

SECTION J RURAL FIRE PROTECTION

J.1 GENERAL

- J.1.1** The purpose of this section is to aid developers in meeting the County of Vermilion River’s rural fire protection needs through the proper construction and location of “dry hydrant” fire suppression facilities in rural areas and rural subdivisions not serviced by a pressurized municipal fire protection system. These guidelines are intended as a minimum standard only and higher standards should be sought when practical. The County maintains its discretion to require higher standards where specifically required.
- J.1.2** This document is a summary of guidelines only and is not meant to be comprehensive. More specific details should be obtained from the directly from the reference documents.
- J.1.3** The minimum water supplies required by ABC shall be established in, or transportable to, the designated area. If there are no provisions for natural or developed water sources for firefighting in the proposal, the County may require that the developer conduct a flow test to determine if sufficient water can be provided for a minimum of 30 minutes as required by NFPA 1142.
- J.1.4** The standards of this document and NFPA 1142 are not required if:
- a. NFPA 13, 13D, or 13R are fully met to provide an adequate sprinkler system protecting a building; or
 - b. a pressurized municipal system is present which NFPA 1142 considers as a piped communal system capable of 950 L/min flow for a minimum of 2 hours at 140 kPa pressure from fire hydrants at an adequate spacing.
- J.1.5** Although a pressurized system is preferred, the County recognizes that such a system is not always practical due to high costs, low development densities, or specific land use bylaws and regulations. The County has therefore developed these guidelines to identify the level of fire protection that is to be maintained if a pressurized water system is not provided.
- J.1.6** In general, this document is aimed at low-density “acreage” type country residential developments that are becoming more prevalent throughout the County. However, these standards and NFPA 1142 can also provide guidance for fire protection within business, commercial, institutional and industrial developments, though more detailed and site-specific standards may have to be adopted. This document and NFPA 1142, have limitations due to their general

focus. In very specialized or extremely hazardous situations, standards may be applied that exceed the standards set out in this document.

J.2 PURPOSE AND PROFESSIONAL INVOLVEMENT

J.2.1 NFPA 1142 identifies “*minimum requirements for water supplies for structural firefighting purposes in rural and suburban areas where adequate and reliable water supply systems for firefighting purposes, as determined by the authority having jurisdiction, do not otherwise exist.*” These minimum requirements can be increased at the discretion of the local authority.

J.2.2 These standards provided are for general reference only, for use by the development community, facility designers, and in the review and approval process by the County Planning and Development department (P&D), Public Works department (PW), and the County of Vermilion River Fire Services (CVRFS).

J.2.3 As part of the requirements of the Subdivision Conditions, Development Permit, and/or Development Agreement, a fire protection system may be required at the County’s discretion. All calculations and design drawings for such a system must be prepared and stamped by a Professional Engineer registered to practice in the Province of Alberta (Consulting Engineers).

J.3 DEFINITIONS AND FORMULAS

J.3.1 Following are select definitions and calculations from NFPA 1142 to be made by the Consulting Engineers:

Minimum Water Supply (MWS) – The quantity of water required for fire control is calculated as follows. The factors are summarized below, but should be derived directly from NFPA 1142:

- For structures without exposure hazards:

$$MWS = \frac{VS_{tot}}{OHN_{adjusted}} * CCN * EH$$

Where:

MWS = minimum water supply in liters

VS_{tot} = total volume of structure in m³

OHN_{Adjusted} = Occupancy Hazard Classification x metric conversion factor

CCN = Construction Classification Number

EH = Exposure Hazard

For SI (metric) conversions use the following adjusted OHN numbers:

OHN	3	4	5	6	7
Adjusted OHN	0.0224	0.0299	0.0373	0.0448	0.0523

The MWS shall be a minimum of 7,600 L if there is no exposure hazard and a minimum of 11,355 L if an exposure hazard is present.

Construction Classification Number (CCN) – A series of numbers from 0.5 to 1.5 based on building construction classifications outlined in NFPA 220 Standard on Types of Building Construction. Refer to NFPA 1142 and NFPA 220 for details. The CCN closely follows the Type of construction classification as summarized below. Generally Type I (CCN=0.5) construction provides the highest fire resistance, while Type V (CCN=1.5) provides the lowest.

Occupancy Hazard Number (OHN) – A series of numbers from 3 to 7 that are mathematical factors used in a formula to determine total water supply requirements.

Exposure Hazard (EH) – A structure is considered to be an Exposure Hazard, and have an EH factor of 1.5 if:

- It is 9.29 m² (100 ft²) or larger in area and is within 15.24 m (50 ft) of another structure; or
- It has an OHN of 3 or 4 (Severe or High Occupancy Hazard) and is within 15.24 m (50 ft) of another structure.

All others are considered to be No Exposure Hazard, and an EH factor of 1.0 is applied.

Dry Hydrant – An arrangement of pipe permanently connected to a water source other than a piped, pressurized water supply system that provides a ready means of water supply for firefighting purposes and that utilizes the drafting capability of fire department pumpers.

J.4 WATER SUPPLY REQUIREMENTS

J.4.1 The following shall be addressed in the design of any fire protection system (Based on NFPA 1142):

- Water source(s) shall be acceptable to the County, of suitable quality and be maintained and accessible on a year-round basis;

- If the water is from a private source, a water use agreement acceptable to the County shall be required to ensure access to the water source. An example agreement is provided in NFPA 1142;
- Adequate water source indicators (signs and/or painted indicators) acceptable to the County shall be provided, and shall take into account potential for snow depth accumulation and snow plowing operations;
- Means of access to any required water supply or dry hydrant shall be constructed and maintained to meet NFPA 299 *Standard for Protection of Life and Property from Wildfire*; NFPA 1141 *Standard for Fire Protection in Planned Building Groups*; and the County of Vermilion River Municipal Servicing Standards;
- Locations for and the immediate area around dry hydrants shall provide for firefighter safety;
- Dry hydrants shall be located to be accessible under all weather conditions;
- System and site accessibility criteria shall ensure the dry hydrant can be reached with no more than 6 m (19.68 ft) of hard suction hose;
- Dry hydrants shall have a minimum clearance of 6.1 m (20 ft) on each side and to be located a minimum of 30 m (98.4 ft) from any structure. Vehicle traffic shall not be impaired during the use of the dry hydrant;
- Dry hydrants shall be protected from damage by vehicular and other perils, including freezing and damage from ice and other objects;
- Dry hydrant locations shall be made visible from the main roadway during emergencies by reflective marking and signage approved by the County. All identification signs shall be approved by the County and/or Alberta Transportation prior to installation if they are to be located on the right-of-way or are subject to local or provincial laws;
- Vehicle access shall be designed and constructed to support the heaviest vehicle the County currently utilizes;
- Static lift should not exceed 3.1 m to 3.7 m. At design flow, head losses should be less than 6.1 m (20 ft); and
- The hydrant shall be painted as needed in colors determined by the County, with reflective material to maintain visibility during emergencies.

J.4.2 The Minimum Water Supply volume shall be:

- A minimum of 7,600 L if there is no exposure hazard;
- A minimum of 11, 355 L if an exposure hazard is present. The County reserves the right, at its discretion, to require a larger minimum volume to provide a higher level of fire protection for multi-lot subdivisions; or

- As identified in the individual “In-Ground Open Storage Pond” and “Cistern” sections of this document.

J.4.3 If there is no developed or natural water sources contemplated in the proposal, the developer shall make arrangements for an alternative water source that can maintain the rates below as required in NFPA 1142.

TABLE 3.2.3.1. SPECIFICATIONS FOR AGGREGATE

DESIGNATION	1			2			3				4			5		6		7	8	9			
Class (mm)	10	12.5	16	=16(N2)	20	25	40	12.5AW	12.5BW	12.5C	16	20	25	40	10A	10B	80	125	40	25	8		
Percent Passing Metric Sieve (CGSB 8-GP-2M) • m	125 000																	100					
	80 000																100						
	50 000																55-100	55-100					
	40 000						100							100					100				
	25 000					100	70-94						100					38-100	38-100		100		
	20 000					100	82-97					100			55-90								
	16 000		100		100	84-94	70-94	55-85				100						32-85	32-85		90-		
	12 500		100	80-92	89-100				100	100	100	72-95											
	10 000	100	83-92	70-84	78-94	63-86	52-79	44-74	35-65	55-75	70-93	53-82	35-77	30-77	25-72	100	100				85-100	45-75	
	8 000																						100
	5 000	60-75	55-70	50-65	55-70	40-67	35-64	32-62	0-15	0-15	30-60	27-54	15-55	15-55	8-55	70-90	45-70	20-65	20-65		0-15	85-100	
	1250	26-45	26-45	26-45	26-45	20-43	18-43	17-43	0-3	0-3	9-28	9-28	0-30	0-30	0-30	20-45	20-45				40-100	0-5	45-75
	630	18-38	18-38	18-38	18-38	14-34	12-34	12-34															30-50
	315	12-30	12-30	12-30	12-30	9-26	8-26	8-26			0-15	0-15				9-22	9-22	6-30	6-30		17-100		18-30
	160	8-20	8-20	8-20	8-20	5-18	5-18	5-18			0-11	0-11				5-15	5-15						10-21
80	4-10	4-10	4-10	4-10	2-10	2-10	2-10	0-0.3	0-0.3	0-8	0-8	0-12	0-12	0-12	0-10	0-10	2-10	2-15	6-30			5-15	
% FRACTURE BY WEIGHT (2 FACES)	ALL +5000	60+	60+	* SEE NOTE (N1)	60+	60+	60+	50+	75+ (100% 1 Face)	75+ (100% 1 Face)	60+	60+	40+	40+	25+	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
PLASTICITY INDEX (PI)	NP	NP	NP	NP	NP-6	NP-6	NP-6			N/A	N/A	NP-4	NP-4	NP-8	NP-8	NP-8	NP-6	NP-6	NP-8	NP-8	NP-5	NP-5	NP
L.A. ABRASION LOSS PERCENT MAX.	40	40	40	50	50	50	50	35	35	35	35	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	35
FLAKINESS INDEX	N/A							MAX 15				N/A											
COEFFICIENT OF UNIFORMITY (Cu)	N/A																	3+	N/A				

Designations:

- Designation 1 - Asphalt Concrete Pavement
- Designation 2 - Base Course Aggregate
- Designation 3 - Seal Coat Aggregate
- Designation 4 - Gravel Surfacing Aggregate
- Designation 5 - Sanding Material
- Designation 6 - Pit- Run Gravel Fill
- Designation 7 - Cement Stabilized Base Course Aggregate
- Designation 8 - Granular Filter Aggregate
- Designation 9 - Slurry Seal Aggregate

*** Notes:**

- N1. Asphalt Concrete Mix Type 1 - 90+ (98% 1 face)
Asphalt Concrete Mix Type 2 - 70+
Other Asphalt Concrete Mix Types - 60+
- N2. Designation 2 Class 16 Material is for ASBC
- N3. For crushed aggregates other than all Designation 5 and Designation 9 materials, a tolerance of three percent in the amount passing the maximum size sieve will be permitted provided all oversize material passes the next larger standard sieve size.

Total Water Supply Required	Rate Water is Available at Scene
Liters	L/min
9,459	950
9,460 – 37,849	1,900
37,850 – 75,699	2,850
≥75,700	3,800

J.5 FACILITY PLANNING CONSIDERATIONS

In addition to the requirements of NFPA 1142, the County has developed the following criteria:

- J.5.1** The County recognizes that there are several methods for water supply storage. The preferred facility types are constructed in-ground storage tanks (cisterns) and open storage ponds.
- J.5.2** The County will consider applications involving locations within a natural stream, lake or other water body, as long as adequate measures are taken to address issues of seasonal fluctuations in water level, access restrictions, and environmental concerns.
- J.5.3** The County may, where typical installations are not possible, provided satisfactory measures are taken to address concerns with freezing, construction, maintenance, and supply logistics accept the following installations in unusual circumstances:
- Shallow installations;
 - Shallow or seasonal ponds;
 - Above-ground storage tanks; or
 - Bridge installations and/or facilities that include a roadway obstruction between the water source and the dry hydrant.
- J.5.4** Dry hydrants, including their required lands and water storage facilities, shall be zoned as Public Utility Lots.
- J.5.5** There shall be no overhead utilities on the Public Utility Lot.
- J.5.6** There shall be no underground utilities permitted on the Public Utility Lot where there may be interference with operation of the dry hydrant and/or its water supply, or where the dry hydrant and/or the water supply operations could impede the utility.
- J.5.7** As outlined in NFPA 1142, the need and locations for a dry hydrant depends on a number of factors, including but not limited to:
- Current and future population and building trends;
 - Property values being protected;
 - Potential for loss;
 - Proximity to structures (dry hydrant to be min. 30 m (98.4 ft) from structure it is protecting);

- Fire history of the area protected;
- Current water supply systems;
- Potential water supply sources and reliability;
- Cost of project, and
- Other factors of local concern (location of responding fire department, etc).

J.5.8 The spacing and locations of dry hydrants will remain within the discretion of the County, CVRFS and P&D, with input from engineering professionals and other agencies (i.e. ASRD). For any particular subdivision, many factors must be considered, such as nearest responding fire department, proximity to existing lakes and ponds, proximity to forested areas, the nature of and value of proposed structures, setbacks and other factors.

J.5.9 Provided an elevated fire hazard risk does not exist, and on approval by the County, dry hydrant requirements may be reduced where a proposed development is within a reasonable distance and response time from an existing hamlet or community with a pressurized municipal water system that has adequate capacity to provide fire water flow.

J.5.10 Shared dry hydrant systems may be considered by the County on a site by site basis to reduce cost among proposed developments, or to improve fire protection in existing areas adjacent to proposed developments.

J.6 GENERAL DESIGN CONSIDERATIONS

J.6.1 The design of the dry hydrant, including miscellaneous materials and liners, shall be for a minimum life span of 25 years.

J.6.2 The materials of construction shall be suitable to meet fire flow needs and shall be appropriate for the installation conditions. Buried pipe should be rated for suction conditions. Should rubber gasket PVC be proposed, it shall meet AWWA C900 or C905 with a minimum Class 150 (DR18) rating and wall thickness. Should HDPE pipe be proposed, it shall be rated a minimum 150 psi (DR11). Should Steel Pipe be considered, it shall be a minimum of Schedule 40, with corrosion protection and sacrificial anodes considered. Minimum size suction and buried piping is 250 mm (10 inch) diameter. Above ground metal pipe shall be primed and painted to color acceptable by the County.

J.6.3 The dry hydrant shall be designed and constructed to provide a minimum flow of 840 L/min at draft.

- J.6.4** The fire department connection shall consist of a 100 mm Storz type quick connect fitting steamer port or equal. The Protective cap on the connection shall be acceptable to the County and meet the requirements of NFPA 1963 *Standard for Fire Hose Connections*.
- J.6.5** All pipe shall be adequately bedded and all trenches and excavations fully compacted to 98% SPD minimum. Pipe Cover should consider the potential for frost penetration of a least 2.6 m (8.5 ft).
- J.6.6** The dry hydrant riser shall be primed and painted above ground in Hi-viz Yellow. Riser shall be protected from vehicular damage by a minimum of four bollards placed in a square configuration at a distance of 1.2 to 2.0 m from the riser. Bollards shall be constructed of concrete filled 100 mm diameter steel pipe also primed and painted Chromium Yellow.
- J.6.7** Signage shall be provided at the dry hydrant location as follows:
- Minimum size, 300 mm x 600 mm;
 - Mounted with standard Telespar post system; and
 - Signage to read as follows, in 65 mm red letters against a bright yellow background.
- J.6.8** A gravelled approach shall be constructed with adequate gravel base (minimum 150 mm (6 inch) depth of 25 mm (1 inch) crush gravel on 300 mm (12 inch) compacted native material), culvert (min. 400 mm diameter), and of sufficient length and width to allow the responding fire truck to pull fully out of traffic with a minimum 1.5 m (5 ft) clearance on all sides to allow for safety during filling operations.
- J.6.9** Access to a dry hydrant location shall be designed as right-in/right-out, however, access to or from the opposite traffic direction shall not be inhibited by any type of barrier.
- J.6.10** A reliable water source for filling and topping up, the dry hydrant must be identified and approved by the County prior to approval of the development permit. The dry hydrant assembly, as well as the method of topping up, shall be approved by the County and any other Provincial and/or Federal approving agency as required. Filling can be achieved by a dedicated well, stream access, or in the case of buried tank storage only, trucked in. For open ponds, topping up by trucking in is not acceptable due to the larger volumes typically stored within ponds, and the potential for larger losses due to seepage and evaporation when compared to buried tanks. Open ponds filled by storm water flows may be acceptable, provided adequate sedimentation traps are provided upstream of the

fill location, and emergency overflow provisions are made. Storm water routes that flow adjacent to the facility, allowing off-stream filling, are preferred rather than routes that directly flow through the facility, which can have higher maintenance and potential for damage due to flood events.

J.6.11 The area within a distance of 3.0 m (10 ft) around the hydrant assembly shall be surfaced with gravel or similarly inert material to minimize growth of grass, brush, or other vegetation.

J.6.12 The County reserves the right to request, at its discretion, materials and geotechnical information relating to the design of roads, approaches, backfill, bedding, foundations, material tests (i.e. concrete, liner materials, etc.) as required. All such information shall be provided by and stamped by a Professional Engineer registered in Alberta.

J.7 IN-GROUND OPEN STORAGE PONDS – DESIGN CONSIDERATIONS

J.7.1 When calculating the MWS, consideration shall be given to the practicality of constructing an open storage pond. Based upon the criteria outlined below, assuming a square pond with a 3 m x 3 m (10 ft x 10 ft) bottom, the minimum active Water Supply Volume (below the ice allowance and above the suction line intake) that can be provided by a constructed open pond is 182 m³ (48,100 us gal). The following design criteria should be considered:

- Minimum 3H:1V side slopes inside and outside;
- Minimum horizontal bottom dimension of 3.0 m (10 ft);
- Minimum depths as per table below;
- Minimum driving bank of 4.0 m width around pond, and
- Fencing typically 2.0 m beyond driving bank.

	Depth	Volume
Minimum freeboard above ice	0.3 m	151,400 L (152 m ³)
Minimum ice depth allowance	1.0 m	371,687 L (372 m ³)
Minimum active storage depth	1.05 m	182,058 L (182 m ³)
Dead Storage	1.15 m	52,422 L (53 m ³)
Minimum Total Pond Depth	3.5 m	758,324 L (758 m ³)

Note: 1 m³ = 1,000 L

- J.7.2** The above design criteria accommodate the minimum desired frost cover of 2.6 m (8.5 ft) above pipes. Vertical risers that may contain water within the frost zone and area thereby subject to freezing may require special treatment (i.e. heat trace, insulation, etc.) to prevent a frost plug from forming. See NFPA 1142 for examples. Satisfactory operation of the riser must be demonstrated over a period of two winters before final acceptance by the County, including necessary field proof tests witnessed by the County.
- J.7.3** The minimum site area required is 30 m x 30 m (100 ft x 100 ft), or approximately 0.09 ha (0.22 ac.) based upon a square pond and the above criteria not including any allowance for an approach. Given this, plus the additional area required for an approach and other geometries, for example; the minimum total site area required for an open pond and dry hydrant would be in the order of 0.2 ha (0.5 ac). Larger areas may be required depending on site conditions.
- J.7.4** Ponds shall only be considered in areas where water sources for topping up by means other than trucking in are available (i.e. wells, stormwater routes, stream access).
- J.7.5** The ponds must hold and maintain water on a continuous basis;
- where groundwater conditions merit it, the pond may be unlined to allow for replenishment by natural infiltration. If unlined, deepening of all or a portion of the pond should be considered to allow for anticipated fluctuations in water level; and
 - in all situations, lining is required. Lining can be *in situ* native clay materials or synthetic liners. Both must be properly designed by a qualified geo-technical Engineer. Synthetic liners can include plastic (HDPE or PVC) and clay (i.e. bentonite) materials, or variations thereof. Generally plastic liners should be a minimum of 40 to 60 mil thickness (1.0 – 1.5 mm), with the HDPE on the thicker end of the range. Joints should be fused or similarly sealed. HDPE liners are generally more resistant to ultraviolet radiation from sunlight than PVC and bentonite liners typically require compacted clay or gravel armor cover. Gravel armor is also necessary to hold necessary to hold down a liner in areas subject to high water table. The minimum acceptable thickness for a compacted clay liner is 0.6 m (2.0 ft). The minimum requirement for cover by gravel armor is a 0.3 m (1.0 ft) thick layer containing at least 25% by weight material with a size range of 100 mm to 200 mm (4 inch to 8 inch).
- J.7.6** Should an exposed PVC or HDPE plastic liner be used, the side slopes can be slippery to maintenance personnel and animals, especially if wet. For safety,

consideration should be given to roughening the liner surface to provide adequate traction, covering the exposed liner with clay or gravel to allow footing, and/or decreasing the side slopes. These measures should be applied to all sides of the liner. If the liner is left exposed, the pond must be fenced.

J.7.7 Ponds equipped with an exposed plastic liner, a 2.0 m (6.5 ft) high chain link fence shall be provided around the exterior of the open storage pond and driving bank. The fence shall be located 2.0 m (6.5 ft) outside of the outside shoulder of the driving bank to allow adequate vehicular access around the entire perimeter of the pond. A sliding gate shall be provided so as to not block the entrance or gravel driving surface when open. Preference should be given to locating the fire department connection outside of the gate.

J.7.8 Warning signage at open ponds shall meet the following requirements:

- A minimum of four signs, one on each corner of the pond, installed diagonally;
- Minimum size, 600 mm x 900 mm (24 inch x 35 inch);
- Mounted with a standard Telespar post system; and
- Signage to read as follows, against a bright yellow background:

CAUTION (75 mm Red Letters)

THIN ICE (65 mm Black Letters)

DROWNING HAZARD (65 mm Black Letters)

J.7.9 The pond shall be provided with a means to monitor water level, such as by staff gauge. The developer shall supply tables indicating storage volumes at various water levels.

J.8 STORAGE TANKS/CISTERNS – DESIGN CONSIDERATIONS

J.8.1 Cisterns and buried underground tanks are acceptable storage facilities for dry hydrants. They are an alternative in rural subdivisions where open surface water sources are not readily available, where available land and/or top-up capabilities for open ponds are severely limited, where development densities and property values are high, or where a number of other factors and considerations make them more feasible. Cisterns and tanks should be sized based upon NFPA *Minimum Water Supply calculations*. Sizing shall be such that Minimum Water Supply volume is provided as active storage, meaning the volume of water available to be pumped out of the tank or cistern, not including water below the suction intake.

J.8.2 Tanks shall be provided with an adequate dry hydrant head assembly, vent assembly and fill assembly. Examples are provided in NFPA 1142.

J.8.3 For larger more intensive developments, large concrete cisterns illustrated in NFPA 1142 may be required by the County of Vermilion River. Some specifics of the cisterns are as follows:

- Cisterns located no more than 671 m (2,200 ft) truck travel distance from the nearest lot line of the furthest lot;
- Minimum capacity of 113,560 L (30,000 us gal);
- Concrete construction (alternative may be considered);
- Suction system capable of 3,800 L/min (1000 us gal/min) for 75% of the cistern capacity;
- Access approach complete with protective bollards.

J.9 FEES AND DEVELOPMENT LEVIES

J.9.1 The County of Vermilion River reserves the right to develop levies and fees for equitable distribution of costs for provision of rural fire protection facilities. Where warranted, the County of Vermilion River will develop Endeavor to assist policies.

J.10 REFERENCES

- A. Alberta Building Code 2006 (ABC)
- B. NFPA Standard 1142, Water Supplies for Suburban and Rural Fire Fighting (NFPA 1142)
- C. County of Vermilion River's Municipal Servicing Standards (Standards)

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