

# Wetland Status, Change, and Seasonal Inundation Dynamics for Assessing the Vulnerability of Waterfowl Habitat within the ABoVE Study Domain

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## Project Summary

**Project Goals:** Characterize changes in waterfowl habitat using remote sensing approaches developed from field, airborne, and satellite data collected during the ABoVE research campaigns, including the ABoVE Airborne Campaigns of 2017 and 2018.

Provide data for understanding impacts to natural resources valuable to local/aboriginal communities (e.g. waterfowl hunting) and to inform regional-scale land and waterfowl management policies and practices.

### Project Objectives:

**Objective 1:** Develop wetland type and surface inundation products for the ABoVE boreal region based on remote sensing approaches developed by the research team. The methods utilize advanced remote sensing capabilities of SAR and optical systems. We will use ABoVE field and remote sensing data, including data collected for the ABoVE Airborne Campaigns of 2017, 2018, and new collections through the summer of 2021.

**Obj. 1a: Wetland Type:** Extend mapping within northern Canada using hybrid Electro-optical (EO) and Synthetic Aperture Radar (SAR) methods developed by the research team. We will extend the efforts underway for the previous MTU ABoVE projects, related NASA IDS research, and ongoing DUC efforts to map wetland type across high waterfowl use areas (Figure 1).

**Outcome:** Extended maps of wetland type for two focus regions where waterfowl resources are vital components of indigenous peoples' livelihoods.

**Obj. 1b: Inundation:** Refine and validate L-band SAR wetland inundation mapping algorithm for the boreal region of ABoVE. We will use existing wetland inundation mapping methods developed by Co-I Chapman (Chapman et al. 2015) to develop and validate wetland inundation maps.

**Outcome:** Development of boreal-specific inundation products from L-band SAR to monitor seasonal wetland dynamics.

**Objective 2: Waterfowl habitat suitability assessment:** Use products developed in Objective 1 on wetland type, change, and inter- and intra- annual inundation dynamics to assess the utility and additive value of remote sensing-derived products for assessing spatial and temporal dynamics in habitat suitability based on waterfowl abundance metrics.

**Outcome:** Demonstrated use of products developed under Objective 1 to advance our ability to model long-term implications of wetland habitat changes for sustainability and distribution of waterfowl populations.

The expectation is that improved wetland characterization will be useful for forecasting habitat suitability and, hence, waterfowl distribution and trends under climate change. We will test this approach in the Mackenzie River Delta region, Peace-Athabasca Delta and Slave River Delta regions of Canada (Figure 1), which are high waterfowl use areas with long temporal records of waterfowl breeding population data, remote sensing information (satellite and aerial, including 2017/18 ABoVE Airborne Campaigns), and current partnerships with indigenous communities.

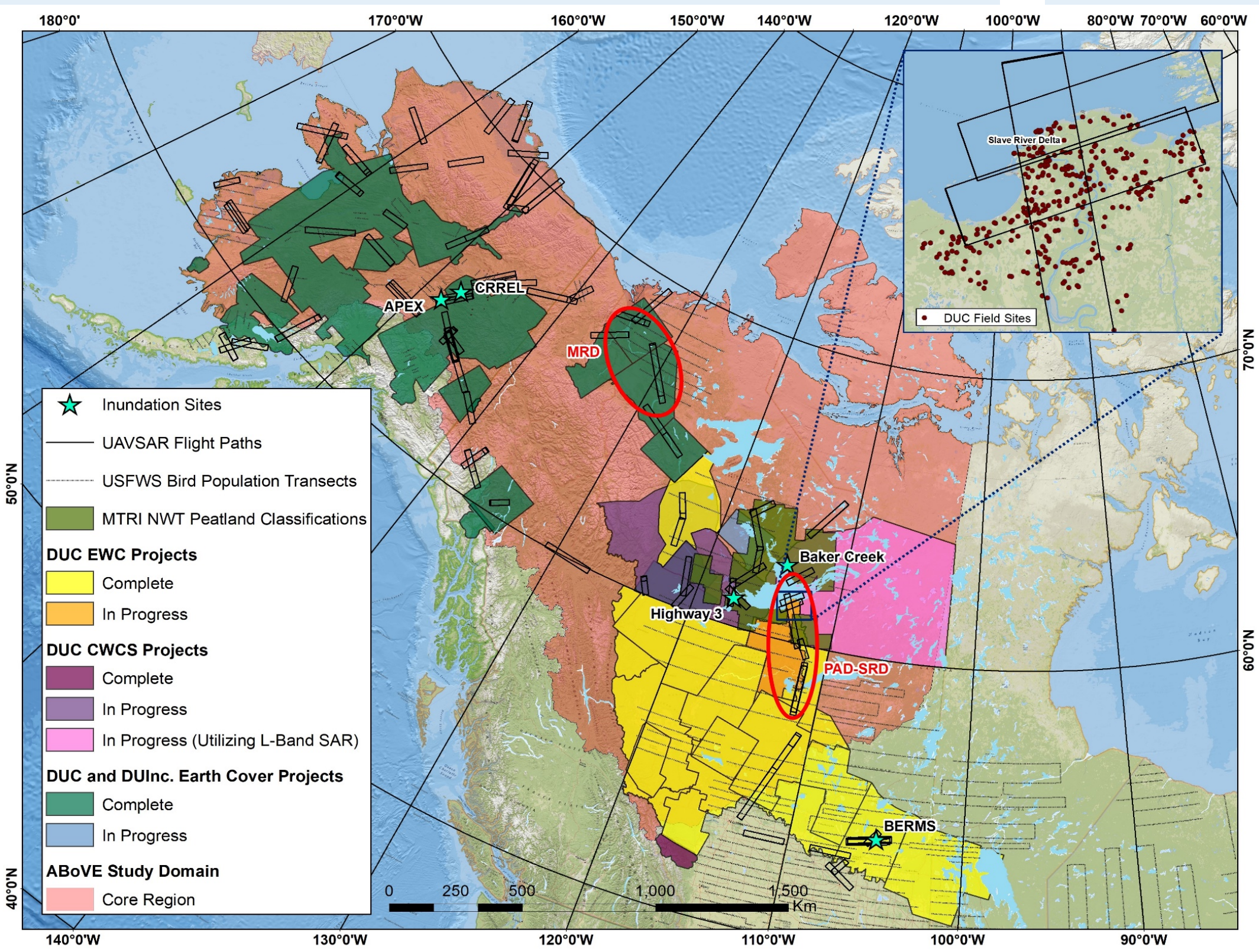
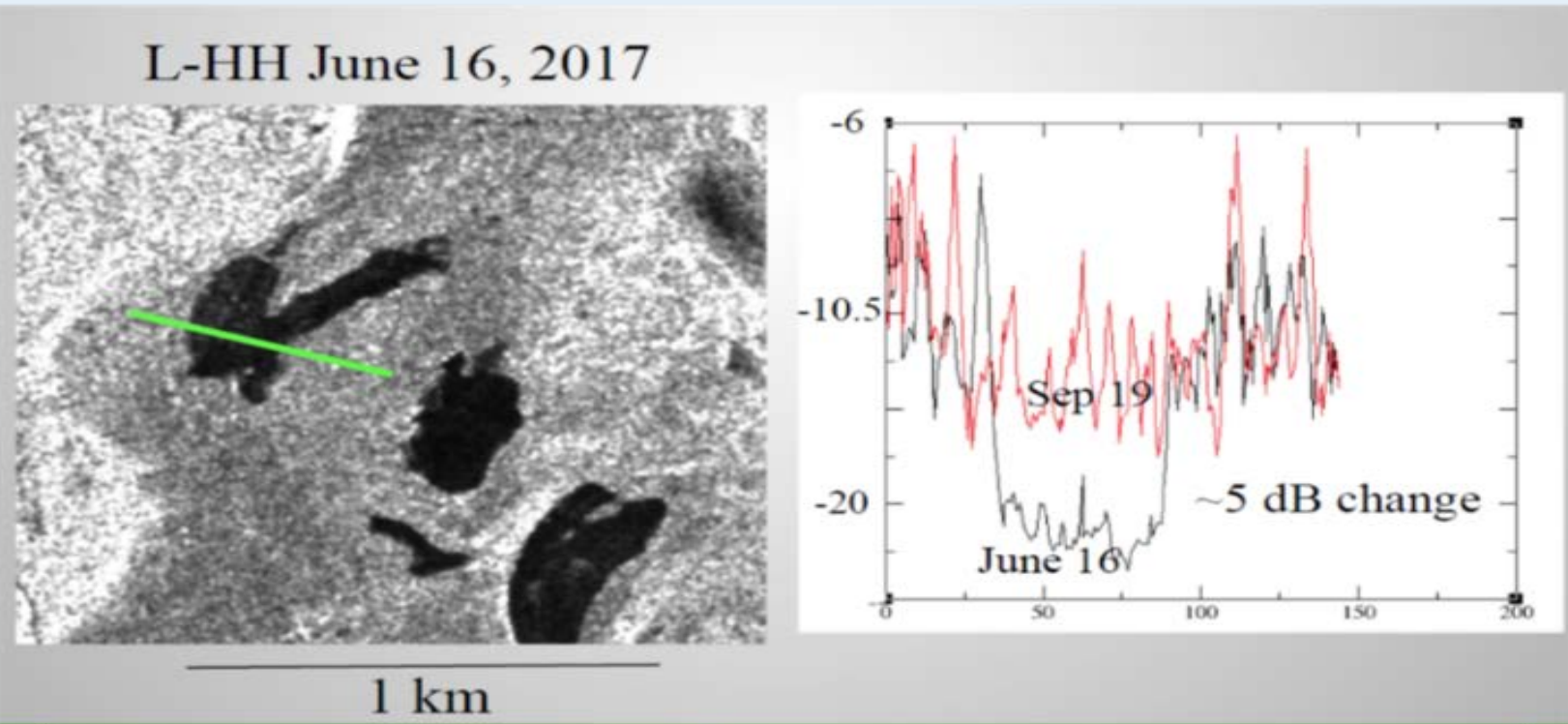


Figure 1: ABoVE study domain with focus regions circled in red for wetland mapping, inundation monitoring, and waterfowl monitoring studies. Field validation data for inundation mapping is shown as blue stars. Example of DUC waterfowl field data collection locations for the Slave River Delta are shown in the inset map.

## Data and Methods

### Objective 1a: Methods to Map wetland types

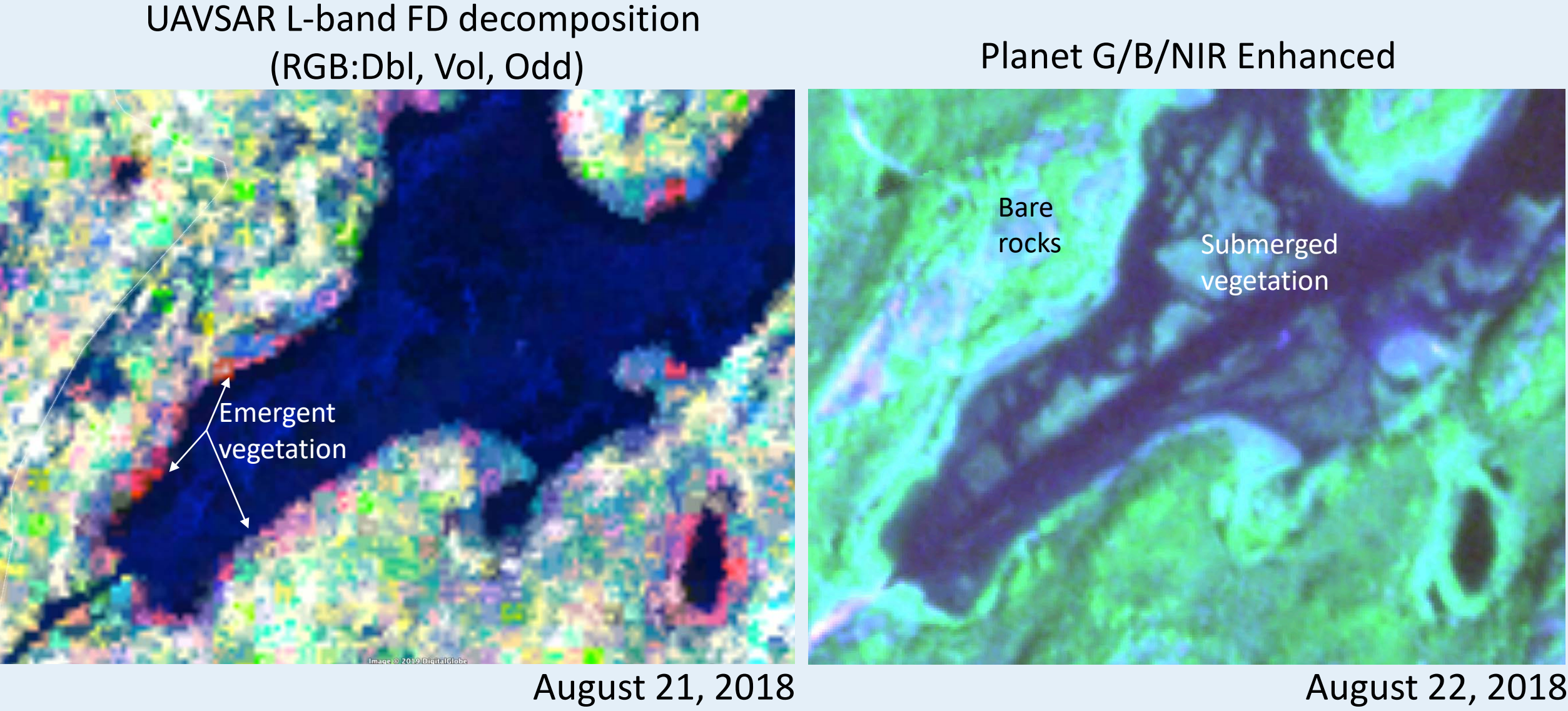
- Acquire SAR and EO data
  - Landsat Archive & Sentinel-2
  - L-band UAVSAR, Sentinel-1, Radarsat, & PALSAR
- Run SAR-EO algorithm for high waterfowl use areas
  - Methods from Bourgeau-Chavez et al., 2015, 2017
  - Incorporate other datasets (e.g. elevation, such as ArcticDEM)
- Field validation data collection
  - Utilize data from previous field campaigns
  - Additional data collection for the Mackenzie River



June 16, 2017 Inundated 1 m below top of vegetation  
September 14, 2017 Not inundated (dry) below top of vegetation

Figure 2: L-band SAR imagery of the wetlands at Bonanza Creek APEX site showing seasonal inundation dynamics.

### Baker Creek Field Site, NWT



### Project Collaborators

Stuart Slattery, Ducks Unlimited Canada, Edmonton, AB, Canada  
Jennifer Baltzer, Wilfrid Laurier University, Waterloo, ON, Canada  
Christopher Spence, Environment Canada, Saskatoon, SK, Canada

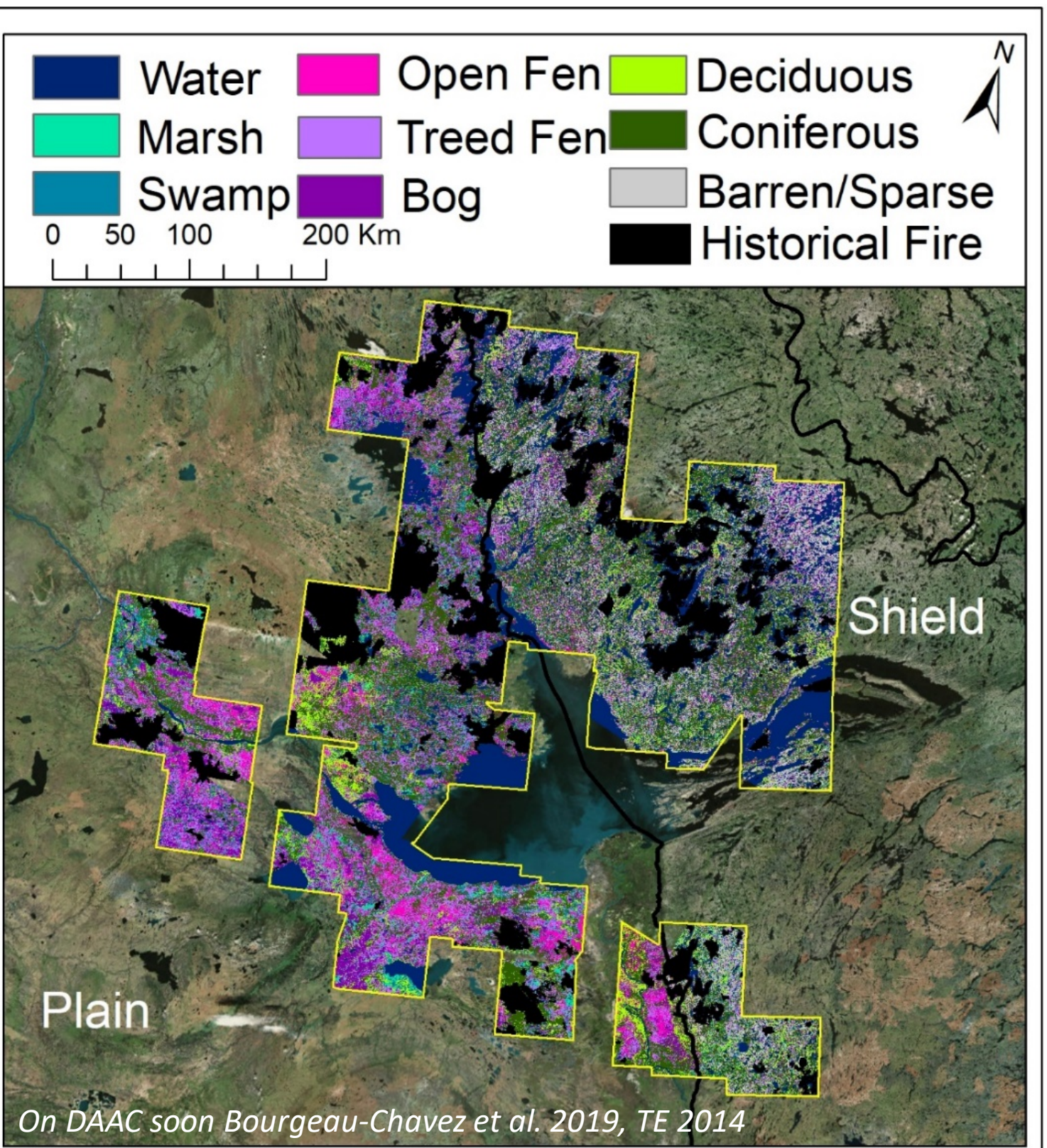


Figure 3: Example of MTRI ABoVE region land cover maps (Bourgeau-Chavez et al. 2017, 2019)

### Objective 1b: Develop an advanced wetland inundation mapping algorithm

- Collect field data for inundation algorithm refinement and validation
- Analyze airborne SAR data: Quad-pol SAR data of selected wetlands from UAVSAR
- Acquire and analyze a time sequence of SAR data
- Develop classification of inundation extent products from the L-band SAR data

## Outcomes and Project Significance

- Build on the expertise of DUC team members and linkages to land management agencies to develop a much improved assessment of regional waterfowl habitat characteristics and assessment of potential changes through modeling activities.
- Contribute in a significant way to regional and local scale biodiversity studies by developing an ability to use remote sensing to inform habitat models and industrial impact assessments for flora and fauna reliant on wetland habitats, including resident and migratory songbirds and shorebirds, ungulates (caribou and moose), small mammals (beaver, muskrat), and amphibians.



- Connect to the Northern Water Futures project and efforts underway by Environment Canada through explicit collaborations and planning coordination.

### DUC Wetland Mapping & Associated Products and Activities

#### Objective 2: Waterfowl habitat suitability assessment

- Prepare datasets for waterfowl abundance models
- Develop, test, and run waterfowl abundance predictive models
- Generate spatial maps of predicted waterfowl abundance

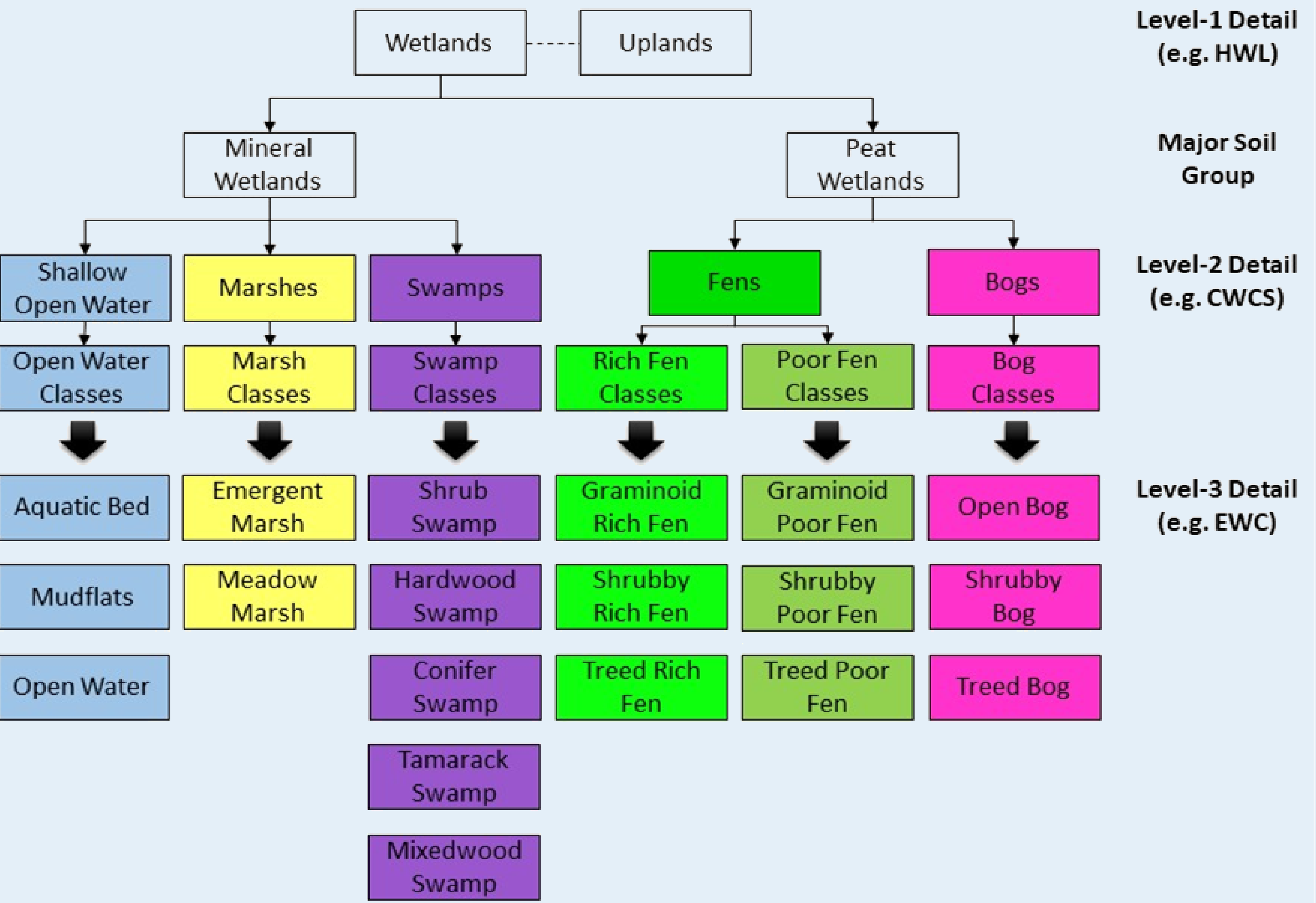


Figure 4: Enhanced Wetland Classification (EWC) and Canadian Wetland Classification (CWCS) classes used in DUC wetland classification maps.