2.4. Water Crossings

Water crossings included a wide variety of natural water features, such as:

- Permanent streams
- Seasonal streams
- Permanent drains
- Ephemeral drains
- Beaver floods
- Natural spring
- runoff

All water crossing are risk ranked as either high, medium, or low, based on these criteria:

- risk class – high: fish-bearing;
- risk class – medium: potentially fish-bearing and steep slopes; and
- risk class – low: not fish-bearing and gentle slopes

The type of water crossing structure prescribed is based on both risk ranking and site-specific features. Generally, portable bridges or snow and ice crossings were used for crossing streams, while culverts were used for crossing drains, swales, and beaver floods.

2.4.1. Water Crossing Locations

Water crossing locations were chosen based on these specific guidelines:

- The crossing location should be free of downed woody material and be positioned at the narrowest point along the straight segment of the reach.
- The crossing location must be positioned at right angles to the watercourse and where there is enough area to construct gentle, direct and stable road approaches.
- Water crossings must provide uninhibited access for fish migration to both upstream and downstream habitats year-round.
- In areas known to support or potentially support fish, portable bridges, snow and ice crossings or open bottom culverts are preferred.
- The removal of riparian vegetation along proposed crossing locations must be kept to a minimum on newly constructed forest roads.

2.4.2. Stream Assessments

Detailed stream assessments were conducted on proposed water crossings that have the potential to support fish or fish habitat. The assessment data were summarized and used to develop forest road access strategies and water crossing development plans that minimized disturbance to aquatic environments. Where stream assessments were warranted, information was collected on a variety of stream attributes (Table 2.3) within a sample reach of 100 m. Data were collected on stream hydrology, morphology, in-stream cover and substrate habitat characteristics, as well as fish and invertebrate communities that inhabit the watercourse. The information was then summarized and used to assist in prescribing the most appropriate water crossing type for that stream.

Once a stream or river was confirmed to have fish or fish habitat, stream assessments are no longer needed on that stream or river. Therefore, the need for stream assessments have decreased over time as the stream information has increased.

Table 2.4 Stream Assessment summary for FML #3.

Operating Year	# Stream Assessments
2006-2007	3
2007-2008	1
2008-2009	2
2009-2010	1
2010-2011	0
2011-2012	0
2012-2013	0
2013-2014	0
2014-2015	0
2015-2016	0
2016-2017	0
2017-2018	0
2018-2019	0
Totals	**7**

2.4.3. Water Crossing Types

There were three main types of water crossings used: bridges, culverts, and snow and ice crossings.

2.4.3.1. *Bridges*

Bridge crossings often prescribed are engineered portable structures that can be installed with relative ease. Typical construction considerations for forest road bridges are described as follows:

- Bridge footings will be constructed out of stabile material to prevent sedimentation. Logs, timbers, and soil wrapped in geotextile are some examples of appropriate footings.
- Wing walls will be constructed on all bridge installations and will remain in place during unfrozen conditions (spring, summer, and fall).
- Disturbance to the existing streamside vegetation will be minimized during construction. This will ensure natural re-vegetation after decommissioning as well as stabilization while the structure is active.

2.4.3.2. *Culverts*

Culvert crossings were typically installed during dry conditions in the spring, summer and autumn months. In some cases, small PVC culverts were used to assist continuous flow during winter months within a winter snow and ice crossing. The following general procedures and considerations were used for culvert installations:

- were designed to support a Q100 flood event.
- Were planned for periods of low flow; if the watercourse is flowing, the flow was blocked temporarily to enable dry installation.
- Large boulders or rocks were removed from streambed in order to prevent culvert damage.
- While maintaining the original slope of the watercourse, the culvert was embedded approximately 10% of its diameter.
- Geotextile may be laid underneath culvert if suitable base material was not present.
- Suitable backfill material was then placed around culvert and compacted to ensure culvert stability.
- The inlets and outlets were rip rapped or re-vegetated if conditions warrant (slope, flow, channel width *etc.*).

2.4.3.3. *Snow and Ice*

Temporary snow and ice crossings were common structures constructed during winter operations. The following guidelines were implemented during the construction of snow and ice crossings:

- Construction of snow and ice crossings occurred during freezing temperatures for water.
- Snow pushed into watercourse was free from dirt and or logging debris.
- Clean snow may be hauled in from an outside location if not present on site.
- Water was pumped onto snow to strengthen and stabilize crossing.
- During deactivation a trench was constructed in order to allow for unobstructed flow during the spring melt.

Site-specific choices were made about stream crossing type (*i.e.* bridge, culvert, or snow and ice crossing). The annual water crossing installations are summarized in Table 2.5.

Table 2.5 Water crossing installation summary.

Year	Portable Bridge	Culvert	Snow & Ice	Total
2006-2007	4	11	13	**28**
2007-2008	7	4	16	**27**
2008-2009	4	14	6	**24**
2009-2010	0	6	6	**12**
2010-2011	4	20	7	**31**
2011-2012	2	11	8	**21**
2012-2013	3	18	6	**27**
2013-2014	9	25	2	**36**
2014-2015	2	18	11	**31**
2015-2016	1	8	7	**16**
2016-2017	1	18	10	**29**
2017-2018	2	17	10	**29**
2018-2019	1	16	11	**28**
Total	**40**	**186**	**113**	**339**

2.4.4. *Water Crossing Conditions*

The condition of water crossings is displayed in Figure 2.9. Crossings are referred to as existing when they are active (black symbols on map). Crossings that are removed are referred to as rehabilitated. Rehabilitated crossings are depicted by a green symbol.

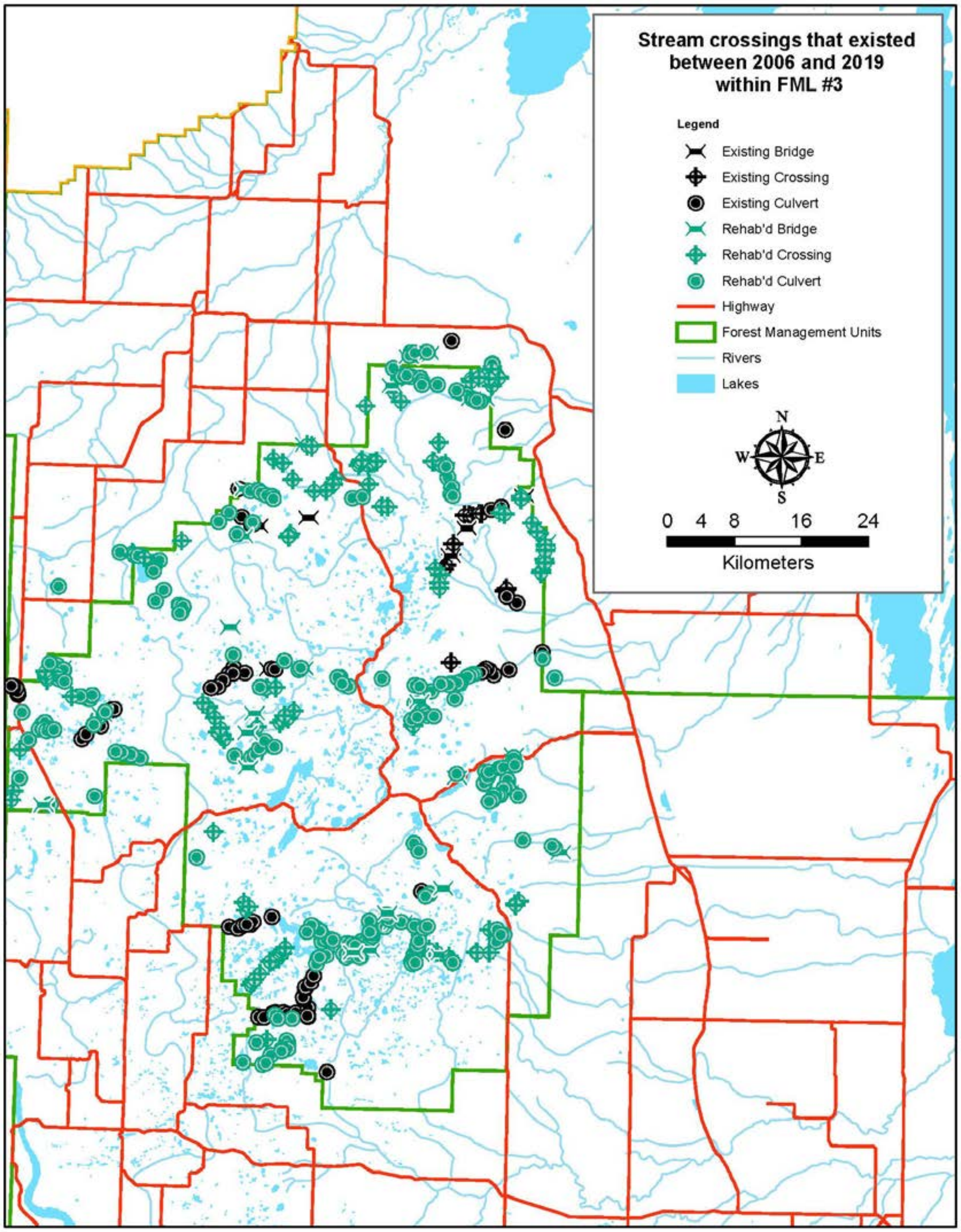

Figure 2.9 Water crossings in Forest Management Licence #3.

*note a second copy of this map with a much larger scale and detail exists in Appendix 1.

2.4.5. Water Crossing Decommissioning

Once harvesting was complete and the forest road was deactivated, water crossings along the road are removed and decommissioned (Table 2.6).

Table 2.6 Water crossing rehabilitation and decommissioning summary by crossing type.

Year	Portable Bridge	Culvert	Snow & Ice	Total
2006-2007		*not actively tracked*		
2007-2008		*not actively tracked*		
2008-2009		*not actively tracked*		
2009-2010		*not actively tracked*		
2010-2011	0	0	9	**9**
2011-2012	5	32	16	**53**
2012-2013	4	13	14	**31**
2013-2014	4	16	15	**35**
2014-2015	1	25	2	**28**
2015-2016	1	14	2	**17**
2016-2017	11	47	13	**118**
2017-2018	3	35	21	**59**
2018-2019	0	10	23	**33**
Totals	**29**	**192**	**162**	**383**

The following water crossing decommissioning activities vary by site, and may include one or more of the following procedures:

- establishment of sediment control fences on land and instream where required;
- Removing the structure (culvert or bridge);
- Removal and sloping of fill used to construct crossing;
- Sloping the roadbed away from the watercourse;
- Track walking the slopes;
- Installation of cross ditches to divert runoff from roadbed into standing vegetation;
- Stabilization of the exposed soil by spreading grass seed and covering with either Rolled Erosion Control Products (RECP), straw mulch or slash debris from harvesting and road construction activities;
- Permanent (long term) decommissioning can also involve the planting of trees and shrubs, as well as other bioengineering techniques;
- Snow and Ice crossings are decommissioned by digging a shallow trench in the ice to prevent spring runoff from backing up and scouring the banks on flowing streams. On swales the snow and ice melts naturally in the spring;
- Once the work is completed, sites were monitored on a semi-annual basis to ensure that the soil stabilization techniques applied are working effectively.

Temporary water crossing decommissioning involves removing the structure (*e.g.* culvert), sloping the roadbed away from the watercourse, track-walking the slopes, installing cross ditches to divert runoff from roadbed into standing vegetation, and stabilizing the exposed soil by spreading grass seed and covering with either Rolled Erosion Control Products or straw mulch. The same crossing may be re-installed in later years (*e.g.* reusing the same road for second-pass harvest).

Permanent decommissioning involves removing the structure, sloping the road fill material away from the watercourse to near natural conditions prior to construction, track-walking the slopes, and installing cross ditches to divert runoff water from the roadbed into standing vegetation (Figure 2.10) The exposed soil was then seeded and covered with either erosion matting or straw mulch.

Snow and Ice crossings were decommissioned by digging a shallow trench in the ice to prevent runoff from backing up and scouring the banks on flowing streams. The snow and ice crossing then melts naturally.

Figure 2.10 Water crossing decommissioning examples.

2.4.6. *Water Crossing Inspections*

All installed, maintained, and deactivated water crossings in FML #3 were monitored. The water crossing inspection program monitored (Table 2.6) the conditions of active, deactivated, and rehabilitated crossings each spring and fall. This identifies any issues at crossings that could lead to failures or deposition of material into streams. Crossing inspections include: proper culvert alignment; culvert blockage; culvert damage or corrosion; and whether or not the culvert has become perched over time. The water crossing inspection also monitors the effectiveness of the erosion and sediment control measures.

Each stream was photographed, and comments were made on a water crossing inspection form. The Stream Team reviewed inspections and made decisions regarding follow-up maintenance activities, if necessary. Water crossing inspections were conducted until the vegetation reaches a level where the potential for erosion was no longer a concern.

Table 2.7 Number of water crossing inspections.

Operating Year	# Crossing Inspections
2006-2007	264
2007-2008	170
2008-2009	146
2009-2010	110
2010-2011	170
2011-2012	198
2012-2013	164
2013-2014	168
2014-2015	123
2015-2016	177
2016-2017	183
2017-2018	190
2018-2019	189
Total	**2,252**

2.4.7. Water Crossing Decommissioning Success

Water crossing decommissioning success was verified by water crossing field inspections. LP staff follow the field procedure entitled 'Field Procedures for Water Crossing Inspections' (2018). This procedure requires a field inspection, completion of a water crossing checklist, and photos of the decommissioned water crossing.

Overall water crossing decommissioning success was characterized by:

- Normal water flow of the original water feature
- erosion and sediment control techniques withstood spring runoff and peak flow events
- vegetation reached a sufficient level to stabilize soil

Water crossing decommissioning success was further verified by final inspections from the Manitoba Government. Conservation Officers completed a 'Timber Inspection Report', which has a stream crossing sub-section within the 'cut block area compliance' section.

Water crossing MGL-C16 is an example of a successful water crossing decommissioning. The crossing was first proposed in 2012, a steel bridge installed in 2012, decommissioned in 2013, and monitored until fall 2014. MGL-C16 was deemed successful, and no longer needed to be monitored after the fall of 2014.

Proposed crossing MGL-C16 (across) was submitted in the 2012 operating plan. The water crossing prescription had a preferred structure of a portable bridge.

A steel bridge was installed in 2012 (winter picture). The site was monitored, checklist completed, and photographed.

Once operations were complete, the steel bridge was removed. The decommissioned site was monitored, checklist completed, and photographed in fall 2013.

The decommissioned site was monitored a second year, checklist completed, and photographed in fall 2014.Water crossing MGL-C16 was deemed successfully decommissioned.

2.5. Planning and Harvesting

Harvest block design was an important component of forest management. Research suggests harvest plans should attempt to emulate natural disturbance patterns in order to provide structural diversity in the regenerating forest and to promote Sustainable Forest Management. In the boreal forest the primary natural disturbance was fire. Fires create landscape mosaics of various sized patches of standing burned and unburned trees (softwood and hardwood), large and small openings and irregular boundaries, often following natural features. Harvest block design implemented various natural disturbance pattern elements on the ground. Site specific considerations such as wetlands, special ecological features, boundaries following natural features to maximize forest edge, and other unique features were all used during block design.

2.5.1. Harvest Shape

Numerous forest resource values were considered in the design of harvest blocks at the stand and landscape levels. These values include watersheds, exceptional features, protected areas, silviculture, aesthetics, wildlife habitat, wetlands, riparian areas, harvesting economics, site features, stand types, and the needs of other stakeholders.

Harvest block shapes were designed utilizing natural boundaries, water features, roads and trails, administrative areas (*e.g.* parks and Forest Management Units), exceptional features (*e.g.* mineral licks and cabins), stand boundaries and stakeholder or public input. The resulting blocks were designed to minimize the effect on aquatic and terrestrial ecosystems, aesthetics and stakeholder or public concerns. Using natural boundaries can also reduce impacts of natural events such as blow down.

Harvest block boundaries were designed to follow natural boundaries (Figure 2.11). The harvest block shape is affected by planning for water features, wetlands, wildlife features, topography, and riparian habitat.

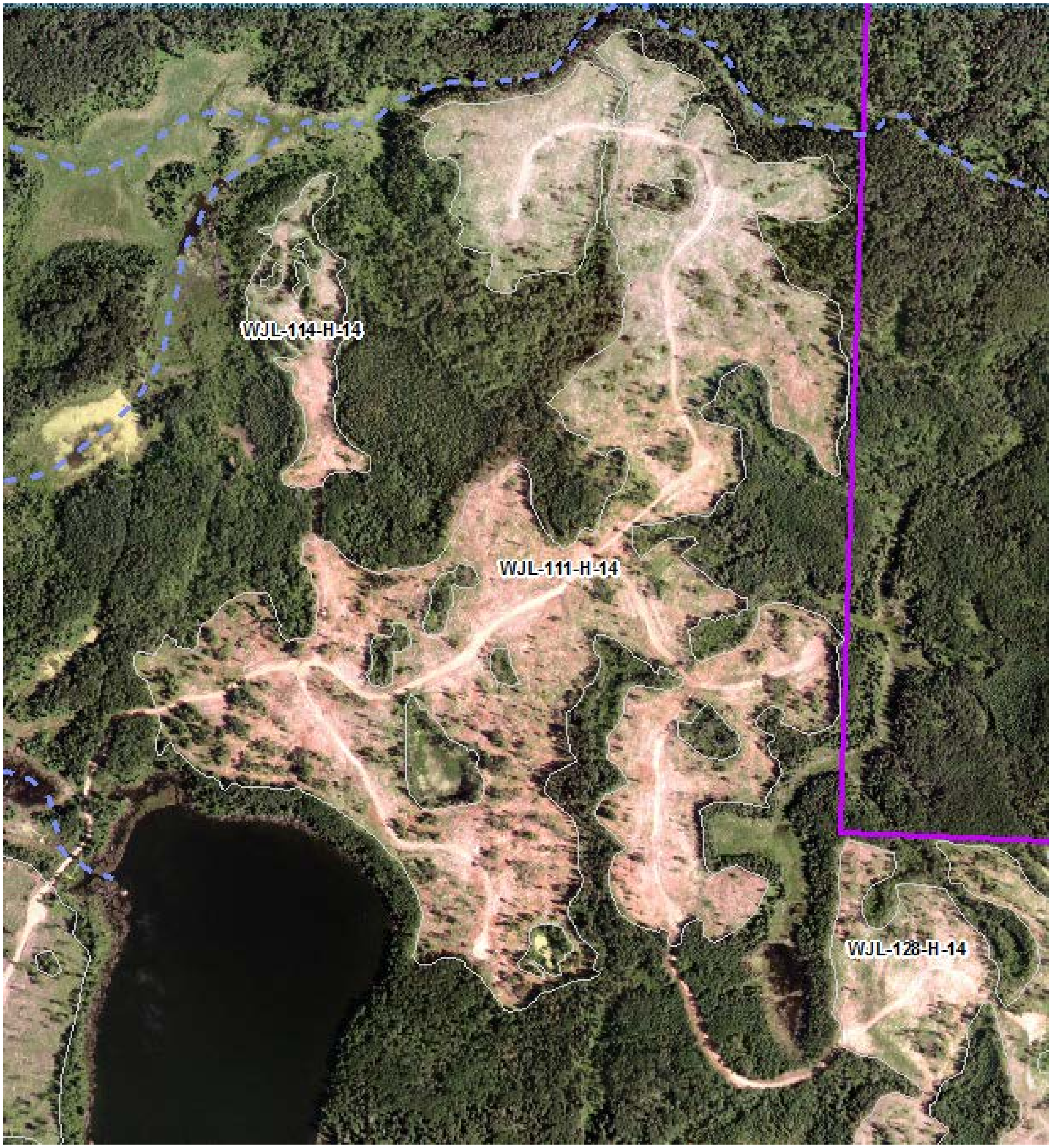

Figure 2.11 Harvest block that shows harvest shape, leave areas, riparian zones, and buffers.

2.5.2. Leave Areas

Leave areas were retained within harvest blocks. Generally, the in-block leave areas were identified if they were discernable on the imagery used. Leave areas included small wetlands, meadows, non-operable areas, areas of blow down and/or any other discernable features. Some areas such as parts of a block with high softwood understory or immature trees also became leave areas.

Leave areas outside the cutblock boundary were also left for future harvest (*i.e.* second and third pass harvest blocks) and to provide wildlife habitat. These areas were approximately the same size as the adjacent harvest block. Second and third-pass harvest blocks are eligible for harvest once the adjacent harvest block regeneration has reached the regeneration height specified in the government guidelines (3 meters for hardwood and 1 meter for softwood regeneration). The timing of the future harvest can be shortened or lengthened for specific sites if there are habitat concerns, timber loss from disease or blowdown or harvest timing concerns.

2.5.3. Riparian Management Areas

Management of riparian areas along water features was done at the planning stage. Forests along water features were managed and buffered depending of site specific characteristics and the social values of the water feature. Each riparian area along water features was examined and appropriate management or buffers were mitigated with Manitoba government representatives.

The guidebook Forest Management Guidelines for Riparian Management Areas (2008) helped government and forest industry planners make informed management decisions about the forest adjacent to riparian areas. This process focused on social, ecological, and economic criteria. The use of these keys helped create appropriate management prescriptions for riparian management areas.

2.5.4. Buffers

Buffers were incorporated in planning for wildlife features, including:

- Eagle, osprey and heron rookery nests
- Active stick nests larger than 60 cm (owl, hawk, raven)
- Bat caves
- Snake hibernacula
- Mineral licks
- Springs
- Native grass meadows
- Large mammal dens (*e.g.* bear den)

Forest Management Guidelines for Terrestrial Buffers (2010) guided government and forest industry planners' buffer decisions.

2.5.5. Harvest Methods

The method of harvest used in Forest Management Licence #3 was almost always variable retention harvesting, described below. However, selective harvesting of large white spruce sawlogs has been a method used by small Quota Holders. Forest health outbreaks may warrant clearcut harvesting in order to control a specific insect or disease. Clearcutting was an appropriate harvest method for salvage logging.

2.5.5.1. *Variable Retention Harvesting*

Variable retention harvesting provided a variety of wildlife habitat and helped to conserve biodiversity at the stand level. The practice of variable retention harvesting referred to keeping live and dead standing wildlife trees, protecting understorey vegetation, and leaving coarse woody material behind after harvest (Figure 2.12). The characteristics of variable retention harvesting varied depending on the nature of the harvest area.

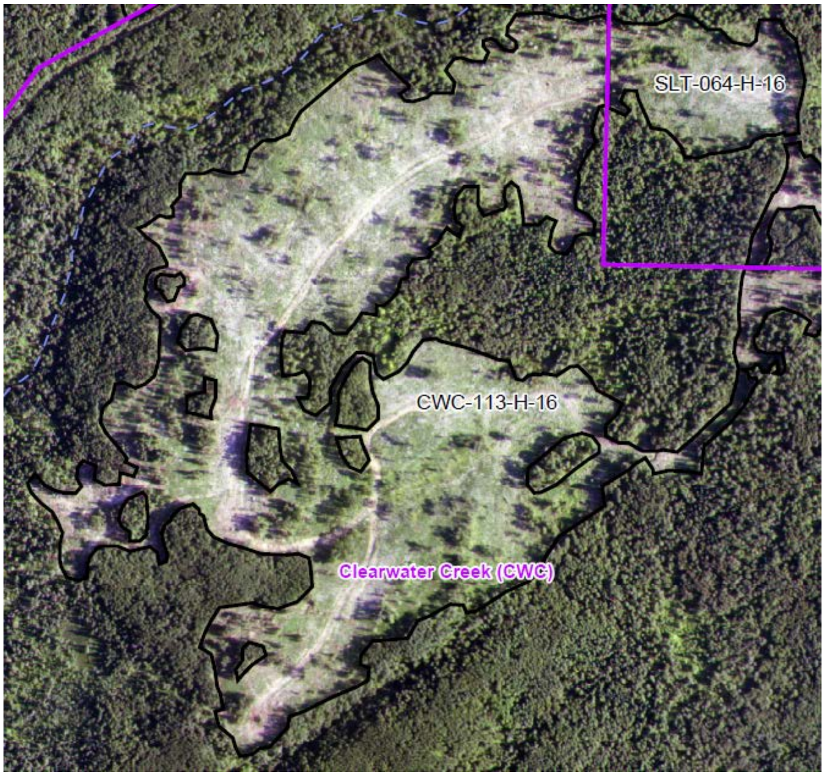

Figure 2.12 Aerial imagery of variable retention harvesting, characterized by retention patches and single trees purposefully left within the cutblock boundary.

The variable retention target was to maintain a minimum of 8 to 12 wildlife trees per hectare. Approximately five percent or greater of the standing forest volume was maintained within harvest areas. Wildlife trees were left in a combination of variable-sized patches and single trees. Snags and coarse woody debris were also retained, often in conjunction with live tree patches.

2.5.5.2. *Snags*

Live trees eventually die and become snags. Dead standing trees (*i.e.* snags) provide forage, nesting and cover habitat for a number of primary and secondary cavity dependent species as well. Dead standing trees fall down and become coarse woody material. Therefore, forest habitat needed to conserve the presence of native animal species was continuously provided.

Snags were maintained within harvest areas. Snags were most often retained inside wildlife tree patches. Snags were also maintained within the cutblock.

2.5.5.3. *Coarse Woody Debris*

Coarse woody debris provided habitat for many species and was an important component in sustaining elements of biodiversity. Coarse woody debris was considered essential for conserving forest biodiversity. Various practices were employed in order to encourage an abundant source of coarse woody material left within harvest areas. Logging operations were required to top and limb all harvested trees at the stump in order to ensure the maintenance of woody material left scattered throughout cutovers.

Various practices were employed to encourage the maintenance of coarse woody material in the harvest areas. Coarse woody debris (CWD) refers to sound and rotting logs and stumps that provide habitat for plants, animals, and insects, and was a source of nutrients for soil development that were found in both natural and harvested areas. CWD provided an important structural habitat element that promoted biodiversity at a stand level.

2.5.5.4. *Understory Softwood*

Immature white spruce occupying the understory of the hardwood ecosystems were protected, when the density of white spruce was high enough to warrant understory protection. Logging contractors were encouraged to leave softwood understory trees within variable retention clumps, wherever possible. Softwood understory protection was common in small localized areas, even within pure hardwood areas with only a few mature softwood trees.

2.5.5.5. *Wildlife Debris Piles*

In designated harvest blocks, wildlife debris piles have been constructed to promote small mammal habitat. Based on concerns expressed during discussions with local trappers, debris piles were created in harvest areas in the Duck Mountains. These piles were constructed within 100 m of the block boundary and riparian features to encourage use of the harvest area by marten and other small mammals. The debris piles provided cover between residual patches, which helped to establish wildlife travel corridors through harvested areas connecting the adjacent forest. The piles also provide cover for many species of small mammals, which were a food source for marten.

Wildlife debris piles (WDPs) were constructed from logging slash, tops, limbs, and larger logs. Piles were located approximately 50 to 100 m from block or riparian edges to facilitate immediate use by marten and other animal species. Proximity to residual tree patches within harvested areas was considered prior to establishment. WDPs provided cover habitat between residual patches, which helps establish travel corridors through harvested areas. When piles were constructed, large elevated pieces of coarse woody debris or 'stringers' were placed connecting the pile to the adjacent forest. This provided access to WDPs in the winter through openings created between the snow and stringer and in summer along the logs.

In forest areas where pine marten were known to inhabit, wildlife debris piles were placed within cutovers along the edges of adjacent stands to promote aggregations of small mammals that pine marten typically prey upon. Marten also used these piles as cover habitat as they travel through harvest areas. Wildlife debris piles also provided den habitat and contributed to travel corridors through harvest areas. The maintenance of wildlife debris piles provided critical habitat over the short-term and medium-term.

2.5.6. Harvest Area

The area harvested within FML #3 was represented by several metrics, including:

- Area harvested by softwood Quota Holders, hardwood Quota Holders, and Louisiana-Pacific Canada Ltd. hardwood;
- Area of watersheds in a harvested state (within the Duck Mountains only); and
- Disturbance size metrics (*e.g.* average cut blocks size, minimums, and maximums).

2.5.6.1. *Area Harvested*

Annual area harvested includes all hardwood, mixedwoods, and softwood stands, of both Quota Holders and Louisiana-Pacific Canada Ltd. harvested areas (Table 2.8).

Table 2.8 Annual area harvested by Forest Management Unit.

	Area Harvested (ha)			
Year	**FMU 10**	**FMU 11**	**FMU 13**	**Total**
2006-2007	26.3	214.6	2,123.3	**2,364.2**
2007-2008	309.9	205.6	2,190.8	**2,706.4**
2008-2009	10.0	92.2	1,028.3	**1,130.5**
2009-2010	17.7	247.9	820.2	**1,085.7**
2010-2011	33.6	146.8	1,633.6	**1,814.1**
2011-2012	0.0	274.3	1,307.5	**1,581.8**
2012-2013	22.6	144.3	1,075.3	**1,242.3**
2013-2014	68.9	112.0	1,634.8	**1,815.7**
2014-2015	105.9	73.2	2,476.4	**2,655.5**
2015-2016	0.0	54.5	1,278.7	**1,333.2**
2016-2017	70.7	72.8	1,497.0	**1,640.5**
2017-2018	0.0	268.7	1,860.3	**2,129.0**
2018-2019	0.0	220.5	1,960.1	**2,180.6**
Totals	**665.6**	**2,127.6**	**20,886.3**	**23,679.5**
averages	*60.5*	*163.7*	*1,606.6*	*1,821.5*

Less area was harvested during the economic recession during the years 2008 and 2009 (Figure 2.13).

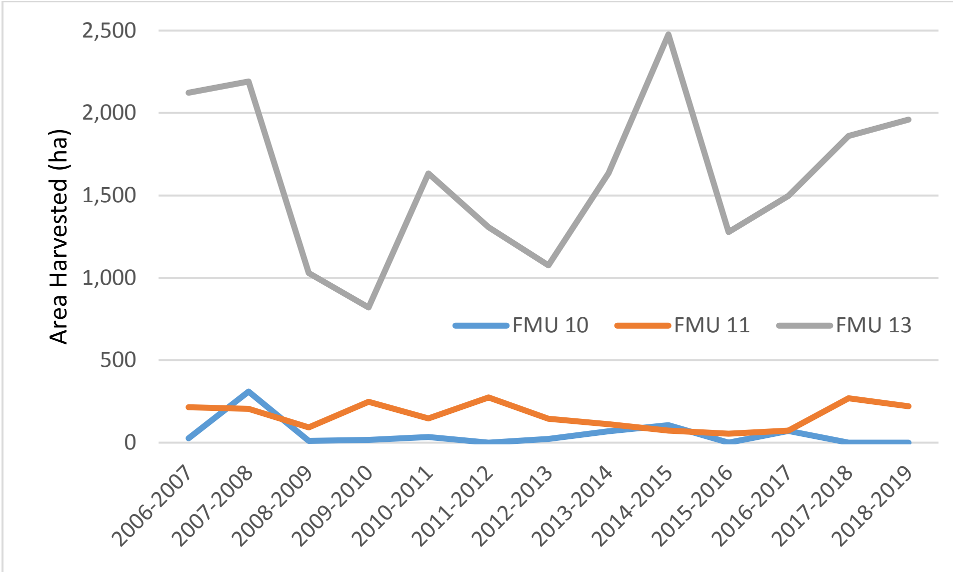

Figure 2.13 Annual area harvested by Forest Management Unit.

Annual area harvested is also shown by ecological strata. The ecological strata are based on ecosystem groups of both soils and vegetation (Figure 2.14).

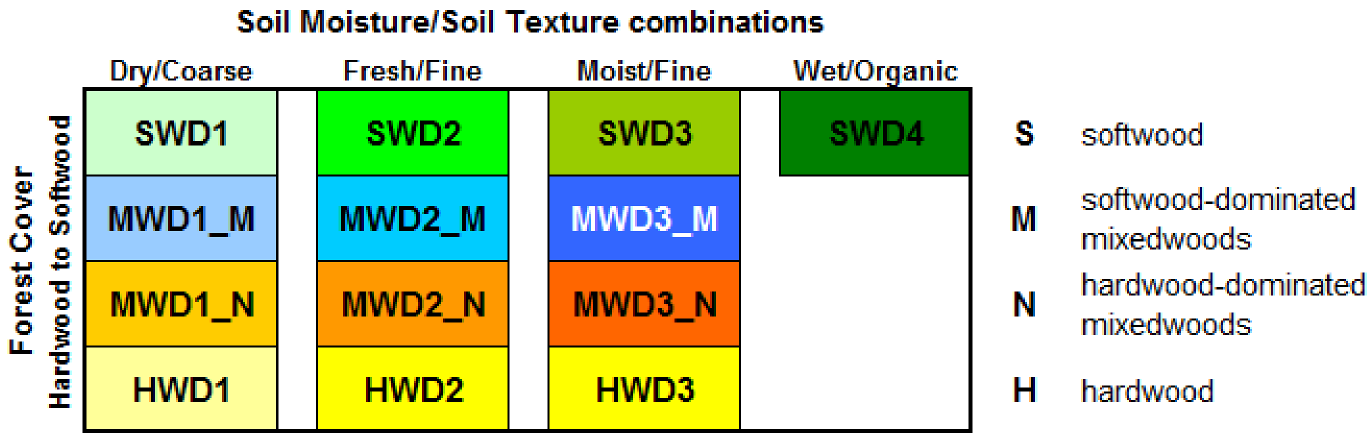

Figure 2.14 Ecological strata for FML #3.

The annual area harvested by ecological strata is shown in Table 2.9. The most common ecological strata harvested are HWD2, MWD2_N, MWD2_M, SWD2 and SWD3. The remaining less-common strata have significantly less harvesting activity.

Table 2.9 Annual area harvested by ecological strata.

	H			N			M			S				
Year	HWD 1	HWD2	HWD 3	MWD 1_N	MWD 2_N	MWD 3_N	MWD 1_M	MWD 2_M	MWD 3_M	SWD 1	SWD 2	SWD 3	SWD 4	**total areas (ha) by year**
2006-2007	122	1,301	9	28	512	24	0	110	0	0	128	93	36	**2,364**
2007-2008	231	930	19	108	959	42	0	90	1	1	172	140	13	**2,706**
2008-2009	28	238	12	88	402	19	0	102	0	0	143	81	17	**1,130**
2009-2010	112	295	195	46	258	14	0	43	0	0	31	69	24	**1,086**
2010-2011	188	600	8	72	651	35	0	106	1	0	63	59	32	**1,814**
2011-2012	1	562	8	18	596	17	0	184	3	2	51	130	12	**1,582**
2012-2013	54	544	25	6	392	5	0	51	0	0	100	52	13	**1,242**
2013-2014	74	681	14	112	531	32	0	72	0	13	148	128	12	**1,816**
2014-2015	106	1,336	6	11	638	15	0	291	2	4	176	62	8	**2,655**
2015-2016	8	430	6	2	361	10	0	161	0	0	239	87	30	**1,333**
2016-2017	46	682	20	37	425	11	0	68	3	65	204	59	21	**1,641**
2017-2018	205	595	18	132	521	18	0	346	0	5	393	74	42	**2,349**
2018-2019	61	866	8	195	463	9	0	104	17	49	265	115	30	**2,161**
total area by strata	1,236	9,060	345	854	6,709	249	0	1,727	27	140	2,114	1,148	289	23,880

A map showing all harvested areas, including softwood quota holders, hardwood quota holders, and Louisiana-Pacific Canada Ltd. hardwood harvest, is shown in Figure 2.15.

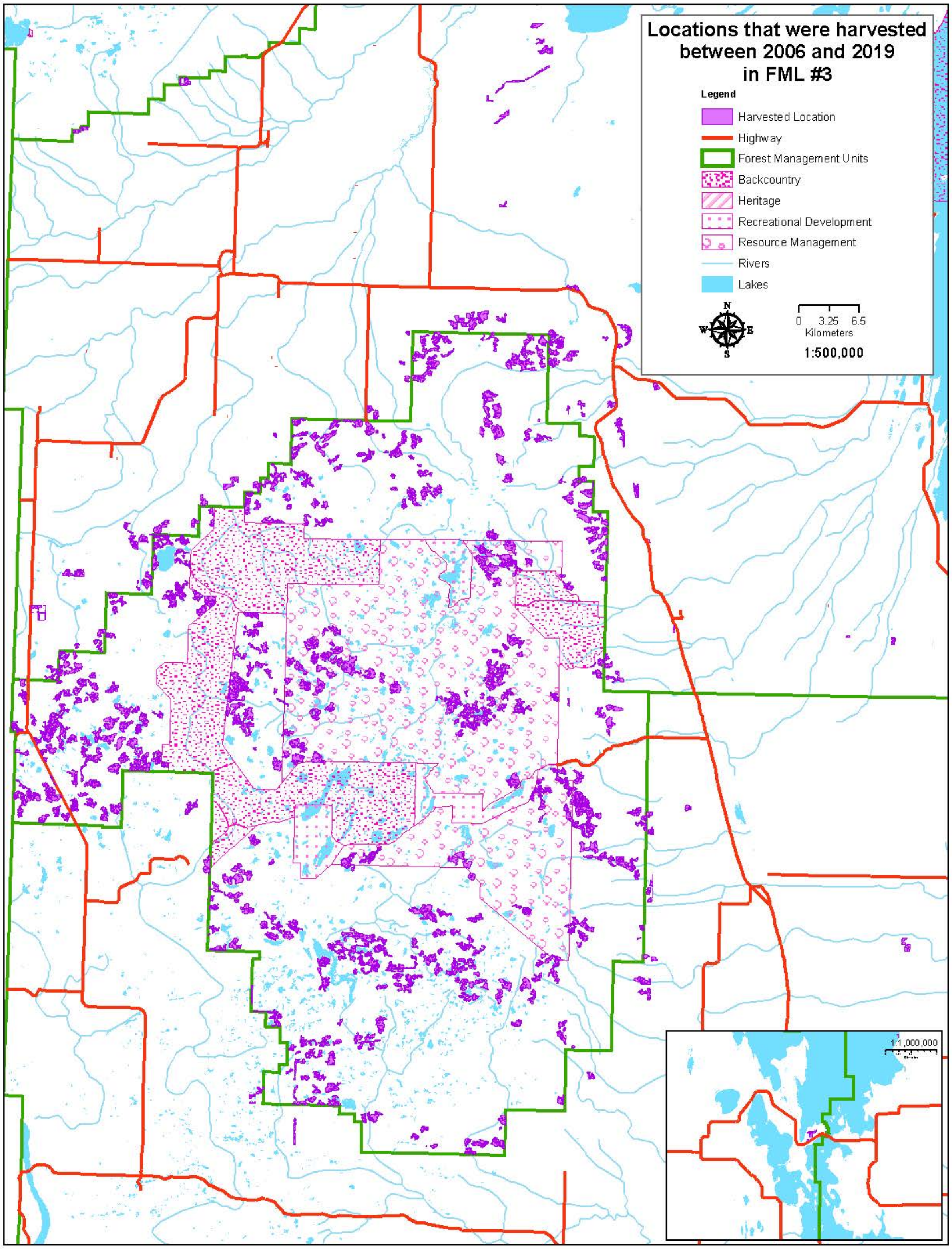

Figure 2.15 Area harvested in Forest Management Licence #3 (2006 to 2019).

*note a second copy of this map with a much larger scale and detail is in Appendix 2.

2.5.6.2. ***Watershed Area in a Harvested State***

Environment Act License (2191E) states in Section 17 (ii) that:

> *The Licensee shall: "limit the area in a watershed which is in a harvested and not sufficiently regenerated state, as determined by subsection 17(i) of this Licence"*

A watershed analysis of existing and proposed harvesting operations was calculated at the basin level to track the actual percentage of forested land within each watershed in a 'harvested state'. Cut blocks were considered to be in a 'harvested state' for five years following harvest for hardwood species, and 15 years post-harvest for softwood species. After regenerating trees reach a minimum height (2 m for softwood and 3 m for hardwood), cut blocks were considered forested and no longer in a 'harvested state'. The percent of productive forest in a harvested state by basin was significantly less than the existing 30% maximum in all basins (Figure 2.16). Most basins have decreased in percent of a harvested state between 2011 and present, except the Central Valley basin.

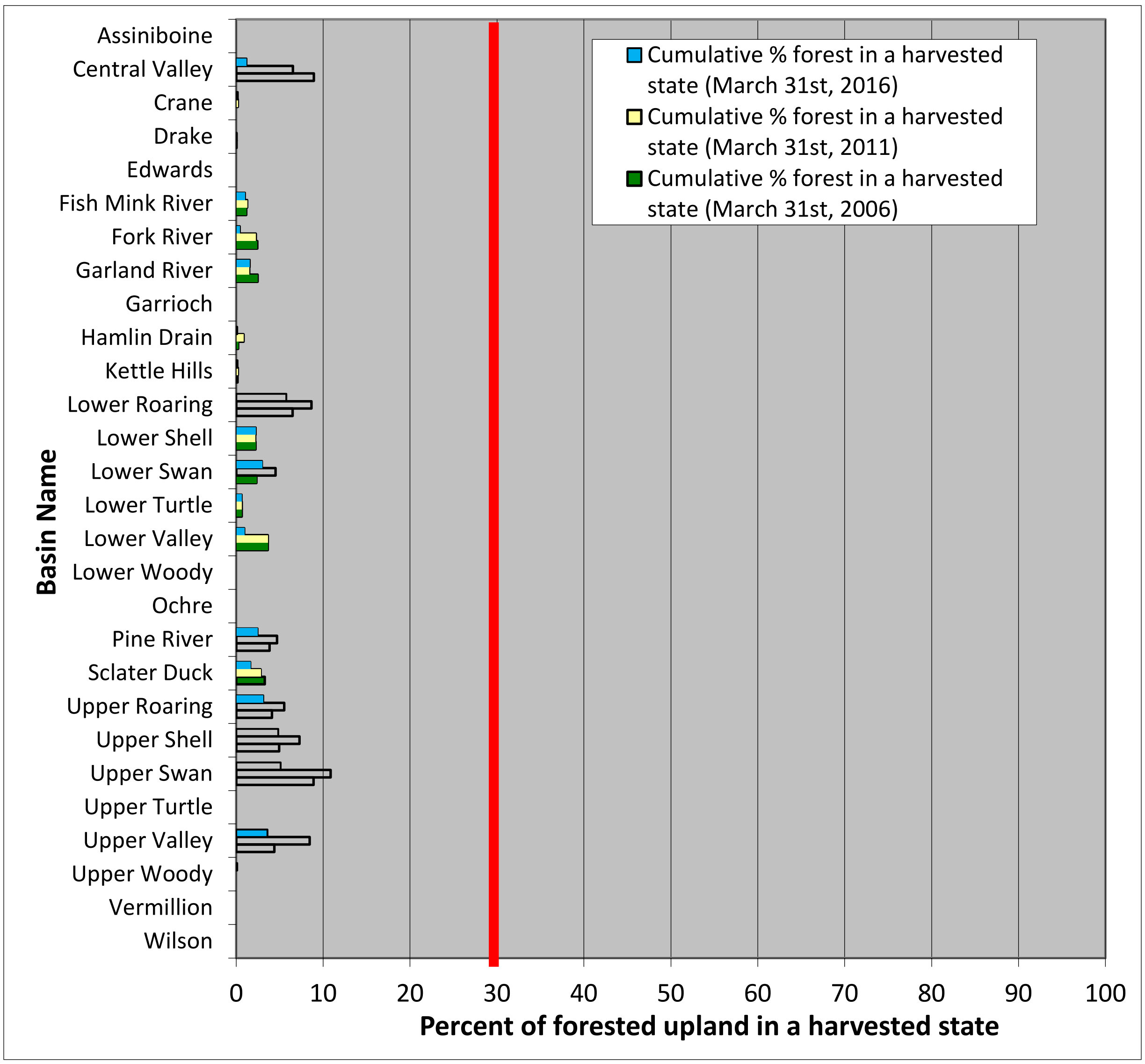

Figure 2.16 Percentage of each basin in a harvested state (2006 to 2016) was less than the 30% restriction (red line).

2.5.6.3. *Disturbance Sizes*

Cut blocks had a relatively consistent average size of approximately 30 ha since 2006 (Table 2.10 and Figure 2.17). Variability of disturbance sizes (Table 2.11 and Figure 2.18) contributes to coarse-filter biodiversity.

Table 2.10 Historical cutblock sizes.

averages	*63*	*30.3*	*1.3*	*104.2*	*24.0*

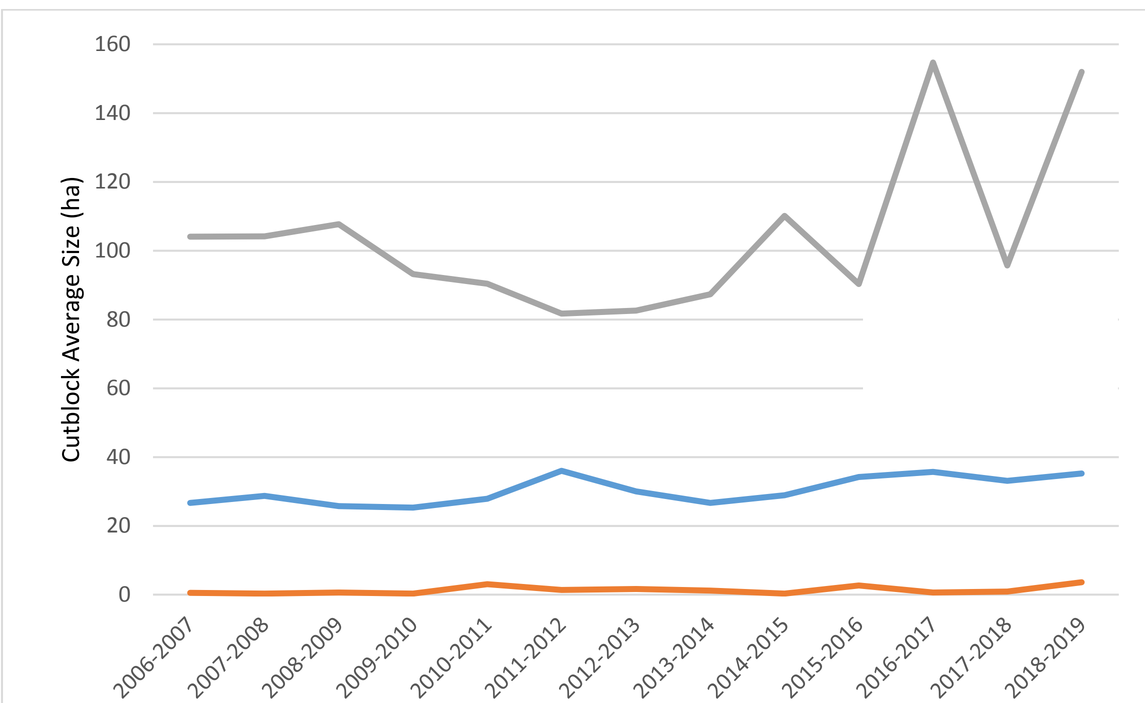

Figure 2.17 Historical disturbance sizes.

Table 2.11 Disturbance area by 20 ha size classes.

	Area (ha) by Disturbance Size (20 ha classes)					
Year	**0.1 20.0 ha**	**20.1 40.0 ha**	**40.1 60.0 ha**	**60.1 80.0 ha**	**80.1 100.0 ha**	**100.1 ha plus**
2006-2007	429.3	556.4	712.4	493.1	0.0	104.1
2007-2008	495.9	757.2	715.8	267.0	358.9	104.2
2008-2009	243.3	237.9	152.4	215.2	174.6	107.7
2009-2010	156.9	409.8	221.7	204.2	93.2	0.0
2010-2011	290.2	707.8	377.1	269.0	169.9	0.0
2011-2012	215.9	254.1	377.5	571.0	163.4	0.0
2012-2013	227.5	515.4	552.7	515.4	82.6	0.0
2013-2014	289.2	776.9	639.5	126.6	173.8	0.0
2014-2015	379.8	832.4	607.9	416.5	179.2	212.2
2015-2016	124.2	359.8	441.2	146.5	261.5	0.0
2016-2017	141.3	414.3	362.0	370.1	93.1	259.7
2017-2018	274.2	750.8	455.4	514.3	354.2	0.0
2018-2019	279.0	452.5	461.3	484.0	352.0	152.0
Totals	**3,546.6**	**7,025.2**	**6,076.9**	**4,592.8**	**2,456.4**	**939.8**
Averages	***272.8***	***540.4***	***467.5***	***353.3***	***189.0***	***72.3***

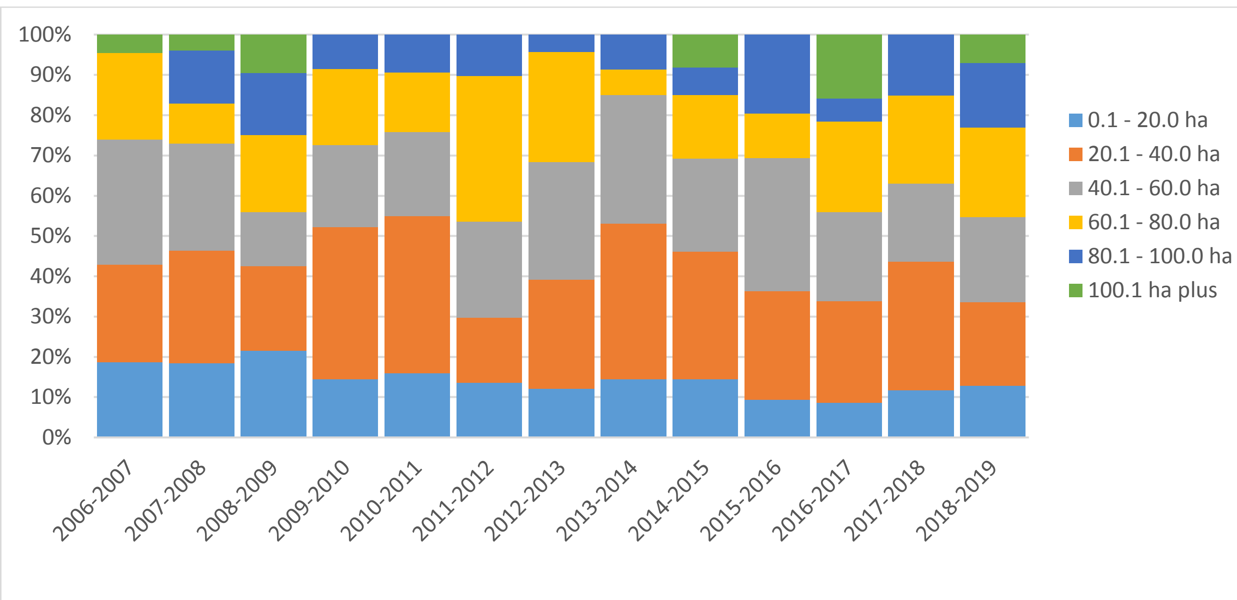

Figure 2.18 Disturbance area percent by 20 ha size classes.

2.5.7. Harvest Volumes

Wood volume was an important metric to track. Each Forest Management Unit within FML #3 has an annual maximum softwood and hardwood volume or AAC (Annual Allowable Cut). The actual softwood and hardwood volumes were compared to the AAC maximums as well as minimums, maximums, and five-year averages. LP has a maximum hardwood harvest level of 100,000 m3 during the bird breeding season, May, June, and July. The volume of hardwood harvested during this period is tracked and compared to the 100,000 m^3 threshold.

2.5.7.1. *Softwood and Hardwood Volumes Compared to the Allowable Cut*

FMU 10 softwood AAC (Annual Allowable Cut) is only 210 m^3 per year. No pure softwood blocks were planned to obtain this small volume of softwood. It merely allows for some residual softwood to be harvested from a hardwood or mixedwood block. In some years no softwood was harvested, while other years the Quota Holders exercised their right to a three-year volume average which exceeds the AAC (Table 2.12 and Figure 2.19).

Table 2.12 Softwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 10.

	FMU 10		
Operating Year	**Actual Swd harvest (m^3)**	**Swd AAC (m^3)**	**% of AAC**
2006-2007	335	210	160%
2007-2008	594	210	283%
2008-2009	130	210	62%
2009-2010	0	210	0%
2010-2011	148	210	70%
2011-2012	0	210	0%
2012-2013	0	210	0%
2013-2014	0	210	0%
2014-2015	125	210	60%
2015-2016	0	210	0%
2016-2017	258	210	123%
2017-2018	0	210	0%
2018-2019	0	210	0%
swd totals	**1,590**	**2,730**	**58%**
undercut		*1,140*	

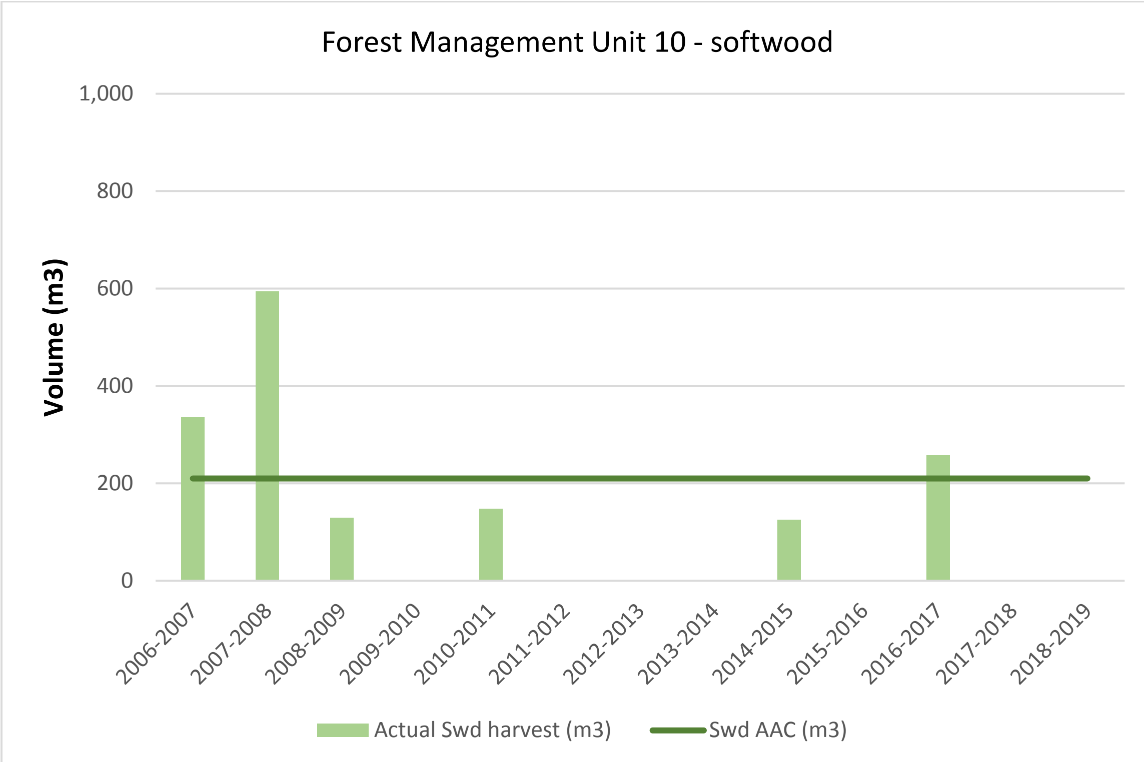

Figure 2.19 Softwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 10.

FMU 10 hardwood volumes come from two sources: open crown land; and leased crown land. Therefore, Table 2.13 reports on both sources of hardwood.

Table 2.13 Hardwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 10.

Operating Year	FMU 10 Open Crown			FMU 10 Leased Crown		
	Actual Hwd harvest (m^3)	Hwd AAC (m^3)	% of AAC	Actual Hwd harvest (m^3)	Hwd AAC (m^3)	% of AAC
2006-2007	3,109	7,850	7%	6,045	128,220	5%
2007-2008	10,163	7,850	28%	28,462	128,220	22%
2008-2009	1,658	7,850	1%	0	128,220	0%
2009-2010	3,146	7,850	2%	0	128,220	0%
2010-2011	1,363	7,850	4%	3,469	128,220	3%
2011-2012	0	7,850	0%	0	128,220	0%
2012-2013	3,669	7,850	47%	0	128,220	0%
2013-2014	7,932	7,850	101%	1,838	128,220	1%
2014-2015	11,401	7,850	145%	5,893	128,220	5%
2015-2016	0	7,850	0%	0	128,220	0%
2016-2017	9,287	7,850	118%	0	128,220	0%
2017-2018	0	7,850	0%	0	128,220	0%
2018-2019	0	7,850	0%	0	128,220	0%
hwd totals	**51,727**	**102,050**	**51%**	**45,707**	**1,666,860**	**3%**
undercut		***50,323***			***1,621,153***	

To date, slightly more open crown land volume has been harvested in FMU 10 than leased crown land volume (Figure 2.20). Note that in some years, no hardwood is harvested in FMU 10.

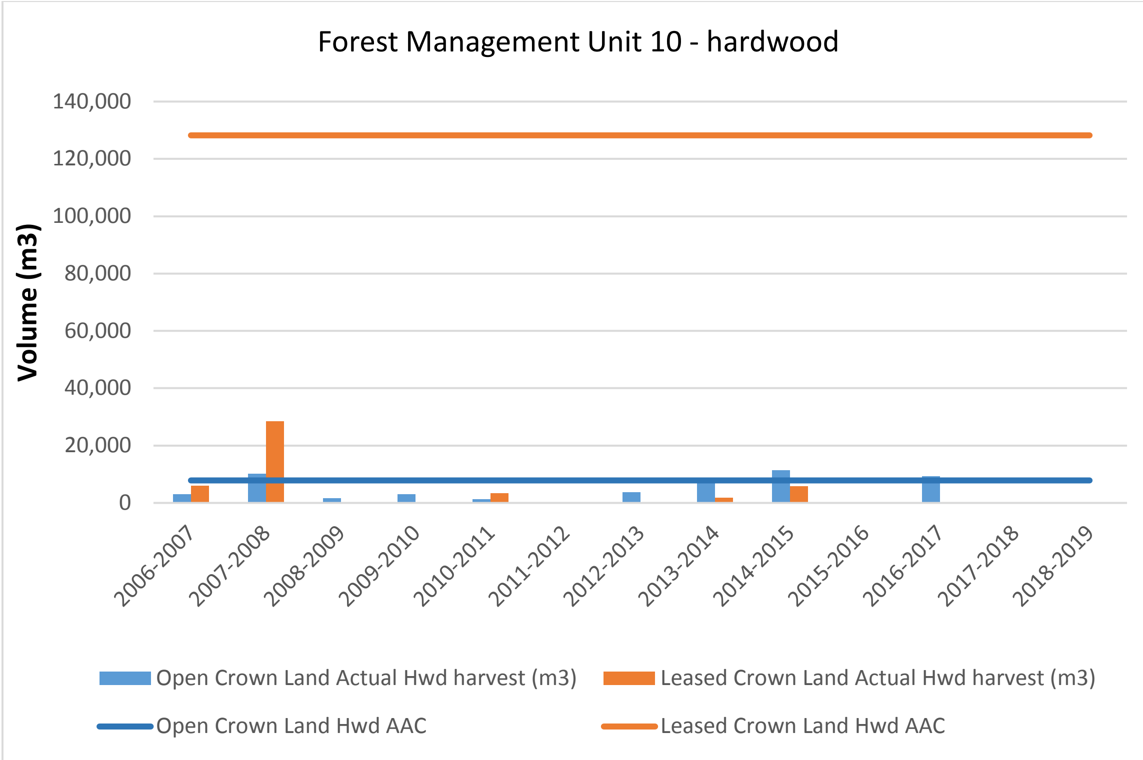

Figure 2.20 Hardwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 10.

Only a small portion of FMU 11 softwood annual allowable cut has been utilized (Table 2.14 and Figure 2.21). The softwood AAC was changed on April 1st, 2018 to 26,819 m^3, an increase of 8,189 m^3. Most of the softwood in FMU 11 is harvested from mixedwood blocks. The softwood quota volume in FMU 11 is 5,649 m^3.

Table 2.14 Softwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 11.

	FMU 11		
Operating Year	Actual Swd harvest (m^3)	Swd AAC (m^3)	% of AAC
2006-2007	3,725	18,630	20%
2007-2008	97	18,630	1%
2008-2009	76	18,630	0%
2009-2010	4,695	18,630	25%
2010-2011	1,319	18,630	7%
2011-2012	1,601	18,630	9%
2012-2013	2,468	18,630	13%
2013-2014	660	18,630	4%
2014-2015	981	18,630	5%
2015-2016	343	18,630	2%
2016-2017	320	18,630	2%
2017-2018	1,233	18,630	7%
2018-2019	9,272	26,819	35%
swd totals	**26,791**	**250,379**	**11%**
undercut		*223,588*	

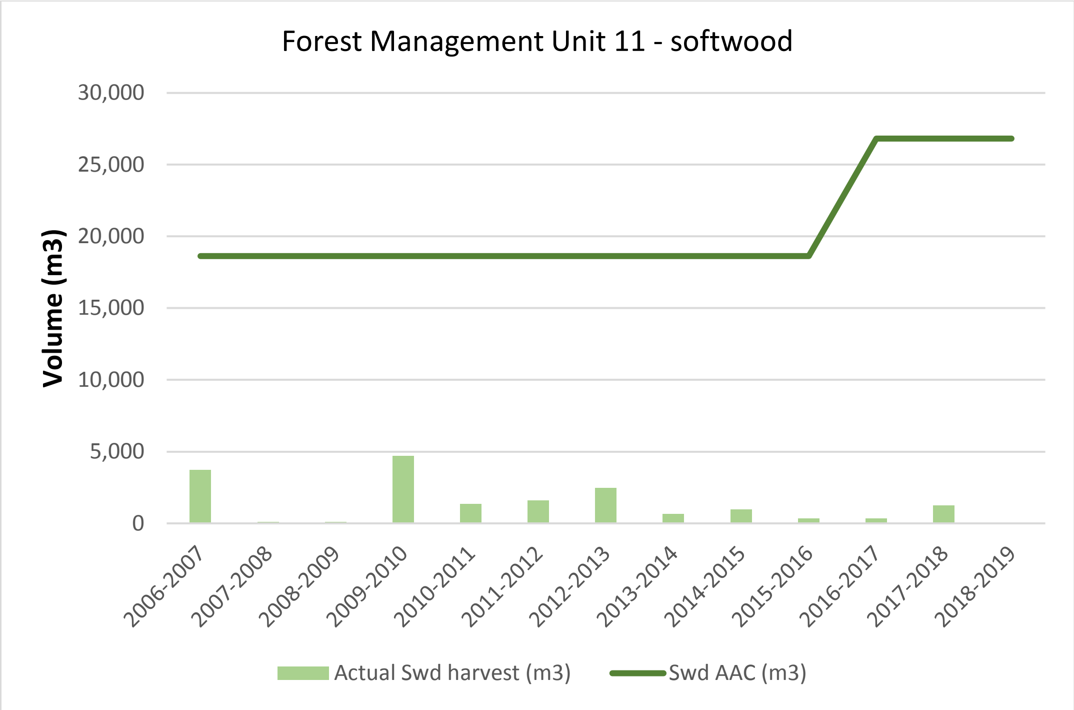

Figure 2.21 Softwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 11.

FMU 11 hardwood volumes came from two sources: open crown land and leased crown land up until April 1st, 2018. The AAC in FMU 11 was amalgamated to one volume (92,004 m^3) after this date. The table reports on both sources of hardwood up to the 2017-18 season. Prior to this date more open crown land volume than leased crown land volume has been harvested (Table 2.15 and Figure 2.22). To date FMU 11 has been undercut.

Table 2.15 Hardwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 11.

	FMU 11 Open Crown			FMU 11 Leased Crown		
Operating Year	Open Crown Land Actual Hwd harvest (m^3)	Open Crown Land Hwd AAC (m^3)	% of AAC	Leased Crown Land Actual Hwd harvest (m^3)	Leased Crown Land Hwd AAC (m^3)	% of Leased Crown AAC
2006-2007	30,521	51,310	26%	6,717	92,890	7%
2007-2008	24,920	51,310	22%	7,074	92,890	8%
2008-2009	16,879	51,310	12%	0	92,890	0%
2009-2010	41,276	51,310	30%	1,592	92,890	2%
2010-2011	17,321	51,310	20%	11,728	92,890	13%
2011-2012	29,041	51,310	20%	5,108	92,890	5%
2012-2013	35,824	51,310	25%	6,096	92,890	7%
2013-2014	15,850	51,310	11%	3,124	92,890	3%
2014-2015	16,685	51,310	12%	0	92,890	0%
2015-2016	9,978	51,310	7%	0	92,890	0%
2016-2017	10,367	51,310	11%	1,802	92,890	2%
2017-2018	48,600	51,310	53%	0	92,890	0%
2018-2019	22,494	92,004	22%		*	
hwd totals	**319,754**	**1,822,404**	**18%**	**43,241**	**1,114,680**	**4%**
undercut		*1,502,650*			*1,071,439*	

*Leased Crown land AAC was amalgamated into Open Crown land in 2018-2019

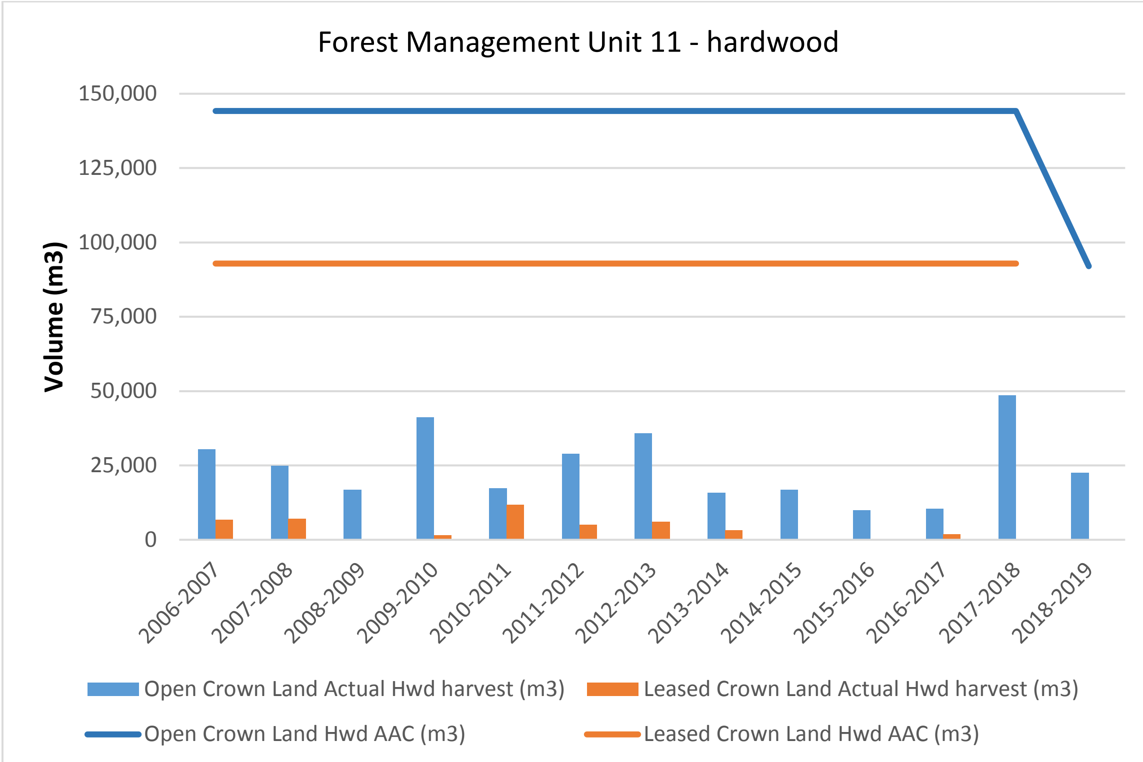

Figure 2.22 Hardwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 11.

FMU 13 (Duck Mountain Provincial Forest) consists of open crown land only. There is no leased land within the boundaries of the Duck Mountain Provincial Forest. Both softwood and hardwood volumes are reported together (Table 2.16 and Figure 2.23) for FMU 13.Softwood harvest has been 85% of the annual allowable cut since 2006.The hardwood Quota Holders and Louisiana-Pacific Canada Ltd. have utilized 62% of the hardwood annual allowable cut since 2006.

Less hardwood and softwood was cut than normal during the global recession in 2008 and 2009, due to lower demand for forest products. In 2015-2016, the Minitonas OSB mill was temporarily shut down to convert from Orientated Strand Board (OSB) to siding production, which resulted in less wood processed during the 2015-2016 operating year.

Table 2.16 Softwood and hardwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 13.

Operating Year	FMU 13			FMU 13		
	Actual Swd harvest (m3)	Swd AAC (m3)	% of AAC (m3)	Actual Hwd harvest (m3)	Hwd AAC (m3)	% of AAC (m3)
2006-2007	154,883	176,606	88%	314,976	348,823	90%
2007-2008	175,605	176,606	99%	320,428	348,823	92%
2008-2009	116,137	176,606	66%	142,090	348,823	41%
2009-2010	85,420	176,606	48%	105,455	348,823	30%
2010-2011	174,994	176,606	99%	231,997	348,823	67%
2011-2012	168,926	176,606	96%	171,294	348,823	49%
2012-2013	118,358	176,606	67%	148,175	348,823	42%
2013-2014	142,308	176,606	81%	212,151	348,823	61%
2014-2015	178,366	176,606	101%	348,876	348,823	100%
2015-2016	147,234	176,606	83%	125,022	348,823	36%
2016-2017	178,686	176,606	101%	193,526	348,823	55%
2017-2018	236,506	234,022	101%	208,287	311,934	67%
2018-2019	180,208	234,022	77%	255,789	311,934	82%
totals	**2,057,631**	**2,410,710**	**85%**	**2,778,067**	**4,460,921**	**62%**
undercut		*353,079*			*1,682,854*	

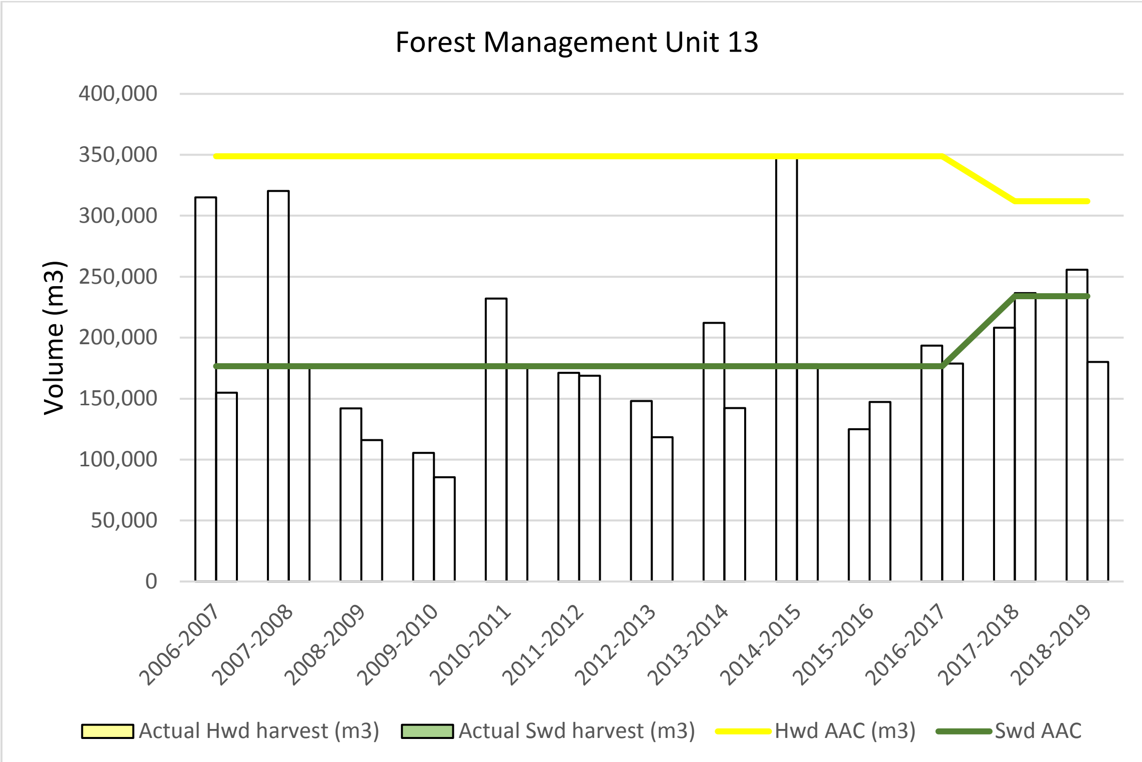

Figure 2.23 Hardwood and softwood actual harvest compared to Annual Allowable Cut for Forest Management Unit 13.

2.5.7.2. *Maximum and Minimum Harvest Levels*

The Forest management Licence #3 Agreement specifies a maximum hardwood harvest level of 900,000 m^3 per year, and a minimum five-year average harvest level of 400,000 m^3 (from FML #3 and FMUs 12 and 14). The total harvest for each year shows that the maximum harvest level has not been exceeded (Figure 2.24). Note that there was no softwood minimum or maximum requirement in the Forest Management Licence Agreement.

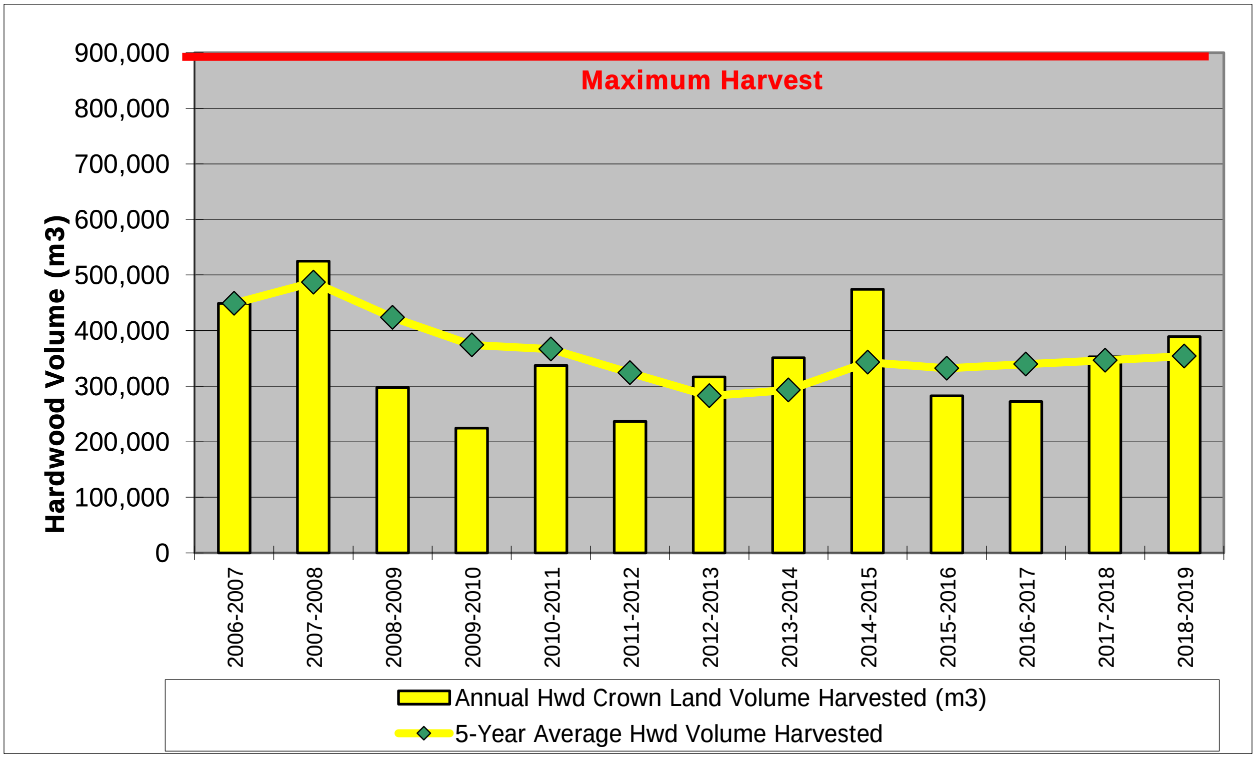

Figure 2.24 Annual hardwood harvest and five-year average hardwood harvest.

2.5.7.3. *Annual Harvest Volume during Bird Breeding Season*

To reduce the potential impacts of hardwood operations on breeding birds, LP was required to minimize harvest of hardwoods in May, June and July of each year. Harvest of hardwoods may not exceed a total of 100,000 m^3 for these three months according to Manitoba Environment Act License 2191E (1996).

The amount of LP hardwood harvest during the bird breeding season is consistently less than the 100,000 m^3 maximum Figure 2.25. Storing a larger winter inventory in the mill yard helps reduce the need to harvest during the summer bird breeding season. Quota holder harvest during the bird breeding season is not tracked.

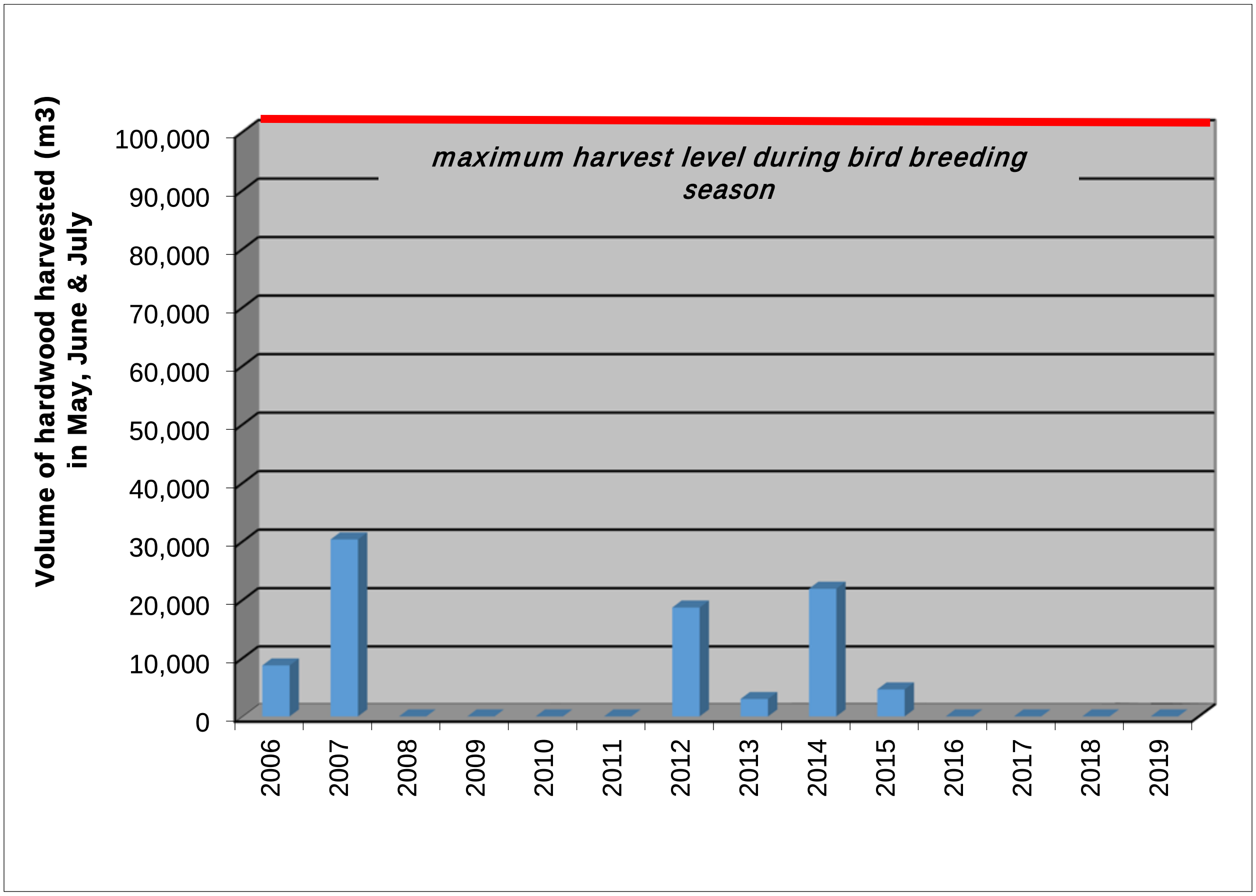

Figure 2.25 Volume of hardwood harvested during the bird breeding season (May to July), with a comparison to the annual maximum harvest level.

2.5.8. Crown Fees

Crown fees consist of three separate charges:

1) **Stumpage** – fee for the right to harvest trees from Crown land. The stumpage money collected was general revenue for the Province of Manitoba.

2) **Forest Renewal Charge (FRC)** – fee for renewal of harvested sites. Note that since Jan. 1st, 2007 softwood renewal efforts were funded directly by the Mountain Forest Section Renewal Company (MFSRC). Specifically, the MFSRC directly pays for tree planting, site preparation, and surveys as these renewal expenses occur (approximately \$5.75 per m^3).No softwood renewal money was paid to the provincial government.

   Hardwood renewal efforts were funded directly (\$0.50 per m^3) and managed by LP. LP directly pays for hardwood regeneration surveys and any other hardwood renewal costs. No hardwood renewal money was paid to the provincial government. Quota Holder hardwood renewal money was deposited into the FML #3 hardwood renewal fund and used to fund hardwood regeneration surveys on hardwood Quota Holder cut blocks.

3) **Fire Protection Charge (FPC)** – fee to offset the fire fighting and fire prevention costs the Province of Manitoba undertakes to protect forest resources. A \$0.17 per cubic metre was uniformly charged for both softwood and LP and Quota Holder hardwood.

Table 2.17 summarizes all Crown fees paid by softwood and hardwood users in FML #3, from 2006 to 2019.

Table 2.17 Total hardwood and softwood fees paid for wood harvested within FML #3 (source: Province of Manitoba).

Year	Hardwood Stumpage Fees ($)	Softwood Stumpage Fees ($)	**Hardwood Renewal Fees ($)	Softwood Renewal Fees ($)	Hardwood Protection Fees ($)	Softwood Protection Fees ($)	Totals
2006-2007	$1,384,774	$456,906	$222,761	$1,036,169	$75,739	$26,330	**$3,202,678**
2007-2008	$1,146,938	$223,351	$150,000	$500,000	$94,787	$29,869	**$2,144,946**
2008-2009	$427,299	$335,376	$150,000	$500,000	$27,307	$19,327	**$1,459,309**
2009-2010	$446,435	$147,635	$134,410	$457,269	$43,475	$15,852	**$1,245,075**
2010-2011	$608,755	$308,805	$126,884	$687,000	$59,296	$29,998	**$1,820,738**
2011-2012	$299,765	$298,431	$85,647	$623,000	$29,120	$28,990	**$1,364,954**
2012-2013	$437,999	$206,103	$146,420	$859,859	$31,105	$53,181	**$1,734,667**
2013-2014	$386,444	$307,075	$207,415	$900,518	$261,512	$28,269	**$2,091,233**
2014-2015	$620,515	$400,306	$31,750	$1,108,472	$60,564	$32,762	**$2,254,369**
2015-2016	$330,438	$358,999	$3,053	$892,383	$27,188	$26,506	**$1,638,566**
2016-2017	$995,925	$841,849	$10,533	$1,799,678	$47,753	$53,604	**$3,749,342**
2017-2018	$1,603,909	$1,018,428	$8,072	$1,271,617	$39,021	$38,293	**$3,979,340**
2018-2019	*	*	*	*	*	*	*****
Totals	**$8,689,196**	**$4,903,263**	**$1,276,945**	**$10,635,965**	**$796,867**	**$382,981**	**$26,685,217**

*waiting for numbers from the Province of Manitoba

**hardwood renewal fee tracking changed in 2014-2015 (internally funded hardwood renewal)

2.6. Harvesting Practices and Associated Activities

2.6.1. Harvest Equipment Used

All harvest operations are mechanical logging operations. The harvest equipment used varies slightly, but typically consists of the following equipment options by harvesting stage.

Felling – Feller bunchers were used to cut standing trees. A saw cuts each tree, while the accumulator arms allow for several trees to held and form a ‘bunch’. The bunch of whole trees is then laid on the forest floor.

Topping and limbing – Power saws or stroke delimbers were commonly used to delimbing the branches off the stem, and to cut the top off.Power saws weare more commonly used for topping and limbing hardwood, while softwoods were often stroke delimbed.

Skidding – A grapple skidder was used to move bunched tree stems to roadside for processing and hauling.

Slashing – A slasher or processor head on an excavator processed tree-length stems at roadside. Hardwood tree-lengths were processed into 2.54 m (8 foot) lengths. Softwood tree-lengths that are sawlogs were processed into 5.1 m (16 foot), 3.8 m (12 foot), or 3.2 m (10 foot) lengths. Softwood chipperwood had variable lengths.

Loading- A swing loader on a tracked excavator was used to load processed logs onto a haul truck.


Hauling – The wood was then hauled to a mill. Trailer configurations included Super B (8 axle), B-train (7 axle), or Tridem (6 axle).

2.6.2. Wood Storage and Processing Areas

Softwood storage sites (Figure 2.26) were established throughout FML # 3 on a yearly basis. Some wood was skidded to roadside within the cut block for further processing or chipping with a portable chipper at a later time. In other instances, wood was forwarded, or moved off-site, to a location that provided all weather access roads to the wood for processing or chipping. There was typically a small amount of incidental hardwood that was forwarded to these sites as well.

Figure 2.26 Softwood stockpile site.

Hardwood storage sites (Figure 2.27) have been far less common in FML #3 than softwood storage sites. Hardwood storage sites have been established within cut blocks that have all weather access with wood being skidded to roadside and processed later. In some cases, processed wood has been left within the cut block as a result of early thaws causing roads to deteriorate and trucks being unable to haul the wood.

Figure 2.27 Hardwood stockpile site at block JFL-010

2.6.3. Storage, handling, and disposal of hazardous, non-hazardous, domestic, and recyclable solid and liquid waste

Fuel, diesel or gasoline, was stored in an approved fuel storage tank (steel tank). Oil or hydraulic fluid was stored in the original container, typically a 20-litre plastic pail with a sealed lid.

Fuel was dispensed from the storage tank to a machine. A fuel hose runs from the tank to a fuel nozzle at the end of the hose. Typically, a large spill kit is present at the camp or by the fuel tank. A small spill kit was present with any vehicle equipped with fuel slip tank (*e.g.* pick-up trucks).

Manufacture's WHMIS labels were on the containers of all hazardous materials. Each contractor had a binder of Material Safety Data Sheets (MSDSs) from the product supplier. The MSDS sheets provided detailed information about product composition, reactivity, health effects, protective equipment and procedures, and emergency procedures.

All waste was removed from the site. As per the Work Instructions, all contractors contained all waste and remove waste from the work site regularly (*e.g.*, waste oil, waste oil filters, grease tubes, oil containers, chains, wedges, files, jugs, unused fuel and oil, skidder chokers, mainline, haul truck wrappers/binders, cigarette packages, pop cans, lunch bags, *etc.*).

Transport of Dangerous Goods - The Dangerous Goods Handling and Transportation Act sets out requirements for the handling and transportation of dangerous goods and hazardous waste. This Act enabled the provincial government to establish standards pertaining to the generation, storage, transportation and disposal of hazardous waste.

Recyclables were also removed from the logging site. Small local towns have recycle collection, which is later transported to a larger processing facility. Swan River, Roblin, and Dauphin have recycling processing facilities.

2.6.4. Logging camps included associated water supplies and wastewater storage and disposal

Most loggers in FML #3 commuted to the harvesting site and did not use logging camps. The minority of loggers that used logging camps for overnight accommodations were very small scale (*i.e.* 2 to 10-person camps). Furthermore, these camps are temporary. Logging camps typically consisted of one or two trailers on wheels.

The water supply for these temporary camps is potable water that is hauled in to supply the camp. Potable water is held in a storage tank. No wells of any sort are dug. Waste water from the camp was temporarily stored in containers. The wastewater was then removed from camp for disposal.