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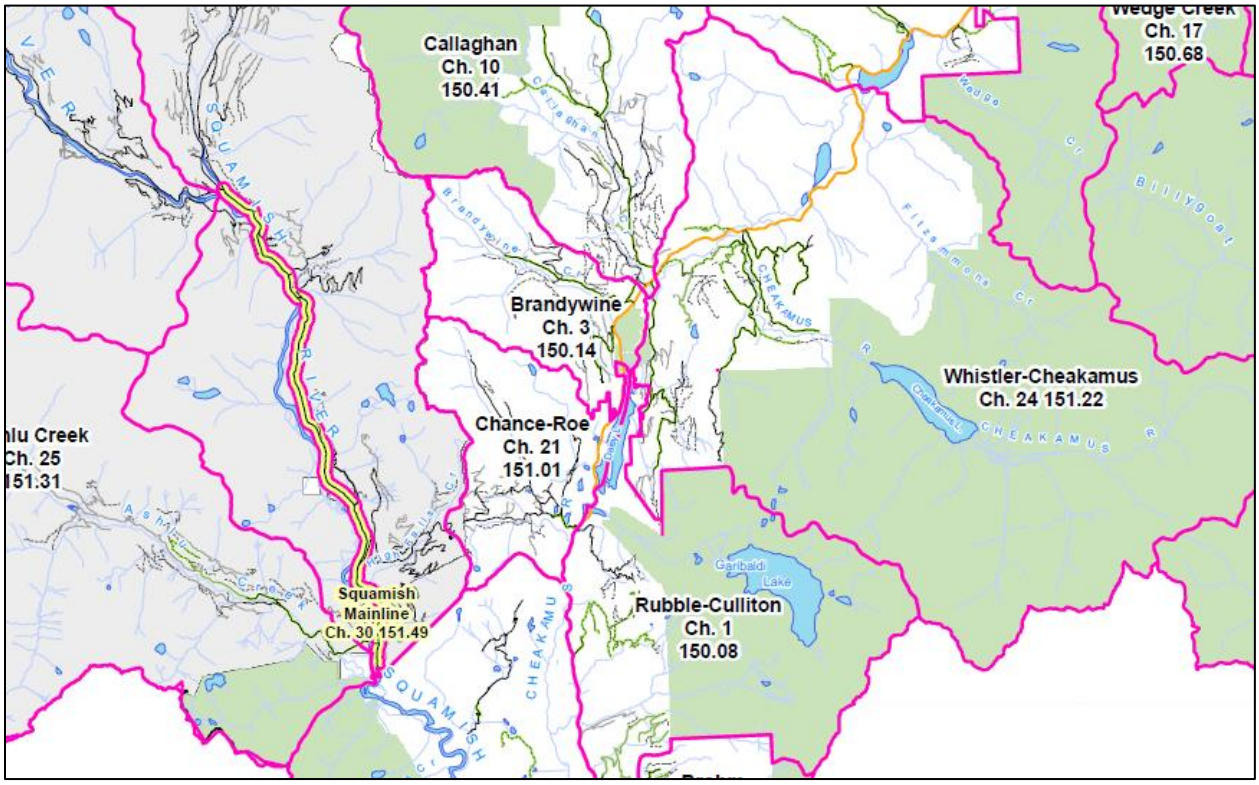

Guidance on assigning radio channels across the landscape

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BACKGROUND

BC has thousands of kilometres of forest service roads that are used by forestry and other resource industries, commercial transportation, and the general public. Many vehicles on these roads utilize VHF mobile 2-way radio communications to help anticipate when they will encounter other road users and, thereby, avoid collisions. In British Columbia, a new radio communications protocol is being implemented on Forest Service Roads (FSR). The protocol consists of a set of dedicated VHF radio channels, standardized call procedures and new signage. The new resource road radio communications protocols are gradually being implemented throughout the Province.

The process of implementing a new resource road radio protocol is a complex process involving developing implementation plans, purchasing and installing new radio communication signage, re-programming mobile radios with the set of new radio channels (RR-1 to 35 and LD-1 to 5 channels), assigning radio channels across the landscape, and communication with stakeholders throughout the process. The intent of this document is to provide guidance about assigning radio channels across the landscape. This document also will be incorporated within a larger report that discusses all aspects of implementing RR radio channels in a new area.

This document was prepared on behalf of the BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO). Further information about the protocol, as well as copies of all of the maps referenced in this guide, can be found at the FLNRO Engineering Branch website at the road radio project hot link (http://www.for.gov.bc.ca/hth/engineering/Road_Radio_Project.htm)

ASSIGNING RESOURCE ROAD CHANNELS TO ROAD NETWORKS

It is important to think strategically and provide for logical assignment of RR channels over the landscape. Two tasks must be completed before assigning new RR channels to road networks. First, road systems should be reviewed to identify opportunities for rationalizing the number of road names. This is also the time to examine road naming conventions and determine if there is a need to streamline or improve any local practices. Second, the landscape must be partitioned into map polygons that enable logical assignment of RR channels.

These tasks should be completed at least six months prior to implementing the new communications protocol in a particular area. Six months lead time is needed because other duties are contingent upon completion of a review, including finalization of a radio area polygon map with channel assignments, preparation and installation of radio channel stickers and new road signs, and other communication activities.

Road system review

Resource road systems gradually expand over time to meet the needs of natural resource development. Sometimes a road system evolves in a piecemeal fashion resulting in a confusing and disjointed set of road names. For example, several roads may eventually link up to form one mainline. However, the original road names may be retained resulting in a new mainline with several different names along its length. Further, there may be different road naming conventions used for branch and spur roads in a region. The result of inconsistent road names is a confusing patchwork especially for new road users unfamiliar with the local jargon.

A first step in implementing the new radio communications protocol is to review the road systems in a Forest District, or other resource road jurisdiction, and identify opportunities to: a) rationalize road names, and b) streamline road naming conventions. This is an important step because a standard format for road kilometre signs has been established for the Province. The new format specifies inclusion of the road name on each kilometre sign. A review before new road signs are ordered and installed could prevent the need for sign changes and additional costs in the future. Another potential benefit of a review is that fewer road names and a clear system for branch roads should make it easier for users to adopt the new protocol.

Other points to consider in a road system review are:

- ***Communicate with road managers in neighbouring jurisdictions***

Inform other tenure holders and road management jurisdictions about your road review. Ensure that one road spanning several jurisdictions will have a consistent name. Discussions with other managers may produce new knowledge about development plans and help in the design of a road naming system for the long-term benefit of all users.

- ***Consult with road user groups***

Seek input from stakeholders though road user groups. Discuss the implementation of the new communications protocol at user group meetings. Take the opportunity to present road network maps at group meetings and solicit suggestions for rationalizing the current system of road names.

Partitioning the landscape

After road names have been reviewed and finalized, RR channels must be assigned to road systems throughout the area. This requires partitioning of the landscape into logical units suitable for channel assignment. After creating the geographic units, RR channels are assigned to each radio area polygon and to mainlines that warrant their own channels. The RR channels need to be distributed across the landscape so that the likelihood of interference is minimized. The following points provide additional guidance for partitioning the landscape and assigning road channels.

As a first step, partition the landscape into relatively large geographic units, such as watersheds. Remember that there are only 35 road channels available for assignment. If too many small geographic units are created, the channels will be used up before adequate spacing and distribution of channels is achieved. Because VHF radio waves propagate as a line-of-sight phenomenon, rough terrain will form natural and logical divisions between adjacent polygons. One approach may be to focus on a main FSR and capture all roads tributary to the FSR when delineating a map polygon for a particular drainage.

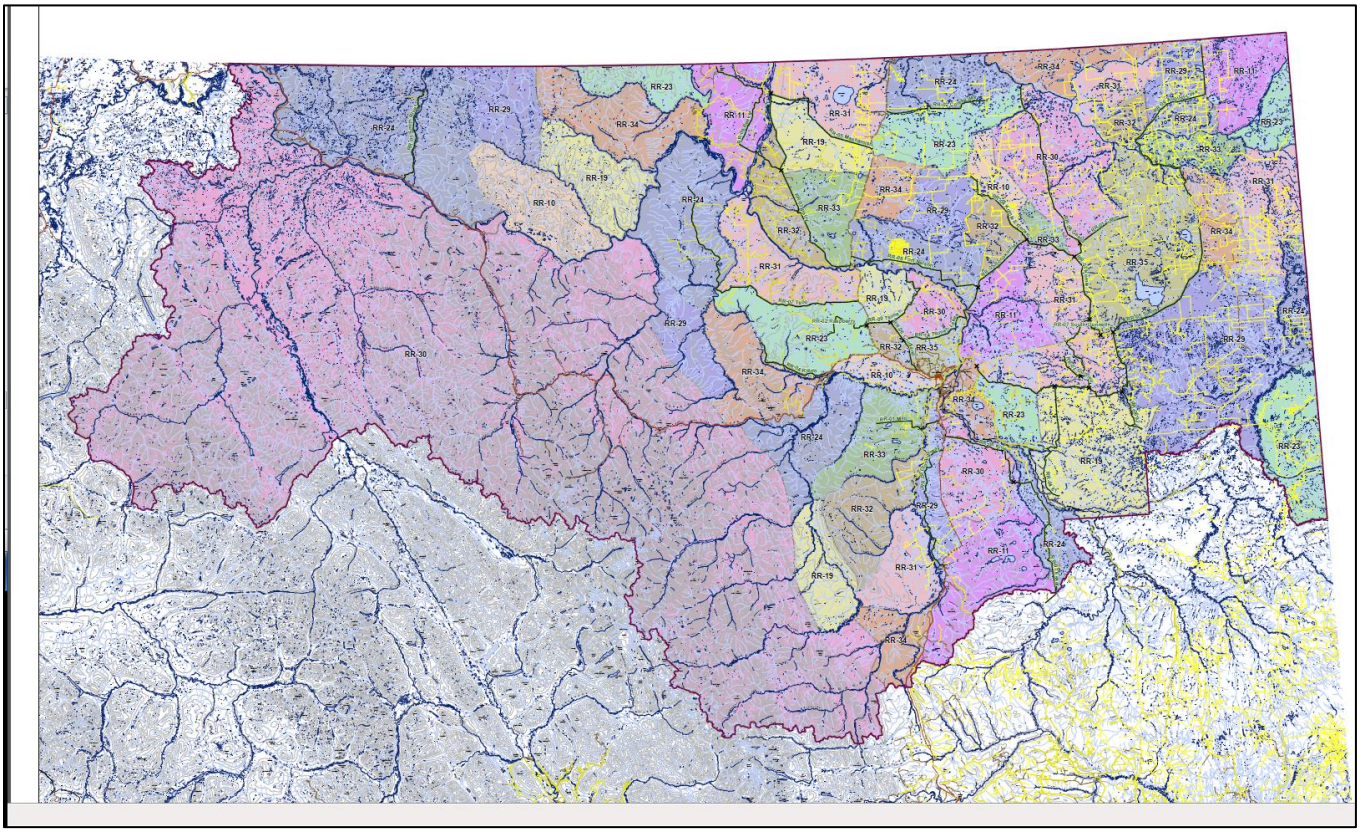


Figure: Proposed polygon sizes in the Fort Nelson Resource District vary from huge (on the undeveloped western edge) to relatively small polygons near Fort Nelson.

Some mainline roads, with high traffic volumes, experience a heavy demand for radio airtime. Users struggle for an opportunity to make their calls in a timely manner. To reduce the likelihood of interference, it would be warranted to assign an RR channel to the mainline (i.e., create a linear polygon along the mainline) and assign other channels to the surrounding area polygons that contain the adjacent branch roads. However, there are some down sides to this approach. First, if widely

adopted, it would significantly increase the number of radio channels required to service a region. Second, when users are traveling on a branch road, and approaching a mainline junction, they will be unaware of the upcoming traffic patterns until they switch over to the mainline road channel. Drivers will have to make additional radio calls to ask if there are vehicles in the vicinity or wait at the junction until they understand traffic flow before entering onto the mainline.

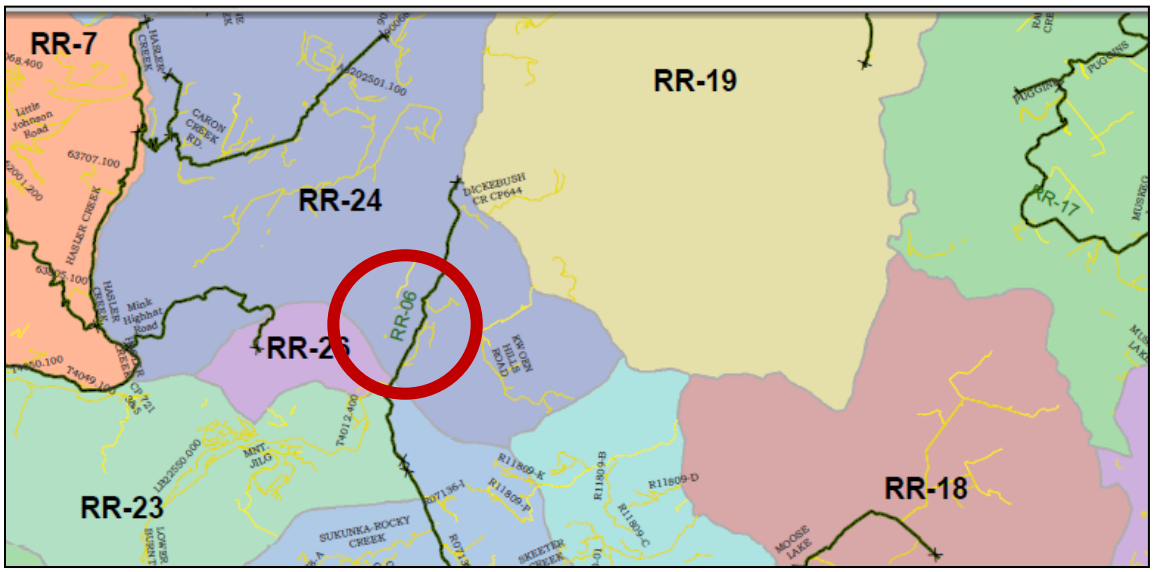


Figure: Busy roads in the Peace Resource District are assigned radio channels (e.g., RR 06).

Actual reception range experienced in the field is hard to predict and varies greatly with local conditions. Radio waves can be reflected, diffracted, scattered and absorbed by terrain features and vegetation. Steep terrain does not necessarily dictate partitioning the geography into smaller units. Sometimes radio waves are propagated readily along narrow valleys while low rolling topography and tall vegetation may limit transmission distances.

It may be advisable to conduct a preliminary exercise of defining a few radio area polygons in representative sections of local topography. This can be done by selecting areas with different topography (e.g., mountains, rolling hills, transition topography) and rationalising what arrangement would work best there now and in the foreseeable future. When confident that the polygon layout rationale is appropriate to your specific types of terrain, use the methodology to delineate polygons across the landscape.

The following are recommendations for polygon layout that produced good results in the south Peace Resource District pilot[1]:

a) ***Mountainous terrain*** where radio signals will be well contained.

- Cover each valley with a polygon. This may be suitable for areas with minimal industrial and recreational use, or areas with one licensee.

[1] Steve Amonson, FLNRO District Engineering Officer, Dawson Creek, BC. January 2014.

- Consider the necessity of subdividing the valley polygon to accommodate secondary/ tertiary use. In addition, consider applying linear polygons (assigning channels) to busy roads in the valley. This may be more suited to active areas where, with only one channel, the likelihood of radio interference would be high.

b) ***Gently rolling terrain*** where there are no clear breaks in topography or access options.

- Assign channels to the mainline roads with borders of the linear polygon defined by the rolling terrain to either side.
- Assign one or more polygons to the areas between the linear mainline polygons, depending on use level.

c) ***Transitioning terrain*** where high areas overlook a lower, relatively flat terrain.

- Radios may transmit for long distances from the top of a hill overlooking a plain so be very cautious in these areas. Try breaking the channel assignments at the lower slope.

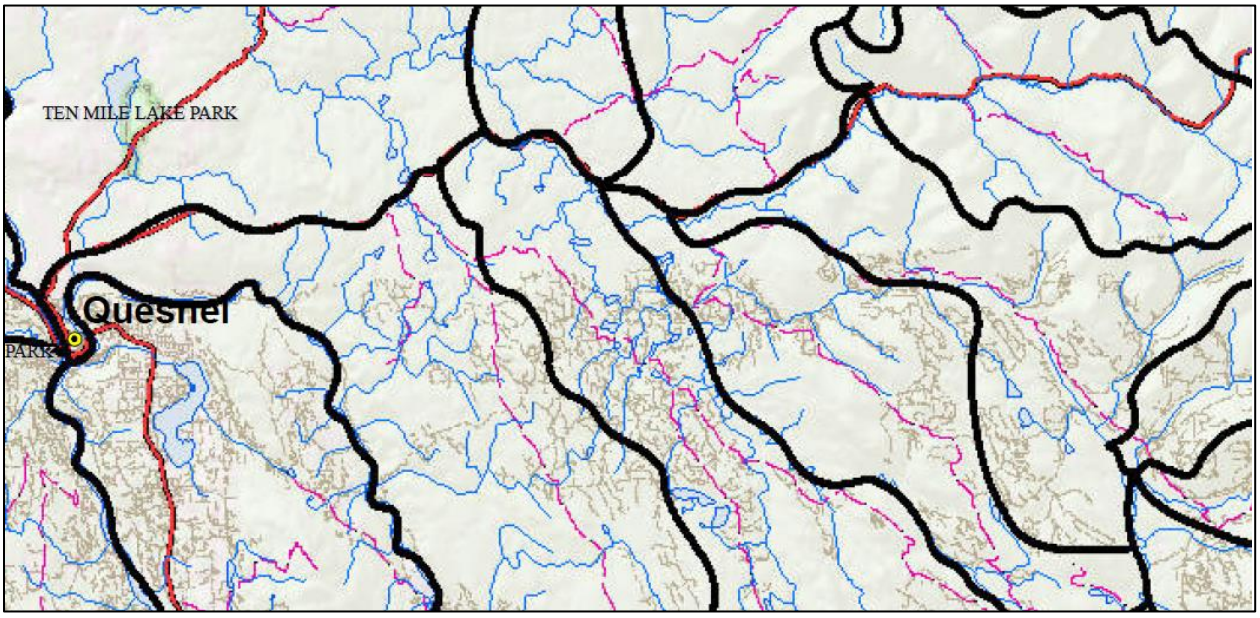


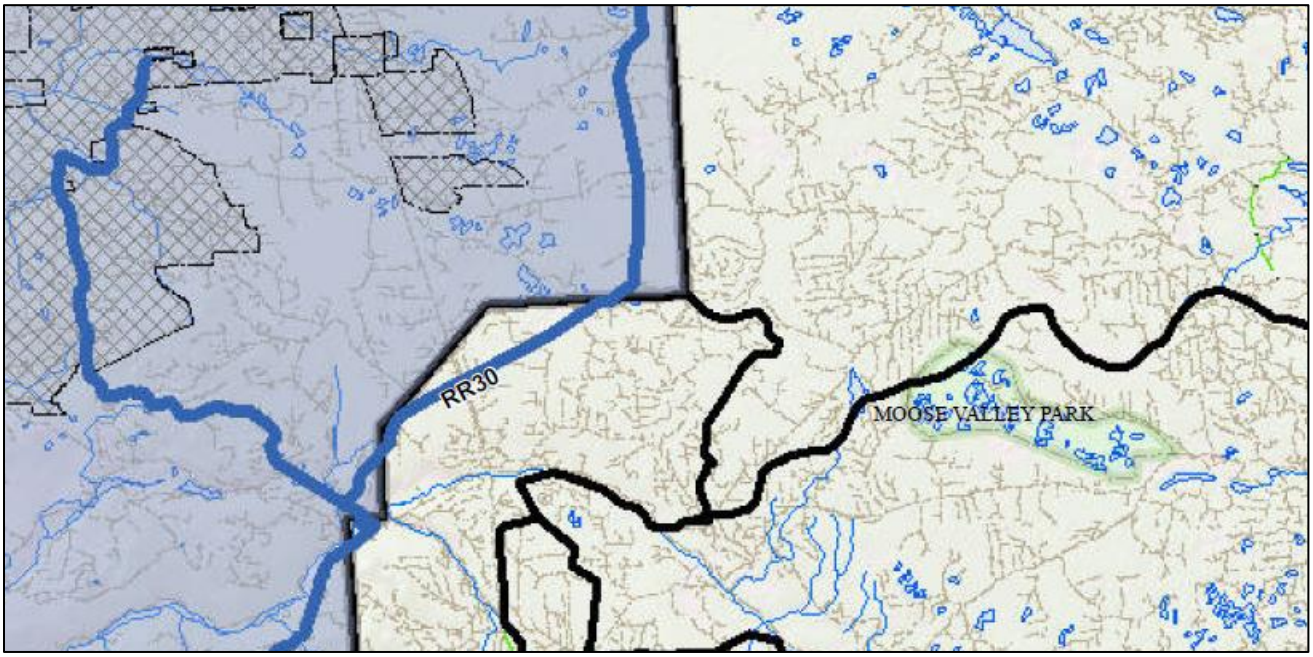
Figure: Proposed polygons east of Quesnel follow major forest roads and their boundaries were dictated by the gently rolling terrain and by the Quesnel-Barkerville highway.

It is important to have consultation with stakeholders and the public about the polygon layout prior to assigning radio channels. Review the polygon layout with the affected road safety committees and major licensees. Seek input on the location and extent of active and planned operations. Optimally, polygons are extended from the production/ harvest area to the terminus so as to minimize the number of times trucks must change road channels when travelling the most commonly used routes.

Rollout of the resource road radio communications protocol has been on a voluntary, non-compulsory basis. To-date, it has been applied to only FSRs and some PDRs. In order to facilitate eventual adoption on all resource roads in BC, it is recommended to partition all of the landscape. Consider delineating linear polygons along busy mainlines authorized under road permits, too, as this may facilitate future adoption of the communications protocol by the forest companies.

Consult road managers in neighboring districts to:

- access copies of GIS base maps with polygons and road channel assignments;
- identify which roads cross district boundaries; and,
- identify which forest companies are operating across district boundaries.



A mainline road in the Cariboo-Chilcotin District (assigned RR30) crosses into the 100 Mile House Resource District.

Currently, each district creates and maintains its own GIS base map of radio area polygons and road channel assignments during implementation. Where road networks or company operating areas cross district boundaries for reasons of safety and efficiency it may be better to extend polygon boundaries into the neighboring district or implement both districts together.

Assigning road channels to the polygons and mainlines

After partitioning the landscape into radio area polygons, the road channels should be assigned to each polygon and each mainline with a linear polygon. Pre-existing road channel assignments must be considered in this process—maintain the same buffer (separation) distances across district boundaries

and Provincial borders as maintained within the newly partitioned landscape. Obviously, therefore, assigning channels to a landscape surrounded by districts already using the radio protocol will be subject to more constraints. Inform road managers in neighboring districts about the final road channel assignments so that they can avoid channel assignment conflicts in the future.

The going first advantage

The south Peace Resource District and south Coast districts were the first to implement the new radio protocol so they don't need to buffer from bordering districts. That was a big advantage. When the Fort Nelson Resource District and the northern part of the Peace Resource District implement, channel assignments can proceed smoothly northward from the south Peace Resource District with little constraint from the existing assignments. However, if the Mackenzie Resource District waits until after the Prince George Resource District has assigned channels then some of its flexibility will be lost. It is unclear whether one will run out of channels; however, systematically working away from assignment areas is less risky.

Radio transmissions can travel for very substantial distances given certain situations. Avoid assigning the same channel to polygons on opposite sides of large water bodies even if they are separated by long distances (e.g., 150 km). Transmissions from high elevation roads overlooking plains (transition areas) may require 120 km buffer distances between roads or polygons with the same road channel.

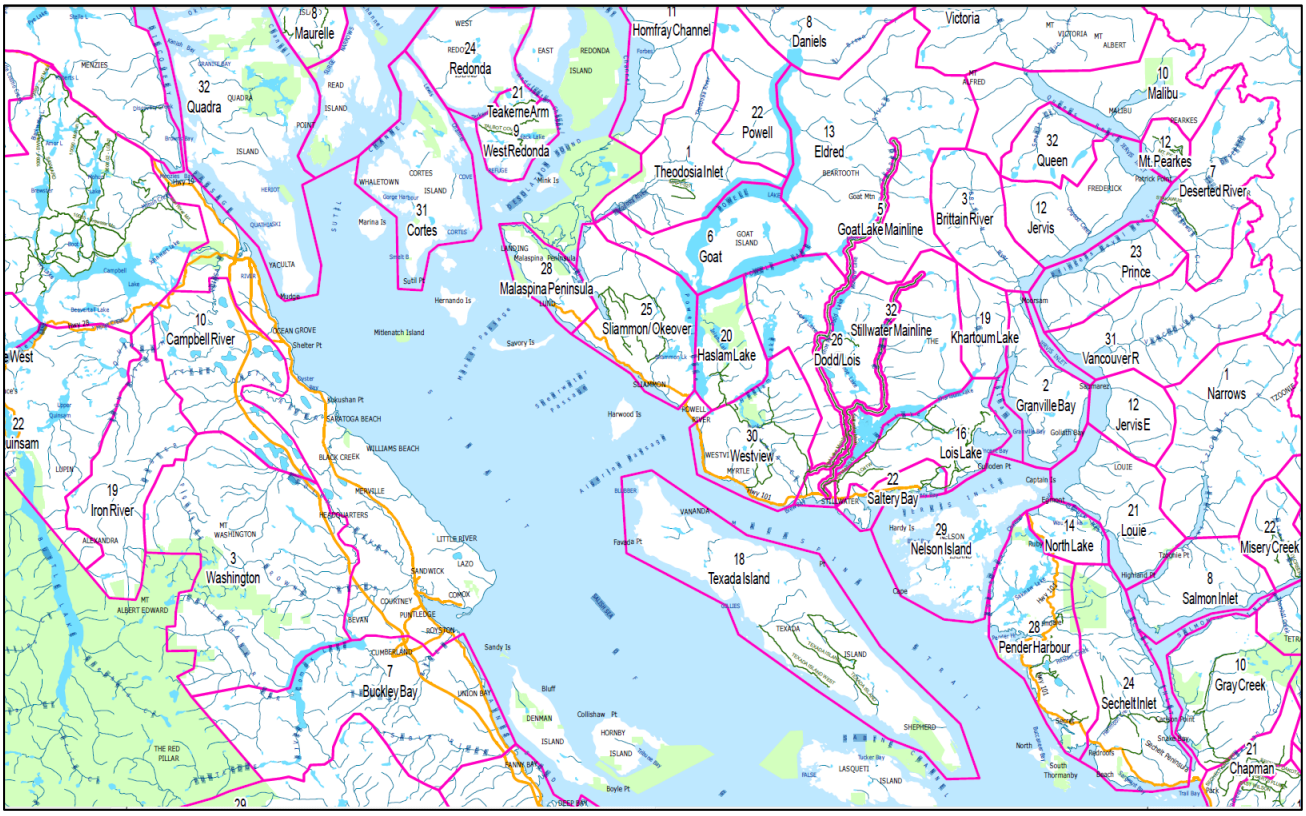


Figure: Radio channel assignments on the south Coast take into account the possibility of long transmission distances across water.

The team responsible for channel assignments used in the south of the Peace Resource District provided the following buffer distance recommendations[2]:

- In contained areas (contained by mountainous topography) – 60 km minimum
- In well contained areas (mountainous topography with large valleys) – 80 km minimum
- In moderately contained areas (rolling topography) – 100 km minimum
- In poorly contained areas (areas with transition topography) – 120 km minimum
- No containment (across large bodies of water) – 200 km minimum

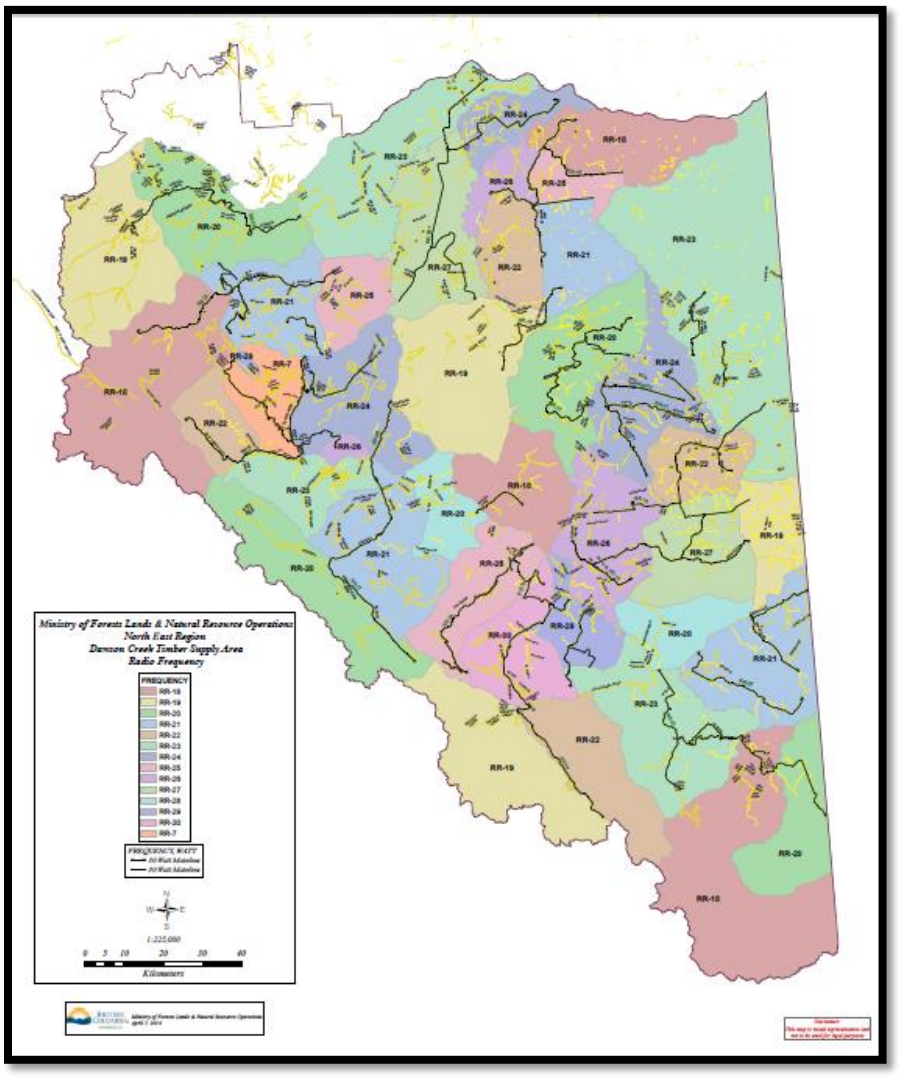


Figure: RR radio channel assignment map of the south Peace Resource District.

[2] Steve Amonson, FLNRO District Engineering Officer, Dawson Creek, BC. January 2014.

Buffer distances in the south Peace Resource District were estimated as the shortest distance between the boundary edges of polygons with the same channel. In most cases, that is not where the industrial activity will be so the buffer distances were conservative. Buffer distances may also be defined as being between the geographic middles of the polygons, between the points of highest elevation, or between existing active roads within the polygon, however, it is recommended to be conservative with buffer assignments of the same channel.

It was necessary to change the radio channel for two polygons in the south Peace pilot. These polygons had buffer distances of 60 and 80 Km but this was found to be insufficient to avoid interference. Changing the channel assignments created additional work and was demoralizing (changing signs in the field, re-communicating the change in assignment, updating journey mgt. plans, etc.). Avoid this, if possible, by being conservative with buffer distances when doing the initial layout.

Although calls from afar will be overridden by calls from close by, the constant noise from distant calling may create a safety issue if radio users turn down their radios or stop listening to incoming calls. This is another reason to take care with the initial channel layout.

Keep some channels in reserve

It is recommended to hold some channels in reserve in case of unforeseen incidents of interference or future development activity that can't be solved with the set of assigned channels. The number of reserve channels will vary given the number and size of polygons, however, at least 5 channels should be held in reserve if possible.

The final layout of radio channels across the landscape **must be approved** by Industry Canada before it can be implemented. When the preliminary assignment of radio channels to mainlines and polygons is complete, provide Industry Canada's regional technical staff with GIS shape files of the landscape, roads, polygons and channel assignments. Industry Canada will conduct a technical review of the channel layout and identify potential locations for interference as well as opportunities for consolidating the range of channels.

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