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**ACRONYMS & ABBREVIATIONS**

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<th>Definition</th>
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<tr>
<td>AEP</td>
<td>Alberta Environment and Parks</td>
</tr>
<tr>
<td>AWW</td>
<td>Alberta Wildlife Watch</td>
</tr>
<tr>
<td>AVC</td>
<td>Animal-Vehicle Collision</td>
</tr>
<tr>
<td>AVCPL</td>
<td>Animal-Vehicle Collision Prone Location</td>
</tr>
<tr>
<td>CMA</td>
<td>Contract Maintenance Area</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>GoA</td>
<td>Government of Alberta</td>
</tr>
<tr>
<td>HMC</td>
<td>Highway Maintenance Contractor</td>
</tr>
<tr>
<td>KDE+</td>
<td>Kernel Density Estimate+</td>
</tr>
<tr>
<td>Org. ID</td>
<td>Organization ID</td>
</tr>
<tr>
<td>TDRA</td>
<td>TIMS Data Repository Application</td>
</tr>
<tr>
<td>TIMS</td>
<td>Transportation Information Management System</td>
</tr>
<tr>
<td>WSSR</td>
<td>Wildlife Site Sensitivity Rating</td>
</tr>
</tbody>
</table>

**DEFINITIONS**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal Carcass Data</td>
<td>Animal carcass data collected using the AWW application. An animal carcass report is assumed to represent an animal-vehicle collision.</td>
</tr>
<tr>
<td>AWW Application</td>
<td>Smartphone application supported in iOS, Android, and BlackBerry devices.</td>
</tr>
<tr>
<td>AWW Dashboard</td>
<td>AWW Program tool to monitor and report AWW data as a snapshot in time. The AWW Dashboard includes clear and concise graphics at the provincial and regional scales to provide an efficient Program checkup.</td>
</tr>
<tr>
<td>AWW Mitigation Toolbox</td>
<td>Alberta Transportation’s guidebook of AVC mitigation technologies and structures.</td>
</tr>
<tr>
<td>AWW Program</td>
<td>The Program developed to identify and prioritize animal-vehicle collision prone locations, identify cost-effective mitigation, and to evaluate mitigation performance. The Program includes four components: 1) the AWW System, 2) Alberta Transportation’s Mitigation Planning and Design Standards, 3) User Engagement Plan, and 4) Annual Review.</td>
</tr>
<tr>
<td>AWW System</td>
<td>Collects, manages, analyzes, and reports AWW data, identifies and prioritizes AVC mitigation locations, and evaluates mitigation performance.</td>
</tr>
<tr>
<td>AWW Viewer</td>
<td>Alberta Transportation’s stakeholders and partners with view only access to the AWW website tool.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Mitigation Data Repository</td>
<td>Map and document storage of AVC mitigations across the provincial highway network.</td>
</tr>
<tr>
<td>Organization ID</td>
<td>A unique code given to each company and or organization registered as a Principal Contributor to use the AWW application. The code is provided by Alberta Transportation’s Operations Manager (for HMCs) or Alberta Transportation’s System Administrators within Environmental Management Services.</td>
</tr>
<tr>
<td>Principal Contributor</td>
<td>An AWW application user that has been identified as critical for the acquisition of animal carcass and live sighting data. Principal Contributors are Highway Maintenance Contractors and Government of Alberta staff.</td>
</tr>
<tr>
<td>Project User</td>
<td>Alberta Transportation’s project-specific consultants with primarily view-only (restricted editor) access to the AWW website tool.</td>
</tr>
<tr>
<td>Regional Administrator</td>
<td>An AWW website manager for designated Region(s). Example Regional Administrators are those with an Alberta Transportation regional consulting assignment.</td>
</tr>
<tr>
<td>System Administrator</td>
<td>A supervisor for the AWW application and website. Limited to Alberta Transportation staff.</td>
</tr>
<tr>
<td>User Key</td>
<td>A unique identifier for individual smartphones that is generated by the AWW System.</td>
</tr>
</tbody>
</table>
Alberta Wildlife Watch Program Overview

Animal-vehicle collisions (AVCs) are a significant problem in Alberta affecting motorist safety and wildlife populations. Alberta Transportation designed the Alberta Wildlife Watch (AWW) Program as a solution to reduce AVCs on provincial highways improve driver safety and minimize the impacts of highways on wildlife populations. The AWW Program and its goals are highlighted in a video available at https://youtu.be/zBknpdganB8.

AWW Program is designed to:

1. Identify AVC-prone locations (AVCPLs);
2. Provide high-quality data for effective decision making;
3. Develop departmental policy & standards; and
4. Allow for innovation and evaluate long term mitigation effectiveness.

High-quality data is collected using the AWW application1. Data analyses to identify and prioritize statistically significant AVCPLs are automatically performed on the AWW website tool2. Together, the AWW application and website tools support the decision making process for AVC mitigation.

AVCPLs identified are prioritized for mitigation and evaluated for feasibility. Once approved for mitigation, Alberta Transportation’s Terms of Reference for AVC mitigation projects outline the design and tender process including the development of an AVC Mitigation Plan. Alberta Transportation’s mitigation standards and considerations are incorporated into planning and design to ensure each mitigation project contributes to the Program goals. Once a mitigation project is complete, the applicable mitigation construction reports and AVCPL records are stored and mapped in the Mitigation Data Repository. This builds an AVC mitigation inventory that is linked to the AWW data and AVCPL analyses (animal carcass data collected before and after the mitigation project) to facilitate mitigation performance monitoring. Its effectiveness at reducing AVCs is evaluated using standardized performance criteria.

Over time, standard performance of the overall AWW Program and provincial mitigations are evaluated to ensure continued alignment with the AWW Program’s goals. Lessons learned from this long-term review influences Alberta Transportation’s mitigation standards, construction and innovation, evaluation criteria, and all System components.

Figure 1 displays the AWW Program structure.

---

1 Smartphone application for iOS, Android, and BlackBerry devices.
2 A modern browser, such as Chrome, is required for the website tool (Internet Explorer is not recommended).
Figure 1: Alberta Wildlife Watch Program Structure
Appendix B: Data & User Management and Analyses

1.0 INTRODUCTION

The development of the Alberta Wildlife Watch (AWW) smartphone application is Alberta Transportation’s solution to substantially improve the quality of data being collected across the province (refer to Appendix A). This allows for the data to be quality controlled and analyzed in a timely manner. This is an effective solution to the traditional animal-vehicle collision (AVC) data collection approach.

AVC data is traditionally collected from police reports. Incidents that result in property damage $2,000 or more (prior to 2011 the damage threshold was $1,000), a human fatality, and or human injury are filed using a paper process. This traditional method involves considerable data entry and results in data entry errors and data access delays. Currently, the delay to access the traditional AVC data is two years after an AVC has occurred.

As a result of the delay, AVC reduction considerations are not effectively integrated into Alberta Transportation’s project delivery process. Wildlife and wildlife mitigation are considered in the Environmental Evaluation for a given project; however, due to lack of reliable and current data, mitigation is often difficult to plan.

The AWW System solves these challenges by 1) automating the animal carcass and live sighting data entry (as outlined in Appendix A), and 2) providing a platform to efficiently manage and analyze the data (described here in Appendix B). Timely access to the data is improved and the risk of data errors is reduced by the automation and efficient design of the AWW application (i.e., drop down selections). Data collected using the AWW application is automatically submitted to the AWW website once a network connection is available. This allows for near real-time access to the data. Once collected in the field and stored on the AWW System’s website, animal carcass and live sighting data is accessible to Alberta Transportation and other selected users. This provides a platform to quality control the data, register and manage select users (i.e., data contributors), and analyze the data. This ensures the highest-quality data, and simple effective analyses.

Reliable and timely access to the data provides Alberta Transportation the ability to locate and prioritize provincial animal-vehicle collision prone locations (AVCPLs). This aids the decision-making process and provides solid justification for mitigating AVCs. Appendix B outlines how the website maintains the integrity and accuracy of the data to ensure high-quality data and effective analyses of AVCPLs by:

1. Managing Data:
   a. Data quality control;
   b. Coach Principal Contributors; and
   c. Integration of other Alberta Transportation information.

2. Managing Users:
   a. Administer user roles and responsibilities; and
   b. Data change history.

3. Analyzing Data using a Provincial Approach (Including the Identification of AVCPLs).
Near real-time access for data analyses provides Alberta Transportation the ability to identify and respond to AVCPLs in a timely manner, synchronize AVC reporting with the annual provincial collision statistics, and effectively engage with stakeholders and the public.

High-quality data is managed and analyzed within the AWW website tool by identified key users. It is their responsibility to ensure quality data is 1) attained/maintained, 2) analyzed, and 3) advanced through the AWW Program.

### 2.0 USER ROLES AND RESPONSIBILITIES

The AWW website tool efficiently manages multiple users. Three different users 1) Project Users, 2) Regional Administrators, and 3) System Administrators access, manage, and analyze the AWW data (Table1). Each have distinct responsibilities under the data and user management and analyses component (Table 1). For users to view, manipulate, or export certain parts of the AWW website they must have the proper credentials (i.e., username) that are determined by the System Administrator.

#### Table 1: User Responsibilities for Data/User Management and Analysis

<table>
<thead>
<tr>
<th>User</th>
<th>Access Permission(s)</th>
<th>Management and Analysis Responsibilities</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>User Management</td>
</tr>
<tr>
<td>1. Project Users</td>
<td>Website Tool</td>
<td></td>
</tr>
<tr>
<td>2. Regional Administrators</td>
<td>Smartphone &amp; Website Tools</td>
<td></td>
</tr>
<tr>
<td>3. System Administrators</td>
<td>Smartphone &amp; Website Tools</td>
<td>✓</td>
</tr>
</tbody>
</table>

Principal Contributors and AWW Viewers are Highway Maintenance Contractors and Alberta Transportation stakeholders and partners. Both users have no responsibilities for AWW data and user management and analyses. Principal Contributors responsibility are outlined in Appendices A and D.

AWW Viewers have no designated responsibilities under the AWW Program; however, have view-only access to the AWW website tool. Once registered by the System Administrator, AWW Viewers are emailed a username and password automatically from the AWW website (email will be sent from info@albertawildlifewatch.ca). AWW Viewer accounts are deactivated by System Administrators upon an agreed upon completion date.

### 2.1 Project Users

Project Users are Alberta Transportation’s project-specific consultants. With view-only access to the AWW data, this user is able to incorporate AWW’s data and analyses (including identifying and priority ranking AVCPLs) into their project work. To facilitate project-specific work, Project Users are able to download the AWW database and analyses for all traffic control segments that fall within their project limits. They may then incorporate any required AVC mitigation within, or adjacent to their project. Additional analyses of data may be required outside the AWW website tool.
Once registered by the System Administrator, Project Users are emailed a username and password automatically from the AWW website (email will be sent from info@albertawildlifewatch.ca). Project User accounts are deactivated by Regional Administrators upon project completion.

### 2.2 Regional Administrators

**Regional Administrators** are selected by Alberta Transportation for regional consulting assignments. Individual Regional Administrators gain access to the AWW application using an Organization ID (Org. ID) code and the website tool using an assigned username and password system. Both the Org. ID code and the user name and password are assigned by the System Administrator. Alternatively, the Org. ID may be requested from Alberta Transportation's Environmental Services Section, Technical Standards Branch.

Regional Administrators play a primary role within the AWW System. Under the data and user management and analyses component, Regional Administrators’ primary responsibilities include 1) data management (i.e., quality control), and 2) data analyses (including identifying and priority ranking AVCPLs). Regional Administrators are also responsible for deactivating Project User accounts when their projects are complete.

### 2.3 System Administrators

**System Administrators** are responsible for the overall management of the AWW Program and its users, including the AWW website tool. This role includes access to all AWW data and management systems and is restricted to Alberta Transportation staff. Responsibilities include assigning and managing all other users, registering usernames and passwords for Project Users and Regional Administrators, overseeing data quality control, managing information available from other Alberta Transportation applications, and integrating/sharing data analyses results. Registration of all AWW Program users is completed through the AWW website’s Administration tab.

### 3.0 MANAGING DATA

Animal carcass and live sighting data collected using the AWW application are managed within the AWW website tool. Once in the website, the data are reviewed and, where warranted, data quality is further improved. This ensures that data is the highest quality and as reliable as possible when locating and prioritizing provincial AVCPLs. This is achieved by:

- Quality controlling the data;
- Coaching Principal Contributors; and
- Integrating with other Alberta Transportation applications.

Once in the website, data is further protected from loss. Data is backed up on a nightly basis using the Acronis software program.

### 3.1 Data Quality Control

Animal carcass and live sighting records are automatically uploaded from the AWW application to the website tool. Once in the website, records are initially marked as Pending and are available to Regional Administrators for quality control purposes. This quality control process increases the reliability of the data.
Quality control is completed on the AWW website’s Record Management tab. Regional Administrators have the ability to view the record, its location, and photo(s) submitted from the AWW application. Updates to the animal species, gender, and condition (animal carcass or live sighting) are permitted during the quality control process. Quality control benefits most when using photo(s) submitted with the record.

Animal carcass and live sighting records and or individual photos may be archived if deemed to be invalid during quality control. Archived items are removed from the database and map layers; however, are retrievable for export and may be restored by a Regional or System Administrator.

To help with the quality control process, an easy drop-down list of pre-identified quality control remarks are provided. This includes the most common errors encountered during the quality control process. An example quality control remark is: *species corrected*. All quality control remarks are automatically included in the AWW database. It is in the database where the true benefit of these pre-identified quality control remarks is most evident. It allows the entire provincial database to be sorted based on a specific data error (i.e., *species corrected*). This simple and effective manipulation to the database allows Regional Administrators to easily identify, manage, and report primary data errors and error rates, and target additional coaching of Principal Contributors.

Uncommon errors, not available in the quality control drop-down list, may be manually entered by the Regional Administrator in the notes section. This manual notes section allows the Regional Administrator to report a cautionary notice. This may be warranted when a species is recorded well outside its known provincial range and a photo was not submitted to verify the observation. These quality control notes are also included in the provincial export database. However, Regional Administrators are responsible for notifying Alberta Transportation of suggested AWW System improvements (i.e., application coaching and or engagement needs).

Once the record is quality checked, the Regional Administrator changes the record status from Pending to Verified- Photo (i.e., verified using a photo record) or Verified-No Photo (i.e., verified without a photo record available). All data, including Pending records, data corrections, and quality control remarks/notes are available for analyses.

The quality control process maximizes data processing efficiency. This includes a streamlined quality control page that 1) displays the applicable record information needed to quickly determine data quality, 2) warns of possible errors, and 3) easily progresses to the next Pending record.

The quality control page is designed specifically to limit three potential data errors:

1. Species identification;
2. Location; and
3. Duplicate records.

The management of these three errors is important to improve data reliability.

**3.1.1 Species Identification**

Correct species data provides a better understanding of species involved in AVCs, animal movements, and seasonal AVC rates. This allows Alberta Transportation to target mitigation specific to species involved in collisions and manage species at risk. Ultimately, species identification errors in the database have the potential to influence a mitigations effectiveness to reduce AVCs.
The AWW application limits species identification errors by including a species identification guide. Alberta Transportation has also delivered hard copies of the species identification guide as part of the Principal Contributors Engagement Plan (Appendix F). This attempts to reduce the number of species identification errors entering into the database.

Once in the website, species identification is quality checked using the record’s photo(s) submitted. Records with on-site photo(s) and correctly identified species are re-classified from Pending to Verified-Photo. Photos showing clear evidence of incorrect species are corrected by the Regional Administrator in the quality control process. Records submitted without photos are re-classified from Pending to Verified-No Photo by the Regional Administrator.

Animal carcasses in particular may be difficult to identify. To aid in species identification, Regional Administrators are able to zoom into the photo. If needed, Regional Administrators are also able to email the photo to a provincial expert for species confirmation (e.g., AEP biologists, Royal Alberta Museum curators).

During the species quality control process using animal photos, Regional Administrators are also able to manually adjust the records’ animal gender and age classification. This process also allows records of broad species groupings (e.g., duck species) available on the application to be manually changed to a finer species classification (e.g., Mallard).

### 3.1.2 Location

Location data directly influences the identification and magnitude of AVCPLs. Accurate location data allows Alberta Transportation to identify mitigation needs, design mitigation appropriate for the entire AVCPL, and effectively monitor mitigation performance.

The AWW application provides spatial accuracy within ± 10 metres by using the smartphone’s built in Global Positioning System (GPS). It is designed to automatically record the GPS location at the users’ position when submitting the report. Similarly, the AWW application geo-references the location of each photo submitted with the record. This maximizes the location accuracy of the data.

Once in the AWW website, the records and photo location data are available for quality control. The quality control page simplifies the location check by mapping both the record and photo locations together. This allows the Regional Administrator to quickly verify any discrepancies. In addition, a notification alerts the Regional Administrator if the record and photo locations differ by more than 100 metres.

Manual adjustment to the records’ location is not permitted. However, a location error notification is saved to the record and entered into the database. This is accomplished during the quality control process and involves selecting a pre-identified quality control remark: record location ≥100 m from photo location. Both the record and photo(s) GPS locations are provided in the database for export and further analyses if needed.

### 3.1.3 Duplicate Record

Duplicate records are defined as multiple AWW application records of the same animal carcass. Large numbers of duplicate carcass records may introduce bias into the AWW database, resulting in an overestimate of the magnitude of AVCs at a particular location. Duplicate live sighting records are considered inherent to the natural movement of wildlife. Multiple live sighting records are not regarded as duplicates within the AWW website tool.
The AWW website tool minimizes the risk of duplicate carcass records by restricting AWW application users to Principal Contributors that are primarily highway maintenance contractors and Government of Alberta staff. Any duplicate records submitted are later managed in the AWW website tool as part of the quality control process.

The quality control process includes an automatic approach to help identify potential duplicate carcass records. During the quality control, a notification alerts the Regional Administrator of all AWW records reported within a 500 m radius and within 1 week of each other (i.e., 14 day span; e.g., a record submitted January 15 is matched to observations from January 8 to January 22). These records are considered possible duplicates, irrespective of the animal species and submitting organization, until further evaluated by the Regional Administrator.

To efficiently evaluate possible duplicates, the species, observation date, record identification number, and submitting Organization ID are listed and mapped for each. Any record determined to be a duplicate by the Regional Administrator is archived and removed from the database.

### 3.2 Coach Principal Contributors

Data quality is also contingent upon the practices of Principal Contributors (i.e., the highway maintenance contractors). The AWW application is designed to be user-friendly; requiring little time to learn and use on a daily basis.

Similarly, a package of various AWW application training materials are provided to Principal Contributors at deployment (refer to Appendix F). These include an introduction video to the AWW Program (available at [https://youtu.be/zBknpgdganB8](https://youtu.be/zBknpgdganB8)), a detailed AWW application user manual, species identification guide, a simple user guide poster, and travel-sized application guide cards. These are found on Alberta Transportation’s website under the Technical Resources tab [http://www.transportation.alberta.ca/6003.htm](http://www.transportation.alberta.ca/6003.htm)

Coaching occurs after deployment of the AWW application, on an as-needed basis. It involves directed instruction specific to the Principal Contributor’s needs. Regional Administrators are responsible for monitoring and coaching the Principal Contributors, as needed. Principal Contributors are monitored within the AWW website tool using their unique Org. ID’s associated with each AWW record. The AWW website tool includes a dashboard summary of Principal Contributor records and error rates. This provides a high-level overview of the system operations and alerts administrators of potential areas of concern. The AWW Dashboard specifically monitors the primary data errors, Principal Contributor submission rates, and application versions in use. This allows Regional Administrators to easily and effectively monitor coaching needs and initiate an applicable coaching approach. The AWW Dashboard is described further in Section 5.4.

The coaching approach (e.g., phone call, letter, in-person training) is determined by the System Administrator and the Principal Contributor Engagement Plan (Appendix F). Factors that determine the coaching approach and schedule, include but not limited to, the severity of the concern and the ease with which coaching is best communicated.

Coaching is a simple, yet effective method to increase data quality.

### 3.3 Incorporate Other Alberta Transportation Information

The AWW website tool must also remain current by incorporating other available Alberta Transportation information and mapping. This helps maintain data quality throughout operations, and a seamless transition of data/information sharing among Alberta Transportation applications. This is particularly important at the data analyses and project planning stages.
Alberta Transportation’s TIMS Data Repository Application (TDRA) is a centralized database which receives provincial highway information from multiple applications. AWW is one of several applications within the TDRA. Integration of the AWW System with the TDRA ensures data reliability and maintains data consistency across Alberta Transportation’s applications.

Alberta Transportation’s Informatics and Modelling team maintains custodianship of the highway data used by AWW. They update the highway data annually to include highway upgrades, re-alignments, and new road projects. Similarly, traffic control sections are defined and managed by Alberta Transportation’s Modelling and Analysis team using Highway segments with uniform traffic volumes. This is completed by taking the current highway control sections and dividing them, if needed, into “Traffic Control Sections”. The AWW System uses the highway and traffic control section information and shapefiles as base maps for data analyses. In particular, the AWW website sources snapshot highway, control section, traffic control section, and kilometre point information from the TDRA.

AWW is designed to incorporate the most contemporary information and mapping from the TDRA. Integration of this information is currently completed manually once annually; however, automation is ultimately preferred as it reduces the potential for human error. This ensures data quality is maintained and provides confidence in the AWW data analyses through time.

4.0 MANAGING USERS

The AWW System’s data management approach helps improve and maintain high data quality standards. By comparison, the AWW user management approach helps protect the integrity of the AWW data. Protecting the integrity of the data includes processes to reduce the risk of data corruption and data bias and increase the overall reliability of the data. This supports a higher-level of confidence in the data to aid AVCPL mitigation decision-making.

The AWW System’s user management approach helps protect the integrity of the data by:

- Limiting user access; and
- Recording data changes in a change history log.

4.1 Limiting User Access

Alberta Transportation protects the integrity of the data by limiting access to the AWW application’s Principal Contributors and website tool to designated AWW Viewers, Project Users, and Administrators with the proper credentials. This includes access to both the AWW application and the website tool based on the user’s responsibilities. For instance, Principal Contributors must receive an Organization Identification code to open the AWW application. Proper credentials to access the AWW application and website tools are distributed by the System Administrator.

Access to the AWW application is limited to select Principal Contributors to minimize risk of duplicate carcass records. Each Principal Contributors’ phone is given a unique User Key identifier when first submits an AWW application record. This User Key identifies an individual smartphone, without identifying the individual person. In exceptional cases, this allows the data collected by an individual Principal Contributor of known concern to be manually archived and removed from the database. This protects the database from bias and increases the overall reliability of the data.

3 Access to the AWW application is also limited to Principal Contributors with safety plans addressing the safe use of smartphones.
Similarly, each Regional Administrator has a unique username and password to quality control records collected within their Region(s). They have view-only access to records collected elsewhere to protect data integrity. This protects the integrity of the data by reducing the risk of data corruption.

### 4.2 Data-Change History

A data-change history strengthens the reliability of the data and reduces the risk of the data being subverted. A change history provides a chronological record of individual AWW record updates. The date and time of a change, and the user name of the Administrator are recorded. In addition, the previous and new attribute value for all changed attributes are also recorded. For example, records changed from “Pending” to “Verified-No Photo” are included in the change history.

### 5.0 ANALYZING DATA

The AWW website tool utilizes several analytical approaches to yield the most accurate and practical solutions for Alberta Transportation. Data analysis within the AWW website is automated, to the extent possible, and relevant to Alberta Transportation’s traffic safety mandate. This includes analyses that can be used to locate and prioritize AVCPLs and determine effective mitigation to improve highway safety.

Wild large-bodied species are the primary target in the AWW analyses, which reflect Alberta Transportation’s highway safety mandate. These targets species (Table 2) pose the highest risk of property damage and human fatalities/injuries when struck. Large-bodied species are selected based on their physical size and weight; and generally, represent species the size of wolves and larger.

#### Table 2: Alberta Wildlife Watch Large-Bodied Animals

<table>
<thead>
<tr>
<th>North American Bison</th>
<th>Moose</th>
<th>Unknown Deer Species</th>
<th>Wolf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mountain Goat</td>
<td>Elk</td>
<td>Woodland Caribou</td>
<td>Grizzly and Black Bear</td>
</tr>
<tr>
<td>Bighorn Sheep</td>
<td>Mule and White-Tailed Deer</td>
<td>Pronghorn</td>
<td>Cougar</td>
</tr>
</tbody>
</table>

However, Alberta Transportation recognizes Alberta Environment and Parks (AEPs) mandate to conserve wildlife including species at risk across the province. Traffic and provincial highways can adversely affect wildlife and species at risk populations. Thus, it is important for capital planning and species conservation to consider highway-related and AVCs mitigations for all wildlife. As a result, the AWW website also includes analysis tools to better identify and understand adverse effects highways may have on other wildlife.

All species, including species at risk, are included in the analyses. The AWW application and website tools collect and analyze data primarily on medium and large-bodied species including those listed as Endangered, Threatened, and Special Concern under the federal *Species at Risk Act* (Schedule 1), Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the Alberta *Wildlife Act* (Table 3). Smaller-bodied species at risk are inconspicuous, and thus inconsistently reported by Principal Contributors. As a result, smaller-bodied species at risk data is unreliable; however, still forms part of the AWW analyses if it is included in the AWW database (i.e., reported by Principal Contributors).
Table 3: Species at Risk Targeted in Alberta Wildlife Watch*

<table>
<thead>
<tr>
<th>Species</th>
</tr>
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<tbody>
<tr>
<td>North American Bison</td>
</tr>
<tr>
<td>Grizzly Bear</td>
</tr>
<tr>
<td>Swift Fox</td>
</tr>
<tr>
<td>Prairie Rattlesnake</td>
</tr>
<tr>
<td>Woodland Caribou</td>
</tr>
<tr>
<td>Wolverine</td>
</tr>
<tr>
<td>American Badger</td>
</tr>
</tbody>
</table>

* Manual updates to the list of species at risk is required annually to incorporate any newly listed species.

To support Alberta Transportation’s traffic safety mandate and species conservation, the AWW website tool analyzes animal carcass and live sighting data using:

1. Interactive mapping;
2. Animal carcass and live sighting data summaries;
3. Animal-vehicle collision prone location analyses;
4. AWW Dashboard; and an
5. Exportable database.

All active AWW data records, including those pending quality control, are included in the data analyses (archived records excluded).

5.1 Interactive Mapping

The AWW website tool’s interactive map provides visual context and clarification to the data, and cursory analyses of when and where AVCs occur. Maps are an essential component of the AWW website tool. The AWW interactive map provides an effective representation of animal carcass patterns, juxtaposed to surrounding landscape/terrain features and management regions (e.g., Contract Maintenance Areas). This functional map is most beneficial when prioritizing, planning, and mitigating AVCPLs.

Several key features of the AWW interactive map include data search functions, display of the raw animal carcass and live sighting data, and descriptive and analytical results including the AVCPL analysis. The AWW interactive map allows the user to select a number of data filters to generate and display analyses, including:

- AVCPLs for select species/species groups;
- spatial boundaries (e.g., Region, Contract Maintenance Area, and a user-drawn polygon);
- dates (e.g., start and end dates for data search);
- species (i.e., multi-species selection);
- animal condition (e.g., animal carcass or live sighting); and
- incident details (e.g., carcass removed, human fatality, injury, property damage).
Mapped data is displayed as clusters of raw data, individual record locations, and AVCPL algorithm tools (refer to Sections 5.2 and 5.3). As users zoom into the map, the data clusters recalculate based on the users preferred scale. Hyperlinks from the map connect to record details, analyses, and the database export.

The AWW interactive map also provides additional visual context to the surrounding landscape/terrain features to further support understanding of the data analyses. Surrounding landscape and terrain features often influence animal abundance and where AVCs occur. Open Street Map satellite and terrain visual modes, protected habitat blocks, and wildlife movement linkage zones represent existing landscape/terrain features in AWW. Protected habitat blocks include areas with minimal land development and relatively continuous wildlife habitat. This map layer includes: Provincial Parks and Protected Areas, National Parks, Provincial Wildlife Sanctuaries, and Provincial Special Access Zones. Protected habitat blocks represent natural landscapes that persist through time.

AWW maps wildlife movement linkage zones; identified by Alberta Environmental and Parks (AEP) as Key Wildlife and Biodiversity Zones. These include areas important for overwintering ungulates, principally occurring along major river valleys, and which are intended to represent important local and regional wildlife movement corridors. In addition to public safety concerns around AVCs, Alberta Transportation recognizes AEPs concerns about the landscape level ecological impacts of roads and traffic. Wildlife connectivity is an important part of AEP’s mandate to manage the wildlife in the province. Thus, it is important for capital planning and species conservation to consider how wildlife movement corridors or linkage zones intersect with provincial highways. The sharing of data will further support the collaboration between these departments regarding their concerns related to wildlife connectivity at specific highways allowing both ministries to meet their mandates and potentially that of our federal counterparts within Alberta. Known linkage zones are included as a map layer in AWW and the program is soft coded to allow anticipated updates and new mapping, as it becomes available from AEP.

The AWW interactive map of animal carcass and live sighting data is hyperlinked to additional detailed analyses (Sections 5.2 and 5.3). This provides a seamless connection from the mapping component to detailed record analyses.

5.2 Animal Carcass and Live Sighting Raw Data Summaries

The raw animal carcass and live sighting data are automatically summarized within the AWW website tool using tables and graphs. These summaries provide simple analyses of the raw data, including the number of records submitted and animal carcasses and live animals.

The raw animal carcass and live sighting data summaries provide an initial understanding of the species most recorded, seasonal and annual trends, and the magnitude and locations of AVC and wildlife movements. Data analyses may be tailored to specific parameters of interest, for instance a species at risk, specific location across the province, date range, or incident report (i.e., suspected property damage). Hyperlinks directly from the interactive map supports these analyses. Summary tables and graphs include:

1. Total number of records submitted;
2. Total number of animal carcasses and/or live sightings;
3. Total of each species and percent representation in the dataset;
4. Total number of records each month; and
5. Total number of records each year.
Raw data summaries are fundamental to the overall understanding of animal carcass and live sightings at various temporal and spatial scales. The AWW website tool then completes further data analyses to locate and prioritize areas needing mitigation to improve highway safety.

### 5.3 Animal-Vehicle Collision Prone Locations

Alberta Transportation’s ability to quickly access, analyze, and compare animal carcass data, at a provincial scale, is a critical component of AWW. The AWW animal carcass data, generated from the AWW application, is provided at a sufficient level of detail to identify and prioritize AVCPLs, and determine the magnitude of the issue across Alberta. The AWW website tool automatically performs the cluster and density analyses and maps the results in a simple and informative manner.

Before the analyses begins, the animal carcass data is assigned to a corresponding highway traffic control section. To do so, animal carcasses located (i.e., x,y coordinates) within 75 metres of the highway are forced into the corresponding road traffic control section using a “snap to line” tool. Traffic control sections represent areas along the highway with similar traffic volumes. It is important to have driving conditions (e.g. traffic volume) for each traffic control section as consistent as possible as driver speed and traffic volume all impact the frequency and severity of an AVC.

Once animal carcass data is assigned a traffic control section the AVCPL analysis is initiated. Two animal carcass analyses tools identify and prioritize AVCPLs: 1) animal carcass clusters (Section 5.3.1); and 2) animal carcass density (i.e., animal carcasses/kilometre/year; Section 5.3.2). Statistically significant animal carcass clusters and or highway zones with high animal carcass densities are identified as an AVCPL. This provides Alberta Transportation with a list of AVCPL that may warrant mitigation. This list is then ranked based on strength and stability (the number of animals included in the AVCPL) of each AVCPL, which allows AVC reduction considerations to be effectively integrated into Alberta Transportation’s project delivery process.

Analyses may be completed based on four chosen user selected species/species groups. Species/species groupings available for selection are:

1. Moose carcasses;
2. Deer carcasses;
3. Large-bodied animal carcasses; and
4. All reported species carcasses.

These species/species groupings are most applicable to the overall provincial road network. Moose and deer are most commonly reported in AVCs in Alberta. This allows Alberta Transportation to identify species-specific AVCLPs. Similarly, the large-bodied animal carcass filter identifies AVCLPs of highest risk to the travelling public. AVCPLs with all reported species carcasses represent areas that pose the greatest risk to driver safety and species conservation.
Alberta Transportation considered developing a species analysis filter specific to species at risk carcasses within the AWW System. However, at this time, an insufficient number of species at risk carcasses are reported (due to their low populations). As a result, cluster analysis is not the appropriate statistical tool for monitoring species at risk. The locations of all species at risk carcasses are important, and the AWW website tool addresses these by 1) including species at risk carcasses in the “all reported species” analyses, and 2) automatically identifying mapped clusters (regardless of statistical strength) that include a species at risk.

In addition to species/species groupings, a minimum of five years of data is typically required by Alberta Transportation before data analyses is completed. This specified time period will be re-evaluated using the AWW data and AVCPL analyses. For now, a minimum of one year of data along an individual highway is acceptable as a temporary option to begin investigating AVCPLs.

**Batch Processing**

The AWW website tool automates the analyses, to the extent possible. AVCPL analyses is completed each night as a batch process. Thus saving analyses computation time and providing AVCPL results on an as-needed basis. These standard methods to identify and prioritize AVCPLs is a key component of the AWW System. They provide an easy and reliable method across the province and allows comparisons among years (e.g., mitigation performance monitoring) and similar highways.

**5.3.1 Animal Carcass Clusters**

Kernel Density Estimate+ (KDE+) software\(^4\) (Bíl et al. 2013\(^5\), 2016\(^6\)) was selected to determine non-random clusters of animal carcass reports or AVCLPs across the province. It enables Alberta Transportation to easily and defensibly 1) identify and 2) prioritize statistically significant animal carcass clusters. KDE+ looks for significant clusters of animal carcasses within each traffic control section. Using a Monte Carlo method of repeated random simulations, KDE+ defines clusters above the 95 percentile level within each traffic control section as significant.

KDE+ takes into account a number of factors during the statistical analyses and prioritizing of AVCPLs. Significant clusters are ranked according to a cluster strength (which takes into account factors like the number of carcasses and length of the AVCPL cluster) to help prioritize areas for mitigation. The strongest and most stable clusters are those with a KDE+ strength ≥0.6 and ≥ 5 carcasses/cluster. These are clusters that are consistently observed over time and won’t change in their strength if one or two animals are added or have gone unreported. Weaker and or unstable clusters are those with a KDE+ strength <0.6 and ≤ 4 carcasses/cluster. Each of the strong and weak/unstable clusters are mapped along respective highway sections. These criteria for strong versus weak clusters will be re-examined and updated after the AWW Program has been running province wide for at least three years.

KDE+ requires two sets of points (i.e., animal carcass data) and line shapefiles (i.e. traffic control sections). Alberta Transportation uses traffic control sections as the line shapefiles because traffic volumes are assumed to be consistent within each section, and they are used for other traffic safety analyses in Alberta. The AWW website tool incorporates existing TDRA traffic control section information and shapefiles (refer to Section 3.3) each year. The traffic control sections are integrated into the AWW System manually, on a yearly basis, to ensure the analysis is being completed using the current network information.

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On a daily basis, the KDE+ analysis is applied to the entire provincial road network, analyzing only those sections in which new records have been submitted each day. The AWW website tool acts as a current day calculator and calculates the significant collision-prone locations using the current highway length and reported carcasses (i.e., carcasses within 75 metres of the highway are forced to a traffic control section using a “snap to line” tool; carcasses beyond 75 metres from the highway are excluded from the KDE+ analysis). No consideration of historical highway alignment changes are included.

Results from the AVCPL analyses are displayed as map layers on the AWW interactive map based on the filter chosen by the user (e.g., large-bodied animals). Users can manually select a cluster on the map to access the associated summary data and download the cluster shapefiles. Detailed results tables are also provided for review. These tables provide the highway and control section, KDE+ section number, cluster begin and end locations, number of animal carcasses in the cluster, number of species at risk carcasses in cluster, cluster strength, years of data, and if the cluster is located inside a wildlife linkage zone. This KDE+ report table is available in an excel comma separated format, and is customizable by the geo-boundary (i.e., Highway 63).

One strength of the KDE+ method is that it is accessible in GIS. As a result, the data is also available as a shapefile. Additional strengths of the KDE+ clustering method are:

1. Provides reliable cluster identification even when animal carcasses are under-reported (i.e., reporting rates may vary across the province depending on different levels of Principal Contributor effort);
2. Prioritizes cluster areas (e.g., highlights significant clusters, and ranks clusters according to their statistical strength);
3. Provides information about the number of carcasses/cluster and cluster length along the road;
4. Clusters are independent of scale, such that the location and length of clusters do not change (e.g., if the user is viewing a single highway or looking at the entire provincial highway network); and
5. Does not require equal section lengths (as other aggregating methods do; e.g. 100 metre segments) and, therefore is more stable when highway realignments occur.

Despite the many strengths of using the KDE+ methodology, three shortcomings of KDE+ have been identified:

1. KDE+ does not identify areas with a high number of carcass records that are distributed across a larger road zone (non-clustered). As a solution, the AWW System also calculates the animal carcass density (refer to Section 5.3.2).
2. KDE+ cannot be used on Traffic Control Sections that are less than 200 metres in length. As a temporary solution Regional Administrators manually inspect animal carcass records along these sections on an annual basis. AWW maps each of these short sections to ease manual inspections.
3. KDE+ does not recognize animal carcass clusters that may extend over the end of one traffic control section and the beginning of the adjacent section. AWW solves this by: highlighting clusters which occur within 75 metres of the end of a section for further inspection to ensure that an animal carcass cluster which overlaps the end of one traffic control section and the beginning of the adjacent section will not be overlooked. Regional Administrators are required to examine any highlighted clusters within 75 metres of the end of a road segment and report any cluster which may have been missed in the KDE+ analysis.
5.3.2 Animal Carcass Density

Animal carcass densities are a supporting tool for KDE+ analyses to allow comparisons with existing published AVC and AVC mitigation cost-benefit analyses. Many AVCPLs are spatially clustered but not all. Animal carcasses may be observed in a random pattern in homogenous landscapes with similar habitat types and terrain. These homogenous landscapes may not have clearly defined wildlife movement corridors and highway crossing locations. As a result, AVCPLs may extend across a larger road zone representing landscape features.

Animal carcass densities are calculated for highway control sections that are divided into 1 km segments and include the most recent five years of data. Prior to five years of data, the AWW website tool calculates a density with no minimum period of time to allow prompt analyses. Density represents the number of animal carcasses per traffic control section length per year (animal carcass/km/year).

The AWW website tool automatically calculates and reports animal carcass densities across the province. Reports are provided in a succinct table that prioritizes highway control sections. Reports detail the corresponding highway control section, section length, number of animal carcasses, density result, years of data, if species at risk were involved, and if a wildlife linkage zone is present.

The AWW interactive map displays highway control section densities across the province. With the addition of more provincial data, a provincial threshold will be evaluated, and will support comparisons with published AVC mitigation cost-benefit analyses. In the interim, Alberta Transportation considers highway sections with animal carcass densities ≥ 3 carcasses/km/yr. as an AVCPL.

The interactive map is hyperlinked to allow access to summary data specific for each high animal carcass density zone mapped.

Animal carcass density and KDE+ analyses are a complementary solution to identify and prioritize AVCPLs across the province. The AWW website tools data analyses approach meets Alberta Transportation's traffic safety mandate and provides an effective solution to prioritize capital planning and justify spending.

5.3.3 AVCPL Location Identification Report

Once AVCPLs are identified using the animal carcass cluster and density analyses, the results are detailed in an AVCPL Identification Report. Each AVCPL is given a priority rank based on the animal carcass cluster/density strength and evaluated for its technical and financial feasibility (refer to Section 5.3.3.1). Recommended mitigation type(s) for all AVCPL mitigation projects determined to be feasible are provided, along with a high-level cost estimate.

5.3.3.1 Wildlife Site Sensitivity Rating

The primary function of a Wildlife Site Sensitivity Rating (WSSR) is to determine if a mitigation project is feasible. The WSSR includes field verification by a Professional Biologist that identifies key site-specific considerations that may affect AVC mitigation options. Examples of site specific considerations include existing highway access, land use changes, adjacent land ownership, topography, water table levels, soil/geotechnical conditions, highway design, and existing highway infrastructure (i.e., bridge structures) that could serve to facilitate and or hinder mitigation. For consistency, the WSSR is prepared utilizing a standardized template for each AVCPL.
The WSSR will be completed for all priority AVCPLs and submitted with the AVCPL Identification Report (Section 5.3.3.) identifying Project Level Priorities7 and or Annual Regional Report for Ministry and GoA Level Priorities; (Appendix E) to Environmental Services. All AVCPLs where mitigation is determined to be feasible are identified in the Annual Provincial Report (Appendix E) and may advance to mitigation planning and design. AVCPLs where mitigation is determined not to be feasible are recorded in the Mitigation Data Repository (Appendix C).

Project Level Priorities will be required to complete the WSSR for any AVCPL within or adjacent to the project limits. This assessment is independent of the provincial priority. The reports generated by this work will form an appendix to the projects’ Environmental Evaluation.

5.4 AWW Dashboard

The AWW Dashboard is an administrative tool that displays the AWW System’s key performance indicators at a glance. Data and user management indicators of the AWW Program are provided in clear and concise graphics at the provincial and regional scales to provide an efficient Program checkup.

Regional Administrators are responsible for monitoring the AWW Dashboard regularly for system functionality and Principal Contributor performance.

The AWW Dashboard will provide summary information in four key areas:

1. Provincial Statistics Summary;
2. Regional Statistics Summary;
3. Engagement Monitoring; and
4. Mitigation Summary.

By its nature, the Dashboard is a view-only reporting tool; all information displayed is calculated automatically by the AWW website. All AWW Program users may view but not edit or remove data from the dashboard.

5.5 Export Database

Further data analyses may be completed outside the AWW website by exporting the AWW database. All animal carcass and live sighting records are accessible for export to registered users (i.e., System and Regional administrators, and Project Users), including photos if submitted. The database includes all record details collected using the AWW application, as well as quality control remarks and notes, and the GPS locations of the record and photos.

To support further analysis of the data, the AWW website tool auto-fills several additional database parameters based on the record location. This includes the highway name (if known), control section, Region, District, Municipality, Contract Maintenance Area, and if located inside a known wildlife linkage zone. Similarly, the database auto-fills columns for large-bodied animal and species at risk based on species recorded in Tables 2 and 3.

7 The Region assesses if Project Level mitigation priorities can be funded. If funds are not available, the proposed mitigation project(s) is submitted for funding consideration at a Ministry Level through the Annual Regional Report.
The database may be exported with or without the photos. Similarly, portions of the database may be exported based on pre-selected parameters (e.g., woodland caribou). The database is provided in an excel comma separated format for easy manipulation and analysis. This allows Alberta Transportation to easily share data with stakeholders.

6.0 PREVIEW: MITIGATION DATA REPOSITORY

Collecting, storing, managing, and analyzing high-quality data are the preliminary steps (Appendices A and B) to reduce AVCs on provincial highways, improve driver safety, and reduce the impacts of highways on wildlife populations. Subsequent steps are outlined in the following Appendices documents (Appendices C-F).

Once stored on the AWW website, animal carcass and live sighting data is accessible to Alberta Transportation and other select users. With this near real-time availability to the data, the AWW website tool supports the ability to quality control the data, register and manage users (i.e., Principal Contributors), and complete data analysis in a timely manner to suitably locate and prioritize provincial AVCPLs for mitigation.

With this knowledge, Alberta Transportation is able to confidently choose the best mitigation for each site and review the relative performance of existing AVC mitigations. The AWW Mitigation Data Repository provides an organized and secure system to store, update, and analyze AVC-specific mitigations across the province. This is outlined in Appendix C (Mitigation Data Repository).