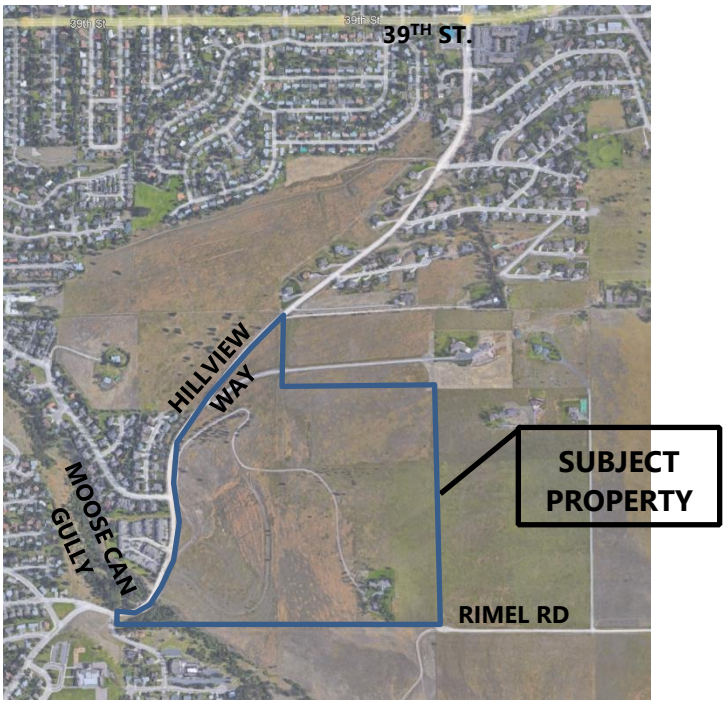
Water System Engineering Report
Wildroot



Moose Can Gully - Hillview Way,
Missoula, Montana 59803

Owner/Developer:

PANDO

Kiely Wilson and Lance Gutsch
Pando Holdings
205 Detroit Street, Suite 200
Denver, CO 80206

Engineer:

Cushing Terrell

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Cushing Terrell
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Cushing Terrell Project No. HILLVIEW_SUBDIV
November 29, 2023

PRELIMINARY – FOR REVIEW PURPOSES ONLY

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1.0 INTRODUCTION

The Wildroot project is a proposed 105-acre residential subdivision development with a total count of 450 units. This unit count includes the approved multi-family development of 203 units and an additional 21 townhome lots and 226 single family lots. Approximately 66 acres is located within the City of Missoula limits, 39 acres is in Missoula County and will be annexed as part of the subdivision process. The subject property has an approved water main extension serving the multi-family development and townhomes which connects to the Hillview Way water main in two locations. The proposed 226 single family lots are outside of the allowable pressure zone to be directly serviced from the Hillview Way water main. Therefore, the proposed system will be served by a storage tank and associated pumps.

The intent and purpose of this report is to provide the necessary engineering documentation and calculations for the public water main extension to service the 226 units in the upper pressure zone of the proposed subdivision. The report provides calculations and documentation to meet the requirements of the Montana DEQ (MTDEQ) and City of Missoula (COM).

The following references were used in the design of the water main extension.

- City of Missoula 2018 Water System Master Plan (Master Plan)
- Missoula City Public Works Standards and Specifications Manual (MCPWSS)
- Montana Public Works Standard Specifications (MPWSS)
- MTDEQ Circular No. 1 (DEQ-1)
- City of Missoula Zoning Map

1.1 Location

Figure 1.1: Overall Location Map

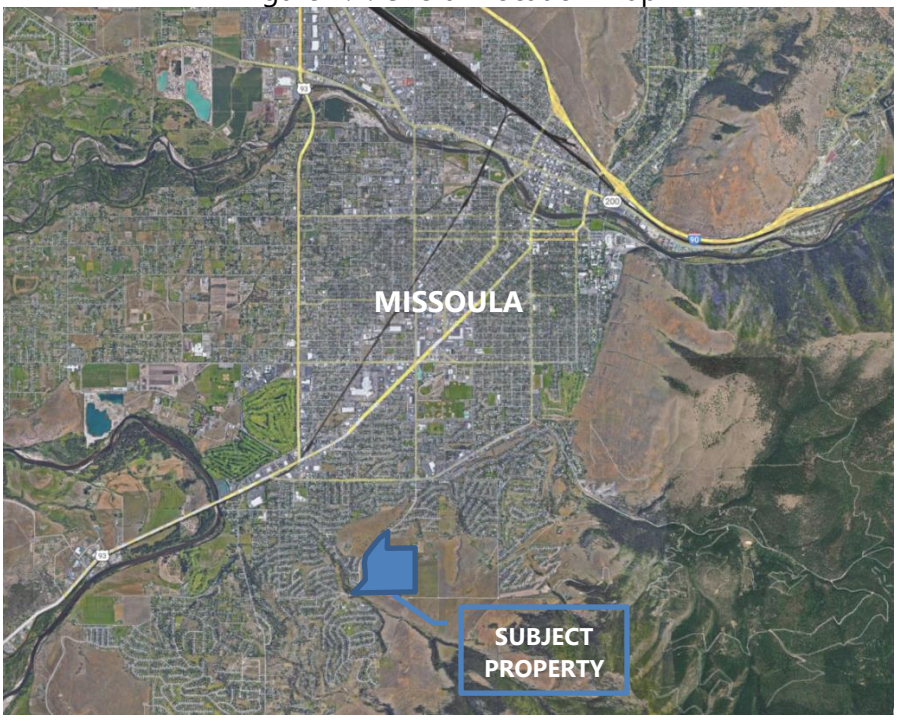
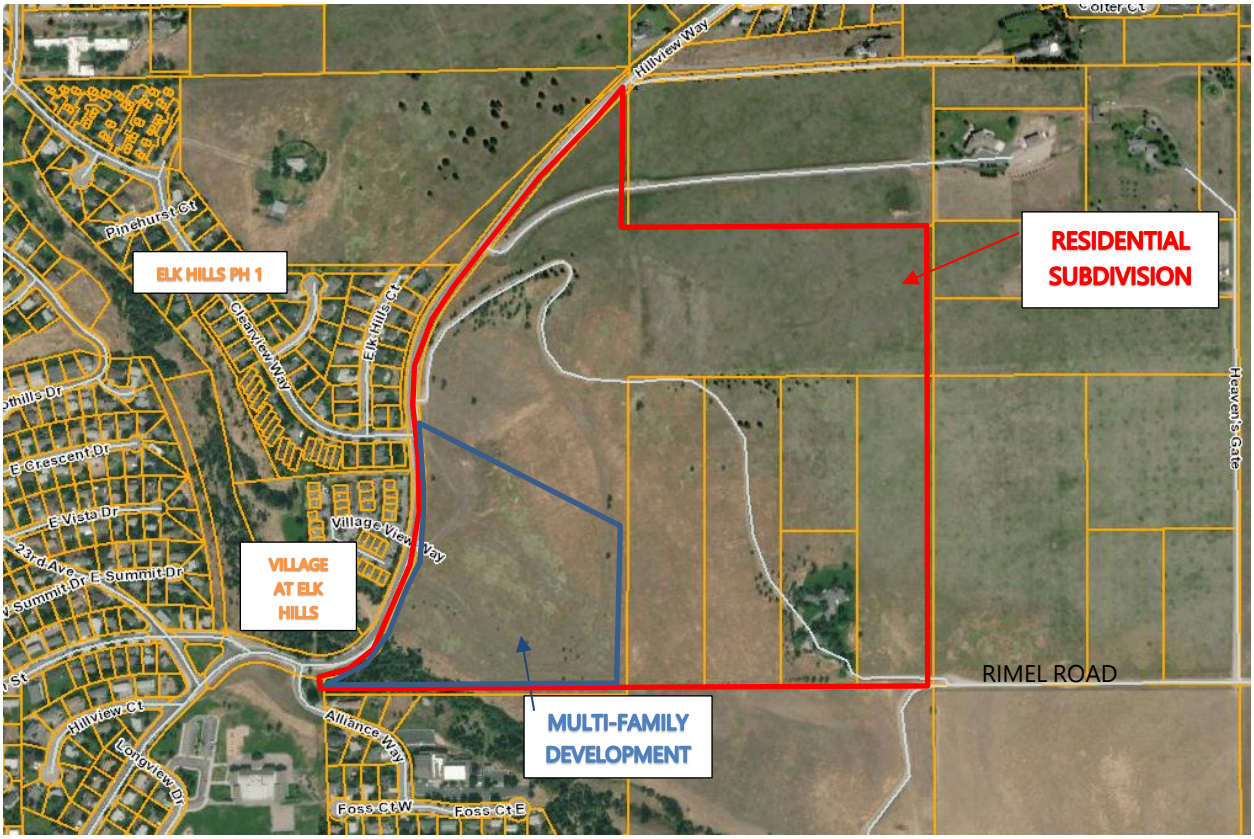


Figure 1.2: Detailed Location Map



1.2 Topographic Features and Slopes

The development is proposed on a steep site. Topography ranges from slopes of 0-25 percent. The highest elevation on the property being approximately 3665 feet and the lowest approximately 3405 feet.

1.3 Geologic Features and Geotechnical Data

The geotechnical investigation from the report prepared by Lorenzen Soil Mechanics, Inc. titled, *"Hillview Subdivision Geotechnical Engineering Report – Phase 2"* dated September 13, 2022 is provided in this submittal. The bury depth of the water system will comply with the City of Missoula and Montana DEQ requirement of 6 feet of cover to top of pipe. Bedding material will be placed in accordance with Missoula Standard Detail 401 and MPWSS. The geotechnical report states the material at the pipe bury depth is generally poorly graded gravel with frequent cobbles or clayey gravel with sand.

The report does not indicate the presence of groundwater in the project area. In the 22 test pits excavated to depths between up to 8.5 feet below ground surface groundwater was not encountered. The report indicates the shallowest groundwater in a nearby well log to be 317 feet below ground surface.

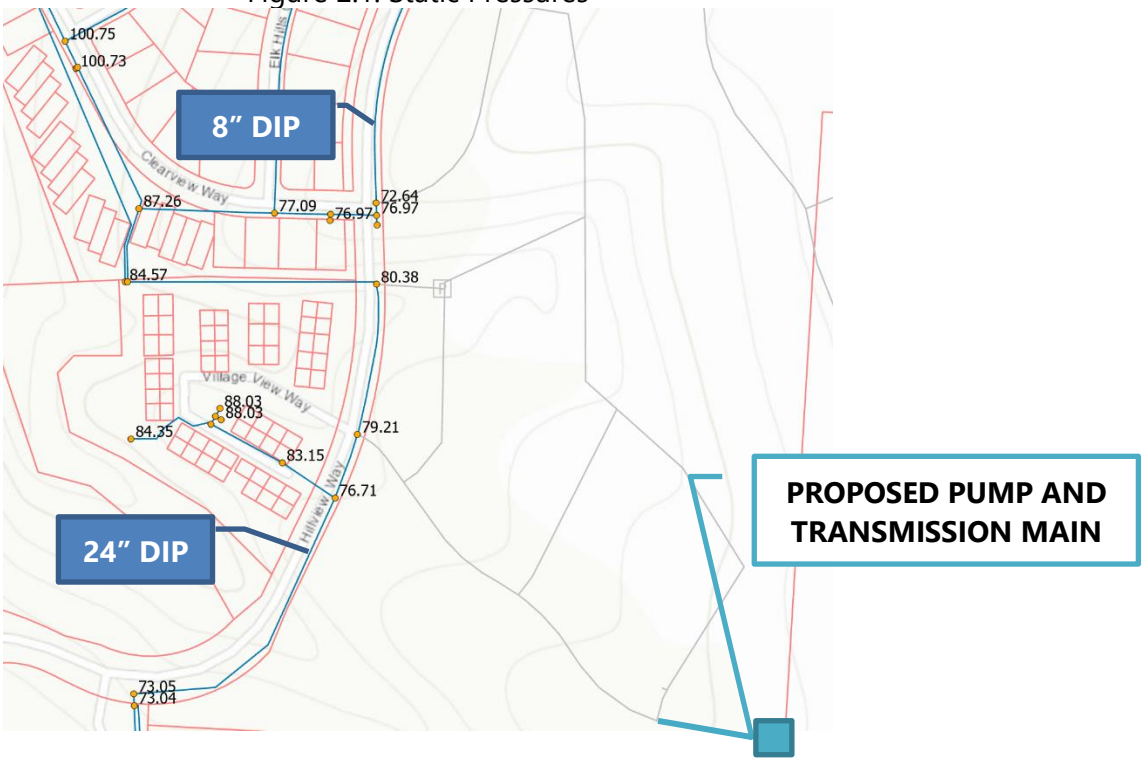
Wetlands within the property are located within Moose Can Gully. The wetlands will not be impacted by the proposed project.

2.0 WATER MAIN DESIGN

2.1 Existing Water Supply

The existing water supply adjacent to this development is the City of Missoula existing Skyview pressure zone. The water main associated with this project is the existing 24" Ductile Iron Pipe (DIP) in Hillview Way on the south side of the subject property. On February 22, 2022 the City of Missoula provided the static pressures of nodes near the proposed development. See Figure 2.1 below.

Figure 2.1: Static Pressures



2.2 Proposed Water System

In chapter 3 of the Missoula Master Plan this parcel is mapped within the existing service zone and study area and in the design process it has been confirmed that this development is serviceable under the Missoula Water system. Per City of Missoula request the design also evaluates four adjacent properties for future development. It is assumed each adjacent parcel will be developed to the maximum extent possible under the existing zoning as single-family residential lots. This results in an additional 277 single-family lots to be served from the water main improvements of this subdivision. Therefore, the proposed design anticipates a total of 503 units. An exhibit showing the proposed upper system and adjacent lots to be served is included in Appendix A.

The proposed design of this system will utilize the approved and constructed Lower Water System associated with the Multi-Family development. An 8" DIP water main will connect to the existing 8" DIP water main south of Building E in the Rimel ROW and extend east to a proposed transmission pumphouse. This pumphouse will move the water approximately 129 feet vertically to a storage tank located in the southeast corner of the property. Due to significant grade change across the development two pressure zones are identified as shown in X400 and X401 in Appendix A. The two zones will be separated by one pressure reducing valve (PRV). However, a second distribution line will pressure Zone 2 (lower zone) by gravity from the storage tank. To pressurize Zone 1 (upper zone) water from the tank will be conveyed to a second pumphouse. This pumphouse is designed to have pumping capacity to service the 226 units and will have available space for an additional pump to service the adjacent developments.

The layout of the proposed public water main meets the City of Missoula design criteria and will be located within public rights-of-way or minimum 20' wide easements. The public water main will be separated from the proposed sanitary sewer main by a minimum distance of 10 feet, wall to wall. Per the MCPWSS fire hydrants will be installed so not to exceed 250' from newly constructed residential buildings, and per the International Fire Code (IFC), hydrants along roadways will be spaced at 500-foot intervals. Gate valves will be installed at the connection point to the existing mains as well as on property lines, per City standards.

2.3 Water Main Design

The water system is designed per the MCPWSS and DEQ-1. Water demands are shown in Table 2.1 using the MCPWSS values for average day demand and max day demand per residence. Per City request the peak hour demand per residence was increased based on data from existing subdivisions. The maximum peak hour in that data is 3.95gpm. This flowrate is used for the peak hour demand per residence in this design.

The storage tank is designed per the requirements of DEQ-1 to store the fire demand of 1500gpm for two hours plus the average day demand. This is shown in Table 2.2 as a minimum storage requirement of 342,000 gallons. The designed tank provides approximately 350,000 gallons. The tank design drawings are included in Appendix A.

As mentioned in Section 2.2 the proposed water system is designed as two pressure zones separated by one PRV. This PRV will be constructed in phase 4 as shown in the phasing exhibits in Appendix A. Pressures on the inlet side of the PRV are designed at approximately 110 psi and will be reduced to 45 psi on the outlet side. This reduction ensures the pressures at the low elevations of the project are within the accepted range for the City of Missoula.

SCADA will be provided for management of the system by the City of Missoula. SCADA control nodes will be installed in each of the pumphouses and PRV. The maximum line run between SCADA nodes is less than 2,000 feet. The main SCADA panel is located in the transmission pumphouse building.

The proposed water system distribution is modeled in WaterCAD by Bentley and results are included in Appendix C. The model is laid out with nodes for each block of services. The demands are added to the nodes and the fire demand is added at the highest elevation hydrant location. The fire demand was analyzed at 1500gpm for 2 hours. A Hazen-Williams "C" Factor of 130 was used in the pipe evaluation for the city standard Ductile Iron Pipe (DIP). The City requires a minimum working water pressure of 45 psi. However, the City has confirmed that the maximum of 100 psi can be exceeded to minimize city-maintained PRVs. To accommodate these higher pressures PRVs will be required within residences to restrict back to International Plumbing Code (IPC) requirement of 80 psi maximum.

Table 2.1: Water Demands

	Upper System											
	UNIT TYPE	UNITS	Total No. of People/ Residence	Total No. of People	Avg. Demand per Residence (gpcpd)	Avg. Demand (gpd)	Avg. Demand per Residence (gpm)	Avg. Demand (gpm)	Max Day Demand per Residence (gpm)	Max Day Demand (gpm)	Peak Hour Demand per Residence (gpm)	Peak Hour Demand (gpm)
Zone 1	Single Family	155	2.3	357	140	49,910	0.22	34.1	1.27	196.85	3.95	612.25
Zone 2	Single Family	71	2.3	163	140	22,862	0.22	15.62	1.27	90.17	3.95	280.45
Adj. Dev.	Single Family	277	2.3	637	140	89,194	0.22	60.94	1.27	351.79	3.95	1094.15
	TOTAL	503				161,966		110.66		638.81		1986.85

Table 2.2: Tank Sizing

FIRE FLOW (gpm)	TIME (min)	TOTAL (gal)	TANK SIZE (gal)
1500	120	180,000	341,966

3.0 CONCLUSION

The proposed public water main extension meets the requirements of the Missoula City Public Works Standards and Specifications Manual and DEQ Circular 1 and has adequate capacity to meet the demands of 226 Wildroot single-family lots and up to 277 single-family lots of adjacent future developments.

Cushing Terrell

Appendix A: Water System Exhibits

WATER SYSTEM REQUIREMENTS		
PHASE	QUANTITY	DESCRIPTION
2	1460 LF	8" DUCTILE IRON WL (INC, VALVE, TEES, BENDS, ETC.)
3	5065 LF 1884 LF 1 1 1 2 1 2	8" DUCTILE IRON WL (INC, VALVE, TEES, BENDS, ETC.) 12" DUCTILE IRON WL (INC, VALVE, TEES, BENDS, ETC.) BOOSTER BUILDING (TRANSMISSION) 350,000 CONCRETE WATER STORAGE TANK BOOSTER BUILDING (DISTRIBUTION) GENERATOR SCADA SYSTEM REDUCER
4	4014 LF 1 1	8" DUCTILE IRON WL (INC, VALVE, TEES, BENDS, ETC.) PRESSURE REDUCING VALVE ASSEMBLY SCADA CONNECTED TO PHASE 3
5	1097 LF	8" DUCTILE IRON WL (INC, VALVE, TEES, BENDS, ETC.)
6	1971 LF	8" DUCTILE IRON WL (INC, VALVE, TEES, BENDS, ETC.)
7	1592 LF	8" DUCTILE IRON WL (INC, VALVE, TEES, BENDS, ETC.)

LEGEND

- PHASE 2
- PHASE 3
- PHASE 4
- PHASE 5
- PHASE 6
- PHASE 7
- PRESSURE ZONE 1 BOUNDARY
- PRESSURE ZONE 2 BOUNDARY
- LOWER SYSTEM BOUNDARY

ZONING R40
20 ACRES
20 DWELLING UNITS

PARCEL B
COS 4371
Owner: Sun Developments LLC

NOTE: ADDITIONAL PRV TO BE INSTALLED FROM PRESSURE ZONE 1 TO PROVIDE SECONDARY WATER SUPPLY CONNECTION.

PARCEL 1B
COS 5323
Owner: Shirley A Jensen

PARCEL 1B
COS 5770
Owner: Mark Ward

NOTE: NODE PRESSURES SHOWN ARE AT FULL BUILD OUT OF ADJACENT DEVELOPMENTS.

ASSUMPTIONS

1. SCHOOL SITE / BUILDING WILL BE DESIGNED TO ONLY REQUIRE A SINGLE HYDRANT W/ DURATION OF 120 MIN. = 180,000 GAL.

60.00 MUNICIPAL ACCESS & UTIL EASEMENT

60.00 MUNICIPAL ACCESS & UTIL EASEMENT

EL: 3578.55
108±PSI

EL: 3568.03
50±PSI

EL: 3568.11
112±PSI

EL: 3517.44
72±PSI

PARALLEL WATER MAINS

EL: 3598.29
96±PSI

FUTURE DEVELOPMENT CONNECTION

ZONING R10
10 ACRES
37 DWELLING UNITS

EL: 3567.69
45±PSI

PRV LOCATION

EL: 3568.61
110±PSI

EL: 3618.52
90±PSI

FUTURE DEVELOPMENT CONNECTION

350 STUDENTS
7400 GPD
OR
RS. 4
20 ACRES
110 DWELLING UNITS

ZONING R5.4
20 ACRES
110 DWELLING UNITS

EL: 3571.22
46±PSI

W1/2SE1/4
Missoula County School District #1

EL: 3664.91
68±PSI

COMBINED FLOW RATES IF MAINTAINED AS SCHOOL SITE.
Q = 64,774 GPD.
IF ALL SINGLE FAMILY.
Q = 98,194 GPD.

FUTURE DEVELOPMENT CONNECTION

TRANSMISSION BOOSTER PUMP BUILDING

DISTRIBUTION BOOSTER PUMP BUILDING

350,000 GALLON STORAGE TANK

HILLVIEW WAY

CLEARVIEW WAY

VILLAGE VIEW WAY

RIMEL ROAD

LOCAL A

LOCAL B

LOCAL C

LOCAL D

LOCAL E

LOCAL F

LOCAL G

LOCAL H

LOCAL I

ELK HILLS PHASE 1

VILLAGE AT ELK HILLS

FELLOWSHIP HEIGHTS SUBDIVISION

TRACT A
COS 5325
Owner: John A Rimel Family Trust

TRACT B
COS 5325
Owner: Rimel Whitney Trustee

S6 S7 S8

1 X400 OVERALL WATER PLAN

NORTH

0 75 150 300

SCALE: 1" = 150'

Upper System											
	UNIT TYPE	UNITS	Total No. of People/ Residence	Total No. of People	Avg. Demand per Residence (gpcpd)	Avg. Demand (gpd)	Avg. Demand per Residence (gpm)	Avg. Demand (gpm)	Max Day Demand per Residence (gpm)	Max Day Demand (gpm)	Peak Hour Demand per Residence (gpm)	Peak Hour Demand (gpm)
Zone 1	Single Family	155	2.3	357	140	49,910	0.22	34.1	1.27	196.85	4	620.00
Zone 2	Single Family	71	2.3	163	140	22,862	0.22	15.62	1.27	90.17	4	284.00
Adj. Dev.	Single Family	277	2.3	637	140	89,194	0.22	60.94	1.27	351.79	4	1108.00
	TOTAL	503				161,966		110.66		638.81		2012.00

FIRE FLOW (gpm)	TIME (min)	TANK TOTAL (gal)	TANK SIZE (gal)
1500	120	180,000	341,966

WATER SYSTEM REQUIREMENTS PER PHASE

Phase 1:
The Multi-Family development will be connected to the existing water system in Hillview Way. The pressure in Hillview ranges between 75 and 80 psi. The development will have two connections into Hillview Way and will contain looped 8" Public ductile iron waterline to provide domestic water and fire suppression needs of the 5 Multi-Family Buildings that are currently under construction. Fire Hydrants have been designed to meet International Fire Code (IFC) and City of Missoula Fire Department requirements.

Phase 2:
This phase contains 21 Townhouses that will be connected to the existing water system in Hillview Way. The development will create a lasso line that is connected at Hillview Way and will create a loop along the private access road and back into Local A. This will provide domestic water supply to each townhouse and to public fire hydrants for fire protection. Fire hydrants will be installed to comply with IFC requirements. Domestic services will be stubbed out to each parcel.

Phase 3:
This phase contains an extension of the public water system, and will include booster buildings and a new water storge tank. The system will be designed to provide for the needs of the proposed subdivision and future developable parcels to the east and north of the project site. Future expansion will account for approximately 90,000GPD of additional capacity.

Starting at the connecting to the existing public water supply in Hillview Way, a new line will be extended eat to a new booster building (FF Elev. = 3450') that will boost water pressures to allow for filling a water storage tank at (FF Elev. = 3640'). The tank will be 342,000 gallons and will be approximately 24' tall (with the bottom 4' buried to reduce freeze potential). The volume includes 180,000 gallons for fire suppression, 72,772 gallons for domestic use within the subdivision, and an additional 89,194 gallons for future domestic needs.

A booster building will be constructed adjacent to the water storage tank. Booster pumps will generate pressure for the upper portion of the development and have capacity to be adjusted for a higher pressure setting when development occurs on the vacant land to the east. Booster pumps will be designed to provide the required peak flow rate with the larges pump out of commission.

The subdivision will contain two pressure zones. The first will be pressurized by the booster pumps described above. The lower zone will be a gravity system supplied connected to the transmission line between the lower booster building and the water storage tank.

Fire hydrants will be installed to comply with requirements of IFC. Domestic services will be stubbed out to each parcel.

A new SCADA system will be designed and connected to the City of Missoula Water Departments system to allow for monitoring and control of the water system remotely.

Phase 4:
This phase contains 8" public ductile iron piping as well as the single pressure reducing valve is proposed to link the two pressure zones. Fire hydrants will be installed to comply with IFC. Domestic services will be stubbed out to each parcel.

Phase 5:
This phase contains 8" public ductile iron piping along the new roadways. Fire hydrants will be installed to comply with IFC. Domestic services will be stubbed out to each parcel.

Phase 6:
This phase contains 8" public ductile iron piping along the new roadways. Fire hydrants will be installed to comply with IFC. Domestic services will be stubbed out to each parcel.

Phase 7:
This phase contains 8" public ductile iron piping along the new roadways. Fire hydrants will be installed to comply with IFC. Domestic services will be stubbed out to each parcel.

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MISSOULA, MONTANA
WILDROOT

EXHIBIT

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REVISIONS

NOT FOR CONSTRUCTION - EXHIBIT

OVERALL WATER PLAN

X400

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ZONING R40
20 ACRES
20 DWELLING UNITS

PARCEL B
COS 4371
Owner: Sun Developments LLC

PARCEL 1B
COS 5323
Owner: Shirley A Jensen

PARCEL 1B
COS 5770
Owner: Mark Ward

60.00 MUNICIPAL ACCESS & UTIL EASEMENT

60.00 MUNICIPAL ACCESS & UTIL EASEMENT

ELK HILLS
PHASE 1

HILLVIEW WAY

LOCAL C

LOCAL C

LOCAL E

LOCAL D

LOCAL D

LOCAL H

LOCAL F

LOCAL A

LOCAL B

CLEARVIEW WAY

LOCAL A

LOCAL G

LOCAL A

LOCAL F

LOCAL G

VILLAGE AT ELK HILLS

VILLAGE VIEW WAY

RIMEL ROAD

LOCAL A

RIMEL ROAD

LOCAL I

ZONING R10
10 ACRES
37 DWELLING UNITS

Owner: Bender Reality LLC

20 ACRES
350 STUDENTS
7400 GPD
OR
RS. 4
20 ACRES
110 DWELLING UNITS

W1/2SE1/4
Missoula County School
District #1

ZONING R5.4
20 ACRES
110 DWELLING UNITS

PLAT H12
Missoula County School
District #1

FELLOWSHIP HEIGHTS SUBDIVISION

S6

S7

S8

TRACT A
COS 5525
Owner: John A Rimel Family Trust

TRACT B
COS 5525
Owner: Rimel Whitney Trustee

NORTH

1
X401
OVERALL UTILITY PLAN - WATER

0 75 150 300
SCALE: 1" = 150'

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WILDROOT

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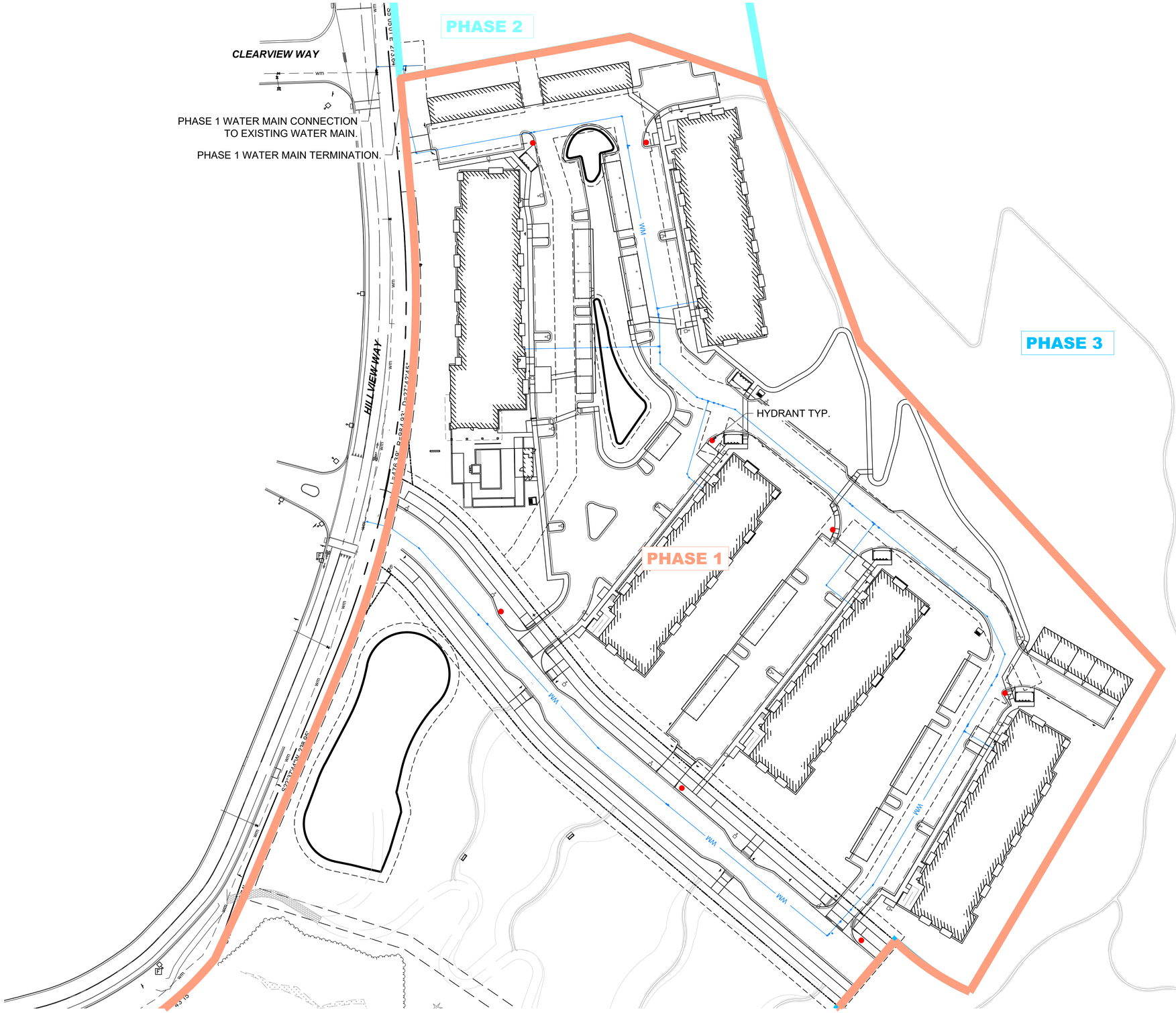
OVERALL UTILITY PLAN - WATER

X401

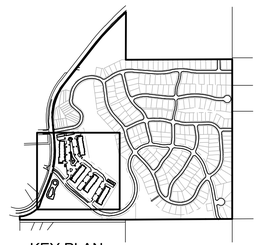


NORTH

1 / X402 PHASE 1 HYDRANT PLAN

0 25 50 100

SCALE: 1" = 50'



KEY PLAN

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WILDROOT

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PHASE 1 FIRE HYDRANT LAYOUT

X402

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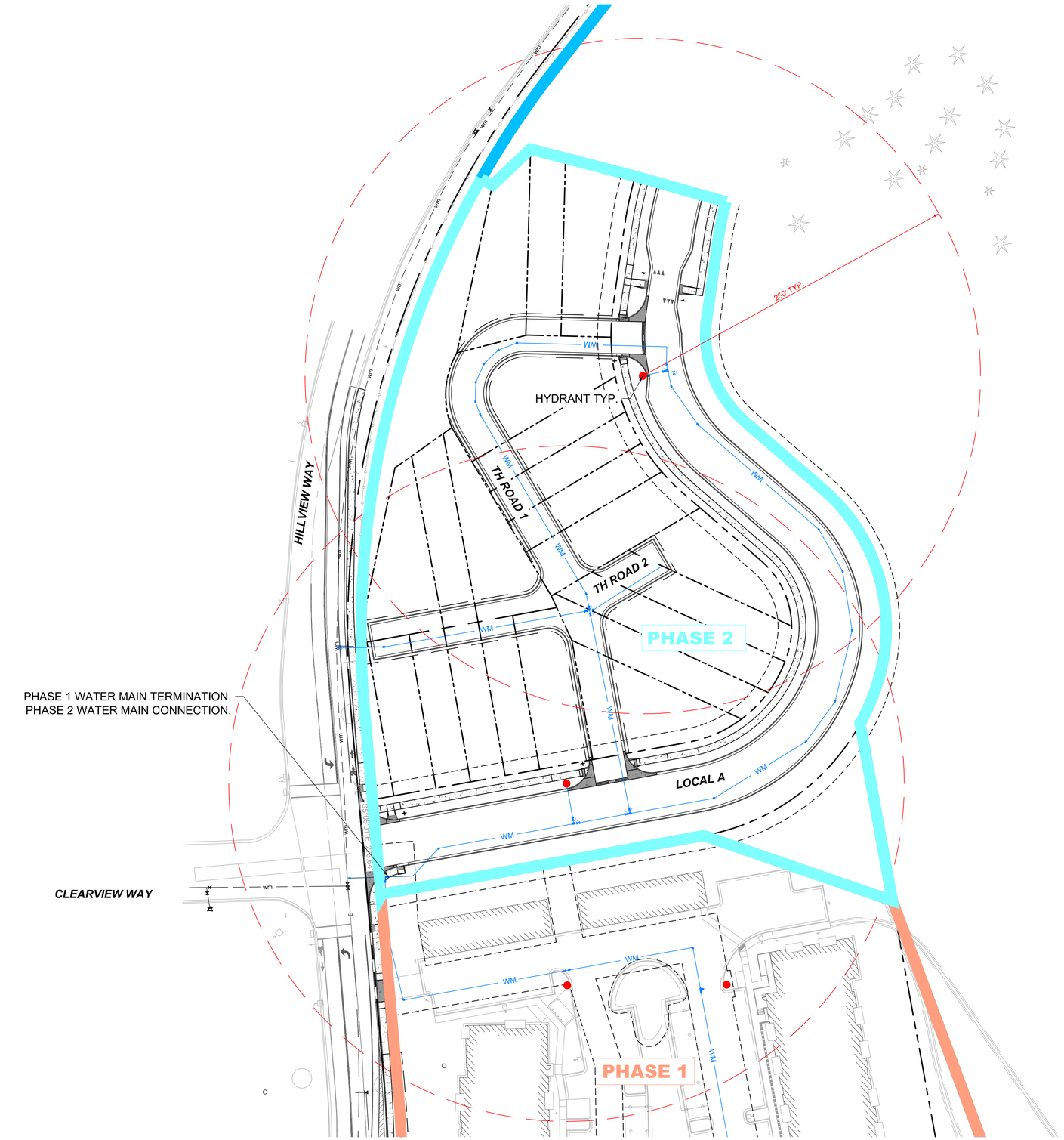

NORTH

1 X403 PHASE 2 HYDRANT PLAN

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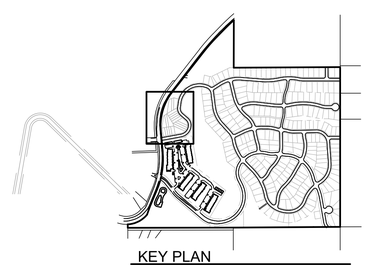
SCALE: 1" = 40'



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PHASE 2 FIRE HYDRANT LAYOUT

X403

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PHASE 3 WATER MAIN TERMINATION.

LOCAL C

PHASE 6

PHASE 7

PHASE 2

250' TYP.

LOCAL A

PHASE 3 WATER MAIN TERMINATION.

LOCAL B

PHASE 4

PHASE 5

PHASE 3

HYDRANT TYP.

PHASE 3 WATER MAIN TERMINATION.

LOCAL F

PHASE 3 WATER MAIN TERMINATION.

PHASE 3 WATER MAIN TERMINATION.

LOCAL G

RIMEL ROAD

PHASE 3 WATER MAIN TERMINATION.

LOCAL I

PHASE 1

PHASE 3 WATER MAIN CONNECTION TO EXISTING WATER MAIN.

RIMEL ROAD

WM

PHASE 3 WATER MAIN TERMINATION.

KEY PLAN

NORTH

1 / X404 PHASE 3 HYDRANT PLAN

0 45 90 180

SCALE: 1" = 90'

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PHASE 3 FIRE HYDRANT LAYOUT

X404

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PHASE 7

PHASE 4 WATER MAIN TERMINATION.

PHASE 6

LOCAL C

250' TYP.

PHASE 4 WATER MAIN TERMINATION.

PHASE 4 WATER MAIN TERMINATION.

PHASE 5

WM

LOCAL D

PHASE 3 WATER MAIN TERMINATION.
PHASE 4 WATER MAIN CONNECTION.

8'8" x 6'8" CONCRETE
PRV VAULT

LOCAL E

LOCAL B

LOCAL F

LOCAL G

HYDRANT TYP.

PHASE 4

RIMEL ROAD

LOCAL A

PHASE 3 WATER MAIN TERMINATION.
PHASE 4 WATER MAIN CONNECTION.

PHASE 3

PHASE 3 WATER MAIN TERMINATION.
PHASE 4 WATER MAIN CONNECTION.

PHASE 3 WATER MAIN TERMINATION.
PHASE 4 WATER MAIN CONNECTION.

NORTH

1
X405
PHASE 4 HYDRANT PLAN

0 30 60 120
SCALE: 1" = 60'

KEY PLAN

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WILDROOT

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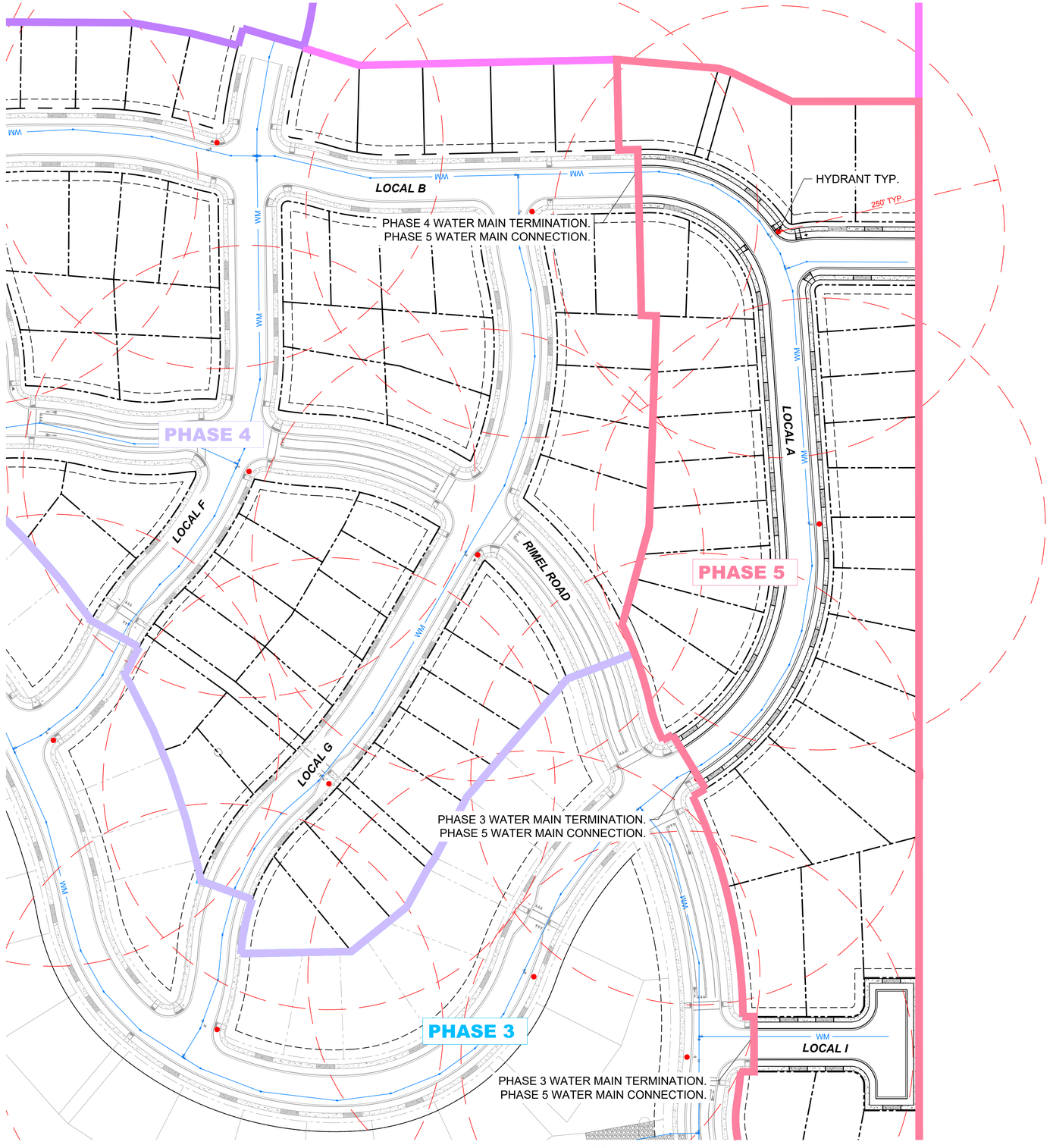
REVISIONS
-

PHASE 4 FIRE
HYDRANT LAYOUT

X405



NORTH

1 / X406 PHASE 5 HYDRANT PLAN

0 30 60 120

SCALE: 1" = 60'

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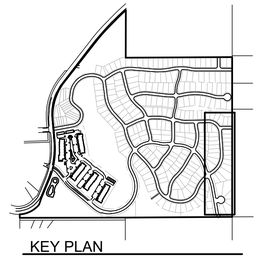

KEY PLAN

PHASE 5 FIRE HYDRANT LAYOUT

X406

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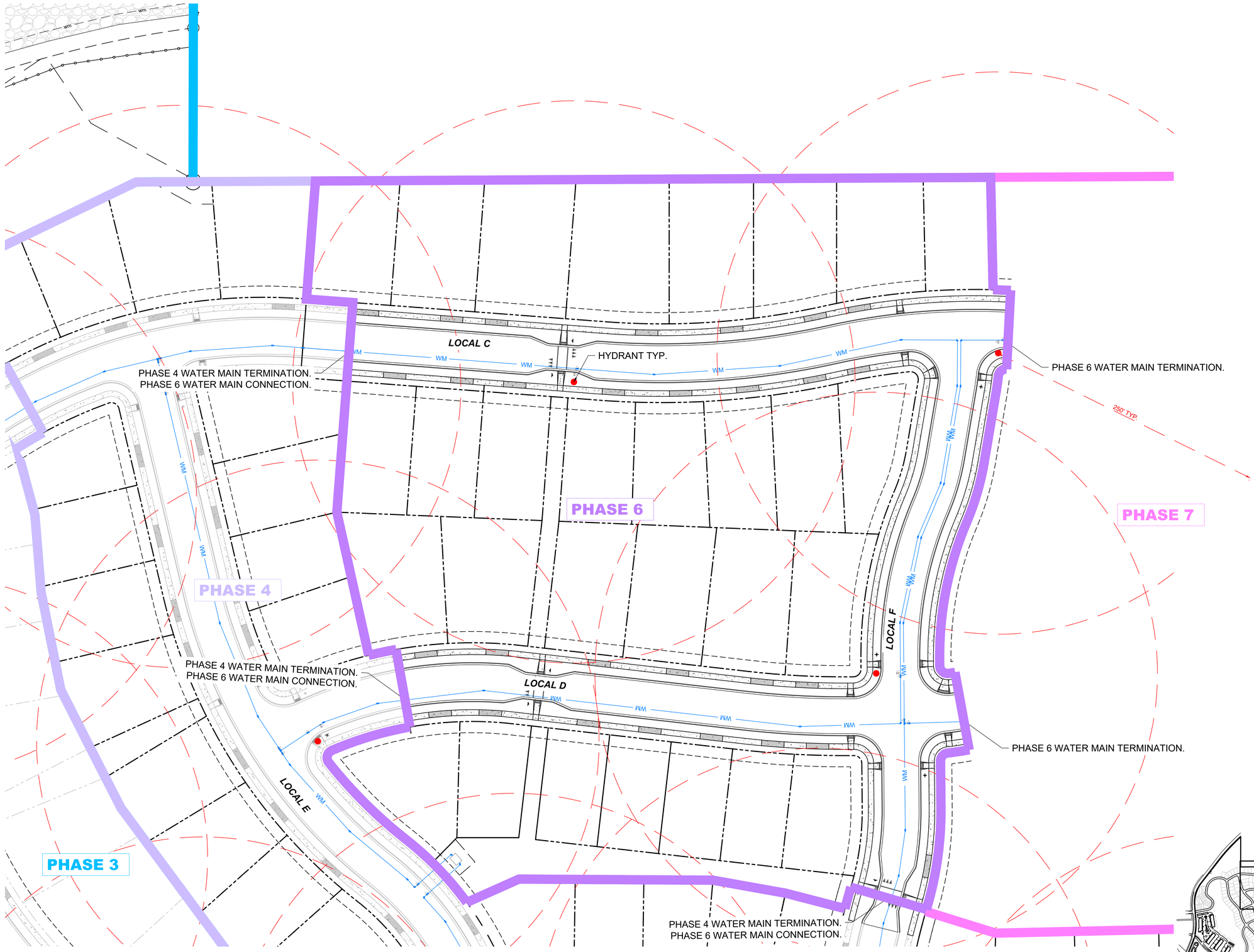
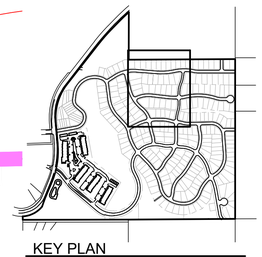


NORTH

1 / X407 PHASE 6 HYDRANT PLAN

0 20 40 80
SCALE: 1" = 40'


KEY PLAN

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WILDROOT

NOT FOR CONSTRUCTION - EXHIBIT

EXHIBIT

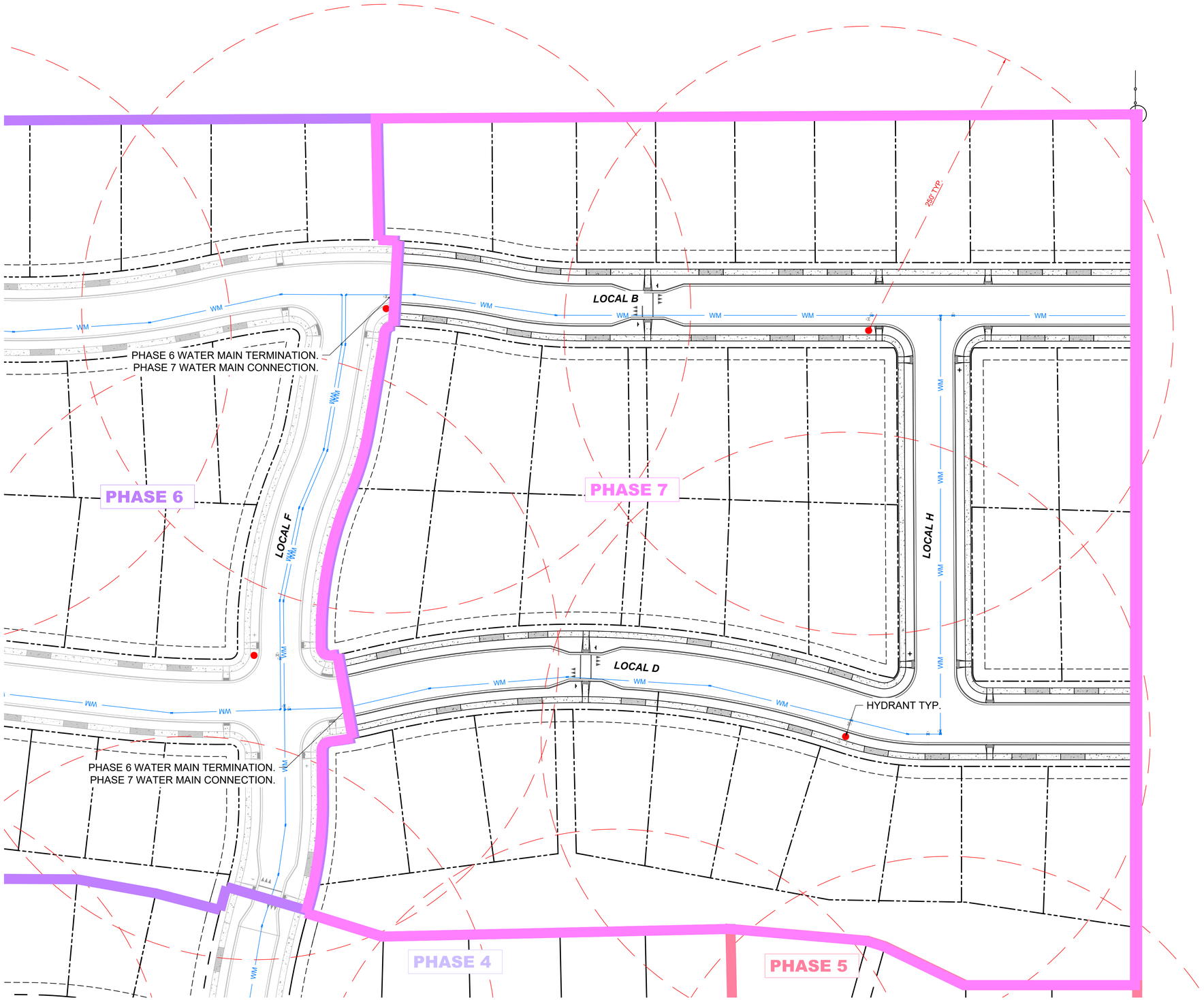
12.05.2023
DRAWN BY | MAHONEY
CHECKED BY | MASCIA
REVISIONS
-

PHASE 6 FIRE HYDRANT LAYOUT

X407

Cushing Terrell.

cushingterrell.com
800.757.9522



NORTH

1 / X408 PHASE 7 HYDRANT PLAN

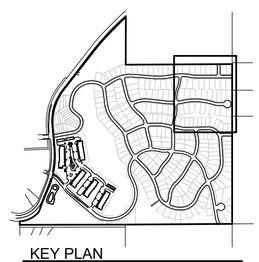
0 20 40 80

SCALE: 1" = 40'

MISSOULA, MONTANA
WILDROOT

EXHIBIT

12.05.2023
DRAWN BY | MAHONEY
CHECKED BY | MASCIA
REVISIONS
-

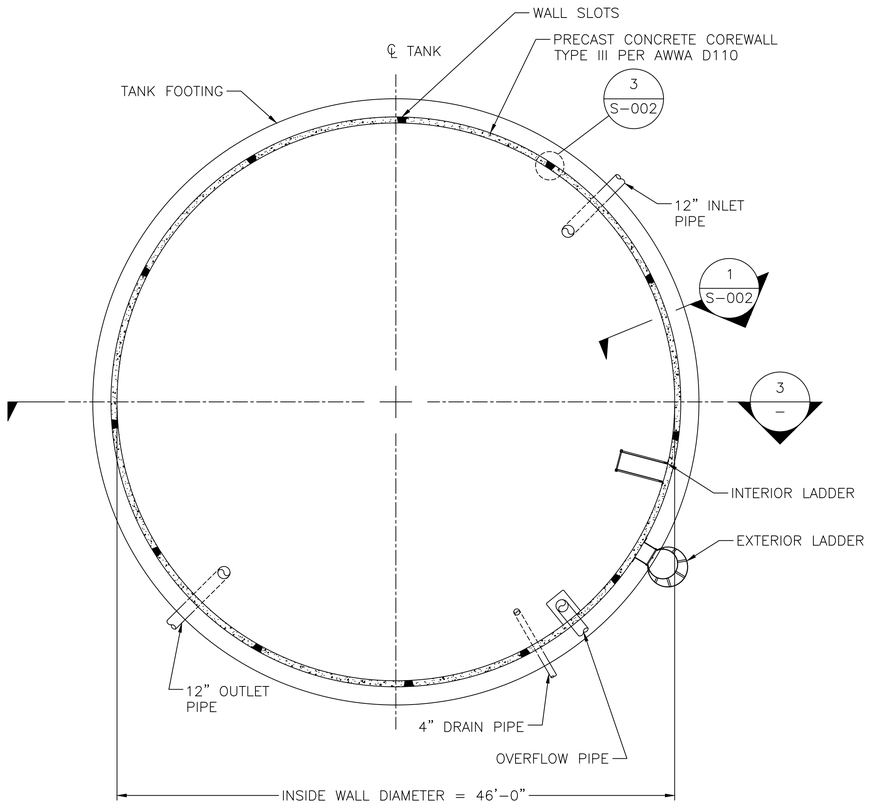


KEY PLAN

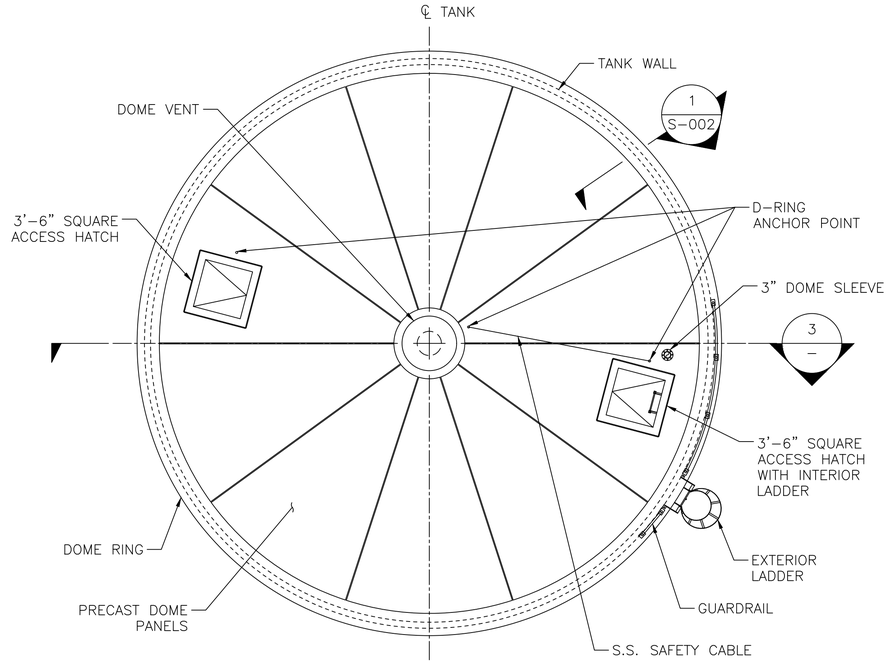
NOT FOR CONSTRUCTION - EXHIBIT

PHASE 7 FIRE HYDRANT LAYOUT

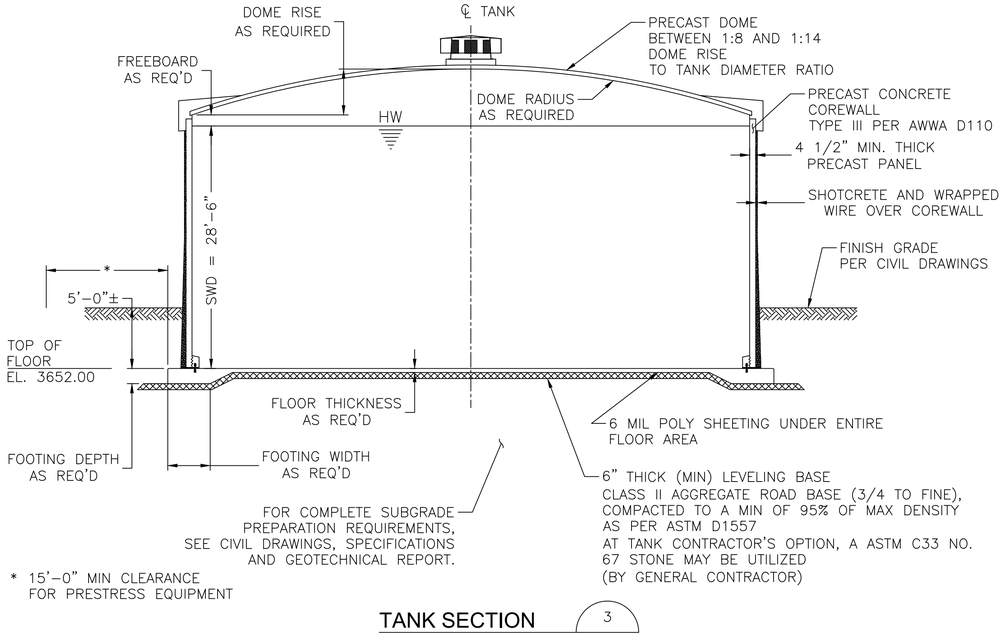
X408



FLOOR PLAN 1 –



DOME PLAN 2 –



TANK SECTION 3 –

GENERAL NOTES:
*ALL DIMENSIONS SHOWN ARE MINIMUM REQUIREMENTS. TANK CONTRACTOR, AS DEFINED IN THE SPECIFICATIONS, TO VERIFY DIMENSIONS WITH STRUCTURAL CALCULATIONS.

A. DESIGN LOADS
1. ROOF LOAD : 20.0 PSF LIVE; SNOW
2. LIQUID (WATER) : 62.4PCF
3. Ri, IMPULSIVE STRUCTURAL RESPONSE COEFFICIENT : 3.25 (ASCE 7 WITH CABLES) 1.50 (ASCE 7 W/O CABLES) 3.50 (AWWA WITH CABLES) 1.50 (AWWA W/O CABLES)
4. Rc, CONVECTIVE STRUCTURAL RESPONSE COEFFICIENT : 1.0
5. ANALYSIS PROCEDURE USED : EQUIVALENT LATERAL FORCE ANALYSIS BASED ON AWWA D110 AND ACI 350.3

B. CONCRETE AND SHOTCRETE
1. FLOOR, AND FOOTINGS : 4000 PSI
2. DOME, DOME RING AND DOME SLOTS : 4000 PSI
3. PRECAST WALL : 4000 PSI
4. SHOTCRETE FOR WIRE COVER (1C:3S) AND COVER COAT (1C:4S) : 4500 PSI
5. SEE TECHNICAL SPECIFICATION FOR COMPLETE MIX DESIGN INFORMATION INCLUDING MINIMUM CEMENT CONTENT, MAXIMUM WATER–CEMENT RATIO, AGGREGATE SIZE AND ACCEPTABLE ADMIXTURES.
6. SEE TECHNICAL SPECIFICATION FOR CONCRETE PLACING AND FORMING PROCEDURES.

C. METALS
1. ALL STAINLESS STEEL (SST) TO BE 304L UNLESS OTHERWISE NOTED.

D. REINFORCING STEEL
1. ALL REINFORCING IN TANK SHALL CONFORM TO ASTM A615 GRADE 60 UNLESS OTHERWISE NOTED ON THESE DRAWINGS.
2. REINFORCING STEEL CALLED OUT AS GALVANIZED SHALL HAVE A CLASS 1 COATING IN ACCORDANCE WITH ASTM A767, WITHOUT CHROMATE.

E. EARTHWORK REQUIREMENTS
1. MINIMUM COMPACTION OF CRUSHED ROCK AND SUBGRADE UNDER AND AROUND PIPE BLOCKS AND UNDER FLOOR AND FOOTINGS SHALL EQUAL 95% RELATIVE COMPACTION AS DETERMINED IN ACCORDANCE WITH ASTM D1557.
2. COMPACTION OF BACKFILL AROUND TANK SHALL EQUAL 90% RELATIVE COMPACTION AS DETERMINED IN ACCORDANCE WITH ASTM D1557. USE ONLY HAND HELD COMPACTION EQUIPMENT WITHIN 5' OF TANK WALL AND LIGHTWEIGHT EQUIPMENT (15,600 LBS MAX) BEYOND THE 5' AND WITHIN 15' OF THE TANK SO AS NOT TO DAMAGE THE WALL. BRING UP THE BACKFILL AROUND THE TANK IN UNIFORM LIFTS WHEN POSSIBLE. DIFFERENCE IN BACKFILL HEIGHTS DURING INSTALLATION SHALL NEVER EXCEED THE FINAL DIFFERENCE IN BACKFILL HEIGHTS.

0.35 MG WATER STORAGE TANK

MISSOULA, MT
ENGR.: CUSHING TERRELL
MISSOULA, MT

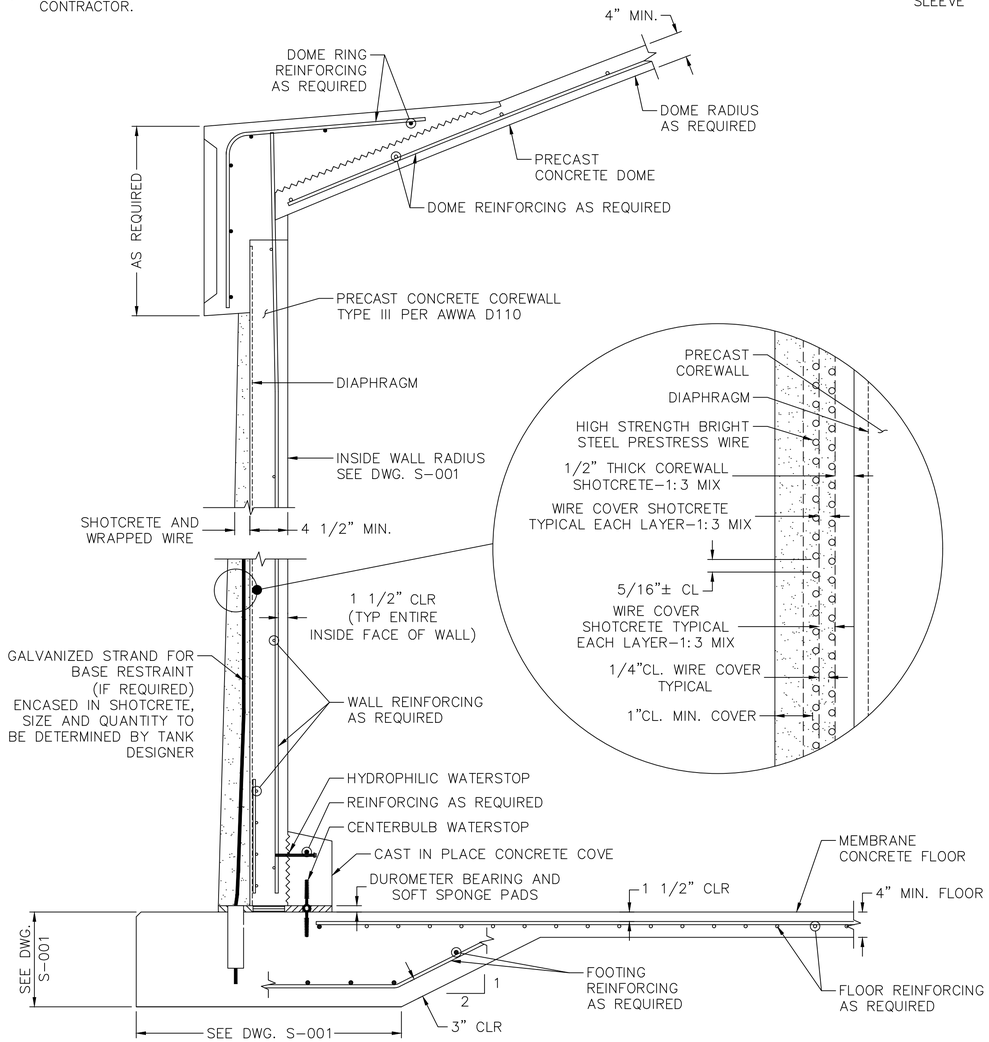
REV	DATE	DESIGNER	DESCRIPTION	DATE: 09/14/23
DWN: CYATES		CHK: YLUO		

AWWA D110 TYPE III PRECAST CONCRETE STORAGE TANK

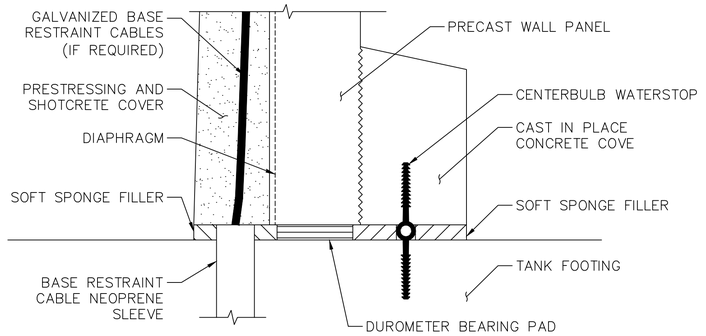
TANK PLANS AND SECTION

DRAWING NUMBER
S–001

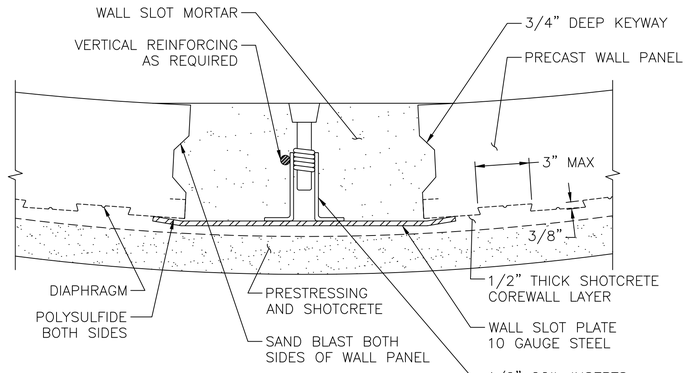
NOTES:
1) FOOTING AND FLOOR TO BE FINISHED PER SPECIFICATIONS.
2) MAINTAIN CLEARANCE BETWEEN THE INDIVIDUAL STRANDS IN THE BASE RESTRAINT CABLE SETS (DO NOT BUNDLE). CABLES MAY TOUCH WITHIN 2' OF THE BOOT.
3) THE COMBINED FLOOR AND WALL FOOTING SHALL BE POURED MONOLITHICALLY UNLESS APPROVED BY THE ENGINEER.
4) BASE RESTRAINT CABLES MAY BE BENT PRIOR TO INSTALLATION.
5) BASE RESTRAINT CABLE DESIGN REQUIREMENTS TO BE DETERMINED BY TANK CONTRACTOR.



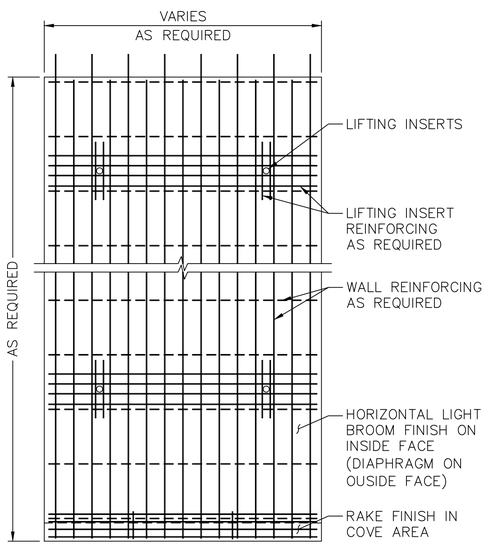
FOOTING, WALL AND ROOF SECTION 1 S-001



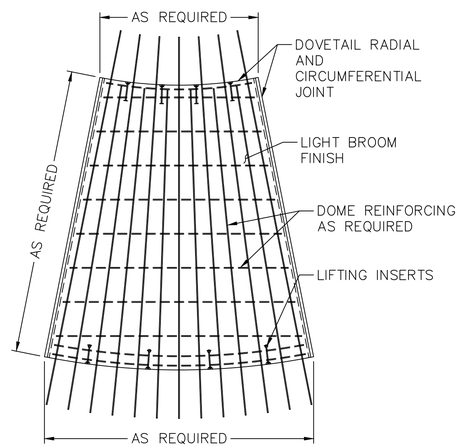
WALL BASE 2 –



WALL SLOT 3 S-001



PRECAST WALL PANEL 4 –
QTY. AS REQ'D



PRECAST DOME PANEL 5 –
QTY. AS REQ'D

0.35 MG WATER STORAGE TANK

MISSOULA, MT
ENGR.: CUSHING TERRELL
MISSOULA, MT

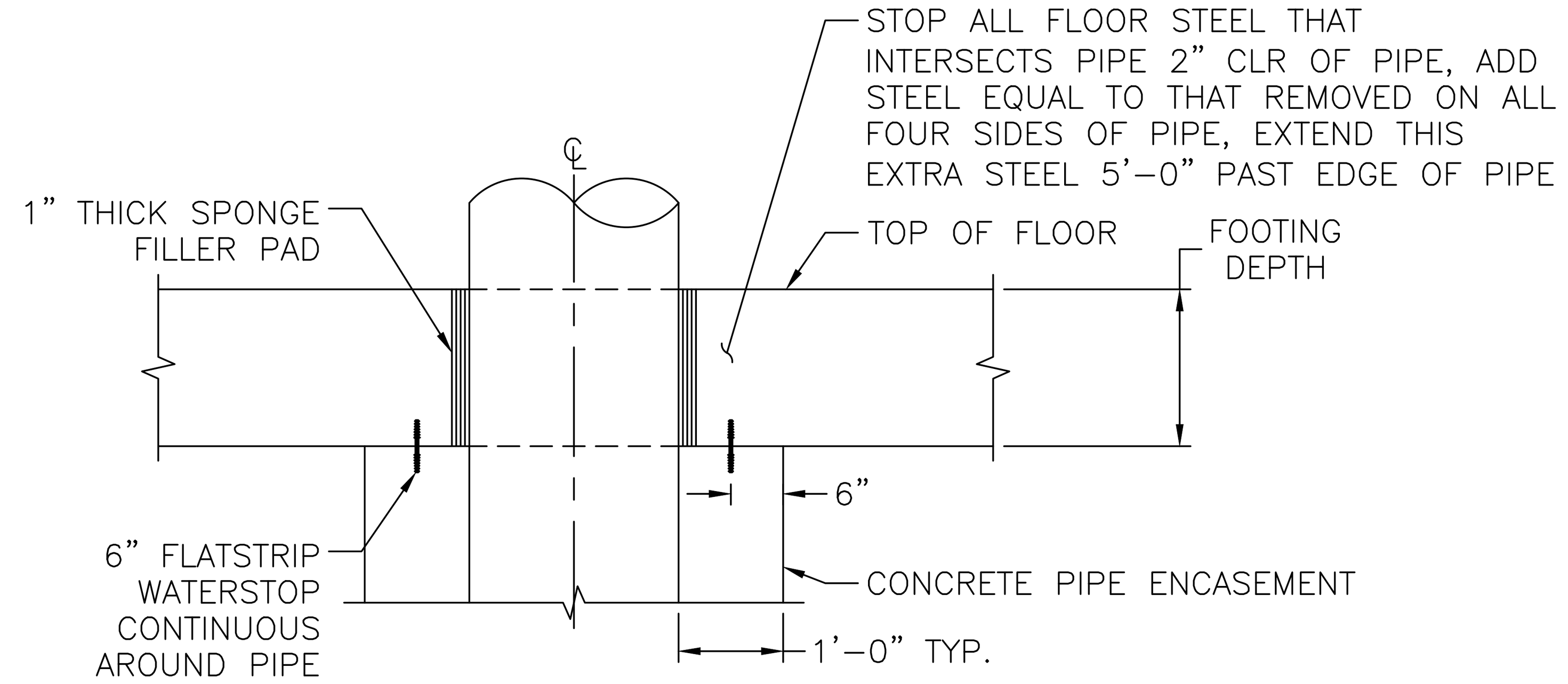
REV	DATE	DESCRIPTION
DWN: CYATES	CHK: YLUO	DESIGNER

DATE: 09/14/23

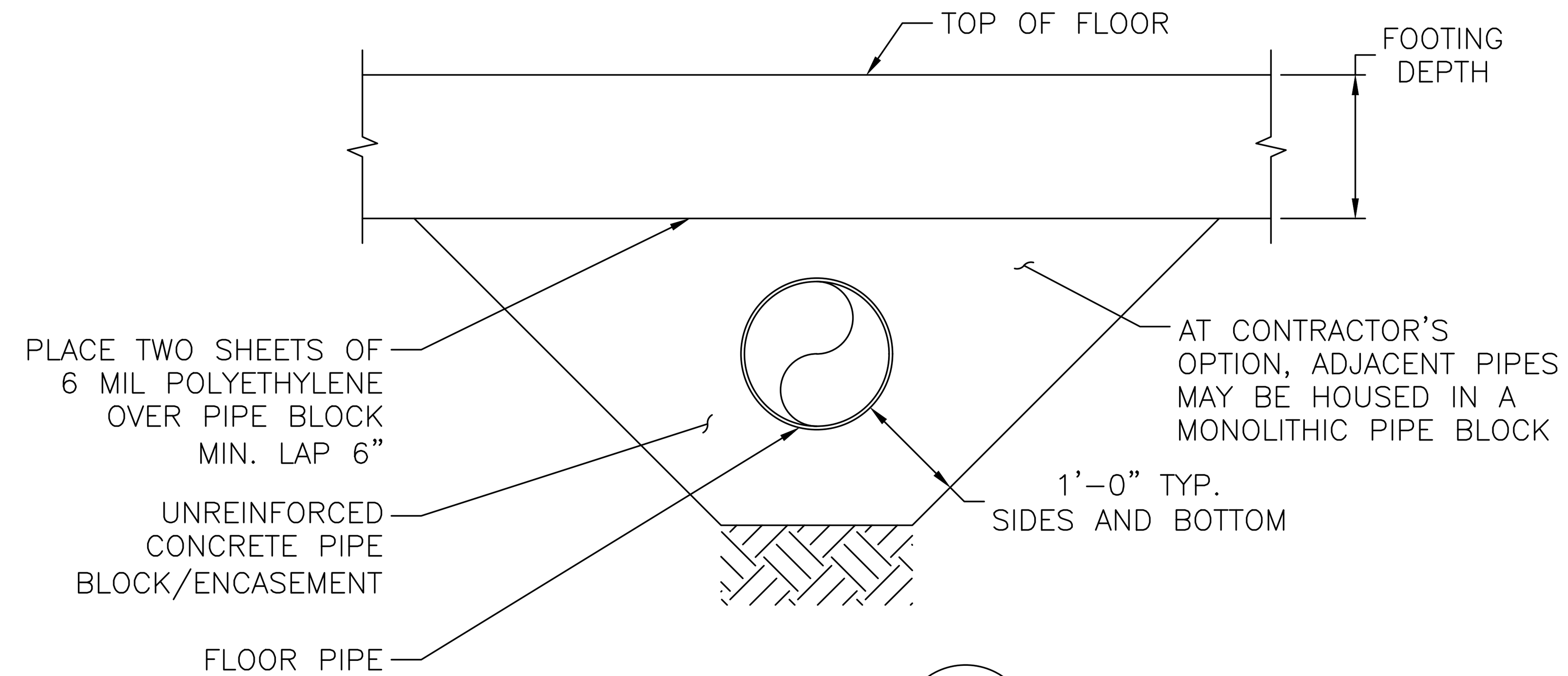
AWWA D110 TYPE III PRECAST CONCRETE STORAGE TANK

ROOF, WALL AND FOOTING

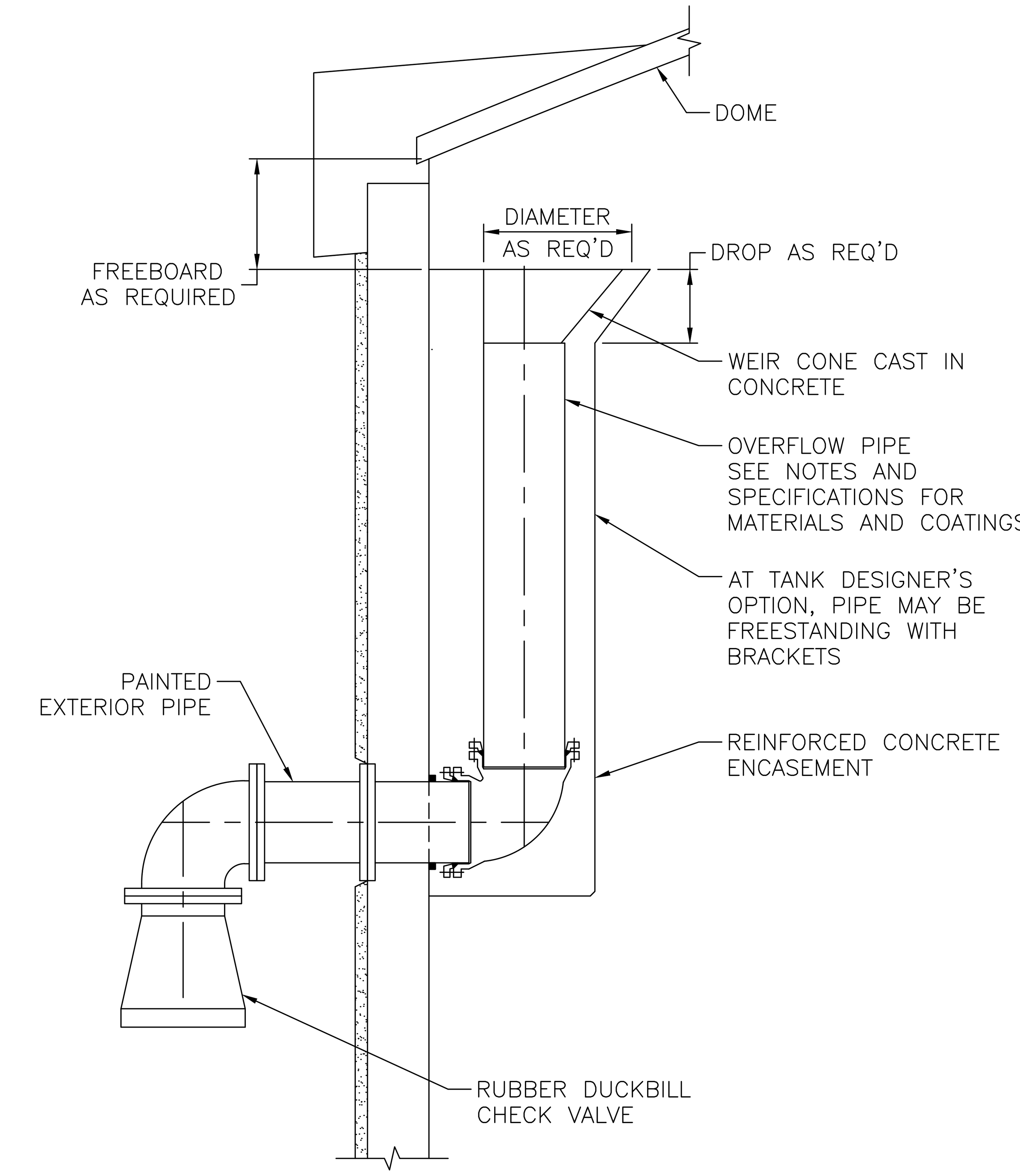
DRAWING NUMBER
S-002



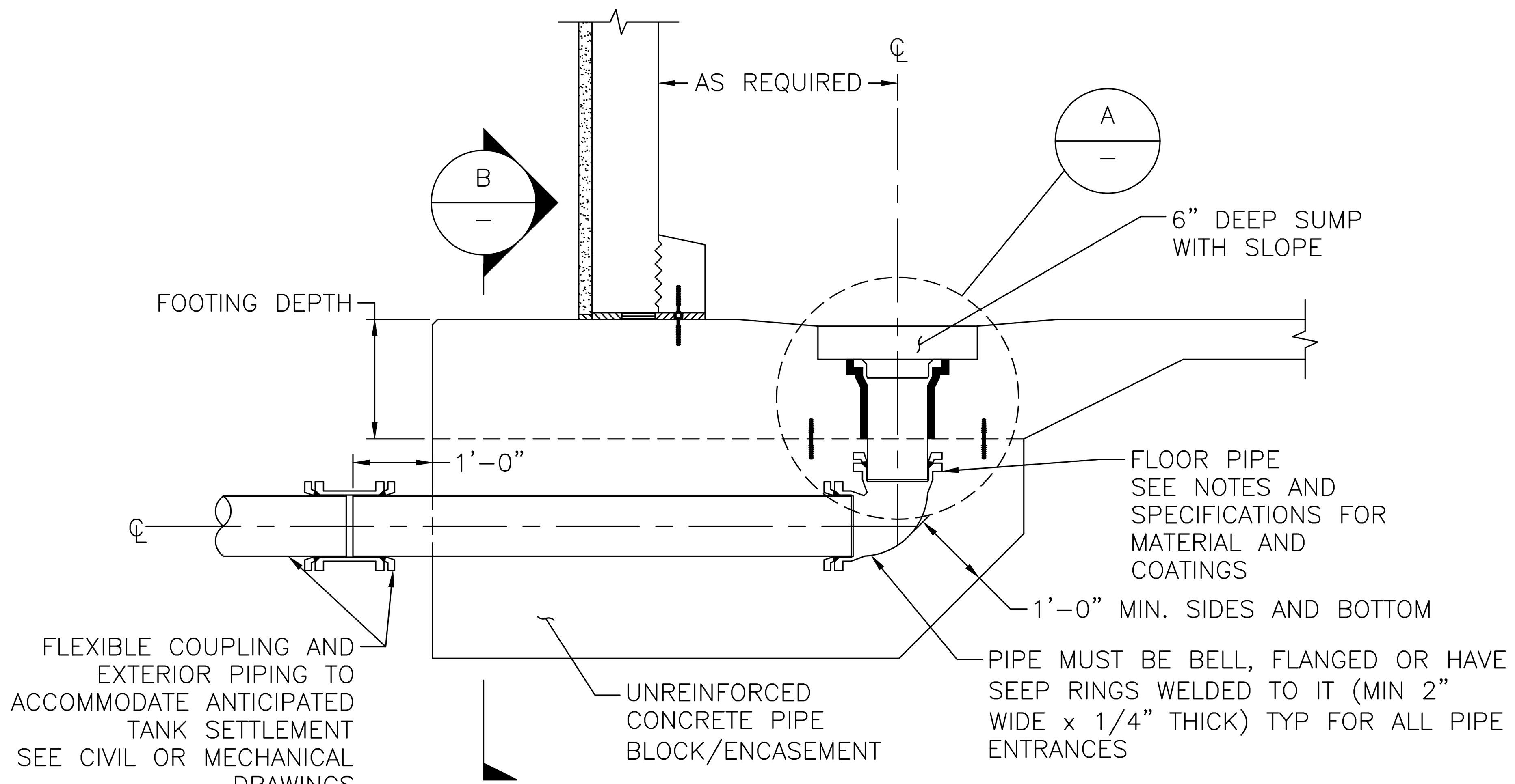
TYPICAL FLOOR PIPE ENTRANCE A –



PIPE SECTION B –



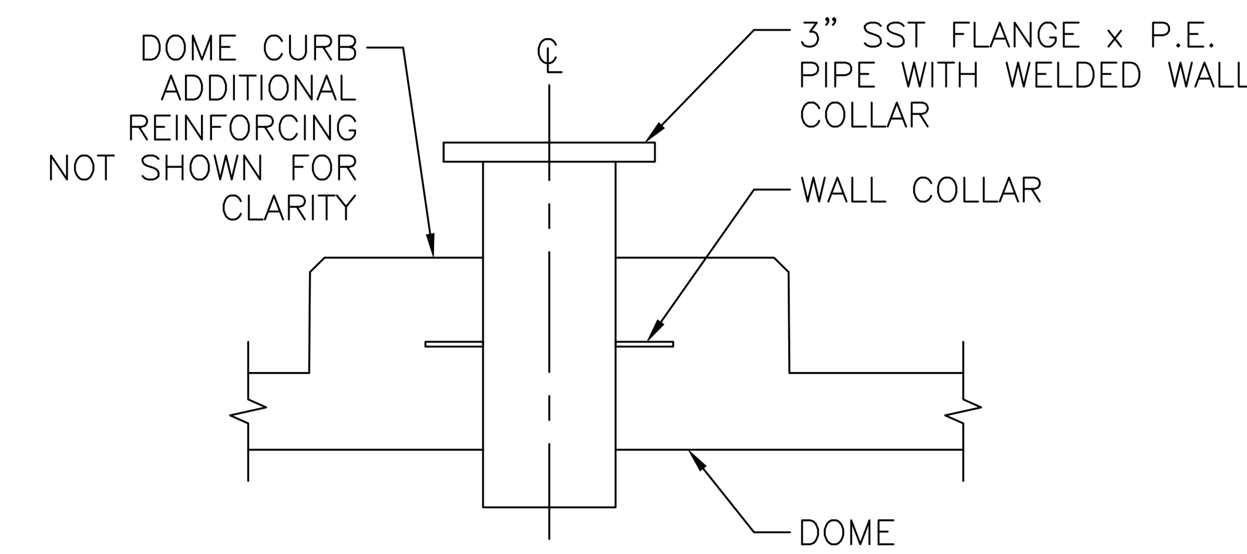
OVERFLOW PIPE 4 S-001



DRAIN PIPE 2 S-001

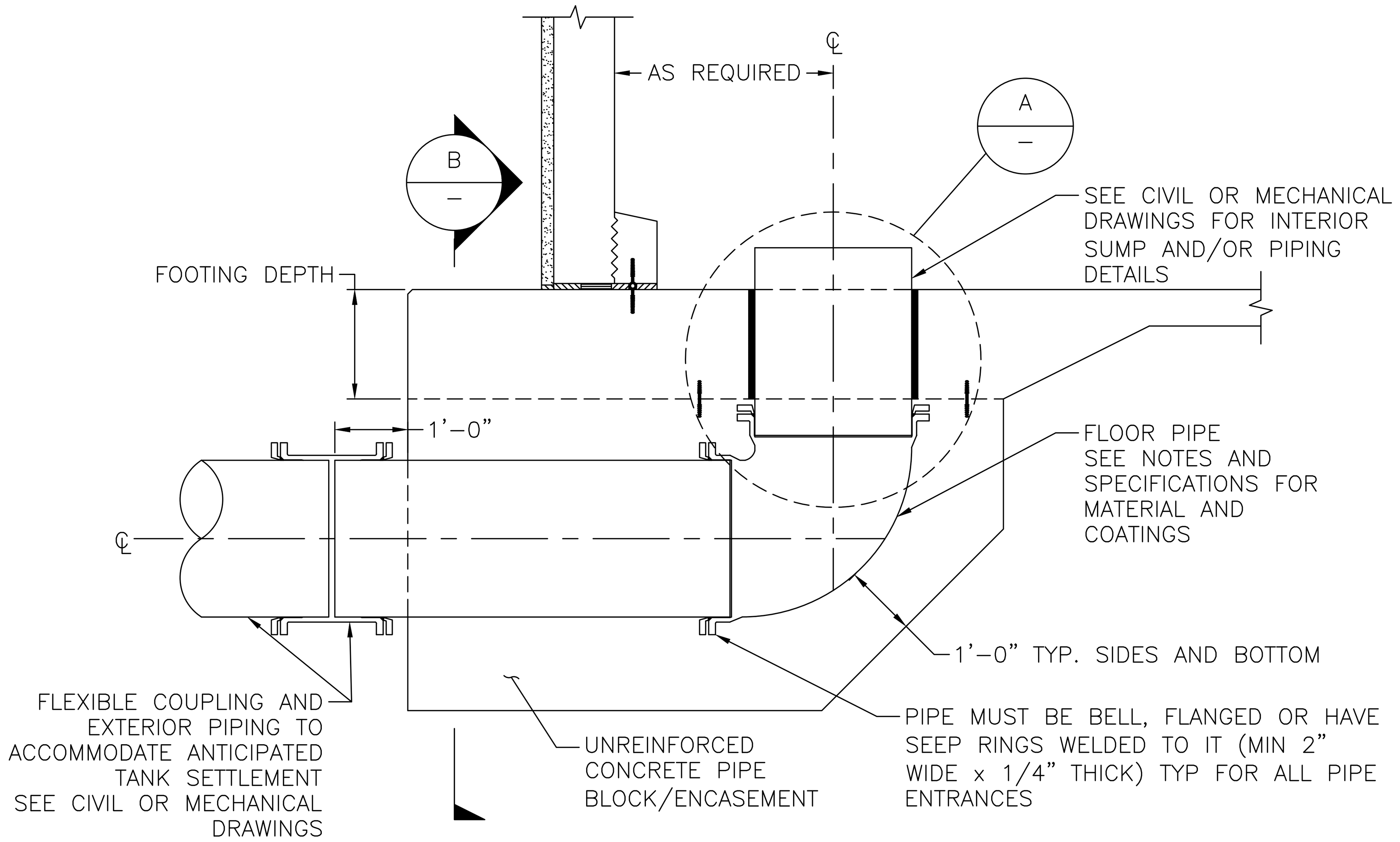
PIPING NOTES:

1. ALL PIPE MATERIAL TO BE D.I.C.L. UNLESS NOTED OTHERWISE.
2. EPOXY COAT EXTERIOR OF PIPING INSIDE TANK. NO COATING ON PIPE IN CONTACT WITH CONCRETE.
3. EXTERIOR PIPING CONNECTION TO BE DESIGNED TO TOLERATE EXPECTED TANK SETTLEMENT.

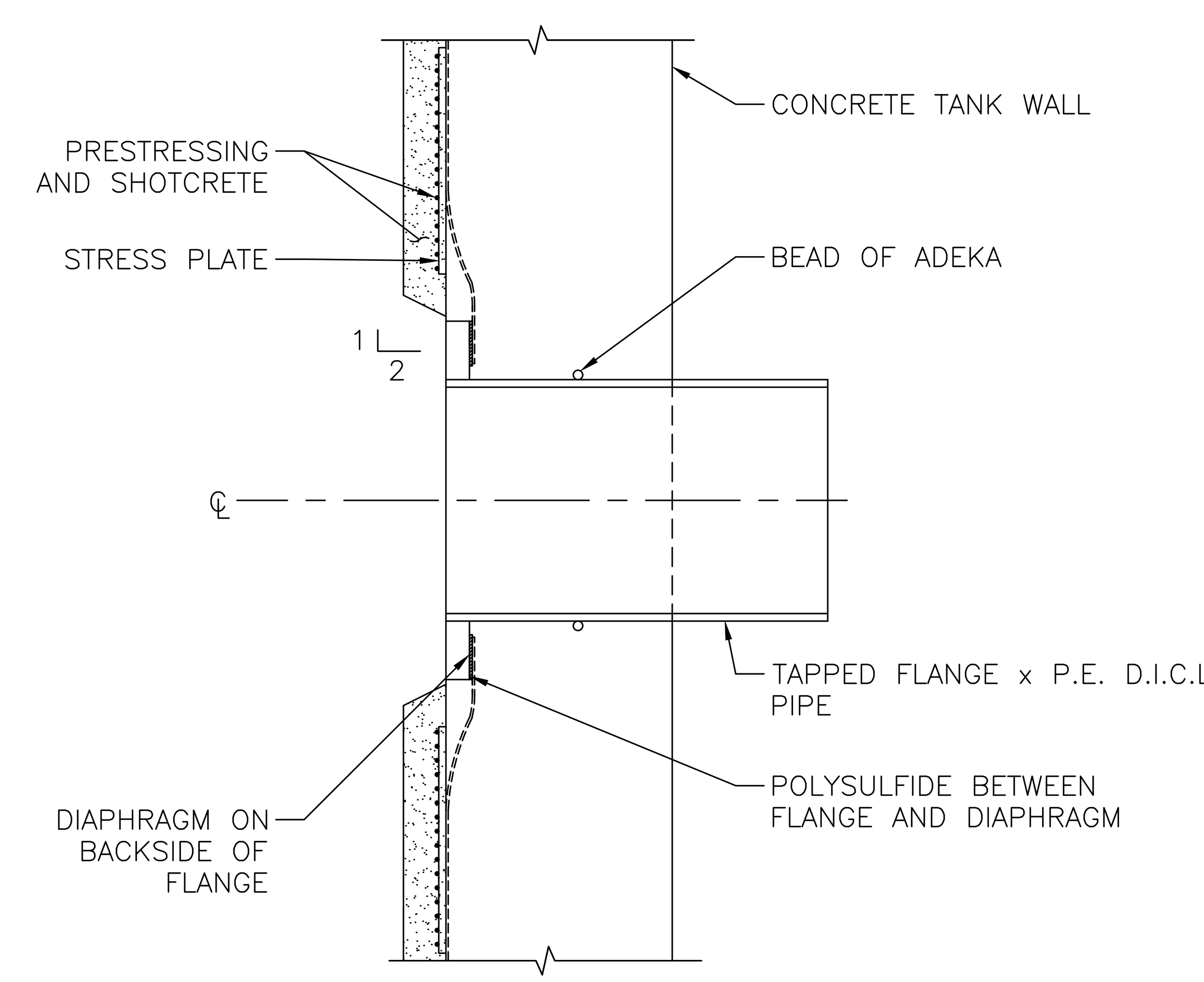


DOME SLEEVE 3 S-001

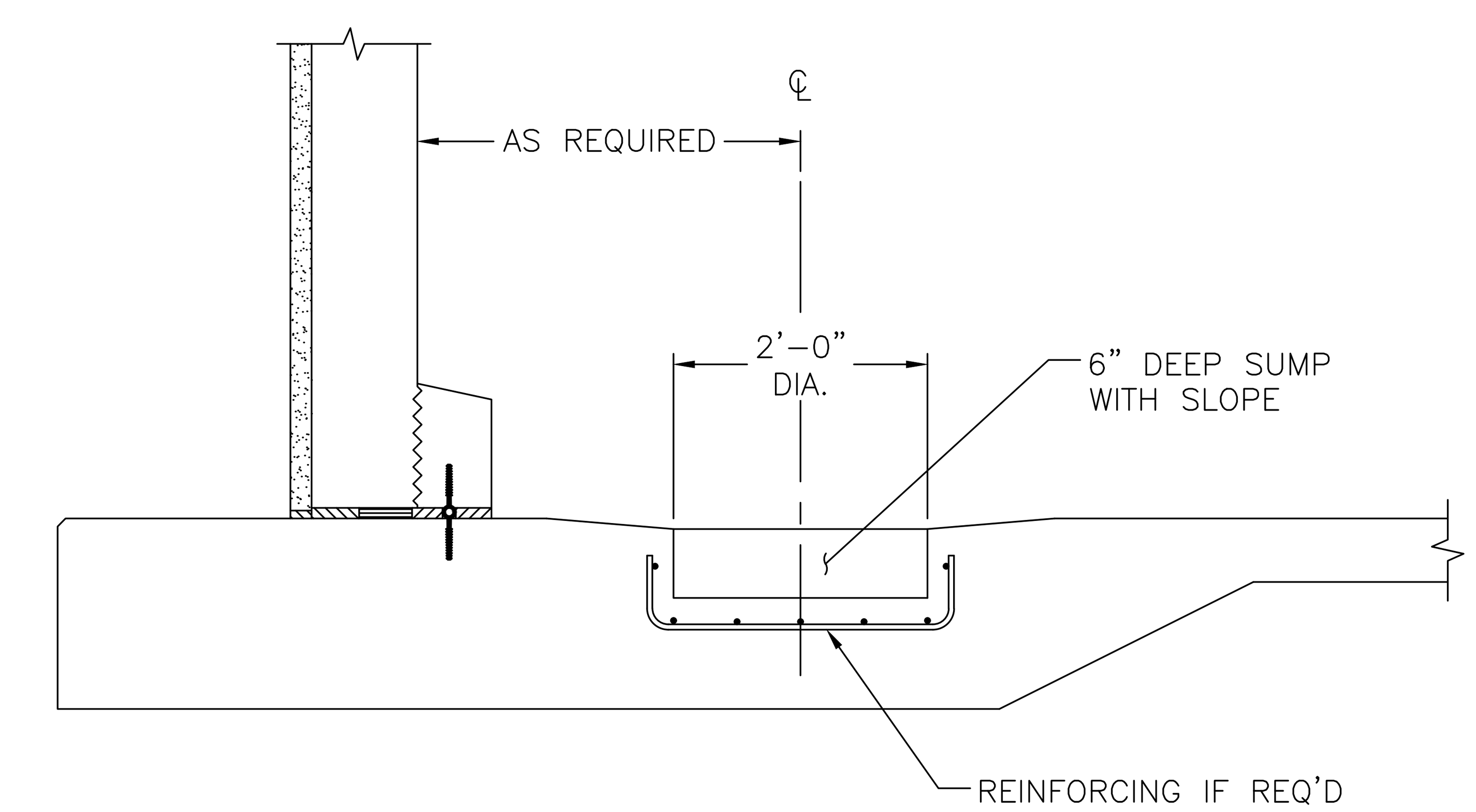
1 REQ'D



TYPICAL FLOOR PIPE 1 –



TYPICAL WALL PIPE ENTRANCE C –



SUMP 5 S-001

0.35 MG WATER STORAGE TANK

MISSOULA, MT

ENGR.: CUSHING TERRELL

MISSOULA, MT

DATE: 09/14/23

DWN: CYATES | CHK: YLUO

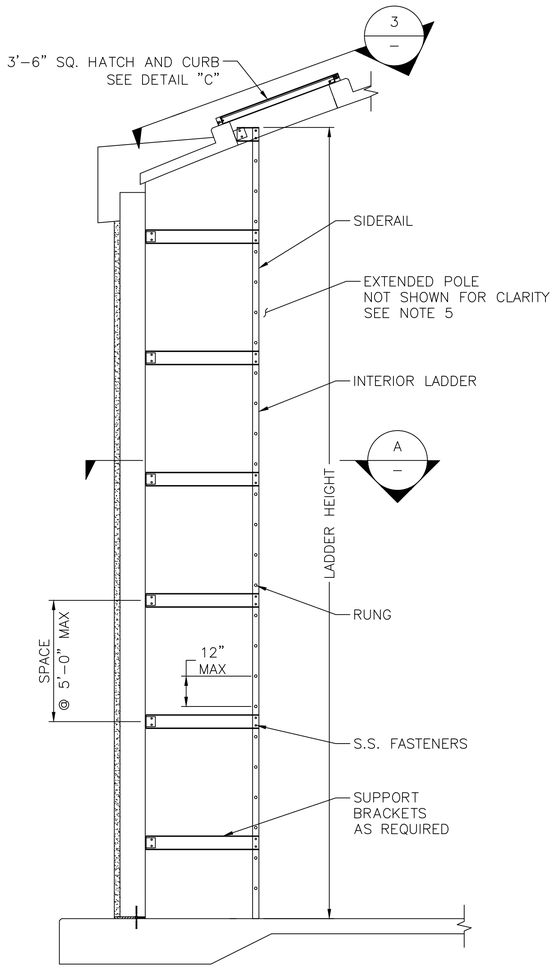
REV	DATE	DESIGNER	DESCRIPTION

AWWA D110 TYPE III PRECAST CONCRETE STORAGE TANK

TANK PIPING

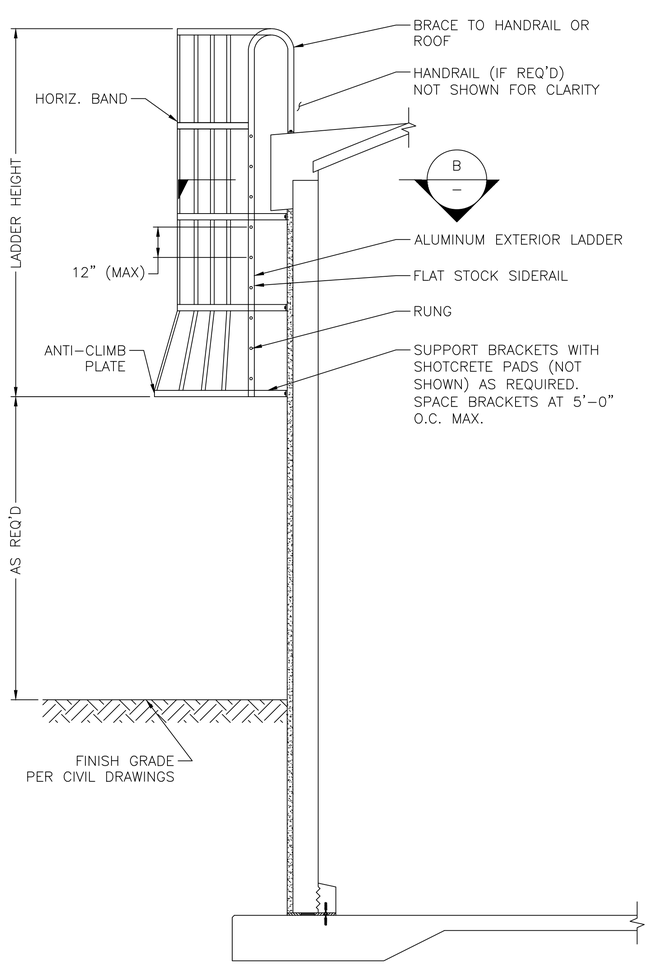
DRAWING NUMBER

S-003



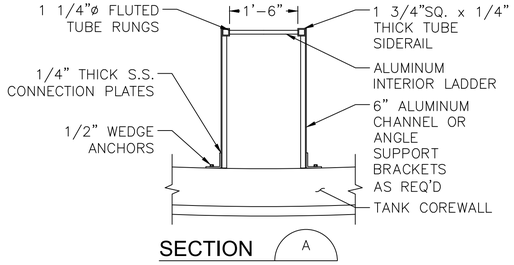
INTERIOR LADDER 1
1 REQ'D S–001

INTERIOR LADDER NOTES:
1) LADDER MATERIAL SHALL BE ALUMINUM.
2) OSHA COMPLIANT FALL PREVENTION DEVICE SHALL BE INSTALLED (SST).
3) LADDER RUNGS TO BE SOLID BARS AND FLUTED.
4) USE SST WEDGE ANCHORS FOR ALL CONNECTIONS TO CONCRETE UNLESS NOTED OTHERWISE.
5) ALU. LADDER EXTENDED PIPE REQ'D.



EXTERIOR LADDER 2
1 REQ'D S–001

EXTERIOR LADDER NOTES:
1) ALL MATERIAL FOR EXTERIOR LADDER, SIDERAILS, RUNGS AND BRACKETS TO BE 6061–T6 ALUMINUM.
2) OSHA COMPLIANT FALL PREVENTION DEVICE SHALL BE INSTALLED (SST).
2) LADDER RUNGS TO BE SOLID BARS AND KNURLED.
3) ALL WELDS TO BE 3/16" MINIMUM.
4) ALL ALUMINUM IN CONTACT WITH CONCRETE MUST BE COATED WITH A HEAVY BITUMASTIC COATING, EPOXY PAINT OR SHIMMED USING PVC.
5) USE SST WEDGE ANCHORS FOR ALL CONNECTIONS TO CONCRETE UNLESS NOTED OTHERWISE.
6) WHERE SST BOLTS ARE IN CONTACT WITH DISSIMILAR METALS, USE INSULATING SLEEVES AND PHENOLIC WASHERS TO ELECTRICALLY ISOLATE THE BOLTS.
7) WHERE SST BOLTS ARE PLACED IN THE WALL EXTERIOR, DRILL AND PLACE AFTER WRAPPING AND BEFORE FINAL SHOTCRETING.



SECTION A
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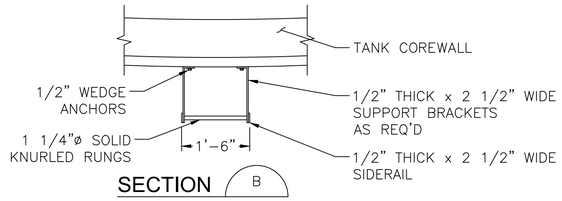

SECTION B
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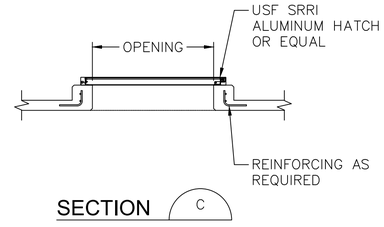
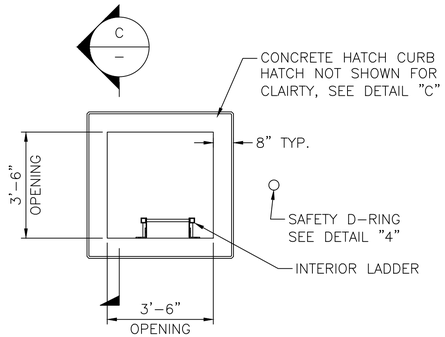
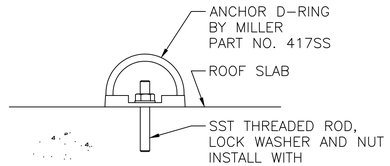


SECTION C
–

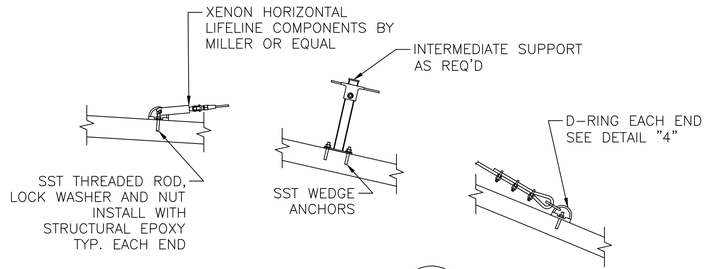
ROOF HATCHES NOTES:
1) HATCHES TO BE SINGLE LEAF USF SRRI ALUMINUM HATCHES OR EQUAL.
2) ALL ALUMINUM IN CONTACT WITH CONCRETE MUST BE COATED WITH A HEAVY BITUMASTIC COATING, EPOXY PAINT OR SHIMMED USING PVC.
3) USE SST WEDGE ANCHORS FOR ALL CONNECTIONS TO CONCRETE UNLESS NOTED OTHERWISE.
4) WHERE SST BOLTS ARE IN CONTACT WITH DISSIMILAR METALS, USE INSULATING SLEEVES AND PHENOLIC WASHERS TO ELECTRICALLY ISOLATE THE BOLTS.



3'-6" SQ. ACCESS HATCH 3
2 REQ'D S–001



SAFETY D-RING 4
AS REQ'D –



SAFETY CABLE D
–

0.35 MG WATER STORAGE TANK

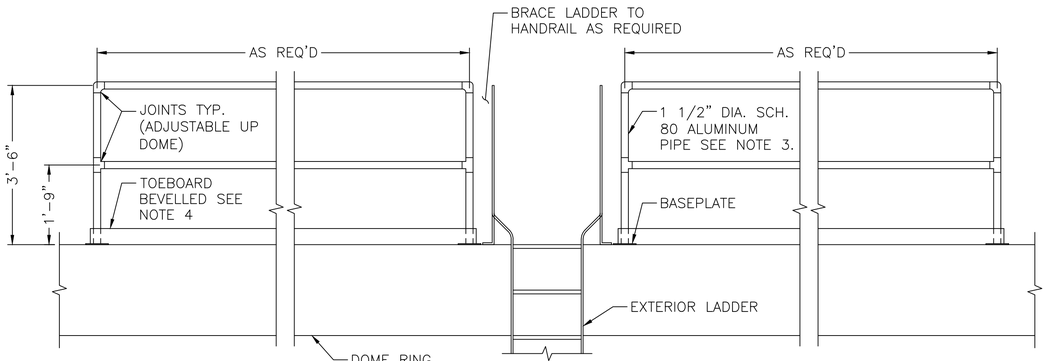
MISSOULA, MT
ENGR.: CUSHING TERRELL
MISSOULA, MT

REV	DATE	DESCRIPTION
DWN: CYATES	CHK: YLUO	DATE: 09/14/23

AWWA D110 TYPE III PRECAST CONCRETE STORAGE TANK

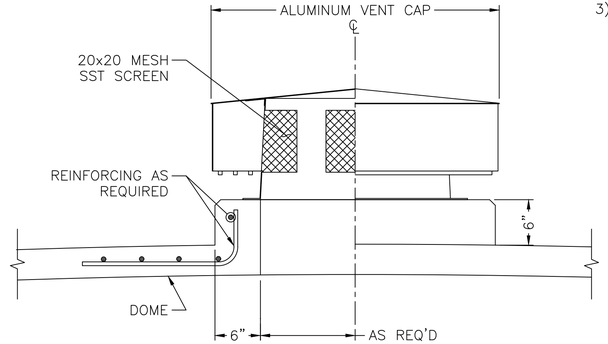
TANK LADDERS AND HATCHES

DRAWING NUMBER
S–004



GUARDRAIL ELEVATION 1
1 REQ'D S-001

GUARDRAIL NOTES:
1) ALL MATERIAL FOR RAILS AND POSTS TO BE 6061-T6 ALUMINUM.
2) HANDRAIL FITTINGS SHALL BE SPEEDRAIL BY HOLLAENDER, INC OR EQUAL.
3) HORIZONTAL RAILS AND POSTS TO BE 1 1/2" SCH 80 PIPE.
4) HOLLAENDER BEVELED TOE BOARD SHALL BE ATTACHED TO FRONT RAIL.
5) USE SST FOR ALL BOLTS UNLESS NOTED OTHERWISE.
6) USE SST WEDGE ANCHORS FOR ALL CONNECTIONS TO CONCRETE UNLESS NOTED OTHERWISE.



DOME VENT 2
1 REQ'D S-001

ROOF VENT NOTES:
1) VENT TO BE ALUMINUM.
2) SIZE PER PROJECT VENTING RATES.
3) USE SST WEDGE ANCHORS FOR ALL CONNECTIONS TO CONCRETE UNLESS NOTED OTHERWISE.

0.35 MG WATER STORAGE TANK

MISSOULA, MT
ENGR.: CUSHING TERRELL
MISSOULA, MT

REV	DATE	DESCRIPTION

DWN: CYATES CHK: YLUO DATE: 09/14/23

AWWA D110 TYPE III PRECAST CONCRETE STORAGE TANK

MISCELLANEOUS APPURTENANCES

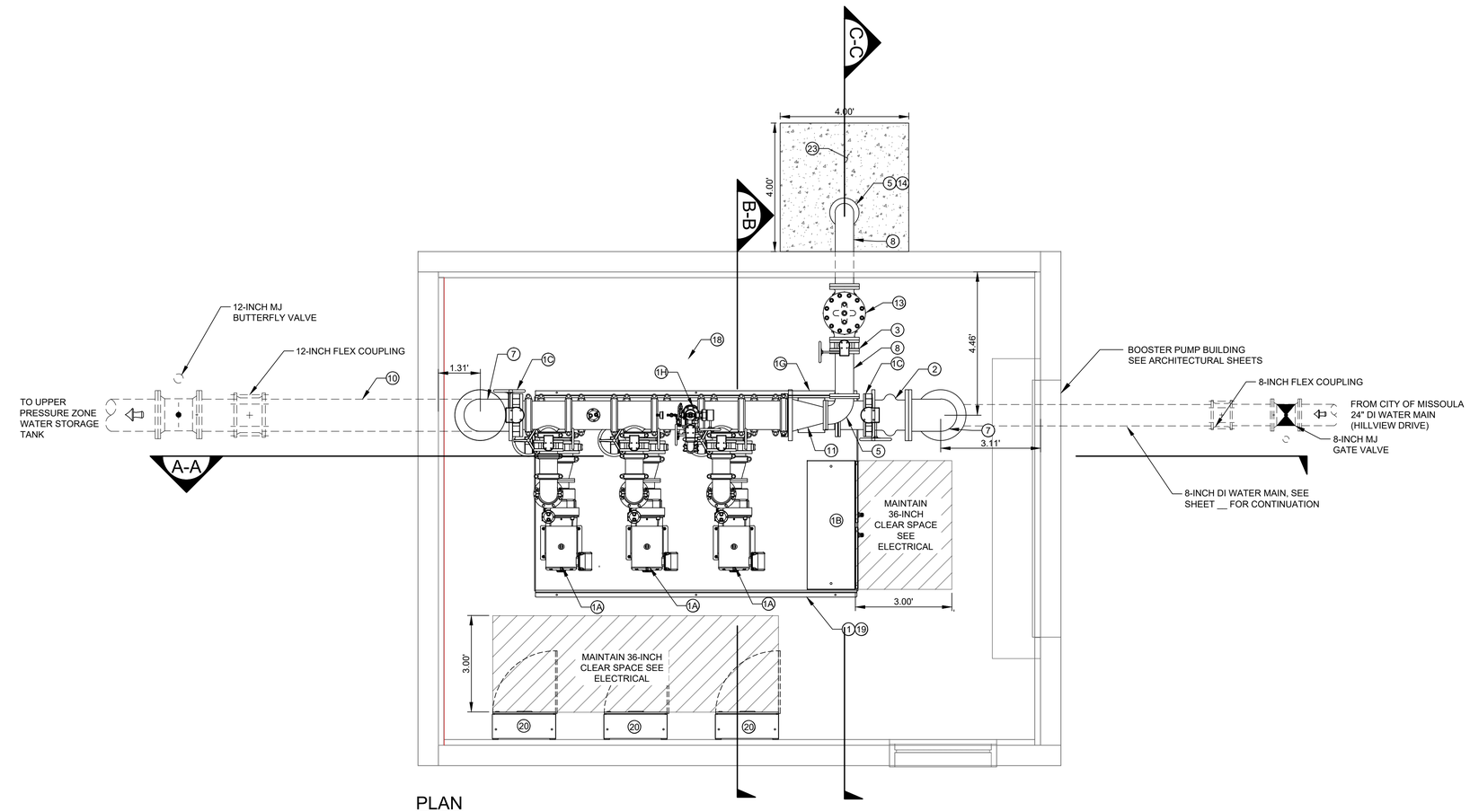
DRAWING NUMBER
S-005

Cushing Terrell

Appendix B: Booster Pump Report

BOOSTER PUMP SPECIFICATIONS	
SITE CONDITIONS	
ELECTRICAL INPUT	480V, 3 PH, 60Hz
STATION PERFORMANCE	
NORMAL DUTY	500-750 GPM @ 60 PSI BOOST
HIGH FLOW	1500 GPM @ 60 PSI BOOST
PUMP DESIGN CRITERIA	
TYPE	END SUCTION CENTRIFUGAL
MOTOR STARTING	VARIABLE FREQUENCY DRIVE
MOTOR NAMEPLATE (HP)	40 HP / ODP
MOTOR NOMINAL SPEED	3600 RPM
DESIGN PERFORMANCE	750 GPM @ 140 FT TDH
MIN. PUMP EFFICIENCY	75%
QUANTITY	3

BOOSTER PUMP HOUSE NOTES			
NOTE	DESCRIPTION	QTY	UNIT
1	PACKAGE BOOSTER PUMPING STATION, 500-1500 GPM FLOW RANGE*** (480V, 3 PH)	1	LS
1A	40 HP / 750 GPM CENTRFUGAL HIGH FLOW DUTY PUMP *** (750 GPM @ 140 FT TDH)	3	EA
1B	CONTROL PANEL (VFD) ***	1	EA
1C	12-INCH FL BUTTERFLY VALVE***	2	EA
1D	8-INCH FL BUTTERFLY VALVE***	3	EA
1E	6-INCH FL BUTTERFLY VALVE***	3	EA
1F	3-INCH AUTOMATIC AIR RELEASE VALVE ***	5	EA
1G	12-INCH MAGNETIC FLOW METER, BADGER M2000 SERIES OR APPROVED EQUAL ***	1	EA
1H	3-INCH PRESSURE RELIEF CONTORL VALVE, WATTS LLF115 OR APPROVED EQUAL***	1	EA
2	12-INCH EXPANSION JOINT, GENERAL RUBBER MAXI-JOINT SERIES 1015, OR APPROVED EQUAL	2	EA
3	6-INCH FL BUTTERFLY VALVE	1	EA
4	8-INCH MJ GATE VALVE		EA
5	6-INCH 90-DEG BEND	2	EA
6	8-INCH 90-DEG BEND	1	EA
7	12-INCH 90-DEG FL BEND	4	EA
8	6-INCH CL 350 DI FL PIPE	1	LS
9	8-INCH CL 350 DI FL PIPE	1	LS
10	12-INCH CL 350 DI FL PIPE	1	LS
11	6-INCH X 12-INCH FL REDUCER	1	EA
12	8-INCH X 12-INCH FL REDUCER	1	EA
13	6-INCH SURGE ANTICIPATING GLOBE VALVE, CAL-VAL 52-01 OR APPROVED EQUAL	1	EA
14	# 24 STAINLESS STEEEL WIRE MESH ON DISCHARGE TURNDOWN	1	EA
15	PRESSURE TRANSDUCER	1	EA
16	MANUAL PRESSURE GAUGE	1	EA
17	SMOOTH NOSE SAMPLE TAP	1	EA
18	FLOOR DRAIN, SEE MECHANICAL PLUMBING PLAN FOR CONTINUATION	3	EA
19	CONCRETE MECAHNICAL PAD SEE ARCHITECTURAL PLAN FOR CORRDINATION	1	LS
20	BUILDING ELECTRICAL/SCADA/ATS PANEL, SEE ELECTRICAL PLAN FOR CORRDINATION	1	LS
21	BOOSTER PUMP BUILDING, SEE ARCHITECTUREAL PLAN FOR CORRDINATION	1	LS
22	PIPE STAND	1	LS
23	48-INCH SQUARE CONCRETE SPLASH BLOCK	1	LS
***	DENOTES EQUIPMENT PROVIDED AS PART OF BOOSTER PUMP PACKAGE SKID		



PLAN

1 BOOSTER PUMPHOUSE BUILDING SCHEMATICS

SCALE: 1" = 2'

11/28/2023 5:09 PM

75% REVIEW SET

Cushing Terrell.

cushingterrell.com
800.757.9522

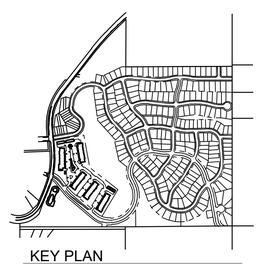
Morrison Maierle
engineers · surveyors · planners · scientists
406.542.8880 1055 Mount Ave.
Missoula, MT 59801 m-m.net

MISSOULA, MONTANA

HILLVIEW

PRELIMINARY PLAT

10.13.2023
DRAWN BY | RCB
CHECKED BY | AJM
REVISIONS

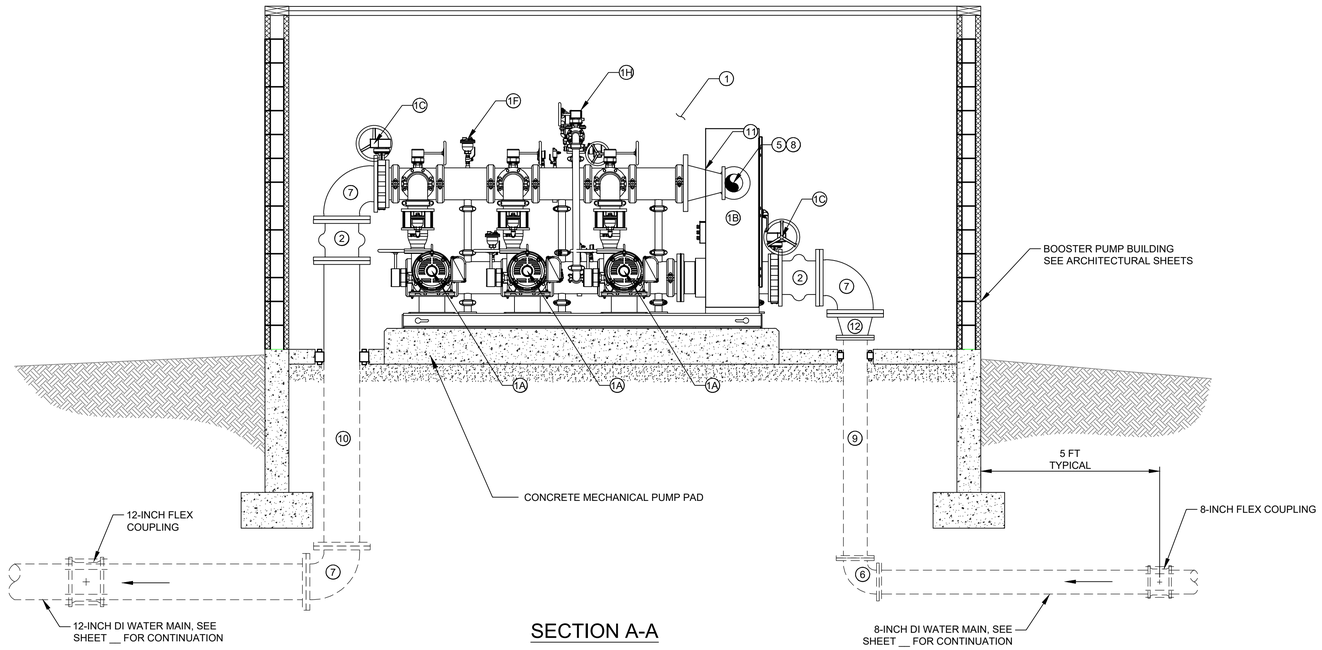


KEY PLAN

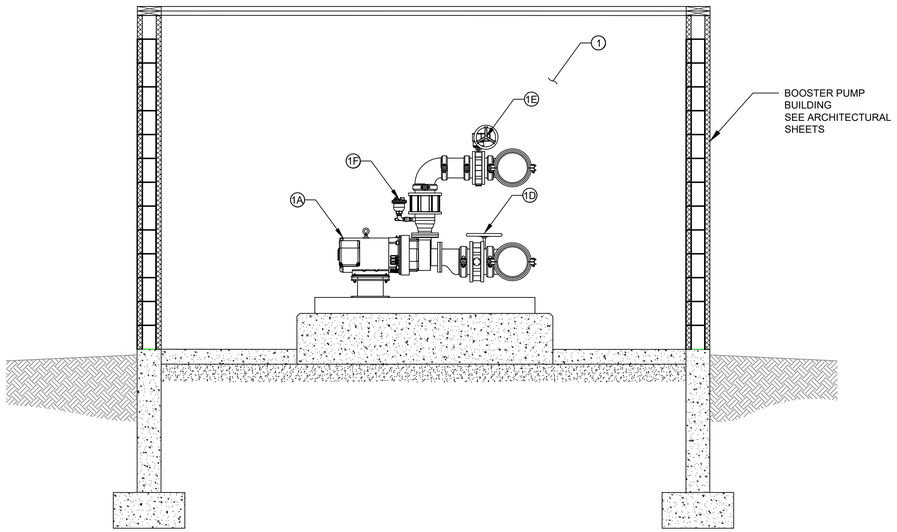
NOT FOR CONSTRUCTION

PUMP HOUSE MECHANICAL PIPING PLAN: LOWER PUMP HOUSE

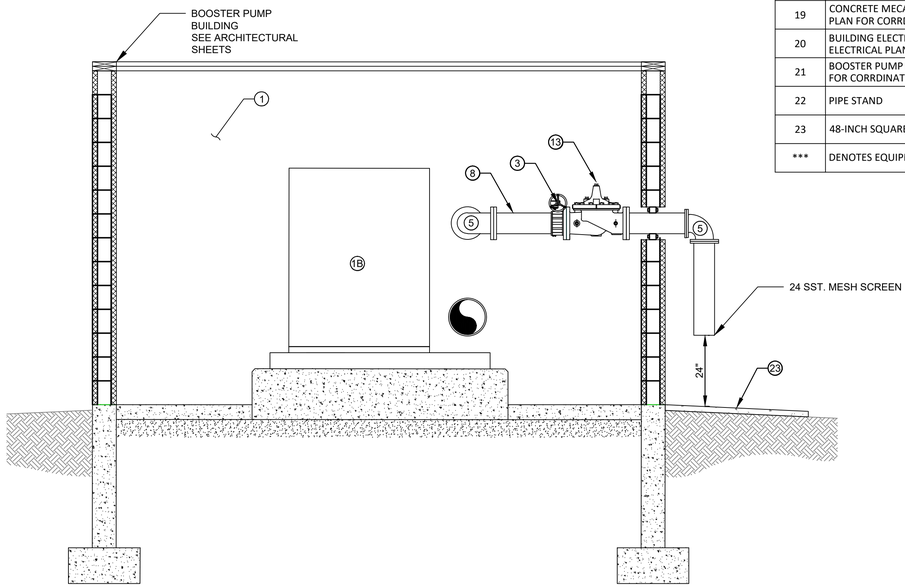
M101



SECTION A-A



SECTION B-B



SECTION C-C

BOOSTER PUMP HOUSE NOTES			
NOTE	DESCRIPTION	QTY	UNIT
1	PACKAGE BOOSTER PUMPING STATION, 500-1500 GPM FLOW RANGE*** (480V, 3 PH)	1	LS
1A	40 HP / 750 GPM CENTRFUGAL HIGH FLOW DUTY PUMP *** (750 GPM @ 140 FT TDH)	3	EA
1B	CONTROL PANEL (VFD) ***	1	EA
1C	12-INCH FL BUTTERFLY VALVE***	2	EA
1D	8-INCH FL BUTTERFLY VALVE***	3	EA
1E	6-INCH FL BUTTERFLY VALVE***	3	EA
1F	3-INCH AUTOMATIC AIR RELEASE VALVE ***	5	EA
1G	12-INCH MAGNETIC FLOW METER, BADGER M2000 SERIES OR APPROVED EQUAL ***	1	EA
1H	3-INCH PRESSURE RELIEF CONTORL VALVE, WATTS LLF115 OR APPROVED EQUAL***	1	EA
2	12-INCH EXPANSION JOINT, GENERAL RUBBER MAXI-JOINT SERIES 1015, OR APPROVED EQUAL	2	EA
3	6-INCH FL BUTTERFLY VALVE	1	EA
4	8-INCH MJ GATE VALVE		EA
5	6-INCH 90-DEG BEND	2	EA
6	8-INCH 90-DEG BEND	1	EA
7	12-INCH 90-DEG FL BEND	4	EA
8	6-INCH CL 350 DI FL PIPE	1	LS
9	8-INCH CL 350 DI FL PIPE	1	LS
10	12-INCH CL 350 DI FL PIPE	1	LS
11	6-INCH X 12-INCH FL REDUCER	1	EA
12	8-INCH X 12-INCH FL REDUCER	1	EA
13	6-INCH SURGE ANTICIPATING GLOBE VALVE, CAL-VAL 52-01 OR APPROVED EQUAL	1	EA
14	# 24 STAINLESS STEEEL WIRE MESH ON DISCHARGE TURNDOWN	1	EA
15	PRESSURE TRANSDUCER	1	EA
16	MANUAL PRESSURE GAUGE	1	EA
17	SMOOTH NOSE SAMPLE TAP	1	EA
18	FLOOR DRAIN, SEE MECHANICAL PLUMBING PLAN FOR CONTINUATION	3	EA
19	CONCRETE MECAHNICAL PAD SEE ARCHITECTURAL PLAN FOR CORRDINATION	1	LS
20	BUILDING ELECTRICAL/SCADA/ATS PANEL, SEE ELECTRICAL PLAN FOR CORRDINATION	1	LS
21	BOOSTER PUMP BUILDING, SEE ARCHITECTUREAL PLAN FOR CORRDINATION	1	LS
22	PIPE STAND	1	LS
23	48-INCH SQUARE CONCRETE SPLASH BLOCK	1	LS
***	DENOTES EQUIPMENT PROVIDED AS PART OF BOOSTER PUMP PACKAGE SKID		

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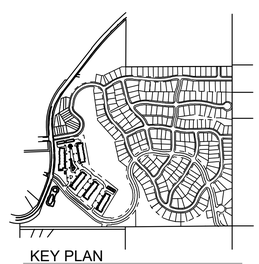
REVISIONS



KEY PLAN

NOT FOR CONSTRUCTION

M102

1 BOOSTER PUMPHOUSE BUILDING SCHEMATICS

SCALE: 1" = 2'

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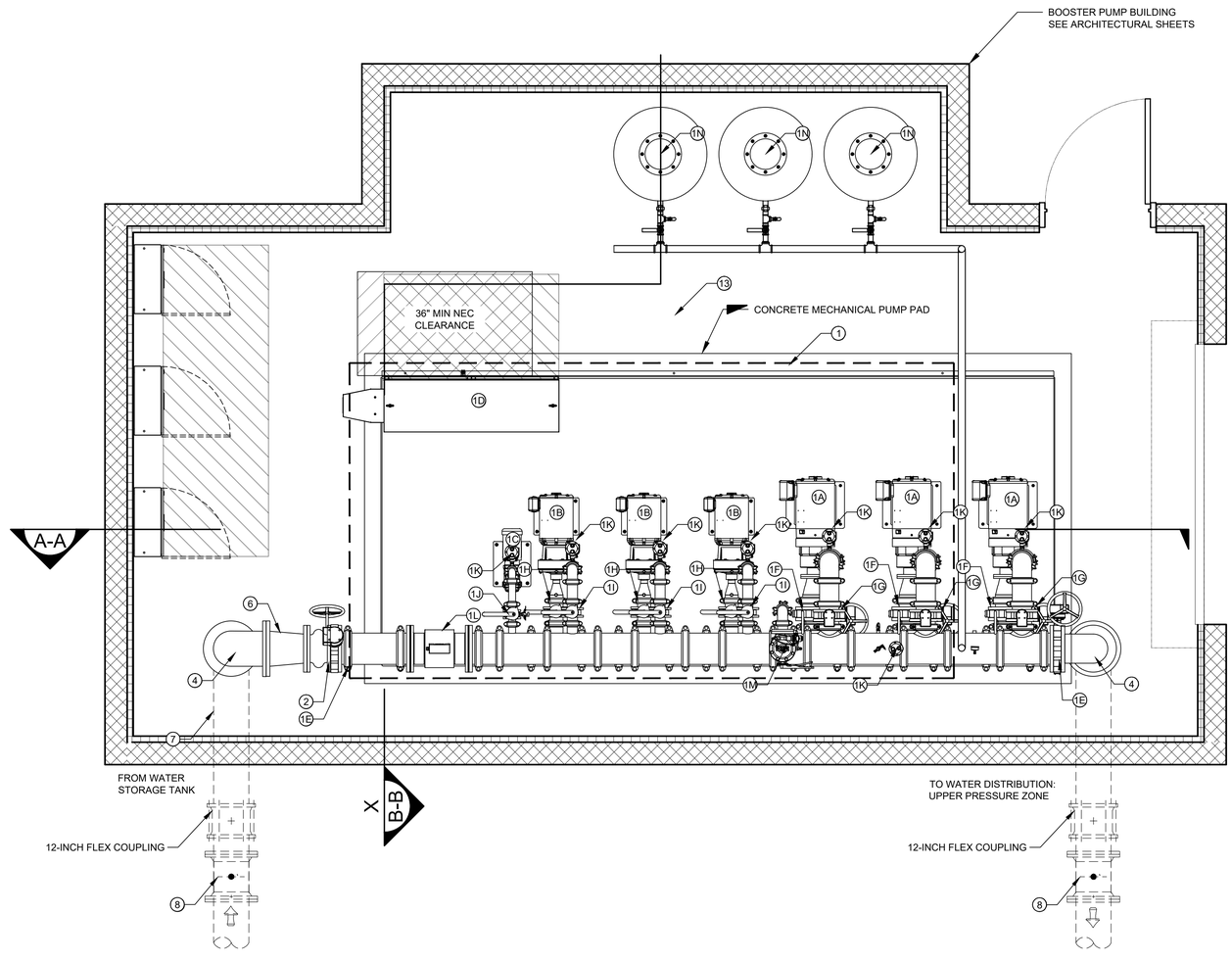

BOOSTER PUMP SPECIFICATIONS	
SITE CONDITIONS	
ELECTRICAL INPUT	480V, 3 PH, 60Hz
STATION PERFORMANCE	
NORMAL DUTY	35-1,990 GPM @ 75 PSI BOOST
HIGH FLOW	890-1500 GPM @ 75 PSI BOOST
PUMP DESIGN CRITERIA: JOCKEY PUMP	
TYPE	END SUCTION CENTRIFUGAL
MOTOR STARTING	VARIABLE FREQUENCY DRIVE
MOTOR NAMEPLATE (HP)	3 HP / ODP
MOTOR NOMINAL SPEED	3600 RPM
DESIGN PERFORMANCE	35 GPM @ 180 FT TDH
MIN. PUMP EFFICIENCY	75%
QUANTITY	1
PUMP DESIGN CRITERIA: DUTY PUMP	
TYPE	END SUCTION CENTRIFUGAL
MOTOR STARTING	VARIABLE FREQUENCY DRIVE
MOTOR NAMEPLATE (HP)	30 HP / ODP
MOTOR NOMINAL SPEED	3600 RPM
DESIGN PERFORMANCE	300 GPM @ 180 FT TDH
MIN. PUMP EFFICIENCY	75%
QUANTITY	3
PUMP DESIGN CRITERIA: HIGH FLOW PUMP	
TYPE	END SUCTION CENTRIFUGAL
MOTOR STARTING	VARIABLE FREQUENCY DRIVE
MOTOR NAMEPLATE (HP)	50 HP / ODP
MOTOR NOMINAL SPEED	3600 RPM
DESIGN PERFORMANCE	750 GPM @ 180 FT TDH
MIN. PUMP EFFICIENCY	75%
QUANTITY	3

BOOSTER PUMP HOUSE NOTES			
NOTE	DESCRIPTION	QTY	UNIT
1	PACKAGE BOOSTER PUMPING STATION, 15-1990 GPM FLOW RANGE*** (480V, 3 PH)	1	LS
1A	50 HP / 750 GPM CENTRFUGAL HIGH FLOW DUTY PUMP *** (750 GPM @ 180 FT TDH)	3	EA
1B	30 HP / 300 GPM CENTRFUGAL HIGH FLOW DUTY PUMP *** (300 GPM @ 180 FT TDH)	3	EA
1C	3 HP / 35 GPM CENTRFUGAL HIGH FLOW DUTY PUMP *** (35 GPM @ 180 FT TDH)	1	EA
1D	CONTROL PANEL (VFD) ***	1	EA
1E	10-INCH LUG BUTTERFLY VALVE***	2	EA
1F	8-INCH LUG BUTTERFLY VALVE***	3	EA
1G	6-INCH LUG BUTTERFLY VALVE***	3	EA
1H	4-INCH LUG BUTTERFLY VALVE***	2	EA
1I	3-INCH LUG BUTTERFLY VALVE***	3	EA
1J	2-INCH LUG BUTTERFLY VALVE***	2	EA
1K	AUTOMATIC AIR RELEASE VALVE ***	5	EA
1L	10-INCH MAGNETIC FLOW METER, BADGER M2000 SERIES OR APPROVED EQUAL ***	1	EA
1M	3-INCH PRESSURE RELIEF CONTORL VALVE, WATTS LLF115 OR APPROVED EQUAL***	1	EA
1N	PRESSURE TANK ASSEMBLY, BELL & GOSSETT WTA-452 WITH UNION, SAMPLING PORT AND 2-INCH GATE VALVE	3	EA
2	10-INCH EXPANSION JOINT, GENERAL RUBBER MAXI-JOINT SERIES 1015, OR APPROVED EQUAL	2	EA
3	12-INCH 90-DEG FL BEND	3	EA
4	10-INCH 90-DEG FL BEND	2	EA
5	12-INCH FL TEE	0	EA
6	12-INCH x 10-INCH FL DI REDUCER	2	EA
7	12-INCH CL 350 DI FL PIPE	1	LS
8	12-INCH LUG BUTTERFLY VALVE***	0	EA
9	12-INCH FL DISMANTLING COUPLER	0	EA
10	PRESSURE TRANSDUCER	1	EA
11	MANUAL PRESSURE GAUGE	1	EA
12	SMOOTH NOSE SAMPLE TAP	1	EA
13	FLOOR DRAIN, SEE MECHANICAL PLUMBING PLAN FOR CONTINUATION	3	EA
14	CONCRETE MECAHNICAL PAD SEE ARCHITECTURAL PLAN FOR CORRDINATION	1	LS
15	BUILDING ELECTRICAL PANEL, SEE ELECTRICAL PLAN FOR CORRDINATION	1	LS
16	BOOSTER PUMP BUILDING, SEE ARCHITECTUREAL PLAN FOR CORRDINATION	1	LS
17	PIPE STAND	1	LS
18	2-INCH GALVANIZED STEEL PIPE	1	LS
19	1-INCH AUTOMATIC AIR RELEASE VALVE, CLA-VAL 3410-AR116.3	1	EA
***	DENOTES EQUIPMENT PROVIDED AS PART OF BOOSTER PUMP PACKAGE SKID		

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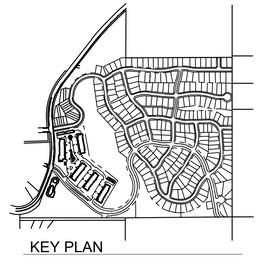
MISSOULA, MONTANA
HILLVIEW

1 BOOSTER PUMPHOUSE BUILDING SCHEMATICS
SCALE: 1" = 2'

PRELIMINARY PLAT


KEY PLAN

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REVISIONS

PUMP HOUSE MECHANICAL PIPING PLAN:UPPER PUMP HOUSE

M201

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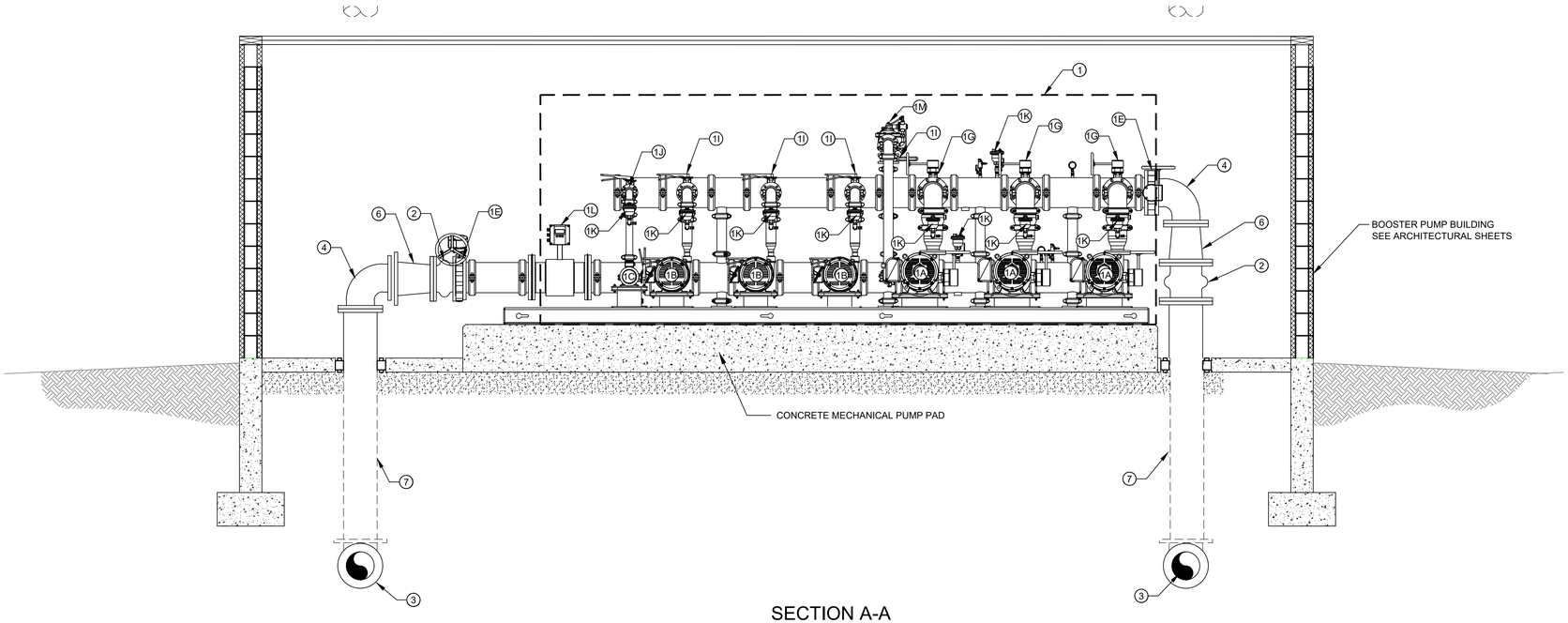
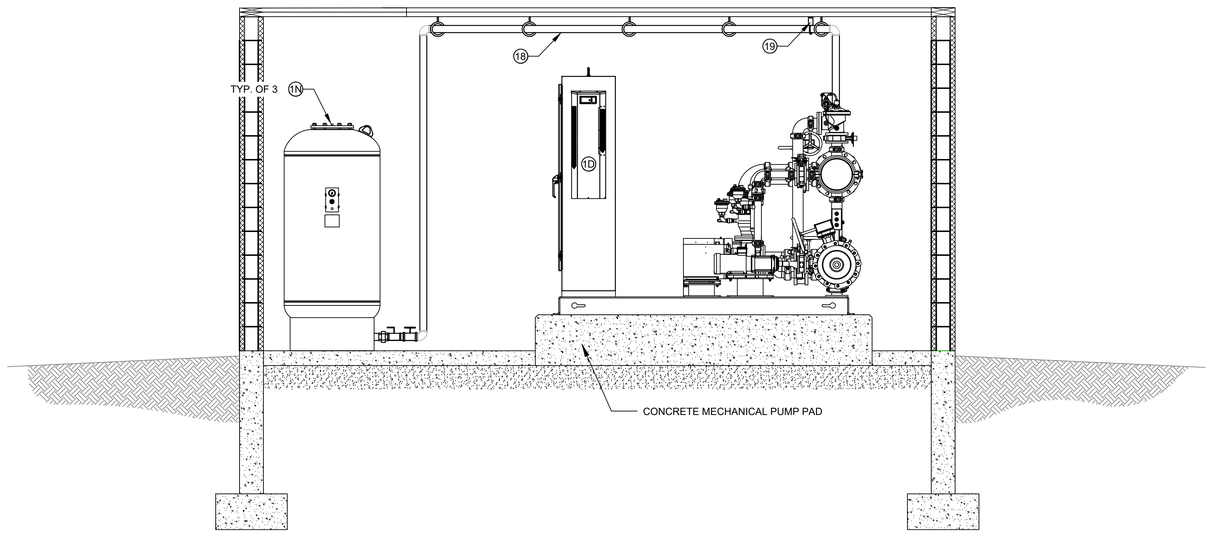


SECTION A-A



SECTION B-B

BOOSTER PUMP HOUSE NOTES			
NOTE	DESCRIPTION	QTY	UNIT
1	PACKAGE BOOSTER PUMPING STATION, 15-1990 GPM FLOW RANGE*** (480V, 3 PH)	1	LS
1A	50 HP / 750 GPM CENTRFUGAL HIGH FLOW DUTY PUMP *** (750 GPM @ 180 FT TDH)	3	EA
1B	30 HP / 300 GPM CENTRFUGAL HIGH FLOW DUTY PUMP *** (300 GPM @ 180 FT TDH)	3	EA
1C	3 HP / 35 GPM CENTRFUGAL HIGH FLOW DUTY PUMP *** (35 GPM @ 180 FT TDH)	1	EA
1D	CONTROL PANEL (VFD) ***	1	EA
1E	10-INCH LUG BUTTERFLY VALVE***	2	EA
1F	8-INCH LUG BUTTERFLY VALVE***	3	EA
1G	6-INCH LUG BUTTERFLY VALVE***	3	EA
1H	4-INCH LUG BUTTERFLY VALVE***	2	EA
1I	3-INCH LUG BUTTERFLY VALVE***	3	EA
1J	2-INCH LUG BUTTERFLY VALVE***	2	EA
1K	AUTOMATIC AIR RELEASE VALVE ***	5	EA
1L	10-INCH MAGNETIC FLOW METER, BADGER M2000 SERIES OR APPROVED EQUAL ***	1	EA
1M	3-INCH PRESSURE RELIEF CONTORL VALVE, WATTS LLF115 OR APPROVED EQUAL***	1	EA
1N	PRESSURE TANK ASSEMBLY, BELL & GOSSETT WTA-452 WITH UNION, SAMPLING PORT AND 2-INCH GATE VALVE	3	EA
2	10-INCH EXPANSION JOINT, GENERAL RUBBER MAXI-JOINT SERIES 1015, OR APPROVED EQUAL	2	EA
3	12-INCH 90-DEG FL BEND	3	EA
4	10-INCH 90-DEG FL BEND	2	EA
5	12-INCH FL TEE	0	EA
6	12-INCH x 10-INCH FL DI REDUCER	2	EA
7	12-INCH CL 350 DI FL PIPE	1	LS
8	12-INCH LUG BUTTERFLY VALVE***	0	EA
9	12-INCH FL DISMANTLING COUPLER	0	EA
10	PRESSURE TRANSDUCER	1	EA
11	MANUAL PRESSURE GAUGE	1	EA
12	SMOOTH NOSE SAMPLE TAP	1	EA
13	FLOOR DRAIN, SEE MECHANICAL PLUMBING PLAN FOR CONTINUATION	3	EA
14	CONCRETE MECAHNICAL PAD SEE ARCHITECTURAL PLAN FOR CORRDINATION	1	LS
15	BUILDING ELECTRICAL PANEL, SEE ELECTRICAL PLAN FOR CORRDINATION	1	LS
16	BOOSTER PUMP BUILDING, SEE ARCHITECTUREAL PLAN FOR CORRDINATION	1	LS
17	PIPE STAND	1	LS
18	2-INCH GALVANIZED STEEL PIPE	1	LS
19	1-INCH AUTOMATIC AIR RELEASE VALVE, CLA-VAL 3410-AR116.3	1	EA
***	DENOTES EQUIPMENT PROVIDED AS PART OF BOOSTER PUMP PACKAGE SKID		

1 BOOSTER PUMPHOUSE BUILDING SCHEMATICS

SCALE: 1" = 2'

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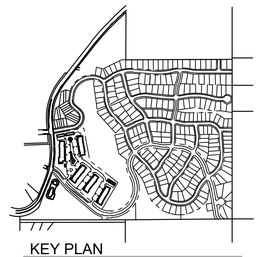

KEY PLAN

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PUMP HOUSE MECHANICAL PIPING PLAN: UPPER PUMP HOUSE

M202

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52-01 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes																		
	Inches	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36
	mm	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
Basic Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G
	End Detail	T	T	T, F, Gr*	T, F, Gr	T, F, Gr*	T, F, Gr	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	55	93	125	210	300	460	800	1800	3100	4900	7000	8400	11000	14000	17000	25000	42000	50000
	Maximum Surge	120	210	280	470	670	1000	1800	4000	7000	11000	16000	19000	25000	31000	39000	56500	63000	85000
Suggested Flow (Liters/Sec)	Maximum	3.5	6	8	13	19	29	50	113	195	309	442	530	694	883	1073	1577	2650	3150
	Maximum Surge	7.6	13	18	30	42	63	113	252	441	693	1008	1197	1577	1956	2461	3560	3975	5360

100-01 Series is the full internal port Hytrol.

*Globe Grooved Only

CRL-60 Pilot Control

Direct-acting, spring loaded, diaphragm type relief pilot capable of opening and closing within very close pressure limits.

CRA Pilot Control

Automatically reduces a higher inlet pressure to a lower outlet pressure. Direct acting, spring loaded, diaphragm type - hydraulic or pneumatic operation.

Adjustment Ranges

High Pressure Pilot (CRL-60)

0 to 75 psi
20 to 200 psi *
100 to 300 psi
250 to 600 psi

Low Pressure Pilot (CRA)

2 to 30 psi
15 to 75 psi
30 to 300 psi *

*Supplied unless otherwise specified
Other ranges available, please consult factory

Temperature Range

Water: to 180°F

Materials

Standard Pilot System Materials

Pilot Control: Low Lead Bronze
Trim: Stainless Steel 303
Rubber: Buna-N® Synthetic Rubber

Optional Pilot System Materials

Pilot systems are available with optional Aluminum, Stainless Steel or Monel materials.

When Ordering, Specify:

1. Catalog No. 52-01
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Threaded or Flanged
6. Trim Material
7. Adjustment Range
8. Desired Options
9. When Vertically Installed

Valve Options

X141 Pressure Gauge

X101AR Valve Position Indicator with Air Release

X101 Valve Position Indicator

X144 e-FlowMeter

X43H Strainer

Stainless Steel Pilot

TECHNICAL MEMORANDUM

Hillview Subdivision – Water System Booster Building Hydraulic Performance

Cushing Terrell

Hillview Subdivision

Prepared by: Aaron McConkey, PE & Jake Miller, PE

Reviewed by: Engineer Name, PE

Date: November 29, 2023

Morrison-Maierle
Missoula Office
1055 Mount Ave
Missoula, MT 59801

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1 SYTEM DEMANDS

1.1 Domestic Demands and Commercial Water System Demands

The Hillview Subdivision project includes 226 single family homes within Phases 3-7. The water system service these phases includes two separate water boosting stations that will supply the subdivision and will be sized for future growth of adjacent developments. The adjacent property may be developed in two different manners, one being a school site and the other being a residential subdivision. The table below summarizes the water demands included in sizing of the two water booster stations.

Upper System – Hillview Subdivision								
Unit Type	Units	No. Persons/ Dwelling	Total No. Persons	Avg Demand per Person (gpdpc)	Avg. Demand (gpd)	Avg. Demand (gpm)	Max Day Demand (gpm)	Peak Hour Demand* (gpm)
Hillview Single Family	226	2.3	520	140	72,800	49.72	287.02	892.7
Adjacent School		500	500	22	11000	7.64		
Adjacent Residential Development	277	2.3	637	140	89,194	60.94	351.79	1094.15
Total Hillview + School	226		1020		83800	57.36	287.02	892.7
Total Hillview + Adjacent Residential	503		1157		161994	110.66	638.81	1986.85
* PEAK HOUR DEMANDS ARE BASED ON 3.95 GPM PER EQUIVELANT DWELLING UNIT								

The total Hillview Subdivision + Adjacent Residential development will have the greatest water demands and has been used for sizing of the water booster stations.

2 BOOSTER PUMP HYDRAULIC MODEL

In support of development of the proposed land subdivision, the water system will require two additional pressure zones. These pressure zones will be supplied from a new water tank and two proposed booster pump stations. The booster pumps are to be located within the Hillview Subdivision located off Hill View Way at Section 05, Township 12 North, Range 19 West, Missoula, MT. The pumps are to be sized based on the demands that meet the City of Missoula

Public Works Standards, Montana Department of Environmental Quality Circular-1 Standards and Montana Public Works Standard Specifications.

A hydraulic model using InfoWater Pro software by Autodesk was created for the Hillview Water System Booster Pumps project based on information provided from the subdivision layout. The model created includes scenarios for average day demand (ADD), max day demand (MDD) and peak hour demand (PHD) as identified in the Water Exhibit. The pipeline was modeled in two design options, the first as the Water Exhibit identifies, 8-inch diameter ductile iron main from the lower system booster pump station to Pressure Zone 2 where it transitions to 12-inch diameter ductile iron main and extends to the new water storage tank with a 8-inch diameter tank outlet to the upper system booster pump station. The second pipeline design option was modeled as 12-inch diameter ductile iron main from the lower system booster pump station to the new water storage tank with an 8-inch diameter tank outlet to the upper system booster pump station. The second design option was modeled for PHD only to determine if a lower capacity pump station could be used if the diameter of the main was increased from 8-inch diameter to 12-inch diameter from the lower booster station to Pressure Zone 2 connection. Each modeled option was checked for compliance with Department of Environmental Quality Circular-1. The results for each scenario and design option are provided within the table on the following page.

MODEL RESULTS:

DEMAND SCENARIO	PUMP LOCATION	ELEVATION (FT)	UPSTREAM PRESSURE (PSI)	DOWNSTREAM PRESSURE (PSI)	FLOW (GPM)	HEAD GAIN (FT)	AVAILABLE NPSH (FT)
ADD	Lower	3,447.00	67.77	130.2	2,184.25	144.1	189.5
	Upper	3,652.00	8.67	77.98	36.52	159.98	53.08
MDD	Lower	3,447.00	63.62	128.85	2,140.57	150.54	179.94
	Upper	3,652.00	8.66	77.65	210.82	159.21	53.07
PHD	Lower	3,447.00	63.62	128.8	2,141.35	150.42	179.94
	Upper	3,652.00	8.66	77.32	293.82	158.47	53.06
PHD 12" Mainline	Lower	3,447.00	63.5	105.62	2,479.29	97.22	179.66
	Upper	3,652.00	8.66	77.32	293.82	158.47	53.06

Pump sizing is based on peak hour demand (PHD) and average day demand for maximum and standard operating conditions, respectively. The lower booster pump station will need to provide a total flow rate of 1,000 gpm at approximately 130 psi for peak hour demand and a total flow rate of 500 gpm at approximately 130 psi for the average day demand. The upper pump station will require a total flow rate of 1990 gpm at approximately 78 psi for peak hour demand and a total flow rate of 110 gpm at approximately 78 psi for the average day demand.

This information will be used for determining the number of pumps required and the development of requirements for vendors to provide booster pump proposals and technical data.

3 TECHNICAL SPECIFICATIONS – LOWER PUMP

The Lower Pump Station is located adjacent to Phase 1 of the Hillview Subdivision and will connect to an 8-inch DI water main. The lower pump station will be equipped with a Spanco 1ALU1208 1-ton aluminum gantry crane or equal for pump maintenance. Water demands in the Upper Zone storage tank will control pumping operations. Two set points within the tank will call for additional water, (1) Operational Storage and (2) Equalization Storage.

The total water storage in the Upper Hillview Subdivision Zone is +/- 350,000 gallons. This includes 180,000 gallons of fire storage and 167,000 gallons of average day demand storage. The average day demand storage can be divided into operational storage and equalization storage. During normal operation the Lower Booster Station will maintain water within the operational storage zone. During Peak Hour demands the Lower Booster Station will maintain water within the equalization storage zone.

Equalization storage is determined as the volume of water required to sustain 2.5 hours of water when demands are equal to the peak hour demand and production is at a rate equal to the total capacity with the largest well out of service. During the equalization storage zone of the water storage tank two of the three pumps will called for service.

Equalization Storage = (PHD- Q_s) X 150 mins

Equalization Storage = (1,990 gpm – 1,000 gpm)(150 Min) = 148,000 gallons

Operational storage is determined as the remainder of the volume of water within the average date demand storage. During the operation storage zone of the water storage tank one of the three pumps will be called for service.

Operational Storage = Total Tank Volume – Fire Storage – Equalization Storage

Operational Storage = 350,000 gal – 180,000 gal – 148,000 gal

Operational Storage = 19,000 gal

Recharge of the operational storage zone of the tank will take +/- 50 minutes during average day demands at full buildout of the system.

During events that cause the water storage tank to enter the fire storge zone, all three booster pumps can be called. During this event the peak flow of the station will equal the total fire flow requirements of the Upper Hillview Subdivision Pressure Zone.

Protection from surge events and transient pressures will be provided in the booster pump building. A surge anticipating valve shall be sized to evacuate the maximum flow of the pump system which is 1,500 gallons. A 6-inch Cla-Val 52-10 or equal globe pattern valve has capacity to evacuate 1,800 gallons per minute as a maximum sustained flow and 4,000 gallon per minute surge event. In addition to the surge anticipating valve, the booster system will have a closed loop pressure relief valve that is set at 65 psi and discharges to suction manifold of the package booster pump package.

System Type:	Potable Booster System
SITE CONDITIONS	
Installation Location	Lower Pressure Booster, Hillview Subdivision
Electrical Input (V/Ø/Hz):	480V/ 3 Phase / 60 Hz
STATION PERFORMANCE	
Normal Duty	500 – 1,000 GPM @ 60 PSI Boost
High Flow	1,500 GPM @ 60 PSI Boost
HIGH FLOW PUMPS	
Type:	End Suction Centrifugal
Motor Starting	Variable Frequency Drive
Motor Nameplate (HP/Enclosure):	30 HP / ODP
Motor Nominal Speed (Maximum)	3600 RPM
Design Performance:	500 GPM @ 140′ TDH
Minimum Pump Efficiency @ Design:	80%
Quantity:	3

THEORY OF OPERATION

Pump Sequence of Operation: Lead/Standby/High Flow

The first Duty Pump shall start when water storage as monitored in water storage tank hits set point 1. A variable frequency drive (VFD) shall be used to start one pump and shall ramp to 100% at a set interval not less than 60 seconds and maintain 100% until the water storage tank is at set point 0. As demand increases from the water storage tank such that one pump does not maintain water levels above set point 1 and water levels are lowered to set point 2, pump 2 shall be activated, a variable frequency drive (VFD) shall be used to start a second pump and shall ramp to 100% at a set interval not less than 60 seconds and maintain 100% until the water storage tank is at set point 1. As demand increases and water elevation in the tank is below set point 2, the lead duty pump shall be 100%. The third duty pump shall start automatically once water levels reach set point 3 in the water storage tank.

As demand decreases, the entire process shall take place in reverse order.

Pumps shall enter sleep mode via either of two user selectable sleep modes: 1) Sleep by Flow or 2) VFD Frequency. The Standby High Flow Pump shall take the place of the failed duty pump. The system shall automatically alternate Lead/Standby pump designations based on total operation time and pump faults. Using the controller touchscreen, an operator shall be able to adjust the alternation time, as well as to manually alternate Lead and Standby designations.

Set Point 0 – Storage Full 350,000 gallons

Set Point 1 – 80% of Operational Storage Depletion, 335,000 gallons

Set Point 2 – 100% of Operational Storage Depletion, 331,000 gallons

Set Point 3 – 100% of Operational and Equalization Storage Depletion, 180,000 gallons

SYSTEM PROTECTIONS

Provide the following at a minimum:

Mechanical System Protections:

- **PRIME LOSS**
- **LOW FLOW**
- **HIGH FLOW**
- **LOW LEVEL (SOURCE TANK)**
- **LOW DISCHARGE PRESSURE**
- **HIGH DISCHARGE PRESSURE**

Electrical System Protections:

- **HIGH OR LOW VOLTAGE**
- **PHASE LOSS/IMBALANCE**
- **VFD FAULTS**
- **MOTOR STARTER FAILURE**
- **ANALOG TRANSMITTER FAILURE**

4 TECHNICAL SPECIFICATIONS – UPPER ZONE BOOSTER PUMP

The Upper Hillview Subdivision Booster Station is located directly adjacent to the 350,000 gallon water storage tank and connected to the water storage tank with a 12-inch DI water main. The upper pump station will be equipped with a Spanco 1ALU1208 1-ton aluminum gantry crane or equal for pump maintenance. The Upper Hillview Subdivision Booster Pump Station is sized to provide water demands to the subdivisions 226 lots and the adjacent undeveloped property with the potential of an additional 277 single family residential lots. Figure 4-1 summarize 100% buildout demands of the water system. Two pressure zones will be served by the booster station, these pressure zones are connected with a pressure reducing valve. Proportioning of the water system demands of the Hillview Subdivision are discussed in greater detail within the hydraulic analysis attached to this report. For pump sizing it is assumed that 100% of the Hillview Subdivisions are required to be delivered through the booster station, this would be the case if the gravity connection from the water storage tank to the lower Hillview pressure zone is not in service.

Table 4-1
Upper Hillview Booster Station Design Summary

Design Parameter	Hillview Subdivision	Adjacent Residential	Total	
No. of Units	226	277	503	Units
Total No. of Persons	520	637	1157	Persons
Average Day Demand @ 140 gpdpc	72800	89180	161980	Gal per Day per Capita
Average Day Demand	51	62	112	GPM
Max Day Demand	292	358	649	GPM
Peak Hour Demand @ 3.95 gpm per EDU	893	1094	1987	GPM

The proposed subdivision is proposed to be developed in 5 phases and future adjacent property would also likely be developed in multiple phases. Design considerations have been made for water demands on a cumulative demand basis for the 5 phases of the Hillview Subdivision. Table 4-2 provides a cumulative breakdown of water demands in the phase subdivision.

Table 4-2
Cumulative Water System Demands

Design Parameter	Hillview Phase 3	Hillview Phase 4	Hillview Phase 5	Hillview Phase 6	Hillview Phase 7	
No. of Units	58	132	164	192	226	Units
Total No. of Persons	133.4	303.6	377.2	441.6	519.8	Persons
Average Day Demand @ 140 gpdpc	18676	42504	52808	61824	72772	Gal per Day per Capita
Average Day Demand	13	30	37	43	51	GPM
Max Day Demand	75	170	212	248	292	GPM
Peak Hour Demand @ 3.95 gpm per EDU	229	521	648	758	893	GPM

The Upper Hillview Subdivision booster station will provide constant pressure to the service are with a constant running station consisting of a jockey pump, multiple duty cycle pumps, multiple high flow pumps and hydro-pneumatic pressure tanks. All pumps within the package system will be VFD controlled. Figure 4-3 provides a summary of target pumping rates for the jockey pumps, duty pumps and high flow pumps. The jockey pump is sized to meet average day demands for Phase 3 and 4 and will provide flows during minimum system demands in conjunction with the hydro-pneumatic storage tanks. The duty pumps area sized to provide peak hour demands for Phase 4-7. The high flow pumps are sized to provide both fire flows and peak hour demands when full buildout of the Hillview Subdivision and adjacent property is developed. The total pumping capacity of the station with the largest pump removed from service is 2,435 gpm which exceeds both the total combined peak hour demand and the fire flow demand.

Figure 4-3
Upper Booster Pump Design Parameters

Unity Type	Flow Rate (GPM)	Head (ft)	Number of Pumps	Max Flow Per Pump (GPM)
Jocky Pump	35	180	1	35
Duty Pump	35-900	180	3	300
High Flow Pump	900-1990	180	3	750
Maximum Pumping Capacity with Larges Pump Out of Service				2435

To accommodate the phased buildout of the water system and limit short pump cycling of the jockey pump hydro-pneumatic storage is proposed within the Upper Hillview Booster Station. Storage demands are based on two factors. (1) Minimum time for pump/VDF restart is generally 3 minutes, storage is adequate sized for average day demand to meet the 3 minute target for pump shutdown, restart and ramp up to 100 % within the jockey pump. (2)[1] Hydro-pneumatic tank drawdown is size for 30 minute no flow shutdown with a water system demand equal to 25% of the average day demand. Sizing of the hydro-pneumatic storage tanks has been completed for Phase 3 & 4. As buildout expands beyond Phase 3 & 4 the system will have over 132 units in service and minimum system flows are anticipated to be within the range of the constant running jockey pump and duty pumps.

[1] Technical Manual, THE-1096A, Domestic Water Pressure Boosting Design Manual, Bell and Gossett, Reprinted ASHREA Guide and Data Book 197, Chap 66.

Average Day Demand Phase 3&4 = 30 gpm
Low/No Flow = 25% of Average Day Demand = 7.5 gpm
Pump Time off Target = 30 minutes
Tank Draw Down Pressures = 70 psi – 60 psi
Tank Draw Down Factor = 0.111[2]
Acceptance Volume = Low/No Demand Flow X Draw Down Factor
= 7.5 gpm x 0.111 = 68 Gal

To accommodate service without removal of the booster pumps multiple ASME diaphragm expansion tanks are proposed. Three Bell& Gossett WTA 452 tanks will provide a total volume of 568 gallons with a acceptance volume of 67 gallons when the differential pressure is set at 10 psi.

The booster system will have a closed loop pressure relief valve that is set at 70 psi and discharges to suction manifold of the package booster pump package.

[2] Technical Manual, THE-1096A, Domestic Water Pressure Boosting Design Manual, Figure 5.6, Bell and Gossett, Reprinted ASHREA Guide and Data Book 197, Chap 66.

System Type:	Potable Booster System
SITE CONDITIONS	
Installation Location	Upper Pressure Booster, Hillview Subdivision
Electrical Input (V/Ø/Hz):	480V/ 3 Phase / 60 Hz
STATION PERFORMANCE	
Normal Duty	1 – 900 GPM @ 75 PSI Boost
High Flow	1,990 GPM @ 75 PSI Boost
PUMP DESIGN CRITERIA	
MAIN PUMP	
Type:	End Suction Centrifugal
Motor Starting	Variable Frequency Drive
Motor Nameplate (HP/Enclosure):	25 HP / ODP
Motor Nominal Speed	3600 RPM
Design Performance:	300 GPM @ 180′ TDH
Minimum Pump Efficiency @ Design:	75%
Quantity:	3
JOCKEY PUMP	
Type:	End Suction Centrifugal
Motor Starting	Variable Frequency Drive
Motor Nameplate (HP/Enclosure):	3.5 HP /ODP
Motor Nominal Speed	3600 RPM
Design Performance:	35 GPM @ 180′ TDH
Minimum Pump Efficiency @ Design:	60%
Quantity:	1
HIGH FLOW PUMPS	
Type:	End Suction Centrifugal
Quantity:	3
Motor Starting	Variable Frequency Drive
Motor Nameplate (HP/Enclosure):	50 HP / ODP
Motor Nominal Speed (Maximum)	1800 RPM
Design Performance:	750 GPM @ 180′ TDH
Minimum Pump Efficiency @ Design:	75%

THEORY OF OPERATION

Pump Sequence of Operation: Lead/Standby/High Flow

The Jockey Pump shall start when the system pressure drops below the system pressure setpoint. A variable frequency drive (VFD) shall vary its speed as needed to maintain the system pressure setpoint at variable flow rates. As demand decreases, the Lead pump shall enter sleep mode via either of two user selectable sleep modes: 1) Sleep by Flow or 2) VFD Frequency.

The first Duty Pump shall start when demand reaches 95% of the jockey pump capacity. A variable frequency drive (VFD) shall vary its speed as needed to maintain the system pressure setpoint at variable flow rates. As demand increases each additional High Flow Pump will start and vary its speed as needed to maintain the system pressure setpoint at variable flow rates.

The first High Flow pump shall start automatically when demand exceeds the capacity of the duty pumps. A variable frequency drive (VFD) shall vary its speed as needed to maintain the system pressure setpoint at variable flow rates. As demand increases each additional High Flow Pump will start and vary its speed as needed to maintain the system pressure setpoint at variable flow rates. As demand decreases, the entire process shall take place in reverse order.

Pumps shall enter sleep mode via either of two user selectable sleep modes: 1) Sleep by Flow or 2) VFD Frequency. The Standby High Flow Pump shall take the place of the failed duty pump. The system shall automatically alternate Lead/Standby pump designations based on total operation time and pump faults. Using the controller touchscreen, an operator shall be able to adjust the alternation time, as well as to manually alternate Lead and Standby designations.

SYSTEM PROTECTIONS

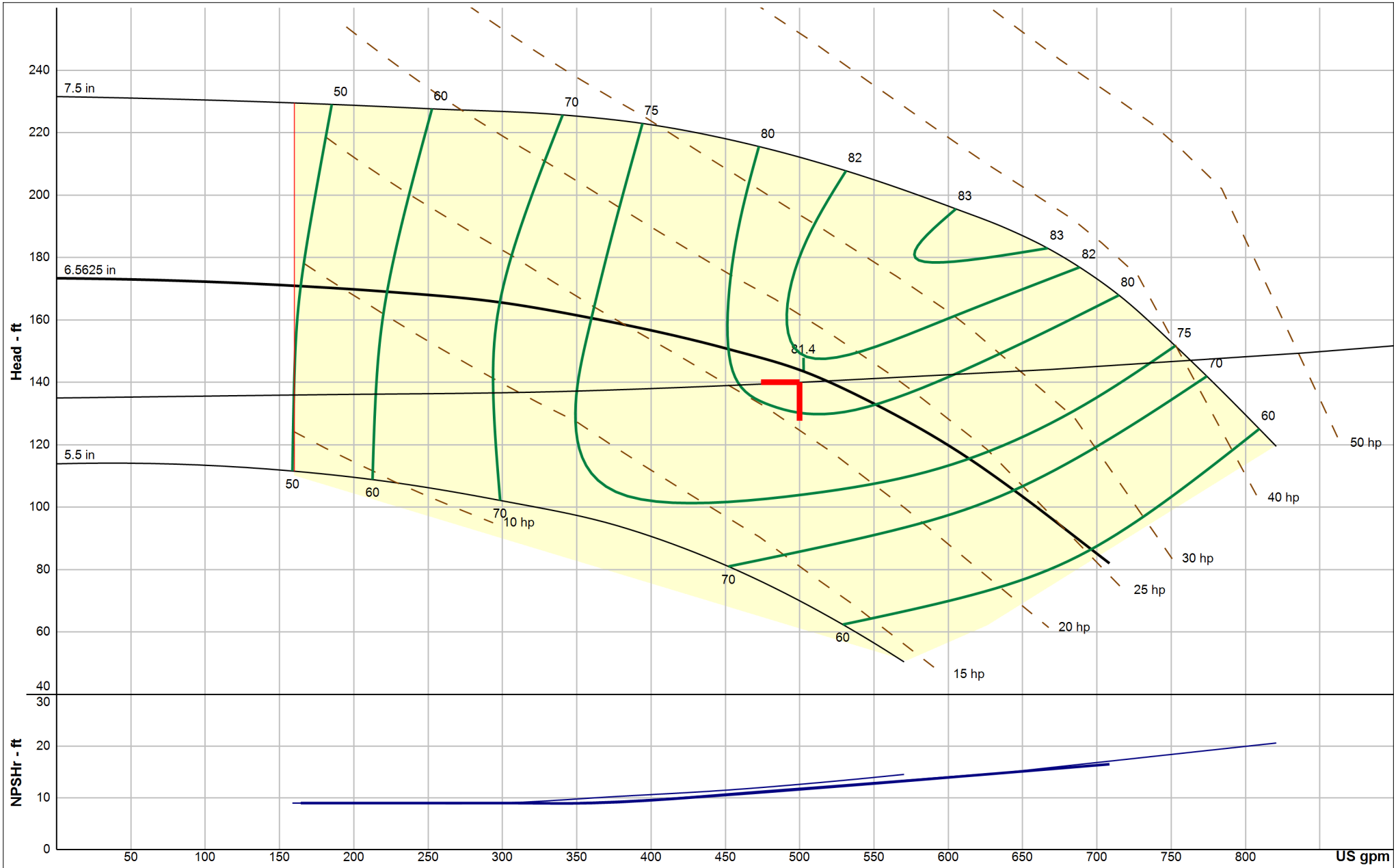
Provide the following at a minimum:

Mechanical System Protections:

- **PRIME LOSS**
- **LOW FLOW**
- **HIGH FLOW**
- **LOW LEVEL (SOURCE TANK)**
- **LOW DISCHARGE PRESSURE**
- **HIGH DISCHARGE PRESSURE**

Electrical System Protections:

- **HIGH OR LOW VOLTAGE**
- **PHASE LOSS/IMBALANCE**
- **VFD FAULTS**
- **MOTOR STARTER FAILURE**
- **ANALOG TRANSMITTER FAILURE**



Min flow line represents the absolute lowest flow pump can operate. For flow rates to the left of the first efficiency line on the curve, consult your Cornell Sales representative. Actual efficiency and HP may vary depending on mounting configuration. Refer to Catalog curve.

Company:	Morrison-Maierle	Cornell		Size:	3WHA
Name:	Lower Hillview Duty Pump	Catalog: Cornell.60, Vers 3.15.0		Speed:	3525 rpm
Date:	11/28/2023	NSF-61 - 3600 rpm		Dia:	6.5625 in
		Design Point: 500 US gpm, 140 ft		Curve:	3WHA36
		Static Head: 135 ft			

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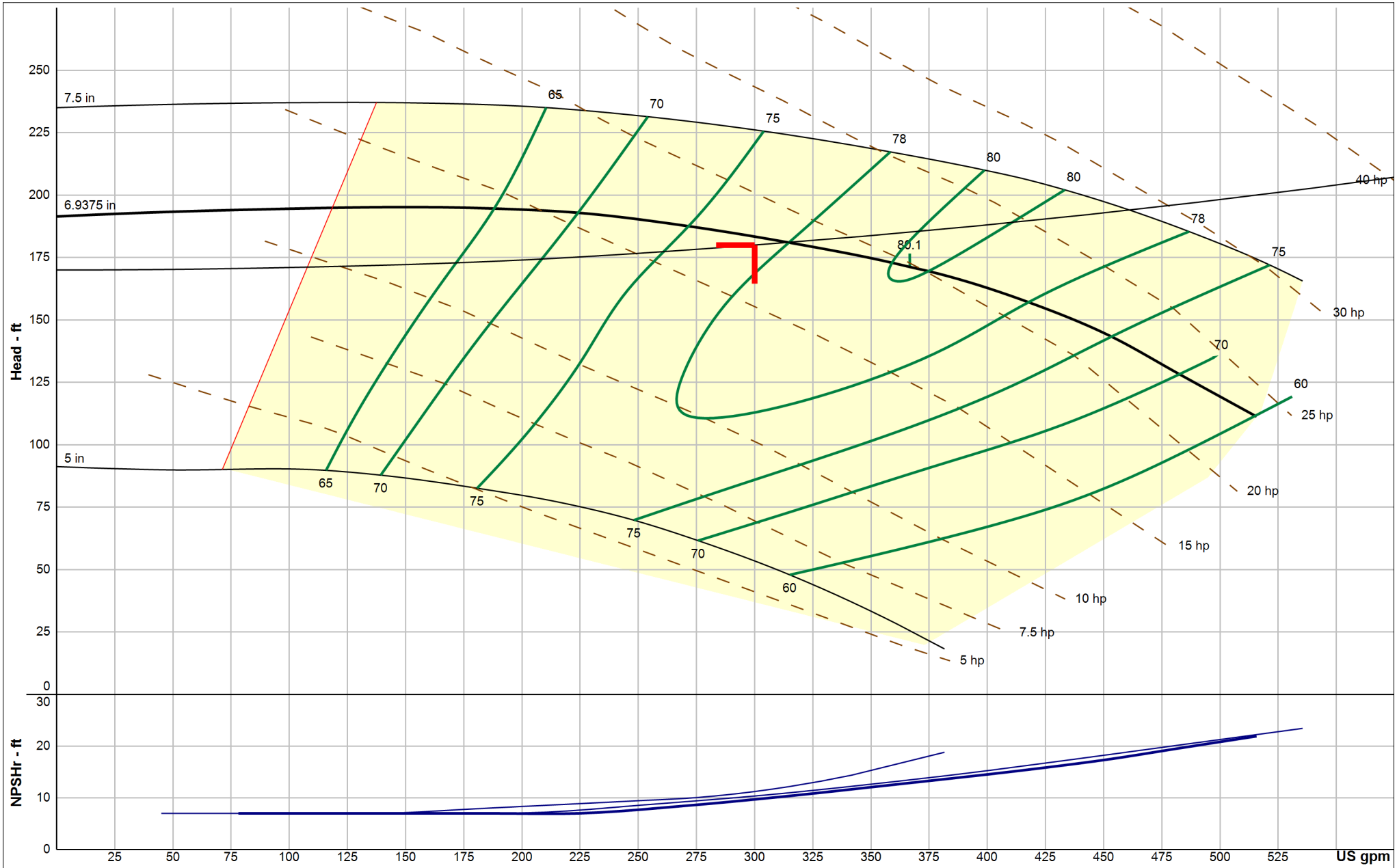

Min flow line represents the absolute lowest flow pump can operate. For flow rates to the left of the first efficiency line on the curve, consult your Cornell Sales representative. Actual efficiency and HP may vary depending on mounting configuration. Refer to Catalog curve.

Company:	Morrison-Maierle	Cornell		Size:	2.5WH
Name:	Upper Hillview Duty Pump	Catalog: Cornell.60, Vers 3.15.0		Speed:	3525 rpm
Date:	11/28/2023	NSF-61 - 3600 rpm		Dia:	6.9375 in
		Design Point:	300 US gpm, 180 ft	Curve:	25WH36
		Static Head:	170 ft		

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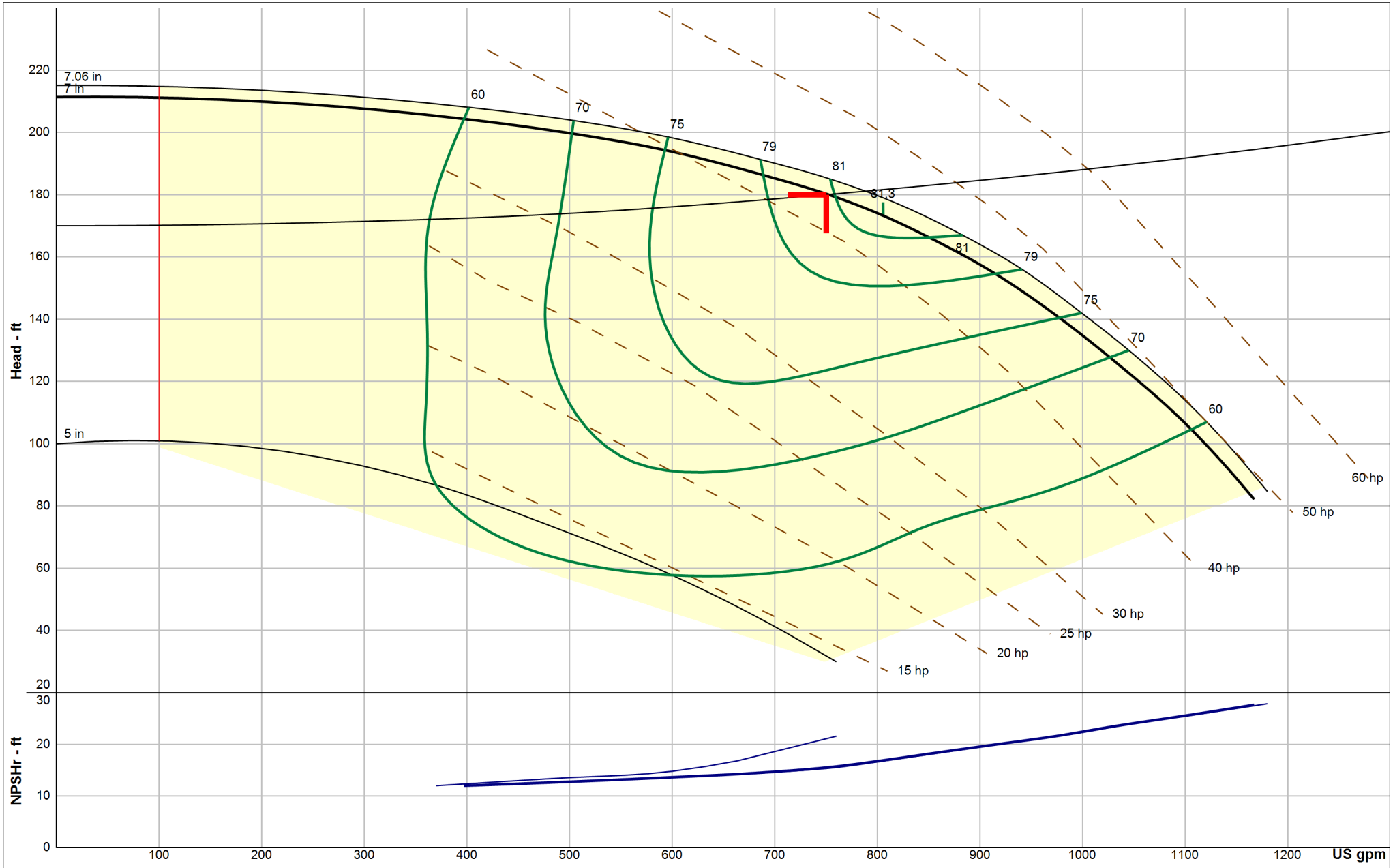

Min flow line represents the absolute lowest flow pump can operate. For flow rates to the left of the first efficiency line on the curve, consult your Cornell Sales representative. Actual efficiency and HP may vary depending on mounting configuration. Refer to Catalog curve.

Company:	Morrison-Maierle	Cornell	Size:	4WH
Name:	Hillview Upper High Flow	Catalog: Cornell.60, Vers 3.15.0	Speed:	3560 rpm
Date:	11/28/2023	NSF-61 - 3600 rpm	Dia:	7 in
		Design Point: 750 US gpm, 180 ft	Curve:	4WH36
		Static Head: 170 ft		

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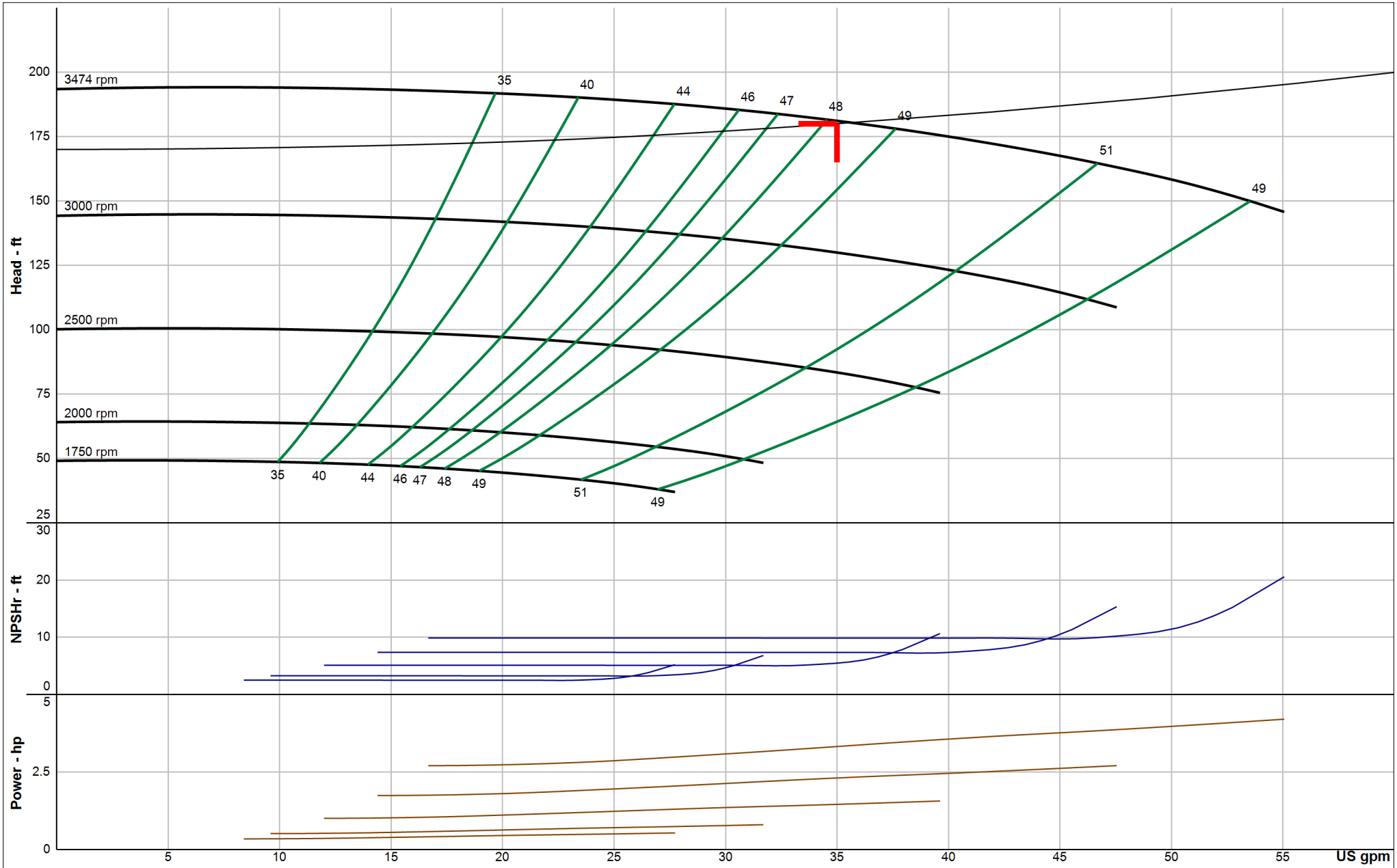

Min flow line represents the absolute lowest flow pump can operate. For flow rates to the left of the first efficiency line on the curve, consult your Cornell Sales representative. Actual efficiency and HP may vary depending on mounting configuration. Refer to Catalog curve.

Company:	Morrison-Maierle	Cornell	Size:	1WC
Name:	Upper Booster Jockey Pump	Catalog: Cornell.60, Vers 3.15.0	Speed:	3495 rpm
Date:	11/28/2023	Clear Liquids - 3600 rpm	Dia:	6.6875 in
		Design Point: 35 US gpm, 180 ft	Curve:	1WC36
		Static Head: 170 ft		

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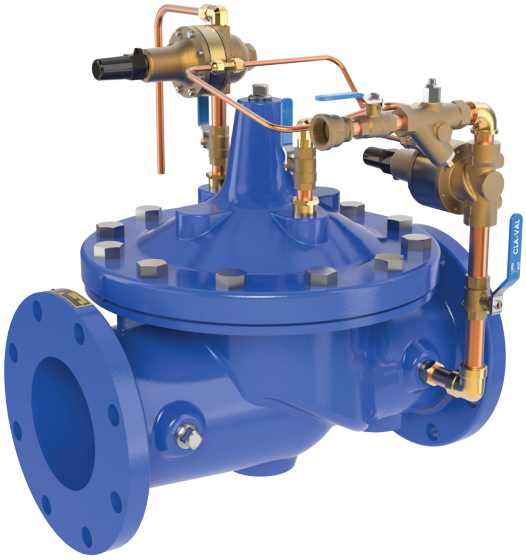
CLA-VAL™

MODEL **52-01**

Pressure Relief & Surge Anticipator Valve



- **Protects Against Water Hammer Surges**
- **Opens On Initial Low Pressure Wave**
- **Closes Slowly To Prevent Subsequent Surges**
- **Adjustable Over A Wide Range of Settings**

The Cla-Val Model 52-01 Surge Anticipator Valve is indispensable for protecting pumps, pumping equipment and all applicable pipelines from dangerous pressure surges caused by rapid changes of flow velocity within a pipeline.

When pumping systems are started and stopped gradually, harmful surges do not occur. However, should a power failure take place, the abrupt stopping of the pump can cause dangerous surges in the system which could result in severe equipment damage.

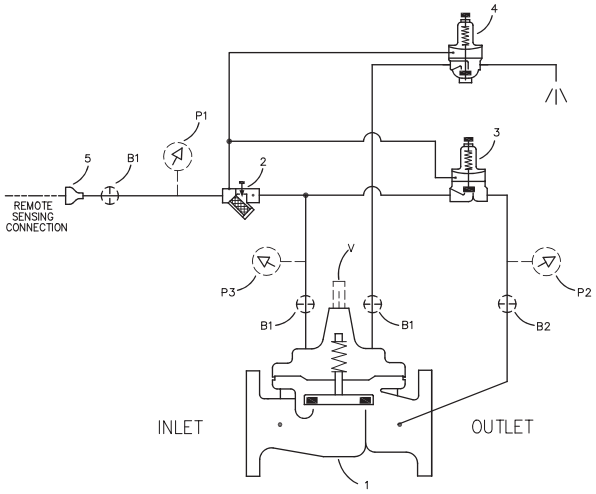
Power failure to a pump will usually result in a down surge in pressure, followed by an up surge in pressure. The surge control valve opens on the initial low pressure wave, diverting the returning high pressure wave from the system. In effect, the valve has anticipated the returning high pressure wave and is open to dissipate the damage causing surge. The valve will then close slowly without generating any further pressure surges.

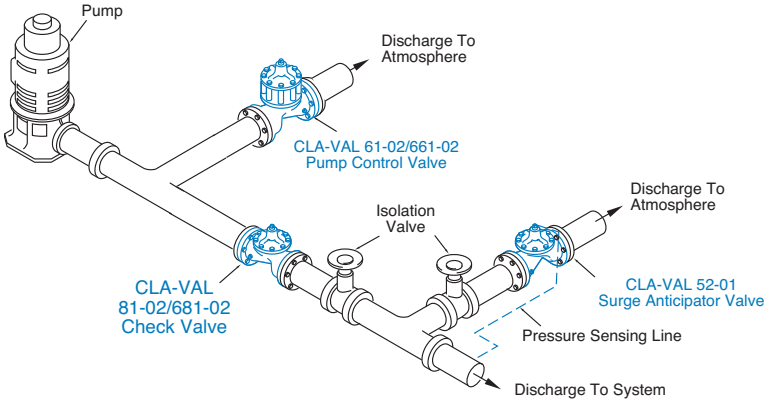
Schematic Diagram

Item	Description
1	100-01 Hytrol Main Valve
2	X42N-3 Strainer Needle Valve
3	CRL-60 Pressure Relief Control
4	CRA Pressure Reducing Control
5	Bell Reducer

Optional Features

Item	Description
B	CK2 Isolation Valve
P	X141 Pressure Gauge
V	X101 Valve Position Indicator





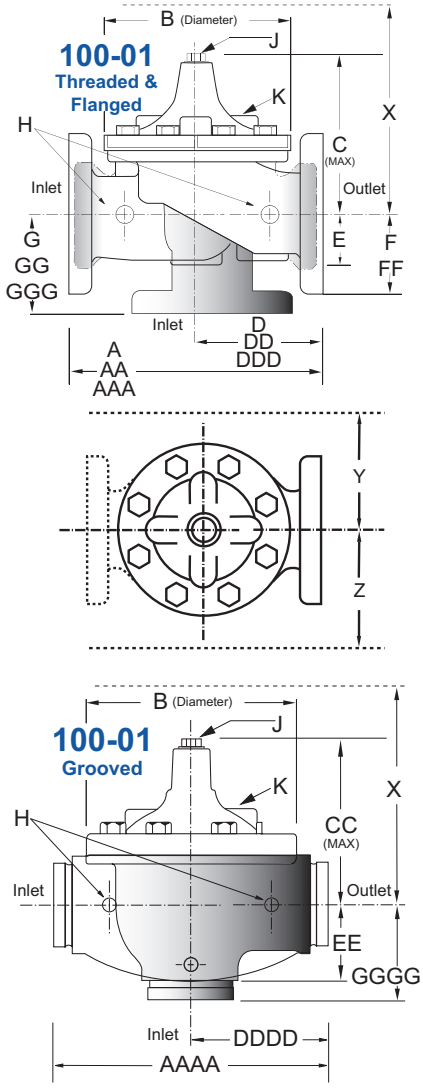
Typical Application

The 52-01 discharges to atmosphere from a tee in the pump discharge header. The valve anticipates surges caused by power failure as well as acting as a standard over pressure relief valve.

Note: The remote pressure sensing line should be ¾" minimum I.D. installed with a 2° slope from the valve to the pipeline to avoid air pockets.

Note: We recommend protecting tubing and valve from freezing temperatures.

Model 52-01 (Uses 100-01 Hytrol Main Valve)



Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class				
		Flanged			Grooved	Threaded
Grade	Material	ANSI Standards*	150 Class	300 Class	300 Class	End‡ Details
ASTM A536	Ductile Iron	B16.42	250	400	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400	400
UNS 87850	Bronze	B16.24	225	400	400	400

Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
‡ End Details machined to ANSI B2.1 specifications.
Valves for higher pressure are available; consult factory for details

Materials

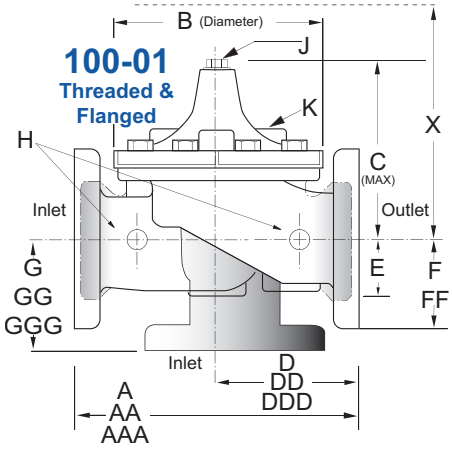
Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	1" - 36"	1" - 16"	1" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		
For material options not listed, consult factory. Cla-Val manufactures valves in more than 50 different alloys.			

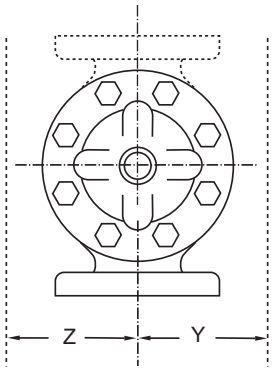
Model 52-01 Dimensions (In Inches)

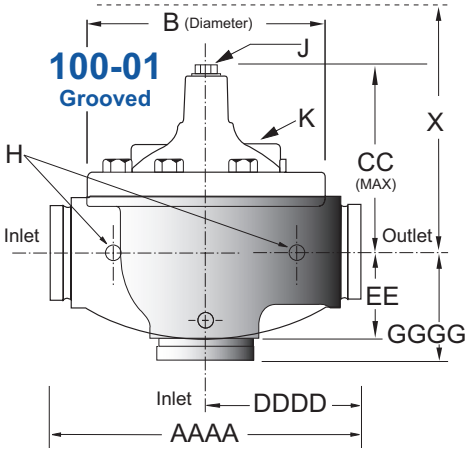
Valve Size (Inches)	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24	30	36
A Threaded	7.25	7.25	7.25	9.38	11.00	12.50	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	8.50	9.38	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38	46.00	52.00	61.50	63.00	72.75
AAA 300 ANSI	—	—	9.00	10.00	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50	47.64	53.62	63.24	64.50	74.75
AAAA Grooved End	—	—	8.50	9.00	11.00	12.50	15.00	20.00	25.38	—	—	—	—	—	—	—	—	—
B Diameter	5.62	5.62	5.62	6.62	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50	41.50	45.00	53.16	56.00	66.00
C Maximum	5.50	5.50	5.50	6.50	7.56	8.19	10.62	13.38	16.00	17.12	20.88	24.19	25.00	39.06	41.90	43.93	54.60	59.00
CC Maximum Grooved End	—	—	4.75	5.75	6.88	7.25	9.31	12.12	14.62	—	—	—	—	—	—	—	—	—
D Threaded	3.25	3.25	3.25	4.75	5.50	6.25	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	4.00	4.75	5.50	6.00	7.50	10.00	12.69	14.88	17.00	19.50	20.81	—	—	30.75	—	—
DDD 300 ANSI	—	—	4.25	5.00	5.88	6.38	7.88	10.50	13.25	15.56	17.75	20.25	21.62	—	—	31.62	—	—
DDDD Grooved End	—	—	—	4.75	—	6.00	7.50	—	—	—	—	—	—	—	—	—	—	—
E	1.12	1.12	1.12	1.50	1.69	2.06	3.19	4.31	5.31	9.25	10.75	12.62	15.50	12.95	15.00	17.75	21.31	24.56
EE Grooved End	—	—	2.00	2.50	2.88	3.12	4.25	6.00	7.56	—	—	—	—	—	—	—	—	—
F 150 ANSI	—	—	2.50	3.00	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75	15.00	16.50	19.25	22.50	28.50
FF 300 ANSI	—	—	3.06	3.25	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.00	16.50	19.25	24.00	30.00
G Threaded	1.88	1.88	1.88	3.25	4.00	4.50	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	4.00	3.25	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69	—	—	22.06	—	—
GGG 300 ANSI	—	—	4.25	3.50	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50	—	—	22.90	—	—
GGGG Grooved End	—	—	—	3.25	—	4.25	5.00	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
J NPT Cover Center Plug	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	1.00	1.00	1.25	1.50	2.00	1.00	1.00	1.00	2.00	2.00
K NPT Cover Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
Stem Travel	0.40	0.40	0.40	0.60	0.70	0.80	1.10	1.70	2.30	2.80	3.40	4.00	4.50	5.10	5.63	6.75	7.50	8.50
Approx. Ship Weight (lbs)	15	15	15	35	50	70	140	285	500	780	1165	1600	2265	2982	3900	6200	7703	11720
Approx. **X** Pilot System	11	11	11	13	14	15	17	29	31	33	36	40	40	43	47	68	79	85
Approx. **Y** Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	40	45
Approx. **Z** Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	42	47

Note: The top two flange holes on valve size 36 are threaded to 1 1/2"-6 UNC.

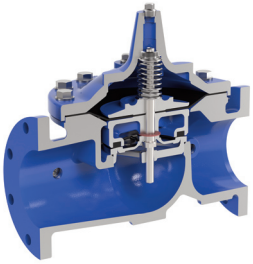
Model 52-01 **Metric Dimensions** (Uses 100-01 Hytrol Main Valve)







Model 100-01 Full Port Hytrol Main Valve



Model 52-01 Dimensions (In mm)

Valve Size (mm)	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
A Threaded	184	184	184	238	279	318	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	216	238	279	305	381	508	645	756	864	991	1051	1168	1321	1562	1600	1848
AAA 300 ANSI	—	—	229	254	295	337	397	533	670	790	902	1029	1105	1210	1326	1606	1638	1899
AAAA Grooved End	—	—	216	228	279	318	381	508	645	—	—	—	—	—	—	—	—	—
B Diameter	143	143	143	168	203	232	292	400	508	600	711	832	902	1054	1143	1350	1422	1676
C Maximum	140	140	140	165	192	208	270	340	406	435	530	614	635	992	1064	1116	1387	1499
CC Maximum Grooved End	—	—	120	146	175	184	236	308	371	—	—	—	—	—	—	—	—	—
D Threaded	83	83	83	121	140	159	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	102	121	140	152	191	254	322	378	432	495	528	—	—	781	—	—
DDD 300 ANSI	—	—	108	127	149	162	200	267	337	395	451	514	549	—	—	803	—	—
DDDD Grooved End	—	—	—	121	—	152	191	—	—	—	—	—	—	—	—	—	—	—
E	29	29	29	38	43	52	81	110	135	235	273	321	394	329	381	451	541	624
EE Grooved End	—	—	52	64	73	79	108	152	192	—	—	—	—	—	—	—	—	—
F 150 ANSI	—	—	64	76	89	95	114	140	171	203	241	267	298	381	419	489	572	724
FF 300 ANSI	—	—	78	83	95	105	127	159	191	222	260	292	324	381	419	489	610	762
G Threaded	48	48	48	83	102	114	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	102	83	102	102	127	152	203	219	349	378	399	—	—	560	—	—
GGG 300 ANSI	—	—	102	89	110	111	135	165	216	236	368	397	419	—	—	582	—	—
GGGG Grooved End	—	—	—	83	—	108	127	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
J NPT Cover Center Plug	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	1.00	1.00	1.25	1.50	2.00	1.00	1.00	1.00	2.00	2.00
K NPT Cover Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
Stem Travel	10	10	10	15	18	20	28	43	58	71	86	102	114	130	143	171	190	216
Approx. Ship Weight (kgs)	7	7	7	16	23	32	64	129	227	354	528	726	1027	1353	1769	2812	3494	5316
Approx. **X** Pilot System	280	280	280	331	356	381	432	737	788	839	915	1016	1016	1093	1194	1728	2007	2159
Approx. **Y** Pilot System	229	229	229	229	254	280	305	508	559	610	661	737	762	813	864	991	1016	1143
Approx. **Z** Pilot System	229	229	229	229	254	280	305	508	559	610	661	737	762	813	864	991	1067	1194

*Consult Factory

52-01 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes																		
	Inches	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36
	mm	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
Basic Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G
	End Detail	T	T	T, F, Gr*	T, F, Gr	T, F, Gr*	T, F, Gr	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	55	93	125	210	300	460	800	1800	3100	4900	7000	8400	11000	14000	17000	25000	42000	50000
	Maximum Surge	120	210	280	470	670	1000	1800	4000	7000	11000	16000	19000	25000	31000	39000	56500	63000	85000
Suggested Flow (Liters/Sec)	Maximum	3.5	6	8	13	19	29	50	113	195	309	442	530	694	883	1073	1577	2650	3150
	Maximum Surge	7.6	13	18	30	42	63	113	252	441	693	1008	1197	1577	1956	2461	3560	3975	5360

100-01 Series is the full internal port Hytrol.

*Globe Grooved Only

CRL-60 Pilot Control

Direct-acting, spring loaded, diaphragm type relief pilot capable of opening and closing within very close pressure limits.

CRA Pilot Control

Automatically reduces a higher inlet pressure to a lower outlet pressure. Direct acting, spring loaded, diaphragm type - hydraulic or pneumatic operation.

Adjustment Ranges

High Pressure Pilot (CRL-60)

0 to 75 psi
20 to 200 psi *
100 to 300 psi
250 to 600 psi

Low Pressure Pilot (CRA)

2 to 30 psi
15 to 75 psi
30 to 300 psi *

*Supplied unless otherwise specified
Other ranges available, please consult factory

Temperature Range

Water: to 180°F

Materials

Standard Pilot System Materials

Pilot Control: Low Lead Bronze
Trim: Stainless Steel 303
Rubber: Buna-N® Synthetic Rubber

Optional Pilot System Materials

Pilot systems are available with optional Aluminum, Stainless Steel or Monel materials.

When Ordering, Specify:

1. Catalog No. 52-01
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Threaded or Flanged
6. Trim Material
7. Adjustment Range
8. Desired Options
9. When Vertically Installed

Valve Options

X141 Pressure Gauge

X101AR Valve Position Indicator with Air Release

X101 Valve Position Indicator

X144 e-FlowMeter

X43H Strainer

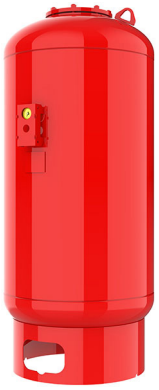
Stainless Steel Pilot

Bell & Gossett
a xylem brand

SUBMITTAL A-315G

JOB: **REPRESENTATIVE:**

UNIT TAG:	ORDER NUMBER:	DATE:
ENGINEER:	SUBMITTED BY:	DATE:
CONTRACTOR:	APPROVED BY:	DATE:



Series "WTA" (ASME) Hydro-Pneumatic Tanks

For potable water systems

DESCRIPTION

Series "WTA" hydro-pneumatic diaphragm tanks are ASME rated, pre-charged vessels. The Series "WTA" tank will help protect the pump and pressure switches against short cycling. The domestic well tank delivers adequate water under pressure between pump cycles to meet the required demand. It will provide economical system operation by minimizing pump starts, extending pump motor life, and saving energy. The "WTA" tank will also assist the pump in meeting peak demand. All Series "WTA" tanks include an integrated bladder integrity monitor and are available with sight glass and/or seismic restraints.

Products comply with ANSI/NSF Standard 61.

CONSTRUCTION

System Connection: Carbon Steel
Shell: Steel
WTA-401 - WTA-405: Butyl Diaphragm Liner
WTA-447 - WTA-457: Replaceable Butyl Bladder
Designed and Constructed per ASME Section VIII, Division 1

FACTORY PRECHARGED

WTA-401 - WTA-405: 30 PSI
WTA-447 - WTA-457: 40 PSI

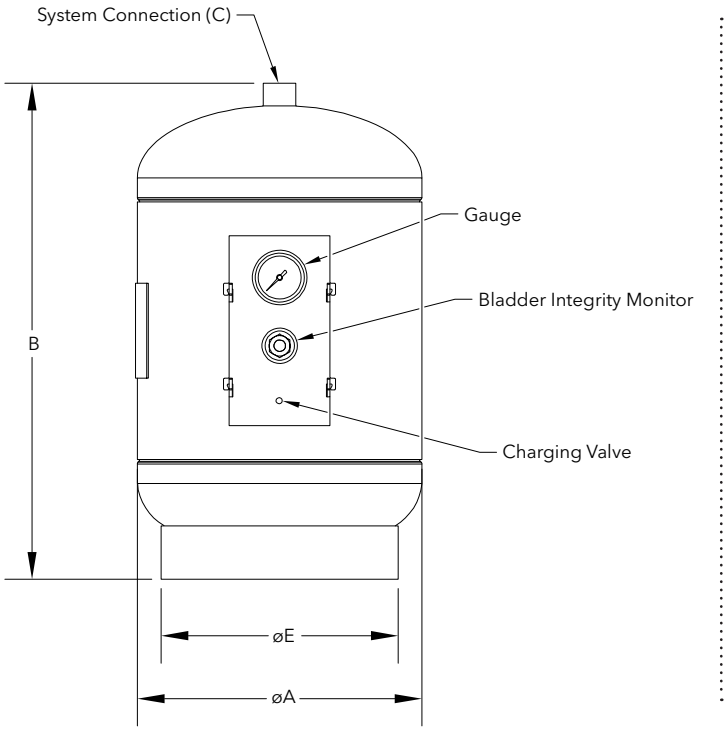
MAXIMUM OPERATING LIMITS

Maximum Design Pressure:
WTA-401 - WTA-405: 200 PSI (1,379 kPa)
WTA-447 - WTA-457: 125 PSI (862 kPa)
Maximum Design Temperature: 240°F (116°C)

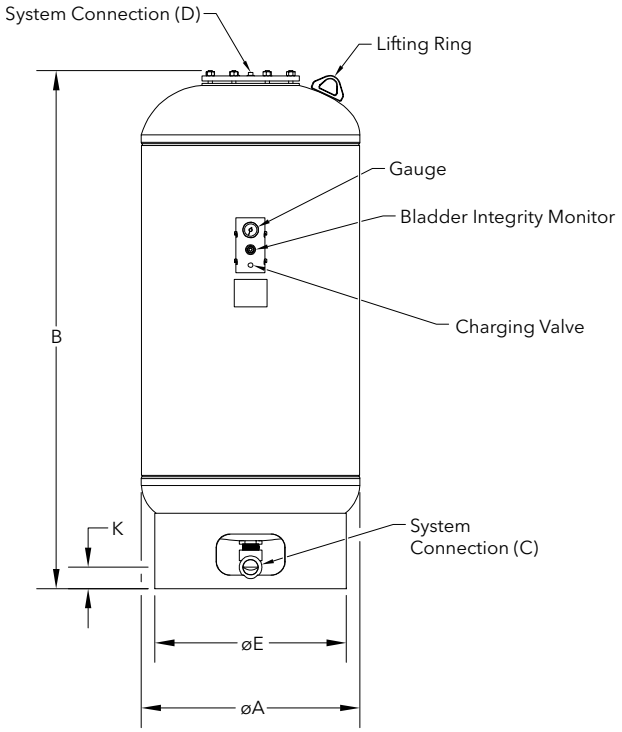
SCHEDULE

MODEL	PART NUMBER	TANK VOLUME Gal (L)	ACCEPTANCE VOLUME Gal (L)	TAGGING INFORMATION	QUANTITY
WTA-401	1BN369LF	17 (64)	12 (45)		
WTA-402	1BN370LF	25 (95)	17.5 (66)		
WTA-403	1BN371LF	34 (129)	23.5 (89)		
WTA-404	1BN372LF	78 (295)	53 (200)		
WTA-405	1BN373LF	90 (340)	60 (227)		
WTA-447	1BN374LF	53 (200)	53 (200)		
WTA-448	1BN375LF	80 (300)	79 (300)		
WTA-449	1BN376LF	106 (400)	106 (400)		
WTA-450	1BN377LF	132 (500)	132 (500)		
WTA-451	1BN378LF	158 (600)	158 (600)		
WTA-452	1BN379LF	211 (800)	211 (800)		
WTA-453	1BN380LF	264 (1,000)	264 (1,000)		
WTA-454	1BN381LF	317 (1,200)	317 (1,200)		
WTA-455	1BN382LF	370 (1,400)	370 (1,400)		
WTA-456	1BN383LF	422 (1,600)	422 (1,600)		
WTA-457	1BN384LF	528 (2,000)	528 (2,000)		

xylem



Models WTA-401 through WTA-405



Models WTA-447 through WTA-457

DIMENSIONS AND WEIGHTS

Model	A in (mm)	B in (mm)	C (NPT)	D (NPT)	E in (mm)	K in (mm)	Ship Wt. lbs (kg)	Flooded Wt.* lbs (kg)
WTA-401	16 (406)	25 (635)	1	N/A	14 (356)	N/A	64 (29)	206 (93)
WTA-402	16 (406)	34 (864)	1	N/A	14 (356)	N/A	84 (38)	292 (132)
WTA-403	16 (406)	45 (1,143)	1	N/A	14 (356)	N/A	97 (44)	380 (172)
WTA-404	24 (610)	47 (1,194)	1-1/2	N/A	20 (508)	N/A	259 (118)	909 (412)
WTA-405	24 (610)	53 (1,346)	1-1/2	N/A	20 (508)	N/A	283 (129)	1,033 (469)
WTA-447	24 (610)	43 (1,092)	1-1/2	3/4	20 (508)	5.25 (133)	210 (95)	651 (295)
WTA-448	24 (610)	55 (1,397)	1-1/2	3/4	20 (508)	5.25 (133)	225 (102)	891 (404)
WTA-449	30 (762)	49 (1,245)	1-1/2	3/4	24 (610)	5.25 (133)	300 (136)	1,183 (537)
WTA-450	30 (762)	57 (1,448)	2	3/4	24 (610)	5.25 (133)	335 (152)	1,435 (651)
WTA-451	30 (762)	65 (1,651)	2	3/4	24 (610)	5.25 (133)	360 (164)	1,676 (760)
WTA-452	32 (813)	76 (1,930)	2	3/4	28 (711)	5.25 (133)	475 (216)	2,233 (1,013)
WTA-453	36 (914)	87 (2,210)	3	N/A	30 (762)	9.13 (232)	735 (334)	2,934 (1,331)
WTA-454	36 (914)	98.5 (2,510)	3	N/A	30 (762)	9.13 (232)	745 (339)	3,386 (1,536)
WTA-455	36 (914)	110.5 (2,807)	3	N/A	30 (762)	8.88 (225)	900 (409)	3,982 (1,806)
WTA-456	48 (1,219)	84 (2,134)	3	N/A	42 (1,067)	9.13 (232)	1,210 (550)	4,725 (2,143)
WTA-457	48 (1,219)	96 (2,438)	3	N/A	42 (1,067)	9.13 (232)	1,305 (593)	5,703 (2,587)

Dimensions subject to change. Not to be used for construction purposes.
*Approximate weight 100% full occurs if bag fails or if air charge is lost.

xylem
Let's Solve Water

Xylem Inc.
8200 N. Austin Avenue
Morton Grove, IL 60053
Tel: (847) 966-3700 Fax: (847) 965-8379
www.xylem.com/bellgossett

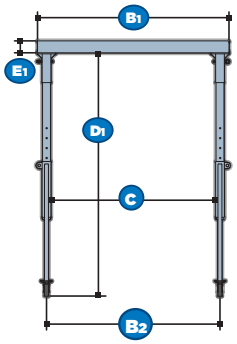
SPANCO

GANTRY CRANES

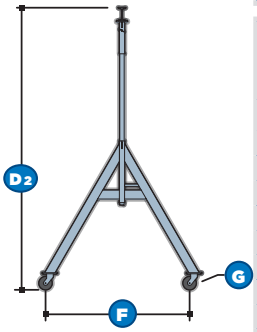
A-Series

Aluminum Adjustable Height & Span

A CAPACITY	B1 OVERALL SPAN	B2 MAX. SPAN BETWEEN WHEEL CENTERS	C CLEAR SPAN	D1 HEIGHT UNDER BEAM Min.	D1 HEIGHT UNDER BEAM Max.	D2 OVERALL HEIGHT Min.	D2 OVERALL HEIGHT Max.	E1 BEAM SIZE	E2 FLANGE WIDTH	F TREAD	G CASTER DIA.	NET WT. (LBS.)	MODEL
½ TON	8'	7' 3"	6' 11"	6' 6"	9' 0"	6' 11"	9' 5"	ALU5"X3.43#	3"	4' 2"	6"	116	0.5ALU0809
		7' 3"	6' 11"	8' 6"	11' 0"†	8' 11"	11' 5"	ALU5"X3.43#	3"	4' 2"	6"	135	0.5ALU0811
	10'	9' 3"	8' 11"	6' 6"	9' 0"	7' 0"	9' 6"	ALU6"X4.3#	3-3/8"	4' 2"	6"	131	0.5ALU1009
		9' 3"	8' 11"	8' 6"	11' 0"†	9' 0"	11' 6"	ALU6"X4.3#	3-3/8"	4' 2"	6"	150	0.5ALU1011
	12'	11' 3"	10' 11"	6' 6"	9' 0"	7' 2"	9' 8"	ALU8"X6.35#	4"	4' 2"	6"	164	0.5ALU1209
		11' 3"	10' 11"	8' 6"	11' 0"†	9' 2"	11' 8"	ALU8"X6.35#	4"	4' 2"	6"	183	0.5ALU1211
	15'	14' 3"	13' 11"	6' 6"	9' 0"	7' 2"	9' 8"	ALU8"X6.35#	4"	4' 2"	6"	192	0.5ALU159
		14' 3"	13' 11"	8' 6"	11' 0"†	9' 2"	11' 8"	ALU8"X6.35#	4"	4' 2"	6"	211	0.5ALU1511



A CAPACITY	B1 OVERALL SPAN	B2 MAX. SPAN BETWEEN WHEEL CENTERS	C CLEAR SPAN	D1 HEIGHT UNDER BEAM Min.	D1 HEIGHT UNDER BEAM Max.	D2 OVERALL HEIGHT Min.	D2 OVERALL HEIGHT Max.	E1 BEAM SIZE	E2 FLANGE WIDTH	F TREAD	G CASTER DIA.	NET WT. (LBS.)	MODEL
1 TON	8'	7' 3"	6' 10"	5' 7"	8' 1"	6' 1"	8' 7"	ALU6"X4.3#	3-3/8"	4' 6"	6"	150	1ALU0808
		7' 3"	6' 10"	7' 7"	10' 1"	8' 1"	10' 7"	ALU6"X4.3#	3-3/8"	4' 6"	6"	157	1ALU0810
		7' 3"	6' 10"	9' 7"	12' 1"†	10' 1"†	12' 7"†	ALU6"X4.3#	3-3/8"	4' 6"	6"	197	1ALU0812
	10'	9' 3"	8' 10"	5' 7"	8' 1"	6' 3"	8' 9"	ALU8"X6.35#	4"	4' 6"	6"	180	1ALU1008
		9' 3"	8' 10"	7' 7"	10' 1"	8' 3"	10' 9"	ALU8"X6.35#	4"	4' 6"	6"	187	1ALU1010
		9' 3"	8' 10"	9' 7"	12' 1"†	10' 3"†	12' 9"†	ALU8"X6.35#	4"	4' 6"	6"	227	1ALU1012
	12'	11' 3"	10' 10"	5' 7"	8' 1"	6' 3"	8' 9"	ALU8"X6.35#	4"	4' 6"	6"	192	1ALU1208
		11' 3"	10' 10"	7' 7"	10' 1"	8' 3"	10' 9"	ALU8"X6.35#	4"	4' 6"	6"	199	1ALU1210
		11' 3"	10' 10"	9' 7"	12' 1"†	10' 3"†	12' 9"†	ALU8"X6.35#	4"	4' 6"	6"	239	1ALU1212
	15'	14' 3"	13' 10"	5' 7"	8' 1"	6' 5"	8' 11"	ALU10"X8.76#	4-5/8"	4' 6"	6"	248	1ALU1508
		14' 3"	13' 10"	7' 7"	10' 1"	8' 5"	10' 11"	ALU10"X8.76#	4-5/8"	4' 6"	6"	255	1ALU1510
		14' 3"	13' 10"	9' 7"	12' 1"†	10' 5"†	12' 11"†	ALU10"X8.76#	4-5/8"	4' 6"	6"	295	1ALU1512
	18'	17' 3"	16' 9"	5' 10"	8' 4"	6' 11"	9' 5"	ALU12"X10.99#*	5"	4' 4"	8"	389	1ALU1808
		17' 3"	16' 9"	7' 10"	10' 4"	8' 11"	11' 5"	ALU12"X10.99#*	5"	4' 4"	8"	401	1ALU1810
		17' 3"	16' 9"	9' 10"	12' 4"†	10' 11"†	13' 5"†	ALU12"X10.99#*	5"	4' 4"	8"	441	1ALU1812
	20'	19' 3"	18' 9"	5' 10"	8' 4"	6' 11"	9' 5"	ALU12"X10.99#*	5"	4' 4"	8"	423	1ALU2008
		19' 3"	18' 9"	7' 10"	10' 4"	8' 11"	11' 5"	ALU12"X10.99#*	5"	4' 4"	8"	435	1ALU2010
		19' 3"	18' 9"	9' 10"	12' 4"†	10' 11"†	13' 5"†	ALU12"X10.99#*	5"	4' 4"	8"	475	1ALU2012



A CAPACITY	B1 OVERALL SPAN	B2 MAX. SPAN BETWEEN WHEEL CENTERS	C CLEAR SPAN	D1 HEIGHT UNDER BEAM Min.	D1 HEIGHT UNDER BEAM Max.	D2 OVERALL HEIGHT Min.	D2 OVERALL HEIGHT Max.	E1 BEAM SIZE	E2 FLANGE WIDTH	F TREAD	G CASTER DIA.	NET WT. (LBS)	MODEL
2 TON	8'	7' 3"	6' 9"	5' 10"	8' 4"	6' 6"	9' 0"	ALU8"X6.35#	4"	4' 4"	8"	237	2ALU0808
		7' 3"	6' 9"	7' 10"	10' 4"	8' 6"	11' 0"	ALU8"X6.35#	4"	4' 4"	8"	246	2ALU0810
		7' 3"	6' 9"	9' 10"†	12' 4"†	10' 6"†	13' 0"†	ALU8"X6.35#	4"	4' 4"	8"	276	2ALU0812
	10'	9' 3"	8' 9"	5' 10"	8' 4"	6' 8"	9' 2"	ALU10"X8.76#	4-5/8"	4' 4"	8"	274	2ALU1008
		9' 3"	8' 9"	7' 10"	10' 4"	8' 8"	11' 2"	ALU10"X8.76#	4-5/8"	4' 4"	8"	286	2ALU1010
		9' 3"	8' 9"	9' 10"†	12' 4"†	10' 8"†	13' 2"†	ALU10"X8.76#	4-5/8"	4' 4"	8"	313	2ALU1012
	12'	11' 3"	10' 9"	5' 10"	8' 4"	6' 10"	9' 4"	ALU12"X10.99#	5"	4' 4"	8"	322	2ALU1208
		11' 3"	10' 9"	7' 10"	10' 4"	8' 10"	11' 4"	ALU12"X10.99#	5"	4' 4"	8"	334	2ALU1210
		11' 3"	10' 9"	9' 10"†	12' 4"†	10' 10"†	13' 4"†	ALU12"X10.99#	5"	4' 4"	8"	361	2ALU1212
	15'	14' 3"	13' 9"	5' 10"	8' 4"	6' 10"	9' 4"	ALU12"X10.99#	5"	4' 4"	8"	355	2ALU1508
		14' 3"	13' 9"	7' 10"	10' 4"	8' 10"	11' 4"	ALU12"X10.99#	5"	4' 4"	8"	367	2ALU1510
		14' 3"	13' 9"	9' 10"†	12' 4"†	10' 10"†	13' 4"†	ALU12"X10.99#	5"	4' 4"	8"	394	2ALU1512

A CAPACITY	B1 OVERALL SPAN	B2 MAX. SPAN BETWEEN WHEEL CENTERS	C CLEAR SPAN	D1 HEIGHT UNDER BEAM Min.	D1 HEIGHT UNDER BEAM Max.	D2 OVERALL HEIGHT Min.	D2 OVERALL HEIGHT Max.	E1 BEAM SIZE	E2 FLANGE WIDTH	F TREAD	G CASTER DIA.	NET WT. (LBS.)	MODEL
3 TON	8'	7' 2"	6' 8-1/2"	6' 2"	8' 2"	7' 2"	9' 2"	ALU12"X10.99#	5"	4' 8"	8"	350	3ALU0808
		7' 2"	6' 8-1/2"	7' 8"	10' 2"	8' 8"	11' 2"	ALU12"X10.99#	5"	4' 8"	8"	369	3ALU0810
		7' 2"	6' 8-1/2"	9' 8"†	12' 2"†	10' 8"†	13' 2"†	ALU12"X10.99#	5"	4' 8"	8"	416	3ALU0812
	10'	9' 2"	8' 8-1/2"	6' 2"	8' 2"	7' 2"	9' 2"	ALU12"X10.99#	5"	4' 8"	8"	372	3ALU1008
		9' 2"	8' 8-1/2"	7' 8"	10' 2"	8' 8"	11' 2"	ALU12"X10.99#	5"	4' 8"	8"	391	3ALU1010
		9' 2"	8' 8-1/2"	9' 8"†	12' 2"†	10' 8"†	13' 2"†	ALU12"X10.99#	5"	4' 8"	8"	438	3ALU1012
	12'	11' 2"	10' 8-1/2"	6' 2"	8' 2"	7' 3"	9' 3"	ALU12"X10.99#	5"	4' 8"	8"	426	3ALU1208
		11' 2"	10' 8-1/2"	7' 8"	10' 2"	8' 9"	11' 3"	ALU12"X10.99#	5"	4' 8"	8"	445	3ALU1210
		11' 2"	10' 8-1/2"	9' 8"†	12' 2"†	10' 9"†	13' 3"†	ALU12"X10.99#*	5"	4' 8"	8"	491	3ALU1212
	15'	14' 2"	13' 8-1/2"	6' 2"	8' 2"	7' 3"	9' 3"	ALU12"X10.99#*	5"	4' 8"	8"	467	3ALU1508
		14' 2"	13' 8-1/2"	7' 8"	10' 2"	8' 9"	11' 3"	ALU12"X10.99#*	5"	4' 8"	8"	479	3ALU1510
		14' 2"	13' 8-1/2"	9' 8"†	12' 2"†	10' 9"†	13' 3"†	ALU12"X10.99#*	5"	4' 8"	8"	532	3ALU1512

* Capped Beam

† 2' Height Extension Kit Included

TECHNICAL MEMORANDUM

Hillview Subdivision – Water System Booster Building Hydraulic Performance

Cushing Terrell

Hillview Subdivision

Prepared by: Aaron McConkey, PE & Jake Miller, PE

Reviewed by: Engineer Name, PE

Date: November 29, 2023

Morrison-Maierle
Missoula Office
1055 Mount Ave
Missoula, MT 59801

Morrison Maierle
engineers ▪ surveyors ▪ planners ▪ scientists

1 SYTEM DEMANDS

1.1 Domestic Demands and Commercial Water System Demands

The Hillview Subdivision project includes 226 single family homes within Phases 3-7. The water system service these phases includes two separate water boosting stations that will supply the subdivision and will be sized for future growth of adjacent developments. The adjacent property may be developed in two different manners, one being a school site and the other being a residential subdivision. The table below summarizes the water demands included in sizing of the two water booster stations.

Upper System – Hillview Subdivision								
Unit Type	Units	No. Persons/ Dwelling	Total No. Persons	Avg Demand per Person (gpdpc)	Avg. Demand (gpd)	Avg. Demand (gpm)	Max Day Demand (gpm)	Peak Hour Demand* (gpm)
Hillview Single Family	226	2.3	520	140	72,800	49.72	287.02	892.7
Adjacent School		500	500	22	11000	7.64		
Adjacent Residential Development	277	2.3	637	140	89,194	60.94	351.79	1094.15
Total Hillview + School	226		1020		83800	57.36	287.02	892.7
Total Hillview + Adjacent Residential	503		1157		161994	110.66	638.81	1986.85
* PEAK HOUR DEMANDS ARE BASED ON 3.95 GPM PER EQUIVELANT DWELLING UNIT								

The total Hillview Subdivision + Adjacent Residential development will have the greatest water demands and has been used for sizing of the water booster stations.

2 BOOSTER PUMP HYDRAULIC MODEL

In support of development of the proposed land subdivision, the water system will require two additional pressure zones. These pressure zones will be supplied from a new water tank and two proposed booster pump stations. The booster pumps are to be located within the Hillview Subdivision located off Hill View Way at Section 05, Township 12 North, Range 19 West, Missoula, MT. The pumps are to be sized based on the demands that meet the City of Missoula

Public Works Standards, Montana Department of Environmental Quality Circular-1 Standards and Montana Public Works Standard Specifications.

A hydraulic model using InfoWater Pro software by Autodesk was created for the Hillview Water System Booster Pumps project based on information provided from the subdivision layout. The model created includes scenarios for average day demand (ADD), max day demand (MDD) and peak hour demand (PHD) as identified in the Water Exhibit. The pipeline was modeled in two design options, the first as the Water Exhibit identifies, 8-inch diameter ductile iron main from the lower system booster pump station to Pressure Zone 2 where it transitions to 12-inch diameter ductile iron main and extends to the new water storage tank with a 8-inch diameter tank outlet to the upper system booster pump station. The second pipeline design option was modeled as 12-inch diameter ductile iron main from the lower system booster pump station to the new water storage tank with an 8-inch diameter tank outlet to the upper system booster pump station. The second design option was modeled for PHD only to determine if a lower capacity pump station could be used if the diameter of the main was increased from 8-inch diameter to 12-inch diameter from the lower booster station to Pressure Zone 2 connection. Each modeled option was checked for compliance with Department of Environmental Quality Circular-1. The results for each scenario and design option are provided within the table on the following page.

MODEL RESULTS:

DEMAND SCENARIO	PUMP LOCATION	ELEVATION (FT)	UPSTREAM PRESSURE (PSI)	DOWNSTREAM PRESSURE (PSI)	FLOW (GPM)	HEAD GAIN (FT)	AVAILABLE NPSH (FT)
ADD	Lower	3,447.00	67.77	130.2	2,184.25	144.1	189.5
	Upper	3,652.00	8.67	77.98	36.52	159.98	53.08
MDD	Lower	3,447.00	63.62	128.85	2,140.57	150.54	179.94
	Upper	3,652.00	8.66	77.65	210.82	159.21	53.07
PHD	Lower	3,447.00	63.62	128.8	2,141.35	150.42	179.94
	Upper	3,652.00	8.66	77.32	293.82	158.47	53.06
PHD 12" Mainline	Lower	3,447.00	63.5	105.62	2,479.29	97.22	179.66
	Upper	3,652.00	8.66	77.32	293.82	158.47	53.06

Pump sizing is based on peak hour demand (PHD) and average day demand for maximum and standard operating conditions, respectively. The lower booster pump station will need to provide a total flow rate of 1,000 gpm at approximately 130 psi for peak hour demand and a total flow rate of 500 gpm at approximately 130 psi for the average day demand. The upper pump station will require a total flow rate of 1990 gpm at approximately 78 psi for peak hour demand and a total flow rate of 110 gpm at approximately 78 psi for the average day demand.

This information will be used for determining the number of pumps required and the development of requirements for vendors to provide booster pump proposals and technical data.

3 TECHNICAL SPECIFICATIONS – LOWER PUMP

The Lower Pump Station is located adjacent to Phase 1 of the Hillview Subdivision and will connect to an 8-inch DI water main. The lower pump station will be equipped with a Spanco 1ALU1208 1-ton aluminum gantry crane or equal for pump maintenance. Water demands in the Upper Zone storage tank will control pumping operations. Two set points within the tank will call for additional water, (1) Operational Storage and (2) Equalization Storage.

The total water storage in the Upper Hillview Subdivision Zone is +/- 350,000 gallons. This includes 180,000 gallons of fire storage and 167,000 gallons of average day demand storage. The average day demand storage can be divided into operational storage and equalization storage. During normal operation the Lower Booster Station will maintain water within the operational storage zone. During Peak Hour demands the Lower Booster Station will maintain water within the equalization storage zone.

Equalization storage is determined as the volume of water required to sustain 2.5 hours of water when demands are equal to the peak hour demand and production is at a rate equal to the total capacity with the largest well out of service. During the equalization storage zone of the water storage tank two of the three pumps will called for service.

Equalization Storage = (PHD- Q_s) X 150 mins

Equalization Storage = (1,990 gpm – 1,000 gpm)(150 Min) = 148,000 gallons

Operational storage is determined as the remainder of the volume of water within the average date demand storage. During the operation storage zone of the water storage tank one of the three pumps will be called for service.

Operational Storage = Total Tank Volume – Fire Storage – Equalization Storage

Operational Storage = 350,000 gal – 180,000 gal – 148,000 gal

Operational Storage = 19,000 gal

Recharge of the operational storage zone of the tank will take +/- 50 minutes during average day demands at full buildout of the system.

During events that cause the water storage tank to enter the fire storge zone, all three booster pumps can be called. During this event the peak flow of the station will equal the total fire flow requirements of the Upper Hillview Subdivision Pressure Zone.

Protection from surge events and transient pressures will be provided in the booster pump building. A surge anticipating valve shall be sized to evacuate the maximum flow of the pump system which is 1,500 gallons. A 6-inch Cla-Val 52-10 or equal globe pattern valve has capacity to evacuate 1,800 gallons per minute as a maximum sustained flow and 4,000 gallon per minute surge event. In addition to the surge anticipating valve, the booster system will have a closed loop pressure relief valve that is set at 65 psi and discharges to suction manifold of the package booster pump package.

System Type:	Potable Booster System
SITE CONDITIONS	
Installation Location	Lower Pressure Booster, Hillview Subdivision
Electrical Input (V/Ø/Hz):	480V/ 3 Phase / 60 Hz
STATION PERFORMANCE	
Normal Duty	500 – 1,000 GPM @ 60 PSI Boost
High Flow	1,500 GPM @ 60 PSI Boost
HIGH FLOW PUMPS	
Type:	End Suction Centrifugal
Motor Starting	Variable Frequency Drive
Motor Nameplate (HP/Enclosure):	30 HP / ODP
Motor Nominal Speed (Maximum)	3600 RPM
Design Performance:	500 GPM @ 140′ TDH
Minimum Pump Efficiency @ Design:	80%
Quantity:	3

THEORY OF OPERATION

Pump Sequence of Operation: Lead/Standby/High Flow

The first Duty Pump shall start when water storage as monitored in water storage tank hits set point 1. A variable frequency drive (VFD) shall be used to start one pump and shall ramp to 100% at a set interval not less than 60 seconds and maintain 100% until the water storage tank is at set point 0. As demand increases from the water storage tank such that one pump does not maintain water levels above set point 1 and water levels are lowered to set point 2, pump 2 shall be activated, a variable frequency drive (VFD) shall be used to start a second pump and shall ramp to 100% at a set interval not less than 60 seconds and maintain 100% until the water storage tank is at set point 1. As demand increases and water elevation in the tank is below set point 2, the lead duty pump shall be 100%. The third duty pump shall start automatically once water levels reach set point 3 in the water storage tank.

As demand decreases, the entire process shall take place in reverse order.

Pumps shall enter sleep mode via either of two user selectable sleep modes: 1) Sleep by Flow or 2) VFD Frequency. The Standby High Flow Pump shall take the place of the failed duty pump. The system shall automatically alternate Lead/Standby pump designations based on total operation time and pump faults. Using the controller touchscreen, an operator shall be able to adjust the alternation time, as well as to manually alternate Lead and Standby designations.

Set Point 0 – Storage Full 350,000 gallons

Set Point 1 – 80% of Operational Storage Depletion, 335,000 gallons

Set Point 2 – 100% of Operational Storage Depletion, 331,000 gallons

Set Point 3 – 100% of Operational and Equalization Storage Depletion, 180,000 gallons

SYSTEM PROTECTIONS

Provide the following at a minimum:

Mechanical System Protections:

- **PRIME LOSS**
- **LOW FLOW**
- **HIGH FLOW**
- **LOW LEVEL (SOURCE TANK)**
- **LOW DISCHARGE PRESSURE**
- **HIGH DISCHARGE PRESSURE**

Electrical System Protections:

- **HIGH OR LOW VOLTAGE**
- **PHASE LOSS/IMBALANCE**
- **VFD FAULTS**
- **MOTOR STARTER FAILURE**
- **ANALOG TRANSMITTER FAILURE**

4 TECHNICAL SPECIFICATIONS – UPPER ZONE BOOSTER PUMP

The Upper Hillview Subdivision Booster Station is located directly adjacent to the 350,000 gallon water storage tank and connected to the water storage tank with a 12-inch DI water main. The upper pump station will be equipped with a Spanco 1ALU1208 1-ton aluminum gantry crane or equal for pump maintenance. The Upper Hillview Subdivision Booster Pump Station is sized to provide water demands to the subdivisions 226 lots and the adjacent undeveloped property with the potential of an additional 277 single family residential lots. Figure 4-1 summarize 100% buildout demands of the water system. Two pressure zones will be served by the booster station, these pressure zones are connected with a pressure reducing valve. Proportioning of the water system demands of the Hillview Subdivision are discussed in greater detail within the hydraulic analysis attached to this report. For pump sizing it is assumed that 100% of the Hillview Subdivisions are required to be delivered through the booster station, this would be the case if the gravity connection from the water storage tank to the lower Hillview pressure zone is not in service.

Table 4-1
Upper Hillview Booster Station Design Summary

Design Parameter	Hillview Subdivision	Adjacent Residential	Total	
No. of Units	226	277	503	Units
Total No. of Persons	520	637	1157	Persons
Average Day Demand @ 140 gpdpc	72800	89180	161980	Gal per Day per Capita
Average Day Demand	51	62	112	GPM
Max Day Demand	292	358	649	GPM
Peak Hour Demand @ 3.95 gpm per EDU	893	1094	1987	GPM

The proposed subdivision is proposed to be developed in 5 phases and future adjacent property would also likely be developed in multiple phases. Design considerations have been made for water demands on a cumulative demand basis for the 5 phases of the Hillview Subdivision. Table 4-2 provides a cumulative breakdown of water demands in the phase subdivision.

Table 4-2
Cumulative Water System Demands

Design Parameter	Hillview Phase 3	Hillview Phase 4	Hillview Phase 5	Hillview Phase 6	Hillview Phase 7	
No. of Units	58	132	164	192	226	Units
Total No. of Persons	133.4	303.6	377.2	441.6	519.8	Persons
Average Day Demand @ 140 gpdpc	18676	42504	52808	61824	72772	Gal per Day per Capita
Average Day Demand	13	30	37	43	51	GPM
Max Day Demand	75	170	212	248	292	GPM
Peak Hour Demand @ 3.95 gpm per EDU	229	521	648	758	893	GPM

The Upper Hillview Subdivision booster station will provide constant pressure to the service are with a constant running station consisting of a jockey pump, multiple duty cycle pumps, multiple high flow pumps and hydro-pneumatic pressure tanks. All pumps within the package system will be VFD controlled. Figure 4-3 provides a summary of target pumping rates for the jockey pumps, duty pumps and high flow pumps. The jockey pump is sized to meet average day demands for Phase 3 and 4 and will provide flows during minimum system demands in conjunction with the hydro-pneumatic storage tanks. The duty pumps area sized to provide peak hour demands for Phase 4-7. The high flow pumps are sized to provide both fire flows and peak hour demands when full buildout of the Hillview Subdivision and adjacent property is developed. The total pumping capacity of the station with the largest pump removed from service is 2,435 gpm which exceeds both the total combined peak hour demand and the fire flow demand.

Figure 4-3
Upper Booster Pump Design Parameters

Unity Type	Flow Rate (GPM)	Head (ft)	Number of Pumps	Max Flow Per Pump (GPM)
Jocky Pump	35	180	1	35
Duty Pump	35-900	180	3	300
High Flow Pump	900-1990	180	3	750
Maximum Pumping Capacity with Larges Pump Out of Service				2435

To accommodate the phased buildout of the water system and limit short pump cycling of the jockey pump hydro-pneumatic storage is proposed within the Upper Hillview Booster Station. Storage demands are based on two factors. (1) Minimum time for pump/VDF restart is generally 3 minutes, storage is adequate sized for average day demand to meet the 3 minute target for pump shutdown, restart and ramp up to 100 % within the jockey pump. (2)[1] Hydro-pneumatic tank drawdown is size for 30 minute no flow shutdown with a water system demand equal to 25% of the average day demand. Sizing of the hydro-pneumatic storage tanks has been completed for Phase 3 & 4. As buildout expands beyond Phase 3 & 4 the system will have over 132 units in service and minimum system flows are anticipated to be within the range of the constant running jockey pump and duty pumps.

[1] Technical Manual, THE-1096A, Domestic Water Pressure Boosting Design Manual, Bell and Gossett, Reprinted ASHREA Guide and Data Book 197, Chap 66.

Average Day Demand Phase 3&4 = 30 gpm
Low/No Flow = 25% of Average Day Demand = 7.5 gpm
Pump Time off Target = 30 minutes
Tank Draw Down Pressures = 70 psi – 60 psi
Tank Draw Down Factor = 0.111[2]
Acceptance Volume = Low/No Demand Flow X Draw Down Factor
= 7.5 gpm x 0.111 = 68 Gal

To accommodate service without removal of the booster pumps multiple ASME diaphragm expansion tanks are proposed. Three Bell& Gossett WTA 452 tanks will provide a total volume of 568 gallons with a acceptance volume of 67 gallons when the differential pressure is set at 10 psi.

The booster system will have a closed loop pressure relief valve that is set at 70 psi and discharges to suction manifold of the package booster pump package.

[2] Technical Manual, THE-1096A, Domestic Water Pressure Boosting Design Manual, Figure 5.6, Bell and Gossett, Reprinted ASHREA Guide and Data Book 197, Chap 66.

System Type:	Potable Booster System
SITE CONDITIONS	
Installation Location	Upper Pressure Booster, Hillview Subdivision
Electrical Input (V/Ø/Hz):	480V/ 3 Phase / 60 Hz
STATION PERFORMANCE	
Normal Duty	1 – 900 GPM @ 75 PSI Boost
High Flow	1,990 GPM @ 75 PSI Boost
PUMP DESIGN CRITERIA	
MAIN PUMP	
Type:	End Suction Centrifugal
Motor Starting	Variable Frequency Drive
Motor Nameplate (HP/Enclosure):	25 HP / ODP
Motor Nominal Speed	3600 RPM
Design Performance:	300 GPM @ 180′ TDH
Minimum Pump Efficiency @ Design:	75%
Quantity:	3
JOCKEY PUMP	
Type:	End Suction Centrifugal
Motor Starting	Variable Frequency Drive
Motor Nameplate (HP/Enclosure):	3.5 HP /ODP
Motor Nominal Speed	3600 RPM
Design Performance:	35 GPM @ 180′ TDH
Minimum Pump Efficiency @ Design:	60%
Quantity:	1
HIGH FLOW PUMPS	
Type:	End Suction Centrifugal
Quantity:	3
Motor Starting	Variable Frequency Drive
Motor Nameplate (HP/Enclosure):	50 HP / ODP
Motor Nominal Speed (Maximum)	1800 RPM
Design Performance:	750 GPM @ 180′ TDH
Minimum Pump Efficiency @ Design:	75%

THEORY OF OPERATION

Pump Sequence of Operation: Lead/Standby/High Flow

The Jockey Pump shall start when the system pressure drops below the system pressure setpoint. A variable frequency drive (VFD) shall vary its speed as needed to maintain the system pressure setpoint at variable flow rates. As demand decreases, the Lead pump shall enter sleep mode via either of two user selectable sleep modes: 1) Sleep by Flow or 2) VFD Frequency.

The first Duty Pump shall start when demand reaches 95% of the jockey pump capacity. A variable frequency drive (VFD) shall vary its speed as needed to maintain the system pressure setpoint at variable flow rates. As demand increases each additional High Flow Pump will start and vary its speed as needed to maintain the system pressure setpoint at variable flow rates.

The first High Flow pump shall start automatically when demand exceeds the capacity of the duty pumps. A variable frequency drive (VFD) shall vary its speed as needed to maintain the system pressure setpoint at variable flow rates. As demand increases each additional High Flow Pump will start and vary its speed as needed to maintain the system pressure setpoint at variable flow rates. As demand decreases, the entire process shall take place in reverse order.

Pumps shall enter sleep mode via either of two user selectable sleep modes: 1) Sleep by Flow or 2) VFD Frequency. The Standby High Flow Pump shall take the place of the failed duty pump. The system shall automatically alternate Lead/Standby pump designations based on total operation time and pump faults. Using the controller touchscreen, an operator shall be able to adjust the alternation time, as well as to manually alternate Lead and Standby designations.

SYSTEM PROTECTIONS

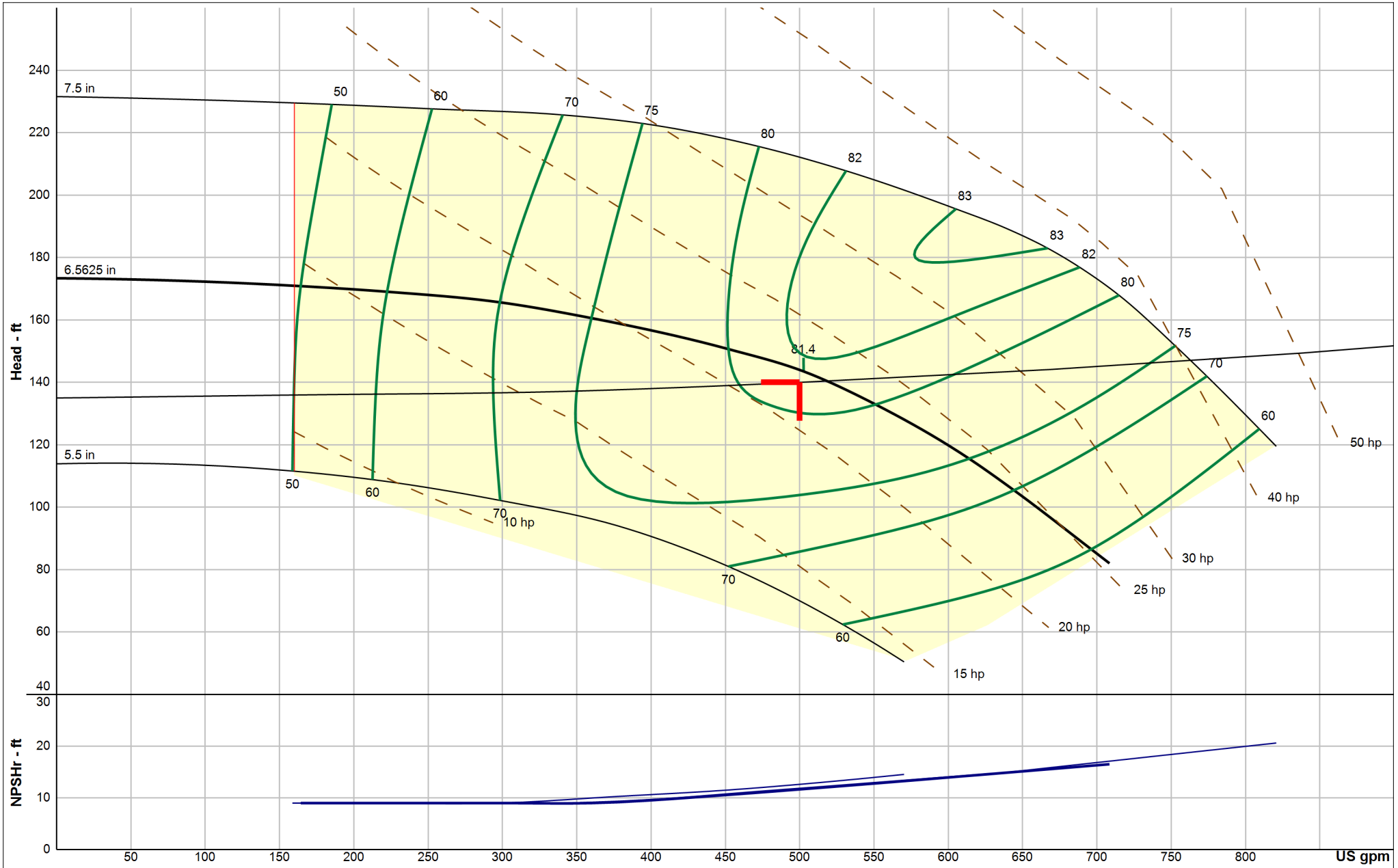
Provide the following at a minimum:

Mechanical System Protections:

- **PRIME LOSS**
- **LOW FLOW**
- **HIGH FLOW**
- **LOW LEVEL (SOURCE TANK)**
- **LOW DISCHARGE PRESSURE**
- **HIGH DISCHARGE PRESSURE**

Electrical System Protections:

- **HIGH OR LOW VOLTAGE**
- **PHASE LOSS/IMBALANCE**
- **VFD FAULTS**
- **MOTOR STARTER FAILURE**
- **ANALOG TRANSMITTER FAILURE**



Min flow line represents the absolute lowest flow pump can operate. For flow rates to the left of the first efficiency line on the curve, consult your Cornell Sales representative. Actual efficiency and HP may vary depending on mounting configuration. Refer to Catalog curve.

Company:	Morrison-Maierle	Cornell		Size:	3WHA
Name:	Lower Hillview Duty Pump	Catalog: Cornell.60, Vers 3.15.0		Speed:	3525 rpm
Date:	11/28/2023	NSF-61 - 3600 rpm		Dia:	6.5625 in
		Design Point: 500 US gpm, 140 ft		Curve:	3WHA36
		Static Head: 135 ft			

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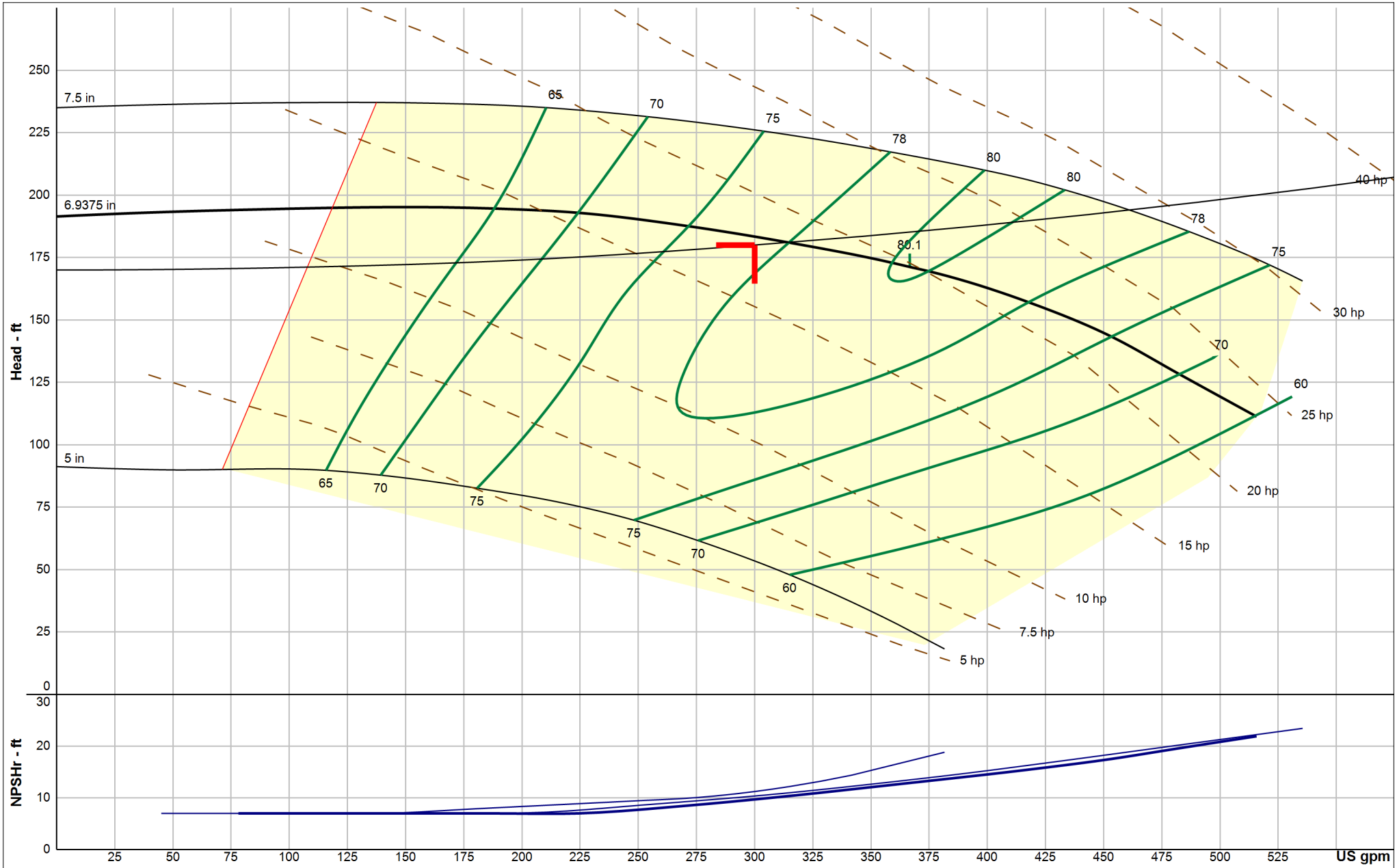

Min flow line represents the absolute lowest flow pump can operate. For flow rates to the left of the first efficiency line on the curve, consult your Cornell Sales representative. Actual efficiency and HP may vary depending on mounting configuration. Refer to Catalog curve.

Company:	Morrison-Maierle	Cornell		Size:	2.5WH
Name:	Upper Hillview Duty Pump	Catalog: Cornell.60, Vers 3.15.0		Speed:	3525 rpm
Date:	11/28/2023	NSF-61 - 3600 rpm		Dia:	6.9375 in
		Design Point:	300 US gpm, 180 ft	Curve:	25WH36
		Static Head:	170 ft		

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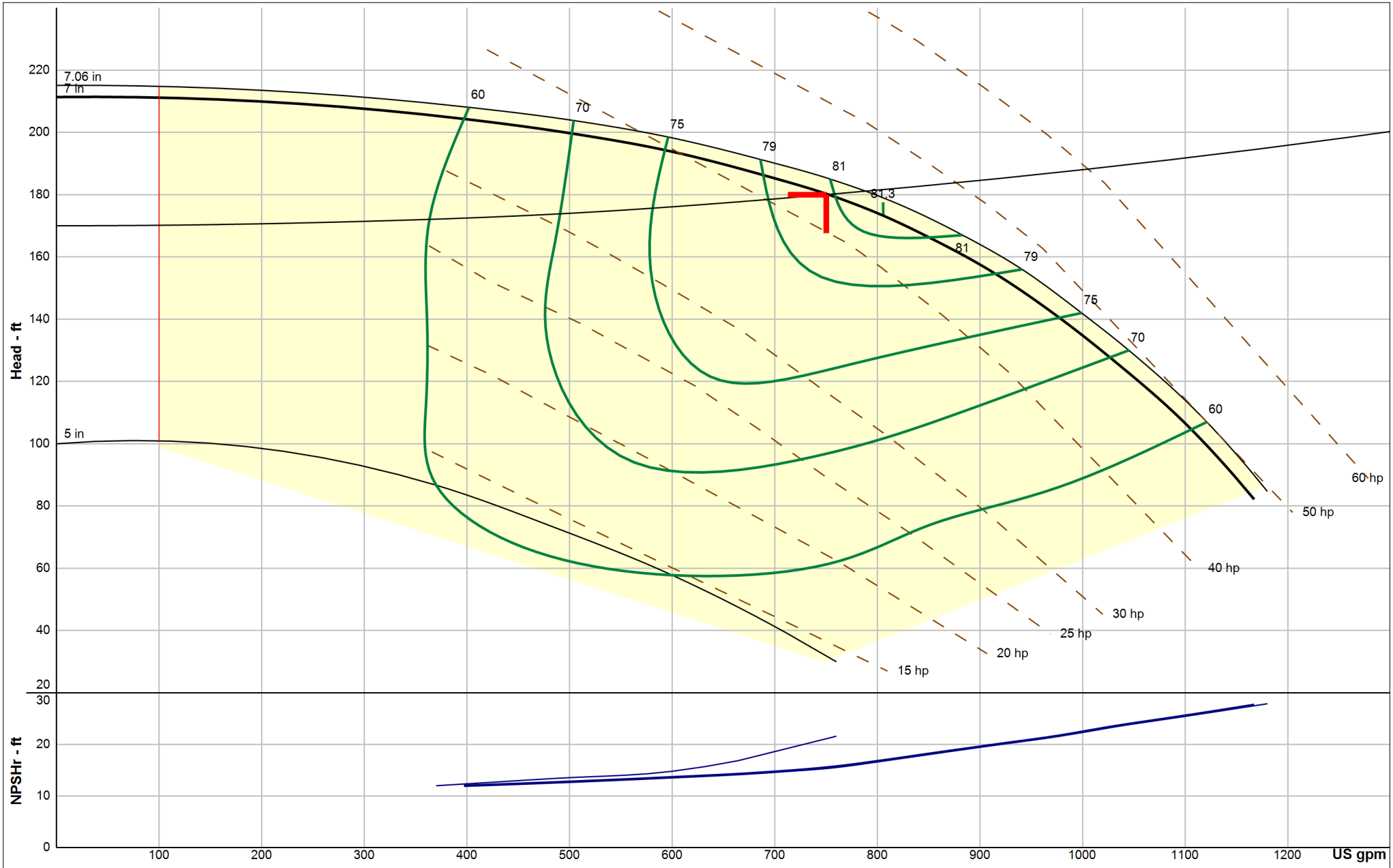

Min flow line represents the absolute lowest flow pump can operate. For flow rates to the left of the first efficiency line on the curve, consult your Cornell Sales representative. Actual efficiency and HP may vary depending on mounting configuration. Refer to Catalog curve.

Company:	Morrison-Maierle	Cornell	Size:	4WH
Name:	Hillview Upper High Flow	Catalog: Cornell.60, Vers 3.15.0	Speed:	3560 rpm
Date:	11/28/2023	NSF-61 - 3600 rpm	Dia:	7 in
		Design Point: 750 US gpm, 180 ft	Curve:	4WH36
		Static Head: 170 ft		

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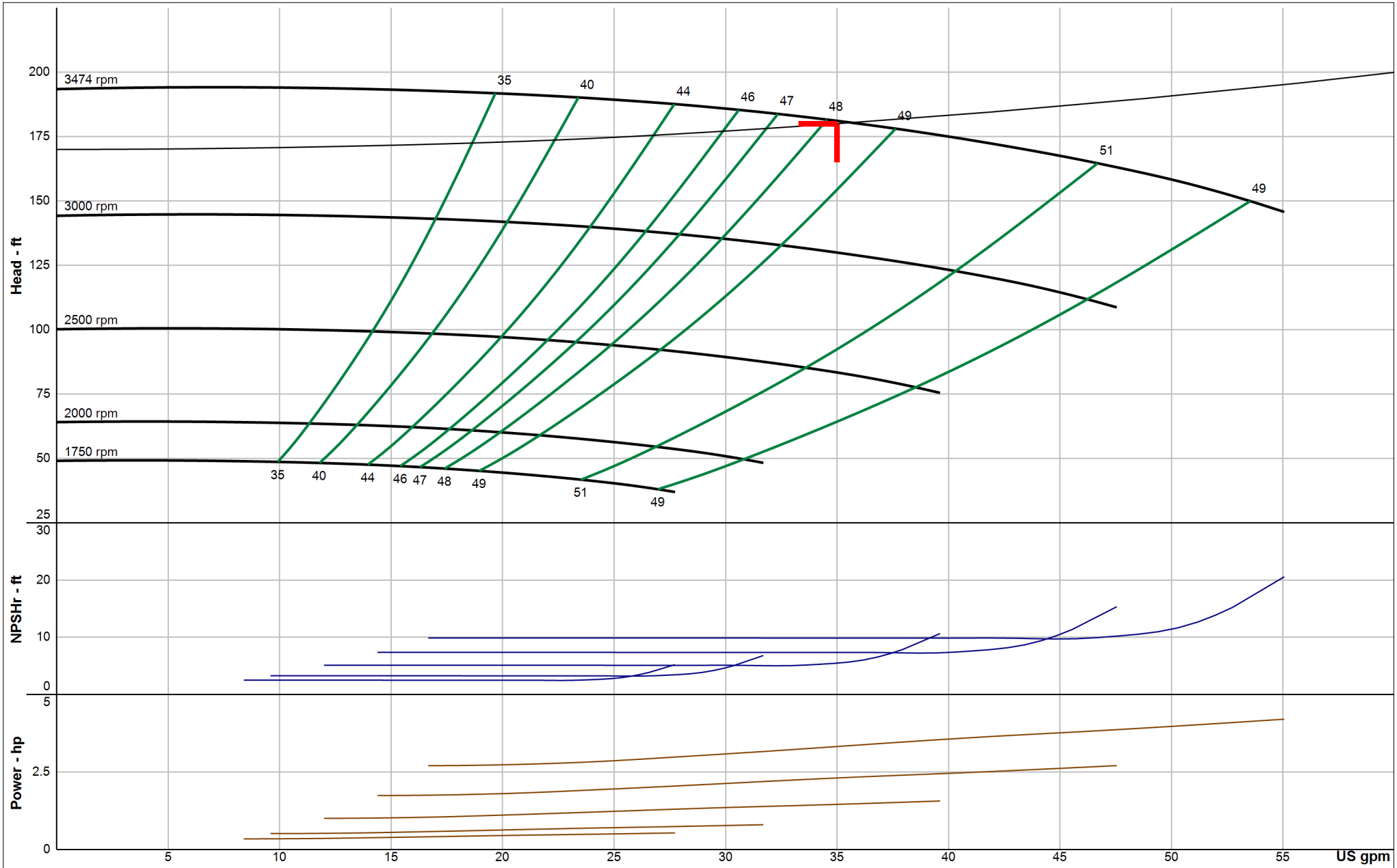

Min flow line represents the absolute lowest flow pump can operate. For flow rates to the left of the first efficiency line on the curve, consult your Cornell Sales representative. Actual efficiency and HP may vary depending on mounting configuration. Refer to Catalog curve.

Company:	Morrison-Maierle	Cornell	Size:	1WC
Name:	Upper Booster Jockey Pump	Catalog: Cornell.60, Vers 3.15.0	Speed:	3495 rpm
Date:	11/28/2023	Clear Liquids - 3600 rpm	Dia:	6.6875 in
		Design Point: 35 US gpm, 180 ft	Curve:	1WC36
		Static Head: 170 ft		

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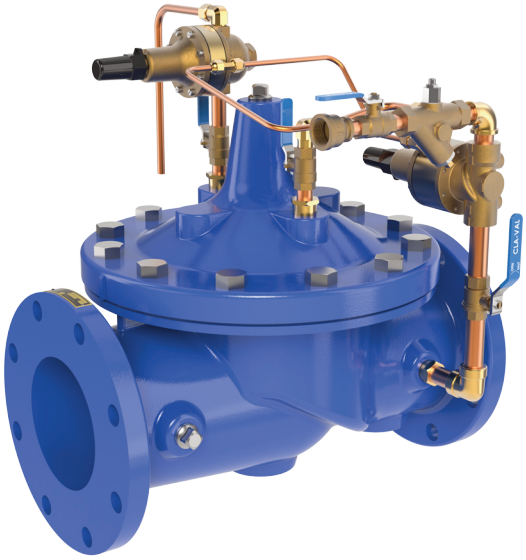
CLA-VAL™

MODEL **52-01**

Pressure Relief & Surge Anticipator Valve



- **Protects Against Water Hammer Surges**
- **Opens On Initial Low Pressure Wave**
- **Closes Slowly To Prevent Subsequent Surges**
- **Adjustable Over A Wide Range of Settings**

The Cla-Val Model 52-01 Surge Anticipator Valve is indispensable for protecting pumps, pumping equipment and all applicable pipelines from dangerous pressure surges caused by rapid changes of flow velocity within a pipeline.

When pumping systems are started and stopped gradually, harmful surges do not occur. However, should a power failure take place, the abrupt stopping of the pump can cause dangerous surges in the system which could result in severe equipment damage.

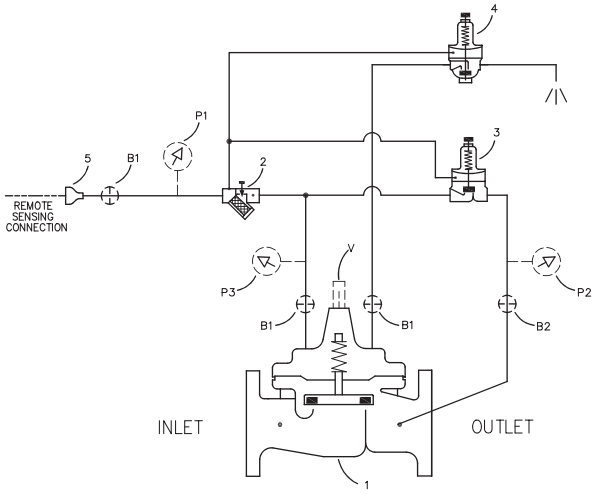
Power failure to a pump will usually result in a down surge in pressure, followed by an up surge in pressure. The surge control valve opens on the initial low pressure wave, diverting the returning high pressure wave from the system. In effect, the valve has anticipated the returning high pressure wave and is open to dissipate the damage causing surge. The valve will then close slowly without generating any further pressure surges.

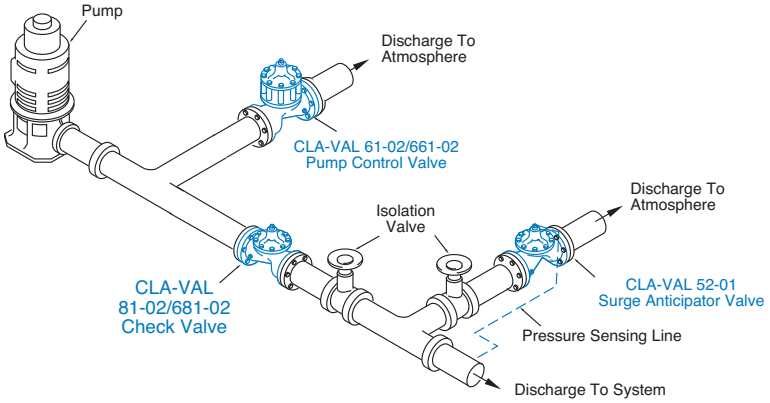
Schematic Diagram

Item	Description
1	100-01 Hytrol Main Valve
2	X42N-3 Strainer Needle Valve
3	CRL-60 Pressure Relief Control
4	CRA Pressure Reducing Control
5	Bell Reducer

Optional Features

Item	Description
B	CK2 Isolation Valve
P	X141 Pressure Gauge
V	X101 Valve Position Indicator





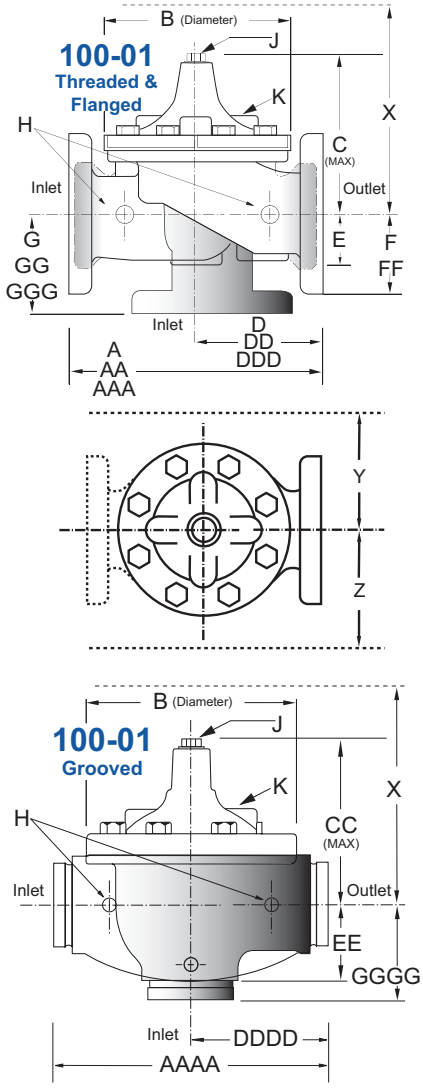
Typical Application

The 52-01 discharges to atmosphere from a tee in the pump discharge header. The valve anticipates surges caused by power failure as well as acting as a standard over pressure relief valve.

Note: The remote pressure sensing line should be ¾" minimum I.D. installed with a 2° slope from the valve to the pipeline to avoid air pockets.

Note: We recommend protecting tubing and valve from freezing temperatures.

Model 52-01 (Uses 100-01 Hytrol Main Valve)



Pressure Ratings (Recommended Maximum Pressure - psi)

Valve Body & Cover		Pressure Class				
		Flanged			Grooved	Threaded
Grade	Material	ANSI Standards*	150 Class	300 Class	300 Class	End‡ Details
ASTM A536	Ductile Iron	B16.42	250	400	400	400
ASTM A216-WCB	Cast Steel	B16.5	285	400	400	400
UNS 87850	Bronze	B16.24	225	400	400	400

Note: * ANSI standards are for flange dimensions only.
Flanged valves are available faced but not drilled.
‡ End Details machined to ANSI B2.1 specifications.
Valves for higher pressure are available; consult factory for details

Materials

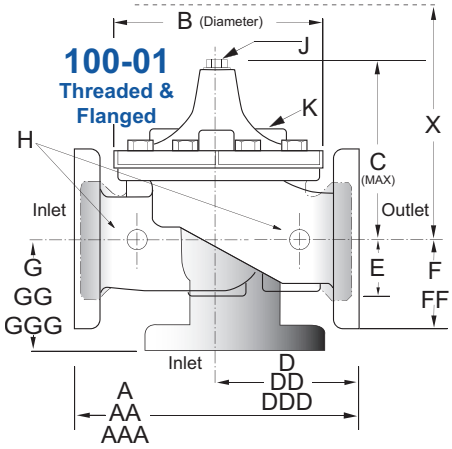
Component	Standard Material Combinations		
Body & Cover	Ductile Iron	Cast Steel	Bronze
Available Sizes	1" - 36"	1" - 16"	1" - 16"
Disc Retainer & Diaphragm Washer	Cast Iron	Cast Steel	Bronze
Trim: Disc Guide, Seat & Cover Bearing	Bronze is Standard Stainless Steel is Optional		
Disc	Buna-N® Rubber		
Diaphragm	Nylon Reinforced Buna-N® Rubber		
Stem, Nut & Spring	Stainless Steel		
For material options not listed, consult factory. Cla-Val manufactures valves in more than 50 different alloys.			

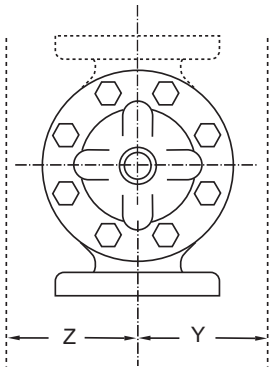
Model 52-01 Dimensions (In Inches)

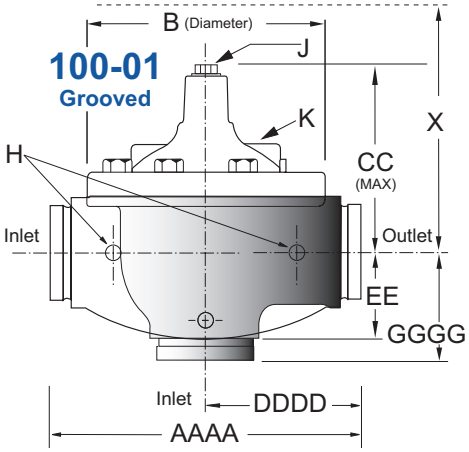
Valve Size (Inches)	1	1 1/4	1 1/2	2	2 1/2	3	4	6	8	10	12	14	16	18	20	24	30	36
A Threaded	7.25	7.25	7.25	9.38	11.00	12.50	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	8.50	9.38	11.00	12.00	15.00	20.00	25.38	29.75	34.00	39.00	41.38	46.00	52.00	61.50	63.00	72.75
AAA 300 ANSI	—	—	9.00	10.00	11.62	13.25	15.62	21.00	26.38	31.12	35.50	40.50	43.50	47.64	53.62	63.24	64.50	74.75
AAAA Grooved End	—	—	8.50	9.00	11.00	12.50	15.00	20.00	25.38	—	—	—	—	—	—	—	—	—
B Diameter	5.62	5.62	5.62	6.62	8.00	9.12	11.50	15.75	20.00	23.62	28.00	32.75	35.50	41.50	45.00	53.16	56.00	66.00
C Maximum	5.50	5.50	5.50	6.50	7.56	8.19	10.62	13.38	16.00	17.12	20.88	24.19	25.00	39.06	41.90	43.93	54.60	59.00
CC Maximum Grooved End	—	—	4.75	5.75	6.88	7.25	9.31	12.12	14.62	—	—	—	—	—	—	—	—	—
D Threaded	3.25	3.25	3.25	4.75	5.50	6.25	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	4.00	4.75	5.50	6.00	7.50	10.00	12.69	14.88	17.00	19.50	20.81	—	—	30.75	—	—
DDD 300 ANSI	—	—	4.25	5.00	5.88	6.38	7.88	10.50	13.25	15.56	17.75	20.25	21.62	—	—	31.62	—	—
DDDD Grooved End	—	—	—	4.75	—	6.00	7.50	—	—	—	—	—	—	—	—	—	—	—
E	1.12	1.12	1.12	1.50	1.69	2.06	3.19	4.31	5.31	9.25	10.75	12.62	15.50	12.95	15.00	17.75	21.31	24.56
EE Grooved End	—	—	2.00	2.50	2.88	3.12	4.25	6.00	7.56	—	—	—	—	—	—	—	—	—
F 150 ANSI	—	—	2.50	3.00	3.50	3.75	4.50	5.50	6.75	8.00	9.50	10.50	11.75	15.00	16.50	19.25	22.50	28.50
FF 300 ANSI	—	—	3.06	3.25	3.75	4.13	5.00	6.25	7.50	8.75	10.25	11.50	12.75	15.00	16.50	19.25	24.00	30.00
G Threaded	1.88	1.88	1.88	3.25	4.00	4.50	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	4.00	3.25	4.00	4.00	5.00	6.00	8.00	8.62	13.75	14.88	15.69	—	—	22.06	—	—
GGG 300 ANSI	—	—	4.25	3.50	4.31	4.38	5.31	6.50	8.50	9.31	14.50	15.62	16.50	—	—	22.90	—	—
GGGG Grooved End	—	—	—	3.25	—	4.25	5.00	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
J NPT Cover Center Plug	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	1.00	1.00	1.25	1.50	2.00	1.00	1.00	1.00	2.00	2.00
K NPT Cover Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
Stem Travel	0.40	0.40	0.40	0.60	0.70	0.80	1.10	1.70	2.30	2.80	3.40	4.00	4.50	5.10	5.63	6.75	7.50	8.50
Approx. Ship Weight (lbs)	15	15	15	35	50	70	140	285	500	780	1165	1600	2265	2982	3900	6200	7703	11720
Approx. **X** Pilot System	11	11	11	13	14	15	17	29	31	33	36	40	40	43	47	68	79	85
Approx. **Y** Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	40	45
Approx. **Z** Pilot System	9	9	9	9	10	11	12	20	22	24	26	29	30	32	34	39	42	47

Note: The top two flange holes on valve size 36 are threaded to 1 1/2"-6 UNC.

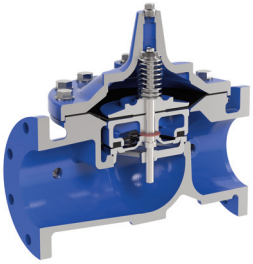
Model 52-01 **Metric Dimensions** (Uses 100-01 Hytrol Main Valve)







Model 100-01 Full Port Hytrol Main Valve



Model 52-01 Dimensions (In mm)

Valve Size (mm)	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
A Threaded	184	184	184	238	279	318	—	—	—	—	—	—	—	—	—	—	—	—
AA 150 ANSI	—	—	216	238	279	305	381	508	645	756	864	991	1051	1168	1321	1562	1600	1848
AAA 300 ANSI	—	—	229	254	295	337	397	533	670	790	902	1029	1105	1210	1326	1606	1638	1899
AAAA Grooved End	—	—	216	228	279	318	381	508	645	—	—	—	—	—	—	—	—	—
B Diameter	143	143	143	168	203	232	292	400	508	600	711	832	902	1054	1143	1350	1422	1676
C Maximum	140	140	140	165	192	208	270	340	406	435	530	614	635	992	1064	1116	1387	1499
CC Maximum Grooved End	—	—	120	146	175	184	236	308	371	—	—	—	—	—	—	—	—	—
D Threaded	83	83	83	121	140	159	—	—	—	—	—	—	—	—	—	—	—	—
DD 150 ANSI	—	—	102	121	140	152	191	254	322	378	432	495	528	—	—	781	—	—
DDD 300 ANSI	—	—	108	127	149	162	200	267	337	395	451	514	549	—	—	803	—	—
DDDD Grooved End	—	—	—	121	—	152	191	—	—	—	—	—	—	—	—	—	—	—
E	29	29	29	38	43	52	81	110	135	235	273	321	394	329	381	451	541	624
EE Grooved End	—	—	52	64	73	79	108	152	192	—	—	—	—	—	—	—	—	—
F 150 ANSI	—	—	64	76	89	95	114	140	171	203	241	267	298	381	419	489	572	724
FF 300 ANSI	—	—	78	83	95	105	127	159	191	222	260	292	324	381	419	489	610	762
G Threaded	48	48	48	83	102	114	—	—	—	—	—	—	—	—	—	—	—	—
GG 150 ANSI	—	—	102	83	102	102	127	152	203	219	349	378	399	—	—	560	—	—
GGG 300 ANSI	—	—	102	89	110	111	135	165	216	236	368	397	419	—	—	582	—	—
GGGG Grooved End	—	—	—	83	—	108	127	—	—	—	—	—	—	—	—	—	—	—
H NPT Body Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
J NPT Cover Center Plug	0.25	0.25	0.25	0.50	0.50	0.50	0.75	0.75	1.00	1.00	1.25	1.50	2.00	1.00	1.00	1.00	2.00	2.00
K NPT Cover Tapping	0.375	0.375	0.375	0.375	0.50	0.50	0.75	0.75	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
Stem Travel	10	10	10	15	18	20	28	43	58	71	86	102	114	130	143	171	190	216
Approx. Ship Weight (kgs)	7	7	7	16	23	32	64	129	227	354	528	726	1027	1353	1769	2812	3494	5316
Approx. **X** Pilot System	280	280	280	331	356	381	432	737	788	839	915	1016	1016	1093	1194	1728	2007	2159
Approx. **Y** Pilot System	229	229	229	229	254	280	305	508	559	610	661	737	762	813	864	991	1016	1143
Approx. **Z** Pilot System	229	229	229	229	254	280	305	508	559	610	661	737	762	813	864	991	1067	1194

*Consult Factory

52-01 Valve Selection	100-01 Pattern: Globe (G), Angle (A), End Connections: Threaded (T), Grooved (GR), Flanged (F) Indicate Available Sizes																		
	Inches	1	1¼	1½	2	2½	3	4	6	8	10	12	14	16	18	20	24	30	36
	mm	25	32	40	50	65	80	100	150	200	250	300	350	400	450	500	600	750	900
Basic Valve 100-01	Pattern	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G, A	G	G	G, A	G	G
	End Detail	T	T	T, F, Gr*	T, F, Gr	T, F, Gr*	T, F, Gr	F, Gr	F, Gr*	F, Gr*	F	F	F	F	F	F	F	F	F
Suggested Flow (gpm)	Maximum	55	93	125	210	300	460	800	1800	3100	4900	7000	8400	11000	14000	17000	25000	42000	50000
	Maximum Surge	120	210	280	470	670	1000	1800	4000	7000	11000	16000	19000	25000	31000	39000	56500	63000	85000
Suggested Flow (Liters/Sec)	Maximum	3.5	6	8	13	19	29	50	113	195	309	442	530	694	883	1073	1577	2650	3150
	Maximum Surge	7.6	13	18	30	42	63	113	252	441	693	1008	1197	1577	1956	2461	3560	3975	5360

100-01 Series is the full internal port Hytrol.

*Globe Grooved Only

CRL-60 Pilot Control

Direct-acting, spring loaded, diaphragm type relief pilot capable of opening and closing within very close pressure limits.

CRA Pilot Control

Automatically reduces a higher inlet pressure to a lower outlet pressure. Direct acting, spring loaded, diaphragm type - hydraulic or pneumatic operation.

Adjustment Ranges

High Pressure Pilot (CRL-60)

0 to 75 psi
20 to 200 psi *
100 to 300 psi
250 to 600 psi

Low Pressure Pilot (CRA)

2 to 30 psi
15 to 75 psi
30 to 300 psi *

*Supplied unless otherwise specified
Other ranges available, please consult factory

Temperature Range

Water: to 180°F

Materials

Standard Pilot System Materials

Pilot Control: Low Lead Bronze
Trim: Stainless Steel 303
Rubber: Buna-N® Synthetic Rubber

Optional Pilot System Materials

Pilot systems are available with optional Aluminum, Stainless Steel or Monel materials.

When Ordering, Specify:

1. Catalog No. 52-01
2. Valve Size
3. Pattern - Globe or Angle
4. Pressure Class
5. Threaded or Flanged
6. Trim Material
7. Adjustment Range
8. Desired Options
9. When Vertically Installed

Valve Options

X141 Pressure Gauge

X101AR Valve Position Indicator with Air Release

X101 Valve Position Indicator

X144 e-FlowMeter

X43H Strainer

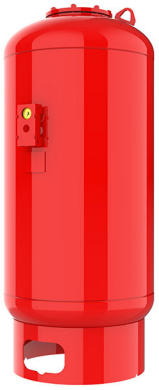
Stainless Steel Pilot

Bell & Gossett
a xylem brand

SUBMITTAL A-315G

JOB: **REPRESENTATIVE:**

UNIT TAG:	ORDER NUMBER:	DATE:
ENGINEER:	SUBMITTED BY:	DATE:
CONTRACTOR:	APPROVED BY:	DATE:



Series "WTA" (ASME) Hydro-Pneumatic Tanks

For potable water systems

DESCRIPTION

Series "WTA" hydro-pneumatic diaphragm tanks are ASME rated, pre-charged vessels. The Series "WTA" tank will help protect the pump and pressure switches against short cycling. The domestic well tank delivers adequate water under pressure between pump cycles to meet the required demand. It will provide economical system operation by minimizing pump starts, extending pump motor life, and saving energy. The "WTA" tank will also assist the pump in meeting peak demand. All Series "WTA" tanks include an integrated bladder integrity monitor and are available with sight glass and/or seismic restraints.

Products comply with ANSI/NSF Standard 61.

CONSTRUCTION

System Connection: Carbon Steel
Shell: Steel
WTA-401 - WTA-405: Butyl Diaphragm Liner
WTA-447 - WTA-457: Replaceable Butyl Bladder
Designed and Constructed per ASME Section VIII, Division 1

FACTORY PRECHARGED

WTA-401 - WTA-405: 30 PSI
WTA-447 - WTA-457: 40 PSI

MAXIMUM OPERATING LIMITS

Maximum Design Pressure:
WTA-401 - WTA-405: 200 PSI (1,379 kPa)
WTA-447 - WTA-457: 125 PSI (862 kPa)
Maximum Design Temperature: 240°F (116°C)

SCHEDULE

MODEL	PART NUMBER	TANK VOLUME Gal (L)	ACCEPTANCE VOLUME Gal (L)	TAGGING INFORMATION	QUANTITY
WTA-401	1BN369LF	17 (64)	12 (45)		
WTA-402	1BN370LF	25 (95)	17.5 (66)		
WTA-403	1BN371LF	34 (129)	23.5 (89)		
WTA-404	1BN372LF	78 (295)	53 (200)		
WTA-405	1BN373LF	90 (340)	60 (227)		
WTA-447	1BN374LF	53 (200)	53 (200)		
WTA-448	1BN375LF	80 (300)	79 (300)		
WTA-449	1BN376LF	106 (400)	106 (400)		
WTA-450	1BN377LF	132 (500)	132 (500)		
WTA-451	1BN378LF	158 (600)	158 (600)		
WTA-452	1BN379LF	211 (800)	211 (800)		
WTA-453	1BN380LF	264 (1,000)	264 (1,000)		
WTA-454	1BN381LF	317 (1,200)	317 (1,200)		
WTA-455	1BN382LF	370 (1,400)	370 (1,400)		
WTA-456	1BN383LF	422 (1,600)	422 (1,600)		
WTA-457	1BN384LF	528 (2,000)	528 (2,000)		

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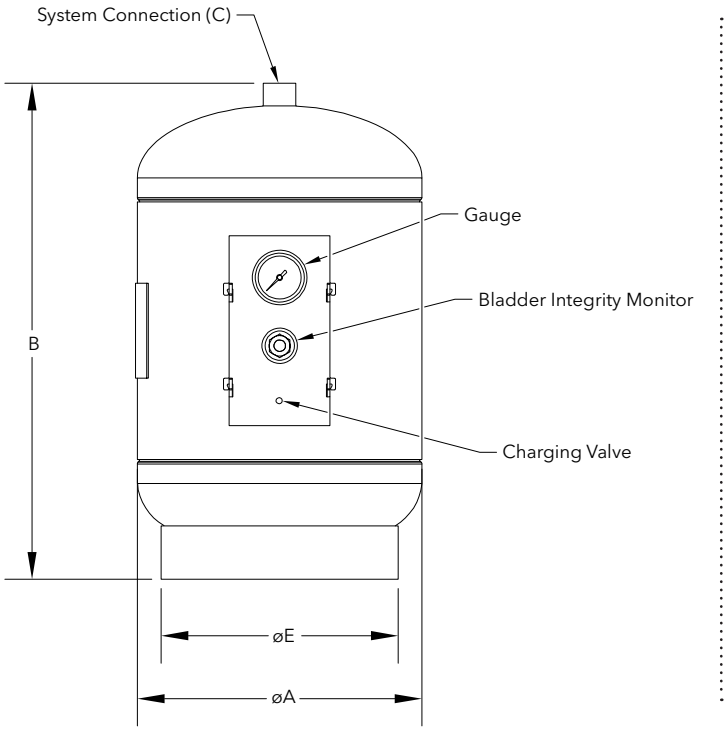
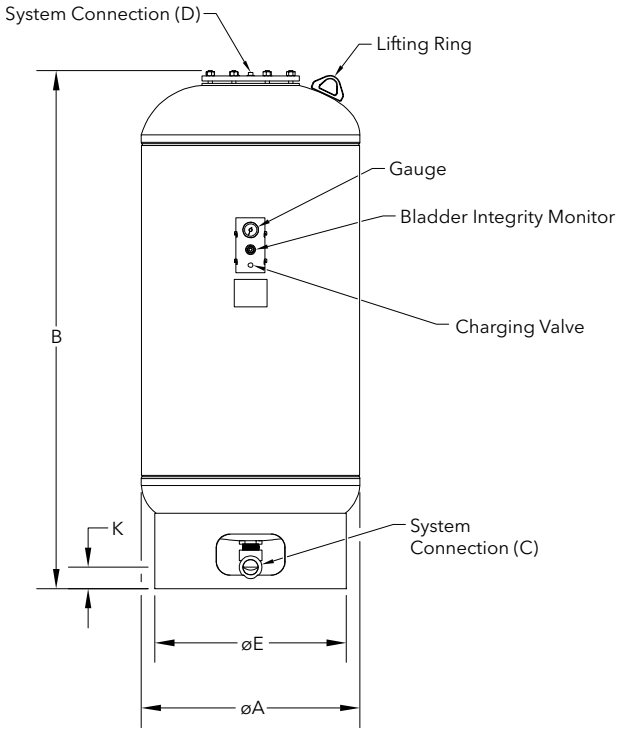


Models WTA-401 through WTA-405



Models WTA-447 through WTA-457

DIMENSIONS AND WEIGHTS

Model	A in (mm)	B in (mm)	C (NPT)	D (NPT)	E in (mm)	K in (mm)	Ship Wt. lbs (kg)	Flooded Wt.* lbs (kg)
WTA-401	16 (406)	25 (635)	1	N/A	14 (356)	N/A	64 (29)	206 (93)
WTA-402	16 (406)	34 (864)	1	N/A	14 (356)	N/A	84 (38)	292 (132)
WTA-403	16 (406)	45 (1,143)	1	N/A	14 (356)	N/A	97 (44)	380 (172)
WTA-404	24 (610)	47 (1,194)	1-1/2	N/A	20 (508)	N/A	259 (118)	909 (412)
WTA-405	24 (610)	53 (1,346)	1-1/2	N/A	20 (508)	N/A	283 (129)	1,033 (469)
WTA-447	24 (610)	43 (1,092)	1-1/2	3/4	20 (508)	5.25 (133)	210 (95)	651 (295)
WTA-448	24 (610)	55 (1,397)	1-1/2	3/4	20 (508)	5.25 (133)	225 (102)	891 (404)
WTA-449	30 (762)	49 (1,245)	1-1/2	3/4	24 (610)	5.25 (133)	300 (136)	1,183 (537)
WTA-450	30 (762)	57 (1,448)	2	3/4	24 (610)	5.25 (133)	335 (152)	1,435 (651)
WTA-451	30 (762)	65 (1,651)	2	3/4	24 (610)	5.25 (133)	360 (164)	1,676 (760)
WTA-452	32 (813)	76 (1,930)	2	3/4	28 (711)	5.25 (133)	475 (216)	2,233 (1,013)
WTA-453	36 (914)	87 (2,210)	3	N/A	30 (762)	9.13 (232)	735 (334)	2,934 (1,331)
WTA-454	36 (914)	98.5 (2,510)	3	N/A	30 (762)	9.13 (232)	745 (339)	3,386 (1,536)
WTA-455	36 (914)	110.5 (2,807)	3	N/A	30 (762)	8.88 (225)	900 (409)	3,982 (1,806)
WTA-456	48 (1,219)	84 (2,134)	3	N/A	42 (1,067)	9.13 (232)	1,210 (550)	4,725 (2,143)
WTA-457	48 (1,219)	96 (2,438)	3	N/A	42 (1,067)	9.13 (232)	1,305 (593)	5,703 (2,587)

Dimensions subject to change. Not to be used for construction purposes.
*Approximate weight 100% full occurs if bag fails or if air charge is lost.

xylem
Let's Solve Water

Xylem Inc.
8200 N. Austin Avenue
Morton Grove, IL 60053
Tel: (847) 966-3700 Fax: (847) 965-8379
www.xylem.com/bellgossett

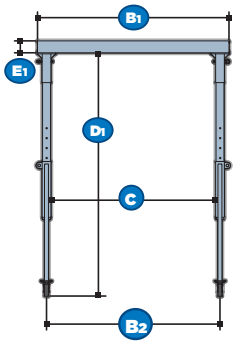
SPANCO

GANTRY CRANES

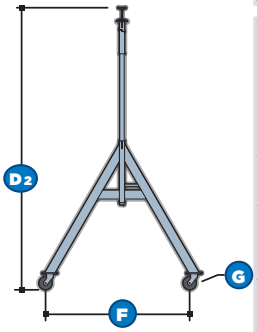
A-Series

Aluminum Adjustable Height & Span

A CAPACITY	B1 OVERALL SPAN	B2 MAX. SPAN BETWEEN WHEEL CENTERS	C CLEAR SPAN	D1 HEIGHT UNDER BEAM Min.	D1 HEIGHT UNDER BEAM Max.	D2 OVERALL HEIGHT Min.	D2 OVERALL HEIGHT Max.	E1 BEAM SIZE	E2 FLANGE WIDTH	F TREAD	G CASTER DIA.	NET WT. (LBS.)	MODEL
½ TON	8'	7' 3"	6' 11"	6' 6"	9' 0"	6' 11"	9' 5"	ALU5"X3.43#	3"	4' 2"	6"	116	0.5ALU0809
		7' 3"	6' 11"	8' 6"	11' 0"†	8' 11"	11' 5"	ALU5"X3.43#	3"	4' 2"	6"	135	0.5ALU0811
	10'	9' 3"	8' 11"	6' 6"	9' 0"	7' 0"	9' 6"	ALU6"X4.3#	3-3/8"	4' 2"	6"	131	0.5ALU1009
		9' 3"	8' 11"	8' 6"	11' 0"†	9' 0"	11' 6"	ALU6"X4.3#	3-3/8"	4' 2"	6"	150	0.5ALU1011
	12'	11' 3"	10' 11"	6' 6"	9' 0"	7' 2"	9' 8"	ALU8"X6.35#	4"	4' 2"	6"	164	0.5ALU1209
		11' 3"	10' 11"	8' 6"	11' 0"†	9' 2"	11' 8"	ALU8"X6.35#	4"	4' 2"	6"	183	0.5ALU1211
	15'	14' 3"	13' 11"	6' 6"	9' 0"	7' 2"	9' 8"	ALU8"X6.35#	4"	4' 2"	6"	192	0.5ALU159
		14' 3"	13' 11"	8' 6"	11' 0"†	9' 2"	11' 8"	ALU8"X6.35#	4"	4' 2"	6"	211	0.5ALU1511



A CAPACITY	B1 OVERALL SPAN	B2 MAX. SPAN BETWEEN WHEEL CENTERS	C CLEAR SPAN	D1 HEIGHT UNDER BEAM Min.	D1 HEIGHT UNDER BEAM Max.	D2 OVERALL HEIGHT Min.	D2 OVERALL HEIGHT Max.	E1 BEAM SIZE	E2 FLANGE WIDTH	F TREAD	G CASTER DIA.	NET WT. (LBS.)	MODEL
1 TON	8'	7' 3"	6' 10"	5' 7"	8' 1"	6' 1"	8' 7"	ALU6"X4.3#	3-3/8"	4' 6"	6"	150	1ALU0808
		7' 3"	6' 10"	7' 7"	10' 1"	8' 1"	10' 7"	ALU6"X4.3#	3-3/8"	4' 6"	6"	157	1ALU0810
		7' 3"	6' 10"	9' 7"	12' 1"†	10' 1"†	12' 7"†	ALU6"X4.3#	3-3/8"	4' 6"	6"	197	1ALU0812
	10'	9' 3"	8' 10"	5' 7"	8' 1"	6' 3"	8' 9"	ALU8"X6.35#	4"	4' 6"	6"	180	1ALU1008
		9' 3"	8' 10"	7' 7"	10' 1"	8' 3"	10' 9"	ALU8"X6.35#	4"	4' 6"	6"	187	1ALU1010
		9' 3"	8' 10"	9' 7"	12' 1"†	10' 3"†	12' 9"†	ALU8"X6.35#	4"	4' 6"	6"	227	1ALU1012
	12'	11' 3"	10' 10"	5' 7"	8' 1"	6' 3"	8' 9"	ALU8"X6.35#	4"	4' 6"	6"	192	1ALU1208
		11' 3"	10' 10"	7' 7"	10' 1"	8' 3"	10' 9"	ALU8"X6.35#	4"	4' 6"	6"	199	1ALU1210
		11' 3"	10' 10"	9' 7"	12' 1"†	10' 3"†	12' 9"†	ALU8"X6.35#	4"	4' 6"	6"	239	1ALU1212
	15'	14' 3"	13' 10"	5' 7"	8' 1"	6' 5"	8' 11"	ALU10"X8.76#	4-5/8"	4' 6"	6"	248	1ALU1508
		14' 3"	13' 10"	7' 7"	10' 1"	8' 5"	10' 11"	ALU10"X8.76#	4-5/8"	4' 6"	6"	255	1ALU1510
		14' 3"	13' 10"	9' 7"	12' 1"†	10' 5"†	12' 11"†	ALU10"X8.76#	4-5/8"	4' 6"	6"	295	1ALU1512
	18'	17' 3"	16' 9"	5' 10"	8' 4"	6' 11"	9' 5"	ALU12"X10.99#*	5"	4' 4"	8"	389	1ALU1808
		17' 3"	16' 9"	7' 10"	10' 4"	8' 11"	11' 5"	ALU12"X10.99#*	5"	4' 4"	8"	401	1ALU1810
		17' 3"	16' 9"	9' 10"	12' 4"†	10' 11"†	13' 5"†	ALU12"X10.99#*	5"	4' 4"	8"	441	1ALU1812
	20'	19' 3"	18' 9"	5' 10"	8' 4"	6' 11"	9' 5"	ALU12"X10.99#*	5"	4' 4"	8"	423	1ALU2008
		19' 3"	18' 9"	7' 10"	10' 4"	8' 11"	11' 5"	ALU12"X10.99#*	5"	4' 4"	8"	435	1ALU2010
		19' 3"	18' 9"	9' 10"	12' 4"†	10' 11"†	13' 5"†	ALU12"X10.99#*	5"	4' 4"	8"	475	1ALU2012



A CAPACITY	B1 OVERALL SPAN	B2 MAX. SPAN BETWEEN WHEEL CENTERS	C CLEAR SPAN	D1 HEIGHT UNDER BEAM Min.	D1 HEIGHT UNDER BEAM Max.	D2 OVERALL HEIGHT Min.	D2 OVERALL HEIGHT Max.	E1 BEAM SIZE	E2 FLANGE WIDTH	F TREAD	G CASTER DIA.	NET WT. (LBS)	MODEL
2 TON	8'	7' 3"	6' 9"	5' 10"	8' 4"	6' 6"	9' 0"	ALU8"X6.35#	4"	4' 4"	8"	237	2ALU0808
		7' 3"	6' 9"	7' 10"	10' 4"	8' 6"	11' 0"	ALU8"X6.35#	4"	4' 4"	8"	246	2ALU0810
		7' 3"	6' 9"	9' 10"†	12' 4"†	10' 6"†	13' 0"†	ALU8"X6.35#	4"	4' 4"	8"	276	2ALU0812
	10'	9' 3"	8' 9"	5' 10"	8' 4"	6' 8"	9' 2"	ALU10"X8.76#	4-5/8"	4' 4"	8"	274	2ALU1008
		9' 3"	8' 9"	7' 10"	10' 4"	8' 8"	11' 2"	ALU10"X8.76#	4-5/8"	4' 4"	8"	286	2ALU1010
		9' 3"	8' 9"	9' 10"†	12' 4"†	10' 8"†	13' 2"†	ALU10"X8.76#	4-5/8"	4' 4"	8"	313	2ALU1012
	12'	11' 3"	10' 9"	5' 10"	8' 4"	6' 10"	9' 4"	ALU12"X10.99#	5"	4' 4"	8"	322	2ALU1208
		11' 3"	10' 9"	7' 10"	10' 4"	8' 10"	11' 4"	ALU12"X10.99#	5"	4' 4"	8"	334	2ALU1210
		11' 3"	10' 9"	9' 10"†	12' 4"†	10' 10"†	13' 4"†	ALU12"X10.99#	5"	4' 4"	8"	361	2ALU1212
	15'	14' 3"	13' 9"	5' 10"	8' 4"	6' 10"	9' 4"	ALU12"X10.99#	5"	4' 4"	8"	355	2ALU1508
		14' 3"	13' 9"	7' 10"	10' 4"	8' 10"	11' 4"	ALU12"X10.99#	5"	4' 4"	8"	367	2ALU1510
		14' 3"	13' 9"	9' 10"†	12' 4"†	10' 10"†	13' 4"†	ALU12"X10.99#	5"	4' 4"	8"	394	2ALU1512

A CAPACITY	B1 OVERALL SPAN	B2 MAX. SPAN BETWEEN WHEEL CENTERS	C CLEAR SPAN	D1 HEIGHT UNDER BEAM Min.	D1 HEIGHT UNDER BEAM Max.	D2 OVERALL HEIGHT Min.	D2 OVERALL HEIGHT Max.	E1 BEAM SIZE	E2 FLANGE WIDTH	F TREAD	G CASTER DIA.	NET WT. (LBS.)	MODEL
3 TON	8'	7' 2"	6' 8-1/2"	6' 2"	8' 2"	7' 2"	9' 2"	ALU12"X10.99#	5"	4' 8"	8"	350	3ALU0808
		7' 2"	6' 8-1/2"	7' 8"	10' 2"	8' 8"	11' 2"	ALU12"X10.99#	5"	4' 8"	8"	369	3ALU0810
		7' 2"	6' 8-1/2"	9' 8"†	12' 2"†	10' 8"†	13' 2"†	ALU12"X10.99#	5"	4' 8"	8"	416	3ALU0812
	10'	9' 2"	8' 8-1/2"	6' 2"	8' 2"	7' 2"	9' 2"	ALU12"X10.99#	5"	4' 8"	8"	372	3ALU1008
		9' 2"	8' 8-1/2"	7' 8"	10' 2"	8' 8"	11' 2"	ALU12"X10.99#	5"	4' 8"	8"	391	3ALU1010
		9' 2"	8' 8-1/2"	9' 8"†	12' 2"†	10' 8"†	13' 2"†	ALU12"X10.99#	5"	4' 8"	8"	438	3ALU1012
	12'	11' 2"	10' 8-1/2"	6' 2"	8' 2"	7' 3"	9' 3"	ALU12"X10.99#	5"	4' 8"	8"	426	3ALU1208
		11' 2"	10' 8-1/2"	7' 8"	10' 2"	8' 9"	11' 3"	ALU12"X10.99#	5"	4' 8"	8"	445	3ALU1210
		11' 2"	10' 8-1/2"	9' 8"†	12' 2"†	10' 9"†	13' 3"†	ALU12"X10.99#*	5"	4' 8"	8"	491	3ALU1212
	15'	14' 2"	13' 8-1/2"	6' 2"	8' 2"	7' 3"	9' 3"	ALU12"X10.99#*	5"	4' 8"	8"	467	3ALU1508
		14' 2"	13' 8-1/2"	7' 8"	10' 2"	8' 9"	11' 3"	ALU12"X10.99#*	5"	4' 8"	8"	479	3ALU1510
		14' 2"	13' 8-1/2"	9' 8"†	12' 2"†	10' 9"†	13' 3"†	ALU12"X10.99#*	5"	4' 8"	8"	532	3ALU1512

* Capped Beam

† 2' Height Extension Kit Included

Morrison Maierle
engineers • surveyors • planners • scientists

memo

TO:

FROM: Aaron McConkey, PE

PREPARED BY: Jake Miller, PE

DATE: June 20, 2023

JOB NO.: 1993.033

RE: Hillview Booster Pumps – Hydraulic Model

CC:

☐**Urgent** ☒**For Review** ☐**Please Comment** ☐**Please Reply** ☐**For Your Use**

Morrison-Maierle was hired by Cushing Terrel to size the hydraulic components for the booster pumps as part of the Hillview Water System Booster Pumps project. The booster pumps are to be located within the Hillview Subdivision located off Hillview Way at Section 05, Township 12 North, Range 19 West, Missoula, MT. The pumps are to be sized based on the demands provided by Cussing Terrel and meet the City of Missoula Public Works Standards, Montana Department of Environmental Quality Circular-1 Standards and Montana Public Works Standard Specifications.

Morrison-Maierle created a hydraulic model using InfoWater Pro software by Autodesk for the Hillview Water System Booster Pumps project based on information provided by Cushing Terrel. Elevations, demands, and dimensions are based on the Water Exhibit 1/X103 dated January 4, 2023 and response to RFI No. 1 dated June 9, 2023. The model created includes scenarios for average day demand (ADD), max day demand (MDD) and peak hour demand (PHD) as identified in the Water Exhibit. The pipeline was previously modeled in two design options, the first as the Water Exhibit identifies, 8-inch diameter ductile iron main from the lower system booster pump station to Pressure Zone 2 where it transitions to 12-inch diameter ductile iron main and extends to the new water storage tank with a 8-inch diameter tank outlet to the upper system booster pump station. The second pipeline design option was modeled as 12-inch diameter ductile iron main from the lower system booster pump station to the new water storage tank with an 8-inch diameter tank outlet to the upper system booster pump station. The second design option was modeled for PHD only to determine if a lower capacity pump station could be used if the diameter of the main was increased from 8-inch diameter to 12-inch diameter from the lower booster station to Pressure Zone 2 connection. Each modeled option was checked for compliance with Department of Environmental Quality Circular-1. The results for each scenario and design option are provided within the table on the following page.

Model Results:

Demand Scenario	Pump Location	Elevation (ft)	Upstream Pressure (psi)	Downstream Pressure (psi)	Flow (gpm)	Head Gain (ft)	Available NPSH (ft)
ADD	Lower	3,447.00	67.77	130.2	2,184.25	144.1	189.5
	Upper	3,652.00	8.67	77.98	36.52	159.98	53.08
MDD	Lower	3,447.00	63.62	128.85	2,140.57	150.54	179.94
	Upper	3,652.00	8.66	77.65	210.82	159.21	53.07
PHD	Lower	3,447.00	63.62	128.8	2,141.35	150.42	179.94
	Upper	3,652.00	8.66	77.32	293.82	158.47	53.06
PHD 12" Mainline	Lower	3,447.00	63.5	105.62	2,479.29	97.22	179.66
	Upper	3,652.00	8.66	77.32	293.82	158.47	53.06

Pump sizing is based on peak hour demand (PHD) and average day demand for maximum and standard operating conditions, respectively. The lower booster pump station will need to provide a total flow rate of 2,141 gpm at approximately 129 psi for peak hour demand and a total flow rate of 2,184 gpm at approximately 130 psi for the average day demand. The upper pump station will require a total flow rate of 294 gpm at approximately 77 psi for peak hour demand and a total flow rate of 37 gpm at approximately 78 psi for the average day demand.

The model was updated November 2023 with added demand to Pressure Zone 1 for the Future Development Boundary identified on the updated Water Exhibit 1/X103. The update also included more accurate elevations. The previous model results were used to determine a total of 3 pumps per booster pump station. The lower booster station was sized at 3 pumps with 500 gallon per minute flow rates for a total flow rate of 1500 gallons per minute. The upper booster station was sized at 3 pumps with 667 gallon per minute flow rates for a total flow rate of 2000 gallons per minute. The updated results are provided below:

Demand Scenario	Pump Location	Elevation (ft)	Upstream Pressure (psi)	Downstream Pressure (psi)	Flow (gpm)	Head Gain (ft)	Available NPSH (ft)
ADD	Lower	3,520.41	46.15	77.05	2,628.12	71.32	139.64
	Upper	3,647.54	9.73	79.02	94.82	159.91	55.54
MDD	Lower	3,520.41	46.14	76.84	2,630.75	70.85	139.62
	Upper	3,647.54	9.69	77.72	547.37	157	55.45
PHD	Lower	3,520.41	46.12	76.31	2,637.16	69.69	139.56
	Upper	3,647.54	9.4	66.17	1,702.45	131.02	54.79

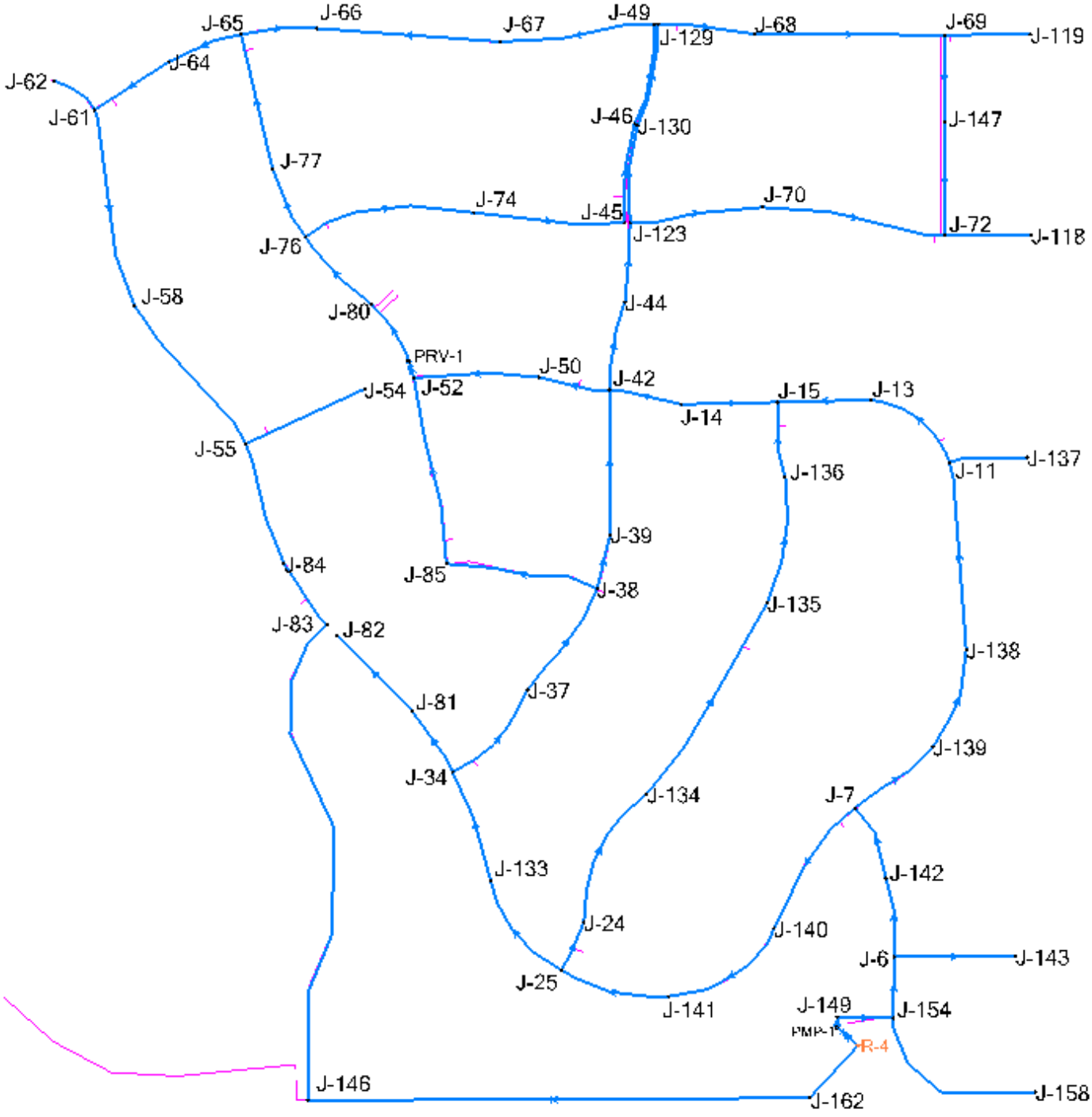
The lower booster pump station will need to provide a total flow rate of 2,638 gpm at approximately 77 psi for peak hour demand and a total flow rate of 2,629 gpm at approximately 77 psi for the average day demand. The upper pump station will require a total flow rate of

1,703 gpm at approximately 67 psi for peak hour demand and a total flow rate of 95 gpm at approximately 79 psi for the average day demand.

This information will be used for determining the number of pumps required and the development of requirements for vendors to provide booster pump proposals and technical data.

Cushing Terrell

Appendix C: WaterCAD Model


J-65
J-66
J-67
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J-130
J-147
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PRV-1
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J-138
J-81
J-37
J-139
J-34
J-134
J-7
J-133
J-142
J-24
J-140
J-6
J-143
J-25
J-141
J-149
J-154
PMP-1
R-4
J-146
J-162
J-158

				With Adj Dev Pump		Without Adj Dev Pump	
Junction	Elevation (ft)	Zone	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)	Hydraulic Grade (ft)	Pressure (psi)
J-6	3652	Zone - 1	0	3822.6	74	3771.26	52
J-7	3640.8	Zone - 1	0	3822.1	78	3770.76	56
J-11	3613	Zone - 1	0	3821.84	90	3770.5	68
J-13	3602	Zone - 1	10	3821.78	95	3770.43	73
J-14	3591	Zone - 1	10	3821.67	100	3770.33	78
J-15	3598	Zone - 1	0	3821.73	97	3770.39	75
J-24	3603	Zone - 1	10	3821.75	95	3770.41	72
J-25	3604	Zone - 1	0	3821.76	94	3770.42	72
J-34	3579	Zone - 1	0	3821.67	105	3770.33	83
J-37	3578	Zone - 1	10	3821.65	105	3770.31	83
J-38	3594	Zone - 1	0	3821.63	98	3770.29	76
J-39	3594	Zone - 1	10	3821.63	98	3770.29	76
J-42	3563	Zone - 1	0	3821.63	112	3770.29	90
J-44	3580	Zone - 1	10	3821.62	105	3770.28	82
J-45	3573	Zone - 2	0	3677.98	45	3677.98	45
J-46	3567	Zone - 2	10	3677.97	48	3677.97	48
J-49	3562	Zone - 2	0	3677.97	50	3677.97	50
J-50	3580	Zone - 1	10	3821.62	105	3770.27	82
J-52	3568	Zone - 1	0	3821.6	110	3770.26	88
J-54	3565	Zone - 2	0	3677.96	49	3677.96	49
J-55	3554	Zone - 2	0	3677.96	54	3677.96	54
J-58	3542	Zone - 2	10	3677.96	59	3677.96	59
J-61	3517	Zone - 2	10	3677.96	70	3677.96	70
J-62	3511	Zone - 2	0	3677.96	72	3677.96	72
J-64	3517	Zone - 2	10	3677.97	70	3677.97	70
J-65	3529	Zone - 2	0	3677.97	64	3677.97	64
J-66	3538	Zone - 2	10	3677.97	61	3677.97	61
J-67	3556	Zone - 2	10	3677.97	53	3677.97	53
J-68	3566	Zone - 1	10	3821.61	111	3770.26	88
J-69	3574	Zone - 1	0	3821.61	107	3770.26	85
J-70	3581	Zone - 2	10	3821.61	104	3770.27	82
J-72	3588	Zone - 1	0	3821.61	101	3770.27	79
J-74	3566	Zone - 2	10	3677.98	48	3677.98	48
J-76	3552	Zone - 2	0	3677.99	55	3677.99	55
J-77	3543	Zone - 2	10	3677.98	58	3677.98	58
J-80	3564	Zone - 2	10	3678.02	49	3678.02	49
J-81	3573	Zone - 1	10	3821.67	108	3770.33	85
J-82	3571	Zone - 1	10	3821.67	108	3770.33	86
J-83	3571	Zone - 2	0	3677.96	46	3677.96	46
J-84	3567	Zone - 2	0	3677.96	48	3677.96	48
J-85	3580	Zone - 1	0	3821.62	105	3770.27	82
J-118	3594	Zone - 1	0	3821.61	98	3770.27	76
J-119	3572	Zone - 1	0	3821.61	108	3770.26	86

J-123	3573	Zone - 1	0	3821.61	108	3770.27	85
J-129	3562	Zone - 1	0	3821.61	112	3770.27	90
J-130	3567	Zone - 1	10	3821.61	110	3770.27	88
J-133	3589	Zone - 1	10	3821.71	101	3770.37	78
J-134	3579	Zone - 1	10	3821.74	105	3770.4	83
J-135	3634	Zone - 1	0	3821.73	81	3770.39	59
J-136	3602	Zone - 1	10	3821.73	95	3770.39	73
J-137	3615	Zone - 1	0	3821.84	89	3770.5	67
J-138	3627	Zone - 1	10	3821.95	84	3770.61	62
J-139	3636	Zone - 1	10	3822.02	80	3770.68	58
J-140	3623	Zone - 1	10	3821.96	86	3770.62	64
J-141	3612	Zone - 1	0	3821.85	91	3770.51	69
J-142	3649.5	Zone - 1	0	3822.35	75	3771.01	53
J-143	3657.75	Zone - 1	10	3822.6	71	3771.26	49
J-146	3563	Zone - 2	0	3677.96	50	3677.96	50
J-147	3585	Zone - 1	10	3821.61	102	3770.26	80
J-149	3649.97	Zone - 1	0	3823	75	3771.66	53
J-154	3655	Zone - 1	0	3822.81	73	3771.47	50
J-158	3665	Zone - 1	0	3822.81	68	3771.47	46
J-162	3638.96	Zone - 1	0	3672	14	3672	14