Ecosystem Management Emulating Natural Disturbance Project

2015 Annual Report

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1. Executive Summary

2015 was a busy year both on the ground: at the EMEND site with the completion of the Forest Mensuration and Understory Vegetation Collections, several graduate students finishing their field work; and within the EMT: hosting the graduate student tour, a high level partner's meeting, creation of the EMEND business case, plans in place to move forward with an NSERC Industry Chair application with the UoA, as well as 2 high level field tours, and a workshop.

The EMT saw a small representative change with Mike Williamson taking over as the Peace River GoA representative position. Drs. John Spence, and David Langor continue to be the lead scientists on the project, although Dr. Spence has announced his retirement to be December 2016. Amanda (Amy) Hayden continues to act in the role of Project Coordinator. Fuse consulting continues to be contracted to perform our Knowledge Exchange Program including: the writing of three research notes (EMEND Insights), the preparation of the student engagement sessions with the GoA and DMI, the coordination of the High level partners meeting, the Business Case development, and the tour trail renewal project.

The core crew made up of our two lead field assistants: Anderson, Jeff and Del Bel Belluze, Vince; as well as our field assistants: Appleby-Millette, Julien, Atheah, Dacota, and Junas-Grant, Josephine; who were led by Harris, Matthew the field program manager. The core crew accumulated over 5000 hours on core projects and grad students and their field assistants and lab techs assisted in over 1500 hours of core associated work. Core work was funded by a FRIAA-FRIP grant as well as GoA funds. We were awarded another FRIAA-FRIP grant for work in 2016, however other funds will be necessary to finish core collections on time.

Odsen, Sonya successfully defended her thesis this fall while several other graduate students performed field work including: Domahidi, Zoltan (MSc), Echiverri, Laureen (MSc), Franklin, Caroline (PhD), Robinson, Matthew (MSc), Ronzani, Silvia (PhD), and Sewell, Paul (PhD). There were also several students working in labs sorting samples, performing data analysis, and writing theses. These students include: Alam, Hosen (MSc), Amos, Jared (MSc), Bartels, Samuel (PDF), Khan, Sarah (PhD), Lee, Seung-Il (PhD), Whitbeck, Kristen (PDF), Wu, Linhao (PhD), Xing, Dingliang (PDF). The funding for our graduate students (NSERC-CDR and NSERC-Strategic WAM) finishes in 2016. If the EMT wishes to continue the momentum obtained with these two funding projects additional funding will be necessary in the very near future.

Several updates were made to the camp facilities including outside recycling bins, benches in the mud room, and additional shelving in the common room. Due to an incident that occurred during the late fall 290 will more than likely be written-off, older ATVs are going to need to be retired, and the lab roof will need to be repaired therefore additional funding is going to be needed to start to refresh this field equipment and infrastructure.

2015 saw the continued success of the EMEND health and Safety Program. University Health and Safety representative visited the site to perform an audit and site inspection; we passed with flying colours, and a few suggestions. Near Misses and Incidents per capita decreased this year which is a positive sign.

2. EMEND Project Introduction

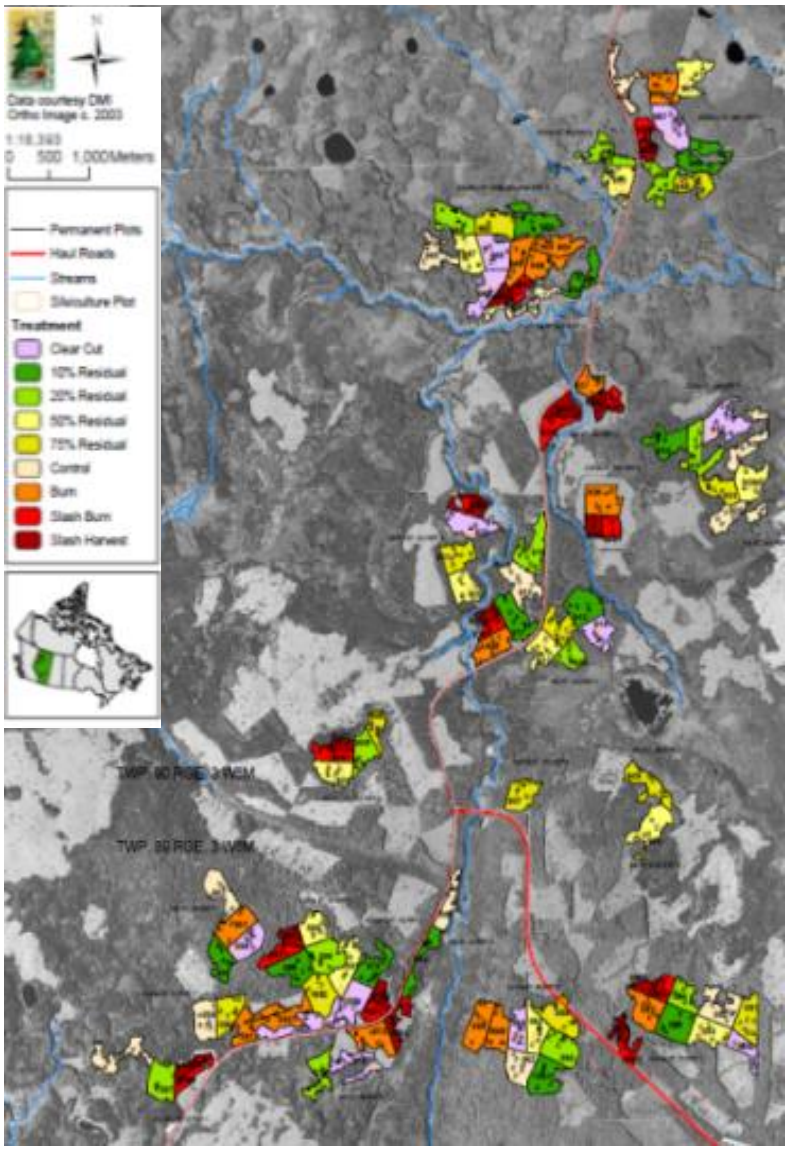
The EMEND (Ecosystem-Based Management Emulating Natural Disturbance) Project, is a valuable and highly unusual resource, remotely located NW of Peace River, Alberta, Canada. The heart of EMEND is a large-scale (1000 ha) variable retention harvest experiment set within a 7000 hectare forested landscape which is protected for long-term ecological research highly relevant to sustainable forestry in the western boreal region. EMEND was originally designed to answer questions about how retention of green-tree residuals affects harvest cost, forest regeneration, patterns of succession, biodiversity, nutrient cycling, ground water characteristics and public perception of forestry activities, and to be a resource for developing science-based provincial policies about forest management. We believe that the project is the largest single site-manipulative forestry experiment in the world. It has been used by the Canadian government to illustrate the modern Canadian approach to forest management around the world. Since its inception it has inspired other research efforts around the globe. However, EMEND was the first of its kind, and the most advanced of these undertakings.

The experimental site has been developed through significant industrial and public investment. Project design and planning occurred during 1996-97 through many meetings of a scientific committee involving both federal and provincial government, universities and industry. The experiment was laid out in previously un-harvested forest in 1998-99, and harvest treatments were executed during in the winter of 1999. Collection of the experiment-wide or "core" data required to monitor EMEND has been initiated at 5 year intervals, and given limited resources, 2-3 years are required to collect these data. The initial goal was to support world-class research activity for at least one stand rotation, or approximately 80-100 years. The experiment allows scientists to study a real working industrial forest, within the western boreal plain, from initial harvest through a first rotation harvest. This will provide unique insights into processes over an entire woodland life cycle. The project's assets comprise an 'experimental site', a 'remote field research facility' (camp & field lab), developed through contributions from the industry and the University of Alberta together with a large grant from the Canadian Foundation for Innovation, as well as some limited equipment (trucks, ATVs, chain saws, etc.).

Research funded through EMEND consists of two main components: 1) a core research program that is designed to elucidate long-term (i.e., >10 years) patterns of response to disturbance on the research site while answering questions defined by industry and government partners; and 2) a graduate student program that seeks to answer a broad range of focused scientific questions about the responses of biodiversity, productivity, and social values to variable retention harvesting through original scholarly research conducted at EMEND. Work under component #2 connects EMEND to a vibrant international research culture and provides exceptional educational opportunities to secure the interests of university-based scientists, while that under component #1 assists industry and governments directly with development toward objectives that can be defended today, and that are set in the context of the evolution of effective operating rules and policy for forestry in Alberta. Taken together these efforts comprise the double edges of the research and development sword, which we aim to keep as sharp as possible, given the resources available.

EMEND continues to inform management applications and policy in a way that balances social, environmental and economic values, so that the project remains relevant across northern boreal landscapes. While the program's roots are founded in forest management questions, the fundamental knowledge of the structure and function of boreal ecosystems holds distinct value beyond the forest sector, and should be of significant value to any group attempting to manage boreal forest land, including the

energy sector. The research site is readily accessible by an all-weather forest road that facilitates both research and demonstration of the benefits of EMEND to a wide variety of audiences. The project consequently enjoys regular visitors as well as growing national and international reputation for its design, credibility, long-range view and its longevity as a model partnership of industry, government and academic collaborators.



3. EMEND Management Team

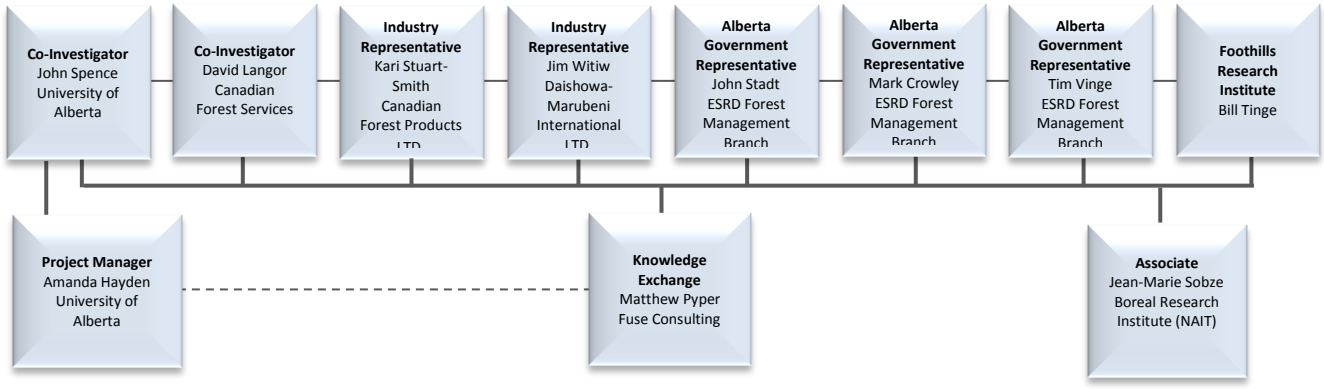
EMEND continues to see direction occur through an EMEND Management Committee (EMC) which is comprised of representatives from our central partner organizations. Management of the research and extension program occurs through the University of Alberta (UA), with scientific leadership shared between the University of Alberta and Natural Resources Canada (through the Northern Forestry Centre (NoFC)). There was a small change in organization representation in 2015 with Mike Williamson taking over for Mark Crowley who was the Peace River GOA acting EMC representative. The EMC members in 2015 included:

- John Spence (UofA, Science Co-Lead)
- Dave Langor (NRC, NoFC, CFS, Science Co-Lead)
- Jim Witiw (DMI)
- Kari Stuart-Smith (Canfor)
- John Stadt (Alberta ESRD –Forest Management Branch)
- Mike Williams (Alberta ESRD –Forest Management Branch, Peace River)
- Bill Tinge (Foothills Research Institute)
- Jean-Marie Sobze (novaNAIT Boreal Research Institute, AFEX) (Associate Member)

NovaNAIT Boreal Research Institute, AFEX (BRI) is interested in joining the EMC as a full partner organization. They have brought at number of proposals for specific projects to the table, along with indicating that they wish to be involved both in the Core Project as well as current graduate programs in any way they can. The EMC endorses their potential role as a full partner.

Fuse Consulting, continues to be contracted by the EMC to facilitate the knowledge exchange program with external contract support, as determined by the EMEND partner organizations. Matthew Pyper, Fuse Consulting President and manager, is also contracted to assist in facilitating EMC meetings.

3.1. EMEND Management Committee Organizational Chart 2015



3.2. Committee Activities

2015 has seen much activity by the EMC including hosting a high-level meeting with partner organization to discuss EMENDs outcomes to date as well as continued support of the project into the future. This resulted in the creation of a Business Case that was submitted to all partner organizations as well as potential new partners to gather support for an NSERC Industrial Chair Position at the University of Alberta. This position would solidify a Lead Scientist position within the University to fill the gap of the imminent retirement of Dr. John Spence in December 2016. Partner organizations also participated in directing two high-level tours of the EMEND landscape along with a workshop to gather support for the project within current industry partners as well as within other industries aside from forestry.

4. Core Project Personnel

PROJECT COORDINATOR

Amanda (Amy) Hayden continues in the position of EMEND Program Coordinator. She works closely with Drs Spence (UA) and Langor (NoFC), to support development of programs at EMEND. This position is responsible for: reporting, funding and financial reconciliation, health and safety program management, equipment and infrastructure management, graduate student and PDF liaison, EMC liaison, core project management and planning, human resources needs, knowledge exchange contact, trainings, camp and site management, and answering correspondence and requests.

FIELD PROJECT MANAGER

Matthew Harris was hired this year to act as Field Project Manager for the period of May to October 2015. His responsibilities encompassed the day to day running of camp, organizing daily work of the Core Crew, data integrity, and the front line health and safety advocate. His position helped to alleviate a large portion of Amy's work load during the field season. Matthew reported to Amy Hayden and Dr. John Spence.

DATABASE MANAGER

Brad Tamm, of Northern Forestry Centre (NRCan), continues to be the database manager. Brad is responsible for the proper running and functioning of the EMEND data base. He provides appropriate access to database requests, enters, cleans and organizes data, updates information, and provides clarification on data to those who need it. Brad reports to Dave Langor, John Spence, and Amy Hayden.

WEBSITE MANAGER

Jon Elofson, of Northern Forestry Centre (NRCan), continues to be the website manager with administrative access by Amy Hayden and Matthew Pyper. Jon is responsible for designing and maintaining the website as well as making any major changes that are requested. Jon reports to Dave Langor, John Spence and Amy Hayden.

CAMP FACILITIES COORDINATOR / CAMP COOKS

This year due to a number of changes the management of camp was converted over to the University of Alberta instead of a contracted organization. Two full time cooks and a part time cook were hired to look after: cooking, cleaning and the general running of camp services such as groceries, water, and sewage. Sandy Bjorgan and Kathy Hayden were hired as regular camp cooks while Lavern Cuff was hired on a part-time basis to take over duties while the others were on days off. The camp facilities coordinators all reported directly to Amy Hayden with John Spence as their supervisor.

CORE CREW

Lead Field Assistants

Two lead field assistants were hired this year to ensure that individuals with adequate field experience were coupled with our field assistants with less experience. Jeffery Anderson and Vincent Del Bel Belluze were hired into these positions and were responsible for ensuring the daily field work requirements were met, data was collected appropriately and safety practices were occurring on the site. Their direct supervisors were Matthew Harris and Amy Hayden with John Spence as their supervisor.

Field Assistants

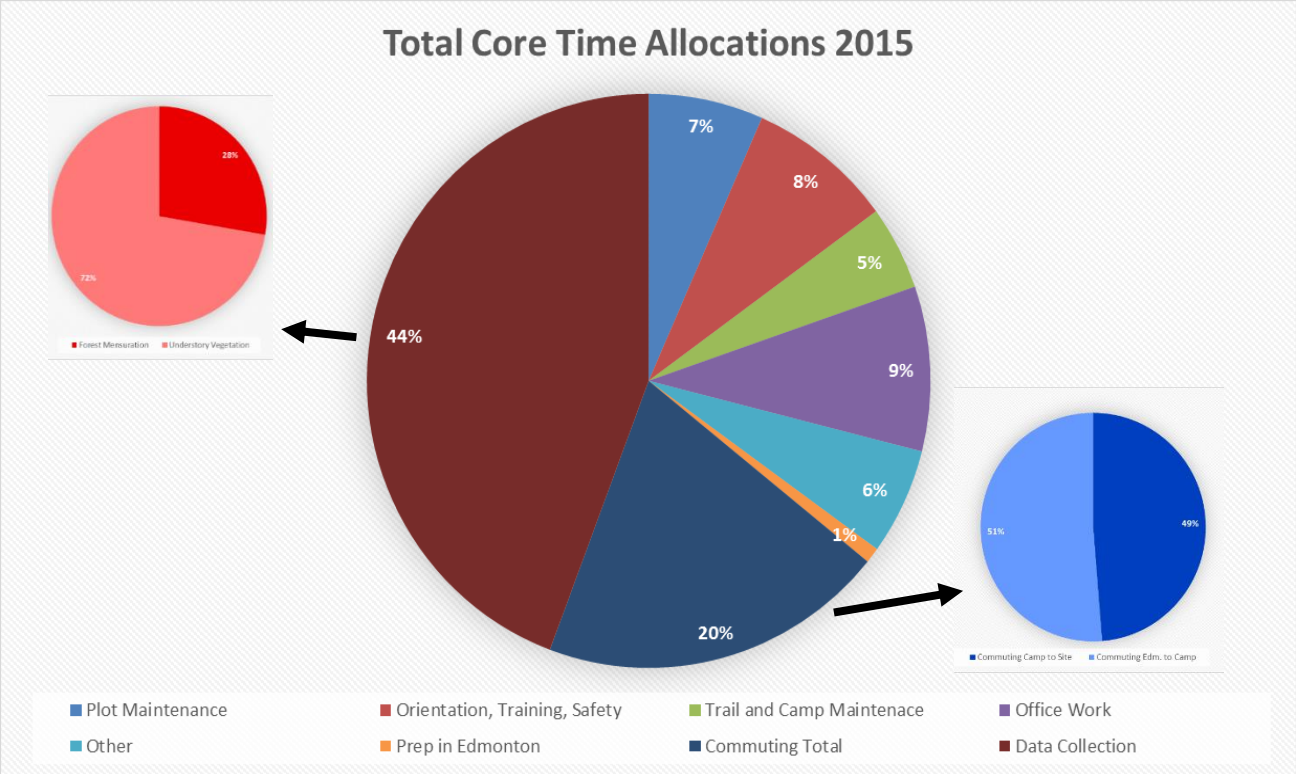
Three field assistants were hired this year. Their responsibilities were to collect data and assist with core project needs. Julien Appleby-Millette was hired as a Lead Field assistant in training as he returned to the program with a decent knowledge of many aspects of the core program but little experience with understory vegetation assessments. Josephine Junas-Grant and Dacotah Ateah were hired as field assistants. They reported directly to Matthew Harris with Amy Hayden and John Spence as supervisors.

5. Core Activities

Core Activities centre around the EMEND core project objectives including but not limited to data collection and site integrity and maintenance.

5.1. Core Activities Summary-2015

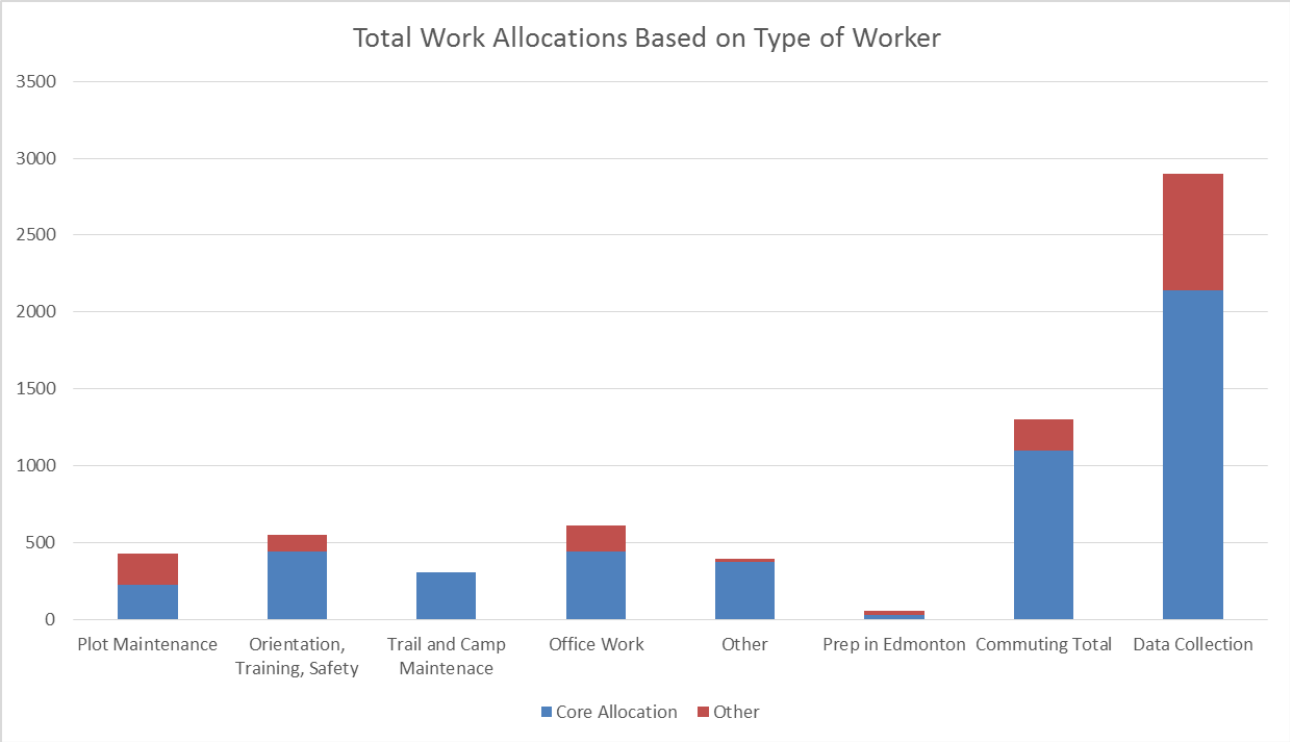
2015 was a very active year for the Core Program despite having some setbacks with funding issues. We had a very determined and dedicated core crew this year, a number of graduate students also helped in core related activities. Please note that most numbers provided are an approximation to the actual value.



Above is a chart that depicts the percentage of all person hours allocated to specific projects associated with the 2015 Core Program (May to October). Due to a number of constraints and timelines with core funding we found it necessary to 1) use other sources of man power and 2) have a fall field season (September to October). Thanks to: Zoltan Domahidi (MSc. with Spence) and his field assistant (Megan O'Niel); Terri Hill and Ryan James field technicians in the Macdonald lab; Laureen Echiverri (MSc with Macdonald); and, Caroline Franklin (PhD with Macdonald) and her field assistant (Micki Baydack); a large portion of the EMEND understory vegetation survey was completed along with part of the Forest Mensuration. Students in these labs needed this data from these surveys so it was imperative that it be collected in 2015. All students followed EMEND Core Protocols, participated in trainings, and assisted in identification and pressing of specimen. Thanks to the generous donation of Ryan (Field Technician) and the specialized equipment by the Macdonald Lab and the Government of Alberta, Agriculture and Forestry we were able to re-plot all EMEND Permanent Sample Plots (PSP) this fall. It was hoped that we would be able to start the Coarse Woody- Material and Snag Surveys this fall as well, however funds were not in place soon enough to allow for this.

This year over 6,500 person hours were used in EMEND Core Projects; almost 1,500 of these were donated hours from Graduate students, their field assistants, and field technicians. Not included in this number however also part of the core program is the sorting and identification of the arthropod collection of 2014

by Linhao Wu and his lab assistant; the identification of unknown species from the 2004/2009/2010 understory vegetation collection, and the mounting and labeling of the EMEND understory reference collection by the Macdonald Lab and associates to the lab. This fall season we were able to accommodate almost 890 person hours to EMEND Core Projects mainly Plot Maintenance and Data Entry.



The Forest Vegetation Data collection was completed this summer (a combine 44%, or over 2900 hours). Zoltan Domahidi donated 130 hours from himself and his field assistant Megan O'Neil. About 765 hours were donated by the Macdonald Lab through the assistance of Caroline Franklin and her field assistant Micki Baydack, Laureen Echiverri who performed understory vegetation assessments (minus the Bryophyte sample); and Teri Hill and Ryan James who completed the Bryophyte collection of 108 PSPs. These numbers include time spent moving from PSP to PSP.

Orientation Training and Safety made up approximately 9% of the Core Program or about 570 person hours. This section includes but is not limited to: core trainings, safety orientations for all users, core daily tailgate meetings, safety meetings and trainings, and time spent on safety issues. It includes any time spent by graduate students and field assistant's participation.

Camp Maintenance represented approximately 5% of the Core Program time (310 hours). This section included maintaining the grass, constructing outdoor recycling bins, constructing benches in the mudroom, putting together the water structure, putting together the picnic structure and picnic tables, and fixing the gas pump. No trail maintenance was performed as part of the core crews work schedule. However 2 days were spent at EMEND cleaning-up the trail in B and clearing the new trail in G by the AESRD Fire Heli-Hack crew (this time is not represented in these charts). A small amount of time (12 hours) was put in by the core crew to do final preparation of the tour trails and to put the signs up on the pavilion in preparation for the tours that were held at EMEND this summer.

Office Work took up approximately 9% (620 hours) of the combined person hour. Office work included: paperwork, documentation, quality control, data entry, inventorying and organizing, and

correspondence/communications. The category "Other" ,which included supply runs, work for graduate students, cleaning vehicles, participating in tours, and moving equipment between camp and the site; represented approximately 6% (375 hours) of our combine person hours for the core program. Preparation in Edmonton was necessary for our fall field season and represented 1% of our person hours in the core program. This time was spent preparing for the fall field season.

Plot Maintenance only occurred in the Fall field season, however it represented 7% of our overall person hours in the core program and 48% of our fall field season person hours. 207 of these hours were donated to the core program from the Macdonald lab as Ryan James assisted in the collection of GIS data as well as maintenance of the plots. In total 1800 GPS points were taken representing each PSP's start, end and vegetation plot.

The last category is commuting. Total commuting represented 20% (1300 hours) of the core project hours. Commuting to and from the site equaled 635 hours (10%) and commuting from Edmonton to camp equaled 670 hours (10%).

It was hoped that we could have started Coarse Woody Materials (CWM) and Snag assessments this fall as well; however funds were not available to us in time to support this initiative.

The 10 Year Synthesis chapters are gradually coming together. The current anticipated outline looks like this:

CH 1: Introduction (Spence)
CH 2: The EMEND Landscape (Bergeron)
CH 3: The Experiment (Solarik, Pinzon)
CH 4: Productivity and Silviculture (Solarik)
CH 5: Forest Structure Dynamics (Pinzon)
CH 6: Biodiversity (Pinzon, Dabros)
CH 7: Coarse Woody Materials (Williams)
CH 8: Soils and Nutrient Fluxes (Bergeron?)
CH 9: Synthesis, Conclusions & Recommendations (Spence)
*a chapter on Forest Health and Dynamics was recently removed from the outline.

Please see below a brief description of the progress of each chapter below.

Chapter 1 remains unwritten as it is imperative to have the remaining chapter fairly close to completion before this is written.

Chapter 2 is nearly completed in the past year Dr. Bergeron has incorporated new data to complete a better picture of EMEND's Fire Landscape. He will be in contact with John Stadt at Alberta Agriculture and Forestry to get some additional maps created for the chapter.

Chapter 3 has been separately written by both Kevin Solarik (MSc.) and Dr. Jaime Pinzon. The two pieces will be merged to create the completed chapter.

Chapter 4 is mostly written and waiting on edits/comments from Drs John Spence and Dave Langor. Mr. Solarik is hoping some additional photos will be found to round out the chapter.

Chapter 5 is a newly developed chapter that is a section already written for chapter 6 but will make an excellent chapter on its own. Dr. Pinzon just needs to spend some time making a few additions required to make it a functioning chapter of its own, then it will be ready for editing.

Chapter 6 after compilation, cleaning and working with the extensive biodiversity data Drs Jaime Pinzon and Anna Dabros (Natural Resources Canada) are currently busy writing this chapter in two parts: invertebrates and vegetation. Thanks to the assistance from Dr. Macdonald, Dr. Kristen Whitbeck, Dr. Samuel Bartels, Ryan James, Teri Hill and numerous others for identification of unidentified specimen from past collections to ensure the dataset accuracy.

Chapter 7 has been written by Daryl Williams (MSc.) (Natural Resources Canada) and is in preliminary editing by Drs John Spence and David Langor.

Chapter 8 is still in the research stage. Dr. Bergeron is more than likely going to write this chapter with the assistance of Dr. Barbara Kischuk (Natural Resources Canada). However there is little left to be discussed that is not already in a paper written in 2015 by Dr. Kischuk. This chapter may be pulled from the finished product if there is not enough to discuss within the Synthesis.

Chapter 9 has yet to be written by Dr. Spence as he is waiting for several more chapters to be completed before wrapping up conclusions and recommendations.

5.2. Planned Core Activities - 2016

Many activities related to the 15 Year Post-Harvest Assessment are left to be completed within the Core Program. The extent to which these can be fully engaged is dependent on funding, and the timing of provided funding. We are hoping to have a 4-8 person crew in the 2016 field season as there is a great deal left to do to complete this assessment.

We were lucky enough to have received a FRIAA-FRIP Grant from a proposal written by Dr Colin Bergeron to help manage the costs of most of the programs needs including six field assistants to collect Shrub, Snag, and Coarse Wood Material Data. If additional funding can be obtained it is hoped that we can add additional field assistants to the Bryophyte and shrub collections. However, this funding would need to be secured by March 2016 to ensure that field assistants with appropriate technical skills were recruited. These additional field assistants are essential to completing the 15 Year Re-measurement on time, without them it will be highly likely that this re-measurement could take up 2 additional years to complete.

We also acknowledge a presently un-funded requirement for continuing Core Crew effort for baseline and PSP maintenance. Trail maintenance including bridge building and trail clearing has been removed from the core work plan on the advice of the EMC. However, the funds necessary to carry out these much needed maintenance and safety requirements is still needed.

The 10 Year Synthesis report is still on our radar and sections are now ready for internal-team editorial review with a targeted submission to publisher for technical editing-stage mid-2016.The project is being led by a post-doctoral writing team in collaboration with the EMEND science leads.

6. Graduate Studies Activities

Graduate research projects are managed through the EMC. This research must be focused on questions/topics deemed relevant to northern boreal forest conservation, management or for which the EMEND landscape provides an exemplary template for the work.

6.1. Graduate Student Activities – 2015

EMEND provides an invaluable educational opportunity for domestic and international post-secondary graduate students. We offer them simultaneous exposure to policy and management challenges, associated with the Canadian boreal forest across-sectors, through interaction with EMEND partners during the course of their research.

2015 saw the continuation of our annual partner/graduate student engagement tour. Six students visited the DMI Woodland Office Building and Mill in Peace River as well as the Provincial Building in Edmonton. Graduate students presented a) proposed work, b) work that has been completed, or, c) work that has been completed and their proposed work moving forward. A number of employees from a variety of departments within our partner organizations within participated to become more informed about EMEND, and especially, to help provide grad students with different perspectives of how/where their work could be used when complete. Partners were able to showcase on the ground use of EMEND research to graduate students in the field tour component of our partner/student engagement. EMEND also hosted several field tours with industrial and governmental employees that allowed our graduate students to highlight their work. For a list of EMEND related published articles please see Appendix:

6.1.1. Successful Thesis Completion in 2015

Sonya Odsen-M.Sc. Candidate with Dr. John Spence-Boreal bird response to variable retention harvest September 2015 saw the completion of Sonya Odsen's (MSc) project with a successful defense of her thesis. Below is a brief description of Ms. Odsen's thesis.

The Canadian boreal forest is vital breeding habitat for North American songbirds. Extensive anthropogenic disturbances within this biome are therefore of conservation concern. Using unharvested stands as controls, I examined the effects of variable retention management (VRM) relative to clear-cuts on songbird assemblages and individual species in a boreal mixedwood forest. Breeding season point count surveys were performed in 10-ha cutblocks applied across four dominant forest types (deciduous dominated, deciduous with spruce understory, mixedwood, and coniferous dominated), and harvested in winter 1998/99 to five retention levels (clear-cut (2%), 10%, 20%, 50%, and 75%), plus unharvested controls. Surveys were conducted prior to harvest in 1998, and subsequent to harvest in 1999, 2000, 2005, 2006, 2012, and 2013 at the Ecosystem Management by Emulating Natural Disturbance (EMEND) experiment in northwestern Alberta. In the first two post-harvest years, songbird assemblages in stands with less than 75% retention differed significantly from those in unharvested stands. After 14-15 years, assemblages in stands with 20% retention or higher no longer differed significantly from the controls, suggesting accelerated recovery within high retention stands. In the controls, however, species richness increased after 7-8 years, and species composition changed after 14-15 years, suggesting that c. 10-ha unharvested stands were too small to maintain unchanged songbird assemblages of undisturbed forest. Closer examination of six old forest-associated species - brown creeper (Certhia americana), winter wren (Troglodytes hiemalis), ovenbird (Seiurus aurocapilla), black-throated green warbler (Setophaga virens), Canada warbler (Cardellina canadensis), and western tanager (Piranga/udoviciana) revealed that 20-75% retention prevented significant declines of all six species, and five of the six species increased significantly

after 14-15 years. This suggests that variable retention management can be useful for conservation of songbird assemblages and species typical of unharvested forest. However, spatial trade-offs, lagged recovery in harvested stands, and assemblage changes in unharvested stands reinforce the importance of larger (> 10 ha) forest reserves in harvest planning. Currently Ms. Odsen is writing papers for journal submission in early 2016. For more information on Ms. Odsen's work please see our EMEND Insight #6.

6.1.2. Progress from graduate students/PDF funded under the EMEND NSERC CRD Grant:

Kristen Whitbeck—Post Doctoral Fellow with Dr. Ellen Macdonald—Thresholds of resilience and recovery for understory plants

Dr. Whitbeck coordinated and contributed to identification of bryophyte samples remaining to be identified. Unfortunately (for us) she left to take up a permanent position but the postdoctoral position has now been filled by Dr. Bartels. Before leaving, Whitbeck passed along well-documented descriptions of her work, the datasets and summaries of the analyses to date and plans for further analysis to Dr. Bartels so he has been able to settle quickly into the task.

Samuel Bartels-Post-Doctoral Fellow with Dr. Ellen Macdonald—Thresholds of resilience and recovery for Understory plants

Dr. Bartels has finished reconciling the data and is currently analyzing data and writing. He was able to use Dr. Whitbecks work and notes to easily slip into this project with little delay.

Caroline Franklin—Ph.D. Candidate— Dr. Ellen Macdonald-- Thresholds of resilience and recovery for understory plants.—Dr. Scott Nielsen—How do fur bearers use landscapes harvested by variable retention?

Ms. Franklin's second year has been impressive. In the lab she has spent her time entering, cleaning and performing preliminary analysis of her previous field season's data, and has developed her thesis research proposal. In the field she collected the remaining data about understory vascular composition. The Furbearer sub- project is moving along nicely with two students splitting the field work required for the project. Ms. Franklin deployed 25 motion triggered wildlife cameras in conifer dominated compartments to observe species use in the winter months (October to May). She completed her data entry and has written the thesis proposal for this project. In the summer months Ms. Franklin re-deployed the camera traps, collected vegetation structure data at the camera locations, established linear pellet count transects and conducted 2 pellet counts. She has been able to redeploy her camera traps for this winter.

Cassandra McKenzie—Dr. Sylvie Quideau—How do forest floor processes respond to variable retention harvesting?

Field samples have been collected by a fellow student under a different project, within Dr.Quideau's lab (Sewell, Paul-PhD. Candidate). There were delays beyond our control in starting Ms. McKenzie's program, but she will be officially starting in February 2016.

Jared Amos – M.Sc. Candidate with Dr. John Spence—The effect of retention harvesting on pollinator population assemblages in the boreal forest of Alberta

Mr. Amos presented an overview of his work at the World Forestry Congress in autumn 2014, and since then, has spent most of this year completing the identification of some of the most difficult species, doing data analysis and working on writing his thesis. He is on track to complete his work during the second term of 2016 with funding no longer available for his project under the CRD.

Seung-Il Lee – PhD candidate with Dr. John Spence – Early colonization of white spruce dead wood by saproxylic beetles in mixed stands

Mr. Lee has spent a majority of this past year writing his thesis chapters and preparing them for submission for publication. A second chapter has now appeared in Forest Ecology & Management and a third is nearly ready for submission. The thesis will include one more data chapter which is now in an advanced draft. Mr. Lee has also attended and presented at 2 conferences, the World Forestry Congress and the North American Forest Ecology Workshop. He will defend in January 2016.

Hosen Alam—Ph.D with Dr. Soung Ryu—Can we create fire resilience landscapes under variable retention scenarios?

This year Mr. Alam started his analysis of the data collected in the previous field seasons. He is working to estimate duff moisture using variables such as duff depth, leaf area index, bulk density, and basal area. Mr. Alam is currently writing his thesis, and we hope for a defense in December 2015, although given the disruption due to his supervisor leaving the university this may be delayed until no later than April 2016.

Zoltan Domahidi—M.Sc. Candidate— Drs. Scott Nielsen & John Spence—How do fur bearers use landscapes harvested by variable retention?

Mr. Domahidi who is responsible for the winter work planned and laid out two 200m transects (N-S and E-W) in each compartment with 3 replications of each. Mr. Domahidi also attempted the first winter field season at EMEND; however, many challenges were discovered with winter work in this remote site. We think that we have responded to overcome them and that the coming winter field season will be more successful. Zoltan has completed one survey of these transects this fall season with the help of Caroline Franklin.

Matthew Robinson—M. Sc. Candidate with Dr. Scott Nielsen—Variable retention forestry's effect on amphibian populations

During the winter Mr. Robinson entered past field season data, performed preliminary data analysis, and participated in partner engagement sessions. During the past field season he conducted breeding pool surveys (16), as well as pit-fall trapping (64) to assess movement of young wood frogs. He also collected vegetation habitat sampling of both the pit-fall trapping array areas as well as breeding pool sites (also water depth, chemistry, and algae collections were done at each of the breeding pools).

***Linhao Wu*—Ph.D. Candidate with Drs. John Spence and Fangliang He—Incorporating Succession into Temporal Variation.**

Mr. Wu has used the past year to sort and identify the ground beetle samples collected during his 2014 field season. He has also taken this time as an opportunity to do some initial data analysis of previous data from the EMEND database. Linhao presented on his work at last year's World Forestry Congress and at the recent European Carabidologist's Meeting.

Sarah Kahn—Ph.D Candidate with Dr. Glen Armstrong—The trade-off between flow of wood products and conservation of biodiversity.

Mrs. Kahn has been busy getting herself acquainted with her sub-project, the data, and the different analytical programs she will use to answer this important question. She was able to visit the EMEND Site along with participating in partner engagement sessions. Mrs. Kahn has analyzed the data set and extrapolated the essential biodiversity data from the EMEND datasets. She has also been writing her research proposal and preparing for her candidacy exam. Unexpectedly, Mrs. Kahn left the program this fall.

Jaime Pinzon—Post Doctoral Fellow with Dr. John Spence

Dr. Pinzon was initially brought onto this project as a Post-Doctoral Fellow under supervision by Dr. Spence and Dr. He and is now a Research Associate within Dr. Spence's Lab. Pinzon is an essential member of the broader EMEND research team, assisting most students with the analysis and use of the EMEND database that he understands very well. Dr. Pinzon also sat on Odsen's thesis defense. His central task in the EMEND work is responsibility for the integrated overview of the exceptional 15-yr biodiversity dataset that has resulted from the project, including results achieved under the CRD.

6.1.3. Progress under FRIAA-FRIP/Industry funded Projects:

Colin Bergeron—Post Doctoral Fellow with Dr. John Spence—Local carbon dynamics associated with coarse woody debris **(DMI)**

In order to develop carbon management policies based on sound scientific knowledge in mixedwood boreal forests, it is crucial to understand where carbon is stored and how fast it exits this storage. In this study, we synthetized data acquired from tree, shrub, dead woody material, and soil mensuration at EMEND to give an accurate empirical picture of where the carbon is stored in four stand types (conifer dominated (CD), deciduous/coniferous mix (MX), deciduous dominated with spruce understory (DU) and deciduous dominated (DD)) characteristic of the boreal mixedwood forest. Preliminary analysis of empirical data presented in Table 1 reveals that the mature mixedwood forest stores around 210 tons of carbon per hectare (TC/ha) but amount of carbon stored varies according to stand type with coniferous stands storing larger amount of carbon than deciduous stands (CD: 248 TC/ha; MX: 222 TC/ha; DU: 192 TC/ha; DD: 180 TC/ha). These results are very close to what was found in mixedwood forest for aspen dominated stands in western Quebec (Strukelj et al. 2015), and deciduous/coniferous mix stands in Ontario (Lee et al. 2002).

It is however, somewhat higher than what was found in an aspen dominated mixedwood forest in Manitoba (Martin et al. 2005). Living trees store from 98 TC/ha in deciduous to 138 TC/ha in coniferous stands, soils store from 65 TC/ha in deciduous to 82 TC/ha in coniferous stands, deadwood stores from 15 TC/ha in deciduous to 27 TC/ha in coniferous stands, shrubs store from 2.2 TC/ha in deciduous to 0.6 TC/ha in coniferous stands. On average, about 60% of the carbon is stored in living trees, 30% in soils, 9% in deadwood and 0.5% in shrubs. It is also interesting to note that the major pool of carbon (50%) in mixedwood forest is the above ground portion or living tree, which is the very resource that forest industries extract from the ecosystem. Thus, ecosystem based forest management strategies such as variable retention harvesting have an enormous potential to preserve in-situ carbon retention and improve resilience of mixedwood boreal forest to harvesting regime.

According to our previous results, deadwood represent at least 10% (between 14 and 27 TC/ha) of the total carbon stored in the mixedwood boreal forest. In a parallel study, we wanted to know how fast the carbon was lost from the deadwood pool and what influenced decay speed. Thus, we set out to determine deadwood decay rates for most common tree species in the mixedwood forest. We used trees that were cut in 2002 for a fire history study, from which basal discs were collected and the remaining portion was left in the forest. After 12 years of decay, we resampled these trees and determined the wood density loss between the original disc and the disc collected after 12 years of decay. Preliminary results presented in Table 2 show that deadwood lost on average 42% of wood density over 12 years (range of wood density loss between 30% and 66%). In the mixedwood forest, wood density loss for trees falling to the ground is on average 3.5% per year for the first twelve year. Aspen and balsam poplar had the fastest decay rate with a loss of 50% and 47% wood density over 12 years. Black spruce and white spruce had a lower decay rate with a loss of 37% and 35% for the same period and eastern larch had the lowest decay rate with a loss of 29% of wood density. Surprisingly, there was a large variation of wood density within decay class and within

a single piece of deadwood. Within our 6 decay class system, decay class recorded after 12 years of decay varied between 2 and 5. Aspen also seems to decay faster in spruce dominated sites than in aspen dominated sites. These results have several implications. We found that in a natural setting, deadwood loses biomass at a rate of about 3.5% per year over the first twelve years of decay. This means that in order to keep a stable or increasing carbon pool in deadwood, recruitment must be at least 3.5% of its biomass. Furthermore, carbon stored in larch and black and white spruces will be locked longer than if it was stored in aspen or balsam poplar. An open canopy also seems to increase decomposition rates, meaning that suggesting that variable retention harvesting may allow the retention of carbon locked in deadwood. Finally, the large variability in wood density within decay class suggest that the decay class system traditionally used in deadwood study may not be the best representation of decay stage of deadwood, which may affect the accurate quantification of carbon in deadwood.

Table 1. Carbon stored in the four mixedwood boreal stand types of the EMEND experiment before harvesting. Measurements were taken from 25 ca. ten ha compartments for each of the cover types. Units are in metric tons of carbon per hectare (TC/ha). DD: deciduous dominated; DU: deciduous dominated with spruce understory; MX: deciduous/coniferous mix; CD: coniferous dominated.

	DD (TC/ha)	DD (%)	DU (TC/ha)	DU (%)	MX (TC/ha)	MX (%)	CD (TC/ha)	CD (%)	Average (TC/ha)	Average (%)
Living trees	**97.8**	**54.32**	**127.0**	**66.30**	**134.3**	**60.58**	**138.3**	**55.76**	**124.3**	**59.12**
Aboveground	81.1	45.09	105.0	54.85	111.6	50.36	114.7	46.24	103.l	49.04
Belowground	16.6	9.24	21.9	11.45	22.6	10.21	23.6	9.51	21.2	10.08
Deadwood	**14.7**	**8.2**	**13.7**	**7.2**	**22.4**	**10.1**	**27.4**	**11.0**	**19.S**	**9.3**
Down Woody	9.1	5.08	9.4	4.91	13.6	6.13	17.7	7. 14	12.5	5.92
Tree DWM	7.3	4.08	7.9	4.12	10.1	4.58	14.1	5.71	9.9	4.70
Shrub DWM	0.4	0.23	0.2	0.09	0.1	0.05	0.1	0.03	0.2	0.09
Unknown	1.4	0.77	1.3	0.70	3.3	1.50	3.5	1.41	2.4	1.14
Snags	5.6	3.10	4.3	2.26	8.8	3.96	9.7	3.90	7.1	3.37
Soil	**65.3**	**36.29**	**50.0**	**26.12**	**64.1**	**28.94**	**81.7**	**32.96**	**65.3**	**31.06**
Forest Floor	25.9	14.40	·25.5	13.31	25.6	11.56	37.8	15.25	28.7	13.65
0-7cm mineral	28.1	15.62	14.0	7.33	23.6	10.64	26.1	10.53	23.0	10.92
10-17cm mineral	11.3	6.28	10.5	5.48	14.9	6.73	17.8	7.18	13.6	6.48
Shrubs	**2.2**	**1.21**	**0.8**	**0.41**	**0.9**	**0.40**	**0.6**	**0.24**	**1.1**	**0.53**
Tree Regeneration	0.2	0.13	0.4	0.20	0.4	0.16	0.2	0.09	0.3	0.14
Shrubs	1.9	1.07	0.4	0.22	0.5	0.23	0.4	0.15	0.8	0.39
TOTAL	**180.0**	**100**	**191.5**	**100**	**221.7**	**100**	**248.0**	**100**	**210.3**	**100**

Table 2. Deadwood density variation over 12 years of in-situ decay for common tree species of northwestern Alberta

Tree Species	Mean Original density (g/cm3)	# trees	Mean post-decay density (g/cm3)	# trees	Density loss (g/cm3)	% decay
Aspen	0.463	12	0.233	14	0.230	50
Balsam Poplar	0.389	11	0.202	11	0.187	48
Black Spruce	0.451	7	0.284	9	0.167	37
White spruce	0.385	15	0.249	16	0.136	35
Eastern Larch	0.563	4	0.398	4	0.165	29
Average	**0.432**	**49**	**0.253**	**54**	**0.179**	**42**

Some caveats of the data presented in this report and also common to most carbon quantification exercises must be presented to the readers. For example, carbon stored in the belowground portion of snags is not accounted for in this report. Deadwood biomass stored as stump and root is not very well known and requires much effort to quantify. At least 10% of total forest ecosystem carbon is stored belowground in living trees and the relative importance of this pool may increase after harvest. Soil carbon is also likely underestimated as carbon was measured for 0 cm to 7 cm and 10 cm to 17 cm in the mineral soil. Furthermore, all deadwood material was attributed the same wood density for carbon quantification and the decomposition study presented in Table 2 will help improve this aspect of the dataset. All woody material was also assumed to have the same carbon content (50% of the biomass). However, carbon content may vary by species or state of decay. A root decay assessment in the EMEND compartments will be undertaken in 2016 in order to improve the knowledge of belowground tree carbon storage.

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6.1.4. Progress under the NSERC Strategic Grant: Wet Areas Mapping (WAM)

Wiebe Nijland—Post Doctoral Fellow with Dr. Nicholas Coops (UBC)—Forest Structure using LiDAR and LANDSAT data

Dr. Nijiland's funding for this project ended in January 2015. He has now left the project to further his career in GIS analysis. His maps are consistently used by a number of our graduate students including those on other projects. We wish Wiebe all the best in his career.

Paul Sewel—Ph.D Candidate with Drs Sylvie Quideau and Miles Dyck-assess the soil ecosystem and investigate the underlying process controlling the differences in carbon fluxes, soil moisture, terrain gradients, and vegetation

Mr. Sewell started his project in May 2015. He was able to complete his first field season of two to collect his soil samples as well as the samples needed by a colleague in his lab. Paul spent the first part of his project preparing for the field season by acquiring the necessary trainings needed to work on the field site and making plans for his project.

Silvia Ronzani—Ph.D. Candidate with Dr. John Spence—Epigaeic beetles as a predictor variable using WAM

Ms Ronzani has been working hard in 2015 to sort to species the specimen she collected in her first field season (2014). With this information she was able to do some very preliminary analysis of her 2014 data. Silvia completed her second field season in August 2015 where she collected from several new sampling sites as well as her previous sites of 2014 which included 522 traps in 261 sampling sites. Currently Silvia is sorting her new specimen. Silvia presented some of her findings in September at the 17th European Carabidologists Meeting.

Laureen Echiverri—M. Sc Candidate with Dr. Ellen Macdonald—assessing the relationship between remotely sensed predictor variables and vascular plants.

Ms Echiverri has had a busy 2015. She completed her second and final field season collecting vascular understory vegetation and forest structure data. During her off season Laureen identified the unknown plant specimen she collected and entered her data. She has also done some very preliminary data analysis.

Kristen Whitbeck—Post Doctoral Fellow (initially M.Sc) with Dr. Ellen Macdonald—Bryophytes as a predictor variable using WAM.

A majority of Kristen's time this year was spent identifying past unidentified samples. Unfortunately (for us) she left to take up a permanent position but the postdoctoral position has now been filled by Dr. Bartels. Before leaving, Whitbeck passed along well-documented descriptions of her work, the datasets and summaries of the analyses to date and plans for further analysis to Dr. Bartels so he has been able to settle quickly into the task.

Samuel Bartels-Post Doctoral Fellow (initially M.Sc) with Dr. Ellen Macdonald-Bryophytes as a predictor variable using WAM.

Dr. Bartels has finished reconciling the data and is currently analyzing data and writing. He was able to use Dr. Whitbeck's work and notes to easily slip into this project with little delay.

Dingliang Xing-Post Doctoral Fellow with Dr. Fangliang He-LiDAR predictive terrain modeling for forest productivity.

Mr. Xing has spent his first year with the project busily learning about the project, assessing the database and the datasets and writing. He has produced his first manuscript on growth of residual trees after harvest in relation to WAM. He is currently working on a second one which will discuss forest regeneration/carbon.

6.1.5. Students with other Funding

Zoltan Domahidi-MSc. with Dr. John Spence and Dr. Scott Nielsen-Nesting preference and productivity of cavity nesting owls in managed boreal landscapes

2015 was a busy year for Mr. Domahidi. His field season started in January and continued sporadically through to the start of the summer field season. In this winter/spring season Zoltan hung and monitored several nesting boxes distributed throughout EMEND. During the summer field season forest mensuration data around the nest boxes was collected and several more nest boxes were hung in the greater EMEND/Sulfur Lake area. Although no owls were found during nesting season Mr. Domahidi continues to investigate monitoring methods.

Jessica Iltgen-Honors Undergraduate, Lakehead University supervised by Jaime Pinzon-Assessing for areas of high biodiversity by utilization of LiDAR Wet Areas Mapping (WAM) with indicator guilds of spiders.

Miss Iltgen spent the field season as the field assistant of Silvia Ronzani. Though this experience she became interested in spiders and started developing an honour's thesis around similar work as Ms. Ronzani. Miss Iltgen will be using the spider sample collected during Ms. Ronzani's field work in both the 2014 and 2015. Drs. Jaime Pinzon and John Spence have assisted her throughout the summer to draft her proposal, plan data assessment and develop reference papers.

6.2. Planned Graduate Student Studies Activities- 2016

2016 will see a continued assortment of students in the EMEND graduate student mix thanks to the DMI/Canfor/ NSERC collaborative research development grant; the WAM Strategic Grant; the DMI FRIAA-FRIP funding; as well as individual study projects taking place at EMEND. With the start of one new student under the CRD as well as a continuation of Dr. Bergeron's work in carbon dynamics.

We look forward to bringing on new students to work on the biodiversity, wildlife, soils, fire, and social dimensions of the EMEND project as well as remote sensing and landscape scale management planning. These funding grants anchors the relevance of these diverse themes to the CCFM criteria defining sustainable forest management in Canada's boreal forest, with the intent of inspiring refinement or development of science-based management tools, practices and policy. 2016 will see the end of our NSERC CRD and NSERC Strategic funding. If continued graduate work is desire, exploration of further grants will be necessary to expand and grow our graduate program into 2017.

2016 looks to be a relatively slow year for graduate student field work with a potential of 5 graduate students doing field working at EMEND this summer, however, a number of our graduate students will be in the lab/office completing data analysis, and thesis writing. A short summary on these projects can be found below. 2016 will see a continuation of our partner/graduate student engagement sessions and also include our government organizations and a workshop in the fall.

6.2.1. NSERC-CRD Grant

1. ***Samuel Bartels--Post-Doctoral Fellow (Macdonald)—Thresholds of resilience and recovery for understory plants.*** Dr. Bartels will continue to assist with the input of newly identified specimen from past field seasons. He will also assist in writing the Biodiversity chapter for the synthesis report as well as at least one more paper for review.

2. ***Caroline Franklin--PhD Candidate (Macdonald)—Thresholds of resilience and recovery for understory plants.*** Ms. Franklin will begin analyzing her data more thoroughly in the early 2016. She will be spending much of her time writing her chapter 2 and 3 of her thesis and readying them for submission for Academic journals.

3. ***Cassandra MacKenzie--M.Sc. Candidate (Quideau)—Forest floor processes response to variable retention harvesting.*** Ms. MacKenzie is set to start her program in February 2016. She will begin her year with some preliminary data analysis of data collected for her by a colleague. It is planned that Cassandra will participate in her first and most likely only full field season June-August.

4. ***Jared Amos—MSc Candidate (Spence)—The effect of retention harvesting on pollinator population assemblages in the boreal forest of Alberta.*** Continued efforts are being made to ensure that Mr. Amos completes his thesis with a defense date no later than April 2016.

5. ***Seung-Il Lee—PhD Candidate (Spence)—Early Colonization of white spruce dead wood by saproxylic beetles in mixed stands.*** Mr. Lee has now completed his writing and is set to defend his thesis in January 2016.

6. **Hosen Alam—*MSc* Candidate (Ryu)—*Duff Moisture Dynamics*.** Mr. Alam has finished writing and is set to defend his theisis in January 2016.

7. **Zoltan Domahidi—M. Sc. Candidate/Caroline Franklin—PhD Candidate (Nielsen)—*How do fur bearers use landscapes harvested by variable retention?*** Mr. Domahidi and Ms. Franklin continue to work on different aspects of this project. Mr Domahidi plans to do winter field work for this project by doing transect counts of small mammal tracks. Ms. Franklin has redeployed camera traps this winter and hopes to collect adequate data form this coming winter season. Both will be starting to analyze data and write thesis chapters.

8. **Matthew Robinson--M. Sc. Candidate (Nielsen)—*Variable retention forestry's effect on amphibian populations.*** Mr. Robinson has completed all field seasons funded by this project. However he is seeking assistance elsewhere in hopes of completing one more field season to round out his data sample. If this funding does not go ahead Mr. Robinson will concentrate on data analysis and writing in the coming year.

9. ***Linhao Wu*—Ph.D. Candidate (Spence)—Incorporating Succession into Temporal Variation.** Mr. Wu will continue to identify the ground beetle portion of the arthropod collection of 2014. He will also continue to analyze both the past EMEND ground beetle data as well as the new 2014 collection. Linhao will start writing and developing papers based on his results and processes.

10. ***Sarah Kahn—Ph.D Candidate (Armstrong)—The trade-off between flow of wood products and conservation of biodiversity.*** This project is currently on pause with the loss of Mrs. Kahn. It is hoped that Dr. Spence, Ms. Hayden will be able to communicate with Mrs. Kahn in the hopes of either (a) bringing her back into the project; (b) getting access to her work to provide a new student with a jumping off point, and to give them a head-start on completing this project closer to its projected ending date.

6.2.2. FRIAA-FRIP Grants

1. **Colin Bergeron—Post Doctoral Fellow (Spence)—*Local carbon dynamics associated with coarse woody debris (DMI).*** Colin Bergeron-Research Associate with Dr. John Spence- Quantification of Carbon and other Biodiversity-base Ecosystem Services, Associated Core Re-measurements and 1oth Year Synthesis (DMI) Dr Bergeron will be doing data analysis, and writing as well as assisting in field work needs in 2016.
2. ***Jaime Pinzon- Research Associate with Dr. John Spence- Quantification of Carbon and other Biodiversity-base Ecosystem Services, Associated Core Re-measurements and 1oth Year Synthesis (DMI)***. Dr. Pinzon will be assisting with writing, and editing the 10 Year Synthesis as well as assisting with data analysis and work planning.
3. ***Seung-Il Lee-Post Doctoral Fellow with Dr. John Spence- Quantification of Carbon and other Biodiversity-base Ecosystem Services, Associated Core Re-measurements and 1oth Year Synthesis (DMI).*** Dr. Lee will be assisting with field work, data analysis for the Carbon assessment as well as assisting with the 10 Year Synthesis.

6.2.3. NSERC-Strategic Grant--WAM

1. **Paul Sewell—Ph.D Candidate (Quideau)—The relation and underlying processes of soil ecosystems to terrain gradients and vegetation cover**. In 2016 Mr Sewell plans to do some preliminary analysis of the data from his 2015 season. During his second field season Paul intends to monitor soil respiration along constrained toposequences as well as look at soil profiles along these toposequences.

2. **Silvia Ronzani—Ph. D Candidate (Spence)—*Using epigaeic beetles as a function of the predicator variables of landscape management.*** Ms. Ronzani plans to continue her identification of specimen, draft a paper using the 2014/2015 data, and participate in a third and final field season.

3. **Laureen Echiverri--M.Sc. Candidate (Macdonald)—*Assessing the predictability of remote sensed predictor variable and vascular plants*.** Ms. Echiverri plans to finish her plant identification, begin her data analysis and start writing her thesis.

4. **Samuel Bartels-PDF (was a M.Sc. Project) (Macdonald)-Assessing the predictability of remote sensed predictor variables and patterns of bryophyte diversity.** Dr. Bartels will be spending the year doing data analysis as well as writing articles for submission to academic journals.

5. **Dinglian Xing—Postdoctoral Fellow (Nielsen, Spence, Macdonald)—*LiDAR predictive terrain modeling for forest productivity*.** Dr. Xing will be continuing with his analysis/modeling as well as the writing of several more papers.

6. **Unknown Postdoctoral Fellow (Nielsen, He)-Trade-off and optimization modeling for forest harvest planning.** This PDF will be brought on later in the year to assist in combining the data of all the projects associated within this grant and creating trade-off and optimization models to assist in forest harvest planning. Recruiting is currently under way for this position.

6.2.4. Other Students, Other Funding

7. **Zoltan Domahidi-MSc. with Dr. John Spence and Dr. Scott Nielsen-Nesting preference and productivity of cavity nesting owls in managed boreal landscapes.** Mr. Domahidi will be performing his second field season this spring and summer where he will be monitoring his nest boxes (72 within the EMEND site and 97 in the EMEND/Sulfur Lake area) for absence/presence, egg numbers, survival rate, etc. He will also be putting out recording devices to catch calling to indicate the presence of owls in the area.

8. **Jessica lltgen-Undergraduate, Lakehead University supervised by Jaime Pinzon-- Assessing for areas of high biodiversity by utilization of LiDAR Wet Areas Mapping (WAM) with indicator guilds of spiders.** In 2016 Miss lltgen will finish identifying samples, perform data analysis, and write her thesis for graduation in April 2016.

9. **Additional Students:** There are no additional students at this time. However, other projects not associated completely to EMEND strategic funding could be studying varying topics across the EMEND landscape in the coming years.

The EMC hopes this renewal of EMEND research opportunity will also prepare enthusiastic students as the next generation workforce to meet the challenges of one of Canada's flagship sectors through a highly interactive university-industry-government collaboration. It is with this in mind that partner-graduate engagement opportunities are being developed for 2016.

7. Knowledge Exchange Program

The main objective of this knowledge exchange work is to ensure communication of research results to project partners, and ensure mutual learning between students and industry partners. Fuse Consulting LTD. was contracted to fulfill our needs and did so extraordinarily well.

7.1. KE Activities Summary – 2015

Most of our 2015 Knowledge Exchange Activities were covered under the NSERC-CRD funding, however Natural Resources Canada and Canfor (FRIAA) supported the costs incurred in the Tour Trail signage and Visitor Staging Area (Pavilion).

This past year three research notes (EMEND Insights) were completed and four additional notes are planned for completion by December 2015. These notes present the primary findings and management implications to project partners in an easily accessible format and writing style. The notes can be found on our website at: http://emendproject.org/pages/read/emend-insights

After the success of our first innovative student-partner engagement sessions in 2013/2014 we delivered another round of sessions, this time including the Government of Alberta, Agriculture and Forest Division into the mix. We plan that these events will become an annual tradition for our graduate students. These sessions are designed to allow students to present on their projects, get feedback from our partner organizations, get an insight into what our partners may be looking for from their research, and learn about potential job positions within our partner organizations. We believe that this sort of engagement is proving extremely beneficial to both the students and the partners, and that it increases both the relevance and science quality of the work at EMEND. In the plans for the future is a partner workshop (November) where students finishing their work or getting close to finishing their work will present their results and a group discussion will be moderated to identify broad conclusions and management implications for the partners.

In addition to our student partner engagement secession we organized and delivered two major field tours comprised of high-level partner representatives and technical employees. Among other things, these allowed us to highlight the graduate research being conducted at EMEND. Students provided brief on- site descriptions of their work and were encouraged to mingle with our tour groups. In order to support our field tours, new tour trail signage was created and installed by Fuse Consulting. In addition, our newly dedicated Visitor Staging Area, commonly known as the Pavilion or Abley Courner, was finished this spring.

Fuse was also contracted to create an EMEND Business Case and coordinate with all partners/potential partners in regards to the EMEND NSERC Industry Chair support. As in past years Matthew Pyper was contracted to perform EMC Meeting Facilitation.

7.2. Planned KE Activities – 2016

2016 Potential KE Activities are as follows:

- 4-5 EMEND Insights (Pinzon, Williams, Lee, Amos)
- Student Partner Engagement Tours (spring/Summer) DMI, Cantor, GoA
- Student Workshop (fall)
- Targeted Workshop for Industry Personnel-targeting EMEND findings and their applications
- Public Relations/Social Networking
- EMENDs Interactive Website Additions

8. EMEND Infrastructure and Capital Investments

EMEND partners and researchers benefit from a range of infrastructure representing capital investments that support field activities and promotion. These include a University funded base camp and field lab (equipment, buildings), a temporary camp site, the research forest site compartments, all-weather road access, All Terrain Vehicles (ATV), and a visitor staging area. The project also relies on a website and database for storing and sharing data and project information. It is important that the EMT maintain an eye on the condition of these fundamental elements supporting the research effort. For a list of proposed projects and/or costs please see Appendix 5.

8.1. Camp Facilities

The EMEND Camp Facilities were heavily used during the 2015 summer field season, with almost 1670 person days during the regular field season. User fees, which are based on person days, were again implemented for users of the camp facilities including costs associated with catering, utilities, and maintenance needs; completing the move to a self-sustaining camp model, camp is now unsupported directly by any funding. Camp costs will continue in this manner unless funding/subsidies present themselves. Camp fees were approximately $116/night per person.

Increasing camp costs and reduced services proved an opportune reason to attempt to run the camp under University direction with these responsibilities falling on the Project Coordinator. This year two cooks (plus a substitute) were hired, all services needed at camp, and all food and supply costs came directly to the university. These small changes made it remarkably easier to track camp costs as well as ensure adequate services to the camp. The cost of a Field Program Manager was also added to the cost of running camp to offset costs associated with time spent performing Camp Management Activities by the Project Coordinator (approximately 150 hrs were used in season preparation, supply purchasing, and camp management). After a few bumps and a steep learning curve, it appears that as long as the time allotment needed for these management needs (with substantially be reduced in coming years) is available this is an entirely feasible endeavor for the Project Manager to look after. In addition, several of the additional duties that were taken care of by the Project Manager can be moved to be covered under the duties of the Camp Kitchen/Facilities Coordinator/Cook position. In the recent years camp costs were approximately $120/night/person which is a savings of $4. This savings will increase I believe next year as a number of costs will decrease next year with a few minor changes.

Camp Running Budget Regular Field Season 2015	
Expenses	
Wages & Benefits	$ 129,740
Food & Supplies	$ 23,046
Utilities & Camp Maintenance	$ 23,051
Fuel Costs	$ 3,207
Other	$ 14,975
Subtotal Expenses	***$ 194,019.00***
Total User nights	1669
Cost per night per user	***$ 116.50***
Incomes	
EMEND Core User Fees	$ 69,084.50
EMEND Project Student User Fees	$ 101,178.00
Non-EMEND Project User Fees (UofA)	$ 46,600.00
Non-EMEND Project User Fees (other)	$ -
	$ -
Subtotal Incomes	***$ 216,862.50***

It will be necessary in future years to require either advanced payment of anticipated camp costs, or monthly invoicing to ensure adequate funds are available as needed. It is the Project Coordinators belief that due to an ageing building and limited funding for such endeavors it may be in the Projects best interest to begin to run camp with a small yearly profit to assist with increasing maintenance bills and other needs the camp may need.

Off-season regular (running water) use of the camp facilities this year was possible until late October when temperatures started to drop low enough to require the plumbing to be winterized. Off-season winterized use of camp occurred January through March and is expected to continue late this year (November & December) therefore the field toilet along with disposable bags with biodegradable gel appears to have been a pertinent purchase.

The core crew assisted in a number of projects around the camp including maintaining the grass; creating seating/storage for the mud room; a recycling storage station outside; constructing the water tank structure; putting up the outdoor eating area and putting together picnic tables; taking apart unused planters; creating additional storage in the common room; fixing the fuel pump; and cleaning up the lab after a roof leak.

Thanks to surplus 2014 funding from Natural Resources Canada, the Camp Facilities has been outfitted with a new 4600L fuel tank (including removing old tank); (2) a better structure to protect the water tank; (3) three additional tents and frames; (4) 3 picnic tables and temporary tent structure for eating outside; and (5) a hazardous materials storage cabinet which were all very beneficial this year.

A few areas were identified as potential topics to be addressed in the future: (1) more lab space/ATV storage is needed on site, especially with the leak discovered in the lab trailer; (2) control of the noxious invasive weeds at camp; (3) new mattresses for the tents; (4) more accommodations including but not limited additional dining room space, washroom space, and bedrooms; (5) leaky lab roof repairs; (6) fire alarm system maintenance; and, (7) painting tent structure exteriors (all necessary supplies are already purchased).

8.2. Field Infrastructure

The Visitor Staging Area was completed early this year with assistance from Cantor (FRIAA), AESRD, DMI and the Core Crew. This structure now commonly known as the Pavilion is situated at Abele Corner, the cross- road of the P2-200, Cantor, and South Notekewin Access Roads. On June 23 the EMEND Partners, and university representatives hosted the Abele family and a few 2010 core crew members (who were close to Suzanne) to dedicate the Pavilion in Susanne's memory and honour. The purpose of the dedication is to keep alive the spirit of Susanne and to ensure all who work and visits the EMEND Site are aware of her dedication to the project and our dedication to the safety of our employees. Two tour Trails (B Trail and G Trail) were revitalized this year with trail clearing, provided by a Peace River AESRD Fire Heli-Hack Crew; and new signage created by Fuse Consulting. Financial contributions from Cantor, Natural Resources Canada, and Fuse Consulting made this trail revitalization possible. It has been proposed that these tour trails each be dedicated to people who have been important to the project.

Trail and bridge maintenance should be considered areas of concern to be addressed in 2016 and future years. EMEND has approximately 30 kilometers of ATV trail. About half of this is located in wetter areas. Many of the ATV trail in EMEND are becoming quite degraded (especially in wet areas). Solutions need to be considered in the near future as some areas within the site may become inaccessible by ATV. All the trails were surveyed this fall to assist in creating an action plan for the EMEND ATV trails. There are a number of areas where bridges are needed to reduce the degradation of small wet hollow areas along the trails, 2-3 places where bridges are needed and one area where a beaver dam will need to be destroyed or a board walk created across a new pond for access (ATV or foot) as well as the safety concerns of our users. Trail sign upgrades would also be helpful for new staff and graduate cohorts. Several things need to be done: (1) trail brushing to widen the trails/control the trees that are encroaching/growing on the trails; (2)

trail maintenance for deep ruts, wet areas, and dangerous spots; (3) clearing fallen trees along the trails; (4) structure building (bridges, boardwalks, etc.). Options should be looked into for trail maintenance as there may be an alternative with swamp mats (environmental mats) wood mats that are often used in transmission line, construction, and oil and gas operations.

Two areas of concern for trail degradation

A second area to consider that the partners should be aware of is the spread of prohibited noxious and noxious weeds at the EMEND site and camp. Canada Thistle, Scentless Chamomile, and Knapweed (all designated noxious or prohibited noxious species under the Alberta Weed Control Act) have all been sighted at EMEND and all have the ability to take over a disturbed site rapidly. This year Scentless Chamomile was identified within at least one PSP in C.

Canada Thistle

Scentless Chamomile

Knapweed

Core Permanent Sample Plots (PSPs) and Site markings such as boundaries, baselines, ellipse, and other markings are rapidly degrading. As these markings are essential to the project the remarking of many of these assets is a project that should be considered in the coming future. Luckily all the PSPs were re-labeled and marked this fall when there GPS coordinates were reassessed by Ryan James and 2 core crew members (Matthew Harris and Julien Appleby-Millette). It is essential that funding be put into having all the other site markings renewed as soon as possible. Additional issues with PSPs and site marking which are becoming evident within this 15 year post harvest assessment include: (1) obvious trampling of understory plots; (2) obvious walking trails through the mid line of PSPs; (3) others work too close to PSPs (digging/marking trees, etc.); and, (4) managing flagging tape.

8.3. EMEND Core Field Equipment

2015 was a very active year for a large majority of the EMEND field equipment. Thanks to the surplus NRCan funds 4 new ATVs, a 4 quad trailer, 2 Snowmobiles, 7 hand held radios, 2 Hypsometers, 3 hand held GPS devices, 4 snowmobile/ATV helmets, and a snowmobile ramp were purchased for use at EMEND. All 15 ATVs were used during the year with 3 ATVs left as floats for when additional ATVs were needed or ATVs were in for repairs. Three ATVs will be removed from the EMEND Fleet this year due to safety concerns and increased costs to keep them functional. The snowmobiles were used in trainings and were used on one field excursion in 2015. It is expected that these machines will get much more use in the 2015/2016 winter field season. The radios were actively used by all EMEND users which assisted in decreasing costs associated with renting radios. It is suggested that hand mic's be purchased to increase their usability and safety of users. The Hypsometers and GPS devices were put to use this year by both the core crew and the

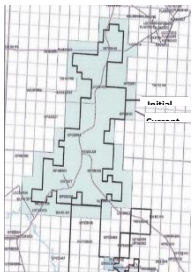
graduate students who needed them. Both EMEND trucks were used throughout the year to assist graduate students in decreasing the costs associated with vehicle rentals. Unfortunately, due to an incident 290 will be out of commission perhaps indefinitely, we will not know until an appraisal report is completed. To see a list of the EMEND Core Fleet and Field Equipment please go to Appendix: 4. All ATVs, trucks, and trailers were maintained and stored in Edmonton. Luckily Renewable Recourses provided the use of a sea can (which fit 10 of the 15 ATVS) and the University's Field Research Office (FRO) allowed us to use their sea can this winter.

All our field gear appears to be in good shape and ready to be used in the 2016 field season. To make data collection more accurate and to remove some human error it has been suggested that barcode scanners would be a great addition to the core field equipment. Since new handheld computers (PDAs) are also going to be required in the coming years (as our current equipment is running Microsoft XP-an expired operating system) these two devices could be combined into one device, as many "PDA" machines have barcode scanning capabilities. A member of the core crew also suggested having small digital cameras with the core crews; these could be used to document samples, and have an image of PSP through time, group photos, etc. It is imperative that the vehicle fleet says on our radars as we have potentially lost one vehicle and the rest is aging and over the coming years will need to be replaced.

Currently we require graduate student researchers and other users to arrange their own vehicles. That being said this is becoming increasingly difficult for many supervisors who do not have the extra funding or lab fleets to provide this much needed equipment to their students. For a prioritized list of Equipment/ Infrastructural needs please see Appendix 5.

8.4. EMEND PNT (Research Site Integrity Project)

The enhanced protection of the research forest lands (7000ha) and collective EMEND research investments in this site continues to be protected under a fairly strict PNT. This protection does not assure a solution for pre-existing sub-surface rights holders, however all surface land applications received by Alberta on the EMEND landscape will now see initial screening by Edmonton ESRD staff. It is relevant to discuss whether we will pursue stricter protection rights.



8.5. EMEND Website and Database

Canadian Forestry Service (CFS) continues to host the EMEND Website and database and provide the time and services of: Brad Tamm who maintains the database and Jon Elofson who maintains the EMEND website. Some minor changes to the EMEND website will be coming in 2016 to update the website and provide better information to students and supervisors. A SharePoint site will hopefully also be incorporated to assist in file and information sharing.

9. Health and Safety Program

The Health and Safety Program (which was completed in 2014) was thoroughly combed over and approved by our University of Alberta department and distribution to all Partners. This new document was due to the collaboration and hard work of Mr. Gord Winkle, Matthew Pyper, Dr. John Spence, and Amanda Hayden. The plan addresses Cardinal Rules, Required Work Practices, Critical Procedures, Certification and Training, Standard Operating Procedures, Referenced Procedures as well as numerous appendices related to safety at EMEND. This plan standardizes all Safety Protocols and ensures that all staff, students and users of the EMEND Site and Camp Facilities have the knowledge required to work safely and be prepared for most situations. It is anticipated that this living document will grow and change as needed by the project, partners, administration, and funding bodies. A standardized Safety Orientation has also been prepared and presented to all EMEND users, attendance and participation is mandatory. An initial 3-4 hour presentation as well as a returnee refresher presentation have been designed and in use. The returnee refresher orientation will be shorter and will highlight updates to the Health & Safety Program and to remind returnees of the most important aspects of the Plan. It is anticipated that in the coming year an orientation designed around English as a second language/foreign students/new Canadians orientation will be added to the orientation styles. This orientation will allow employees and students who have little knowledge of the Canadian Health and Safety program to become more familiar with our legislation and regulations.

There are also plans to make the safety orientation a mini online course set up through the University of Alberta's Moodle/E-class site. This course would be a series of videos that capture each section of the safety plan. Small tests will be set up to ensure information is being retained. This program allows the director customize the class for each participants so that only the components of the safety program that are necessary for their work at EMEND is mandatory for them to participate in.

This summer two of the University of Alberta's Environmental Health and Safety Committee and a departmental representative conducted a brief Audit of the projects Health and Safety Program as well as a site and documentation inspection. EMEND passed with flying colours, a few minor recommendations, and is being show-cased as a glowing example within the University community.

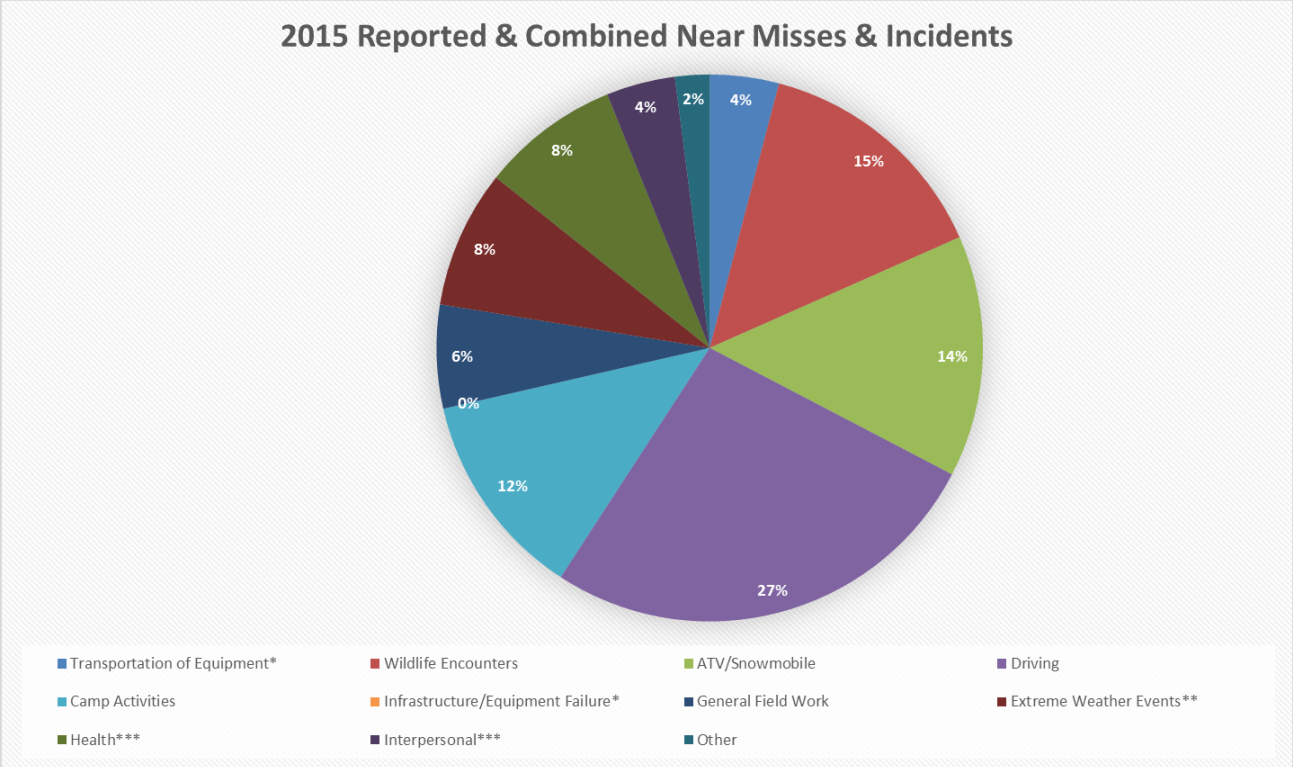
A continuing concern is the ever increasing costs of trainings required by our researchers as well as the necessary safe equipment purchase and maintenance. The lists of trainings required as well as the costs of the equipment needed are steadily on the rise. Despite this most funding provided does not allow for many of these costs within their budgets.

9.1. 2015 Near Misses/Incidents

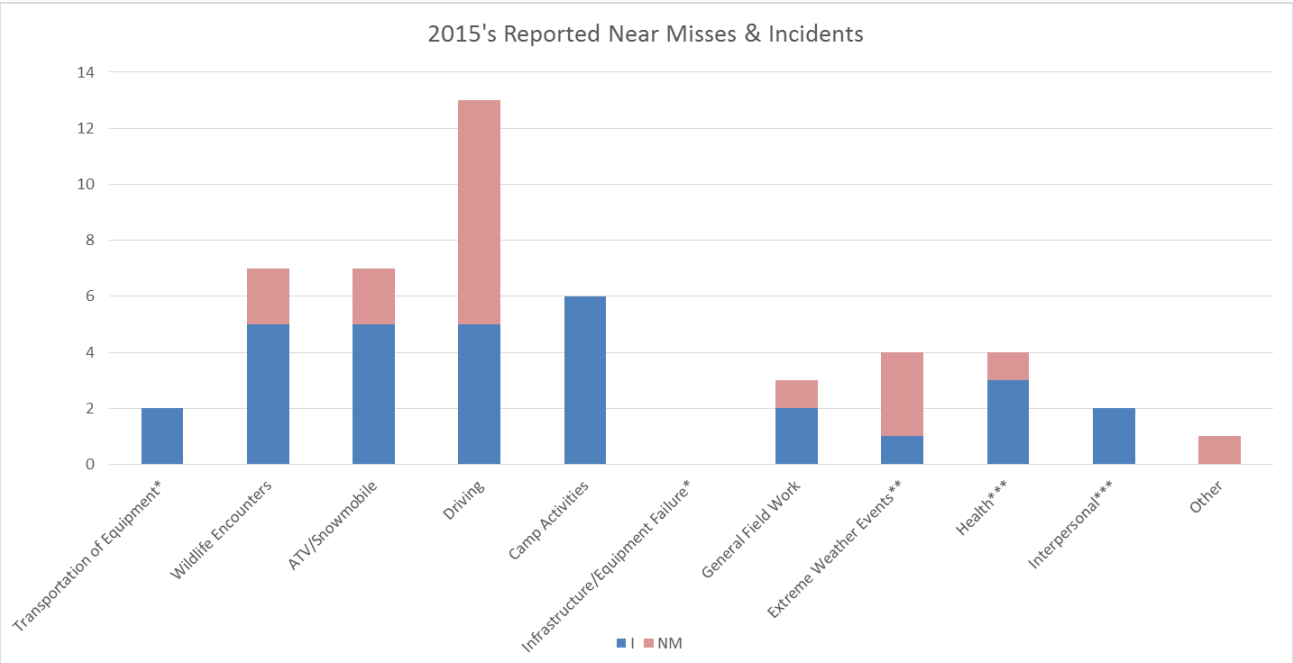
In 2015, forty-eight combined near misses and incidents were reported through documented reports or verbal communications. Thirty-one of these were considered incidents and sixteen were considered near misses. To see a complete list of these please see Appendix 7. These reported incidents and near misses occurred at the EMEND Site, Camp Facilities, or while on EMEND Business (traveling).

Increased numbers of users, almost continuous field activity throughout the year, and continued support from the staff, students, and visitors of EMEND is depicted in the total number of incidents at forty-eight (49). Although many of these were minor in nature and the EMEND Emergency Response Plan/Safety Program was used well several incidents resulted in minor injury and damage equipment; while four incidents resulted in visits to the emergency room of the hospital, and one may have resulted in the writing off of one of the EMEND trucks (290).

Below is a table shows the categorical split of all reported incidents and near misses in 2015. Also provided is a table that shows the split between the reported Incidents and near misses within each of these categories. Discussions around each category will follow.



Transportation of ATVs includes the hauling, loading, unloading and strapping of ATVs;
Wildlife Encounters includes all incidents/near misses related to wildlife (bear, grouse, moose);
ATV incidents include all incidents related to using or maintenance of the ATV;
Driving includes all incidents occurring while using a vehicle (exhaustion, distraction, wildlife, other drivers);
Camp Activities includes anything that occurred while at the camp facilities;
Infrastructure/Equipment Failure includes bridges breaking, radios malfunctioning, and SAT phone lost calls;
Extreme Weather Events includes: high temperatures, smoke, dust, wind, lightning, etc. incidents; and,
Other includes: illness, bear spray miss use, etc.



The category with the most reported incidents and near misses in 2015 was driving. The five incidents reported in this section included: vandalism of a student's truck while parked in Peace River (rock thrown through the back window); dead battery while parked at a site; blown tire on the P2-200; driving away with a passenger half in the vehicle; and a roll over on HWY 43 due to slippery roads. Near Misses (eight) in this section included: fish-tailing on a snow covered rutty P2-200; 2 occasions of locking keys in a vehicle; rock in the break of a vehicle; near collision with white tailed deer; balding tires on a work vehicle; and. on-going problems with road-radio protocols.

Wildlife Encounters had seven total incidents and near misses. To be defined as an incident with wildlife the wildlife must display aggressive behaviour, bear deterrents be used, and/or be within 5m or less of the animal. To be considered as a near miss wildlife will be present within the general proximity while on foot or ATV and/or you can hear them in the bush but cannot see them. The five incidents included: curious bears approaching workers in the field; bears guarding sites from workers both on foot or ATV; use of bear bangers and air horns; bluff charge of a bear. The two near misses that reported involved: bears being unaware of workers in the field but leaving as soon as noise was made by workers; and driving past a bear on the side of the road while on the side of the road. It is important to note that approximately 30 sightings within the EMEND site were recorded and more than 100 if you include the siting along the P2-200 headed into the site.

ATV and Snowmobile use had seven total incidents and near misses reported. In cases where ATVs or Vehicles get stuck in mud, snow, etc. we differentiate the events into incidents and near misses on the need to use a winch. If a winch is used it is considered an incident. The five reported incidents in this category included: 3 events of being stuck in mud that resulted in the need to be winched out (one it was necessary to bring a truck down to the spot to use the truck as an anchor as no viable trees were available; one incident of a quad rolling over at slow speeds while attempting to cross a beaver dam (the rider was able to jump free and was not injured); and, a wrist injury while attempting to get a snowmobile unstuck. The two reported near misses included: an ATV that was having mechanical issues; and, getting a snowmobile stuck on some debris in the ditch (easily able to get free).

Camp Activities resulted in six incidents including: banged shin on tailgate while unloading equipment; cut finger (required trip to hospital and stiches); bruised eye due to shelving panel popping out of place; cut finger from cleaning up old metal around camp; burnt finger from lawn mower; sun burn while working outside.

Extreme Weather Events resulted in four incidents and near misses. The one incident involved staying in the field too long in the heat. The three near misses involved heat; initial smoke being spotted; and, continued stand-by policy put in place for access to the field during the wild fire's dangerously active period (July 2 to August 20). It is important to note that this was one of the shining examples of our Emergency Response Plan at its best. Although it had been smoky in the area for some time the column of smoke was spotted by workers around 2:30. The pair immediately called 310-FIRE from their SAT Phone, them myself. At which point we decided that they would contact all crews working in the field and have them end their work immediately. One group could not be reached by radio or SAT Phone so one core group on their way past the area went in to see if they could get better radio reception closer to the group. They were found and all returned to old camp to leave. Fire crews on their way in stopped in to get a count of people active in the area and to have us report in to dispatch as soon as all EMEND workers were out of the field. When I had returned from my errands I immediately contacted DMI staff to ensure they were aware of the fires and that their workers were out of the field. Constant communication between DMI, AESRD Fire Dispatch

and the communications officer ensured that we were all well informed and able make appropriate decisions about field work. An additional layer of safety net was added with a daily check -in-out process with the Fire dispatch so they too were aware of our staff numbers in the area. Although many were not aware of the actual threat to EMEND both fires came close to running through the EMEND site and would have without intervention of the fire crews that worked diligently on them and the support of higher ranking staff at the Fire Command who were able to persuade the necessary people to get the funding necessary to adequately fight those fires.

General Field work had three reported incidents and near misses. The two incidents that were reported involved twisting an ankle walking through dense alder; and, an unknown bug bite on the head that resulted in extreme swelling and pain (resulted in a hospital visit). The one reported near miss occurred as a result of a slip on a log that did not result in injury.

General Health Issues had 4 reported incidents and near misses. The three incidents included: a field assistant who had not been feeling well and who had a history of negative reactions to the flu that resulted in hospital admissions (this staff was sent home and required to get a doctor's note clearing them for field work); two case of flu that were not controllable and resulted in visits to the hospital. The one documented near miss was a result of heat and too much water causing head ache and general poor health for two days.

Transportation of equipment involved two incidents these included debris in eye (while wearing safety glasses) from washing equipment before taking it to be serviced; and, during the loading of a snowmobile traction was lost due to a slippery decking.

Two Interpersonal incidents occurred this year resulting in the creation of this category. The first incident involved the reciprocated pranking of individuals in a group which was perceived as inappropriate by a number of others at camp as it seemed to be in a sexual nature. The second incident involved a verbal confrontation between two very different individuals. It was precipitated by another event during the day but was the result of several miss-communications and un-documented issues between the two.

There was one near miss documented under the category of other which involved encountering bear hunters inside a compartment within Block C. Hunters were definitely very prevalent this year with more than 5 sightings of them within the site, but also several encounters within the compartments.

9.2. Near Miss/Incident Trends – 2012-2015

Type	2015			# 2014			# 2013			# 2012		
	I	NM	Total	I	NM	Total	I	NM	Total	I	NM	Total
Transportation of Equipment*	2	0	2	2	3	5	0	4	4	0	0	0
Wildlife Encounters	5	2	7	2	3	5	4	3	7	0	1	1
ATV/Snowmobile	5	2	7	2	6	8	6	2	8	0	1	1
Driving	5	8	13	1	1	2	1	2	3	0	6	6
Camp Activities	6	0	6	0	0	0	4	1	5	0	3	3
Infrastructure/Equipment Failure*	0	0	0	0	3	3	3	6	9	0	0	0
General Field Work	2	1	3	2	3	5	2	1	3	2	1	3
Extreme Weather Events**	1	3	4	7	2	9	0	3	3	0	0	0
Health***	3	1	4	0	0	0	0	0	0	0	0	0
Interpersonal***	2	0	2	0	0	0	0	0	0	0	0	0
Other	0	1	1	0	4	4	0	0	0	0	0	0
Total	31	18	**49**	16	25	**41**	20	22	**42**	2	12	**14**
Person Days	1640			1193			579			378		
Per capita	0.019	0.011	**0.030**	0.013	0.021	**0.034**	0.035	0.038	**0.073**	0.005	0.032	**0.037**

* Added in 2013

** Added in 2014

***Added in 2015

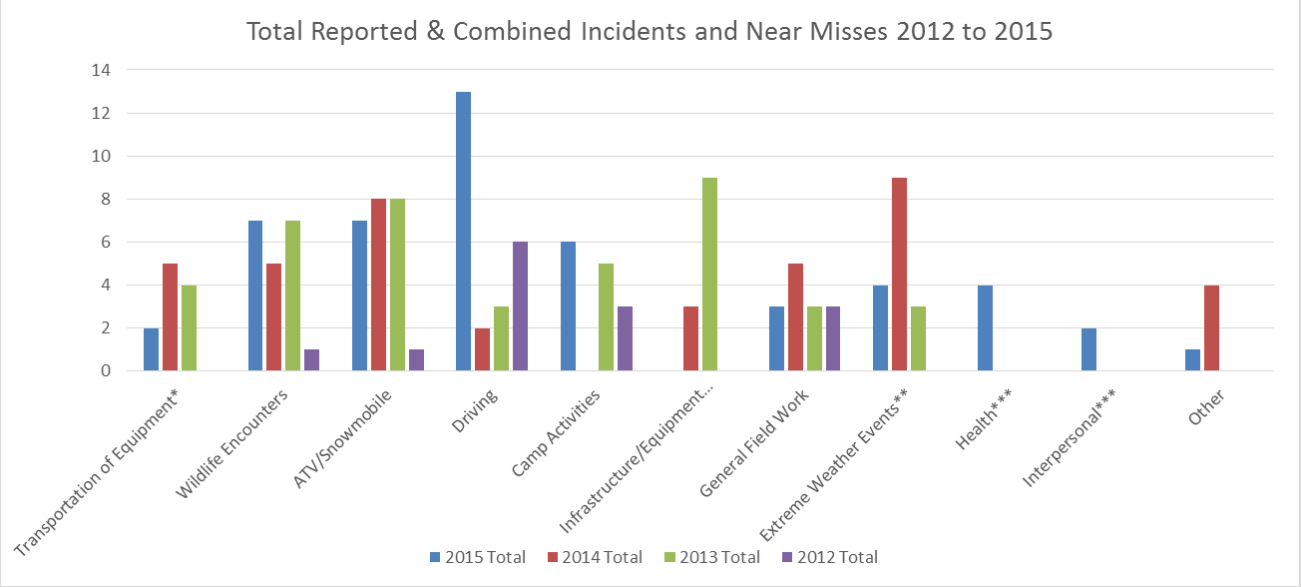
Definitions:

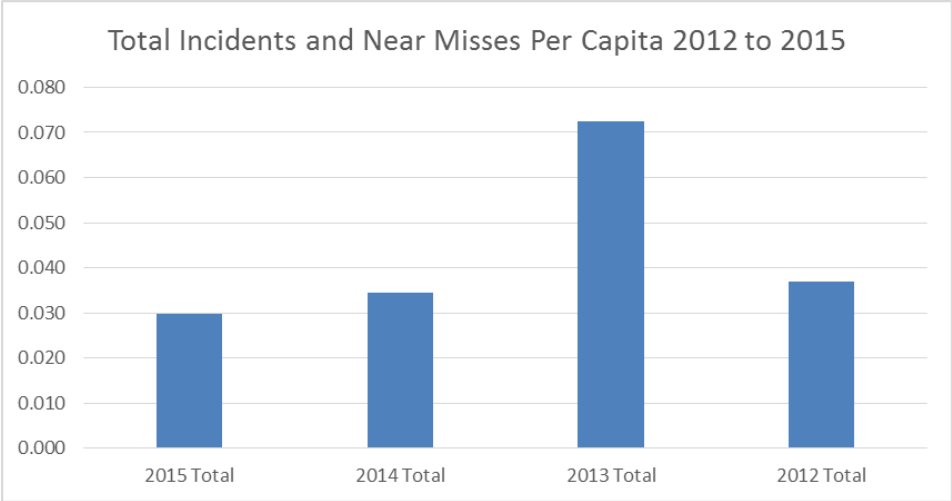
Incident: an unplanned event that causes personal harm or injury, or results in damage to equipment/infrastructure, or where other expenses were incured.

(Example 1: if a winch needs to be used by an atv or truck; Example 2: if a wildlife deterent needs to be used; Example 3: if a worker is within 5 meters or less of wildlife)

Near Miss: an unplanned event that interupts normal procedure and could have precipitated an incident

(Example 1: when workers on foot or atv sight (greater then 5m) or hear wildlife in their general vacinity; Example 2: if an atv gets stuck but can become unstuck with out the assistance of a winch)





The above table and graph, provide us with a comparison tool which we can use to determine trending near miss and incidents to help us make additional changes to our Health and Safety Plan/Program. It was suggested that sheer numbers of incidents and near misses were not as appropriate as there has been an increase in users and user days in the past few year. It is important to note that the current reporting system was adopted in 2013. The incidents and near misses were recorded after the field season and therefore may not be as accurate as present season. It is also important to note that there have been an ever increasing person days (people working in the field throughout the year instead of summer field season only) as well as total number of users in the past few years which will have contributed to these numbers. Another contributing factor to this may also be the fact that staff and students are becoming more and more aware of their responsibilities in reporting issues and therefore more incidents and near misses are being reported. Per capita our total number of reported incidents and near misses is actually down, from previous years. There was a substantial increase in incidents and near misses which involved driving and a small increase in wildlife encounters.

9.3. Recommendations and Anticipated Changes for 2016

After going over the documented near miss and incident forms and through discussions with staff and students the following suggestions have been made to improve the effectiveness of the EMEND Health and Safety Program.

- Policy and Procedure Changes (FAP)
  - Equipment
    - Update equipment policy to incorporate when to remove equipment from use.
  - Driving and Vehicles
    - Consider closing the road to EMEND users during the spring season (once road thaw starts)until road conditions improve
    - Keys in pockets, gas tank, etc., or locking doors
    - Ensure interior and exterior lights are off, charging stuff out of lighter/etc. before leaving vehicle
    - Before starting the vehicle ask "all ready" and wait for a response from all passengers before starting the vehicle and putting it in gear.
    - Add check road reports to SOP, FAP, etc.
  - ATVing
    - Walk through wet or muddy areas in new sites or if unsure of their depth
    - Speed limits for types of trails (slowdown in wet areas, etc.)
  - Field Work
    - Regular check-ins with field assistants to ensure they are doing fine in case of heat, exposure, exercise.

        - Ensure that all field assistants are aware of the difficulty of field work
        - Ensure clear communication of appropriate work attire even while at camp
        - Stress the need to keep and appropriate pace for all workers and this should change depending on what you are doing (slower in dense bush, carrying addition weight, heat, etc.)
        - Increase awareness of surrounding CWS, take extra precautions when the need to climb over CWE and take you time
        - When in doubt about the ability of a field assistant to perform field work due to illness or physical fitness have them bring in a doctor's note approving field work.
        - Mark ditches and trails for debris that could impede snowmobile use before snow falls (fall)
    - Site Safety, Protection, and Integrity
        - Continued site integrity and safety due to wild fire and other natural disturbance
        - Trail maintenance high priority (put policy in place)
    - Camp
        - Pranking: (1) Pranking needs to be mutually acceptable by all parties involved; (2) Cannot affect people's personal spaces (beds); (3) Cannot be of a sexual nature; and, (4) It must end if anyone at camp becomes uncomfortable with what is occurring
    - Other
        - Policy to protect staff, students, users, visitors of hunting within the site
            - Seek some sort of protective status that prohibits hunting?
        - Dealing with interpersonal issues between staff, students, etc.
- Training and Safety Meeting Changes
    - lead eye time
    - picking routes through wet areas
    - Weight distribution on uneven terrain
    - how to do a vehicle inspection
    - how to Fill out paperwork
    - Mid-season wildlife encounters recap to ensure people are still following all wildlife encounters policy
    - Improve the training with bear spray and bear banger use.
    - Add scenarios (ERP tests) to the safety meetings not just demonstrations
- Training/Certification
    - Record keeping form with individual sign-off on un-presented trainings and certifications
- Other
    - Consider reducing the speed within the site
    - Talk to DMI about radio usage policies
    - Create a system for tracking road radio use problems and perhaps some sort of penalties to those who continually break them (DMI)
    - Simplify forms: use check-marks, initials, and signatures better to reduce/simplify forms

We will also have to keep in mind the limited financial allocations to safety equipment and upgrades that could be encountered in coming years due to financial constraints. For example, the number of near misses resulting from ratchet straps loosening while ATVs are in transport may require yearly purchasing of new straps to maintain their integrity. ATV helmets should be replaced any time a helmet sustains a fall, or large hit, or is older than 5 years. Mandatory training costs are not covered by the university. Trail maintenance in busy data collection years is almost impossible and new bridge building unfeasible. Bear spray now expires annually or biannually and needs to be replace regularly even if not used (bear bangers are similar).

It is important for the continued integrity of the EMEND health and safety program it is important that a third party audit is performed. It is essential that safety trainings, equipment, and PPE be considered and included/added to future funding applications.

In 2013 and 2014 the EMEND Management Team committed to a number of changes to the Health & Safety Program. Many of these have been completed however there are few that have not. Please see the list of incomplete suggestions from 2013 and the full list from 2014

- (2013) Not only requiring ATV safe rider training and defensive driving for drivers but to also incorporate EMEND based training opportunities during orientation to provide employees and researchers an opportunity to learn different techniques required for the differences in their original training grounds and the conditions at EMEND. (lead-eye time, mapping routes, maneuvering in mud, etc.) (in development with University trainers and EH&S)
- (2013) Proposed changes to the EMEND maps (not complete),
- (2013) Proposal for ATV storage at Camp Facilities (not competed),
- (2013) Suggestion for motion censored lights or better lighting in parking lot at EMEND camp facilities (In progress, going up in spring)
- (2013) The university should consider engaging some form of annual 3rd_party audit of the Health and Safety Program to enable continual improvement cycle and arms-length assessment of its implementation and the documentation and field-evidence level. Such audits are a standard-of- practice assisting credibility and due diligence (Incomplete)
- (2013) Re-initiate the Emergency Response plan testing with assessment and feedback. (Incomplete, scheduled for 2016 field season)
- (2014) Implementation of ATV Safety Check lists (completed)
- (2014) Implementation of Vehicle Safety Check Lists (completed) (UoA protocol cleared up by admin)
  (2014) Implementation of Maintenance Checklist to ensure all work is completed by mechanics. (Complete)
- (2014) Contracted trail maintenance and bridge building plan and proposal (In-Progress)
- (2014) Clarification form University of Alberta on Religious traditions and field work (In-Progress)
- (2014) Updated Wildlife Safety Protocol to include mandatory bear banger presence with users without close vehicle/ATV presence (Completed)
- (2014) Enhanced Safety Orientations for foreign staff and students who are not used to Canadian Safety Standards/English as a 2"d language, etc. (In-Progress)
- (2014) Add extra water (cold) and electrolyte to safety gear required by users (Completed)
- (2014) Implementation of a Camp Seasonal Safety Checklist (Completed)
- (2014) Inclusion of Bear Bangers to SOP Transportation and Use of Bear Spray (Completed)
- (2014) Sign off on the EMEND Health and Safety Plan by the University of Alberta Environmental Health & Safety Department (EH&S). (Incomplete, attempting)
- (2014) Inclusion of winter field work policy and protocols (Completed)
- (2014) Addition of a trailer loading and unloading cheat-sheet added to the vehicle safety documents (Complete)

After consultation with the EMC these are the suggestions for changes for the 2016 year:

- Consider EMEND owned equipment only for use of core program and not graduate students
- Discuss trends using per capita as well as actuals (Completed)
- Document wildlife encounter incidents and near misses in proportion to sightings (Completed)

10. Funding & Financials

The EMEND Project relies solely on the support of partner agencies and funding bodies for the running and management of all work (Core and Graduate) surrounding the EMEND Project. Currently financial funding is coming from the Government of Alberta (GoA), the Government of Canada (GoC) (NRCan), Natural Sciences & Engineering Research Council (NSERC)—Strategic & CRD grants, DMI, and the University of Alberta (UoA). We also rely on a large amount of in-kind contributions which come from UoA, GoA, GoC, DMI, Canfor, NAIT Boreal Research Institute (BRI), Foothills Research Institute (fRI), and numerous other agencies. Please see Appendices: 8 and 9 for more information on past, present and expected future funding and Appendix 10 for important funding dates. All amounts in tables have been rounded to the nearest dollar.

10.1. Core Activity Financial Summary – 2015

Funding support for the 2015 Core activities at EMEND was provided by the AESRD (Biodiversity), and the DMI/FRIAA-FRIP Funding (Productivity).

10.1.1. FRIAA-FRIP (DMI): Core Productivity and Coarse Woody Debris

DMI FRIAA-FRIP Funding was awarded to the program for Core Productivity data collection and Coarse Woody Debris analysis. This funding is for $150,000 a year for two years, 2014 and 2015. Therefore 2015 will be last year of this support through this grant.

In 2015 we were able to hire 4 student field assistants who were supported under this grant: Vincent Del Bel Belluze (Lead Field Assistant), Julien Appleby-Millette (field Assistant), Josephine Junas-Grant (Field Assistant), and Dacotah Ateah (field assistant). These field assistants were responsible for collecting the remainder of the data for our Forest Measurements. Due to unexpected delays of other funding we needed to keep his salary on this account until we were able to move it to its permanent home. Therefore Mr. Appleby-Millette's salary for October is expected to be moved to another account. Dr. Colin Bergeron remained on the project in 2015 as the associated Post-Doctoral Fellow. We were able to supplement his salary from a small salary only grant from NRCan and therefore will be able to extend his wage into 2016 as accounted in our expected transactions.

Due to a few late invoices we had been waiting on to finalize camp fees these user fee have not yet been removed. These fees are expected to be removed soon. Due to some unexpected additional Laboratory costs our Lab and field supplies section was over extended in both years. In the near future these expenses will be moved to other accounts and accounted for under other budgets. Due to some unexpected delays in other funding it was necessary to place some Equipment Maintenance fees on this account until we are able to move them over. This is expected to be sometime in the near future. As is expected the University Overhead Fee for this instalment was $25,000.

Due to the completion of this project this account will be closed as of March 31, 2016 and all changes to be made will be made before this date.

10.1.2. FRIAA-FRI P (DMI): Quantification of Carbon and Other Biodiversity-base Ecosystem Services, Associated Core Re-measurements and 10 Year Synthesis

DMI FRIAA-FRIP Funding was awarded to the program for collection of Core data including: Coarse Woody Materials, snags, shrubs and bryophytes. It will also provide an analysis and interpretation of the carbon dynamics on the EMEND permanent sample plots. This is a one year project supporting this work from January 1, 2016 to December 31, 2016 when the final report is required to be submitted. We were awarded $341,520

10.1.3. Alberta Environment Sustainable Resource and Development Funding

Due to a number of changes in the Alberta Government, including the movement of our funding department from Alberta Environment and Sustainable Resource Development to the Department of Agriculture and Forestry, a number of delays and hurdles have been encountered in 2015. Upon receiving excellent news in 2014 that EMEND funding had been added as a budgetary line item at AESRD these changes in departments have made it more difficult to allocate these resources as DAF has no budget for project funding. Therefore the expected $133,000 minimum funding from the Government of Alberta was reduced to $50,000 for 2015. These changes have also placed delays in the university receiving these funds that the project will run into additional hurdles in moving expenses from other funds before the funding expiry date of March 31, 2016.

Thankfully there was some surplus funds from the 2014 funds that have allowed us to barely float the core program through 2015.

Dr. Jaime Pinzon was paid under this funding to continue his work on the EMEND 10 Year Synthesis as well as to assist students in their EMEND related work. Until Jaime's new funding kicks in he will continue to be paid under this account as predicted in the expected expenditures column. One field assistant was hired on under this funding. Jeffery Anderson who was a lead assistant helped collect core related data and supervise field assistants while in the field. Julien Appleby-Millette was hired on for September and October to do plot maintenance and data entry. He was able ensure that more than three quarters of the data collected this summer was ready for the database. Due to availability of funds Julien's wage and benefits were placed on another account and will be transferred over as soon as possible. Additionally we subsidized two graduate student's stipends. One month of an employee's wages and benefits were placed on this account by accident. The transfer of these funds to another account is addressed in the expected changes to the account.

Field and lab supplies were over charged due to a minor mistake. This is being addressed and is expected to be removed before March 31, 2016. Due to a late invoice camp fees could not be charged in the fall. These expenses are expected to be processed immediately. Due to an error an expense was charged to the wrong account and this mistake is being fixed. Dr. Spence, Dr. Bergeron, and Dr. Pinzon traveled together to conference to speak on a number of EMEND topics. For this reason funds were set aside to cover some of their expenses related to the conference.

To be able to accomplish all the work needed we have provided a best case scenario budget as well as a budget if we receive a similar amount of funds to 2015.

If we had the optimal funding we would:

- Hire: (1) hire a PDF to assist in the bryophyte collection including training, identification and overseeing the collection; (2) Top up the salaries of Dr. Jaime Pinzon and Seung-Il Lee who are mainly funded under the new FRIAA-FRIP funding, however their full wages are not covered under that funding; (3) wage for program and field management; (4) hire 6 additional field assistants to assist in data collection; and (5) hire 2 Lab Support/Data Entry personnel for part-time work for 6 months.
- Dedicate $5000 to Lab/Field supplies, safety equipment and training needs
- Have $ 65,000 to cover all potential camp fees
- Have $ 32,000 to cover costs of vehicle rental, gas, Kms, and ATV maintenance
- Have $ 2500 for Research Associates and PDFs to go to conferences

If we receive $50,000 we would:

- Support Dr. Jaime Pinzon's wage top-up and one additional field assistant.
- Have $2000 for Lab/Field Supplies, safety equipment needs, and trainings.
- Have $9000 for camp fees
- Have $2500 for ATV maintenance and gas

10.1.4. Other Core Funding

In 2013 the EMEND Project received a grant from the University of Alberta that covered $30,000 of our EMEND Project Coordinator/Field Project Manager positions for the years 2013, 2014, and 2015. This amount is slightly under half of the Project Coordinator's wage and benefits and expires in December 2015.

2015 also saw the successful competition of a Canadian Summer Jobs (CSJ) position. This funding is put in place by Service Canada and assists in creating positions for summer students. We received $3,672 for one of our field positions. In 2016 we will more than likely apply again. There is also another program through the Alberta Government called the Summer Temporary Employment Program (STEP) which we will attempt to take advantage of.

10.2. Grad Studies Activities Financial Summary – 2015

Funding support for the 2015 grad student activities at EMEND came in the form of a NSERC-CRD agreement; DMI-FRIAA-FRIP; and, the NSERC-Strategic grant for WAM research.

10.2.1. NSERC-CRD Funding

The NSERC CRD grant provides 5 years of funds with financial and in-kind support from DMI and in-kind support from Canfor. In its third year of funding all but one position need to be filled (this person is in ready to start May 2015). A number of sub-projects started later than anticipated due to poor recruitment/lack of appropriate candidates for positions. It is our intention to push the funds for these projects into come years. Both a complete project budget (all 5 years) as well as a current budget has been provided below.

This budget is still significantly under budget due to student start dates and changes in projects. There are three noted over expenditures two in Salary and Benefits and one in Lab/field supplies sections. The over expenditures within Salaries and Benefits are using leftover funds from previous years (2012 or 2013). The over expenditure in lab/field supplies is a result of additional field and safety equipment and training needs, these will be limited in 2015 however. Two 2015 budgets have been provided: the initial budget and an adapted budget that takes into account the carry over needs and changes around sub-project late starts.

Salaries and Benefits is made up of several types of positions Graduate Students, Post-Doctoral Fellows, and Project Management. Given late student starts and the fact that some students received scholarships, we underspent by approximately $32,000 in salaries. Although there was no original budget for post-doctoral fellows in this year; however, we have incurred expenditures under this section because the budgeted PDF position was filled a year later then we had intended. The actual cost is also lower, as the individual (Whitbeck) who initially held this position took a job with another organization and we were required to once again recruit for this position. Luckily this process only took 2 months so the impact will be limited. Due the delayed start and the position being empty for 2 months we will keep Dr. Bartels for a full-year contract within 2016. There appears to be an approximately $4,120 over-expenditure under project management; however, this is covered by funding in this category unspent in past years. It also shows that

in 2016 we will be spending $13,460 over budget; however, this entirely covered by unused salary allocated to this position in past years, when the salary could be covered by alternative sources.

Under equipment and facilities we have underspent by approximately $44,800 to date. This underspending is accounted for as follows: 1) we did not have a student in place for sub-project #3 last year, and 2) two of our students were able to complete their field work more quickly than budgeted. However, higher than expected costs associated with use of a remote field camp has run a number of researchers over budget on their camp facility costs. When the project was initiated actual costs of running camp, estimated at $80/day/person, were lower than initially expected and this resulted in some surplus that could cover additional days required by some student. However this source of funds has disappeared as the costs of running the camp have increased to approximately $120/day/person. In the revised plan expenditures will exceed allocated budget by c. $31,700, reflecting both the present real costs and the requirements of late-coming students. Thus, the under-expenditure noted above will be fully absorbed by the overall project requirements.

Expenditures for materials and supplies we were under budget for 2 reasons. First, a student with significant anticipated lab expenses ($15,000) for the past year was not yet in place. As this individual will join us early in 2016, the costs will be incurred in coming years. Funds available for supplies were underspent by just under half, mainly because of unexpected assistance from supervisor's labs with equipment and other needs. It may be that some of these will be charged back to us in the current fiscal year.

The travel section includes expenses associated with conferences and field work. Conference expenses are not fully accounted for in this year as many conferences are held within the fall months. We anticipate that a minimum of $2500 will be spent on conference travel between September and January. This is slightly under budget; however this category was somewhat over-expended in previous years.

Costs of field work are under budget for the past reporting period because: 1) one student (sub-project 3) was not in place, and 2) several students had shorter 2015 field seasons than expected. Another contributing factor for lower expenses than budgeted in this category is that costs of field work have been supplemented by unexpected assistance from both partner organizations and collaborator labs, especially with respect to in obtaining or renting equipment. Predicted budget for 2016 is larger than anticipated to account for field seasons of late comer students. It is important to note that even with the group under spending on Field work costs some sub-projects are way over budget in this section. The reason for this is: (1) winter and fall field work is significantly more expensive than summer, (2) although many sub-project supervisors were able to assist with field supply costs several could not find lab allocations for vehicles and all-terrain vehicles to be used by students supported by this grant (the core program was able to help out in some areas for this however they cannot be counted on in all years).

It appears that we have not spent any of our budgeted publication funding; however, these costs are beginning to come in now, and will be doubtlessly accounted for in future updates. It appears that we will over spend in our 'Knowledge Exchange or Technology Transfer' section by almost $4000; however, this is due to having students ready to produce research notes earlier than expected, and costs of having a more student-partner engagement opportunities, hosting 2 field tours and a workshop. This $5000 is accounted for in the overall project budget, as we have underspent on our Knowledge Exchange budgets past years. In 2016 we show a revised budget of $35,000 in this category, which is $10,000 over the initial budget to account for more research notes, and an increased student-partner engagement plan including tours and

workshop as encouraged by the outcomes of the past years. This revision is well-accommodated in the overall project budget as shown in the tables above.

10.2.2. NSERC-Strategic WAM Funding

The WAM NSERC Strategic Grant includes graduate student funding for three years along with funding for field assistants and lab technicians. Please see the below chart for further detail. The WAM NSERC Strategic budget appears to be under budget, however, there are a few changes still to be made for Year 2.

Under salaries and benefits actuals number for students and post-doctoral students is lower than estimated due to students receiving scholarships that are assisting in supporting their wages. One student came onto the project later then anticipate. Assistants including lab and field assistants are much higher due to the necessity to identify unidentified core specimens from previous collections. The wage of Amanda Hayden is being transferred from other accounts to supplement her wage and compensate her for managing the finances and data for the project. It was anticipated that the majority of the work for the Knowledge Broker (Matthew Pyper of Fuse Consulting) would not be needed until Year 3 and therefore his wage will be carried over to Year 3 of this project.

The student assessing Soils under this project was not on in full until the summer season. For this reason the Soil Analysis Costs and Laboratory Expenses were not used in Year 2 but are expected to be used in Year 3. Camp fees appears to be under budget however, due to an error 2 graduate students camp fees were not included and will be transferred to this account. Costs associated with vehicles are slightly over budget however this should not be a problem. Materials and supplies were also over budget. Several of our students concentrated their time on field work and analysis this year. This is why Conferences was significantly under budget. No publications have come out of this work however several are expected out in the coming months. Knowledge Exchange Activities are being planned to cover all three years of budget allotments and will be available by the end of the project and include a workshop and several insights. No software and printing was needed this year however with the increase in data analysis and conference attendance in Year 3 this will more than likely be made up.

10.3. In-Kind Support

The EMEND Project would not be what it is without the support and contribution of the people and organizations surrounding it. These people and organizations donate in-kind support in a number of ways including but not limited to: wages and benefits of graduate student supervisors, technical assistants, consultants, the EMEND Management Team, and other employees; equipment rental/donation to the program; location/room bookings for meetings; training costs; data, maps, aerial photo use; tour needs (helicopter charter, etc.) and so much more.

11. Appendices

Appendix 1: Graduate Student and Core Crew Scheduling

	Supervisor	Type	Name	2012	2013	2014	2015	2016	2017
NSERC-CRD	Spence/Acorn	MSc	Sonya Odsen	VR Harvesting and Birds					
	Macdonald	PDF	Kris Whitbeck		Understory Plants				
	Macdonald	PhD	Caroline Franklin			Thresholds of understory plants			
	Quideau	MSc	Cassandra MacKenzie			Forest Floor Processes and VR Harvesting			
	Spence/Langor	MSc	Jared Amos	VR Harvesting and Pollinators					
	Spence/Langor	PhD	Seung-Il Lee	Deadwood and Beetle diversity					
	Ryu	PhD	Hosen Alam			Fire resilient Landscapes			
	Nielsen	MSc	Zoltan/Caroline			VH Harvesting and Fur bearer use			
	Nielsen/Eaton	MSc	Matthew Robinson			VH Harvesting and Amphibians			
	He/Spence	PhD	Linhao Wu		VH Harvesting and Landscape Biodiversity				
	Armstrong	PhD	Sarah Kahn		Trade-Offs—Biodiversity and Wood Products				
	Spence/Langor/He	PDF	Jaime Pinzon	10 Year Synthesis					
	Spence	PM	Matthew/ Amy	EMEND Project Coordination					
NSERC-Strategic--WAM	Coops (UBC)	PDF	Wiebe Nijland			Forest Structure Matrix			
	Nielsen/Macdonald	PDF	Dingliang Xing			Terrain Modeling			
	Dyck/Quideau	PhD				Soils and Underlying Processes			
	Spence/Langor	PhD	Silvia Ronzani			Beetles and predictor variables			
	Macdonald, Spence	MSc	Laureen Echiverri			Vascular Plants & Remote Sensing			
	Macdonald, Caners	PhD	Kris Whitbeck			Bryophytes & Remote Sensing			
	Nielsen/He	PDF						Modeling/trade-offs	
FRIAA-FRIP	Spence	PDF	Colin Bergeron			Coarse Woody Materials			
	Spence	LFA				Productivity and Silviculture			
	Spence	CCFA				Productivity and Silviculture			
	Spence	LFA				Productivity and Silviculture			
	Spence	CCFA				Productivity and Silviculture			
AESRD Funding	Spence	PDF	Jaime Pinzon			Lab Technician and 10 Year Synthesis			
	Spence	LFA				Biodiversity			
	Spence	CCFA				Biodiversity			
	Spence	LFA				Biodiversity			
	Spence	CCFA				Biodiversity			
	Spence	PM	Amy Hayden			EMEND Project Coordination			

Appendix 2: Graduate Student Framework

This document describes the EMEND Management Committee's (EMC) *vision* for graduate-student research within the greater EMEND project and outlines its operational aspects in relation to fiscal support through the EMC. Graduate research is one of many aspects of the project relevant to operations managed by the EMC. Others include management of the core ecosystem-response monitoring activities, secondary research projects, financial strategies and budgets, field research site infrastructure and resources, field site management (logistics, environmental), camp and field-lab management, health and safety strategies, reporting, and knowledge exchange (technology transfer). Investment in graduate education is a central pillar of EMEND and so it is appropriate that it is co-managed by the EMC along with all the other aspects of the project.

The purpose of this document is to clarify the engagement of graduate student participants within EMEND and the polices surrounding the use of the EMEND research facility and site. It recognizes the significant financial investment of various funding entities as well as the in-kind investments of the EMEND partners, research leads and participating graduate students. Finally, the document provides important information for prospective students and research scientists considering engagement in EMEND research. In particular, this document focuses on: opportunities for graduate funding, access to infrastructure, interaction and the overall learning experience provided by EMEND.

Contents:

A INTRODUCTION

Research at EMEND, is managed through the EMC, and falls into two **principal categories:**

1) **Category 1** – Collection of experiment-wide or "core" data, delivered primarily by the centralized research group ("Core Crew" under direction of University of Alberta and Canadian Forest Service staff) at intervals (every 5 years) required to ensure that comparisons of all EMEND treatments can be made over all four forest types. The extensive database associated with the work is managed by the Canadian Forest Service (CFS). The database is accessible to those engaged in category 2a research (as defined below) and also provides principal data input for work of Postdoctoral Fellows associated with the project.
2) **Category 2** – Research planned and executed by researchers who use the EMEND site as a template for projects that are generally focused on functional aspects of forest ecology or specific management questions. Work carried out under this category comprises most graduate student projects and some are initiated by research scientists themselves who are interested in functional questions that support the overall objectives of EMEND as defined above. It includes two subsets of research projects:
   a. research projects with themes guided, approved and supported by the EMC, and
   b. research projects approved for access by the EMC but are not contributing significantly to the general directions being fostered by the overall EMEND project, but which are nonetheless deemed relevant to northern boreal forest conservation, management, or for which EMEND provides a template highly suited for the work.

B EMC Vision for Graduate-Student Research (Category 2a)

A highly unique and distinctive aspect of the EMEND project is its commitment to the development of highly qualified personnel (HQP). *From the start* this commitment to an advanced educational program was built into the EMEND project's planning; at an equivalent level to delivering answers to the fundamental research questions defined by industrial and governmental partners. The EMEND partners aim to foster a graduate-student research program that is *effective* and *dynamic*. These dual imperatives require project management that provides mutual benefits to academic, industry and government partners as well as meeting the professional and educational needs of the lead researchers and students participating in the research. For the purposes of this document, we characterize our objectives below.

1) The EMC defines an **EFFECTIVE** EMEND graduate-student program as having the following 6 distinct and documentable attributes:
   - EMEND fosters an attractive, supportive atmosphere for student experience and development designed to prepare all students for fulfilling careers and equip them for eventual entry into the workforce.
   - The EMC provides advanced clarity with respect to expectations about student funding, support from EMC budget resources, and expected deliverables.
   - The program is compelling, appealing and of leading-edge scientific quality, so as to maintain engaged participation of lead researchers and inspire international attention and sympathetic local understanding.
   - The EMEND program meets academic aspirations, scientific mandates and professional demands of university partners.
   - EMEND provides knowledge-exchange opportunities that promote 2-way communication between partners and researchers, and that provides deliverables that inform specific land management and policy challenges as identified by industry (and government) partners. Involvement in these endeavors is built into the educational programs of all graduate students.
   - The EMC works through transparent and consensus-based administration of funding that values clarity and criteria-based prioritization of research work.
2) A **DYNAMIC** graduate-student program is defined as having the following 5 distinct attributes:
   - Direction, administration and planning of EMEND research is sufficiently flexible to take advantage of potential funding opportunities without compromising any ongoing thesis-based research.
   - Study interests of prospective students are considered in building the research program, as determined in conjunction with their academic supervisors.
   - The program does not limit the creative potential of graduate students but challenges them to think clearly and independently about developing their research questions, approaches and suggested management applications.
   - The research program is responsive to partner needs while maintaining connections with the project's original objectives. Partner needs and EMC supported work at EMEND, however, must reflect the dynamics of evolving challenges within boreal land management disciplines and government policy. This is viewed as opportunity rather than constraint.
   - Although the project's beginnings are rooted in a set of harvest and prescribed fire treatments on the original EMEND landbase, the EMC embraces the philosophy of *adaptive management* in testing elsewhere as appropriate predictions and management prescriptions that flow from EMEND research.

VISION: *EMEND offers a model of interaction during the course of graduate studies that provides both i) benefits that support graduate students and supervising research-leads in meeting high-end educational and scientific objectives, and ii) outcomes with convincing value to business partners and government agencies co-funding this initiative and to other interested partners. In addition to supporting continual improvement of forestland management in northern Alberta, EMEND seeks to be relevant to on-the-ground applications across Canada and to the general discussion of Sustainable Forest Management (SFM) across the globe. The value of our program will be judged by the career paths of our students in addition to the uptake of our results in Canada and the contribution to international dialogue about SFM.*

C Research Themes Appropriate for Graduate Students

The EMC generally supports category 2a research by graduate students within a wide range of themes described in Appendix I. These give focus likely to contribute to improving forest and land management in NW Alberta. The intent in providing these themes is not to describe specific questions that candidate students must embrace. Instead, we intend to provide clarity about relevant themes of interest to the funding partners because these themes will be considered in evaluating the research proposals developed by the students and prioritizing available funding. Thus, it will be helpful for students to point out specific connections their projects will make with these themes in their proposals. Themes are generally anchored to understanding of natural-disturbance, functional dynamics of natural systems, defining the range of natural variation (RNV) and other topics directly relevant to management challenges, public values and current policy issues within mixedwood boreal forest regions. This understanding, in turn, will improve ability of our partners to meet the criteria for SFM as defined by the Canadian Council of Forest Ministers (CCFM). EMEND research supported by the EMC will connect to one of more of the themes outlined in Appendix I and this connection is the basis for distinguishing between category 2a and 2b research projects.

D Financial Support

1) *Funds Available.* Support provided by the EMEND partners and EMC-supported grant funds directed to the EMEND project are aimed by the EMC at one or more specific project areas (e.g., core monitoring, camp & infrastructure, grad-student projects). The specific strategy for EMC-supported graduate-student research includes a combination of:
   - industry contributions primarily targeting graduate-student support for research themes designated by the EMC,
   - grant funds at varying award-success rates pursued collaboratively by the EMEND partners as led by university participants (e.g., NSERC CRD application, NSERC Strategic Grant, NSERC–IPS),
   - Other funds as might be available directly to students or supervisors (e.g., ACA–Biodiversity Grants) at their initiative. Such funds are not managed by the EMC but are considered in allocating other funds to the project so as to extend the reach of partner funding as widely as possible.
2) *Annual Budget Plan.* These will be premised on the following assumptions and understanding reviewed and revised from time to time:
   - Approximate student stipend + benefit costs, and approximate investment period:
     - Post-doc $84,000 maximum over 2yrs
     - PhD $90,000 maximum over 4-5yrs
     - MSc $50,000 maximum over 2.5-3yrs
   - Significant personal support, through scholarships obtained by the student will reduce the portion of the above costs borne by the EMEND project budget.
   - Additional funding will be required for most projects, including contributions to some incidental costs of research (e.g., meetings and publication costs). Although industry will assist as possible and through moral support for grant applications to provide such funding through contribution-matched grants, such costs must remain the final responsibility of the supervising researcher, academic institution and/or student.
   - Incidental costs represent a recognized substantial component of graduate student research cost. Incidental costs fall into four categories as summarized below. Here the EMC states its priority for assisting with such costs.
     i. Overall EMEND costs. These include 'administrative' functions or meeting obligations that fall outside the normal educational components of winning and advanced degrees. Examples include: EMEND Administrative Coordinator, camp office costs, knowledge-exchange (tours, workshops, EMEND partner interactive engagement), etc. These are normally provided through the EMC, subject to availability of funds, but their contribution to the success of EMEND research must be recognized and acknowledged in student publications.
     ii. Special costs of conducting research at EMEND in addition to normal research costs. Examples

include: long-distance travel costs, ATV maintenance, satellite phones, safety training, etc. The EMC attempts to provide budget to assist with such costs when they are defined in applications received.

iii. Normal research costs. Travel and registration costs for presenting EMEND work at scientific meetings, wages field assistants (n.b., assistants are obligatory for EMEND research as no student may work alone), laboratory costs (including computing, chemicals, office supplies, Xerox, etc), publication expenses, etc. To the extent possible the EMC provides funds to assist with these costs; however, researcher can expect to absorb some of these through other funds available to them.

iv. Costs borne by the University and participating research agencies (e.g., CFS). These include indirect costs of research, normally overlooked when research costs are discussed. Examples include: salaries of research supervisors, salaries of technical support staff involved in research projects, library access, computing systems, specialized equipment (e.g., microscopes, HPLC, dendroscan) etc. These costs remain outside the province of the EMC, except through contributions to indirect costs of research when these levied by participating institutions through overhead. Nonetheless, the EMC acknowledges their very real nature and understands that these contribute to the overall value of the project.

3) *Evaluation of proposals. The EMC will prioritize proposal for graduate student funding based on the following criteria:*
   - Fit to the areas of interest as defined in Appendix I.
   - Priority of research for meeting management challenges and government policy needs.
   - Overall scientific quality of the work proposed.
   - Progress as demonstrated in annual progress reports.
   - Extent of student participation in EMEND enrichment activities.

E Non-financial Support

Three principal categories of indirect financial support are provided through the EMC for graduate students working at EMEND: 1) The EMEND research camp, landscape and associated infrastructure, 2) EMEND data and information (project database, including library of aerial-photography (digital + prints), and full access to the EMEMD website), and 3) the EMEND Safety Program. Guidelines for use of these resources and associated student responsibilities are defined below.

1) The **EMEND Research Facility** consists of three complementary components:
   a) A permanent camp and field laboratory facility (funded and developed through a partner supported grant from the Canadian Foundation for Innovation (CFI)), located 10km west of Dixonville, Alberta on private lands owned by the University of Alberta.
   b) A 1000-hectare boreal forest research site of replicated treatments located in the P1 area referenced under the DMI Forest Management Agreement. Treatments were designed and established 1997-1999 approximately 40-50km northwest of the camp infrastructure and at kilometer-30 along DMI's Sulphur Lake Main Haul Road (all-weather road).
   c) Various equipment resources.

Camp. The University of Alberta owned camp/lab facility and land can accommodate up to 30 researchers but optimal capacity is 15-20 people (trailer and tent frame structures). The summer of 2005 was the first summer of full-time operations at the facility. Camp facility operating costs are managed under EMEND budgets for both the core program field crew and accommodation for other EMC approved researchers working at the EMEND research site.

Graduate-students undertaking awarded Category 2a projects receive field accommodation at the EMEND camp as required during the period of field study. Costs exceeding those outlined in approved EMEND budgets are cost-shared by the individual researchers based on their actual facility use; from time to time, surcharges may be

required to fund operation of the field camp. Occasionally researchers not working on the EMEND project (Category 2b) wish to use the EMEND camp facility. These researchers are assessed a full cost-recovery rate plus 15% fee for their use of the research facilities.

The EMEND Core Crew Leader, under policy direction from the EMEND Coordinator, is responsible for the day-to-day administration of the EMEND camp/lab facilities (logistics, supplies, contract services), the Health & Safety Program, Environmental Management System (EMS), use of EMEND project equipment and tracking camp visitors and providing them with orientation.

Whitemud Catering Ltd. of Peace River, AB has historically been contracted for facility catering and operating services from May through to September. Full services (catering and all operating services) are normally provided from May 1 through August 31, after which limited operating services (water and sewer) are provided through to end-September. Services include all food and cleaning services, potable water delivery as well as all sewer and garbage disposal services, camp mobilization and winter decommissioning.

The Research Forest. The research forest is contained within a 7400 hectare working forest landscape of public lands that lie within the DMI's west Forest Management Agreement. Investment in direct costs of research to 2012 on part of the industry partners has accrued to c. $6.1 million, and collectively on the part of all partners to $14+ million. The site is protected by the Province under a Protective Notation (PNT) disposition as a long-range research installation that informs forest management policy and practices. This was necessary in the interests of maintaining site integrity, data continuity for the full-rotation of the project, and protection from edge-effects resulting from future forest harvest.

Equipment. Equipment and resources necessary to support the Core Crew have included up to four highway vehicles (two 4x4 trucks owned by the Department of Renewable Resources and allocated to EMEND, trailers for ATV transport, and other vehicles rented from the University of Alberta Vehicle pool as required). The EMEND trucks are primarily used to transport Core staff between the EMEND camp facility and the research forest. Vans are used to transport Core personnel between Edmonton and the research facility. However, when there is space, graduate students working at EMEND may take advantage of such transport.

Given the remote nature of many treatment blocks at EMEND, ATVs are required to access many research sites. Up to eight ATVs have been necessary for Core Crew use, depending on crew size. ATVs are owned by the Department of Renewable Resources and allocated to EMEND, including some donations from industry partners. The EMEND camp facility also has a large gasoline tank on site for researchers to use in their ATV's and vehicles. Funding for fuel (ATVs for Category 1+2a research, vehicles for Category 1 core work) is part of the Core program budget. Graduate students and their supervisors requiring extensive use of ATVs are expected to provide units dedicated to their projects. From time to time and subject to Core Crew demands, which have first priority for EMEND ATVs, appropriately trained graduate students may use Core Crew ATVs.

2) The **EMEND database and website** are managed by CFS personnel, and access the database is arranged by written application to Mr Brad Tomm at the Northern Forestry Centre. All students working at EMEND are expected to contribute to development of the project database by deposition of geo-referenced raw data resulting from their projects at the end of their programs.

3) Participation in the **EMEND Health and Safety Program** is mandatory for all personnel including graduate students and scientists working at the EMEND field facility. The EMEND partners place high priority on maintaining a safe workplace given the significant risks and hazards associated with the research site's remote location (even the EMEND camp is 40 minutes from the nearest medical assistance, and the research forest 1.5 to 2 hours from medical assistance). From its very beginnings the EMEND Project has developed a safety

program consisting of due diligence procedures and emergency response plans that *all personnel* using the EMEND research site and facilities are required to follow. The adoption of a strong safety focus is targeted to reduce work related injuries and foster a positive attitude towards safety at the EMEND research site.

The University of Alberta provides policy expectations, resources and supervision to manage safety concerns for field research programs through the Field Research Office and Research Services Office. All graduate students are bound by these policies and their interpretation as established and fine-tuned by the EMEND Core Crew Coordinator, who directs all use of the EMEND camp, access to the field site and use of project equipment. The remote location of the EMEND research forest, communication challenges inherent with limited cell-phone coverage on that landscape, the distance of the camp from medical facilities, and youth of those engaged in the day-to-day research work makes diligent attention to maintaining saftey programs and procedures a crucial priority. DMI and Canfor have historically provided guidance and support in the development and annual testing (drills) of the EMEND Health and Safety Program, as well as the EMS (including forest protection components). These plans include specific instructions on how to plan for and react to certain emergency situations such as medical emergencies, overdue/lost persons, and forest fires. DMI also offers training in Bear Awareness and Encounter Prevention & Response to core crew recruits, and has invited participation in the company's ATV training when available. Graduate students working at EMEND are required to familiarize themselves with all safety procedures and to participate safety programs when they are offered.

All Category 2 project researchers are responsible for providing their own required safety supplies, and researchers are not permitted to work on the forest research site without them. The EMC has instituted an agreement for all personnel working at EMEND that clearly defines the EMEND Preparedness and Response Plan, as well as roles and responsibilities of EMEND staff, EMEND Partners, and all Category 2 research personnel. EMEND Program Coordinator, the Core Crew Coordinator and other supervisory and partner staff work closely with the University to monitor, improve and enforce these programs at the EMEND site. Formal reviews of all incidents are shared with the EMC toward program improvements and prevention of recurrence.

F Roles of parties involved in Graduate Programs at EMEND

The EMC administers opportunities for graduate study in collaboration with the University of Alberta (and from time to time, other universities), graduate student supervisors, and science leads from Natural Resources Canada. The EMC reviews graduate student proposals brought forward through interactions with lead researchers, and allocates funding for Category 2a Research, subject to 'contractual' relationships with students receiving EMEND funding awards as defined under Memoranda of Understanding with the institutions managing the funds and in relation to criteria defined above (Section D.3). This section refers strictly to matters outside those defined by university Faculties of Graduate Studies and Research and Departments. No conflict with university-based guidelines are intended and in the unlikely situation where conflict may arise, the university rules will have force of priority.

1. **Roles of the Lead Researcher or Supervisor**: i) Identifying, screening and selecting prospective grad-student candidates based on creative potential and engagement interest in EMEND, ii) guiding development of research proposal, iii) introducing industry-government partners (post-award), iv) strongly encouraging broad student participation and engagement in EMEND (particularly through enrichment activities) through period of study in addition to providing normal academic supervision, v) cooperating with the EMEND Science Lead and the EMEND Program Coordinator to ensure that student data are made available to the data base, student progress reports are filed, students participate in knowledge-exchange, and that clear and accurate financial reports are filed for all funds allocated through the EMC.
2. **Roles of the EMEND Program Coordinator** (reporting to EMEND Science Lead): i) briefing new graduate students to provide orientation to the EMEND program components and model for interactive engagement through supplemental enrichment activities, ii) setting up student engagement meetings and coordinating

plans to visit partners as part of their educational experience, iii) coordinating knowledge-exchange products development, iv) coordination of EMEND data management and website, v) development and implementation of health & safety policies for the project.

3. **Roles of the EMC:** Project proposals that fit within EMEND research theme areas defined in Appendix 1 and that meet pre-requisites for funding will be reviewed by the EMC when brought forward by supervising researcher(s). The EMC will also review grant applications to NSERC (and other agencies) when industry and/or Government of Alberta (GOA) support is sought for such proposals and as brought forward by the lead applicant(s). Brief project descriptions will be reflected in EMC meeting notes.

   The EMC reviews proposals within the timelines driven by grant-funds and other funding sources to determine capacity to support those projects that are of value to the EMEND partners. It may be necessary to occasionally develop additional evaluation criteria and other prioritization mechanisms where projects exceed available funding. Timelines for award decisions will be driven by grant-funding deadlines and EMC budget timeframes.

   Incidental support for projects supported financially will be provided by the EMEND partners, as more specifically described in this framework. Such support will include access to research infrastructure, access to the EMEND database and selected relevant data held by industry and government partners (as subject to partner review of requests and conditions), interactive support from partner staff professionals during the period of student research, field-exposure tours of forest management activities, etc.

G Engagement Expected of EMEND Graduate Students

In order to realize an effective model for research collaboration, student interaction with industry and government partners is crucial to enhance both the student learning experience and the practical value of the research. Students will be expected to interact with partners at three key stages: i) forming the research question development of proposals, ii) mid-course interactions via workshops, field tours and informal discussions, iii) developing management implications from the study and publication of EMEND notes. These expectations are further defined below.

1. **Student Obligations and Deliverables:** The quality of the student learning experience and the practical utility of their work depend partly on their willingness to engage in the highly interactive learning environment open to EMEND participants. Students funded through the EMC will be expected to engage with industry-government partners through a variety of opportunities, and to provide specific deliverables. The opportunity will include the following:
   - Exposure to partner operations (forest management business orientation, tours).
   - Presentations to funding partners and practitioners (e.g., business site presentations, Q/A opportunities).
   - Project presentations at annual EMEND workshops and external conferences,
   - Assistance during EMEND project tours or public events, in including field presentations about student research projects.
   - Project reports (annual progress and final project reports) to EMC.
   - Posters (interim and final) for posting to EMEND website and/or partner worksites with poster formats adjusted to best meet the specific opportunity.
   - Inputs to the EMEND Research Note series, with at least one ERN summarizing management implications of the research to be considered an obligatory part of each student program.
   - All students receiving funding through the EMC will be required to sign a standing written agreement (Appendix 2) accepting the associated obligations at the point-of-award.
2. **Funding Partner Roles: From a business-case perspective, this model offers industry** and government partners:
   - Increased staff connection and learning potential through direct exposure to the research programs of graduate students,
   - Improved assurance that grad-students understand the business of forest management, and strong

encouragement for graduate students to think creatively about the management and policy implications of their work and the requirement that they file such thoughts at the end of their programs.

- The quality of student engagement and value of deliverables to the funding partners is therefore highly dependent on the engagement of the funding partners in 6 areas:
- Developing general directions for graduate projects, and prioritization and annual review projects that are being supported by the EMC,
- Engagement with students early in their programs via introduction by lead supervising researchers (this also ensures interaction with the lead researchers)
- Student orientation to business of forest management (on-site tours, EMEND workshop presentations on FMP, FHP, operations process)
- Access on-request to forest inventory data where needed to support research (subject to Data Sharing Agreements for proprietary corporate data).
- Providing opportunity for student progress-presentations at work-sites (staff interaction opportunity)
- Participation in development, review and dissemination of knowledge exchange publications within respective organizations

Appendix I: Key Research Themes as identified by the EMC and related CCFM criteria

Research Theme		CCFM Criteria
1. Harvest design and silviculture	refining or advancing practices emulating natural disturbance and post disturbance recovery	2,1,5
2. Reclamation strategies or baseline ecology	Informing forest ecosystem recovery within natural range of variability (forest productivity, biodiversity conservation, forest succession, forest structure, productive capacity); targets and indicators for assessing recovery; improved understanding of habitats as used by the biota	2,3
3. Carbon sequestration, productivity and climate change	informing forest management strategies for adaptation, connectivity and assisted migration in northern boreal forests	4
4. Terrestrial biodiversity	monitoring and/or modeling biodiversity response to forest land management strategies and/or natural disturbance (all taxa considered, and work on previously unexplored taxa is especially welcomed); elaboration of connections between biotic elements and overall forest function will increase relevance of proposals; indicator species	1
5. Aquatic systems	monitoring and/or modeling aquatic systems response to forest land management strategies and/or natural disturbance (sub-surface hydrology, surface hydrology, aquatic/riparian biodiversity); work on temporary ponds and their significance is of special interest	3,1
6. Economics and natural capital	monitoring and/or modeling economics, growth/yield productivity and natural capital during forest land management strategies and/or natural disturbance	5
7. Society and culture	monitoring and/or assessing social and cultural response and perspectives on forest land management strategies and/or natural disturbance, including Aboriginal traditional knowledge and values	6
8. Decision support tools, methods and models	development of models for succession, growth/yield, etc.; remote sensing technologies, effectiveness of monitoring systems, improved sampling methods	5
9. Wildfire dynamics and proactive management of disturbance	prescribed fire models, studies of use of fire as a stand management tool, stand-to-landscape applications geared to the mixedwood boreal plains	6,2,5
10. Utilization	work to develop or refine new directions in forest utilization (e.g., bio-economy, DWD management)	5,2,6

Appendix 3: EMEND Publications of 2015

Refereed Journal Articles

Lee, S.-1., Spence, J.R.,Langor, D.W, Pinzon, J.,2015. Retention patch size and conservation of saproxylic beetles in boreal white spruce stands. Forest Ecology and Management 358: 98-107.

Klimaszewski,J.,Godin, B.,Bourdon, C.,Langor, D.,Lee, S.-1., Horwood, D., 2015. New distribution records for Canadian Aleocharinae {Coleoptera, Staphylinidae), and new synonimies for Trichiusa. ZooKeys 498: 51-91.

Conference/Poster Presentations

Amos, J.,J.,D.W. Langor, and J.R. Spence. 2014. The impact of retention harvesting on bee and hoverfly assemblages in the boreal forest of northern Alberta. 24th International Union of Forest Research Organizations {IUFRO) 2014 World Congress, Salt Lake City, Utah, USA, October 5-11,2014

Amos, J., Bell,A., Bergeron, C., Belluz, V.D.B., Domahidi,Z.,La Rocca, C.,Lee, S.-1., Odsen, S.,Pinzon, J., Ronzani,S.,Wu, L., Spence, J.R.,2015. Estimating carabid population size: The relationship between abundance and capture area of pitfall traps. 17th European Carabidologists Meeting, Primosten, Croatia, September 20-25, 2015. {Winner of prize for best poster)

Bergeron, C., J. Pinzon, J.R. Spence, W.J.A. Volney . 2015. Oral. Recent fire history and ground-beetle (Coleoptera: Carabidae) assemblages in mature and old growth boreal forest of northwestern Alberta, Canada. 10th North American Forest Ecology Workshop. 14-18 June, Veracruz, Mexico.

Bergeron, B.,J. Pinzon, J.R. Spence. 2015. Oral. Ecosystem memory and lasting effects of fire history on early post-harvest recovery of a boreal ground-beetle community. 17th European Carabidologists Meeting, September 20-25, Primosten, Croatia.

Franklin, C., Macdonald, S.E.,and Nielsen, S. 2015. Effects of variable retention harvesting on understory vegetation. CONFORWest Interdisciplinary Forestry and Environmental Studies Conference. Friday Harbor, Washington, United States of America (International Conference, Oral Presentation)

Lee, S.-1., Spence, J.R.,Langor, D.W.,2014. Combining of aggregated and dispersed retention is effective for conserving deadwood-associated beetles on managed landscapes. 24th IUFRO 2014 World Congress, Salt Lake City, Utah, USA, October 5-11,2014.

Lee, S.-1., Spence, J.R.,Langor, D.W., 2014. Succession of saproxylic beetles associated with decomposition of boreal white spruce logs. Joint Annual Meeting of the Entomological Societies of Canada and Saskatchewan, Saskatoon, Saskatchewan, Canada, September 28-0ctober 1,2014.

Lee, S.-1., Spence, J.R.,Langor, D.W.,2014. Variable retention harvesting and saproxylic beetle conservation in white spruce stands of boreal ecosystem. Joint Annual Meeting of the Entomological Societies of Canada and Saskatchewan, Saskatoon, Saskatchewan, Canada, September 28-0ctober 1,2014. (Honourable mention in Student Paper Competition)

Lee, S.-1., Spence, J.R.,Langor, D.W. 2015. Retention forestry: Role of aggregated and dispersed retention for conserving saproxylic beetles on boreal white spruce stands. 10th North American Forest Ecology Workshop 2015, Veracruz, Mexico, June 14-18.

Odsen, S.,J. Spence, and J. Acorn. Partial retention harvest benefits songbird assemblages in the boreal forest of Canada. Sustaining Forests, Sustaining People: The Role of Research. 24th IUFRO World Congress. 5-11October, 2014, Salt Lake City, Utah.

Pinzon, J. 2015. Son compatibles el manejo forestal del monte nativo y el mantenimiento de biodiversidad? El caso del bosque boreal en Canada (Are forest management and maintenance of biodiversity compatible? The case of the mixedwood boreal forest of Canada). Invited speaker at the Institute Nacional de lnvestigaci6n Agropecuaria (INIA), June 1st, Tacuaremb6, Uruguay.

Pinzon, J., J.R. Spence, S. Bourassa, He, F. L. 2014. Poster. Small scale distribution in ground-dwelling arthropods reveals big picture patterns. 24th IUFRO World Congress. 5-11October, Salt Lake City, Utah.

Pinzon, J.,J.R. Spence, D.W. Langor, W.J.A. Volney. 2015. Oral. Changes in forest structure 10 years after variable retention harvest in the mixedwood boreal forest of western Canada. 10th North American Forest Ecology Workshop, 14-18 June, Veracruz, Mexico.

Pinzon, J.,J.R. Spence, D.W. Langor, S. Bourassa. 2014. Oral. Variable retention harvesting and sustainable forest management in the boreal forest of Canada: Lessons learned from the EMEND project. 24th IUFRO World Congress. 5-11October, Salt Lake City, Utah.

Robinson, R. (2014). Upland habitat suitability and abundance patterns of wood frogs in post-harvest variable retention stands. Alberta Biodiversity Conservation Chairs Annual Science Advisory Meeting.

Spence, JR. 2015. Forestry implications of an experiment in ecosystem-based management. Department of Environmental Sciences, University of Helsinki. 9 October 2015. Invited Seminar.

Spence, JR & DW Langor. 2015. Sustainable forest management for the boreal mixedwood: something new and something old. 10th North American Forest Ecology Workshop: Sustainable Landscapes, from Boreal to Tropical systems. 14-18 June 2015, Veracruz, Mexico. Invited Keynote.

Spence, JR. Pinzon, J, Bergeron, JAC, Odsen, S, Linhao Wu & David Langor. 2015. Response of forest biodiversity to partial retention harvest in a boreal mixedwood forest: How to manage it? International Congress of Conservation Biology, Montpelier,·France. 2-7 August 2015. Invited presentation

Spence, J.R, J. Pinzon, C. Bergeron, L. Wu & D.W. Langor. 2015. Oral. Recovery of a boreal carabid fauna ten years after variable retention harvest. 17th European Carabidologists Meeting, September 20-25, 2015. Primosten, Croatia.

Spence, J.R. & D.W. Langor. 2015. Green tree retention harvesting and biodiversity: an experiment in . sustainable forest management. Chinese Academy of Forestry, Guangzhou, China. 15 May 2015. Invited Seminar.

Wu, L., Bergeron, J.A.C., Lee, S.-1., Spence, J.R., 2014. 2014. Tree species, decay class, eco-site classification and dead wood decomposition rates in the mixed-wood boreal forest of Canada. 24th IUFRO World Congress, Salt Lake City, Utah, USA, October 5-11, 2014.

Wu, L., J. Pinzon, J.R. Spence & F. He. 2015. Oral. Fine-scale tree spatial distribution and carabid beetle distribution patterns in a Canadian boreal mixedwood. 17th European Carabidologists Meeting,September 20-25, Primosten, Croatia.

Other: Technical Reports, Non-Refereed Articles, etc.

Odsen, S.,J. Spence and F. Schmiegelow. 2015. The role of retention and reserves in the conservation of forest bird communities. EMEND Insights #6 - Department of Renewable Resources, University of Alberta. http://emendproject.org/pages/read/emend-insights

Wood, C., Spence, J., and Langor, D. 2015. Life After Death: The Importance of Deadwood for Beetles in the Boreal Forest. EMEND Insight #5-Department of Renewable Resources, University of Alberta. http://emendproject.org/pages/read/emend-insi ghts

Bodeux, B.,He, F. 2015.Large retention patches support moth biodiversity. EMEND lnsite #4-Department of Renewable Resources, University of Alberta. http://www.emendproject.org/pages/read/emend-insights

Appendix 4: EMEND Core Vehicle Fleet and Equipment

EMEND Vehicle Fleet

Type	Brand	Year	Description	Colour	Condition
Quad	Honda	2003	Fourtrax 250 (Spence Lab)	Red	Poor
Quad	Honda	2003	Fourtrax 250 (Spence Lab)	Red	Poor
Quad	Honda	2004	TE2564 (DMI Donated)	Red	Good
Quad	Honda	2004	TE2564 (DMI Donated)	Red	Good
Quad	Honda	2005	TRX500FES	Yellow	Good
Quad	Honda	2005	TRX500FES	Yellow	Good
Quad	Honda	2005	TRX500FES	Yellow	Good
Quad	Honda	2005	TRX500FES	Yellow	Good
Quad	Honda	2008	Fourtrax 250 (Spence Lab)	1998	Fair
Quad	Honda	2013	TRX420FPE	Red	Excellent
Quad	Honda	2013	TRX420FPE	Red	Excellent
Quad	Honda	2015	TRX420 (NRC)	Red	New
Quad	Honda	2015	TRX420 (NRC)	Red	New
Quad	Honda	2015	TRX420 (NRC)	Red	New
Quad	Honda	2015	TRX420 (NRC)	Red	New
Trailer	RT Trailers	2005	ATV trailer, 16' Long (4 ATV)	Black	Great
Trailer	Scona	1997	10' ATV Trailer (2 ATV)	Black	Good-Fair
Trailer		2015	ATV trailer, 18’ foot long (4 ATV)	Black	New
Truck	Chevrolet	2008	Chevrolet Silverado 2500 HD 4x4	White	Great
Truck	GMC	2005	GMC Yukon XL SLE 2500 4x4	White	Good
Snowmobile	Polaris	2015	Indy 550 ES, Electric Start	Red	New
Snowmobile	Polaris	2015	Indy 550 ES, Electric Start	Red	New

EMEND Core Field Equipment

Amount	Type	Brand	Condition	Need/Replace
1	Chainsaw	Husquvarna	Good	No
1	Chainsaw	Stihl	Good	No
2	Handheld GPS	Garmin	Excellent	2 more
1	Snowmobile Ramp		New	No
1	ATV Ramp		Good	No
2	Digital Measuring Sticks		Great	No
1	Computer	Dell	Poor	Yes
1	Printer	Brother	New	No
1	Laptop	Dell	Poor	Maybe
4	PDAs (Pocket PC)	Dell	Poor	Yes
4	Digital Clinometers	Vertex	Excellent/New	No
7	Handheld Radios	iComm	New	No
2	Calipers		Poor	Yes
5	Handheld Radios	Kenwood/Motorola	Poor	No
1	Repeater		New	No
12	Field First Aid Kits		Great	No
4	Emergency ATV Tire Repair Kit		Great	Maybe
6	Winch Kits		Great	No
12	Fire Extinguishers		Excellent	No

Appendix 5: Proposed EMEND Projects/Costs

Camp Facilities:

- More lab space/ATV storage is needed on site;
- Control of the noxious invasive weeds at camp; and,
- Camp night lighting enhancement or motion sensor to capture site incursions from the roadway beyond the gravel pad
- Increased accommodations, washroom facilities, dining room for increasing number of graduate student needs
- Lab roof repairs
- Fire Alarm/Safety system needs to be serviced
- Furnace in back trailer heat does not work but air does
- Extra storage (small shed) for grad equipment
- Recycling bin with garbage bin

Field Infrastructure:

- Trail and bridge maintenance
- Better trail signage
- Repeater antenna up and active
- Spread of prohibited noxious and noxious weeds at the EMEND site. Canada Thistle, Scentless Chamomile, and Knapweed
- Fenced lot at old camp for storage and for overnight safety (perhaps a tent frame or two)

EMEND Core Field Equipment:

- Purchase of at least 2 new handheld GPS devices, compasses.
- Need new PDA's (field hand held computers)
- Consider bar code scanners to reduce human error
- Small digital cameras for the documentation of samples, and have an image of PSP through time, group photos, etc.
- Renewal of the Core Crew vehicle fleet as the fleet is aging and over the coming years will need to be replaced.
- Winch kits for trucks and ATVs (have all the tools needed to successfully use the winches)

Safety:

- Creation of a safety video, website, or other medium to standardize participants orientation experience

Appendix 6: Prioritized Project Equipment Needs

Priority	Amount Needed	Item	Approximate Cost (each)	Comment
High	2-3	Handheld GPS device	$500	Commercial Solutions
High	Assorted	ATV/SM safety gear (winch kits, tire kits, helmets)	$1000-2500	Approximate cost for all items
High	4	PDAs	$450	
High	Assorted	Yearly Field Supplies	$1000-3000	Approximate cost for all items
High -Mod	Assorted	Yearly First Aid/Safety Gear	$1000-2500	Approximate cost for all items
High-Mod	1	Computer / Laptop	$5000	
Mod-High	4	Bar code Scanner (example CN51)	$3000	BarcodesInc.com
Mod-High	12	bed frames	$300	
Mod - High	1	ATCO trailer Bedrooms + washroom		
Mod	1	Extra outdoor storage		
Mod	2	'Permanent' Tent frames at Old Camp	$2500	
Mod	2	ATVs with winches	$10,000	
Mod		Security fencing		
Mod-Low	1	4X4 Truck with trailer breaks		
Nice to have	1	Movable field trailer (RV for Old Camp) with generator	$25,000	Used

Appendix 7: Documented Near Misses / Incidents 2015

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	**Indirect**	**Root**	
					-At Risk Behaviours -Unsafe Work Conditions	-People -Work Process/task -Materials/Equipment -Environment	-Management System	
19	6/4/15	NM	ATV	ATV kept stalling and would not work properly	Did not inform management of ATV issues	equipment not working properly after servicing	No system in place to determine when to remove equipment from use	Make a policy for determining when equipment should be removed from inventory
20	6/6/15	I	ATV	ATV stuck in much needed to be winched out	Did not assess the trail appropriately	trail maintenance	Trail maintenance should be higher priority, training for lead eye time, and picking routes in wet areas	Trail maintenance needs to be higher priority need to have better training for ATVers
29	7/11/15	I	ATV	While attempting to exit the trail onto Canfor road from compartments 889, 890 Rider 1 got her quad stuck in a foot of water and mud. Both riders attempted to winch the stuck quad out but had no success. They called the FPM at camp from their Satellite phone and he came with Truck unit 260. Using the truck as an anchor for the winch, the stuck quad came out no problem. A cruise vest was always used on the winch as a dampener.	Quading on muddy trails, unmaintained trails	Poor trail conditions.	Trail maintenance should be higher priority, training for lead eye time, and picking routes in wet areas	Walk through wet and muddy areas first to determine areas of shallow water and harder ground. Improve control and traction of quad while driving. Maintain trails.

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
41	8/11/15	I	ATV	While quading along the main trail in I Rider 1 hit some deep ruts and got stuck in sucked in them. Both riders worked together drive logs under the wheels in combination with winching it from behind. They were successful.	Not eyeing the trail enough to see and avoid the ruts.	Poor trail conditions.	More investment in train maintenance.	Pay more attention to the road ahead and avoid deep ruts and other unnecessary obstacles.
45	10/3/15	I	ATV	Crossing rough terrain in cut-line approximately 2km north of sulfur lake road and 3km west of P2200, flipped quad crossing beaver dam.	not using appropriate active rider stance			More aware of weight distribution on uneven terrain.
1	3/11/15	NM	Camp	While unloading a hazardous waste materials container from the back of 260. A bit of snow made the tail gate a bit slick. Person 1's pant leg caught on a tab of the tail gate as they was jumping off and caused them to get caught mid-air. As they fell the pant leg un-caught and they was able to roll out of the fall. No injuries were incurred	hurrying to complete the task	improper equipment to do the task-- thought that it would not be as heavy/awkward	Unprepared for this sort of work within the safety plan	have fork lift and trained forklift operators ready for large equipment maneuvering
6	5/7/15	I	Camp	While putting a cutting knife into its protective sheath, Cook 1's hand slipped and she cut the base of her thumb quite deeply	not paying close enough attention	sheath was too tight for the knife		got rid of the knife sheaths
8	5/12/15	I	Camp	While putting together a shelving unit Cook 1 was hit by the shelf close to her eye, causing a large bruise	should have asked for help, and followed directions			
16	5/28/15	I	Camp	While tidying around camp an odd shaped piece of metal that had some barbs hidden on the bottom, one of the barbs punctured the little finger	Not wearing PPE			

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
39	8/9/15	I	Camp	Burnt thumb on lawnmower engine while attempting to fix it.	Not wearing PPE			Clear communication of PPE use while at camp
4	3/12/15	I	Driving	While driving on snow covered P220 290 started to slide. Driver was going approximately 40km, however ice and ruts under the 1 ½ in of snow were hidden in some areas. 290 was following 260 hauling a trailer going the same speed with little difficulty. Both trucks were in 4WD				Once thaw starts to occur in the spring season may want to consider closing the road to EMEND users until road conditions improve with the drying of the road.
5	5/4/15	NM	Driving	After parking at old camp the keys to the truck got locked inside the cab. No windows were down. They called camp for assistance, who called VP. While in this process they were able to jingle the back window open enough to in through it.	not paying attention			put a policy in place to have keys put in pocket, or vehicle gas tanks as soon as they leave the vehicle
17	5/29/15	NM	Driving	While driving from PR to Camp we nearly missed a white tailed deer who almost swerved in front of the truck. The deer had been camouflaged into the shadows of the trees along the side of the road	Driving too fast for the time of day			
21	6/13/15	I	Driving	Battery to vehicle died on Canfor Road, needed to be boosted, someone had to come from camp to do so	Did not do an appropriate vehicle check or they left something on inside the vehicle		Need to add to protocol checking that all lights, etc. are off before leaving the vehicle	Need to add to protocol checking that all lights, etc. are off before leaving the vehicle
33	7/30/15	I	Driving	Blown tire while driving to camp on P2-200	Not doing a proper tire inspection			

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
34	7/31/15	NM	Driving	While out assisting putting on a tire on 290, PC noticed that 260's tires were almost completed bald. 260 was taken out of service until new tires could be purchased and put on.	staff did not ask questions when they did not know something		Better training on vehicle inspections	Will include vehicle safety inspections into training needs
36	8/3/15	I	Driving	Vince was driver at the end of the day. The crew was sitting in the truck with their doors open, while others loaded their gear and changed their clothes for the drive home. Vince thought that he had heard all the doors close, so he put the car in gear and started to drive forward, unfortunately Jeff was just getting into the vehicle. He was able to jump in but banged his knee re-injuring a chronic injury. He shouted stop and Vince immediately put the car in park.	Not Paying attention, rushing, no mirror checks, distracted		No policy in place for ensuring all passengers are in and buckled before leaving	If driver, before starting, ask "all ready" and wait for a response from all passengers
40	8/11/15	NM	Driving	While driving empty on the P2-200 the driver approached a grader, after radioing the operator for the clear, he passed him. Approximately 500 m's down the road, a loaded chip truck approached. The driver had not been heard on the radio.		Either operator was not using a radio, or due to excessive radio usage from other workers on the road where using up all the air time.	Heavy traffic or not enforcement of radio policies	Talk to DMI about radio usage policies.
44	8/26/15	NM	Driving	While doing an onsite tour with the DMI summer student staff the keys were locked in the vehicle. Luckily the window was down and they were able to pull the lock up on the driver's side door	Not paying attention		key protocol added	Key protocol added

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
47	11/15/15	I	Driving	While driving to camp in 290 the driver lost control attempted to steer out of the skid and caused a fishtail, they hit the ditch and roll on its side. Passenger nor driver were injured in the incident. A tow truck was close by, they called the RCMP to report the accident. Two vehicles also stopped to assist. Two other accidents occurred further down the highway in less than an hour after their accident. May write 290 off	Did not check the road report before leaving Edmonton. Attempted to correct the fishtail but overcorrected		Add check road reports to the SOP	Longer defensive driving course with longer time on the road.
12	5/25/16	NM	Driving	Rock in break, needed to remove tire for full function				
18	06/??/15	I	Driving	While in Peace River for supplies the rental truck was parked in a lot. When they returned the back window had been smashed out and there was a rock in the back seat. They filed a report with the police and protective services on campus				
35	08/15	NM	Driving	Ongoing non-road communications often in another language occurring on road channel which interrupts regular km check ins, especially dangerous for ATVers	Not following road radio protocol		Better Comms. with contractors on appropriate radio Behaviours	Some sort of system to track these difficulties and applied penalties
26	6/26/15	I	Extreme Weather	Grad student and field assistant returned in early afternoon from the field due to heat issues with field assistant	Not used to physical work, or hot temperatures	warm temperatures	inadequate policy for checking health and fitness of field assistants	Continue to regularly check in with field assistants to ensure they are doing fine in the heat

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
27	7/1/15	NM	Extreme Weather	Smoke was spotted by Grad student and reported to 310-FIRE and then contacted the PC. Staff and students were called back to camp until more information was gathered regarding the fire. Kept in close contact with AESRD reporting each morning for an updated and/or check in for the day		Hot Dry season		Everyone followed the ERP perfectly. Great communication between all groups as well as others in the area. This was a great example of the ERP working.
30	7/12/15	I	Extreme Weather	While working outside at camp without a t-shirt on, they got a very bad sunburn on their back and shoulders	Not wearing sunscreen, not wearing a shirt while working		clear communication of appropriate work attire while working at camp	clear communication of appropriate work attire while working at camp
28	7-01-2015 to 07-26-2015		Extreme Weather	Due to fires in the area site was on standby for field work on a daily basis. 2 days the site was closed due to smoke/fire weather predictions from fire base	smoke in the area, and fire too close to the site for safe field work		Need new policy for what to do in this situation. When to close the site, check in policies, etc. communication policy of site integrity in fire situations	Should create a policy with RenR. AESRD, and other partners for continued site safety, need to come up with policy for site protection in cases when threatened by fire or other natural disturbance.
13	5/27/15	I	Field Work	While walking through 862 PSP 5, field assistant got their leg/foot trapped in 15 Alder regrowth. Unable to stop their momentum the fall caused them to strain their hip, knee, and ankle	hurrying	forest regrowth is very dense		stress the need to keep the pace slow when traversing through areas of dense re-growth

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
31	7/18/15	NM	Field Work	While walking down a trail in H field assistant got their heal caught on a log he was climbing over and tripped, falling directly onto another log where they were able to get his hands in front of themselves and catch their fall. The situation could have been much worse had they instead fallen onto a part of the log where a broken branch was sticking out	Climbing over fallen logs and CWD	Big rubber boots awkward while climbing over large logs	Trails not maintained	Maintain trails, increase awareness of surrounding CWD, take extra caution climbing over CWD and take your time
43	8/21/15	I	Field Work	While working in G an unknown bug somehow got into field assistants hardhat and under her hair and bit/stung her. The pain and uncertainty of what happen gave them an anxiety attack, we thought they may be having an allergic reaction. They came back to the camp before going to the hospital.	Hard hat trapped bug next to head	Working in the forest where insects live. Working by/in trees.		Bug repellent. Remain calm, follow the 6 steps in the emergency response plan.
22	6/19/15	I	Health	It was determined that a field assistant was not feeling up to working in the field. Grad student suspects it is due to the heat	Not used to physical work, or hot temperatures	warm temperatures	inadequate policy for checking health and fitness of field assistants	Continue to regularly check in with field assistants to ensure they are doing fine in the heat
23	6/20/15	NM	Health	Not feeling well due to heat and over consumption of water	Not used to physical work, or hot temperatures	warm temperatures	inadequate policy for checking health and fitness of field assistants	Continue to regularly check in with field assistants to ensure they are doing fine in the heat

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
25	6/25/15	I	Health	Around 11:30 Laureen found out that Jaimie was not feeling well, and had not been for quite a while. Laureen also found out that Jaimie has a history of negative reactions to the flu including unconsciousness. Laureen moved Jaimie inside, gave her Gravol for nausea and Tylenol for a fever. She also decided to take her to Edmonton the following day to ensure that she fully regained her health	general health/chronic condition was not communicated when hired as a field assistant		policy for checking general health of field assistants	We are having her bring a doctor's note stating that she can go back to field work.
42	8/18/15	I	Health	Stomach flu. Went to hospital for dehydration				
49	8/25/15	I	Health	While working around camp the cook felt not right. She became quite sick, soon after and then slept for several hours. When she woke up she felt better until she sat up and then was quite ill again. She was taken to hospital due to dehydration. The doctors could not determine what caused the episode, however she had had episodes of vertigo in the past. They assumed this was just an odd case of vertigo. Treated her in the hospital for several hours and then she was release. She spent two days on bed rest, and slowly started working again.				

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
37	8/3/15	I	Interpersonal	Due to the incident that occurred earlier that day a meeting was requested with the other field assistant to discuss the incident. When we met privately in my office, strong words and anger took me off guard as FA1 confronted FA2 about anything that had irked him throughout the season. After substantial time I gained my composure and questioned why these things had not been brought to my attention sooner, it they were a major issue. FA1 did not feel they were a problem until they had been compounded by FA1's opinion of FA2's behaviour of the day. FA2 took all this in his stride however felt very uncomfortable working with FA1 any longer.	bottling emotions, lack of communication		Need policy for dealing with interpersonal issues between staff	Need policy for dealing with interpersonal issues between staff
32	July	I	Interpersonal	Vince and Laureen had a long standing friendship which included pranking each other. Throughout the summer others noticed the escalation of these pranks and a few did not approve of their perhaps sexual nature. A few feared that Laureen did not appreciate	potential sexual harassment issues		Policy for appropriate behaviour at camp	requested that all pranking had to be: (1) acceptable to all parties involved, (2) could not affect people's personal spaces (beds, etc.), (3) could not be of a sexual nature, (4) ended if anyone was uncomfortable with them
14	5/27/15	NM	Other	While working in C 2 field assistants encountered bear hunters within the compartments.		Unknown individuals using weapons on site	No real planning for safety in hunting season	Some sort of ban on hunting while people are in the field?

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
2	3/12/15	NM	Snowmobile	While driving snowmobiles a log hidden by deep snow and a drift caught one ski.		deeper snow then anticipated in the forest	Not completely prepared for a winter field season.	Next year we will be able to create trails early in the season so thigh deep snow will more than likely not be a hazard. We will also mark out areas where large amounts of debris are found in ditches or on trails so that snowmobilers will be aware of what could be under the snow.
3	3/12/15	I	Snowmobile	While attempting to free a ski that was trapped under a hidden log the rider banged their wrist, caused a small bruise and swelling later in the day				
46	10/26/15	I	Transport. of ATVs	While washing ATVs at a car wash while wearing safety glasses debris got into field assistants eye. They were able to flush the eye out.				
48	11/27/15	NM	Transport. of ATVs	While loading a snowmobile on the trailer, the snowmobile hit a slick piece of decking and slid into the front of the trailer where it got grip and stopped.		ice was assessed as snow before loading		check the deck of trailer before loading snowmobiles or ATVs
7	5/8/15	I	Wildlife	While assessing a plot in C a bear approached. One field assistant readied bear spray and the other blew the horn. Both made noise. The bear left line of site but was likely still near. The two stayed to finish the plot afterwards	Working in bear habitat.	Lack of making noise while walking through forest and while working at plot.		Make more noise, stay aware of surroundings. Carry bear spray, bangers, and horn. Continue to make sure people are aware.

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
9	5/14/15	NM	Wildlife	While working on a plot in 929 Jess heard a noise, both of them stood up and noticed a bear running directly towards them. As soon as the bear saw them he stopped dead in its tracks, turned and sprinted at top speeds directly away from them.	Not making excessive noise while working. Working where bears live	Working where bears live	Working where bears live	Make excessive noise.
10	5/21/15	I	Wildlife	While driving ATV's down P2200 a bear was encountered on the side of the road. Core crew stopped and revved the quad engines, yelled and waved to scare the bear into the woods. After the bear did not move Vince attempted to fire off a bear banger but it would not fire. Jeff then fired off his bear banger instead. The bear retreated into the woods and we drove passed safely.		Cartridge possibly expired or coupled with the wrong type of shooter (center fire vs. ring fire). Wildlife habitat on sides of road	Inadequate training for use of bear bangers.	Improve training for bear bangers (as well as bear spray and horns)
11	5/21/15	I	Wildlife	While driving an ATV down P2200 Sylvia drove right past a bear on the side of the road without noticing it.	Not paying attention to wildlife on roadsides while driving	Wildlife habitat on sides of road.		Discuss bear awareness and safe driving at next safety meeting.
38	8/6/15	I	Wildlife	While walking/navigating in 852 Silvia unknowingly approached a bear (5m) and did not see it. Jess, walking behind briefly saw it before it disappeared/left into the understory.	Not paying attention to wildlife or making enough noise to scare the bear away before the encounter. Working where bears also live	Having to travel through the forest while doing work.	Working in areas where bears live.	Make excessive noise. Stop to navigate then survey surroundings while walking

#	Date	NM, I, A	Type	Description	Causes			Ways to decrease/eliminate
					Direct	Indirect	Root	
15	8/12/15	I	Wildlife	While walking North from 898, through a buffer area North 0f 898 2 field assistants encountered a Black Bear. The bear was running adjacent to the two and then stopped about 20 meters away. They readied their bear spray, the two spoke calmly as they slowly attempted to walk away. The bear buff charged briefly (2m). They fired a bear banger. As soon as it blew off, the bear ran. Both left the area.	Working in bear habitat.	Not making enough noise to scare the bear off before the interaction.		Make excessive noise.
24	6/21/15	I	Wildlife.	While traveling to P1 in 891 a bear was encountered. A bear banger was fired, the bear seemed to be defending its territory and would not leave. The field assistants made lots of noise and left the area while keeping others in area informed.	Walking in the forest	Bear habitat	General work duties.	Make more noise, stay aware of surroundings. Carry bear spray, bangers, and horn. Continue to make sure people are aware.

Appendix 7: Expected Project Funding

		2012	2013	2014	2015	2016	Total Grant $
NSERC CRD Grant	Salaries & Benefits	$ 128,662.00	$ 229,750.00	$ 223,713.00	$ 163,075.00	$ 125,800.00	$ 871,000.00
	Equipment/Facility	$ 34,200.00	$ 62,200.00	$ 96,400.00	$ 97,400.00	$ 45,100.00	$ 335,300.00
	Materials & Supplies	$ 4,000.00	$ 15,000.00	$ 29,000.00	$ 29,000.00	$ 21,000.00	$ 98,000.00
	Travel	$ 16,750.00	$ 47,250.00	$ 61,000.00	$ 63,375.00	$ 38,875.00	$ 227,250.00
	Dissemination	$ -	$ 1,100.00	$ 4,400.00	$ 3,300.00	$ 7,700.00	$ 16,500.00
	Tech. Transfer Activities	$ 25,000.00	$ 25,000.00	$ 25,000.00	$ 25,000.00	$ 25,000.00	$ 125,000.00
	Totals	***$ 208,612.00***	***$ 380,300.00***	***$ 439,513.00***	***$ 381,150.00***	***$ 263,475.00***	***$ 1,673,050.00***
NSERC-Strategic--WAM	Salaries & Benefits	n/a	n/a	$ 201,400.00	$ 194,400.00	$ 175,500.00	$ 571,300.00
	Equipment/Facility	n/a	n/a	$ -	$ 5,000.00	$ 5,000.00	$ 10,000.00
	Materials & Supplies	n/a	n/a	$ 6,000.00	$ 9,000.00	$ 3,000.00	$ 18,000.00
	Travel	n/a	n/a	$ 55,000.00	$ 59,000.00	$ 21,000.00	$ 135,000.00
	Dissemination	n/a	n/a	$ -	$ 3,000.00	$ 5,000.00	$ 8,000.00
	Tech. Transfer Activities	n/a	n/a	$ 6,000.00	$ 6,000.00	$ 8,000.00	$ 20,000.00
	Totals	***n/a***	***n/a***	***$ 268,400.00***	***$ 276,400.00***	***$ 217,500.00***	***$ 762,300.00***
FRI Legacy Funding	Salaries & Benefits	$ 163,000.00	$ 73,000.00	n/a	n/a	n/a	***$ 236,000.00***
	Equipment/Facility	$ 7,000.00	$ 21,850.00	n/a	n/a	n/a	***$ 28,850.00***
	Materials & Supplies	$ -	$ 2,500.00	n/a	n/a	n/a	***$ 2,500.00***
	Travel and Vehicles	$ 2,500.00	$ 12,000.00	n/a	n/a	n/a	***$ 14,500.00***
	Tech. Transfer Activities	$ 500.00	$ 1,000.00	n/a	n/a	n/a	***$ 1,500.00***
	Totals	***$ 173,000.00***	***$ 110,350.00***	***n/a***	***n/a***	***n/a***	***$ 283,350.00***
U of A VP Grant	Salaries & Benefits	n/a	$ 30,000.00	$ 30,000.00	$ 30,000.00	n/a	$ 90,000.00
	Equipment Upgrades	n/a	$ 26,000.00	$ -	$ -	n/a	$ 26,000.00
		n/a	***$ 56,000.00***	***$ 30,000.00***	***$ 30,000.00***	***n/a***	***$ 116,000.00***
FRIAA FRIP Fund	Salaries & Benefits	n/a	n/a	$ 90,800.00	$ 90,800.00	n/a	$ 181,600.00
	Equipment/Facility	n/a	n/a	$ 57,900.00	$ 57,900.00	n/a	$ 115,800.00
	Materials & Supplies	n/a	n/a	$ 1,300.00	$ 1,300.00	n/a	$ 2,600.00
	Total	***n/a***	***n/a***	***$ 150,000.00***	***$ 150,000.00***	***n/a***	***$ 300,000.00***
AESRD Funding	Salaries & Benefits	n/a	n/a				
	Equipment/Facility	n/a	n/a				
	Materials & Supplies	n/a	n/a				
	Travel and Vehicles	n/a	n/a				
	Total	***n/a***	***n/a***	***$ 133,000.00***	***?***	***?***	***$ 133,000.00***
NRC an Funding	Salaries & Benefits	n/a	n/a	$ 112,559.00			
	Equipment/Facility	n/a	n/a	$ 132,456.00			
	Materials & Supplies	n/a	n/a	$ 14,829.00			
	Total	***n/a***	***n/a***	***$ 250,844.00***			***$ 250,844.00***
Grand Totals		**$ 208,612.00**	**$ 436,300.00**	**$ 1,271,757.00**	**$ 837,550.00**	**$ 480,975.00**	**$ 3,235,194.00**

Appendix 8: EMEND's Funding and In Kind Support

			2012		2013					2014						
			FRI-Legacy*	NSERC-CRD Grant	FRI-Legacy*	NSERC-CRD Grant	U of A VP Grant	FRIP-VSA	Other	NSERC-CRD Grant	U of A VP Grant	NSERC-Sreat-WAM	AESRD Core Funds	FRIP-VSA	FRIA-FRIP	Other
Funding Bodies	Agency	$	$ 173,000	$ 121,112	$ 110,350	$ 205,300	$ 56,000	$ 79,000		$ 264,513	$ 30,000	$ 268,400	$ 133,000		$ 150,000	
	Industry Contributions--DMI	$		$ 175,000		$ 175,000				$ 175,000						
		In-Kind		$ 18,950		$ 9,450				$ 17.632		$ 7,140			$ 12,229	
	Industry Contributions--CanFor	$														
		In-Kind		$ 7,260		$ 7,260		$ 1440		$ 7,260		$ 5,600		$ 540		
	Other	$														$ 250,844
		In-Kind				$ 48,400			$ 28,700	$ 59,400		$ 206,000				$15,500
		Who							NRCan			NRCan				NRCan
Total			$ 173,000	$ 322,322	$ 110,350	$ 397,010	$ 56,000	$ 80,440		$ 464,405	$ 30,000	$ 487,140	$ 133,000	$ 540	$ 162,229	$ 250,844
Years Combined			***$ 495,322***		***$ 643,800.00***					***$ 1,528,158.00***						

FRI Legacy Funding is audited April 1 to March 31; therefore there is a small amount of funding left over for 2014

			2015				2016	
			NSERC-CRD Grant	U of A VP Grant	NSERC-Stat--WAM	FRIA-FRIP	NSERC-CRD Grant	NSERC-Stat--WAM
Funding Bodies	Agency	$	$ 206,150	$ 30,000	$ 276,400	$ 150,000	$ 88,475	$ 219,500
	Industry Contributions--DMI	$	$ 175,000				$ 175,000	
		In-Kind	$ 9,450		$ 7,140		$ 9,450	$ 7,140
	Industry Contributions--CanFor	$						
		In-Kind	$ 7,260		$ 5,600		$ 7,260	$ 5,600
	Other	$						
		In-Kind						
		Who						
Total			$ 397,86	$ 30,000	$ 289,140	$ 150,000	$ 280,185	$ 232,240
Years Combined			***$ 867,000.00***				***$ 512,425.00***	

Appendix 9: Funding Important Dates

Date	What	Grant	Who
January 1, 2015	YER out to partners	ALL	U of A-Amy
January 1, 2015	File Progress Report with DMI	FRIAA-FRIP	U of A-Amy
January 1, 2015	Invoice FRIAA--$120,000	FRIAA-FRIP	DMI
January 1, 2015	Invoice NSERC--$132,257	NSERC-CRD	U of A-FOR
January 1, 2015	CRD Payment --$132,257	NSERC-CRD	NSERC
January 1, 2015	Invoice DMI-$175,000?	NSERC-CRD	U of A-FOR
January 1, 2015	CRD Payment DMI--$175,000?	NSERC-CRD	DMI
January 15, 2015	File Progress Report with FRIAA	FRIAA-FRIP	DMI-Jim
January 15, 2015	2nd FRIAA Payment--$120,000	FRIAA-FRIP	FRIAA
April 1, 2015	CRD Payment --$132,257	NSERC-CRD	NSERC
April 15, 2015	Annual technical report into DMI	FRIAA-FRIP	U of A-Amy
April 30, 2015	Annual audited financial report and technical reports due	FRIAA-FRIP	DMI-Jim
May 2015-Aug 2015	Monthly Safety Reports to DMI/FRIAA as requested	FRIAA-FRIP	U of A-Amy
July 30, 2015	Quarterly technical report into DMI	FRIAA-FRIP	U of A-Amy
July 30, 2015	Quarterly unaudited financial report/technical reports due	FRIAA-FRIP	DMI-Jim
October 1, 2015	CRD Progress Report 3 Due	NSERC-CRD	U of A-Amy
October 30, 2015	Quarterly technical report into DMI	FRIAA-FRIP	U of A-Amy
October 30, 2015	Quarterly unaudited financial report/technical reports due	FRIAA-FRIP	DMI-Jim
Nov 2015-Jan 1, 2016	EMT Meeting to report on Progress	ALL	U of A-Amy
Nov 2015-Jan 1, 2016	Draft Year End Report out to Partners for Feedback	ALL	U of A-Amy
Nov 2015-Jan 1, 2016	YER Feedback returned to Amy	ALL	Partners
December 31, 2015	Inform of Continued Financial Support by DMI	NSERC-CRD	DMI-Jim
January 1, 2016	YER out to partners	ALL	U of A-Amy
January 1, 2016	File Report with DMI	FRIAA-FRIP	U of A-Amy
January 1, 2016	Invoice FRIAA for $30,000	FRIAA-FRIP	DMI
January 1, 2016	Final Report and deliverables to DMI	FRIAA-FRIP	U of A-Amy
January 1, 2016	CRD Financial Statement Due	NSERC-CRD	U of A-FOR
January 1, 2016	CRD Financial Statement Due	NSERC-CRD	U of A-FOR
January 1, 2016	Invoice NSERC--$206,150	NSERC-CRD	U of A-FOR
January 1, 2016	CRD Payment--$206,150	NSERC-CRD	NSERC
January 1, 2016	Invoice DMI-$175,000?	NSERC-CRD	U of A-FOR
January 1, 2016	CRD Payment DMI--$175,000?	NSERC-CRD	DMI
January 15, 2016	Final Report and deliverables Filed with FRIAA	FRIAA-FRIP	DMI-Jim
January 15, 2016	3rd FRIAA Payment--$30,000	FRIAA-FRIP	FRIAA
January 15, 2016	File Report with FRIAA	FRIAA-FRIP	DMI-Jim
October 1, 2016	CRD Progress Report 4 Due	NSERC-CRD	U of A-Amy
Nov 2016-Jan 1, 2017	EMT Meeting to report on Progress	ALL	U of A-Amy
Nov 2016-Jan 1, 2017	Draft Year End Report out to Partners for Feedback	ALL	U of A-Amy
Nov 2016-Jan 1, 2017	YER Feedback returned to Amy	ALL	Partners
January 1, 2017	YER out to partners	ALL	U of A-Amy
January 1, 2017	Invoice NSERC--$88,475	NSERC-CRD	U of A-FOR
January 1, 2017	CRD Payment--$88,475	NSERC-CRD	NSERC
February 28, 2018	CRD Final Report Due	NSERC-CRD	U of A-Amy