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Executive Director's Report

Dr. Kevin Percy

This issue of *WBEA@Work* highlights some of the Wood Buffalo Environmental Association's air and terrestrial monitoring as well as the accomplishments of our Communications program in 2015.

We begin this issue on a sad note by recognizing the passing of Dennis Jacques, who was a great friend of the Association over many years. Dennis, who passed away on November 20, 2015, was a key architect of WBEA's ecologically-analogous Forest Health Network of 25 jack pine and 24 edge plots. His understanding of the ecology of this region was a great asset to WBEA. Please read more about the life and work of Dennis Jacques in this issue.



The meteorological tower extending above the forest canopy marks the location of WBEA Forest Health Site JP 104, located to the northeast of Fort McMurray off the East Athabasca Highway.

A tangible example of the benefit of Dennis's work can be seen in the results of the report *Assessing Forest Health in the Athabasca Oil Sands Region*, published in 2015 and profiled in this issue. Our jack pine network, extensively sampled and measured in 2011, yielded several interesting conclusions. Firstly, accumulation of sulphur, nitrogen and trace elements was observed in soil and vegetation at plots within 30 km of the nearest source, but decreased as distance from the sources increased. Secondly, there was an indication of changes in forest understory species richness and an increase in jack pine growth due to the large base cation input resulting from fugitive dust emissions from mining and other activities. Thirdly, the risk of adverse biological effects from acidic deposition was judged to be low due to the counteracting effect of base cation deposition to forest sites.

Also of interest in this issue is a report on work conducted by Eric Edgerton, Atmospheric Research and Analysis Inc., Cary, NC, USA, to develop a more accurate way to measure gaseous pollutants at WBEA's network of remote Forest Health plots. Eric's low-power, low-flow annular denuders, powered exclusively by solar energy, yield more accurate and representative data than passive monitoring techniques.

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A major accomplishment during the fall of 2015 was the production of a video about the WBEA-Fort McKay Berry Focus Group. Participation by the Elders and a youth member of the Cree, Dené and Métis community of Fort McKay, who in conjunction with WBEA have been monitoring berries in and around their community since 2012, was a significant contributor to the success of the endeavour. View the video at [WBEA-Fort McKay Berry Focus Group Video](#) to hear the participants speak about the value of monitoring berries and to view the results to date.

[Regional Emission Sources in the Lower Athabasca Oil Sands Region](#) describes an inventory of emissions sources and rates for the Lower Athabasca Region developed by

Mervyn Davies, Stantec Consulting Ltd. WBEA data from industrial stack, heavy hauler and fugitive dust monitoring is a new addition to such inventories and increases their accuracy.

WBEA Communications carried out a varied program in 2015 and details, including the visitors welcomed, reports written, media releases issued and educational outreach opportunities fulfilled, can be found in this issue. The [Oil Sands Monitoring Community Report](#), an electronic interactive newsletter published in January 2016, was a joint venture by six organizations conducting monitoring in Alberta's three Oil Sands Regions.

I hope you enjoy this issue of *WBEA@Work!* 



A source of air emissions in the Lower Athabasca Region.

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Dennis Jacques – A Respected WBEA Scientist

It is with great sadness that WBEA informs members of the passing of Dennis Jacques, on November 20, 2015, in Vancouver. Dennis was a valued contributor to WBEA's monitoring programs, over many years, and his advice and insight will be greatly missed.

Dennis obtained a bachelor's degree in botany and forest ecology at Northern Arizona University, in 1969, and an MSc. in plant biology from Oregon State University. He started his career in ecology with the Earth Satellite Corporation in Berkeley, California, where he developed the use of satellite multiband imagery analysis of vegetation, to support pollution control and land use management studies. Later, he joined the faculty of the University of Calgary, based (1974-1981) at the Kananaskis Centre for Environmental Research.

Over the next thirty-four years, Dennis worked as a consultant to government and industry on land use management and environmental pollution control projects. His achievements included the development and application, along with his colleague and friend, Dr. Allan Legge, of a novel forest health ecosystem monitoring system. This was developed as part of the twenty-five year long boreal forest-sulphur emissions response study, *The Whitecourt Environmental Study*, carried out in central Alberta.

Since 2008 Dennis has contributed to WBEA as a contracted scientist. His proven approach of using ecologically analogous plots to enhance forest health monitoring has helped WBEA to maximize the potential for detection of air pollution signals against the larger backdrop of biological variability at forest sites.



Dennis Jacques. Photo credit: Dr. Allan Legge.

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In 2011, Dennis presented on this approach at the WBEA Symposium, *Alberta Oil Sands, Energy, Industry and the Environment*. Subsequently, Dennis and Allan Legge contributed the chapter, *Ecological Analogues for Biomonitoring Industrial Sulfur Emissions in the Athabasca Oil Sands Region, Alberta, Canada*, to the peer reviewed book resulting from the Symposium.

Dennis was in the region often, working with and advising WBEA staff. He travelled extensively by helicopter to locate the jack pine stands which today make up WBEA's Forest Health Network. Much of the success of WBEA's Deposition Monitoring Program can be attributed to his expertise in locating and selecting these ecologically similar sites. WBEA's Forest Health Network is, in many respects, one of his legacies.

Dennis last visited the region in November when he met with WBEA staff to discuss his 2015 data. Comparison of his recent results with those from earlier years showed a decrease in sulphur uptake by vegetation. Analysis of field samples found that the response of environmental receptors to sulphur dioxide emissions was markedly decreased since the project began in 2008.

Dennis was an active outdoorsman, whether in the field during the course of his ecological work, hiking in and out of the Grand Canyon or climbing mountains in Alaska or the Rockies. Dennis is survived by his wife, Ginny, his children and beloved grandchildren.



Dennis Jacques, far right, during WBEA fieldwork with, from left to right, Dr. Marco Ferretti, Terra Data Environmetrics, Dr. Kevin Percy and Dr. Allan Legge, WBEA.

Dennis generously shared his wealth of ecological knowledge about the northern boreal forest to enhance WBEA's monitoring. ■ ■ ■ ■

Editor's Note: This article is composed of portions of Dennis Jacques' Obituary, which included contributions from Dr. Allan Legge, as well as the personal recollections of Dr. Kevin Percy.

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New Community Report Highlights Environmental Monitoring in Alberta's Oil Sands Regions

Jane Percy, WBEA

The new **Oil Sands Monitoring Community Report**, funded by AEMERA and launched on January 12th, 2016, features the monitoring work of a number of environmental organizations operating in Alberta's Oil Sands Regions.

The interactive electronic Report is the result of the dynamic collaboration of the following partners:

Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA)

Alberta Biodiversity Monitoring Institute (ABMI)

Environment and Climate Change Canada (ECCC)

Lakeland Industry and Community Association (LICA)

Peace River Area Monitoring Program (PRAMP)

Wood Buffalo Environmental Association (WBEA)

In addition to the eighteen articles about a wide-ranging collection of monitoring projects, the Oil Sands Community Report includes information about the six monitoring organizations involved in the work. As well,

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The Oil Sands Monitoring Community Report informs residents in Alberta's three Oil Sands Regions about the environmental monitoring taking place. Pictured above is Gregoire Lake Estates, near Anzac, in the Athabasca Oil Sands Region.

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New Community Report Highlights Environmental Monitoring in Alberta's Oil Sands Region

interactive links in each article provide the reader with more in-depth information related to each project, such as videos, data summaries and related websites. A short survey aims to gauge the reader's awareness of monitoring activities in the Oil Sands Regions and asks them to identify areas they would like to learn more about.

WBEA was tasked with coordinating the production of this first Oil Sands Monitoring Community Report by AEMERA, including soliciting participation from the monitoring partners and stewarding the design and production of the Report.

WBEA articles appearing in the Report include:

- **Making Sense of Odours - WBEA's Community Odour Monitoring Project**
- **Forest Sentinels - WBEA's Lichen Monitoring Tracks Air Pollution in the Athabasca Oil Sands**
- **How's the Air Up There? - Monitoring Air Quality in the Athabasca Oil Sands Region**
- **Harvesting Knowledge - Monitoring Berries in the Athabasca Oil Sands Region**

WBEA Executive Director, Dr. Kevin Percy, said of WBEA's contribution to the Report, "WBEA is pleased to partner with other organizations monitoring in Alberta's Oil Sands to collectively communicate about our work and results. The four articles which WBEA contributed to the Oil Sands Monitoring Community Report present details of our odour, deposition, air quality and Traditional Knowledge monitoring and demonstrate WBEA's responsiveness to our stakeholder's concerns about the environment in the Athabasca Region of the Oil Sands, over the past 18 years."



Celina Harpe, a member of the WBEA-Fort McKay Berry Focus Group, picks cranberries. Berry harvesting by the Group was the focus of an article in the Oil Sands Monitoring Community Report. Photo credit: Janelle Baker.

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WBEA Presentations at SETAC 2015

Jane Percy, WBEA

WBEA staff and contracted scientists presented the results of recent monitoring at the **Society of Environmental Toxicology and Chemistry (SETAC) North America 36th Annual Meeting**, held in Salt Lake City, Utah, from November 1 -5, 2015.

The meeting saw 2,000 scientists, assessors, regulators and managers meet and present findings during platform and poster sessions. WBEA presentations included:

- **Assessing Forest Health in the Athabasca Oil Sands Region of Alberta** – Kevin Percy, WBEA; Allan Legge, Biosphere Solutions; Douglas Maynard, Natural Resources Canada – Canadian Forest Service. This platform presentation summarized the unique mix of emissions sources in the Athabasca Oil Sands Region and WBEA's emission's source-to- environmental sink approach to monitoring deposition, and ecological effects measured in the Forest Health Network of 25 jack pine stand plots. Findings from the **2015 WBEA Forest Health Report** were highlighted.



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Lichens, collected by Dr. Keith Puckett, ECOFIN (pictured), and WBEA staff at WBEA Forest Health sites, were analyzed for Polycyclic Aromatic Hydrocarbons. The results of the work were presented at SETAC 2015. Photo credit: Natalie Bonnell.

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- **Recent Trends in Ambient Air VOC and RSC Concentrations in the Athabasca Oil Sands Region** – Kevin Percy, WBEA, and Tom Dann, R.S. Environmental. This poster presentation provided results and six-year trends from WBEA's monitoring for volatile organic compounds and reduced sulphur compounds at eight regional air monitoring stations.
- **Measurement of Polycyclic Aromatic Compounds in Epiphytic Lichens by GCMS and GC-TOF-MS for Receptor Modeling in the Alberta Oil Sands Region (AOSR)** – W. Studebaker, Tobacco Road Collaborative LLC; K. Percy, WBEA; K. Puckett, ECOFIN; M. Landis, Integrated Atmospheric Solutions LLC. This platform presentation summarized WBEA's work to trace the fate of polycyclic aromatic compound emissions to air throughout the Athabasca Oil Sands Region through the use of advanced source apportionment techniques. ■ ■ ■ ■



For routine measurement of volatile organic compounds (VOC) and reduced sulphur compounds (RSC) in ambient air at 8 air monitoring stations, WBEA follows the Environment Canada (NAPS) Standard Operating Procedures. Sampling is automatically triggered every 6th day, and sampling occurs over 24 hours.

Air is drawn into a Silcosteel® canister, pictured. The canister is shipped to a laboratory where the contents are withdrawn and analyzed using gas chromatography-mass spectrometry. Samples are analyzed for 63 VOC and 20 RSC compounds.

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WBEA's Forest Health Report

Dr. Kevin Percy, WBEA

In addition to air quality monitoring, WBEA also monitors the fate of air borne pollutants as they are carried away from regional sources, out over the boreal forest in the Regional Municipality of Wood Buffalo. Once air pollutants leave a source, such as an industrial stack, they are transported and transformed by meteorology until they eventually fall out of the atmosphere and are deposited onto the forest or other ecosystems. WBEA's Deposition Monitoring Program investigates the effects of air borne pollutants upon the forests in the Athabasca Oil Sands Region, which is situated within the Canadian Boreal Plains Ecozone (with some extension of the Canadian Shield into the northeast), and is dominated by upland jack pine, aspen, and mixed forests, along with bogs and wetlands.

WBEA's Forest Health Monitoring Program

Shortly after its inception in 1997, WBEA established a program to determine if anthropogenic emissions of acidifying compounds such as sulphur dioxide (SO₂) and nitrogen oxide (NO_x) gases were having long-term adverse effects on the regional terrestrial environment, and, if so, to assess the magnitude of any impact.

In 1998, WBEA initiated measurement and sampling at a network of 10 jack pine (*Pinus banksiana* Lamb.) dominated interior forest stand plots (AMEC, 2000). WBEA's plot network is distributed across regional deposition gradients. Five additional plots were added between 1999 and 2003, and two were lost to development.

Another cycle of measurement and sampling of soils and vegetation occurred at 13 jack pine plots in 2004 (8 plots were previously sampled in 1998, and one in 2001). Findings from the 2004 intensive sampling included:

- No direct emissions-related effects were found on foliar retention rate or needle condition.
- No anomalous abiotic effects on tree condition were observed at any of the 13 plots.
- Foliar chemistry data showed that the effect of local industrial emissions was evident in increased concentrations of total sulphur, inorganic sulphur, iron and nickel, all of which are known to be components of oil sands emissions.

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- Despite evidence of increased elemental concentrations in foliage with greater modeled deposition levels, there was no evidence of a negative effect on forest productivity.
- An unexpected, positive association was found between modeled potential acid input and soluble and exchangeable soil magnesium (Mg) and potassium (K) concentrations. This was attributed to ecological site differences unrelated to the impacts of industrial air emissions.

To improve the ability to compare results between monitoring sites throughout the region, a decision was made, following an external science review, to adopt a more comprehensive, integrated Forest Health approach to future monitoring.

The Forest Health monitoring approach examines cause-effect relationships between air pollutants and forest ecosystem function. Between 2008 and 2011, WBEA embarked on a significant science build, including adoption of the ecological analogue approach to site selection. Ecological analogues are forest health sites whose physical and biological characteristics are as similar as possible, thus allowing for the maximum opportunity to detect air pollution effects. WBEA also adopted new biological/physical/chemical indicators such as anion and cation deposition, needle cuticle wax chemistry, bark deposition, and organic soil phospholipid fatty acid analysis. Another change was the instrumentation of forest health plots. By 2011/12, WBEA's Forest Health Network had expanded to

25 interior jack pine stand plots, 25 forest edge plots for early warning of change prior to a measurable effect, 6 meteorological towers, and passive/active monitoring analyzers.

In 2011, a multidisciplinary team of scientists and technical professionals completed an extensive program of sampling and measurement at 21 of the regional forest health plots. Four of the 25 plots were consumed in the Richardson Fire, which burned through 700,000 ha. from May through June in 2011. The results of the monitoring carried out in 2011 have been summarized in the report *Assessing Forest Health in the Athabasca Oil Sands Region*, T.A. Clair and K.E. Percy, Editors.

The twelve-chapter Report integrates monitoring history, network design, results from air/deposition monitoring, deposition modeling, above-and-below-ground biological and chemical measurements made in 2011/12, as well as comparative status of some indicators measured at five plots that were sampled in 1998, 2004 and 2011/12.

Key Results from WBEA's 2015 *Assessing Forest Health in the Athabasca Oil Sands Region Report*:

- The highest passively measured and modeled air concentrations of SO₂, NO₂, ammonia (NH₃), and nitric acid (HNO₃) were reported nearer to the oil sands operations. NH₃ was increased in the southern portion of the region, due to agricultural input.

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- Ozone (O₃) concentrations, as expected, increased with distance from oil sands operations.
- Similar patterns of air concentrations and spatial deposition for sulphur (S) and nitrogen (N) were reported.
- A west to east pattern was detected which resulted in higher S and N concentrations/deposition east of the mining and upgrading operations, than to the west.
- A north-south pattern in air concentrations was detected, which demonstrated the influence of valley topography upon pollutant dispersion.
- Air quality and deposition measurements showed that N and S concentrations/deposition amounts are enhanced within 30 km of oil sands operations, and decline with increasing distance from them.
- N and S air concentrations and deposition amounts reach background levels approximately 40-50 km away from the main oil sands emission sources.
- Trace element and heavy metal concentrations in vegetation generally follow the same spatial distribution pattern.
- Levels of N in jack pine foliage at six plots increased from 1998 to 2012.
- Sulphur was correlated with modeled S+N deposition in both the organic and mineral soil layers.
- Nitrogen is being taken up in vegetation, and is not accumulating in mineral soils.
- Neither soil N or pH showed any correlation with measured deposition.
- Soil microflora, as well as vascular cover, forb cover and shrub richness were strongly and positively related to atmospheric deposition of base cations.
- Despite varying levels of S and N deposition to the plots, there was no acidification detected in soils.
- The role of atmospheric N deposition, as a nutrient, has the potential to increase in relative importance.
- Aluminium (Al) toxicity is considered an important factor in forest deterioration caused by soil acidification. A ratio of base cations (BC) to Al in the soil solution is widely used as an indicator for potentially adverse effects on tree health. There was no correlation between base cation/aluminum (BC: Al) ratios in modeled S and N deposition.
- The BC: Al trigger set under the CEMA Acid Deposition Management Framework was not exceeded, in 2011/12.

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WBEA's Forest Health Report

Overall, the health of the jack pine stands located >13 km from the nearest industrial emissions source (mine, upgrader) was good. Ambient pollutant concentrations and deposition decreased exponentially with increasing distance from sources. Plots closest to sources showed evidence of nitrogen and trace element accumulation in tree foliage and soils. Levels of nitrogen at six plots had increased since the last sampling in 2004. There were indications of change in the state of some indicators, notably soil microflora and plant species richness. The changes were attributed to the base cation loading from fugitive dust sources such as mining, road building/transportation and land clearing.

Since 2011, WBEA has completed an annual field survey of numbered jack pine trees at our plots. Insect and disease incidence/severity, an indicator of tree stress due to air pollutants and drought, is being rated by forest health technicians from Alberta Agriculture and Forestry. The next intensive forest health survey, in WBEA's monitoring cycle, is scheduled for 2016. ■ ■ ■ ■ ■



Clockwise from top left: Measuring jack pine branches at a WBEA Forest Health site; a technician surveys the forest floor species at a WBEA Forest Health site; soil sampling during the 2011 WBEA Forest Health Survey; jack pine needles sampled for cuticle wax chemistry analysis.

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Low-Power Denuder Systems for Measurement of HNO_3 and NH_3 at WBEA Forest Health Sites

Eric Edgerton, Atmospheric Research and Analysis Inc. (ARA), Cary, NC, USA, has field tested a low-power, low-flow annular denuder system for the measurement of nitric acid (HNO_3) and ammonia (NH_3) at four remote WBEA Forest Health sites around the Regional Municipality of Wood Buffalo. The annular denuder systems deliver highly accurate data on both air concentrations and deposition to forests. The initial results of this work are available in the 2014 [WBEA Annual Report](#) section entitled, *Low-Power Denuder Systems for Measurement of HNO_3 and NH_3 at WBEA Forest Health Sites*, pages 94-95.

WBEA monitors gas phase HNO_3 and NH_3 at our Forest Health sites as they are important nutrient inputs for terrestrial and aquatic ecosystems. HNO_3 is formed in the atmosphere, primarily via oxidation of nitrogen dioxide (NO_2) by a hydroxyl radical. NH_3 is emitted to the atmosphere by vegetation and anthropogenic sources (motor vehicles and industrial processes). HNO_3 and NH_3 are highly water soluble and help mediate the acidity of precipitation and aerosols. They also react together under certain atmospheric conditions (low temperature and high relative humidity) to produce particulate ammonium nitrate (NH_4NO_3), an important component of fine particulate matter $<2.5 \mu\text{m}$ ($\text{PM}_{2.5}$). High quality measurements of HNO_3 and NH_3 are therefore critical to understanding the transport, transformation and deposition of nutrients and acidifying species to the landscape.

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Eric Edgerton, ARA (l) and WBEA Field Biologist Cody David (r) examine an annular denuder at a WBEA Forest Health site.
Photo credit: Dr. Allan Legge.

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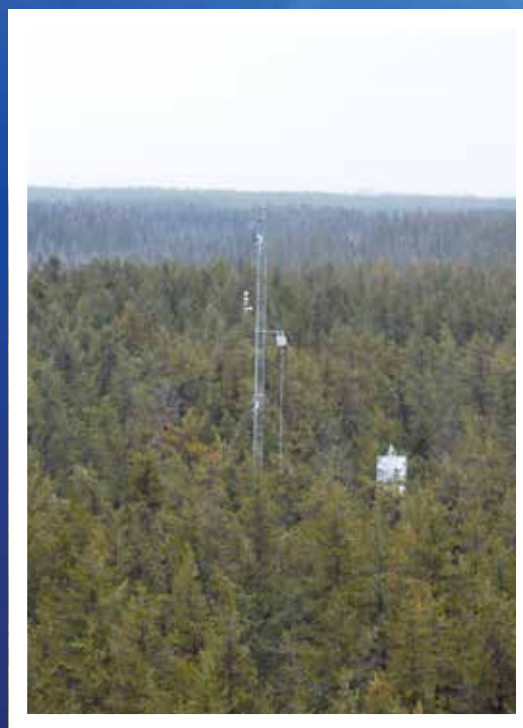
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Previously WBEA monitored these gases by passive techniques. Passive monitoring occurs through the diffusion of atmospheric gases onto coated, pollutant-specific filters set out in the forest. Following filter analysis, the data are estimates of pollution concentrations, averaging the deposition of the gases over the month. In contrast, the annular denuder is an active type of monitoring which continuously draws the surrounding air onto chemically-coated glass tubes to calculate ambient air pollutant concentrations and deposition amounts to the forest canopy, and shows also how concentrations change over time.

The annular denuder system, with modifications for winter operation mode, has delivered highly accurate, and reliable air concentration data from above the forest canopy. Monthly average (February to December 2015) HNO_3 concentrations ranged from $0.1 \mu\text{g m}^{-3}$ to $0.6 \mu\text{g m}^{-3}$. All concentrations above $0.4 \mu\text{g m}^{-3}$ were attributed to forest fire emissions. Ammonia concentrations ranged from the $0.1 \mu\text{g m}^{-3}$ to $4.22 \mu\text{g m}^{-3}$ with the highest concentrations attributed to forest fire emissions.

Measurement of trace atmospheric gases with annular denuders is a United States Environmental Protection Agency (USEPA) validated technology. The WBEA low-power, low-flow version offers the advantages of reliable operation with reduced power consumption. This makes it highly suitable for WBEA's remote Forest Health sites which operate year-round on solar powered systems.

WBEA will continue to employ the annular denuder technique of monitoring HNO_3 and NH_3 at four of Forest Health sites, where the denuders are located on 30 m. meteorological towers, with plans to add two more systems in the future. ■ ■ ■



An annual denuder, located above the forest canopy on a WBEA meteorological tower at a forest health site, continuously monitors HNO_3 and NH_3 .

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Regional Emission Sources in the Lower Athabasca Oil Sands Region

Mervyn Davies, Stantec Consulting Ltd., has contributed a report entitled *Regional Emission Sources*, pages 70-77, to the *2014 WBEA Annual Report*, which reports on the air emission sources in the Lower Athabasca Oil Sands Region.

Accurate data on emissions sources and rates are needed by government, industry and other stakeholders as they consider decisions on air shed management. The report incorporated data from WBEA's source characterization work on upgrader stacks, heavy haulers and fugitive dust, which was carried out from 2008-2014. This new emissions information, never before available, will allow atmospheric modellers to more accurately attribute emissions sources and rates for the Lower Athabasca Oil Sands Region.

The report also details emission rates for volatile organic compounds, halocarbons, carbonyls, polycyclic aromatic hydrocarbons, reduced sulphur compounds and metals.

The emission estimates in the report were prepared for a specific integrated mine and extraction regulatory application and the focus of the assessment and the chemical speciation profiles were selected on this basis. Any uses which a third party makes of these data, or any reliance on decisions made based on it, are the sole responsibilities of such third parties.



Fugitive dust, seen in the atmosphere above a quarry, is an emission source type in the Regional Municipality of Wood Buffalo.

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Regional Emission Sources in the Lower Athabasca Oil Sands Region

Table 1 of the report details the natural and man-made emission sources in the Lower Athabasca Region, and demonstrates that different source types emit different compounds. Table 2 provides the emission rates for these sources.

Table 1: Source Types and Associated Emissions

	Source Type	NO _x	SO ₂	CO	PM _{2.5}	TSP	HC	PAH	RSC	Metals
Stacks	Coke based fuel	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Natural gas	Yes	-	Yes	Yes	-	Yes	Yes	-	-
	Produced Gas/Process Gas	Yes	Yes	Yes	Yes	-	Yes	Yes	Yes	-
Vehicles	Bitumen Mine Fleet	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
	Quarry Fleet	Yes	-	Yes	Yes	-	Yes	Yes	-	Yes
Fugitive	Processing Plant	-	-	-	-	-	Yes	Yes	Yes	-
	Mine Face	-	-	-	-	-	Yes	Yes	Yes	-
	Tailings	-	-	-	-	-	Yes	Yes	Yes	-
	Haul Road Dust	-	-	-	-	Yes	Yes	Yes	-	Yes
Non-Industrial	Heating	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes
	Wood Burning	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes
	Local Traffic	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes
	Highway	Yes	-	Yes	Yes	-	Yes	Yes	Yes	Yes
Natural	Wild fires	Yes	-	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Biogenic	-	-	-	-	-	Yes	-	Yes	-

"Yes" indicates that the indicated source type is associated with the indicated emissions.

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Regional Emission Sources in the Lower Athabasca Oil Sands Region

Table 2: Current Lower Athabasca Emission Rates

Source Type	Emission Rate (t/d)						Emission Rate (kg/d)		
	NO _x	SO ₂	CO	PM _{2.5}	TSP	HC	PAH	RSC	Metals
Stacks	248.2	309.9	134.2	7.3	-	7.6	60.6	317.6	104.1
Plant Fugitive	-	-	-	-	-	48.5	1.9	1,937	-
Mine Fleet	118.0	2.7	80.9	4.5	-	12.8	65.5	-	23.1
Mine Face Fugitive	-	-	-	-	-	31.2	144.5	144.7	-
Fugitive Dust	-	-	-	0.9	35.4	-	8.0	-	1,213
Tailings Fugitive	-	-	-	-	-	23.1	88.0	540.0	-
Non-Industrial	21.0	0.4	73.2	1.6	-	5.1	21.5	-	23.5
Total	387.2	312.9	288.3	14.4	35.4	128.3	390.0	2,939	1,364

HC = non methane hydrocarbon compounds.



Lower Athabasca Oil Sands Region emissions sources, pictured, include industrial stacks, mine fleet exhaust and wildfires.

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New Video Highlights Berry Monitoring by WBEA-Fort McKay Berry Focus Group

Jane Percy, WBEA

The Wood Buffalo Environmental Association's (WBEA) newly released video, *Using Traditional Knowledge and Western Science to Monitor Berry Patches in the Athabasca Oil Sands Region*, documents the latest results of a five-year berry monitoring project carried out in partnership with Elders of the Fort McKay First Nation. View the video at: <https://www.youtube.com/watch?v=VGa6R7jRpnE>

Since 2010, WBEA has partnered with Fort McKay Elders in a Berry Focus Group to explore their concerns about the impact of industrial operations on wild blueberries and cranberries. The Berry Focus Group brings together both Traditional Knowledge Holders and western science to monitor berry patches in and around the community of Fort McKay and farther afield.

In the video, Fort McKay Elders share stories of their community's long history of berry picking, the significance of berries and why they wished to be involved in this monitoring. The Fort McKay Berry Focus Group selected five berry patches to monitor, taking care to choose patches that were at different distances from oil sands mining, upgrading operations and other industrial activities. Janelle Baker, PhD Candidate McGill University, an anthropologist who has been involved with the project from the beginning says, "The value of having the community monitor the health of berry patches is that they've spent their whole lives going to the patches so they have a lifetime of already existing observations and knowing how the patches should be."

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Berry Focus Group member, Shay Laurent, and WBEA Executive Director, Kevin Percy, observe meteorological equipment at monitored berry patch. Photo credit: Jane Percy.

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New Video Highlights Berry Monitoring by WBEA-Fort McKay Berry Focus Group



One of the WBEA-Fort McKay Berry Focus Group monitored berry patches (left) and blueberries and a shelter containing passive air pollution filters (right). Photo credit: Jane Percy.

The evolution of the project has seen monitoring progress, at the request of the Elders, from sharing Traditional Knowledge about the berry patches to inclusion of western science parameters such as passive air pollution monitoring, meteorology monitoring and testing of berries for health promoting constituents. The results of the project for 2014, presented in the video, have provided WBEA and the community of Fort McKay with valuable information.

Results for 2014 passive air pollution monitoring for sulphur dioxide, nitrogen dioxide and volatile organic compounds at five monitored berry patches found that patches closer to industrial development have higher average monthly air borne concentrations than the most remote berry patch located at Moose Lake. These western science results support the Group's Traditional Knowledge that berries closer to their community and the surrounding industries are not as healthful as those from the remote location of Moose Lake. From a western science perspective, these pollutant concentrations were not high enough to cause direct injury to the blueberry and cranberry plants.

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The analysis of health promoting constituents in blueberries harvested during the 2014 field season revealed the following:

- Phenolics, known to have antioxidant properties, were greatest in blueberries remote from industry, and lowest in blueberries closest to industrial development.
- Other healthful compounds such as chlorogenic acid (reported to be involved in lowering blood pressure) and proanthocyanidins (reduce the risk of coronary heart disease) were similarly higher in remote patches than in those closer to the industrial core.

WBEA Executive Director, Dr. Kevin Percy states "One of WBEA's core values is recognition of, respect for and use of Traditional Knowledge. We are very pleased to have been a partner with the Fort McKay Berry Focus Group in this successful initiative to monitor these five berry patches over five years. This joint multi-year project, which brings together the Traditional Environmental Knowledge held by the Fort McKay Elders with western science, contributed by WBEA, is showing a degree of commonality between perceptions and beliefs offered by the Elders and findings offered by western science."

The perception by the Elders that the berries in close proximity to industrial developments were contaminated contributes to their lack of trust in picking berries from those patches. This can impact their harvesting patterns, and can disrupt the harvest of a nutritional traditional food that is grounded in familial and social networks. The Berry Focus Group members continue to harvest berries from patches that are more remote from industrial developments.

The aim of this ongoing project is to use the strength of both Traditional Environmental Knowledge and western science to better understand what influence regional industrial operations may have on berry health, in the Athabasca Oil Sands Region.

WBEA thanks the Fort McKay Sustainability Department and the community of Fort McKay for their continuing support of the project. WBEA thanks the National Research Council for providing the analysis of health promoting constituents in the berries. WBEA is a working partner of the Alberta Environmental Monitoring, Evaluation and Reporting Agency (www.aemera.org) who funded the Berry Focus Group in 2015-16, as well as the production of this video. ■ ■ ■ ■



Celina Harpe, a founding member of the Fort McKay Berry Focus Group, harvests blueberries for testing at a monitored berry patch. Photo credit: Janelle Baker.

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WBEA Communications in 2015

Jane Percy, WBEA

WBEA Communications engages, educates and informs stakeholders throughout the Regional Municipality of Wood Buffalo (RMWB), through a variety of activities and products, about our monitoring work and results. In 2015, the WBEA's Communications program and funding was approved by the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA).

WBEA's Communications Advisory Committee

This committee, composed of representatives of WBEA's General Membership, provided guidance and advice at quarterly meetings:

Peter Fortna - Conklin Resource Development
Advisory Board - Chair

Diane Phillips - Syncrude Canada Ltd.

Shayla Chowdry - Shell Canada Ltd.

Shannon Makinson - Cenovus Energy Inc.

Carla Davidson - Fort McKay First Nation

Andrew Read - Pembina Institute for
Appropriate Development

Kevin Percy - WBEA

Jane Percy - WBEA

Communications Advisor, Melissa Pennell, resigned on June 26th, to pursue another communications opportunity.

Educational Outreach

Some key educational outreach accomplishments in 2015 were:

- Coordination of five WBEA staff as judges at the Father Mercredi Junior High School Science Fair, Fort McMurray, in April.
- A classroom visit and interactive presentations to two grade 7 science classes at Father Mercredi Junior High, Fort McMurray.
- Participation by a WBEA staff member in the Green Mentor Program which inspires youth (students grades 7-12) to develop an action plan on an environmental topic they are passionate about.
- WBEA President, Diane Phillips, presented five Crystal Clean Environment Awards to students participating in the 8th Annual Wood Buffalo Regional Science Fair in March. WBEA has been

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a silver level sponsor for a number of years. Communications also hosted an information booth at the awards ceremony. Winners of the 2015 Crystal Clean Environment Awards were:

- o **Francois Marais, St. Anne School**, for a project entitled *Shrinking Shells*.
- o **Julian Chambrinho, Good Shepherd School**, for a project entitled *Polluted Plants*.
- o **Lizzy VanGenderen, Fort McMurray Christian School**, for a project entitled *Testing the Ozone*.
- o **Darya Abdolmaleki and Tamanna Haque, Westwood Community High School**, for a project entitled *Are You Licensed to Pollute?*



WBEA President, Diane Phillips (centre), presents WBEA Crystal Clean Environment Awards to Darya Abdolmaleki (left) and Tamanna Haque (right), representing Westwood Community High School.

- Communications assisted with WBEA Human Resources participation in a regional Career Day for high school students on October 1st.
- Communications coordinated WBEA participation in the Fuse Social Community Strategy Roadmap, an exercise to look for synergies among regional non-profits.
- At a November, 19th meeting of the TEK Berry Focus Group in Fort McKay, Communications previewed the new Berry Focus Group video.
- Communications coordinated a presentation and question and answer session with the University of Alberta Oil Sands Student Delegation, on November 9th.
- A Conklin Community Betterment session was held in the community on November 17th. Communications coordinated an information booth and basket draw. The Executive Director, pictured, and Director of Operations presented an overview of WBEA regional monitoring, with reference to the new Conklin community ambient air monitoring station, to residents.



Photo credit: Jane Percy.

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Community Outreach

WBEA Communications hosted information booths or made presentations at the following events:

- Fort McMurray Senior's Group – an Earth Day presentation and a question time with the senior's group who meet at the Fort McMurray Public Library, on April 22nd.
- Attended a Human Exposure Monitoring Program-Community Odour Monitoring Program (HEMP-COMP) Information session in Anzac to speak with participants.
- Met with Alberta Energy Regulator (AER) representatives during their visit to WBEA on April 24th.
- Hosted a booth at the Fort McMurray Spring Tradeshaw, April 24-26th, to speak with the public about WBEA's monitoring work and results. Visitors were



Asad Hidayat, Devin Russell and Lisa Kirby, WBEA, greet visitors to the WBEA booth at the Spring 2015 Fort McMurray Tradeshaw. Photo credit: Jane Percy.

invited to complete a short survey about their awareness of AEMERA, air quality monitoring and preferences for delivery of monitoring information. The results were tabulated and shared with AEMERA.

- Attended the Fort McKay Berry Focus Group Verification Meeting, on May 19th, to present and discuss the results of the 2014 field season.
- Hosted a booth at the Fort McMurray Métis Festival, on May 22nd.
- Hosted a booth at the Fort McKay Trade Show, on June 4th. The focus of the booth was WBEA's terrestrial monitoring and, in particular, the WBEA-Fort McKay Berry Focus Group's activities. A terrarium of forest floor plants, identified by Cree, Dene and English names, was presented to inspire conversation about regional terrestrial monitoring.
- Liaised with local wildfire information officers to provide wildfire information and air quality updates to local stakeholders and WBEA members during regional forest fires in June and July.
- Coordinated planning and execution of the WBEA Community Open House, held on Sunday May 31st. The event was held to kick off Environment Week and celebrate WBEA's 17th year of air quality monitoring in the RMWB. WBEA welcomed member representatives, MP David Yurdiga and RMWB Deputy Mayor Keith McGrath.

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Communications planned Air, TEEM and HEMP activities and displays, advertising and tours of the Portable Monitoring Station and the Thickwood headquarters. Children's activities, a barbeque, basket draws and an anniversary cake were also a part of the day. WBEA staff were instrumental in the success of the event, which saw over 100 members of the public in attendance.

Top: Executive Director, Kevin Percy (left) welcomes RMWB Deputy Mayor Keith McGrath (centre) and Fort McMurray - Cold Lake MP David Yurdiga (right) to the May 31st WBEA Community Open House. Photo credit: Alan Reeves. Bottom: Natalie Bonnell and Abena Twumasi-Smith demonstrate an odour identification kit to visitors to WBEA's Community Open House. Photo credit: Alan Reeves.



- Participated in a WBEA-TEK workshop, with representatives of six WBEA Aboriginal members, held in Anzac on August 20th, to discuss new TEK projects.
- Hosted a Fort McMurray Trade Show information booth, September 25-27th. WBEA staff assisted at the booth. A key message sheet was developed and an information session held with staff prior to the event.

WBEA Visitors

WBEA Communications coordinated visits and tours of WBEA facilities and monitoring sites for several delegates and groups throughout the year, including:

- Local MLA Don Scott, who visited WBEA and met with the President and Executive Director on March 14th.
- Bonavista-Gander-Grand Falls-Windsor MP Scott Simms, visited on July 15th, for a meeting and a tour.



Director of Operations, Sanjay Prasad (left) with former Fort McMurray Métis 1935 General Manager, Kyle Harrietha (centre) and MP Scott Simms (right). Photo credit: Jane Percy.

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- The AEMERA CEO and VP's visited on July 30th. The day included discussions on the scientific foundation of WBEA's monitoring, data management and a tour of WBEA facilities as well as ambient air and forest health monitoring sites. Communications participated in planning and coordination of the visit.

WBEA hosted the AEMERA CEO and VP's on July 30th. From left to right: Sanjay Prasad, WBEA Director of Operations; Dr. Fred Wrona, Vice President and Chief Scientist; Dr. Bill Donahue, Vice President and Chief Monitoring Officer; Val Mellesmoen, Vice President of Strategy and External Relations; Jay Nagendran, President and CEO; Dr. Kevin Percy, WBEA Executive Director. Photo credit: Jane Percy.



Advertising

WBEA Communications employed varied advertising strategies and formats to reach stakeholders and key audiences, including:

- Streaming real-time AQHI readings for the Wood Buffalo Region to LCD screens at MacDonald Island Park, the Anzac Recreational Centre and the Fort McMurray International Airport. AEMERA co-branded the airport screen in 2015.
- Scripting regular advertising spots on key local radio stations, including Mix 103.7, Country 93.3 and Cruz FM.
- Designing advertising for special events such as the Fort McMurray Tourism Trade Shows and the WBEA Community Open House.
- Designing advertising and radio ads to promote WBEA's new website launch.
- Placing ads for the Anzac HEMP – COMP in the Willow Lake Newsletter, Anzac, in support of WBEA's Community Odour Monitoring Project.
- Drafting and designing advertising for supplemental editions of the Fort McMurray Today and other trade magazines and community publications, including Connect Magazine, SNAP Wood Buffalo, Red River Current (Fort McKay) and the Willow Lake Newsletter (Anzac area).

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WBEA Communications in 2015

Media Relations

- A media release, *Fort McKay First Nation Rep Joins Wood Buffalo Environmental Association Governance Committee*, was issued on January 26th to announce Ryan Abel's appointment to WBEA's Governance Committee.
- A media release entitled, *New WBEA Website Features Seventeen Years of Air Quality Data for Wood Buffalo Region*, was issued on March 10th to announce the launch of WBEA's new website, offering access to all historical air monitoring data since 1997.
- A media release, *WBEA Recruits Anzac & Surrounding Area Volunteers for Community Odour Monitoring Project*, issued on April 17th, presented details of the project and WBEA's volunteer recruitment efforts.

Ray Porter, Odotech Inc. (left), leads an odour identification session in Anzac, as part of WBEA's Community Odour Monitoring Program. Photo credit: Jane Percy.



- A media release, *WBEA Report Assesses Forest Health in the Athabasca Oil Sands Region*, was issued in conjunction with the release of WBEA's Forest Health Report. The report, released on June 4th, resulted in:
 - A radio interview with the Executive Director, on Rogers, June 4th.
 - Executive Director's appearance on radio talk show, *McMurray Matters*, June 5th.
 - An interview, and subsequently, online and print articles in *Fort McMurray Today*, on July 23rd.
 - An interview, and subsequently, an online article in *Upstream Online*, on July 31st.
 - An interview, and subsequently, online and print articles in the *Daily Oil Bulletin*, on August 18th.
- A media release, *Wood Buffalo Environmental Association Appoints Director of Operations*, was issued, on July 13th, in conjunction with the appointment of Sanjay Prasad as WBEA Director of Operations.
- Forest fires in the region generated a request for interviews, on June 29th, with local media. WBEA's Operation's Manager was interviewed concerning AQHI readings and WBEA's particulate matter monitoring.

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- The Nexen pipeline spill generated a request by CBC TV's *The National* for an interview about air quality in communities in the vicinity. The Executive Director was interviewed, at the WBEA HEMP Portable Air Monitoring Unit, in the community of Anzac, for the segment which ran on July 18th.
- A media release, ***WBEA's New Conklin Lookout Air Monitoring Station, A Monitoring Partnership with AEMERA and EC, Begins Operation***, about the commencement of monitoring at a new southern monitoring station, Conklin Lookout, pictured, was issued on August 18th, resulting in an interview and a print article in *Fort McMurray Today* the following day.
- Shawn McCarthy, *Globe & Mail*, who visited WBEA to tour monitoring sites and interview the Executive Director in May, filed a story in November, as part of a year long look at Fort McMurray by the paper.



- Carter Haydu, June Warren-Nickle's Energy Group *Daily Oil Bulletin* reporter, interviewed the Executive Director about the findings of the Forest Health Report and filed a story on August 18th.
- Tonya Zelinsky, Canada correspondent - Upstream, International Oil & Gas Newspaper, interviewed the Executive Director on Sept. 14th and subsequently filed an article.
- The Executive Director was interviewed by Bastian Confino, reporter for RTS radio television Suisse, on September 22nd.
- ***Alberta Environment and Parks Representative Joins Wood Buffalo Environmental Association Governance Committee***, was the title of a media release issued on November 27th, to announce the appointment of Craig Dockrill.
- On December 2nd, a media release entitled *New Wood Buffalo Environmental Association Video Chronicles Traditional Knowledge and Western Science Berry Patch Monitoring in the Athabasca Oil Sands Region*, issued jointly with the Fort McKay First Nation, announced the completion of the Berry Monitoring Group video. The video played on Shaw TV in December.

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WBEA Communications in 2015

Reports

WBEA informs stakeholders of monitoring results, new initiatives, program updates, events and scientific outcomes through printed and electronic reports.

The *Oil Sands Monitoring Community Report*, a major focus throughout 2015, was launched in early 2016. Managed by WBEA Communications, the electronic, interactive Report was a collaboration between six monitoring organizations, monitoring in the three Oil Sands regions:

- Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA)
- Alberta Biodiversity Monitoring Institute (ABMI)
- Environment and Climate Change Canada (ECCC)
- Lakeland Industry and Community Association (LICA)
- Peace River Area Monitoring Program (PRAMP)
- Wood Buffalo Environmental Association (WBEA)

The Report, which contains eighteen articles contributed by the partners, including links to websites, videos and additional information represents the first collaborative communications effort of monitoring partners. WBEA submitted four articles including:

- **Forest Sentinels: WBEA's Lichen Monitoring Tracks Air Pollution in the Athabasca Oil Sands Region**

- **Making Sense of Odours: WBEA's Community Odour Monitoring Project**
- **How's the Air Up There: Monitoring Air Quality in the Athabasca Oil Sands Region**
- **Harvesting Knowledge: Monitoring Berries in the Athabasca Oil Sands Region**

WBEA@Work, an interactive electronic newsletter, was published in March 2015. The content included:

- Executive Director's Report
- WBEA Representation at the AEMERA Oil Sands Symposium
- WBEA's Traditional Knowledge Program
- WBEA Communication in 2014

The 2014 WBEA Annual Report was our most comprehensive and informative to date at 132 pages. It included data summaries from the air, deposition and human exposure monitoring programs as well as the following new sections:

- Regional Emissions Sources - Mervyn Davies



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- Meteorology Tower Data - Tom Dann
- Data Management in 2014 - Sanjay Prasad
- Mercury and VOC Monitoring Summary - Environment Canada
- AEMERA Summary - Krista Tremblett
- Forest Health Report Summary - Kevin Percy
- Ion Exchange Resin Summary - Mark Fenn and Kevin Percy
- WBEA Publications in 2014

Website and Online Tools

A major accomplishment in 2015 was the redevelopment and launch of WBEA's new website, **Wood Buffalo Environmental Association | Home**. In addition to a new look and feel, the website was designed to enhance the user experience and provide better access to information and services for members and stakeholders. The redeveloped WBEA website is now easier to navigate and more visually appealing. Among its many enhanced features, the new website includes an interactive, multi-layered, **GIS map of all WBEA monitoring sites**, including fixed continuous air monitoring stations, passive sites,

forest health sites, edge plots, etc. It also includes the **Fort McKay Air Quality Index (AQI)**, along side the AQHI and an enhanced **photo library**. The website continued to provide hourly updated air quality and meteorological data from WBEA's fixed, portable and mobile monitoring stations. The new website launched in March 2015.

Right: The new interactive map featured on WBEA's website.

Additions to the WBEA website in 2015 included:

- Wildfire hazards and air quality advisories due to wildfires.
- A page for the new **Conklin Lookout** station.
- The **WBEA Health and Safety Manual**.
- A page for particulate matter monitoring carried out near Conklin, due to forest fires, was active during the summer of 2015.

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WBEA Communications in 2015

WBEA's Facebook and Twitter profiles and YouTube channel expanded WBEA's outreach in 2015. WBEA's social media profiles are coordinated and integrated in order to maximise impact and outreach. In 2015, WBEA tweeted the AQHI forecast for four community stations, daily. The Fort McKay AQI does not have a forecast function, therefore the AQI readings were tweeted twice daily.

Communications Materials and Branding

Among the products developed by Communications in 2015, to support WBEA education and outreach, were:

- A video highlighting the WBEA-Fort McKay Traditional Environmental Knowledge Berry Monitoring Project was completed. WBEA Communications developed the video concept, wrote the script and coordinated the filming. The video, which tells the story of the multi-year berry monitoring project, was filmed over 4 days, at 4 locations, during the September berry harvest. It includes interviews with Elders, WBEA staff and Fort McKay staff and provides results for the 2014 air monitoring, meteorology, and the concentration of health promoting constituents in the berries. The Fort McKay Sustainability Dept. assisted with the logistics and planning for the video. The video was publically released



on December 1st and a joint media release was issued with Fort McKay. The video, in English and English subtitles, may be viewed on the **WBEA website**. Funds to translate video into Cree and Dene are being sought.

- Posters maps of all WBEA monitoring locations were created.
- A 2015 desk calendar featuring WBEA's monitoring programs, governance, stakeholders and outreach was designed and mailed out to stakeholders.



Sally McDonald, Janelle Baker and Howard Lacorde participate in the filming of the WBEA-Fort McKay Berry Focus Group video with videographer, Jamie Coutts, in September 2015. Photo credit: Jane Percy.



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WBEA Communications in 2015

WBEA Program Support

Communications assisted WBEA's programs in the following ways:

- Coordination of a WBEA Staff Information Day on March 13th at MacDonald Island Park. The day included presentations by the Executive Director, Human Resources Advisor, Safety Advisor and WBEA Communications. An Aboriginal Awareness presentation by Holly Fortier of Fort McKay, was a highlight of the day.
- Assistance with recruitment of volunteers for HEMP's Anzac Community Odour Monitoring through advertising, door-to-door flyer distribution and social media posts.
- Designed poster format maps for the Air and Deposition monitoring programs.
- Coordinated photography requirements.



Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA)

The WBEA Communications Program, funded in 2015 by AEMERA included :

- **Air Quality Reporting** - including WBEA Annual Report, annual joint Oil Sands Monitoring Report, WBEA@Work Newsletter and monthly website maintenance.
- **Community Relations** - including Community Open houses, local festivals and trade shows and the Wood Buffalo Regional Science Fair.
- **Communications (Advertising)** - including Advertising, Air Info Line and Meltwater Press.

WBEA participated in AEMERA Engagement/Communications Component Advisory Committee (CAC) meetings throughout 2015, and hosted an information booth at the AEMERA Science Symposium, February 24th & 25th.

WBEA Communications gratefully acknowledges the Communications Advisory Committee and WBEA Members for their guidance, and WBEA staff for assistance with Communications activities in 2015. ■ ■ ■ ■

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