

CANADIAN CONSULTING ENGINEERING AWARDS 2019

LIVESTOCK AND FORAGE CENTRE OF EXCELLENCE

LOCATION: RURAL MUNICIPALITY OF BLUCHER
CLIENT/OWNER: UNIVERSITY OF SASKATCHEWAN
CONSULTANT: ASSOCIATED ENGINEERING
SUBCONSULTANTS: P. MACHIBRODA ENGINEERING LTD.
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ORCHESTRATING A WORLD-CLASS, COLLABORATIVE RESEARCH FACILITY

The University of Saskatchewan's Livestock and Forage Centre of Excellence is one of the world's most advanced livestock research facilities. It amalgamates multiple existing facilities into one location and collaboratively hosts researchers from three University of Saskatchewan colleges along with the Western Beef Development Centre.



"THE LIVESTOCK AND FORAGE CENTRE OF EXCELLENCE WILL BE A GLOBAL LEADER IN INNOVATION, PROMOTING INCREASED PROFITABILITY AND SUSTAINABILITY FOR THE LIVESTOCK AND FORAGE INDUSTRY."

- UNIVERSITY OF SASKATCHEWAN



EXECUTIVE SUMMARY

Internationally renowned for agricultural research, the University of Saskatchewan had a vision to establish a livestock research facility that combines both science and field laboratories and represents the full spectrum of raising livestock in western Canada.

Funded by over \$30 million from industry stakeholders, the University, and the federal and provincial governments, the new **Livestock and Forage Centre of Excellence** amalgamates three separate off-campus research facilities into one location with researchers from the Western College of Veterinary Medicine, College of Agriculture, College of Engineering, and the Western Beef Development Centre. The synergies derived from researchers being in close proximity will allow the academic community to be more responsive as they work together with industry partners.

This new integrated model creates greater opportunities for large-scale research through greater access to project funding and allows for more cost-efficient resource allocation to be used by agricultural researchers, university faculty and students, and local industry and producers.

THE LIVESTOCK AND FORAGE CENTRE OF EXCELLENCE BRINGS TOGETHER EVERY LINK OF THE LIVESTOCK CHAIN FOR AN INTEGRATED APPROACH TO SOLVING IMPORTANT AGRICULTURE INDUSTRY ISSUES

As project managers and engineers for design and construction of the facility, the Associated Engineering team adeptly addressed the requirements of a diverse group of government, industry and academic stakeholders to deliver this technically advanced facility.

The design supports all aspects of cattle's life-cycle, including silage production, feed delivery, storage and handling; cattle housing, handling and health; water supply, manure management, runoff collection and containment, equipment storage, utility servicing, teaching, research, and industry outreach.

A comprehensive environmental monitoring system enables researchers to study the life-cycle impacts of intensive livestock operations on the land, surface water and groundwater, which will inform future regulations. One of the world's most advanced livestock research facilities, the Livestock and Forage Centre of Excellence will improve understanding of how we can produce food more economically and effectively.

This year, the first cattle arrived at the Centre to mark a new era in the University's collaborative research. By offering a collaborative space for researchers, the Livestock and Forage Centre of Excellence will expand the global knowledge of sustainable supply of meat products, further enhancing Saskatchewan's and Canada's reputations as world leaders in agricultural research.



Intensive housing area with capacity for 20 animals



PROJECT BACKGROUND

The University of Saskatchewan wished to amalgamate the independent research in raising cattle undertaken by various faculties and organizations. Associated Engineering worked with the University and stakeholders to design the Livestock and Forage Centre of Excellence, the largest and most comprehensive facilities of its kind in Canada.



Pen alleys, gating, and lighting designed for optimal handling conditions and safety

This innovative facility sets new standards for environmental management, expanding the knowledge of sustainable meat products supply and advances Canada's reputation as a leader in livestock and forage research.

"THIS UNIQUE CENTRE WILL RESEARCH AND MODEL ALL ASPECTS OF RAISING LIVESTOCK ON THE PRAIRIES, HELPING TO MEET THE NEEDS OF PRODUCERS AND CONSUMERS IN CANADA, WHILE ALSO HELPING TO SUSTAINABLY PRODUCE FOOD FOR A GROWING WORLD POPULATION."

UNIVERSITY OF SASKATCHEWAN

COMPLEXITIES AND CHALLENGES

Internationally renowned for agricultural research, the University of Saskatchewan established a vision for a new Livestock and

Forage Centre of Excellence. Funded by over \$30 million from the University, industry, and the provincial and federal governments, the Centre amalgamates three separate off-campus research facilities into one location, creating one of the world's most advanced livestock and forage research facilities. The facility promotes collaboration between scientists, students, researchers and producers, and enhances Canada's reputation in beef research.

As project managers and engineers for design and construction of the facility, Associated Engineering addressed the requirements of a diverse group of government, industry and academic stakeholders. The design supports all aspects of cattle's life-cycle, including silage production, feed delivery, storage and handling; cattle housing, handling and health; water supply, manure management, runoff collection and containment, equipment storage, utility servicing, teaching, research, and industry outreach. A comprehensive environmental monitoring system enables researchers to study the life-cycle impacts of intensive livestock operations on the land, surface water and groundwater, which will inform future regulations.

Associated kept the project on track, working with the subconsultants and the major contractor, along with the University's project teams. The scope of project management challenges led to the creation of three project oversight committees to optimize communication between stakeholders and ensure "everyone had



Site inspection of laboratory area



a voice” during the planning and construction phases of the project:

- The Provincial Steering Committee provided the overall vision for the project and provided the connection between the University as facility owner/operator and the industry groups to which the research would benefit. Their involvement assured that the new research facilities would serve the broader industry and helped garner support financially and otherwise.



Working Committee site inspection of the feedlot

- The University Project Steering Committee represents the project owner and had the overall responsibility for ultimately delivering the project within the approved budget and to the requirements of the participating colleges. They provided the project governance and, through the project directors they appointed, provided the last-stop decision making that was occasionally required during the delivery of the project.
- The Working Committee provided the ongoing design and construction direction to the Associated team, incorporating the individual goals of the researchers and facility operators from each of the colleges and project delivery staff. This group was the most invested, as they were, or they represented, the people who would ultimately be the people creating the research opportunities from the new amalgamated facilities.

Our team’s responsibilities encompassed all major engineering disciplines: civil, agricultural, structural, mechanical, and electrical engineering; construction management; and project management. We addressed rigorous research facility requirements, developed reliable

budgets, sourced materials, devised acceptable alternatives, and worked with the many trades, professions and regulators.

Another challenge was that throughout the project’s development, its requirements were a “moving target”. Concept development began in 2013 and required the design team to gather information on industry standards, provincial regulations, observations from tours of similar facilities, along with, and most importantly, the extraction of the individual visions from each of the University’s researchers, to create a combined feedlot concept.

In 2015, the project was approved for senior government funding with the decision to integrate the Cow-calf Research and Teaching Facility. The project proceeded with a very tight timeline for completion of detailed drawings, which had to be modified significantly multiple times due to budget realities. During the design phase, Associated Engineering facilitated approximately 50 working committee and related workshops to gain consensus from all stakeholders.

Training was another multi-dimensional challenge as it had to be provided for not only the operational staff, but also for the researchers from multiple stakeholders using the facility.

MEETING CLIENT’S NEEDS



Intensive Housing exercise pens

The University’s main objective was to create a Livestock and Forage Centre of Excellence that combines the operation of three existing off-campus facilities into one location, incorporating the Beef Cattle Research and Teaching Unit with a newly constructed Forage and Cow-Calf Research and Teaching Unit. The new consolidated



approach is expected to facilitate the smoother transfer of research findings and leading-edge technology to livestock and forage producers, veterinarians, economists, environmental engineers, and consumers.

The Centre's shared vision is to create "a collaborative initiative, integrating livestock and forage research and development of resources for efficient and effective facilitation of internationally recognized education, research and extension".

The new Centre will build reputations as well as facilities. Thus, there was intense stakeholder scrutiny to successfully deliver this project.

Working collaboratively, the project team designed a one-of-a-kind research facility located on 15 quarter-sections of land, including:

- two research buildings
- a 1600-head-capacity feedlot
- a 350-unit cow-calf facility
- dedicated forage crop research plots
- over 1200 acres of paddocks for forage grazing studies.

The facility has a remarkable level of sophistication,

including:

- the exact soil mixture used in the feedlot pens for long-term performance and impact on the animals
- computer-monitored watering and feeding stations
- consideration of cattle behaviour into facility design
- comprehensive environmental monitoring systems
- hundreds of other modifications to accommodate the recommendations of researchers from the four different institutions and the adjustments to industry-donated equipment not specified in the original plans.

The first cattled arrived this year to mark a new era in the University's collaborative research. The facility will expand the global knowledge of sustainable supply of meat products, further enhancing the province's reputation as a world leader in agricultural research.

Students and faculty from the Western College of Veterinary Medicine, the College of Agriculture and Bioresources, and the College of Engineering will conduct research at the Centre. As well, students will have hands-on learning opportunities in the field with the cattle, and also in the Centre's laboratories.



Layout of cow-calf facilities and feedlot sections



ENVIRONMENTAL BENEFITS



Numerous feed supplements can be added to the primary feeds to allow trials of different mixes to multiple trial groups

A comprehensive environmental monitoring system enables researchers to study the life-cycle impacts of intensive livestock operations on the land, surface water and groundwater, which will establish best practices and inform future regulations.

For the first time, environmental baseline testing was completed prior to construction and commissioning of operations. The sophisticated environmental monitoring system provides the unique opportunity to quantify the impacts of an intensive livestock facility on the land and water environment over time. With the Province's significant collaboration, the Ministry of Agriculture has been using results of the environmental monitoring program from facility since it opened in 2018 to inform the evolution of the Province's future regulations for environmental protection.

The design of the new facilities incorporates the ability to monitor groundwater, soils and air quality. Manure produced from cattle operations is spread on nearby fields using a precision spreader, allowing researchers to study impacts on soil and crop production. Runoff from the cattle pens is collected and stored in approved and lined ponds. The feedlot pens are fully outfitted with instrumentation allowing a wide range of measurements ranging from groundwater elevation to airborne methane levels using laser technology.

A unique feature of the Beef Cattle and Teaching Unit (feedlot) facility is that it is immediately adjacent and up-gradient from wetland operated by Ducks Unlimited. A partnership with the nonprofit organization will allow creation of monitoring stations throughout the wetland so researchers and students can study runoff water quality and impacts to adjacent waters and farmland.

Research projects at the new facility are already underway since the grand opening in fall 2018. This year, the University shared news of a project that will look at the impact of various levels of sulphates in livestock water on the health and welfare of cattle. The project will examine specifically water sulfate concentrations (0 to 3000 parts per million) in water destined for consumption by livestock. This is an important study, as according to the Saskatchewan Ministry of Agriculture, to date, while there has been anecdotal evidence regarding the impact of water

quality on livestock well being, there has not been an empirical study covering this topic.

INNOVATION



Cattle have arrived for research projects

The Livestock and Forage Centre of Excellence is a showcase of technological advancement and innovation, both in its design to accommodate large, live animals throughout their entire lifecycle, and in its ability to satisfy the requirements of a wide range of researchers interested not only in the animals, but also veterinary procedures, laboratory work, forage breeding and production, manure management and precision land application, and overall environmental impact.



Every aspect of the facility – including the base materials specified for the paddocks, and roadways for farm machinery and heavy transport – had to be vigorously examined and approved by highly qualified industry professionals including geotechnical engineers, animal care specialists, civil engineers, the earthworks contractor, and feedlot operators.

For the feedlot pen floors, the project team had to create an appropriate structure as the site soils were not suitable for building the feedlot. Clay was imported, tested, and approved through geotechnical soil tests to meet parameters developed specially for this project by Associated

Engineering and the University of Saskatchewan. The pens and roads were constructed on an engineered structure consisting of layers of geotextile and the imported or locally sourced soils, the roads were then topped with a gravel and recycled asphalt layer to provide all-weather stability.



Innovative use of vendor technologies included the Grow Safe Beef feed monitoring system

“THIS CENTRE OF EXCELLENCE WILL ALLOW FOR IMPORTANT RESEARCH TO BE DONE, GIVING OUR PRODUCERS ACCESS TO THE LATEST INFORMATION, TECHNOLOGIES AND TOOLS THEY NEED TO HELP ENSURE THE PROFITABILITY AND SUSTAINABILITY OF THE LIVESTOCK AND FORAGES INDUSTRIES IN SASKATCHEWAN AND ACROSS CANADA.”

AGRICULTURE AND AGRI-FOOD CANADA



The Data Ranger automated feed mixer and dispenser system helps researchers monitor food intakes for the intensive feeding trials

The facility presented significant technical engineering challenges. The list of components that had to be designed, serviced, procured or otherwise delivered by the project was varied and lengthy. All aspects of the cattle’s life cycle had to be accommodated within the facilities including: silage production, feed delivery, storage and handling, cattle housing and handling, water supply, manure management, runoff collection and containment, equipment storage, utility servicing, teaching, research and industry outreach. Each of these aspects involves a unique engineering approach.

Due to the different types of testing that occurs, the labs had to be outfitted with air, nitrogen, purified water, and appropriate ventilation. The forage that is grown there or fed to the cattle has to be tested, requiring special grinders that otherwise would be housed on campus. There are four types of feed systems that each serve separate areas (pen feed, pen supplements, barn feed, and supplements and feedlot silage) and can’t be combined or serviced by the same sources.

All of the systems need to store enough feed for an entire trial duration (up to several months) and also deliver precisely for research purposes. Some of the components were pre-selected by the University, others were selected by the contractor based on performance specifications, and some were donated pieces of equipment that had to be installed by the contractor.



Beef Cattle Research and Teaching Unit facilities

As the combined facility handles cattle from breeding through to sale for slaughter, the facilities had to be capable of accommodating all stages (typically a farm or feedlot only deals with certain ages and stages). The facility also houses horses and herding dogs that are used for moving cattle.

According to agricultural researchers, the new Livestock and Forage Centre of Excellence is unmatched by any other facility in the world. In the words of the University of Saskatchewan:

“Building on Saskatchewan’s rich history of research, teaching, extension and industry partnerships, the new Livestock and Forage Centre of Excellence will attract world leaders in beef and forage research.”

The Livestock and Forage Centre of Excellence is the first of its kind in agricultural research, encompassing large livestock breeding and care, environmental management, research, and training.

SOCIAL AND ECONOMIC SUSTAINABILITY

Social sustainability is addressed through the facility’s ultimate goal of improving global understanding of how we can produce more food, more economically, effectively, and, in particular, provide better conditions and more humane treatment of the animals.

The growing global population, especially the increasing middle class in emerging developing countries, will increase the demand for meat products in the future. The Livestock and Forage Centre of Excellence offers a collaborative space for researchers that will help expand the global knowledge of sustainable meat product supply for our growing world. This facility will improve understanding

of how we can produce food more economically and effectively.

The economic impact of the Livestock and Forage Centre of Excellence is far-reaching. The facility will further enhance the University of Saskatchewan’s reputation in the field of agriculture. A model of innovation and sustainable livestock management, the Centre will attract top agricultural researchers, teachers, undergraduate and graduate students, and livestock industry leaders to the University for ongoing development. Already, agricultural equipment manufacturers have benefitted from the ability to trial and showcase their innovations to a global audience. Beef cattle producers will benefit from new knowledge and methods to increase production, while reducing input costs.

The Livestock and Forage Centre of Excellence supports growth of our agricultural industry, bringing economic benefits to Saskatchewan and Canada.

“WE NEED THIS CENTRE TO RESEARCH PROBLEMS OF TODAY AND EMERGING ONES OF TOMORROW. THE LIVESTOCK AND FORAGE CENTRE OF EXCELLENCE BRINGS TOGETHER WORLD-CLASS FACILITIES AND FACULTY TO TACKLE THESE CHALLENGES AND DELIVER REAL RESULTS THAT PRODUCERS CAN USE ON THEIR FARMS, RANCHES, AND FEEDLOTS.”

SASKATCHEWAN CATTLEMEN’S ASSOCIATION



CONCLUSION

The development of the Livestock and Forage Centre of Excellence was an intensive, multi-year undertaking by the University of Saskatchewan, the provincial government, as well as the livestock and forage industries in Saskatchewan.

Their historic partnership, commitment, and dedication to deliver on their vision of creating a centre of excellence will enhance Saskatchewan's rich pedigree in agricultural research, teaching, and applied production.



Visitors receiving a tour at the grand opening event

By combining multiple research facilities into one, the Livestock and Forage Centre of Excellence enables researchers a unique opportunity to methodically examine the impact of intensive livestock operations on a "green field" site over several years. This research will help university staff to determine best practices to optimize feedlots and understand the methodologies that can reduce environmental impact on the soil and related water resources.

The new facility will be at the cutting-edge of today's research investigations and allow the industry to be on top of emerging trends and future innovations that benefit Canadian livestock producers, the agriculture industry, and consumers at large.

The Centre will offer interactive outreach programs in the form of field days, demonstrations, industry presentations and seminars. These programs will help to introduce new techniques and technologies to producers and industries that are critical to the advancement, sustainability, and profitability of the livestock and forage industries, and aid in addressing issues important to consumers.

The Livestock and Forage Centre of Excellence will also serve as a vital medium between the agricultural industry and consumers by serving as a public awareness and communications forum, and sharing knowledge between industry and citizens amid a growing demand to increase transparency in livestock production related to animal welfare, animal health, product quality, and food safety.

Already, interest in the new research centre is high and visiting trade delegations, national and international visitors, and school groups, are expected to tour the facilities in the near future.

The successful delivery of this complex project will enable the Livestock and Forage Centre of Excellence to fulfill their vision of becoming a global leader in innovation, promoting increased profitability and sustainability for the livestock and forage industries. The agricultural industry will in turn benefit from the in-depth testing of applications in a real-world environment by researchers, which will translate to an informed decision-making model to determine the most cost-effective approach to managing live herds.

"THERE'S NO DOUBT THAT SASKATCHEWAN IS SEEN AS A LEADER RIGHT NOW WHEN IT COMES TO THE LIVESTOCK AND FORAGE INDUSTRY. BUT WE HAVE AN INCREDIBLE OPPORTUNITY THROUGH THE LIVESTOCK AND FORAGE CENTRE OF EXCELLENCE TO EXPAND THAT EVEN FURTHER - IN WESTERN CANADA, NATIONALLY, AND INTERNATIONALLY."

SASKATCHEWAN FORAGE NETWORK

Associated Engineering is proud of our leadership role in the delivery of this world-class facility. The Livestock and Forage Centre of Excellence will lead to innovative research, hands-on learning and teaching, and industry engagement in all aspects of livestock and forage production on the Prairies, advancing Saskatchewan and Canada's reputation as leaders in sustainable agricultural research and production.



The Livestock and Forage Centre of Excellence project involved the construction of:

- 1,600 animal feedlot including, feed processing, feed storage, and manure handling
- 2,200 square metre research building combining teaching, research, and operations space for intensive livestock study
- 500 animal capacity cow-calf facility for breeding and maternity study
- 1,100 square metre research lab for veterinary studies, breeding studies, and industry outreach
- Over 1,500 acres of replicated paddocks for forage grazing studies
- An extensive environmental monitoring system that will allow for the study of the impact of intensive livestock and manure management on adjacent land, surface water, and ground water
- 15 quarter sections of contiguous University-owned land plus additional contracted or rented lands for feed.

