PRELIMINARY UTILITY REPORT

FOR

ARMORY COMMUNITY

AT

4750 BROADWAY STREET

BOULDER, CO 80304

FOR

ARMORY LAND INVESTORS, LLC

FEBRUARY 2ND, 2015
REVISED APRIL 17, 2015

April 20, 2015

Edward Stafford, Development Review Manager
City of Boulder – Planning and Development Services
1739 Broadway, Third Floor
P.O. Box 791
Boulder, CO 80306-0791

RE: Armory Community
Utility Report – Revised
JVA Job No. 1587.1c

Dear Edward:

As requested by the City of Boulder, JVA has prepared an analysis of the proposed utility design and conditions for the proposed development at the Armory Community. The following report is primarily intended to analyze the water and wastewater demands based on the proposed site improvements. The following Utility Report has been revised from its initial publication dated February 2, 2015 and includes revisions per LUR City comments dated February 27, 2015. This report has been produced in accordance with the City of Boulder Design & Construction Standards. This report has been revised based City of Boulder Comments dated February 27, 2015.

It is our understanding that the information provided herein meets the requirements of the City of Boulder for the utility submission required for the Site Review submittal.

Please contact us if you have any questions regarding this submission.

Sincerely,

JVA, Inc.

_____

Robin L. Kriss, PE
Project Engineer

PRELIMINARY UTILITY REPORT

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4750 BROADWAY STREET
BOULDER, CO 80304

FOR THE

ARMORY LAND INVESTORS, LLC

JVA, Inc.
1319 Spruce Street
Boulder, CO 80302
phone: 303-444-1951
fax: 303-444-1957

JVA Project No. 1587.1c

February 2nd, 2015
Revised April 17, 2015

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UTILITY REPORT

INTRODUCTION

GENERAL LOCATION AND DESCRIPTION

Armory Land Investors, LLC is proposing a development at 4750 Broadway Street in Boulder, Colorado. The subject property is approximately 8.55-acres of developed land located on a tract of land in the Northwest Quarter of the Southwest Quarter of the Southwest Quarter of Section 7, Township 1 North, Range 70 West of the 6th Principal Meridian in the City and County of Boulder, State of Colorado. More specifically, the site is bound by Broadway Street to the west, Lee Hill Drive to the north, 14th Street to the east and an existing residential development to the south. A vicinity map is included in the Appendix of this report.

The proposed development will divide the property and into four blocks separated by two roads and associated right-of-way which will include mixed use buildings, an art pavilion, underground parking, and future development along with associated parking, access drives, sidewalks and landscaping. Block 1 will consist of three buildings; A, B, & C. Building A is the existing Armory building which will be converted into a brewpub and restaurant. Building B will be an arts pavilion, retail and residential space. Building C will be retail and residential space. Block 2 will consist of one mixed used building, Building D, with retail and residential space. Block 3 and 4 will be available for future development. A new detention and water quality basin will be constructed near the southeast corner of the site to handle developed storm runoff.

UTILITIES

WATER SYSTEM

There is an existing 16-inch DIP (ductile iron pipe) water main that runs along Broadway Street to the west, a 12-inch DIP water main that runs along Lee Hill Drive to the north, an 8-inch PVC water main that runs along 14th Street to the east and an 8-inch PVC water main the runs along 13th Street to the south and has a terminus near the south property line. These water mains are part of the City's public water system. There is an existing domestic service line which extends into the site for the existing buildings. However the size and location of the domestic water service connection and meter are unknown at this time.

The project will have 8-inch PVC water mains installed through the site within the proposed right-of-ways. The proposed water main system will be looped and will connect to the existing public water mains at the intersections of Zamia Ave with Broadway and 14th Street. The water mains will also connect to the existing mains along 13th Street at the intersection on Lee Hill Drive and at the existing water main terminus at the southern end of the property within 13th Street.

Blocks 1 and 2 will consist of four separate mixed use buildings distributed through the blocks. Each proposed building entity will have its own water meter and fire service connection except Building E which will share service with Building D. Building A will tap water services from the proposed 8-inch PVC main in 13th Street. Building B will tap water services from the

existing 12-inch DIP main in Lee Hill Road. Building C will tap water services from the proposed 8-inch main in Zamia Avenue. Building D and E will share water services that will be tapped from the proposed 8-inch main in Zamia Avenue. 117

The table below shows a summary of IFC 2015 fire flow requirements for Blocks 1 and 2. Blocks 3 and 4 will be part of future development and are not included at this time.

The fire hydrant demands have been based on square footage of space for each building of the project and type of construction used for the building. Per the 2015-International Fire Code, buildings to be sprinkled may receive a 50% reduction in the required fire flow – a number determined using table B105.1 of that code.

IFC 2015 - Summary Analysis				
Building	**Total Building Floor Area/s (SF)**	**Construction Type**	**Required Fire Hydrant Flow (gpm)***	**Required Number of Hydrants**
Block 1				
Building A	9,496 SF	Type VA	875	1
Building B	33,968 SF	Type 1A and Type VA	1,625	1
Building C	64,318 SF	Type 1A and Type VA	2,250	2
Parking	53,720 SF	Type IA	1,250	1
Block 2				
Building D	53,874 SF	Type VA	2,125	2
Building E	8,554 SF	Type VA	875	1
Parking	34,941 SF	Type IA	1,000	1

*Note: All buildings received a 50% reduction in required fire flow from Table B105.1(2) for being fully sprinkled.

There are eight existing fire hydrants surrounding the site on the adjacent roadways. There are two existing hydrants located near the intersection of Broadway and Zamia Ave. Another existing hydrant is located at the southwest corner of the Broadway and Lee Hill Road intersection. There is an existing hydrant located on the north side of Lee Hill Drive near the intersection of 13th Street. Three more existing hydrants are on the east side of 14th Street, across the road from the proposed site. There is also an existing hydrant at the southern end of the property, located on the west side of 13th Street terminus. Based on the square footage and construction types of the buildings, Block 1 will require five hydrants, and Block 2 will require four hydrants. Hydrants that can be utilized for more than one area are not exclusive to one block. To meet City Code and International Fire Code hydrant count for each building, six proposed hydrants are placed throughout the site. The proposed fire hydrant configuration has been reviewed with the Boulder Fire Marshal.

Final plumbing fixture unit counts for each building and its respective water meter have not been calculated at this time. It is anticipated that they will be provided by a plumbing or mechanical engineer in the application for Building Permit. Water system demands have been approximated using tables from the City of Boulder Design and Construction Standards; Table 5-1: Average Day Water Demands and Table 5-2: Water Demand Peaking Factors for Forecasting Demands. Calculations are included in the appendix. The following demands were forecast by combining residential and commercial demands:

- Building A – 17 gallons per minute (gpm)
- Building B – 32 gpm
- Building C – 46 gpm
- Building D – 54 gpm
- Building E – 5 gpm
- Block 3 future commercial demands 30 gpm
- Block 4 future commercial demands 48 gpm

The total forecast domestic water system demands are 233 gpm for the entire site.

Three irrigation water meters are anticipated for the proposed site. One irrigation meter will be provided for Block 1, one for Block 2, and one for Block 4. The size of the irrigation meters has not yet been determined. Refer to the utility plan for locations.

The layout of the system has been designed so that portions of the water line may be isolated for maintenance by closing valves without disrupting a significant amount of services. Refer to the Utility Plan drawings for locations of valves.

The water mains within and immediately surrounding the site were modeled using WaterCAD to analyze system capacity with respect to limiting velocities in the proposed 8-inch mains. Peak hour demands and an estimated 50 gpm for each irrigation demand were entered into the system. Fire flow analysis was performed with a maximum allowable pipe velocity of 10 feet per second. Calculations, mapping and results from the fire flow analysis are included in the Appendix.

Sanitary Sewer System

As shown on the Utility Plan, there is an existing 8-inch PVC sanitary sewer main traveling through a portion of Broadway Street, an 8-inch PVC main within Lee Hill Drive, and an 8-inch PVC main within 13th Street. Sanitary service to the existing buildings is provided. However, the location of the existing service connections are unknown.

The project proposes to install 8-inch PVC sanitary mains within the site within the proposed right-of-way. Two Sanitary service connections will be provided for the buildings in Block 1. The first connection will be for the exiting Armory building, Building A. The second connection will provide sewer service to the other two buildings within the block. Block 2 will have one sanitary service connection for the building on the block. All proposed services from the buildings will connect to the new 8-inch PVC sanitary sewer mains within the site.

Sanitary sewer service discharges are forecast using Tables 6-1 and 6-2 of the City of Boulder Design and Construction Standards, Average Day Load by Development Type and Factors for Forecasting Wastewater Discharges, respectively. See the appendix for calculations.

The following summary of discharges are forecast by combining residential and commercial discharges:

- Building A – 17,533 gallons per day (gpd)
- Building B – 38,533 gpd
- Building C – 54,133 gpd
- Building D – 62,600 gpd
- Building E – 5,700 gpd
- Block 3 future discharge 34,800 gpd
- Block 4 future discharge 55,000 gpd

The total forecast sanitary sewer discharge for all four blocks of the Armory is 258,400 gpd. The 8-inch sanitary sewer mains should be installed at a minimum slope of 0.45% to maintain minimum required wastewater main capacities.

Storm Sewer System

Runoff from the proposed streets and buildings will be collected and piped towards the onsite water quality and detention basin in the southeast corner of Block 4. The detention release rate will be evaluated so as not to cause hazardous conditions upstream or downstream for the major and minor storm events. The drainage will be conveyed into the public storm sewer system on 14th Street. See Drainage Report prepared by JVA Inc. for reference.

Groundwater System

According to the Geotechnical Engineering Report for the project prepared by Ground Engineering and dated August 14, 2014, groundwater was present on the site at depths ranging from 24 to 31 feet below existing grade. Groundwater levels can be expected to fluctuate with varying seasonal and weather conditions, irrigation demands on or adjacent to the site and with fluctuations in nearby water features. Therefore, groundwater levels during construction or at other times in the future may fluctuate substantially.

Dry Utility System

All dry utilities such as gas, telecom, overhead electric and others will be coordinated with the owner and the utility companies.

Conclusions

The utilities for this Armory Community project have been analyzed carefully to meet the City of Boulder standards. The fire hydrant plan has been reviewed with the City of Boulder Fire Department for initial comments.

REFERENCES

1. "City of Boulder Design and Construction Standards," Revised Edition.
2. "International Fire Code," 2015 Edition.

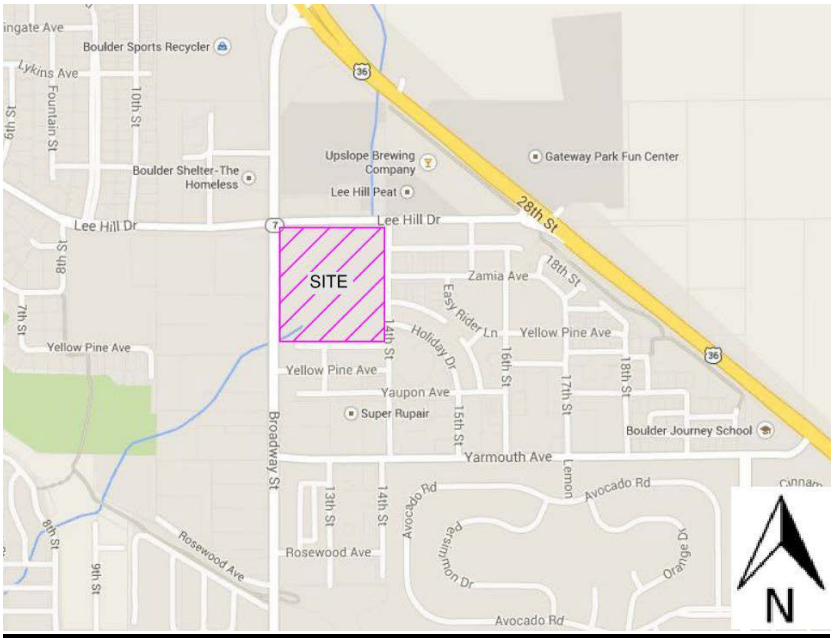
APPENDIX A – SITE MAPS

ARMORY COMMUNITY

AT

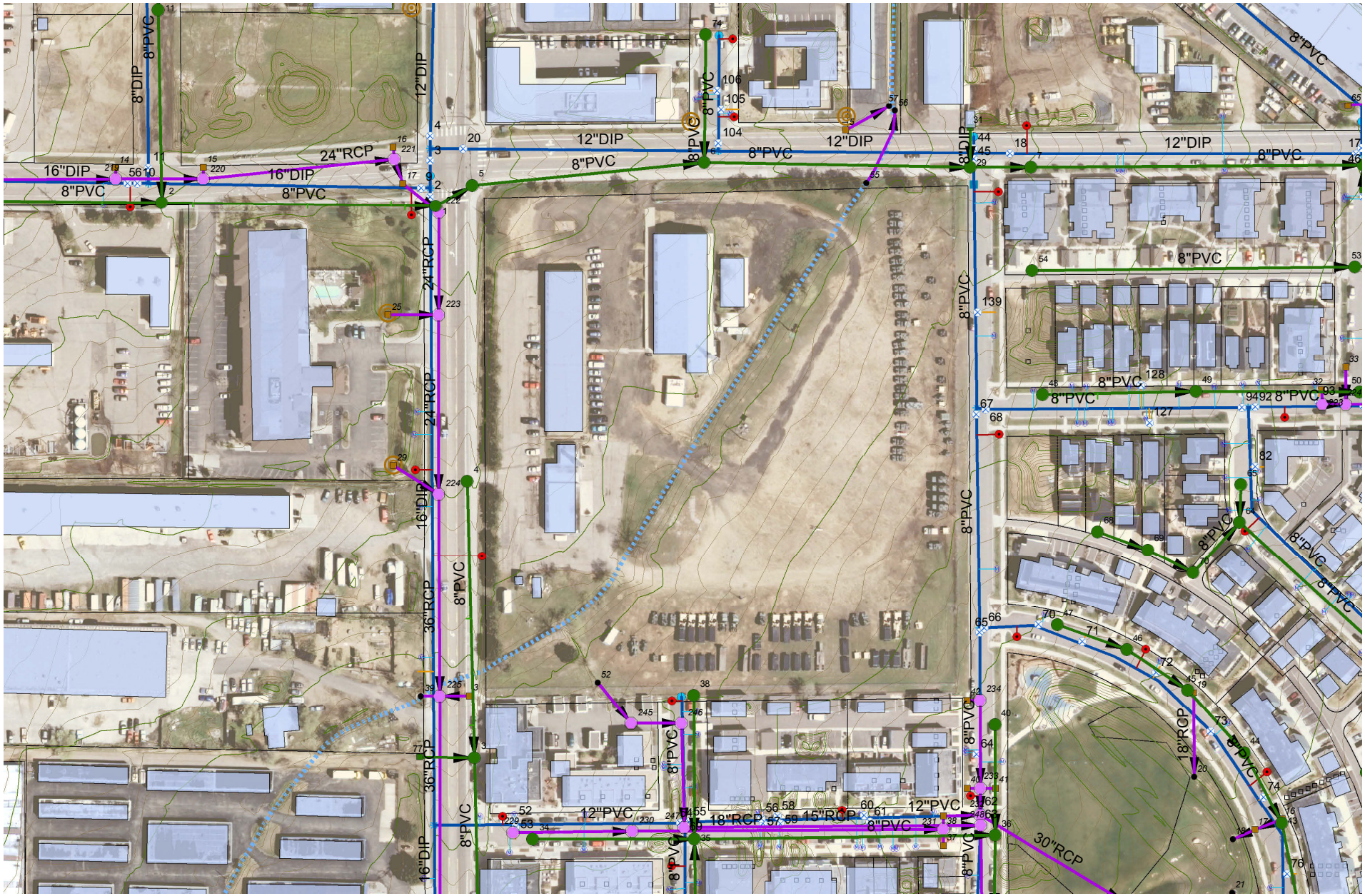
4750 BROADWAY STREET

BOULDER, COLORADO



VICINITY MAP – NOT TO SCALE

UTILITY MAPPING FROM CITY OF BOULDER



WATER SYSTEM MAPPING FROM CITY OF BOULDER

From: Kuhna, Scott <KuhnaS@bouldercolorado.gov>
Sent: Tuesday, April 07, 2015 2:11 PM
To: Danielle I. Breedlove
Cc: Kenneth J. Clifford; John P. Wojcicki; Robin L. Kriss
Subject: RE: Boulder Armory Water Model

APPENDIX B - CALCULATIONS, TABLES AND REFERENCES

APPENDIX B

FIRE-FLOW REQUIREMENTS FOR BUILDINGS

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION B101 GENERAL

B101.1 Scope. The procedure for determining fire-flow requirements for buildings or portions of buildings hereafter constructed shall be in accordance with this appendix. This appendix does not apply to structures other than buildings.

SECTION B102 DEFINITIONS

B102.1 Definitions. For the purpose of this appendix, certain terms are defined as follows:

FIRE-FLOW. The flow rate of a water supply, measured at 20 pounds per square inch (psi) (138 kPa) residual pressure, that is available for fire fighting.

FIRE-FLOW CALCULATION AREA. The floor area, in square feet (m^2), used to determine the required fire flow.

SECTION B103 MODIFICATIONS

B103.1 Decreases. The fire chief is authorized to reduce the fire-flow requirements for isolated buildings or a group of buildings in rural areas or small communities where the development of full fire-flow requirements is impractical.

B103.2 Increases. The fire chief is authorized to increase the fire-flow requirements where conditions indicate an unusual susceptibility to group fires or conflagrations. An increase shall not be more than twice that required for the building under consideration.

B103.3 Areas without water supply systems. For information regarding water supplies for fire-fighting purposes in rural and suburban areas in which adequate and reliable water supply systems do not exist, the *fire code official* is authorized to utilize NFPA 1142 or the *International Wildland-Urban Interface Code.*

SECTION B104 FIRE-FLOW CALCULATION AREA

B104.1 General. The fire-flow calculation area shall be the total floor area of all floor levels within the *exterior walls*, and under the horizontal projections of the roof of a building, except as modified in Section B104.3.

B104.2 Area separation. Portions of buildings which are separated by *fire walls* without openings, constructed in accordance with the *International Building Code,* are allowed to be considered as separate fire-flow calculation areas.

B104.3 Type IA and Type IB construction. The fire-flow calculation area of buildings constructed of Type IA and Type IB construction shall be the area of the three largest successive floors.

Exception: Fire-flow calculation area for open parking garages shall be determined by the area of the largest floor.

SECTION B105 FIRE-FLOW REQUIREMENTS FOR BUILDINGS

B105.1 One- and two-family dwellings, Group R-3 and R-4 buildings and townhouses. The minimum fire-flow and flow duration requirements for one- and two-family *dwellings*, Group R-3 and R-4 buildings and townhouses shall be as specified in Tables B105.1(1) and B105.1(2).

B105.2 Buildings other than one- and two-family dwellings, Group R-3 and R-4 buildings and townhouses. The minimum fire-flow and flow duration for buildings other than one- and two-family *dwellings*, Group R-3 and R-4 buildings and townhouses shall be as specified in Tables B105.2 and B105.1(2).

TABLE B105.1(1)
REQUIRED FIRE-FLOW FOR ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

FIRE-FLOW CALCULATION AREA (square feet)	AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE-FLOW (gallons per minute)	FLOW DURATION (hours)
0-3,600	No automatic sprinkler system	1,000	1
3,601 and greater	No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2) at the required fire-flow rate
0-3,600	Section 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*	500	$^1/_2$
3,601 and greater	Section 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*	$^1/_2$ value in Table B105.1(2)	1

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m.

TABLE B105.1(2)
REFERENCE TABLE FOR TABLES B105.1(1) AND B105.2

FIRE-FLOW CALCULATION AREA (square feet)					FIRE-FLOW (gallons per minute)[b]	FLOW DURATION (hours)
Type IA and IB[a]	Type IIA and IIIA[a]	Type IV and V-A[a]	Type IIB and IIIB[a]	Type V-B[a]		
0-22,700	0-12,700	0-8,200	0-5,900	0-3,600	1,500	
22,701-30,200	12,701-17,000	8,201-10,900	5,901-7,900	3,601-4,800	1,750	Buildings A & E, 875gpm
30,201-38,700	17,001-21,800	10,901-12,900	7,901-9,800	4,801-6,200	2,000	Block 2 Parking, 1000gpm
38,701-48,300	21,801-24,200	12,901-17,400	9,801-12,600	6,201-7,700	2,250	2
48,301-59,000	24,201-33,200	17,401-21,300	12,601-15,400	7,701-9,400	2,500	Block 1 Parking, 1250gpm
59,001-70,900	33,201-39,700	21,301-25,500	15,401-18,400	9,401-11,300	2,750	
70,901-83,700	39,701-47,100	25,501-30,100	18,401-21,800	11,301-13,400	3,000	
83,701-97,700	47,101-54,900	30,101-35,200	21,801-25,900	13,401-15,600	3,250	Building B, 1625gpm
97,701-112,700	54,901-63,400	35,201-40,600	25,901-29,300	15,601-18,000	3,500	3
112,701-128,700	63,401-72,400	40,601-46,400	29,301-33,500	18,001-20,600	3,750	
128,701-145,900	72,401-82,100	46,401-52,500	33,501-37,900	20,601-23,300	4,000	
145,901-164,200	82,101-92,400	52,501-59,100	37,901-42,700	23,301-26,300	4,250	Building D, 2125gpm
164,201-183,400	92,401-103,100	59,101-66,000	42,701-47,700	26,301-29,300	4,500	Building C, 2250gpm
183,401-203,700	103,101-114,600	66,001-73,300	47,701-53,000	29,301-32,600	4,750	
203,701-225,200	114,601-126,700	73,301-81,100	53,001-58,600	32,601-36,000	5,000	
225,201-247,700	126,701-139,400	81,101-89,200	58,601-65,400	36,001-39,600	5,250	
247,701-271,200	139,401-152,600	89,201-97,700	65,401-70,600	39,601-43,400	5,500	
271,201-295,900	152,601-166,500	97,701-106,500	70,601-77,000	43,401-47,400	5,750	
295,901-Greater	166,501-Greater	106,501-115,800	77,001-83,700	47,401-51,500	6,000	4
—	—	115,801-125,500	83,701-90,600	51,501-55,700	6,250	
—	—	125,501-135,500	90,601-97,900	55,701-60,200	6,500	
—	—	135,501-145,800	97,901-106,800	60,201-64,800	6,750	
—	—	145,801-156,700	106,801-113,200	64,801-69,600	7,000	
—	—	156,701-167,900	113,201-121,300	69,601-74,600	7,250	
—	—	167,901-179,400	121,301-129,600	74,601-79,800	7,500	
—	—	179,401-191,400	129,601-138,300	79,801-85,100	7,750	
—	—	191,401-Greater	138,301-Greater	85,101-Greater	8,000	

For SI: 1 square foot = 0.0929 m^2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.
a. Types of construction are based on the *International Building Code*.
b. Measured at 20 psi residual pressure.

TABLE B105.2
REQUIRED FIRE-FLOW FOR BUILDINGS OTHER THAN ONE- AND TWO-FAMILY DWELLINGS, GROUP R-3 AND R-4 BUILDINGS AND TOWNHOUSES

AUTOMATIC SPRINKLER SYSTEM (Design Standard)	MINIMUM FIRE-FLOW (gallons per minute)	FLOW DURATION (hours)
No automatic sprinkler system	Value in Table B105.1(2)	Duration in Table B105.1(2)
Section 903.3.1.1 of the *International Fire Code*	25% of the value in Table B105.1(2)[a]	Duration in Table B105.1(2) at the reduced flow rate
Section 903.3.1.2 of the *International Fire Code*	25% of the value in Table B105.1(2)[b]	Duration in Table B105.1(2) at the reduced flow rate

For SI: 1 gallon per minute = 3.785 L/m.
a. The reduced fire-flow shall be not less than 1,000 gallons per minute.
b. The reduced fire-flow shall be not less than 1,500 gallons per minute.

APPENDIX C

FIRE HYDRANT LOCATIONS AND DISTRIBUTION

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION C101
GENERAL

C101.1 Scope. In addition to the requirements of Section 507.5.1 of the *International Fire Code*, fire hydrants shall be provided in accordance with this appendix for the protection of buildings, or portions of buildings, hereafter constructed or moved into the jurisdiction.

SECTION C102
NUMBER OF FIRE HYDRANTS

C102.1 Minimum number of fire hydrants for a building. The number of fire hydrants available to a building shall be not less than the minimum specified in Table C102.1.

SECTION C103
FIRE HYDRANT SPACING

C103.1 Hydrant spacing. Fire apparatus access roads and public streets providing required access to buildings in accordance with Section 503 of the *International Fire Code* shall be provided with one or more fire hydrants, as determined by Section C102.1. Where more than one fire hydrant is required, the distance between required fire hydrants shall be in accordance with Sections C103.2 and C103.3.

C103.2 Average spacing. The average spacing between fire hydrants shall be in accordance with Table C102.1.

Exception: The average spacing shall be permitted to be increased by 10 percent where existing fire hydrants provide all or a portion of the required number of fire hydrants.

C103.3 Maximum spacing. The maximum spacing between fire hydrants shall be in accordance with Table C102.1.

SECTION C104
CONSIDERATION OF EXISTING FIRE HYDRANTS

C104.1 Existing fire hydrants. Existing fire hydrants on public streets are allowed to be considered as available to meet the requirements of Sections C102 and C103. Existing fire hydrants on adjacent properties are allowed to be considered as available to meet the requirements of Sections C102 and C103 provided that a fire apparatus access road extends between properties and that an easement is established to prevent obstruction of such roads.

TABLE C102.1
REQUIRED NUMBER AND SPACING OF FIRE HYDRANTS

FIRE-FLOW REQUIREMENT (gpm)	MINIMUM NUMBER OF HYDRANTS	AVERAGE SPACING BETWEEN HYDRANTS[a, b, c, f, g] (feet)	MAXIMUM DISTANCE FROM ANY POINT ON STREET OR ROAD FRONTAGE TO A HYDRANT[d, f, g]
1,750 or less	1	500	250
2,000-2,250	2	450	225
2,500	3	450	225
3,000	3	400	225
3,500-4,000	4	350	210
4,500-5,000	5	300	180
5,500	6	300	180
6,000	6	250	150
6,500-7,000	7	250	150
7,500 or more	8 or more[e]	200	120

For SI: 1 foot = 304.8 mm, 1 gallon per minute = 3.785 L/m.

a. Reduce by 100 feet for dead-end streets or roads.

b. Where streets are provided with median dividers that cannot be crossed by fire fighters pulling hose lines, or where arterial streets are provided with four or more traffic lanes and have a traffic count of more than 30,000 vehicles per day, hydrant spacing shall average 500 feet on each side of the street and be arranged on an alternating basis.

c. Where new water mains are extended along streets where hydrants are not needed for protection of structures or similar fire problems, fire hydrants shall be provided at spacing not to exceed 1,000 feet to provide for transportation hazards.

d. Reduce by 50 feet for dead-end streets or roads.

e. One hydrant for each 1,000 gallons per minute or fraction thereof.

f. A 50-percent spacing increase shall be permitted where the building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.1 of the *International Fire Code*.

g. A 25-percent spacing increase shall be permitted where the building is equipped throughout with an approved automatic sprinkler system in accordance with Section 903.3.1.2 or 903.3.1.3 of the *International Fire Code* or Section P2904 of the *International Residential Code*.

(4) Table 5-1 indicates water demand forecasting for average-day conditions.

Table 5-1: Average Day Water Demands

Development Type	Average-Day Demand
Residential	
Low Density	180 gpcd
Medium Density	150 gpcd
High Density	75 gpcd
Commercial	10,000 gpad
Industrial	12,000 gpad

(5) Table 5-2 indicates water demand peaking factors for forecasting demands.

Table 5-2: Water Demand Peaking Factors for Forecasting Demands

Development Type	Maximum/Hour	Maximum/Day
Residential		
Low Density	5.1	5.1
Medium Density	5.0	2.5
High-Density	5.0	2.0
Commercial	2.5	2.5
Industrial	1.5	1.5

(6) Water design flows that reduce the water system pressures below acceptable levels specified in this section or elsewhere in these Standards are considered detrimental to the overall system. In these situations, the Director will deny project approval, or require the developer to provide additional water system improvements, both onsite and offsite, to ensure no reduction in levels of service.

(B) Water Services

Design flows for water services shall be determined in conformance with the most current Uniform Plumbing Code (UPC), adopted by the City of Boulder.

5.05 Materials and Installation

Construction of water-related public improvements shall be in compliance with these Standards. All pipe shall be of adequate strength to support the trench and AASHTO HS-20 highway loadings. The type of pipe to be installed shall comply with these Standards, and shall be based upon applicable design flows, pressures, site conditions, corrosion protection, and maintenance requirements.

5.06 Corrosion Protection

Corrosion protection will be required for all water system improvements where corrosive soil conditions are encountered. The Engineer shall perform a soils resistivity survey to evaluate the corrosion potential of soils in proposed projects or developments, and recommend any necessary corrosion protection measures, such as alternative pipe type or cathodic protection. The Director will review the soils resistivity survey and Engineer's recommendations and the service history for water system corrosion in the area, and determine the pipe type or protection to be used prior to construction plan approval.

JVA Incorporated
1319 Spruce Street
Boulder, CO 80302
Ph: 303.444.1951
Fax: 303.444.1957

Job Name: Boulder Armory
Job Number: 1587.1c
Date: 16-Apr-15
By: RLK

Forecast Water System Demands

Estimate future water demands at Boulder Armory based on Table 5-1 and 5-2 of the Boulder Design and Construction Standards. Add residential and commercial demands for mixed use buildings.

Residential Water Demands

Building A

Type of Residential Unit	Number of Units	Persons Per Unit			
Studio	0	2			
One-Bedroom	0	2			
2-Bedroom	0	3			
		Total Residents	0		
		Average Day Demand (75 gpcd)	0 gpd		
		Peak Hour Demand (5 X Ave Day)	0 gpd	=	0 gpm

Building B

Type of Residential Unit	Number of Units	Persons Per Unit	Sub-Total Residents		
Studio	6	2	12		
One-Bedroom	20	2	40		
2-Bedroom	6	3	18		
		Total Residents	70		
		Average Day Demand (75 gpcd)	5250 gpd		
		Peak Hour Demand (5 X Ave Day)	26250 gpd	=	18 gpm

Building C

Type of Residential Unit	Number of Units	Persons Per Unit	Sub-Total Residents		
Studio	9	2	18		
One-Bedroom	34	2	68		
2-Bedroom	12	3	36		
		Total Residents	122		
		Average Day Demand (75 gpcd)	9150 gpd		
		Peak Hour Demand (5 X Ave Day)	45750 gpd	=	32 gpm

Building D

Type of Residential Unit	Number of Units	Persons Per Unit	Sub-Total Residents		
Studio	8	2	16		
One-Bedroom	34	2	68		
2-Bedroom	10	3	30		
		Total Residents	114		
		Average Day Demand (75 gpcd)	8550 gpd		
		Peak Hour Demand (5 X Ave Day)	42750 gpd	=	30 gpm

Building E

Type of Residential Unit	Number of Units	Persons Per Unit	Sub-Total Residents		
Studio	0	2	0		
One-Bedroom	2	2	4		
2-Bedroom	5	3	15		
		Total Residents	19		
		Average Day Demand (75 gpcd)	1425 gpd		
		Peak Hour Demand (5 X Ave Day)	7125 gpd	=	5 gpm

Commercial Demands

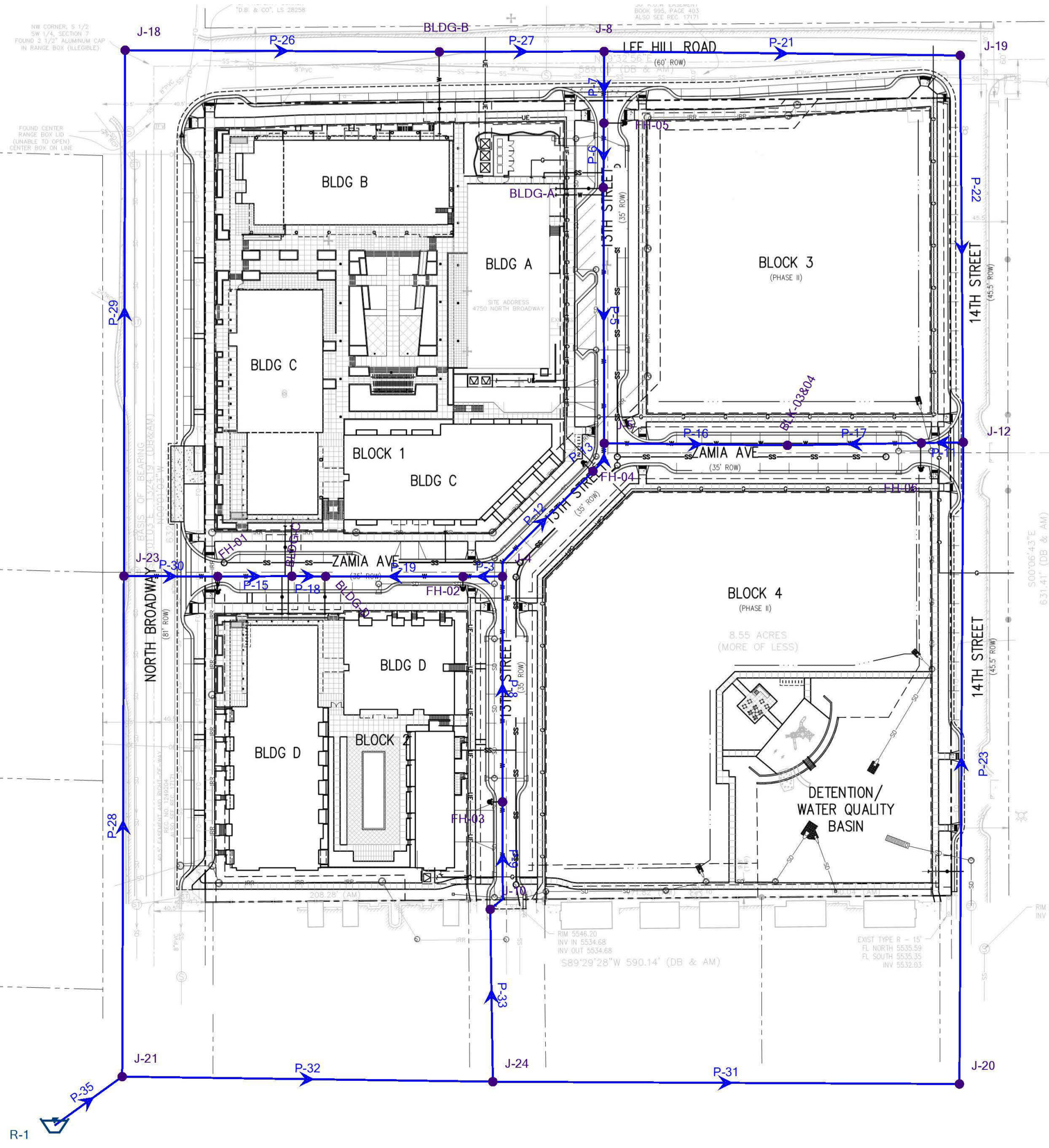
Block	Area	Ave Day Demand (10,000 gpad)	Peak Hour Demand (GPD)	Peak Hour Demand (gpm)
1	2.63	26300	65750	46
2	1.42	14200	35500	25
3	1.74	17400	43500	30
4	2.75	27500	68750	48

Block 1 Demand will be divided amongst Buildings A, B and C.
Block 2 Commercial Demand will be designated to Building D. Building E has no commercial spaces.

Demand Summary by Building

Building	Res Demand	Commrcl Demand	Total Demand
A	0	17	17
B	18	14	32
C	32	14	46
D	30	25	54
E	5	0	5

APRIL 17, 20154
JVA INC.
JOB NUMBER: 1587.1c



FlexTable: Junction Table

Current Time: 0.000 hours

Label	Elevation (ft)	Zone	Demand (gpm)	Hydraulic Grade (ft)	Pressure (psi)	NOTES
BLDG-A	5,557.00	<None>	67	5,849.69	127	17 GPM PEAK HOUR + 50 GPM IRRIGATION DEMANDS
BLDG-B	5,562.00	<None>	32	5,849.73	124	32 GPM PEAK HOUR
BLDG-C	5,560.00	<None>	46	5,849.69	125	46 GPM PEAK HOUR
BLDG-D & E	5,559.00	<None>	109	5,849.69	126	59 GPM PEAK HOUR + 50 GPM IRRIGATION DEMANDS
BLK-03&04	5,550.00	<None>	128	5,849.68	130	78 GPM PEAK HOUR + 50 GPM IRRIGATION DEMANDS
FH-01	5,561.50	<None>	0	5,849.72	125	
FH-02	5,555.50	<None>	0	5,849.69	127	
FH-03	5,558.00	<None>	0	5,849.72	126	
FH-04	5,555.50	<None>	0	5,849.69	127	
FH-05	5,558.00	<None>	0	5,849.71	126	
FH-06	5,544.50	<None>	0	5,849.70	132	
J-4	5,554.50	<None>	0	5,849.70	128	
J-5	5,555.50	<None>	0	5,849.69	127	
J-8	5,558.00	<None>	0	5,849.72	126	
J-10	5,546.00	<None>	0	5,849.74	131	
J-12	5,544.00	<None>	0	5,849.72	132	
J-18	5,568.00	<None>	0	5,849.75	122	
J-19	5,550.00	<None>	0	5,849.72	130	
J-20	5,530.00	<None>	0	5,849.76	138	
J-21	5,553.00	<None>	0	5,849.78	128	
J-23	5,561.50	<None>	0	5,849.76	125	
J-24	5,543.00	<None>	0	5,849.76	133	

FlexTable: Pipe Table

Current Time: 0.000 hours

Label	Length (Scaled) (ft)	Diameter (in)	Material	Hazen-Williams C	Flow (gpm)	Velocity (ft/s)	Minor Loss Coefficient (Local)	Length (User Defined) (ft)
P-3	31	8.0	PVC	150.0	-43	0.27	2.000	0
P-5	202	8.0	PVC	150.0	-14	0.09	2.000	0
P-6	51	8.0	PVC	150.0	-81	0.52	2.000	0
P-7	57	8.0	PVC	150.0	-81	0.52	2.000	0
P-8	178	8.0	PVC	150.0	-75	0.48	2.000	0
P-9	90	8.0	PVC	150.0	-75	0.48	2.000	0
P-11	33	8.0	PVC	150.0	-82	0.52	2.000	0
P-12	113	8.0	PVC	150.0	32	0.20	2.000	0
P-13	26	8.0	PVC	150.0	32	0.20	2.000	0
P-15	59	8.0	PVC	150.0	112	0.72	2.000	0
P-16	145	8.0	PVC	150.0	46	0.29	2.000	0
P-17	106	8.0	PVC	150.0	-82	0.52	2.000	0
P-18	27	8.0	PVC	150.0	66	0.42	2.000	0
P-19	109	8.0	PVC	150.0	-43	0.27	2.000	0
P-21	282	12.0	Ductile Iron	130.0	23	0.07	2.000	0
P-22	306	8.0	PVC	150.0	23	0.15	2.000	0
P-23	508	8.0	PVC	150.0	-59	0.38	2.000	0
P-26	248	12.0	Ductile Iron	130.0	136	0.39	2.000	0
P-27	130	12.0	Ductile Iron	130.0	104	0.29	2.000	0
P-28	396	16.0	Ductile Iron	130.0	248	0.40	2.000	0
P-29	416	16.0	Ductile Iron	130.0	136	0.22	2.000	0
P-30	74	8.0	PVC	150.0	-112	0.72	2.000	0
P-31	369	12.0	PVC	150.0	-59	0.17	2.000	0
P-32	293	12.0	PVC	150.0	-134	0.38	2.000	0
P-33	136	8.0	PVC	150.0	-75	0.48	2.000	0
P-35	66	16.0	Ductile Iron	130.0	382	0.61	2.000	0

FlexTable: Reservoir Table

Current Time: 0.000 hours

ID	Label	Elevation (ft)	Zone	Flow (Out net) (gpm)	Hydraulic Grade (ft)
88	R-1	5,849.80	<None>	382	5,849.80

Fire Flow Node FlexTable: Fire Flow Report

Current Time: 0.000 hours

Label	Satisfies Fire Flow Constraints?	Fire Flow (Available) (gpm)	Flow (Total Available) (gpm)	Velocity of Maximum Pipe (ft/s)	Fire Flow (Needed) (gpm)	Flow (Total Needed) (gpm)	Pressure (Calculated Residual) (psi)	Pressure (Calculated Zone Lower Limit) (psi)	Junction w/ Minimum Pressure (Zone)
BLDG-A	True	2,866	2,933	10.00	1,600	1,667	120	121	J-18
BLDG-B	True	5,000	5,032	9.60	1,600	1,632	116	117	J-18
BLDG-C	True	2,559	2,605	10.00	1,600	1,646	120	121	J-18
BLDG-D & E	True	2,881	2,990	10.00	1,600	1,709	119	120	BLDG-C
BLK-03&04	True	2,845	2,973	10.00	1,600	1,728	122	121	J-18
FH-01	True	2,184	2,184	10.00	1,600	1,600	122	121	J-18
FH-02	True	2,522	2,522	10.00	1,600	1,600	122	121	J-18
FH-03	True	3,093	3,093	10.00	1,600	1,600	119	121	J-18
FH-04	True	3,063	3,063	10.00	1,600	1,600	121	121	J-18
FH-05	True	2,386	2,386	10.00	1,600	1,600	122	121	J-18
FH-06	True	2,536	2,536	10.00	1,600	1,600	127	121	J-18
J-4	True	4,289	4,289	10.00	1,600	1,600	117	118	FH-02
J-5	True	3,908	3,908	10.00	1,600	1,600	118	120	FH-04
J-8	True	5,000	5,000	8.78	1,600	1,600	117	117	BLDG-B
J-10	True	2,521	2,521	10.00	1,600	1,600	127	121	J-18
J-12	True	4,396	4,396	10.00	1,600	1,600	121	119	J-18
J-18	True	5,000	5,000	8.59	1,600	1,600	116	119	BLDG-B
J-19	True	5,000	5,000	9.86	1,600	1,600	117	118	J-8
J-20	True	4,647	4,647	10.00	1,600	1,600	130	120	J-18
J-21	True	5,000	5,000	8.59	1,600	1,600	127	121	J-18
J-23	True	5,000	5,000	8.59	1,600	1,600	121	118	J-18
J-24	True	4,841	4,841	10.00	1,600	1,600	128	120	J-18

(2) Wastewater collection mains shall be designed to ensure transport of suspended materials and preclude material deposits considering minimum-day flows.

(3) The peak flow shall be determined using average-day forecasts adjusted by a peaking factor and including the allowed and any existing system infiltration or inflow.

(4) Flow capacity and loading data of existing and future conditions for the City's major wastewater collection system shall be obtained from the Utilities Division for use in designing and analyzing proposed improvements. This information is compiled using the City's standard Hydra hydraulic analysis program, and is available in both hard copy and electronic formats.

(5) The minimum-day flow shall be determined using average day-forecasts adjusted by a minimum flow factor and including the allowed and any existing infiltration or inflow.

(6) Average-day flow forecasts shall include the ultimate area, population density, existing wastewater flow, anticipated industrial discharge, and any allowed infiltration/inflow, that produces the greatest wastewater flow rates.

(7) Surface water, ground water, or cooling water shall not be discharged into the wastewater collection system. Prohibited connections include roof drains, storm inlets, foundation perimeter drains, area drains for open patios or driveway entrances to parking structures, and ground water sump systems.

(8) Floor drains internal to covered parking structures, that collect drainage from rain and ice drippings from parked cars or water used to wash-down internal floors, shall be connected to the sanitary sewer using appropriate grease and sediment traps.

(9) Table 6-1 indicates wastewater discharge forecasting for average-day conditions:

Table 6-1: Average Day Load by Development Type

Development Type	Average Day Load
Residential	100 gpcd
Average Persons per Single-Family Unit	3.2
Average Persons per Multi-Family Unit	2.0
Non-Residential	
Commercial	5000 gpad
Industrial	4500 gpad
Infiltration	200 gidm**

NOTES: * The Industrial Average-Day Load Indicates Non-Water Intensive Industrial Development
** Gallons Per Inch-Diameter-Mile

(10) The average-day forecast loads indicated in Table 6-1 represent minimum forecast loads in determining design flows. Where proposed development is known (based on specific applications or use), and the anticipated wastewater loads exceed the minimum forecast demands, the greater load shall be used to determine design flows.

(11) Table 6-2 indicates the wastewater peaking and minimum flow factors for forecasting discharges. These flow factors are, used to determine minimum required wastewater main capacity:

Table 6-2: Factors for Forecasting Wastewater Discharges

Collection Main Diameter	Minimum Factor	Peaking Factor
10 inches and smaller	0.25	4.0
12 to 15 inches	0.30	3.5

JVA Incorporated
1319 Spruce Street
Boulder, CO 80302
Ph: 303.444.1951
Fax: 303.444.1957

Job Name: Boulder Armory
Job Number: 1587.1c
Date: 16-Apr-15
By: RLK

Forecast Sewer Discharges

Estimate future sewer discharges at Boulder Armory based on Table 6-1 and 6-2 of the Boulder Design and Construction Standards. Add residential and commercial discharges for mixed use buildings.

Residential Discharges

Building A

Type of Residential Unit	Number of Units	Persons Per Unit			
Studio	0	2			
One-Bedroom	0	2			
2-Bedroom	0	2			
		Total Residents	0		
	Average Day Load (100 gpcd)		0 gpd		
	Peak Discharge (4 X Ave Day)		0 gpd	=	0 gpm

Building B

Type of Residential Unit	Number of Units	Persons Per Unit	Sub-Total Residents		
Studio	6	2	12		
One-Bedroom	20	2	40		
2-Bedroom	6	2	12		
		Total Residents	64		
	Average Day Load (100 gpcd)		4800 gpd		
	Peak Discharge (4 X Ave Day)		19200 gpd	=	13 gpm

Building C

Type of Residential Unit	Number of Units	Persons Per Unit	Sub-Total Residents		
Studio	9	2	18		
One-Bedroom	34	2	68		
2-Bedroom	12	2	24		
		Total Residents	110		
	Average Day Load (100 gpcd)		8250 gpd		
	Peak Discharge (4 X Ave Day)		33000 gpd	=	23 gpm

Building D

Type of Residential Unit	Number of Units	Persons Per Unit	Sub-Total Residents		
Studio	8	2	16		
One-Bedroom	34	2	68		
2-Bedroom	10	2	20		
		Total Residents	104		
	Average Day Load (100 gpcd)		7800 gpd		
	Peak Discharge (4 X Ave Day)		31200 gpd	=	22 gpm

Building E

Type of Residential Unit	Number of Units	Persons Per Unit	Sub-Total Residents		
Studio	0	2	0		
One-Bedroom	2	2	4		
2-Bedroom	5	2	10		
		Total Residents	14		
	Average Day Load (100 gpcd)		1050 gpd		
	Peak Discharge (4 X Ave Day)		4200 gpd	=	3 gpm

Commercial Discharges

Block	Area	Ave Day Demand (5,000 gpad)	Peak Discharge (GPD)	Peak Hour Demand (gpm)
1	2.63	13150	52600	37
2	1.42	7100	28400	20
3	1.74	8700	34800	24
4	2.75	13750	55000	38
			170800	119

Block 1 Demand will be divided amongst Buildings A, B and C.
Block 2 Commercial Demand will be designated to Building D. Building E has no commercial spaces.

Discharge Summary by Building

Building	Res. Dischg.	Commrcl. Dishch.	Total Discharge
A	0	17533.33	17533
B	19200	17533.33	36733
C	33000	17533.33	50533
D	31200	28400	59600
E	4200	0	4200
Block 3		34800	34800
Block 4		55000	55000

Armory, Boulder: 8-inch PVC Sewer Main
Worksheet for Circular Channel

Project Description	
Worksheet	Armory: Sanitary Sewer Main 8-inch
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Slope

Input Data		
Mannings Coefficient	0.013	
Depth	4.0	in
Diameter	8.0	in
Discharge	258,400	gpd

Results		
Channel Slope	0.004531	ft/ft
Flow Area	0.2	ft²
Wetted Perimeter	1.04	ft
Top Width	0.67	ft
Critical Depth	0.29	ft
Percent Full	49.5	%
Critical Slope	0.006728	ft/ft
Velocity	2.32	ft/s
Velocity Head	0.08	ft
Specific Energy	5.0	in
Froude Number	0.80	
Maximum Discharge	565,512	gpd
Discharge Full	525,713	gpd
Slope Full	0.001095	ft/ft
Flow Type	Subcritical	