Water Supplies for Suburban and Rural Fire Fighting – NFPA 1142…and more

2018 MANITOBA BUILDING OFFICIALS ASSOCIATION - ANNUAL FALL SEMINAR & TRADE SHOW

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Prevention/Protection

- Spent entire career fighting fires….as an engineer
- Hazard identification & Fire prevention
- Automatic fire protection (NFPA 13, 13R, 13D ….)
- Manual fire protection - with automatic water supply (NFPA 14)
- Manual fire protection - manual water supply (NFPA 1142)

Overview

- What's the problem?
- Code References
- Applicable Occupancies
- Common Water Volume Calculations
- Real World Examples
- Inspect, Test and Maintenance Schedule

What's The Problem?

- Remote Locations
- Significant structures
- No automatic sprinklers
- No private fire water
- No municipal water supply nearby
- Municipal hydrant has insufficient pressure/flow

“Water bottling factory burns down in rural Manitoba”

- "It's very difficult for us, using a volunteer fire department, to get on those fires very quickly," he said.
- "We have to roust the people and we have to get there and get their equipment. And **water's always an issue."**
- There are no fire hydrants in the rural areas, which means the supply of **water must come from a pumper truck.**

quotes from RM of Piney (2013)


Middlebro, MB
July 2013


Middlebro, MB
July 2013

So What's The Problem?

Lack of Useful & Accessible
Fire Fighting Water Supply

Code References
National/Manitoba Building Code (2015)

3.2.5.7. Water Supply

1) Every *building* shall be provided with an adequate water supply for firefighting. (See Note A-3.2.5.7.(1).)

Applies to:

- All *post-disaster buildings*,(hospitals, telephone exchanges, power generating stations, public water treatment and storage facilities, etc.)
- All Group A, *assembly occupancies*,
- All Group B, *care*, *treatment* or *detention occupancies*
- All Group F, Division 1, *high-hazard industrial occupancies*
- All building exceeding 600 m2 (6458 ft2) OR > 3 *storeys* classified as
  - i) Group C, *residential occupancies*,
  - ii) Group D, *business and personal services occupancies*,
  - iii) Group E, *mercantile occupancies*, or
  - iv) Group F, Divisions 2 and 3, *medium-* and *low-hazard*

Firefighting Water Supply NEEDED for ALL:

Group A, Division 1

- Motion picture theatres
- Opera houses
- Television studios admitting a viewing audience
- Theatres, including experimental theatres

Group A, Division 2

- Art galleries
- Auditoria
- Bowling alleys
- **Churches and similar places of worship**
- Clubs, non-residential
- **Community halls**
- Courtrooms
- Dance halls
- Exhibition halls (other than classified in Group E)
- Gymnasia
- Lecture halls
- Libraries
- Licensed beverage establishments
- Museums
- Passenger stations and depots
- Recreational piers
- **Restaurants**
- Schools and colleges, non-residential
- Undertaking premises

Firefighting Water Supply NEEDED for ALL:

Group A, Division 3

Arenas

Indoor swimming pools, with or without spectator seating

Rinks

Group A, Division 4

Amusement park structures (not elsewhere classified)

Bleachers

Grandstands

Reviewing stands

Stadia

Firefighting Water Supply NEEDED for ALL:

Group B, Division 1

Jails

Penitentiaries

Police stations with detention quarters

Prisons

Psychiatric hospitals with detention quarters

Reformatories with detention quarters

Group B, Division 2

Care facilities with treatment

Convalescent /recovery/rehabilitation centres with treatment

Hospices with treatment

Hospitals

Infirmaries

Nursing homes with treatment

Psychiatric hospitals without detention quarters

Respite centres with treatment

Group B, Division 3

Assisted/supportive living facilities

Care facilities without treatment

Children's custodial homes

Convalescent/recovery/rehabilitation centres without treatment

Group homes

Hospices without treatment

Nursing homes without treatment

Reformatories without detention quarters

Respite centres without treatment

Firefighting Water Supply NEEDED for ALL:

Group F, Division 1

Bulk plants for flammable liquids

Bulk storage warehouses for hazardous substances

Cereal mills

Chemical manufacturing or processing plants

Distilleries

Dry cleaning plants

Feed mills

Flour mills

Grain elevators

Lacquer factories

Mattress factories

Paint, varnish and pyroxylin product factories

Rubber processing plants

Spray painting operations

Waste paper processing plants

Firefighting Water Supply NEEDED for Some*:

* All buildings exceeding 600 m2 (6458 ft2) OR > 3 *storeys*

Group C

Apartments

Boarding houses

Clubs, residential

Colleges, residential

Convents

Dormitories

Hotels

Houses

Lodging houses

Monasteries

Motels

Schools, residential

Group D

Banks

Barber and hairdressing shops

Beauty parlours

Dental offices

Dry cleaning establishments, self-service, not using flammable or explosive solvents or cleaners

Laundries, self-service

Medical offices

Offices

Police stations without detention quarters

Radio stations

Small tool and appliance rental and service establishments

Group E

Department stores

Exhibition halls

Markets

Shops

Stores

Supermarkets

Firefighting Water Supply NEEDED for Some*:

* All buildings exceeding 600 m2 (6458 ft2) OR > 3 *storeys*

Group F, Division 2

- Aircraft hangars
- Box factories
- Candy plants
- Cold storage plants
- Dry cleaning establishments not using flammable or explosive solvents or cleaners
- Electrical substations
- Factories
- Freight depots
- Helicopter landing areas on roofs
- Laboratories
- Laundries, except self-service
- Mattress factories
- Planing mills
- Printing plants
- Repair garages
- Salesrooms
- Service stations
- Storage rooms
- Television studios not admitting a viewing audience
- Warehouses
- Wholesale rooms
- Woodworking factories
- Workshops

Group F, Division 3

- Creameries
- Factories
- Laboratories
- Light-aircraft hangars (storage only)
- Power plants
- Salesrooms
- Sample display rooms
- Storage garages, including open air parking garages
- Storage rooms
- Warehouses
- Workshops

Purpose for Providing Water
per A-3.2.5.7.(1)

Provide an adequate Fire Fighting Water Supply to allow Emergency Response Personnel to:

- Enable safe evacuation of occupants
- Conduct search & rescue operations
- Prevent fire from spreading to adjacent buildings
- Provide limited measure of property protection

Sources of Water per A-3.2.5.7.(1)

- The sources of water supply for firefighting purposes may be **natural** or **developed**.
- **Natural** may include ponds, lakes, rivers, streams, bays, creeks, and springs.
- **Developed** sources may include aboveground tanks, elevated gravity tanks, cisterns, swimming pools, wells, reservoirs, aqueducts, artesian wells, tankers, hydrants served by a public or private water system, and canals.

Other Considerations per A-3.2.5.7.(1)

- Available to fire department equipment (pumper truck) under all **climatic conditions**. GOOD DIRECTION
- Volume of on-site water supply is dependent on the building size, construction, occupancy, exposure and environmental impact potential …NOT VERY HELPFUL – no specific references
- Sufficient to allow at least 30 minutes of fire department hose stream use. GOOD DIRECTION
- **AHJ's are left to determine what standard they will accept to determine flowrate/total stored water volume required.**

Water Calculations

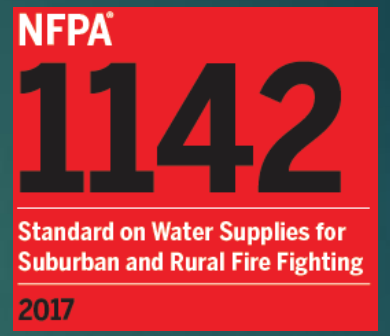
Common Calculation Methods (at Discretion of AHJ)

1998 MBC A-3.2.5.7. (not in Annex of 2005, 2010, 2015 NBC)

Water Supply for Public Fire Protection (Part II)
by Fire Underwriter Survey (FUS)
download at http://www.fireunderwriters.ca

NFPA 1142 WATER SUPPLIES FOR SUBURBAN AND RURAL FIREFIGHTING
"Chapter 4 Calculating Minimum Water Supplies"
NFPA members can view free online OR
Purchase at: https://www.nfpa.org/Codes-and-Standards

Water Calculations



- **EACH METHOD CAN GIVE VERY DIFFERENT RESULTS for the SAME BUILDING**
- **Not an exact science - no one calculation method works well every time.**
- **Good communication is critical between the designer, owner, AHJ (FD & Planning Dept) to land on a reasonable and adequate solution.**

Volume Calculation 1998 MBC A-3.2.5.7.

- Provided by some AHJs as an option for calculating water needs
- Calculation method was provided in the 1998 MBC A-3.2.5.7.
- Removed from 2005 and later NBC
- Very simple if no external exposures.
- Calculates water volume needed

FURTHER INFORMATION

1998 M.B.C A-3.2.5.7

Water Supply. There have been requests for including in the Code a m of determining an acceptable water supply for Part 3 *buildings*. A num methods have been reviewed, by the Canadian Commission on *Buildin* Fire Codes, but unfortunately, so far none has proven to be universally acceptable. The method included in this Appendix Note in was developed as a result of number of studies undertaken by authorities in one province and is presented here for the information of the users of the Code. Apparently, this method is a synthesis of a number of different methods and has been formulated to tie into the classification system and the type of construction recognized by National *Building* Code.

Except for building that has a sprinkler system or a standpipe and hose system, designed in accordance with Subsection 3.2.5., or a *building* that is neither more than 600m2in building area more than 3storys in building height, a building maybe considered to have an adequate supply of water for fire fighting purposes if the quantity available is not less than that derived form the formula.

Q= V x K x S

in which
Q= total water supply in litres
V= total volume of the *building* in cubic metres
K= the water supply co-efficient whose value is 1.5 for a *building* which has any limited distance less than 7.5 m, otherwise whose value is 1.0.

The water supply derived from the formula should be capable of being delivered at a rate of not less than 45L/s for a building foe which the total volume is less than 75.000 L at a rate of 60 L/s for a building for which the total volume is not less than 75.000L. MINIMUM 30 MINUTES

Water Supply Coefficient					
Type of Construction	Classification by Group or Division in Accordance with Table 3.1.2.A				
	A-1 A-3 F-3	A-2 B-1 B-2 C D	A-4	E F-2	F-1
A *building* of *non-combustible* construction with all loadbearing walls, columns, arches, etc, having a *fire resistance* rating not less than that required for the supported *assembly*, but not less than 45 min	11	10	14	17	23
A *building* of *non-construction* in accordance with Sentence 3.1.4.5. (1)	17	15	20	25	34
A *building* having all structure members of non-combustible material, or if of combustible materials, having a *fire resistance* rating of not less than 45 min or of heavy timber construction.	22	19	27	34	45
A *building* of *combustible construction*	34	27	40	50	67

Vol. Calculation – 1998 MBC A-3.2.5.7.

- **V** is Volume of Building (m3)
- **K** is Water Supply Coefficient from table provided based on occupancy and construction type.
- **K** is increased by 50% if Limiting Distance is < 7.5m

$$Q = V \times K \times S$$

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$$Q = V \times K \times S$$

	Q=	V x K x S
in which	Q=	total water supply in litres
	V=	total volume of the *building* in cubic metres
	K=	the water supply co-efficient whose value is 1.5 for a *building* which has any limited distance less than 7.5 m, otherwise whose value is 1.0.

"S" (for external Exposures) is not even defined in this document

S_{Tot} = total of spatial coefficient values from property line exposures on all sides, as obtained from the formula:

$$S_{Tot} = 1.0 + [(S_{Side1}) + (S_{Side2}) + (S_{Side3}) + (S_{Side4})]$$

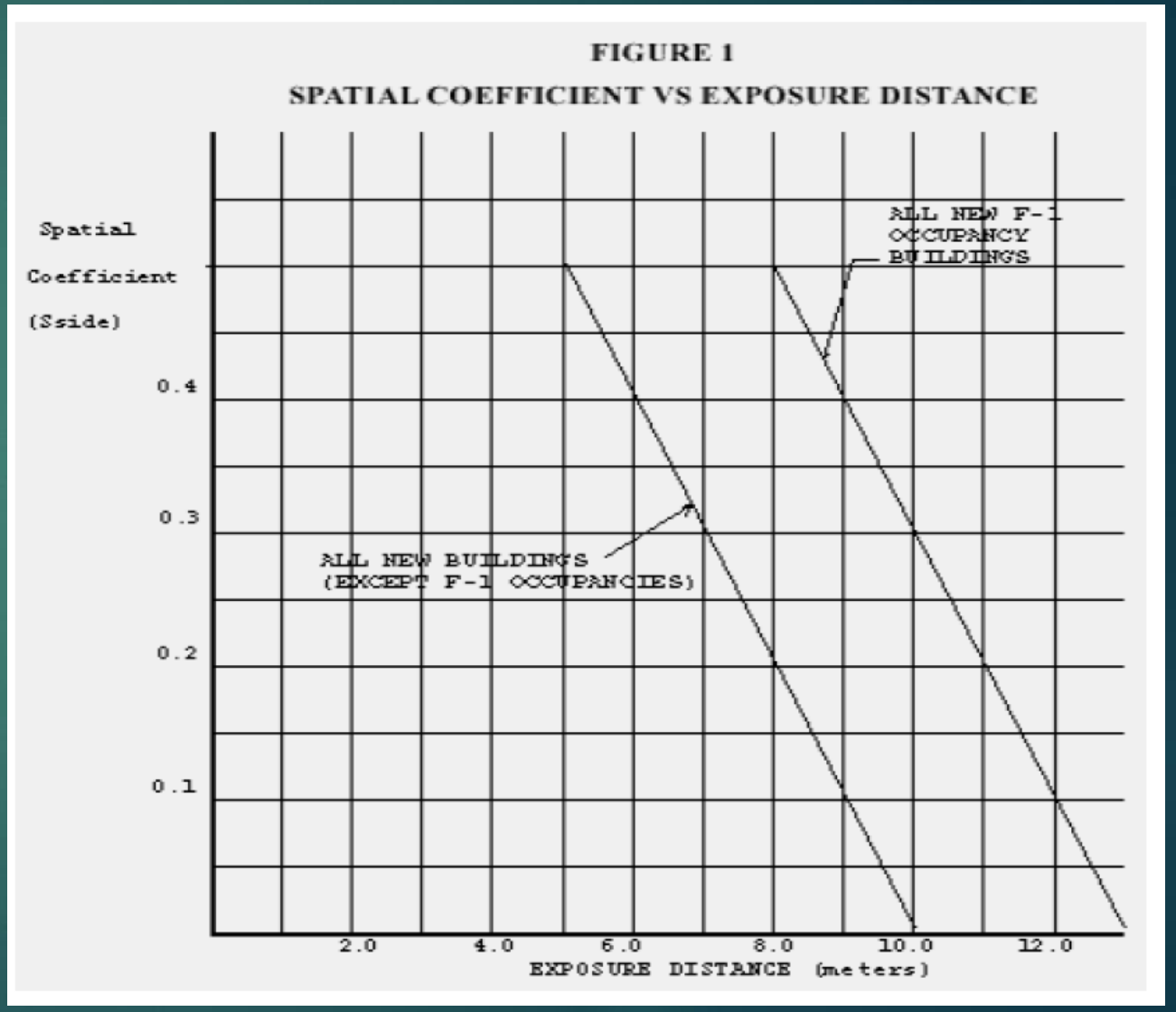
Vol. Calculation – 1998 MBC A-3.2.5.7.

$$Q = V \times K \times S$$

- S_{Side} values are obtained from Figure 1, as modified by (e) and (f) below
- S_{Tot} need not exceed 2.0

(e) Where a masonry wall with a minimum fire-resistance rating of 2 hours and no unprotected openings is provided as an exterior wall, the spatial coefficient "S " for this side of the new building may be considered equal to 0. This exterior masonry wall shall be provided with a minimum 150 mm parapet. Firewalls that divide a structure into two or more buildings may be given similar consideration when evaluating the exposure of the buildings to each other.

(f) The spatial coefficient "S " may be considered equal to 0 when the exposed building is on the same property and is less than 10 m2 in building area.



Flow Calculation – Fire Underwriter Survey (FUS) Method

fire underwriters survey
A SERVICE TO INSURERS AND MUNICIPALITIES

OUTLINE OF PROCEDURE

$$F = 220C\sqrt{A}$$

1. Determine the type of construction.
2. Determine the ground floor area.
3. Determine the height in storeys.
4. Using the fire flow formula, determine the required fire flow (F) in **L/min.**
5. Adjust Flow (F) for occupancy type/hazard.
6. Reduce flow for automatic sprinklers, if any.
7. Increase flow for exposures, if any.

The final figure is rounded to the nearest 1,000 L/min.

Flow Calculation – Fire Underwriter Survey (FUS) Method

$$F = 220C\sqrt{A}$$

Where:

- **F** = the required fire flow in L/min. **Minimum 2000 LPM (526 US gpm)**
- **C** = coefficient related to the type of construction.
- **A** = Total floor area in sq. m.
- Duration is 30 minutes minimum per A-3.2.5.7.(1)

Flow Calculation - FUS

$$F = 220C\sqrt{A}$$

Coefficient (C) related to the type of construction.

C = 1.5 for wood frame construction (structure essentially all combustible).

C = 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior).

C = 0.8 for non-combustible construction (unprotected metal structural components, masonry or metal walls).

C = 0.6 for fire-resistive construction (fully protected steel frame or reinforced concrete floors, roof).

Note:

Can interpolate between construction types if not clearly in one category.

Must stay between 1.5 max. and 0.6 min.

Flow Calculation - FUS

$$F = 220C\sqrt{A}$$

Total floor area (A) in m2

- Includes **all storeys**, but excluding basements at least 50% below grade
- For fire separations
  - Inadequate vertical fire separation (< 1-hr rating) - Use the 2 largest adjoining floors plus 50% of each of any floors immediately above them up to 8 storeys.
  - Adequate vertical fire separation (1-hr or greater rating)- Use only the area of the largest floor plus 25% of each of the two immediately adjoining floors.
  - horizontal fire separation (2-hrs or more) as required by Building Code to reduce floor area.

Flow Calculation - FUS

$$F = 220C\sqrt{A}$$

Adjustments to Calculated Flow (F) for <u>Occupancy Type</u>

- Non-Combustible Occupancy -25%
- Limited Combustible Occupancy -15%
- Combustible No Adjustment
- Free Burning Occupancy +15%
- Rapid Burning Occupancy +25%

Minimum Flow = 2000 LPM (526 US gpm)

Flow Calculation - FUS

$$F = 220C\sqrt{A}$$

Reduction to adjusted Flow (F)

Up to 50% reduction with complete, adequate, supervised automatic sprinkler protection.

- NFPA Compliant Sprinkler System – up to 30% reduction
- Water supply adequate for Sprinklers & FD Hose – additional 10% reduction
- Supervised valves and flow alarms - additional 10% reduction

No Minimum Flow

Flow Calculation - FUS

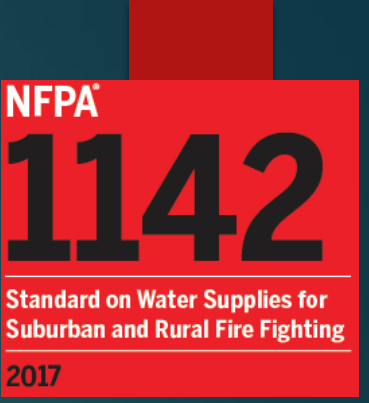
$$F = 220C\sqrt{A}$$

Increase to Original Calculated Flow (F) for EXPOSED STRUCTURES within <u>45 metres</u>

- Adjusted flow shall not exceed **45,000 L/min** nor be less than **2,000 L/min**.
- This percentage increase shall depend upon…..
  - separation between subject building and exposed building(s) 25% (0-3m) to 5% (>30-40 m)
  - Increase is **<u>per side</u>** exposed up to 75% total increase

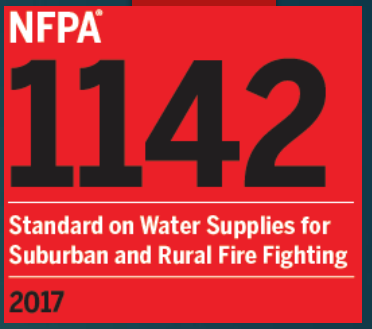
Separation	Charge
0 to 3m	25%
3.1 to 10m	20%
10.1 to 20m	15%
20.1 to 30m	10%
30.1 to 45m	5%

Volume Calculation – NFPA 1142



1.2* Purpose. The purpose of this standard is to assist the AHJ to establish the minimum water supply necessary for structural fire-fighting purposes in those areas where it has been determined that there is no water or inadequate water for fire fighting.

Volume Calculation – NFPA 1142



$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)$$

where:

WS_{min} = minimum water supply in US gal. (no exposure)

VS_{tot} = total volume of structure in ft3

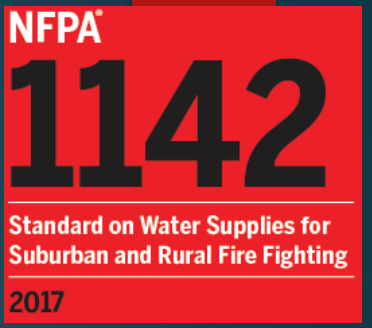
OHC = occupancy hazard classification number

CC = construction classification number

<u>without</u> exposure: 2000 gal. (minimum)

<u>with</u> exposure: multiply WS_{min} by 1.5 (3000 gal. minimum)

Volume Calculation – NFPA 1142

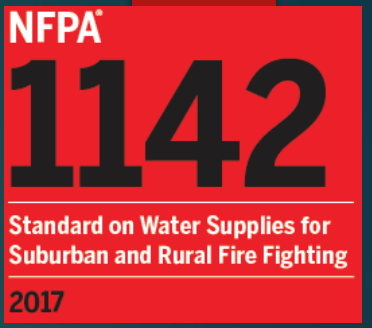


$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)$$

VS_{tot} = total volume of structure in ft3

- Area can be limited by 2 hour fire separations.
- Tall building treated more harshly, even if not more hazardous.

Volume Calculation – NFPA 1142



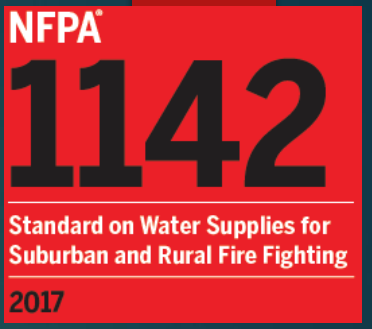
$$WS_{\min} = \frac{VS_{\text{tot}}}{OHC}(CC)$$

***OHC* = occupancy hazard classification number (see Chapter 5)**

- For mixed occupancies, use HIGHEST HAZARD
- OHC = 3 for **Severe Hazard** occupancies (approx. EH2)
- OHC = 4 for **High Hazard** occupancies (approx. EH1)
- OHC = 5 for **Moderate Hazard** occupancies (approx. OH2)
- OHC = 6 for **Low Hazard** occupancies (approx. OH1)
- OHC = 7 for **Light Hazard** occupancies (approx. LH)

Generally the same 5 categories as NFPA 13 Occupancy Classifications but see NFPA 1142, Chapter 5 since not EXACTLY the same.

Volume Calculation – NFPA 1142

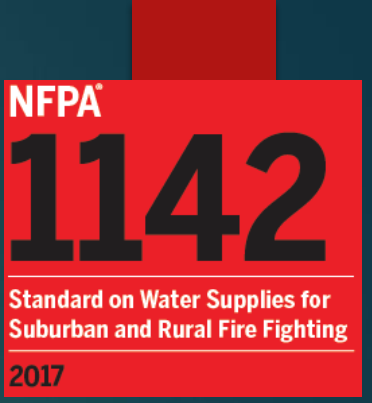


$$WS_{\min} = \frac{VS_{\text{tot}}}{OHC}(CC)$$

CC = construction classification number (see Chapter 6)

- If **Type** has already been determined using NFPA 220 "**Standard on Types of Building Construction**, then use that.
- Otherwise, this gets a bit tricky….
- use Chapter 6, and NFPA 220 as a reference

Volume Calculation – NFPA 1142



CC = construction classification number

- Type I - fire resistive (2-4 hr)
- Type II - fire resistive (0-2 hr)
- Type III - wood or steel frame (0-2 hr)
- Type IV - Heavy timber or steel (0-2 hr)
- Type V - all or part wood (0-1 hr)

This is a general guideline only. Many variables - see Table 6.3.1.

$$WS_{\min} = \frac{VS_{\text{tot}}}{OHC}(CC)$$

Table 6.2.1 Construction Classification Number

Construction Type	Classification Number
Type I (442 or 332)	0.5
Type II (222, 111, or 000)	0.75
Type III (211 or 200)	1.0
Type IV (2HH)	0.75
Type V (111 or 000)	1.5

Table 6.3.1 Fire Resistance Ratings for Type I through Type V Construction (hr)

	Type I		Type II			Type III		Type IV	Type V	
	442	332	222	111	000	211	200	2HH	111	000
Exterior Bearing Walls										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	2	2	2	1	0
Supporting one floor only	4	3	2	1	0	2	2	2	1	0
Supporting a roof only	4	3	1	1	0	2	2	2	1	0
Interior Bearing Walls										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	2	1	0
Supporting one floor only	3	2	2	1	0	1	0	1	1	0
Supporting roofs only	3	2	1	1	0	1	0	1	1	0
Columns										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H*	1	0
Supporting one floor only	3	2	2	1	0	1	0	H*	1	0
Supporting roofs only	3	2	1	1	0	1	0	H*	1	0
Beams, Girders, Trusses, and Arches										
Supporting more than one floor, columns, or other bearing walls	4	3	2	1	0	1	0	H*	1	0
Supporting one floor only	2	2	2	1	0	1	0	H*	1	0
Supporting roofs only	2	2	1	1	0	1	0	H*	1	0
Floor Construction	2	2	2	1	0	1	0	H*	1	0
Roof Construction	2	1½	1	1	0	1	0	H*	1	0
Interior Nonbearing Walls	0	0	0	0	0	0	0	0	0	0
Exterior Nonbearing Walls †	0	0	0	0	0	0	0	0	0	0

Note: Shaded columns indicate those members that are permitted to be of approved combustible material.

*"H" indicates heavy timber members; see 6.3.6 for requirements.

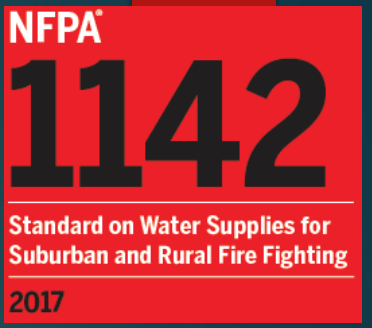
†Exterior nonbearing walls meeting the conditions of acceptance of NFPA 285 are permitted to be used.

NFPA® 1142

Standard on Water Supplies for Suburban and Rural Fire Fighting

2017

Volume Calculation – NFPA 1142



$$WS_{min} = \frac{VS_{tot}}{OHC}(CC)$$

Reduction of volume WS_{min} for sprinklers:

- No clear direction provided
- Fully meeting NFPA 13, 13D, or 13R - AHJ permitted to reduce the water supply for manual fire-fighting purposes.
- Does not meet NFPA standards – no reduction
- Somewhere in between – AHJ can determine reduction.

Volume Calculation – NFPA 1142

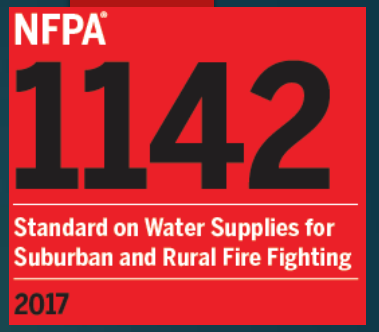


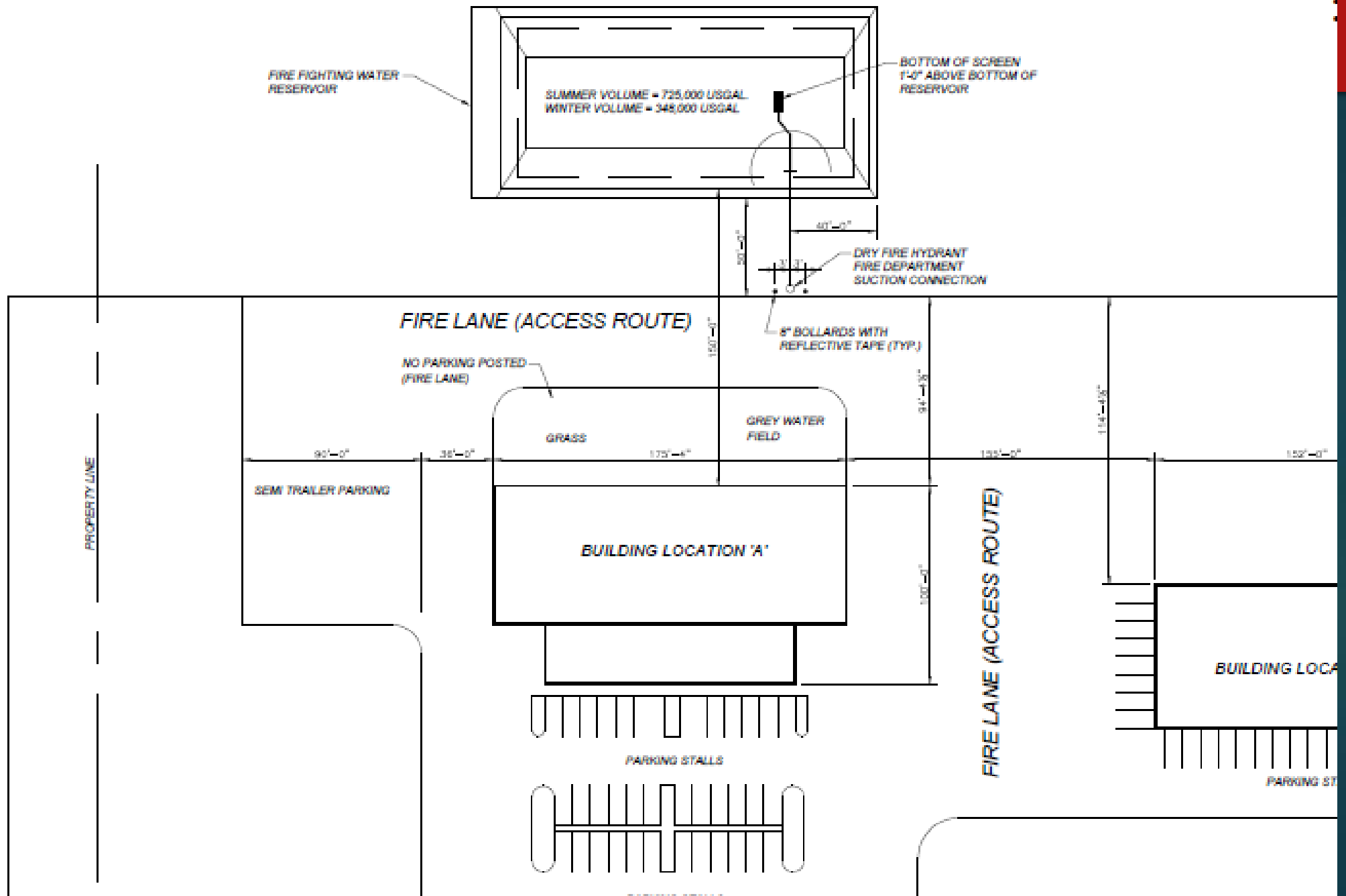
Table 4.6.1 Water Delivery Rate

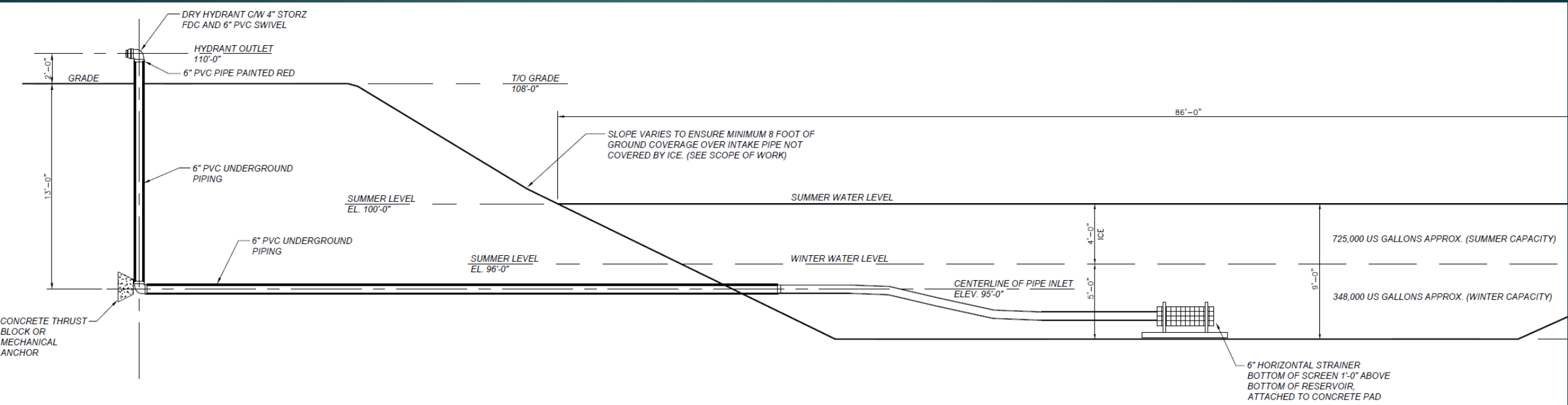
Total Water Supply Required		Water Delivery Rate	
gal	L	gpm	L/min
<2,500	9,459	250	950
2,500–9,999	9,460–37,849	500	1,900
10,000–19,999	37,850–75,699	750	2,850
≥20,000	≥75,700	1,000	3,800

- The AHJ shall be permitted to adjust the water delivery rate, giving consideration to local conditions and need.
- **1000 gpm is easily available from a 6 in. dry hydrant via pumper truck draft.**

Example 1 - Remote Water Supply

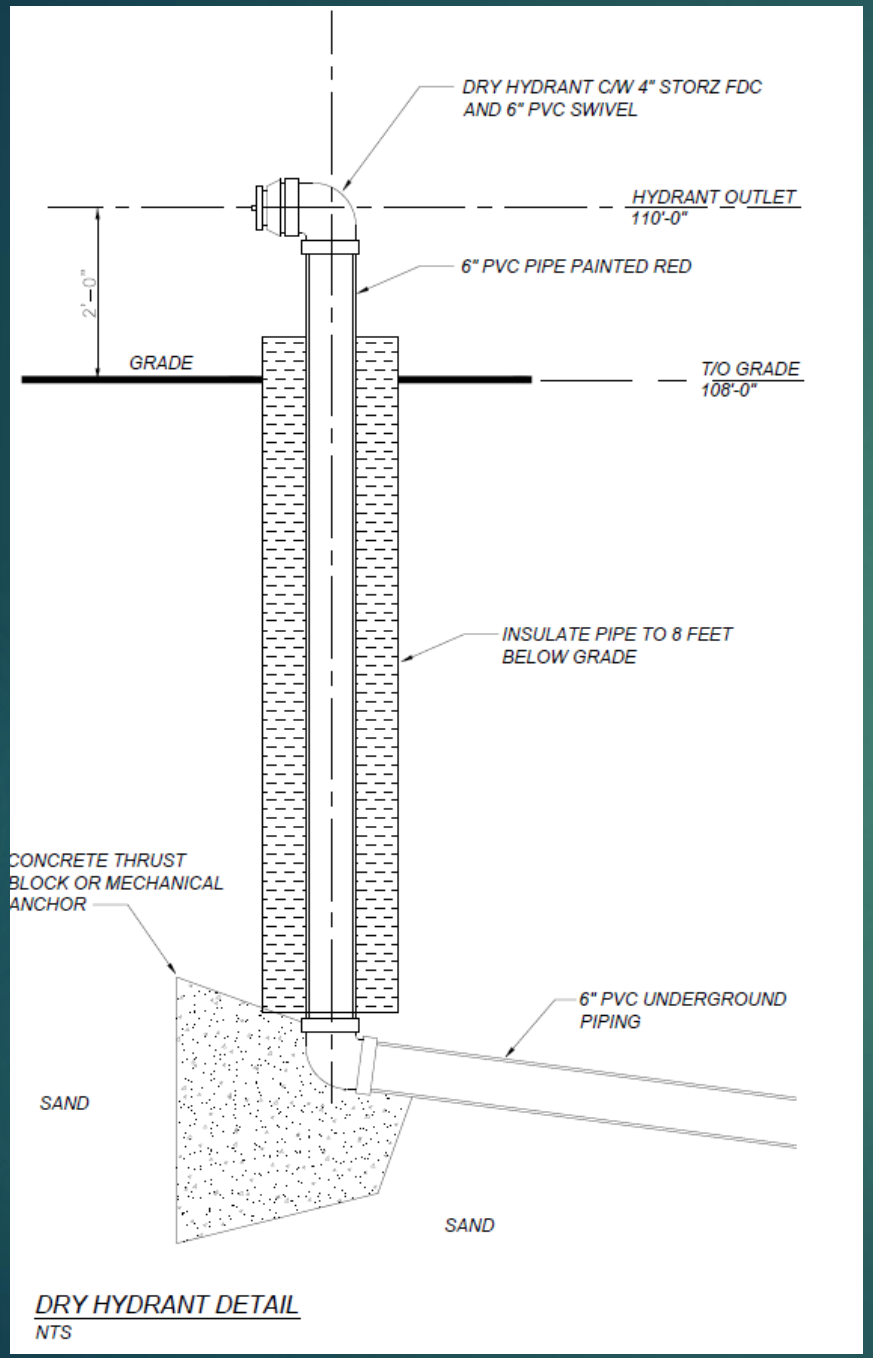
- Remote site – well outside of municipal water
- Light industrial – metal fab shop, vehicle wash/repair
- Non-combustible construction - 2 buildings, good separation
- No natural water sources existing
- No sprinklers required by code
- Fire fighting water supply NEEDED per Building Code.
- 16,000 sf building with 31 ft. ceiling
- **MBC (1998)** volume needed = 89,000 US gal stored water
- **FUS** flow needed = 986 GPM x 30 min = 30,000 gal. stored water
- **NFPA 1142** volume needed = 131,000 gal. stored water
- Worked with AHJ and agreed on 500 gpm for 2 hour duration (or 2000 gpm for 30 min) - 60,000 gal. minimum storage needed
- After the big dig, we had a **348,000 gal. pond**

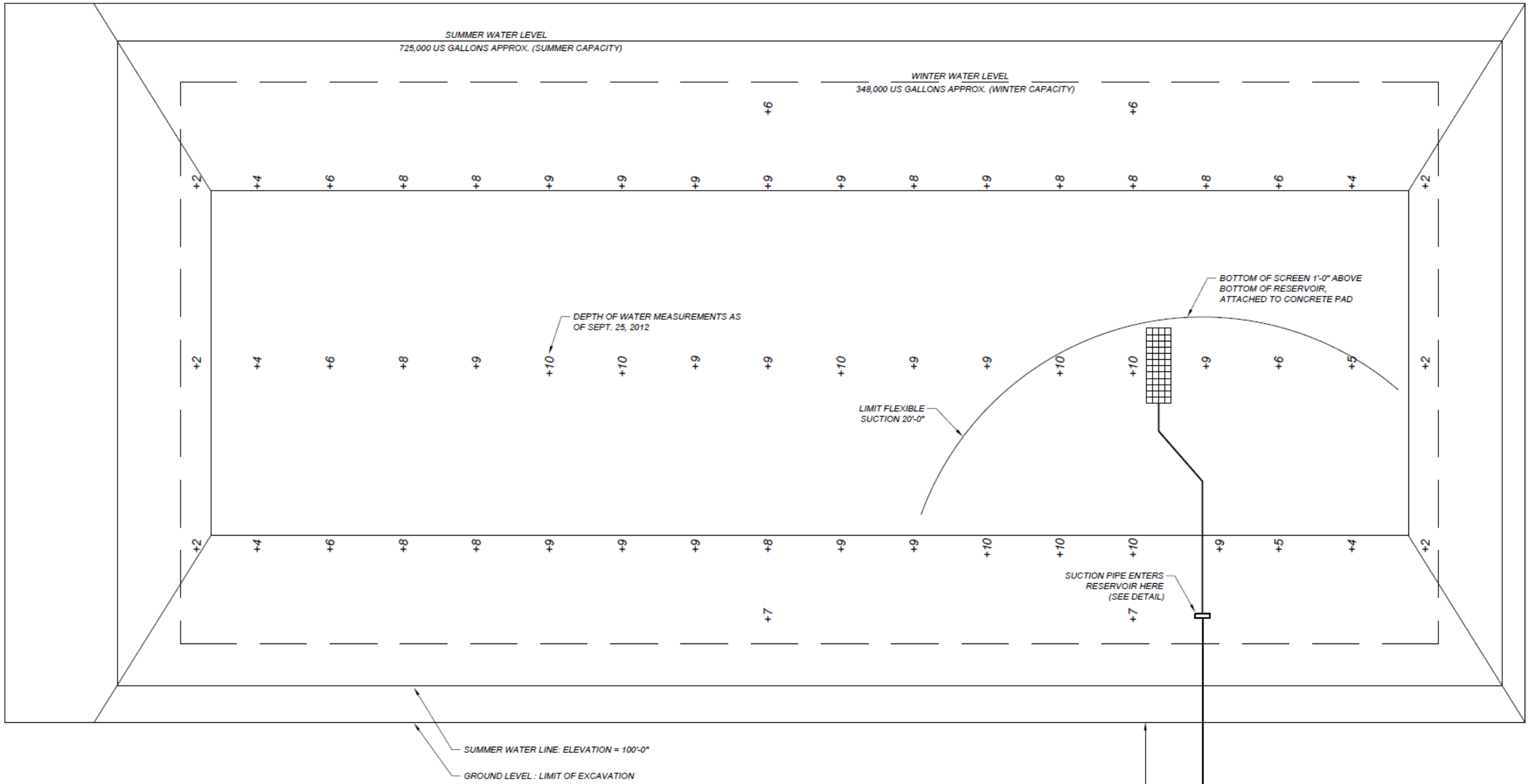

FIRE FIGHTING WATER RESERVOIR
SUMMER VOLUME = 725,000 USGAL
WINTER VOLUME = 345,000 USGAL
BOTTOM OF SCREEN 1'-0" ABOVE BOTTOM OF RESERVOIR
DRY FIRE HYDRANT FIRE DEPARTMENT SUCTION CONNECTION
FIRE LANE (ACCESS ROUTE)
8" BOLLARDS WITH REFLECTIVE TAPE (TYP.)
NO PARKING POSTED (FIRE LANE)
GRASS
GREY WATER FIELD
SEMI TRAILER PARKING
BUILDING LOCATION 'A'
PROPERTY LINE
FIRE LANE (ACCESS ROUTE)
PARKING STALLS
BUILDING LOCA
PARKING ST



RESERVOIR SECTION

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


DRY HYDRANT C/W 4" STORZ FDC
AND 6" PVC SWIVEL
HYDRANT OUTLET
110'-0"
6" PVC PIPE PAINTED RED
2'-0"
GRADE
T/O GRADE
108'-0"
INSULATE PIPE TO 8 FEET
BELOW GRADE
CONCRETE THRUST
BLOCK OR MECHANICAL
ANCHOR
6" PVC UNDERGROUND
PIPING
SAND
SAND
DRY HYDRANT DETAIL
NTS



FIRE FIGHTING WATER RESERVOIR

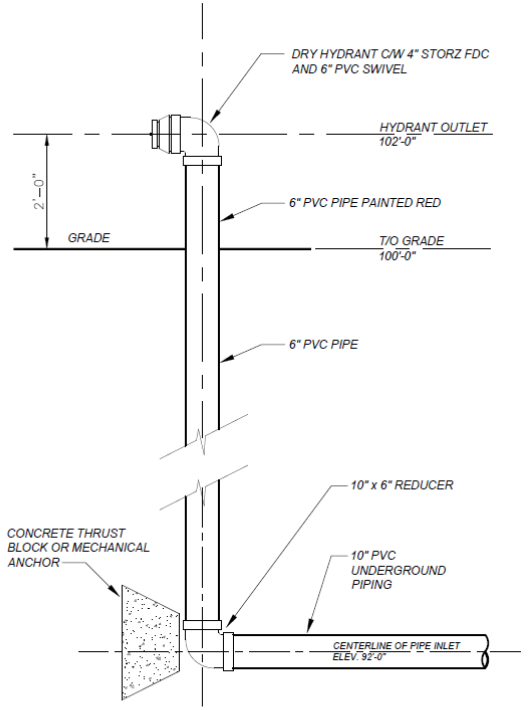
SCALE : 1/4" = 1'-0"


EF MOON


ON FIRE DEPT.
ENCY SERVICES

Example 2 - Remote Water Supply

- Remote site – well outside of municipal water
- Light industrial – non-combustible machine shop
- 103,000 sf building with 22 ft. ceiling
- Natural body of water existing
- No sprinklers required by code.
- Inside Class II hoses stations (100 gpm) provided by pump/tanks
- Fire fighting water supply NEEDED per Building Code.
- **1998 MBC** volume needed = 288,000 gal. stored water
- **FUS** flow needed = 4537 GPM x 30 min = 136,800 gal. stored water
- **NFPA 1142** volume needed = 454,000 gal. stored water
- Natural pond has estimated volume of **537,000 gal** (summer) & **150,000 gal.** (winter) – deemed acceptable by AHJ – dry hydrant connected



DRY HYDRANT DETAIL
NOT TO SCALE

Caparison of Results

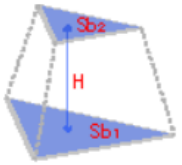
	Calculated Stored Volume US Gal.	
Standard Used	**Example #1**	**Example #2**
MBC (1998)	**89,000**	**288,000**
FUS (30 min)	**30,000**	**136,000**
NFPA 1142	**131,000**	**454,000**

MBC (1998) and NFPA 1142 both calculate volume.
FUS calculates flowrate.

Reservoir Calculations

https://planetcalc.com/131/

Volume of a frustum



Frustum dimensions

Formula: $V = \frac{H}{3}(S_{b1} + S_{b2} + \sqrt{S_{b1}S_{b2}})$

Volume of a frustum

Base area 1 (Sb1): 100

Base area 2 (Sb2): 10

Height (H): 10

Calculation precision: Digits after the decim...

CALCULATE

Volume: 472.08

PLANETCALC, Volume of a frustum

Water Storage Tanks

- This is expensive option and volumes usually designed to minimums.
- Stored water in tanks to meet requirements of NBC 3.2.5.7 may not need to meet all NFPA 22 (tanks for private fire protection) requirements - remember the generous list of acceptable water sources in the Annex.
- Water still needs to be available 12 months of year.
- Indoor plastic tank(s) might be OK, depending on project.
- AHJ can make ruling on this.

Dry Hydrant Maintenance

- Monthly visual inspection to ensure:
  - cap on
  - free of obstructions (clear of vegetation & snow)
  - signage in place
  - no mechanical damage
- Annual inspection of intake screens (if open water) - fish camera.
- Routine (annual) flow testing - requires FD resources.

Summary

- For new developments that fall into one of the categories, this is a life safety Code Requirement.
- Determination of fire water volumes using these calculation methods should be a starting point.
- No such thing as TOO MUCH Fire Protection Water
- Municipal by-laws should leave room for engineering judgement and fire department best practices - open dialogue between designer/owner/AHJ.
- Case x Case basis.
- For existing developments with NO FIRE WATER, this should be a conversation. "Help us help you."
- Risk vs. Consequence
- Owners should want this for their own protection.

Thank You