Wildland Urban Interface
&
Structure Protection

A guide for your use during Wildland Urban Interface Operations

Hunter Bell, III
Structure Protection Specialist

"take a second to make a plan, not a plan every second"

Wildland Urban Interface and Structure Protection

"There is a finite amount of time to integrate what we've learned and pass it on to the next generation." ***Lt. Col. Eric Carlson (USMC Retired)***

Introduction

Wildland firefighting by itself is very challenging and adding structures and other improvements into the equation greatly increases the complexity. Over the last several decades an expansion of communities, homes and other improvements into wildland areas has created a significant challenge for the fire service agencies responsible for providing fire protection in those areas.

WUI fires often overtax the local fire agency resulting in the activation of mutual aid and automatic aid agreements to augment jurisdictional resources. Nearly every WUI fire includes responses from a variety of wildland and municipal fire agencies resulting in the need for clear text and common terminology among emergency responders. This booklet on WUI operations and structure protection is designed to provide common terminology and operating principles for responders. It also includes guidelines and checklists to complement and enhance first responders differing levels of training and experience.

This document describes tactical actions that emphasize firefighter safety during structure protection assignments. Successful WUI firefighting operations are accomplished by selecting sound strategies supported by effective tactical actions that keep firefighters safe, protect the public, and minimize property loss.

Firefighters can prepare themselves for structure protection activities by developing a sound understanding of the wildland structure environment, fire behavior and forecasting, the Risk Management process, tactical terms and associated tactical actions. An understanding of all these components will allow firefighters to safely mitigate the fire's impact upon the values they are charged with protecting.

Information for this guide was compiled from the following sources:

FEMA Field Operations Guide

Incident Response Pocket Guide (IRPG)

FIRESCOPE Field Operations Guide

National Wildfire Coordinating Group (NWCG) S-215 Instructor Guide

Wildland Urban Interface Wildfire Mitigation Reference Guide

Others

Hunter Bell is a Structure Protection Specialist with Northern Rockies Incident Management Team 1, a Complex Incident Management Team. His background is in structure and wildland fire as well as building construction. He has worked at the local government level as a volunteer/volunteer Fire Chief, AEMT, emergency fire fighter (EFF) with Montana DNRC, a couple of seasons with L&C IHC out of Great Falls, with the BLM (AD) out of Billings, and currently as an AD with the USFS out of R9/Ely, MN. He can be reached at the following: hunter_bell@firenet.gov

Leader's Intent

The first and foremost intent during structure protection is to keep firefighters and the public safe. Secondly, once that safety can be ensured, then we can aggressively work towards keeping the wildland fire away from structures, critical infrastructure and communities.

The development of all strategies and tactics should utilize the Risk Management process to ensure firefighter safety. Protecting structures from a wildland fire will not be possible in every situation. Risk to firefighters, fire behavior and availability of resources will dictate the strategies that will be used.

When there is a need to engage in structure protection, firefighters will ensure that they are taking safe, appropriate, and reasonable tactical actions for which they are trained and equipped.

Wildland Structure Environment

The Interface defined: The wildland urban interface is any zone where human-made improvements intermix with wildland fuels.

When making decisions on structure protection, you must consider the overall environment where the structures are located. There are three basic structure environments in the wildland.

Interface – (Also Classic Interface) A condition where structures abut the wildland:

- There is a clear line of demarcation between the structures and the wildland fuels along roads or back fences; however, wildland fuels continue into the developed area.
- Usually identified as housing tracts or developments adjacent to a wildland area.
- There is a greater potential for house-to-house ignition.

Intermix – (Also Mixed Interface) A condition where structures are scattered throughout a wildland area:

- There is no clear line of demarcation; the wildland fuels are continuous outside of and within the developed area.
- Each structure must be assessed independently.
- Usually more complex triage than an interface condition.
- Usually more complex to defend than an interface condition.
- Usually requires a higher ratio of engines to structures

Occluded Interface – A condition generally where structures surround an island of wildland fuels (park, vacant lot or open space). There is a clear line of demarcation between the structures and the wildland fuels.

Definitions

Wildland Urban Inter-Face - Generally speaking, WUI refers to the zone of transition between unoccupied land and human development. It is the line, area or zone where structures and other human development intermingle with undeveloped wildland vegetative fuels.

Fire Adapted Community - A fire adapted community is a "human community consisting of informed and prepared citizens collaboratively planning and taking action to safely coexist with wildland fire." More fully, a FAC is a knowledgeable, engaged community where action of residents and agencies in relation to infrastructure, buildings, landscaping, and the surrounding ecosystem lessen the need for extensive protection actions and enable the community to safely accept fire as part of the surrounding landscape.

Community Wildfire Protection Plan – A CWPP, or equivalent plan, is developed by a community in an area at-risk from wildland fire. The CWPP is a collaborative product involving local government, local firefighting agencies, the state agency which oversees forest management, federal land management agencies (if present in the vicinity), and other interested parties.

Home Ignition Zone – The HIZ is the area where the factors that principally determine home ignition potential during extreme wildfire behavior (high fire intensities and burning embers) are present. The characteristics of a home and its immediate surroundings within 100' comprise the HIZ. This generally equates to a home that is in the defensible structure triage category. For additional study see Dr Jack Cohen, PhD Research Physical Scientist, Retired, USFS.

Defensible Space – Defensible space is a natural and/or landscaped area around a structure that has been maintained and designed to reduce fire danger. By the very definition of defensible it assumes that someone will be there to "defend" the structure.

Values at Risk –The elements of a community or natural area considered valuable by an individual or community that could be negatively impacted by a wildfire or wildfire operations. These values can vary by community and can include diverse characteristics such as homes, specific structures, water supply, power grids, natural and cultural resources, community infrastructure, and other economic, environmental and social values.

Structure Protection – *Protecting a structure from the threat of damage from an advancing wildland fire*. This involves the use of wildland fire protection strategies, tactics, and practices for the purposes of establishing wildland fire control and prevent the spread of wildfire from impinging upon structures. The protection can be provided by both the rural and/or local government fire departments and wildland fire protection agencies.

Structure Fire Suppression – *Interior or exterior actions taken to suppress and extinguish a burning structure or improvement* associated with standard fire protection equipment and training. This is the responsibility of local government entities; however, there are areas where there is no structural fire agency in place.

Strategy - The Incident Commander or Operations Section Chief (when assigned) is responsible for establishing the strategy. The strategy should reflect a "general" plan that is broad in scope and provides direction for accomplishing the incident objectives.

Tactics - Tactics are the specific actions firefighters will take to accomplish the incident objectives. The choice of which tactic to use can come in the form of direction from the Incident Commander, the Operations Section Chief, the Division or it may be a decision made by the unit or resource supervisor depending on the complexity of the incident.

Triage – Structural triage involves *the rapid sorting of structures into categories based on defensibility. It is possibly one of the most challenging tasks facing firefighters in the WUI. *a rapid assessment of conditions and sorting to determine whether a structure can survive the oncoming fire front and fire brand wash based on the amount of intervention given in a short period of time. This process will help determine which tactical action is appropriate for each structure.

Safety Zone – a preplanned area of sufficient size and suitable location that is expected to protect fire personnel from known hazards *without using fire shelters*. Safety Zone guidelines in the IRPG are not designed for structure protection. In interface areas, numerous interruptions of fuel continuity and type allow safe operating areas for interface firefighting. Whether or not a structure or community is defensible or non-defensible is based on the presence of (or lack there of) a safety zone.

Temporary Refuge Area (TRA) – a preplanned area where firefighters can immediately take refuge for temporary shelter and short-term relief without using a fire shelter in the event that emergency egress to an established Safety Zone is compromised. Examples: lee side of structure, inside of structure, large lawn or parking area, cab of apparatus.

Ring Firing – Ring Firing is a defensive firing technique that is usually executed when the threat to structure/man made improvements or natural resources loss is imminent due to wildfire. Ideally ignition occurs supported by holding resources (engines/crews/equipment). However, it can be conditionally utilized prior to egress and returning once the fire front has passed.

Urban Conflagration – Urban conflagration is defined as a large disastrous and destructive fire that spreads beyond natural or artificial barriers.

Fire Behavior Forecasting

Firefighter and public safety are the first priorities in every fire management activity. Using the Standard Firefighting Orders, firefighters are guided to make a fire behavior forecast that considers the fire's potential , both expected and unexpected, at the time of contact with the structure. If at any time the risk to firefighters is determined to be too great, an alternative action should be selected.

It is important to remember that fire conditions can change very quickly, so constant observation and reassessment is necessary; the tactic selected may need to change. Tactical maneuverability or agility is essential to ensure firefighter safety.

Use standardized references to validate your fire behavior forecast:

- Incident Response Pocket Guide (IRPG)
- Look Up, Look Down, Look Around indicators
- Extreme Fire Behavior indicators (spotting, crowning, rate of spread)
- Know what the fire is doing at all times in order to maintain an accurate fire behavior forecast.
- Know current weather conditions and forecasts. Consider wind speed, direction, relative humidity, temperatures.
- Observe current burning activity in order to predict flame length and intensity.
- Consider local weather factors and fire history.
- Evaluate for wind shifts, micro-climates, weather indicators and hazards.
- Evaluate surrounding fuels for type, height, continuity and conditions.

Structure Protection Size-up

Evaluate the location of the structures and surrounding area with the forecasted fire behavior in mind:

- Is wind and slope in alignment with topography leading to the structure?
- Where is the location of the structure on the slope, canyon bottom, mid-slope or ridge top?
- Is the structure in or near a chute, chimney, saddle, or other topographic hazard?

Structure Triage Categories

Select the appropriate structure triage category based on the current expected, and unexpected, fire behavior, the surrounding area fuels and topography, and any defensible space (home ignition zone). Whether or not a structure or community is defensible or non-defensible is based on the presence of (or lack there of) a Safety Zone.

1. **Defensible** – **Stand Alone**: *Safety zone present.* Structure has very few tactical challenges. Firefighters may not need to be directly assigned to protect structure as it is not likely to ignite during initial fire front contact. However, no structure in the path of a wildland fire is completely without need of protection. Patrol following the passage of the fire front will be needed to protect the structure.
2. **Defensible – Prep and Hold:** *Safety zone present*. Structure has some tactical challenges. Firefighters needed on site to implement structure protection tactics during fire front contact.
3. **Non-Defensible - Prep and Leave:** *NO safety zone present*. Structure has some tactical challenges. If time allows, rapid mitigation measures may be performed. Set trigger point for safe retreat. *Remember, pre-incident preparation is the responsibility of the homeowner.* Patrol following the passage of the fire front will be needed to protect the structure.
4. **Non-Defensible - Rescue Drive-By:** *NO safety zone present.* Structure has significant tactical challenges. Firefighters not able to commit to stay and protect structure. If time allows, check to ensure that people are not present in the threatened structure (especially children, elderly, and invalid). Set trigger point for safe retreat. Patrol following the passage of the fire front will be needed to protect the structure.

→ reference IRPG for additional information: page 11 of green section

Defensible, Stand Alone

Defensible, Prep and Hold

Non-Defensible, Prep and Leave

Non-Defensible, Rescue and Drive By

Unknown

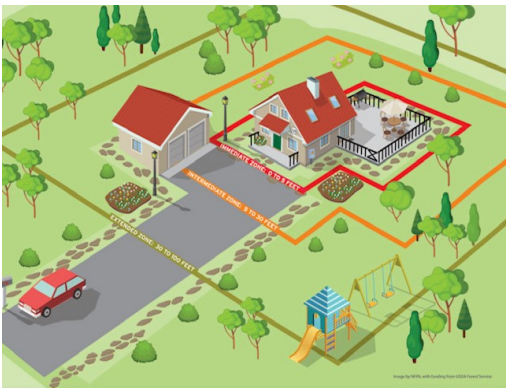
Structure Triage Guidelines

Consider the following factors during structure triage:

- Forecasted fire behavior and intensity – the greater the intensity, the greater the defensible space required.
- Safety Zones should be identified and designated based upon forecasted fire behavior.
- Temporary Refuge Areas (TRA) should be preplanned and identified in the event that an emergency egress to an established Safety Zone is compromised.
- Is there adequate space to park your apparatus safely based upon forecasted fire behavior?
- Do you have adequate lookout and communication capability?
- Evaluate the proximity of the fuels and forecasted flame lengths in relation to the structure; is there defensible space? Or better yet, a Home Ignition Zone.
- What is the position of the structure on the slope relative to fire spread?
- Avoid narrow canyon bottoms, mid-slopes with fire below, or narrow ridges near chimneys and saddles.
- Are there narrow roads, unknown bridge limits and septic tank hazards?
- Are there ornamental plants and combustible debris next to the structure?
- Does the structure have open vents, eaves, decks and other ember traps?
- Are there power lines adjacent to the structure?
- Is there an adequate water supply to support the necessary flow rates and GPM output?
- Did the property owners remain on site?
- Does the structure have a flammable roof and/or siding? A wood roof and siding and/or vinyl siding, along with inadequate defensible space, may make the structure impossible to protect.
- Is there adequate time and available resources to protect the structure? If you do not have time to position resources or there is a lack of resources, then it may be impractical to protect the structure.

What's the difference?

Defensible Space



Home Ignition Zone

OR

Structure Protection Guidelines

Personal Protective Equipment (PPE):

- Structure protection tactics can be undertaken utilizing standard wildland PPE.
- If the structure becomes involved in fire, and a decision is made to extinguish the fire, utilize the appropriate Structure Fire PPE including SCBA's as required.
- **DO NOT** enter a structure to extinguish a fire inside the structure unless you are trained, equipped, and authorized.
- **DO NOT** base your decision to remain at a structure and/or the safety of your personnel on the use of SCBA's.

Apparatus Placement:

- Identify Escape Routes, Safety Zones and TRA's and make them known to all personnel.
- STAY MOBILE and wear all of your PPE.
- Back equipment in for a quick escape.
- Park in a cleared area (watch for overhead hazards).
- Protect your equipment (park behind the structure, placing the structure between equipment and fire front, be aware of spot fires occurring behind you).
- Watch for hazards (drop-offs, pot holes, above-ground fuel storage, chemicals, and septic tanks).
- Keep egress routes clear.
- Have an engine/personnel protection line charged and readily available. Often times referred to as an "Oh Shit" line.
- Avoid long hose lays.
- Try to keep sight contact with all personnel.

Water Use Guidelines:

- Keep at least 100 gallons of water reserve in your tank.
- Top off your tank at every opportunity, use a garden hose if available.
- Draft from a swimming pool, hot tub, or fishpond.
- Stay mobile. Be aware that hydrants may not always work if the system is electrically powered and power is lost in the area.
- Conserve water, avoid wetting down an area with tank water.
- Apply water only if it controls fire spread or significantly reduces the heating of the structure being protected, and only if there is ample water supply.
- Keep fire out of the heavier fuels.
- Extinguish fire at its lowest intensity, not when it is flaring up.
- Have enough water to last for the duration of the main heat wave and to protect personnel.

Class A Foam/Gel Use Guidelines:

- Direct Attack with a Class A Foam – apply to the base of flame.
- Apply Class A Foam to structure (deck, siding and roof if items are flammable) ten to fifteen minutes prior to flame front arrival.
- Foam or gel the structure and the vegetation immediately surrounding the structure.
- Use of CAFS (compressed air foam system) at this time is encouraged if appropriate.

Preparing the Structure

- Treat all structures with the utmost respect for personal property.
- Determine if residents are home. If so, advise them to leave. Give them incident contact information. See Appendix H page 27.
- For roof access, place the owner's ladder at a corner of the structure on the side with the least fire threat and away from the power drop. Ask yourself, "Is there a need for me to be on the roof at this time?"
- Clear the area around above-ground fuel tanks, shutting off tanks (flag effected shut-offs).
- Place combustible outside furniture inside or out away from the structure.
- Close windows and doors, including garage, leaving unlocked.
- Leave outside lights on if power for same is available.
- Remove combustibles immediately next to the structure and scatter firewood.
- Construct a scratch line around out-buildings, power poles and fuel tanks.
- Remove vegetation from the immediate area of the structure.
- Have garden hose(s) charged and placed strategically around the structure for immediate use. If there are homeowner sprinklers use them to wet ground adjacent to structure, but not direct impact on the structure.
- IF URGENTLY NECESSARY USE THE STRUCTURE AS A TEMPORARY REFUGE AREA (TRA). Leave a note for the owner as to your information and why you needed to enter their structure.

Duty Respect Integrity

Structure Protection Strategies

The Incident Commander or Operations Section Chief (when assigned) is responsible for establishing the strategy. The strategy should reflect a "general" plan that is broad in scope and provides direction for accomplishing the incident objectives. For example, the strategy for protecting structures on the right flank of a wildland urban interface fire (WUI) may be to keep the fire away from homes using a coordinated direct attack with aircraft, dozers and crews. At the same time, the strategy for controlling the left flank on the same fire may be to develop an indirect attack, utilizing a small Task Force to burn out along a series of small dirt roads and create a line that will stop the fire from spreading. The strategy must reflect a realistic approach for meeting the objectives for all portions of the fire.

The strategy must take into consideration the numbers and types of resources necessary to accomplish the incident objectives and the reflex time it will take to have them in position. A strategy that requires a large number of resources to execute the plan will fail if the needed resource cannot arrive in a timely fashion.

The strategy is also subject to change due to changes in weather, fire behavior, resource availability and any change with the objectives. For example, firefighters planning to burn out from a road system a mile from the fire front may be forced to change to a direct suppression strategy if a forecast calling for cool weather with accompanying moisture is predicted to arrive before the burnout can be executed.

Structure Protection Tactics

Where the strategy gives firefighters a general plan, tactics are the specific actions firefighters will take to accomplish the incident objectives. The choice of which tactic to use can come in the form of direction from the Incident Commander or the Operations Section Chief, or it may be a decision made by the unit or resource supervisor.

The chosen tactical action must be capable of stopping the advance of the fire or preventing the fire from damaging property and doing so without incurring injuries to firefighting personnel. This means that when choosing a tactical action or when making a tactical plan, it is very important to know what the fire behavior will be at the time firefighters engage the fire.

Base all actions on current, expected and unexpected fire behavior when assessing a structure or community. Are you expecting a ground, surface, or crown fire?

Making an accurate fire behavior forecast in advance of the fire's arrival is the wildland firefighter's greatest challenge. An accurate fire behavior forecast is difficult to make with absolute certainty, but it serves as the basis for determining if a tactical action will be effective and safe.

Recognizing that there is always the potential for error in our fire behavior forecast means that we must compensate for the uncertainties by having alternative actions (tactical maneuver) built into the plan. The key point here is to never get locked into a single plan of action.

Tactical Maneuver

Tactical maneuver implies movement or purposeful reaction to change. Tactical maneuver builds *agility* into a tactical plan by allowing resources to work and move around in a hazardous environment without injury, while remaining effective. Tactical maneuver is most effective when potential changes to the primary plan have been identified and firefighter's reactions to those changes are planned out.

Firefighters must be prepared to utilize tactical maneuver when changing from structure protection mode (defensive) to suppression mode (offensive) when fire behavior allows. It is imperative to take advantage of situations that allow for firefighters to take perimeter control actions and suppress the fire.

Tactical planning must be developed in conjunction with anticipated changes in the fire environment or fire behavior. Tactical maneuver (*agility*) is essential to ensure firefighter safety since legitimate Safety Zones are not always immediately present in the WUI. Firefighters should focus on *agile tactical solutions* to unanticipated changes as opposed to a rigid and inflexible siege approach. It is imperative that contingency planning be a part of every tactical plan. The tactic selected may need to change to compensate for a change in the fire's behavior. Always have a way out!

Tactical maneuver can be an offensive or defensive action. Be prepared to move decisively during lulls in fire activity or take shelter in Temporary Refuge Areas or Safety Zones when the fire is active. Examples of tactical maneuver would be an engine crew going from one structure to another, moving with the fire, or staying behind a house when the fire is hitting hard and moving into full suppression mode when the fire subsides. This requires a continuous assessment of the fire and it's potential. Crews must continually identify Temporary Refuge Areas and Escape Routes to Safety Zones.

...if practicable

Structure Protection Tactical Actions

After making a fire behavior forecast and triaging the assigned structures, responders must now implement the necessary tactics to defend the structure from the advancing fire front. Supervisors must keep in close communication with those they supervise and adjoining forces in the area. The following are the eight tactical actions available to structure protection resources. For further information see Firescope Field Operations Guide: firescope.caloes.ca.gov

Non-Defensible

- **Check and Go**
- **Prep and Leave**
- **Fire Front Following* (*can be defensible)**

Defensible

- **Prep and Hold**
- **Bump and Run**
- **Anchor and Hold**
- **Tactical Patrol**
- **Connect the Dots**

Non-Defensible

CHECK AND GO: This tactic is most appropriate when there is no Safety Zone or TRA present and the forecasted fire spread, intensity, and the projected impact time of the fire front prohibit resources from taking preparation action to defend the structure. Complete a rapid evaluation to check for occupants at the structure, evaluate life threatened and assist in evacuation. Use when fire spread, intensity, lack of time or inadequate defensible space prohibit firefighting resources from safely taking action to defend the home when the fire front arrives. Evaluate the structure for follow-up action when additional resources become available, the fire front passes, or fire behavior intensity is reduced.

PREP AND LEAVE: *Prep and Leave* implies that some preparation of the structure may be safely completed prior to resources leaving the area. A tactic used when a Safety Zone or TRA are not present and/or when fire spread and intensity are too dangerous to stay in the area when the fire front arrives, but there is adequate time to prepare a structure for defense ahead of the fire front. Utilized for structures when potential fire intensity makes it to dangerous for fire resources to stay when the fire front arrives. When there is some time to prepare a structure ahead of the fire; resources should engage in rapid, prioritized fire defense preparations and if available foam the structure prior to leaving. Resources should leave with adequate time to avoid the loss of Escape Routes. Advise residents to leave and notify supervisors of any residents who choose to stay so that you can follow-up on their welfare after the fire front passes. As with Check and Go, Prep and Leave is well suited for engine strike teams and task forces.

FIRE FRONT FOLLOWING: A tactic used to come in behind the fire front. This action is taken when there is insufficient time to safely set up ahead of the fire, or the intensity of the fire would likely cause injury to personnel located in front of the fire. The goal of Fire Front Following is to search for victims, effect perimeter control, extinguish spot fires around structures, control hot spots and reduce ember production.

Defensible

PREP AND HOLD: *Prep and Hold (Defend)* is a tactic used when a Safety Zone and TRA are present and adequate time exists to safely prepare a structure for defense prior to arrival of the fire front. This is an ideal multiple resource tactic especially common in neighborhoods where efforts may be coordinated over a wide area. A tactic used when it is possible for fire resources to stay when the fire front arrives. Fire behavior MUST be such that it is safe for firefighters to remain and engage the fire. Adequate Escape Routes to a Safety Zone must be identified. A Safety Zone or TRA must exist on site. Firefighters must be vigilant to sudden changes in the fire intensity and be prepared to move to the TRA or withdraw along the Escape Route to the Safety Zone. Adequate time must exist to safely prepare the structure for defense prior to the arrival of the fire front.

BUMP AND RUN: *Bump and Run* is a tactic where resources typically move ahead of the fire front in the spotting zone to extinguish spot fires and hot spots, and to defend as many structures as possible. Bump and Run may be effective in the early stages of an incident when the resource commitment is light and structure defense is a priority. Bump and Run may also be used on fast moving incidents when there are adequate resources available, but when effort must be made to control or steer the head and shoulders of the fire to a desired end point. Perimeter control and structure defense preparation are secondary considerations with the Bump and Run Tactic. Resources must remain mobile during Bump and Run and must constantly identify Escape Routes to Safety Zones and Temporary Refuge Areas as they move with the fire front. Bump and Run is a defensive tactic when the fire front impact is imminent in the WUI and there are not enough resources to effectively take perimeter control action. It is an offensive tactic when resources are steering the head of the fire to a desirable end point. The tactic is useful when terrain and fuels are suitable for mobile attack. Front line supervisors and Strike Team/Task Force Leaders must realize that Bump and Run places resources in front of the fire front and that extreme caution should be exercised. Control lines in front of the fire should be identified and prepared with dozers and fire crews enabling the Bump and Run resources to direct the fire to a logical end point. This is a frontal attack strategy and a Watch Out Situation. Control lines in front of the main fire must be reinforced with retardant drops, coordinated firing operations and engine support.

ANCHOR AND HOLD: Anchor and Hold is a tactic utilizing control lines and large water streams from fixed water supplies in an attempt to stop fire spread. The goal is to extinguish structure fires, defend exposures, and reduce ember production. Anchor and Hold can be referred to as taking a stand to stop the progression of the fire. Anchor and Hold tactics are more effective in urban neighborhoods where the fire is spreading from house to house. Establishing an Anchor and Hold line requires considerable planning and effort and utilizes both fixed and mobile resources:

- Fixed engines should be spotted in safe areas where they can safely withstand any fire situation.
- Mobile engines or task forces can engage in individual structure defense actions or perimeter control and re-supply from fixed water sources.
- Mobile engines should be prepared to re-deploy to other areas should the fire escape the Anchor and Hold line. Ground resources, such as engine crews and hand crews should staff hose lines and be prepared to extinguish hot spots, the fire perimeter, and structures.
- Handcrew Strike Teams should be deployed to construct fire control lines whenever needed and conduct firing operations.

TACTICAL PATROL: *Tactical Patrol* (or Mop-up and Patrol) is a tactic where the key element is mobility and continuous monitoring of an assigned area. Vigilance, situational awareness and active suppression actions are a must. Tactical Patrol can either be initiated:

- After the main fire front has passed and flames have subsided but when the threat to structures remain. Patrol areas where the fire has passed but the risk to structures remains from fire brands smoldering in void places, on roofs, in rain gutters and stored material near buildings.
- In the neighborhoods away from the interface where there is predicted to be significant ember cast and accumulated ornamental vegetation. The goal is to patrol areas downwind of potential ember showers. The tactic should be used to extinguish hot spots or secondary structure ignitions, and address safety issues such as power lines, weakened trees, and other hazards.

CONNECT THE DOTS: Resources assigned to structure defense operations effectively stop forward spread in a particular area, which then becomes a “dot” in the overall perimeter control effort. Connecting the contained points along the fire perimeter – typically near the structures at risk.

Appendix A
Wildland Fire Management Guiding Principles

- The first priority for all-risk decisions is life-safety, both firefighters and the general public.
- Incident containment strategies specifically address and integrate protection of defensible improved property and wildland values.
- Direct protection of improved property is undertaken when it is safe to do so, where there is sufficient time and appropriate resources available, and when the action directly contributes to achieving the overall incident objectives.
- The firefighter's decision to accept direction to engage in structure protection actions is based on the determination that the property is defensible and the risk to firefighters can be safely mitigated under the current or potential fire conditions.
- A decision to delay or withdraw from structure protection operations is the appropriate course of action when made in consideration of firefighter safety, current or potential fire behavior, or lack of defensibility of the structure or groups of structures.
- Firefighters at all levels are responsible for making risk decisions appropriate to their individual knowledge, experience, training and situational awareness.
- Every firefighter is responsible for awareness of the factors that affect their judgment and the decision-making process, including a realistic perception of their own knowledge, skills, and abilities, the presence of life threat or structures, fire behavior, availability of resources, social/political pressures, mission focus, and personal distractions such as home, work, health, and fatigue.
- An individual's ability to assimilate all available factors affecting situational awareness is limited in a dynamic wildland and urban interface environment.
- It is the responsibility of every firefighter to participate in the flow of information with supervisors, subordinates and peers. Clear and concise communication is essential to overcome limitations in situational awareness.

Appendix B
Risk Management Process

Step 1 Situational Awareness

- Gather information
- Objective(s)
- Previous Fire Behavior
- Communication
- Weather Forecast
- Who's in Charge?
- Local Factors
- Scout the Fire

Step 2 Hazard Assessment

- Estimate Potential Fire Behavior Hazards
- Look Up/Look Down/Look Around Indicators
- Identify Tactical Hazards
- 18 Watch Outs
- What other safety hazards exist?
- Consider severity vs. probability

Step 3 Hazard Control

- 10 Firefighting Orders
- LCES Checklist – MANDATORY
- Escape Route
- Anchor Point
- Downhill Checklist (if applicable)
- What other controls are necessary?

don't let your emotions dictate your actions

*reference IRPG for additional information: page 1 of green section

Step 4 Decision Point

Are controls in place for identified hazards?

- NO – Reassess situation
- YES - Next Question

Are selected tactics based on expected fire behavior?

- NO - Reassess situation
- YES - Next question

Have instructions been given and are they understood?

- NO - Reassess situation
- YES - Next step

Step 5 Evaluate

- Personnel
- Low experience level with local factors?
- Distracted from primary tasks?
- Fatigue or stress reaction?
- Hazardous attitude?
- The situation: what is changing?
- Are strategy and tactics working?

Appendix C
LCES Checklist

LCES must be established and known to all firefighters before it is needed.

LOOKOUTS

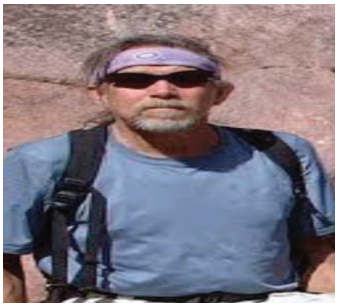
- Experienced/Competent/Trusted
- Enough Lookouts at good vantage points
- Knowledge of crew locations
- Knowledge of escape and safety locations
- Knowledge of trigger points
- Map/Weather Kit/Watch/Binoculars/Radio/Phone/IAP

COMMUNICATIONS

- Radio frequencies confirmed
- Backup procedures and check-in times established
- Provide updates on any situation change
- Sound alarm early, not late

ESCAPE ROUTE (S)

- More than one Escape Route
- Avoid steep uphill Escape Routes
- Scouted: Loose Soils/Rocks/Vegetation
- Times: Slowest person/Fatigue and Temperature Factors
- Marked: Flagged for day or night (place escape route flagging so it is located on the right side of the route as you exit the area.)
- Evaluate: Escape Time vs. Rate of Spread
- Vehicles parked for escape
- An entire community may be non-defensible if the escape route is compromised by wildfire spread



Who am I and what's my connection to LCES?

SAFETY ZONE(S)

- Survivable without a fire shelter
- Back into clean burn
- Natural Features: Rock Areas/Water/Meadows
- Constructed Sites: Clear Cuts/Roads/Helispots
- Scouted for size and hazards
- Upslope?
- Downwind?
- Heavy Fuels?
- Escape time and Safety Zone size requirements
- Will change as fire behavior changes
- More heat impact = Larger Safety Zone

Note: Although Safety Zones and viable Escape Routes shall always be identified in the WUI environment, they may not be immediately available should the fire behavior increase unexpectedly. Often a Temporary Refuge Area (TRA) is more accessible in the WUI environment. A TRA will provide temporary shelter and short-term relief from an approaching fire without the use of a fire shelter and allow the responders to develop an alternate plan to safely survive the increase in fire behavior.

***for further information regarding safety zones refer to Appendix D and search: wildfire safety zones at Missoula Fire Sciences Lab.**

Always have an exit strategy

Appendix D
Safety Zone Guidelines

Safe Separation Distance

Safe Separation Distance (SSD) takes the guidelines from the IRPG (which is based on safety zone size considering radiant heat only) and expands these calculations built on radiant heat *as well as* convective heat from wind and/or terrain features. Since the original calculations assume no wind and no slope, safety zones downwind or upslope from the fire may require larger separation distances.

Δ VALUES				
Wind Speed (mph)	Burning Conditions	Slope		
		Flat <15%	Moderate 15-35%	Steep >35%
Light 0 – 10	Low	1	1	2
	Moderate	1	1	2
	Extreme	1	2	3
Moderate 10 – 20	Low	1.5	3	4
	Moderate	2	4	5
	Extreme	2.5	5	5
High >20	Low	3	4	6
	Moderate	3	5	7
	Extreme	4	5	10

Watch-out Situation

What are the old guidelines?

SSD = 4 x flame height

What is the new SSD guideline?

SSD = 8 x Vegetative Height (VH) x Δ Factor

Where does the "8" come from in the new SSD equation? Missoula Fire Lab experimentation showed flame heights will be approximately two times the height of the vegetation in a crown fire situation. Therefore, 4 x flame height = 8 x vegetation height. The Δ Factor is based on research that accounts for slope, wind speed, burning conditions and both convective and radiation for flames.

Δ Factor = Wind/Slope/Burning Condition Factor

This new guideline is based on research that accounts for slope, wind speed, burning conditions and both convection and radiation for flames.

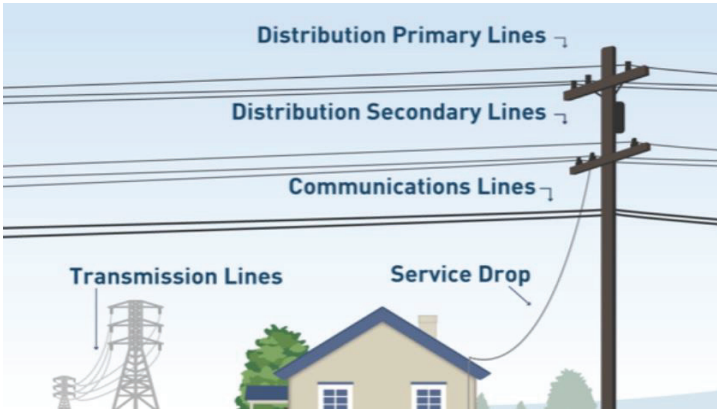
Example: Given a stand of lodgepole with an average height of 100' on 20% slope, moderate burning conditions, and a fore-casted windspeed of 10-20 mph. Inputs: VH = 100', wind speed = 10-20 mph (moderate), Burning Conditions (moderate), moderate slope

SSD = 8 x 100 x 4 (burning condition factor from the table) =

3,200 feet of SAFE SEPARATION DISTANCE

Appendix E
Power line Safety

- If there is a downed conductor on a vehicle, stay in the vehicle until the power company arrives. If the vehicle is on fire or fire is near, jump clear of the vehicle, keeping feet together as you hit the ground and don't hang on to the car.
- Smoke, water, and retardant are all good conductors and can cause power line-to-ground arc.
- Do not operate heavy equipment under power lines.
- Do not use power line right-of-way as a jump or cargo drop spot.
- Do not drive with long antennas under power lines.
- Do not fuel vehicles under power lines.
- Do not stand near power lines during retardant drops.
- Do not park under power lines.
- Do not apply straight stream to power lines.
- Maintain a 35-foot distance from transmission lines.
- Spot fires or low ground fires can be fought with hose lines if heavy smoke or flame is not within 100 feet of the power lines.
- If safe, extinguish wood poles burning at the base to prevent downed wire hazards later.
- Tactic: pre-treat/scrape around base of power transmission pole.



*service lines, when buried, are typically 2 feet underground, by code, when not buried in conduit.

Appendix F
Tactical Engagement Process - P. A. C. E.

Structure defense firefighting in the Wildland Urban Interface (WUI) is inherently dangerous because it is primarily associated with *indirect* firefighting. An approaching fire is a dynamic event and subject to sudden changes that can be very difficult to anticipate. Structure protection should start with a determination of the exit strategy.

Indirect firefighting safety mitigations depend on fire behavior forecasts made in advance of the fire's arrival. Accurate fire behavior forecasts are difficult to make with absolute certainty and, at the same time, these forecasts are the crux for determining effective safety mitigations (Temporary Refuge Areas, Escape Routes and Safety Zones).

With firefighter safety hanging in the balance of accurate fire behavior estimates that cannot be assured, it is imperative that a multi-step safety plan be established to compensate for the uncertainties. Firefighters must anticipate the unexpected and build agility (Tactical Maneuver) into their plan with *contingency planning*.

The lexicon for contingency planning is: P.A.C.E.

Urban Conflagration

P - Primary Plan [Offense]

- Is focused on firefighter safety
- Is focused on mission objectives
- Yields the most desirable results
- (Staffing hose lines to suppress the fire around a structure)

A - Alternate Plan (Offense)

- A fall back plan that closely supports the Primary Plan
- The results may be less desirable but still supports the Primary Plan
- (Retreating into or behind the structure until fire intensity diminishes)

C - Contingency Plan [Defense]

- A plan totally focused on the firefighter's safety
- Move to a Temporary Refuge Area (an area that provides short-term relief) or withdraw along the Escape Route
- Move into a Safety Zone

E - Emergency Plan [Defense]

- A plan totally focused on individual firefighter survival
- When threatened by fire, firefighters should get to their pre-identified Safety Zone.

Implement P.A.C.E. prior to engaging in any structure protection action:

P – Primary

A – Alternate

C – Contingency

E – Emergency

Appendix G
Engagement - Draw-D

As with military operations, there are FIVE Levels of Engagement in firefighting - DRAW-D. These actions apply to all aspects of wildland firefighting from the incident strategy to the individual line assignments and structure protection. They identify a thoughtful and mindful approach to choosing the appropriate tactical action. Use of DRAW-D as Levels of Engagement incorporates a "can do" attitude in every Level of Engagement and every Level of Engagement is equal in value to the overall effort as the other:

D – **Defend** – Holding actions, protecting priority areas

- Protect the structures
- Hold and improve the line

R – Reinforce – Bring more resources to bear

- Add resources necessary to advance or defend

A – Advance – Anchor and Flank

- Direct or indirect attack
- Active burnout operations

W – Withdraw – Cease current activities until conditions modify

- Abandon an established position or constructed line in response to an increase in fire intensity

D -- Delay --Wait until the situation has modified sufficiently

- Allow and wait for a different level of engagement
- Waiting for conditions to meet pre-identified triggers necessary to advance or defend

Critical Infrastructure?

Appendix H
Customer Contact

What to do when you arrive at a residence and the homeowners/customers are still in place. This is a point in time during your initial arrival on scene that can set the tone for how things will be received by the customers. At this point, no matter what color your apparatus might be, Duty, Respect, and Integrity will get you a long way.

Introduce yourself (ENG Captain Peter, with the DNR, etc) Explain why you're on scene (wildland fire up the road; are they aware of the fire). Let them know if there are any evacuation orders (Ready, Set, Go etc). Explain what your purpose is for being on their property (evaluation, triage, planning, structure protection). Ask if it would be alright to do a walk-around of their structures. Any hazards (animals, storage tanks, etc)?

If all is going well up to this point, that's great. And to be honest here, most of the time all goes well. Be prepared to answer a lot of questions. Answer them only to your actual knowledge of present conditions. Refer all other questions that you are uncomfortable answering up the chain of command. Listed below are some items to mention to the customer when they ask "what do you need us to do?" before they leave, or if they're staying in place. *

**We as firefighters can not require someone to vacate their property, only a LEO can possibly require the property owner to vacate their ground. If they do choose to stay, please make a note on your ICS 214 as to their name, number of occupants, address , etc. and give this information to who you're working for (chain of command).*

Advice to property owners of recommended tasks.

Discuss with them the concepts of Defensible Space and Home Ignition Zone.

Advise them of the 6 P's (items to take with them when they evacuate). **P**eople, **P**rescriptions, **P**apers, **P**ersonal Needs, **P**riceless Items, and **P**ets and have their "go bag" ready to go.

Other tasks the property owners can accomplish to help responders be more successful in protection operations:

- Close all windows, doors, and garage doors (leave doors unlocked)
- Close all interior doors
- Leave exterior lights on so your home is visible to firefighters
- Shut off air conditioning; shut off pilot lights
- Move flammable materials (curtains, furniture) away from windows
- Cover over all vents with plywood or fine mesh metal insect screen wire
- Remove porch furniture, door mats, potted plants, wood piles, clutter; store inside
- Clean out flammables (scrap wood, etc.) from under and adjacent to structure
- LPG tanks and gas cans away from structures in driveway/gravel area
- Clean out area around LPG tanks and fuel tanks
- Connect garden hoses to outside spigots for use by firefighters
- Don't leave sprinklers running: this can effect water pressure
- Back your car in and have it ready to go. Full tank of fuel too
- *if they have farm animals advise them to move them asap...avoiding congestion on evacuation routes

Appendix I
Sprinklers

On almost every extended attack operation the use and implementation of sprinklers for structure defense will be considered. Countless hours of planning, ordering and supplying, set-up and operation are spent on this very tactic. Pumps of all types, numerous fittings and hose types, as well as varying sources of water supply are all coordinated in this effort. Not to mention the hundreds of impact style sprinkler heads. All this in an effort to give a structure or critical piece of infrastructure a better chance of surviving the potential onslaught of burning fire brands and embers as well as direct flame contact. Then what typically happens is all this ordinance has to be picked up, returned to supply, cleaned, and re-stocked for the next fire.

Sprinkler use is commonly implemented in an attempt to wet down flammable materials and often more appropriately to increase the humidity level around and adjacent to the item being protected. In certain instances, sprinkler heads are placed so close to the structure and in turn applying water with such direct force that water damage occurs both outside but more importantly on the interior areas of the structure being protected.

Generally, the average home (structure) is designed to shed water as water falls from the sky. Homes in coastal areas (the gulf and oceans) are designed more to handle horizontal water. The vast majority of wildland fires are not in coastal zones and thus homes in these regions are not designed for horizontal water application, especially with the force that an impact sprinkler head can emit.

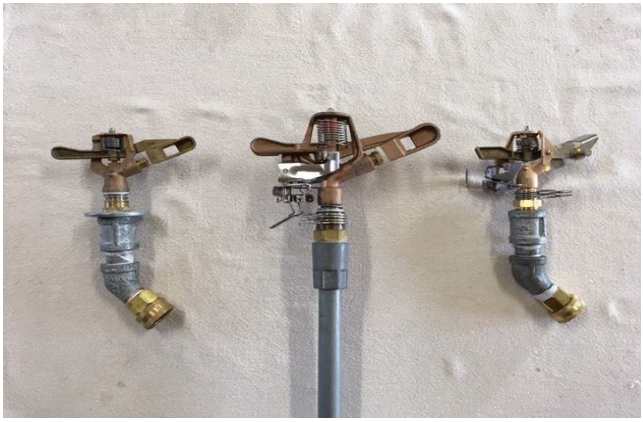
Numerous structures have been flooded during attempts at effective structure defense. In certain cases, the damage is evident as soon as sprinklers are applying their water streams: think log buildings here where there are no interior coverings of the exterior wall. In other more troubling occurrences, the water damage can be hidden for extended periods of time and surface months later not as water but as black mold: think common building construction with 2x walls and interior sheetrock treatments.

When the decision is made to make a defensive stand against an approaching wildfire, implement the placement of sprinkler heads and the accompanying water curtain with forethought as to how the resulting water stream will affect the item being protected. Some of this planning will depend on the type/design of the impact sprinkler head available on the incident. Generally, there are 2 styles of sprinklers available in the national cache system. The most common style available is one that makes a full rotation (360*) with no other pattern choice. The other less typical style, and is more preferable for structure protection, comes with the ability to limit or control the rotational pattern of the output.

The first style comes in NFES Kit #1048 with model #0999 sprinkler head, and is typically the one distributed by most cache locations. Commonly arriving with 4 heads to a kit, along with various fittings, and easily recognizable by the presence of 8 orange ground stakes. These are the impact sprinkler heads that offer no rotational control. ***On occasion these kits might be stocked with an older model sprinkler head with rotational control and consider yourself lucky if that's the case. See Appendix J.

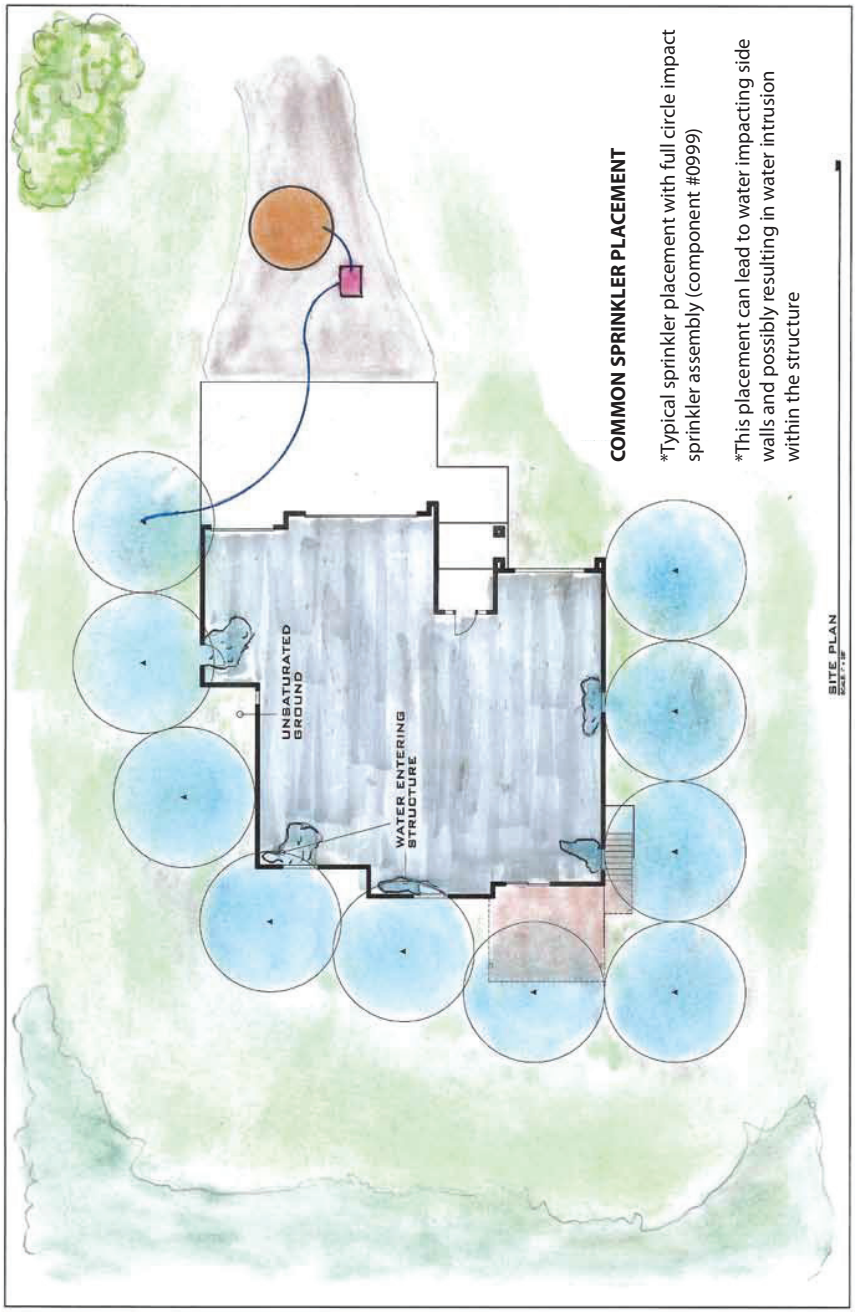
The second type of sprinkler assembly comes in NFES Kit #8653, with model #07736 sprinkler head, and is really the preferred style of impact sprinkler. This is due to its ability to offer the option of a limited/settable rotational spray pattern other than a full rotation (although that setting is available with this type). These however arrive 4 to a carton but with only the sprinkler heads, and are attached/plumbed to and through "music stands." These are typically only available in the Northern Rockies cache. See Appendix J.

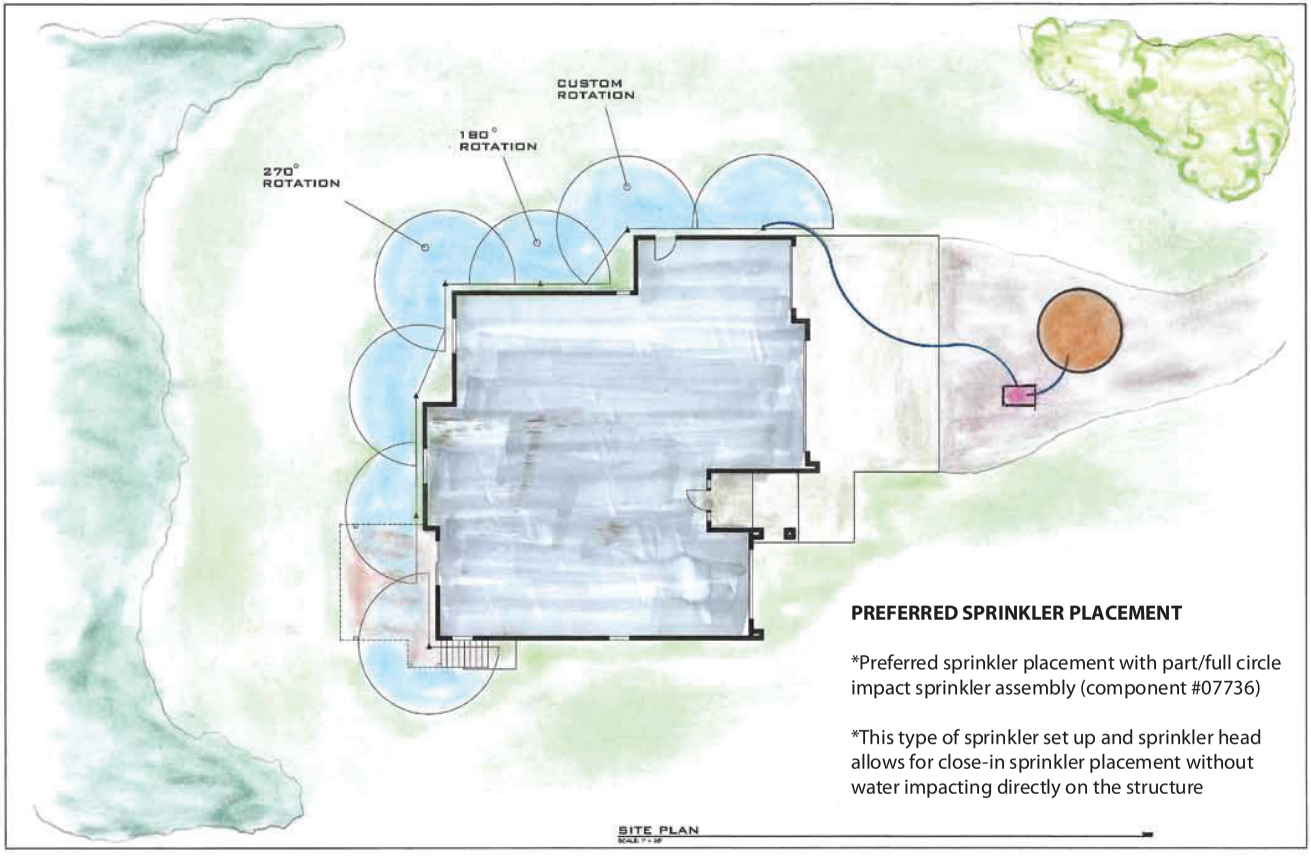
With either type of impact sprinkler assembly, the primary objective is to wet down the receptive fuels adjacent to the structure to both make for less flammable materials and to bring up the humidity in the surrounding atmosphere. It does not require a lot of water! Also, when placing sprinklers try and select placements that will allow the overlap of the subsequent water pattern.



Impact Sprinkler Heads: #0999 (orange stakes), #07736 (music stand), and an older version. If you happen to get kits with this last style of head: trip lever, deflection shield, and set screw to break the water stream consider yourself lucky!

The following 4 drawings are courtesy of Spring Creek Landscape, Billings, MT





PREFERRED SPRINKLER PLACEMENT

*Preferred sprinkler placement with part/full circle impact sprinkler assembly (component #07736)

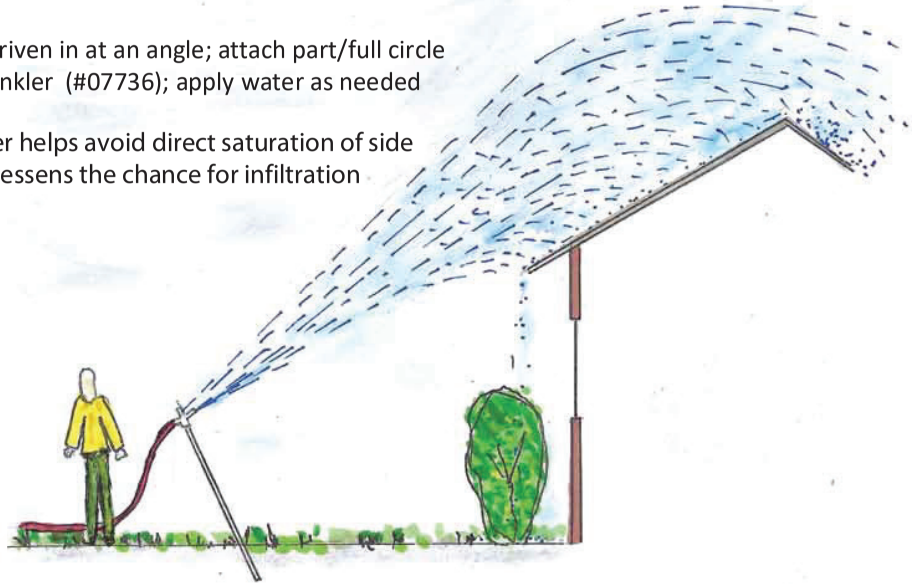
*This type of sprinkler set up and sprinkler head allows for close-in sprinkler placement without water impacting directly on the structure

Option for wetting the roof deck without gaining access to roof surface

*objective here is to loft water onto the roof deck and to avoid lifting shingles/shakes

*"t-post" driven in at an angle; attach part/full circle impact sprinkler (#07736); apply water as needed

*this further helps avoid direct saturation of side walls and lessens the chance for infiltration



WETTING THE ROOF DECK

CLOSE-IN SPRINKLER PLACEMENT

Option for close-in sprinkler placement with full rotation sprinkler head

*objective here is to use hardware commonly provided for structure protection (NFES #1048/orange stake sprinkler kit) along with proper placement to apply water adjacent to value at risk

*install orange stake (with impact sprinkler head attached) at an angle leaning into value at risk: use additional orange stake to stabilize head, and maybe some fiber tape for good measure

*this placement will avoid direct saturation of siding materials and lessens the chance for water infiltration while allowing ground cover adjacent to value at risk to become damp

*generally placing the set up about 3'-4' from corner of structure works best, but adjust as needed

Appendix J
Pump Kit & Sprinkler Kit-Typical Inventory Items

PUMP-MARK 3 PUMP-NATIONAL STANDARD #0148

PUMP-PORTABLE HIGH PRESSURE W/ FUEL LINE	1

HOSE- 1½" NH X 3' COTTON/LINED	1	ALLICE PACK W/ STRAPS	1
HOSE-SUCTION 1½" NH X 10' RUBBER	1	SPILL CONTAINMENT BERM	2
HOSE- GARDEN 3/4" X50'	1	CLOTH-OIL SORBENT	4
VALVE- FOOT W/STRAINER 1½" NH	1	TANK-GASOLINE-5GAL PUMP ADAPTED*	1
VALVE- PRESSURE RELIEF 1½" NH	1	2 CYCLE OIL, 5GAL MIX 12.8OZ	1
VALVE-CHECK & BLEEDER 1½" NH	1	TAG-2 STROKE (FOR MIXED CANS)	2
VALVE-GATED WYE 1½" X 1½" X 1 ½"	1	TAG-SHIPPING "TOE" TAG BLANK**	10
VALVE-SHUT OFF 3/4"	2	KIT-PUMP TOOL ROLL	1
REDUCER- 2" NP-F TO 1 ½" NH-M	1	CLAMP-HOSE SHUT OFF	1
REDUCER- 1½" NH-F TO 1" NP-M	2	WRENCH-SPANNER	1
REDUCER - 1" NP-F TO 3/4" M	1	PRIMER-HAND, MARK 3	1
ADAPTER-1 ½" NH-F TO 1 ½" NP-M	1	PAIL-COLLAPSIBLE	1
ADAPTER-1 ½" NP-F TO 1 ½" NH-M	1	CORD-NYLON 100'	1
COUPLING-DOUBLE FEMALE 1 ½" NH-F	1	GASKET-HOSE, 1 ½" & 1" – 3 EACH	6
COUPLING-DOUBLE MALE 1 ½" NH-M	1	NOZZLE- PLASTIC- 1 ½" NH	1
NOZZLE- PLASTIC- 1" NP	1	STRAINER-FISH 100GPM	1
NOZZLE- TWIN TIP- 1" NP (FORESTER)	1	INSTRUCTIONS-HIGH PRESSURE PUMP	1

*GASOLINE TANK SUPPLIED EMPTY

PUMP- 4 CYCLE LIGHTWEIGHT-NATIONAL STANDARD #008606

INSTRUCTIONS-LIGHTWEIGHT PUMP	1	HOSE-GARDEN ¾" X 50'	8
PUMP-PORTABLE LIGHTWEIGHT 4 CYCLE	1	NOZZLE-GARDEN HOSE ¾"	2
HOSE-SUCTION W/STRAINER	1	GASKET-GARDEN HOSE ¾"	4
OIL-SAE 10-30WT (PUMP/NOT MIX)	1	REDUCER-1 ½" NH-F TO 1" NP-M	1
SPARK PLUG-PUMP SPECIFIC	1	REDUCER-1" NP-F TO ¾"	1
CONTAINER-FUEL/OIL 2 COMPARTMENT	1	VALVE-3/4" BRASS SHUT OFF	2
TAG-SHIPPING "TOE" TAG BLANK **	10	VALVE-WYE-GATED ¾"X ¾"X ¾"	2
SPILL CONTAINMENT BERM	1	TOOL KIT-VARIOUS WRENCHES	1
CLOTH-OIL SORBENT	2	PAIL-COLLAPSIBLE	1

**PLEASE USE TAGS TO DESIGNATE ANY TYPE OF FUEL: STRAIGHT GAS, DIESEL, PUMP MIX, BURN MIX, SAW MIX

02/2023

SPRINKLER KIT-NATIONAL STANDARD #001048

SPRINKLER HEAD ASSEMBLY	4	GARDEN HOSE ¾" X 50'	5
ORANGE STAKES W/CLAMPS	8	NOZZLE-GARDEN HOSE ¾"	1
REGULATOR-WATER PRESSURE ¾"	4	NOZZLE-PLASTIC 1 1/2 " NH	1
VALVE-SHUT OFF ¾" NH	4	GASKET- GARDEN HOSE ¾"	5
VALVE-WYE, GATED ¾" X ¾" X ¾"	2	CORD-NYLON (P-CORD) 100'	2
TEE-HOSELINE 1 ½" NH X 1 ½" NH X 1"NP	4	PIN-PANEL, HOLD DOWN 8"	12
REDUCER- 1 ½" NH-F TO 1" NP-M	1	NAILS-DUPLEX, DOUBLE HEAD 1# BOX	1
REDUCER- 1" NP-F TO ¾" NH-M	1	CLAW HAMMER	1
INSTRUCTIONS-SPRINKLER KIT	1	PRUNING SAW	1

SPRINKLER KIT-NORTHERN ROCKIES SPECIFIC #008653

SPRINKLER ASSEMBLY, TRIPOD "MUSIC STAND"	4
PIN-PANEL, HOLD DOWN 8"	12
CORD-NYLON (P-CORD) 100'	1

02/2023

Mark III

Lightweight

Appendix K
Pump Information & Operation

Mark III

General Information

- Mark III uses 50:1 fuel mix.
- When ordering a Mark III it is usually best practice to order 2 pumps with kits. This will ensure you have a backup in the event of unforeseen mechanical issues.
- Allow ample warm-up time before operating at full throttle.
- Always use a draft hose with a foot-valve and fish strainer.

Setting up and Operating

1. Connect fuel line to pump and tank. An arrow on the fuel line will indicate the direction of flow of fuel. You may need the fuel can to be slightly higher than the pump.
2. Attach draft hose to pump and tighten with a spanner wrench.
3. Attach pig-tail with y-valve or t-valve to discharge side of pump.
4. Use hand priming pump to prime the pump head. If a priming pump is not available you can use a bucket to hand fill the pump head.
5. Pull the decompression switch out until it clicks (new pumps do not have decompression switch).
6. Pull the choke on START if pump is cold.
7. Move throttle switch to 'START AND WARM UP' position.
8. Pull the start cord until the pump fires. After it fires turn the choke off.
9. Put the choke on RUN and pull cord until pump starts running.
10. Allow the engine to run before adjusting the throttle.

Troubleshooting

- Ensure the pump is getting fuel. The fuel line has a priming bubble on it to start the flow of fuel.
- Check the spark plug for any residue. Clean and regap if necessary.
- When ordering fuel it often comes straight with bottles of 2-cycle for the operator to mix. If you are unsure if it has been mixed ASK someone.
- Check the foot-valve to ensure it is operating properly and not buried in the mud.

Mark III Trouble-shooting Chart

A- Engine Doesn't start
B- Starts momentarily then stops
C– Runs irregularly or misses
D– does not idle properly
E– Doesn't develop normal power
F– Overheats
G– Backfires

A	B	C	D	E	F	G	POSSIBLE CAUSE	REMEDY
X	X						Fuel supply tank empty	Refill tank
X	X						Fuel supply valve closed	Open supply valve
X	X						Air vent on fuel tank closed	Open air vent
X	X	X					Defective fuel supply hose	Replace
X	X	X					Dirty fuel strainer screen	Remove and clean, or replace**
X	X	X					Leak in fuel supply system	Tighten or replace fittings
X	X	X	X	X			Carburetor mountings loose	Tighten mountings
X	X	X					Water or dirt in fuel system	drain, flush thoroughly
X	X						Engine flooded	Close fuel, remove spark plug, open choke & throttle, pull until excess gas exhausted**
		X		X	X		Wrong gas in fuel mixture	Drain, flush thoroughly, replace**
				X	X		Wrong oil in fuel mixture	Drain, flush thoroughly, replace**
				X	X		Not enough oil in fuel mix	Drain, replace with correct mix**
X	X	X	X	X	X		Too much oil in fuel mix	Drain, replace with correct mix**
							Engine not warmed up properly	Allow longer warm up period
		X		X			Air filter dirty	Remove, clean in gasoline
		X	X				Idle mixture screw miss-adjusted	Close idle screw, then 1/2 turn counter-clockwise to reset**
X		X	X	X	X	X	Spark plug fouled or defective	Clean or replace
X							No spark	Check stop switch or broken cable points**
X							stop switch or cable shorted	Check switch &/or replace**
X	X	X	X	X	X		Weak or intermittent spark	Checkpoints, coils & condenser**
X		X	X	X			Breaker points worn or dirty	Clean &/or replace**
X						X	Defective condenser	Check or replace**
		X	X	X	X		Wrong type of spark plug	Plug must have 1/8" gap
X			X	X	X	X	Ignition timing incorrect	Inspect points, clean or replace**
		X		X	X		Excessive carbon deposits	Clean or replace muffler**
				X	X		Cooling system dirty	Clean fan housing
				X	X		Muffler blocked or dirty	Replace
				X	X		Main adjustment screw mis-adjusted	Close main adjustment screw, then turn 1 1/2 turns counter-clockwise to reset**
** Pump may need additional work, refer to owner's manual								

Pump and Water Handling Information (cont.)

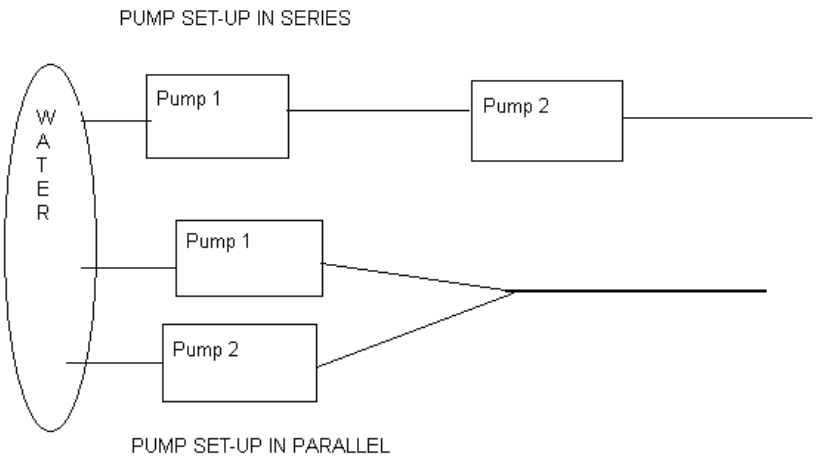
Special Considerations for a water show

- Consider the distance you need to pump water to determine the most effective setup.
- When ordering plan for some hose to break.
- Every 200 feet of 1 1/2" hose will need at least 1-gated, 1 reducer, 100 ft. of 1", and 1 nozzle (be specific when order-ing or you will get something you don't want).

Series and Parallel Pumping

Series: 2 pumps are connected in-line (distance between the pumps may very). This will increase PRESSURE.

Parallel: 2 pumps side-by-side pumping water is pumped from each pump into a single hose lay. This will increase VOLUME.



Sprinklers

- Sprinklers are designed to operate at 50 psi.
- The more you can avoid installing sprinklers on a straight line of 3/4"hose, the more consistent performance you can expect.
- In other words, try to maintain a comprehensive hose-lay feeding sprinklers (1-1/2" trunk to laterals every 100').

Series Pumping Procedures

***Set-up**:*

Pump 1

1. Set-up the first pump near the water source. Prime the pump and prepare it to be started.
2. Attach a short section of 1 1/2" hose with a pressure relief valve to the pump discharge. Attach a check and bleeder valve to the pressure relief valve.
3. Attach the connecting hose to the check and bleeder valve. The length of the connecting hose varies based on the ability of pump 1 to push enough volume of water to pump 2.

Pump 2

1. Attach a 1 1/2" double female coupling to the suction port.
2. Connect the hose from pump 1 to the double female (this will supply pump 2 with water.)
3. Connect a pressure relief and check and bleeder valve to the discharge port using a pig tail.
4. Connect the hose lay to the pig tail.

Operation:

Operation may require 2 people depending on the distance between the two pumps. Ensure all fittings are tightened with a spanner wrench.

1. Start pump 1 and allow it to warm up (you should have good flow to pump 2).
1. Bring pump 1 to full operating speed and ensure water is flowing to pump 2.
2. Start pump 2 and allow it to warm up.
3. Slowly increase the speed of the 2 pumps until they are working together.
4. Constant attention will be required to both pumps and all the hardware between them to prevent cavitation of a pump.

Parallel Pumping Procedures:

Set-up:

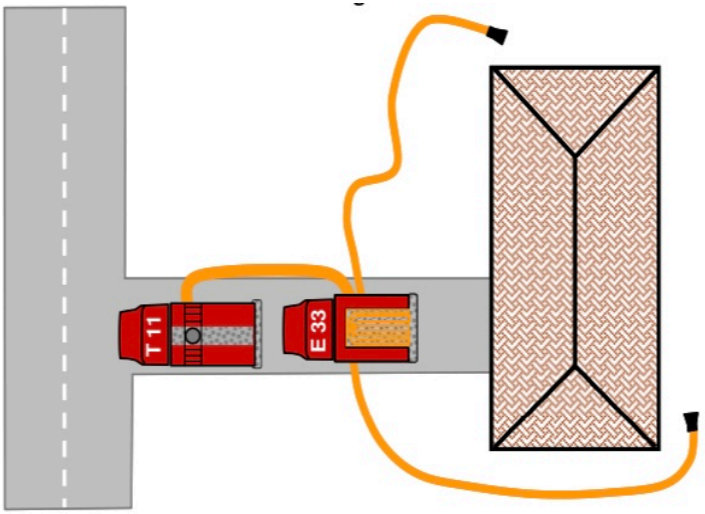
1. Set–up 2 pumps as if you were going to operate a single pump. If you set them up close together monitoring and operating will be much easier.
2. Attach a check and bleeder valve to both pump 1 and 2, using a 1 1/2" pig tail. This will prevent head pressure.
3. Use a Siamese gated-y (usually not readily available), or use 2 double female couplings and a double male coupling to invert a regular gated-y. This will connect the two pumps into one hose-lay.

Operation:

Either pump can be started or stopped at anytime with out affecting the other.

1. Start each pump using the standard operation of a Mark III.
2. Ensure water is reaching the hose-lay.
3. One person should be near the pumps at all times to ensure proper operation.

Note: Ensure that you have a well supplied water source, as running two pumps parallel will require more water.



Typical Engine Tactic

Appendix L
Appliance Order

DATE: DATE AND TIME NEEDED:

DIVISION: DELIVERY LOCATION:

QTY	ITEM/DESCRIPTION	NFES#
	1 1/2” HOSE-NH ~ 100'	1239
	1” HOSE-NPSH ~ 100'	1238
	GARDEN HOSE, 3/4” ~ 50'	1016
	1 1/2” x 1 1/2” x 1 1/2” NH GATED WYE	0231
	1” X 1” X 1” NPSH GATED WYE	0259
	WYE-GATED 3/4” X 3/4” X 3/4	0272/0904
	TEE-HOSELINE, 1 1/2” X 1 1/2” X 1”	0731
	TEE-HOSELINE, W/VALVE 1 1/2” X 1 1/2” X 1”	0230
	TEE-HOSELINE W/CAP 1” X 1” X 3/4"	1809
	TEE-HOSELINE W/CAP 1" X 1" X 1"	2240
	REDUCER-1 1/2” NH-F TO 1” NPSH-M	0010
	REDUCER-1” NPSH-F TO 3/4” NH-M (GARDEN HOSE)	0733
	ADAPTER, 1 1/2” NH-F TO 1 1/2” NPSH-M	0006
	ADAPTER, 1 1/2” NPSH-F TO 1 1/2” NH-M	0007
	COUPLING, DOUBLE FEMALE, 1 1/2” - 1 1/2” NH-F	0857
	COUPLING, DOUBLE MALE, 1 1/2”- 1 1/2” NH-M	0856
	COUPLING, DOUBLE FEMALE, 1”- 1” NPSH-F	0710
	COUPLING, DOUBLE MALE, 1”-1” NPSH-M	0916
	NOZZLE-PLASTIC-1 ½” NH	0137
	NOZZLES 1” ☐ PLASTIC-NPSH-0138 ☐ TWIN TIP-NPSH-0024	
	3/4” NOZZLE-GARDEN-BRASS	0136
	MARK 3 PUMP-HIGH PRESSURE-2 CYCLE (WITH KIT)	0148/3870
	PUMP-LIGHTWEIGHT-HIGH PRESSURE-4 CYCLE (WITH KIT)	8606
	PUMP-VOLUME (WITH KIT) NRK-8655 or 0641	
	GAS, STRAIGHT UNLEADED (NON-ETHANOL) – 5 GALLONS	
	2 CYCLE OIL, 5 GAL MIX, 12.8 OZ	
	SUCTION HOSE-1 1/2” NH 10'	0115
	TANK-FREE STAND ☐ 1800 GL-0668 ☐ 3000 GL-0568 ☐ 6000 GL-6031	
	TANK-FOLDING ☐ 1000 GAL-0661 ☐ 1500 GAL-0664	
	SPRINKLER KIT (4/KIT) SPRINKLER HEAD WITH STAKES	1048
	SPRINKLER KIT (4/BOX) TRIPOD W/ 30” EXTENSION (MISSOULA ONLY)	8653

NAME: POSITION:

PHONE:

HSB

Appendix M
WUI - 6 Minutes For Safety

The primary consideration of any operation is to assure firefighter and public safety. It is a must to assess potential fire behavior, ingress and egress, nature of the threat, hazardous materials, and available water supplies before engaging in the protection of any structure.

Factors that may make an attempt to save a structure too dangerous:

- The fire is making a sustained run and there is little or no clearance between the structure and the fuel.
- The fire behavior is extreme; spot fires are numerous and the spread is outpacing containment.
- Water supply will not last as long as the threat of the fire.
- The fire intensity dictates that you leave the fire area immediately.
- The structure is constructed of wood and has a wood shake roof.
- The roof of the structure is more than one-quarter involved.
- There is fire inside the structure, or windows are broken and there is no way to quickly repair or cover them.
- You cannot safely remain at the structure because your escape route could become unusable.

When implementing a plan to protect structures, consider the following.

- Do not enter a burning structure unless you are trained, equipped and authorized. Firefighter safety is the number one priority.
- Always stay mobile and wear all personal protective equipment.
- Back in apparatus to allow for a quick escape.
- Coil a short, charged hose line with nozzle on your engine for safety and quick knock down capability. No long hose lays.
- Reserve at least 100 gallons of water in your tank.
- Check the road system before the fire approaches. Know bridge limits, alternate access routes, and turnouts for apparatus.
- Determine if residents are home. Leave the inside and outside lights on, regardless of the time of day. Close all doors.
- Place the owner's ladder at a corner of the home on the side with the least fire threat.
- Coil and charge homeowners garden hoses.
- Check and mark hazardous materials.

Wildland Urban Interface Watch Outs:

Consider the Wildland Urban Interface Watch Outs in completing a risk analysis for the urban interface area to be protected.

- Poor access and narrow, one-way roads. A rapidly spreading fire could trap apparatus and personnel before they can turn around or move away from the flames and smoke.
- Observe bridge limits. Exceeding bridge limits could lead to bridge failure with a resultant blocking of ingress/egress routes that could result in the loss of an escape route or loss of equipment.
- Inadequate water supply. Without a reserve supply of water, the fire can overtake an area before the fuels can be cleared away.
- Natural fuels are located 30 feet or closer to structures on level ground. Remember structures on slopes require greater clearance.
- Structures are located on canyon slopes or in chimneys on slopes of 30% or more with continuous, flashy fuels. The resulting rate of spread of any fire in this terrain can quickly extend beyond control.
- Extreme fire behavior: Situations involving crowning, large flame heights, and erratic fire behavior can extend in an unpredictable manner beyond the control of any number of personnel.
- Strong winds of 25+ miles per hour: Winds increase the chance of spotting over the heads of firefighters and trapping them between both fire areas. Winds also cause greater preheating of fuels in the path of a fire front.
- The need to evacuate the public, livestock, pets, and/or animals. This critical activity can pull personnel from the firefighting activity and can distract attention from fire behavior at a time when the greatest alertness is needed.
- Propane and above ground fuel tanks that are next to wooden structures or close to vegetation.
- Power lines and poles:
  What is their location in relation to the structures that are being protected? Watch for both overhead and downed power lines.
- Local citizens are attempting suppression activities. Lack of knowledge in fire suppression may lead to unsafe tactics.
- Airtanker retardant drops and helicopter bucket operations: Establish communications and keep fire personnel out of the drop zone.

Appendix N
Planning Tools and Mapping

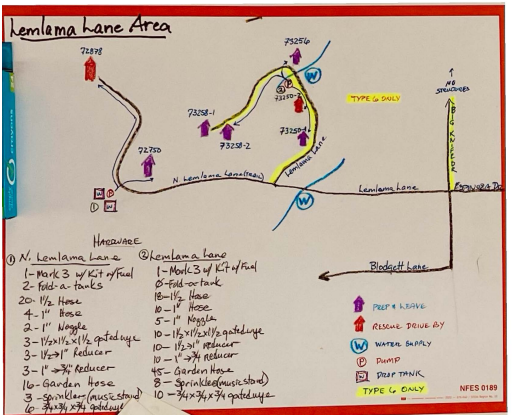
So, you've been assigned to the Structure Group. Good Deal. You'll need to build a kit hopefully before you roll out for the assignment, or stopping by a local hardware store can get you most of what you might need. Also, the great folks in Logistics/Supply at the ICP can help with a few of these items.

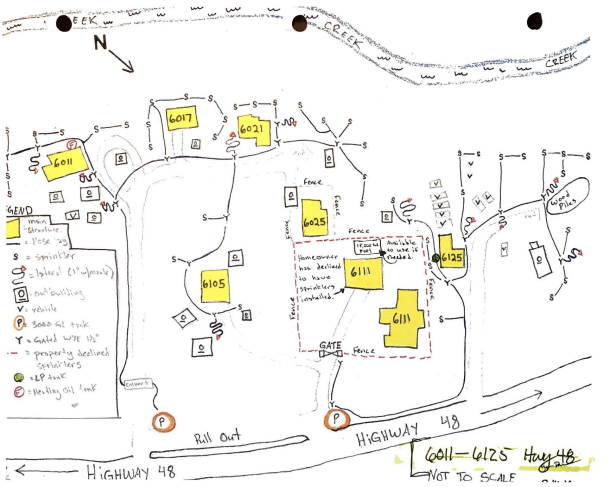
When you're assigned to structure protection sometimes it's point protection, trying to stay ahead of the approaching wildfire. Other times, you might have a bit more time to do some planning. Either way, some of these items below will more than likely be of use to you and your crew.

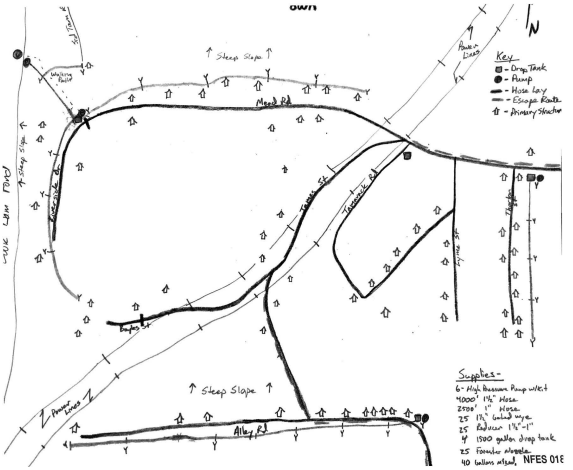
Identifying structures with an attached address number simplifies your operation in the long run. Other than saying "the log house with the green roof" actually calling out a fire number or address on a certain road can get everyone talking with common terminology. Pie plates and a king size Sharpie, as well as a staple gun, can go a long way towards achieving this goal.

Flagging tape, when used appropriately, can help immensely in communicating to others what's ahead. Using a fine point Sharpie and writing on the tape what the tape means at that point in time is wicked good. Everyone uses too much pink. Blue for water source, Yellow/Black for hazards. Escape Route flagging on the right side when you are heading out (away from the hazard). Checkered flagging of varying colors indicating structure occupancy (yellow-vacated, red-occupied).

Other tools not pictured are the electronic mapping applications: Avenza, Field Maps, CalTOPO and onX Hunt to name a few. Also Google Earth, Google Maps, and others.







amateurs study tactics...professionals study logistics

Appendix O
Structure Assessment Checklist

Address/Property Name

- Numerical street address, ranch name, etc.
- Number of residents on site
- Every property needs some numerical identifier...not just "log house with green roof"

Road Access

- Road surface (paved, gravel, unimproved, dirt)
- Adequate width, vegetation clearance and Safety Zones along road
- Undercarriage problems (4x4 access only)
- Turnouts and turnarounds
- Bridges (load limits) and/or flammable material
- Stream crossings (approach angle, crossing depth and surface)
- Terrain (road slope, location on slope, near chimneys, saddles, canyon bottom)

Structure/Building

- Single residence or multi-complex, out buildings (barn, storage)
- Does building have unknown or hazardous materials?
- Exterior walls (stucco or other noncombustible, log, vinyl, and wood)
- Large unprotected windows facing heat source.
- Proximity of any aboveground fuel tanks (propane, fuel oil, gasoline, etc.)
- Roof material (wood shake, asphalt, noncombustible)
- Eves (covered with little overhang, exposed with large overhang)
- Other features (wood deck, wood patio cover and furniture, wood fencing)

Clearances/Exposures/Defensible Space

- Structure location (narrow ridge, canyon, mid-slope, chimney)
- Adequate clearance around structure, minimum of 100 feet (steeper the slope, the more clearance required)
- Surrounding fuels (larger, denser the fuels, the more clearance required)
- Flammable fuels (trees, ladder fuel, shrubs) adjacent to structure (is there time for removing these fuels?)
- Other combustibles near structure (wood piles, furniture, fuel tanks)
- Is there adequate clearance around fuel tank?
- Power lines or transformers (DO NOT park under power lines)

Hazardous Materials

- Chemicals (Look for DOT/NFPA/UN symbols)
- Pesticides and herbicides
- Petroleum products
- Paint products

Water Sources

- Hydrant/standpipe. When connecting with hydrant, be aware of operation, flow rate and GPM output. Size and venting capability of engine or water tender may not be able to handle hydrants with high flow and GPM rates. Consider a conversation with the water plant manager prior to using hydrants.
- Hose bib on structure (power supply?)
- Storage tank
- Swimming pool, hot tub, fish pond
- Irrigation ditch
- Streams or lakes
- Homeowner pre-set pumps.

Evacuation

- Is safe evacuation possible? (Identify safe refuge for those who cannot be evacuated.)
- Coordinate with on-scene law enforcement and emergency services personnel.

Estimated Resources for Protection

- Number(s) and type(s) of engines, water tenders, crews, dozer's (General Guidelines: one engine per structure, one additional engine for every four structures to be used as “backup” and for patrol. For structures that are close together (50 feet or less), one engine may be adequate to protect two structures).
- Type and number of aircraft available.
- Hand crews.

???

SITE & STRUCTURE ASSESSMENT

Date_____**Incident Name/Number**_____ **Evaluator (E, C, or O #)**_____ **Site #**_____
Address_____ **Lat**_____ **Long**_____
Type: ☐**Residential** ☐**Agricultural** ☐**Other** **Occupants:** ☐**Yes** ☐**No** ☐**Unknown** **Livestock:** ☐**Yes** ☐**No**

*****BASE ALL DECISIONS & ACTIONS ON CURRENT & EXPECTED FIRE BEHAVIOR*****

☐ YES ⇦⇦⇦⇦⇦ **SAFETY ZONE** ⇨⇨⇨⇨⇨ NO ☐
① ← circle → ② ③ ← circle → ④

DEFENSIBLE PREP & HOLD	DEFENSIBLE STAND ALONE	NON-DEFENSIBLE PREP & LEAVE	NON-DEFENSIBLE RESCUE/DRIVE BY

*L C E S *

SAFETY			PROTECTION RESOURCES		PREP TIME
YES☐	ESCAPE ROUTE	☐NO	☐ENG1	☐HAND CREW	☐NONE NEEDED
YES☐	GOOD COMMO	☐NO	☐ENG3	☐HEAVY EQUIP	☐LESS THE 30 MIN
YES☐	ACCESS IS GOOD	☐NO	☐ENG6	☐SPRINKLERS	☐MORE THAN 1 HOUR
YES☐	4 X 4 REQUIRED	☐NO	☐WTT2	☐OTHER	

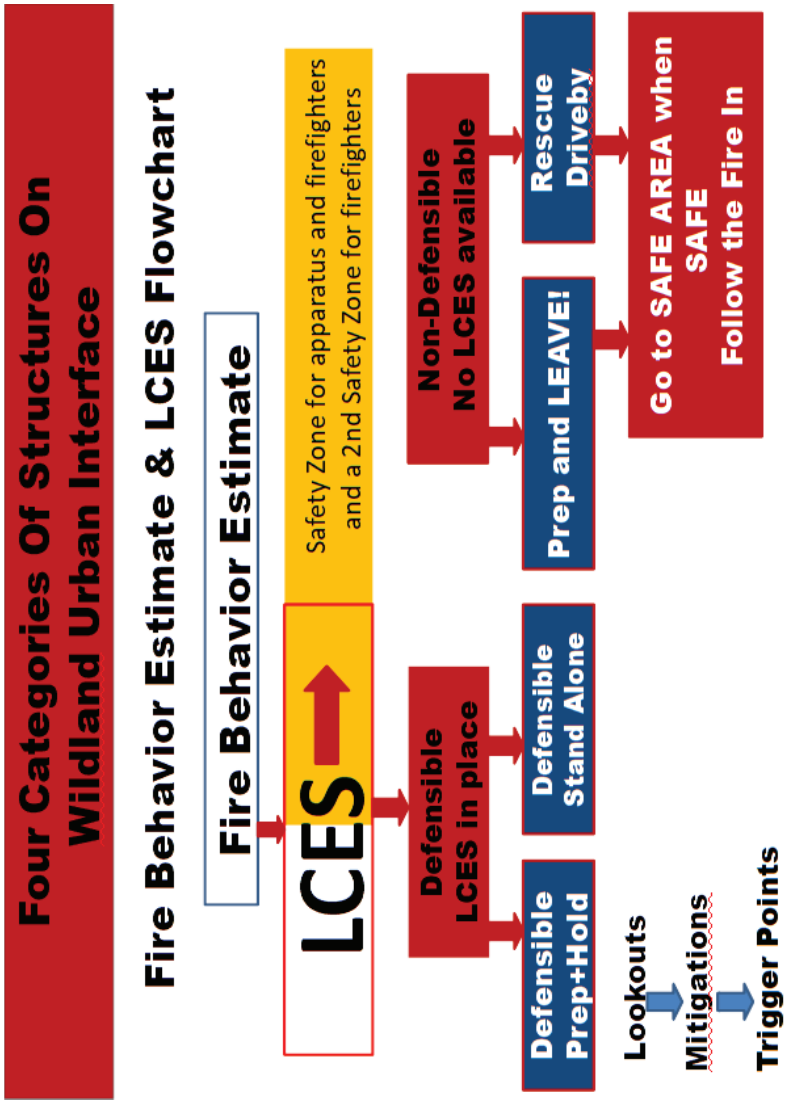
MAIN STRUCTURE
ROOF: METAL/TILE/ASPHALT ☐ WOOD ☐
SIDING: STUCO/BRICK/CONCRETE ☐ VINYL ☐
WOOD: LAP ☐ LOG ☐ PLYWOOD ☐
DISTANCE FROM PRIMARY FUELS_____
NUMBER OF OUTBUILDINGS_____
WATER ☐ WELL ☐ OTHER ☐
POWER ON: YES ☐ NO ☐

HAZARDS
OVERHEAD POWER YES ☐ NO ☐
ABOVE GROUND FUEL STORAGE YES ☐ NO ☐
SEPTIC TANK YES ☐ NO ☐ ► LOCATED YES ☐ NO ☐
BRIDGE CROSSING YES ☐ NO ☐
YARD ART YES ☐ NO ☐
-VEHICLES, TRAILERS, JUNK, ETC.
OTHER_____

PROBABLITY OF SUCCESS
POOR FAIR GOOD EXCELLENT

Has this information been entered into: ☐Field Maps ☐Avenza ☐_____ HSB

Appendix Q
LCES Flowchart



J P Harris

Appendix R
MEDICAL PLAN (ICS 206 WF)

Medical Incident Report

FOR A NON-EMERGENCY INCIDENT, WORK THROUGH CHAIN OF COMMAND TO REPORT AND TRANSPORT INJURED PERSONNEL AS NECESSARY.

FOR A MEDICAL EMERGENCY: IDENTIFY ON SCENE INCIDENT COMMANDER BY NAME AND POSITION AND ANNOUNCE "MEDICAL EMERGENCY" TO INITIATE RESPONSE FROM IMT COMMUNICATIONS/DISPATCH.

Use the following items to communicate situation to communications/dispatch.

1. CONTACT COMMUNICATIONS / DISPATCH (Verify correct frequency prior to starting report)
Ex: "Communications, Div. Alpha. Stand-by for Emergency Traffic."

2. INCIDENT STATUS: *Provide incident summary (including number of patients) and command structure.*
Ex: "Communications, I have a Red priority patient, unconscious, struck by a falling tree. Requesting air ambulance to Forest Road 1 at (Lat./Long.) This will be the Trout Meadow Medical, IC is TFLD Jones. EMT Smith is providing medical care."

Severity of Emergency / Transport Priority	☐ **RED / PRIORITY 1 Life or limb threatening injury or illness. Evacuation need is IMMEDIATE** *Ex: Unconscious, difficulty breathing, bleeding severely, 2° – 3° burns more than 4 palm sizes, heat stroke, disoriented.* ☐ **YELLOW / PRIORITY 2 Serious Injury or illness. Evacuation may be DELAYED if necessary.** *Ex: Significant trauma, unable to walk, 2° – 3° burns not more than 1-3 palm sizes.* ☐ **GREEN / PRIORITY 3 Minor Injury or illness. Non-Emergency transport** *Ex: Sprains, strains, minor heat-related illness.*	
Nature of Injury or Illness & Mechanism of Injury		*Brief Summary of Injury or Illness (Ex: Unconscious, Struck by Falling Tree)*
Transport Request		*Air Ambulance / Short Haul/Hoist Ground Ambulance / Other*
Patient Location		*Descriptive Location & Lat. / Long. (WGS84)*
Incident Name		*Geographic Name + "Medical" (Ex: Trout Meadow Medical)*
On-Scene Incident Commander		*Name of on-scene IC of Incident within an Incident (Ex: TFLD Jones)*
Patient Care		*Name of Care Provider (Ex: EMT Smith)*

3. INITIAL PATIENT ASSESSMENT: *Complete this section for each patient as applicable (start with the most severe patient)*

Patient Assessment: See IRPG page 106

Treatment:

4. TRANSPORT PLAN:

Evacuation Location (*if different*): (*Descriptive Location (drop point, intersection, etc.) or Lat. / Long.*) Patient's ETA to Evacuation Location:

Helispot / Extraction Site Size and Hazards:

5. ADDITIONAL RESOURCES / EQUIPMENT NEEDS:

Example: Paramedic/EMT, Crews, Immobilization Devices, AED, Oxygen, Trauma Bag, IV/Fluid(s), Splints, Rope rescue, Wheeled litter, HAZMAT, Extrication

6. COMMUNICATIONS: Identify State Air/Ground EMS Frequencies and Hospital Contacts as applicable

Function	Channel Name/Number	Receive (RX)	Tone/NAC *	Transmit (TX)	Tone/NAC *
COMMAND					
AIR-TO-GRND					
TACTICAL					

7. CONTINGENCY: ***Considerations:*** ***If primary options fail, what actions can be implemented in conjunction with primary evacuation method? Be thinking ahead.***

8. ADDITIONAL INFORMATION: *Updates/Changes, etc.*

REMEMBER: Confirm ETA's of resources ordered. Act according to your level of training. Be Alert. Keep Calm. Think Clearly. Act Decisively.

ICS 206 WF (03/18)

Appendix S
ACTIVITY LOG (ICS 214)

1. Incident Name:	2. Operational Period: Date From: Date To: Time From: Time To:	
3. Name:	4. ICS Position:	5. Home Agency (and Unit):

6. Resources Assigned:

Name	ICS Position	Home Agency (and Unit)

7. Activity Log:

Date/Time	Notable Activities

8. Prepared by: Name: _____ Position/Title: _____ Signature: _____

ICS 214, Page 1 Date/Time: _____

10 STANDARD FIREFIGHTING ORDERS

1. Keep informed on fire weather conditions and forecasts.
2. Know what your fire is doing at all times.
3. Base all actions on current and expected behavior of the fire.
4. Identify escape routes and safety zones, and make them known.
5. Post lookouts when there is possible danger.
6. Be alert. Keep calm. Think clearly. Act decisively.
7. Maintain prompt communications with your forces, your supervisor, and adjoining forces.
8. Give clear instructions and be sure they are understood.
9. Maintain control of your forces at all times.
10. Fight fire aggressively, having provided for safety first.

18 WATCH OUT SITUATIONS

1. Fire not scouted and sized up.
2. In country not seen in daylight.
3. Safety zones and escape routes not identified.
4. Unfamiliar with weather and local factors influencing fire behavior.
5. Uninformed on strategy, tactics, and hazards.
6. Instructions and assignments not clear.
7. No communication link with crewmembers or supervisor.
8. Constructing line without safe anchor point.
9. Building fireline downhill with fire below.
10. Attempting frontal assault on fire.
11. Unburned fuel between you and fire.
12. Cannot see main fire; not in contact with someone who can.
13. On a hillside where rolling material can ignite fuel below.
14. Weather becoming hotter and drier.
15. Wind increases and/or changes direction.
16. Getting frequent spot fires across line.
17. Terrain and fuels make escape to safety zones difficult.
18. Taking a nap near fireline.