West Central Airshed Society
P.O. Box 7421, Drayton Valley, Alberta T7A 1S6

WCAS Agriculture Meeting
Meeting Notes
March 8, 2005

9:00 a.m. to 10:15 a.m.
Main Board Room
Penn West Building, 50th Avenue West
Drayton Valley, AB

In Attendance:

Cecil Anderson	Pembina Agriculture Protection Association
Jim Bolton	TransAlta
Greg Gabert	Penn West Petroleum Ltd.
Mary Griffiths	Pembina Institute of Appropriate Development
Robert Kitching	Brazeau County
Rick Phaneuf	Alberta Environment

WCAS:

Bob Scotten	Executive Director
Barb Johnson	WCAS

Absent with Regrets:

Audrey Kelto	Leduc County
Robert Raimondo	EPCOR
Larry Williams	Alberta Environment
Mike Woods	Weyerhaeuser Ltd.
Steve Probert	Capital Health
Gwen Wood	EUB
Dave Stewart	Talisman Energy

Action Items

Action Item 1: Bob to seek advice from Elaine Ryl as to whether the Genesee bio-plot should be seeded this spring.

Action Item 2: Bob to follow up on the NAPS station proposal from the federal government.

Ongoing Action Items

Ongoing Item 1: Bob to contact the Environmental Law Centre to inquire about conservation easements and what benefit they could bring to those who grant them.

Ongoing Item 2: Bob to inquire about protocol requirements for testing heavy metals and other toxins from Enviro-test Laboratories.

1. Welcome and Introductions

   Cecil Andersen called the meeting to order at 9:10 a.m. Committee members were welcomed.

2. Approval of November 30, 2004 Draft Minutes

   The meeting notes of the November 30, 2004 were accepted by consensus.

3. Review of the November 30, 2004 Action Items

Action Item 1: Bob to seek advice from Dr. Allan Legge on how WCAS could obtain the bio-monitoring model from Dr. Sagar Krupa (this is an ongoing action). **Complete.** Dr. Legge provided an explanatory note concerning the agriculture model. (Attachment A). The correspondence described the model as a process/procedure that could be referenced in the event of duplicating the agriculture bio-monitoring project rather than a tangible software tool that predicted crop responses given a set of variable parameters.

Action Item 2: Bob to contact the Environmental Law Centre to inquire about conservation easements and what benefit they could bring to those who grant them. In addition, Bob would contact Blue Sky Environmental Trust to inquire about their land trusts (having obtained the contact information from Roy). **Ongoing**. Bob indicated that the Law Centre had advised that information would be sent to him directly with respect to this matter.

Action Item 3: Roy to give Bob contact information for both Blue Sky Environmental Trust and the Winnipeg lab that undertakes sampling for heavy metals, etc. **Complete.** Bob reported that Enviro-test Laboratories (ETL) located in Edmonton could perform a full range of metal samplings.

Action Item 4: Bob to find out what sampling of vegetation is currently being undertaken by other groups in Alberta. He will inquire from Alberta Agriculture, the Clean Air Strategic Alliance (CASA) and others. **Complete.** Bob reported that he was unable to find current information or information specific to the West Central region.

Action Item 5: Bob to inquire about protocol requirements for testing heavy metals and other toxins at the Winnipeg lab. **Ongoing.** Bob agreed to obtain this information from Enviro-test Laboratories.

4. Recommendations for Continuing the WCAS Agriculture Program

Bob circulated a copy of a letter received from Dr. Legge. After a lengthy discussion it was decided that Bob would coordinate a meeting to include Elaine Ryl, Dick Puurveen, Jim Robertson, Dr. Kindzierski and other expert representatives to discuss long term plans of the Agriculture program based on the information obtained from Dr. Legge.

In addition, committee members asked as to the condition of the future Genesee agriculture plot. It was noted that members felt that the plot should be in an available state. Bob agreed to contact Elaine Ryl as to whether the plot should be seeded this spring.

5. Funding Discussion

Bob reported that a meeting with the Alberta Environment Minister, Guy Boutilier, was extremely positive with respect to support for Alberta Airsheds. The Minister encouraged the Society to forward a list on non-participating members. The Minister also suggested that the Ministry could provide the Society with a supportive letter that could be included with annual membership fee billings.

It was also reported that the federal government were in discussions for promoting a National Air Pollution Surveillance (NAPS) station in each of the provincial Airshed networks. It was noted that initiation of a NAPS station would qualify each Airshed for financial support. The funding would include a provision for the equipment, a maintenance fee of $35k and reimbursement for repairs on equipment exceeding $500. Concern was voiced regarding the continuance of such funding past the federal governments budget year. Bob agreed to follow up on the NAPS station-funding proposal by the federal government.

6. General Discussion

Bob indicated that the 37th National Air Symposium hosted by Dr. Legge would be held in Banff this year, March 25-28th. It was noted that Bob, Barb and/or Cecil would be attending the event.

The agriculture meeting concluded at 10:00 a.m.

ATTACHMENT A

March 6, 2005

To: Mr. Bob Scotten, West Central Airshed Society (WCAS)
From: Dr. Allan Legge, Biosphere Solutions

RE: WCAS Agricultural Biomonitoring Program 1998-2002 Alfalfa

Dear Bob,
You asked me to provide the WCAS Board Members with some overview comments on the results of the alfalfa biomonitoring program. It is my understanding that the reason for this request is that some of the WCAS stakeholders were having some difficulty in understanding what the scientific results of the alfalfa biomonitoring program meant in a practical sense. The following material is presented to provide that understanding and background to the stakeholders.

The overall purpose of the WCAS Agricultural Biomonitoring Program was to determine whether or not the air quality in the West Central Airshed was having an adverse impact on crops in the region. The main air pollutants of concern were sulphur dioxide (SO_2), nitrogen oxides (NO and NO_2) and ozone (O_3). The view was held that the potential adverse impact on crop plants from these air pollutants could range from visible injury to the leaves of sensitive plant species in the short-term to potential reductions in crop yield in the long-term and therefore, those issues needed to be assessed.

To address this concern in the West Central Airshed Region, a series of five agricultural biomonitoring locations were established using two plants species know from the scientific literature to be sensitive to air pollution stress. The five locations were Violet Grove, Tomahawk, Carrot Creek, Breton and Alder Flats. The two plants species used were Saskatoon Serviceberry (*Amelanchier alnifolia* Nutt.) cultivar 'Smokey' and alfalfa (*Medicago sativa* L.) cultivar 'Beaver' both of which were grown by producers in the West Central Region. The Saskatoon was known to be sensitive to sulphur dioxide exposure and was used as the short-term bioindicator of visible injury to the leaves. The alfalfa was known to be sensitive to sulphur dioxide, nitrogen oxides and ozone exposure and alfalfa yield was used as the long-term bioindicator end-point. The

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Saskatoon plants were evaluated 'qualitatively' for the presence of visible leaf injury at all five biomonitoring locations on a survey basis. Alfalfa yield, however, could be 'quantitatively' assessed in the study plots at the three biomonitoring locations (Violet Grove, Tomahawk and Carrot Creek) where there were also measurements of key air quality and meteorological parameters (i.e. climatic/ environmental growth regulating factors). These measurements were essential because it is primarily the interaction over time of changing alfalfa plant biology with the changing climatic factors and air quality which determines alfalfa yield. The following discussion addresses the assessment of alfalfa yield in the alfalfa plots at the three biomonitoring locations in the West Central Airshed over the five year period 1998-2002.

To understand the approach taken in the assessment of alfalfa yield, it is essential to understand that plant biology, environmental plant growth regulating factors and air quality all display dynamic highly variable properties that vary in time and space. The key, as well as the challenge, for the assessment of alfalfa yield was the coupling of the variable growth dynamics of the alfalfa plants over given time periods with the highly variable and dynamic environmental growth regulating variables and air quality variables over the same time periods. The purpose of this coupling was to determine the extent to which alfalfa yield was influenced by the environmental growth regulating variables and/or the air quality variables. Put another way, this coupling of alfalfa yield with the environmental growth regulating parameters and the air quality parameters would help establish cause-effect relationships. This coupling was achieved using Multivariate Statistical Regression Models with alfalfa yield as the dependent variable and the environmental growth regulating parameters (air temperature, global solar radiation, relative humidity and precipitation depth) and air quality parameters (SO_2 , NO_x and O_3) as the independent variables or the predictors.

The three main growth stages of alfalfa from crop emergence to harvest are characterized by a growth curve (i.e. logistic sigmoidal growth curve) which is based upon a series of field measurements of alfalfa biomass. Since there were two alfalfa

harvests per growing season in the West Central Airshed biomonitoring plots, two growth curves were derived for each alfalfa plot each year. Basic, biologically meaningful descriptive statistics were used to define the environmental growth regulating parameters and the air quality parameters (mean, median, mode, standard deviation, range, maximum, minimum and the 25^{th}, 50^{th}, 75^{th} and 95^{th} percentiles) for each of the three alfalfa growth stages. The scientific challenge was to mathematically characterize the independent variables or predictors in such a way as to account for as much of the variability of the measured crop parameters as possible. Mallow's Critical Point Regression was used to select the 'best of the best' yield models to avoid the mistake of over-parameterizing or over-fitting the model by using too many predictors. It is important to understand that the development of the Multiple Regression Alfalfa Yield Model was an iterative process which allowed the use of only the complete data sets of the independent variables or predictors generated over the 1998-2002 time frame. To optimize the number of complete data sets available, missing data were filled-in, wherever possible, by the application of a method developed previously in a different study and verified here for its accuracy by checking against the measured data. It should be noted that the final model in the present case can only be used for assessing alfalfa yields in the time frame with measured data (e.g. 1998-2002).

What the model showed was that alfalfa yield over the 1998-2002 time period was strongly influenced by the environmental growth regulating variables as well as the air quality variables, with the air temperature and ozone being the most important. It is equally noteworthy that the model provided a quantitative estimate (per cent contribution) of each predictor (e.g. ozone, sulphur dioxide, the oxides of nitrogen and temperature) to the total variability in the measured alfalfa yield ('high', 'low' and all yields). Based on the scientific literature as well as the peer review comments provided to the WCAS on the final report, it is very important for the WCAS Board Members to understand that this is the first time that this has ever been accomplished.

To assess alfalfa yields in the future in the West Central Airshed using the same

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Multiple Regression Model approach, one will have to take the same climate, air quality and crop measurements as taken in the 1998-2002 time period and go through the same processes noted above to create the appropriate Multiple Regression Alfalfa Yield Model for the new time period to account for the variability of the independent variables and the influence those variables have had on alfalfa yield.

A second model (Discriminant Analysis or DA) was used to classify the alfalfa yields into 'high' and 'low' using the same predictors as in the previous model. DA corroborated the results obtained in the previous model. That being said, DA can only predict whether a yield is 'high' or 'low' but not by how much. Put another way, DA is a classification model that categorizes individual alfalfa harvests into two groups. The value of this approach is that in the future, if full data sets are available for all of the predictors, one can forecast whether the yield will be 'high' or 'low' during each harvest at each study location, without actually measuring the yield. This is extremely important in streamlining any future efforts in determining the impacts of changing climate and air quality on alfalfa yields at the study locations.

I hope that this information helps the WCAS Board Members.