AS-BUILT AS OF 9/5/2013, SEE DRF-340004



NOTES

1. SEE DWG 761188 FOR POINT TABLE, LEGEND AND NOTES.
2. THIS DRAWING IS QUALITY LEVEL 4.
3. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

DATUM: HORIZONTAL: RWMC SITE SPECIFIC
VERTICAL: NAVD 88

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY		SIGN AND DATE
DESIGN: J.L. WITT	N/A	N/A
DRAFTER: K. KELLER	Kris Keller CWI 2013.09.10 14:52:13 -06'00'	
TECHNICAL CHECK: N.K. ROGERS	N/A	N/A
ENG GROUP SUPERVISOR: N.K. ROGERS	N/A	N/A
DESIGN LEAD: N.K. ROGERS	N/A	N/A
DRAFTING CHECK/ EFFECTIVE DATE: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 09:27:22 -06'00'	
PROJECT NUMBER: 30198		
DRF NUMBER: 326838		

Idaho Cleanup Project CH2M HILL BechtelBWXT Idaho, LLC

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
WMF-1617
RETRIEVAL ENCLOSURE 5 & AIRLOCK 5
SITE GRADING PLAN

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	02	136	761186	3

SCALE: NOTED SHEET 1 OF 1

RW-1267

File: 761186-3.dwg
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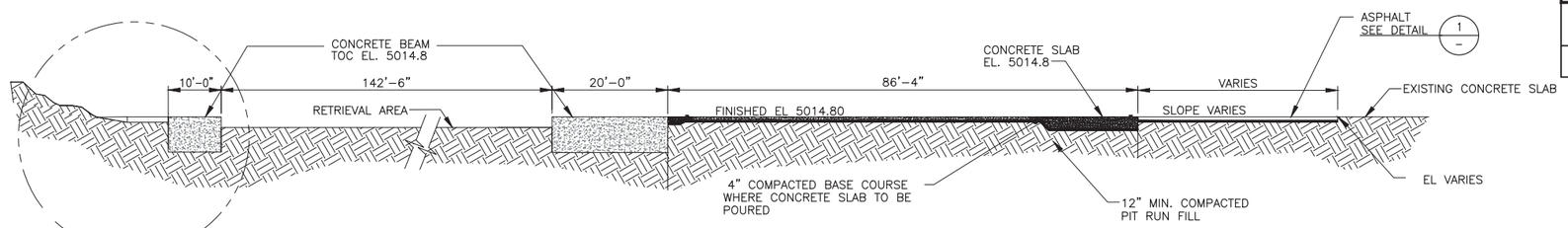
Date: 09/10/13 - 2:42 PM
Layout Name: Grading
ID: KJ1

FMT-D1-REV 2012-02-14

REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED INCORPORATED FDC-6348, AS-BUILT AS OF 5-10-2012, SEE DRF-336389
2	AS-BUILT AS OF 9/5/2013, SEE DRF-340004



SECTION A 761186
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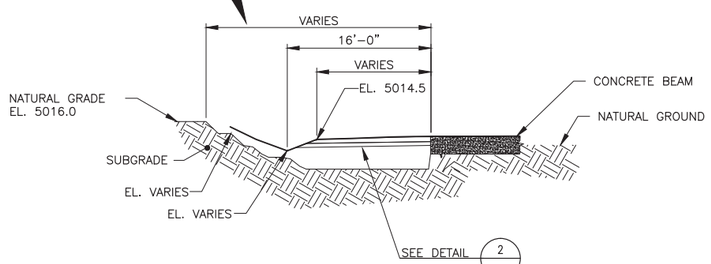
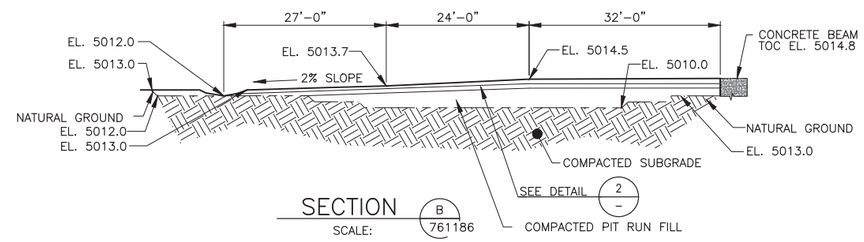


ENLARGED VIEW
SCALE: NTS



SECTION B 761186
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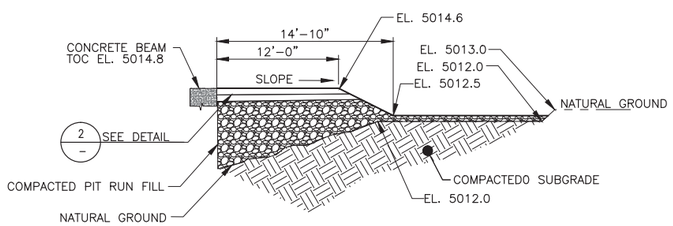

SECTION C 761186
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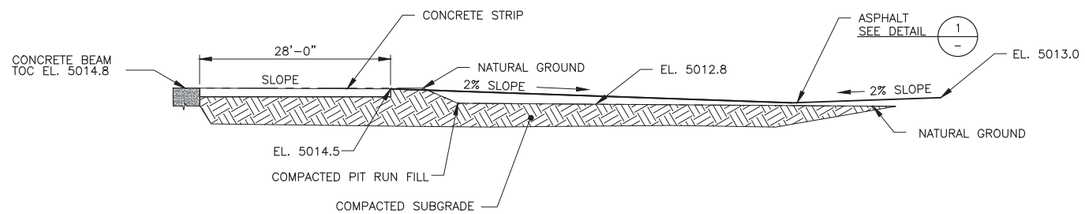

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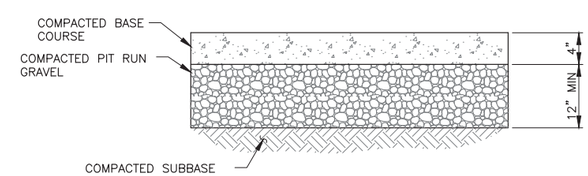
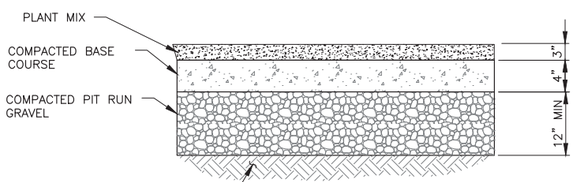


DETAIL 2 –
SCALE: 1"=1.0'



DETAIL 1 –
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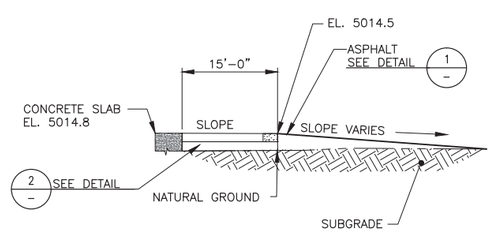

SECTION E 761186
SCALE:

NOTES

1. THIS DRAWING IS QUALITY LEVEL 4.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

Paul D. Leonard
CWI
2013.09.18 08:58:21 -06'00'
LICENSED PROFESSIONAL ENGINEER
13530
STATE OF IDAHO
PAUL D. LEONARD

2

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

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J.L. WITT	N/A N/A
DRAFTER: K. KELLER	Kris Keller CWI 2013.09.10 14:52:27 -06'00'
TECHNICAL CHECK: N.K. ROGERS	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS	N/A N/A
DESIGN LEAD: N.K. ROGERS	N/A N/A
DRAFTING CHECK/ EFFECTIVE DATE: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 09:27:42 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 326838	

Idaho Cleanup Project CH2M HILL BWXT IDAHO, LLC

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
WMF-1617
RETRIEVAL ENCLOSURE 5 & AIRLOCK 5
GRADING SECTIONS AND DETAILS

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	02	136	761187	2

SCALE: NOTED
SHEET 1 OF 1

RW-1267

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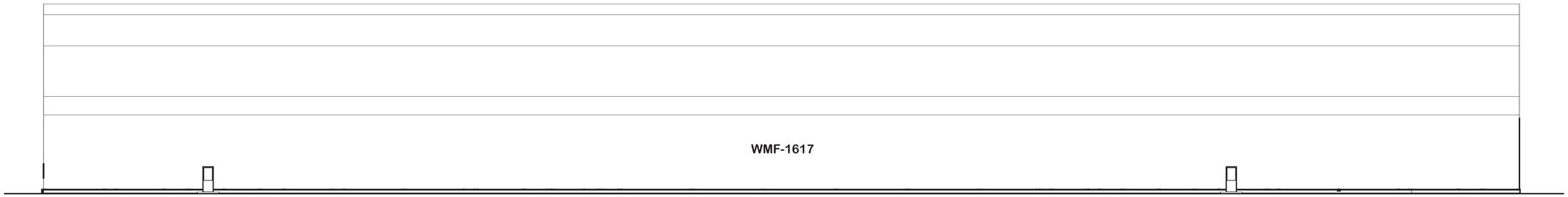
Date: 09/10/13 - 2:37 PM
Layout Name: Layout1
ID: KJ1

FMT-D1-ICP REV 2017-02-28

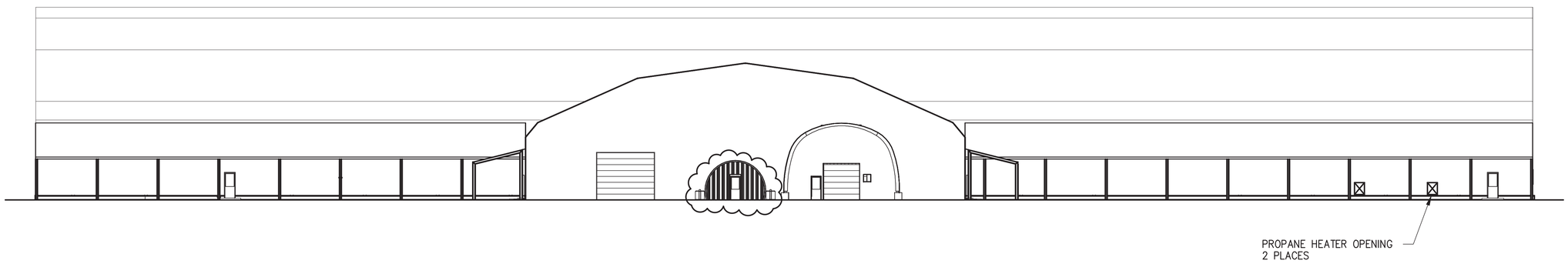
NOTES

1. THIS DRAWING IS A QUALITY LEVEL 3.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

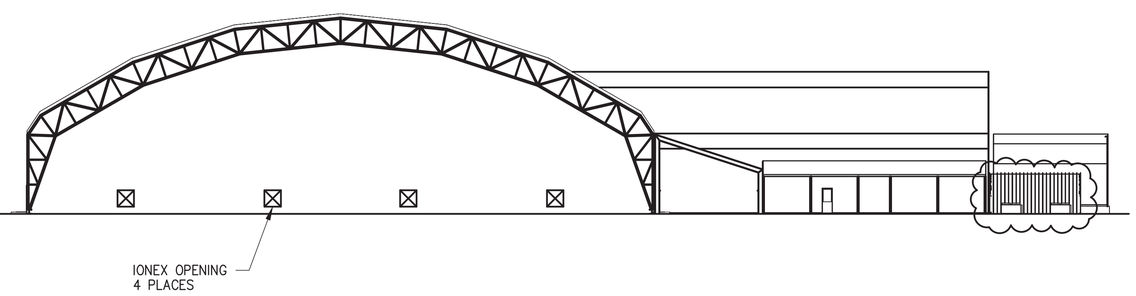
REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE INCORPORATED FDC 6342, 6849 & 6932 AS-BUILT AS OF 5/10/2012 SEE DRF-336389
2	INCORP FDC-8916, -9033, -9043, -9083 & -9091, AS-BUILT AS OF 9-5-2013, SEE DRF-340004
3	DRAWING ASSESSED AND VERIFIED AS-BUILT AS OF 2-21-2019, SEE DRF-362093
4	INCORPORATED FDC-12044, AS-BUILT AS OF 4-24-2019, SEE DRF-362759



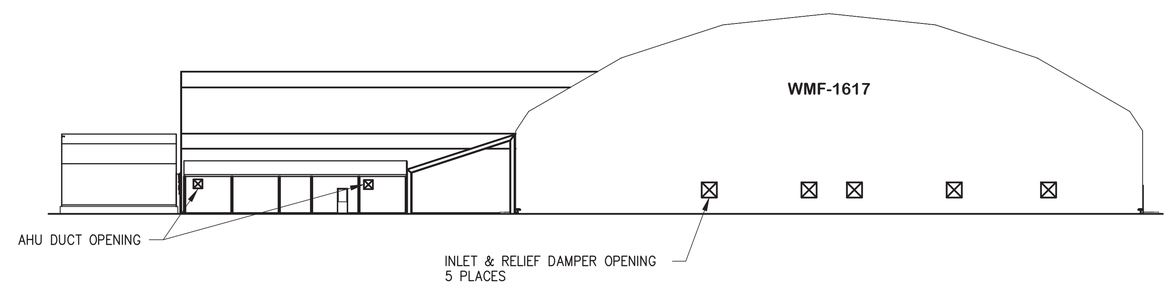
EAST ELEVATION
SCALE: 1/16"=1'-0"



WEST ELEVATION
SCALE: 1/16"=1'-0"



NORTH ELEVATION
SCALE: 1/16"=1'-0"



SOUTH ELEVATION
SCALE: 1/16"=1'-0"

Paul D. Leonard
Fluor Idaho
2019.05.02 14:27:06-06'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

2

X-REF DRAWING
762161 – RE5
762163 – AIRLOCK 5

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: N/A	– –
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2019.05.02 09:10:12 -06'00'
TECHNICAL CHECK: N/A	– –
ENG GROUP SUPERVISOR: N/A	– –
DESIGN LEAD/AUTHORITY: D.J. McGARY	Doug J. McGary Fluor Idaho 2019.05.02 14:35:31 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2019.05.02 15:08:59 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 326838	

Idaho Cleanup Project Core Fluor IDAHO

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
WMF-1617 RE5/AL5

BUILDING ELEVATIONS

SIZE	INDEX CODE NUMBER AREA	TYPE	CI	ORIG	DWG-	REV
D	098	1617	01	136	761193	4

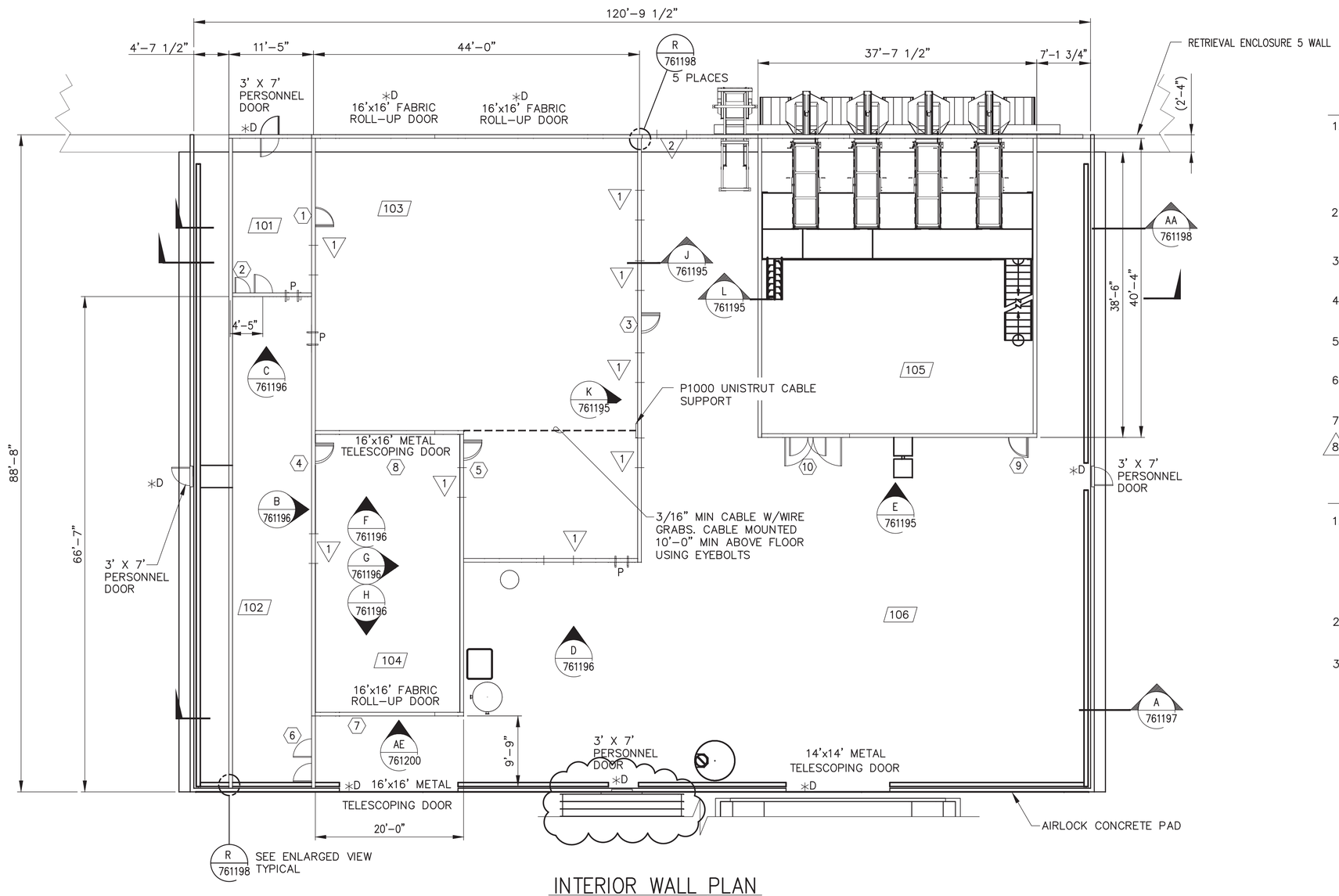
SCALE: NOTED SHEET 1 OF 1

RW-1279

File: 761193-4.dwg Path: C:\Users\bxs\Documents\BXS\RW-1279 (ARPs Start 1-31-2019)\DRF-362759 Date: 05/02/19 – 8:23 AM Layout Name: A-2 ID: BXS

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE INCORPORATED FDC 6342, 6595, 6622, 6709, 6722, 6806, 6818, 6856, 6879, 6930, 6942, 6970 & 7055 AS-BUILT AS OF 5/10/2012 SEE DRF-336389
2	ADDED P.E. STAMP AND NOTE 8 INCORPORATED FDC-8686 AND 9111. AS-BUILT AS OF 9/5/2013 SEE DRF-340004
3	INCORPORATED FDC-10437, AS-BUILT AS OF 5-16-2017, SEE DRF-354575
4	INCORPORATED FDC-12044, AS-BUILT AS OF 4-24-2019, SEE DRF-362759

RETRIEVAL ENCLOSURE 5



INTERIOR WALL PLAN

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

NOTES

1. METAL STUDS AND TRACKS ARE 20-GAGE OR HEAVIER AT 12" O.C. FOR WALLS OVER 15'-0". SHORTER WALLS ARE SPACED AT 16" O.C. FASTENERS USED TO ASSEMBLE METAL STUD WALLS SHALL BE AT A MINIMUM, NUMBER 8 MODIFIED TRUSS HEAD SCREWS. METAL STUD BASE TRACK FOR THE WALL BETWEEN RE5 AND AL5 IS FASTENED TO THE RE5 BASE BEAM WITH HILTI X-EDNI MX BALLISTIC POINT NAILS.
2. TAPE CONTINUOUSLY ALL METAL WALL PANEL JOINTS AND SCREW HEADS BETWEEN THE RE AND THE AL SEE ROOM FINISH SCHEDULE, DRAWING 761199, FOR APPLICABLE METAL LINER PANEL.
3. SUPPORT LEGS W/BASE PLATES THAT LAND ON EXISTING EMBEDDED PLATES ARE WELDED WITH 1/4" FILLET WELD ALL AROUND BASE PLATE.
4. WELDED IN ACCORDANCE WITH AWS D1.1. VISUALLY INSPECTED WELDED PER REQUIREMENTS OF AWS D1.1. ACCEPTANCE CRITERIA PER TABLE 6.1.
5. LADDERS AND STAIRS ANCHORED WITH 1/2"ø ASTM A-307 MIN. ALL THREAD W/5" MIN. EMBEDMENT.
6. DPS'S AND CATWALK SUPPORTS ANCHORED WITH 5/8"ø ASTM A-307 MIN. ALL THREAD W/5" MIN. EMBEDMENT.
7. THIS DRAWING IS A QUALITY LEVEL 3.
8. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

GENERAL DESIGN NOTES

1. GENERAL BUILDING DESIGN:
   AIRLOCK 5 ENCLOSURE INCLUDES FRAMED WALLS:
   a. 88'-0"x120'-0"=10,580 SF (INTERIOR DIMENSIONS)
   b. CU FT=180,000
   RETRIEVAL ENCLOSURE STRUCTURE:
   a. 380'-0" x165'-0"= 62,700 SF
   b. CU FT=1,191,000
2. DESIGN CODES:
   a. GENERAL – INTERNATIONAL BUILDING CODE (IBC) 2006
   b. STEEL/CONCRETE – SEE STRUCTURAL DRAWINGS AND NOTES
3. OCCUPANCY:
   a. OCCUPANCY CLASSIFICATION:
      • FACTORY INDUSTRIAL GROUP F-1, MODERATE HAZARD, INDUSTRIAL
   b. BUILDING TYPE: II-B
   c. NFPA 101, LIFE SAFETY CODE (LATEST EDITION):
      • SPECIAL PURPOSE INDUSTRIAL, ORDINARY HAZARD
4. DESIGN LOADS (FOR INTERIOR WALLS ONLY):
   a. NPH.....PERFORMANCE CATEGORY 1
   b. SNOW.....NOT APPLICABLE s = 0.328g AND S_1 = 0.13g
   c. WIND .....NOT APPLICABLE
   d. SEISMIC .....PER IBC, SITE CLASS C, I=1.0, S

LEGEND

- STRUCTURE PROVIDED BY RUBB BUILDING SYSTEMS
- 6-INCH METAL STUD WALL AND METAL LINER(S)
- ROOM NUMBER. SEE ROOM FINISH SCHEDULE ON DRAWING 761199
- DOOR NUMBER. SEE DOOR SCHEDULE ON DRAWING 761199
- WINDOW NUMBER. SEE WINDOW SCHEDULE ON DRAWING 761199
- *D DOOR, FRAME AND HARDWARE FURNISHED BY BUILDING MANUFACTURER

X-REF DRAWING

762163 – AIRLOCK 5
762164 – AIRLOCK 5 EQUIPMENT

Paul D. Leonard
Fluor Idaho
2019.05.02 15:12:26-06'00'
PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

8

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: N/A	– –
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2019.05.02 09:09:55 -06'00'
TECHNICAL CHECK: N/A	– –
ENG GROUP SUPERVISOR: N/A	– –
DESIGN LEAD/AUTHORITY: D.J. McGARY	Doug J. McGary Fluor Idaho 2019.05.02 14:36:21 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2019.05.02 15:09:15 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 326838	

Idaho Cleanup Project Core Fluor IDAHO

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
WMF-1617 AL5
AIRLOCK 5
INTERIOR WALL PLAN

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	00	136	761194	4

SCALE: NOTED SHEET 1 OF 1

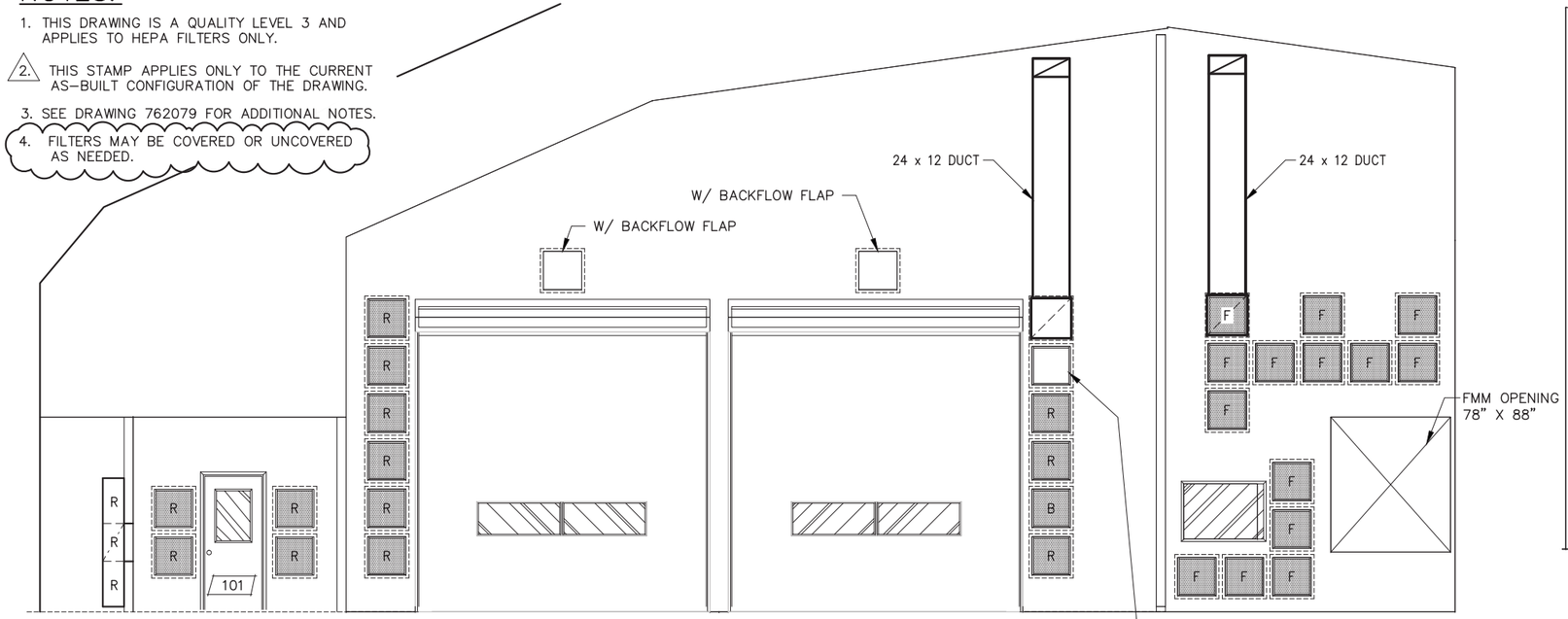
RW-1279

FMT-D1-ICP REV 2017-02-28

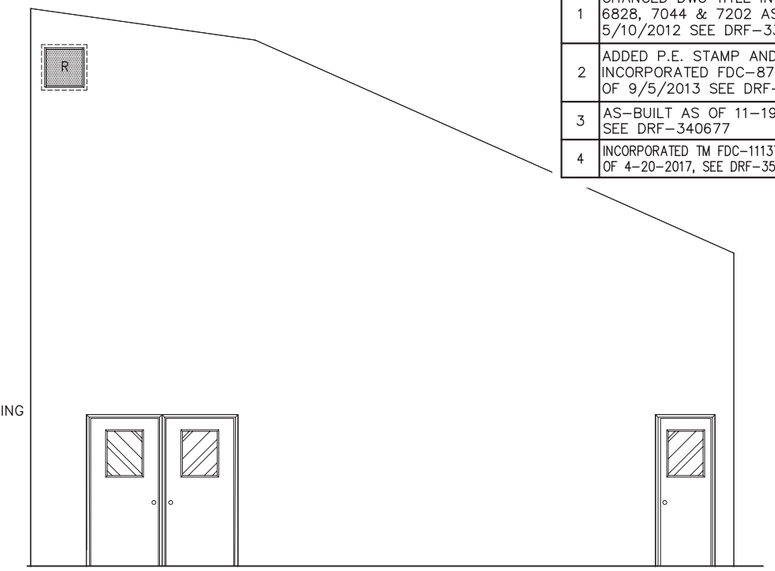
NOTES:

1. THIS DRAWING IS A QUALITY LEVEL 3 AND APPLIES TO HEPA FILTERS ONLY.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.
3. SEE DRAWING 762079 FOR ADDITIONAL NOTES.
4. FILTERS MAY BE COVERED OR UNCOVERED AS NEEDED.

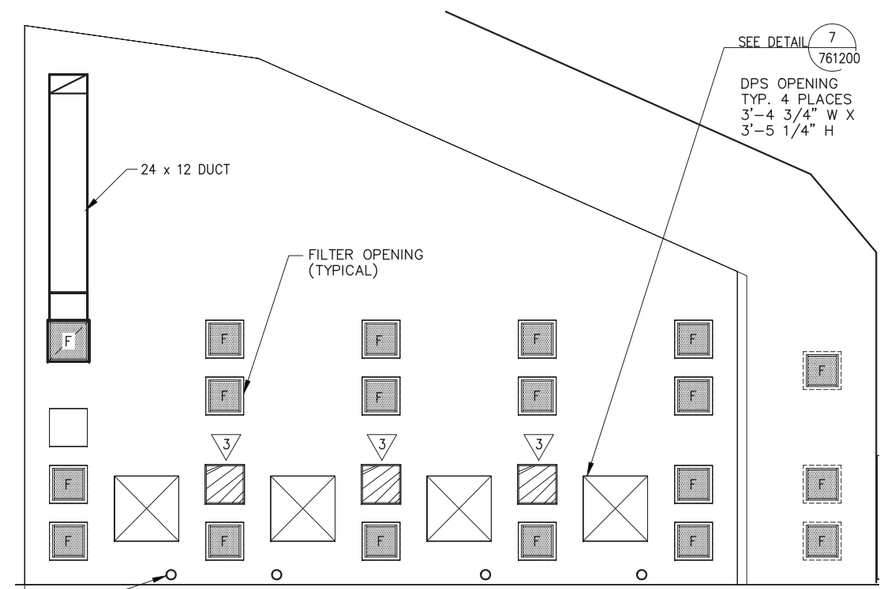
REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE INCORPORATED FDC 6828, 7044 & 7202 AS-BUILT AS OF 5/10/2012 SEE DRF-336389
2	ADDED P.E. STAMP AND NOTE 2. INCORPORATED FDC-8750. AS-BUILT AS OF 9/5/2013 SEE DRF-340004
3	AS-BUILT AS OF 11-19-2013, SEE DRF-340677
4	INCORPORATED TM FDC-11137, AS-BUILT AS OF 4-20-2017, SEE DRF-354225



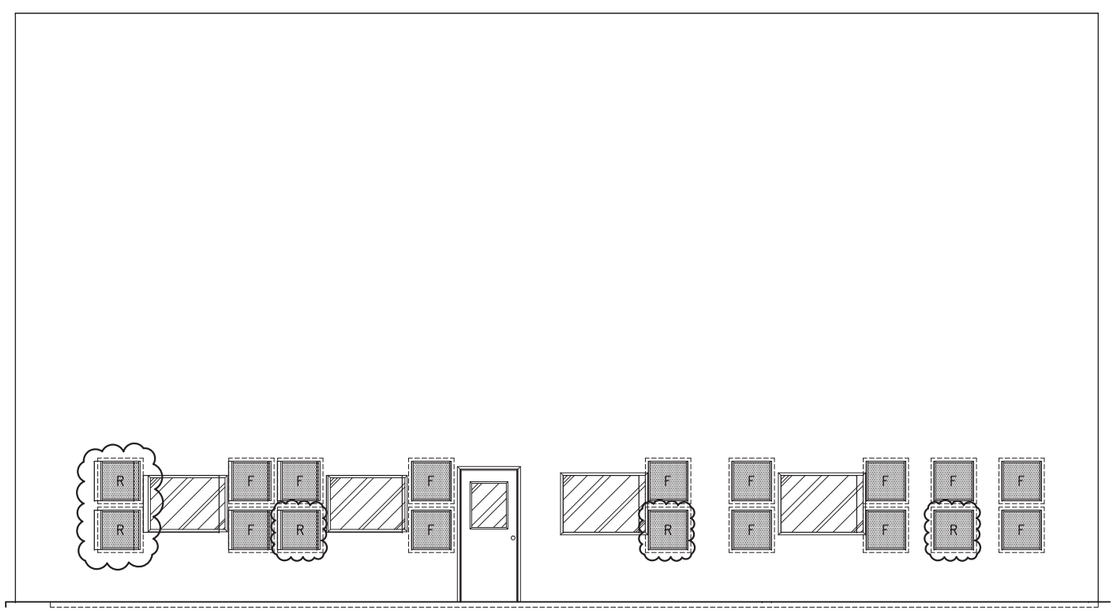
ELEVATION J 761194
ROOM 103 EAST WALL



ELEVATION E 761194
ROOM 106 EAST WALL



ELEVATION L 761194
ROOM 105 EAST WALL



ELEVATION K 761194
ROOM 106 NORTH WALL

LEGEND

- FILTER FRAME ONLY
- F — HEPA FILTER
- R — ROUGHING FILTER W/ BACKFLOW FLAP
- B — FILTER BLANKED OFF
- X — WINDOW NUMBER

SEE WINDOW AND FRAMED OPENING SCHEDULE ON DWG 761199

Paul D. Leonard
Fluor Idaho
2017.05.15 07:27:51 -06'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2017.05.11 11:50:34 -06'00'
TECHNICAL CHECK: EGS	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD/AUTHORITY: D.J. McGARY	Doug J. McGary Fluor Idaho 2017.05.11 15:28:31 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2017.05.15 07:27:51 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 327002	

Idaho Cleanup Project Core Fluor IDAHO

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
WMF-1617 AL5
AIRLOCK 5
INTERIOR ELEVATIONS

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	01	136	761195	4

SCALE: NOTED — SHEET 1 OF 1

RW-1275

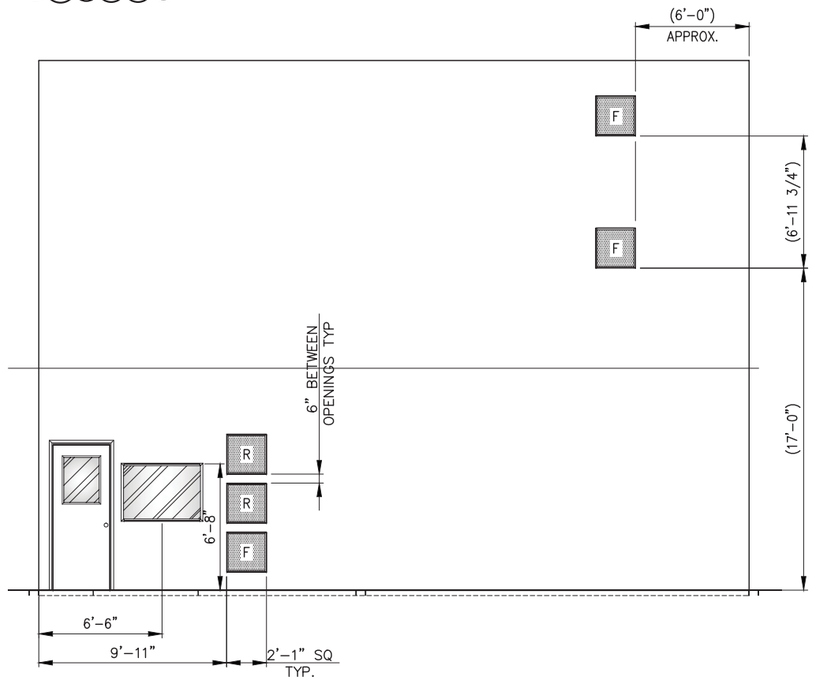
File: 761195-4.dwg
Path: C:\Users\bxs\Documents\BXS\RW-1275 (ARPs Start 2-1-2011)
Date: 05/11/17 – 10:19 AM | Layout Name: A-4 | ID: BXS

FMT-D1-ICP REV 2017-02-28

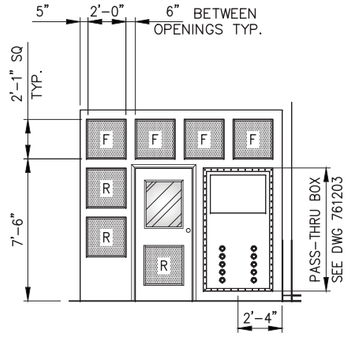
NOTES:

1. THIS DRAWING IS QUALITY LEVEL 3 AND APPLIES ONLY TO THE HEPA FILTERS.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.
3. SEE DRAWING 762079 FOR ADDITIONAL NOTES.
4. FILTERS MAY BE COVERED OR UNCOVERED AS NEEDED.

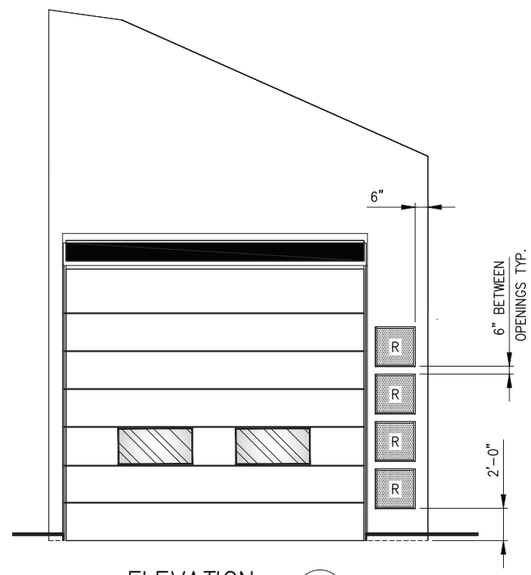
REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE INCORPORATED FDC 6523, 6753, 6907 & 7044 AS-BUILT AS OF 5/10/2012 SEE DRF-336389
2	ADDED P.E. STAMP & NOTE 2. AS-BUILT AS OF 9/5/2013 SEE DRF-340004
3	INCORPORATED FDC-9445, AS-BUILT AS OF 2-18-2014, SEE DRF-341385
4	CHANGED DWG TITLE, INCORPORATED FDC-10283, AS-BUILT AS OF 2-9-2015, SEE DRF-344541
5	INCORPORATED TM FDC-11137, AS-BUILT AS OF 4-20-2017, SEE DRF-354225



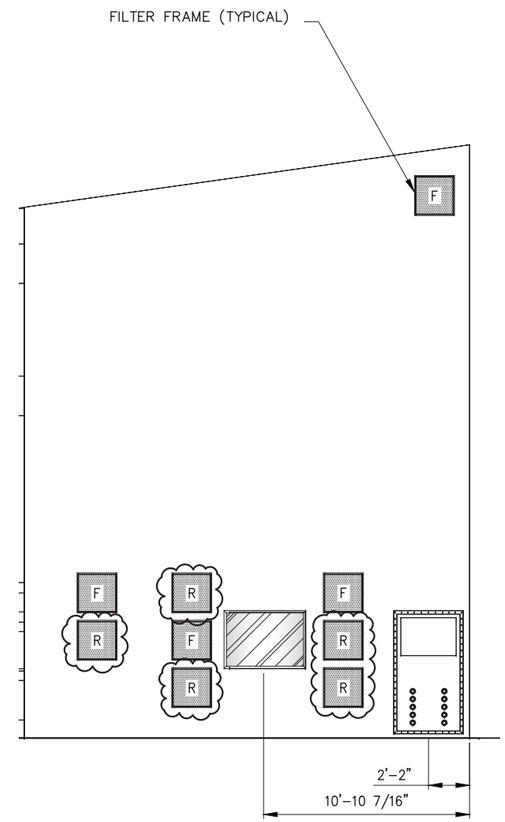
ELEVATION G 761194
ROOM 104 SOUTH WALL



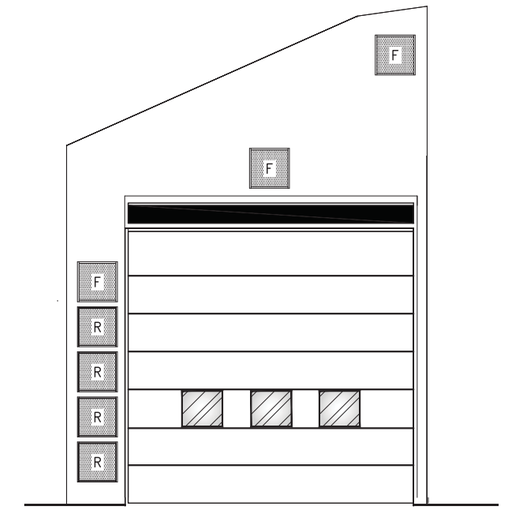
ELEVATION C 761194
ROOM 101 WEST WALL



ELEVATION H 761194
ROOM 104 WEST WALL



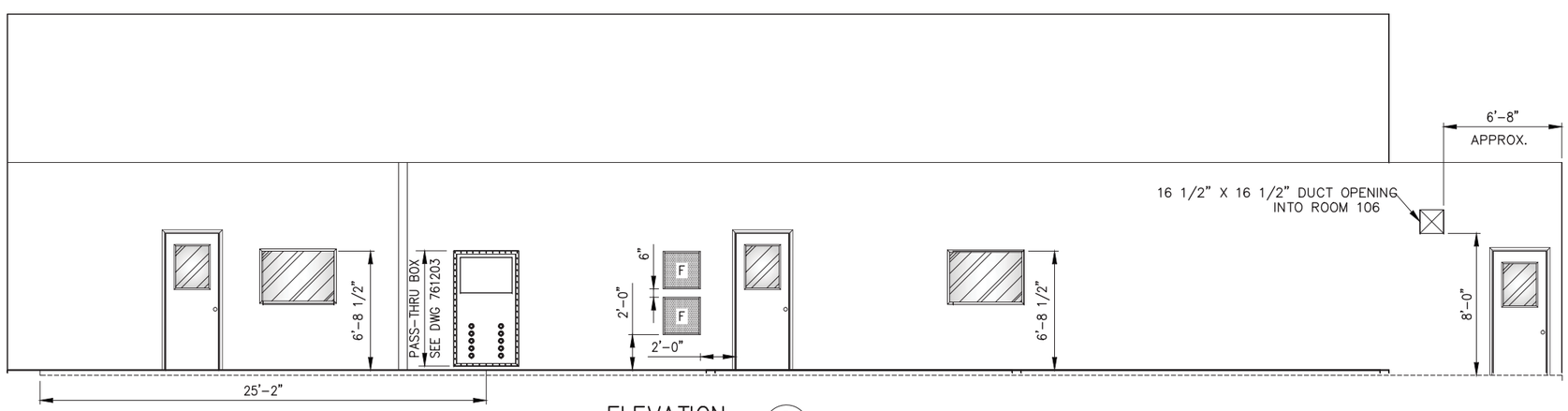
ELEVATION D 761194
ROOM 106 EAST WALL



ELEVATION F 761194
ROOM 104 EAST WALL

LEGEND

- FILTER FRAME ONLY
- F — HEPA FILTER
- R — ROUGHING FILTER W/ BACKFLOW FLAP
- B — FILTER BLANKED OFF



ELEVATION B 761194
ROOM 102 SOUTH WALL

Paul D. Leonard
Fluor Idaho
2017.05.11 15:29:12 -06'00'
PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: F.S. WARD	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2017.05.11 11:50:22 -06'00'
TECHNICAL CHECK: EGS	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD/AUTHORITY: D.J. McGARY	Doug J. McGary Fluor Idaho 2017.05.11 15:29:12 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2017.05.15 07:27:22 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 326838	

Idaho Cleanup Project Core Fluor IDAHO

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
WMF-1617
AIRLOCK 5
INTERIOR ELEVATIONS

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	01	136	761196	5

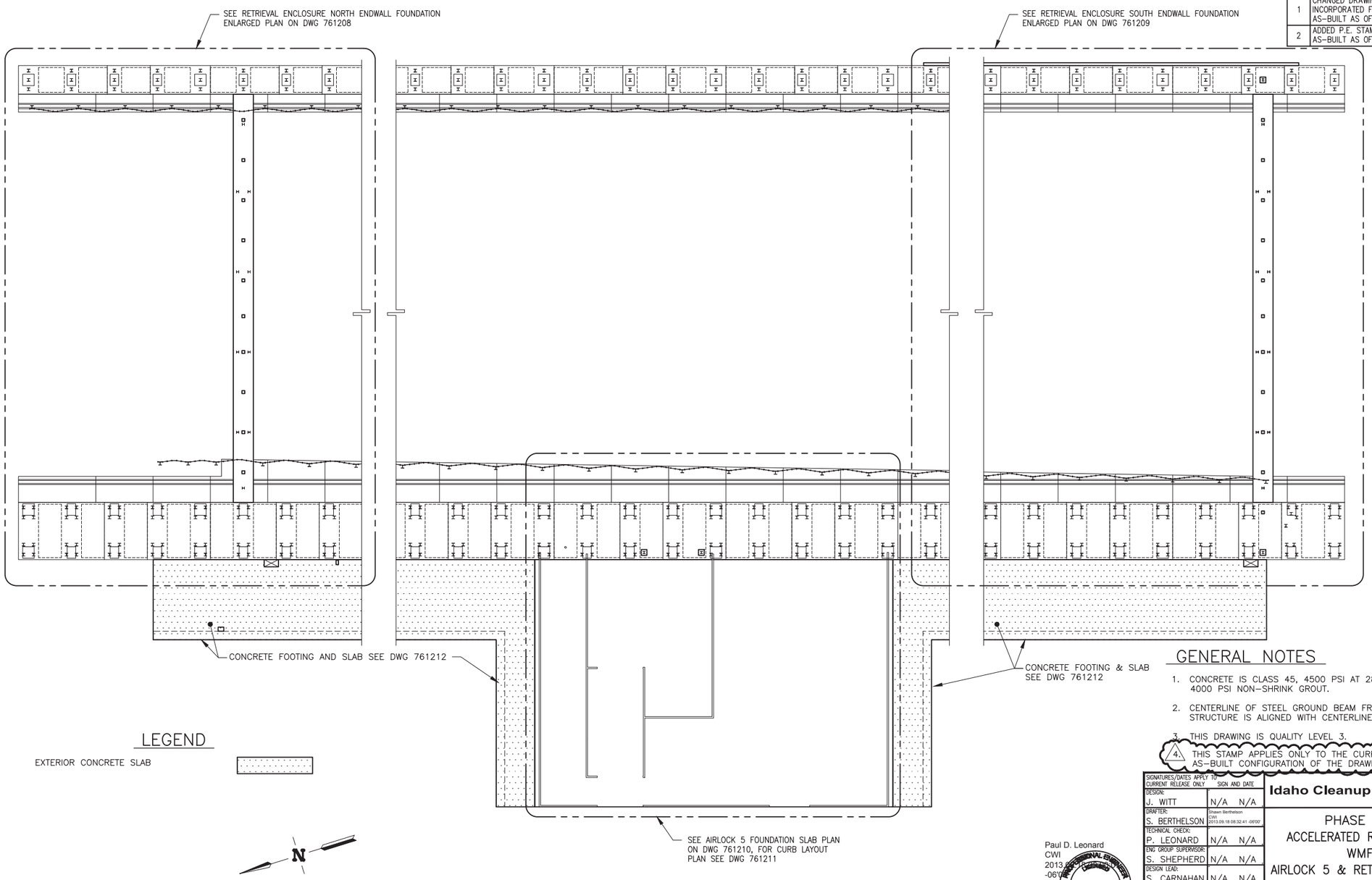
SCALE: NOTED — SHEET 1 OF 1

RW-1275

File: 761196-5.dwg
Path: C:\Users\bxs\Documents\BXS\RW-1275 (ARPs Start 2-1-2017)
Date: 05/11/17 – 10:27 AM | Layout Name: A-5
ID: BXS

FMT-D1-REV 2012-02-14

REVISIONS	
REV.	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-6472, AS-BUILT AS OF 5-10-2012, SEE DRF-336389
2	ADDED P.E. STAMP AND NOTE 4. AS-BUILT AS OF 9-5-2013, SEE DRF-340004



LEGEND

EXTERIOR CONCRETE SLAB

GENERAL NOTES

1. CONCRETE IS CLASS 45, 4500 PSI AT 28 DAYS. GROUT IS 4000 PSI NON-SHRINK GROUT.
2. CENTERLINE OF STEEL GROUND BEAM FROM RETRIEVAL ENCLOSURE STRUCTURE IS ALIGNED WITH CENTERLINE OF GRADE BEAMS.
3. THIS DRAWING IS QUALITY LEVEL 3.
4. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

AIRLOCK & RETRIEVAL ENCLOSURE FOUNDATION PLAN

SCALE: 1/16"=1'-0"

Paul D. Leonard
CWI
2013.09.18 09:32:41 -06'00'

PROFESSIONAL ENGINEER CERTIFICATE 13530 STATE OF IDAHO PAUL D. LEONARD

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT	N/A N/A
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:32:41 -06'00'
TECHNICAL CHECK: P. LEONARD	N/A N/A
ENG GROUP SUPERVISOR: S. SHEPHERD	N/A N/A
DESIGN LEAD: S. CARNAHAN	N/A N/A
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:39:45 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 326838	

Idaho Cleanup Project CH2M HILL BWG IDAHO, LLC

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
WMF-1617
AIRLOCK 5 & RETRIEVAL ENCLOSURE 5
FOUNDATION PLAN AND LEGEND

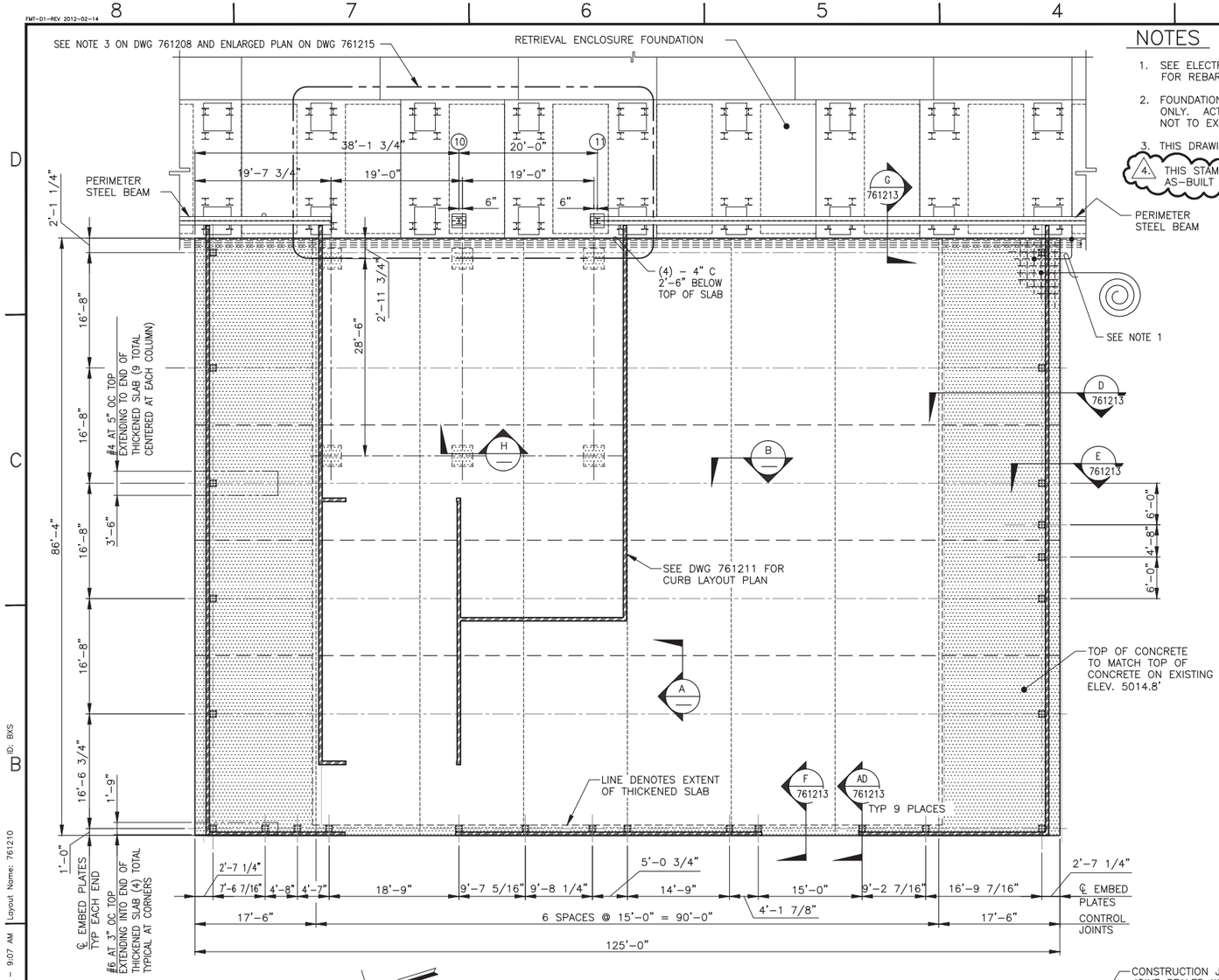
SIZE	INDEX CODE NUMBER (AREA / TYPE / CI / ORIG)	DWG-	REV
D	098 1617 60 136	761207	2

SCALE: NOTED SHEET 1 OF 1

RW-1267

Plot: 761207-2.dwg
Path: L:\RE-S\RCRA\RCRA-DRAWINGS\9-5-13
Date: 09/12/13 - 9:05 AM | Layout Name: 761207
ID: BXS

FMT-D1-REV 2012-02-14



AIRLOCK FOUNDATION SLAB PLAN

SCALE: 1/8"=1'-0"

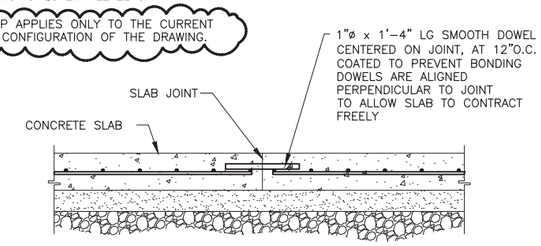
LEGEND

- CONCRETE CURB
- CONSTRUCTION JOINT
- CONTROL JOINT
- THICKENED SLAB

NOTES

1. SEE ELECTRICAL DRAWINGS 761217 AND 761218 FOR REBAR GROUNDING.
2. FOUNDATION DESIGN SHOWN IS BASED ON ESTIMATED BUILDING REACTIONS ONLY. ACTUAL SERVICE LEVEL BUILDING REACTIONS FOR THE AIRLOCK ARE NOT TO EXCEED 30 KIPS UPLIFT, 35 KIPS LATERAL.
3. THIS DRAWING IS QUALITY LEVEL 3.
4. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

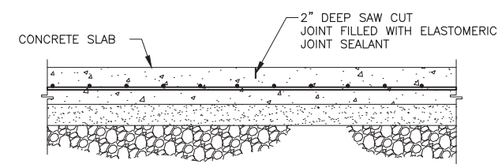
REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-6282, -6342, -6573 & -6587, AS-BUILT AS OF 5-10-2012, SEE DRF-336389
2	ADDED P.E. STAMP AND NOTE 4. AS-BUILT AS OF 9-5-2013, SEE DRF-340004



CONSTRUCTION JOINT (CENTERED BETWEEN COLUMNS)

SECTION A

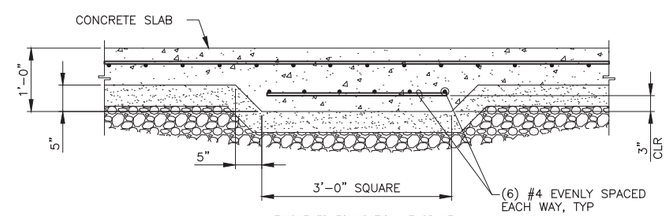
SCALE: 1"=1'-0"



CONTROL JOINT

SECTION B B 761212

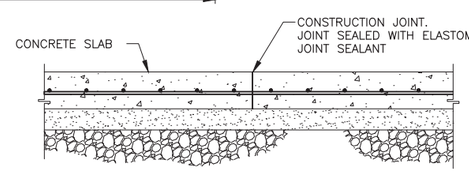
SCALE: 1"=1'-0"



THICKENED FOUNDATION AT CRANE

SECTION H

SCALE: 1"=1'-0"



CONSTRUCTION JOINT IN SNOW CANOPY

SECTION AE 761212

SCALE: 1"=1'-0"

1' 0 1' 2' 3' 4' 5' 10' 15'

SCALE: 1/8" = 1'-0"

1' 0 1'

SCALE: 1" = 1'-0"

Paul D. Leonard
CWI
2013.09.18 08:32:28 -06'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

4

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: P. LEONARD	N/A	N/A
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:32:28 -06'00'	
TECHNICAL CHECK: J. WITT	N/A	N/A
ENG GROUP SUPERVISOR: S. SHEPHERD	N/A	N/A
DESIGN LEAD: S. CARNAHAN	N/A	N/A
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:40:40 -06'00'	
PROJECT NUMBER: 30198		
DRF NUMBER: 326838		

Idaho Cleanup Project CH2MHILL

PHASE V OF THE ACCELERATED RETRIEVAL PROJECT WMF-1617 AIRLOCK 5 FOUNDATION SLAB PLAN, LEGEND AND SECTIONS

SIZE	INDEX CODE NUMBER	DWG-	REV
D	AREA TYPE CI DISC 098 1617 62 136	761210	2
SCALE: NOTED		SHEET 1 OF 1	

RW-1267

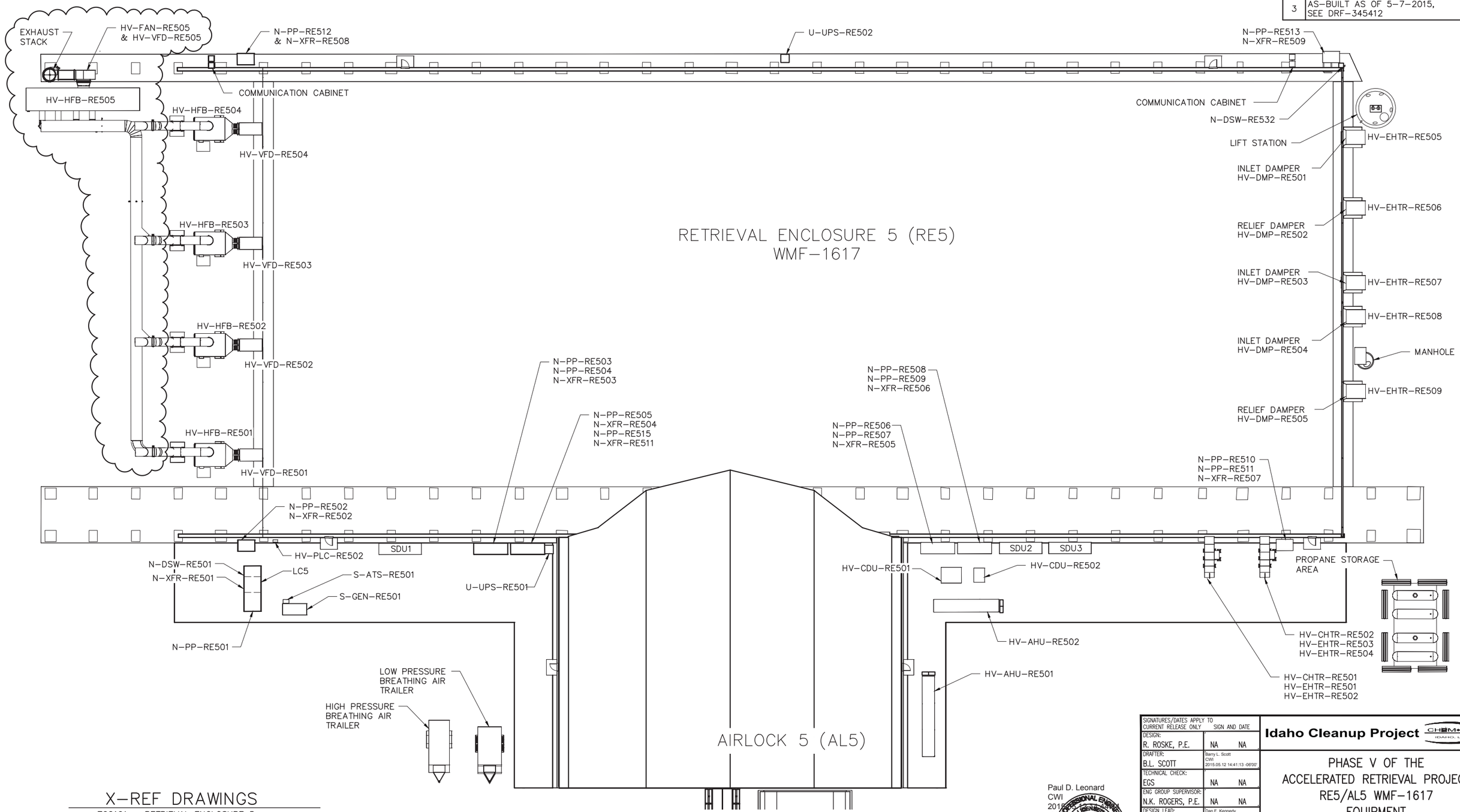
File: 761210-2.dwg Path: L:\KE-S\RCRA\RCRA-DRAWINGS\S-5-13 Date: 09/12/13 - 9:07 AM Layout Name: 761210 ID: BXS

FMT-D1-REV 2012-02-14

NOTES:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE INCORPORATED FDC 6732, 7022, 7119 & 7155 AS-BUILT AS OF 5/2/2012 SEE DRF-336389
2	ADDED P.E. STAMP & NOTE 2. AS-BUILT AS OF 9/5/2013 SEE DRF-340004
3	AS-BUILT AS OF 5-7-2015, SEE DRF-345412



X-REF DRAWINGS

762161 – RETRIEVAL ENCLOSURE 5
762162 – RETRIEVAL ENCLOSURE 5 EQUIPMENT
762163 – AIRLOCK 5
762164 – AIRLOCK 5 EQUIPMENT

RETRIEVAL ENCLOSURE 5 EQUIPMENT LOCATION PLAN

SCALE: 1/16" = 1'-0"

Paul D. Leonard
CWI
2015.05.12 14:41:13 -06'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: R. ROSKE, P.E.	NA	NA
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.05.12 14:41:13 -06'00'	
TECHNICAL CHECK: EGS	NA	NA
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	NA	NA
DESIGN LEAD: D.F. KENNEDY	Dain F. Kennedy CWI 2015.05.12 14:48:26 -06'00'	
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson CWI 2015.05.12 14:51:46 -06'00'	
PROJECT NUMBER: 30198		
DRF NUMBER: 327002		

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
RE5/AL5 WMF-1617
EQUIPMENT
LOCATION PLAN

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	02	136	762023	3

SCALE: NOTED SHEET 1 OF 1

RW-1271

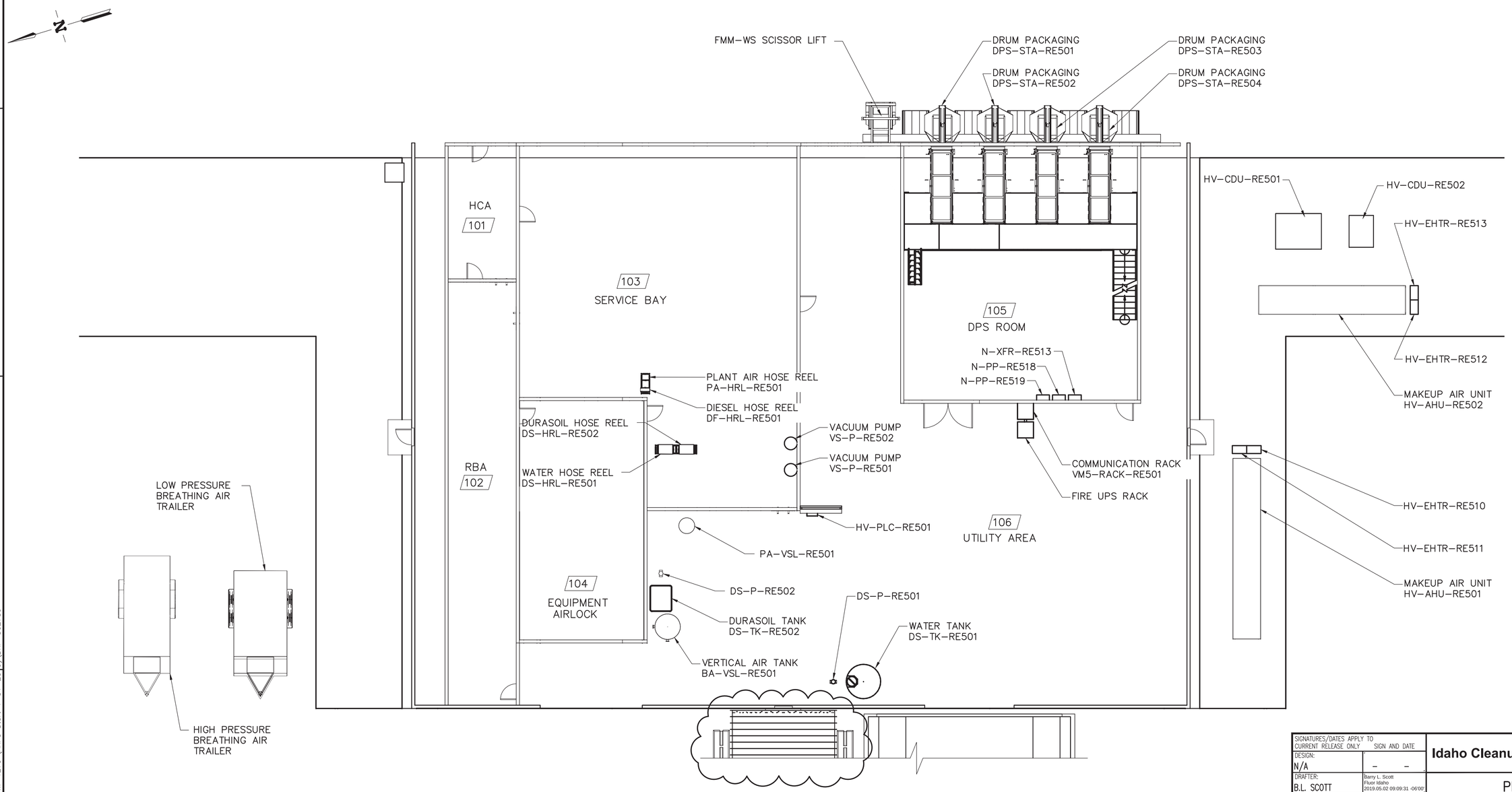
File: 762023-3.dwg
Path: C:\Users\bxs\Documents\BXS RW-1271 (ARPs Start 11-3-2014)
Date: 05/12/15 – 2:23 PM | Layout Name: Layout1 | ID: BXS

FMT-D1-ICP REV 2017-02-28

NOTES:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE INCORPORATED FDC 6573, 6871, 6902 & 7155 AS-BUILT AS OF 5/2/2012 SEE DRF-336389
2	ADDED P.E. STAMP & NOTE 2. AS-BUILT AS OF 9/5/2013 SEE DRF-340004
3	DRAWING ASSESSED AND VERIFIED AS-BUILT AS OF 11-21-2017, SEE DRF-357971
4	INCORPORATED FDC-12044, AS-BUILT AS OF 4-24-2019, SEE DRF-362759



AIRLOCK 5 EQUIPMENT LOCATION PLAN

SCALE: 1/8"=1'-0"

X-REF DRAWING

762161 – RE5
762162 – RE5 EQUIPMENT
762163 – AIRLOCK 5
762164 – AIRLOCK 5 EQUIPMENT

Paul D. Leonard
Fluor Idaho
2019.05.02 15:25:24 -06'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: N/A	– –
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2019.05.02 09:09:31 -06'00'
TECHNICAL CHECK: N/A	– –
ENG GROUP SUPERVISOR: N/A	– –
DESIGN LEAD/AUTHORITY: D.J. McGARY	Doug J. McGary Fluor Idaho 2019.05.02 14:37:26 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2019.05.02 15:08:40 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 327002	

Idaho Cleanup Project Core Fluor IDAHO

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
WMF-1617 AL5
AIRLOCK 5
EQUIPMENT LOCATION PLAN

SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CL	ORIG		
D	098	1617	02	136	762024	4

SCALE: NOTED

SHEET 1 OF 1

RW-1279

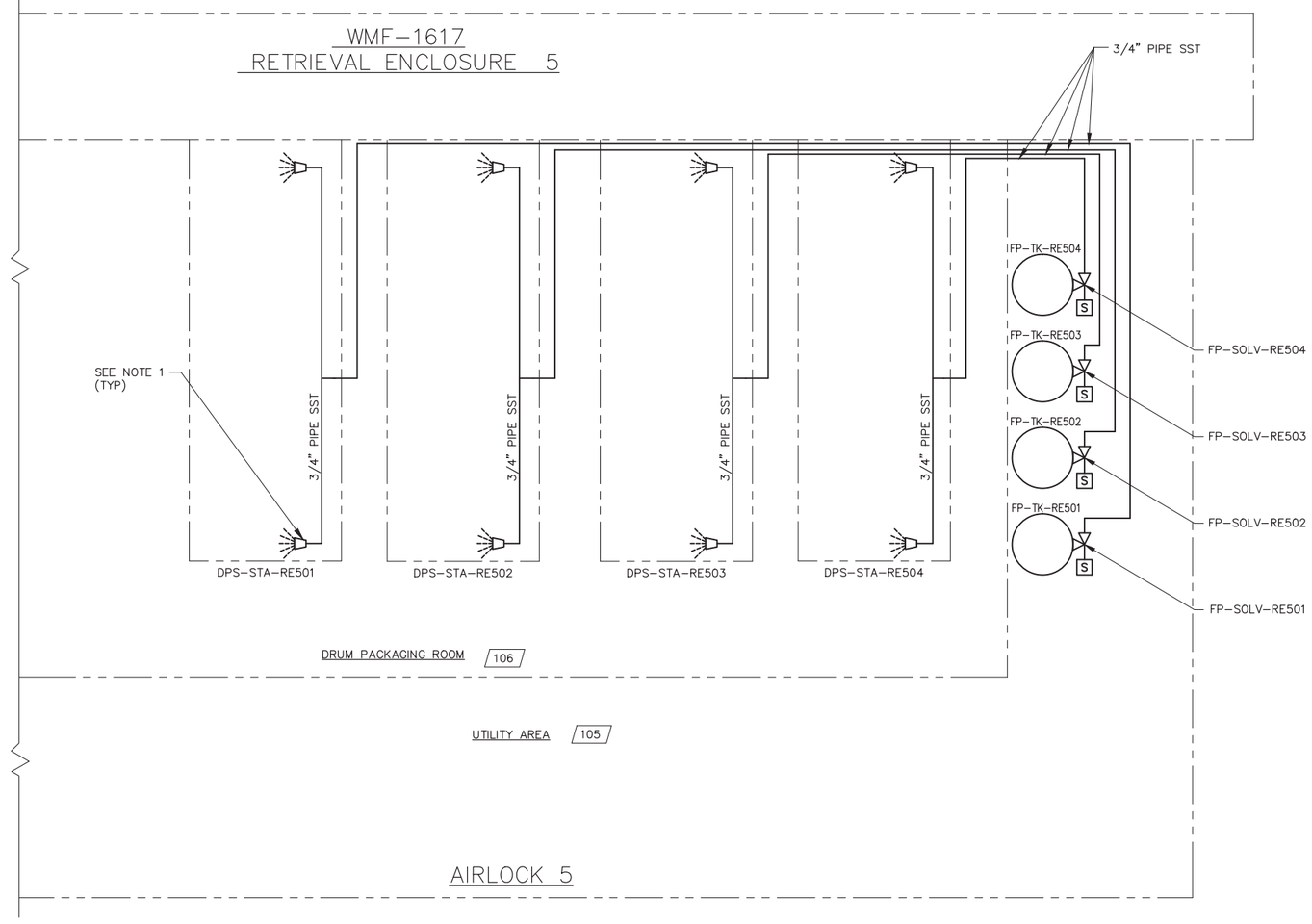
File: 762024-4.dwg
Path: C:\Users\bxs\Documents\BXS RW-1279 (ARPs Start 1-31-2019)\DRF-362759
Date: 05/02/19 – 8:52 AM | Layout Name: A-1
ID: BXS

FMT-D1-REV 5.2

NOTES:

1. DISCHARGE NOZZLE HEADS SPRAY DOWNWARD.
2. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
3. THIS STAMP AND SIGNATURE VERIFIES THAT THE FIRE PROTECTION EQUIPMENT IS INSTALLED IN THE GENERAL LOCATIONS SHOWN ON THIS DRAWING.

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, AS-BUILT AS OF 9/16/2010 SEE DRF-331288
2	DRAWING ASSESSED AND VERIFIED AS-BUILT AS OF 5/3/2012 SEE DRF-336389
3	ADDED P.E. STAMP AND NOTE 3. AS-BUILT AS OF 9/5/2013 SEE DRF-340004



FIRE PROTECTION SYSTEM DIAGRAM

NTS

LEGEND

S — CHEMICAL STORAGE CYLINDER WITH INTEGRAL SOLENOID VALVE

DISCHARGE NOZZLE

Douglas Clark
CWI
2013.09.18 09:42:29 -06'00'

PROFESSIONAL ENGINEER REGISTERED 11200 STATE OF IDAHO DOUGLAS W. CLARK

3

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: H. VESELKA	NA	NA
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:24:48 -06'00'	
TECHNICAL CHECK: D. CLARK, P.E.	NA	NA
ENG GROUP SUPERVISOR: R. ROSKE, P.E.	NA	NA
DESIGN LEAD: N.K. ROGERS, P.E.	NA	NA
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:42:29 -06'00'	
PROJECT NUMBER: 30198		
DRF NUMBER: 327002		

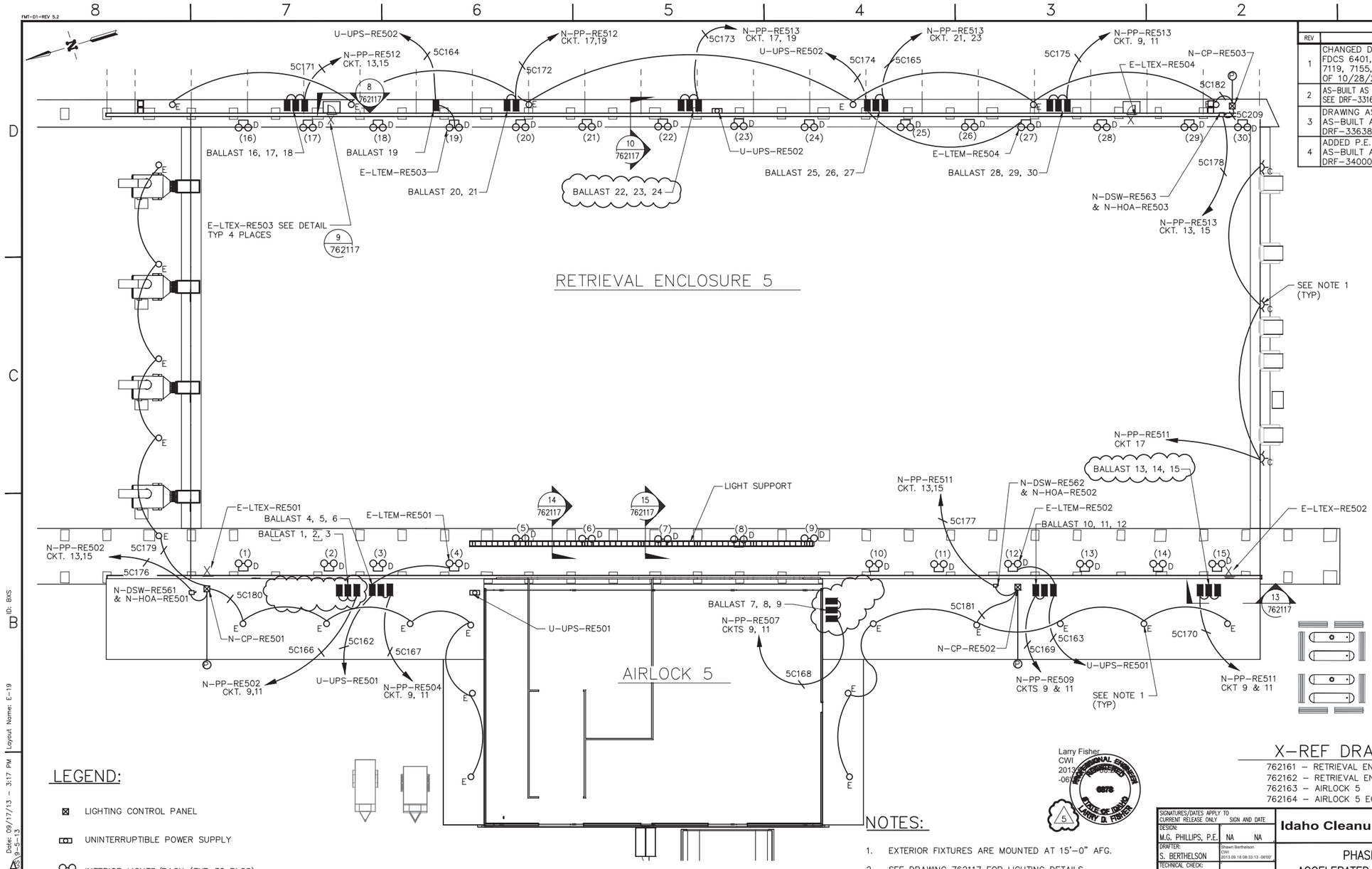
Idaho Cleanup Project CH2M HILL WG IDAHO, LLC

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
RE5/AL5 WMF-1617
DPS FIRE PROTECTION SYSTEM
DRY CHEMICAL DIAGRAM

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	12	136	762067	3

SCALE: NONE SHEET 1 OF 1

File: 762067-3.dwg
Path: S:\KE-S\RCRA\RCRA-DRAWINGS\9-5-13
Date: 09/17/13 - 1:59 PM | Layout Name: FP-1 | ID: BSL



LEGEND:

- LIGHTING CONTROL PANEL
- UNINTERRUPTIBLE POWER SUPPLY
- INTERIOR LIGHTS/RACK (TYP 30 PLCS)
- BALLAST, LIGHTING, REMOTE
- PHOTO-EYE SENSOR (PES)
- EXIT SIGN PHOTO LUMINESCENT MOUNT ABOVE DOOR ACCUFORM #PLW275GN

RETRIEVAL ENCLOSURE 5 LIGHTING PLAN

SCALE: 1/16"=1'-0"

NOTES:

1. EXTERIOR FIXTURES ARE MOUNTED AT 15'-0" AFG.
2. SEE DRAWING 762117 FOR LIGHTING DETAILS.
3. SEE DRAWINGS 762119, 762120, 762121, 762122 & 762123 FOR CABLE & CONDUIT SCHEDULES.
4. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
5. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

Larry Fisher
CWI
2013-06-20

X-REF DRAWINGS

762161 – RETRIEVAL ENCLOSURE 5
762162 – RETRIEVAL ENCLOSURE 5 EQUIPMENT
762163 – AIRLOCK 5
762164 – AIRLOCK 5 EQUIPMENT

REV.	DESCRIPTION
1	CHANGED DWG TITLE, INCORPORATED FDCS 6401, 6680, 6732, 6923, 7022, 7119, 7155, 7267 & 7276 AS-BUILT AS OF 10/28/2010 SEE DRF-331574
2	AS-BUILT AS OF 11/9/2010 SEE DRF-331696
3	DRAWING ASSESSED AND VERIFIED AS-BUILT AS OF 5/9/2012 SEE DRF-336389
4	ADDED P.E. STAMP AND NOTE 5 AS-BUILT AS OF 9/5/2013 SEE DRF-340004

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: M.G. PHILLIPS, P.E.	NA NA
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:33:13 -06'00'
TECHNICAL CHECK: L.D. FISHER, P.E.	NA NA
ENG GROUP SUPERVISOR: W.H. REED, P.E.	NA NA
DESIGN LEAD: N.K. ROGERS, P.E.	NA NA
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:43:09 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 327002	

Idaho Cleanup Project CH2M HILL BechtelWG

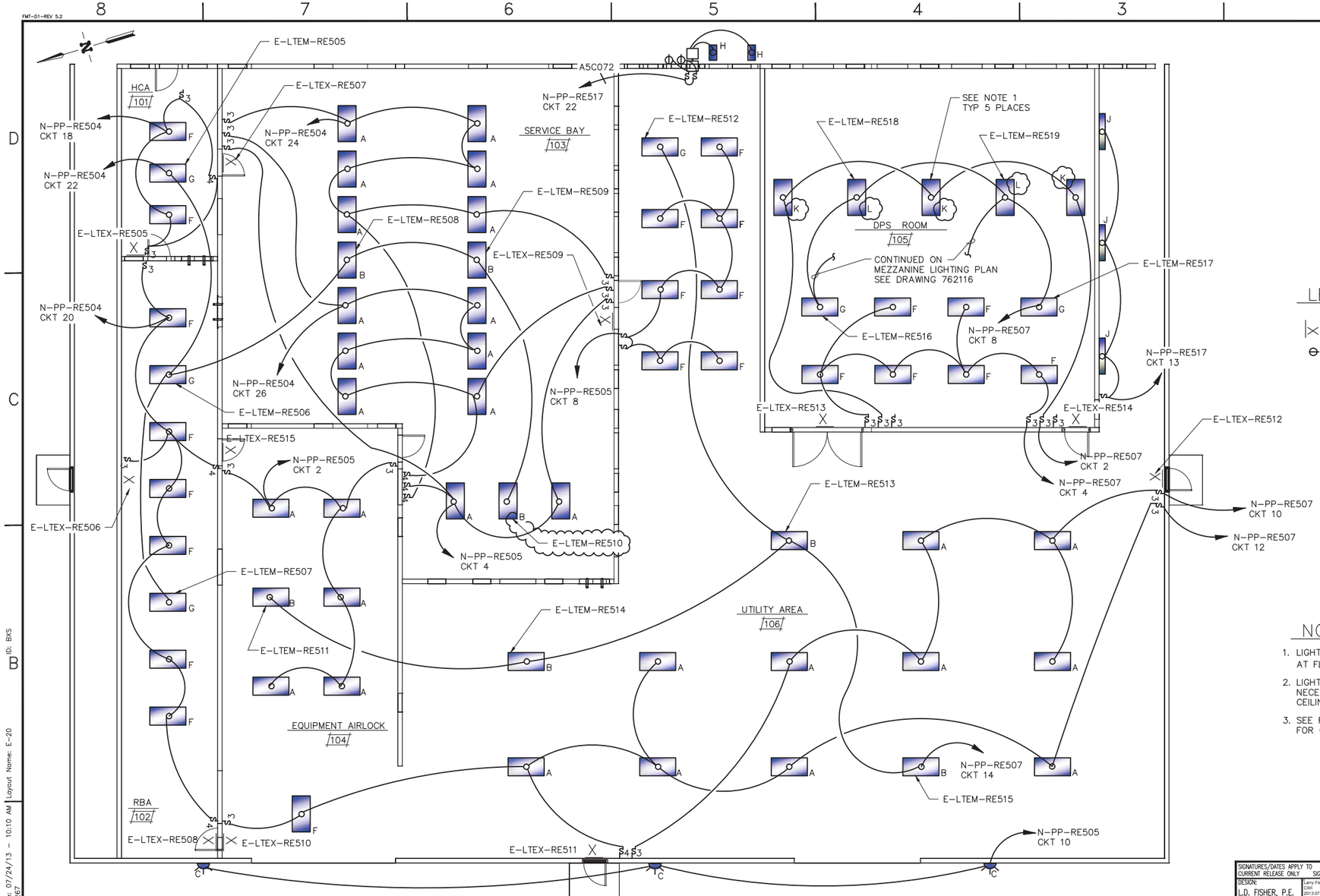
PHASE V OF THE ACCELERATED RETRIEVAL PROJECT RE5/AL5 WMF-1617

RE5 LIGHTING PLAN

SIZE	INDEX CODE NUMBER: AREA	TYPE	CI	DRG	DWG-	REV
D	098	1617	10	136	762114	4

SCALE: NOTED — SHEET 1 OF 1

File: 762114-4.dwg
Path: L:\RE-5\ECRA\ECRA-DRAWINGS\9-5-13
Date: 09/17/13 – 3:17 PM | Layout Name: E-19
ID: BXS



AIRLOCK 5 LIGHTING PLAN

SCALE: 3/16" = 1'-0"

X-REF DRAWINGS

762163 – AIRLOCK 5

REVISIONS	
REV.	DESCRIPTION
1	CHANGED DWG TITLE, INCORPORATED FDCS 6865, 6956, 7009, 7020, 7021, 7028, 7265 & 7296 AS-BUILT AS OF 10/29/2010 SEE DRF-331574
2	DRAWING ASSESSED AND VERIFIED AS-BUILT AS OF 5/9/2012 SEE DRF-336389
3	INCORPORATED FDC-9000, AS-BUILT AS OF 6-27-2013, SEE DRF-339468

LEGEND

EXIT SIGN, PHOTO-LUMINESCENT PERMANENTLY MOUNT ABOVE DOOR ACCUFORM #PLW275GN

20A SINGLE RECEPTACLE

NOTES:

1. LIGHTS ARE MOUNTED UNDER THE DPS DECK PLATE AT FLOOR LEVEL.
2. LIGHTING MOUNTING HEIGHT WAS ADJUSTED AS NECESSARY TO AVOID OBSTRUCTIONS AND/OR CEILING SLOPE
3. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.

Larry Fisher
CWI
2013
-06

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: L.D. FISHER, P.E.	Larry Fisher CWI 2013.07.24 15:09:34 -06'00'
DRAFTER: B.L. SCOTT	Barry Scott CWI 2013.07.24 12:32:46 -06'00'
TECHNICAL CHECK: N/A	NA NA
ENG GROUP SUPERVISOR: N/A	NA NA
DESIGN LEAD: N/A	NA NA
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson CWI 2013.07.25 07:29:31 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 327002	

Idaho Cleanup Project CH2M HILL BechtelBWXT IDAHO, LLC

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
RE5/AL5 WMF-1617

AL5 LIGHTING PLAN

SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CI	DBGC		
D	098	1617	10	136	762115	3

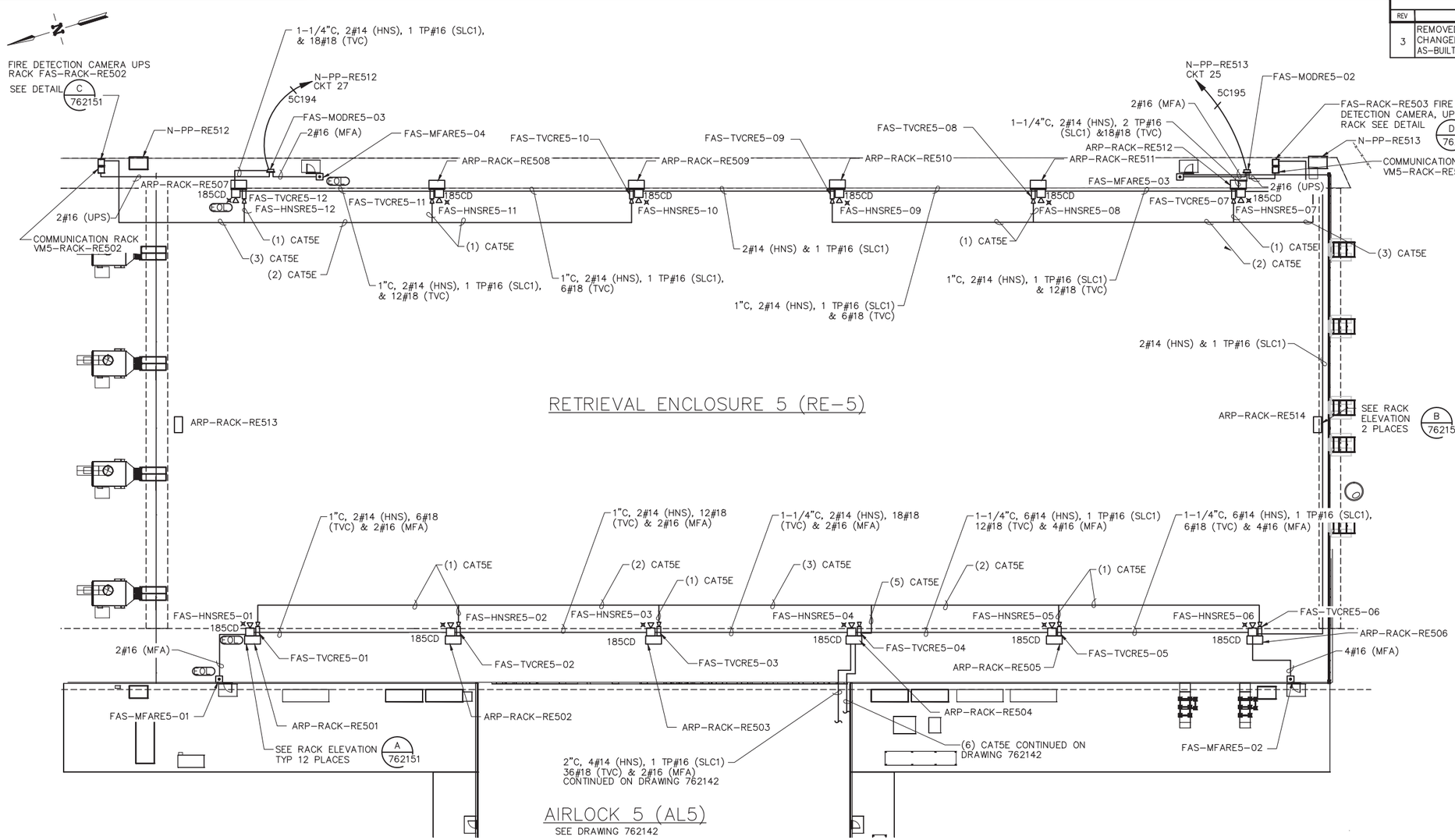
SCALE: NOTED

SHEET 1 OF 1

FMT-D1-REV 5.2

File: 762115-3.dwg
Path: C:\Users\bxs\Documents\BXS\WM-1617
Date: 07/24/13 – 10:10 AM | Layout Name: E-20 | ID: BXS

REVISIONS	
REV.	DESCRIPTION
3	REMOVED PRIOR REVISION HISTORY, CHANGED DRAWING TITLE, AS-BUILT AS OF 9-5-2013, SEE DRF-340004



RE5 FIRE ALARM FLOOR PLAN

SCALE: 1/16" = 1'-0"

LEGEND

- MANUAL FIRE ALARM STATION
- HORN/STROBE
- EOL END OF LINE RESISTOR
- SMOKE/FIRE DETECTION CAMERA WITH HOUSING

NOTES:

1. ALL CONDUCTORS ARE IN 3/4"C UNLESS SHOWN OTHERWISE ON THE DRAWING.
2. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
3. THIS STAMP AND SIGNATURE VERIFIES THAT THE FIRE PROTECTION EQUIPMENT IS INSTALLED IN THE GENERAL LOCATIONS SHOWN ON THIS DRAWING.

Douglas W. Clark
CWI
2013.09.18 09:11:00 -06'00'
PROFESSIONAL ENGINEER REGISTERED 11200 STATE OF IDAHO DOUGLAS W. CLARK

X-REF DRAWINGS

762161 – RETRIEVAL ENCLOSURE 5
762162 – RETRIEVAL ENCLOSURE 5 EQUIPMENT
762163 – AIRLOCK 5

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: W.B. FARMER	NA	NA
DRAFTER: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:01:34 -06'00'	
TECHNICAL CHECK: D.W. CLARK, P.E.	NA	NA
ENG GROUP SUPERVISOR: W.H. REED, P.E.	NA	NA
DESIGN LEAD: N.K. ROGERS, P.E.	NA	NA
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson CWI 2013.09.18 09:25:15 -06'00'	
PROJECT NUMBER: 30198		
DRF NUMBER: 327002		

Idaho Cleanup Project CH2M HILL WG IDAHO, LLC

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
RE5/AL5 WMF-1617
RETRIEVAL ENCLOSURE 5
FIRE ALARM PLAN

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	12	136	762141	3

SCALE: NOTED SHEET 1 OF 1

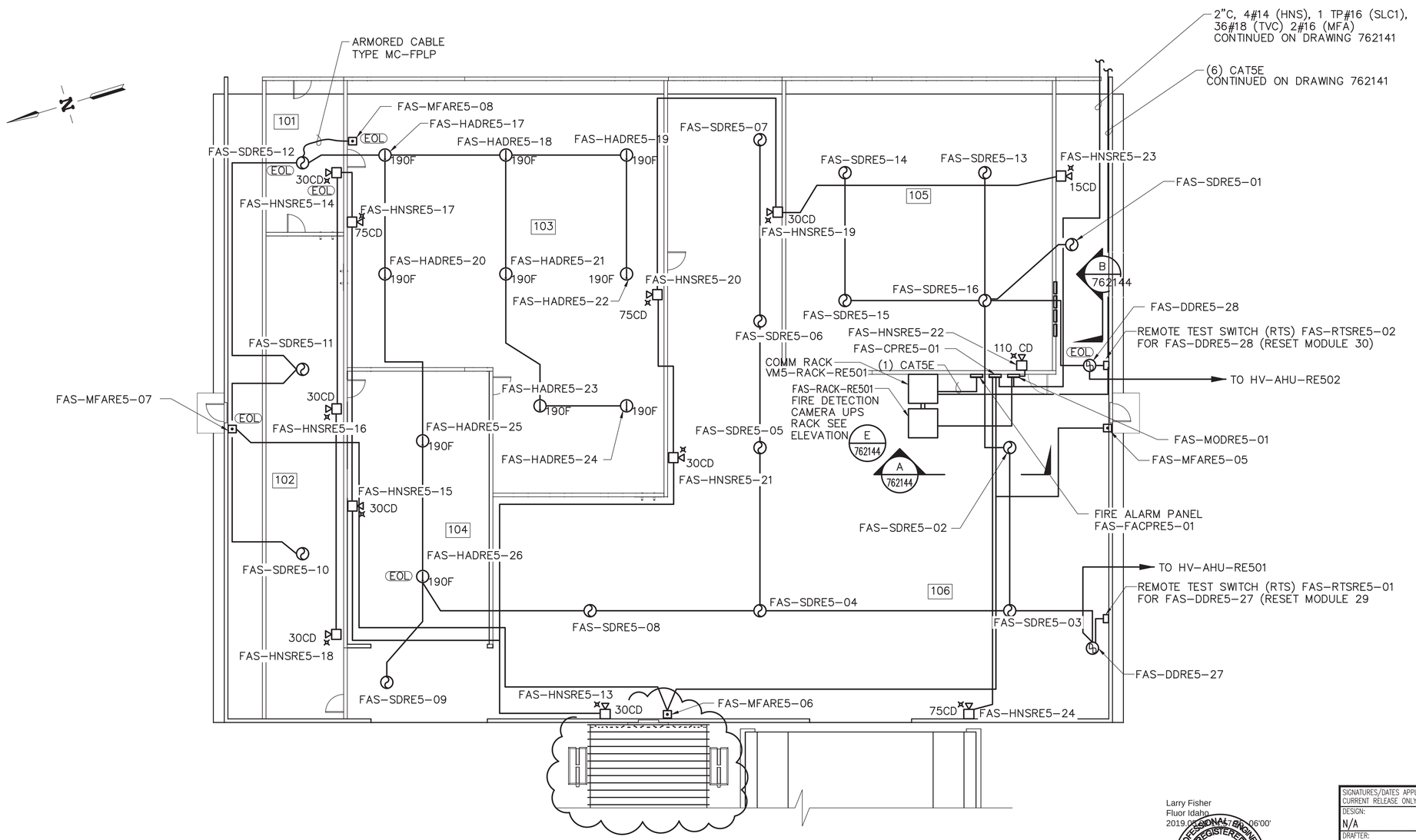
File: 762141-3.dwg
Path: S:\RE-5\RCRA\RCRA-DRAWINGS
Date: 09/17/13 - 2:01 PM
Layout Name: FA-1
ID: BSL

FMT-D1-ICP REV 2017-02-28

NOTES:

1. ALL CONDUCTORS ARE IN 3/4"C UNLESS SHOWN OTHERWISE.
2. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
3. THIS DRAWING IS TO BE USED IN CONJUNCTION WITH DWGS:
   762145 FIRE ALARM CONTROL PANEL FAS-FACPRE5-01 CONNECTION DIAGRAM
   762146 FAS-CPRE5-01 WIRING DIAGRAM, FAS-DDRE5-27 & FAS-DDRE5-28 WIRING DIAGRAM.
4. THIS STAMP AND SIGNATURE VERIFIES THAT THE FIRE PROTECTION EQUIPMENT IS INSTALLED IN THE GENERAL LOCATIONS SHOWN ON THIS DRAWING.

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, INCORPORATED FDCS 6412, 6921 & 7173 AS-BUILT AS OF 10/13/2010 SEE DRF-331493
2	DRAWING ASSESSED AND VERIFIED AS-BUILT AS OF 5/7/2012 SEE DRF-336389
3	AS-BUILT AS OF 9-5-2013, SEE DRF-340004
4	INCORPORATED FDC-10120, AS-BUILT AS OF 4-6-2017, SEE DRF-354109
5	INCORPORATED FDC-12044, AS-BUILT AS OF 4-24-2019, SEE DRF-362759



AIRLOCK 5 FLOOR PLAN

SCALE 1/8" = 1'-0"

LEGEND

- MANUAL FIRE ALARM STATION
- HORN/STROBE
- END OF LINE RESISTOR
- SMOKE DETECTOR
- HEAT DETECTOR (190F)
- DUCT SMOKE DETECTOR
- FIRE ALARM PANEL

Larry Fisher
Fluor Idaho
2019.05.02 15:17:06 -06'00'

PROFESSIONAL ENGINEER REGISTERED 6878 STATE OF IDAHO LARRY D. FISHER

4

X-REF DRAWING

762163 – AIRLOCK 5

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: N/A	– –
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2019.05.02 09:09:13 -06'00'
TECHNICAL CHECK: N/A	– –
ENG GROUP SUPERVISOR: N/A	– –
DESIGN LEAD/AUTHORITY: D.J. McGARY	Doug J. McGary Fluor Idaho 2019.05.02 14:38:09 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2019.05.02 15:08:23 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 327002	

Idaho Cleanup Project Core Fluor IDAHO

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
RE5/AL5 WMF-1617
AIRLOCK 5
FIRE ALARM PLAN

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	12	136	762142	5

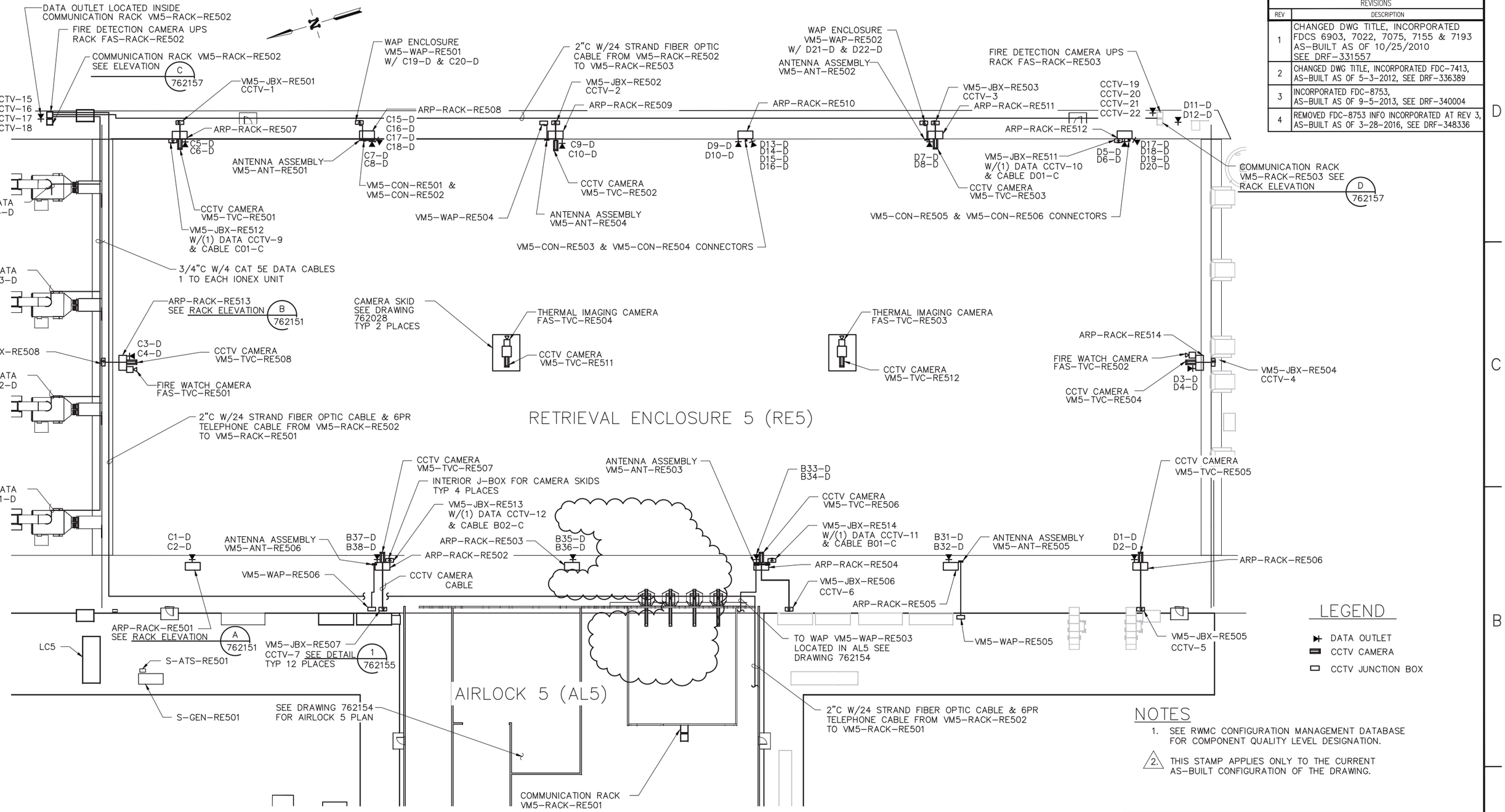
SCALE: NOTED SHEET 1 OF 1

RW-1279

File: 762142-5.dwg
Path: C:\Users\bxs\Documents\BXS RW-1279 (ARPs Start 1-31-2019)\DRF-362759
Date: 05/02/19 – 8:56 AM | Layout Name: FA-2
ID: BXS

FMT-D1-REV 5.2

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, INCORPORATED FDCS 6903, 7022, 7075, 7155 & 7193 AS-BUILT AS OF 10/25/2010 SEE DRF-331557
2	CHANGED DWG TITLE, INCORPORATED FDC-7413, AS-BUILT AS OF 5-3-2012, SEE DRF-336389
3	INCORPORATED FDC-8753, AS-BUILT AS OF 9-5-2013, SEE DRF-340004
4	REMOVED FDC-8753 INFO INCORPORATED AT REV 3, AS-BUILT AS OF 3-28-2016, SEE DRF-348336



LEGEND

- DATA OUTLET
- CCTV CAMERA
- CCTV JUNCTION BOX

NOTES

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

RE5 DATA/DATA CCTV FLOOR PLAN

SCALE: 1/16" = 1'-0"

LAST NO. USED

DATA/DATA	B38-D
DATA/DATA	C20-D
DATA/DATA	D22-D
DATA	CCTV-22

X-REF DRAWINGS

762161 – RETRIEVAL ENCLOSURE 5
762162 – RETRIEVAL ENCLOSURE 5 EQUIPMENT
762163 – AIRLOCK 5
762164 – AIRLOCK 5 EQUIPMENT

Larry Fisher
CWI
2016.04.12 -06'00'

PROFESSIONAL ENGINEER REGISTERED 6878 STATE OF IDAHO LARRY D. FISHER

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: W.B. FARMER	NA NA
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2016.04.11 15:54:18 -06'00'
TECHNICAL CHECK: EGS	NA NA
ENG GROUP SUPERVISOR: W.H. REED, P.E.	NA NA
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2016.04.11 16:02:35 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2016.04.11 16:30:41 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 327002	

Idaho Cleanup Project CH2M+WG IDAHO, LLC

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
WMF-1617
RETRIEVAL ENCLOSURE 5
DATA/DATA CCTV FLOOR PLAN

SIZE	INDEX CODE NUMBER (AREA / TYPE / CL / ORIG)	DWG-	REV
D	098 / 1617 / 06 / 136	762153	4

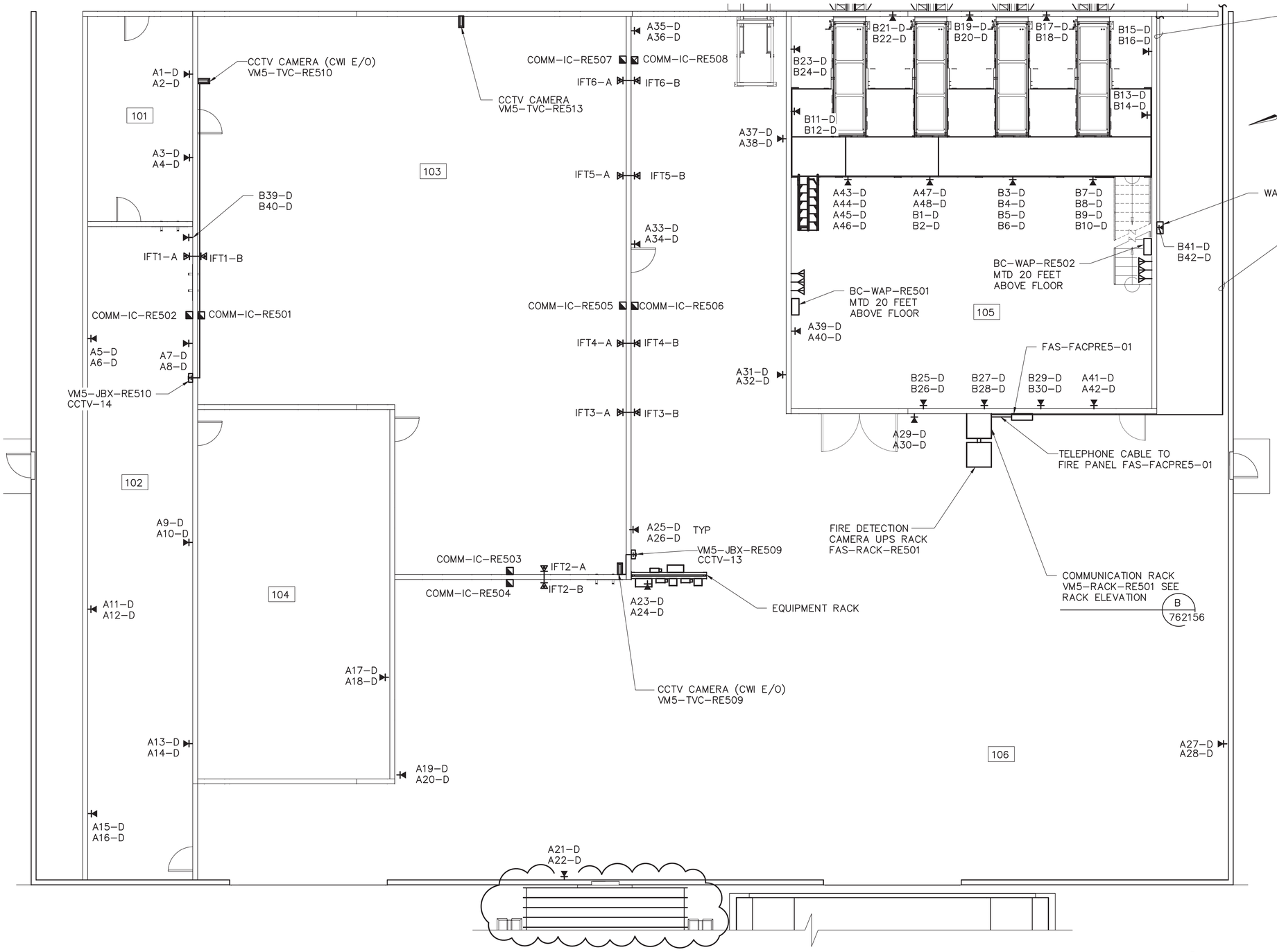
SCALE: NOTED — SHEET 1 OF 1

RW-1273

File: 762153-4.dwg
Path: C:\Users\bxs\Documents\BXS\RW-1273 (ARPs Start 1-12-2016)
Date: 04/11/16 – 3:47 PM | Layout Name: Layout1 | ID: BXS

FMT-D1-ICP REV 2017-02-28

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, INCORPORATED FDCS 6871 & 6903 AS-BUILT AS OF 10/25/2010 SEE DRF-331557
2	DRAWING ASSESSED AND VERIFIED AS-BUILT AS OF 5/7/2012 SEE DRF-336389
3	INCORPORATED FDC-8657 AS-BUILT AS OF 10/25/2012 SEE DRF-337759
4	INCORPORATED FDC-8752, AS-BUILT AS OF 9-5-2013, SEE DRF-340004
5	INCORPORATED FDC-10570, AS-BUILT AS OF 10-13-2015, SEE DRF-347089
6	INCORPORATED FDC-12044, AS-BUILT AS OF 4-24-2019, SEE DRF-362759



NOTES:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

LEGEND

- DATA/DATA OUTLET
- IFTx-x INSTRUMENT FEED THRU OUTLET
- INTERCOM UNIT CLEAR-COM #KB-701
- INTERCOM UNIT CLEAR-COM #KB-701 AND POWER SUPPLY, #PS-702
- CCTV CAMERA
- CCTV JUNCTION BOX
- OMNI-DIRECTIONAL HIGH-GAIN ANTENNA

LAST NO. USED

DATA/DATA	A48-D
DATA/DATA	B42-D
DATA	CCTV-14

AIRLOCK 5 FLOOR PLAN

SCALE: 3/16" = 1'-0"

X-REF DRAWINGS

762163 – AIRLOCK 5
762164 – AIRLOCK 5 EQUIPMENT

Larry Fisher
Fluor Idaho
2019.05.02 09:08:57 -06'00'

PROFESSIONAL ENGINEER REGISTERED 6878 STATE OF IDAHO LARRY D. FISHER

2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: N/A	– –
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2019.05.02 09:08:57 -06'00'
TECHNICAL CHECK: N/A	– –
ENG GROUP SUPERVISOR: N/A	– –
DESIGN LEAD/AUTHORITY: D.J. McGARY	Doug J. McGary Fluor Idaho 2019.05.02 14:39:46 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2019.05.02 15:07:58 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 327002	

Idaho Cleanup Project Core Fluor IDAHO

PHASE V OF THE ACCELERATED RETRIEVAL PROJECT RE5/AL5 WMF-1617 DATA/DATA, CCTV AND INTERCOM FLOOR PLAN

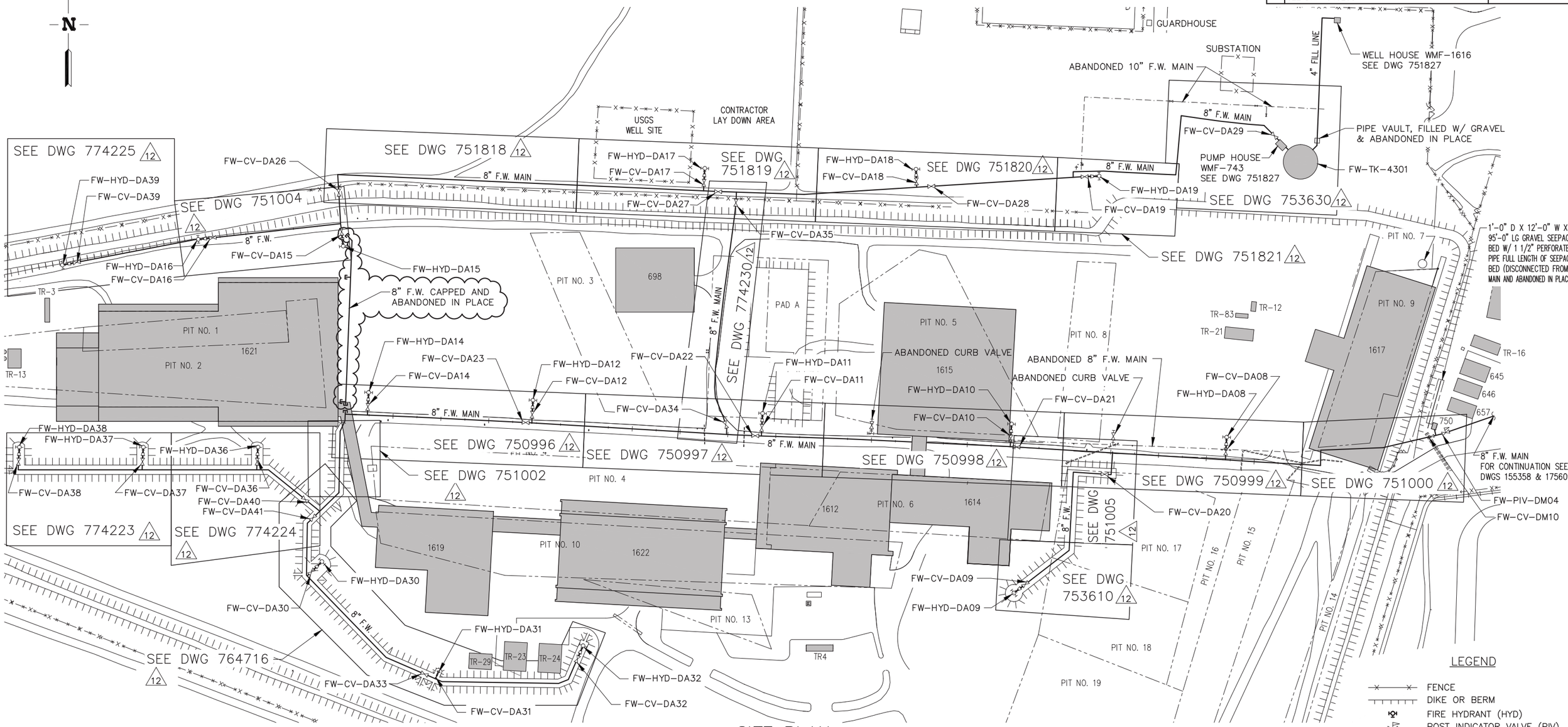
SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	06	136	762154	6

SCALE: NOTED SHEET 1 OF 1

RW-1279

File: 762154-6.dwg Path: C:\Users\bxs\Documents\BXS\RW-1279 (ARPs Start 1-31-2019)\DRF-362759 Date: 05/02/19 – 9:00 AM Layout Name: Layout1 ID: BXS

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
19	REMOVED PRIOR REVISION HISTORY, INCORPORATED FDC-10683, AS-BUILT AS OF 1-19-2016, SEE DRF-347622	3-15-2016	
20	AS-BUILT AS OF 3-24-2016, SEE DRF-348288	3-30-2016	



SITE PLAN

NOTES

1. ALL UNDERGROUND F.W. PIPING IS CL. 200 C.I. W/ MJ FITTINGS OR TYTON JT. FITTINGS (SEE SPECS) IN ACCORDANCE W/ NFPA 24.
2. THRUST BLOCKS ARE PROVIDED IN ACCORDANCE W/ NFPA 24. THRUST BLOCKS ARE CAST IN PLACE AGAINST UNDISTURBED TRENCH WALLS WHEN NOT UTILIZING THRUST RESTRAINT SYSTEM PIPING.
3. REMOVED
4. REMOVED
5. REMOVED
6. LAYOUT OF FIREWATER PIPING IS BASED UPON RWMC SITE SPECIFIC DATUM TO AGREE WITH THE RWMC NORTH AND SOUTH CONTROL POINTS WHICH HAVE BEEN MEASURED WITH A 1991 GPS FIRST LEVEL CONTROL. FOR THE LOCATION OF PIPING COMPONENTS SEE RWMC DRAFTING. FIELD VERIFY BEFORE BEGINNING SUBSURFACE WORK.
7. REMOVED
8. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
9. SEE DRAWING 415445 SHEET 3 FOR THE OPERATIONS AREA PRIMARY FIREWATER PUMP HOUSE P & ID.
10. THE PRIMARY RWMC FIRE WATER SUPPLY SYSTEM FROM WMF-639 CONSISTS OF TWO 2000 GPM PUMPS OPERATING AT 125 PSI NET DISCHARGE PRESSURE (ONE DIESEL ENGINE DRIVEN, ONE ELECTRIC MOTOR DRIVEN 480 VAC) TAKING SUCTION FROM A 250,000 GALLON (MINIMUM LEVEL 207,413 GALLON) GRADE LEVEL WATER STORAGE TANK. THE ELECTRIC MOTOR DRIVEN PUMP AUTOMATICALLY STARTS AT 120 PSIG. THE DIESEL ENGINE DRIVEN PUMP AUTOMATICALLY STARTS WHEN THE SYSTEM PRESSURE DROPS TO BELOW 110 PSIG AND AFTER A 24 SECOND TIME DELAY.
11. THE SECONDARY WATER SUPPLY FROM WMF-743 CONSISTS OF A 1500 GPM AT 85 PSIG NET, AUTOMATIC STARTING, DIESEL ENGINE DRIVEN FIRE PUMP TAKING SUCTION FROM FW-TK-4301 GRADE LEVEL SUCTION TANK.

12. REFERENCE DRAWING ONLY.

13. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

Paul D. Leonard
CWI
2016.03.30 08:15:16 -06'00'
PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

13

PROJECT NO. 015575

QTY. REQD.	QUAL. LEVEL	PART OR IDENTIFYING NO.	DESCRIPTION/MATERIAL/SPECIFICATION	ITEM/ FIND

PARTS LIST

DIMENSIONING AND SYMBOLOGY ARE AMERICAN NATIONAL STANDARD UNLESS OTHERWISE SPECIFIED
SURFACE ROUGHNESS 125
DIMENSIONS AND TOLERANCES ARE IN INCHES
TOLERANCES: .X = ±.1
DECIMALS: .XX = ±.03
.XXX = ±.010
FRACTIONS ±1/8
ANGULAR ±2°
DO NOT SCALE DRAWING

NEXT ASSY/REF DWG	N/A	
P.M.	D.L. FRENCH	11/5/92
DESIGN MGR	J.C. KVAMME	11/5/92
DESIGN	D.R. SCHIESS	DATE 11/9/92
CHECKED	D.R. SCHIESS	DATE 11/9/92
DRAWN	B.L. SCOTT	DATE 5/27/92
RELEASE	A.L. WATLINGTON	DATE 11-9-92

EG&G Idaho, Inc.

RWMC — SDA AREA

RADIOACTIVE WASTE MANAGEMENT COMPLEX
SDA FIREWATER PIPING
PLOT PLAN

SIZE	INDEX CODE NUMBER (AREA / TYPE / CL / ORIG)	DRAWING NO.	REV
D	098 0200 52 220	177425	20
SCALE 1'=100' & NOTED		SPEC CODE	SHT 1 OF 1

RW-1273

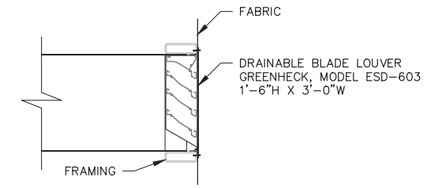
File: 177425-20.dwg
Path: C:\Users\bxs\Documents\BXS\RW-1273 (ARPs Start 1-12-2016)
Date: 03/30/16 – 8:09 AM Layout Name: Sheet 1 ID: BXS

FMT-D1-REV 4

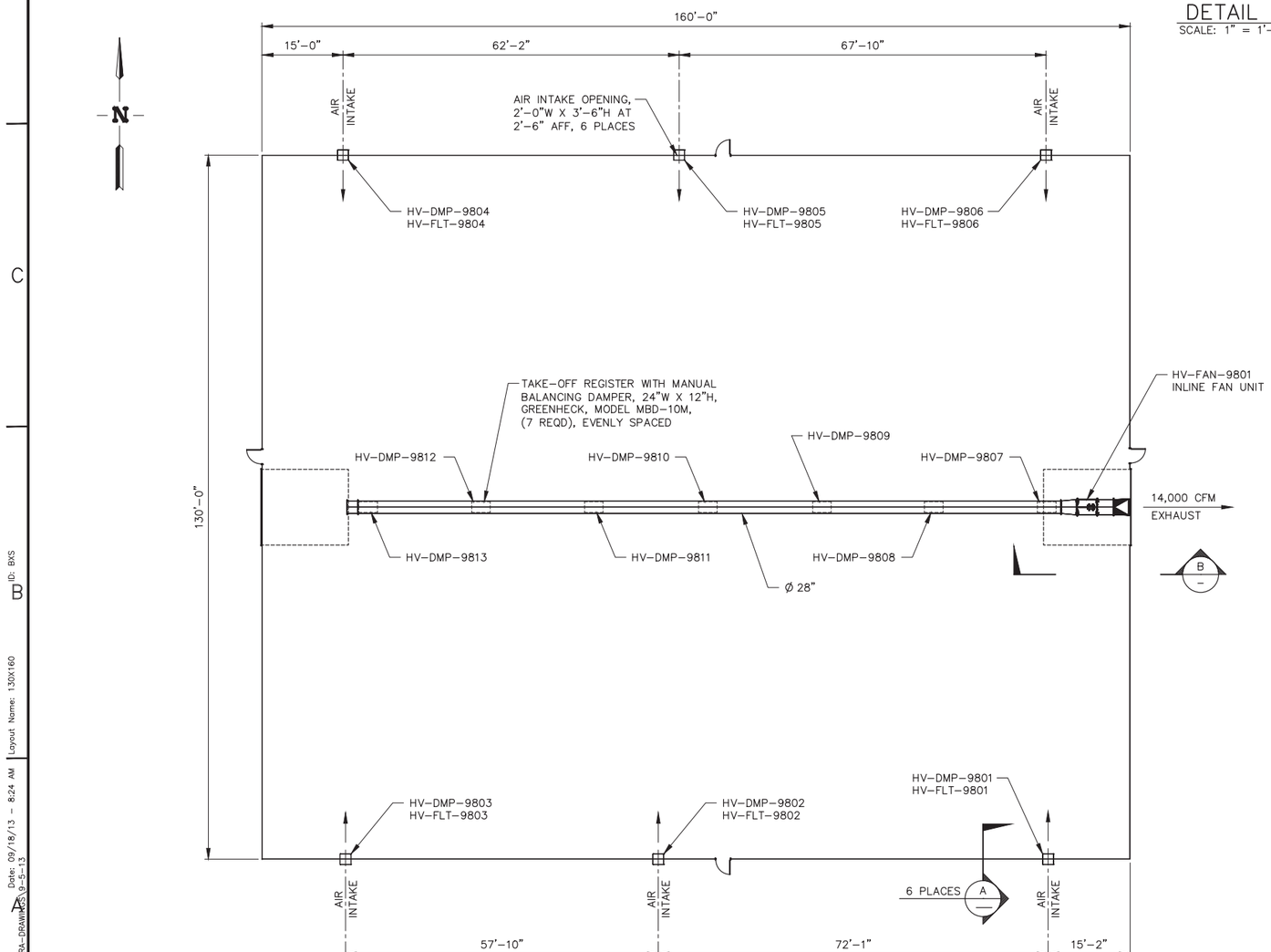
NOTES

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT SAFETY CATEGORY DESIGNATION
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

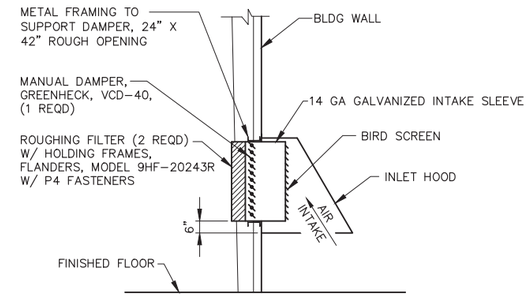
REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:
1	CHANGED DRAWING TITLE & INDEX CODE CLASS, INCORPORATED PERTINENT INFO FROM DWG 631229, AS-BUILT AS OF 9-29-2005, SEE DAR-125738	10-6-2005
2	DRAWING ASSESSED AND VERIFIED AS-BUILT AS OF 1/26/2012 SEE DRF-335441	2/6/2012
3	ADDED P.E. STAMP AND NOTE 2. AS-BUILT AS OF 9/5/2013 SEE DRF-340004	9-18-2013



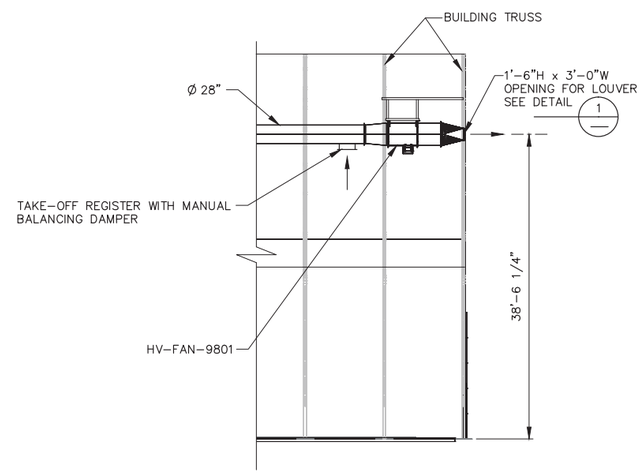
DETAIL 1
SCALE: 1" = 1'-0"



HVAC FLOOR PLAN
SCALE: 3/32" = 1'-0"



SECTION A
SCALE: 3/8" = 1'-0"



SECTION B
SCALE: 1/8" = 1'-0"

Paul D. Leonard
CWI
2013
-0610

PROFESSIONAL ENGINEER 13530 STATE OF IDAHO PAUL D. LEONARD

REQUESTER: S.L. AUSTAD	
DESIGN: L.E. GUILLEN	
DRAWN: E.L. TOMLIN	
PROJECT NO.	23927
SPCL CODE	
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO. 124246	
EFFECTIVE DATE: 7-20-05	

Idaho Cleanup Project CH2M HILL

RWMC
TARGETED WASTE REMOVAL
AND DISPOSITION PROJECT
STORAGE ENCLOSURE
VENTILATION PLAN, SECTIONS AND DETAIL

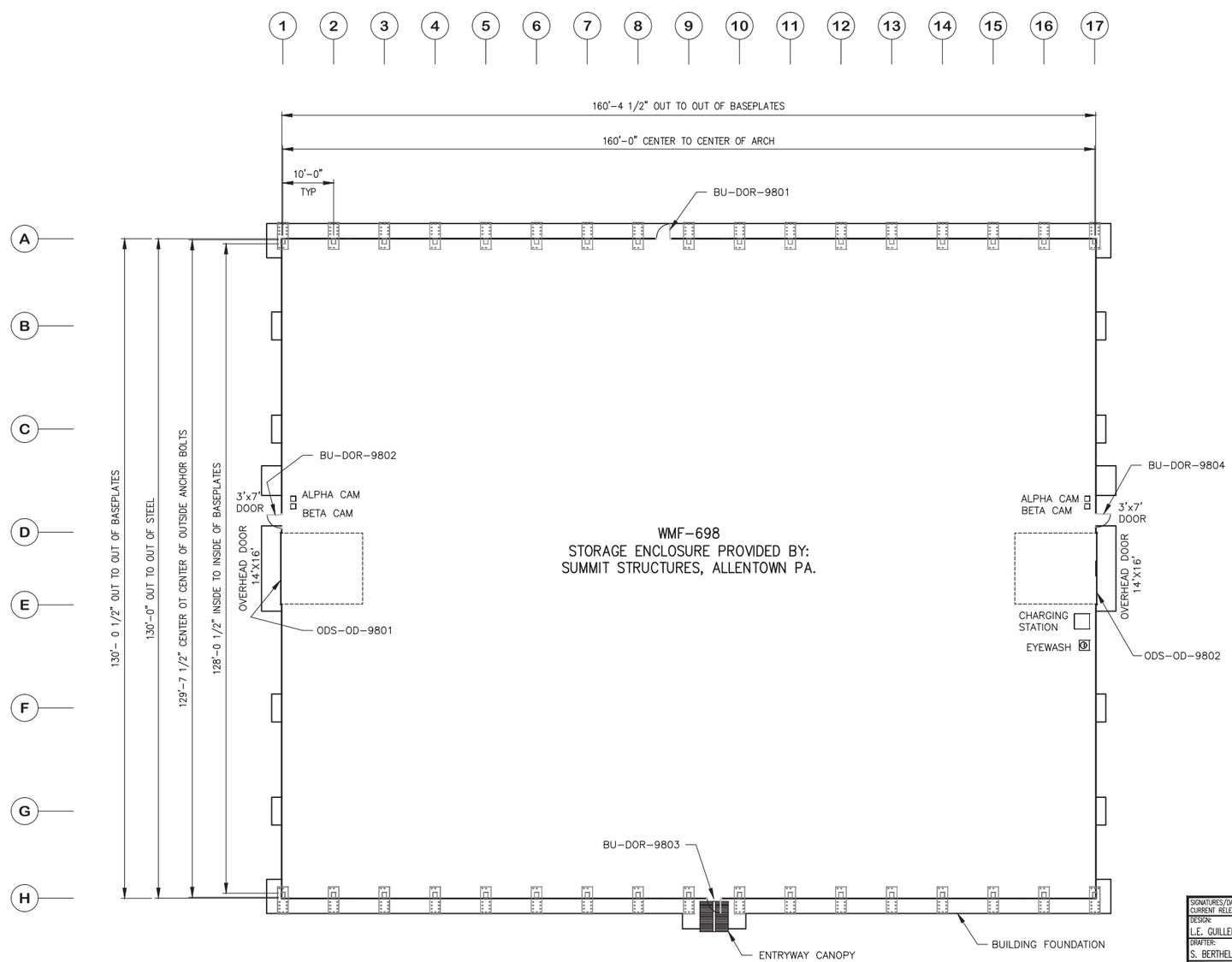
SIZE	INDEX CODE NUMBER					DWG-	REV
	AREA	TYPE	CL	DISC			
D	098	0698	22	136		631228	3

SCALE: NOTED
SHEET 1 OF 1

File: 631228-3.dwg
Path: L:\KE-S\RCRA\RCRA-DRAWINGS\9-5-13
Date: 09/18/13 - 8:24 AM | Layout Name: 130X160
ID: BKS

FMT-D1-REV 5.2

REVISIONS	
REV.	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-6025, AS-BUILT AS OF 11-17-2009, SEE DRF-328954
2	INCORPORATED FDC-7494, AS-BUILT AS OF 1-17-2011, SEE DRF-332225
3	DRAWING ASSESSED AND VERIFIED AS-BUILT AS OF 1/26/2012 SEE DRF-335441
4	ADDED P.E. STAMP AND NOTE 2. AS-BUILT AS OF 9/5/2013 SEE DRF-340004



WMF-698
STORAGE ENCLOSURE PROVIDED BY:
SUMMIT STRUCTURES, ALLENTOWN PA.

STORAGE ENCLOSURE PLAN

SCALE: 3/32"=1'-0"
12,480 DRUM MAX COUNT

NOTES

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

GENERAL NOTES

1. GENERAL DESIGN:
   DESIGN CODES:
   - GENERAL – INTERNATION BUILDING CODE (2003 EDITION)
   - CONCRETE – ACI-318-00
   - STEEL – AISC (NINTH EDITION)
   - IBC OCCUPANCY: S-2
   - IBC BUILDING TYPE: IIB
   - NFPA 101 OCCUPANCY: ORDINARY HAZARD STORAGE
   - DESIGN LOADS: SEE SPC-521

Paul D. Leonard
CWI
2013.09.18 09:26:54 -06'00'

PROFESSIONAL ENGINEER LICENSED 13530 PROFESSIONAL ENGINEER PAUL D. LEONARD

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: L.E. GUILLEN	N/A	N/A
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:26:54 -06'00'	
TECHNICAL CHECK: EGS	N/A	N/A
ENG GROUP SUPERVISOR: S.L. AUSTAD	N/A	N/A
DESIGN LEAD: S.L. AUSTAD	N/A	N/A
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:14:47 -06'00'	
PROJECT NUMBER: 23927		
DRF NUMBER: 124246		

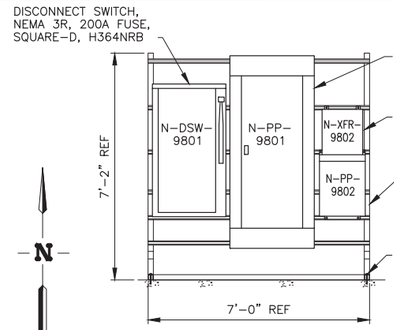
Idaho Cleanup Project CH2M HILL WG IDAHO, LLC

RWMC
TARGETED WASTE REMOVAL
AND DISPOSITION PROJECT
STORAGE ENCLOSURE
PLAN

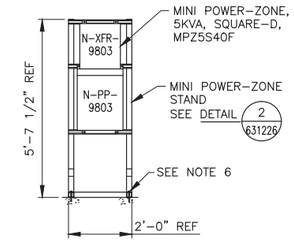
SIZE	INDEX CODE NUMBER (AREA / TYPE / CL / DRBC)	DWG-	REV
D	098 / 0698 / 00 / 136	631225	4
SCALE: NOTED		SHEET 1 OF 1	

RW-1265

File: 631225-4.dwg
Path: L:\CE-S\RCRA\RCRA-DRAWINGS\S-3
Date: 09/12/13 – 11:46 AM | Layout Name: S-3
ID: BXS



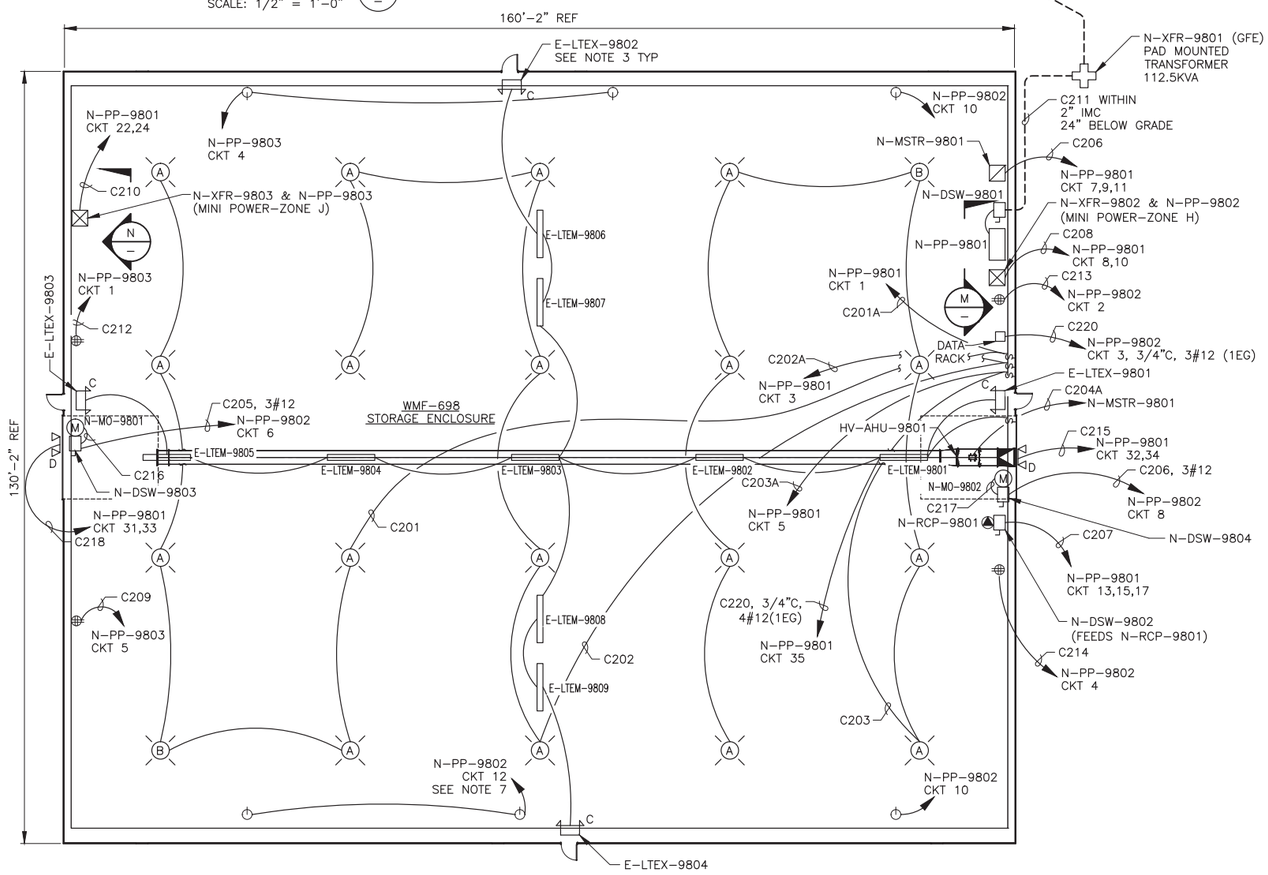
ELEVATION (M)
SCALE: 1/2" = 1'-0"



ELEVATION (N)
SCALE: 1/2" = 1'-0"

EXISTING POWER POLE 49-28 (12.47KV LINE), SEE NOTE 4

C200 3#2 & 1#6EG, CLX TYPE MC-HL, 15KV 24" BELOW GRADE OR 24" COMPACTED COVER AT ROAD CROSSING THEN SURFACE RUN TO TRANSFORMER SEE NOTE 5



NORMAL POWER AND LIGHTING
SCALE: 3/32" = 1'-0"

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:
4	REMOVED PRIOR REVISION HISTORY, AS-BUILT AS OF 1/26/2012, SEE DRF-335441	2/6/2012
5	ADDED P.E. STAMP AND NOTE 9. AS-BUILT AS OF 9/5/2013, SEE DRF-340004	9-18-2013

NOTES

1. LUMINAIRE LOCATION IS APPROXIMATE. LUMINAIRES ARE SUPPORTED FROM THE TRUSSES. MOUNT PER MANUFACTURER'S INSTRUCTIONS.
2. UPPER CASE LETTERS WITHIN OR NEAR LUMINAIRE INDICATE LUMINAIRE TYPE, SEE LUMINAIRE SCHEDULE, SEE SHEET E-1.
3. EMERGENCY EXIT LIGHTS AND SIGNS ARE NOT TO BE SWITCHED AND MUST BE ON AT ALL TIMES.
4. USE EXISTING/AVAILABLE RISER AND CUTOUTS.
5. IF ROCK IS ENCOUNTERED AND 24" BELOW GRADE IS NOT POSSIBLE THEN COVER CONDUIT IN CONCRETE PER FDC-SD-11. CONNECT TO TRANSFORMER WITH 200A LOAD BREAK ELBOWS.
6. ANCHOR STAND TO CONCRETE FLOOR USING ø3/8" EXPANSION ANCHORS WITH 1 1/2" MIN EMBEDMENT. FIELD LOCATE AS REQD. ANCHOR STAND PRIOR TO INSTALLING EQUIPMENT.
7. USE #10 AWG (VOLTAGE DROP).
8. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
9. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

LEGEND

- SINGLE 5-20R RCPT; MARKED "CAM USE"
- POWER POLE
- GFCI PROTECTED QUAD RECEPTACLE
- CHARGING STATION RECEPTACLE (480V, 3ø)
- POWER PANEL
- MINI POWER-ZONE
- TRANSFORMER
- DISCONNECT SWITCH
- MOTOR STARTER
- MOTOR FOR ROLL UP DOOR
- CEILING MOUNT LUMINAIRE, LETTER INDICATES FIXTURE TYPE
- EMERGENCY EXIT LIGHT & SIGN WITH BATTERY BACKUP
- EXTERIOR LIGHTING, LETTER INDICATES FIXTURE TYPE
- UNDERGROUND RACEWAY
- ABOVE GROUND RACEWAY

X-REF DRAWING

631242

Larry Fisher
CWI
2013
-067

FOR DRAWING INDEX SEE DRAWING NO. 631223

SCALE: 1/2" = 1'-0"
SCALE: 3/32" = 1'-0"

DESIGN PHASE: N/A
SAFETY CATEGORY: NOTE 8

REQUESTER: S.L. AUSTAD
DESIGN: M.G. PHILLIPS
DRAWN: J.L. ROBERTS
PROJECT NO. 23927
SPCL CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO. 124246
EFFECTIVE DATE: 7/20/05

Idaho Cleanup Project CH2M HILL WG IDAHO, LLC

RWMC
TARGETED WASTE REMOVAL
& DISPOSITION PROJECT
WMF-698 STORAGE ENCLOSURE
NORMAL POWER AND LIGHTING PLAN

SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	G	ORIG		
D	098	0698	10	136	631233	5

SCALE: NOTED
SHEET 1 OF 1

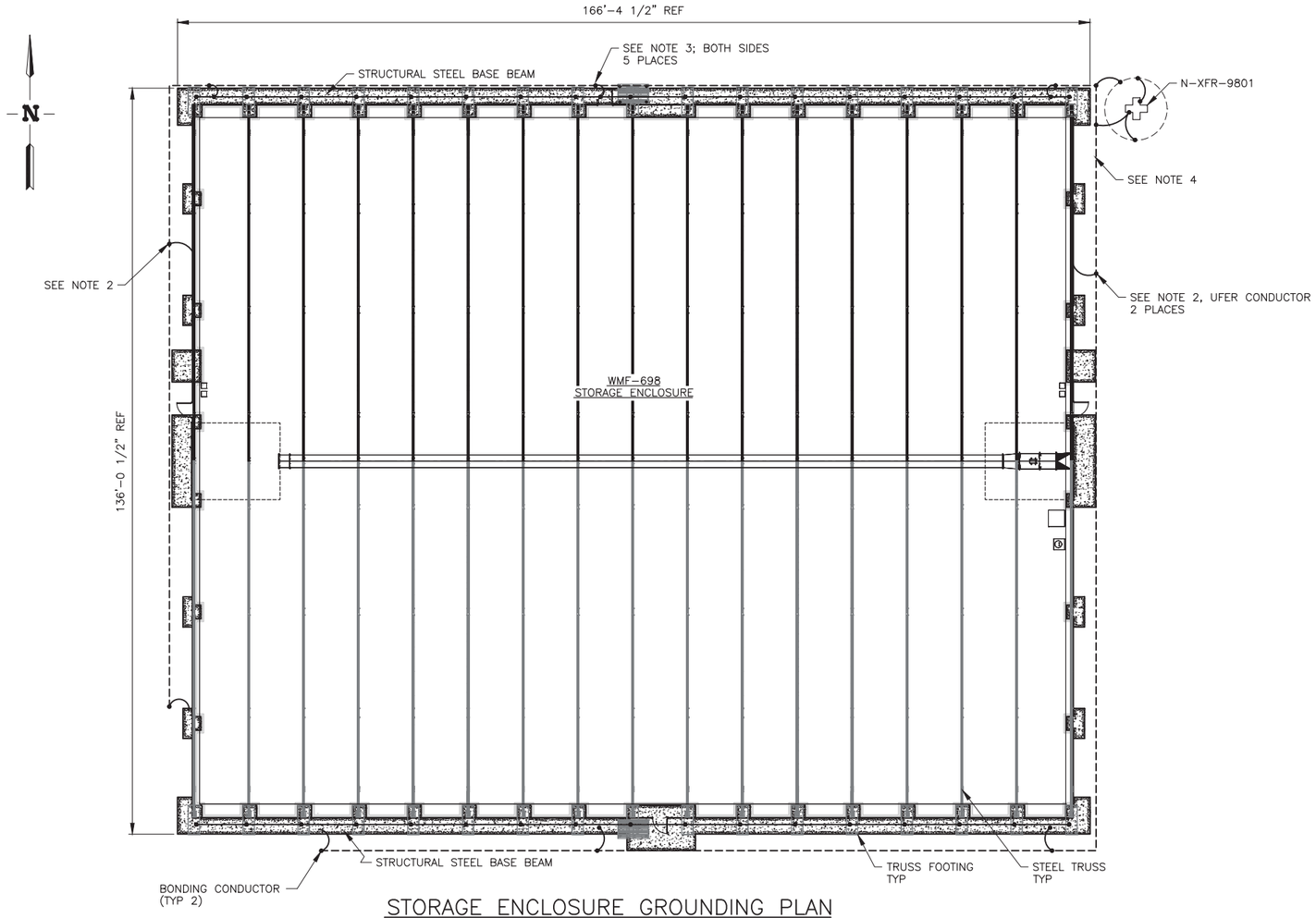
RW-1264

FMT-D1-REV 4

File: 631233-5.dwg
Path: L:\KE-S\RCRA\RCRA-DRAWINGS
Date: 09/16/13 - 8:26 AM
Layout Name: D Size
ID: BKS

FMT-D1-REV 5.2

REVISIONS	
REV.	DESCRIPTION
1	CHANGED DWG TITLE AS-BUILT AS OF 1/26/2012 SEE DRF-335441
2	ADDED P.E. STAMP AND NOTE 7. AS-BUILT AS OF 9/5/2013 SEE DRF-340004



STORAGE ENCLOSURE GROUNDING PLAN

SCALE: 3/32" = 1'-0"

NOTES

1. ALL LIGHTNING PROTECTION AND GROUNDING CONDUCTORS ARE #2/0 AWG BARE COPPER.
2. CONCRETE-ENCASED ELECTRODE (UFER) CONDUCTOR IS BONDED TO BUILDING GROUNDING RING.
3. BUILDING GROUNDING RING IS BONDED TO STRUCTURAL STEEL BASE BEAM.
4. BUILDING GROUNDING RING IS AGAINST THE PERIMETER SIDE OF STEM WALL 30" BELOW GROUND LEVEL AROUND THE STORAGE ENCLOSURE AS SHOWN.
5. STRUCTURAL STEEL BASE BEAM GROUND CONDUCTOR IS BONDED TO STRUCTURAL STEEL.
6. THIS IS A QUALITY LEVEL 4 SYSTEM.
7. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

LEGEND

- GROUND CONNECTION
- BURIED GROUND WIRE
- EXPOSED GROUND BONDING CONDUCTOR
- TRANSFORMER

Larry Fisher
CWI
2013.09.18 09:17:41
-06'00'

7

X-REF DRAWING

631242

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: M.G. PHILLIPS	N/A	N/A
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:28:39 -06'00'	
TECHNICAL CHECK: M.W. VAUGHN	N/A	N/A
ENG GROUP SUPERVISOR: T.M. HIPP	N/A	N/A
DESIGN LEAD: S.L. AUSTAD	N/A	N/A
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:17:45 -06'00'	
PROJECT NUMBER: 23927		
DRF NUMBER: 124246		

Idaho Cleanup Project CH2M HILL IDAHO, LLC

RWMC
TARGETED WASTE REMOVAL
AND DISPOSITION PROJECT
STORAGE ENCLOSURE
GROUNDING PLAN

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	0698	10	136	631234	2

SCALE: NOTED SHEET 1 OF 1

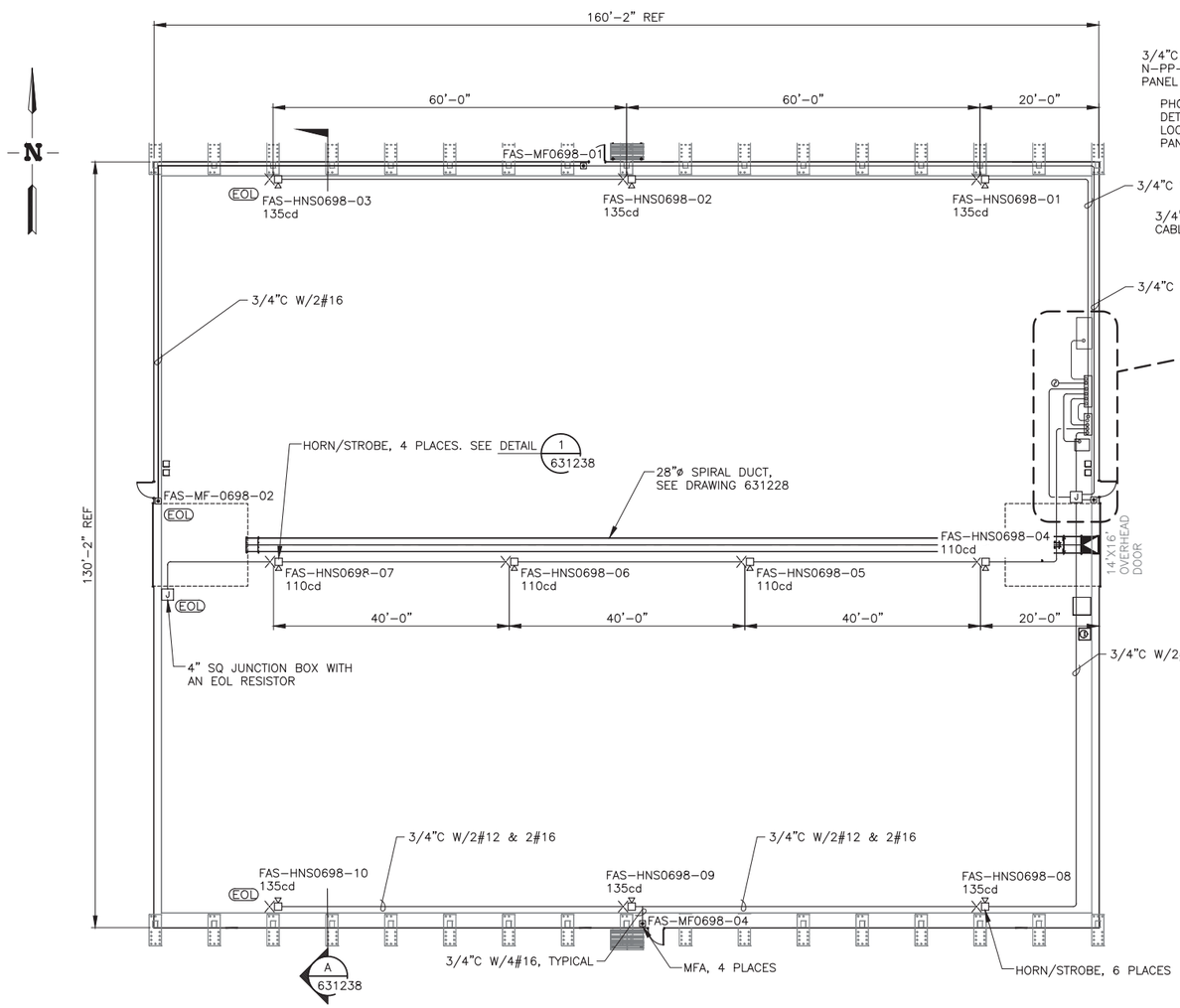
File: 631234-2.dwg
Path: L:\RE-S\RCRA\RCRA-DRAWINGS\9-5-13
Date: 09/12/13 - 11:48 AM | Layout Name: D Size
ID: BKS

FMT-D1-REV 5.2

NOTES

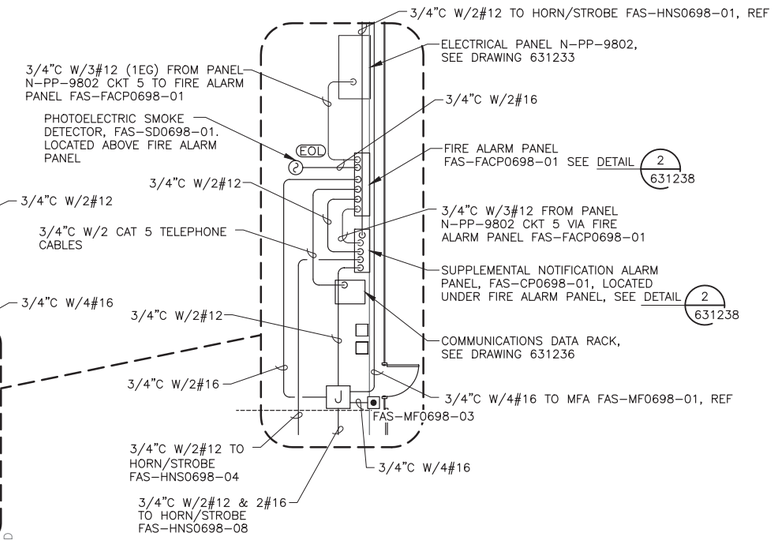
1. SEE DRAWINGS 631239 & 631240 FOR WIRING DIAGRAMS AND DRAWING 631241 FOR BATTERY CALCULATIONS.
2. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
3. THIS STAMP AND SIGNATURE VERIFIES THAT THE FIRE PROTECTION EQUIPMENT IS INSTALLED IN THE GENERAL LOCATIONS SHOWN ON THIS DRAWING.

REVISIONS	
REV.	DESCRIPTION
1	CHANGED DWG TITLE INCORPORATED FDC 2884 AS-BUILT AS OF 1/26/2012 SEE DRF-335441
2	ADDED P.E. STAMP AND NOTE 3. AS-BUILT AS OF 9/5/2013 SEE DRF-340004



STORAGE ENCLOSURE PLAN

SCALE: 3/32" = 1'-0"



LEGEND

- MANUAL FIRE ALARM STATION
- HORN/STROBE
- EOL — END OF LINE RESISTOR
- SMOKE DETECTOR

Douglas Clark
CWI
2013-06

PROFESSIONAL ENGINEER REGISTERED 11200 STATE OF IDAHO DOUGLAS W. CLARK

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: BRUNSON	N/A N/A
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:24:10 -06'00'
TECHNICAL CHECK: D.W. CLARK	N/A N/A
ENG GROUP SUPERVISOR: W.H. REED	N/A N/A
DESIGN LEAD: T. LANGENWALTER	N/A N/A
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:18:35 -06'00'
PROJECT NUMBER: 23927	
DRF NUMBER: 124426	

Idaho Cleanup Project CH2MHILL IDAHO, LLC

RWMC
TARGETED WASTE REMOVAL
AND DISPOSITION PROJECT
STORAGE ENCLOSURE
FIRE ALARM PLAN

SIZE	INDEX CODE NUMBER AREA	TYPE	CA	CODE	DWG-	REV
D	098	0698	12	136	631237	2

SCALE: NOTED — SHEET 1 OF 1

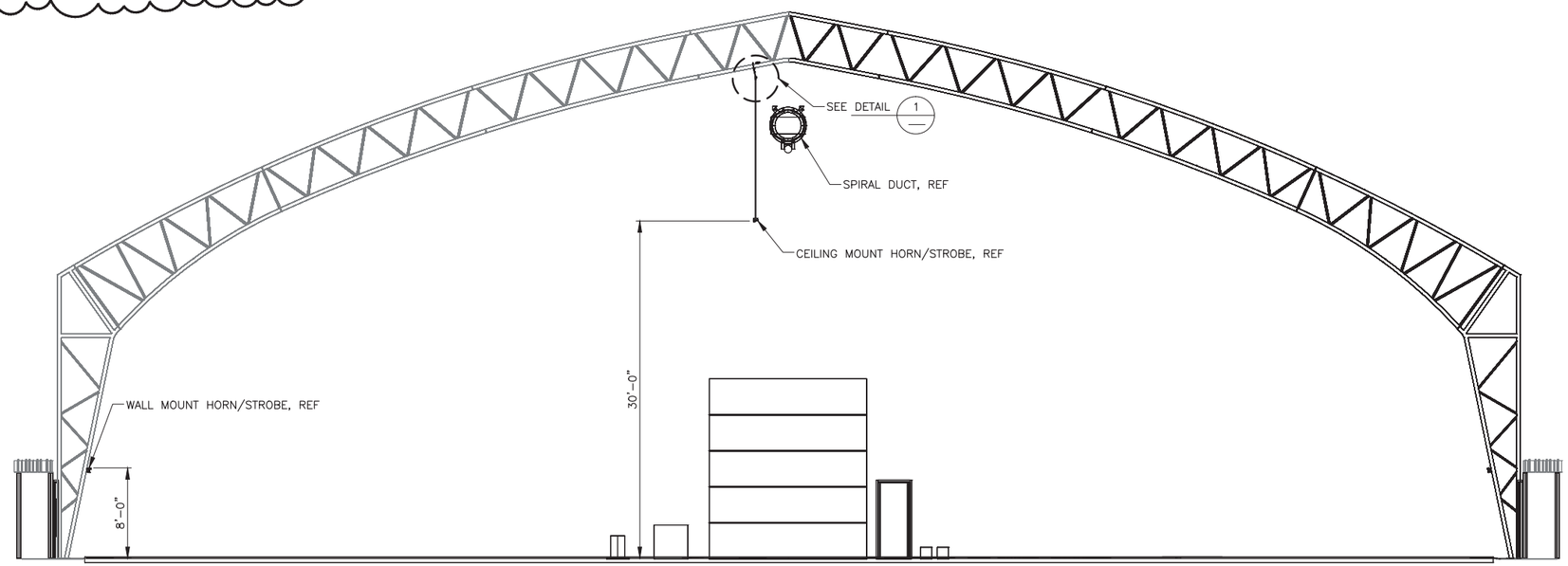
File: 631237-2.dwg
Path: S:\RE-S\RCRA\RCRA-DRAWINGS\9-5-13
Date: 09/17/13 - 1:45 PM | Layout Name: Layout1 | ID: BSL

FMT-D1-REV 5.2

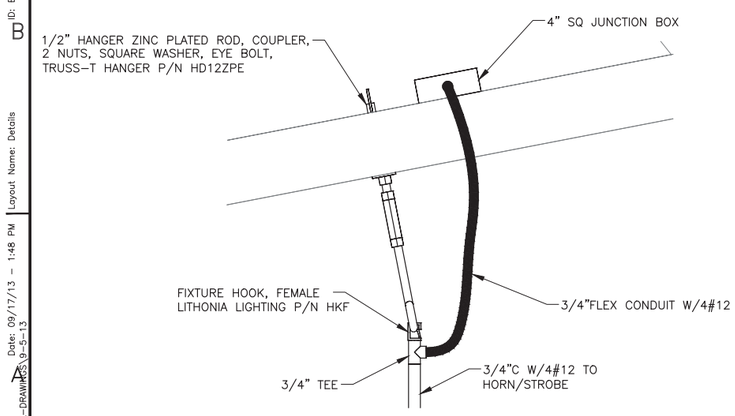
NOTES

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT LEVEL DESIGNATION.
2. THIS STAMP AND SIGNATURE VERIFIES THAT THE FIRE PROTECTION EQUIPMENT IS INSTALLED IN THE GENERAL LOCATIONS SHOWN ON THIS DRAWING.

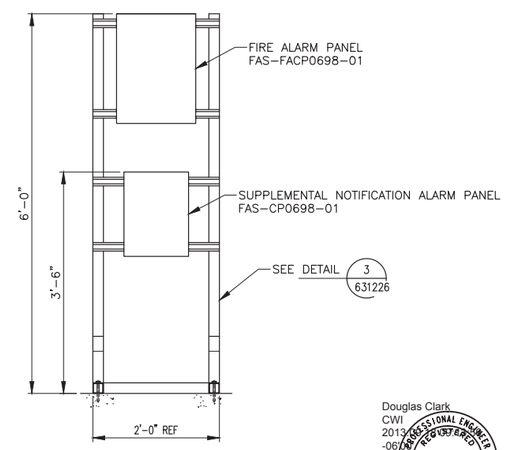
REVISIONS	
REV.	DESCRIPTION
1	CHANGED DWG TITLE AS-BUILT AS OF 1/26/2012 SEE DRF-335441
2	ADDED P.E. STAMP AND NOTE 2. AS-BUILT AS OF 9/5/2013 SEE DRF-340004



SECTION A 631237
SCALE 3/16 = 1'-0"



DETAIL 1
SCALE: 3"=1'-0"



DETAIL 2 631237
SCALE: 3"=1'-0"

Douglas Clark
CWI
2013.09.18 08:24:26 -06'00'

PROFESSIONAL ENGINEER REGISTERED 11200 STATE OF IDAHO DOUGLAS W. CLARK

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: BRUNSON	N/A	N/A
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:24:26 -06'00'	
TECHNICAL CHECK: D.W. CLARK	N/A	N/A
ENG GROUP SUPERVISOR: W.H. REED	N/A	N/A
DESIGN LEAD: T. LANGEWALTER	N/A	N/A
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:33:18 -06'00'	
PROJECT NUMBER: 23927		
DRF NUMBER: 124426		

Idaho Cleanup Project CH2M HILL BWXT IDAHO, LLC

RWMC
TARGETED WASTE REMOVAL
AND DISPOSITION PROJECT
STORAGE ENCLOSURE
FIRE ALARM SECTION AND DETAILS

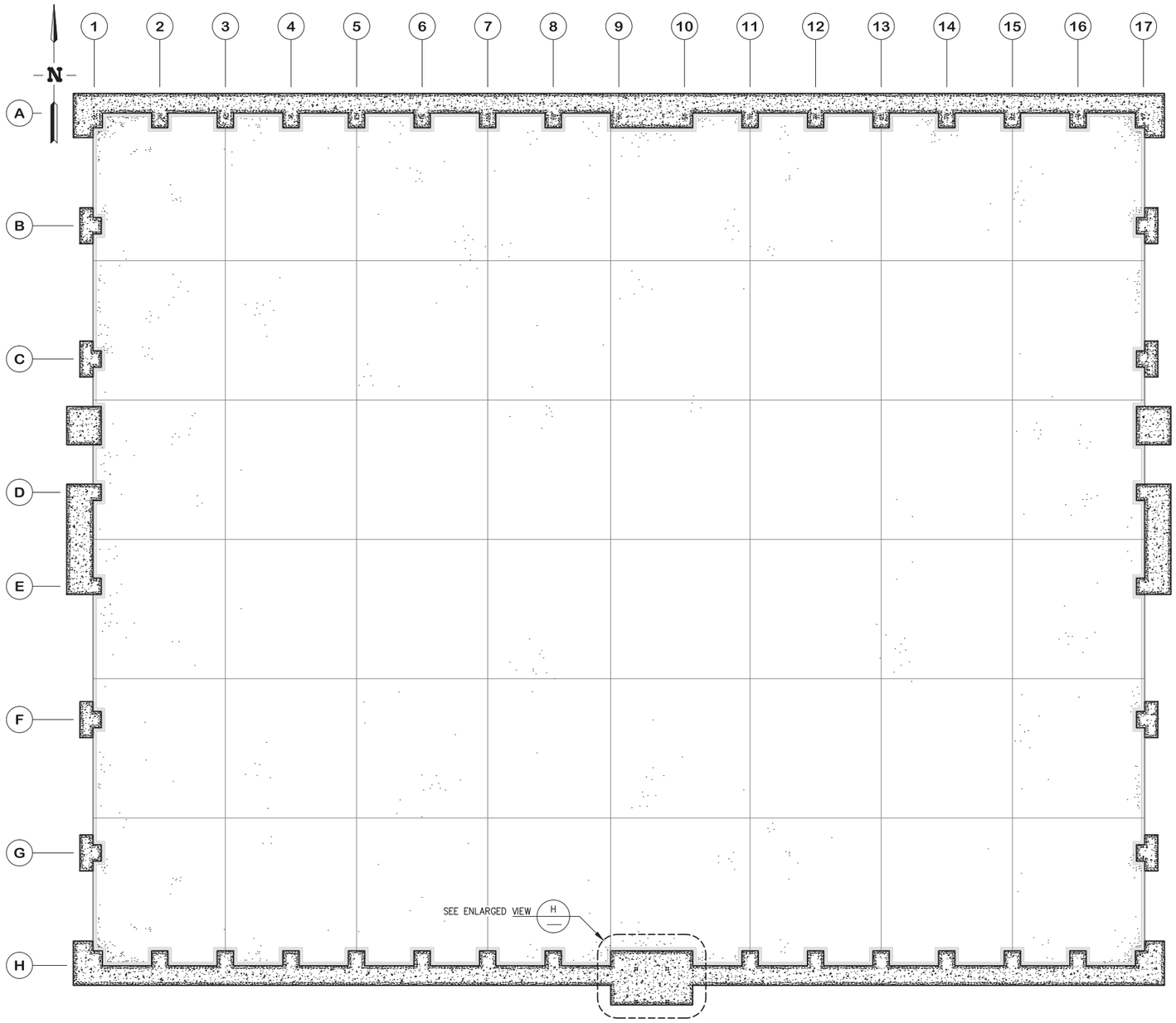
SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CI	ORG		
D	098	0698	12	136	631238	2

SCALE: NOTED
SHEET 1 OF 1

File: 631238-2.dwg
Path: S:\WE-S\RCRA\RCRA-DRAWINGS\9-5-13
Date: 09/17/13 – 1:48 PM | Layout Name: Details
ID: BSL

FMT-D1-REV 5.2

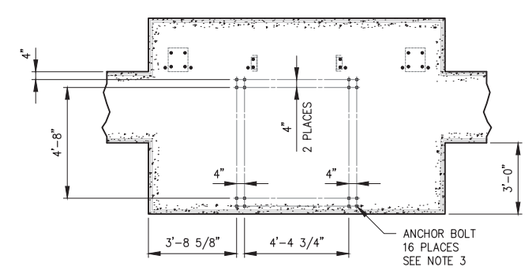
REVISIONS	
REV.	DESCRIPTION
1	CHANGED DWG TITLE INCORPORATED FDC-SE-6 AS-BUILT AS OF 1/26/2012 SEE DRF-335441
2	ADDED P.E. STAMP AND NOTE 7. AS-BUILT AS OF 9/5/2013 SEE DRF-340004



FOUNDATION INSTALLATION PLAN
SCALE: 1/8"=1'-0"

NOTES:

1. REINFORCEMENT IS #4 REBAR AT 12" OC MAXIMUM SPACING EACH WAY, EACH FACE.
2. ENCLOSURE ANCHOR BOLTS ARE 5/8" DIAMETER ASTM A325 BOLTS. PROJECT 2" ABOVE CONCRETE. EMBEDMENT IS A MINIMUM OF 9". FLAT WASHERS ARE 1 1/2" DIAMETER .
3. CANOPY ANCHOR BOLTS ARE 1/2" DIAMETER ASTM A307 OR ASTM A325 BOLTS. PROJECTED 2" ABOVE CONCRETE. EMBEDMENT IS A MINIMUM OF 4". FLAT WASHERS ARE 1 3/8" DIAMETER
4. SEE PAD REFERENCE DRAWINGS 627916 & 627917 FOR ADDITIONAL INFORMATION.
5. SEE DRAWING 631234 FOR GROUNDING PLAN.
6. THIS IS A QUALITY LEVEL 4 SYSTEM.
7. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



ENLARGED VIEW H
SCALE: 3/8"=1'-0"

Paul D. Leonard
CWI
2013.09.18 08:26:24 -06'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: S.A. JENSEN	N/A N/A
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:26:24 -06'00'
TECHNICAL CHECK: EGS	N/A N/A
ENG GROUP SUPERVISOR: V.J. BALLS	N/A N/A
DESIGN LEAD: C.J. HURST	N/A N/A
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:13:38 -06'00'
PROJECT NUMBER: 023927	
DRF NUMBER: 123945	

Idaho Cleanup Project — CH2M HILL BechtelBWXT Idaho, LLC

RWMC
TARGETED WASTE REMOVAL AND DISPOSITION PROJECT
STORAGE ENCLOSURE
FOUNDATION PLAN

SIZE	INDEX CODE NUMBER: AREA	TYPE	ID	DISC	DWG-	REV
D	098	0698	62	136	631130	2

SCALE: NOTED — SHEET 1 OF 1

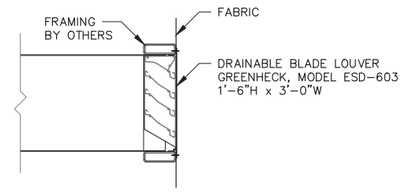
File: 631130-2.dwg
Path: L:\RE-S\RCRA\RCRA-DRAWINGS\9-5-13
Date: 09/12/13 – 1:13 PM | Layout Name: S-1 | ID: BXS

FWT-D1-REV. 5.2

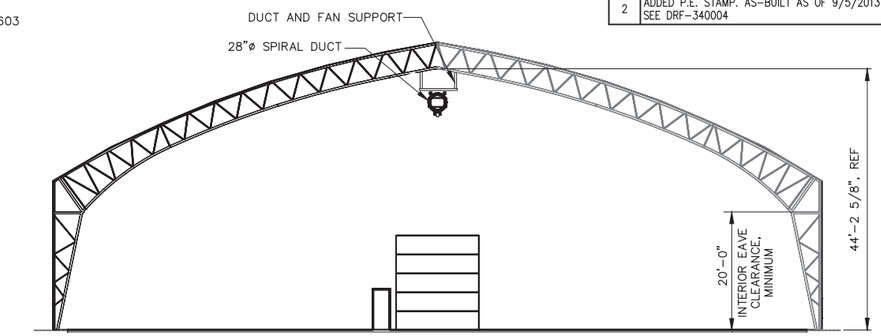
NOTES:

1. THIS IS A QUALITY LEVEL 4 SYSTEM.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

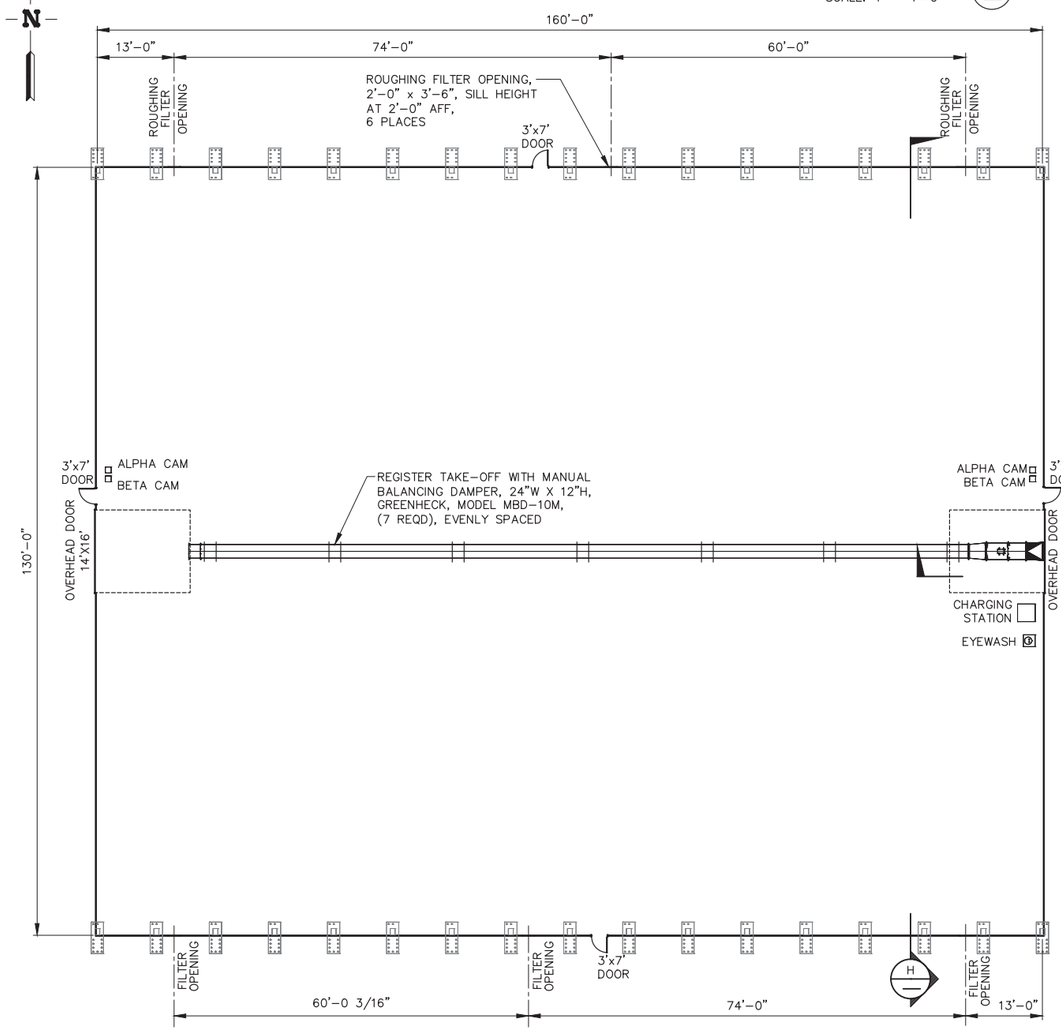
REVISIONS	
REV.	DESCRIPTION
1	CHANGED DWG TITLE AS-BUILT AS OF 1/26/2012 SEE DRF-335441
2	ADDED P.E. STAMP. AS-BUILT AS OF 9/5/2013 SEE DRF-340004



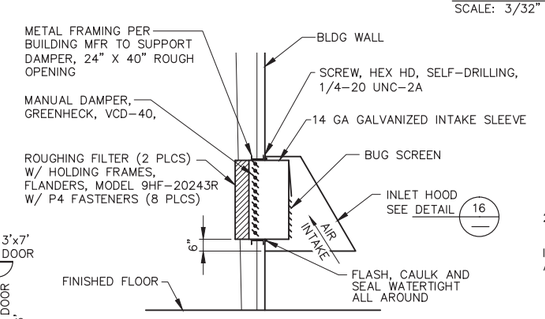
DETAIL (30)
SCALE: 1" = 1'-0"



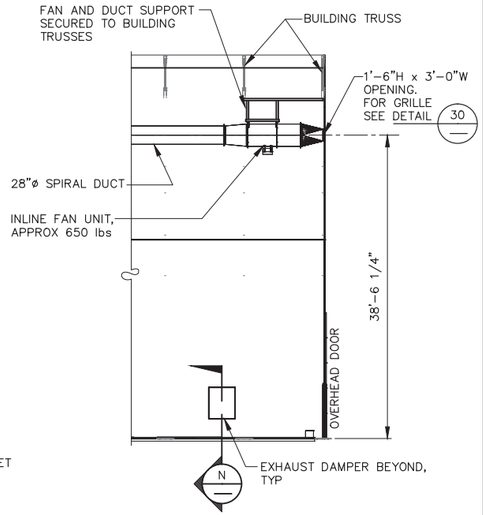
SECTION (H)
SCALE: 3/32" = 1'-0"



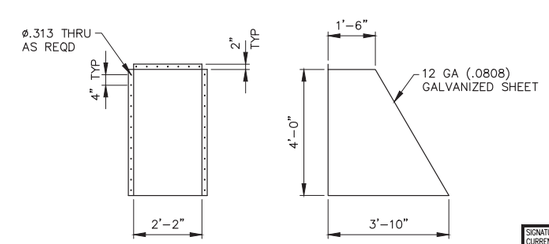
STORAGE ENCLOSURE PLAN
SCALE: 3/32" = 1'-0"
12,480 DRUM MAX COUNT



SECTION (N) (N 631228)
SCALE: 3/8" = 1'-0"



SECTION (M) (M 631228)
SCALE: 1/8" = 1'-0"



DETAIL (16)
SCALE: 1/2" = 1'-0"

Paul D. Leonard
CWI
2013.09.18 08:25:52 -06'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: D.E. NISHOKA	N/A	N/A
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:25:52 -06'00'	
TECHNICAL CHECK: EGS	N/A	N/A
ENG GROUP SUPERVISOR: S.L. AUSTAD	N/A	N/A
DESIGN LEAD: S.L. AUSTAD	N/A	N/A
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:11:02 -06'00'	

INDEX CODE NUMBER			
AREA	TYPE	CL	ORIG
098	0698	22	090

PROJECT NUMBER: 23927
DRF NUMBER: 112500

Idaho Cleanup Project CH2M-WG IDAHO, LLC

RWMC
TARGETED WASTE REMOVAL AND DISPOSITION PROJECT
STORAGE ENCLOSURE
PLAN AND SECTIONS

SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CL	ORIG		
D	098	0698	00	136	627752	2

SCALE: NOTED
SHEET 1 OF 1

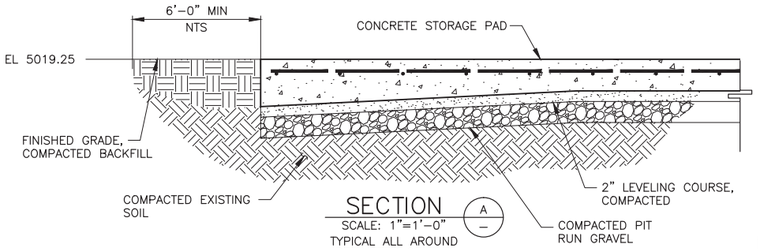
File: 627752-2.dwg
Path: L:\RE-5\RCRA\RCRA-DRAWINGS\V5-5-13
ID: BXS | Layout Name: 130X160 | Date: 09/12/13 – 11:54 AM

FMT-D1-REV 5.2

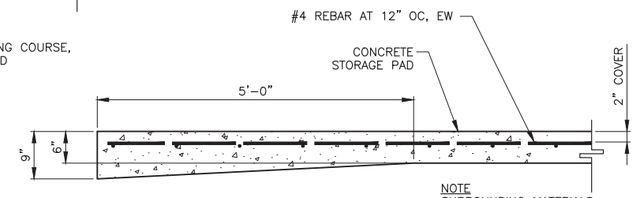
NOTES

1. THIS IS A QUALITY LEVEL 4 SYSTEM.
2. HORIZONTAL DATUM IS RWMC SITE SPECIFIC.
3. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE INCORPORATED FDC-RI-12 AS-BUILT AS OF 1/26/2012 SEE DRF-335441
2	ADDED P.E. STAMP AND NOTE 3. AS-BUILT AS OF 9/5/2013 SEE DRF-340004

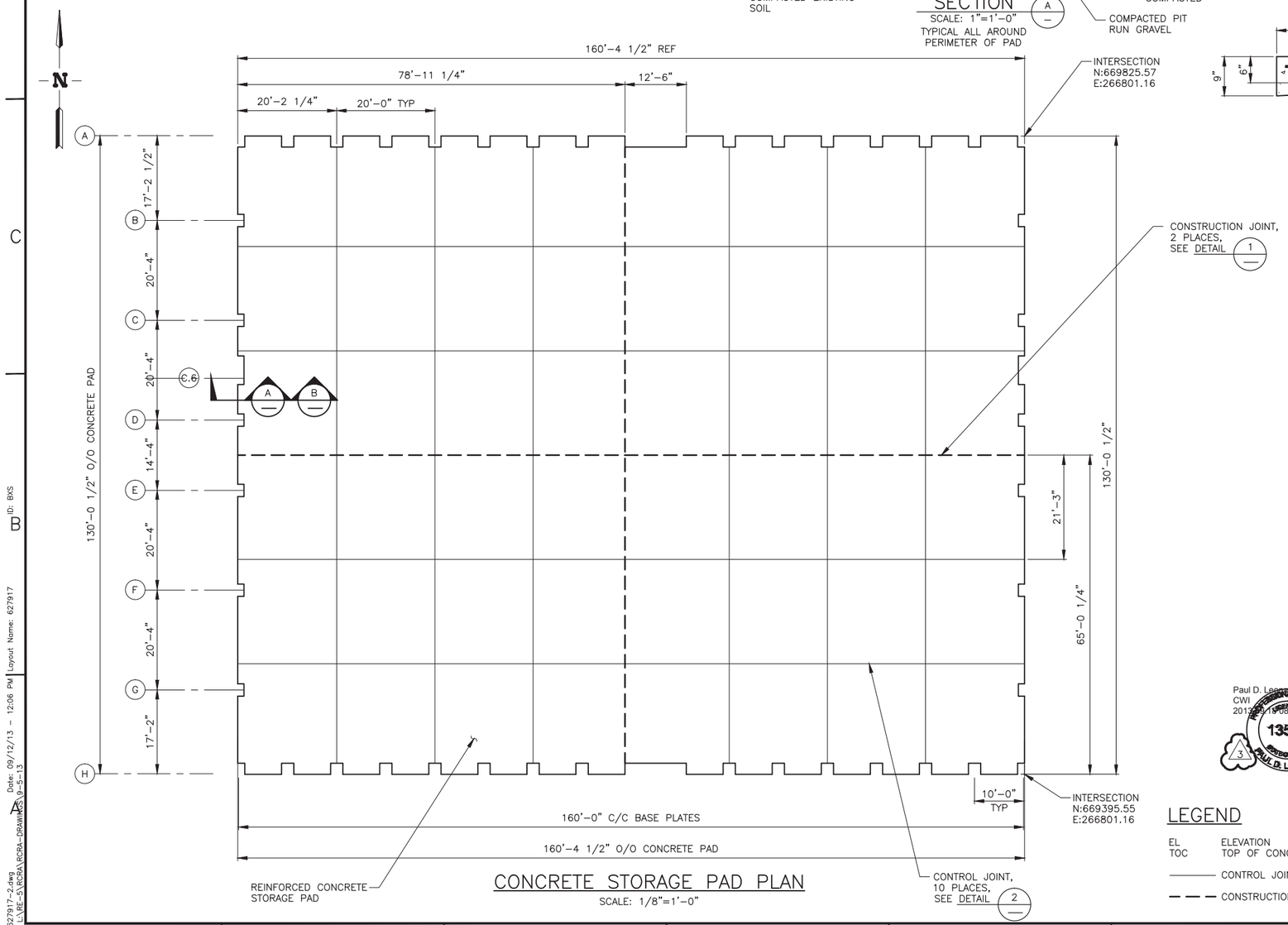


SECTION (A/—)
SCALE: 1"=1'-0"
TYPICAL ALL AROUND PERIMETER OF PAD

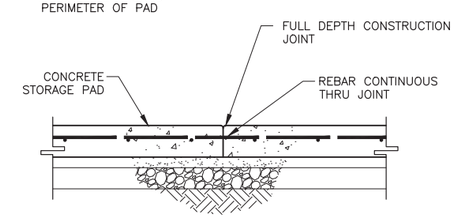


NOTE
SURROUNDING MATERIALS NOT SHOWN FOR CLARITY

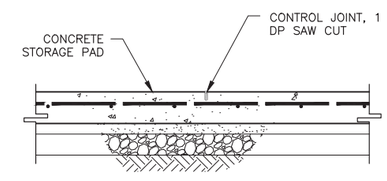
SECTION (B/—)
SCALE: 1"=1'-0"
TYPICAL ALL AROUND PERIMETER OF PAD



CONCRETE STORAGE PAD PLAN
SCALE: 1/8"=1'-0"



CONSTRUCTION JOINT DETAIL (1/—)
SCALE: 1"=1'-0"



CONTROL JOINT DETAIL (2/—)
SCALE: 1"=1'-0"

Paul D. Leonard
CWI
2013.09.18 08:45:26 -06'00'

PROFESSIONAL ENGINEER 13530 STATE OF IDAHO PAUL D. LEONARD

LEGEND

EL	ELEVATION
TOC	TOP OF CONCRETE
———	CONTROL JOINT
— — —	CONSTRUCTION JOINT

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: R.F. LIPPERT	N/A	N/A
DRAFTER: S. BERTHELSON	Shawn Berthelson CWI 2013.09.18 08:26:39 -06'00'	
TECHNICAL CHECK: N/A	N/A	N/A
ENG GROUP SUPERVISOR: N/A	N/A	N/A
DESIGN LEAD: N/A	N/A	N/A
DRAFTING CHECK/ EFFECTIVE DATE: B.L. SCOTT	Barry Scott CWI 2013.09.18 09:12:20 -06'00'	
PROJECT NUMBER: 23927		
DRF NUMBER: 112500		

Idaho Cleanup Project CH2M HILL BOOZ ALLEN

RWMC
TARGETED WASTE REMOVAL AND DISPOSITION PROJECT
STORAGE ENCLOSURE
PAD PLAN, SECTIONS, AND DETAILS

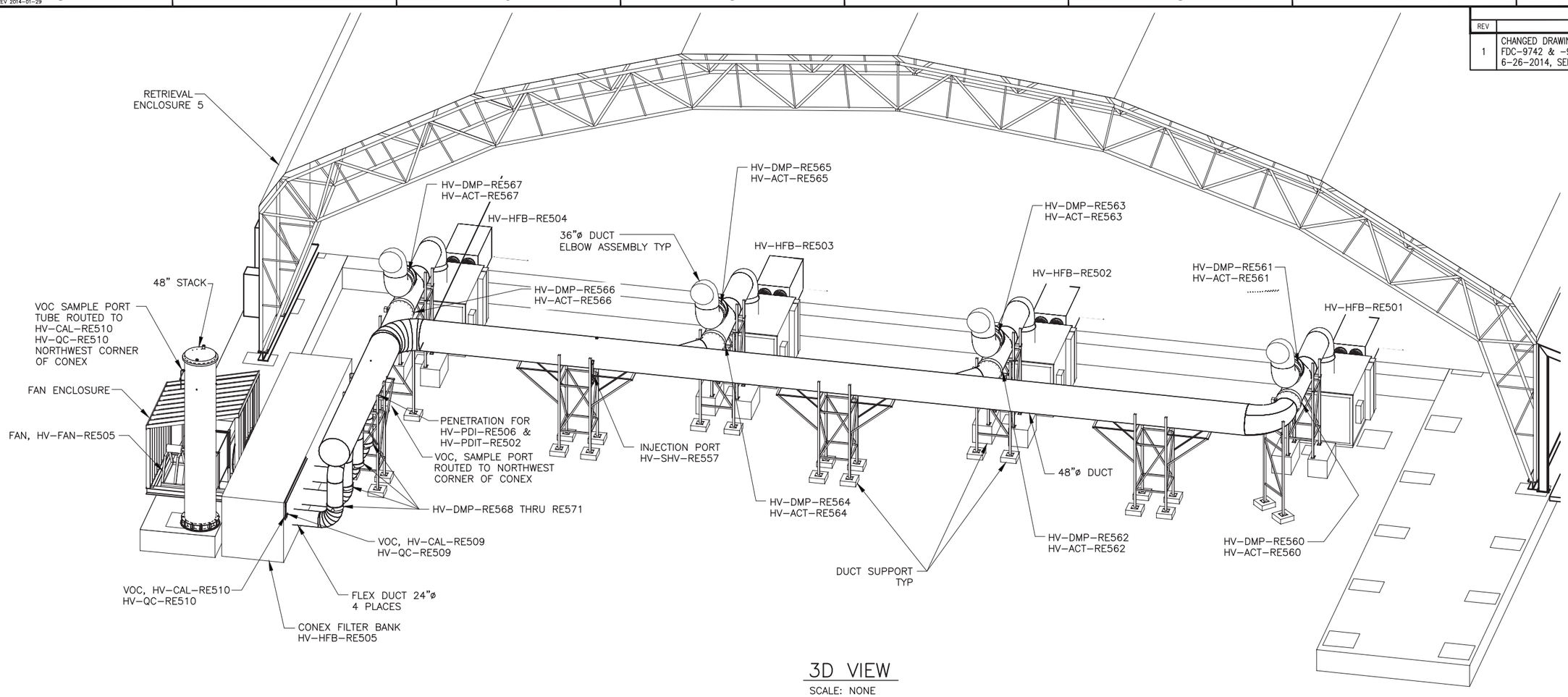
SIZE	INDEX CODE NUMBER: AREA	TYPE	CI	ORIG	DWG-	REV
D	098	100	02	090	627917	2

SCALE: NOTED
SHEET 1 OF 1

File: 627917-2.dwg
Path: L:\KE-S\RCRA\RCRA-DRAWINGS\9-5-13
Date: 09/12/13 - 12:06 PM | Layout Name: 627917
ID: BXS

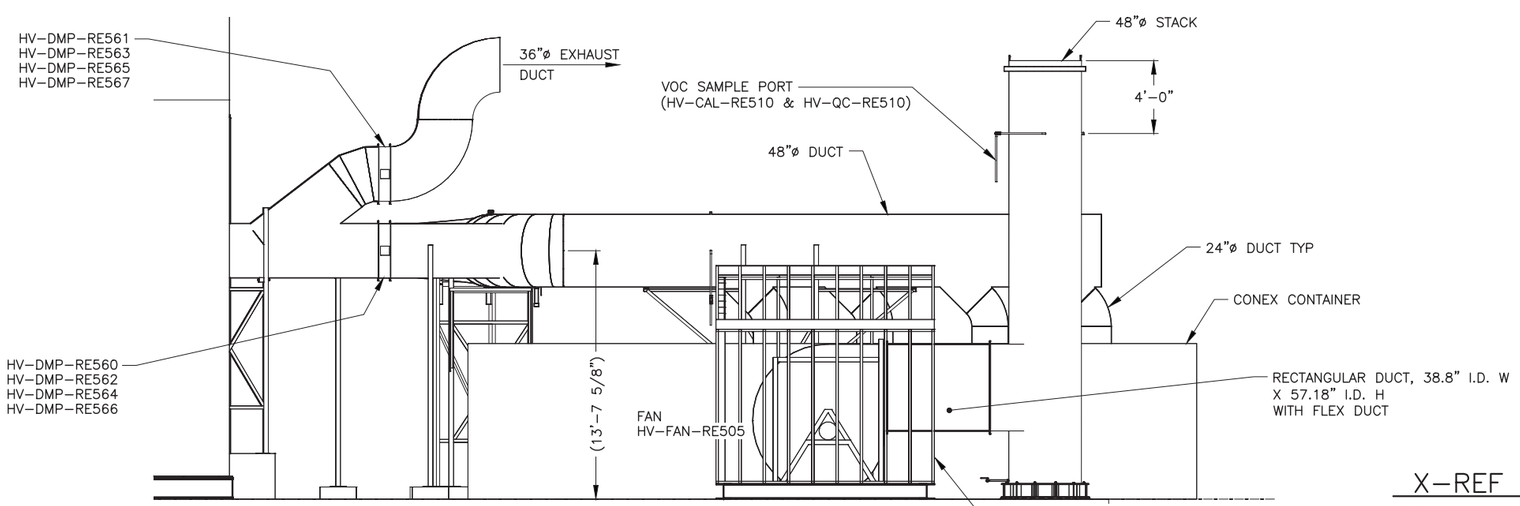
FMT-D1-REV 2014-01-29

REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-9742 & -9752, AS-BUILT AS OF 6-26-2014, SEE DRF-342452



3D VIEW

SCALE: NONE



VIEW F

SCALE: 1/4"=1'-0" 783976

NOTES:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. FOR SUPPORT OF TUBING AND/OR SMALL PIPE SEE DETAIL 11 / 783969

X-REF DRAWINGS

762161 – RETRIEVAL ENCLOSURE 5
762162 – RETRIEVAL ENCLOSURE 5 EQUIPMENT

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: N.O. SEAVER	N/A N/A
DRAFTER: B.L. SCOTT	Barry Scott CWI 2014.07.22 16:27:32 -06'00'
TECHNICAL CHECK: D.E. KELLER, P.E.	N/A N/A
ENG GROUP SUPERVISOR: R.L. EASTMAN, P.E.	N/A N/A
DESIGN LEAD/AUTHORITY: D.F. KENNEDY	Dan F. Kennedy CWI 2014.07.24 10:59:41 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson CWI 2014.07.24 11:04:51 -06'00'
PROJECT NUMBER: 30198	
DRF NUMBER: 341219	

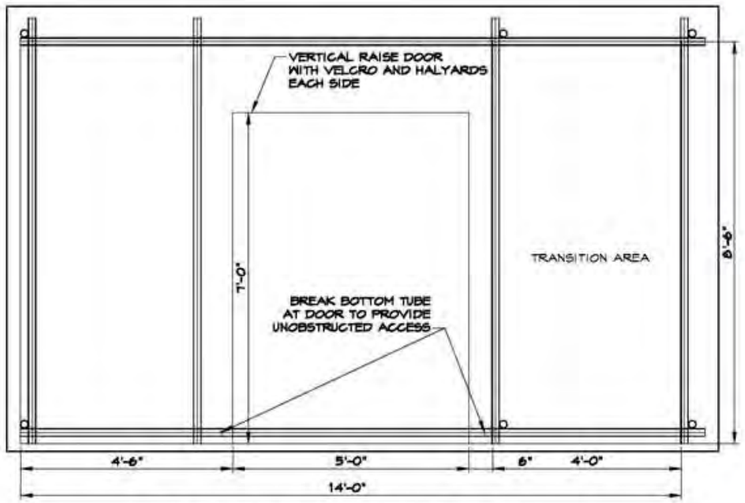
Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE V OF THE
ACCELERATED RETRIEVAL PROJECT
RE5/AL5 WMF-1617
RE5 VENTILATION
3D VIEW AND EAST VIEW

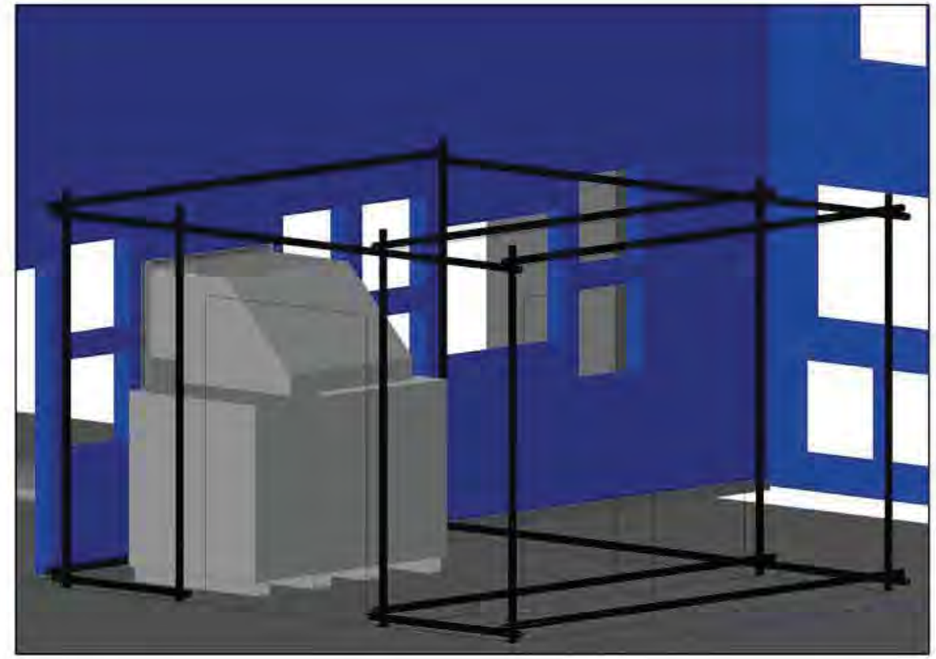
SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1617	20	136	783977	1

SCALE: NOTED — SHEET 1 OF 1

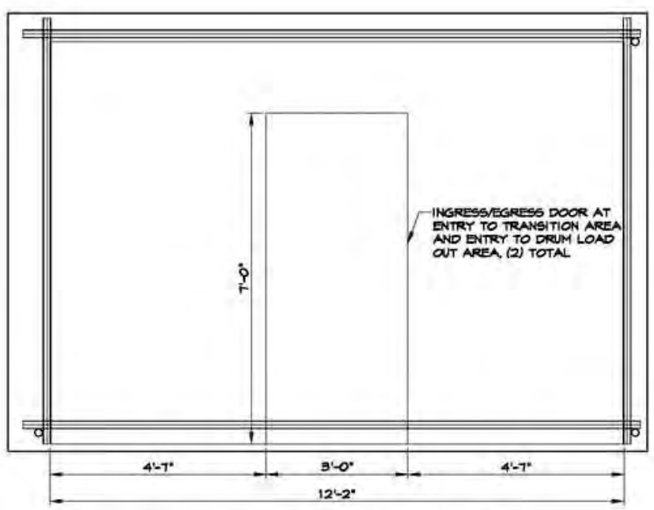
ID: BXS
Layout Name: V-2
Date: 07/22/14 – 3:02 PM
File: 783977-1.dwg
Path: C:\Users\bxs\Documents\BXS\RW-1269 (ARPs)



SIDE VIEW LOOKING EAST



DRUM OUT "TUBE AND KNUCKLE" ENCLOSURE



FRONT VIEW LOOKING NORTH

EXHIBIT 1. RWMC WMF-1617 RE5/AL5 DRUM OUT ENCLOSURE VIEW

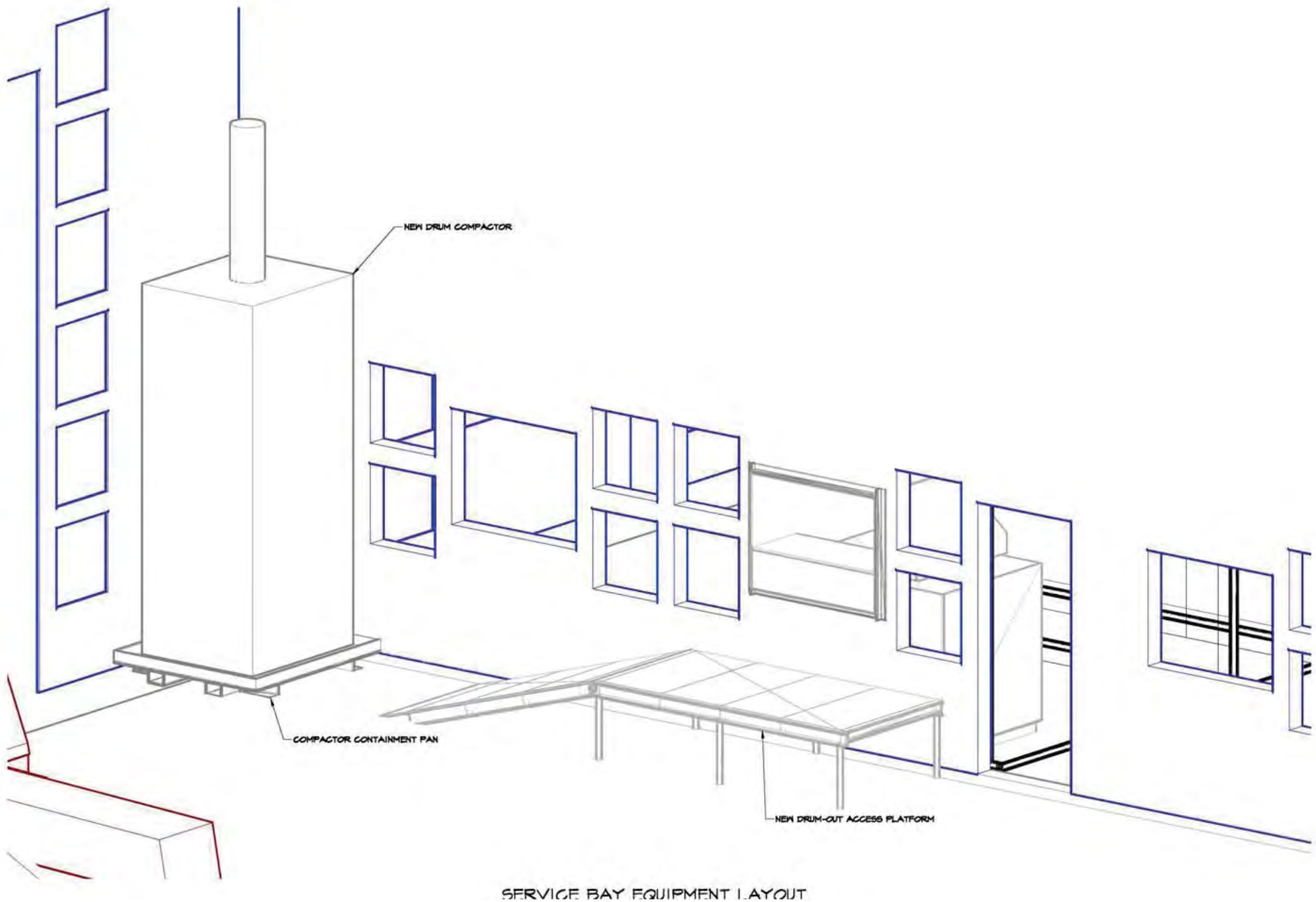
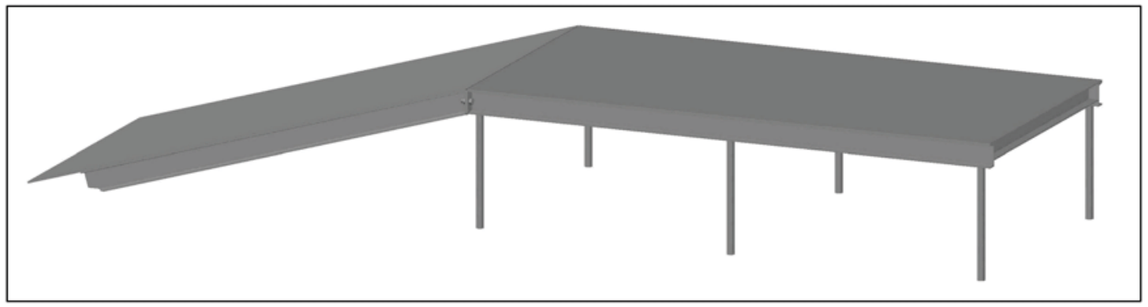
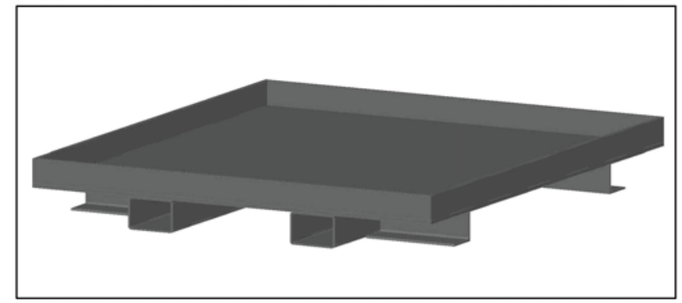


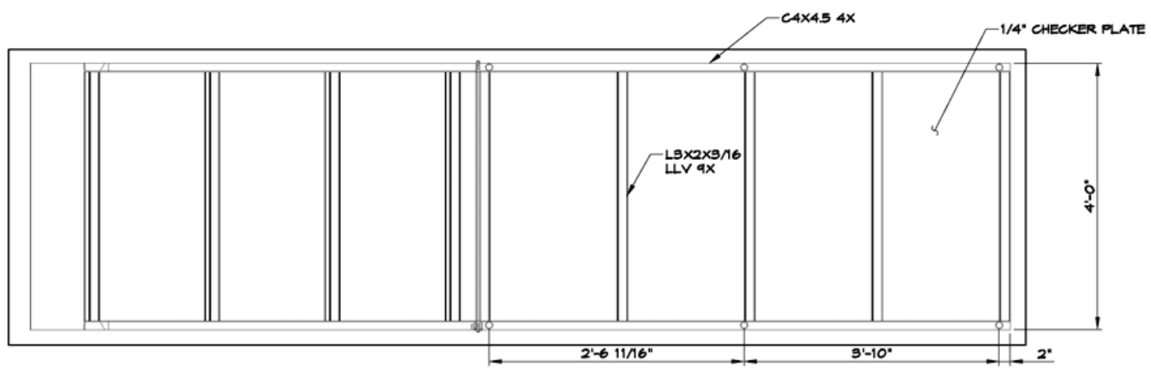
EXHIBIT 2. RWMC WMF-1617 RE5/AL5 SERVICE BAY EQUIPMENT LAYOUT

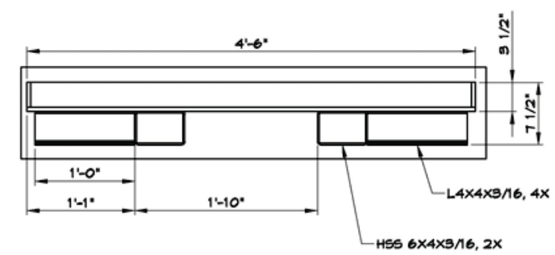


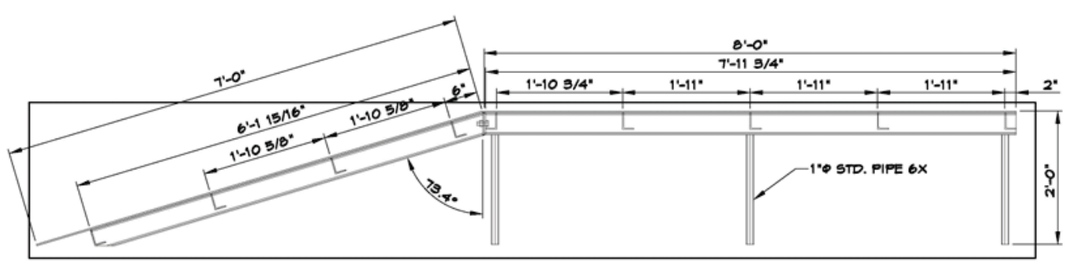
DRUM OUT ACCESS PLATFORM



COMPACTOR CONTAINMENT PAN







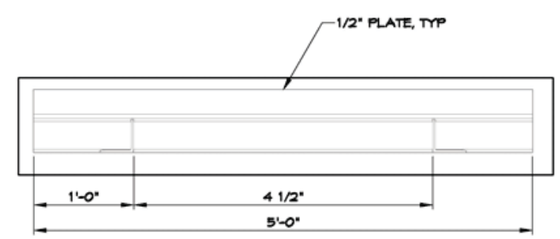
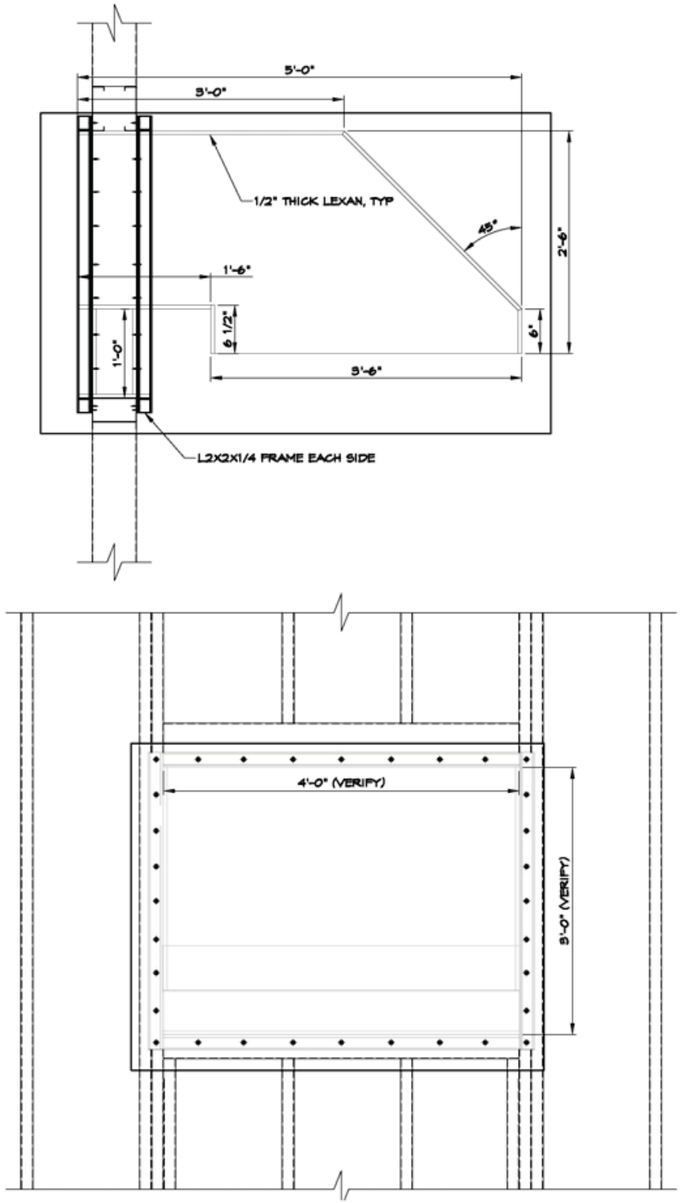
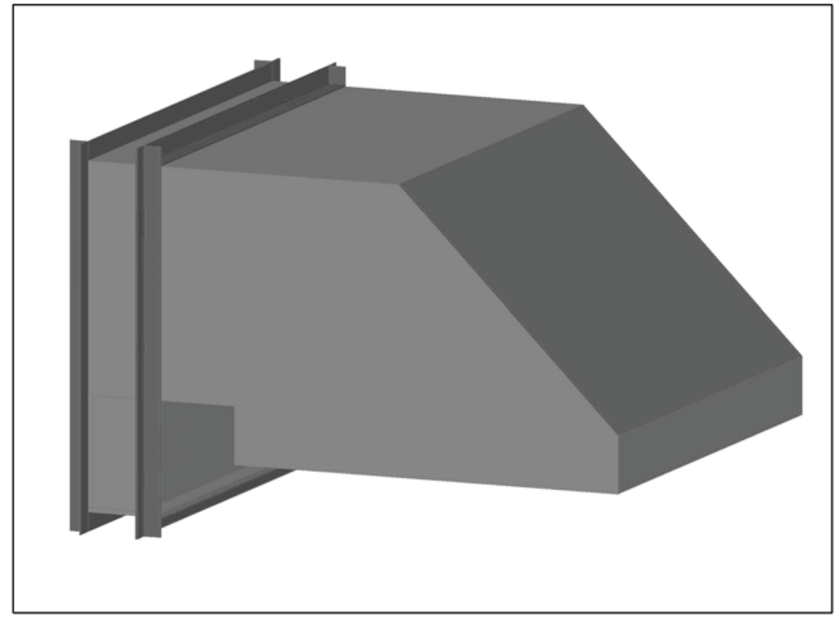


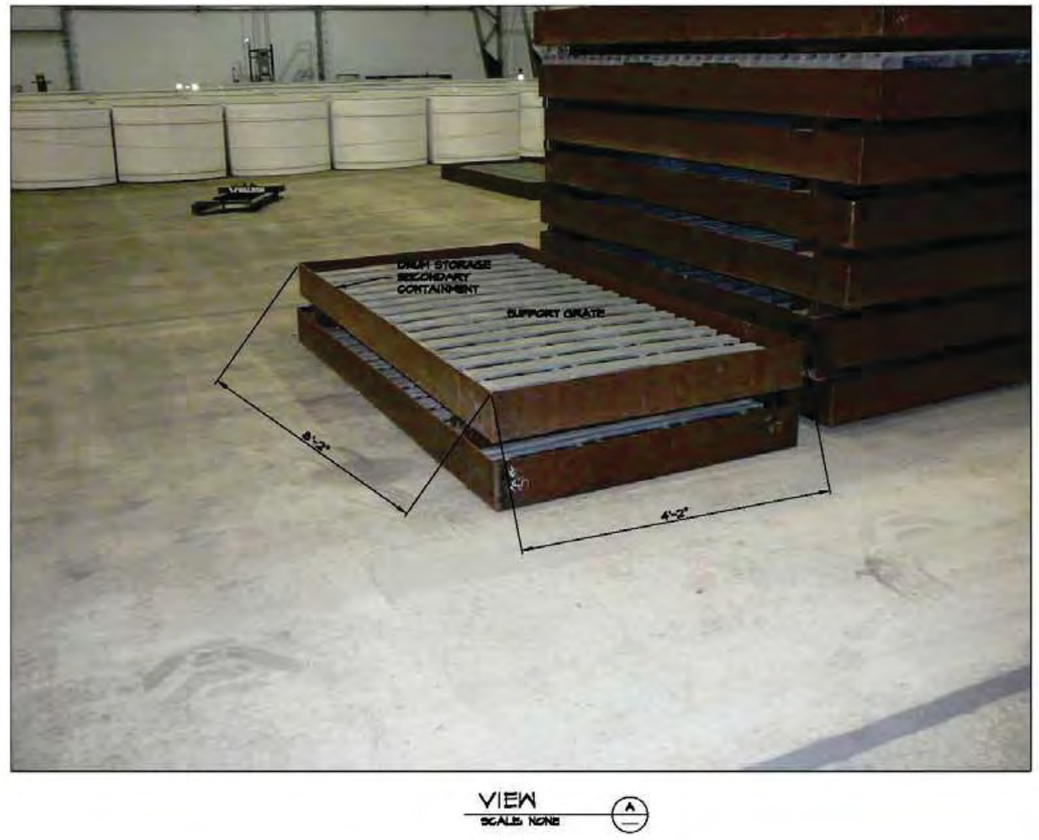
EXHIBIT 3. RWMC WMF-1617 RE5/AL5 DRUM OUT ACCESS PLATFORM AND COMPACTOR CONTAINMENT PAN DETAILS





DRUM OUT HOPPER

EXHIBIT 4. RWMC WMF-1617 RE5/AL5 DRUM OUT HOPPER AND DETAILS



DRUM STORAGE SECONDARY CONTAINMENT
ENGINEERING SKETCH #11

EXHIBIT 5. DRUM STORAGE SECONDARY CONTAINMENT

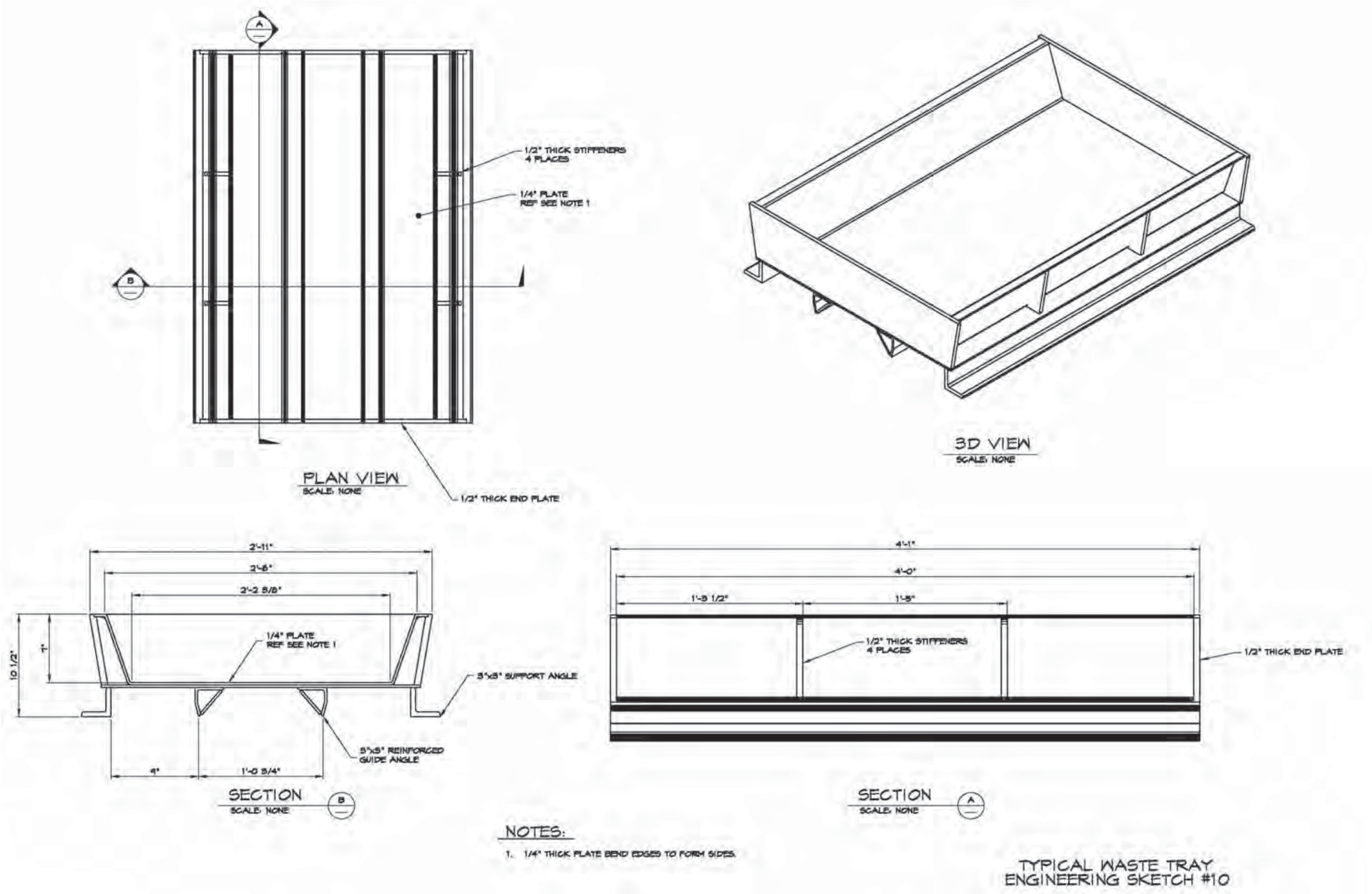


EXHIBIT 6. TYPICAL WASTE TRAY

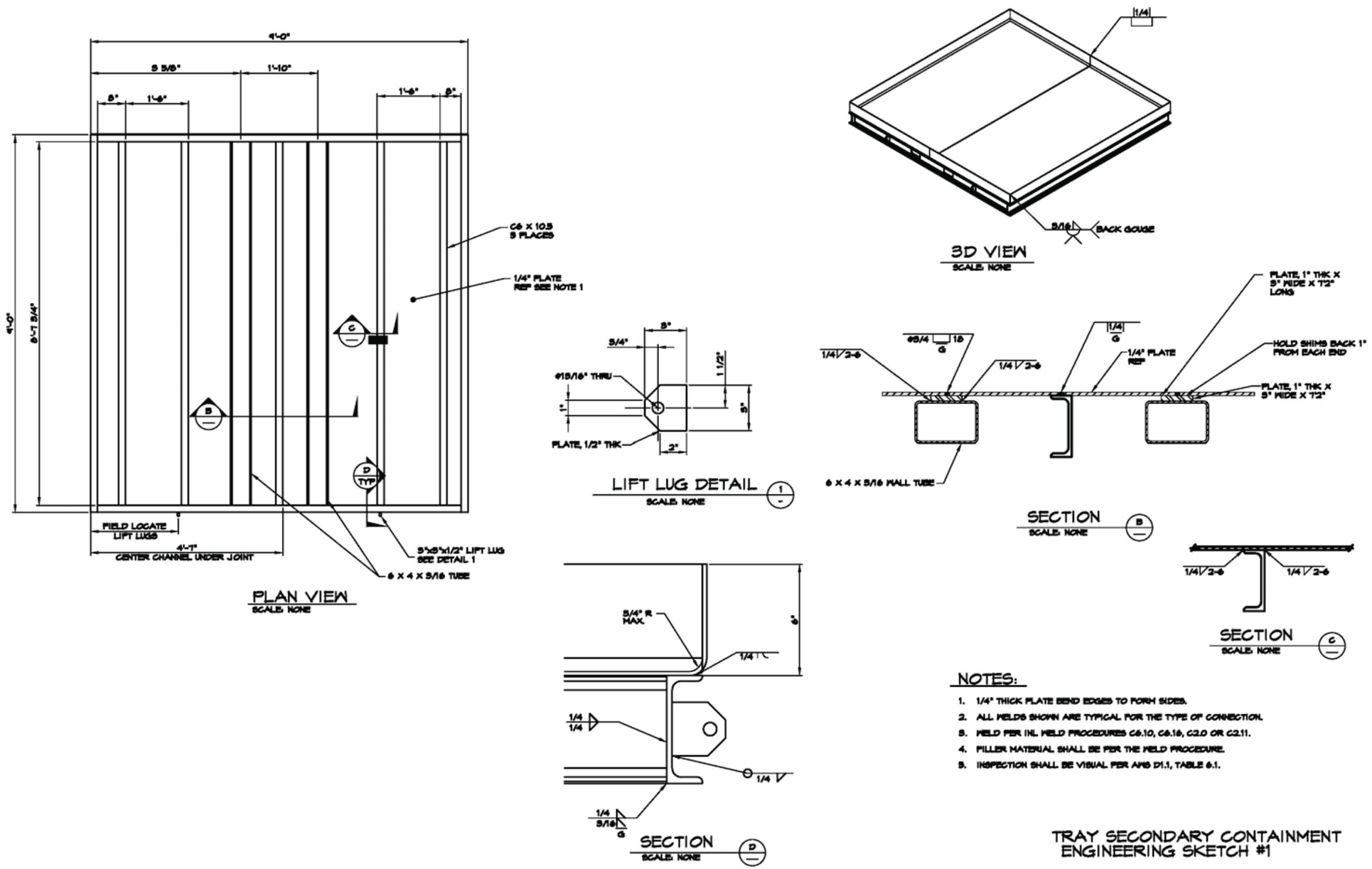
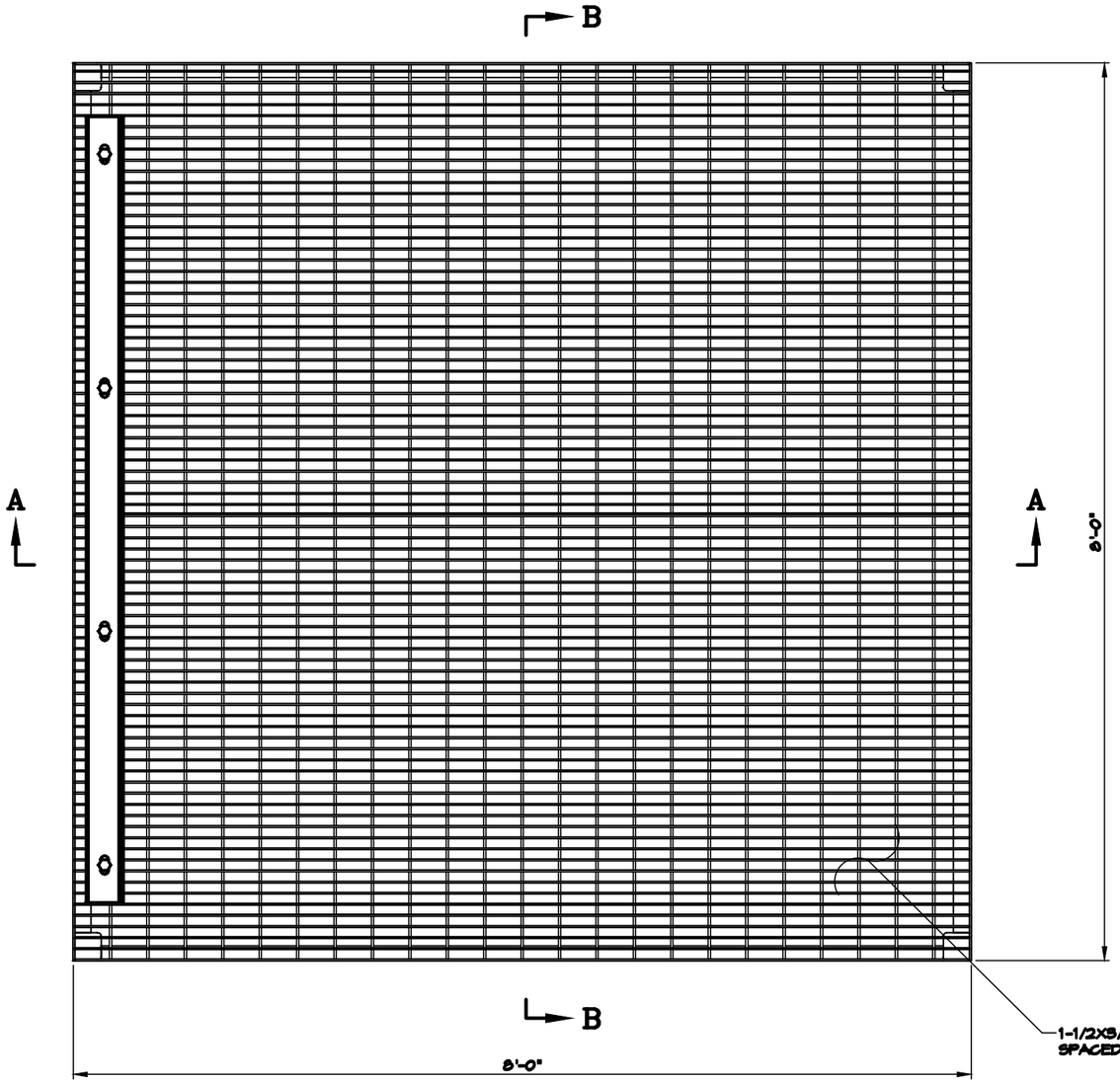
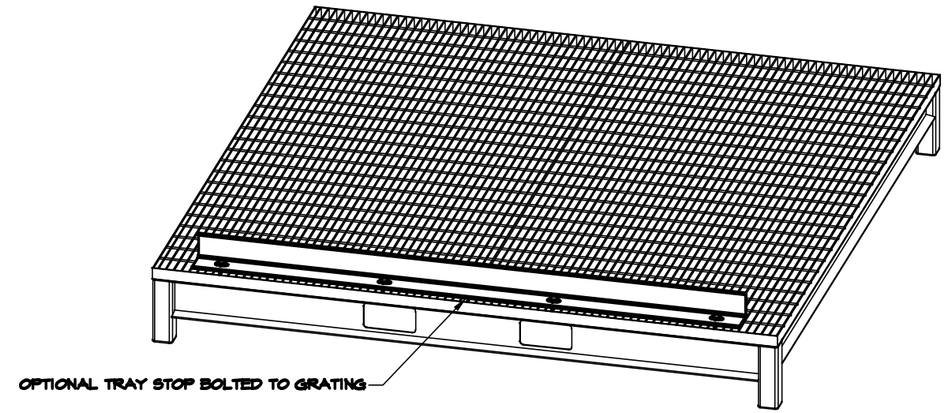


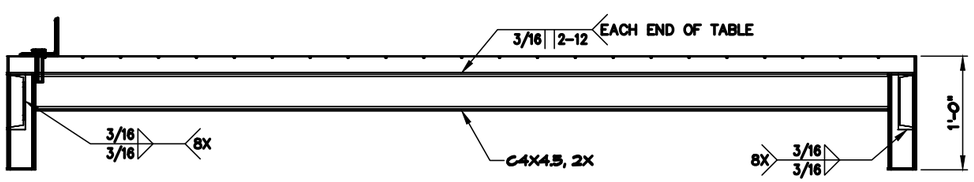
EXHIBIT 7. TRAY SECONDARY CONTAINMENT



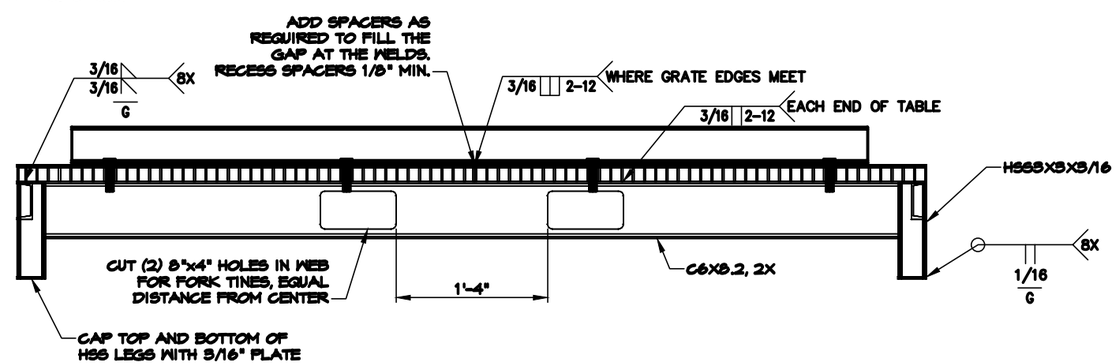


NOTES:

1. ALL WELDS SHOWN ARE TYPICAL FOR THE TYPE OF CONNECTION.
2. WELD PER INL WELD PROCEDURES C6.10, C6.16, C2.0 OR C2.11.
3. FILLER MATERIAL SHALL BE PER THE WELD PROCEDURE.
4. INSPECTION SHALL BE VISUAL PER AWS D1.1, TABLE 6.1.
5. ALL MATERIAL SHALL BE CARBON STEEL, MIN 36 KSI.



SECTION A



SECTION B

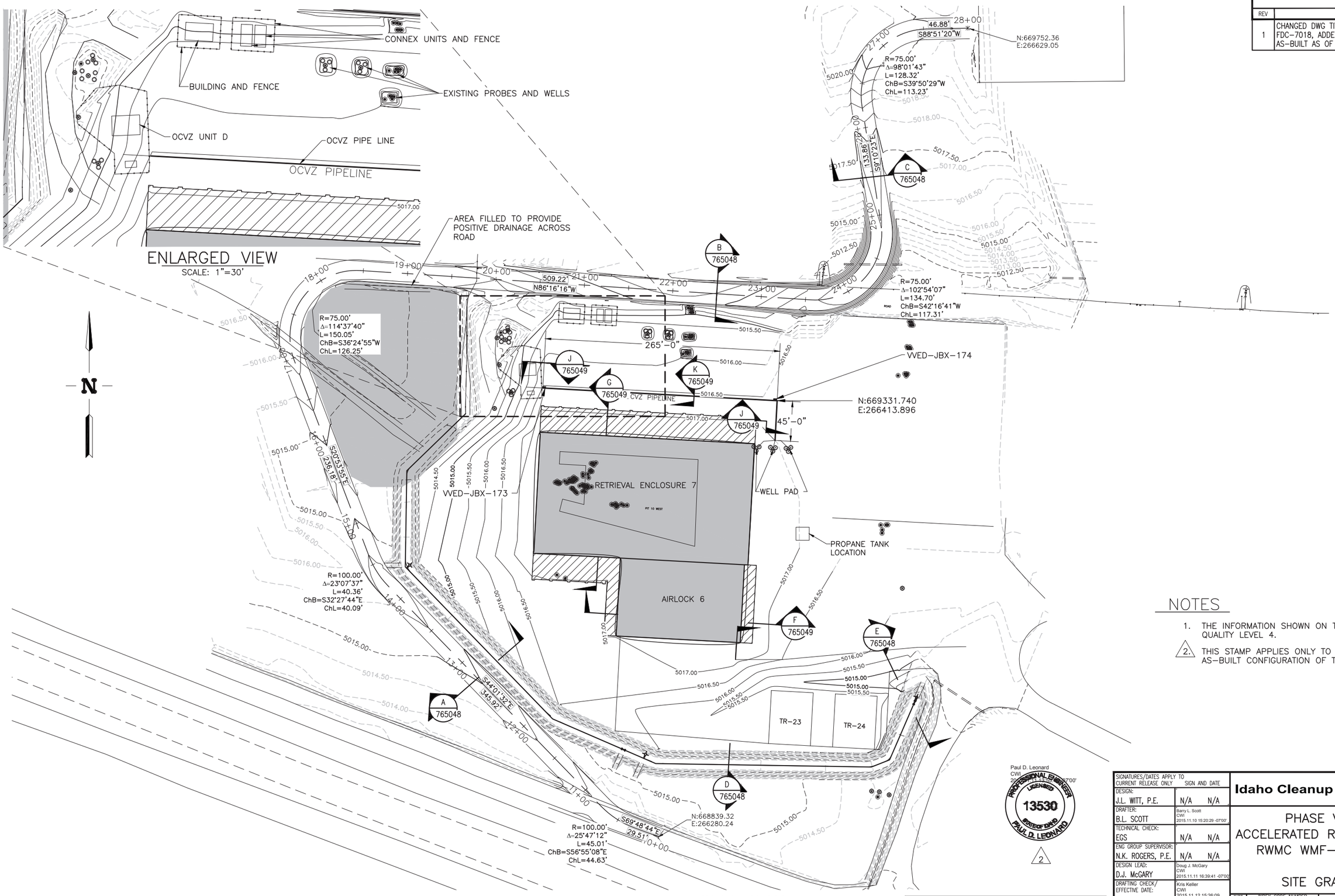
WASTE TRAY SUPPORT TABLE
ENGINEERING SKETCH #4

EXHIBIT 8. WASTE TRAY SUPPORT TABLE

File: Tray TableExhibits.dwg Date: 04/12/17 – 12:47 PM Layout Name: Layout1 ID: LEONPD
Path: L:\RE-5\RCRA\Sludge Drum Repackaging\Tray Grate Table

FMT-D1-REV 2012-02-14

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, INCORPORATED FDC-6933 & FDC-7018, ADDED P.E. SEAL AND NOTE 2, AS-BUILT AS OF 10-14-2015, SEE DRF-347017



SITE PLAN

SCALE: 1"=50'

DATUM: HORIZONTAL: RWMC SITE SPECIFIC
VERTICAL: NAVD-88

NOTES

1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 4.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J.L. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:20:29 -07'00'
TECHNICAL CHECK: EGS	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:39:41 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:26:09 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 328838	

Idaho Cleanup Project CH2M•WG Idaho, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6

SITE GRADING PLAN

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1619	02	136	765045	1

SCALE: NOTED SHEET 1 OF 1

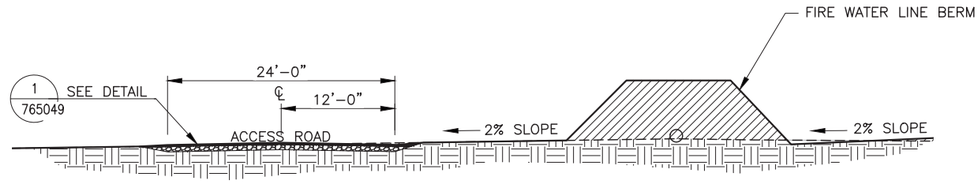
File: 765045-1.dwg
Path: Y:\RE-7\RCRA\RCRA Drawings
Date: 11/03/15 - 9:39 AM Layout Name: 765045
ID: KJ1

FMT-D1-REV 2012-02-14

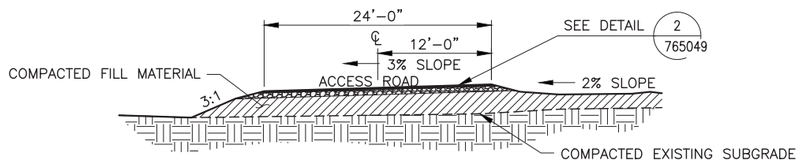
REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE & INDEX CODE, INCORPORATED FDC-6827, SEE DRF-337302
2	CHANGED DRAWING TITLE, ADDED P.E. STAMP AND NOTE 2, AS-BUILT AS OF 10-14-2015, SEE DRF-347017

NOTES

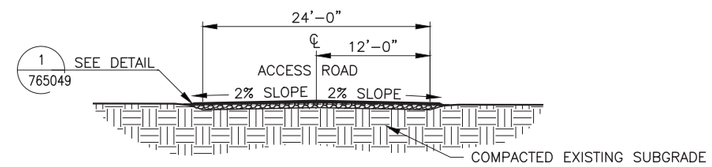
1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 4.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



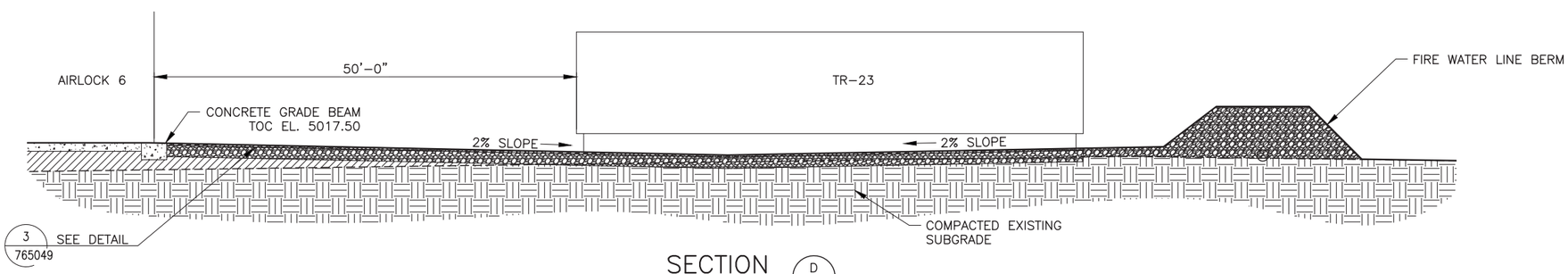
SECTION A 765045
SCALE: NTS



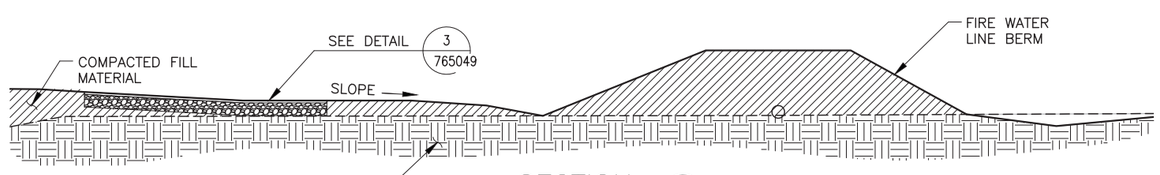
SECTION B 765045
SCALE: NTS



SECTION C 765045
SCALE: NTS



SECTION D 765045
SCALE: NTS



SECTION E 765045
SCALE: NTS

Paul D. Leonard
CWI
2015.11.12 15:26:17 -07'00'
PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD
2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J.L. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:21:10 -07'00'
TECHNICAL CHECK: EGS	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:40:17 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:26:17 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 328838	

Idaho Cleanup Project CH2M+WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 GRADING SECTIONS

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1619	02	136	765048	2

SCALE: NOTED
SHEET 1 OF 1

RW-1271

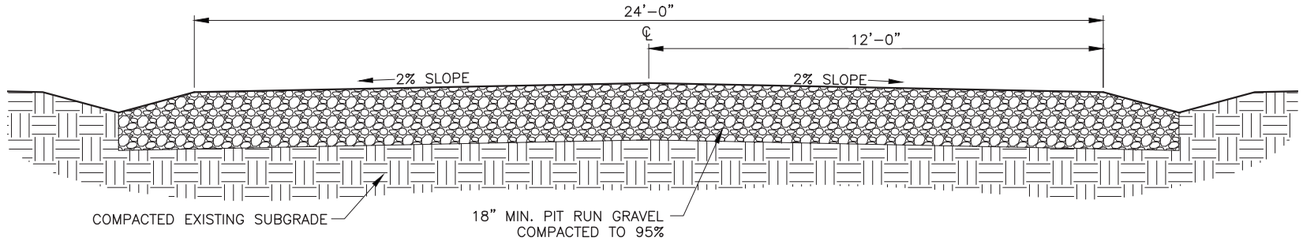
File: 765048-2.dwg
Path: I:\RE-7\RCRA\RCRA Drawings
Date: 11/09/15 - 9:06 AM | Layout Name: C-6 | ID: BXS

FMT-D1-REV 2012-02-14

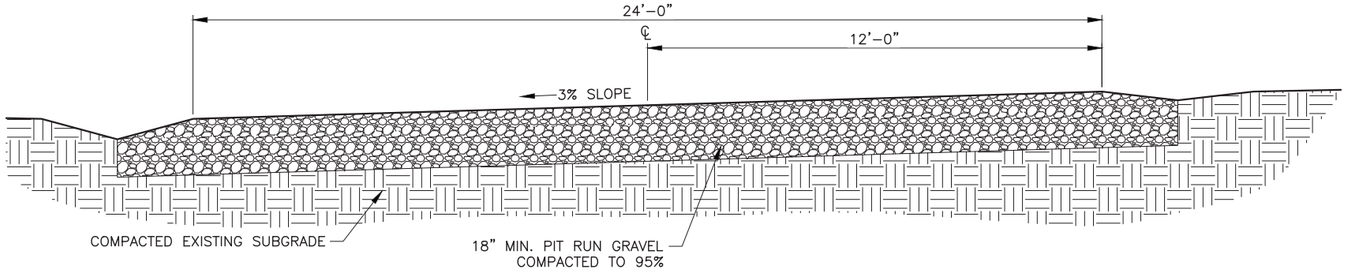
REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE & INDEX CODE, INCORPORATED FDC-6827, -6933 & -7018, SEE DRF-337302
2	CHANGED DWG TITLE, CORRECTED PER FDC-7018, ADDED P.E. STAMP AND NOTE 2, AS-BUILT AS OF 10-14-2015, SEE DRF-347017

NOTES

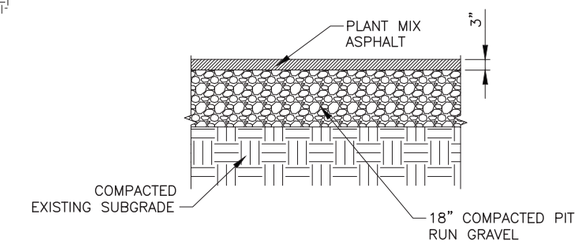
1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 4.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



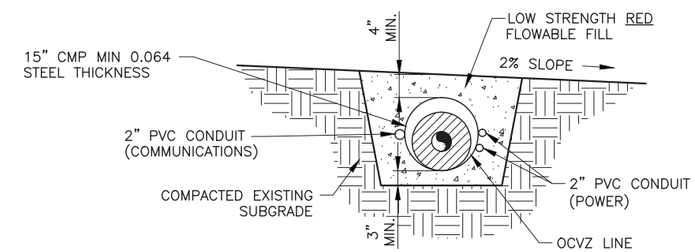
TYPICAL ACCESS ROAD CROSS SECTION (1 / 765048)
SCALE: 3"=1'-0"



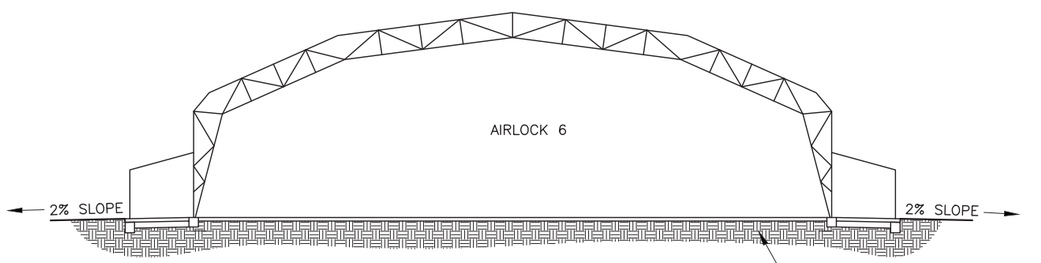
TYPICAL ACCESS ROAD SUPER ELEVATION (2 / 765048)
SCALE: 3"=1'-0"



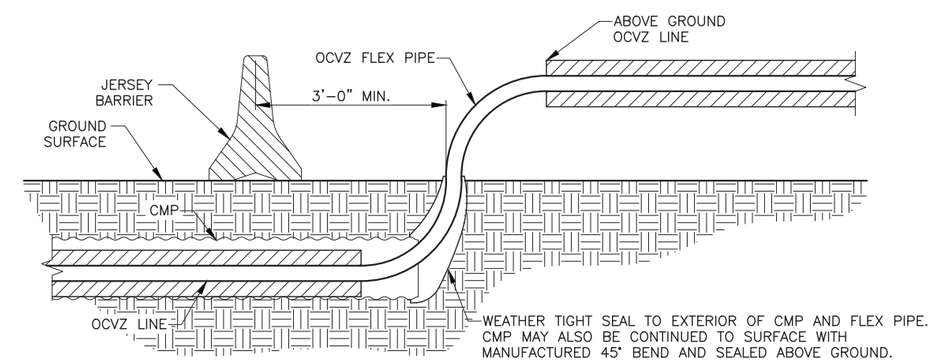
DETAIL (3 / 765048)
SCALE: NTS



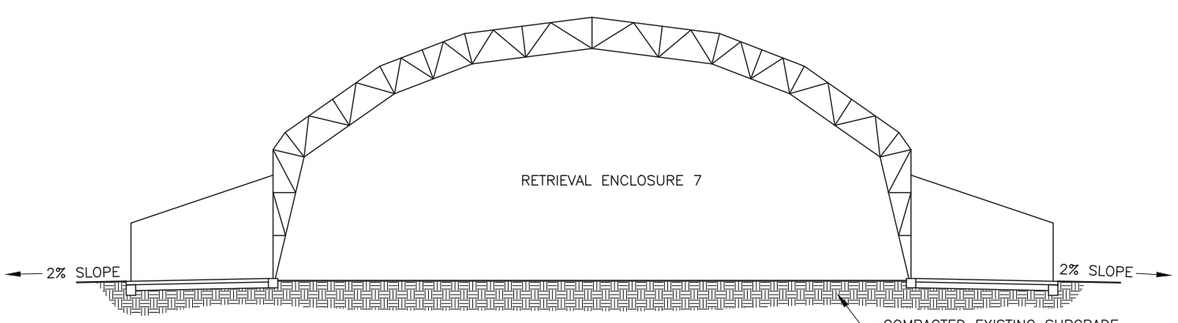
SECTION (K / 765045)
SCALE: NTS



SECTION (F / 765045)
SCALE: NTS



SECTION (J / 765045)
SCALE: NTS



SECTION (G / 765045)
SCALE: NTS

Paul D. Leonard
CWI
2015.11.12 15:26:31 -07'00'
PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD
2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J.L. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:21:28 -07'00'
TECHNICAL CHECK: EGS	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:41:00 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:26:31 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 328838	

Idaho Cleanup Project CH2M+WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 GRADING SECTIONS AND DETAILS

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1619	02	136	765049	2

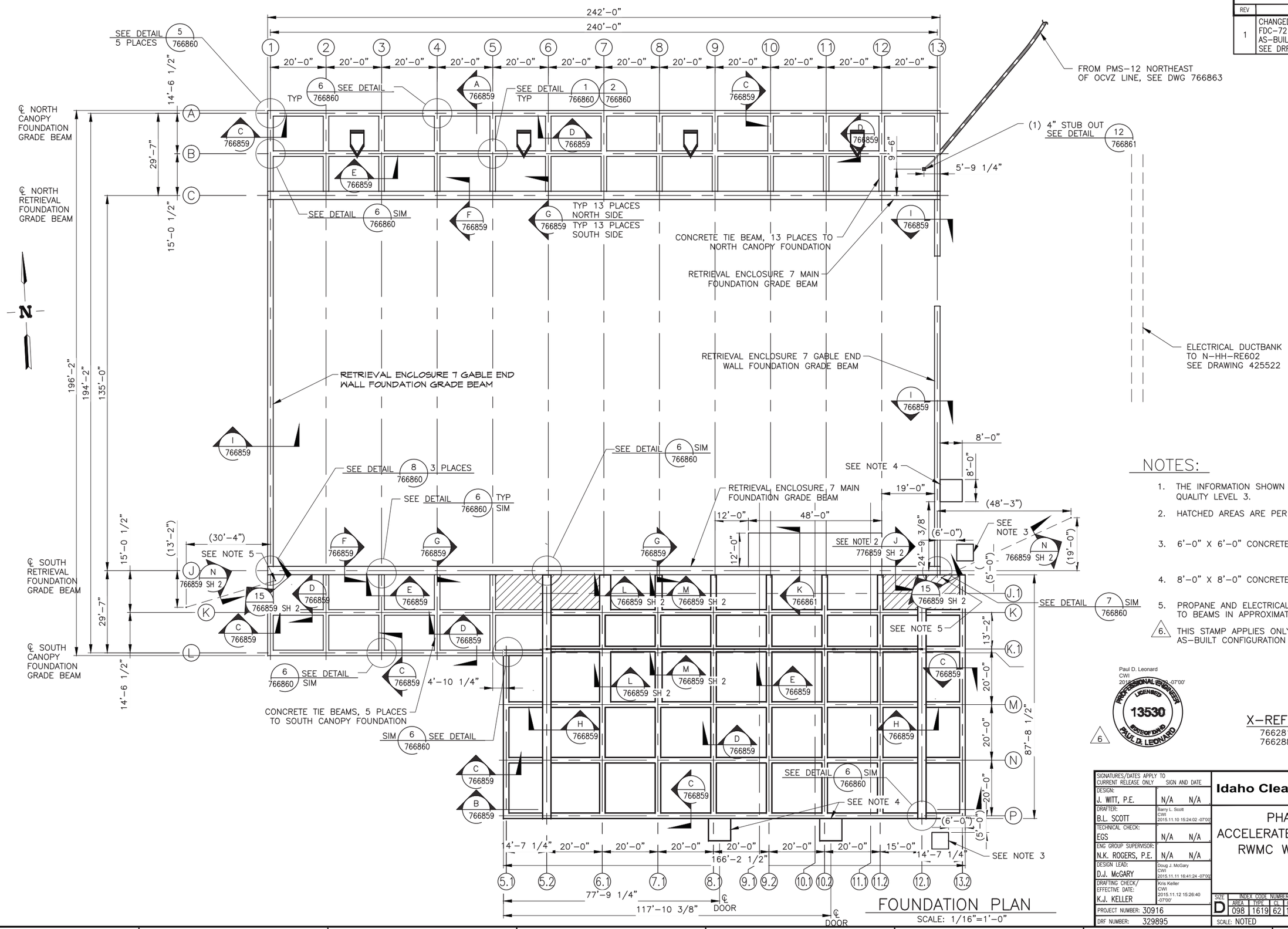
SCALE: NOTED — SHEET 1 OF 1

File: 765049-2.dwg
Path: Y:\RE-7\RCRA\RCRA Drawings
Date: 11/03/15 – 8:15 AM | Layout Name: C-7 | ID: BXS

RW-1271

FMT-D1-REV 2012-02-14

REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-7219 & -7331, ADDED P.E. STAMP, AS-BUILT AS OF 10-14-2015, SEE DRF-347017



FOUNDATION PLAN

SCALE: 1/16"=1'-0"

NOTES:

1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 3.
2. HATCHED AREAS ARE PER SECTION J 766859 SH 2
3. 6'-0" X 6'-0" CONCRETE PAD PER DETAIL 14 766859 SH 2
4. 8'-0" X 8'-0" CONCRETE PAD PER DETAIL 14 766859 SH 2
5. PROPANE AND ELECTRICAL CONDUIT PLACED NEXT TO BEAMS IN APPROXIMATE LOCATION SHOWN.
6. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

Paul D. Leonard
CWI
2015.11.12 15:26:40 -07'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

X-REF DRAWINGS

766281 – AL6
766288 – RE7

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:24:02 -07'00'
TECHNICAL CHECK: EGS	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:41:24 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:26:40 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329895	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 FOUNDATION PLAN

SIZE	INDEX CODE NUMBER (AREA / TYPE / GL / ORIG)	DWG-	REV
D	098 / 1619 / 62 / 136	766857	1

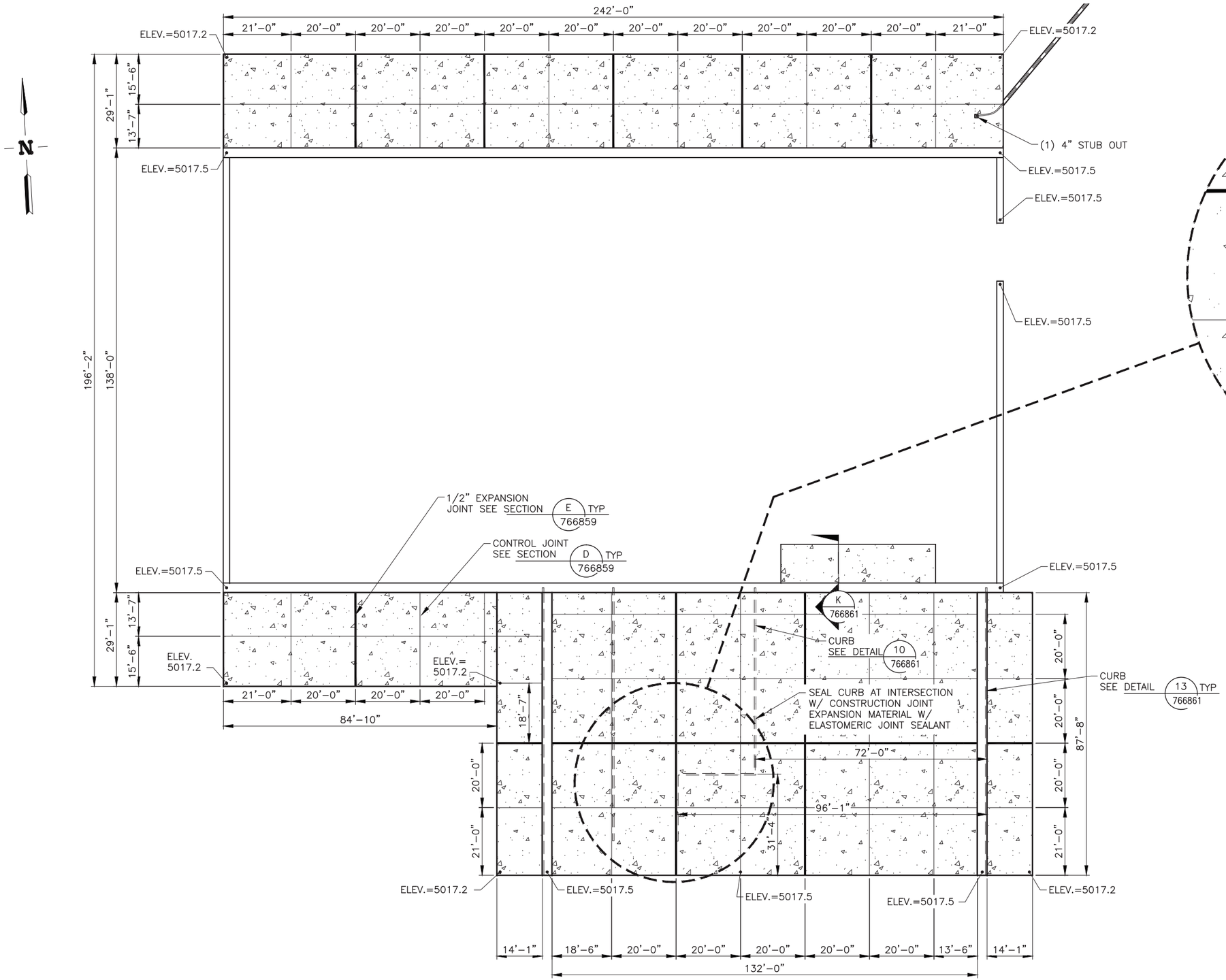
SCALE: NOTED — SHEET 1 OF 1

RW-1271

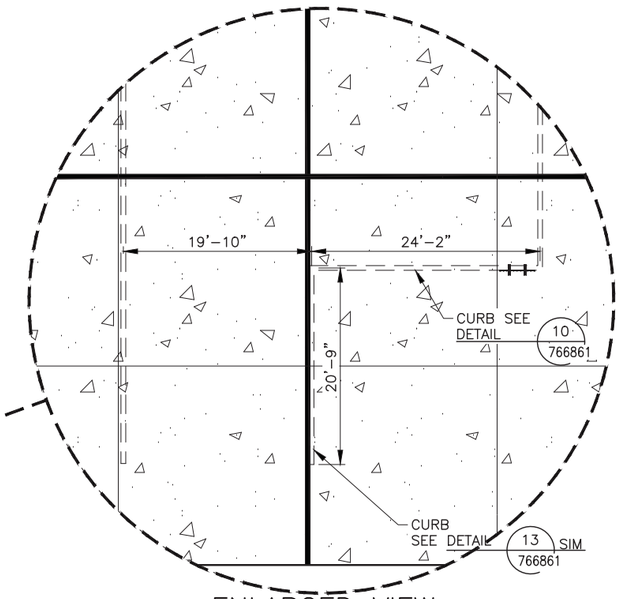
File: 766857-1.dwg
Path: Y:\RE-7\RCRA\RCRA Drawings
Date: 11/02/15 – 5:01 PM | Layout Name: S-1 | ID: BXS

FMT-D1-REV 2012-02-14

REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-7332, ADDED P.E. STAMP, AS-BUILT AS OF 10-14-2015, SEE DRF-347017



SLAB PLAN
SCALE: 1/16"=1'-0"



ENLARGED VIEW
SCALE: 1/8"=1'-0"

NOTES:

1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 3.
2. ALL ELEVATIONS ARE TOP OF CONCRETE/TOP OF SLAB.
3. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

Paul D. Leonard
CWI
2015.11.12 -07'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

3

X-REF DRAWINGS

766281 – AL6
766288 – RE7

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:24:30 -07'00'
TECHNICAL CHECK: EGS	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:41:43 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:28:15 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329895	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 FOUNDATION SLAB PLAN

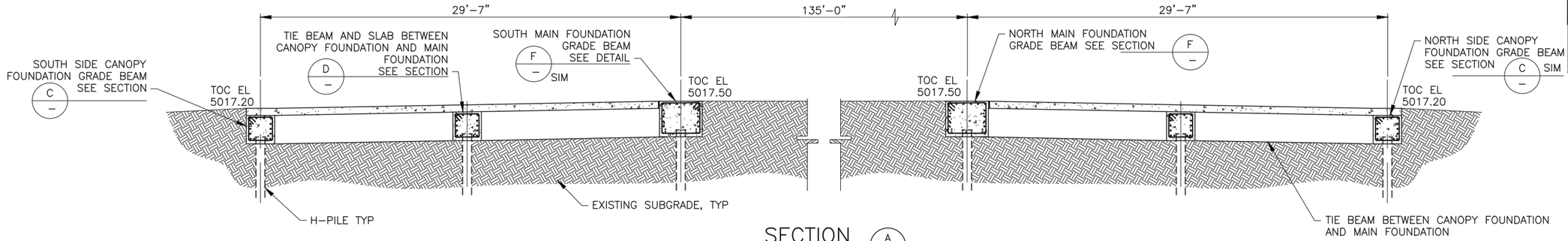
SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CL	ORIG		
D	098	1619	62	136	766858	1

SCALE: NOTED SHEET 1 OF 1

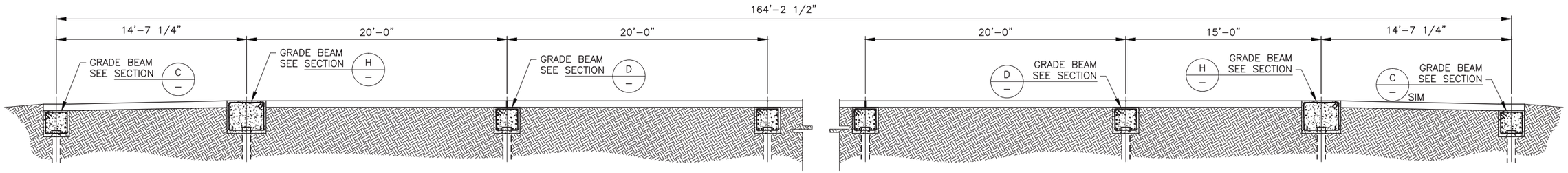
File: 766858-1.dwg
Path: Y:\RE-7\RCRA\RCRA Drawings
Date: 11/03/15 – 1:25 PM Layout Name: S-1
ID: BXS

FMT-D1-REV 2012-02-14

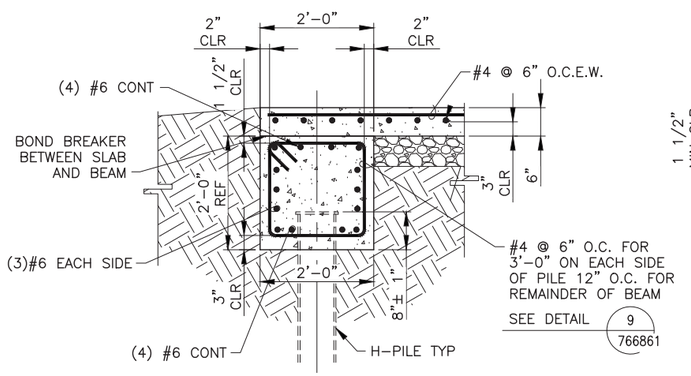
REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, ADDED SHEET 2, INCORPORATED FDC-7219 & -7251, ADDED P.E. STAMP, AS-BUILT AS OF 10-14-2015, SEE DRF-347017



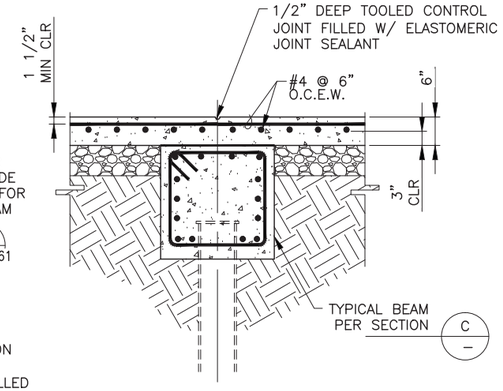
SECTION A 766857
SCALE: 1/4"=1'-0"



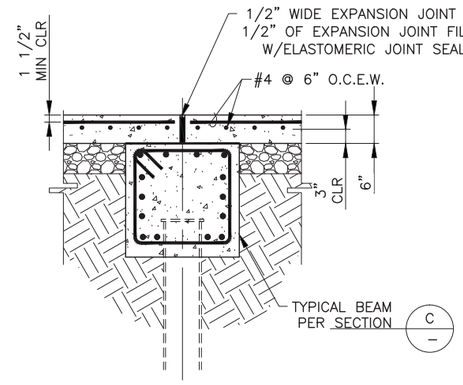
SECTION B 766857
SCALE: 1/4"=1'-0"



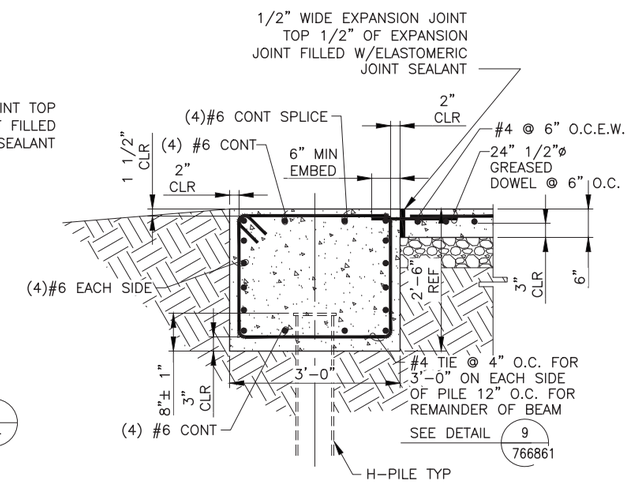
SECTION C C 766857
SCALE: 3/4"=1'-0"



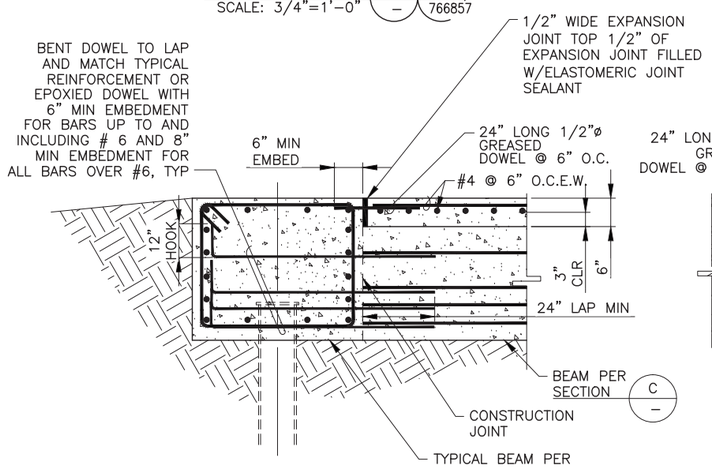
SECTION D D 766857 & 766858
SCALE: 3/4"=1'-0"



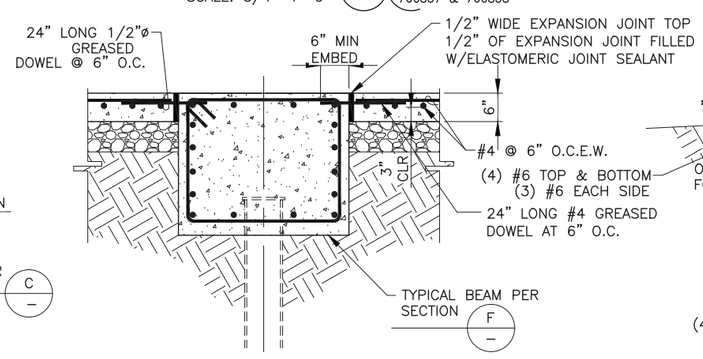
SECTION E E 766857 766858
SCALE: 3/4"=1'-0"



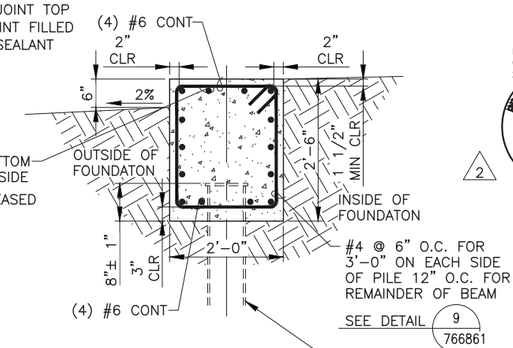
SECTION F F 766857
SCALE: 3/4"=1'-0"



SECTION G 766857
SCALE: 3/4"=1'-0"



SECTION H H 766857
SCALE: 3/4"=1'-0"



SECTION I 766857
SCALE: 3/4"=1'-0"

Paul D. Leonard
CWI
2015.11.12 15:28:04 -07'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

2

NOTES:

1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 3.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

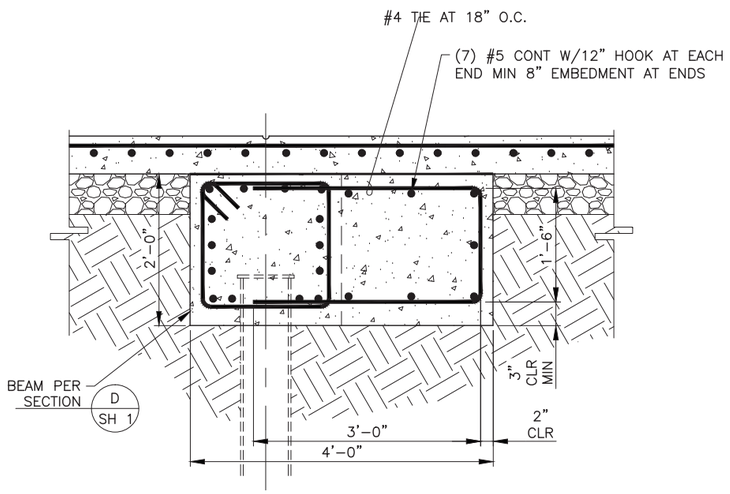
SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:33:37 -07'00'
TECHNICAL CHECK: EGS	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:42:05 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:28:04 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329895	

Idaho Cleanup Project CH2M+WG IDAHO, LLC

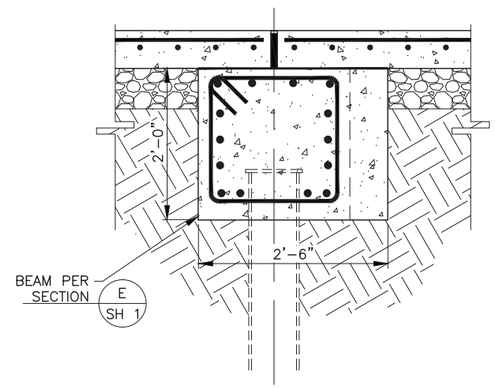
PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 FOUNDATION SECTIONS

SIZE	INDEX CODE NUMBER (AREA / TYPE / CL / ORIG)	DWG-	REV
D	098 / 1619 / 62 / 136	766859	1
SCALE: NOTED		SHEET 1 OF 2	

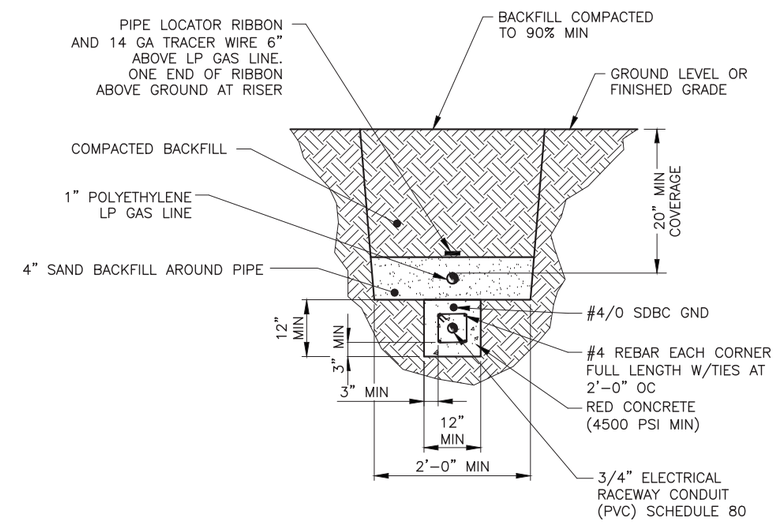
File: 766859-1.dwg
Path: H:\RE-7\RCRA\RCRA Drawings
Date: 11/02/15 – 4:37 PM
Layout Name: Sheet 1
ID: BXS



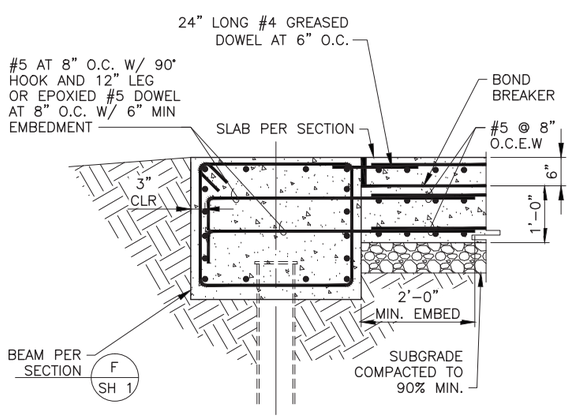
RE7 5-TON CRANE SUPPORT (L / 766857)
SCALE: 1"=1'-0



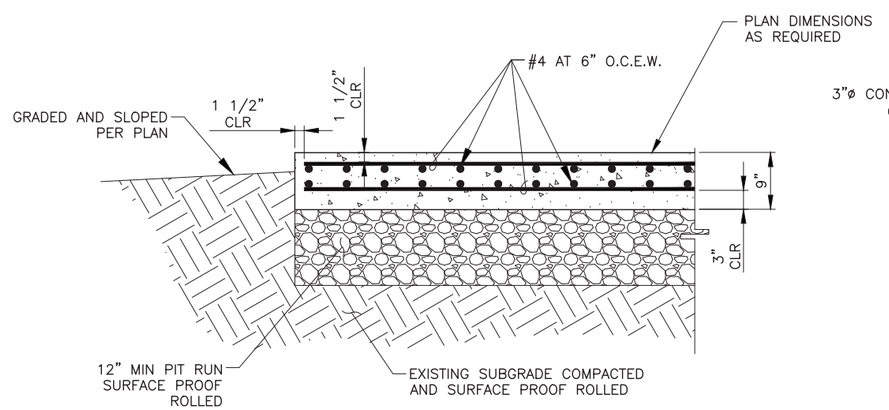
RE7 5-TON CRANE SUPPORT (M / 766857)
SCALE: 1"=1'-0



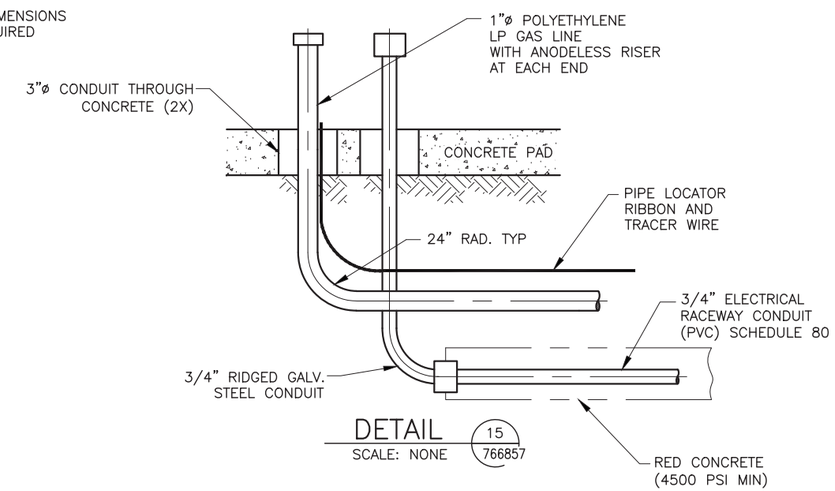
SECTION (N / 766857)
SCALE: NONE



SECTION (J / 766857)
SCALE: 3/4"=1'-0



CAST IN PLACE PAD (14 / 766857)
SCALE: 1"=1'-0



DETAIL (15 / 766857)
SCALE: NONE

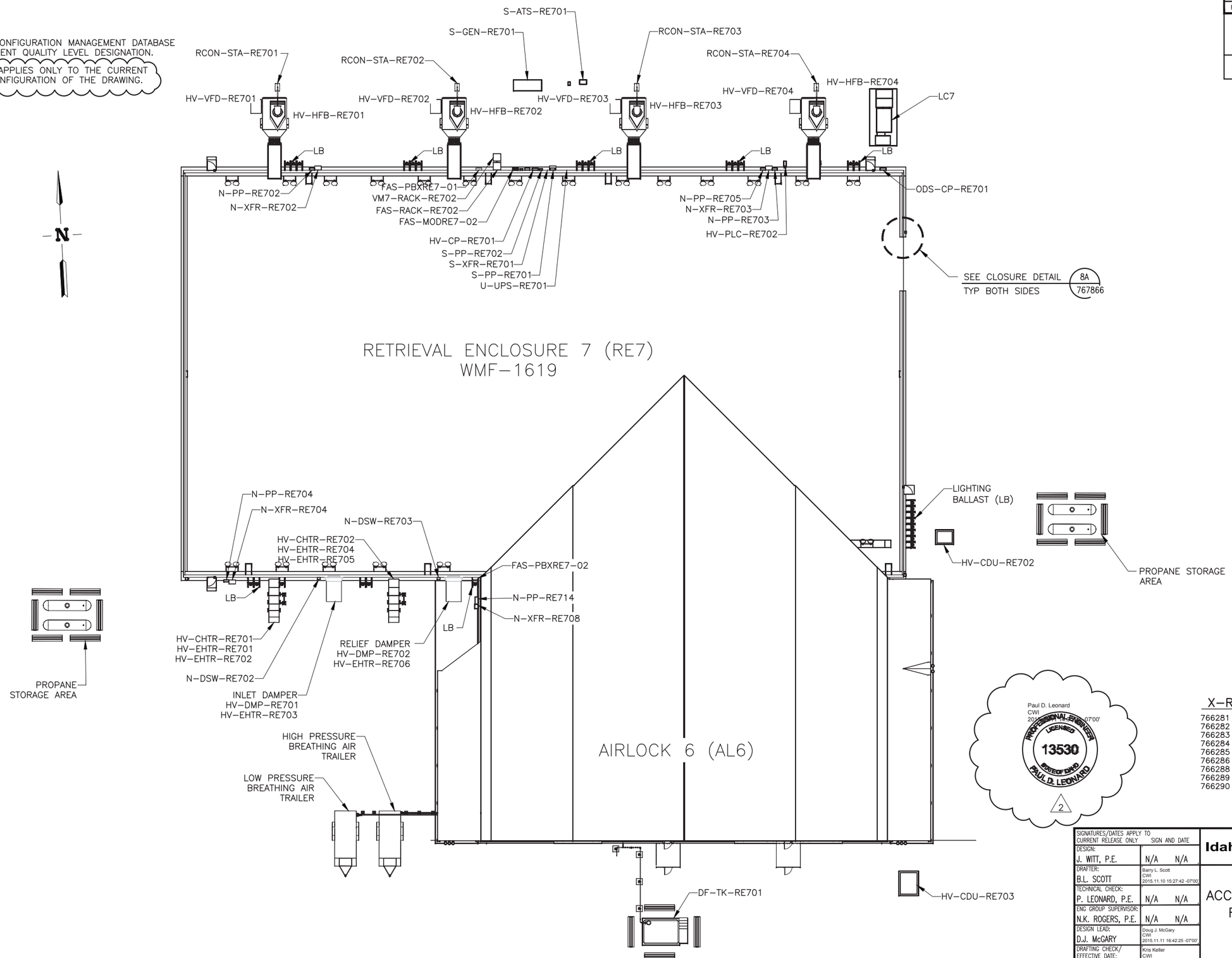
SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CL	ORIG		
D	098	1619	62	136	766859	1
SCALE: NOTED					SHEET 2	

FMT-D1-REV 2012-02-14

REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-7817, AS-BUILT AS OF 6-4-2012, SEE DRF-336586
2	ADDED P.E. STAMP AND NOTE 2, AS-BUILT AS OF 10-14-2015, SEE DRF-347017

NOTES

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



EQUIPMENT LOCATION PLAN

SCALE: 1/16" = 1'-0"

Paul D. Leonard
CWI
2015.11.12 15:27:45 -07'00'
PROFESSIONAL ENGINEER
LICENSED
13530
STATE OF IDAHO
PAUL D. LEONARD
2

X-REF DRAWINGS

766281 – AL6
766282 – AL6 HVAC
766283 – AL6 ELECTRICAL
766284 – AL6 PIPING
766285 – AL6 DPS
766286 – AL6 EQUIPMENT
766288 – RE7
766289 – RE7 HVAC
766290 – RE7 ELECTRICAL

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:27:42 -07'00'
TECHNICAL CHECK: P. LEONARD, P.E.	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:42:25 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:27:45 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M HILL BOC IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 EQUIPMENT LOCATION PLAN

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1619	02	136	767855	2

SCALE: NOTED

SHEET 1 OF 1

RW-1271

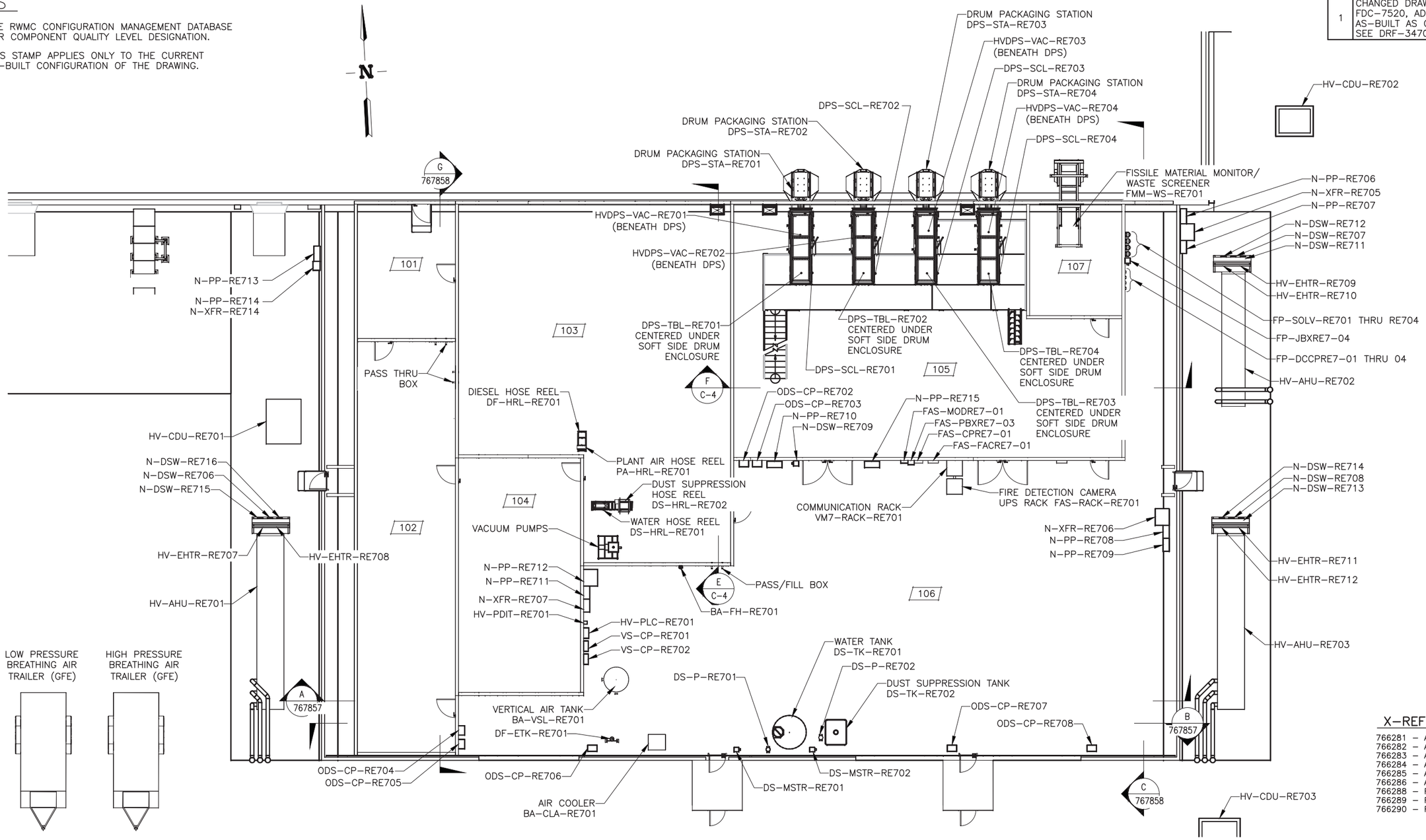
File: 767855-2.dwg
Path: Y:\RE-7\RCRA\RCRA Drawings
Date: 11/02/15 – 4:09 PM | Layout Name: C-1 | ID: BXS

FMT-D1-REV 2012-02-14

REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-7520, ADDED P.E. STAMP, AS-BUILT AS OF 10-14-2015, SEE DRF-347017

NOTES

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



X-REF DRAWINGS

766281 – AL6
766282 – AL6 HVAC
766283 – AL6 ELECTRICAL
766284 – AL6 PIPING
766285 – AL6 DPS
766286 – AL6 EQUIPMENT
766288 – RE7
766289 – RE7 HVAC
766290 – RE7 ELECTRICAL

AIRLOCK 6 (AL6) EQUIPMENT LOCATION PLAN

SCALE: 1/8" = 1'-0"

Paul D. Leonard
CWI
2015.11.24 -07'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE	
DESIGN: J. WITT, P.E.	N/A	N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:28:00 -07'00'	
TECHNICAL CHECK: P. LEONARD, P.E.	N/A	N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A	N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:42:44 -07'00'	
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:27:19 -07'00'	
PROJECT NUMBER: 30916		
DRF NUMBER: 329428		

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 (AL6) EQUIPMENT LOCATION PLAN

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1619	02	136	767856	1

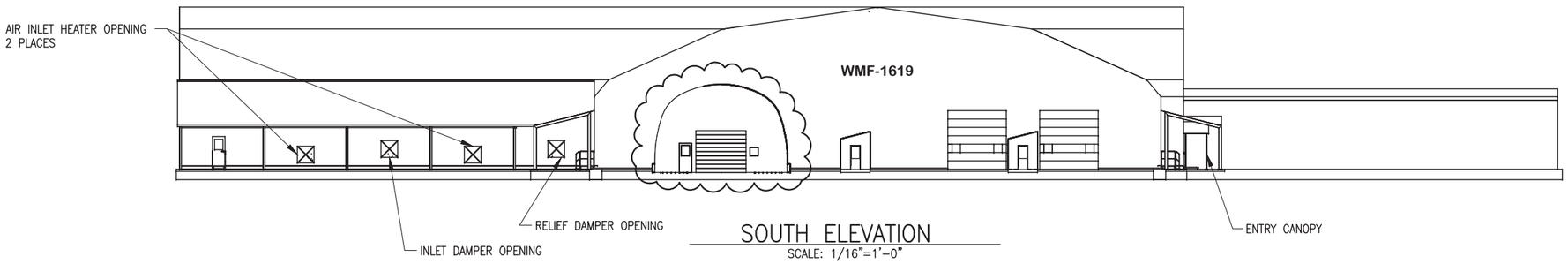
SCALE: NOTED SHEET 1 OF 1

RW-1271

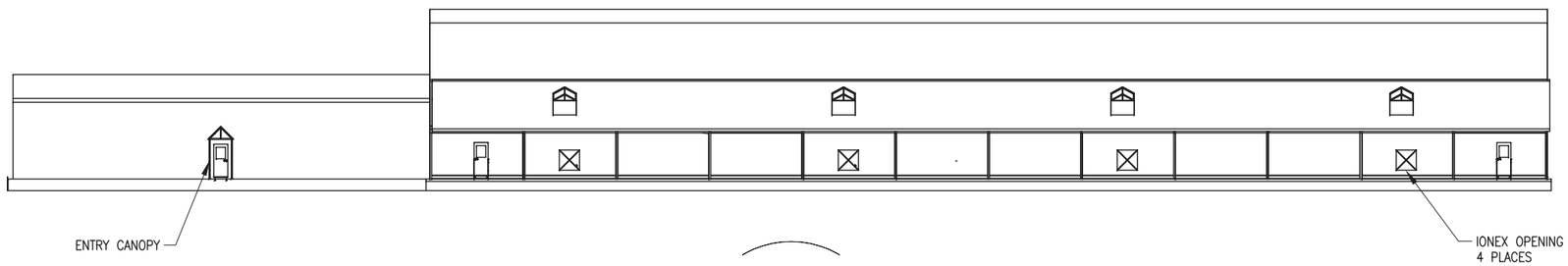
File: 767856-1.dwg
Path: Y:\RE-7\RCRA\RCRA Drawings
Date: 11/02/15 – 3:44 PM | Layout Name: C-2 | ID: BXS

FMT-D1-REV 2012-02-14

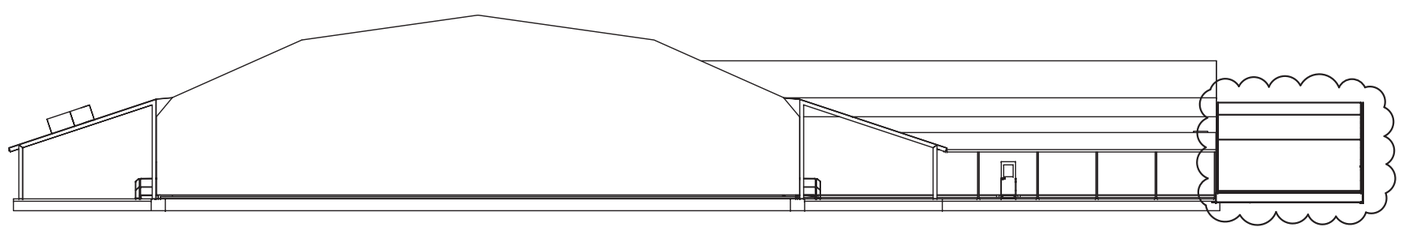
REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, ADDED P.E. STAMP, INCORPORATED FDC-9657, AS-BUILT AS OF 10-14-2015, SEE DRF-347017
2	INCORPORATED FDC-10701, AS-BUILT AS OF 5-12-2016, SEE DRF-348740



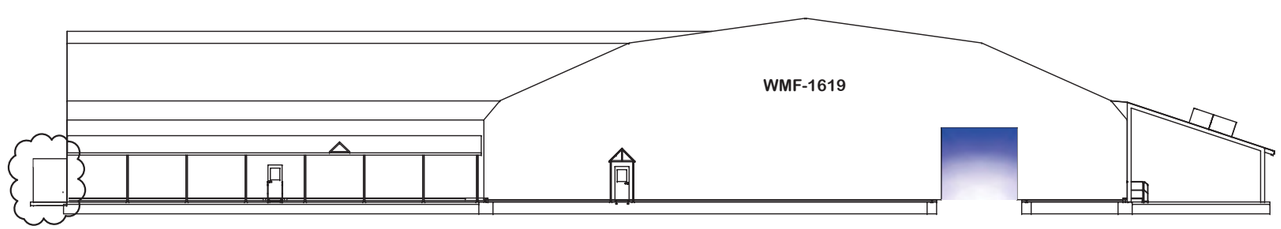
SOUTH ELEVATION
SCALE: 1/16"=1'-0"



NORTH ELEVATION
SCALE: 1/16"=1'-0"



WEST ELEVATION
SCALE: 1/16"=1'-0"



EAST ELEVATION
SCALE: 1/16"=1'-0"

NOTES

1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 3.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

Paul D. Leonard
Fluor Idaho
2016.06.16 13:52:37 -06'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2016.06.16 11:12:17 -06'00'
TECHNICAL CHECK: P. LEONARD, P.E.	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary Fluor Idaho 2016.06.16 12:52:56 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2016.06.16 13:03:30 -06'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6

BUILDING ELEVATIONS

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1619	00	136	767863	2

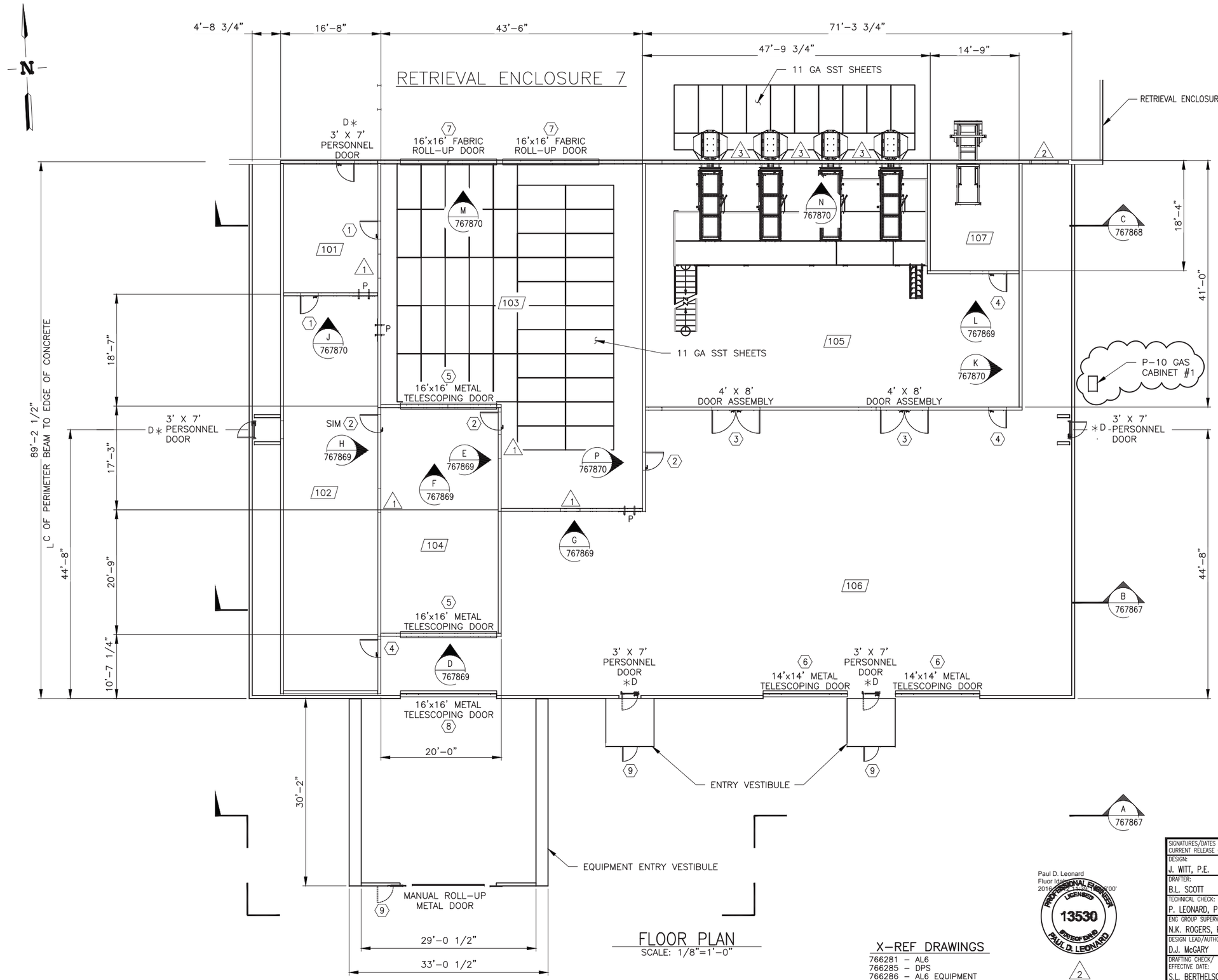
SCALE: NOTED SHEET 1 OF 1

RW-1273

File: 767863-2.dwg
Path: C:\Users\bxs\Documents\BXS\RW-1273 (ARPs Start 1-12-2016)
Date: 06/15/16 - 5:06 PM Layout Name: A-3 ID: BXS

FMT-D1-ICP REV 2016-08-02

REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-7520 & -9657, ADDED P.E. STAMP, AS-BUILT AS OF 10-14-2015, SEE DRF-347017
2	INCORPORATED FDC-10701, -10773 & -10820, AS-BUILT AS OF 5-12-2016, SEE DRF-348740
3	AS-BUILT AS OF 10-11-2016, SEE DRF-351743



FLOOR PLAN
SCALE: 1/8"=1'-0"

LEGEND

- ROOM NUMBER. SEE ROOM FINISH SCHEDULE ON SHEET A-5
- DOOR NUMBER. SEE DOOR SCHEDULE ON SHEET A-5
- WINDOW NUMBER. SEE WINDOW SCHEDULE ON SHEET A-5
- *D — DOOR, FRAME AND HARDWARE FURNISHED BY BUILDING MANUFACTURER
- P — PASS THRU BOX OR PASS/FILL BOX

NOTES

1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 3.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

X-REF DRAWINGS

766281 – AL6
766285 – DPS
766286 – AL6 EQUIPMENT
766288 – RE7

Paul D. Leonard
Fluor Idaho
2016.10.12 14:16:25 -06'00'
PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2016.10.12 11:26:27 -06'00'
TECHNICAL CHECK: P. LEONARD, P.E.	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD/AUTHORITY: D.J. McGARY	Doug J. McGary Fluor Idaho 2016.10.12 14:03:28 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2016.10.12 14:16:25 -06'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project Fluor IDAHO

PHASE VII OF THE
ACCELERATED RETRIEVAL PROJECT
RWMC WMF-1619 RE7/AL6
AIRLOCK 6
FLOOR PLAN

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1619	00	136	767864	3

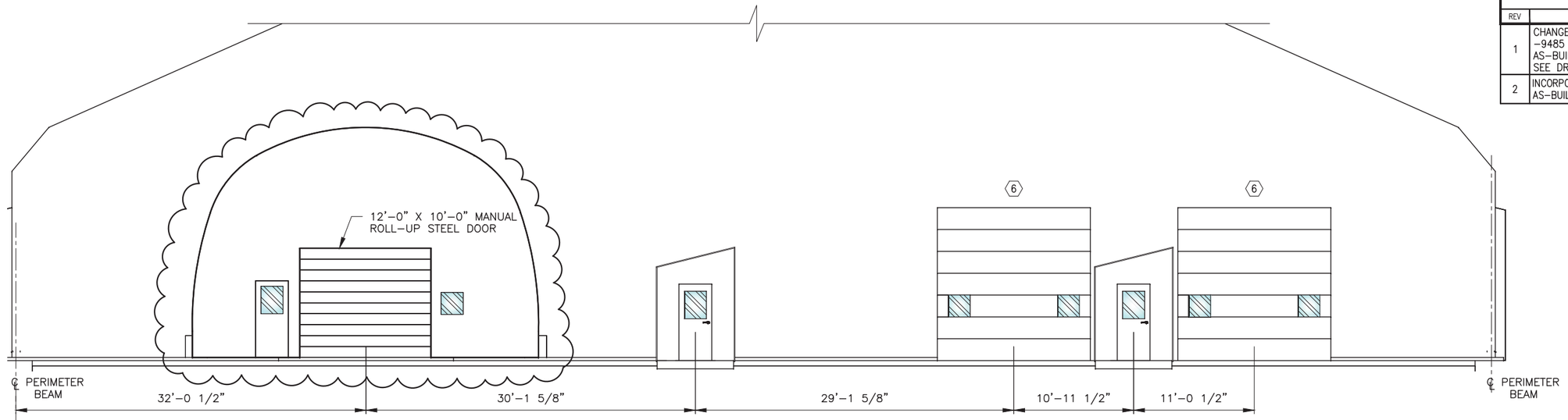
SCALE: NOTED
SHEET 1 OF 1

RW-1273

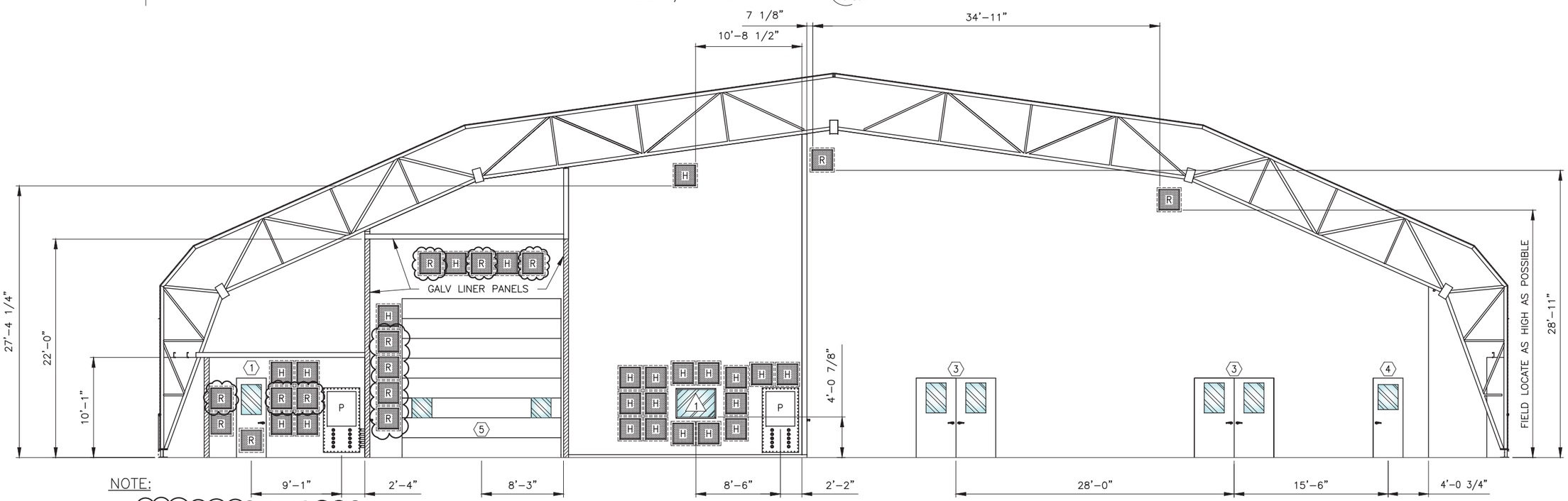
File: 767864-3.dwg
Path: C:\Users\bxs\Documents\BXS\RW-1273 (ARPs Start 1-12-2016)
Date: 10/12/16 – 11:19 AM | Layout Name: A-4
ID: BXS

FMT-D1-REV 2012-02-14

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, INCORPORATED FDC-8242, -9485 & -9657, ADDED P.E. STAMP, AS-BUILT AS OF 10-14-2015, SEE DRF-347017
2	INCORPORATED FDC-10693 & -10701, AS-BUILT AS OF 5-12-2016, SEE DRF-348740



BUILDING ELEVATION (A / 767864)
SCALE: 3/16" = 1'-0"



BUILDING SECTION (B / 767864)
SCALE: 3/16" = 1'-0"

NOTE:

1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 3 AND APPLIES ONLY TO THE HEPA FILTERS.
2. THE FILTER BLANK LOCATIONS SHOWN AND THE NUMBER OF FILTERS WITH BLANKS INSTALLED ARE FOR THE ORIGINAL DESIGN CONFIGURATION ONLY. THE BLANKS MAY BE REMOVED, INSTALLED OR FILTERS REMOVED AND REINSTALLED AS NEEDED TO PROVIDE PROPER AIR FLOW AND ACCEPTABLE CONTAMINATION CONTROL FOR AIRLOCK 6.
3. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.
4. SEE DRAWING 767948 FOR ADDITIONAL NOTES.

LEGEND

H	HEPA FILTER
R	ROUGHING FILTER

Paul D. Leonard
Fluor Idaho
2016.06.16 12:17:17 -06'00'
PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD
3

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2016.06.16 09:37:09 -06'00'
TECHNICAL CHECK: P. LEONARD, P.E.	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary Fluor Idaho 2016.06.16 12:51:57 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2016.06.16 13:01:23 -06'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 BUILDING SECTIONS

SIZE	INDEX CODE NUMBER (AREA / TYPE / CL / ORIG)	DWG-	REV
D	098 / 1619 / 00 / 136	767867	2
SCALE: NOTED		SHEET 1 OF 1	

RW-1273

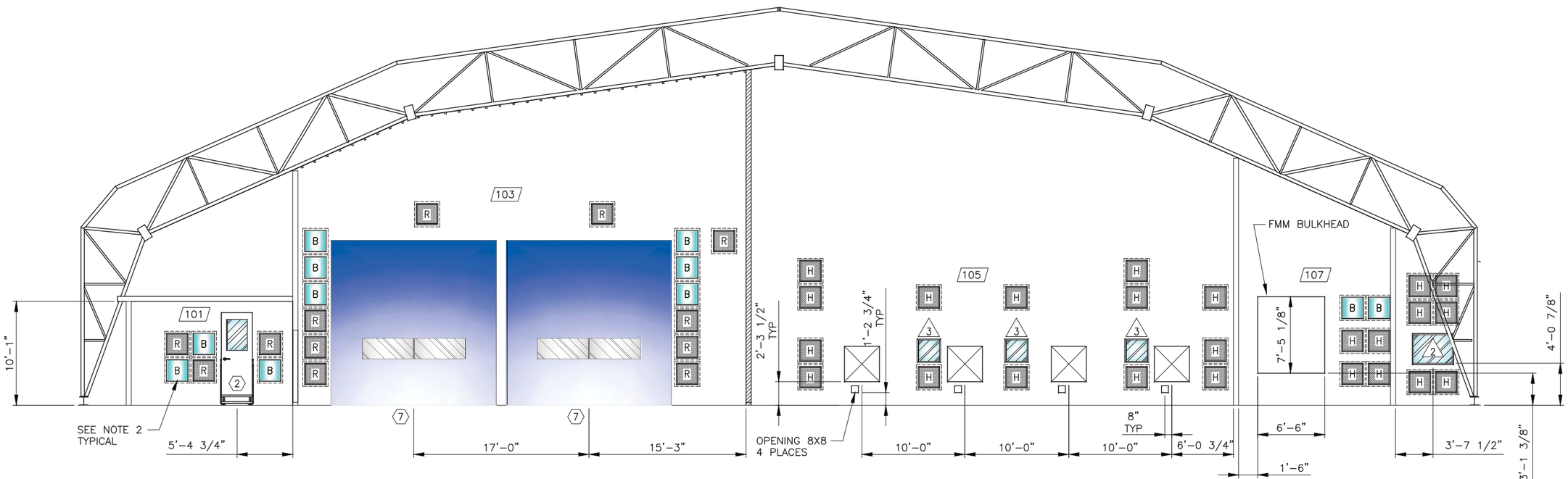
File: 767867-2.dwg
Path: C:\Users\bxs\Documents\BXS\RW-1273 (ARPs Start 1-12-2016)
Date: 06/16/16 - 7:20 AM Layout Name: A-7 ID: BXS

FMT-D1-REV 2012-02-14

REVISIONS	
REV	DESCRIPTION
1	CHANGED DRAWING TITLE, INCORPORATED FDC-7486, -7520, -7586 & 8242, ADDED P.E. STAMP, AS-BUILT AS OF 10-14-2015, SEE DRF-347017

NOTES:

1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 3.
2. THE FILTER BLANK LOCATIONS SHOWN AND THE NUMBER OF FILTERS WITH BLANKS INSTALLED ARE FOR THE ORIGINAL DESIGN CONFIGURATION ONLY. THE BLANKS MAY BE REMOVED, INSTALLED OR FILTERS REMOVED AND REINSTALLED AS NEEDED TO PROVIDE PROPER AIR FLOW AND ACCEPTABLE CONTAMINATION CONTROL FOR AIRLOCK 6.
3. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



SECTION C 767864
SCALE: 3/16"=1'-0"

X-REF DRAWINGS
766281 – AL6

LEGEND

- H — HEPA FILTER
- R — ROUGHING FILTER
- B — BLANK

Paul D. Leonard
CWI
2015.11.12 15:28:22 -07'00'
PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

3

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:35:18 -07'00'
TECHNICAL CHECK: P. LEONARD, P.E.	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:44:03 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:28:27 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 BUILDING SECTION

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1619	00	136	767868	1

SCALE: NOTED — SHEET 1 OF 1

RW-1271

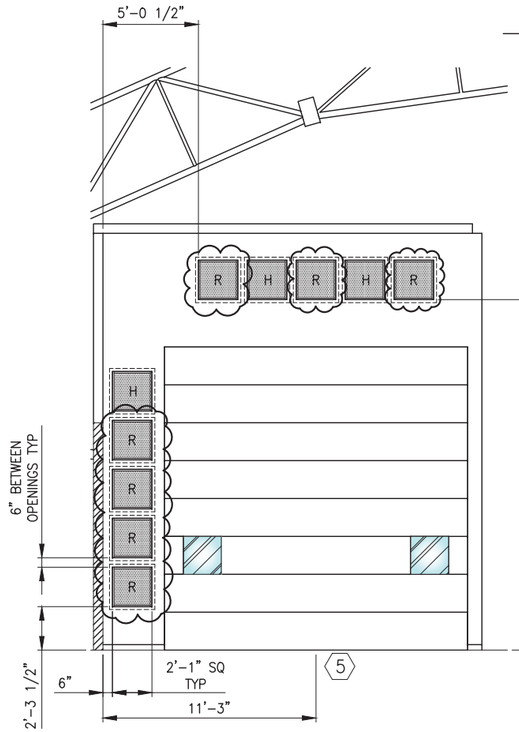
File: 767868-1.dwg
Path: Y:\RE-TYROA\RCRA Drawings
Date: 11/02/15 - 1:50 PM
Layout Name: A-8
ID: BXS

FMT-D1-REV 2012-02-14

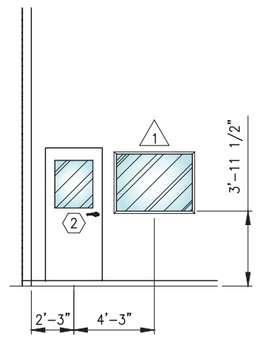
REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, INCORPORATED FDC-8242, ADDED P.E. STAMP, AS-BUILT AS OF 10-14-2015, SEE DRF-347017
2	INCORPORATED FDC-10693 & -10773, AS-BUILT AS OF 5-12-2016, SEE DRF-348740

NOTES

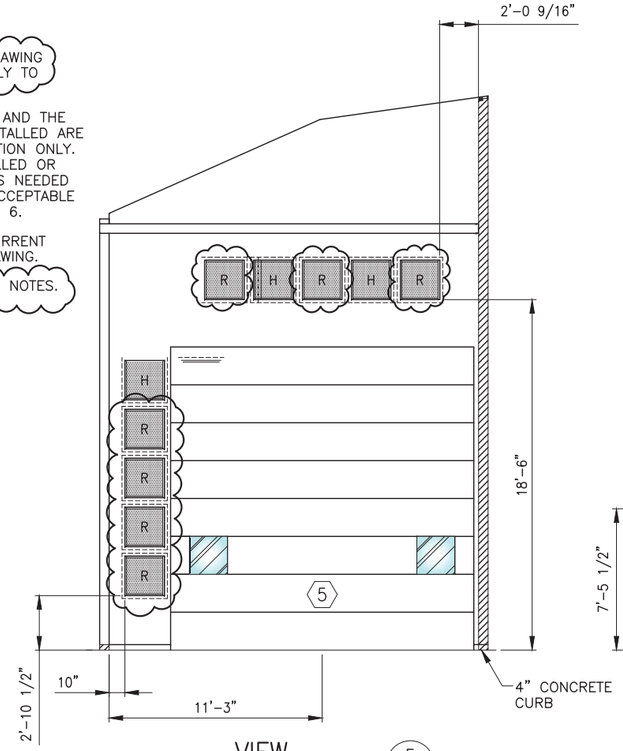
1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 3 AND APPLIES ONLY TO THE HEPA FILTERS.
2. THE FILTER BLANK LOCATIONS SHOWN AND THE NUMBER OF FILTERS WITH BLANKS INSTALLED ARE FOR THE ORIGINAL DESIGN CONFIGURATION ONLY. THE BLANKS MAY BE REMOVED, INSTALLED OR FILTERS REMOVED AND REINSTALLED AS NEEDED TO PROVIDE PROPER AIR FLOW AND ACCEPTABLE CONTAMINATION CONTROL FOR AIRLOCK 6.
3. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.
4. SEE DRAWING 767948 FOR ADDITIONAL NOTES.



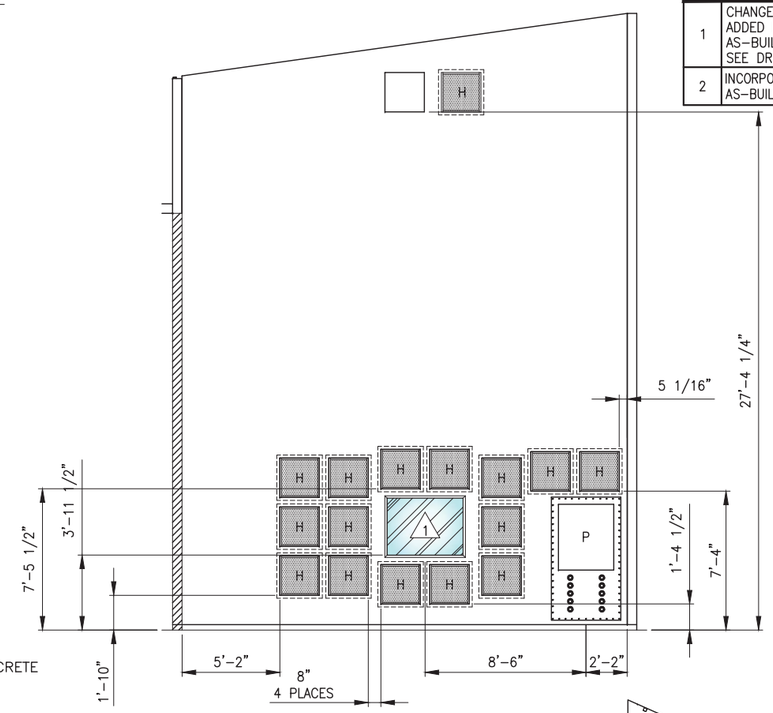
VIEW D 767864
SCALE: 1/4" = 1'-0"



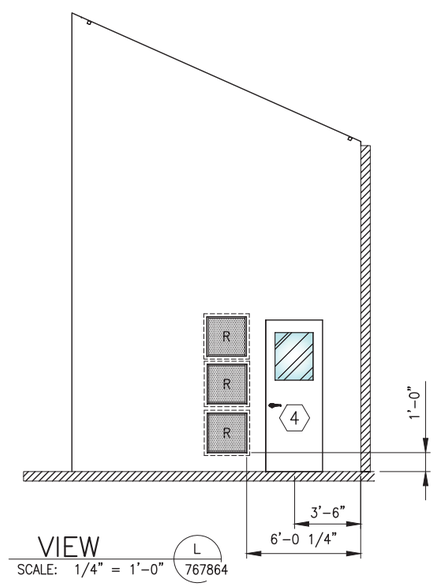
VIEW E 767864
SCALE: 1/4" = 1'-0"



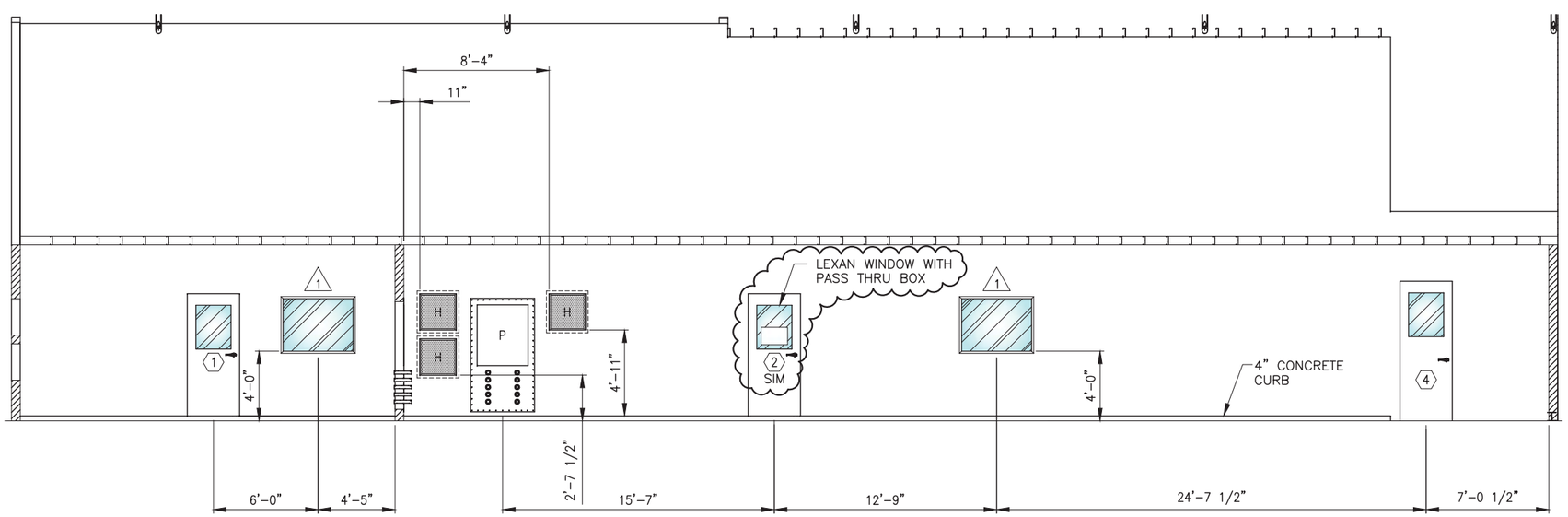
VIEW F 767864
SCALE: 1/4" = 1'-0"



VIEW G 767864
SCALE: 1/4" = 1'-0"



VIEW L 767864
SCALE: 1/4" = 1'-0"



ELEVATION H 767864
SCALE: 1/4" = 1'-0"

LEGEND

- H — HEPA FILTER
- R — ROUGHING FILTER

X-REF DRAWINGS

766281 – AL6

Paul D. Leonard
Fluor Idaho
2016.06.16 13:02:18 -06'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott Fluor Idaho 2016.06.16 09:37:50 -06'00'
TECHNICAL CHECK: P. LEONARD, P.E.	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary Fluor Idaho 2016.06.16 12:52:15 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2016.06.16 13:02:18 -06'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 INTERIOR ELEVATIONS

SIZE	INDEX CODE NUMBER: AREA	TYPE	CL	ORIG	DWG-	REV
D	098	1619	00	136	767869	2

SCALE: NOTED — SHEET 1 OF 1

RW-1273

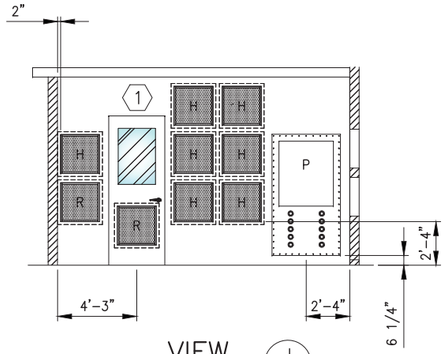
File: 767869-2.dwg
Path: C:\Users\bxs\Documents\BXS\RW-1273 (ARPs Start 1-12-20 6)
Date: 06/16/16 – 7:24 AM | Layout Name: A-9 | ID: BXS

FMT-D1-REV 2012-02-14

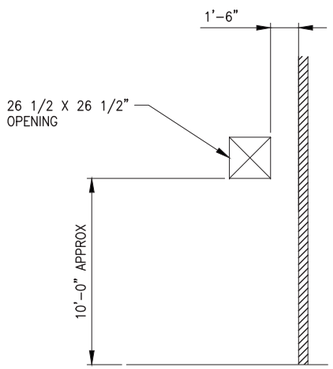
REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, INCORPORATED FDC-7501, -7586, -8242 & -9485, ADDED P.E. STAMP, AS-BUILT AS OF 10-14-2015, SEE DRF-347017

NOTES:

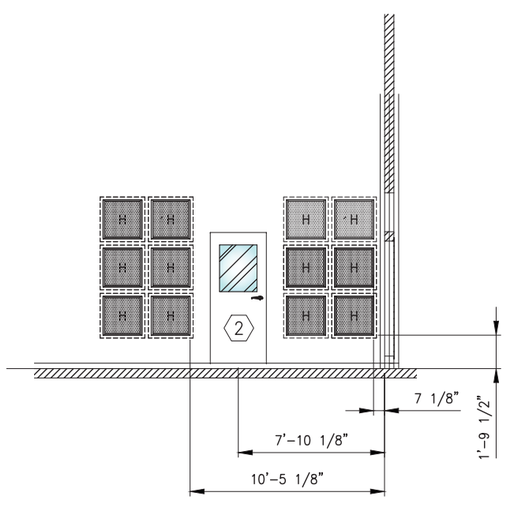
1. THE INFORMATION SHOWN ON THIS DRAWING IS QUALITY LEVEL 3.
2. THE FILTER BLANK LOCATIONS SHOWN AND THE NUMBER OF FILTERS WITH BLANKS INSTALLED ARE FOR THE ORIGINAL DESIGN CONFIGURATION ONLY. THE BLANKS MAY BE REMOVED, INSTALLED OR FILTERS REMOVED AND REINSTALLED AS NEEDED TO PROVIDE PROPER AIR FLOW AND ACCEPTABLE CONTAMINATION CONTROL FOR AIRLOCK 6.
3. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



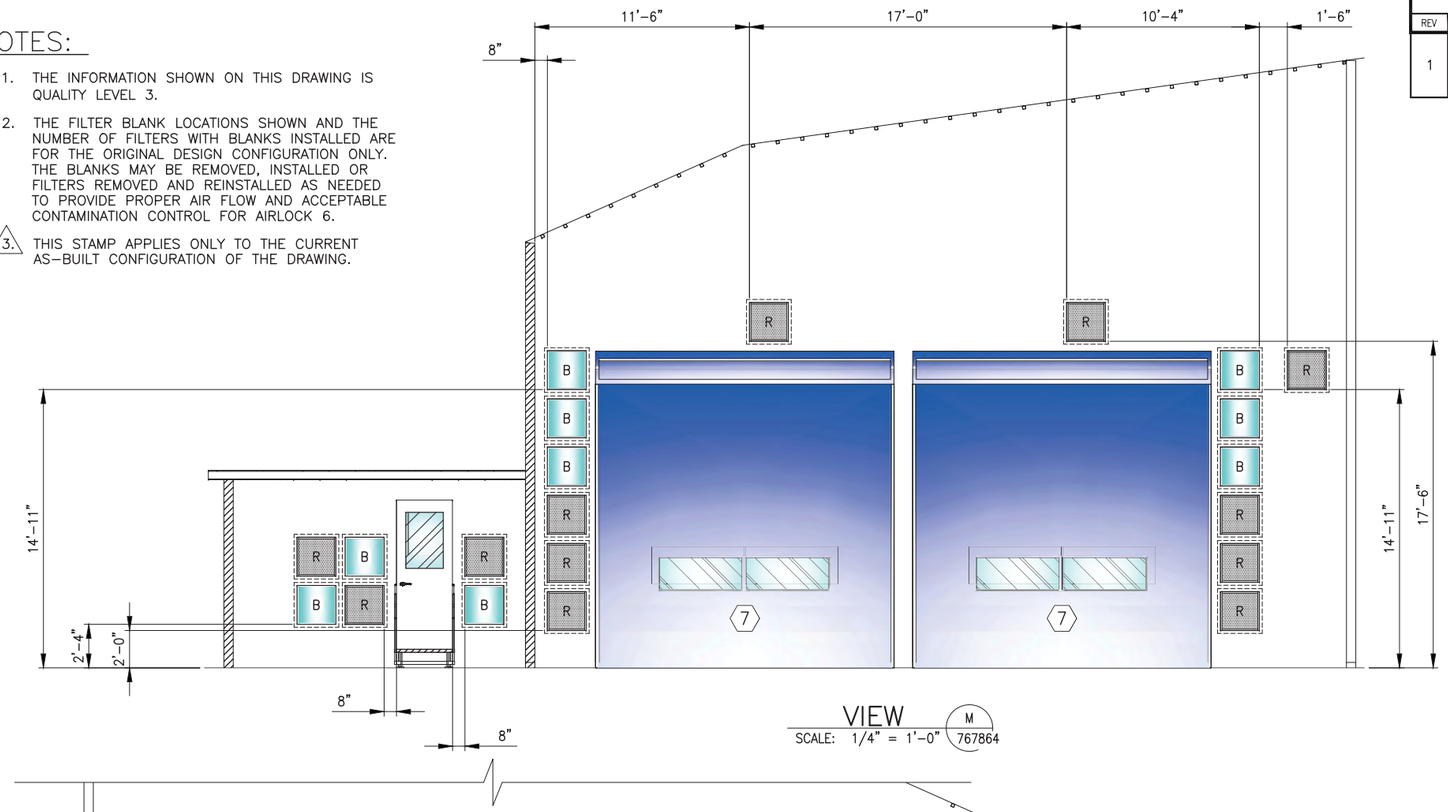
VIEW J 767864
SCALE: 1/4" = 1'-0"



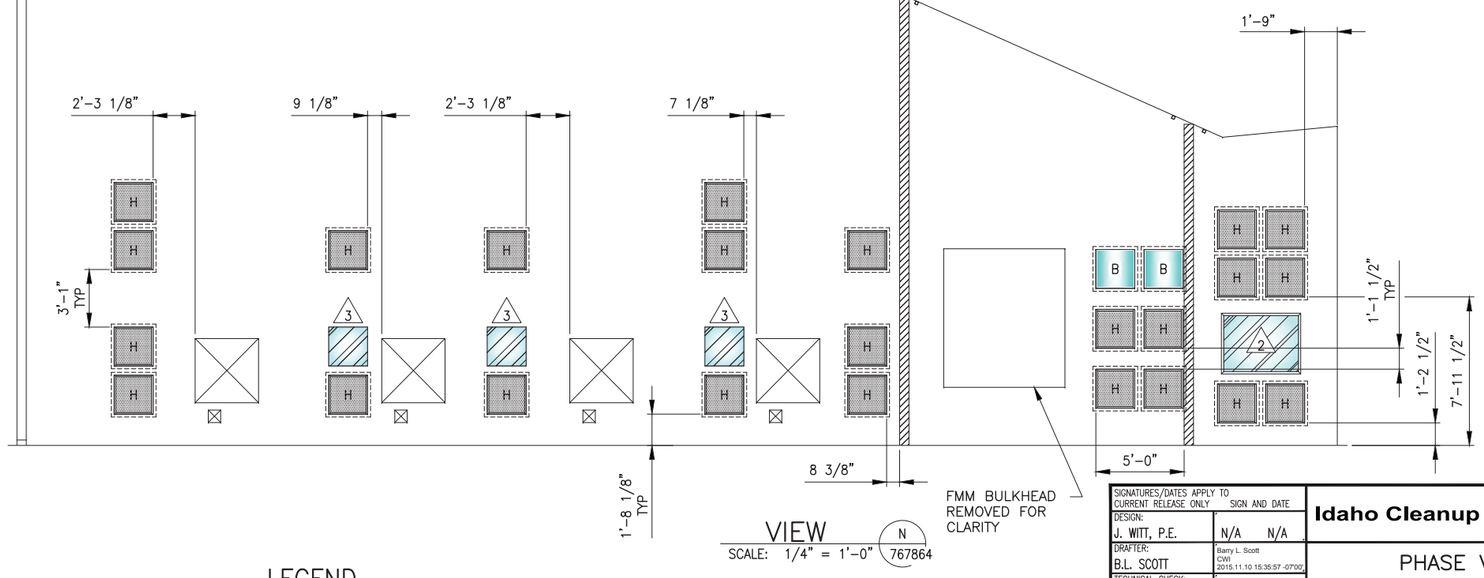
VIEW K 767864
SCALE: 1/4" = 1'-0"



VIEW P 767864
SCALE: 1/4" = 1'-0"



VIEW M 767864
SCALE: 1/4" = 1'-0"



VIEW N 767864
SCALE: 1/4" = 1'-0"

LEGEND

H	HEPA FILTER
R	ROUGHING FILTER
B	BLANK

X-REF DRAWINGS
766281 – AL6

Paul D. Leonard
CWI
2015.11.12 15:29:42 -07'00'

PROFESSIONAL ENGINEER LICENSED 13530 STATE OF IDAHO PAUL D. LEONARD

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: J. WITT, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:35:57 -07'00'
TECHNICAL CHECK: P. LEONARD, P.E.	N/A N/A
ENG GROUP SUPERVISOR: N.K. ROGERS, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:44:45 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:29:42 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE
ACCELERATED RETRIEVAL PROJECT
RWMC WMF-1619 RE7/AL6
AIRLOCK 6
INTERIOR ELEVATIONS

SIZE	INDEX CODE NUMBER AREA	TYPE	CI	ORIG	DWG-	REV
D	098	1619	00	136	767870	1

SCALE: NOTED SHEET 1 OF 1

RW-1271

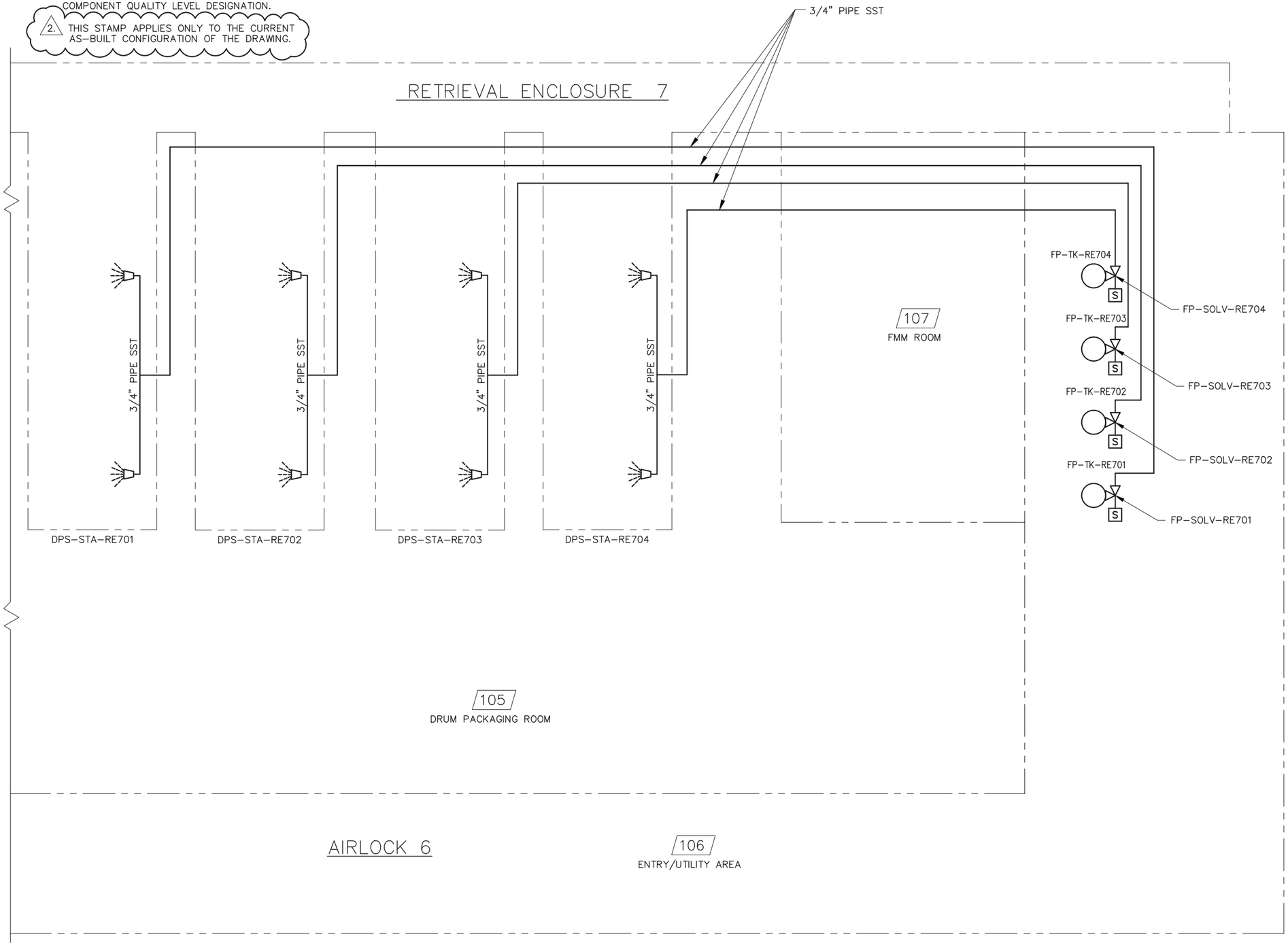
File: 767870-1.dwg
Path: Y:\RE-IT\RCRA\RCRA Drawings
Date: 11/02/15 - 12:03 PM
Layout Name: A-10
ID: BXS

FMT-D1-REV 5.2

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, CHANGED INDEX CODE CLASS, AS-BUILT AS OF 10/5/2011 SEE DRF 334556
2	ADDED P.E. STAMP & NOTE 2, AS-BUILT AS OF 10-14-2015, SEE DRF-347017

NOTE:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



LEGEND

FP	FIRE PROTECTION
TK	TANK
S	CHEMICAL STORAGE CYLINDER WITH INTEGRAL SOLENOID VALVE
	DISCHARGE NOZZLE

Stephen Thorne
Hukari-Ascendent
2015.10.14 15:32:13 -07'00'
PROFESSIONAL ENGINEER REGISTERED 9302 STATE OF IDAHO STEPHEN D. THORNE
2

SIGNATURES/DATES APPLY TO CURRENT RELEASE ONLY	SIGN AND DATE
DESIGN: C. SUTTON, P.E.	N/A N/A
DRAFTER: B.L. SCOTT	Barry L. Scott CWI 2015.11.10 15:36:25 -07'00'
TECHNICAL CHECK: D. CLARK, P.E.	N/A N/A
ENG GROUP SUPERVISOR: R. EASTMAN, P.E.	N/A N/A
DESIGN LEAD: D.J. McGARY	Doug J. McGary CWI 2015.11.11 16:45:08 -07'00'
DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:30:20 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE
ACCELERATED RETRIEVAL PROJECT
RWMC WMF-1619 RE7/AL6
DRUM PACKAGING STATION
DRY CHEMICAL P & ID

SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CL	ORIG		
D	098	1619	24	136	767935	2

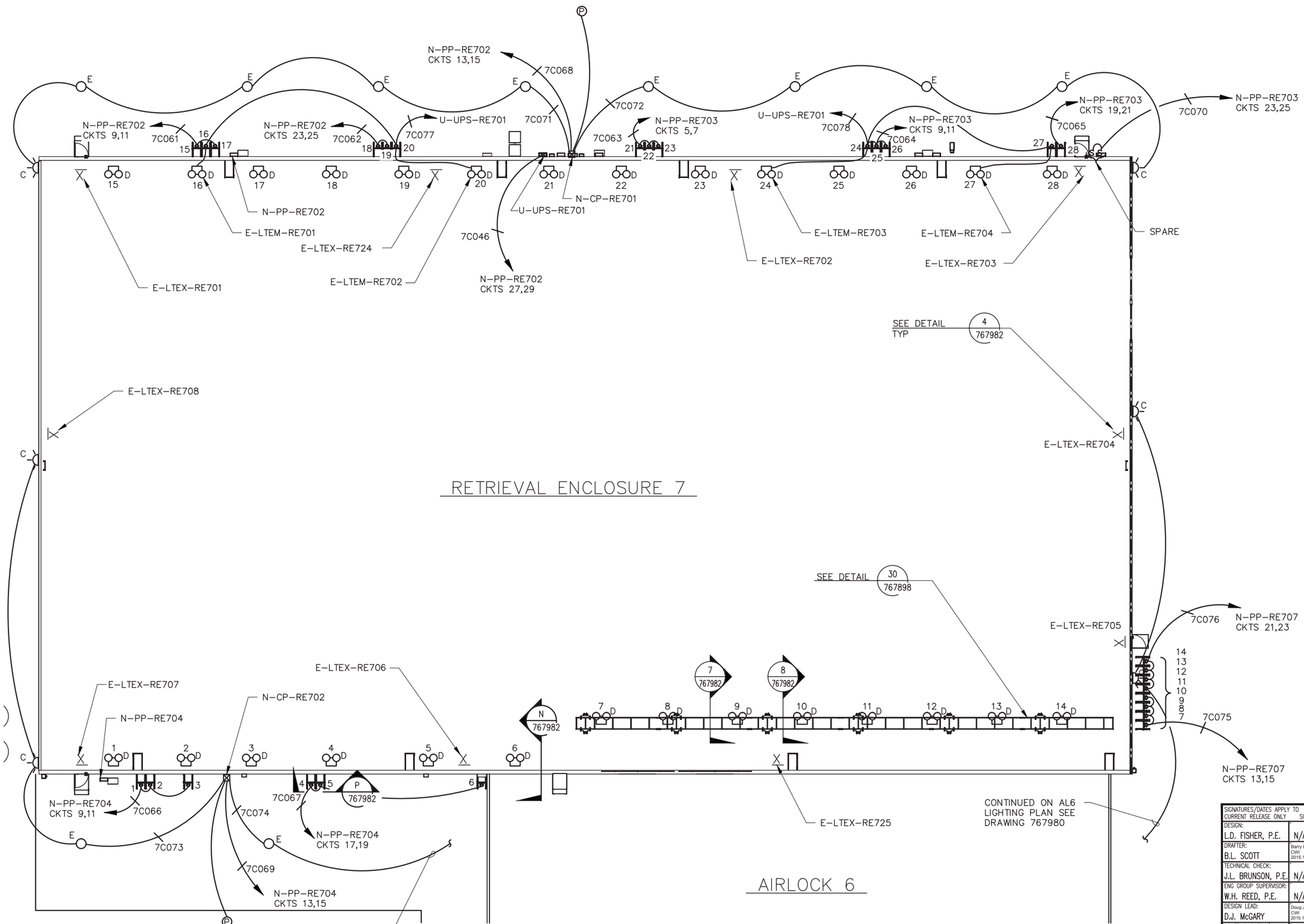
SCALE: NONE SHEET 1 OF 1

DRY CHEMICAL SYSTEM P & ID

File: 767935-2.dwg
Path: Y:\RE-7\RCRA\RCRA Drawings
Date: 11/10/15 - 2:44 PM Layout Name: FP-1 ID: BXS

FMT-D1-REV 5.2

REVISIONS	
REV	DESCRIPTION
1	CHANGED DWG TITLE, AS-BUILT AS OF 11/23/2011 SEE DRF-335037
2	INCORPORATED FDC-8314 AS-BUILT AS OF 10/25/2012 SEE DRF-337757
3	ADDED P.E. STAMP & NOTE 5, AS-BUILT AS OF 10-14-2015, SEE DRF-347017



RE7 LIGHTING PLAN

SCALE 3/32" = 1'-0"

NOTES:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. SEE DRAWING 767982 FOR LIGHTING DETAILS.
3. SEE DRAWINGS 767986, 767987 & 767988 FOR CABLE & CONDUIT SCHEDULE.
4. SEE DRAWING 7677981 FOR LUMINAIRE SCHEDULE.
5. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

LEGEND:

- LIGHTING CONTROL PANEL
- UNINTERRUPTIBLE POWER SUPPLY
- LIGHTS/RACK
- BALLAST, LIGHTING, REMOTE
- PHOTO-EYE SENSOR (PES)
- EXIT SIGN PHOTO LUMINESCENT
- OVERHEAD FIXTURE
- EXTERIOR WALL FIXTURE
- OUTDOOR RATED LIGHT SWITCH (208V)

Larry Fisher
CWI
2015.11.11 16:46:08 -07'00'
PROFESSIONAL ENGINEER REGISTERED 6876 STATE OF IDAHO LARRY D. FISHER
5

X-REF DRAWINGS

766281 – AL6
766288 – RE7
766290 – RE7 ELECTRICAL

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ENG GROUP SUPERVISOR: W.H. REED, P.E.	N/A N/A
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DRAFTING CHECK/ EFFECTIVE DATE: K.J. KELLER	Kris Keller CWI 2015.11.12 15:29:55 -07'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M+WG IDAHO, LLC

PHASE VII OF THE
ACCELERATED RETRIEVAL PROJECT
RWMC WMF-1619 RE7/AL6
RETRIEVAL ENCLOSURE 7
LIGHTING PLAN

SIZE	INDEX CODE NUMBER (AREA / TYPE / CL / ORIG)	DWG-	REV
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ID: BXS

FMT-D1-REV 5.2

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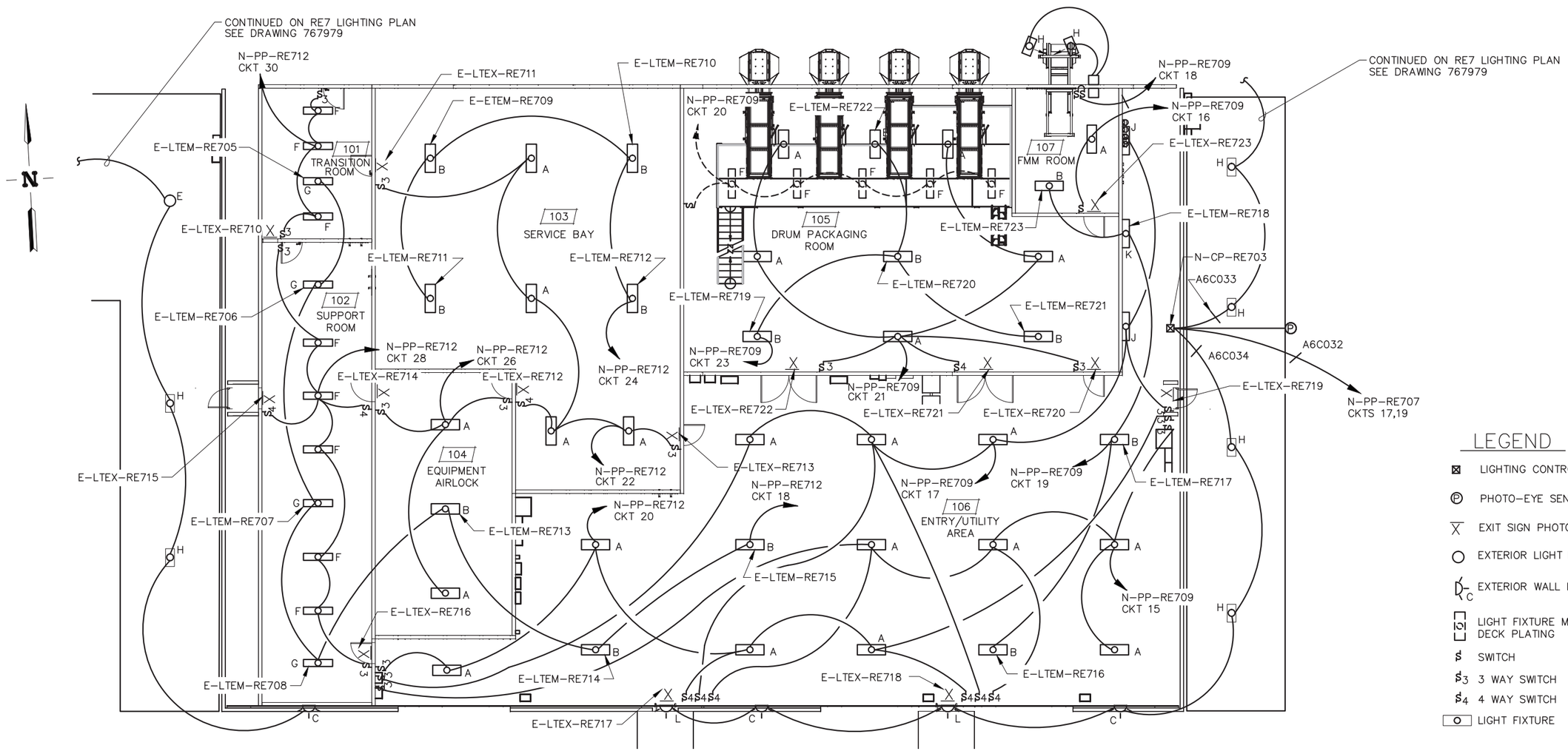
2	AS-BUILT AS OF 12-13-2011, SEE DRF-335182
3	ADDED P.E. STAMP & NOTE 4, AS-BUILT AS OF 10-14-2015 SEE DRF-347017

NOTES:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. SEE DRAWING 767988 FOR CABLE SCHEDULE.
3. SEE DRAWING 767981 FOR LUMINAIRE SCHEDULE.
4. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



LEGEND

- LIGHTING CONTROL PANEL
- PHOTO-EYE SENSOR (PES)
- EXIT SIGN PHOTO LUMINESCENT
- EXTERIOR LIGHT FIXTURE
- EXTERIOR WALL LIGHT FIXTURE
- LIGHT FIXTURE MOUNTED UNDER DPS DECK PLATING
- SWITCH
- 3 WAY SWITCH
- 4 WAY SWITCH
- LIGHT FIXTURE

AL6 LIGHTING PLAN

SCALE: 1/8" = 1'-0"

X-REF DRAWINGS

766281 – AL6
766283 – AL6 ELECTRICAL
766285 – AL6 DPS

Larry Fisher
CWI
2015.11.12 15:37:57 -07'00'
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4

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ENG GROUP SUPERVISOR: W.H. REED, P.E.	N/A N/A
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PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M HILL BOOZ ALLEN HAMILTON

PHASE VII OF THE
ACCELERATED RETRIEVAL PROJECT
RWMC WMF-1619 RE7/AL6
AIRLOCK 6
LIGHTING PLAN

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
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RW-1271

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FMT-D1-REV 5.2

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2	INCORPORATED FDC-8314 AS-BUILT AS OF 10/25/2012 SEE DRF-337791
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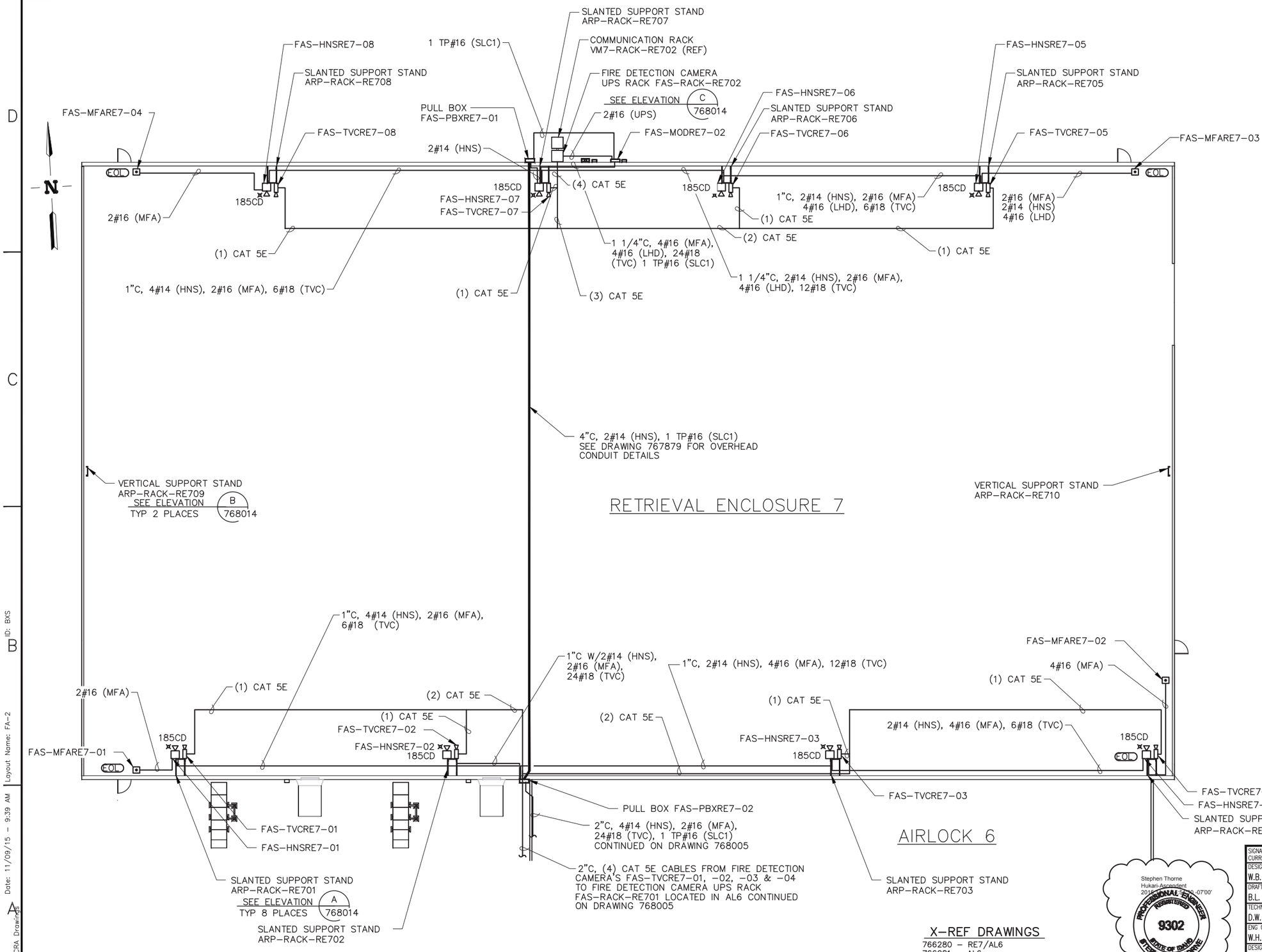

RE7 FIRE ALARM PLAN

SCALE: 3/32" = 1'-0"

NOTES:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

LEGEND

- MANUAL FIRE ALARM STATION
- HORN/STROBE
- EOL END OF LINE RESISTOR
- SMOKE/FIRE DETECTION CAMERA WITH HOUSING

X-REF DRAWINGS

766280 – RE7/AL6
766281 – AL6
766284 – AL6 PIPING
766288 – RE7
766289 – RE7 HVAC
766290 – RE7 ELECTRICAL

Stephen Thorne
Hukari-Ascendent
2016.03.29 09:00:00 -07'00'
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2

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PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M+WG IDAHO, LLC

PHASE VII OF THE
ACCELERATED RETRIEVAL PROJECT
RWMC WMF-1619 RE7/AL6
RE7
FIRE ALARM PLAN

SIZE	INDEX CODE NUMBER (AREA / TYPE / CL / ORIG)	DWG-	REV
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FMT-D1-REV 5.2

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NOTES:

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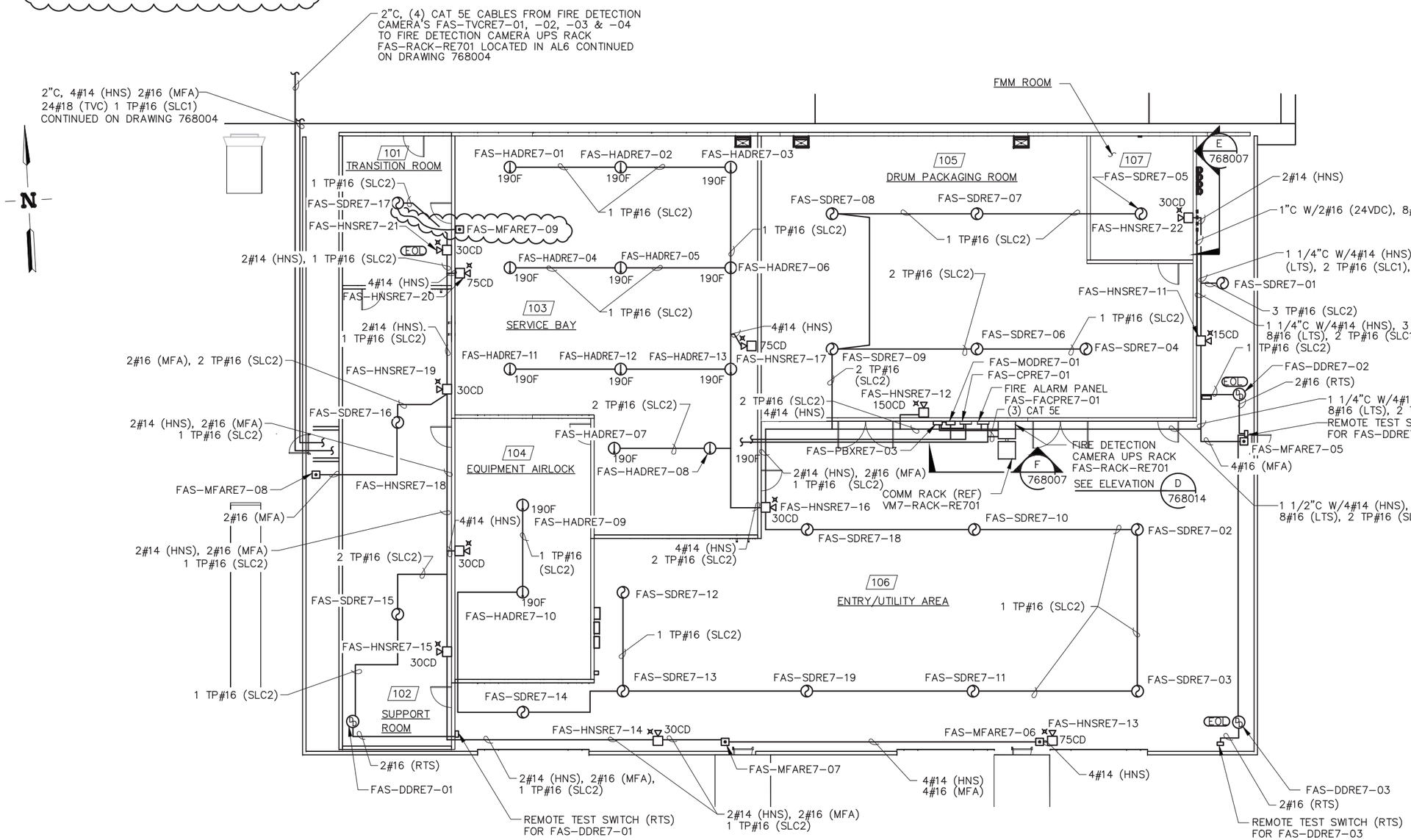
2. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.



AIRLOCK 6 FIRE ALARM PLAN

SCALE: 1/8" = 1'-0"

LEGEND

- MANUAL FIRE ALARM STATION
- HORN/STROBE
- EOL — END OF LINE RESISTOR
- SMOKE DETECTOR
- 190F — HEAT DETECTOR
- DUCT SMOKE DETECTOR
- FACP — FIRE ALARM PANEL

Stephen Thorne
Hukari-Ascendent
2015.11.12 15:29:49 -07'00'
PROFESSIONAL ENGINEER REGISTERED 9302 STATE OF IDAHO STEPHEN D. THORNE
2

X-REF DRAWINGS

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766282 – AL6 HVAC
766283 – AL6 ELECTRICAL
766289 – RE7 HVAC

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DRF NUMBER: 329428	

Idaho Cleanup Project CH2M HILL WG IDAHO, LLC

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 FIRE ALARM PLAN

SIZE	INDEX CODE NUMBER				DWG-	REV
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FMT-D1-REV 5.2

NOTES:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. SEE DRAWING 768014 FOR SLANTED SUPPORT STAND AND VERTICAL SUPPORT STAND DETAILS.

3. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.

REVISIONS	
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2	INCORPORATED FDC-8314 AS-BUILT AS OF 10/25/2012 SEE DRF-337791
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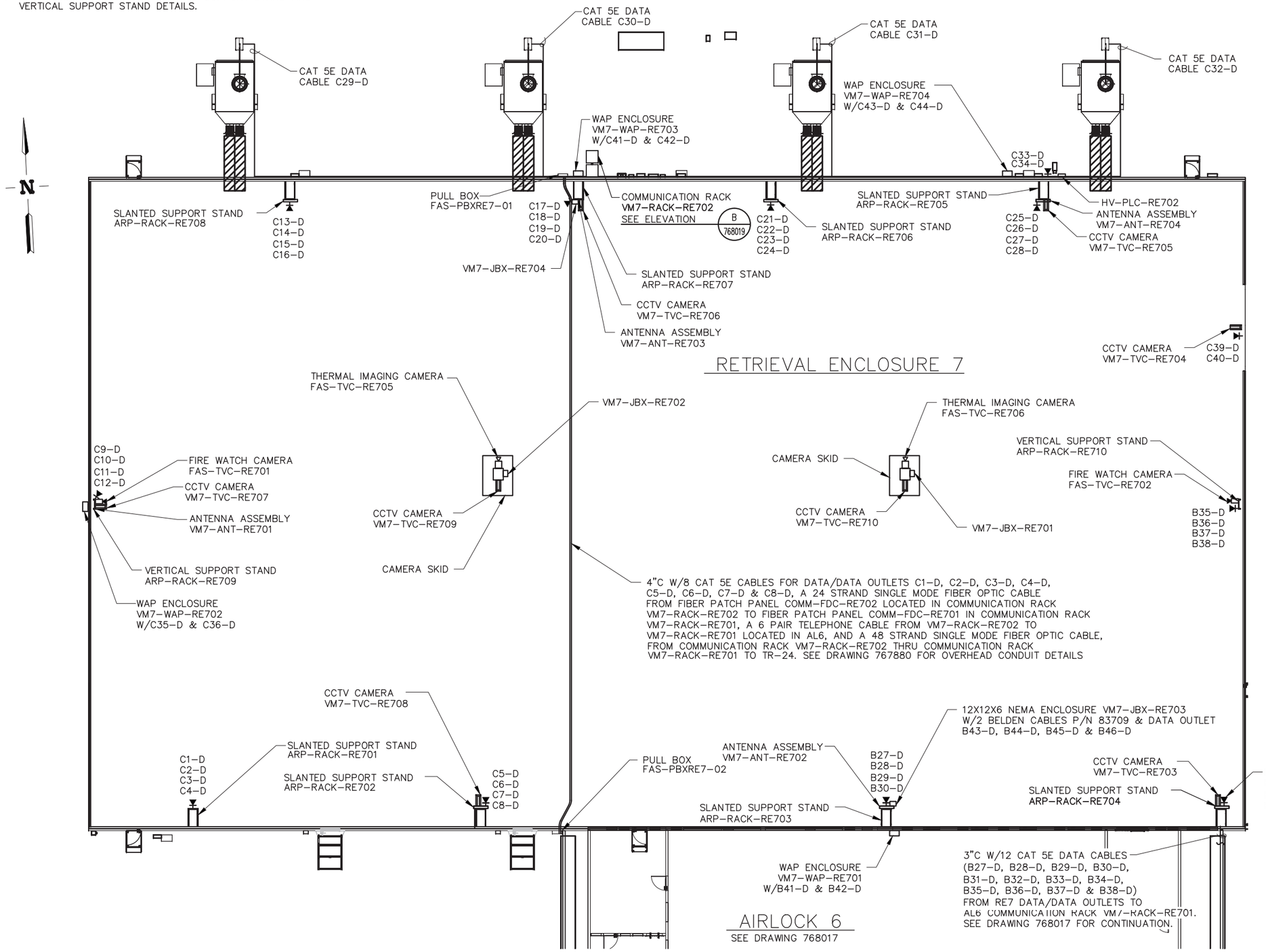

RE7 DATA/DATA PLAN

SCALE 3/32" = 1'-0"

LEGEND

DATA/DATA/DATA/DATA OUTLET

LAST NO. USED

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DATA/DATA	C44-D

X-REF DRAWINGS

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766288 – RE7
766289 – RE7 HVAC
766290 – RE7 ELECTRICAL

Larry Fisher
CWI
2015.11.13 15:31:03 -07'00'
PROFESSIONAL ENGINEER REGISTERED 6878 STATE OF IDAHO LARRY D. FISHER
3

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PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project CH2M•WG IDAHO, LLC

PHASE VII OF THE
ACCELERATED RETRIEVAL PROJECT
RWMC WMF-1619 RE7/AL6
RETRIEVAL ENCLOSURE 7
DATA/DATA CCTV PLAN

SIZE	INDEX CODE NUMBER				DWG-	REV
	AREA	TYPE	CL	ORIG		
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SCALE: NOTED — SHEET 1 OF 1

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FMT-D1-ICP REV 2017-02-28

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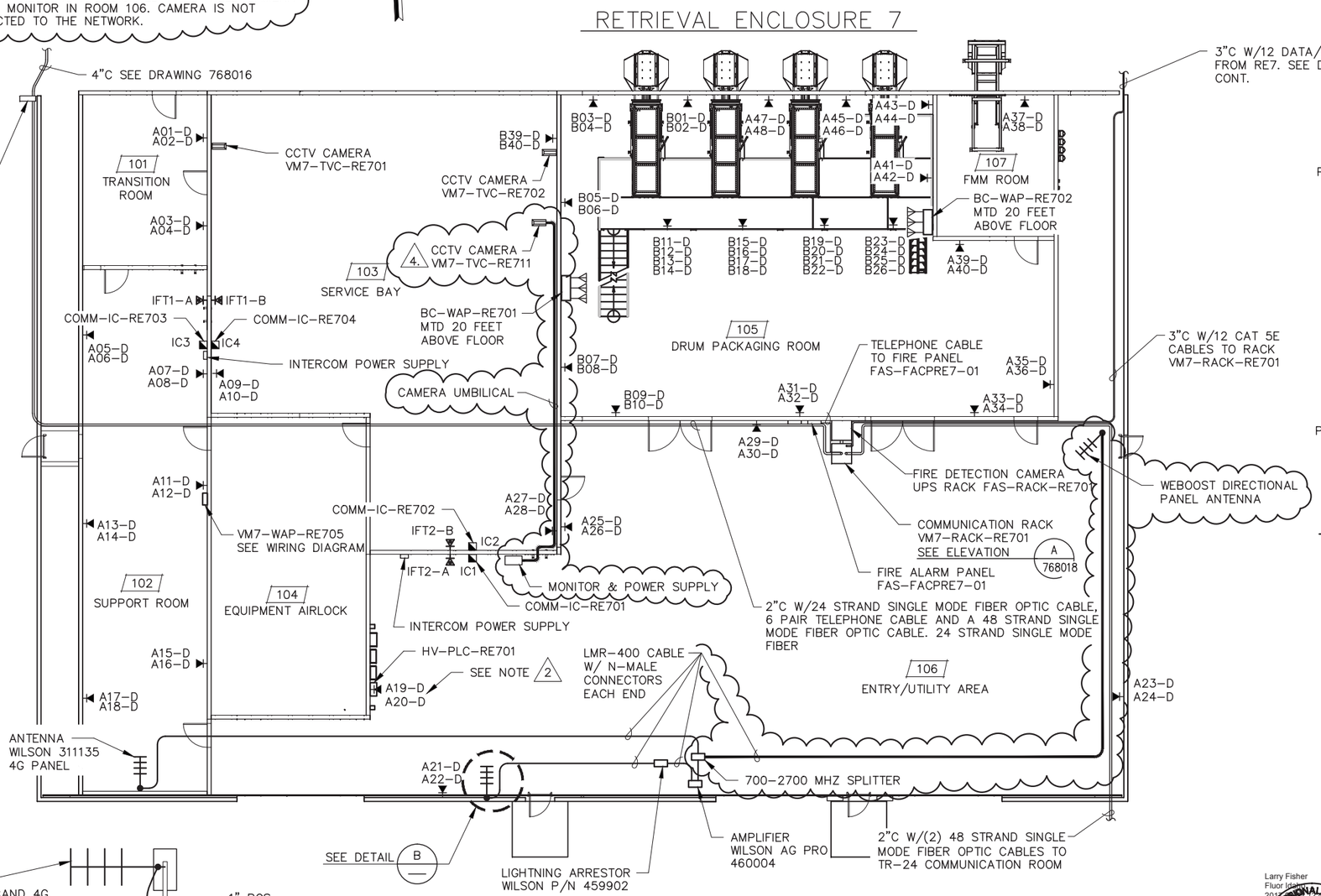
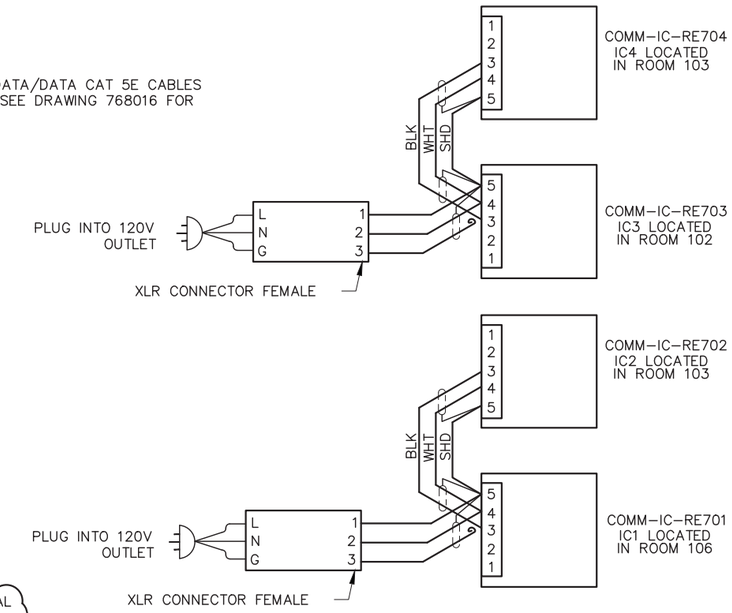
NOTES:

1. SEE RWMC CONFIGURATION MANAGEMENT DATABASE FOR COMPONENT QUALITY LEVEL DESIGNATION.
2. DATA OUTLET A19-D, A20-D LOCATED INSIDE PLC AND IS DEDICATED TO HV-PLC-RE701.
3. THIS STAMP APPLIES ONLY TO THE CURRENT AS-BUILT CONFIGURATION OF THE DRAWING.
4. VM7-TVC-RE711 IS A DEDICATED HAND-HELD CAMERA TO THE MONITOR IN ROOM 106. CAMERA IS NOT CONNECTED TO THE NETWORK.



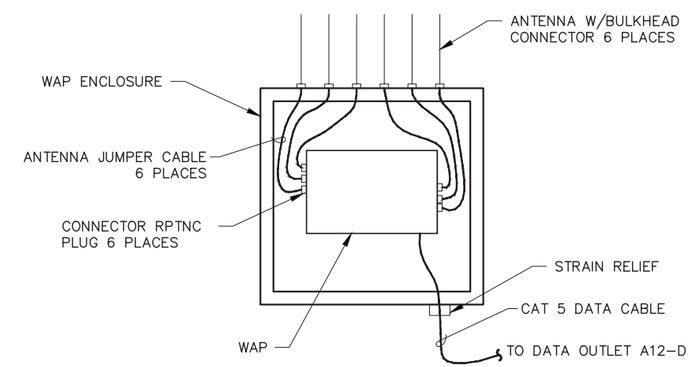
AIRLOCK 6 DATA/DATA PLAN

SCALE: 3/16" = 1'-0"

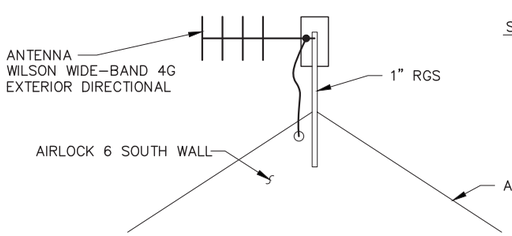


INTERCOM COMMUNICATIONS WIRING DIAGRAM

NTS



VM7-WAP-RE705 WIRING DIAGRAM



DETAIL B

SCALE: NONE

LEGEND

- DATA/DATA OUTLET
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- IC-x INTERCOM UNIT CLEAR-COM #KB-701
- INTERCOM POWER SUPPLY CLEAR-COM #PS-702
- OMNI-DIRECTIONAL HIGH-GAIN ANTENNA

LAST NO. USED

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DATA/DATA	B46-D

X-REF DRAWINGS

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766283 – AL6 ELECTRICAL
766285 – AL6 DPS
766290 – RE7 ELECTRICAL

Larry Fisher
Fluor Idaho
2017.06.12 12:48:26 -06'00'

PROFESSIONAL ENGINEER REGISTERED 6878 STATE OF IDAHO LARRY D. FISHER

3

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TECHNICAL CHECK: J.L. BRUNSON,P.E.	N/A N/A
ENG GROUP SUPERVISOR: W.H. REED, P.E.	N/A N/A
DESIGN LEAD/AUTHORITY: D.J. McGARY	Doug J. McGary Fluor Idaho 2017.06.12 12:35:35 -06'00'
DRAFTING CHECK/ EFFECTIVE DATE: S.L. BERTHELSON	Shawn Berthelson Fluor Idaho 2017.06.12 12:48:26 -06'00'
PROJECT NUMBER: 30916	
DRF NUMBER: 329428	

Idaho Cleanup Project Core Fluor IDAHO

PHASE VII OF THE ACCELERATED RETRIEVAL PROJECT RWMC WMF-1619 RE7/AL6 AIRLOCK 6 DATA/DATA & CCTV PLAN AND INTERCOM WIRING DIAGRAM

SIZE	INDEX CODE NUMBER AREA	TYPE	CL	ORIG	DWG-	REV
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RW-1275

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APPENDIX 2

100-YEAR FLOODPLAIN AND 25-YEAR RUNOFF ANALYSES FOR THE RADIOACTIVE WASTE MANAGEMENT COMPLEX AREA AT THE IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY (INEEL/EXT-02-00093)

INEEL/EXT-02-00093

Revision 0
December 2001

100-Year Floodplain and 25-Year Runoff Analyses for the Radioactive Waste Management Complex Area at the Idaho National Engineering and Environmental Laboratory

T. Mitchell, P.E.
S. Mitchell
J. Humphrey, PhD
D. Kennedy
T. Funderburg

INEEL/EXT-02-00093
Revision 0

100-Year Floodplain and 25-Year Runoff Analyses for the Radioactive Waste Management Complex Area at the Idaho National Engineering and Environmental Laboratory

T. Mitchell, P.E.[1]
S. Mitchell[1]
J. Humphrey, PhD[1]
D. Kennedy[2]
T. Funderburg[2]

Published December 2001

1. Clear Creek Hydrology
2. North Wind Environmental, Inc.

Idaho National Engineering and Environmental Laboratory
Environmental Affairs
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Affairs
Under DOE Idaho Operations Office

ABSTRACT

This hydrologic study of the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering and Environmental Laboratory (INEEL) was conducted to identify the 100-year overland floodplain boundary for the major surface water channels at the site. The RWMC comprises the Subsurface Disposal Area (SDA), the Transuranic Storage Area (TSA) and the Administrative facilities supporting the RWMC. The Main Channel Flow System (MCFS) was constructed through the RWMC area to control storm water run-on to and runoff from the SDA, TSA and administrative areas. The MCFS has undergone several modifications throughout the history of this facility in order to meet changes in the building layouts, subsurface drainage systems, and the overall hydrologic conditions of the RWMC area. Previous studies identified areas where some buildings in the TSA perimeter may be within the limits of the 25- and 100- and year floodplains. Construction of new buildings, topography modifications, and replacement of one bridge on Adams Boulevard over the past several years have prompted the need to revise the floodplain mapping for the RWMC.

The study was conducted to evaluate the largest 25-year and 100-year flood flows through this facility. Summer, winter rain on snow, and winter rain on snow with frozen ground conditions were evaluated as a part of this study to identify the maximum flows anticipated for storms with these return intervals. Flood flows were generated using hydrologic models of the facility and incorporated into hydraulic models of the MCFS. Peak water surface profiles were used to develop a map with 100-year floodplain boundaries to represent conditions at the RWMC as of August 2001.

CONTENTS

ABSTRACT iii

1. INTRODUCTION 1

1.1 General 1

1.2 Objective 2

1.3 Previous Investigations 2

1.4 Acknowledgements 3

2. REGIONAL HYDROLOGY 6

2.1 Climatology and Historic Flooding Data Sources 6

2.2 Historical Flood Events 7

2.3 Summer and Winter Design Storm Conditions 8

2.3.1 Design Storm Precipitation 8
2.3.2 Snowmelt 10
2.3.3 Frozen Ground and Concrete Impermeable Frost 11

2.4 Summer and Winter Design Storm Parameters 12

3. HYDROLOGIC MODELING 15

3.1 Hydrologic Characteristics and Modeling Parameters 16

3.1.1 Watershed and Sub Area Delineation 16
3.1.2 Soil Type and Vegetation 16
3.1.3 Impervious Surfaces 19
3.1.4 Natural Surface Channels 19
3.1.5 Storm Water Retention Areas 19
3.1.6 Main Channel Flow System 19

3.2 Hydrologic Modeling and Analysis 20

3.2.1 SCS Curve Numbers and Precipitation Losses 20
3.2.2 Time of Concentration 21
3.2.3 HEC-1 Model Input and Output 24

3.3 Hydrologic Modeling Results 25

3.4 Comparison of Results to Historic Rain/Snow/Frozen Ground Floods 28

3.5 Discussion of Previous Hydrologic Studies and Reports 29

4. Hydraulic Analysis 33

4.1 Main Channel Flow System 33

4.1.1 Channel Geometry 33
4.1.2 Bridges and Culverts 33
4.1.3 Roughness Coefficients 33
4.1.4 Hydraulic Modeling Process and Equations 34
4.1.5 HEC-RAS Model Simulations 36

4.2 TSA Surface/Subsurface Drainage Network Modeling 36

4.2.1 SWMM Program Input Parameters 36
4.2.2 Storm Water Runoff Hydrographs 37
4.2.3 SWMM Analysis 37
4.2.4 SWMM Modeling Results 38

4.3 25- and 100-year Floodplain Mapping 38

5. CONCLUSIONS 40

6. REFERENCES 41

Sheet 1—Main channel flow system 100-Year Flood Plain

Appendix A—RWMC Watershed Boundary

TABLES

2-1. Precipitation depths for summer design storms. 9

2-2. Precipitation depths for winter design storms. 9

2-3. Precipitation depths for winter rain on frozen ground design storms. 10

3-1. SCS Curve Numbers for sage-grass complexes. 18

3-2. SCS Curve numbers used in hydrologic modeling. 20

3-3. Time of concentration (t_c) for sub basins. 22

3-4. Peak flow for individual sub basins. 26

3-5. Peak flows input into HEC-RAS Models for each return period. 28

4-1. Basin 22 TSA Perimeter Storm Water Management Modeling, 25-Year Summer Cloudburst. 39

Figures

1. RWMC area map. 4

2. RWMC plan view. 5

3. 25-year, 24-hour summer storm hydrographs. 31

4. 100-year, 24-hour summer storm hydrographs. 31

5. 25-year, 24-hour winter storm hydrographs. 32

6. 100-year, 24-hour winter storm hydrographs. 32

7. Main channel flow system modeled cross-section numbers. 35

ACRONYMS

AMC	antecedent moisture condition
amsl	above mean sea level
CFS	cubic feet per second
DDF	depth duration frequency
HEC-HMS	Hydrologic Engineering Center Hydrologic Management System
HEC-RAS	Hydrologic Engineering Center River Analysis System
INEEL	Idaho National Engineering and Environmental Laboratory
MCFS	Main Channel Flow Systems
NOAA	National Oceanographic and Atmospheric Administration
NRCS	National Resource Conservation Service
NWS	National Weather Service
RCRA	Resource Conservation and Recovery Act
RWMC	Radioactive Waste Management Complex
SCS	Soil Conservation Service
SDA	Subsurface Disposal Area
SWMM	Storm Water Management Model
TRU	transuranic
TSA	Temporary Storage Area
USCOE	United States Corps of Engineers
USGS	United States Geological Survey

100-Year Floodplain and 25-Year Runoff Analyses for the Radioactive Waste Management Complex Area at the Idaho National Engineering and Environmental Laboratory

1. INTRODUCTION

1.1 General

The Radioactive Waste Management Complex (RWMC), located in the southwestern quadrant of the Idaho National Engineering and Environmental Laboratory (INEEL), encompasses a total of 174 acres and is divided into three separate areas by function: the Subsurface Disposal Area (SDA), the Transuranic Storage Area (TSA), and the Administrative Area (see Figure 1 RWMC area map and Figure 2 RWMC plan view). The original facility covered 13 acres and was used for shallow burial of solid radioactive waste. In 1958, the burial ground was expanded to 88 acres. Relocation of the security fence in 1988 to the outside of the dike surrounding the burial ground established the current 95.9-acre size of the SDA. The TSA was added to the RWMC in 1970. Located adjacent to the east side of the SDA, TSA encompasses 56.1 acres and is used for retrievable storage of transuranic (TRU) waste pending characterization, certification, and shipment out of the state to a permanent disposal repository. The 22-acre Administrative area maintains administrative offices, maintenance buildings, equipment storage, and miscellaneous support facilities.

Though the RWMC is located within a natural topographic depression, no permanent surface water features are located near the site. However, the local depression tends to hold precipitation and to collect additional runoff from the surrounding slopes. Surface water within the surrounding area eventually infiltrates the soils or evaporates before reaching the Big Lost River (Keck 1998).

Historically, the SDA has been flooded by local runoff at least three times because of a combination of snowmelt, rain and warm winds. The Main Channel Flow System (MCFS), consisting of dikes and drainage channels, was constructed around the perimeter of the SDA in response to the first flooding event, which occurred in 1962. Following a second flood in 1969, the height of the dike was increased and the drainage channel around the perimeter was enlarged. The dike was breached by accumulated snowmelt in 1982, resulting in a third inundation of open pits within the SDA. Significant flood-control improvements included increasing the height and breadth of the dike, deepening and widening the drainage channel, and contouring to eliminate the formation of surface ponds and route runoff to the drainage channel. Localized runoff from surrounding slopes is now prevented from entering the SDA by the perimeter drainage channel and dike surrounding the facility. Runoff from within the SDA is directed to the perimeter drainage channel, thus exiting the disposal area.

The Big Lost River, 2-mi north of the RWMC, is at an elevation 30-ft to 40-ft higher than the SDA (DOE-ID, 1998). However, the Big Lost River poses no flood threat to the RWMC (DOE-ID, 1998). The Big Lost River flows northeast, away from the RWMC, to its termination in the playas. A detailed flood-routing analysis of a hypothetical failure of Mackay Dam resulting from hydrologic and seismic failure shows that the RWMC would not be inundated by the severe flooding caused by the failure of the dam (Koslow and Van Haaften 1986). Big Lost River flows have not entered the RWMC since operations began in 1952. However, evidence indicates alluvial deposits in the RWMC area were possibly deposited during the Pleistocene period. A mineralogical correlation of surficial sediment from

area drainages with sedimentary interbeds at the RWMC suggests that the present day drainage patterns of the streams may be similar to historical patterns (Bartholomay 1990).

1.2 Objective

The primary objective of this project is to determine the magnitude and extent of the hypothetical 100-year flood event within the RWMC drainage area and develop a floodplain map from the hypothetical storm event as required by state and federal regulations to determine whether RWMC facilities are constructed in the 100-year floodplain. The secondary objective is to ensure that the facilities storm drain system will pass, at a minimum, the 25-year 24-hour peak storm flow for the TSA.

1.3 Previous Investigations

The potential for flooding in the Big Lost River and in the RWMC watershed has been evaluated through several studies performed at the INEEL. Specific aspects of these studies that are relevant to the current study are discussed below and in subsequent sections of this report.

Tullis and Koslow (1983) characterized Big Lost River floods with recurrence intervals greater than 25 years by a statistical analysis of short-term historical records and through the study of slack-water deposits. The United States Geological Survey (USGS) (Berenbrock and Kjelstrom, 1998) evaluated flood potential on the Big Lost River by applying a one-dimensional hydraulic model to calculate water-surface elevations and estimating the areas of inundation for the 100-year peak flow. Ostenaa, et al. (1999) performed a paleoflood study of the Big Lost River that included estimates of paleohydrologic bounds, hydraulic modeling, and development of Bayesian flood-frequency statistics.

Koslow and Van Haaften (1986) utilized the National Weather Service (NWS) DAMBRK model to simulate four different hypothetical Mackay Dam failure scenarios. One of these scenarios consisted of a hydraulic (piping) failure of the dam combined with Big Lost River runoff from the 100-year recurrence interval flood and subsequent hypothetical failure of Mackay Dam. In this modeled flood scenario, the INEEL Diversion Dam was overtopped by one foot of water at an elevation of 5066 ft msl. The magnitude of the combined probability of the 100-year recurrence interval flood with Mackay Dam failure was not specified in this report, but by definition is less than the probability of the 100-year runoff event alone. Likewise, the probability of the hydrologic events discussed in the current report with the simultaneous occurrence of a hypothetical Mackay Dam failure is much less than 0.01. Analyses of hydrologic events with probabilities less than 0.01 (recurrence intervals greater than 100-years) were considered beyond the scope of this report. Appendix A of the Koslow and Van Haaften (1986) report included a local basin snowmelt study that indicated a low potential for flooding from heavy rains and snowmelt at the facilities.

Dames and Moore (1993 and 1996) performed hydrologic studies of the RWMC watershed area utilizing the available topographic mapping data that represented current surface conditions at the time. The hydrologic analyses performed for the 1993 report included development of 100-, 500- 1000-year, ½ PMF, and PMF hydrographs for sub-basins contributing surface runoff to the main channel flow system (MCFS) of the RWMC. The scope of the 1996 study was specific to evaluating runoff produced by the rain-only 500-year precipitation event.

Zukauskas, et al. (1992) evaluated the adequacy of the storm water drainage control systems at the RWMC in preventing flooding of the TSA resulting from 25- and 100-yr return interval, 24-hr duration, storm events. Taylor, et al. (1994) performed hydrologic analyses as part of their siting activities for new waste handling facilities at the INEEL.

Large-scale aquifer pumping and infiltration tests in the RWMC area by Wood and Norrell (1996) were performed in a constructed basin in which the top 4 ft of topsoil was removed for construction. This study resulted in infiltration flux values that ranged from 1.42×10^{-3} gpm/ft^2 to 2.35×10^{-3} gpm/ft^2 (0.14 in/hr to 0.23 in/hr, respectively). The time weighted average infiltration flux for this experiment was 1.99×10^{-3} gpm/ft^2 (0.19 in/hr).

The current study was performed to include recent precipitation and temperature data, and to address changes that have occurred in topography and facility structures since the previous studies were performed. Topographic data were collected in an aerial photogrammetry flight by Aero-Graphics of Salt Lake City, Utah on October 17, 2000. These data were used to develop the topographic maps that were used in this hydrologic analysis. This hydrologic study was performed pursuant to the surface water requirements relative to the RCRA Part B permit application requirements of 40 Code of Federal Regulations (CFR) Parts 260-281.

1.4 Acknowledgements

Appreciation is extended to Ken Beard, BBWI at the INEEL who provided horizontal and vertical control for this project by use of a Global Positioning System (GPS). Mr. Beard developed survey control targets in support of the aerial photogrammetric flight, surveyed channel cross-sections and provided survey data for hydrologic control structures.

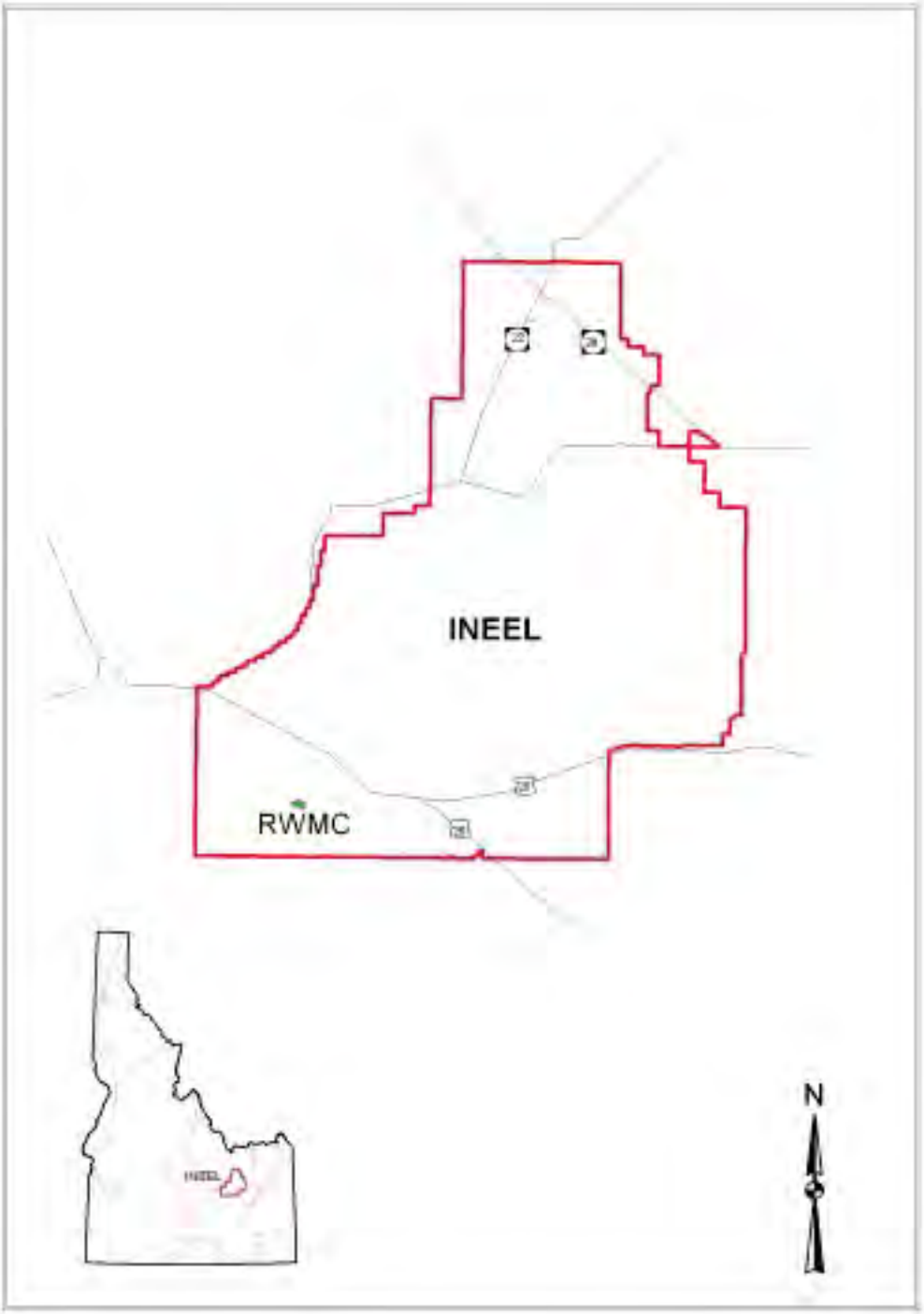
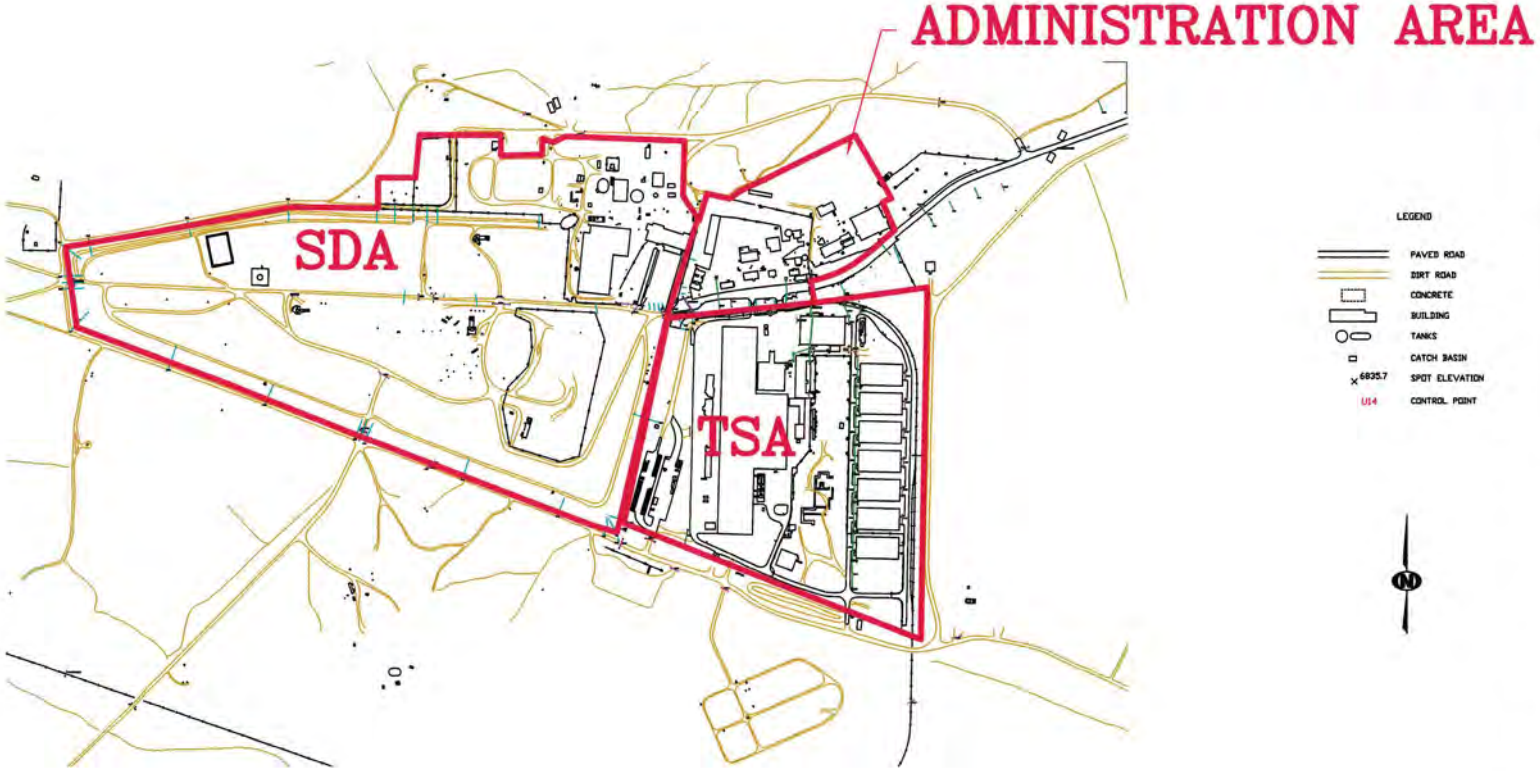


Figure 1. RWMC area map.

Figure 2. RWMC plan view.



SUBCONTRACT NO. 00000008, Rev. #3	INEEL
REQUESTED: Neil Hutten	Figure 2: RWMC Plan View
Report Eng: NEEL/EXT-02-00003	
DRAWN: Tim Funderburg	
PROJECT NO. NA	
SPEC CODE NA	Figure 2.dwg — REV 0
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	
EFFECTIVE DATE: 12-13-2001	SCALE: — Figure 2

2. REGIONAL HYDROLOGY

A detailed hydrologic analysis was developed specifically for the watershed area contributing to the MCFS to identify the peak 25- and 100-year flood flows and associated floodplains for the RWMC area. An investigation and review of available regional hydrology documentation was conducted in order to determine the appropriate design storm conditions and watershed parameters for use in hydrologic and hydraulic modeling of the site. Several sources of information were utilized to determine existing conditions during previous flooding events throughout southeastern Idaho and the surrounding area, which provides a measure of flood and regional hydrologic conditions for the RWMC facility at INEEL. This section of the report discusses the sources of information reviewed as a part of the evaluation of regional hydrologic conditions, which in turn was used to develop design storm parameters and precipitation statistics for the hydrologic modeling.

2.1 Climatology and Historic Flooding Data Sources

Several sources of information relating to climatology and historic flooding were utilized in determining regional hydrologic conditions for the INEEL and the RWMC facility. Regional hydrologic information is available for southeastern and central Idaho. A report prepared by Taylor (1994), references seven gauge sites and design storms. This report, however, is limited to information relating specifically to stream flows and storm water runoff for the INEEL and the RWMC. Data sources used in this hydrologic study were obtained from the National Weather Service for the area within and surrounding the INEEL. Data utilized for areas outside of the INEEL property were selected for hydrologic regimes with similar characteristics including southern Idaho, northern Utah, northern Nevada and southwestern Montana. Data sources utilized in this hydrologic investigation include the following:

- United States Geological Survey, Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States, Open File Report 93-419, 1994.
- National Weather Service, INEEL Winter Flood Events, Idaho Falls 46W Data (1952 – 2000).
- National Weather Service, Idaho Falls FAA, Idaho Falls Airport Gage data (1948 – 1952).
- National Weather Service, Idaho Falls 2ESE Gage Data (1952 – 1960)
- National Weather Service, Idaho Falls 16SE Gage Data (1960 – 1997)
- National Weather Service, Dubois Gage Data (1948 – 1997)
- National Weather Service, Twin Falls Gage Data (1978 – 1997)
- Eugene L. Peck and E. Arlo Richardson, An Analysis of the Causative Factors of the February 1962 Floods in Utah and Eastern Nevada, National Weather Service, Salt Lake City, Utah, 1962.
- United States Army Corps of Engineers, Humbolt River and Tributaries, Nevada, Design Memorandum No. 1, Sacramento District, 1975.
- Soil Conservation Service, National Engineering Handbook, 1972

- Dr. John H. Humphrey, Meteorological Analysis, Flood Control Master Plan, Washoe County, Nevada, 1994.

- CH2MHill, Inc., Silver Bow Creek Flood Modeling Study, 1989.

- United States Army Corps of Engineers (USCOE), Northwest Division, Snow Hydrology, 1972.

In addition to the data sources identified above, several reports and technical memoranda regarding the RWMC facility were reviewed to evaluate previous flooding events and hydrologic studies including:

- Dames and Moore, Flood Evaluation Study, Radioactive Waste Management Complex, Idaho National Engineering Laboratory, Idaho Falls, Idaho, 1993.

- K.N. Keck, 25-Year, 24-hour Storm Evaluation for the Transuranic Storage Area, Document No. INEEL/EXT-98-00472, 1998.

- Clinton O. Kingsford, PE and Karen N Keck, As-Built Condition of the Surface Water Drainage System at the SDA, Document No. INEL/EXT-97-00603, June 1997.

- J. Sagendorf, Meteorological Information for RWMC Flood Potential Studies, National Oceanic Atmospheric Administration, Environmental Research Laboratories, Air Resources Laboratory Field Research Division, Idaho Falls, Idaho, 1991.

- J. Sagendorf, Precipitation Frequency and Intensity at the Idaho National Engineering Laboratory, National Oceanic and Atmospheric Administration, Technical Memorandum ERL ARL-215, Air Resources Laboratory, Silver Spring, Maryland, 1996.

2.2 Historical Flood Events

There have been several significant flood events within southern Idaho, northern Utah and northern Nevada with documented information dating from the early 1900's through the present. Four events in particular have enough recorded information to estimate conditions experienced during winter rain and snowmelt storms with return periods ranging from 25 to 100 years. The four events occurred in February 1962, January 1969, February 1980 and February 1982. Of these events, the 1962 rain-on–snow conditions were estimated to represent a storm with a return period of 50 to 100 years (DOE-ID 1998). Climatological and general flooding information was obtained for all of these events and used to evaluate conditions anticipated during a 100-year return period storm. The data provides an approximate measure of the peak flow anticipated for the RWMC complex.

All of the observed flood events required an unusual set of climatological conditions including a wet fall season, very cold temperatures through December, January, and February with little or no snow cover, no thawing of the ground, and some accumulation of snow just prior to the flooding period. This set of conditions would result in a shallow snow cover underlain by concrete impermeable frost.

Based on the historic flooding information and according to limited United States Geological Survey (USGS) stream gage data in the area surrounding INEEL, regional hydrologic conditions indicate that peak flows of 30 to 60 cubic feet per second per square mile (cfs/mi^2) can be expected during a 100-year rain-on-snow event in watersheds similar in size to that of the RWMC watershed. Seven gauge sites identified at the INEEL indicated peak flows of 10 cfs per square mile to 76 cfs per square mile

(Taylor et. al, 1994). The regional flood flow information was used as an approximation of the 100-year flood model developed for the RWMC.

In addition to the peak flow estimations provided by the USGS documentation, limited information relating to runoff volumes was obtained from previous hydrologic studies. Sagendorf (1991) indicates that the 1962 flood event produced approximately 30 acre-ft of runoff in the SDA boundary. It should be noted that there was no perimeter ditch constructed around the SDA at the time, and the 30 acre-ft of runoff was generated in the watershed area contributing to the SDA (3.435 mi^2). Previous reports also indicate that 20 acre-ft of runoff flooded the SDA boundary in 1969, however, it is not known which portions of the watershed contributed to the flooding (a drainage ditch and dike had been constructed around the SDA subsequent to the 1962 event).

2.3 Summer and Winter Design Storm Conditions

In order to evaluate the largest 100-year flood event for the RWMC facility, three separate conditions were considered. Design storms were developed separately for summer cloudburst storms and for winter rain-on-snow and frozen ground events. Separating the different conditions provides more accurate determination of precipitation depths for various return period storms and better representation of hydrologic conditions during the summer and winter seasons. Design storm parameters for the summer and winter conditions are discussed in the following paragraphs.

2.3.1 Design Storm Precipitation

Precipitation depths for summer and winter storms were determined primarily from gage data collected from the City of Idaho Falls and INEEL. Specific gage sites included the following:

- Idaho Falls 46W, National Weather Service (NWS) data (located at the CFA, INEEL).
- Idaho Falls, FAA, National Weather Service data (located at the airport in Idaho Falls).

Gage data from these sources is available for approximately 50 years, providing sufficient data to conduct a statistical analysis for precipitation depths. Depth-duration-frequency (DDF) curves were developed for this study from the gage data obtained from the NWS using standard procedures of ranking maximum observed precipitation depths and plotting data on a log normal probability distribution. Power curve functions were developed for evaluating precipitation depth-duration-frequency statistics for the RWMC facility. The power curve function equation is shown below.

$$Depth = a * t^b$$

where:

Depth	=	design storm precipitation depth (in.)
a	=	statistical parameter based on ranked gage data
b	=	statistical parameter based on ranked gage data
t	=	time (minutes).

Using the above equation, precipitation depths were determined for 5-, 15-minute and 1-, 2-, 3-, 6-, 12- and 24-hour storm events with return periods ranging from 2 to 100 years. It should be noted that the

precipitation depths developed for design storms used in this hydrologic analysis were prepared independently from previous studies and analyses, including those prepared by J. Sagendorf (1991 and 1996), Keck (1998) and Dames and Moore (1993). Most significantly, the DDF statistics developed for this hydrologic analysis compare closely with those prepared by J. Sagendorf in 1996. Slight differences can be identified in precipitation depths for each design storm and return frequency from specific data periods used in developing the statistics, differences in interpretation of best-fit curves and lines, and engineering judgment.

Summer DDF curves were developed from gage data between the months of May through September. Summer precipitation depths (in.) are shown in Table 2-1.

Table 2-1. Precipitation depths (in.) for summer design storms.

Summer Cloudburst Depth Duration Frequency D=a*t^b										
Recurrence	a	b	5-min	15-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
2-year	0.095	0.305	0.155	0.217	0.331	0.409	0.463	0.572	0.707	0.873
5-year	0.154	0.282	0.242	0.331	0.489	0.594	0.666	0.810	0.985	1.197
10-year	0.199	0.269	0.307	0.412	0.599	0.721	0.804	0.969	1.168	1.408
25-year	0.262	0.257	0.396	0.525	0.750	0.897	0.995	1.189	1.421	1.698
50-year	0.302	0.253	0.454	0.599	0.851	1.014	1.124	1.339	1.596	1.901
100-year	0.359	0.243	0.531	0.693	0.971	1.149	1.268	1.501	1.776	2.102

Winter DDF curves were developed using precipitation gage data over the period of record during the months from November through March, when wet soil conditions will occur. Winter precipitation depths (in.) are shown in Table 2-2.

Table 2-2. Precipitation depths (in.) for winter design storms.

Winter Rainfall Depth Duration Frequency D=a*t^b										
Recurrence	a	b	5-min	15-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
2-year	0.015	0.506	0.034	0.059	0.119	0.169	0.208	0.295	0.419	0.595
5-year	0.026	0.469	0.055	0.093	0.177	0.246	0.297	0.411	0.569	0.787
10-year	0.035	0.447	0.072	0.117	0.218	0.297	0.357	0.486	0.663	0.903
25-year	0.047	0.427	0.093	0.149	0.270	0.363	0.432	0.580	0.780	1.049
50-year	0.058	0.413	0.113	0.177	0.315	0.419	0.495	0.659	0.878	1.169
100-year	0.071	0.397	0.135	0.208	0.361	0.475	0.558	0.735	0.967	1.274

Winter rain on frozen ground DDF curves were developed using precipitation gage data over the period of record during the months of January and February, when frozen ground conditions will occur. Winter rain on frozen ground precipitation depths (in.) are shown in Table 2-3.

Table 2-3. Precipitation depths (in.) for winter rain on frozen ground design storms.

Winter Rain on Frozen Ground Depth Duration Frequency D=a*t^b										
Recurrence	a	b	5-min	15-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
2-year	0.011	0.506	0.024	0.042	0.084	0.119	0.147	0.208	0.296	0.420
5-year	0.018	0.469	0.039	0.065	0.125	0.172	0.209	0.289	0.400	0.553
10-year	0.025	0.447	0.051	0.083	0.154	0.210	0.252	0.343	0.467	0.637
25-year	0.031	0.433	0.066	0.106	0.191	0.257	0.305	0.411	0.552	0.742
50-year	0.033	0.427	0.079	0.124	0.221	0.294	0.347	0.462	0.615	0.819
100-year	0.041	0.413	0.094	0.145	0.252	0.332	0.390	0.513	0.675	0.889

It should be noted that the data and procedures used in developing the DDF curves for the various seasonal events are standard meteorological methods used by the NWS and National Oceanographic and Atmospheric Administration (NOAA). Differences in the DDF statistics prepared for this study can be identified in precipitation depths associated with the various storm durations and return periods when compared to other DDF curves prepared for INEEL. The differences are the result of the specific seasonal periods used to develop the curves and judgment in best-fit curves for statistical representation of precipitation data.

In preparing the three different sets of DDF curves for this study, data were separated according to seasonal variations when summer, winter and winter frozen ground conditions exist. This separation of the data often results in lower precipitation depths and intensities used for modeling during the winter season as compared to summer and to the year as a whole. Winter storms typically have lower depths and rainfall intensity than other times of the year and separation of this data from the entire period of record provides a more accurate determination of DDF statistics when evaluating specific seasonal storm events.

2.3.2 Snowmelt

Snowmelt was incorporated into hydrologic models for the RWMC flood study in order to evaluate winter storm events. Data for snow depths and water content was developed from the winter precipitation statistics, and previous rain-on-snow events observed throughout the region surrounding INEEL. Several assumptions were made regarding contributing factors to the snowmelt including the following:

- Maximum daily temperature is 46° F and average daily temperature is 42° F.
- Wind speed of 20 miles per hour
- Constant snowmelt during the 24-hour storm period
- Little delay for snowmelt contribution to runoff.

Using equations presented in the USCOE snow hydrology manual, with a mean temperature of 42° F and wind speed of 20 mph, snowmelt was calculated as 0.06 in/hr. This constant snowmelt was added to the design storm precipitation for use in hydrologic modeling of the winter rain-on-snow and frozen ground event. This constant snowmelt adds 1.44 in. of water to the rainfall event throughout the duration of the 25- and 100-year, 24-hour winter storms.

2.3.3 Frozen Ground and Concrete Impermeable Frost

Frozen ground and concrete impermeable frost increase the runoff volume and associated peak flows during winter storms by limiting the infiltration capacity of the soil, and in the case of concrete impermeable frost, effectively increasing the amount of impervious surface within a watershed. Several climatological factors contribute to developing frozen ground and concrete impermeable frost including, but not limited to, the following:

- Wet fall and early winter season, sufficient to allow accumulation of water in the surface soil layers
- Continuous cold weather
- Little or no snow accumulation to insulate the ground.

For the purposes of this study, it is necessary to distinguish between frozen ground and concrete impermeable frost in order to estimate the impervious surface area in the watershed. Frozen ground occurs annually during the winter season as cold temperatures freeze moisture in surface and vadose zone soils. However, this condition does not preclude infiltration as cracks develop, porosity in the soil-ice structure still exists, and root structures provide additional pathways for water to enter the soil profile. To become a completely impervious frost layer, sufficient moisture must be present to saturate the soil and sustained freezing temperatures must develop sufficient frost and ice to eliminate all infiltration capability in the soil profile. This condition is described as concrete impermeable frost.

Previous investigations have been conducted to evaluate the presence and severity of concrete impermeable frost during winter rain-on-snow and frozen ground events (Humphrey 1994). During this study, known gage data were used to calibrate hydrologic models of the watershed contributing to Silver Bow Creek during winter storm events. It was determined through this study that although concrete impermeable frost existed in the watershed, it did not cover the entire surface area, was found to exist only in very narrow elevation ranges throughout the watershed, and that water infiltration occurs in areas where frozen ground (not impermeable frost) exists.

Results of the Silver Bow Creek investigation were used to develop a rating index to assign probability to the recurrence of concrete impermeable frost. This index is used to evaluate rainfall, temperatures, snow and other climatological factors that allow concrete impermeable frost to develop. Climatological data from the INEEL area were used evaluate the probability of concrete impermeable frost development as a part of this study. It was determined that concrete impermeable frost has the potential to develop in the INEEL area approximately every 5 to 10 years.

Additionally, an estimate of the percentage of the ground surface representing concrete impermeable frost was developed from site-specific conditions at INEEL and results of the Silver Bow Creek investigation. Vegetation, exposed surface soils, soil porosity and other factors contribute to the development of concrete impermeable frost. For the watershed surrounding the RWMC, vegetative cover was estimated to be 50% and exposed soils have fairly good water transmission properties (B group).

Concrete impermeable frost was estimated to represent 33% of the watershed area during this study, based on the following assumptions:

1. Exposed surface soils represent 50% of the natural watershed area. 67% of exposed surface soils are subject to developing concrete impermeable frost. Total concrete impermeable frost in the natural watershed is then 33%.

2. Concrete impermeable frost will not develop in the remaining 50% of the watershed area due to the presence of vegetative cover and root structures; shallow sedimentary soils over basalt and exposed basalt areas allowing infiltration and lack of saturated soil.

Review of previous studies conducted at INEEL further indicate that although concrete impermeable frost will exist in portions of the watershed, it is overly conservative to assume that the presence of frozen ground eliminates all infiltration. A report prepared in 1994 (Taylor et. al, 1994) states "..the assumption of frozen ground presumes zero infiltration of the surface...zero infiltration appears overly conservative...assumption of zero infiltration was used in order to obtain demonstrably conservative results." This previous study further supports the assumption that impermeable concrete frost does not exist over the entire watershed area. Natural watershed areas can have concrete impermeable frost, which occupies less than 100% of the natural watershed during winter.

There are no universally accepted methods for establishing recurrence interval or areal extent of concrete impermeable frost during winter seasons. Generally accepted methods include estimations of impervious surfaces using hydrologic models of watersheds with available stream gage data. In the absence of site-specific data, it is necessary to estimate concrete impermeable frost and resulting impervious surface area from climatological data, known watershed properties, experience with similar sites, and comparison to other studies. Representing 33% of the natural watershed area as concrete impermeable frost provides a reasonable estimate of expected impervious ground conditions during winter storm events for INEEL based on the hydrologic conditions of the watershed, available surface area for impermeable frost to develop, and experience with similar studies.

2.4 Summer and Winter Design Storm Parameters

Summer and winter design storm parameters were developed for subsequent hydrologic modeling of the contributing watershed to the RWMC and MCFS. The storm parameters were developed from the statistical analyses of the data collected primarily from the INEEL gage with additional supporting information as described in the previous sections. The following design storm parameters were used in hydrologic modeling of the various return period and seasonal conditions.

- 25- and 100-year Summer Thunderstorms (Cloudburst)
  - 25-and 100-year, 24-hour storm events
  - 1.70 and 2.10 in. of precipitation, respectively, from statistical analyses and data presented in Table 2-1.
  - Embedded peak 5- and 15-minute, 1-, 2-, 3-, 6-, 12- and 24-hour rainfall depths and intensities.
- 25-year, 24-hour Winter Precipitation (Rain or Rain-on-Snow) with frozen ground
  - 5-year, 24-hour storm event

- 5-year frozen ground conditions
- 0.553 in. of precipitation
- 0.06 in./hour constant snowmelt (1.44 in. total depth for 24 hours)
- Embedded peak 5- and 15- minute, 1-, 2-, 3-, 6-, 12- and 24-hour rainfall depths and intensities.

- 100-year Winter Precipitation (Rain on Snow) with Frozen Ground
  - 20-year, 24-hour storm event
  - 5-year frozen ground conditions
  - 0.72 in. of precipitation
  - 0.06 in./hour constant snowmelt (1.44 in. total depth for 24 hours)
  - Embedded peak 5- and 15-minute, 1-, 2-, 3-, 6-, 12- and 24-hour rainfall depths and intensities.

The design storm parameters for the various storms used in this hydrologic study are statistically equivalent or greater than the return frequencies for the 25- and 100-year events. The return interval for a particular storm event has a probability equal to the inverse of the return interval as shown in the following equation:

$$P = \frac{1}{return\ period}$$

Therefore, the probability of the 25- and 100-year events are 0.04 and 0.01, respectively. Additionally, the probability of different events can be multiplied to determine combined probabilities representing statistically equivalent, greater return period events. As described above, the 100-year rain on snow with frozen ground event has a combination of the 20-year precipitation and 5-year frozen ground conditions, therefore this combined probability of events is statistically equivalent to the 100-year event:

$$P_{100} = P_{20} * P_5 = \frac{1}{20} * \frac{1}{5} = \frac{1}{100} = 0.01$$

Review of available literature suggests that concrete impermeable ground conditions happen every 5 to 10 years. Therefore, the 20-year rainfall was combined with the 5-year frozen ground condition to determine the 100-year event.

The probabilities for the 20-year rainfall and 5-year frozen ground conditions are sufficiently independent to allow their combination in a joint probability distribution because the design storm precipitation is developed from rainfall gage data for the period of record for several different gages around the INEEL region, including the CFA and Idaho Falls gages. In some cases, the period of record is more than 50 years and provides sufficient data for separation of winter and summer thunderstorm precipitation depths and a thorough statistical analysis of the precipitation depths associated with various

storm durations, intensities and return periods for seasonal events. This statistical analysis is based on precipitation depths alone, and does not consider other environmental factors that may contribute to precipitation including temperature and other regional climatological conditions.

The frozen ground probability is developed from a variety of climatological factors including temperatures, wind speeds, freezing temperature duration, precipitation during winter months, and is based on an index developed by Dr. John H. Humphrey, PhD, PE (personal communication, 2001). The index was developed for frozen ground during the months of November through March, and is based on climatological data from the CFA and Idaho Falls gages.

The combined probability of the 20-year rainfall and 5-year frozen ground represents a 100-year return period probability. For the purposes of this hydrologic study, snowmelt has been added to the winter design storm events in order to provide additional runoff. Adding the snowmelt to the design storms increases the return period of the storms, as the presence of snow during the event has additional statistical probability which should be multiplied in the combined probabilities. However, the probability of snow during the design storms has been neglected to account for possible variations in truly frozen ground, design storm precipitation depths and other hydrologic parameters used to represent the watershed and sub areas. Neglecting the probability of snowmelt in the combined probabilities of the design storm events provides a conservative approach to estimating the peak flood flow by adding additional water without considering the probability of the presence of snow anticipated for the RWMC facility and the MCFS.

3. HYDROLOGIC MODELING

The HEC-1 computer program was selected for this hydrologic analysis because it provides the most flexibility in modeling methods and allows detailed input of watershed parameters, stage-storage-routing information, design storm precipitation, snowmelt and other hydrologic modeling parameters impacting storm water runoff. A comparison of commonly available computer modeling programs was conducted as a part of this study and included HEC-1, SCS TR-20 and SCS TR-55, resulting in the following conclusions:

1. The SCS TR-20 and TR-55 models have several limitations in defining watershed characteristics and storm water runoff flow paths, which may affect peak flow estimations for the contributing watershed area at INEEL. HEC-1/HMS allows input of several different parameters regarding land use, soil types, vegetative conditions, hydrologic connectivity and others affecting storm water runoff, which provides more reasonable runoff modeling results.

2. The SCS TR-55 model relies on standard design storm parameters (i.e., Types I, II, III etc.,) to develop rainfall hydrographs based on a given rainfall depth. Design storms were developed from site-specific data and produce more accurate results in flood modeling programs by eliminating geographic effects on rainfall (i.e., mountains, rain-shadow effects, etc.). Using the HEC-1/HMS modeling program allows entry of site-specific design storm data developed for the RWMC.

3. The TR-55 model was developed for Urban Hydrology. The RWMC is more representative of natural conditions, with a relatively limited developed area within the regional watershed boundary.

4. The HEC-1/HMS computer program provides flexibility in runoff evaluation methods used in sub areas within the watershed boundary. HEC-1/HMS provides the ability to use different runoff evaluation methods within the same model, which may be more applicable to varying conditions within the regional boundary (i.e., Kinematic wave, Muskingum, Muskingum-Cunge, SCS methods).

The hydrologic modeling for this study was conducted using ProHEC1 Plus, an enhanced version of the Hydrologic Engineering Center's HEC-1 program (Dodson and Associates, ProHEC1 Plus, 1995). This program generates rainfall/runoff hydrographs for watershed and sub basins based on several hydrologic parameters including, but not limited to, the following:

- Watershed and sub basin area
- Soil type and vegetative cover
- Impervious surfaces
- Surface features such as exposed bedrock and fractures
- Stream channel flow patterns
- Natural and constructed reservoirs or storm water retention areas
- Storm water runoff controls

- Unique hydrologic features.

Details of the hydrologic modeling parameters and processes are included in the following sections.

3.1 Hydrologic Characteristics and Modeling Parameters

Hydrologic characteristics of the watershed are discussed in the following sections and, where applicable, modeling parameters are discussed.

3.1.1 Watershed and Sub Area Delineation

Topographic mapping and field inspection of hydrologic and hydraulic features were used to delineate the contributing watershed and sub basins of the RWMC. Topographic mapping provided by INEEL and portions of a USGS quadrangle map were used to identify the outer boundary of the watershed. Sub basins were delineated within the outer watershed boundary based on several factors including the following:

- Major and minor surface water runoff drainage patterns and flow lengths
- Location of culverts, storm water runoff controls, local reservoir areas (storage)
- Key features and junctions in the MCFS
- General hydrologic regime and field conditions

The total contributing area to the RWMC facility and the MCFS up to the Adams Boulevard Bridge is 4.33 mi^2 (2771 acres). The total contributing area of the watershed investigated as a part of this study is 6.39 mi^2 (4090 acres). The total watershed area considered in this study includes the total area contributing to the RWMC and one additional sub-basin that contributes to the MCFS downstream of the Adams Boulevard Bridge. This larger area was evaluated in order to identify the presence or absence of backwater effects with the potential to influence the floodplain near the SDA and TSA boundaries. The major watershed boundary was divided into 40 sub basins for subsequent hydrologic modeling. The sub basins are identified on the RWMC watershed boundary map (see Appendix A).

3.1.2 Soil Type and Vegetation

Native soils in the area of the RWMC facility are primarily sandy silt loam, with sand fractions ranging in size from very fine to coarse. Soil depths range from very shallow to very deep and are intermixed with basalt flows. Soil cover placed over disposal area pits and within the SDA boundary were constructed using borrow materials from areas around the complex and have similar textures to those found within the contributing watershed area. Regional soils data indicate that soils are primarily loess, designated as a B hydrologic soil group. This soil group allows moderate infiltration and consist of silts, sands and to a lesser extent, clays.

The vegetation in the RWMC facility watershed is a sage-grass community consisting of sagebrush and primarily wheat grasses. Cover was estimated at approximately 50 percent during the field investigation conducted at the site.

The Soil Conservation Service (SCS) National Engineering Handbook provides estimates for curve numbers for forest-range complexes in the Western United States (SCS, 1972). The curve number is used

in hydrologic modeling to represent the soil and vegetation conditions within a watershed and accounts for precipitation losses and excesses. According to the SCS reference, curve numbers may range from 28 to 96 for sage-grass complexes, depending on soil group and vegetative cover. Low numbers indicate Group B soils with high percentage of vegetative cover and high numbers indicate Group D soils with little or no vegetative cover.

Curve numbers are adjusted from standard conditions to represent the conditions in a watershed prior to the rainfall-runoff event being modeled. Antecedent Moisture Condition I (AMC I) represents dry soil conditions typical of soil conditions preceding summer thunderstorms, with no precipitation prior to the model storm. AMC III represents wet soil conditions during winter and spring seasons, where it is likely that some moisture has been retained in the soils from previous storms and snowmelt. Curve numbers taken from the SCS handbook are shown in Table 3-1.

The curve numbers were selected from tables shown in the SCS National Engineering Handbook, Section 4, Hydrology, 1972, page 9.11. Curve numbers were selected to represent natural conditions identified in the field, with further support from SCS documentation, the infiltration test report, and experience with similar sites. Curve numbers were also selected accordingly to represent antecedent moisture conditions (AMC) anticipated in each storm. Saturated soils during winter storms used AMC-III. Normal soils during summer events used AMC-II, although dry conditions are more likely in the summer.

Soils in the RWMC area are generally a silty loam with a small fraction of clay, based on soil texturing during the field investigation. The SCS Engineering Handbook and other supporting documentation designate these soils in the Hydrologic Soil Group B (moderate infiltration rates). Additionally, infiltration rates presented in the Integrated Large-Scale Aquifer Test Report (Wood and Norrell, 1996) range from 0.14 to 0.23 in/hr. The results of the infiltration rate testing further support the use of Hydrologic Soil Group B curve numbers.

Other information used in selecting the curve numbers included vegetative cover and condition. During the field investigation, vegetative cover was estimated to be 50%, consisting of sagebrush and a bunchgrass understory.

Curve numbers for sage-grass complexes, B Group; Soil under normal AMC (II) range from 28 to 74 for 100 to 0% cover, respectively. These values are presented in Table 3-1 of the report.

Based on the vegetative conditions with a Hydrologic Soil Group B, a curve number of 52 was selected to represent the natural watershed conditions and areas where soils from the watershed have been used for constructing portions of the RWMC facility. This CN was used for the summer thunderstorm events, although it should more likely be adjusted accordingly for AMC I conditions (which would result in a lower CN).

The CN of 52 was adjusted to AMC II conditions (saturated soil condition) for the winter storm events. A CN of 71 was selected to represent the unfrozen portion of soils in the natural watershed during the winter rain-on-snow and frozen ground events.

A curve number of 99 was used for all impervious surfaces including building rooftops, parking lots, roads, and other paved and impervious surfaces in all design storm events. This curve number was also used to represent concrete impermeable ground portions of the watershed during winter storm events.

Table 3-1. SCS Curve Numbers[1] for sage-grass complexes.

Antecedent Moisture Condition II (Standard)			
Vegetative Cover (%)	Hydrologic Soil Group B	Hydrologic Soil Group C	Hydrologic Soil Group D
0	74	87	96
20	65	78	88
40	56	68	79
60	47	59	70
80	37	49	61
100	28	40	52
Antecedent Moisture Condition I (Summer Condition)			
0	55	73	89
20	45	60	75
40	36	48	62
60	28	39	51
80	20	30	41
100	14	22	32
Antecedent Moisture Condition III (Winter Condition)			
0	88	95	99
20	82	90	95
40	75	84	91
60	67	77	85
80	57	69	78
100	48	60	71
Frozen Ground	99	99	99

[1]Section 4, Hydrology, SCS National Engineering Handbook, 1972.

A curve number of 52 was used for modeling summer thunderstorms for natural conditions within the watershed and sub areas. A curve number of 71 was used to model unfrozen ground for natural conditions within the watershed and sub areas during winter storm events. A curve number of 82 was used to model unfrozen portions of sub areas with buildings and constructed roads where compaction may increase runoff potential during winter storm events. A curve number of 99 was used to represent frozen portions of the watershed during winter rain-on-snow and frozen ground events.

3.1.3 Impervious Surfaces

There are limited areas of impervious surfaces within the natural watershed around the RWMC facility. Existing natural impervious surfaces include exposed bedrock outcrops. Bedrock outcrops, where present, were estimated to cover 5 percent of the surface in sub basins. Man-made impervious surfaces include buildings and parking lots in the immediate vicinity of the TSA and SDA areas. The impervious surface area created by man-made features was estimated from topographic mapping and aerial photography of the site. A curve number of 99 was used for all impervious surface portions of the watershed during all storm events.

3.1.4 Natural Surface Channels

The topography of the watershed at the RWMC is generally low rolling hills and flat open areas. There are very few natural channels in the sub basins within the regional watershed, with very limited areas of scour and erosion damage resulting from storm water runoff. In general, incised channels do not form until the lower portions of the watershed, near the MCFS, where sufficient storm water runoff has been concentrated and directed through culverts and storm water control structures. Representative channel sections in the lower portions of the watershed were evaluated in the field to provide information to be used in the subsequent hydrologic modeling.

3.1.5 Storm Water Retention Areas

Several storm water retention areas exist within the watershed contributing to the RWMC and MCFS. Culverts exist in the railroad grade south of the facility which will limit storm water runoff peak flows coming from the area south of the railroad grade. A total of 7 culverts were identified within the RWMC watershed along the railroad grade, ranging in size from 1×1 ft to 2×2.5 ft and constructed of natural rock materials (basalt) near the base of the railroad embankment. The culverts were surveyed as a part of the field investigation to evaluate stage-storage-discharge for the areas to the south of the railroad grade. Additional storm water retention areas were identified on topographic mapping of the site and incorporated into the hydrologic models for this study.

The storm water retention areas used for stage-storage-routing in this hydrologic study will be subject to flooding during the 25 and 100-year storm events. These stage-storage areas were not incorporated into the 25-and 100-year floodplain boundary mapping for the RWMC facility for several reasons. The floodplain in the stage-storage-routing areas located south of the railroad embankment are not located in the vicinity of any buildings or construction areas and have no impact on the RWMC facility area. For modeling purposes, it was assumed that all storage areas were empty prior to the model storm events. This is representative of actual conditions.

3.1.6 Main Channel Flow System

The MCFS is a constructed channel that begins at the north side of the SDA, flows west, south, then east along the SDA boundary, north between the SDA and TSA, east along the northern border of the TSA, under Adams Boulevard and ultimately to the Big Lost River. The channel has undergone several modifications to prevent storm water runon from entering the SDA and TSA areas and to convey storm water runoff from the contributing watershed around the RWMC to the Big Lost River, away from facility buildings. The MCFS was surveyed during this investigation and is further discussed in Section 4.1.

3.2 Hydrologic Modeling and Analysis

The rainfall-runoff modeling was conducted using HEC-1, with input parameters based on the design storm statistics and hydrologic conditions of the watershed area. The SCS method for storm water loss and excess was used within the hydrologic models to generate storm water runoff hydrographs for selected locations in the watershed area. Specific parameters incorporated into the models created as a part of this study are discussed in the following sections.

3.2.1 SCS Curve Numbers and Precipitation Losses

The SCS curve numbers were selected to represent the watershed condition based on soils information, vegetative cover, impervious surfaces and frozen ground considerations (see Table 3-2). In order to represent frozen ground conditions during the winter storm events, the sub areas were separated into two portions, designated as A and B in the model. Two-thirds (67%) of the basin was considered as unfrozen ground with AMC III soil conditions. One-third (33%) of the basin was represented as concrete impermeable ground with a curve number of 99 for impervious surface as discussed in Section 2.3.3. Hydrographs for the two separate portions of each sub area were combined to determine peak flow from the whole sub area, prior to combining flows with other sub areas.

The SCS method accounts for precipitation losses from infiltration and evaporation and precipitation excess contributing to runoff within the curve number. Other methods including Kinematic wave, Muskingum, Muskingum-Cunge account for the losses using initial and constant loss parameters and were tested with variations of the HEC-1 models generated for this study. These other methods also allow evaluation of snowmelt separate from rainfall using climatological data to determine snowmelt rates. After evaluation of different methods for determining peak runoff, the SCS method was determined to be the most reasonable for the watershed, rainfall, snowmelt and frozen ground conditions. The Kinematic Wave, Muskingum, and Muskingum-Cunge methods utilize overland flow parameters, shallow concentrated flow conditions and channel flow parameters to determine time of concentration and peak flow within a sub area of the watershed. Input of the sub area parameters into the HEC-1 program generated widely varied results within the different sub areas due to long overland flow lengths anticipated at this site, variations in frozen ground and natural soil conditions, and a variety of other factors affecting the model results. Due to the variances in results and long overland flow paths, kinematic wave, Muskingum and Muskingum-Cunge methods were used only for estimating time of concentration and channel routing in the HEC-1 models.

Table 3-2. SCS Curve numbers used in hydrologic modeling.

	Winter Rain on Snow/Frozen Ground				Summer Cloudburst			
	Sub Area Portion A[1]		Sub Area Portion B[2]		Sub Area Portion A		Sub Area Portion B	
Sub Area(s)	CN	%	CN	%	CN	%	CN	%
1-19, 21, 24-35, 36-39	71	67	99	33	52	99	99	1
20, 22	82	40	99	60	52	40	99	60

1. Each Sub area was separated into two portions, A and B. Portion A represents that portion of the subarea that is not frozen during the winter events, and natural soil conditions during summer events.

2. Portion B represents that portion of the sub area considered concrete impermeable ground and impervious surface area in winter events, and impervious surface area during summer events.

3.2.2 Time of Concentration

The time of concentration is used to assist in the definition of runoff characteristics within the individual watershed. The time of concentration for a watershed is defined as the travel time of water from the hydraulically most distant point of the watershed to the point of interest (generally the most downstream point). The time of concentration for each watershed was estimated by measuring three components of storm water runoff flow paths including overland flow, shallow concentrated flow, and channel flow, and determining appropriate roughness coefficients and other parameters that influence water flow. A summary of the travel time associated with the three flow conditions (i.e., overland, shallow, and channel flow) and time of concentration for each basin is presented in Table 3-3. The equations used in evaluating total time of concentration are standard equations for the three different flow components as shown below.

$$t_{overland} = \frac{0.007 * (nL)^{0.8}}{\sqrt{P_2} S^{0.4}}$$

$$t_{shallow} = \frac{L}{V}, \; where \; V = 16.1345\sqrt{S}$$

$$t_{channel} = \frac{L}{V}, \; where \; V = \frac{CR^{0.667} S^{0.5}}{\eta}$$

Where:

η= manning's roughness coefficient

L = length of flow (ft)

P_2 = 2-year, 24-hour precipitation depth (in.)

S = slope (ft/ft)

R = hydraulic radius (ft)

V = velocity (ft/s)

C = 1.49 (constant)

Existing topographic maps were used to determine flow distances and slopes, and roughness coefficients were estimated using the aerial photography and observed field conditions. A summary of the travel time associated with the three flow conditions (i.e., overland, shallow, and channel flow) and time of concentration for each basin is presented in Table 3-3.

Table 3-3. Time of concentration (t_c) for sub basins.

Hydrologic Modeling, Sub Area Time of Concentration (t_c)				
Sub Area	Overland Flow	Shallow Conc. Flow	Channel Flow	t_c (minutes)
1	0.47	2.58	54.14	57.19
2	0.51	7.30	57.30	65.11
3	0.49	18.14	38.40	57.02
4	0.70	9.19	16.14	26.03
5	0.84	30.92	72.70	104.46
6	0.89	7.75	34.17	42.80
7	1.10	4.71	92.23	98.05
8	0.80	6.13	27.50	34.43
9	0.72	12.40	55.66	68.77
10	0.85	50.03	42.17	93.05
11	0.67	13.07	48.62	62.36
12	0.57	14.16	25.99	40.71
13	0.73	4.68	19.67	25.08
14	0.73	24.08	34.75	59.56
15	1.04	3.13	22.57	26.07
16	0.97	8.49	16.67	26.20
17	0.56	34.32	6.73	42.02
18	0.75	34.43	10.25	45.24
19	0.75	3.89	17.60	22.24
20	Channel reach only, no t_c evaluated.			
21	0.67	3.58	27.83	32.08
22	0.51	6.20	15.53	22.24
24	Closed sub area - non contributing			
25	0.89	5.84	8.79	15.51
26	0.63	2.98	15.05	18.66
27	Closed sub area - non contributing			
28	0.67	18.46	62.35	81.49

Table 3-3. (continued).

Hydrologic Modeling, Sub Area Time of Concentration (t_c)				
Sub Area	Overland Flow	Shallow Conc. Flow	Channel Flow	t_c (minutes)
29	0.56	3.58	23.51	27.65
30	0.75	8.91	53.25	62.91
31	0.60	23.76	84.92	109.28
32	0.55	6.20	33.50	40.25
33	0.49	4.53	23.45	28.46
34	0.56	9.84	7.42	17.82
35	0.28	1.66	19.03	20.97
36	0.39	14.61	26.36	41.35
37	0.67	5.41	103.95	110.03
38	0.57	1.85	26.92	29.34
39	0.85	8.94	22.92	32.70
40	Closed sub area - non contributing			

The time of concentration for sub area 1 is shown in the following equations.

Sub Area 1: Overland Flow: L= 300 ft, (η)= 0.13, P_2=0.873 in. (summer), S = 0.05 ft/ft

$$t_{overland} = \frac{0.007 * (0.13 * 300)^{0.8}}{\sqrt{0.873} * 0.05^{0.4}} = 0.47 \text{ min}$$

Sub Area 1: Shallow Concentrated Flow: L=500, S=0.04

$$t_{shallow} = \frac{500}{16.1345\sqrt{0.04}} = 154.9 \text{ sec} = 2.58 \text{ min}$$

Sub Area 1: Channel Flow: L=5150 ft, C=1.49, R=0.339, S=0.0097, η=0.045

$$t_{channel} = \frac{5150}{\frac{1.49 * 0.339^{0.667} * 0.0097^{0.5}}{0.045}} = 3{,}249.4 \text{ sec} = 54.14 \text{ min}$$

The total time of concentration is the sum of the three component times for each basin (for some basins, with more defined channels contributing to the main channel, two channel flow sections may be used). For Sub Area 1 the total time of concentration is shown below.

$$t_c = t_{overland} + t_{shallow} + t_{channel} = 0.47 \text{ min} + 2.58 \text{ min} + 54.14 \text{ min} = 57.19 \text{ min}$$

3.2.3 HEC-1 Model Input and Output

The hydrologic modeling was completed using the HEC-1 computer program with watershed and sub area properties incorporated into the models based on the parameters discussed in the previous sections. The models were used to generate peak flows at key locations contributing to the MCFS in order to evaluate the 25-and 100-year flood profiles.

HEC-1 input is completed using "cards" to represent different sub area parameters, rainfall statistics, reservoir and channel routing parameters, sub area connectivity and hydrograph combinations, as well as a wide variety of model controls and output parameters. The card identifier is the first two characters on the lines contained in the input file, which the HEC-1 program uses to perform the hydrologic modeling process. Limited information is included in text in the HEC-1 input files, identifying sub basins, routing reaches, hydrograph combinations and other significant steps within the models and can, to some degree, be used to follow the general modeling process. Complete descriptions of the "cards" used in the HEC-1 input files can be reviewed in HEC-1 User's Manuals available from the USCOE website or other HEC-1 resources on the internet.

The peak flow associated with each sub area within the contributing watershed was evaluated in the HEC-1 modeling program. These included the following:

- 25-year, 24-hour summer thunderstorm
- 25-year, 24-hour winter rain-on-snow with frozen ground
- 100-year, 24-hour summer thunderstorm

- 100-year, 24-hour winter rain-on-snow with frozen ground.

Combined hydrographs defining flow conditions throughout the MCFS were also evaluated in the HEC-1 models.

3.3 Hydrologic Modeling Results

The HEC-1 analysis of the different return period storm events indicate that the 25- and 100-year rain-on-snow and frozen ground events contribute the largest peak flow to the MCFS when considering the watershed as a whole. The HEC-1 analysis also identifies that the 25-year and 100-year summer storm event will generate the highest peak flow from the TSA sub area (sub area 22). These results are indicative of the low permeability of the frozen ground in the watershed and the imperviousness of the TSA.

A summary of the peak flow within each subbasin area for the various model storm events is provided in Table 3-4. A summary of peak flows for several key combinations of sub area hydrographs contributing to the MCFS is shown in Table 3-5. Representative hydrographs for peak flows are shown in Figures 3 (25-year, 24-hour summer storm hydrographs) through Figure 6 (100-year, 24-hour winter storm hydrographs). Discussion of specific results of the hydrologic modeling for each individual storm event is provided in the following.

1. The 25-year, 24-hour winter rain-on-snow with frozen ground event generates the highest peak flow in the contributing watershed as a whole for the RWMC facility, for storms with this return period. The 25-year, 24-hour winter rain-on snow and frozen ground event was used to identify the 25-year floodplain for the MCFS and surrounding areas. This event generates 104 cubic feet per second (cfs) at the Adams Boulevard Bridge and 177 cfs at the junction downstream of Adams Boulevard.

2. The 100-year, 24-hour winter rain-on-snow with frozen ground event generates the highest peak flow in the contributing watershed as a whole for the RWMC facility, for storms with this return period. This storm event was used to identify the 100-year floodplain for the MCFS and surrounding areas. This event generates 133 cfs at the Adams Boulevard Bridge and 232 cfs at the junction downstream of Adams Boulevard.

3. The 25-year and 100-year summer events generate the highest peak flow for the TSA sub area due to the amount of impervious surface in this basin. Rainfall intensity drives the peak flow conditions and during summer storm events rainfall intensity is significantly greater than winter events. The amount of impervious surface within the TSA boundary was estimated to be 60 %, and when combined with the short time of concentration for this basin, generates approximately 47 cfs during the 25-year summer event, and 61 cfs during the 100-year summer event. The 25-year summer event was used to evaluate the capacity of all storm drain system and culverts located near the buildings in the TSA. The 100-year summer event was used to evaluate the 100-year flood profile conditions within the TSA boundary.

Table 3-4. Peak flow for individual sub basins.

HEC-1 Model Analysis, Peak Flow (cfs)				
Sub Area	25-year Summer	25-year Winter	100-year Summer	100-year Winter
1	1	10	1	14
2	<1	3	<1	4
3	1	7	1	10
4	1	5	1	7
5	1	11	1	15
6	2	13	2	18
7	1	11	1	14
8	<1	2	<1	3
9	2	17	2	23
10	2	20	2	27
11	1	10	1	14
12	1	9	1	12
13	1	9	2	13
14	1	7	1	10
15	1	4	1	6
16	1	7	1	10
17	1	7	1	10
18	1	10	2	14
19	1	4	1	6
20	1	1	1	2
21	1	6	1	9
22	47	10	61	14
24	Closed sub area – non contributing			
25	<1	3	1	4
26	1	5	1	8
27	Closed sub area – non contributing			
28	3	33	4	45

Table 3-4. (continued).

HEC-1 Model Analysis, Peak Flow (cfs)				
Sub Area	25-year Summer	25-year Winter	100-year Summer	100-year Winter
29	2	11	2	17
30	1	6	1	9
31	2	20	2	27
32	1	5	1	8
33	1	8	2	12
34	<1	1	<1	2
35	<1	1	1	2
36	<1	1	<1	2
37	1	17	2	23
38	1	8	1	11
39	2	19	3	27
40	Closed sub area – non contributing			

Hydrographs from individual sub areas were combined in the HEC-1 models according to storm water runoff flowpaths as water from one sub area flows into the upper reach of the next downstream sub area or as several sub areas combine at their most downstream point. Combining the sub areas provides a representative model analysis of the entire watershed, allowing evaluation of peak storm water runoff flows at any location within the watershed. Eleven locations where hydrographs were combined in the HEC-1 model were selected for subsequent hydraulic (HEC-RAS) modeling of the MCFS to evaluate peak flows where significant flow changes occur. Significant flow changes were identified at channel junctions where combined sub area flows enter the MCFS. Combined hydrographs and significant changes in peak flow incorporated into subsequent hydraulic models of the MCFS are shown in Table 3-5.

Combined hydrographs for 5 of the cross-section locations used in hydraulic modeling are shown in Figures 3 through 6. The hydrographs are presented to provide a representation of the channel flows associated with cross section 300, 900, 2000, 2900 and 4200 (See Table 3-5 for sub area hydrograph combinations used to generate the graphs) throughout the duration of the 24-hour storms. Only 5 locations are shown in the following figures in order to better view the hydrographs for each location. The hydrographs for summer storms show a significant spike in the channel flow near hour 12 due to the rainfall distribution associated with summer storms. Rainfall intensity increases during a summer storm near hour 12 causing the peak runoff to occur shortly thereafter. The hydrographs for winter storms show a smaller spike near hour 12, with a more drawn-out flow condition. Rainfall intensity during a winter storm is more consistent throughout the duration of the storm, with a smaller peak intensity near hour 12. The winter storm rainfall distribution generates the longer storm water runoff hydrograph, with the peak occurring near hour 12 and sustained flows for the remainder of the storm.

Table 3-5. Peak flows input into HEC-RAS Models for each return period.

Subarea Hydrograph Combination	Cross-section location	25-year summer peak flow (cfs)	25-year winter peak flow (cfs)	100-year summer peak flow (cfs)	100-year winter peak flow (cfs)
17	4300	1	7	1	10
16,17	4200	2	14	2	19
16, 17, 38	3500	2	19	2	27
14, 15, 16, 17, 38	3400	2	25	3	36
5-7, 9-12, 14-17, 31, 38	2900	2	59	2	71
5-7, 9-12, 14-17, 21, 31, 38	2800	2	63	2	76
5-7, 9-17, 21, 31, 38	2200	7	63	10	76
5-7, 9-17, 20, 21, 31, 38	2100	7	69	10	85
5-7, 9-18, 20-22, 25, 31, 38	2000	47	83	62	104
1, 3-18, 20-22, 25, 26, 31, 33, 35, 36, 38	900 (Adams)	51	104	70	133
All	300	56	177	77	232

3.4 Comparison of Results to Historic Rain/Snow/Frozen Ground Floods

A detailed model calibration was not performed for this hydrologic analysis due to limited availability of documented flood flow conditions throughout the Snake River Plain. There are no identified stream gage records throughout the region surrounding INEEL, which are representative of the hydrologic and hydraulic conditions at the RWMC facility. Typically, with known watershed area, hydrologic parameters, stream channel parameters and climatological, precipitation and stream flow gage data, a model calibration can be conducted, comparing model results to measured data in order to verify modeling results. However, there are no data sources that would allow a calibration of the hydrologic models prepared for the RWMC facility. As an alternative, regional hydrology was used to compare results of this study to historic data, including documented estimations of peak flow expected in upper watershed areas for rain on snow and frozen ground events.

The 100-year peak flow associated with the watershed area contributing to the Adams Boulevard Bridge (Cross-section 900) is estimated at 133 cfs, according to the HEC-1 analysis for this study. The contributing area to the Adams Boulevard Bridge is 4.33 square miles, resulting in an average peak flow of 31 cfs/mi^2. The peak flow associated with the entire watershed modeled in this study is 232 cfs, with a total contributing area of 6.39 square miles, resulting in an average peak flow of 36 cfs/mi^2. These

average peak flows are consistent with those flows identified in the historic rain-on-snow and frozen ground events (~ 30-60 cfs/mi^2) documented throughout the region surrounding INEEL and the RWMC facility.

The consistency of the modeling results with documented flood events provides a measure of the reasonableness of watershed parameters, snowmelt and frozen ground parameters, and the overall model setup for the RWMC facility.

3.5 Discussion of Previous Hydrologic Studies and Reports

Several hydrologic and hydraulic studies have been performed at INEEL, including the RWMC facility, to evaluate various return period storms. Watershed characteristics, historic flood events, and precipitation statistics have been used in hydrologic modeling to identify floodplains and flood conditions during storms with return periods of 25 to 10,000 years and probable maximum events. A brief discussion of similarities and differences between previous reports and this investigation is provided in the following paragraphs. This discussion is provided for informative purposes only and is not intended to validate or discount the methods, procedures, analyses and results of other studies.

A site investigation report prepared by Taylor, et al., in 1994 discusses precipitation and snowmelt depths associated with various return period storms, frozen ground (impermeable concrete frost), hydrologic modeling parameters and previous flooding events for the INEEL area. The information contained in the Taylor report generally agrees with and affirms the analyses and results of this study. Specifically, the Taylor report indicates that the winter rain-on-snow with frozen ground is the most extreme 100-year event for INEEL, with comparable precipitation and snowmelt. The report references concrete permeable frost and states that "*the assumption of frozen ground presumes zero infiltration…everywhere*", however, that "*zero infiltration appears overly conservative*", providing support for representing only a reasonable portion of the watershed as concrete impermeable frost during winter storms. Additionally, the Taylor report references seven sources of gage data around INEEL during the 1962 flood event, measuring peak flows in the range of 10 to 76 cfs/mi^2, which indicates that the peak numbers identified in this report are consistent with the findings of the previous site investigation and historic gage data.

Another investigation of the RWMC was conducted by Dames and Moore (Dames and Moore, 1993) to prepare floodplain maps and to evaluate storms with various return periods up to a probable maximum event. Changes in topography and additional site developments since the time of the 1993 study prompted the need for updating the 100-year floodplain. The methods, procedures, and results of the Dames and Moore study are very similar to those of this study, with slight differences in specific hydrologic parameters and resulting peak flows for the watershed and RWMC facility. Results of the Dames and Moore study indicate that the peak flow for the subject watershed are approximately 40 cfs/mi^2, similar to the 31 to 36 cfs/mi^2 identified in this study. The results of the Dames and Moore analysis as well as this study are well within the range of the gage data identified for the 1962 event at INEEL and documentation of historic flooding on the Humboldt River, validating these results as well as previous studies.

It should be noted that flow gage data referenced in this study serves as a general calibration of the results of the hydrologic modeling conducted to delineate the 100-year floodplain. A wide range of flows are presented in this study for regional hydrologic conditions, including the 10 to 76 cfs/mi^2 experienced in watersheds throughout INEEL during the 1962 flood event (Taylor et. al, 1994) and the 30-60 cfs/mi^2 referred to from a historical flooding literature search (USCOE, 1975). However, these ranges provide only a limited measure of expected flows for comparison purposes. Calibration to a known gage site (as those identified around INEEL) requires analysis of the watershed condition where the gage is located,

including natural and man-made features which may impact storm water runoff, and knowledge of the gage construction and flow rating methods.

Results of this and other studies present similar conditions and peak flows associated with a 100-year return period storm and are well within the limits presented in historic flood documentation, indicating that these studies provide a reasonable measure of the magnitude of the floods anticipated at the RWMC.

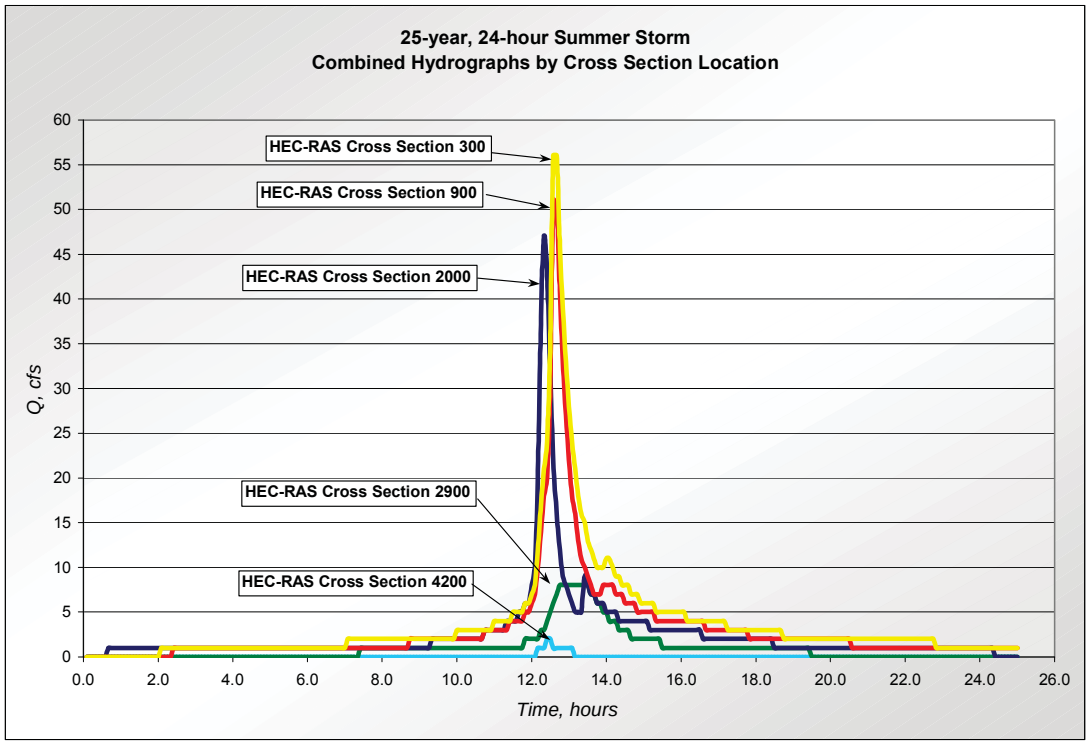


Figure 3. 25-year, 24-hour summer storm hydrographs.

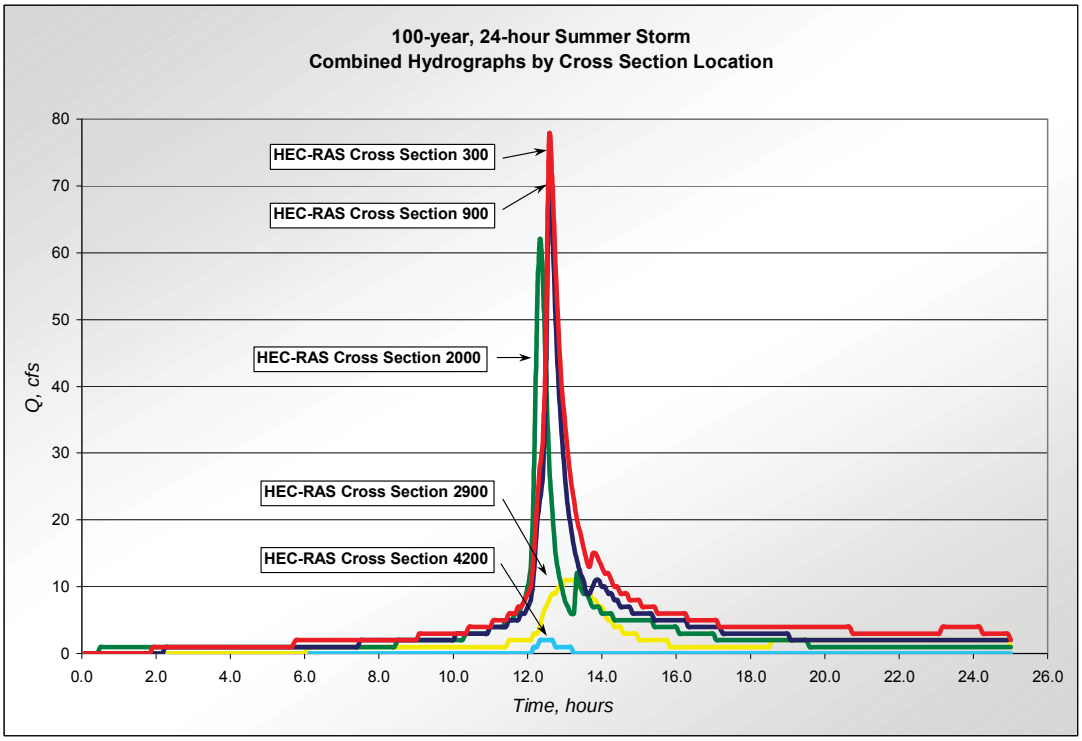


Figure 4. 100-year, 24-hour summer storm hydrographs.

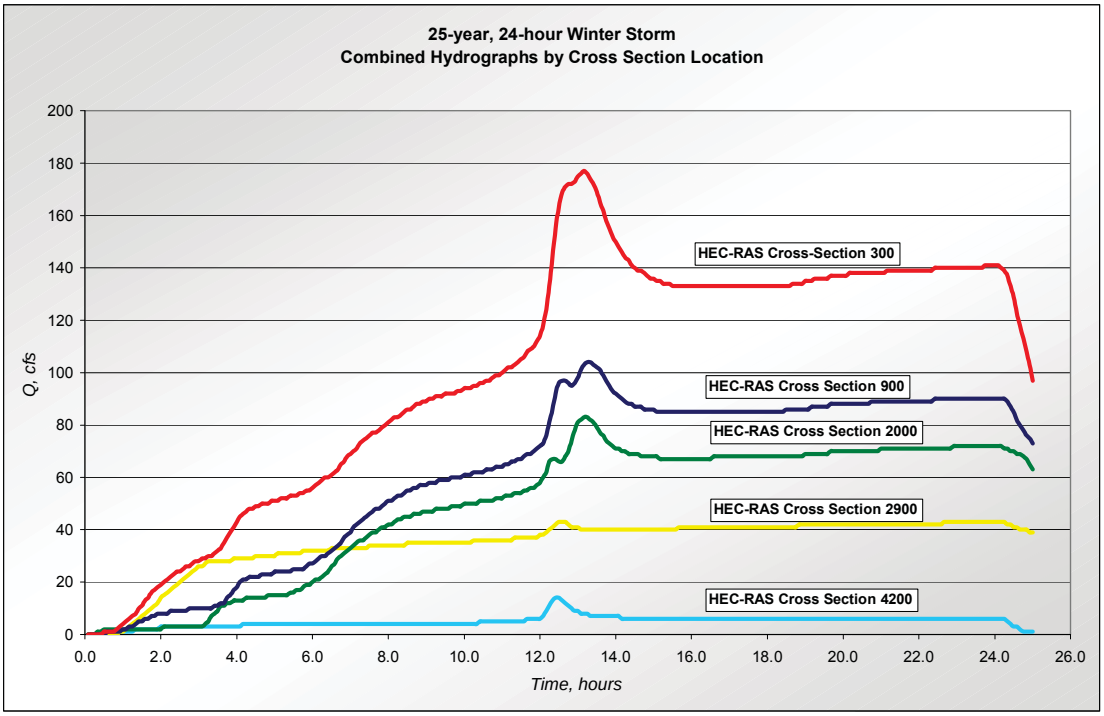


Figure 5. 25-year, 24-hour winter storm hydrographs.

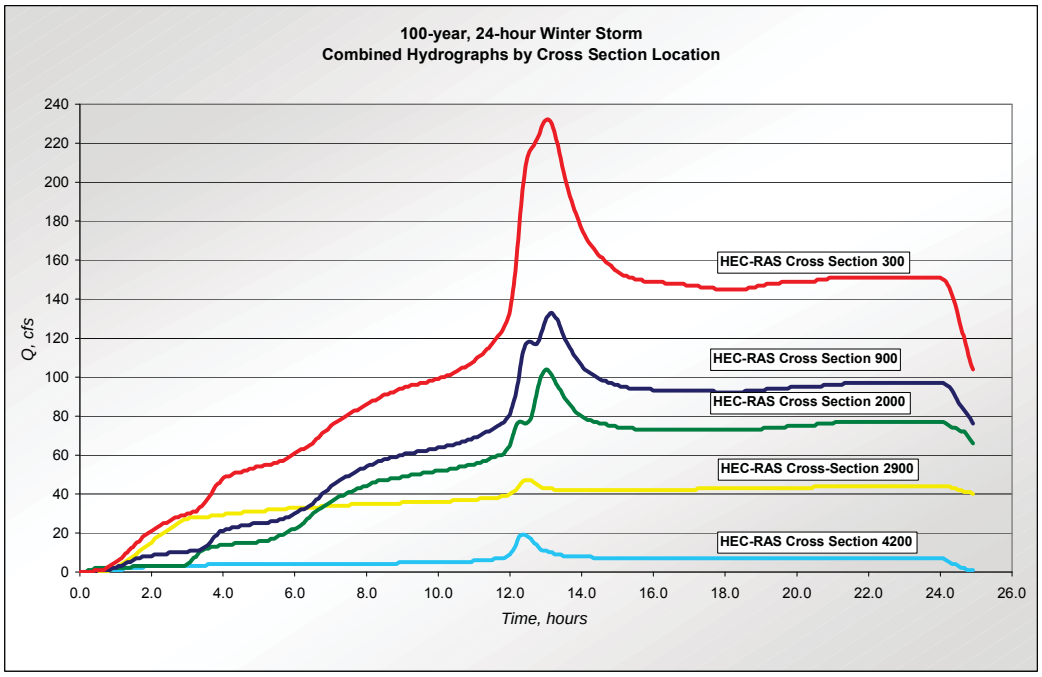


Figure 6. 100-year, 24-hour winter storm hydrographs.

4. HYDRAULIC ANALYSIS

The water surface profiles for the 25- and 100-year peak flood flow were developed using hydraulic models of the MCFS with all structures including bridges and culverts. The 100-year, 24-hour winter rain-on-snow event was used to identify the 100-year floodplain in this study. The methodology, assumptions and results of the hydraulic modeling of the MCFS are discussed in section 4.1. Water surface profiles and the storm water drainage system capacity in the TSA boundary were developed using hydraulic models of the inlets, pipes, culverts, and surface drainage channels for the 25-year event. The methodology, assumptions and results of the hydraulic modeling of the storm drain systems in the TSA are discussed in section 4.2

4.1 Main Channel Flow System

The MCFS was analyzed using the Hydrologic Engineering Center's River Analysis System (HEC-RAS, v. 3.0.1.). Field data collected during the course of this investigation was incorporated into a model of the channel and storm water runoff hydrographs resulting from HEC-1 simulations were input to determine the peak water surface profile during the storm event. Model parameters and assumptions used in generating the peak water surface profiles are described in the following paragraphs. Modeled cross section locations are identified in Figure 7 (Main channel flow system Modeled Cross Section Locations).

4.1.1 Channel Geometry

The MCFS was surveyed in the field during the course of this investigation using GPS and traditional instrumentation. Forty-two cross-sections were surveyed in the channel for the purposes of conducting the hydraulic analysis, beginning at the uppermost end of the channel and continuing west around the SDA. The MCFS has a subtle divide along the northern side of the SDA. One short portion of the channel flows east along the northern boundary and then south to its intersection with the main channel. To the west of the divide, the main channel begins and proceeds westward around the SDA, between the SDA and TSA, along the northern end of the TSA, under Adams Boulevard, and ultimately to the Big Lost River.

4.1.2 Bridges and Culverts

All hydraulic structures including bridges and culverts crossing the main channel were measured, surveyed and incorporated into hydraulic models of the channel. Additionally, all culverts and storm sewer system piping entering the main channel were measured to identify locations where significant flow changes in the main channel may occur. Measurements taken at each structure include opening widths, heights and/or diameters as applicable, channel geometry at the faces of the structure, number of culverts, entrance and exit geometry and other parameters that may influence hydraulic capacity. Several culverts entering the MCFS are equipped with valves. For the purpose of this study, all culverts were modeled with valves open in order to represent the maximum potential peak flow.

4.1.3 Roughness Coefficients

Roughness coefficients, or Manning's η, were estimated from field observations of conditions in the channel and overbank areas. The roughness coefficients vary greatly within the main channel ranging from 0.058 for rough, rocky segments, 0.042 for vegetated segments and 0.025 for constructed concrete segments. Areas outside of the channel, in the overbank segments were modeled using roughness coefficients ranging from 0.05 to 0.075, depending on surface and vegetation conditions observed in the field. These values were taken from the range of values identified in various engineering resource handbooks including the HEC-RAS User's Manual, with specific roughness values selected based on professional engineering judgment and experience with similar channel conditions. Values for the

channel and overbank reaches were varied accordingly to the conditions observed in the channel bottom, on side-slopes and areas outside of the constructed channel.

4.1.4 Hydraulic Modeling Process and Equations

The HEC-RAS computer program is used to model water surface profiles in a channel and incorporates channel and overbank geometry, channel length and slope (profile), roughness coefficients, and hydraulic structure data. Channel and flow properties modeled in HEC-RAS are used to evaluate a wide variety of flow conditions including flow depth, velocity, critical depths, and backwater effects from hydraulic structures. The program provides flow property solutions based on three equations; the energy equation, Manning's equation, and where necessary the momentum equation. The primary equation used to relate channel geometry, profile and roughness is Manning's equation:

$$Q = \frac{1.49}{\eta} A \left(\frac{A}{WP} \right)^{0.667} S^{0.5}$$

Where: Q = discharge, cfs

η = Manning's roughness coefficient

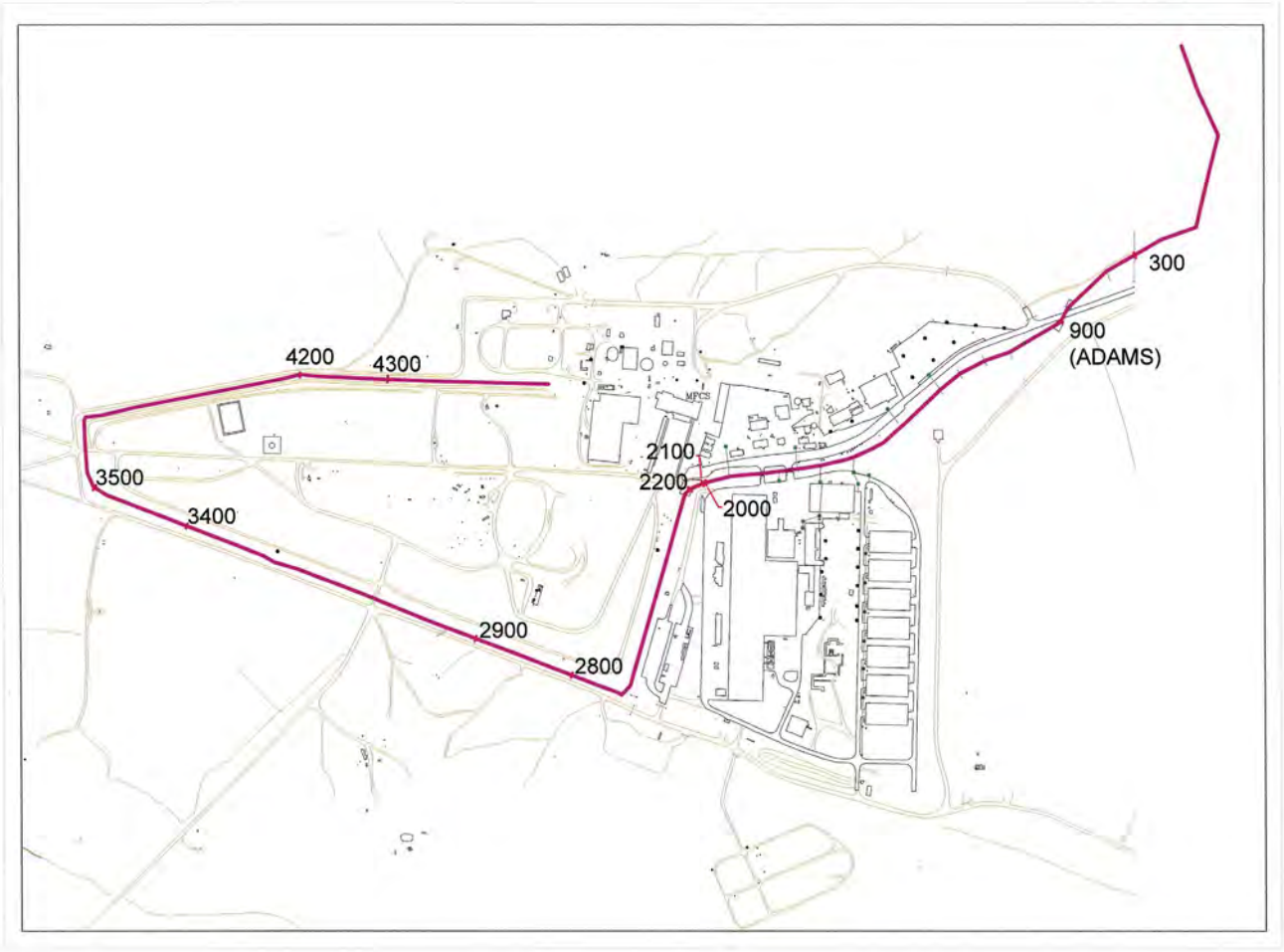
A = flow area, ft^2

WP = wetted perimeter,ft

S = channel slope, ft/ft

This equation relates the discharge and channel geometry to evaluate the flow area and wetted perimeter, which, in turn, determines the flow depth and water surface elevation at each cross-section within the model. Using an iterative process of solving the energy equation, Manning's equation and where necessary, the momentum equation, HEC-RAS provides a detailed analysis of the flow conditions in the modeled stream channel.

Figure 7. Main channel flow system modeled cross-section numbers.



SUBCONTRACT NO. 00000066, Rel. #3	INEEL
REQUESTER: Neil Hutten	Figure 7: Main Channel Flow System Modeled Cross Section Numbers
REPORT Dg: NEEL/EXT-02-00063	
DRAWN: Tim Funderburg	
PROJECT NO. NA	
SPEC CODE NA	
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE / CAGE CODE / INDEX CODE NUMBER (AREA, TYPE, DI, DISC) / DWG- Figure-7 / REV 0
EFFECTIVE DATE: 12-13-2001	SCALE: / Figure-7

4.1.5 HEC-RAS Model Simulations

Peak flows from the 25- and 100-year hydrographs were taken from the HEC-1 hydrologic simulations and input into the HEC-RAS model of the main channel to identify the water surface profile during the simulated storm events. A total of 11 hydrographs, as identified in Table 3-5, were incorporated into the HEC-RAS model to accurately model channel junctions with major contributing sub area combinations.

The HEC-RAS model simulations indicate two general locations where the channel has insufficient capacity to convey both the 25-year and 100-year peak flows. Cross-sections in the uppermost reach of the MCFS on the north side of the SDA in sub basins 16, 17 and 18 identify water surface elevations above the channel banks. Additionally, water outside of the defined channel is shown in areas above and below the Adams Boulevard Bridge where the channel becomes shallow with a flat slope. The areas where 100-year peak flows exceed the capacity of the MCFS are shown on Sheet 1 (Main channel flow system 100-year floodplain). The remainder of the MCFS has sufficient capacity to convey the peak flood flow anticipated during the 25- and 100-year events.

The portions of the main channel with insufficient capacity during the peak 100-year flow have the potential to cause flooding in the area north of the SDA (an equipment laydown area) and in the area down gradient of the Adams Boulevard Bridge. Although this flooding potential exists, it is not expected to impact any buildings in the administrative area, buildings in the TSA perimeter, or buildings in the SDA boundary because the ground surface elevation is greater than the 100-year flood elevation predicted by the model. Further discussion of the areas subject to flooding during the 25- and 100-year events is presented in the following section.

4.2 TSA Surface/Subsurface Drainage Network Modeling

The surface drainage channels and subsurface drainage piping system in the Transuranic Storage Area were modeled using the Environmental Protection Agency's Storm Water Management Model (SWMM; USEPA 1994). This model provides a detailed analysis of storm drain system piping networks including pipe and inlet flow conditions, water surface elevations, flow velocities, and design capacities of pipe system components. The program generates detailed flow hydrographs resulting from storm water runoff input into the model, and simultaneously solves for flow conditions in all pipes and components using the energy equation, Manning's equation and the momentum equation to evaluate the storm drain system as a whole. The program can be used in conjunction with water surface profile data from HEC-RAS to evaluate backwater effects at storm drain system outfall locations, and to input additional storm water flow from storm drain systems into channels modeled in HEC-RAS.

It should be noted that the SWMM modeling for the TSA storm drain piping networks was conducted for the 25-year peak storm event in order to identify any flooding that may occur and to delineate the associated floodplain for the storm drain systems. The 25-year peak storm event is required to meet RCRA guidelines and requirements. RCRA guidelines do not require analysis of a 100-year peak flow for storm drain facilities such as the one serving the TSA area of the RWMC. Discussion of the SWMM program and modeling parameters used in this analysis are discussed in the following sections.

4.2.1 SWMM Program Input Parameters

The SWMM program combines storm water drainage system parameters including piping and inlet characteristics and configurations and storm water runoff hydrographs to generate a flow model of the drainage network during a design storm event. All connected components of the storm drainage system can be modeled together in order to identify backwater influences and pipes with insufficient capacity.

Input parameters for the SWMM program include the following:

- Pipe diameter, shape, length depths in the inlets or basins and roughness
- Surface channel shapes, lengths and roughness (where combinations of surface and subsurface drainage exist)
- Inlet type, surface and invert elevations
- Pipe and inlet connectivity data
- Storm water runoff hydrographs for the duration of the runoff event
- Outfall type and water surface elevation at the outfall during the runoff event (to identify backwater effects on the drainage system where outlet elevations are located near the bottom of surface channels).

The storm water drainage network inlets and culvert locations were surveyed during the field investigation at the RWMC. All necessary data to complete a storm water management model of this system was collected for the basins and culverts in the TSA area. Field data were incorporated into the SWMM input files and used to determine pipe capacities and peak flow during the runoff event.

4.2.2 Storm Water Runoff Hydrographs

A detailed storm water runoff hydrograph was developed from the HEC-1 model of the 25-year summer storm analysis and used to evaluate the drainage system. The runoff hydrograph for the TSA (sub area 22) was proportioned to various inlets throughout the drainage system according to their respective contributing areas and surface runoff flow paths. In each major segment of the drainage network, runoff is input into end of line inlets in order to evaluate all pipes and channels in the segment. A summary of the pipe capacities with the ratio of anticipated peak flow during the 25-year summer event is shown in Table 4-1.

4.2.3 SWMM Analysis

The SWMM program analysis provides detailed information regarding peak flows, pipe capacity, and pipe surcharge depths in and above the catch basins (inlets). During the modeling process, the SWMM program computes the flow and velocity in each pipe throughout the duration of the storm based on pipe size, roughness, slope, length and catch basin connections. The program also computes water surface elevations in the catch basins, including surcharge (water surface above pipe) due to insufficient pipe capacity. The surcharge elevation at the inlets indicates where insufficient pipe capacity may cause surface flooding. A detailed description of the information input to and output from the SWMM program and used in evaluating any surface flooding resulting from insufficient capacity is provided in the following:

Input information:

- Pipe segment describes upstream and downstream catch basin locations for each pipe segment modeled in the program. Inlet information in the model includes ground elevation and basin invert elevation.
- Pipe diameter and roughness (based on pipe material).

- Pipe slope, based on upstream and downstream basin invert elevations and pipe length.

Output information:

- Pipe capacity (design capacity) and peak flow.

- Ratio of design capacity to peak flow. This parameter, shown in the following table may indicate pipes where insufficient capacity can cause surface flooding. A ratio less than 1 shows sufficient capacity in the pipe segment for the storm water runoff input into the model. A ratio greater than 1 indicates pipe segments where the upstream junction is surcharged, providing additional head to drive storm water runoff through the pipe.

- Junction surcharge elevation above ground elevation indicates inlets where surcharge water in the basin has reached the surface and can cause flooding. Values of zero for this output parameter indicate that, although surcharge water may be present in the basin, the water surface elevation does not rise above the ground elevation and cause flooding.

A summary of the pipe capacities, ratio of design to peak flow, and junction surcharge above ground elevation for the anticipated peak flow during the 25-year summer event is shown in Table 4-1.

4.2.4 SWMM Modeling Results

In general, all pipes and surface channels within the TSA storm water drainage systems have sufficient capacity to convey the 25-year peak runoff event. The TSA storm drain system will safely pass the 25-year 24-hour peak flow. No surface flooding was identified in the SWMM program, however, some basins become surcharged during the peak flow, causing the ratio of design to peak flow to exceed a value of 1. Although some basins do have surcharge water providing additional head on the downstream pipe segments, this surcharge is not expected to cause any surface flooding beyond the ground elevation at the inlets.

4.3 25- and 100-year Floodplain Mapping

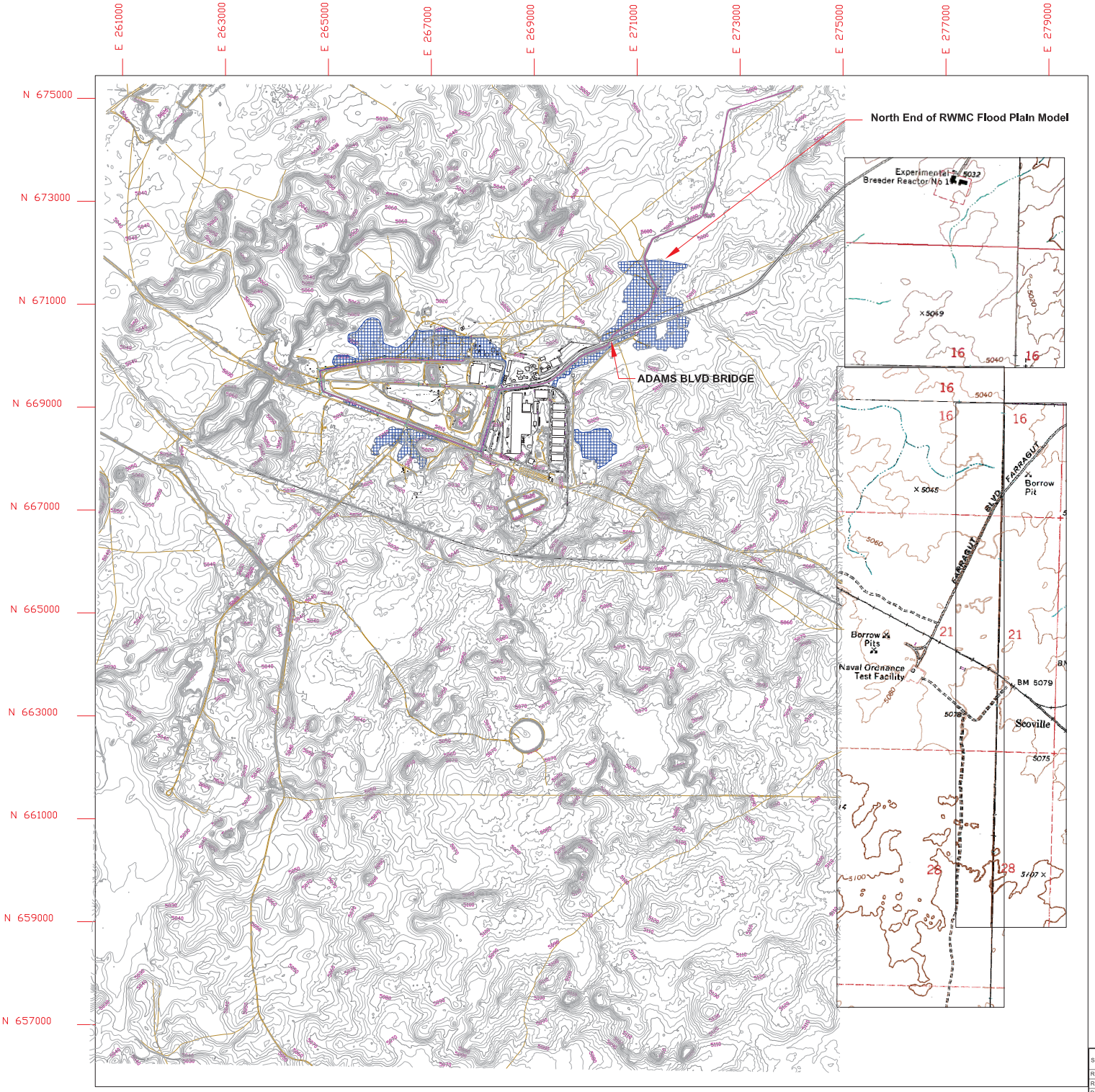
The 25- and 100-year floodplains were identified on topographic mapping of the RWMC facility using results of the HEC-RAS model simulations. The water surface elevations resulting from the 25-and 100-year flow were plotted at each cross-section used in the HEC-RAS model and a map of the associated floodplain area drawn in between the points and sections. In locations where the channel capacity was exceeded, the water surface was extended away from the channel to all points where the water surface elevation was contained. Surface water flow paths away from the main channel were also considered within the areas subject to flooding in order to identify all areas associated with the 25- and 100-year floodplains (i.e., culverts, surface channels, storm drains, etc.). The overall 100-year floodplain boundaries are identified in Sheet 1 (Main Channel Flow System 100-year floodplain) located at the end of this section.

Table 4-1. Basin 22 TSA Perimeter Storm Water Management Modeling, 25-Year Summer Cloudburst.

Pipe Segment (upstream and downstream junction)	Pipe Size (in.)	Pipe Type	n	Slope	Pipe Length (ft)	Design Capacity (DC) CFS	Ratio of DC to Computed Peak Flow	Junction Surcharge Elevation Above Ground Elevation
cb010→cb011	12	CMP	0.022	0.0230	161	3.19	1.17	0.0
cb011→cb007	12	CMP	0.022	0.0283	166	3.54	0.97	0.0
cb007→cb008	12	CMP	0.022	0.0102	166	2.13	1.49	0.0
cb008→cb009	15	CMP	0.022	0.0088	159	3.58	0.89	0.0
cb009→cb010	15	CMP	0.022	0.0090	166	3.63	0.94	0.0
cb010→cb011	18	CMP	0.022	0.0096	166	6.09	1.23	0.0
cb011→cb012	18	CMP	0.022	0.0102	166	6.28	1.18	0.0
cb012→out12	24	CMP	0.022	0.0068	163	11.0	0.67	0.0
cb016→cb16x	12	CMP	0.022	0.0180	39	2.82	1.25	0.0
cb16x→cb005	12	CMP	0.022	0.0180	100	2.82	1.25	0.0
in005→cb005	dual 12×18 elliptical	CMP	0.022	0.0094	85	12.1	0.39	0.0
cb005→cb004	dual 12×12	CPVC	0.015	0.0239	117	11.9	0.69	0.0
cb004→out04	dual 12×18 elliptical	CMP	0.022	0.0106	85	12.9	0.63	0.0
in013→cb013	24	CMP	0.022	0.0104	48	13.6	0.53	0.0
cb013→cb014	24	CMP	0.022	0.0226	71	20.1	0.36	0.0
in006→cb006	18	CMP	0.022	0.0046	43	4.23	1.11	0.0
cb006→cb014	18	CMP	0.022	0.0231	91	9.43	0.48	0.0
cb014→out14	dual 13×16 elliptical	CMP	0.022	0.0091	88	11.4	1.06	0.0

*cb110 included in model although not currently connected to system

**There is no threshold value that would indicate whether the DC to Computed Flow ratio is a concern. A DC to Computed Flow ratio greater than one is not a concern as long as the junction's ground elevation is not exceeded. For the conditions utilized in the analysis of the TSA storm drain system (25-year storm) no supplemental pumping should be needed in the TSA area.



LEGEND

- Main Channel Flow System
- Paved Road
- Dirt Road
- Concrete
- Building
- Tanks
- Fence
- Rail Road
- Guard Rail
- Catch Basin
- Index Contour
- Intermediate Contour
- 100-Year Flood
- 21 USGS Quad Section Number

General Notes

The watershed contributing to the main channel flow system immediately downstream (north) of the Adams Blvd. bridge was included in this study so that backwater effects could be evaluated at the Adams Blvd. bridge box culvert. This watershed area was added to this map by scaling a portion of the digital USGS quadrangle map to fit the topographic map produced by the October 17, 2000 aerial photography.

N

1000 500 0 500 1000

Scale: 1" = 1000'
Contour Interval: 2 foot

Base Map: Planimetric and 2 ft. contour layers are derived from 200 ft. aerial photogrammetric imagery collected on 10/17/2000 by Aero-Graphics, Inc., Salt lake City, UT.

Horizontal Datum NAD 27, ID East Zone, State Plane Coord
Vertical Datum NGVD 29
Units: U.S. Survey Foot

Subcontract No. 00000088, Rel. #3	INEEL
Requester: Neil Hutten	Sheet 1: Main Flow Control System 100-Year Flood Plain
Report IDR: INEEL/EXT-02-00093	
Drawn: Tim Funderburg	
Project No. NA	
Spec Code NA	
For review/approval signatures See DAR No.	Size E; Cage Code; Index Code Number (Area, Type, CL, ORG.); DEQ_SHEET_1.dwg; Rev 0
Effective Date: 12-13-2001	Scale: 1"=1000'; Sheet 1

5. CONCLUSIONS

The conclusions of this hydrologic and hydraulic study at the RWMC facility are presented below:

1. The extent of the 100-year floodplain, as determined in this study, is shown in Sheet 1. Based on this analysis, there are no RCRA treatment, storage, or disposal facilities located within the 100-year floodplain at the RWMC. The floodplain is primarily contained within the MCFS in the SDA and TSA areas. As a result of this study, these facilities are outside of the 100-year floodplain and there will be no "washout" of hazardous waste as a result of the 100-year event.

2. The hydrologic and hydraulic modeling indicates that there are areas around the SDA and TSA perimeters subject to some degree of flooding during the 100-year flood. In general, the areas immediately around the SDA and TSA perimeters within 100-year floodplain are low-lying areas acting as small storage reservoirs that will fill prior to discharging water to the main channel. This flooding around the SDA and TSA perimeters does not impact any administrative buildings, buildings inside the SDA perimeter dike, or structures within the TSA complex.

3. The 100-year floodplain encompasses the fenced construction lay-down area north of the SDA perimeter. This flooding is the result of excess storm water runoff in sub-areas 16, 17 and 18 which will combine in shallow surface storage and cross over the sub area boundaries, ultimately discharging west through basins 17 and 16, and east through basin 18, where the lay-down area is located. The area surrounding the lay-down area has been encompassed in the 100-year floodplain because of limited topographic relief in this vicinity.

4. The 100-year floodplain encompasses the area around the Adams Boulevard Bridge. A downstream junction provides additional storm water runoff to the main channel in a channel reach with little or no slope combined with shallow channel geometry. This combination of additional flow and limited channel capacity causes a significant amount of flooding around the Adams Boulevard Bridge, however, does not impact any buildings at the RWMC facility.

5. Backwater effects from hydraulic structures on the main channel were analyzed in the hydraulic models in order to identify any flooding potential created by bridges or culverts. The analysis of peak flows anticipated during the 100-year flood event indicates that all hydraulic structures on the main channel have sufficient capacity to convey the flood flow with little or no backwater effects.

6. Backwater effects on the storm drains located in the TSA perimeter and near the administrative buildings from the water surface elevation in the main channel resulting from the 100-year flood event were evaluated to determine any flooding potential resulting from the storm drain piping and inlets. Flood water from the MCFS will have minor effects on the storm drain function. The TSA storm drain system will safely pass the 25-year 24-hour peak flow.

7. The only facility area that would be inundated as a result of the 100-year flood is a construction/lay-down area north of Pit 9.

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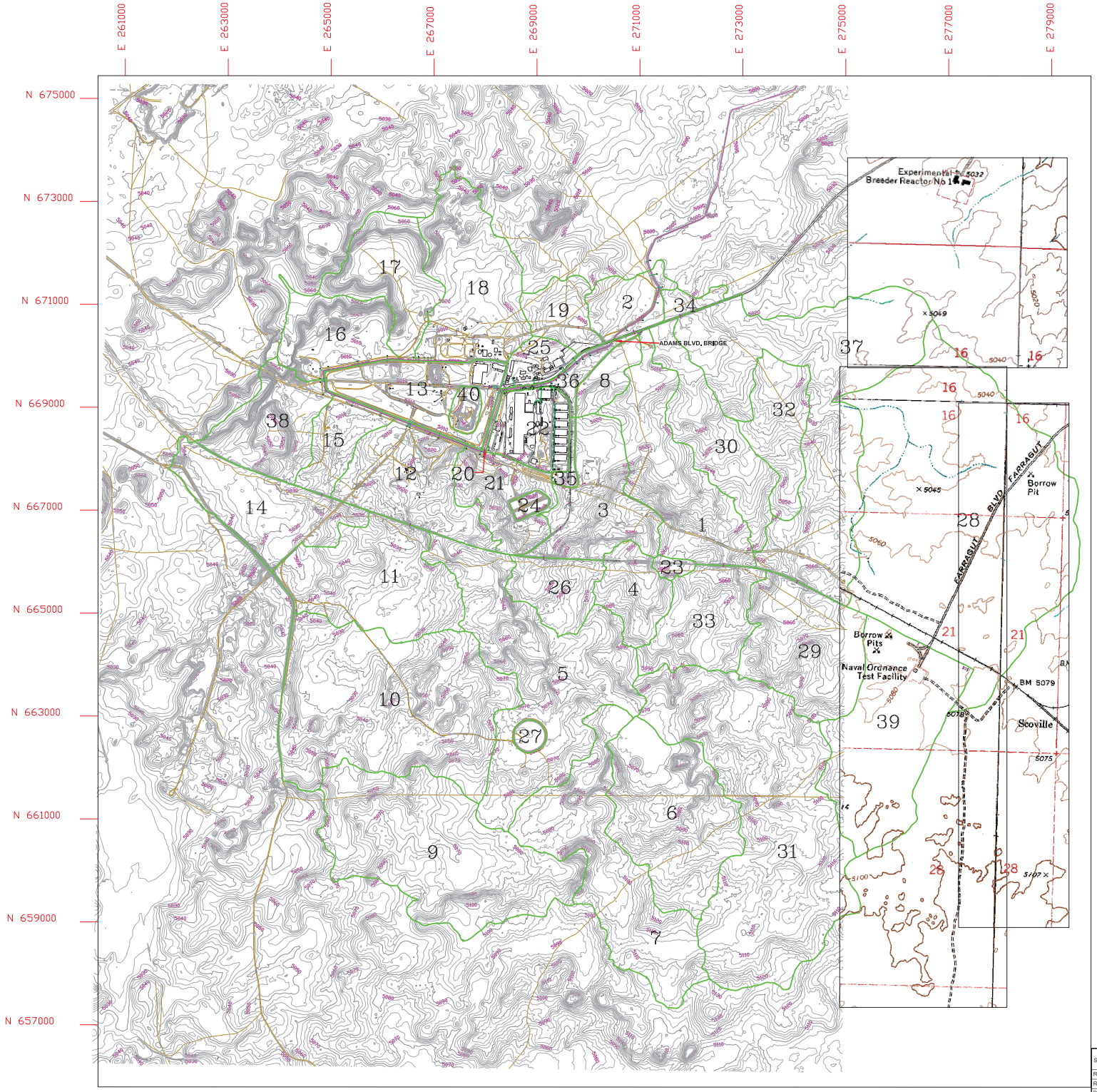
Appendix A

RWMC Watershed Boundary



LEGEND

- Main Channel Flow System
- Paved Road
- Dirt Road
- Concrete
- Building
- Tanks
- Fence
- Rail Road
- Guard Rail
- Catch Basin
- Index Contour (7000)
- Intermediate Contour
- Sub Watershed Boundary
- 28 Sub Watershed Number
- 21 USGS Quad Section Number

General Notes

The watershed contributing to the main channel flow system immediately downstream (north) of the Adams Blvd. bridge was included in this study so that backwater effects could be evaluated at the Adams Blvd. bridge box culvert. This watershed area was added to this map by scaling a portion of the digital USGS quadrangle map to fit the topographic map produced by the October 17, 2000 aerial photography.

1000 500 0 500 1000

Scale: 1" = 1000'
Contour Interval: 2 foot

Base Map: Planimetric and 2 ft. contour layers are derived from 200 ft. aerial photogrammetric imagery collected on 10/17/2000 by Aero-Graphics, Inc., Salt lake City, UT.

Horizontal Datum NAD 27, ID East Zone, State Plane Coord
Vertical Datum NGVD 29
Units: U.S. Survey Foot

Subcontract No. 00000088, Rel. #3	INEEL	
Requester: Neil Hutten	Appendix A RWMC Watershed Boundary	
Report ID#: INEEL/EXT-02-00093		
Drawn: Tim Funderburg		
Project No. NA		
Spec Code NA		
For review/approval signatures See DAR No.	Size E; Cage Code; Index Code Number (Area, Type, CI, Dig.); DEQ_APPENDIX_A.dwg; Rev 0	
Effective Date: 12-13-2001	Scale: 1"=1000'	Sheet A

APPENDIX 3

REPORT 228

Project No.: 23927, 25580

MANAGING FREE LIQUID IN NEWLY GENERATED WASTE DRUMS

Document ID: RPT-228
Revision ID: 0
Effective Date: 06/14/07

REPORT

Project No.: 23927, 25580

MANAGING FREE LIQUID IN NEWLY GENERATED WASTE DRUMS

Idaho Cleanup Project

CH2M◆WG Idaho, LLC is the Idaho Cleanup Project contractor for the U.S. Department of Energy

RPT-228
Revision 0
Project No. 23927, 25580

Managing Free Liquid in Newly Generated Waste Drums

Rodney Kimmitt

June 2007

Idaho Cleanup Project
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14516

ABSTRACT

The presence of free liquid in some drums of targeted sludge from the AR Project was initially discovered in December 2006. Since that time, free liquid has been found in about 40% of the sludge drums. Free liquid must be less than 1% by volume for waste sent to the Waste Isolation Pilot Plant (WIPP). Although the moisture content in the sludge is not known, visual examination ensures that no free liquid exists in the waste when it is placed in drums. The most likely mechanism for release of free liquid is capillary flow by gravity through the unsaturated sludge. This process may be enhanced by the effect of freeze-thaw cycles due to temporary storage in unheated buildings. A comparison was made of several potential absorbents, using a nominal one gal of liquid as a basis. It is recommended that two gal of Oil-Dri® be added to each drum of sludge to absorb free liquid that may form.

CONTENTS

ABSTRACT iii

ACRONYMS vii

1. POTENTIAL FREE LIQUID RELEASE FROM SLUDGE WASTE 1

1.1 Mechanisms for Liquid Release 1

1.2 Fluid Flow in Waste 2

1.3 Comparison of Absorbents 2

1.4 Discussion and Recommendations 4

2. REFERENCES 4

Appendix A—Free Liquid Flow and Absorption 7

Appendix B—Material Safety Data Sheet for Oil-Dri® Floor Absorbent 13

TABLES

1. Comparison of Absorbents 3

ACRONYMS

AMWTP	Advanced Mixed Waste Treatment Plant
ARP	Accelerated Retrieval Project
DPS	Drum Packaging System
MSE	MSE Technology Applications, Inc. of Butte, Montana
RFP	Rocky Flats Plant
RTR	real-time radiography
SDA	Subsurface Disposal Area

Managing Free Liquid in Newly Generated Waste Drums

1. POTENTIAL FREE LIQUID RELEASE FROM SLUDGE WASTE

About a gallon of free liquid was observed during routine examination of a sample drum at the Advanced Mixed Waste Treatment Plant (AMWTP) in December, 2006. The drum consisted of sludge waste exhumed and repackaged at the Accelerated Retrieval (AR) Project. Since that time about 40% of AR Project sludge waste drums have been found to contain free liquid.

Free liquid has been observed in drums of both inorganic sludge and organic sludge generated at the Rocky Flats Plant (RFP). During the 3,100 m^3 Project, approximately 1,150 drums (6% of the total) had absorbent added to them prior to shipment. Liquid was observed above the sludge.

A study of the organic sludge from RFP indicated that free liquid organic compounds can be separated from the sludge matrix.[1] This observation was made during coring of organic sludge drums for sampling. Additional evidence comes from surrogate testing. The release of free liquid from the calcium silicate matrix is possible because the pore size of the matrix decreases when shear force is applied.

Based on observation of drums of sludge waste from RFP, there is evidence for the formation of free liquids.

1.1 Mechanisms for Liquid Release

Inorganic sludge from RFP consists primarily of metal precipitates (oxides and hydroxides) that were filtered before being packaged and shipped to Idaho. The rotary drum filter used at RFP produced a moist filter cake, at or near saturation. This may explain why free liquid was found on top of inorganic sludge drums during the 3,100 m^3 Project.[2] That waste had not been opened or repackaged since shipment to Idaho, and its moisture content was probably quite high. The exhumed waste that was recently sampled had a somewhat different history. It was buried for decades, not stored in a building. The original drum may have corroded enough to form small holes that would allow free liquid to drain out. Even if holes did not develop while the waste was interred, the original drum was split open during exhumation, and this would have released any free liquid. Even if the waste was not moist to the touch, but had dried somewhat, it would still be expected to retain at least as much moisture as the surrounding soil. This can be as much as 30% by weight. **So the drum with a net weight of 204 lb could contain about 60 lb of water, even if the waste appeared dry when it was packaged.**

There are several possible mechanisms for the formation and movement of free liquid in the drum. The first is evaporation and condensation. The first sludge drum with free liquid was initially packaged in May 2006 and stored in buildings without heat or air conditioning. During the summer months, cycles of evaporation and condensation could have occurred. However, any accumulation of liquid water from this process would be slow. Because of the limited void volume in the drum (probably no more than half of the drum volume), only about 3 grams of condensate could form in a single daily evaporation-condensation cycle. Even if all of the condensate drained to the bottom of the drum and was not subject to further evaporation, this process would require several years to generate a gallon of free liquid. Although evaporation and condensation probably occurred in the drum, that process could be only a minor contributor to the free liquid.

Water can also collect in the pores of the waste and settle by gravity. The inorganic sludge has the general appearance of soil, so a vadose zone flow model can probably be applied to the waste. In this model water flows through small pores. The process can be described by a variation of Darcy's equation[3]:

$$q = K(\theta)\ \mathrm{grad}(H)$$

where

$K(\theta)$ = unsaturated hydraulic conductivity, cm/sec

grad H = gradient of head loss (cm/cm)

q = fluid flux, $cm^3/(sec\text{-}cm^2)$ or cm/sec.

For flow in unsaturated media, the hydraulic conductivity is a function of water content. Hubbell and his co-workers have estimated that vadose zone fluxes at the INL can range from 0.2 to 10,000 cm/yr (roughly 10^{-9} to 10^{-4} cm/sec).[4] For comparison, a flux of 10^{-7} cm/sec over one-fourth of the cross-sectional area of a drum would result in the collection of almost a third of a gallon of liquid in 7 months. Because hydraulic conductivities can vary by many orders of magnitude, it is very difficult to precisely estimate the flow rate of fluid in unsaturated media, particularly without performing experimental work. However, this downward flow of water through the pores of unsaturated sludge has at least the potential to generate the volume of water observed in the drums currently under investigation.

Before being transported to the AMWTP for characterization, drums are stored in the unheated WMF-698 building. While there the drums are subject to freeze-thaw cycles as well as periods of evaporation and condensation. Studies have been conducted on the impact of freezing and thawing on fluid movement in soils. These studies have relevance because the RFP sludge waste materials have properties similar to those of silty soil (inorganic sludge) or clay-like soil (organic sludge). It has been shown that one or two freeze-thaw cycles increase the hydraulic conductivity by one or even two orders of magnitude.[5] It is easy to see from the equation above that such a change in hydraulic conductivity can have a major effect on the rate at which liquid flows through the waste.

1.2 Fluid Flow in Waste

From recent observations using real-time radiography (RTR), more than one third of the sludge drums checked have been found to contain free liquid in the bottoms of the drums, always inside the rigid liners. As long as the liquid can flow by gravity towards a layer of absorbent, the absorbent will be effective in removing free liquid from the drum. Appendix A provides a discussion of the rationale for putting absorbent inside the rigid liners of drums.

1.3 Comparison of Absorbents

It is suggested that inorganic absorbents be used to eliminate the potential for additional gas generation in the waste drums and to alleviate any concerns regarding criticality safety. The commercial product, Oil-Dri® is composed of montmorillonite or attapulgite clay and crushed quartz. These clays are also known as Fuller's Earth. The basic ingredients are very similar to those of the Aquaset and Petroset products frequently used for solidification of radioactive waste. Those two products are also based on montmorillonite clay.

The Oil-Dri® vendor literature indicates that this product is effective for water or organic liquids.[6] The Material Safety Data Sheet (see Appendix B) indicates that heat can be generated if Oil-Dri® is used to absorb unsaturated hydrocarbon liquids. Both tetrachloroethylene and trichloroethylene contain double bonds as do other unsaturated hydrocarbons. Other possible organics in the Subsurface Disposal Area (SDA) are saturated and do not have the potential for heating. Testing of Aquaset and Petroset at MSE Technology Applications in Butte, MT during 2006 showed that these materials did not react at all with these chlorinated solvents.[7] Since Oil-Dri® is composed of the same or a similar type of clay as the Aquaset and Petroset materials tested at MSE, it is highly unlikely that Oil-Dri® will react with the saturated organics. Even if an exothermic reaction were to occur, the contacting of fluid in a waste drum with the absorbent would take place over several days or weeks. This long duration would allow any heat to dissipate.

Oil-Dri® is a relatively inexpensive, multi-purpose product. Its absorptive capacity is not as high as specially engineered absorbents, such as Aquaset and Petroset. The table below shows the expected performance of Oil-Dri® for absorbing free liquid in drums.

As noted above, testing was performed with a mixture of Aquaset and Petroset products on a variety of chemical compounds, including organic chemicals expected to be in the SDA. These products effectively absorbed with the simulated rinse waters or organic liquids tested, but did not otherwise react with them. Unlike the Oil-Dri® product, one material is not suited for both aqueous and organic liquids. As the name implies, Aquaset absorbs aqueous liquids such as rinse water and K-W decontamination solution. Petroset II-G would be used in drums containing oils and chlorinated solvents. The table below shows characteristics and performance of the Aquaset and Petroset products, based on vendor literature.[8] It should be noted that a blend of Aquaset and Petroset II-G could be used as a single-product additive to drums. Table 1 shows the quantities needed for a blended absorbent to deal with either aqueous or organic liquid.

Table 1. Comparison of absorbents.

Comparison of Absorbents Basis: absorption of 1 gal of free liquid				
Parameter	Aquaset (aqueous only)	Petroset II-G (organic only)	Aquaset + Petroset II-G	Oil Dri® (all liquids)
Composition	Montmorillonite clay	Montmorillonite clay	Montmorillonite clay	Montmorillonite/attapulgite clay + quartz
Bulk Density of Absorbent, lb per gal (see Note 2)	9.6	6.4	7.8	4.8
Application Rate, gal of absorbent per gal of free liquid	0.33	0.43	0.76	2.1
Volume of Absorbent Required, gal	0.33	0.43	0.76	2.1
Typical Unit Cost, $/lb	$4.00	$4.00	$4.00	$0.10-$0.20
Cost per Drum	$12.67	$11.01	$23.68	$1.01-$2.02

Notes:
1. Densities and application rates based on vendor literature.
2. Density differences in similar clays due largely to differences in particle size.
3. Unit costs do not include shipping or tax.

Based on RTR observation the volume of liquid is typically about one gallon. Using as a basis one gal of liquid, Table 1 shows the amounts of absorbents needed per drum of waste and the associated cost. Information in the table is based on published vendor literature. Physical testing will be conducted in the future to determine the specific amount of absorbent to be applied when dealing with variable amounts of free liquid.

1.4 Discussion and Recommendations

Clay-based absorbents are expected to be effective in eliminating free liquid formed after waste exhumed from the SDA is repackaged. The engineered absorbents, Aquaset and Petroset, are very efficient. Less than half a gal of either absorbent can absorb one gal of liquid. Even if Aquaset and Petroset were blended together in drums to address both aqueous and organic liquids, the required volume would be less than half that of Oil-Dri®. However, the high unit cost of the materials makes them expensive to use when compared with Oil-Dri®. A disadvantage of Oil-Dri® is that it would increase waste volume by about 4% (2.1 gal in a 55-gal drum), compared to a less than 1.4% increase for the Aquaset and Petroset products (0.4 gal or 0.76 gal in a 55-gal drum).

Because the free liquid is expected to collect between the tray liner and the rigid liner, absorbent can be added to drums at some point before they are attached to the DPS. This can be done in the area where drums are staged before use. Using Aquaset and Petroset would require that care be taken to ensure that drums containing Aquaset were used for inorganic sludge and drums with Petroset were used with organic sludge. If this is not practical, the Aquaset or Petroset may be added from the DPS before the waste is placed in a drum. These operational issues are a disadvantage for Aquaset and Petroset. This disadvantage could be overcome by pre-blending Aquaset and Petroset II-G, then adding the mixture to drums as a single product in the same manner as Oil-Dri®.

It is recommended that Oil-Dri® floor absorbent be used to absorb any free liquids that form in drums of sludge packaged in the SDA. The application rate should be 2 gal per drum, based on an assumed maximum of one gal of free liquid formed. Because Oil-Dri® absorbs both aqueous and organic liquid, it can be added inside the rigid liners of every drum used for targeted waste. The addition can be done at any convenient location before the drums are used.

2. REFERENCES

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6. Web Site, http://www.fastenalmanufacturing.com/web/products/detail.ex?sku=635000-131463, visited January 24 2007.

7. MSE Technology Applications, Inc, "Accelerated Site Cleanup Programs Testing and Demonstration Project Final Report–Sorbent Testing For The Solidification of Unidentified Rocky Flats Laboratory Liquids at the Idaho National Laboratory", MSE-106, September, 2006.

8. Web Site, http://www.fluid-tech-inc.com/Rad%20Waste.htm, visited January 10, 2007.

Appendix A

Free Liquid Flow and Absorption

Appendix A

Free Liquid Flow and Absorption

Free liquid has been discovered in the rigid liners of a number of drums of ARP sludge waste. The liquid occupies the space between the tray liner and the rigid liner inside some drums; in other drums the liquid is in this space plus inside the tray liner, in void spaces in the waste. To date, virtually all free liquid has been found in the bottoms of drums, and all pockets of liquid inside the waste matrix have been hydraulically interconnected, with the liquid in the bottom of the drum. The exceptions to this have been very small amounts of liquid, typically less than half a cup, on the tops of drums, in the folds of the transfer bags. In other words, all liquid found inside tray liners has been adjacent to liquid between the tray liners and the rigid liners. No isolated pockets of free liquid have been found inside the waste matrix. This is an important observation. It indicates that all pockets of liquid can be absorbed by putting absorbent inside the rigid liners before placing waste in drums. The following discussion demonstrates why this conclusion is valid.

Figure A-1 represents a hypothetical situation in a sludge drum containing free liquid. Liquid is present on both sides of the tray liner. Actual observation consistently shows that the two fluid levels are the same. However, the figure represents the condition in which some liquid released by the waste has not yet flowed through the tray liner.

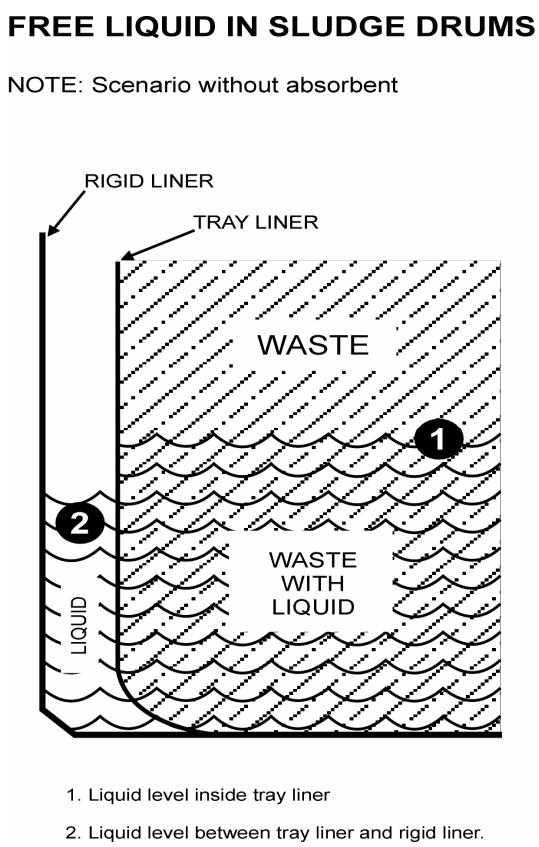

Figure A-1. Free Liquid in Sludge Drums.

Tray liners have been shown to be liquid-permeable. This was confirmed recently by putting about two gallons of water in a tray liner. Initially the fabric was water tight, but water started leaking from the seams in about one minute. Within twenty-four hours the fabric became saturated with water and was leaking.

Flow from the inside to the outside of the tray liner can be described using the Bernoulli equation[1]:

$$\Delta V^2/2g_c + (g/g_c)*(z_2-z_1) + \Delta P/\rho + fl = 0$$

Where:

ΔV = difference in velocity between points 1 and 2 = $V_2 - V_1$

g_c = gravitational constant, 32.2 ft/sec^2

g = acceleration of gravity, 32.2 ft/sec^2

z_1, z_2 = heights above an arbitrary datum, ft

ΔP = pressure difference between points 1 and 2, lbs/ft^2

ρ = density of fluid, lbs/ft^3

fl = friction loss, ft of fluid flowing

The points 1 and 2 in Figure A-1 were chosen to facilitate analysis. At the tops of the two fluid columns the pressure should be the same, essentially atmospheric pressure. So $\Delta P = 0$. Flow will occur if ΔV^2 is greater than zero. Rearranging Bernoulli's equation and solving for ΔV^2 gives:

$$\Delta V^2 = -2*g*(z_2 - z_1) - 2*g_c*fl$$

Now $z_2 < z_1$, so the first term is positive. The difference in height, called head, between points 1 and 2 provides the motive force for fluid flow. The second term on the right hand side of the equation is subtracted from the first term because the resistance to flow imposed by the tray liner reduces the net motive force. This has the effect of slowing the velocity of liquid flowing out of the tray liner. Liquid will flow out of the tray liner as long as $z_2 < z_1$. Loss of head due to friction is proportional to the flow rate. If there is no flow, friction is zero. As flow increases, friction losses become significant and effectively impose an upper limit on flow rate.

Putting absorbent between the tray liner and the rigid liner will promote the flow of liquid out of the tray liner. As liquid collects in the space between the two liner it will be absorbed. Unless the absorbent becomes totally saturated, there will not be a column of free liquid between the tray liner and the rigid liner. So z_2 will be low relative to z_1. This will have the impact of maximizing the motive force defined by $(z_2 - z_1)$ as free liquid collects in pockets inside the tray liner.

It should be emphasized that this technical argument is only valid if liquid collects adjacent to the tray liner. If free liquid becomes trapped in pockets inside the bulk matrix, there is no connection between the fluid and the absorbent. In such situations absorbent located between the tray liner and the rigid liner would be useless. Real time radiography of drums to date has shown that, when free liquid is present, it is always adjacent to the tray liner in the bottom of the drum and/or at the bottom of the drum in the space between the tray liner and the rigid line. No isolated pockets of free liquid have been found inside the sludge matrix.

REFERENCES

(to Appendix A)

1. Bennett, C.O. and J.E. Myers, Momentum, Heat, and Mass Transfer, McGraw-Hill, New York, NY, 1962, page 164.

Appendix B

Material Safety Data Sheet for Oil-Dri® Floor Absorbent

Appendix B

Material Safety Data Sheet for Oil-Dri® Floor Absorbent

Product Name:	**Floor Absorbent**
Manufacturer MSDS:	1003000
Manufacturer Name:	Oil-Dri Corporation of America
Address:	410 North Michigan Avenue Chicago, IL 60611
	Emergency: (800) 424-9300
Business Phone:	(312) 321-1515
Revision Date:	January 3, 2005
	Chemical Name: Fullers Earth
Product Codes:	

NFPA

0

HMIS

HEALTH	1
FIRE	0
REACTIVITY	0
PPE	

SECTION 2: COMPOSITION, INFORMATION ON INGREDIENTS 1003000

Ingredient Name	CAS#	Ingredient Percent
Quartz (crystalline silica)	14808-60-7	10-20% Bulk
OSHA PEL TWA:	10 mg/m3/% SiO2 + 2	
ACGIH TLV TWA:	0.05 mg/m3 0.000085% in the respirable range	
Fullers Earth	8031-18-3	80-90%
OSHA PEL TWA:	5 mg/m3 (respirable fraction)	
Other Exposure Guidelines:	TLV: 3 mg/m3 TWA (respirable fraction); 10 mg/m3 TWA (inhalable dust)	

NOTE:

PEL: OSHA Permissible Exposure Limit.
TLV: American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value.
TWA: 8 hour Weighted Average.
STEL: Short Term Exposure Limit.

SECTION 3: HAZARDS IDENTIFICATION 1003000

Emergency Overview:	This product is a non-combustible, chemically inert mineral. This mineral sample contains a small amount of naturally occurring crystalline silica as quartz. Prolonged overexposure to respirable crystalline silica may cause lung disease (silicosis). IARC, in Monograph 68, has concluded that crystalline silica inhaled in the form of quartzfrom occupational sources is carcinogenic to humans (Group 1); however, carcinogenicity was not detected in all industrial circumstances studied. Because applications and exposure data indicate that exposure to respirable quartz in this product with normal use is well below the OSHA Permissible Exposure Limit (PEL) and ACGIH ThresholdLimit Value (TLV); and because the company is not aware of any scientific or medical data available indicating that exposure to dust from this product under conditions of normal use will cause silicosis or cancer; adverse affects would not be expected from normal use of this product.

Applies to All Ingredients:

Potential Health Effects:	
Eye Contact:	Contact may cause mechanical irritation and possible injury.
Skin Contact:	No adverse effects expected.
Inhalation:	Inhalation of excessive concentrations of dust may cause irritation of mucous membranes and upper respiratory tract.
Ingestion:	No adverse effects expected with unused material.
Chronic Health Effects:	Inhalation of excessive concentrations of any dust, including this material, may lead to lung injury. This product contains crystalline silica. Excessive inhalation of respirable crystalline silica may cause silicosis, a progressive, disabling and fatal disease of the lung. Symptoms may include cough, shortness of breath, wheezing and reduced pulmonary function.
Carcinogenicity:	The international Agency for Research on Cancer (IARC), in Monograph 68 has concluded that crystalline silica inhaled in the form of quartz or cristobalite, from occupational sources is carcinogenic to humans (Group 1). However, in making the overall evaluation, the Working Group noted that carcinogenicity was not detected in all industrial circumstances studied. Carcinogenicity may be dependent on inherent characteristics of the crystalline silica or on external factors affecting its biological activity or distribution of its polymorphs. The National Toxicology Program (NTP) classifies crystalline silica as reasonably anticipated to be a carcinogen. Because applications and exposure data indicate that exposure to respirable quartz in this product, with normal use, is well below the OSHA Permissible Exposure Limit (PEL) and ACGIH Threshold Limit Value (TLV); and because the company is not aware of any scientific or medical data available indicating that exposure to dust from this product under conditions of normal use will cause silicosis or cancer; adverse effects would not be expected from normal use of this product.
Sensitizer Information:	No adverse effects expected.
Aggravation of Pre-Existing Conditions:	None currently known.

SECTION 4: FIRST AID MEASURES 1003000

Eye Contact:	Immediately flush eyes with cool running water, lifting upper and lower lids. If irritation persists or foreign body in the eye, get immediate medical attention.
Skin Contact:	None needed for normal use.
Inhalation:	Remove to fresh air.
Ingestion:	If used material is ingested, get medical attention due to possibility of chemical contamination. If large amount of unused material is swallowed, get immediate medical attention.

SECTION 5: FIRE FIGHTING MEASURES 1003000

Fire:	FLAMMABLE LIMITS: Not applicable
Flash Point:	This product is not combustible.
Extinguishing Media:	Use media that is appropriate for surrounding fire.
Hazardous Combustion Byproducts:	None
Fire Fighting Instructions:	None required.
Unusual Fire Hazards:	This product does not normally present a fire or explosion hazard, however, at concentration exceeding 0.1 oz/ft3 dusts can be ignited by sparks or other ignition sources. Minimize hazard by avoiding the generation of airborne dusts, electrically grounding equipment to prevent static sparks and by eliminating ignition sources in the work area. Combustion products may be hazardous.

SECTION 6: ACCIDENTAL RELEASE MEASURES 1003000

Spill Cleanup Measures:	Sweep up and collect for re-use or disposal

SECTION 7: HANDLING and STORAGE 1003000

Handling:	Avoid breathing dust. If clothing becomes dusty, launder before re-use.
Storage:	Store in a dry area.

SECTION 8: EXPOSURE CONTROLS, PERSONAL PROTECTION 1003000

Engineering Controls:	For operations where the exposure limit may be exceeded, local exhaust ventilation is recommended.
Skin Protection Description:	None required for normal use.
Eye/Face Protection:	Safety glasses or goggles recommended.
Respiratory Protection:	For operations where the exposure limit may be exceeded, a NIOSH/MSHA approvedhigh efficiency particulate respirator is recommended.
Other Protective:	None required for normal use.
Exposure Limits:	Refer to Section 2.

SECTION 9: PHYSICAL and CHEMICAL PROPERTIES 1003000

Physical State/Appearance:	Granules
Color:	Gray to tan
Odor:	No odor
Physical State:	Solid
pH:	Not applicable
Vapor Pressure:	Not applicable
Vapor Density:	Not applicable
Boiling Point:	Not applicable

Melting Point:	Not applicable
Solubility:	IN WATER: Insoluble
Specific Gravity:	2.2
Coefficient of Water/Oil Distribution:	Not available.

SECTION 10: STABILITY and REACTIVITY 1003000

Chemical Stability:	Stable
Incompatibilities with Other Materials:	Contact of dry clay with turpentine, vegetable oil or other unsaturated organic compounds, or with hydrofluoric acid may generate heat and/or fire. Do not use with these compounds.
Hazardous Polymerization:	Will not occur.
Hazardous Decomposition Products:	None

SECTION 11: TOXICOLOGICAL INFORMATION 1003000

Toxicological Paragraph:	No data available.

SECTION 12: ECOLOGICAL INFORMATION 1003000

Ecological Paragraph:	No data available.

SECTION 13: DISPOSAL CONSIDERATIONS 1003000

Waste Disposal:	Dispose in accordance with local, state and federal environmental regulations. Unused material is suitable fordisposal in sanitary landfill. Used material may be subject to regulation, depending on the nature of the materialabsorbed. Check with appropriate regulatory authority for used material containing hazardous waste.

SECTION 14: TRANSPORT INFORMATION 1003000

DOT Shipping Name:	Not regulated
DOT UN Number:	Not applicable
DOT Hazard Class:	Not applicable
DOT Packing Group:	Not applicable
DOT Subpart E Labeling Requirement:	None

SECTION 15: REGULATORY INFORMATION 1003000

Applies to all ingredients:

TSCA 8(b): Inventory Status:	All of the components of this product are listed on the EPA TSCA Inventory or exempt from notification requirements.
Section 304:	None
Section 312 Hazard Category:	
Chronic:	Yes
Section 313 Toxic Release Form:	None
State:	CA PROPOSITION 65: This product contains respirable crystalline silica which is known to the State of California to cause cancer.
Canada WHMIS:	DSL: All of the components of this product are listed on the Canadian Domestic Substance List or exempt from notification requirements.
European Community Chemical Inventory Status:	All of the components of this product are listed on the EINECS Inventory or exempt from notification requirements
Japan MITI:	All of the components of this product are existing chemical substances as defined in the Chemical Substances Control Law.
Australia Chemical Inventory Status:	All of the components of this product are listed on the AICS Inventory or exempt from notification requirements.
Risk Phrases:	EEC: Not Classified as Dangerous under EEC Labeling Regulations
Safety Phrase:	EEC: Not Classified as Dangerous under EEC Labeling Regulations

SECTION 16: ADDITIONAL INFORMATION 1003000

HMIS:	
Health Hazard:	1*
Fire Hazard:	0
Reactivity:	0
NFPA:	
Health:	1
Fire Hazard:	0
Reactivity:	0
MSDS Revision Date:	January 3, 2005

Disclaimer:

The information in this data sheet is believed to be accurate. However, each purchaser should make its own test to determine the suitability of the product for its purposes. OIL-DRI CORPORATION OF AMERICA MAKES NO WARRANTY, EXPRESSED OR IMPLIED, WITH RESPECT TO THE PRODUCT and assumes no responsibility for any risk or liability arising from the use of the information or the product. Statements about the product should not be construed as recommendations to use the product in infringement of any patent.