FIREHARD CANADA

WER · CNEL

Technical Document v1.1

A Canadian Framework for Residential Wildfire Hardening

WER · CNEL Methodology | Version 1.1 | February 2026

Prepared by FireHard Canada | firehard.ca

A Wildernest Systems Inc. project | Smithers, British Columbia

This document describes the FireHard Wildfire Exposure Rating (WER) and Close Neighbour Exposure Level (CNEL) methodology for assessing residential wildfire vulnerability and specifying construction measures for Canadian wildland-urban interface conditions.

The WER system synthesizes the National Research Council of Canada WUI Guide (2021), Australian Standard AS 3959:2018, California Building Code Chapter 7A, the International Wildland-Urban Interface Code (IWUIC 2024), IBHS Wildfire Prepared Home program, and FireSmart Canada guidance into a comprehensive, action-oriented framework for homeowners, contractors, insurers, and authorities having jurisdiction.

DISCLAIMER

The FireHard system — including the WER rating, technical documents, and design guides — is a voluntary framework based on current best practices from wildfire research in Canada, the United States, and Australia. It is not a building code, regulation, or mandatory standard. It does not replace professional engineering, architectural, construction, insurance, or legal advice.

No building is fireproof. Compliance with FireHard specifications does not guarantee survival during a wildfire event. Any costs shown are order-of-magnitude estimates for budgeting purposes only and do not represent an offer to undertake the works at this or any cost.

Future standards: Specifications reflect best available science as of publication. Future Canadian regulation may require component upgrades or additional documentation. Document all hardening work with dated photographs, receipts, and invoices.

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1. Purpose and Scope

1.1 The Canadian Gap

Canada has no mandatory wildfire construction standard. The National Building Code of Canada does not address wildfire exposure. The British Columbia Building Code (BCBC 2018) does not reference wildfire. FireSmart Canada provides awareness-level guidance but does not specify construction details. The National Research Council (NRC) published a voluntary National Guide for Wildland-Urban Interface Fires in 2021, which defines exposure levels and construction classes, but it has not been adopted into any provincial building code and its recommendations reference test standards rather than prescribing practical construction measures.

The result is a gap between awareness and action. Homeowners in Canada's wildfire-prone communities are told their homes are at risk but are not told, with specificity, what to do about it. Contractors lack construction details. Insurers lack a framework for evaluating hardening measures. Authorities having jurisdiction lack a basis for requiring construction upgrades.

Meanwhile, the financial and human costs are accelerating. Canadian insured wildfire losses reached $8.5 billion in 2024. The 2023 fire season burned 18.5 million hectares — seven times the 25-year average. Communities that had never experienced wildfire were evacuated. Jasper, Lytton, Kelowna, Fort McMurray, Slave Lake, and Halifax have demonstrated that wildfire is not a rural or backcountry problem — it is a construction problem that affects subdivisions, schools, and commercial districts.

1.2 What FireHard Provides

The FireHard Wildfire Exposure Rating (WER) and Close Neighbour Exposure Level (CNEL) system addresses this gap by:

1. Defining four wildfire exposure levels based on the dominant threat mechanism (embers, radiant heat, direct flame, flame zone), using Canadian fuel types, terrain, and climate conditions.
2. Specifying construction measures for each WER level across all building envelope components, with materials, dimensions, and product references.
3. Introducing the CNEL system to address structure-to-structure fire spread — the leading cause of loss in WUI events that no other Canadian framework addresses with comprehensive design guidance.
4. Aligning with the NRC Guide's Construction Classes so that when the Guide is eventually adopted into code, WER-rated buildings will meet or exceed requirements.
5. Providing both a simplified self-assessment methodology (for homeowner awareness) and a professional assessment methodology (for engineering reports, insurance documentation, and construction specifications).

Each WER level is a complete, standalone specification. Higher levels are more stringent — they supersede lower levels, not add to them. A builder working to WER-3 uses the WER-3 guide alone, which contains every specification needed for that performance level.

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SCOPE

This methodology applies to residential buildings (Part 9 of NBC) in Canadian wildland-urban interface zones, with particular attention to British Columbia conditions. It may be adapted for other provinces. It does not address commercial, industrial, or multi-storey (Part 3) buildings, though many principles are transferable.

1.3 Referenced Standards and Sources

The WER methodology draws on the following standards, codes, and research. Where specifications conflict, the more conservative (protective) value is adopted.

Source	Description and Relevance
NRC Guide (2021)	National Guide for Wildland-Urban Interface Fires. National Research Council Canada, 192 pp. Defines hazard levels, exposure levels, construction classes CC1(FR) through CC3, and construction measures.
AS 3959:2018 Amd 2	Construction of Buildings in Bushfire-Prone Areas. Standards Australia. Defines BAL levels, 2 mm mesh aperture, bushfire shutter specifications, material requirements by exposure level. The most mature wildfire construction standard globally (30+ years).
California Ch. 7A	California Building Code Chapter 7A: Materials and Construction Methods for Exterior Wildfire Exposure. Defines WUI construction requirements, ASTM E2886 vent testing, prescriptive material standards. Mandatory in all California WUI zones since 2008.
IWUIC 2024	International Wildland-Urban Interface Code (ICC). Model code with 3 hazard classes, defensible space requirements, ignition-resistant construction. Adoption varies by US jurisdiction.
IBHS (2025)	Insurance Institute for Business and Home Safety. Wildfire Prepared Home program. Base and Plus designations with specific component requirements.
FireSmart Canada	FireSmart Wildfire Resilience Best-Practice Checklist. 3 mm non-combustible metal screening. Priority zone vegetation management framework.
ASTM E2886	Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement.
ASTM E2707	Standard Test Method for Determining Fire Penetration of Exterior Wall Assemblies Using a Direct Flame Impingement Exposure.
NBC / BCBC	National Building Code of Canada 2020 / BC Building Code 2018. Part 9 residential construction. Section 9.19 Roof Spaces (ventilation ratios).
CFFDRS / FBP	Canadian Forest Fire Danger Rating System / Fire Behaviour Prediction System. 16 fuel types used for exposure assessment inputs.
NIST TN 1600, 1796, 2205	Post-fire investigations of Witch/Guejito (2007), Amarillo (2011), and Camp Fire (2018). Primary research documenting structure-to-structure ignition as a dominant WUI loss mechanism.

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2. Development Rationale

2.1 Why a New Framework Was Needed

The wildfire science is mature. NIST investigations, IBHS research, Australian Standard AS 3959, and the NRC National Guide collectively describe the threat mechanisms, identify the vulnerable building components, and recommend construction responses. The research is clear: homes can be built and retrofitted to dramatically reduce wildfire loss probability.

But knowledge is not implementation. Canada's existing wildfire programs operate at different layers, and none provides the comprehensive construction design guidance that a homeowner can hand to a contractor:

- **NRC National Guide (2021)** provides the scientific framework — hazard levels, exposure assessment, and construction classes — but references test standards (e.g., 'cladding shall meet CAN/ULC-S134') rather than prescribing specific assemblies. A builder reading the Guide cannot determine what to install without additional research.
- **FireSmart Canada** provides community awareness and vegetation management guidance but explicitly does not cover building construction beyond general recommendations like 'use non-combustible roofing.' It covers the landscape; the building envelope is out of scope.
- **Building codes (NBC/BCBC)** address structural fire safety (life safety during evacuation) but do not address wildfire exposure. The code requires 1-hour fire-rated wall assemblies at limiting distances — but these provisions assume suppression response and intact buildings, not a community-wide conflagration with no suppression available.
- **Insurance industry** recognizes wildfire risk but has no standardized framework for evaluating residential hardening. Policies either cover or exclude WUI properties; there is no mechanism for a homeowner to demonstrate reduced risk through construction measures.

FireHard operates at the implementation layer between these programs. The NRC provides the hazard mapping and community planning framework. FireSmart Canada provides vegetation management and homeowner preparedness guidance. FireHard provides building construction design guidance. These are independent programs — each addressing a different aspect of wildfire resilience, all of which are needed.

2.2 Design Principles

The WER system was developed with the following principles:

- **Comprehensive detail:** Every recommendation includes materials, dimensions, test standards, and product references. 'Use non-combustible cladding' becomes 'fibre cement panel ≥6 mm, metal panel, stucco, or masonry, installed with non-combustible furring and flashing at the wall/foundation junction per TB-01.'
- **Standalone levels:** Each WER level is a complete specification. Higher levels supersede lower levels — they include more stringent versions of every measure, not additional layers.

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- **Binary criteria:** Every specification is pass/fail. The roof is Class A or it isn't. The vent mesh is ≤2 mm or it isn't. There is no 'partial credit' and no subjective interpretation. This makes the system auditable by inspectors, verifiable by insurers, and defensible in permits.
- **Canadian context:** While drawing on Australian and American standards, every specification accounts for Canadian building codes, climate (snow loads, moisture management), fuel types (CFFDRS FBP classifications), and construction practices.
- **Free and open:** All FireHard guides, assessment tools, and technical documents are published free. Wildfire resilience is a community problem; it cannot be solved by proprietary systems.
- **Conservative defaults:** Where international standards conflict, the more protective value is adopted. Where conditions are ambiguous, the higher WER level is assumed.

2.3 Relationship to Existing Programs

FireHard is designed to complement, not replace, existing programs:

Program	Role	FireHard Relationship
NRC National Guide	Science framework: hazard levels, exposure assessment, construction classes	FireHard translates NRC construction classes into comprehensive design guidance. WER levels map directly to NRC CCs.
FireSmart Canada	Community awareness and vegetation management	FireHard covers the building envelope that FireSmart deliberately leaves to others. Both are needed: FireSmart for the landscape, FireHard for the building.
Provincial Building Codes	Life safety during evacuation (structural fire, seismic, etc.)	FireHard addresses property protection — keeping the building standing after the fire passes. Building code addresses getting people out alive. Different objectives, both essential.
Insurance Industry	Risk transfer and pricing	WER certification provides a binary, measurable risk differentiator that insurers can use for underwriting. Class A roof or not. ASTM E2886 vents or not. No interpretation required.

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3. International Code Comparison

Five systems worldwide address wildfire-resistant construction. Each takes a different approach to risk assessment and building response. This section identifies where they converge, where they differ, and what FireHard WER adds to the Canadian context.

3.1 Systems Overview

System	Country	Levels	Status
FireHard WER	Canada	4 WER levels + 3 CNEL tiers. Per-building + per-face assessment.	Voluntary (2025)
NRC National Guide	Canada (2021)	4 exposure levels + 4 construction classes. Fuel-type + distance matrix.	Voluntary
AS 3959:2018	Australia	6 BAL levels (LOW to FZ). Quantitative radiant heat (kW/m²).	Mandatory. Paid ($182 AUD).
IWUIC 2024	United States (ICC)	3 hazard classes. Defensible space + ignition resistance.	Model code. Adoption varies.
California Ch. 7A	California (CBC)	Single standard (no tiers). Ignition-resistant construction.	Mandatory in WUI zones.

3.2 Exposure Level Mapping

Approximate equivalencies between systems. Direct comparison is imprecise because each system uses different assessment methodology, but the construction response at each level is broadly comparable.

System	Low	Moderate	High	Extreme	Flame Zone
FireHard WER	WER-1 <10 kW/m²	WER-2 10–19 kW/m²	WER-3 19–40 kW/m²	WER-4 >40 kW/m²	—
FireHard CNEL	CNEL-1 (6–10m)	CNEL-2 (4–6m)	CNEL-3 (2.4–4m)	<2.4m: P.Eng.	—
NRC Guide	Ember-Only / CC3	Moderate / CC2	High / CC1	High / CC1(FR)	—
AS 3959 BAL	BAL-12.5	BAL-19	BAL-29	BAL-40	BAL-FZ
IWUIC	Class 3 (Moderate)	Class 2 (High)	Class 1 (Extreme)	—	—
CA Chapter 7A	Single ignition-resistant standard applies to all WUI zones				

3.3 Feature-by-Feature Comparison

The following comparison highlights where each system leads, where gaps exist, and where FireHard WER adds capability not found in other frameworks.

Feature	WER	NRC	AS 3959	IWUIC	CA Ch.7A
Risk assessment	Site-specific veg + separation	FBP fuel type + distance	Veg + slope + FDI + distance = kW/m²	AHJ hazard classification	State Fire Marshal zone
Structure-to-structure fire	✓ CNEL system — 3 tiers, per-face	Briefly acknowledged	Structures in BAL assessment	Mentioned in context	Not addressed
Slope adjustment	✓ Functional slope factor	Zone size adjustment	✓ Explicit tables by degree	AHJ discretion	Not explicit

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Radiant heat metric	✓ Estimated kW/m² overlay	Qualitative	✓ Quantitative kW/m²	Qualitative	Test-standard-based
Construction detail	✓ Comprehensive — 6 modules + 3 TBs	General recommendations	✓ Detailed per element	Ignition-resistant specs	Prescriptive + test standard
Wall assembly design	✓ Full layered assembly (TB-01)	Cladding classification only	Cladding + subframe by BAL	Ignition-resistant class	ASTM E2707 wall test
Hot roof / unvented attic	✓ Recommended (TB-01, TB-03)	Not addressed	Not addressed	Not addressed	Not addressed
Sarking membrane	✓ Specified (TB-01, TB-03)	Not addressed	✓ Required BAL-19+	Not addressed	Not addressed
Wildfire shutters	✓ Specified by level	Not addressed	✓ Required BAL-40+/FZ	Not addressed	Not addressed
Ember-resistant vents	✓ ASTM E2886 WER-2+	✓ Required by CC	✓ Required BAL-12.5+	✓ Required	✓ ASTM E2886
Decks and attachments	✓ Detailed (Module 4, TB-03)	General recommendations	✓ By BAL level	Ignition-resistant	✓ ASTM E2632/E2726
Fencing	✓ Detailed (Module 5, TB-02)	General mention	Not covered	Defensible space context	Not addressed
Community planning	✓ Community section	✓ Chapter 4	State planning reference	✓ Access, water supply	Defensible space zones
Insurance integration	✓ WER-rated discount framework	Referenced in analysis	Industry-level	Not addressed	Not addressed
Existing homes	✓ Self-assessment + retrofit guides	✓ Retrofit analysis (ICLR)	Focus on new construction	Some retrofit provisions	New + major reno
Free and accessible	✓ All docs free	✓ Free PDF	Paid ($182 AUD)	Paid ($)	✓ Free (UpCodes)
Maturity	New (2025)	Published 2021	Mature (1991, rev 2018). 30+ years.	Established (2003, rev 2024)	Established (2008)

3.4 Unique Strengths and Gaps

FireHard WER Strengths

- CNEL system for structure-to-structure fire (unique among all five systems)
- Comprehensive construction design guidance with 6 modules and 3 technical bulletins
- Hot roof / unvented attic guidance (unique — no other system addresses this)
- Insurance integration framework with binary pass/fail criteria
- Self-assessment tools for existing homes
- Fencing research integration (NIST TN 2228)
- Radiant heat kW/m² overlay aligned with AS 3959 methodology
- Free and open access to all documents

GAP

FireHard is new (2025) with no adoption history. Credibility must be built through quality, transparency, and alignment with proven international frameworks.

How FireHard Fills Gaps in Other Systems

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- **NRC Guide gaps filled:** Limited construction detail → comprehensive assembly guidance. No wall assembly design → TB-01. Weak structure-to-structure coverage → CNEL system. No shutters or sarking guidance → WER-3/4 specifications.
- **AS 3959 gaps filled:** No separate close-neighbour framework → CNEL. No hot roof guidance → TB-01/TB-03. Fencing not covered → Module 5/TB-02. No community planning → Communities Guide.
- **CA Chapter 7A gaps filled:** Single tier (no graduation) → 4 WER levels. No structure-to-structure → CNEL. No shutters → WER-3/4. No wall assembly design → TB-01.

3.5 Key Findings

No single system covers everything. Australia leads on quantitative risk assessment and mandatory enforcement (30+ years). Canada's NRC Guide leads on community planning and cost-benefit analysis (ICLR $4-saved-per-$1-spent). FireHard WER leads on construction design guidance detail, structure-to-structure fire (CNEL), and practical guidance for existing homes. The US systems are fragmented between IWUIC (model code) and state-level requirements like California Chapter 7A.

FireHard WER is designed to complement, not replace, the NRC National Guide. The NRC Guide provides the hazard framework and community-scale recommendations. FireHard WER provides the comprehensive construction design guidance that the NRC Guide deliberately leaves to others. Together they cover the full spectrum from national hazard mapping to individual building component criteria.

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4. Wildfire Exposure Rating (WER) Levels

The WER system defines four levels of wildfire exposure. Each level is named by the dominant threat mechanism that a building at that exposure would face during a wildfire event. Higher numbers indicate higher exposure and require more stringent construction measures.

The key principle: every WER level includes all threats from the levels below it. A WER-3 building faces embers, radiant heat, AND direct flame. The level name reflects the highest-intensity threat the building must resist.

4.1 Derivation of WER Levels and Thresholds

The four WER levels are not arbitrary categories. They correspond to the four physically distinct wildfire attack mechanisms that a building can experience, each with different intensity, duration, and construction implications. The radiant heat boundaries that define each level are derived from AS 3959 BAL methodology, NIST fire behaviour research, and the NRC National Guide exposure framework.

Radiant Heat Boundaries

The WER system uses estimated radiant heat flux (kW/m²) as the primary physical metric for level assignment, aligned with the AS 3959 approach. The boundaries correspond to material ignition thresholds:

WER Level	Radiant Heat	Physical Basis	Construction Implication
WER-1	<10 kW/m²	Below piloted ignition threshold for most cladding. Primary attack is ember transport through vents, gaps, and accumulated debris. NIST Camp Fire data: ember-caused ignitions at >1 km from fire front.	Seal the envelope. Close gaps >3 mm, screen vents with 2 mm mesh, Class A roof. No cladding upgrade required.
WER-2	10–19 kW/m²	At or above piloted ignition threshold (12.5 kW/m²). Radiant heat can ignite combustible surfaces if an ember provides the pilot source. Vinyl distorts at ~15 kW/m². Single-pane glass may crack. Corresponds to AS 3959 BAL-12.5 to BAL-19.	Ignition-resistant cladding. No vinyl on exposed faces. Tempered glazing. Ember-resistant vents (ASTM E2886). Sarking under tile roofs.
WER-3	19–40 kW/m²	Exceeds spontaneous ignition threshold for wood (~25 kW/m²). Direct flame contact from surface fire or crown fire dropdown is possible. Standard glass fails. Corresponds to AS 3959 BAL-29 to BAL-40.	Non-combustible cladding. Wildfire shutters on exposed elevations. Non-combustible decking and fencing. Unvented attic recommended. ASTM E2886 vents required.
WER-4	>40 kW/m²	Exceeds rapid ignition threshold for all combustibles. Direct flame engulfment. Aluminium melts (660°C). Corresponds to AS 3959 BAL-FZ.	Fire-resistance-rated wall assemblies. Steel or bronze mesh only. Complete non-combustible exterior. Wildfire shutters all elevations. Professional assessment required.

Threat Mechanism Progression

The WER levels are named by the highest-intensity attack mechanism at each exposure level. This is not just a labelling convention — it reflects the fundamentally different construction responses required at each stage:

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- **Embers only (WER-1):** The building envelope must prevent ember entry and resist spot ignitions. The primary failure mode is embers entering through unscreened vents, gaps in eaves, or accumulating in combustible debris. NIST and IBHS research consistently shows that ember entry through vents and gaps causes 60–80% of WUI structure ignitions.
- **Embers + radiant heat (WER-2):** The envelope must resist ember entry AND prevent radiant-heat-induced ignition of exterior surfaces. The failure mode shifts from entry points to surface materials: vinyl siding softens and pulls away, exposing sheathing; untreated timber darkens and eventually ignites with ember pilot; single-pane glass cracks, creating an opening.
- **Embers + radiant heat + direct flame (WER-3):** The envelope must resist all of the above AND withstand direct flame impingement for 5–15 minutes. The failure mode shifts to combustible attachments (decks, fences, pergolas) that act as fire bridges, delivering flame directly to the wall, and to window failure under combined radiant heat and flame exposure.
- **Flame engulfment (WER-4):** The entire building exterior must survive sustained flame contact and extreme radiant heat. No combustible materials are acceptable. The building must function as a fire-rated enclosure.

4.2 Departures from the NRC National Guide

The WER system is designed to complement the NRC National Guide for Wildland-Urban Interface Fires (2021), not to replace it. However, FireHard makes several deliberate departures from the NRC Guide's structure and naming to improve usability and address gaps. These departures are documented here for transparency.

Level Structure and Naming

The NRC Guide uses a two-axis system: Exposure Levels (Nil, Ember-Only, Low, Moderate, High) that describe the fire environment, and Construction Classes (CC3, CC2, CC1, CC1(FR)) that describe the building response. The relationship between exposure levels and construction classes depends on whether vegetation management has been applied.

WER simplifies this to a single four-level system where the level name describes the dominant threat and directly implies the construction response:

NRC Exposure Level	NRC Construction Class	WER Level	Rationale for Mapping
Nil	— (No requirements)	— (No WER)	Property outside WUI. No wildfire construction measures needed.
Ember-Only	CC3	WER-1	Direct mapping. Both address ember attack with screening and sealing.
Low	CC3	WER-1	NRC Low and Ember-Only both map to CC3. WER consolidates into one level because the construction response is identical.
Moderate	CC2	WER-2	Direct mapping. Both address radiant heat with ignition-resistant cladding and enhanced glazing.
High (with veg mgmt)	CC1	WER-3	Direct mapping. Both address direct flame contact with non-combustible cladding and fire-resistant assemblies.

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High (without veg mgmt) or Moderate (without veg mgmt)	CC1(FR)	WER-4	Direct mapping. Both require fire-resistance-rated wall assemblies for flame zone conditions.

Key Simplifications

- **Ember-Only and Low consolidated into WER-1:** The NRC Guide distinguishes Ember-Only from Low exposure, but both map to the same Construction Class CC3 with the same construction measures. WER consolidates these into a single level because the construction response is identical. The distinction between Ember-Only and Low is relevant for hazard mapping but not for the builder installing vent screens.
- **Numbering direction reversed:** The NRC uses CC3 for the lowest construction class and CC1(FR) for the highest. WER uses WER-1 for the lowest and WER-4 for the highest. This is a deliberate choice for public communication: higher number = higher risk is more intuitive for homeowners, contractors, and insurers. The NRC's descending numbering (CC3 is less protective than CC1) causes confusion in practice.
- **Threat-based naming:** WER levels are named by the dominant attack mechanism (Ember, Radiant, Flame, Flame Zone) rather than by abstract class numbers. This communicates the hazard directly: a homeowner told they are 'WER-2: Radiant Heat Exposure' understands the threat more immediately than 'Construction Class CC2.'

Additions Beyond the NRC Guide

- **Radiant heat metric (kW/m² overlay):** The NRC Guide uses qualitative exposure levels. WER adds estimated radiant heat flux ranges aligned with AS 3959 BAL methodology, providing a quantitative basis for level assignment and enabling direct comparison with the Australian standard.
- **CNEL system (Section 5):** The NRC Guide acknowledges structure-to-structure fire spread but does not provide a separate assessment or specification framework for it. CNEL is an entirely new addition to address the leading cause of loss in Canadian WUI events.
- **Comprehensive construction design guidance:** The NRC Guide references test standards (e.g., 'cladding meeting CAN/ULC-S134') but does not prescribe specific assemblies. WER provides material specifications, product references, and installation details through the Design Guides, Construction Detail Modules, and Technical Bulletins.
- **Hot roof / unvented attic guidance:** Not addressed in the NRC Guide, AS 3959, or any other wildfire standard. WER recommends unvented attic assemblies at WER-3 and WER-4 to eliminate the most vulnerable ember entry pathway, with moisture management guidance for Canadian cold climates.
- **Fencing specifications:** The NRC Guide provides general mention. WER provides detailed fencing specifications by level, including the fire-rated timber pathway based on charring rate analysis, informed by NIST TN 2228 fencing research.
- **Wildfire shutters:** Not addressed in the NRC Guide. WER specifies wildfire shutters at WER-3 and WER-4, aligned with AS 3959 Clause 3.7, addressing the glazing vulnerability that other Canadian guidance ignores.

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- **Slope correction table:** The NRC Guide adjusts vegetation management zone sizes for slope. WER provides a simplified slope correction that directly modifies the WER level per building face, making it actionable for self-assessment.
- **Vegetation management credit:** WER explicitly allows a one-level reduction for effective FireSmart vegetation management, creating a direct link between landscape work and construction design criteria.

Deliberate Omissions

- **Community-scale hazard mapping:** The NRC Guide provides detailed methodology for community-scale wildfire hazard assessment (Chapter 4). WER does not replicate this — it is the NRC Guide's strength and should remain its domain. WER starts where the hazard assessment ends: at the building.
- **CFFDRS/FBP detailed calculation:** The NRC Guide incorporates the full CFFDRS/FBP system for fire behaviour prediction. WER simplifies this into four broad fuel categories for self-assessment, while retaining the full FBP classification for professional assessment. The simplification is deliberate: a homeowner needs to know 'coniferous forest' vs 'mixed,' not the difference between C-2 and C-3 fuel types.

DESIGN INTENT

WER is the implementation companion to the NRC Guide. The Guide provides the science and hazard framework. WER provides the specifications. When the NRC Guide is adopted into building code, WER-rated buildings will meet or exceed the code requirements because the level mapping is deliberately conservative — WER specifications at each level meet or exceed the corresponding NRC Construction Class.

4.3 WER-1: Ember Exposure

Threat: Windborne burning embers (firebrands) capable of travelling kilometres ahead of a fire front. Embers can lodge in vents, gutters, gaps, and combustible materials around the building, causing ignition.

Typical conditions: Building is within a region of moderate to high wildfire hazard (NRC Hazard Level 2–4) but has significant separation from wildland fuels, OR effective vegetation management has been applied within 100 m. The dominant exposure is ember transport, not radiant heat or flame.

NRC Guide equivalent: Construction Class CC3. Exposure Level: Ember-Only or Low.

AS 3959 equivalent: Approximately BAL-12.5 (radiant heat flux up to 12.5 kW/m²).

Estimated radiant heat: Less than 10 kW/m².

4.4 WER-2: Radiant Heat Exposure

Threat: Embers PLUS radiant heat from burning vegetation or structures close enough to degrade, ignite, or shatter building components (glazing, cladding, vinyl products) without direct flame contact.

Typical conditions: Building is within 100 m of continuous forest or dense wildland fuels with limited vegetation management. Partial vegetation management (Priority Zones 1A and 1) has been applied but fuels remain in outer zones. Moderate slopes may amplify radiant heat exposure.

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NRC Guide equivalent: Construction Class CC2. Exposure Level: Moderate.

AS 3959 equivalent: Approximately BAL-19 to BAL-29 (radiant heat flux 19–29 kW/m²).

Estimated radiant heat: 10–19 kW/m².

4.5 WER-3: Direct Flame Exposure

Threat: Embers PLUS radiant heat PLUS direct flame contact from burning vegetation, adjacent structures, or accumulated fuels.

Typical conditions: Building is within 30 m of continuous forest or dense fuel with limited vegetation management. Steep uphill slope from fuels toward building. Adjacent combustible structures within 10 m. Vegetation management limited to Priority Zone 1A only.

NRC Guide equivalent: Construction Class CC1. Exposure Level: High with partial vegetation management.

AS 3959 equivalent: Approximately BAL-29 to BAL-40 (radiant heat flux 29–40 kW/m² plus flame contact potential).

Estimated radiant heat: 19–40 kW/m².

4.6 WER-4: Flame Zone

Threat: Complete flame engulfment. The building is within the expected flame length of surrounding fuels and could be directly engulfed by fire. Extreme radiant heat (>40 kW/m²), sustained flame contact, and massive ember bombardment.

Typical conditions: Building is immediately adjacent to dense wildland fuels with no effective vegetation management. Located on a steep slope with continuous fuel below. No separation from forest canopy.

NRC Guide equivalent: Construction Class CC1(FR). Exposure Level: High or Moderate with no vegetation management.

AS 3959 equivalent: BAL-FZ (Flame Zone). Radiant heat flux >40 kW/m² with direct flame engulfment.

WER-4: PROFESSIONAL ASSESSMENT REQUIRED

FireHard strongly recommends against residential construction in WER-4 exposure without professional engineering assessment. Where construction proceeds, fire-resistance-rated exterior walls, steel or bronze mesh only (no aluminium), complete non-combustible exterior, and wildfire shutters on all openings are minimum requirements.

4.7 Cross-Reference to International Standards

WER	Primary Threat	NRC Guide CC	AS 3959 BAL	CA Ch. 7A / IWUIC
WER-1	Embers	CC3	BAL-12.5	IWUIC Zone C
WER-2	Embers + Radiant heat	CC2	BAL-19 to BAL-29	IWUIC Zone B
WER-3	Embers + Radiant heat + Flame	CC1	BAL-29 to BAL-40	IWUIC Zone A
WER-4	Flame engulfment	CC1(FR)	BAL-FZ	Not separately classified

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5. Close Neighbour Exposure Level (CNEL)

5.1 The Problem

Most Canadian subdivision homes are built 2 to 6 metres apart, wall to wall. At these distances, a fully involved neighbouring structure produces radiant heat fluxes of 15 to 80 kW/m² on the exposed face of adjacent buildings. This exceeds the piloted ignition threshold for most combustible cladding materials (approximately 12.5 kW/m² for wood products). The duration of exposure from a structural fire (30 to 90 minutes) far exceeds the brief pulse of a passing wildland fire front (typically 5 to 15 minutes).

Structure-to-structure fire spread is a leading cause of loss in wildland-urban interface events. NIST investigations of the 2018 Camp Fire, 2020 Marshall Fire, and 2021 Lytton fire all document cases where structure-to-structure ignition was the primary loss mechanism in dense neighbourhoods. In Lytton, the majority of structures were lost to fire spread between buildings, not direct wildland fire contact.

The eaves are often the most vulnerable point. Two homes with walls 2.4 metres apart may have eave overhangs that reduce the eave-to-eave separation to 1.2 metres or less. Vinyl soffits with continuous strip vents, facing each other across a narrow gap with a cedar fence running between them — this is the most common high-risk configuration in Canadian subdivisions, and no current code adequately addresses it for WUI conditions.

CNEL measures apply to the portion of the building wall within the horizontal exposure zone (see Section 5.10), not necessarily the entire elevation. This includes exposure from accessory buildings on the same property — a detached garage or workshop produces the same radiant heat as an equivalent structure on a neighbouring lot.

5.2 Research Basis

The CNEL system is based on the following research:

- **NIST TN 1600 (Maranghides & Mell, 2009):** Investigation of the 2007 Witch/Guejito fires. Documented structure-to-structure ignition as a primary spread mechanism. Homes ignited neighbours through radiant heat at separations under 6 metres and through brand transport at greater distances.
- **NIST TN 1796 (Maranghides et al., 2013):** Investigation of 2011 Amarillo, Texas fires. Documented structure-to-structure ignition at separations as small as 1.5 metres, with radiant heat flux exceeding 40 kW/m² at the receiving wall.
- **NIST TN 2205 (Maranghides et al., 2021):** Post-fire investigation of the 2018 Camp Fire. 85 fatalities, 18,804 structures destroyed. Structure-to-structure fire spread was the dominant loss mechanism.
- **NIST TN 2228 (Butler et al., 2022):** Fire spread from combustible fences and mulch to structures. Documented efficient fire transfer along combustible fencing between buildings.
- **IBHS Research (2019–2024):** Most WUI homes that burn are ignited by other structures or embers, not direct wildland flame. IBHS coined ‘the neighbourhood effect’ — surrounding structures’ condition is the dominant factor in individual survival.

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- **AS 3959 Clause 3.5:** View-factor methodology for calculating radiant heat from neighbouring structures. Consistent with NIST field measurements across all separation distances.
- **NRC National Guide (2021):** Recognises structure-to-structure fire spread as significant. CC-1 includes fire-rated wall assemblies on exposing faces.

5.3 Why a Separate Framework Is Needed

The exposure profile from a neighbouring structure is fundamentally different from wildland fire exposure. It is directional (concentrated on the facing elevation), predictable in intensity (based on separation distance and fuel load), longer in duration than a wildland fire front (30–90 minutes versus 5–15 minutes), and produces burning brands (larger debris) rather than the fine ember shower of a wildland fire.

The National Building Code's spatial separation provisions (NBC 9.10.15) assume the exposing building is intact, the fire is contained by a rated assembly, and fire services will respond. In a WUI event, the exposing building may be fully involved with no suppression available. Additionally, NBC 9.10.15.5(4) explicitly exempts accessory buildings on the same property from spatial separation requirements. A combustible shed at 2 metres from your house has zero code-required fire protection between them.

5.4 The Permit Trigger: NBC as Basis of Design

Any structural upgrade to a close-neighbour wall — replacing cladding, adding sheathing, modifying the wall assembly — requires a building permit. When that permit is pulled, the wall assembly must comply with current NBC spatial separation requirements for the actual limiting distance. This NBC-compliant assembly becomes the basis of design for the CNEL system, which layers on WUI-specific additions that the NBC does not address.

NBC 9.10.15.5 requires 45-minute fire-resistance rating plus non-combustible cladding when the limiting distance is less than 1.2 m (i.e., building separation less than 2.4 m with equal setbacks). This is why 2.4 m is the CNEL floor — it aligns with the NBC's most stringent residential spatial separation threshold. Below 2.4 m, the NBC already demands 45-min FRR, NC cladding, and restricted glazing. Above 2.4 m, the permit-triggered NBC compliance provides the structural baseline, and the CNEL system adds: wildfire shutters, ember-resistant vents, sealed soffits, NC fencing, and ground cover management.

5.5 Derivation of CNEL Distance Thresholds

The CNEL distance thresholds (2.4 m, 4 m, 6 m, 10 m) are derived from the relationship between separation distance and incident radiant heat flux from a fully involved single-storey wood-frame residential structure, validated by NIST post-fire investigations, AS 3959 view-factor calculations, and material ignition thresholds, and aligned with NBC spatial separation boundaries.

Radiant Heat vs. Distance

Radiant heat flux from a burning structure decreases with the square of the distance. The key ignition thresholds for combustible building materials are well established:

- **~12.5 kW/m²:** Piloted ignition threshold for wood products. At or above this level, a burning ember or flame landing on the receiving surface can ignite it (AS 3959 BAL-12.5 basis).

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- **~25 kW/m²:** Spontaneous ignition threshold for most wood products. At this level, the surface can ignite without a pilot source — the radiant heat alone is sufficient.
- **~36 kW/m²:** Critical failure threshold for 6 mm tempered glass under sustained exposure. Even intact tempered glass transmits radiant heat — it is not a radiant heat barrier.
- **~40 kW/m²:** Threshold for rapid ignition of all combustible materials, glass fracture in standard windows, and degradation of aluminium components. Corresponds to AS 3959 BAL-40.

NIST Measurements and Modelling

Separation Distance	Radiant Heat Flux	Source	Physical Basis	CNEL Level
< 2.4 m	> 40 kW/m²	NIST TN 1796; AS 3959 Clause 3.5	Exceeds spontaneous ignition for all combustibles. Glass failure. Aluminium degradation. Flame zone equivalent.	Outside CNEL scope. P.Eng. required.
2.4–4 m	25–40 kW/m²	NIST TN 1796; AS 3959 view-factor	At/above spontaneous ignition. Tempered glass approaches failure (~36 kW/m²) under sustained exposure. Direct flame contact possible.	CNEL-3
4–6 m	15–25 kW/m²	NIST TN 1796; AS 3959 radiation modelling	Exceeds piloted ignition (~12.5 kW/m²). Vinyl distorts. Float glass cracks. Timber chars with pilot.	CNEL-2
6–10 m	8–15 kW/m²	NIST TN 1600; AS 3959 Clause 3.5	At/near piloted ignition. Primary risk is brand/ember transport from burning structure.	CNEL-1
> 10 m	< 8 kW/m²	Inverse-square attenuation	Radiant heat below piloted ignition. Brand transport possible but not structurally directional.	No CNEL required

Alignment with AS 3959

The Australian Standard AS 3959:2018 Clause 3.5 requires that where a neighbouring structure is within the assessment distance, its potential contribution to radiant heat must be included in the BAL calculation. The standard's view-factor methodology produces radiant heat estimates consistent with NIST field measurements: approximately 40+ kW/m² at <2.4 m (BAL-FZ/BAL-40), 25–40 kW/m² at 2.4–4 m (BAL-29 to BAL-40), 15–25 kW/m² at 4–6 m (BAL-19 to BAL-29), and 8–15 kW/m² at 6–10 m (BAL-12.5 to BAL-19). The CNEL thresholds are deliberately aligned with these BAL boundaries.

Alignment with NBC Spatial Separation

The National Building Code uses limiting distance to determine fire-resistance ratings and cladding requirements for exposing building faces (NBC 9.10.15.5). The critical NBC threshold is at 1.2 m limiting distance, which requires 45-min FRR and NC cladding. With equal setbacks, this corresponds to 2.4 m wall-to-wall building separation — the CNEL floor. The CNEL system is deliberately aligned with this threshold so that permit-triggered NBC compliance provides the structural baseline.

Duration Factor

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A passing vegetation fire front typically exposes a building face to peak radiant heat for 5–15 minutes. A fully involved neighbouring structure burns for 30–90 minutes. The CNEL construction specifications account for this extended duration. At CNEL-2 (4–6 m), the facing wall must resist 15–25 kW/m² for 30–60 minutes without igniting — this drives the requirement for NC cladding and wildfire shutters as the retrofit glazing solution. At CNEL-3 (2.4–4 m), the facing wall must resist 25–40 kW/m² for up to 90 minutes — this drives the requirement for Type X gypsum sheathing, mineral wool insulation, and mandatory wildfire shutters on all openings.

SUMMARY

The CNEL thresholds map to radiant heat physics, validated by NIST investigations, aligned with AS 3959 BAL methodology, and anchored to NBC spatial separation.

10 m = radiant heat negligible (brand transport only). **6 m** = piloted ignition threshold. **4 m** = spontaneous ignition threshold. **2.4 m** = NBC's most stringent residential threshold / tempered glass failure zone. **<2.4 m** = outside CNEL scope (P.Eng. required).

5.6 CNEL Levels

CNEL-1: Moderate Exposure (6–10 m separation)

Applies when: Separation distance is 6–10 metres, OR separation is 4–10 metres and the neighbouring structure is rated WER-2 or higher.

Radiant heat basis: At 6–10 m from a fully involved single-storey wood-frame structure, incident radiant heat flux is approximately 8–15 kW/m². Primary risk is brand transport and ember exposure, not sustained radiant heat ignition.

Specifications: Class A roof covering. Non-combustible cladding to 400 mm above grade on facing zone. Enclosed NC soffits on facing eave (apply eave-to-eave specification per Section 5.7). NC or fire-rated fencing. Combustible materials cleared from separation zone. NC ground cover within 1.5 m of either structure. Wildfire shutters optional.

CNEL-2: High Exposure (4–6 m separation)

Applies when: Separation distance is 4–6 metres AND the neighbouring structure is rated WER-1 or unrated.

Radiant heat basis: At 4–6 m, incident radiant heat flux is approximately 15–25 kW/m². This exceeds the piloted ignition threshold. The facing wall must resist sustained radiant heat for 30–60 minutes without fire department response.

Complete specification: CNEL-1 measures plus: NC cladding on full CNEL zone. Permit triggers NBC spatial separation compliance on wall assembly (basis of design). ASTM E2886 ember-resistant vents. NC ground cover in full separation zone. NC attachments on facing elevation. Retrofit: wildfire shutters on all CNEL-zone openings (in lieu of glazing replacement). New construction: tempered glazing standard; shutters recommended.

CNEL-2 IS THE WORKHORSE LEVEL

It addresses the most common Canadian suburban condition: homes on standard residential lots with 2–3 m side-

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yard setbacks (4–6 m wall-to-wall). Wildfire shutters are the practical retrofit solution — they install over existing windows without replacement. Typical cost: $3,000–$12,000 retrofit; $1,500–$6,000 incremental new construction.

CNEL-3: Severe Exposure (2.4–4 m separation)

Applies when: Separation distance is 2.4–4 metres AND the neighbouring structure is WER-1 or unrated, OR any high-risk condition at 2.4–10 m.

Radiant heat basis: At 2.4–4 m, incident radiant heat flux is 25–40 kW/m² — approaching the failure threshold of tempered glass (~36 kW/m²). Under the sustained duration of a structure fire (30–90 min), glass alone cannot reliably protect at this flux.

Complete specification: Type X gypsum sheathing (15.9 mm) behind NC cladding. Mineral wool insulation. Wildfire shutters required on all openings in CNEL zone. Sealed NC soffits — no vents on facing eave. NC radiant heat barrier between properties. New construction: tempered glazing plus shutters. Typical cost: $8,000–$25,000 retrofit; $3,000–$12,000 incremental new construction.

Below 2.4 m: Conditions outside the scope of CNEL prescriptive guidance. Radiant heat exceeds 40 kW/m² — spontaneous ignition of all combustibles, glass failure, aluminium degradation. Consult a licensed professional engineer. For accessory buildings at <2.4 m, consider relocation.

5.7 Eave-to-Eave Assessment

The eave-to-eave separation is typically 1–2 metres less than the wall-to-wall separation. The soffit is the single most vulnerable ignition point — it is where embers enter the roof structure and where radiant heat first degrades the building envelope. Two vinyl soffits with continuous strip vents, 1.2 m apart, with a combustible fence fire running between the houses — this is the ignition scenario that repeats in every WUI event.

The CNEL eave specification is driven by eave-to-eave distance, independent of the wall CNEL level:

- **Eave-to-eave < 2 m:** Sealed NC soffit. NO vents on facing eave. Compensating ventilation on non-facing sides or unvented (hot) roof assembly. NC fascia and gutter guard.
- **Eave-to-eave 2–4 m:** Enclosed NC soffit. ASTM E2886 ember-resistant vents only (no continuous strip vents). NC fascia. Gutter guard.
- **Eave-to-eave 4+ m:** Enclosed NC soffit per WER level. Standard ember screening.

This dual-measurement approach (wall-to-wall for the wall assembly, eave-to-eave for the soffit specification) is based on the physics: the soffit is closer than the wall and is the most vulnerable component. It fills a gap the NBC does not address for WUI conditions.

5.8 Wildfire Shutters

Wildfire shutters are the single most impactful retrofit measure for close-neighbour exposure. They provide an opaque radiant heat barrier that blocks heat transmission entirely.

Why shutters instead of tempered glass replacement: (a) Tempered glass is not a radiant heat barrier — heat passes through intact glass and can ignite interior contents. (b) Tempered glass has a failure threshold of approximately 36 kW/m² under sustained exposure — within the CNEL-3 range. (c)

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Retrofitting glazing costs $500–$2,000 per window and requires a certified glazier. Shutters install over existing windows. (d) Shutters are deployable — closed when threat is identified, open at all other times.

Specification: NC panel (steel, aluminium min 1.2 mm, or fibre cement). Manual roller, hinged, or sliding. Full coverage with 50 mm frame overlap. Reference: AS 3959 Clause 3.7, California SFM 12-7A-4A.

At CNEL-2, shutters are recommended as the retrofit solution. At CNEL-3, shutters are required. For new construction at CNEL-2, tempered glazing is the standard with shutters recommended. At CNEL-3, tempered glazing plus shutters.

5.9 Accessory Buildings on the Same Property

CNEL applies to any structure within the assessment distance — not only to neighbouring properties. NBC 9.10.15.5(4) explicitly exempts accessory buildings on the same property from spatial separation requirements facing the dwelling they serve. This means a combustible shed at 2 metres from your house has zero code-required fire protection between them.

Where any accessory building is within 10 metres of the principal dwelling, the CNEL assessment applies to the facing portion of the dwelling wall using the same separation distance thresholds. The accessory building's construction condition determines neighbour credit: if hardened to WER-2+, the CNEL level may be reduced one step. Conversely, accessory buildings with significant combustible storage or fuel are treated as high-risk (CNEL-3 trigger).

COMMON SCENARIO

A 3 m × 4 m wood-frame garden shed at 2.5 metres from the house. This triggers CNEL-3 on the facing wall zone. Options: harden the wall zone, relocate the shed beyond 6 metres, replace with a NC shed, or remove combustible contents and harden the shed to WER-2+ (reducing CNEL to CNEL-1).

5.10 Horizontal Extent of CNEL Application

CNEL measures apply to the portion of the building wall that falls within the horizontal exposure zone. From each end of the exposing structure, project a 45-degree splay line to the receiving wall. The portion of the receiving wall between these two splay lines, plus 1.5 metres on each side as a buffer, is the CNEL-rated zone. The remainder of the wall remains at the property's wildland WER level.

Minimum zone: 3 metres wide, centred on the closest point. Construction transitions: extend NC cladding 300 mm beyond the CNEL zone boundary. Seal the sheathing junction with intumescent caulk. For irregular geometries, use AS 3959 Clause 3.5 view-factor method.

5.11 CNEL Decision Tree

For each building face:

6. Identify all structures within 10 metres — including neighbouring buildings, accessory buildings on the same property, and significant combustible features.
7. Measure wall-to-wall and eave-to-eave separation distances.
8. Determine each structure's condition. Unknown = assume unrated (worst case). Combustible storage = high-risk.

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9. Apply CNEL levels: >10 m = no CNEL. 6–10 m (or 4–10 m with WER-2+) = CNEL-1. 4–6 m with WER-1/unrated = CNEL-2. 2.4–4 m or high-risk = CNEL-3. <2.4 m = P.Eng.
10. Determine horizontal extent using 45° splay method (Section 5.10).
11. Apply eave-to-eave specification independently (Section 5.7).
12. Compare CNEL with wildland WER. Apply whichever is more stringent in the CNEL zone.

5.12 Relationship Between CNEL and WER

CNEL and WER are complementary systems applied independently. The more stringent specification governs within the CNEL-rated zone. A home rated WER-2 with walls 5 m from an unrated neighbour requires CNEL-2 on the exposed wall zone and WER-2 everywhere else. Eave-to-eave at 3.8 m — the facing eave requires enclosed NC soffits with ember-resistant vents.

For properties with no wildland exposure but close-neighbour risk (e.g., dense urban infill), the CNEL system provides standalone guidance.

5.13 New Construction: Property-Line Assessment

For new construction, the CNEL assessment considers both existing conditions and future development potential:

- **Existing neighbour:** Measure actual wall-to-wall distance. Use the real separation, not the property line.
- **Vacant neighbouring lot:** Effective separation = your setback + minimum setback on neighbouring lot under zoning. Assume worst case.
- **Zero/reduced lot-line zones:** Use actual permitted minimum. A 1.2 m setback each side = 2.4 m effective separation = CNEL-3.
- **Accessory building potential:** Consider worst-case accessory building location per zoning (e.g., detached garage at 0.6 m from property line).

5.14 Community-Level Effectiveness

The CNEL system operates on the principle that every home that hardens makes every neighbouring home safer. As more homes in a neighbourhood are hardened, the CNEL levels for remaining unhardened homes effectively decrease. Community-level adoption produces multiplicative rather than additive risk reduction.

This is why FireHard publishes all resources free. A single hardened home gains limited benefit. A row of hardened homes creates a firebreak.

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6. Assessment Methodology

A WER rating can be determined through two pathways: a simplified self-assessment (for homeowner awareness and prioritization) and a professional assessment (for engineering reports, insurance documentation, and construction specifications).

6.1 Simplified Self-Assessment

The simplified method allows a homeowner or contractor to estimate the WER level based on observable site conditions. It is intentionally conservative — where conditions are ambiguous, the higher WER level should be assumed.

Step 1: Confirm Wildfire Hazard

Determine whether the property is within a wildfire hazard area. In British Columbia, use the BC Wildfire Service interactive map or local Community Wildfire Protection Plans (CWPPs). If the property is within or adjacent to a community identified as having wildfire risk, proceed to Step 2.

Step 2: Identify Dominant Fuel Type

Observe the dominant vegetation within 100 m of the building:

Category	Description	Example FBP Types
Coniferous Forest	Spruce, pine, fir, cedar. Dense canopy. High fire intensity. Significant ember production.	C-1 to C-7
Deciduous / Mixed	Aspen, birch, poplar with some conifers. Lower fire intensity. Moderate ember production.	D-1, M-1 to M-4
Grass / Shrub	Open grassland, rangeland, low shrub. Fast-moving fire with shorter flame lengths.	O-1a/b, S-1 to S-3
Managed / Low Fuel	Irrigated lawns, agricultural fields, managed landscapes.	Non-fuel or managed

Step 3: Assess Separation and Slope

Measure or estimate the distance from the building to the nearest edge of continuous wildland fuel. Assess the slope between fuel and building. Uphill slopes amplify fire behaviour.

Step 4: Determine WER Level

Fuel Type	>100 m	30–100 m	10–30 m	<10 m
Coniferous Forest	WER-1	WER-2	WER-3	WER-4
Deciduous / Mixed	WER-1	WER-1	WER-2	WER-3
Grass / Shrub	WER-1	WER-1	WER-2	WER-3
Managed / Low Fuel	—	WER-1	WER-1	WER-2

SLOPE CORRECTION

0–5° = no adjustment. 5–10° = increase WER by one level. 10–15° = increase by one (two if dense coniferous within 30 m). 15–20° = increase by two levels. >20° = default to WER-4 and seek professional assessment.

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VEGETATION MANAGEMENT CREDIT

Effective management per FireSmart Priority Zones 1A–2 may reduce WER by one step. Cannot reduce below WER-1. Should be confirmed by professional assessment.

6.2 Professional Assessment

A professional WER assessment is a site-specific evaluation conducted by a qualified professional (P.Eng.) producing a stamped report. The professional assessment expands the simplified method by incorporating:

- Detailed vegetation survey using CFFDRS FBP fuel type classification within 100 m and up to 2,000 m.
- Slope measurement for all fuel-bearing aspects relative to the building.
- NRC Guide Detailed Method for exposure level determination.
- Building envelope inspection: roof, walls, vents, glazing, doors, subfloor, decks, eaves.
- Gap and penetration survey: all openings >3 mm identified.
- Adjacent structure assessment: combustible structures, fences, decks within 10 m.
- Photographic documentation of all assessed elements.
- WER level assignment with written rationale.
- Prioritized remediation plan with specifications, estimated costs, and implementation sequence.

Report deliverables: Site plan, WER level assignment with basis, building envelope deficiency table with photos, prioritized remediation plan with FireHard specifications, estimated costs, and P.Eng. seal and signature.

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7. Construction Measures by WER Level

This section specifies recommended construction measures for each WER level, organized by building component. Each WER level is a complete, standalone specification — higher levels supersede lower levels with more stringent requirements. Detailed installation guidance is provided in the FireHard Design Guides and Technical Bulletins, available free at firehard.ca.

Component	WER-1 (Ember)	WER-2 (Radiant)	WER-3 (Flame)	WER-4 (Flame Zone)
Roof Covering	Class A fire-rated (metal, concrete tile, clay tile, asphalt w/ Class A).	As WER-1. Full sarking under tile roofs.	As WER-2. NC covering only (metal or concrete tile). No asphalt shingles.	As WER-3. NC roof covering tested to AS 1530.8.1.
Roof Gaps	All gaps >3 mm sealed with NC material.	As WER-1. Corrugation gaps sealed with 2 mm mesh or mineral wool.	As WER-2. All penetration frames NC. PVC pipes replaced with metal.	As WER-3. Penetration frames of corrosion-resistant steel or bronze only.
Gutters	NC gutters (metal). Gutter guards or regular debris removal.	As WER-1. Enclosed gutter guards (NC mesh, ≤2 mm).	As WER-2.	As WER-3. NC gutter guards mandatory.
Eaves & Soffits	Enclosed soffits. NC or fibre cement ≥6 mm. Ventilation screened 2 mm mesh.	As WER-1. Soffit vents with ember guards per AS 3959.	As WER-2. NC soffit only. Consider unvented attic.	NC soffits. Unvented attic preferred. ASTM E2886 vents if vented.
Vents (Gable/Roof)	All vents screened 2 mm corrosion-resistant mesh.	As WER-1. Ember-resistant products. ASTM E2886 recommended.	ASTM E2886 required. NC frames. Consider eliminating gable vents.	ASTM E2886 required. Steel/bronze mesh only. Strongly consider unvented attic.
Foundation Vents	Screened 2 mm mesh. Clear combustible storage from subfloor.	As WER-1.	Enclose subfloor with NC material + 2 mm mesh per AS 3959.	Subfloor fully enclosed. NC supports.
Walls (<400 mm)	NC or fibre cement ≥6 mm, or bushfire-resisting timber.	NC or fibre cement ≥6 mm. No vinyl, no untreated timber.	NC cladding. ASTM E2707 recommended.	Fire-resistance rated wall assembly (≥45 min with veg mgmt; ≥1 hr without).
Walls (>400 mm)	Ignition-resistant cladding recommended.	Ignition-resistant cladding required. No vinyl on exposed elevations.	NC or ignition-resistant cladding tested per ASTM E2707.	Fire-resistance-rated wall assembly. NC cladding throughout.
Windows	Tempered glass or IGUs recommended. Screen openable portions 2 mm mesh.	Tempered/laminated safety glass on exposed elevations. 2 mm mesh on openable.	Tempered/laminated all elevations. Wildfire shutters on exposed. 2 mm mesh all.	All windows protected by shutters per AS 3959 Clause 3.7 OR 2 mm steel/bronze mesh. NC frames.
Doors	Solid core. Weatherstripping. Gaps ≤3 mm.	As WER-1. Glazed portions tempered/laminated. Screen glazed panels 2 mm mesh.	NC or fire-rated doors on exposed elevations. Shutters recommended.	Fire-rated doors all elevations. Shutters or external 2 mm steel/bronze screens.
Decks	NC or ignition-resistant decking within 1.5 m. Clear storage below.	NC or ignition-resistant decking. Underside enclosed/screened 2 mm mesh within 10 m.	NC decking and framing within 3 m. Enclose underside. NC supports.	NC throughout. Deck enclosed with NC wall or 2 mm steel/bronze mesh.
Fencing within 1.5 m	NC fence or NC connection between fence and building.	NC fence within 1.5 m. Combustible fencing detached with NC break.	NC fencing within 6 m of building.	NC fencing within 10 m of building.
Wildfire Shutters	Optional. Recommended for high-value glazing.	Recommended on exposed elevations.	Required on all exposed elevations. Per AS 3959 Clause 3.7.	Required all elevations. Steel or bronze construction.

RETROFIT PRIORITY

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For retrofit projects, begin with the highest-impact items: vents, roof gaps, and eaves. Ember entry through these pathways causes the majority of structure losses. For new construction, all measures for the applicable WER level should be specified from the outset. Free construction detail guides are available at firehard.ca/assess.

7.1 Trim, Accessories and Secondary Components

The primary construction measures table (Section 7) addresses the major building envelope components. However, several secondary components play a critical role in wildfire vulnerability and are frequently overlooked. These components are addressed in detail in the FireHard Construction Detail Guides (Modules 1–6) and the Component & Assembly Reference, but their technical rationale is documented here.

Exterior Trim and J-Channel

Exterior trim — including window and door casings, corner boards, frieze boards, and J-channel — creates concealed cavities between the trim piece and the wall substrate. These cavities trap embers and debris, creating ignition points that are invisible from the exterior and difficult to suppress once ignited. In post-fire investigations (NIST Technical Notes 1796 and 2205), ember accumulation in trim gaps and behind J-channel was identified as a significant ignition pathway.

Component	WER-1	WER-2	WER-3	WER-4
Window/door trim	Seal gaps ≤3mm with NC caulk. Remove debris.	NC or fibre cement trim on exposed faces. Seal all joints.	NC trim all faces. No wood. Metal or fibre cement only.	NC trim all faces. Fire-rated caulk at all joints.
Corner boards	Seal gaps. Remove debris accumulation.	NC or fibre cement on exposed corners.	NC all corners. Metal flashing at wall junction.	Eliminated — NC cladding system with integrated corners.
J-channel	Inspect and seal open ends. Clear debris.	Metal J-channel on exposed faces. Seal open ends with mesh.	Metal J-channel all faces. ≤2mm mesh on all open ends.	Eliminated — integrated NC cladding system or metal trim.
Frieze board	Seal junction with soffit and wall. Clear debris.	NC or fibre cement. Sealed at all edges.	NC material. Metal flashing at wall-soffit junction.	NC material. Continuous fire-stop between wall and soffit.

Design rationale: The progressive approach reflects the threat model. At WER-1, embers are the primary concern — sealing gaps and removing fuel prevents ember lodgement. At WER-2 and above, radiant heat can ignite combustible trim materials themselves, requiring non-combustible replacement. At WER-4, integrated cladding systems that eliminate concealed cavities entirely are specified.

Drip Edge and Flashing

Drip edge and wall-to-roof flashing serve both weatherproofing and fire-resistance functions. Standard aluminium drip edge (≤0.5mm) can deform and create gaps under radiant heat exposure. At WER-2 and above, heavier gauge metal drip edge (minimum 0.7mm aluminium or 26-gauge galvanised steel) is specified to maintain the seal under thermal stress. All roof-to-wall flashing must be metal (no plastic or composite) at all WER levels.

At WER-3 and WER-4, step flashing at roof-wall junctions is specified in stainless steel or copper to prevent corrosion-related failure during the long service life expected of wildfire hardening measures. Exposed wood at these junctions must be eliminated.

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Fascia

The fascia is the vertical board at the eave edge, typically the first wood component exposed to upslope fire or radiant heat from below. Fascia combustion compromises soffit attachment and opens the attic to ember intrusion. The FireHard specification requires non-combustible fascia (aluminium-wrapped, fibre cement, or metal) at WER-2 and above, matching the soffit material requirement. At WER-1, fascia must be maintained in good repair with all gaps sealed.

Foundation-to-Wall Junction

The junction where wall cladding meets the foundation is a debris accumulation zone where embers, leaves, and pine needles collect against the base of the wall. At all WER levels, a minimum 150mm (6-inch) clearance between soil/mulch grade and combustible cladding is specified. At WER-3 and above, the foundation-to-wall junction must include metal flashing extending below the cladding line, and no combustible material (including wood sheathing) may be exposed at this junction.

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8. British Columbia Considerations

8.1 Regulatory Landscape

As of February 2026, no BC regulation requires wildfire-resistant construction for residential buildings. The BCBC 2018 does not address wildfire exposure. Individual local governments may adopt wildfire-related development permit area (DPA) guidelines, but these vary widely and typically address vegetation management rather than construction specifications.

The NRC Guide (2021) is expected to form the basis of a future national WUI code. The NRC is actively developing location-specific wildfire exposure data, funded by Infrastructure Canada's Climate Resilient Built Environment initiative. When this code is published, WER-rated buildings built to this methodology will meet or exceed its requirements.

8.2 Climate and Fuel Considerations

- **Coniferous dominance:** BC's interior is predominantly spruce, pine, and Douglas fir (FBP C-2, C-3, C-4, C-7). These produce extreme fire behaviour with high crown fire potential and massive ember production. Mountain Pine Beetle epidemic created vast stands of dead timber as elevated fuel loads.
- **Terrain:** BC's mountainous terrain amplifies fire behaviour through slope effects. The slope modifier in the WER simplified assessment is critical in BC.
- **Moisture and snow:** Unvented attic assemblies (recommended at WER-3/4) must be carefully designed to manage moisture. Consult BSI-129 for unvented roof assemblies in cold climates.
- **Coniferous debris:** Pine and spruce needles accumulate rapidly. Maintenance frequency is higher in BC than in deciduous-dominant regions.

8.3 Insurance Implications

Canadian insurers are increasingly considering wildfire exposure in residential underwriting. A professional WER assessment report provides documentation insurers can use to evaluate risk reduction. Key recommendations: document all hardening measures with dated photographs; retain receipts for wildfire-resistant materials; request insurer acknowledgment of hardening measures in the policy file; a P.Eng.-stamped WER assessment provides the highest level of documentation.

8.4 BCBC 2018 Ventilation Requirements

WER measures must not compromise code-required attic ventilation. BCBC 2018 Section 9.19 requires: unobstructed vent area of 1/300 of insulated ceiling area (1/150 for roof slopes $<$1:6); minimum 63 mm airspace above insulation; baffles at eave edge extending $\geq$50 mm above insulation. Verify NFVA ratings when specifying ember-resistant vents, as baffled and intumescent designs may have reduced net free vent area.

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9. Maintenance Protocol

Wildfire hardening is not a one-time project. The building envelope degrades, vegetation regrows, and debris accumulates. A building that meets WER-2 specifications at construction can effectively become WER-1 or worse without maintenance.

9.1 Annual Inspection (Spring, Before Fire Season)

- **Vents and mesh:** Inspect all vent screens for damage, corrosion, or clogging. Replace any mesh with apertures exceeding 2 mm. Verify intumescent coatings are intact.
- **Roof and gutters:** Clear all accumulated needles, leaves, and debris from roof surfaces, valleys, gutters, and downspouts. Inspect gutter guards for damage.
- **Gaps and seals:** Inspect all caulking around service penetrations, at roof/wall junctions, and at eave lines. Re-seal any gaps exceeding 3 mm with intumescent fire caulk.
- **Shutters:** Operate all wildfire shutters through a full open/close cycle. Verify manual crank mechanism. Check for gaps >3 mm when closed. Lubricate guide tracks.
- **Vegetation:** Verify defensible space per FireSmart Priority Zones. Remove new growth within 1.5 m of building. Prune branches overhanging roof. Clear combustibles from within 10 m.

9.2 Post-Event Inspection

After any wildfire event within 30 km of the property (even if the building was not directly threatened), inspect all ember-resistant components for heat damage, activated intumescent coatings, or ember accumulation. Document any damage with photographs for insurance records.

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10. Verification Pathways

The WER system recognizes three pathways to meet each specification, mirroring how building codes work — a prescriptive path for straightforward compliance and alternative solution paths.

Deemed-to-Satisfy

Materials and assemblies explicitly named in the FireHard specification. If the design guide lists it, it meets the standard. Example: fibre cement panel, metal cladding, stucco, or masonry all satisfy ‘noncombustible cladding’ without further testing.

Tested Equivalent

Products tested to the referenced standard by a recognized testing laboratory. The manufacturer’s test report is the evidence. Example: an ember-resistant vent tested to ASTM E2886 by an accredited lab meets the WER-2 vent specification.

Engineered Alternative

A P.Eng. assessment demonstrating equivalent performance through analysis. Example: a heavy-timber fence post (140×140 mm minimum) may satisfy the WER-2 fencing specification through charring rate analysis, even though it is not noncombustible.

Fire-Rated Timber

Where a specification says ‘NC or fire-rated,’ fire-rated timber is acceptable when it meets minimum section dimensions. Large-section timber chars at ~0.65 mm/min (Eurocode 5) and can maintain structural integrity for defined periods. At WER-4, all exterior materials must be noncombustible — no timber alternatives.

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11. Subdivision Design and Planning Rationale

The WER and CNEL systems address construction at the individual building level. However, many wildfire risk factors are determined at the subdivision planning stage and cannot be economically addressed through building-level hardening. This section documents the technical basis for the subdivision design recommendations presented in FireHard Technical Bulletin TB-04: Wildfire-Resilient Subdivision Design.

11.1 Building Separation and Radiant Heat

The relationship between building separation distance and structure-to-structure fire spread is governed by radiant heat transfer. Research from NIST (Maranghides et al., 2013), the NRC National Guide (2021), and Australian Standard AS 3959:2018 consistently identifies 12.5 kW/m² as the critical threshold for piloted ignition of common building materials under sustained exposure.

The radiant heat flux from a fully involved residential structure decays with the square of the distance. For a typical Canadian 2-storey residential fire (estimated flame temperature 900–950°C, exposed wall area 50–80 m²), approximate exposures are:

Building Separation	Approx. Radiant Heat Flux	CNEL Tier	Implications
<2.4 m	>40 kW/m²	Below floor — below NBC minimum	Direct flame contact likely. Not addressable through construction alone.
2.4–4.0 m	25–40 kW/m²	CNEL-3 (Critical)	Unpiloted ignition possible. Fire-rated wall assembly required.
4.0–6.0 m	12.5–25 kW/m²	CNEL-2 (High)	Piloted ignition likely. NC cladding on exposed face required.
6.0–10.0 m	5–12.5 kW/m²	CNEL-1 (Moderate)	Reduced ignition risk. Maintenance measures and ember protection.
>10.0 m	<5 kW/m²	No CNEL overlay	Structure-to-structure ignition unlikely. Standard WER measures sufficient.

KEY FINDING

Most Canadian subdivision homes are built 2 to 6 metres apart, wall to wall. At these distances, a fully involved structure can ignite its neighbour through radiant heat alone, without any ember transport. This is the most common high-risk configuration in Canadian subdivisions, and no current Canadian building code adequately addresses it.

11.2 Economics of Separation vs. Hardening

There is a fundamental trade-off between land-use density (building separation) and construction cost (envelope hardening). Wider lot setbacks reduce or eliminate CNEL requirements, but reduce developable lot yield. Narrower setbacks increase lot yield but impose significant construction costs on homeowners for close-neighbour hardening.

Analysis in TB-04 demonstrates that at separations below 4 metres (CNEL-3), the hardening cost per home (≥$25,000) exceeds the marginal land cost of wider setbacks in most non-metropolitan Canadian markets. At 6+ metre separations, CNEL-1 measures cost $2,000–$5,000 per home and are feasible as standard construction upgrades. At 10+ metre separations, CNEL requirements are eliminated entirely.

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The subdivision planning recommendations in TB-04 are based on this analysis: where possible, design subdivisions with building separations ≥6 metres to reduce homeowner hardening costs and improve community-level resilience.

11.3 Subdivision Layout Factors

Beyond building separation, several subdivision design decisions materially affect wildfire outcomes and are documented in TB-04:

- **Road width and access:** Minimum two access/egress routes for subdivisions with >30 dwellings. Minimum 6m road surface width for fire apparatus access. Cul-de-sacs create evacuation bottlenecks and should include turnaround radius ≥12m for fire trucks.
- **Wildland interface setback:** Minimum 30m fuel-managed buffer between subdivision perimeter and unmanaged wildland vegetation, consistent with FireSmart Priority Zone 1+2 recommendations.
- **Lot orientation:** Orient lots so that the minimum number of home facades face the wildland interface. Perimeter lots with side-facing exposure reduce the exposed building area compared to rear-facing exposure.
- **Community fuel breaks:** Roads, parks, and non-combustible infrastructure positioned as fuel breaks within the subdivision to limit fire progression between blocks.
- **Accessory building placement:** Combustible accessory buildings (sheds, garages) within 6m of a principal dwelling increase CNEL exposure. Development guidelines should require non-combustible construction or minimum separation for accessory buildings.
- **Fencing continuity:** Continuous combustible fencing creates fire pathways between structures. Subdivision covenants should require non-combustible fencing within 1.5m of structures or non-combustible fence-to-building connections.

11.4 Development Permit Area (DPA) Integration

In British Columbia, municipalities may establish Wildfire Hazard Development Permit Areas under Section 488(1)(b) of the Local Government Act. TB-04 provides template DPA language that references the FireHard WER and CNEL specifications as conditions of development approval. This creates a mechanism for municipalities to require wildfire-resilient construction without waiting for provincial building code adoption.

The template specifies minimum WER levels based on the development's wildfire exposure assessment, mandatory CNEL assessment for subdivisions with building separations less than 10 metres, and a requirement for the developer to provide a wildfire hardening plan as part of the development permit application.

REFERENCE

See FireHard Technical Bulletin TB-04: Wildfire-Resilient Subdivision Design for the complete subdivision design guidelines, economics analysis, DPA template language, and planner recommendations.

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No building is fireproof: Compliance with the recommendations in this document does not guarantee that a property will survive a wildfire event. Any costs shown are order-of-magnitude estimates for budgeting purposes only and do not represent an offer to undertake the works at this or any cost. Wildfire outcomes depend on fire intensity, duration, wind conditions, ember density, suppression response, terrain, vegetation, neighbouring property conditions, and other factors beyond building construction.

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FireHard Canada (firehard.ca) is a trade name of Wildernest Systems Inc. The Wildfire Exposure Rating (WER) and Close Neighbour Exposure Level (CNEL) systems were developed by the technical team at Wildernest Systems Inc..

FireHard publishes free wildfire hardening resources for Canadian homes: six Construction Detail Modules, three Technical Bulletins, four WER Design Guides, a New Construction Design Guide, a Self-Assessment Guide for Existing Homes, and this Technical Document.

We are building FireHard Canada non-profit organization for stakeholder engagement, peer review, and ongoing refinement. We seek engineers, architects, building scientists, insurers, building officials, researchers, and community advocates.

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