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Wildfire/fuel treatment encounters: Assessing fuel treatment effectiveness

A case study at Logan Lake, British Columbia

PROJECT NUMBER: 301013731

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On August 14, 2021, the Tremont Creek wildfire threatened the community of Logan Lake, British Columbia, when the high-intensity wildfire approached from the north. A wind shift mid-afternoon on August 14 pushed the fire head toward the east with flanking fire spreading toward Logan Lake. Late in the afternoon, extensive aerial suppression operations were conducted to reinforce forest fuel reduction treatment areas on three sides of the community. Later in the evening, suppression crews incorporated fuel treatments in a successful burnout operation to reinforce a control line that had been created by heavy equipment and hand crews.

This case study presents the fire chronology with fuel, weather, and topographic conditions that impacted fire behaviour. A key objective of this case study is to examine how fuel treatments modified fire behaviour or were strategically used to support and enhance suppression operations.

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1 INTRODUCTION

This case study will contribute to a larger research initiative to assess the effectiveness of fuel treatments in moderating fire behaviour and/or improving the potential for successful suppression operations. More specifically, the case study will address the following key questions developed by fuels management specialists within the British Columbia Wildfire Service (BCWS):

1. Was there a change in fire behaviour resulting from the wildfire moving into the fuel treatment area?
2. What factors contributed to a change in fire behaviour?
3. Was there a change in suppression strategy and tactics based on the presence of the fuel treatment or a change in fire behaviour? Did the fuel treatment provide a strategic or tactical advantage in suppression operations?

In the initial stages of this research project, ongoing consultations with the BCWS helped to refine the data collection and analysis processes to develop a framework for a provincial fuel treatment evaluation process that can be applied by a larger group of researchers and wildfire specialists.

FPInnovations has collaborated with personnel from the BCWS and the Ministry of Forests to collect data from multiple sources, including:

- BCWS records (incident action plans, fire progression maps, weather forecasts, notes)
- Field observations in areas of wildfire/fuel treatment encounters
- Eyewitness accounts
- Photographs from suppression personnel
- Fuel treatment maps and prescriptions from fuels management specialists

While there is obvious value in evaluating the fire progression through the preceding five weeks of fire growth with extreme weather conditions and fuel hazards, this case study will focus on the timeframe of the fire encroachment on the community and the fire environment conditions in the immediate vicinity of fuel treatments in the Logan Lake area.

2 FIRE CHRONOLOGY

The Tremont Creek fire started on July 7, 2021, near the town of Ashcroft (38 km NW of Logan Lake) and burned continuously over the next five weeks (Figure 1) under extreme fire hazard conditions created by unseasonable spring drought conditions and a persistent high-pressure system (heat dome[1]).

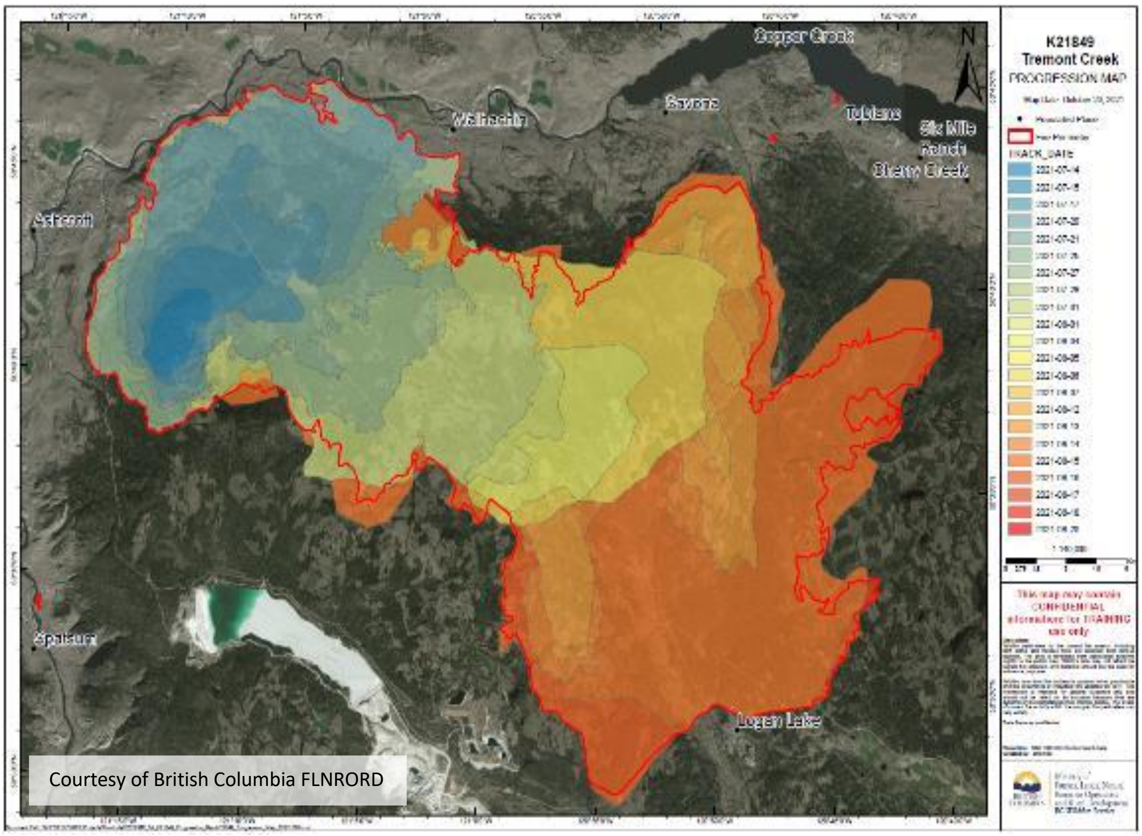

Figure 1. Fire progression map for K21849 (July 14 to August 20, 2021)

On August 12 and 13, two distinct fingers of fire spread rapidly from the southern edge of the main fire along opposite sides of the Tunkwa Lake drainage (Figure 2). On August 14, west winds drove the fire front through forested areas and a community forest cutblock north of Logan Lake with Rank 4 and 5 fire behaviour[2] (intermittent to continuous crown fire) observed at the head of the fire. Flanking fire spread southward toward Logan Lake through the afternoon. At 1738, the south flank was approximately 300 metres from the northernmost cluster of structures at the end of Lea Rig Crescent (Figure 3).

[1] https://www.rmets.org/metmatters/what-heat-dome

[2] https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-response/fire-characteristics/rank

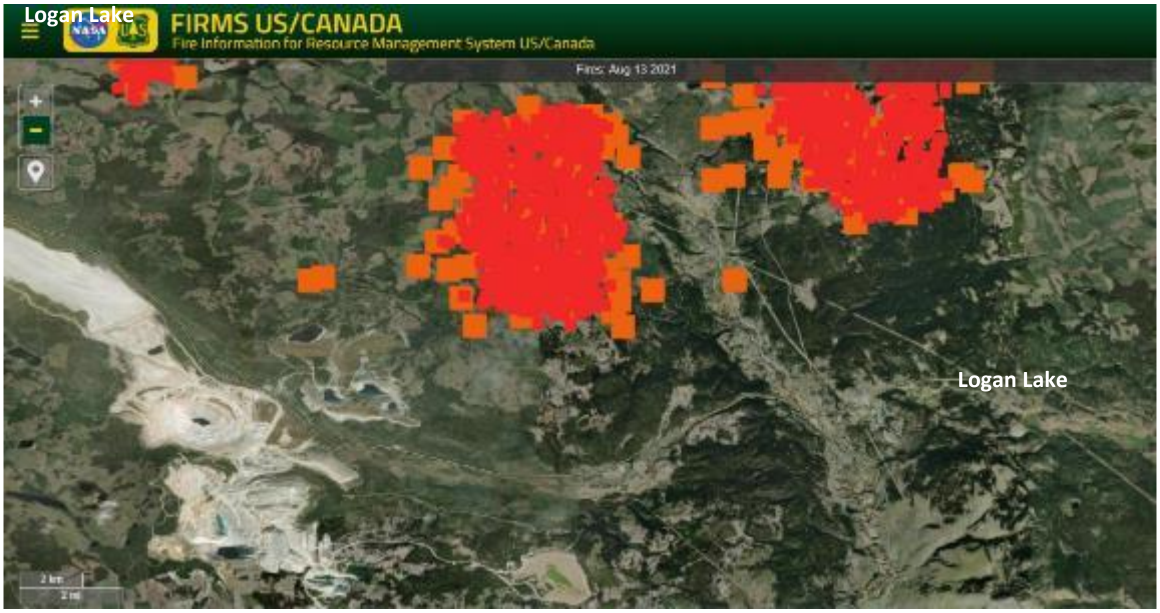

Figure 2. August 13 at 1346 - Two well-developed fire fronts within 5 km of Logan Lake

Figure 3. At 1738, flanking fire approaching the northwest corner of Logan Lake

With a sustained west wind through the afternoon, the fire continued to burn eastward, eventually reaching Highway 97D at the east end of Logan Lake (Figure 4) but did not impact any structures in the community.

Figure 4. The fire's south flank at 1927, with the head of the fire reaching Highway 97D

3 FIRE ENVIRONMENT

3.1 Fuels

As the Tremont Creek fire spread southward from the Tunkwa Lake area, it followed continuous fuels consisting of conifer forests and cutblocks (Appendix A). The primary FBP fuel type assigned to fuels in this area is C-7 (Ponderosa Pine/Douglas-fir). Adjacent to Logan Lake, the conifer forests transitioned to a community forest cutblock and fuel treatments along the north perimeter of the town. The conifer overstory extends into the interface in varying densities with a mix of vegetative and urban fuel in the surface layer (Figure 5).

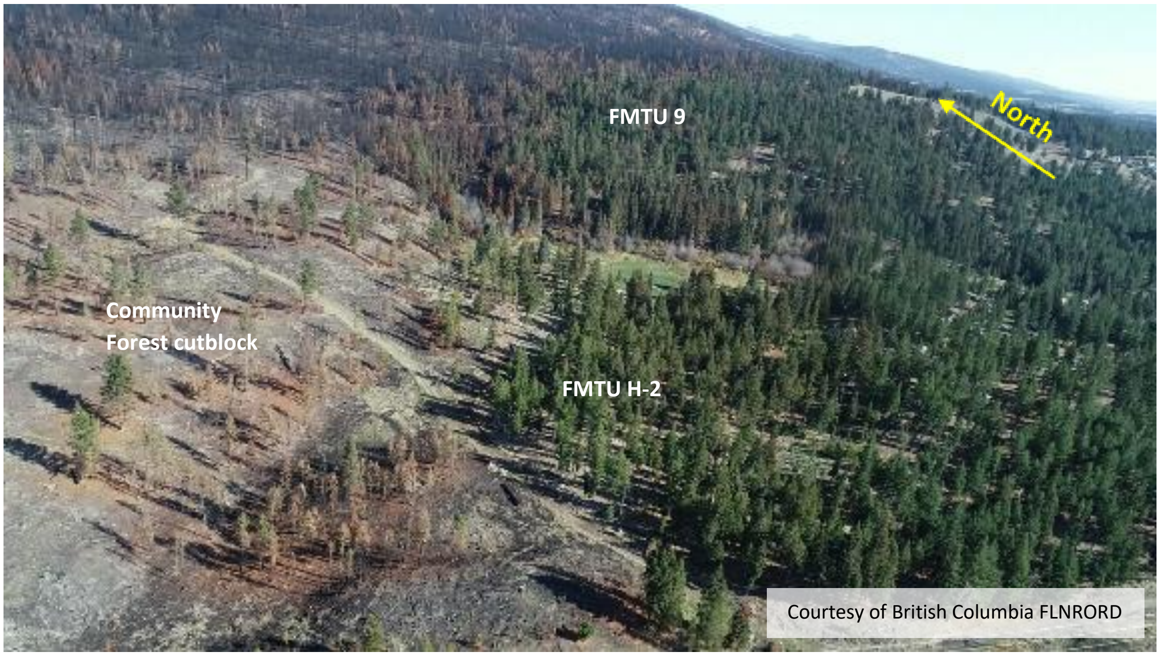

Figure 5. Continuous fuels transition to a recently cut area and fuel treatments

3.1.1 Fuel Treatments

Logan Lake has a long history of forest fuel management as a community resilience strategy, and fuel treatments have been strategically applied on all sides of the community (Appendix B). Fuel treatments completed on the west, north, and east sides were utilized in fire suppression operations on August 14. These fuel treatments are introduced throughout this case study with photos to indicate their location and narrative to describe how the fuel treatments were utilized during suppression operations.

A general strategy stated in prescriptions for the Logan Lake fuel treatment units projected an overall outcome of “a more open stand that will have fewer, more vigorous trees, a safer place to recreate and better access and grazing opportunities for wildlife and cattle. There will be significantly better wildfire suppression opportunities” (Logan Lake 2016). During the suppression operations of August 14, these opportunities included more efficient and effective airtanker retardant delivery and burnout operations.

Pre-treatment stand conditions are detailed in the District of Logan Lake Fuel Management Prescription (Logan Lake 2016), with representative pre-treatment pictures of FMTU-1 and FMTU-11 shown in Figure 6. General forest health conditions for these treatment units were described as devastation by pine beetle and dwarf mistletoe with inter-tree competition in Douglas-fir thickets. In addition to wildfire mitigation objectives, fuel management prescriptions were developed to address these forest health issues.

Four main principles guided the fuel management activities:

1. Retention and minimal disturbance of the forest duff layer, herbs, grasses, and deciduous shrubs that provide the ground cover
2. Retention of a portion of the advanced regeneration of conifers
3. Retention of high-quality wildlife trees where present, in safe locations, to maintain wildlife habitat and vertical structure
4. Retention and future recruitment of large coarse woody debris

Figure 7 shows post-treatment fuel environments approximately 5 years past treatment.

Figure 6. Pre-treatment stand conditions in FMTU-1 (left) and FMTU-11 (right)

Figure 7. Reduced canopy and surface fuels in FMTU-1 (left) and FMTU-11 (right)

3.2 Weather

The extreme fire danger conditions in the Logan Lake area are reflected in the Fire Weather Index (FWI) and weather values (Table 1) from the Leighton Lake and Paska Lake BCWS weather stations. Leighton Lake (elevation 1167 m) is 14 km north of Logan Lake, while Paska Lake (elevation 1440 m) is 10 km to the east.

Table 1. Weather and FWI values from representative BCWS weather stations for August 14

Station	Weather values				Fire Weather Index values					
	T	RH	WS	WD	FFMC	DMC	DC	ISI	BUI	FWI
Leighton Lake	29.3	22	9	83	94.2	179.3	1011	11.9	248.5	44.3
		90th percentile values			93.9			13.2	142.6	
Paska Lake	26.3	19	11	263	96.1	127	782.8	18.6	180.7	56.8
		90th percentile values			93.0			12.6	125.8	

T – Temperature (Celsius)
RH – Relative Humidity (%)
WS – Wind Speed (km/h)
WD – Wind Direction (degrees)

FFMC – Fine Fuel Moisture Code
DMC – Duff Moisture Code
DC – Drought Code
ISI – Initial Spread Index
BUI – Buildup Index
FWI – Fire Weather Index

On the morning of Saturday, August 14, an inversion layer had set up over southern BC, inhibiting vertical mixing below 1500m roughly. The inversion layer is indicated by the temperature profile (line on right) in Figure 8 which shows temperature increasing above the surface to an elevation of approximately 550 m AGL (above ground level).

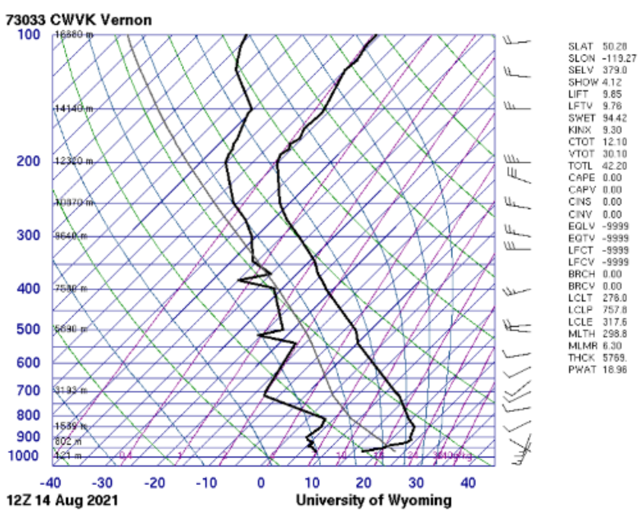

Figure 8. Temperature inversion at 0500 PDT

A spot forecast was issued on Friday, August 13, stating the likelihood of poor venting in the morning.

> "Due to moderate winds the venting would normally be good. However, all the smoke is overwhelming the ecosystem. Smoke may get better after the cold front on Sunday. Only a brief and shallow inversion for Saturday morning which will break early due to heating. We shall continue with an inversion at or near 2000m due to the strong ridge in the area". (BCWS August 13 spot forecast for K21849)

As the inversion layer broke later in the morning, the fire was more exposed to ambient winds which had shifted to a westerly direction (Table 2). Fire behaviour became more column-dominated with greater intensity in the two fire fronts approaching Logan Lake.

> "From Saturday morning through Sunday it will be quite windy. This will give extreme fire behaviour and be a challenge, I am sure. Wind directions will be SW through SE from Saturday until the cold front sometime Sunday late afternoon or evening. Once the cold front goes through winds will go back to NW". (BCWS August 13 spot forecast for K21849)

Table 2. Wind conditions for time of fire encroachment on Logan Lake

	Weather Station			
Time	BCWS Leighton Lake		BCWS Paska Lake	
	WS	WD	WS	WD
1300	9	83	11	263
1400	10	52	10	258
1500	11	37	7	243
1600	10	271	4	0
1700	12	285	13	203
1800	9	270	16	183
1900	10	268	19	196

WS – Wind speed (km/h)

WD – Wind direction (degrees)

Prior to the wildfire encroachment at Logan Lake, an upper ridge was positioned over the coast of BC. The prevailing northwest upper flow mixing down to the surface level had a significant impact on fire behaviour. Between August 11 and 13, north winds recorded at Leighton Lake ranged between 10 and 16 km/h (daily noon readings).

As the ridge flattened out between August 13 and 15, the prevailing upper flow shifted to a westerly flow (Figure 9). With this shift in the upper flow, the predominant surface wind direction late afternoon on August 14 was southwest (Table 2).

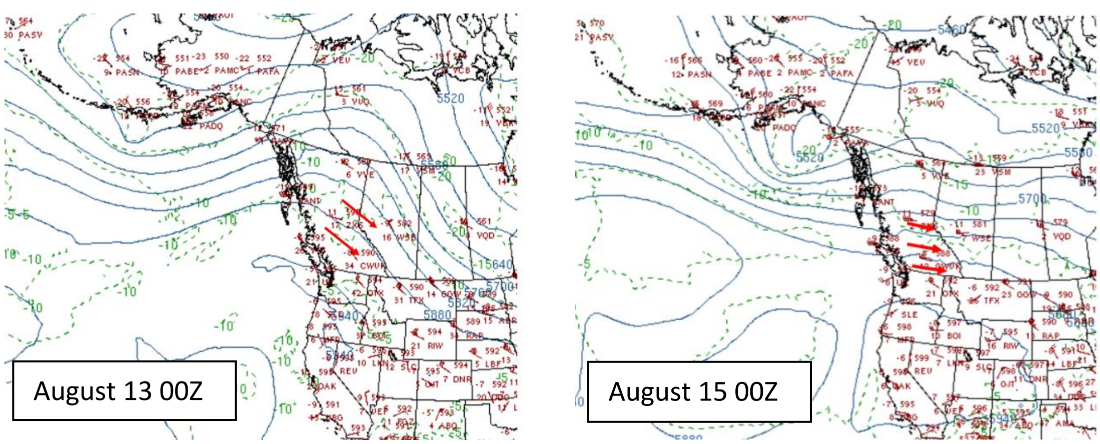

Figure 9. 500 Mb charts indicating shift in upper flow.

3.3 Topography

The topography on the north side of Logan Lake slopes upward toward the north (Figure 10). On the west side of the hydro ROW near FMTU-1, there is a moderate rise toward the north with some isolated steep sections where high fire severity was observed.

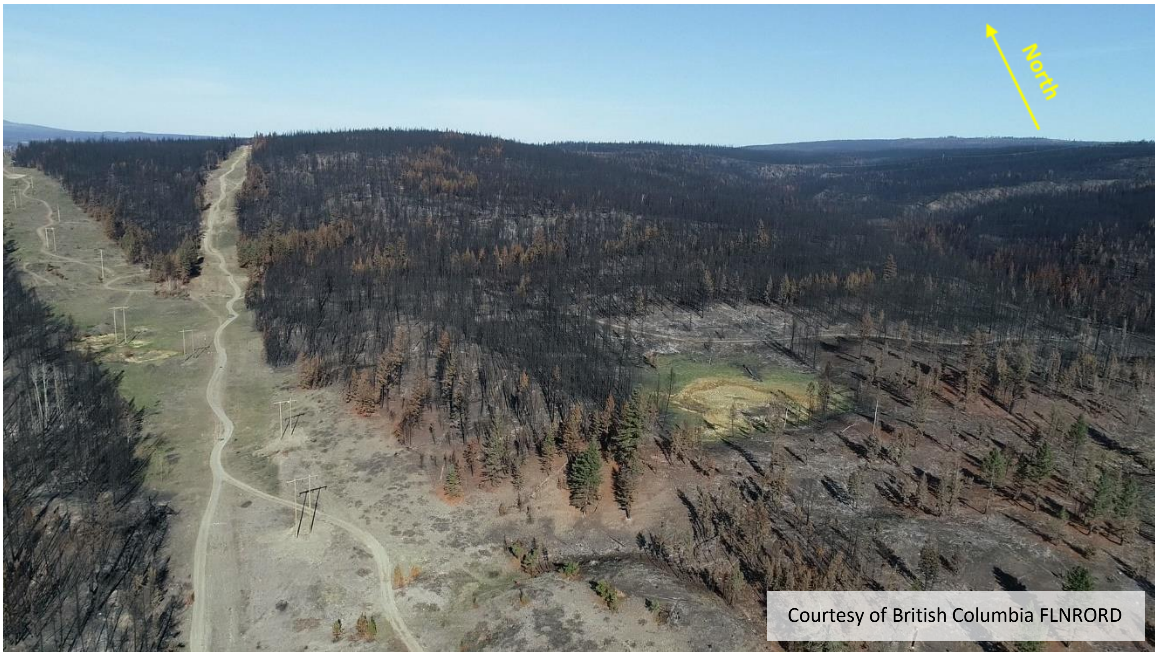

Figure 10. Moderate elevation gain north of Logan Lake

4 ANALYSIS OF FIRE BEHAVIOUR

4.1 Fire Intensity and Severity[3] in Treated vs. Natural Areas

In the early stages of air attack operations on August 14, the free-burning fire (Rank 4 to 5) had crossed Tunkwa Lake road and was burning in an easterly direction, while flanking toward the north end of FMTU 1 and FMTU 3 at the intersection of the two rights-of-way (Figure 11). Prior to this image being taken, three air tanker loads of retardant had been dropped between 1615 and 1626 in the area adjacent to the hydro right-of-way connecting FMTU-1 and FMTU-4.

Observations of fire behaviour and fire intensity in this area could not be made at the time of the fire encroachment. However, post-fire evaluations of fire effects were conducted in this area (Figure 12), with differences noted in fire severity between treated and untreated fuels. In the untreated forest stand north of FMTU-1, we observed complete consumption of foliage and duff. In contrast to this, there were less severe fire impacts in FMTU-1 (Figure 13) with greater canopy retention and less duff consumption.

Figure 11. At 1707, free-burning flank fire moving toward untreated fuels north of FMTU 1

[3] For a detailed discussion of fire intensity vs. fire severity, please see Keeley (2009).

Figure 12. Reduced fire severity in treated fuels in FMTU-1


Figure 13. Fire severity in adjacent areas – untreated (left) and treated in FMTU-1 (right)

A similar contrast in fire severity was observed near the communications tower in the interface between the fuel treatments and the adjacent untreated forest. High fire severity occured in untreated fuels as a result of direct impact of the approaching fire. In contrast, 200 metres away, low fire severity was observed in a fuel-reduced area (FMTU-11) with very patchy burn in the surface layer and minimal scorch on the boles of the stems (Figure 14).

It is suspected that the retardant lines along the north and northeast sides of Logan Lake would have reduced the fire intensity of the advancing fire and limited fire spread into the sheltered cluster of fuel treatments surrounding the communications tower. The north part of FMTU-11 was outside the constructed dozer guard and may have been ignited as part of the burnout operations.

Figure 14. High fire severity in untreated fuels directly impacted by fire front (left) and low fire severity in FMTU-11 (right)

Forest areas and cutblocks north of the community that were directly impacted by high-intensity head fire showed high fire severity with thorough consumption of ground fuels and canopy fuels (Figure 15). A fire behaviour projection for August 14 (Appendix C) predicts similar crown fuel consumption (92%) and surface fuel consumption (3.3 kg/m^2).

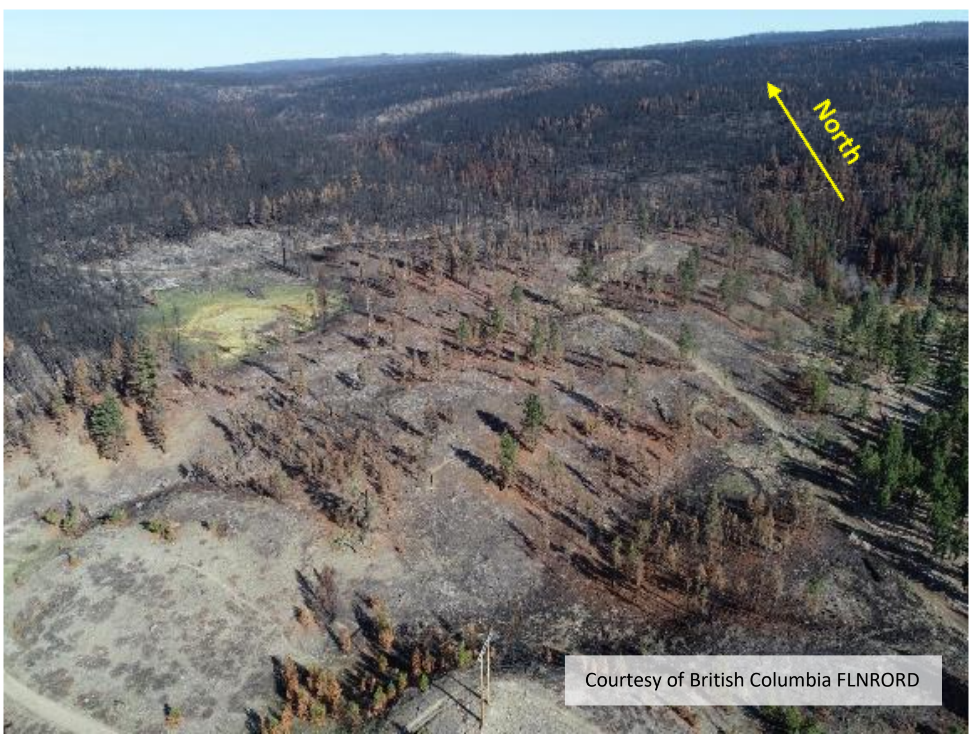

Figure 15. Fire effects in a natural forest stand and cutblock that received full fire impact

5 WILDFIRE RESPONSE APPROACH

5.1 Aerial Suppression

Airtankers supported the incident with retardant delivery from 1540 (first drop) to 1912 (last drop). The overall strategy was to create a barrier to fire spread along the west, north, and east sides of the community. Retardant drops were focused in lighter fuels and along the fire side of linear corridors. Retardant drops reinforced human-made barriers (rights-of-way and fuel treatments) and naturally open areas, including meadows and low-density stands (Figure 16).

Figure 16. Retardant application in open meadows and thinned forest stands

Several fuel treatment areas were utilized in the overall retardant delivery operation (Figure 17). The initial retardant delivery was applied at a moderate coverage level[4] (3 and 4) on all three vulnerable sides of the community. The next mission conducted by another air attack officer focused on the north edge of the community and reinforced the earlier retardant lines with drops at coverage level 8.

[4] Coverage level (US Gal/100 ft^2) is a metric used to indicate the concentration of a retardant drop (Suter 2000).

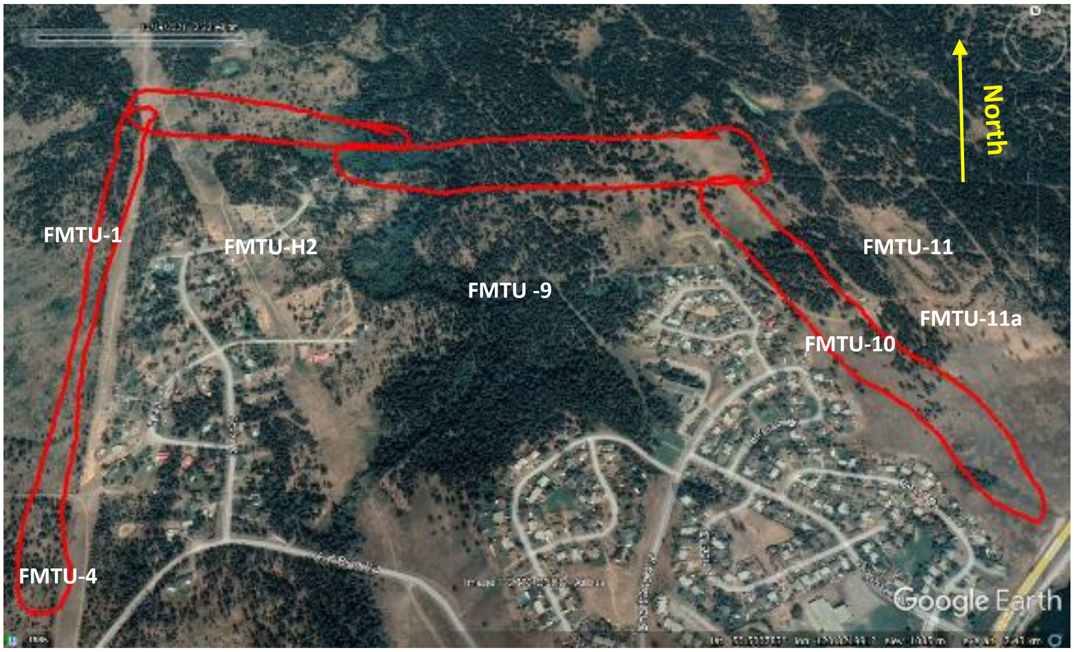

Figure 17. Fuel treatments incorporated in the retardant delivery operation (red lines)

Fire spread resulting from the west wind challenged the fuel treatments and retardant lines with a flanking fire (Figure 18).

Figure 18. Flanking fire approaching fuel treatments along the north edge of Logan Lake

5.2 Control Line Construction and Burnout Operations

At the western end of the community, a control line was constructed, starting at Tunkwa Lake Road, to connect several natural or human-made barriers with fuel treatment areas (Figure 19). These included FMTU 1, pipeline ROW, FMTU 2, hydro ROW, FMTU H2, and a swamp at the end of the control line. This line construction was started at midnight, August 14, and was completed at 0300 August 15. Ignition operations on the north side of this control line started at 0300 and were completed at 0600.

Figure 19. Control line connecting Tunkwa Lake road with rights-of-way and fuel treatments

At the east end of Logan Lake, a control line was constructed, starting at Highway 97D, and continued westward in light fuels in a grassy meadow (Figure 20) to connect with recreation trails (Figure 21) and fuel treatment areas. Because there had been sufficient retardant applied in the area surrounding the tower infrastructure, the control line was shifted toward the northeast with no ignition in the tower area. Ignition north of the control line commenced at 1800 on August 14, with half of the Big Horn unit crews conducting the ignition operation and structural firefighters patrolling south of the highway.

Figure 20. Control line on east end of town linking Highway 97D, fuel treatments and trails

Figure 21. Control line incorporating the existing trail network in the recreation area

A few key takeaways were shared by personnel involved in the control line construction and ignition operations.

- Ignition operations were more productive in areas of reduced fuel. Crews could move faster in lower-volume fuels because fire intensity was reduced, with less chance of flareups and spotting.
- Light fuels in the treatment areas and open meadows enhanced igntion operations with easy ignition and rapid/thorough consumption of fuels in most areas.
- Improved access and egress in the treated areas increased the safety of the operation.
- With easier access along trails/roadways and lighter fuels in treated areas, line resistance was low, and machine guard construction was more productive.
- Grazing reduced fuel load and fire behaviour.

6 DISCUSSION

6.1 Overall Effectiveness of Fuel Treatments

In the last decade, an aggressive fuel management program has modified forest stands surrounding the community of Logan Lake to address multiple ecological and social objectives, including reducing the threat of catastrophic wildfire to the community and other values. During the wildfire/fuel treatment encounter on August 14, 2021, the fuel-reduced areas on the west, north, and east sides of the community were a contributing factor to successful suppression operations which provided for a greater probability of community survival.

The fuel treatment areas surrounding Logan Lake were used to a strong tactical advantage as part of the suppression operations. Air attack with retardant drops took advantage of the thinned areas to create a more robust barrier to fire spread. The open canopy and reduced surface fuel load in the fuel treatment areas and open meadows along the north edge of the community created a very receptive target for effective and efficient aerial retardant delivery. Aerial operations were also aided by the west winds clearing smoke from the targeted drop zones.

Additionally, the thinned areas and the existing trails created tactical opportunities during control line construction and ignition operations. The fuel-reduced areas through the treatment areas, the open meadows, and trail network improved access for fire guard construction and ignition operations. In some cases, existing roads were easily bladed to create a solid barrier to fire spread. With a lower volume of surface fuels in these areas, the low to moderate surface fire intensity allowed for safer and more efficient ignition operations. The subdued fire behaviour in these treatment areas during the ignition operations allowed for a more expedient operation with reduced chances of spot fires across the control line.

6.2 Ground-based Retardant

One interviewee indicated that the solid ground in the Logan Lake area with the numerous trails and access points could have provided a good opportunity to apply retardant with a ground-based applicator. Applying retardant days in advance of an imminent fire encroachment may have been an alternative to the airtanker action that occurred in the last hours prior to fire encroachment.

Our team did not explore the logistics of deploying such a unit or the practicality of retardant application in these areas. However, this scenario at Logan Lake may be a good opportunity to consider the availability of applicators, time required for deployment, and capacity for retardant supply.

6.3 Wind Direction and Impact of Wildfire Encroachment

Several interviewees indicated that the west wind on the afternoon of August 14 was a major factor in reducing the fire intensity that impacted the fuel treatments along the north side of the community. The one treatment that was likely subjected to direct impact of the oncoming fire front was FMTU-1 on the west side of the pipeline ROW (Figure 12). This treatment area had been coated with retardant approximately one hour prior to fire impingement. Relative to the untreated area to the north, there was minimal canopy consumption and surface fuel consumption in FMTU-1 (Figure 19).

If the north winds had persisted on August 14, fire along the north perimeter would have been much more intense as it approached the community. Fuel treatments would have been tested to a greater extent[5], and greater firebrand deposition in the residential areas would have challenged structural protection operations. A greater volume of smoke in the community from a north wind may have hampered structure protection and other suppression operations in the community. A large conifer forest in the central area of Logan Lake was identified as a high-risk area with high probability of ignition and fire spread.

With a north wind and direct fire impact, the fuel treatments with retardant delivery would have been challenged[6], and aerial operations would have been much more difficult due to smoke and visibility concerns.

7 CONCLUSION

The wildfire/fuel treatment encounter observed at Logan Lake and documented in this case study is a unique scenario with site-specific fuel and weather conditions that influenced fire behaviour, suppression operations, and the eventual success in community protection.

This case study has presented key factors that reduced the impact of the encroaching wildfire, as it transitioned from natural forest stands to harvest blocks and fuel treatment areas. A critical

[5] Personal communication (November 23, 2021). Josh Macy, BCWS Division Supervisor.
[6] Personal communication (November 1, 2021). Greg Adams, BCWS Air Attack Officer.

factor that reduced the impact of the encroaching wildfire was the wind shift which pushed the head of the fire in an easterly direction and created a flanking fire approaching the fuel treatment areas along the north perimeter of the community.

The fuel treatment units surrounding the community were a key asset in aerial suppression operations to create a more effective barrier to fire spread. The fuel treatment areas and the existing trail network allowed for easy access for blading dozer guards, and the reduced fuel loading in these areas provided favorable conditions for ignition operations.

The fuel reduction and fire behaviour principles associated with suppression strategies presented in this case study are not exclusive to the Logan Lake wildfire/fuel treatment encounter. These fuel reduction principles are commonly applied in other wildland-urban interface areas. With a better understanding of how the fuel-reduced areas surrounding Logan Lake influenced fire behaviour and suppression strategies, other communities can benefit from these learnings to strategically apply fuel treatments on their landscape and develop response plans that incorporate these fuel treatments in their suppression operations.

8 ACKNOWLEDGEMENTS

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Thanks to all who participated in a site visit to the fire area at Logan Lake and shared valuable perspectives on the wildfire/fuel treatment encounter.

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- Ransome Hall (Operations Section Chief)
- Chris Werrell (Deputy Operations Section Chief)
- Josh Macy (Division Supervisor)
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9 REFERENCES

Keeley, J. E. (2009). Fire intensity, fire severity and burn severity: a brief review and suggested usage. *International journal of wildland fire*, *18*(1), 116-126.

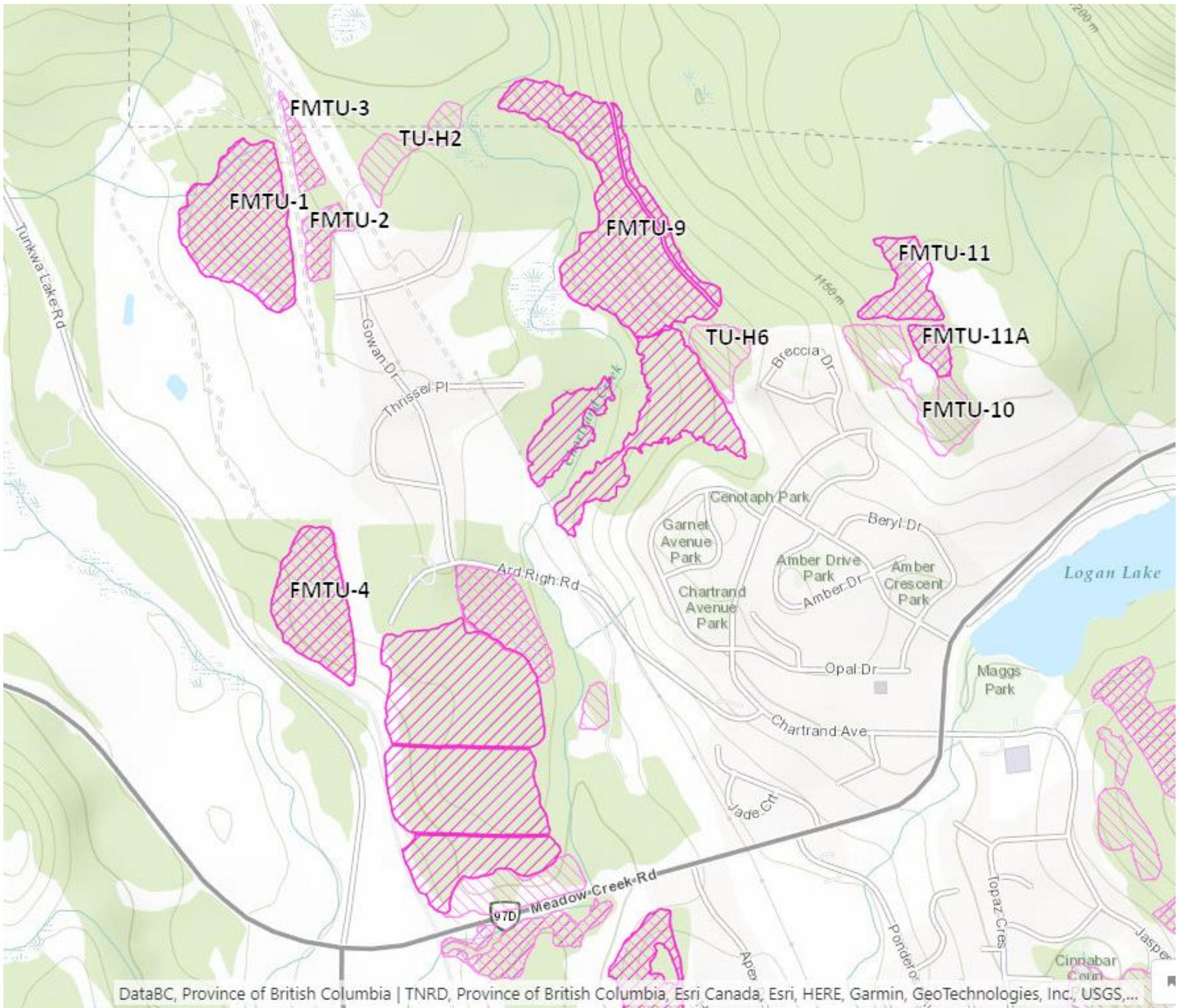
Logan Lake (2015). 2015 SWPI Prescription. District of Logan Lake Wildfire Behaviour Threat Assessment Worksheets and Pictures. Authored by Bruce Morrow. November 25, 2015.

Logan Lake (2016). District of Logan Lake Fuel Management Prescription. Authored by Bruce Morrow. January 27, 2016.

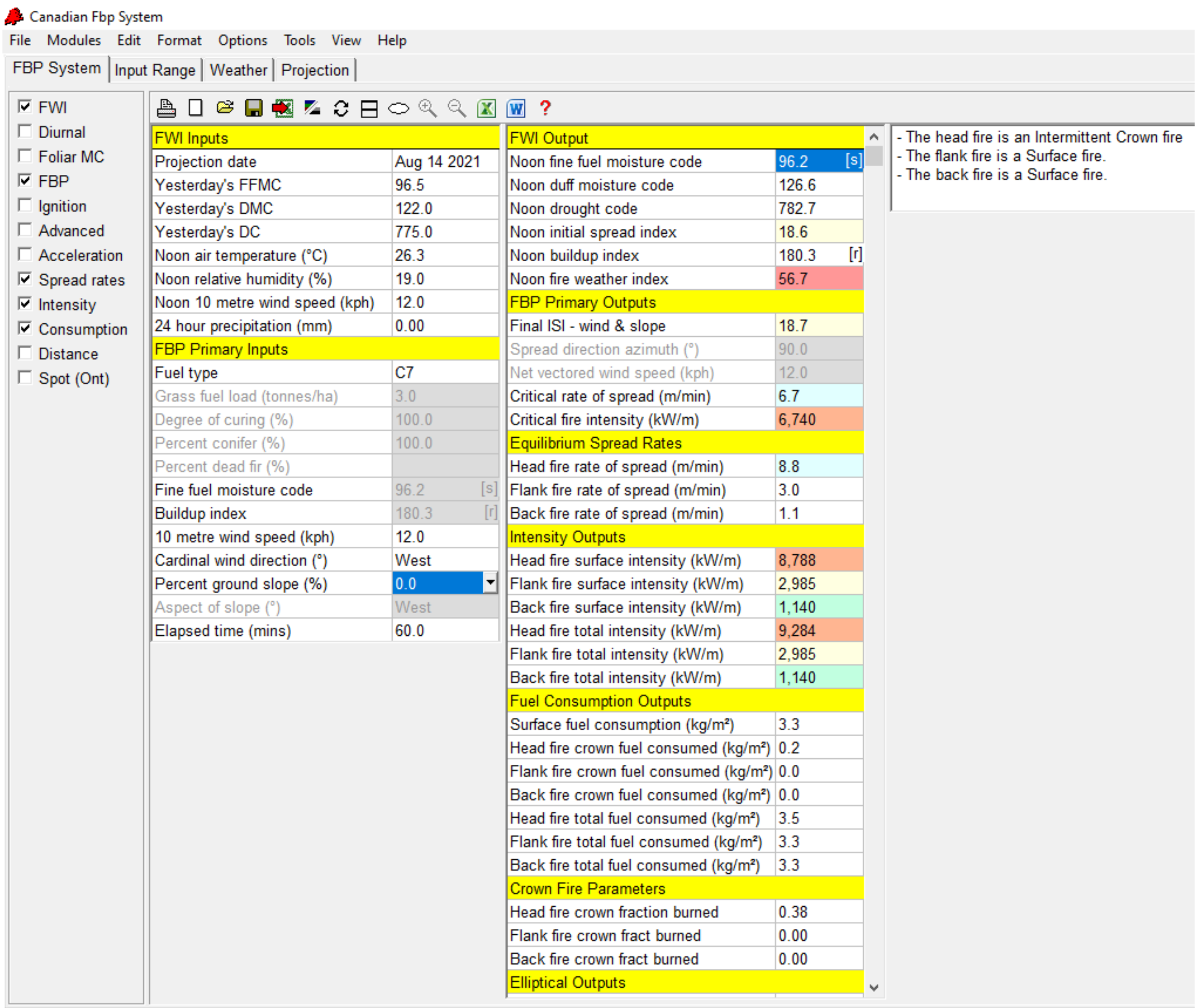
Suter, A. (2000). Drop testing airtankers: a discussion of the cup-and-grid method. Tech. Rep. 0057-2868-MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 14p.

APPENDIX A: GENERAL AREA MAP

APPENDIX B: FUEL TREATMENT UNITS



APPENDIX C: FIRE BEHAVIOUR PROJECTION



FWI Inputs	
Projection date	Aug 14 2021
Yesterday's FFMC	96.5
Yesterday's DMC	122.0
Yesterday's DC	775.0
Noon air temperature (°C)	26.3
Noon relative humidity (%)	19.0
Noon 10 metre wind speed (kph)	12.0
24 hour precipitation (mm)	0.00
FBP Primary Inputs	
Fuel type	C7
Grass fuel load (tonnes/ha)	3.0
Degree of curing (%)	100.0
Percent conifer (%)	100.0
Percent dead fir (%)	
Fine fuel moisture code	96.2 [s]
Buildup index	180.3 [r]
10 metre wind speed (kph)	12.0
Cardinal wind direction (°)	West
Percent ground slope (%)	0.0
Aspect of slope (°)	West
Elapsed time (mins)	60.0

FWI Output	
Noon fine fuel moisture code	96.2 [s]
Noon duff moisture code	126.6
Noon drought code	782.7
Noon initial spread index	18.6
Noon buildup index	180.3 [r]
Noon fire weather index	56.7
FBP Primary Outputs	
Final ISI - wind & slope	18.7
Spread direction azimuth (°)	90.0
Net vectored wind speed (kph)	12.0
Critical rate of spread (m/min)	6.7
Critical fire intensity (kW/m)	6,740
Equilibrium Spread Rates	
Head fire rate of spread (m/min)	8.8
Flank fire rate of spread (m/min)	3.0
Back fire rate of spread (m/min)	1.1
Intensity Outputs	
Head fire surface intensity (kW/m)	8,788
Flank fire surface intensity (kW/m)	2,985
Back fire surface intensity (kW/m)	1,140
Head fire total intensity (kW/m)	9,284
Flank fire total intensity (kW/m)	2,985
Back fire total intensity (kW/m)	1,140
Fuel Consumption Outputs	
Surface fuel consumption (kg/m²)	3.3
Head fire crown fuel consumed (kg/m²)	0.2
Flank fire crown fuel consumed (kg/m²)	0.0
Back fire crown fuel consumed (kg/m²)	0.0
Head fire total fuel consumed (kg/m²)	3.5
Flank fire total fuel consumed (kg/m²)	3.3
Back fire total fuel consumed (kg/m²)	3.3
Crown Fire Parameters	
Head fire crown fraction burned	0.38
Flank fire crown fract burned	0.00
Back fire crown fract burned	0.00
Elliptical Outputs	

- The head fire is an Intermittent Crown fire
- The flank fire is a Surface fire.
- The back fire is a Surface fire.

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