NAIT BOREAL RESEARCH INSTITUTE

TRAINING PROGRAM
SEPTEMBER 21-23, 2016
CHATEAU NOVA, PEACE RIVER, ALBERTA

Alberta Peatland Criteria – Field Training School 2016

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FOREWORD

This field school is a follow-up to the "Peatland Criteria" pre-workshop at the 2016 Alberta Soil Science Workshop in Grande Prairie, February 2016. Dr. Dale Vitt and Susan McGillivray were invited to give an overview on the criteria development and the scientific basis for application and implementation. A resounding consensus after the pre-workshop in Grande Prairie was the need to provide hands-on training for practitioners both in terms of policy application and peatland scientific knowledge. Based on the feedback from attendees and strong requests from various organizations, I have taken the initiative and invited Dr. Dale Vitt, Susan McGillivray, and Dr. Kelman Wieder to help me put together a field training school to provide much-needed, hands-on peatland training for reclamation practitioners and professionals. The two days of in-house lectures and field training will cover topics from peatland and bryophyte ecology, peatland reclamation to criteria application, data collection and interpretation, and survey assessment. On behalf of the organizing committee, I sincerely welcome you to Peace River and hope this session will provide you with the basic peatland knowledge and practical skills in order to apply the criteria in your professional work.

Bin Xu, PhD
NSERC Industrial Research Chair – Peatland Restoration
Boreal Research Institute

PLANNING COMMITTEE

Bin Xu
Boreal Research Institute

Jeannine Goehing
Boreal Research Institute

Dale Vitt
Southern Illinois University Carbondale

Susan McGillivray
Alberta Environment and Parks

R. Kelman Wieder
Villanova University

PARTNERS AND SPONSORS

The Boreal Research Institute would like to thank the following organizations and all of our volunteers for their valued support and contributions.

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NAIT BOREAL RESEARCH INSTITUTE

GENERAL INFORMATION

REGISTRATION

WEDNESDAY, SEPTEMBER 21 | 12:00 – 1:30 PM | CHATEAU NOVA, ELK ROOM

Training Program and name badges will be distributed to all Field Training School participants.

The organizing committee would like to ensure that you enjoy your experience at the Field Training School and your visit to Peace River. Please do not hesitate to contact a committee member with questions and/or concerns. Committee members can be identified with a yellow name badge.

SOCIAL MIXER AND Q&A

THURSDAY, SEPTEMBER 22 | 8:00 – 10:00 PM | CHATEAU NOVA, LOUNGE

Join our speakers for this after-dinner social and Q&A. Drinks and snacks will be available.

MEALS

WEDNESDAY, SEPTEMBER 21

Refreshment Break | 3:30 – 3:45 PM | Chateau Nova, Elk Room

Dinner Buffet | 6:30 – 8:00 PM | Chateau Nova, Restaurant

THURSDAY, SEPTEMBER 22

Breakfast Buffet | 6:00 – 7:00 AM | Chateau Nova, Restaurant

Lunch | 11:30 AM – 12:15 PM | Field Site

Refreshment Break | 3:00 – 3:20 PM | Field Site

Dinner Buffet | 6:30 – 8:00 PM | Chateau Nova, Restaurant

FRIDAY, SEPTEMBER 23

Breakfast Buffet | 6:00 – 7:00 AM | Chateau Nova, Restaurant

Lunch | 12:00 – 1:00 PM | Field Site

EMERGENCY TELEPHONE NUMBERS

Emergency Only – RCMP/Ambulance/Fire: 911

Boreal Research Institute: 780-618-2600

AGENDA

WEDNESDAY, SEPTEMBER 21 | TRAVEL + IN-HOUSE TRAINING

Travel from Edmonton to Peace River | 7:00 AM – 12:30 PM

REGISTRATION & CHECK-IN | 12:00 – 1:30 PM

Welcome and Opening Remarks (Xu) | 1:30 – 1:40 PM

Introduction to Peatlands – or Everything You Need to Know for Determining Reclamation Success in Peatlands (Vitt) 1:40 – 3:30 PM

NETWORKING BREAK 3:30 – 3:45 PM

Alberta Peatlands – Sources or Sinks for Atmospheric CO_2? (Wieder) | 3:45 – 4:45 PM

Reclamation Criteria for Wellsites and Associated Facilities for Peatlands (McGillivray) | 4:45 – 5:45 PM

Assessing Restored Peatland Using the Peatland Reclamation Criteria: A Case Study (Xu) | 5:45 – 6:15 PM

DINNER BUFFET (COST NOT INCLUDED) | 6:30 – 8:00 PM

THURSDAY, SEPTEMBER 22 | FIELD TRAINING

Travel to Field Sites | 7:00 – 8:00 AM

Site #1: Fen Ecology 101 & **Site #2:** Bog Ecology 101 | 8:00 – 11:30 AM

LUNCH BREAK | 11:30 AM – 12:15 PM

Site #3: Guided Disturbed Assessment (Inversion Pad) & **Site #4:** Guided Undisturbed OSE Assessment 12:15 – 4:30 PM

Travel to Chateau Nova | 4:30 – 5:30 PM

DINNER BUFFET (COST NOT INCLUDED) | 6:30 – 8:00 PM

SOCIAL MIXER & Q&A | 8:00 – 10:00 PM

FRIDAY, SEPTEMBER 23 | FIELD TRAINING

Travel to Field Sites | 7:00 – 8:00 AM

Site #5: Guided Linear Feature Assessment & **Site #6:** Independent Trial Pad Assessment | 8:00 AM – 12:00 PM

LUNCH BREAK & WRAP UP | 12:00 – 1:00 PM

Travel to Chateau Nova | 1:00 – 2:00 PM

Travel from Peace River to Edmonton | 2:30 – 7:30 PM

SPEAKER BIOGRAPHIES

DR. BIN XU

BOREAL RESEARCH INSTITUTE

Peace River, Canada

Bin Xu was named NSERC Industrial Research Chair in Peatland Restoration in 2013, leading research focused on the restoration of sensitive peatland ecosystems. Bin received a PhD in Plant Biology from Southern Illinois University Carbondale. He has been involved in restoration projects of peatlands disturbed by oil and gas mining and peat harvesting in Alberta and in eastern Canada. Bin hopes to increase awareness of the importance of peatlands and find cost-effective ways to balance economic needs with those of the environment.

DR. DALE H. VITT

SOUTHERN ILLINOIS UNIVERSITY CARBONDALE

Carbondale, US

Dale H. Vitt is Research Professor and Professor Emeritus of Plant Biology, University Outstanding Scholar, and the former Chair of the Department of Plant Biology at Southern Illinois University Carbondale. His current research interests include responses of communities to disturbance including natural disturbances such as fire, permafrost melt, and autogenic succession, as well as man-made disturbances such as nitrogen deposition, land use change and mining.

Dale is a peatland ecologist and specialist in the ecology and taxonomy of bryophytes (Ph.D. University of Michigan 1970). He was a faculty member in Biological Sciences at the University of Alberta from 1970-2000. From 1990 to 2000 he was Director of the Devonian Botanic Garden.

In 1994, he was awarded the J. Gordin Kaplan award for Excellence in Research at the University of Alberta. His past research efforts have been supported by the Natural Sciences and Engineering Council of Canada (NSERC) and the National Science Foundation (NSF) in the US as well as by industry, provincial government, and NGO's. He has published over 250 peer-reviewed papers and book chapters and mentored 48 graduate students while at the University of Alberta and Southern Illinois University. He has served on both NSERC (Canada) and NSF (US) panels, served as Editor-in-Chief for The Bryologist for 10 years, and was secretary/treasurer for the International Association of Bryologists for over 15 years. His edited books include Boreal Peatland Ecosystems (with Kel Wieder, published by Springer) and Reclamation and Restoration of Boreal Ecosystems (with Jag Bhatti, published by Cambridge University Press).

SUSAN MCGILLIVRAY

ALBERTA ENVIRONMENT AND PARKS

Edmonton, Canada

Susan McGillivray (BSc., P.Ag.) is a reclamation policy specialist with the Land Reclamation Policy Branch, Alberta Environment and Parks. In her 18 years practicing in reclamation, remediation and soil surveying, she has spent the last eight years writing reclamation policy focusing on crown forested land, grassland and peatlands, as well as enjoying the development of staff reclamation and inspection courses.

DR. R. KELMAN WIEDER

VILLANOVA UNIVERSITY

Villanova, US

Kel Wieder is a Professor of Biology at Villanova University and holds an adjunct faculty position in the Faculty of Science and Technology at Athabasca University. As an ecosystem ecologist and biogeochemist, over the past 20 years his work has focused on the structure and function of peatlands in continental western Canada. In collaboration with Dr. Dale Vitt and Dr. Melanie Vile, past and current research has examined peatland carbon cycling under scenarios of ongoing climate change, effects of permafrost thaw and wildfire on bogs, and effects of elevated nitrogen and sulfur deposition from oil sands development on bogs in the Athabasca Oil Sands Region.

In-Class Training

PRESENTATION #1

INTRODUCTION TO PEATLANDS – OR EVERYTHING YOU NEED TO KNOW FOR DETERMINING RECLAMATION SUCCESS IN PEATLANDS

DALE H. VITT

Outstanding University Scholar, Professor and Chair Emeritus
Department of Plant Biology
1125 Lincoln Drive, Life Sciences II Building
Southern Illinois University
Carbondale, IL 62901

Peatlands, or mires as they are sometimes called, are characterized by deep accumulations of incompletely decomposed organic material, or peat. Peat accumulates when carbon that is sequestered in plant biomass through the process of photosynthesis exceeds the long-term loss of this carbon to the atmosphere via decomposition. Peat accumulation is dependent on the input of organic matter produced by photosynthesis. This organic matter is first accumulated in the upper, aerobic (or acrotelm) peat column wherein relatively rapid rates of decomposition occur. The rate at which this partially decomposed organic matter is deposited into the water-saturated, anaerobic peat column (the catotelm), wherein the rate of decomposition is extremely slow, largely determines the amount of carbon that will accumulate at a given site. Globally, peatlands contain about 30% of the world's terrestrial soil carbon.

Peatland site types are defined and can be determined from aspects of hydrology, chemistry, flora, and vegetation. Especially important are: the source of water, acidity and base cation contents, nutrient availability, type of mosses present, and vascular plant vegetation. Peatlands initiate by three processes that are influenced by landscape position, climate, and substrate chemistry. Following initiation, peatlands develop and undergo natural succession to form fens and bogs that are influenced by local factors including rate of water flow, quantity of nutrient inputs, the overall chemistry of the water in contact with the peatland, and the amount of water level fluctuation. Understanding these processes is key for reclamation.

PRESENTATION #2

ALBERTA PEATLANDS – SOURCES OR SINKS FOR ATMOSPHERIC CO_2?

R. KELMAN WIEDER

Assistant Vice Provost for Research
Professor, Department of Biology
Villanova University
Villanova, PA 19085 USA

Peatlands globally are believed to function as a net sink for atmospheric CO_2, a result of the balance between photosynthetic uptake of CO_2 to form plant matter, loss of CO_2 through both live plant respiration and the decomposition of dead plant material. When CO_2 uptake exceeds CO_2 losses, on a m^2 basis, carbon accumulates as peat. Across the global climate spectrum over which peatlands are found, Alberta peatlands persist in a region where annual precipitation is relatively low, about 450 mm per year. Hence, climate, and in particular changing climatic conditions may play a role in determining the source/sink function of peatlands. In addition, Alberta peatlands experience periodic wildfire as well as other disturbances, such as development of peatland sites for oil exploration and extraction.

Approaches to quantifying carbon cycling in peatlands will be discussed, with examples from a relatively undisturbed bog site, a site affected by recent wildfire, and an experimental peatland reclamation study at Shell's Carmon Creek facility, near Peace River. The presentation will focus on an overriding question: can peatland reclamation lead to the recovery of the net carbon sink function for peatlands in Alberta?

PRESENTATION #3

RECLAMATION CRITERIA FOR WELLSITES AND ASSOCIATED FACILITIES FOR PEATLANDS

SUSAN MCGILLIVRAY

Land Reclamation Policy Specialist
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Alberta's energy and resource extraction industries have continued to expand within peatlands. The footprint developed in peatlands can vary widely with respect to the impact to hydrology, organic soils and the peatland vegetation community type. The Peatland Criteria document has been developed with two streams reflecting this diversity of construction practices; the disturbed assessment and the undisturbed assessment.

Minimal disturbance practices are common for winter access activities such as natural gas sites and oil sands exploration. They typically are ready for reclamation certification at much higher rate, due to the lower impact of the construction on key site characteristics. As a result, practitioners will likely assess these sites at much higher numbers than any other. The purpose of this presentation is to focus on the minimal disturbance sites and how they are assessed through the undisturbed and, when required, the disturbed assessment. In addition, further information on strictly the disturbed assessment on a previously clay-padded site will be discussed in class, with a greater focus on the site tour.

PRESENTATION #4

ASSESSING RESTORED PEATLAND USING THE PEATLAND RECLAMATION CRITERIA: A CASE STUDY

BIN XU

NSERC Industrial Research Chair – Peatland Restoration
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We conducted a full peatland assessment using the new criteria on a restored well pad near Peace River, Alberta. In 2012, mineral overburden was removed along with geo-textile and the buried peat was fluffed and gently packed to the surrounding peatland elevation, followed by donor moss transfer. We found that after three years post revegetation, the average peatland species cover is close to 60% for all grids surveyed. Landscape assessment showed no presence of open water or upland features although areas near the main entrance are seasonally flooded and remained wetter than the remainder of the pad throughout the seasons. Vegetation assessment found greater undesirable species cover in these wetter areas where no donor moss material was transferred, leaving the site open to invasion by undesirable species such as cattail. These areas also failed the woody species criterion without tree establishment due to wetness. However, only 1 out of the 9 grids failed the undesirable cover criterion (27%; where 20% = fail). Out of a possible 45 parameter points, our site scored 40 points, exceeding the 36 required to pass.

We will discuss the process for the site evaluation based on the methods outlined in the criteria and our assessment of criteria in terms of clarity, scientific rigour, and most importantly, ease of use. We will discuss how the criteria can be used in reclamation planning and execution to address key areas in the criteria to meet the certification requirements.

Field Training

SITE BACKGROUND – IPAD (INVERSION PAD #1)

BACKGROUND:

In this project, we tested the feasibility of establishing a vegetation community characteristic of moss-dominated peatlands by removing the clay fill and restoring a peat surface followed by donor material transfer. Several different operational techniques were used to remove the clay pad and to create a suitable peat surface (~40cm) for re-vegetation.

Propagules contained in the donor materials kickstarted the re-vegetation process and the establishment of a peat-forming moss layer dominated by *Sphagnum* species. Moss fragments, along with roots, rhizomes, seeds, and spores were collected from three distinctive communities (*Sphagnum*-dominated, brown-moss dominated, and *Polytrichum*-dominated) from the surrounding cutlines and winter roads. The top 10 cm of the moss carpet from each donor site was harvested and spread across the restored site at a 1:10 ratio. *Polytrichum* is an early successional species known to improve soil conditions which favour the establishment of a peat-forming moss carpet. Transferred materials were immediately covered with straw mulch and fertilized with NPK fertilizer to promote spore germination and moss establishment.

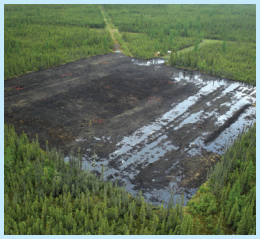
Several stretches of winter roads near the inversion pad were reclaimed in the spring of 2014 by: direct placement of donor islands; donor carpet; and windrows of donor material. The goal was to promote tree (black spruce) growth and eventually close the canopy gap. Larch and black spruce trees were planted in summer 2015.

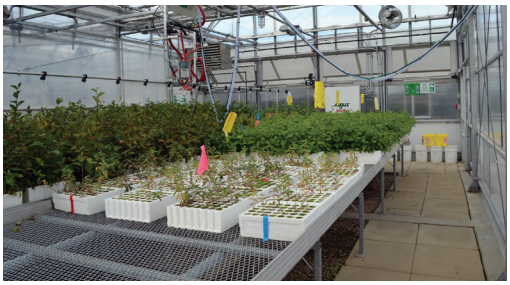
RECLAMATION: WINTER 2011 AND SUMMER 2012

- Multiple clay pad removal/inversion approaches used → created 40 cm peat surface, either with or without clay beneath
- Clay fill moved back into the borrow pit
- Donor material collected from different communities → only the top 10 cm live-peat carpet
- Donor material spread at 1:10 ratio (1 m^2 spread to 10 m^2) followed by mulch cover and fertilization
- Black spruce trees planted in 2013, no additional re-vegetation; no vegetation management

CHALLENGES:

- Clay fill: what to do with it?
- Altered chemistry, hydrology
- Borrow pit reclamation
- Associated features: winter roads
- No reclamation guidance: peatland, wetland, pond?
- No proven techniques → peat inversion?
- Donor transfer? → Disturbing another area? Consequences?





BOREAL RESEARCH INSTITUTE

OVERVIEW

NAIT's Boreal Research Institute is a 9,000-squarefoot, state-of-the-art research facility located in Peace River, 500 kilometers northwest of Edmonton. It is staffed by a team of research scientists and technicians with professional designations in forestry, biology and agrology.

The Institute's facility includes two laboratories, office space for 15 people, an outdoor growing space and a three-bay greenhouse that features computer-controlled humidity, temperature and lighting. The facility was funded by NAIT, Alberta Innovation and Advanced Education, and the Canada Foundation for Innovation, with industry funding from Shell Canada and Penn West Petroleum.

The Boreal Research Institute is a leader in applied research relating to forest and peatland reclamation and is an essential partner for applied science, innovation and enterprise development in Alberta's boreal forest region. With joint funding from the Natural Science and Engineering Research Council of Canada and many industry partners, the Institute has established two Industrial Research Chairs for Colleges to advance research in boreal reclamation, reforestation and peatland restoration.

WHAT WE DO

The Boreal Research Institute develops scientifically based best practices and applied technologies to address present and emerging knowledge gaps in the management and reclamation of disturbed landscapes. We are committed to enhancing the innovation capacity and competitiveness of our industry partners and small- and medium-sized enterprises through the timely publication of technical information, and ready access to our research expertise and technology.

Our mission is to promote the informed use of boreal resources through applied science, education, and partnerships with industry, government agencies, practitioners and academic partners.

FOUR REASONS TO CHOOSE NAIT AS YOUR APPLIED RESEARCH PARTNER:

- **CONNECT PARTNERS:** Strong partnerships and research networks are core to the success of the Boreal Research Institute and benefit our partners, collaborators, students and all Albertans.
- **SOLVE PROBLEMS:** Through prototyping of tools and technologies, we enable organizations to apply solutions to today's forest management challenges and reduce management risks and costs into the future.
- **INDEPENDENT THIRD PARTY:** We offer objective and scientifically credible information at arm's length from government and industry to meet our stakeholders present and emerging reclamation needs.
- **ACCESSIBLE PRODUCTS:** We provide information products, guidelines, and protocols in formats that are widely accessible, to inform operational reclamation practices and enable responsible management and environmental stewardship by industry and small and medium-sized enterprises.

OUR EXPERTISE

The Boreal Research Institute is instrumental in providing novel, scientifically proven, and cost-effective reclamation methods, products, and education for industry in four key programs:

- **Forest Reclamation** – We innovate boreal reforestation methods for industry to improve reclamation success while reducing management risks and costs.
- **Peatland Restoration** – We advance technologies in peatland reclamation and management to reduce the industrial footprint on boreal peatland communities.
- **Plant and Seed Technologies** – We facilitate the collection, treatment, and delivery of native boreal shrub, forb and graminoid species for reclamation in northwestern Alberta.
- **Research Extension and Education** – We promote the timely publication of relevant applied research to enable industry to meet ecological reclamation and reforestation standards on forest and peatland sites throughout Alberta.

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Peatland complex

Sporophytes of *Pohlia nutans* (Copper wire moss)

Sedge dominated fen

Tomenthypnum nitens (Golden fuzzy fen moss) with a few *Sphagnum warnstorfii* (Warnstorf's peat moss) individuals (red coloured)

Treed black spruce bog

Sphagnum squarrosum (Squarrose peat moss) with reproductive capsules (sporophytes) where spores are produced

Flower of *Kamila polifolia* var microphylla (Northern bog-laurel) with morning dew

Smilacina trifolia (Three-leaved false solomon's seal)

Photo credits: Bin Xu, NAIT Boreal Research Institute