# Sahtu Landscape Futures

## Modeling Future Landscape Changes

### Summary

Sahtu ALCES models what the future landscape may look like based on scenarios of natural and human-driven change. It:
- Describes existing landcover
- Simulates future changes
- Displays historic changes
- Supports community decision-making and research

### Sahtu ALCES Partnership

Sahtu ALCES is a partnership of the Sahtu Renewable Resources Board, the Sahtu Environmental Research and Monitoring Forum and their research collaborators. NWT CIMP has funded this three year (2016 – 2019) Sahtu ALCES Online project.

- **Climate, Fire**
- **Population,**
- **Development**

**Landscape Changes Drive**

### Simulating the Future

Simulations explore changes over 50 years to the Sahtu landscape.

It looks at changes driven by climate, fire, population growth, development and other factors. These changes affect future Sahtu landscapes including forest age, Caribou range and habitat, and permafrost and infrastructure.
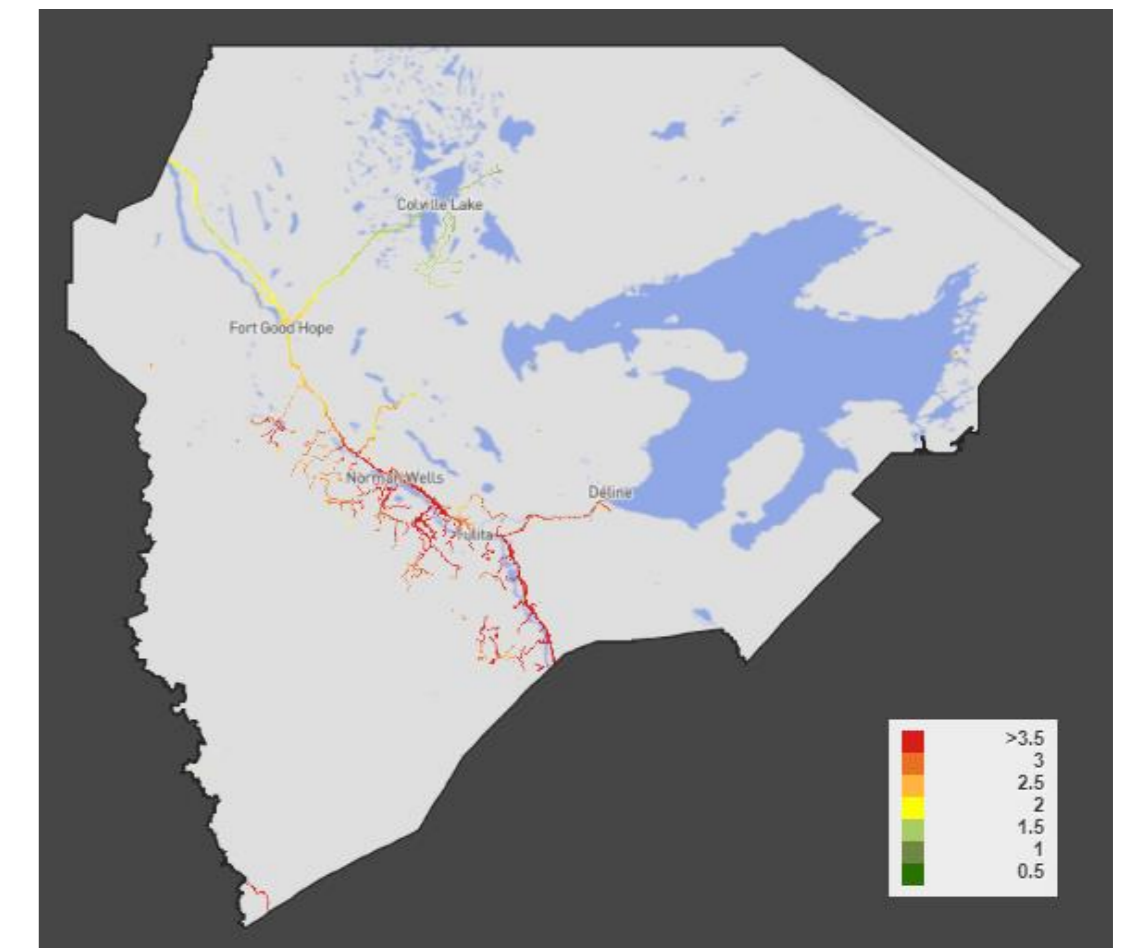
## Key Change Assumptions

**Future Landscapes**

- **Forest Age**
- **Caribou Range**
- **Permafrost**
- **Infrastructure**



*Infrastructure Risk in 2067*

### Change Assumptions

Key drivers of landscape change are factored into the assumptions:
- Climate and fire
- Population and infrastructure
- Energy development
- Mining development

### Looking into the Future

Sahtu ALCES has looked at potential patterns in the Sahtu landscape, including future:
- Land-use footprint
- Forest age and fire
- Caribou range
- Permafrost patterns
- Infrastructure risk

# Sahtu Landscape Disturbance

## Landscape Disturbance by Fire

### Summary of Results

Burn area in the Sahtu Territory grew during simulations of fire under various climate scenarios.
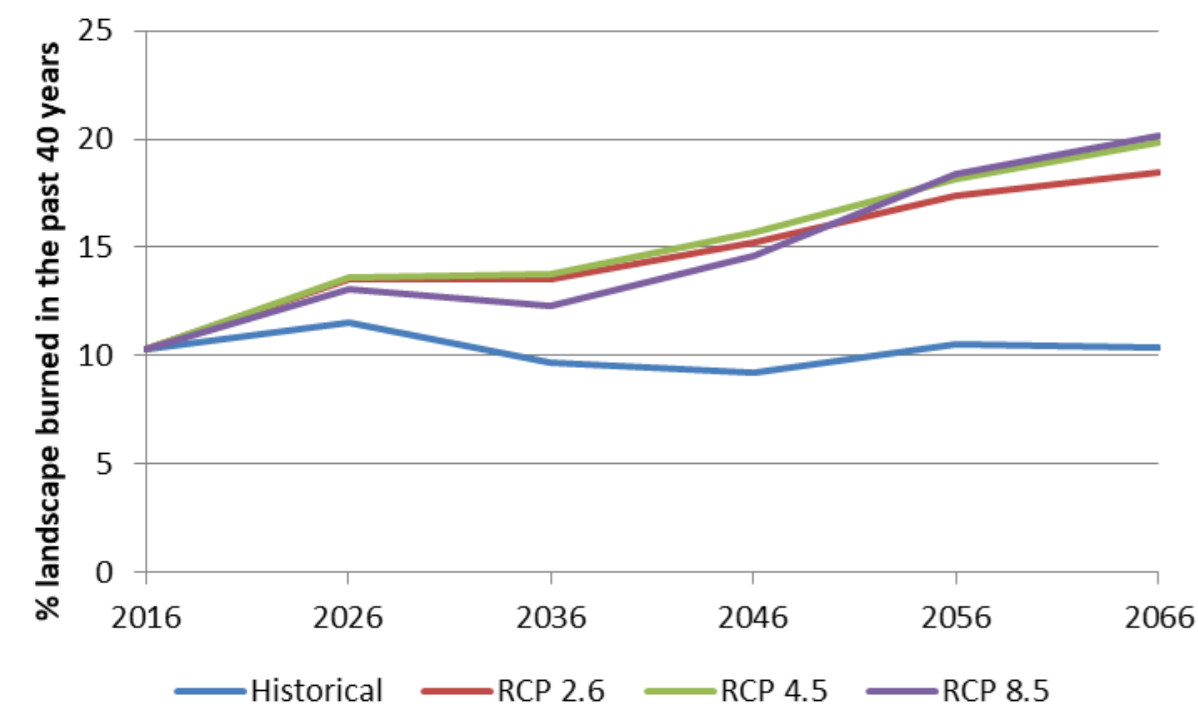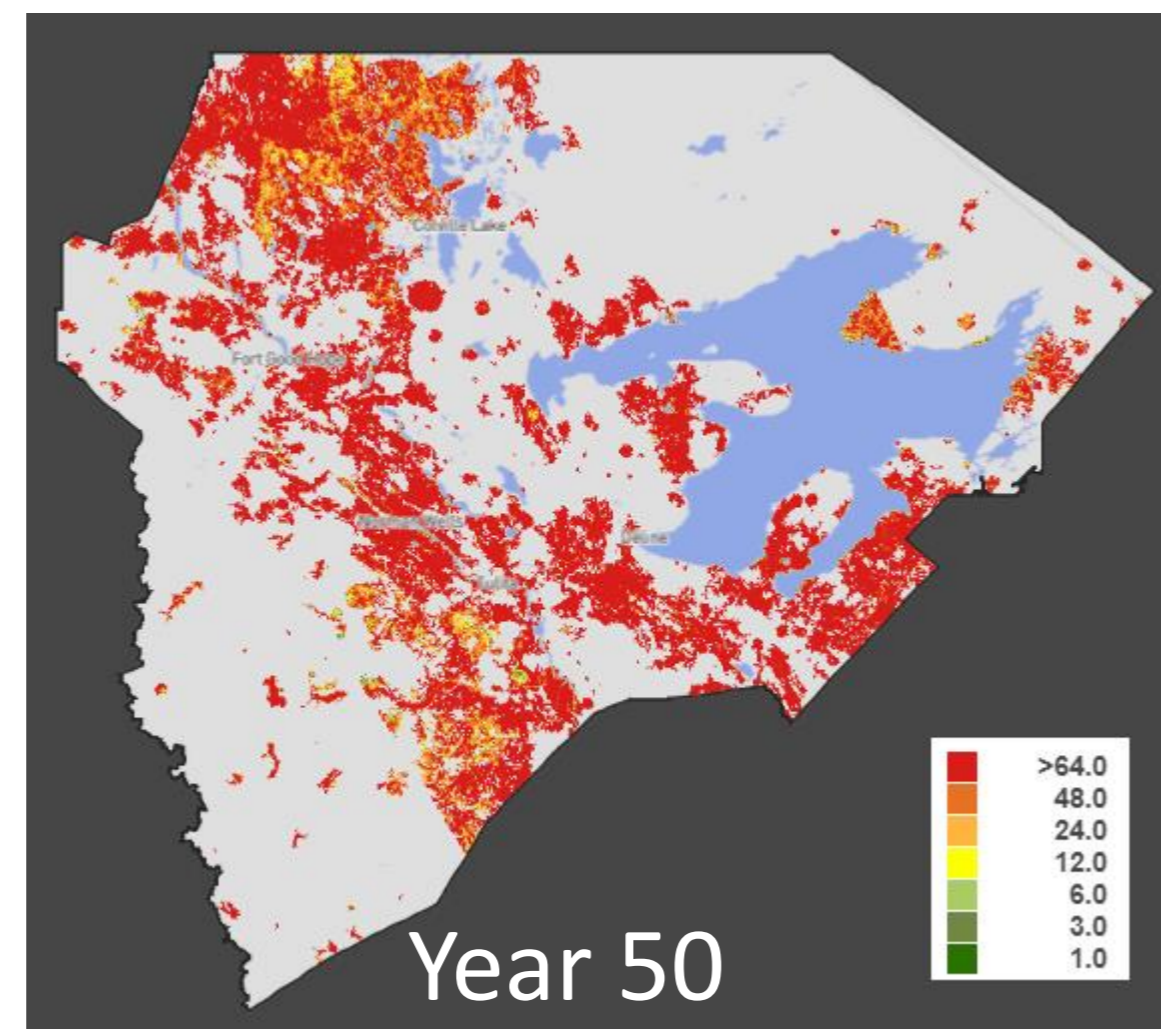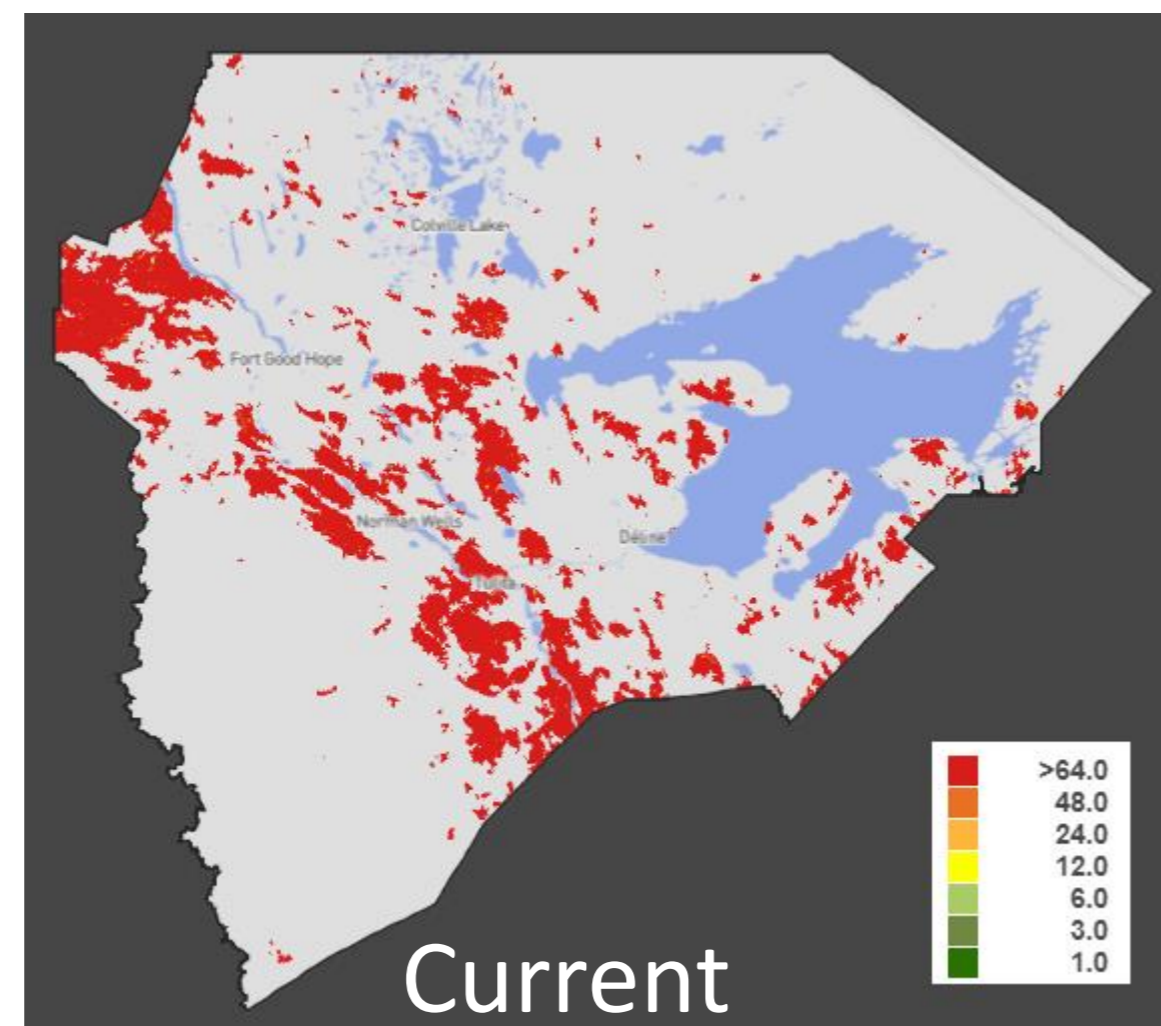


### Methods

- Historical fire rate was modified to incorporate increasing fire rate with climate change
- Local fire probability was influenced by forest age and type
- Fire size based on historical fire data

### Next Steps
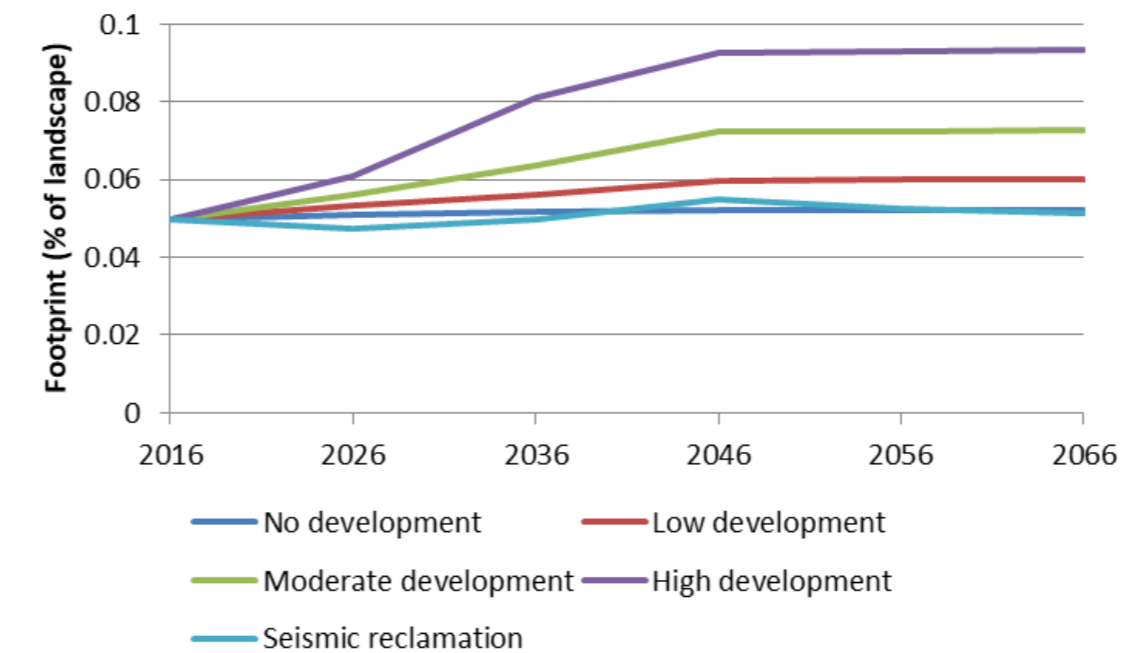
- Assess songbird response to simulated changes in forest age


Current


Year 50

Landscape disturbance (%) by fire within past 40 years under climate scenario RCP 4.5

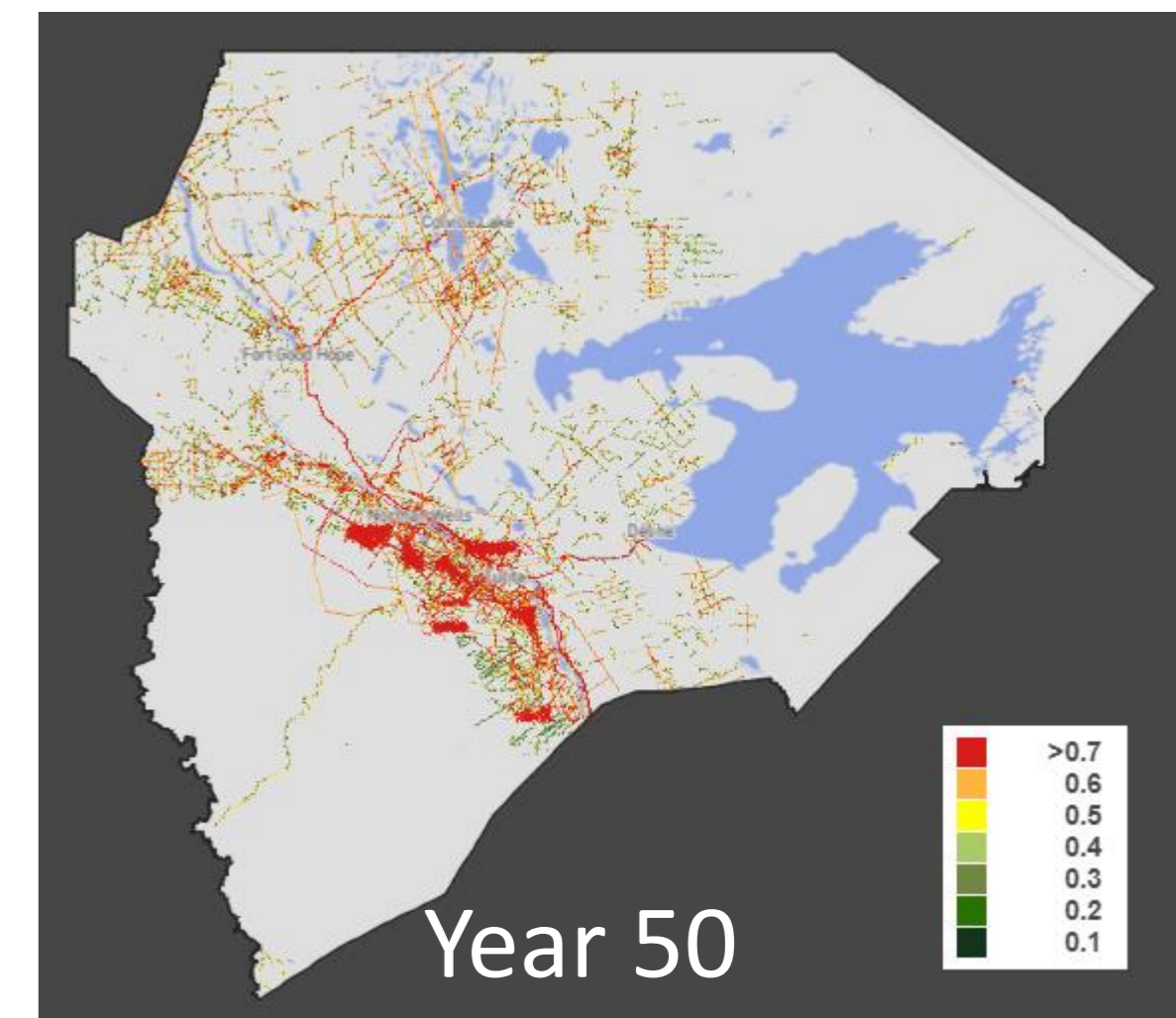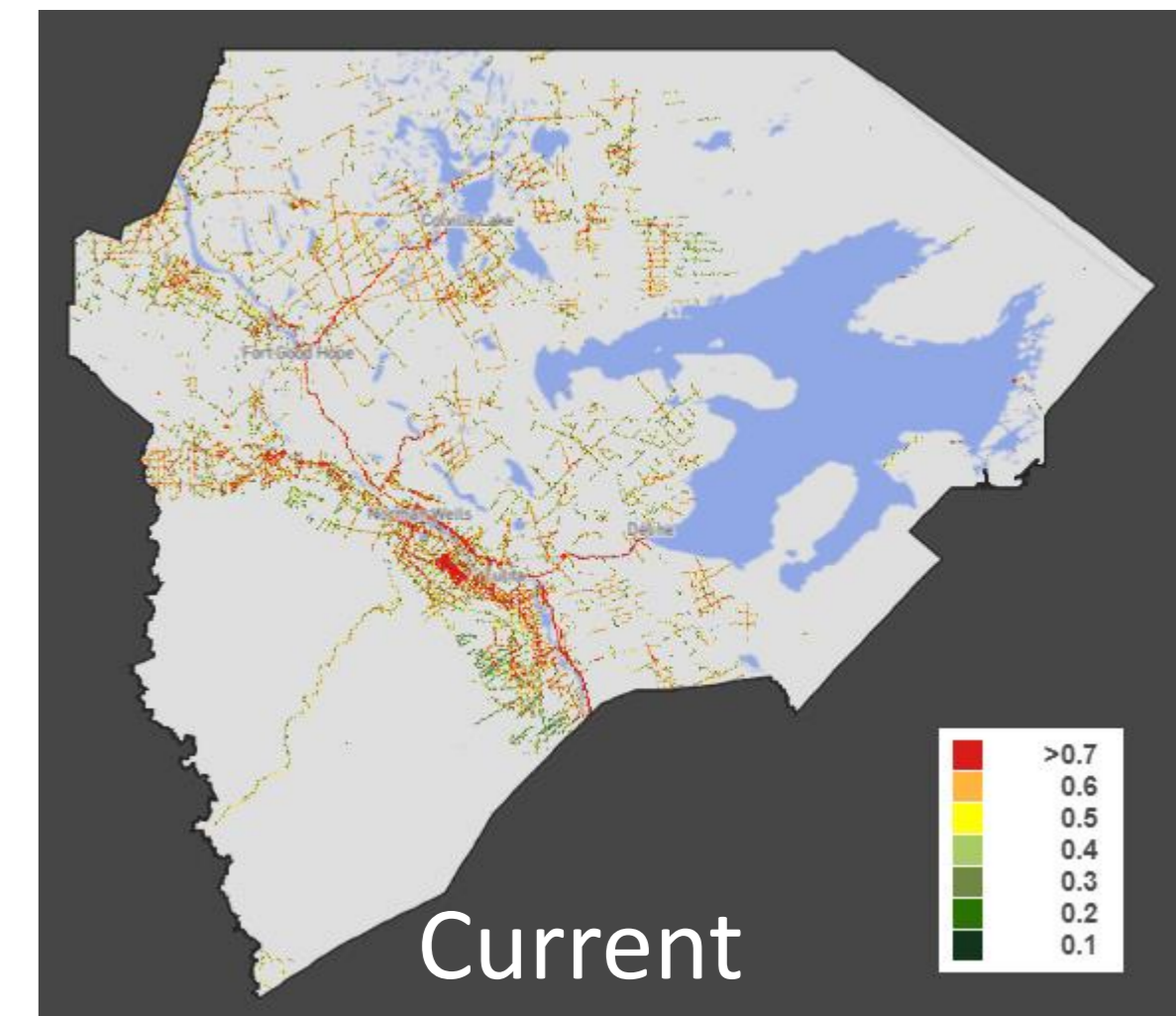## Landscape Disturbance by Land Use

### Summary of Results

Land-use footprint grew under simulations of energy development and seismic reclamation.



### Summary of Methods

- Current footprint inventory used
- Simulated land uses: settlements, oil and gas, mining, and transportation
- Projected development rate based on government and industry reports
- Scenarios simulated to incorporate varying levels of energy sector development


Current


Year 50

Landscape disturbance (%) by land use under moderate development scenario

## Summary of Results

Permafrost declined under climate change scenarios, increasing infrastructure risk.

## Summary of Methods

- Assessed future change in permafrost under climate scenarios. Used approach from Chadburn et al.[1]

*(Climate scenarios- RCP 2.6 (low GHG emissions), RCP 4.5 (intermediate GHG emissions), and RCP 8.5 (high GHG emissions). Mean annual temperature projections were downscaled from the CanESM2 climate model.)*

- An index of risk to infrastructure from permafrost melting was calculated.

*(The ratio of historical to future permafrost extent. Higher values indicate higher levels of permafrost melting and therefore greater risk. All footprint except for seismic lines and trails were included when assessing risk.)*

## Next Steps

- Explore opportunities to refine permafrost projection by incorporating terrain sensitivity.

*[1]Chadburn et al. 2017. An observation-based constraint on permafrost loss as a function of global warming. Natural Climate Change 7:340-345.*
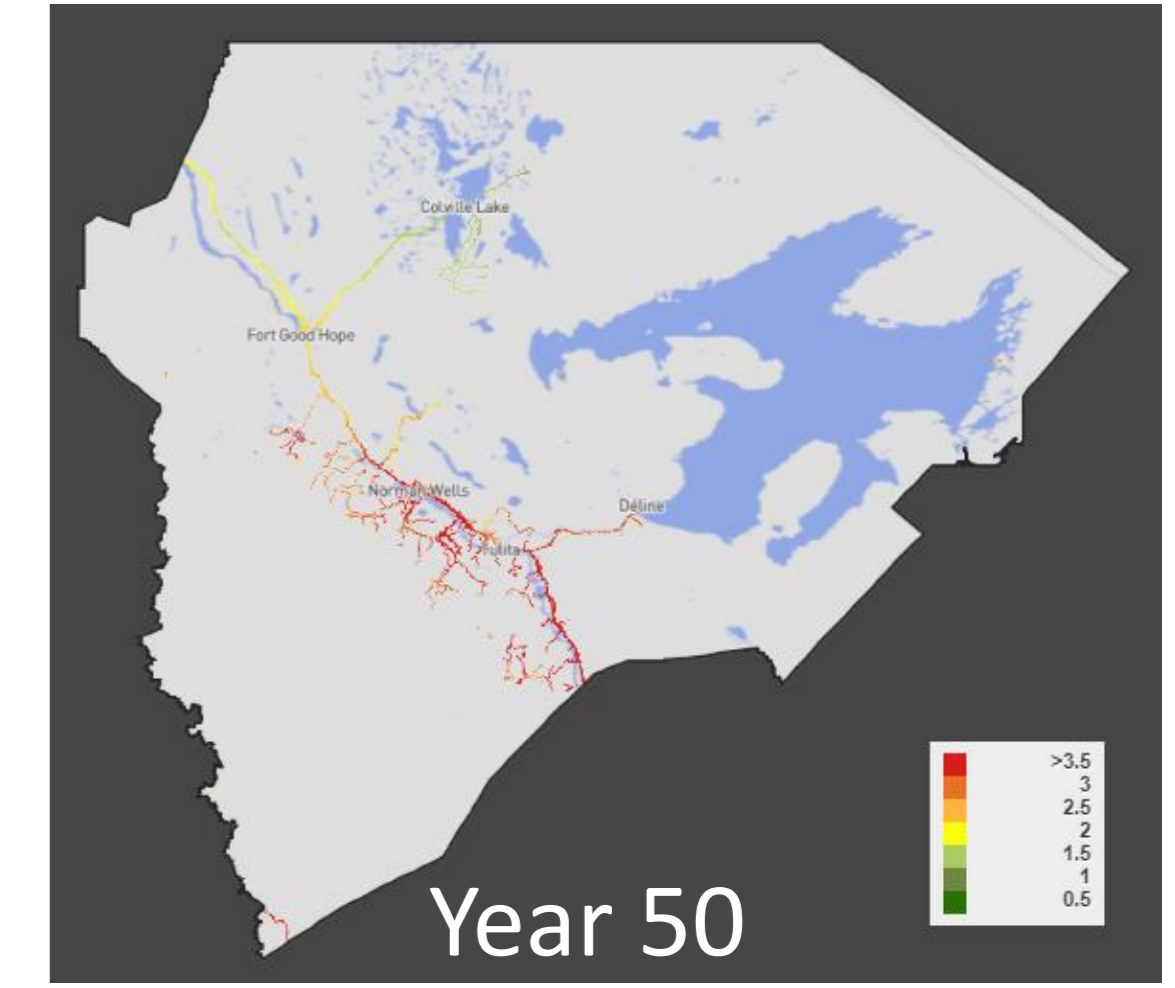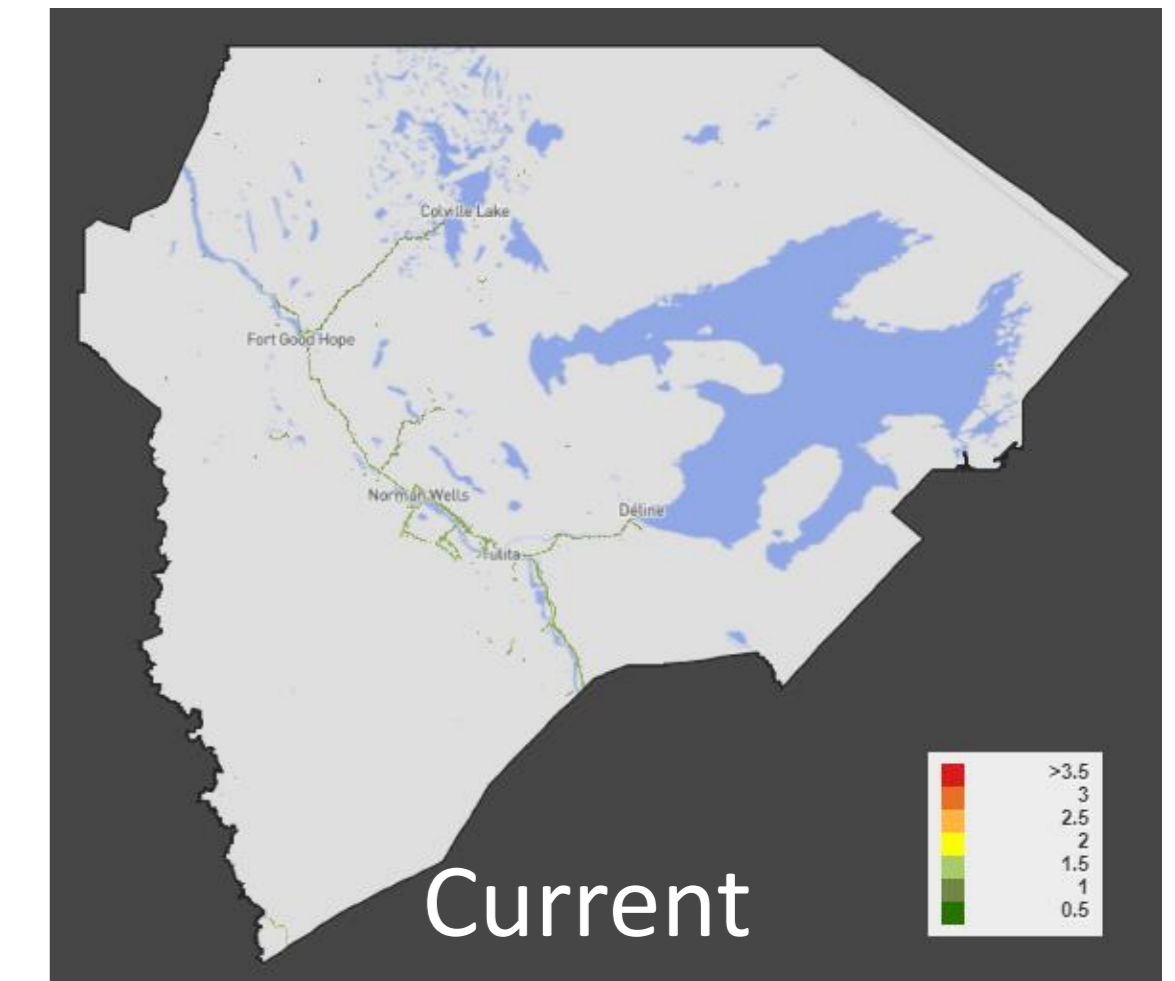
### Temperature
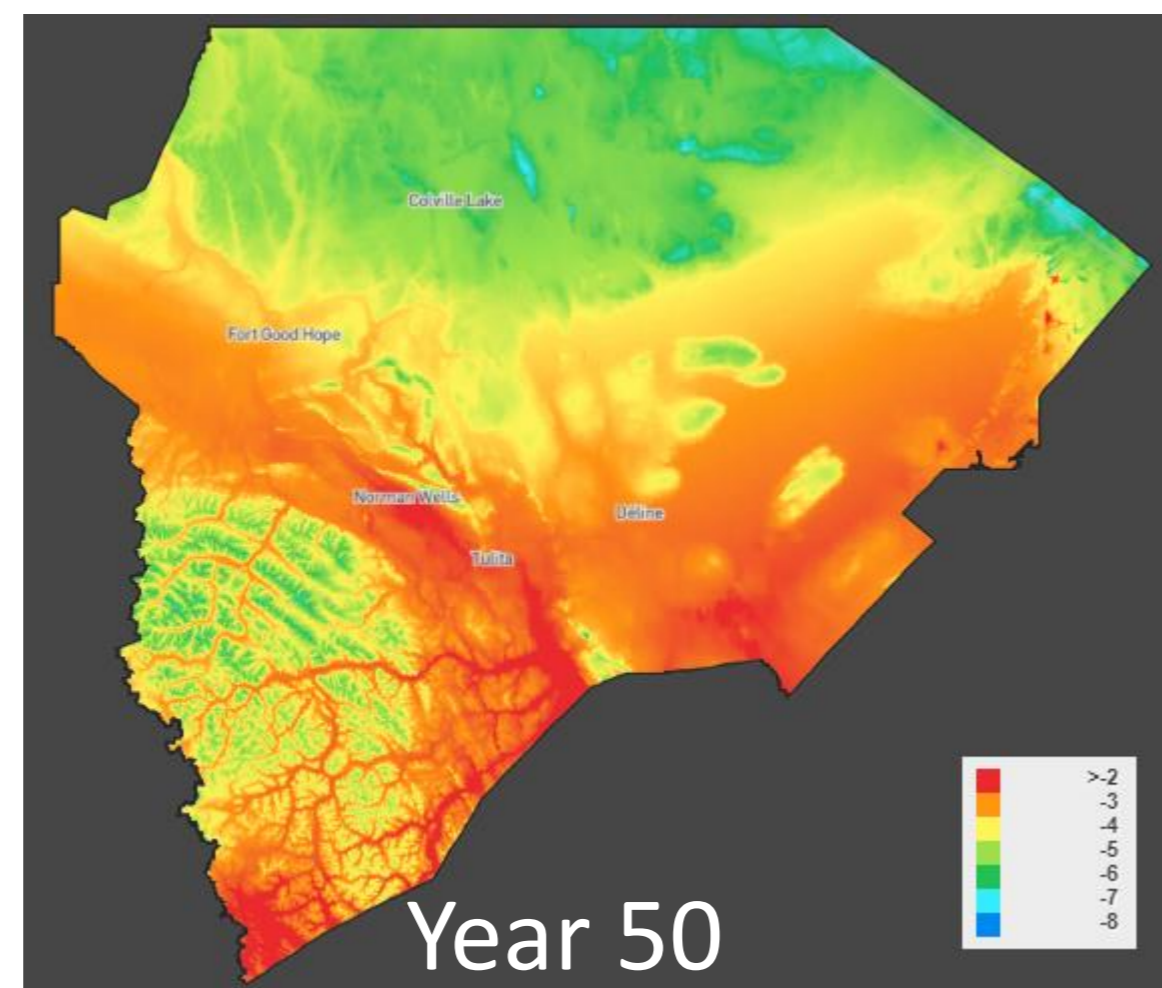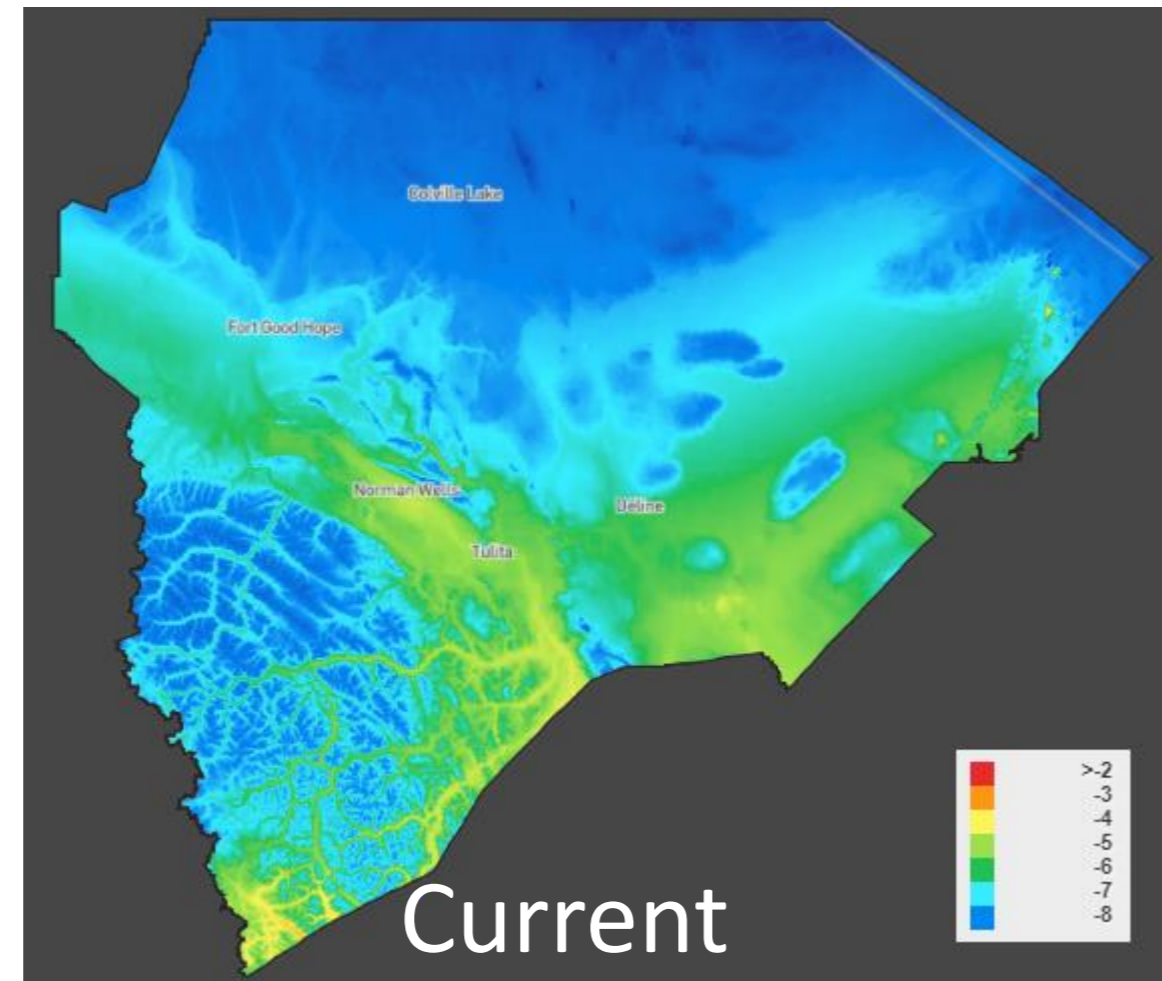


Current



Year 50

Annual **average temperature** (°C) at the start and end of a 50 year projection of climate scenario RCP 4.5. Red indicates higher temperature

### Permafrost
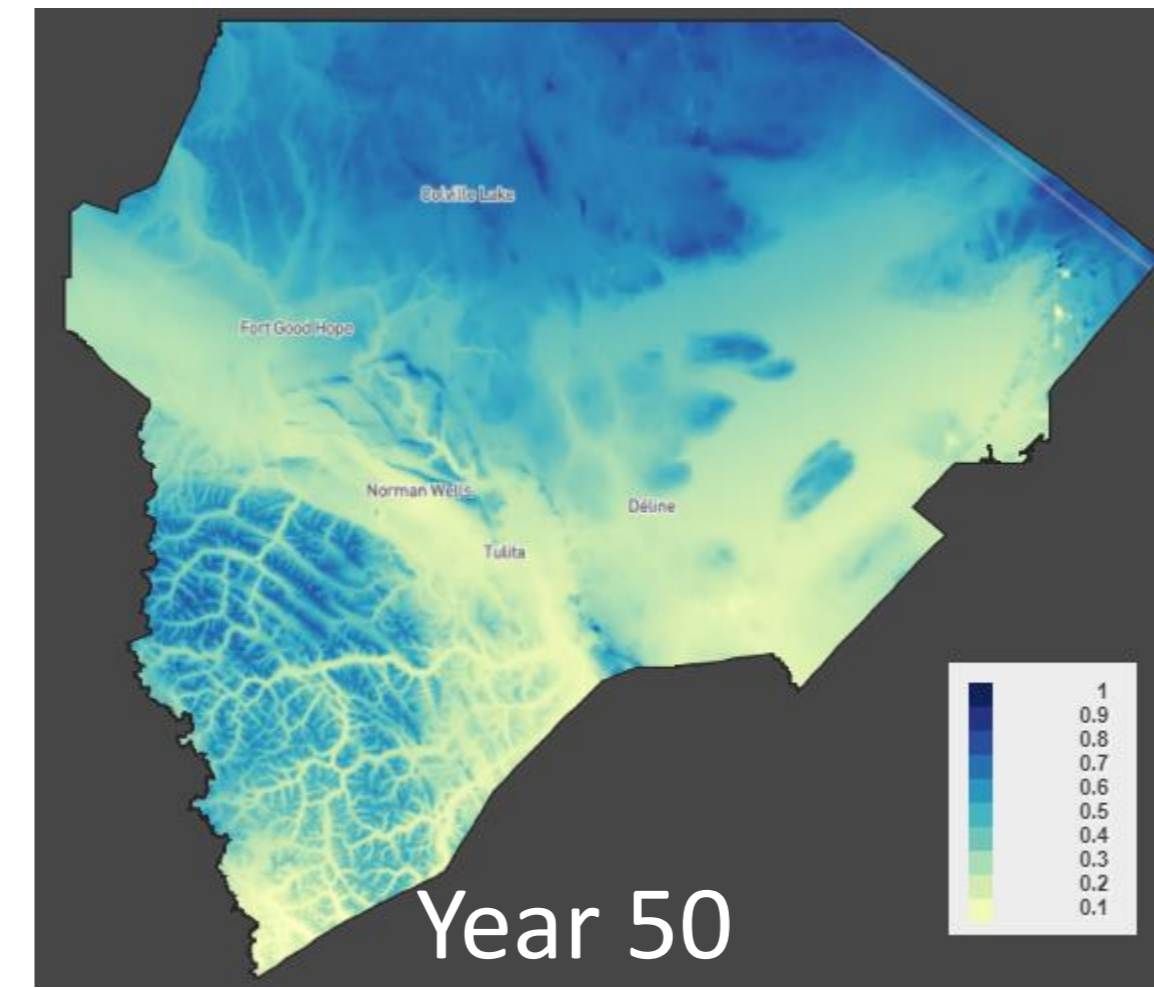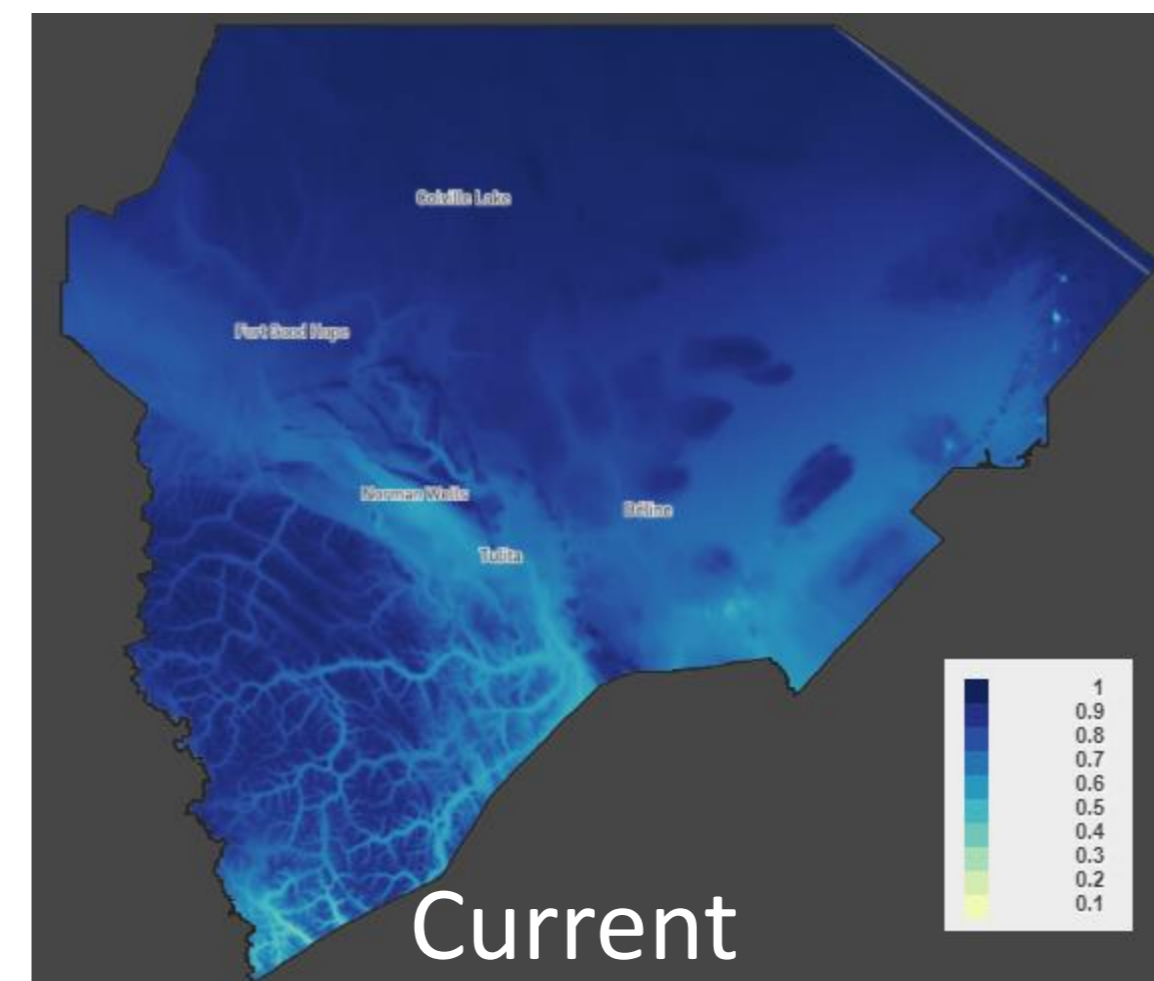


Current



Year 50

**Modeled permafrost** fraction at the start and end of a 50 year climate projection under climate scenario RCP 4.5. Blue indicates more permafrost.

### Infrastructure Risk



Current



Year 50

**I**nfrastructure risk index at the start and end of a 50 year projection of climate scenario RCP 4.5 and high development. Red indicates higher risk to infrastructure from permafrost melting.
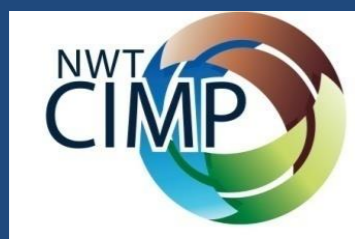
# Woodland Caribou (Todzi)

## Caribou Range Disturbance
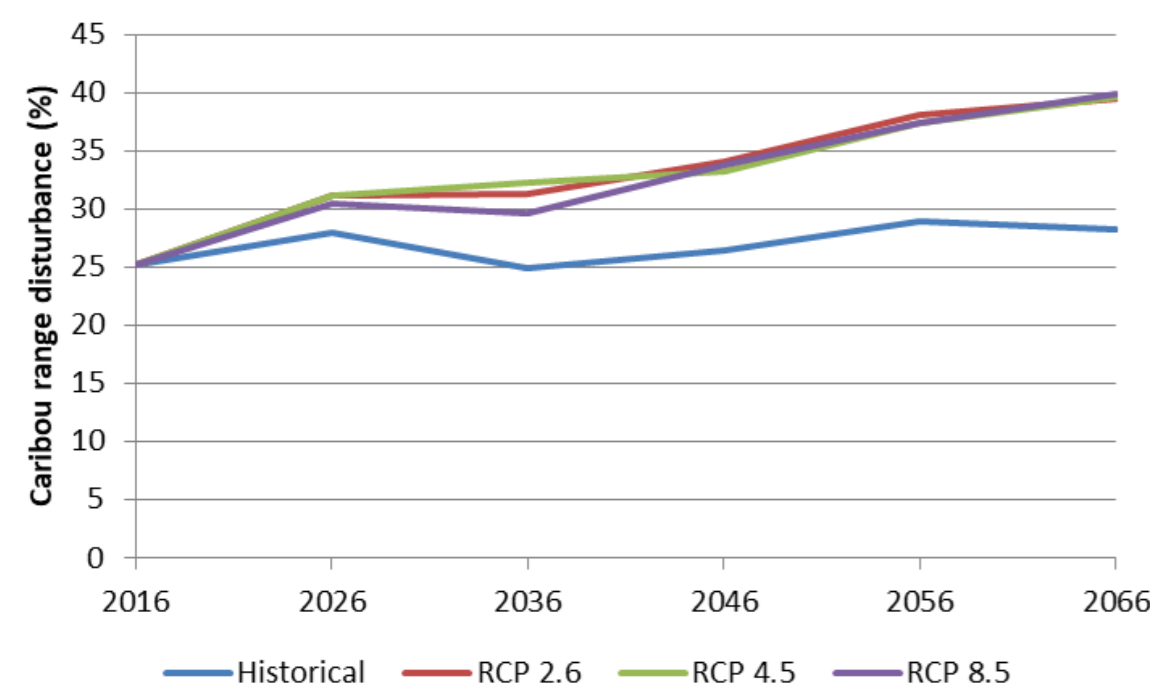
### Summary of Results

- Caribou range disturbance was more sensitive to fire scenarios than development scenarios
- Risk of herd extirpation increases with increased range disturbance. 35% range disturbance is identified in the national recovery strategy as a critical habitat threshold
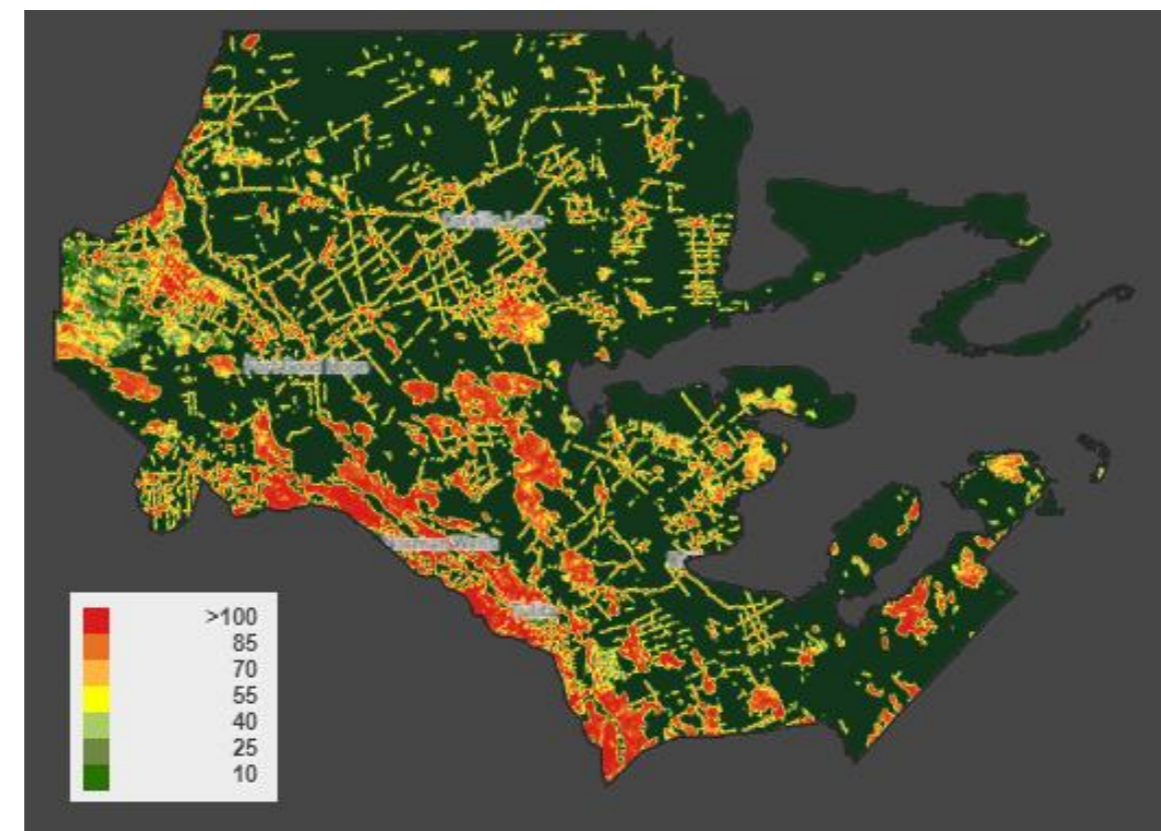
### Summary of Methods

- Calculated range disturbance from simulated landscape composition. *(Disturbance equals area within 500 m of land use footprint or disturbed by fire in the past 40 years)*

### Next Steps

- Review range disturbance calculation. Human disturbance may be exaggerated.


Current


Year 50
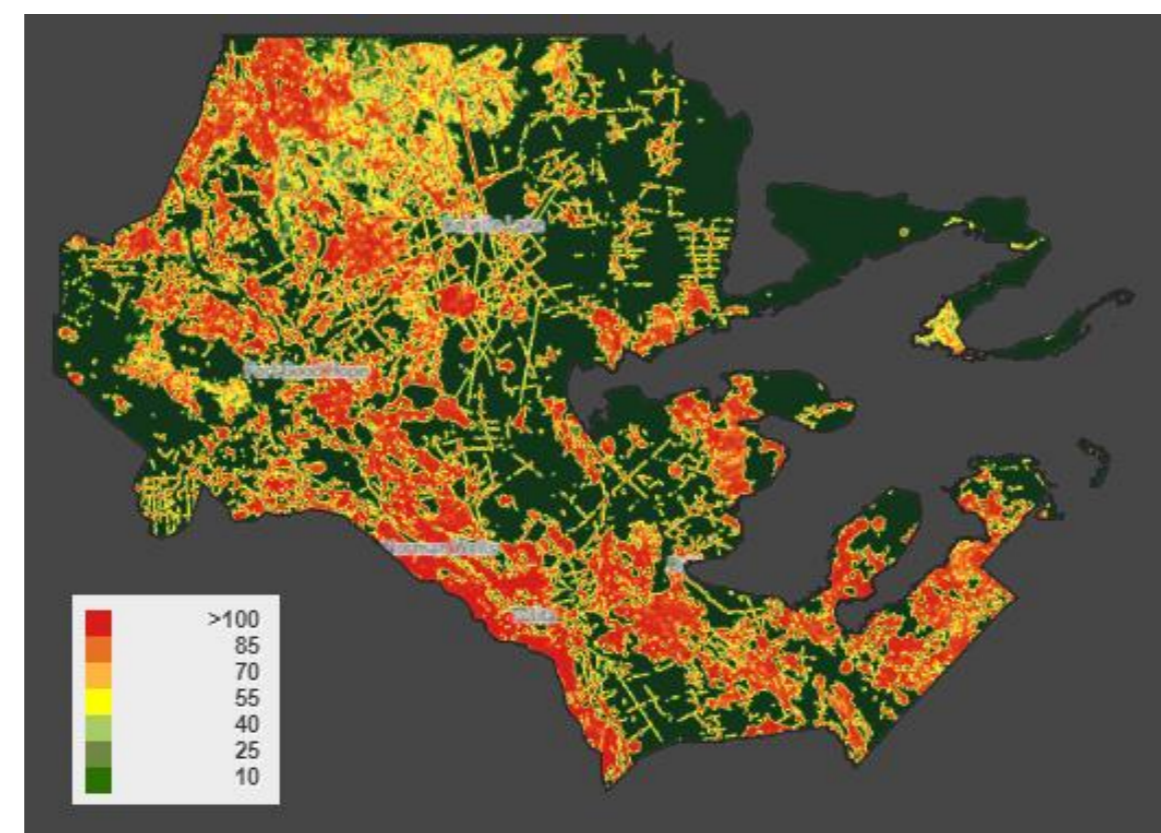


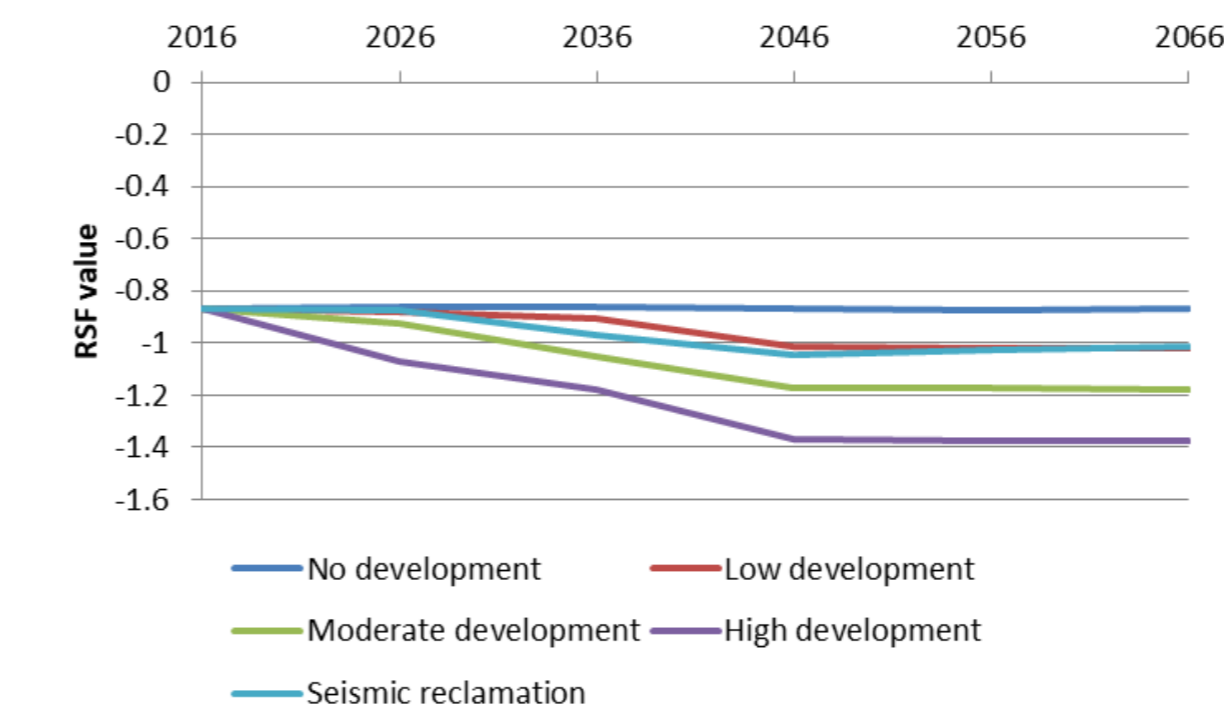Woodland caribou range disturbance under moderate development and fire under climate scenario RCP 4.5

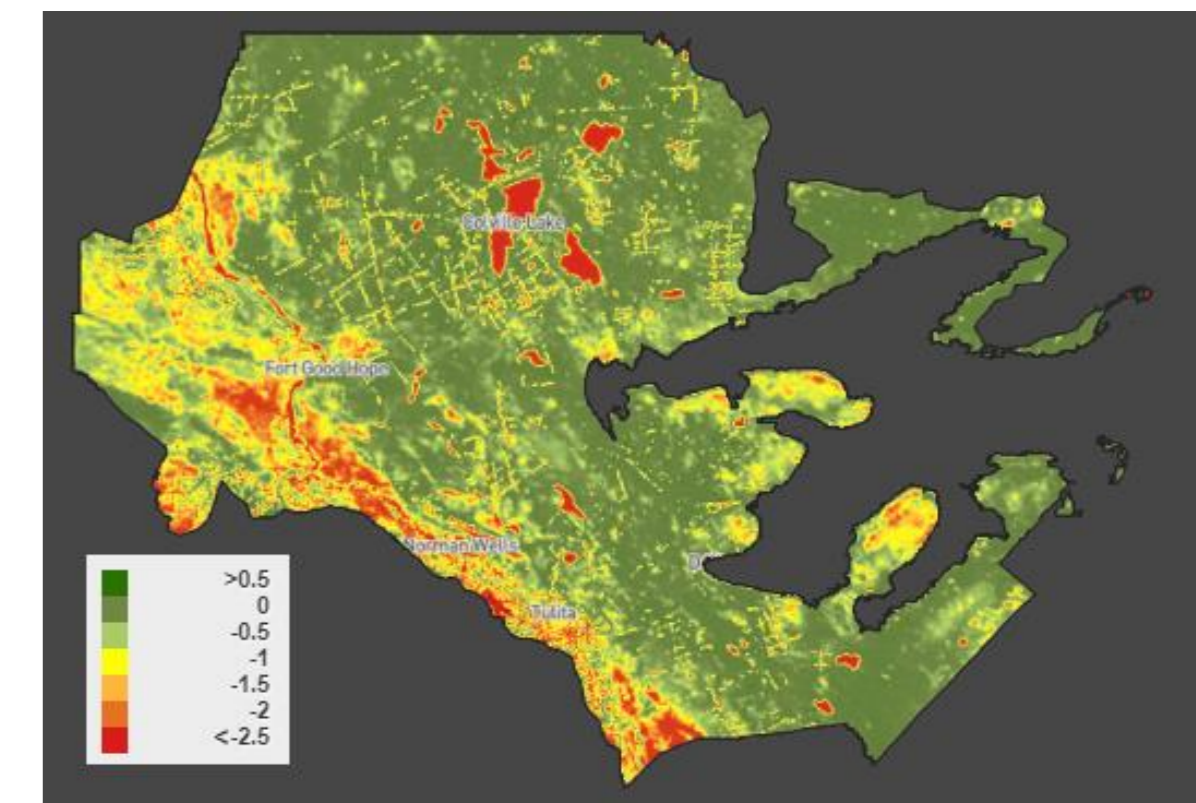## Resource Selection Function (RSF)

### Summary of Results

- Caribou habitat selection was more sensitive to development scenarios than fire scenarios. Overall, however, habitat selection was insensitive to simulated landscape disturbance.
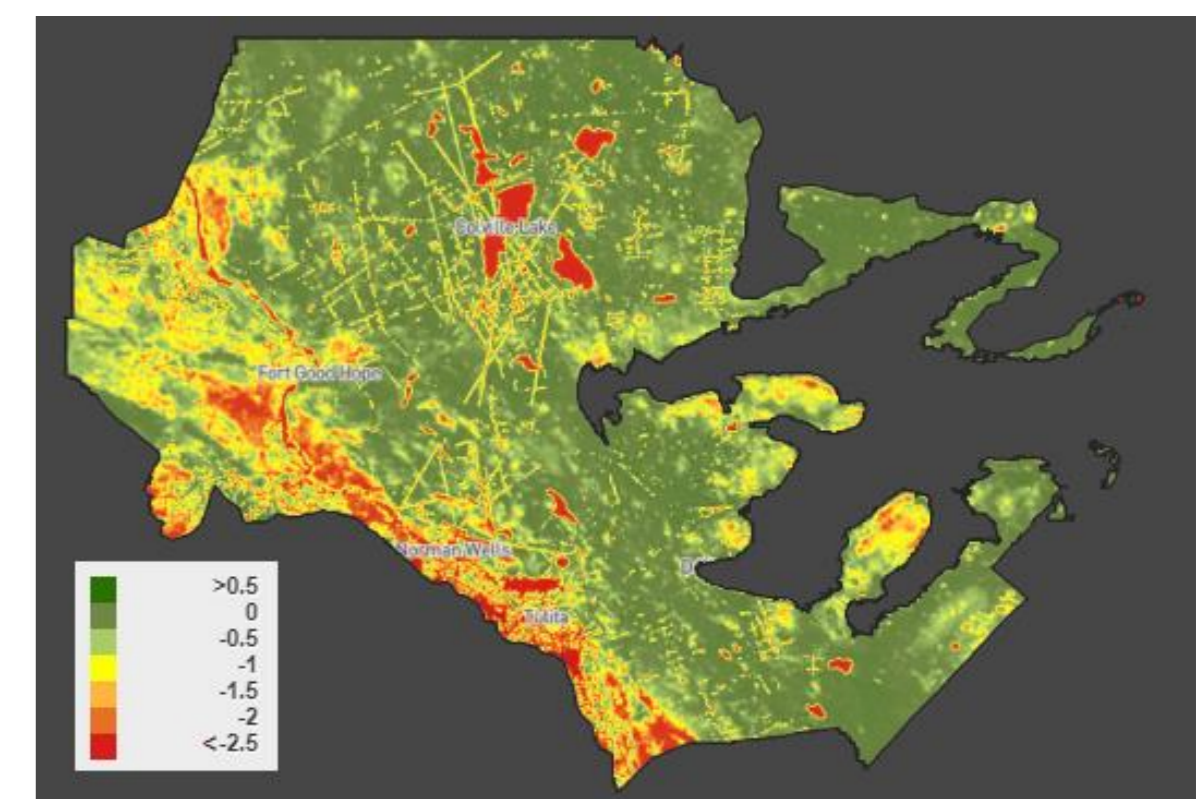
### Summary of Methods

- The RSF describes selection of winter habitat by woodland caribou at the scale of home ranges. Higher values indicate higher selection by caribou.
- The RSF was affected by footprint and fire and other variables such as productivity and elevation.
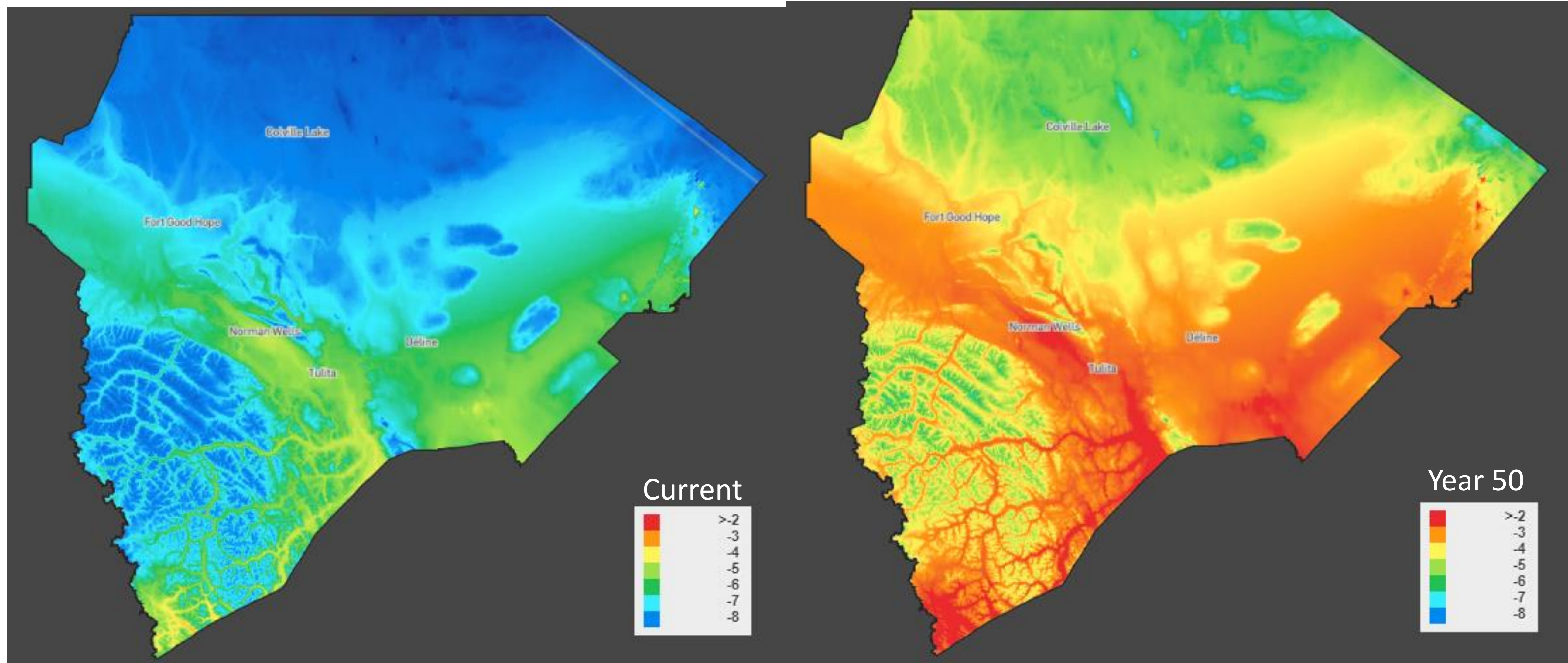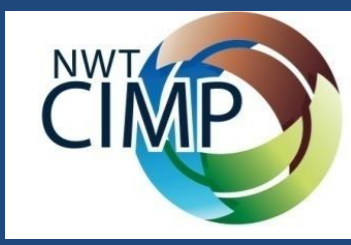- RSF was developed by Stantec Consulting for the Government of NWT
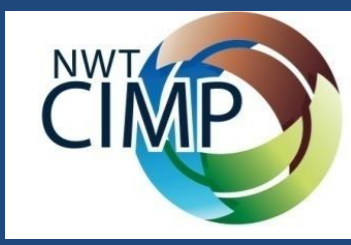

Current


Year 50



Woodland caribou resource selection under moderate development and fire under climate scenario RCP 4.5
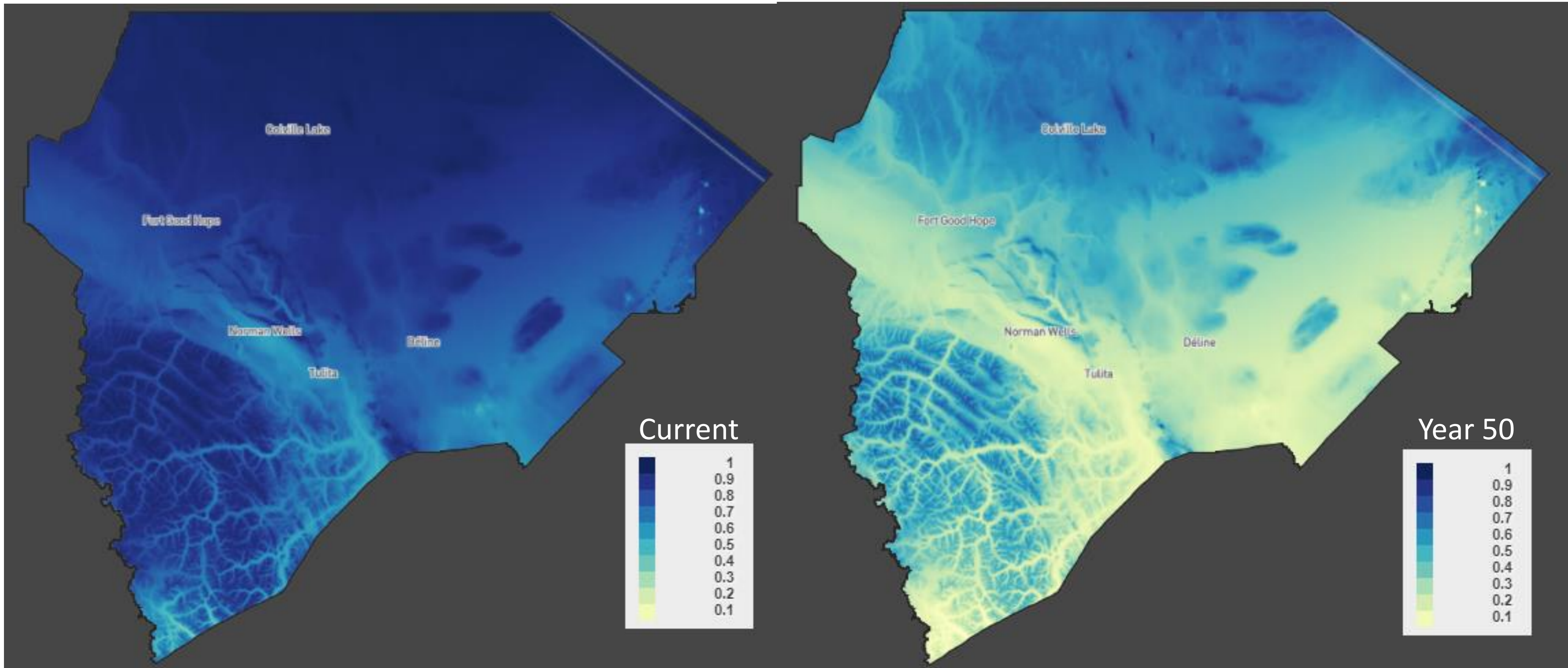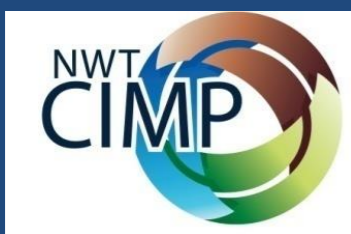
# Sahtu Temperature Change



Annual **average temperature** (°C) at the start and end of a 50 year projection of climate scenario RCP 4.5.
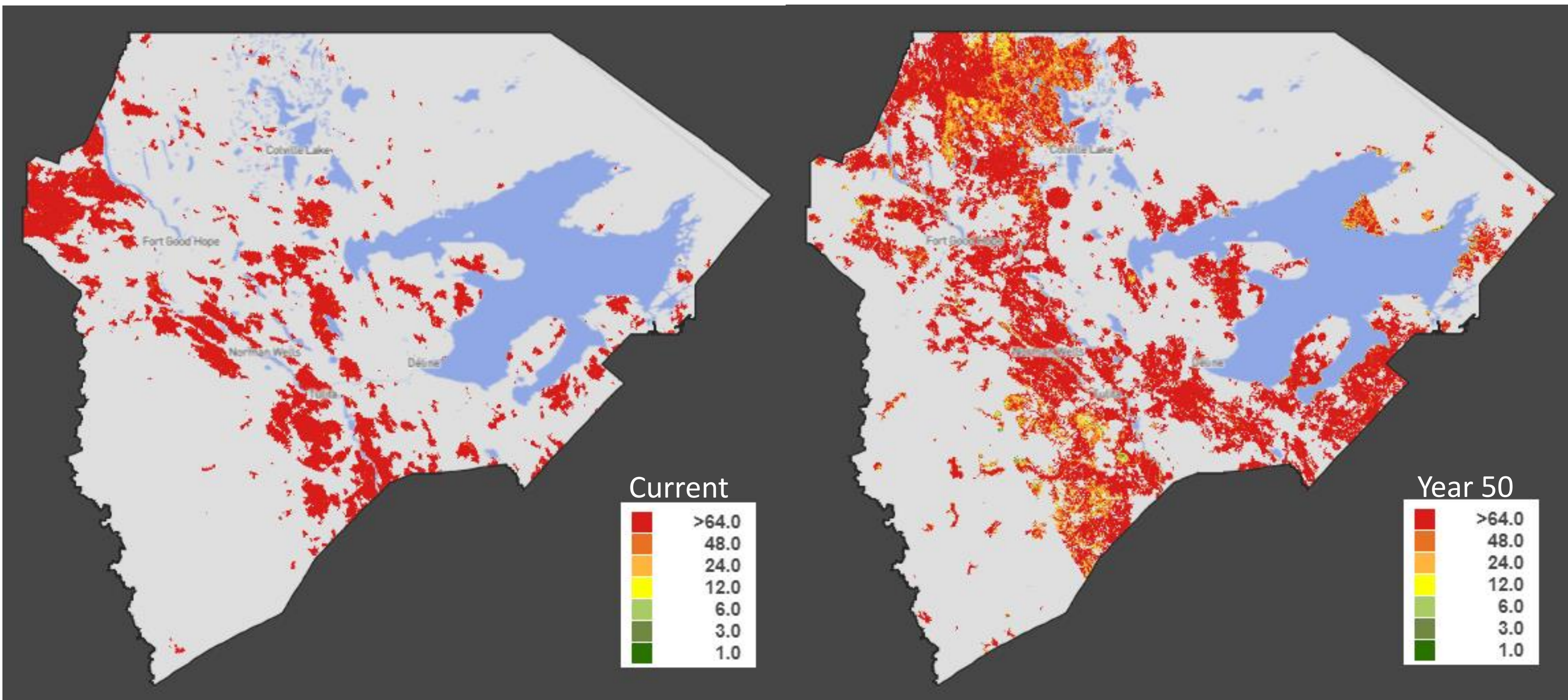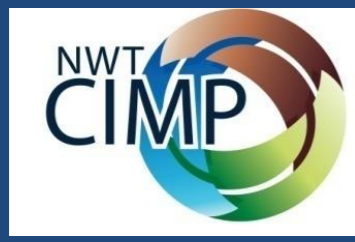Red indicates higher temperature

# Sahtu Permafrost Change



**Modeled permafrost** fraction at the start and end of a 50 year climate projection under climate scenario RCP 4.5.
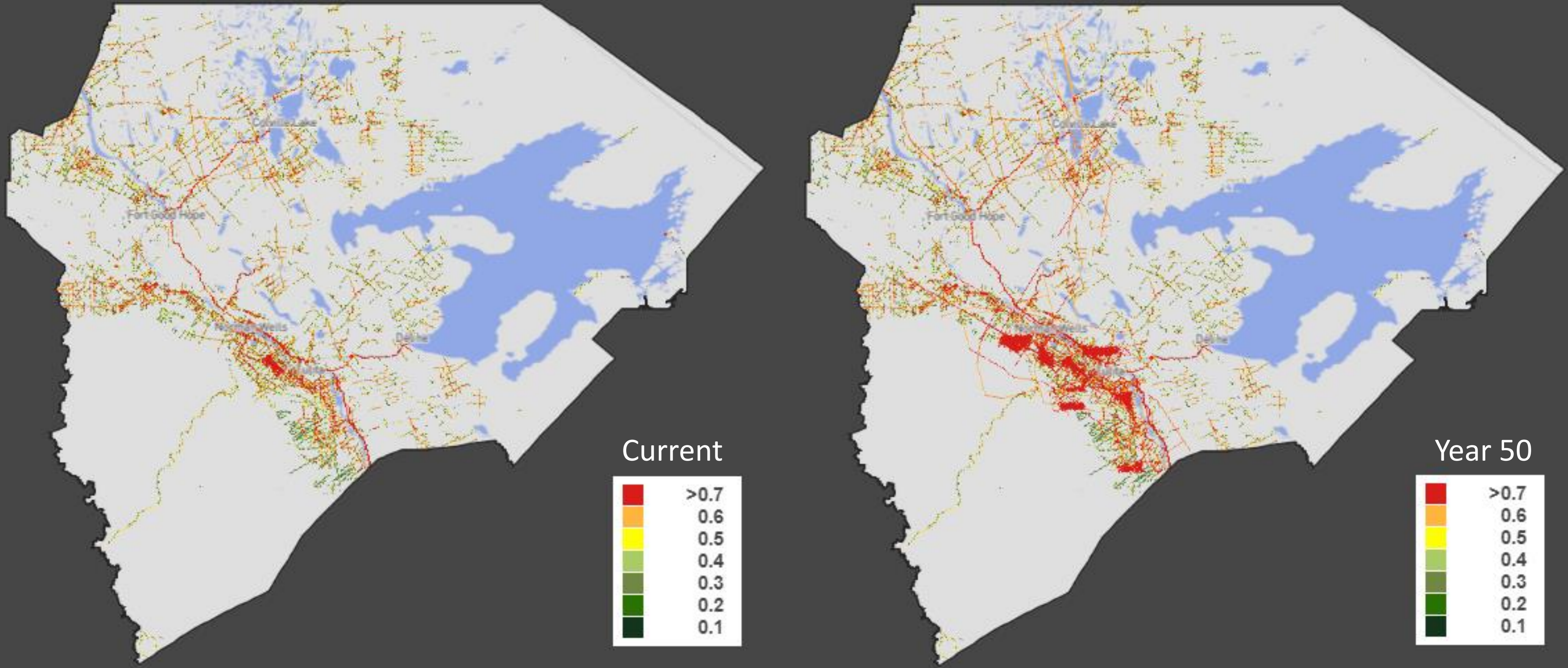Blue indicates more permafrost.
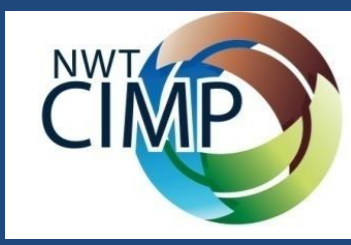
# Sahtu Fire and Forest Age Change



Landscape disturbance (%) by fire within past 40 years under climate scenario RCP 4.5.
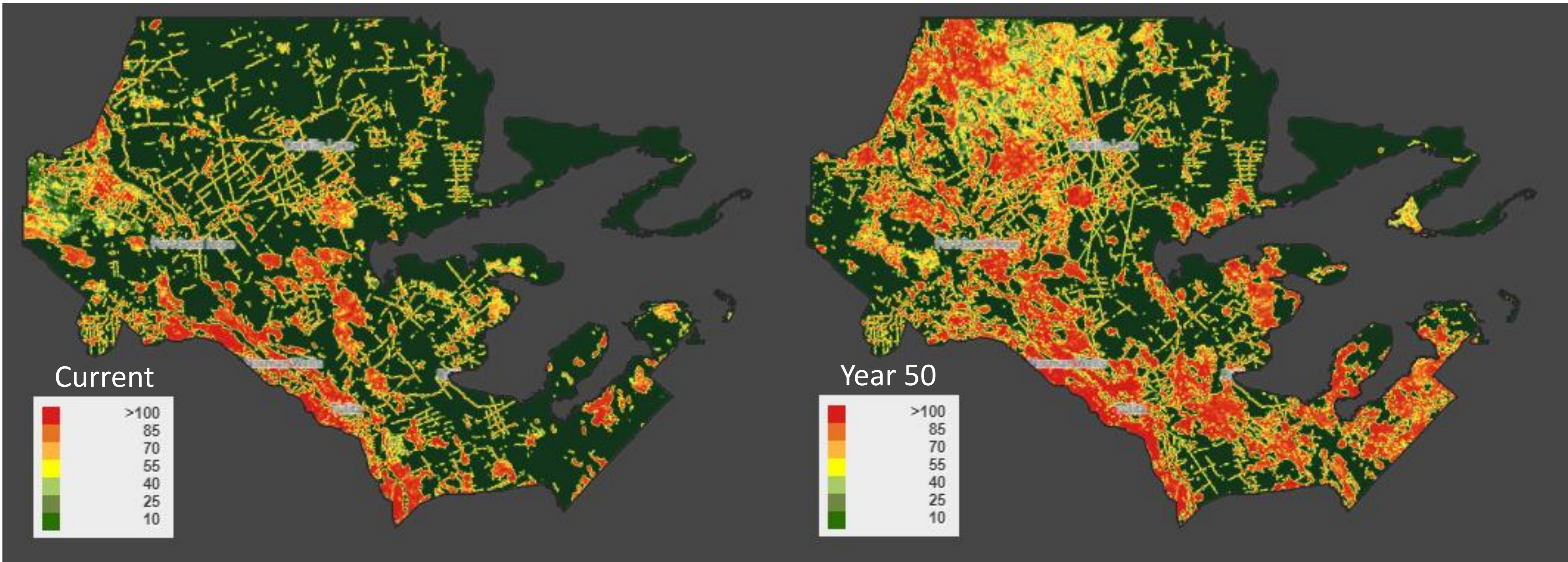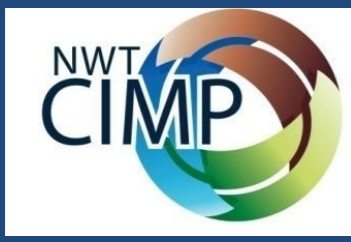
# Sahtu Land Use Change



Landscape disturbance (%) by land use under moderate development scenario
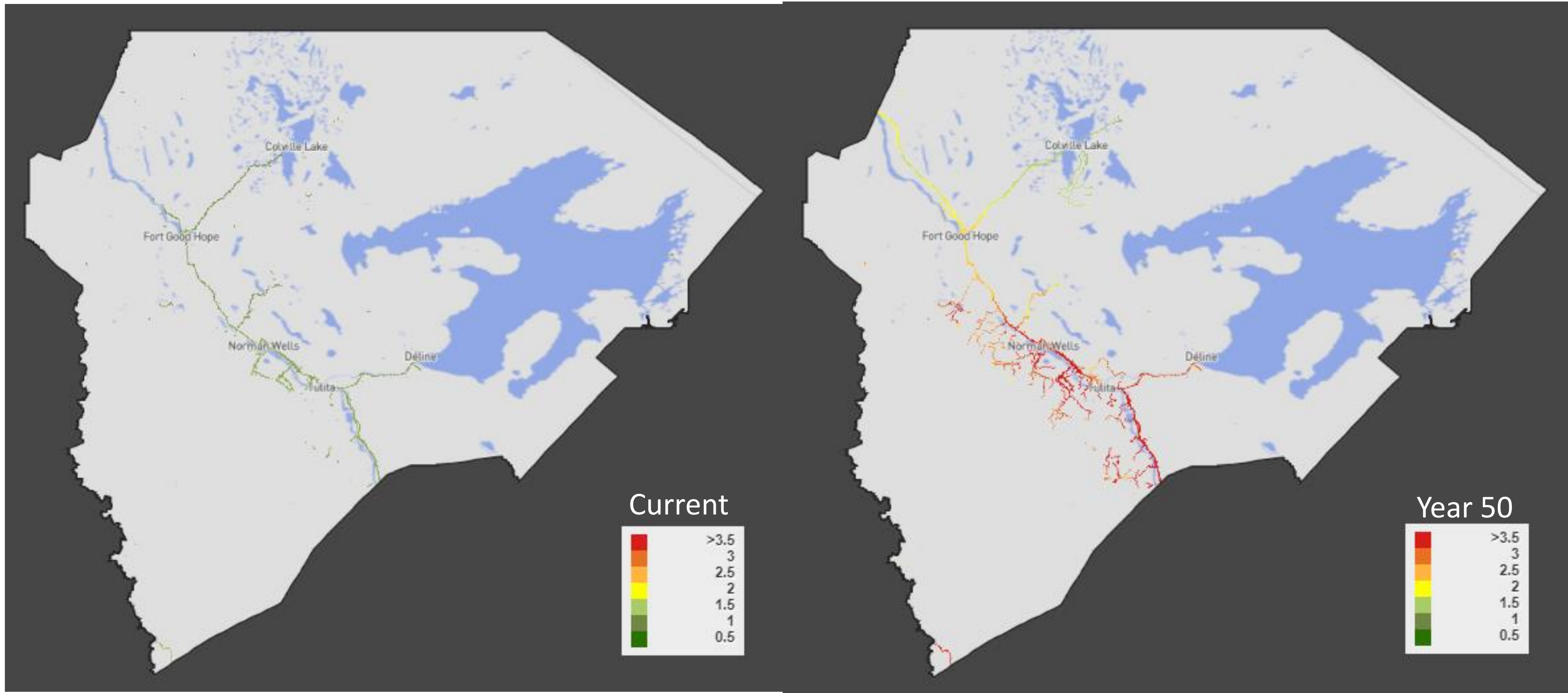
# Woodland Caribou (Todzi) Range Change



Woodland caribou range disturbance from fire and development under moderate development and fire under climate scenario RCP 4.5. Red indicates higher range disturbance.

# Sahtu Infrastructure Risk

**Current**

| | |
|---|---|
| ![red] | >3.5 |
| | 3 |
| | 2.5 |
| | 2 |
| | 1.5 |
| | 1 |
| | 0.5 |

**Year 50**

| | |
|---|---|
| ![red] | >3.5 |
| | 3 |
| | 2.5 |
| | 2 |
| | 1.5 |
| | 1 |
| | 0.5 |

**Infrastructure risk** index at the start and end of a 50 year projection of climate scenario RCP 4.5 and high development. Red indicates higher risk to infrastructure from permafrost melting.