

## **Efficacy of robotic falcons as a bird strike reduction tool at major international airports**

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**Abstract.** Bird strikes are a significant threat to international flight safety and have on occasion been a cause of major aviation accidents with human casualties. According to Federal Aviation Administration, there are over 13,000 bird strikes annually in the United States, with a vast majority of bird strikes occurring during the period of take off and landing of aircraft. Through the projects conducted in complex airspace environments in Grand Forks, ND and Edmonton, AB we have observed an effect of the use of robotic falcons on reduction of bird populations at airports and near airports. A Robird® robotic falcon was used in conjunction with other wildlife management tools, and the data gathered was compared to the previous years to observe efficacy. Throughout the course of our projects, the data shows correlation between reduction of bird strikes at airports and use of robotic falconry, with an observed mean of 82.5% decrease in bird strikes compared to historical data.

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We focus predominantly in and around drones at airports (Slide 2). So while there is a risk and a worry, we're actually taking the lead on how you can integrate and operate them safely and effectively not just in Wildlife Management but in other areas as well. Today we are going to focus on one of our specific air frames which is the Rover, which is a robotic falcon or ornithopter. Then we are going to talk about the last 2 years that we have been working at two major international airports up in Edmonton and Grand Forks. And we have really started to go a little bit into the study on the data. The question that has been over the years, "it looks pretty cool, it looks neat, but is it actually working". So we started to take that deep dive because we are starting to get enough information to show some correlation in and around that.

A little bit about us (Slide 3). We are a fully integrated comprehensive bird hazard drone service-provider. We operate in oil and gas, we operate in forestry, and our main focus is in and around airports. Like I was mentioning before, we are not only flying from a wildlife perspective, but we are also doing other things such as leasor limitations surface scans with Lidar, we are doing

runway analysis and we have really been able to showcase that if done properly and safely, you are able to integrate drones into airport operations on a daily basis with coordination from air traffic control doing the appropriate safety cases and risk assessments. Right now we have done over 1200 flights on airport properties. We are not talking within the control zone, but specifically on airport property. We are showing that this is effective and that you can do it properly.

Before we get any further, I will talk a little bit about the airframe that we will be talking about today (Slide 4). I have a video. For those that have not seen this before, this is the Rover. It is a robotic falcon ornithopter. It has no propellers so it is a flapping-wing technology that is actually designed to have bio-mimicry and is there to look like a peregrine falcon. It is actually designed to look just like a female Peregrine Falcon. It hunts with flapping its wings and that silhouette (inaudible) frequency are what we are able to utilize more effectively at chasing birds away especially once they get in the air. The biggest thing we can do is control birds in a herding method to push them away from those danger zones once

they get up and are spooked away. In addition to this our partners formerly known as Clear Flight Solutions or the Rover Company are actually the original manufacturers of this drone. It started about 14 years ago and it has taken that long to get this operational. We are their North American partners so we have the licencing of the technology for North America we are showing what it is able to do here.

For this study of the data in what we actually looked at we focused in and around the impacts of (inaudible) bird strikes reported. Now as we have been hearing and we will hear continuously on this theme, the level of quality of those data being reported is different between countries. There is a lot of uncertainty in and around what and how you should be reporting it so we focused strictly on strikes. For this one we just looked at bird strikes and if we had an impact on the overall number in any way, shape, or form. We also looked at damaging bird species versus non-damaging bird species (Slide 5). We are really talking about biomass in that case. We did this during our daily rounds so one of the important parts, this is not a scientific study (Slide 6). We did this as part of day-to-day operations. We are commercialized at Edmonton International Airport and down in Grand Forks. We are doing this daily. We are integrating with the wildlife management teams. We have become another tool in the toolbox that is there to help prevent strikes from occurring generally speaking. So every day when we are doing this we are working in and around those risk assessments and safety cases. We are working with a one- or two-person crew that is driving around often hazing the areas that we know the birds are going to be attracted to. We are working at ponds. We are working at water treatment lagoons. We are working airside. We are working in areas where anyone who does this on a daily basis understands that you

can have loafing, they are going to be looking for feed and they are going to be looking for areas to rest. The more you can make it uncomfortable for them the better. Once we engage with the bird flock we are really looking at how to push them out. Where to position ourselves between the runways - danger zones and safe zones - to ensure that we are getting them out of the appropriate area and of course we are always doing our observation tracking as well, which is essentially where were we, what species were observed, how many, how effective was the product at the time.

Of course with all data, when you are looking at it, there are some limitations to it. As I said earlier, this was not a scientific study. This was operational. This was getting there and getting birds away to try to make it safer. With the observational data and reported data that was gathered during operations, one thing we noticed and of course every airport is slightly different in the way in which they are tracking it so in the future one of the things we are going to be doing is standardizing that across all airports so not only would we look at the strike data, we are also looking at the number of birds observed and we are looking at where they are being observed. That can be drastically impacted if you don't have radar by just the number of people in the sky, number of eyes looking up. Are you having double counts, are you having birds being missed because they're in a different areas around the airport? There is some imprecision in that and then of course in the bird strike data that we talked about as well.

A little bit about Edmonton International Airport (Slide 7). They are the first airport in North America and probably in the world that actually decided to integrate drones on a daily basis in the day-to-day operations. They are one of our partners. Their reason for this wasn't that they had a lot of strikes. The reason for it was that they are looking at

enhancing the tactics and techniques, embracing new technology that are being utilized, finding ways to make it more efficient and more effective. They were willing to take that risk to see what the chances are that this is working to improve and how they can continue to enhance it along the way. We have been working there since 2017. We are in our 3<sup>rd</sup> year of operations but those data were not included because we do not have it all gathered and collected yet. We work in an area of Edmonton of about 5,000 acres so the total area of property is 7,000 acres. The area we are limited to not flying in is of course directly over the runways and in the approach paths. We are targeting all other areas. We are working with wildlife biologists. I know Jul Wojnowski is here. If you guys have any questions you can always ask him too. He is working with our teams on a daily basis as well. I did mention earlier that the focus was on all roosting, loafing, feeding areas in and around the airport. We are active up to a 150 feet from the centerline of the airport. We are flying up to 150 feet of aircraft during any time of the day. Like I was saying earlier, we are there as wildlife management support so we are integrated in with the teams. We are still using some traditional methods such as pyrotechnics or acoustic hailing devices to help enhance the product and what we were exactly doing with it. And at the end of the day it is the right tool for the job at the right time. This is really looking at - is this new tool that is being presented on the market actually having an effect?

I would like to switch over to the second study that we looked at which is Grand Forks International Airport and, more importantly, the city's wastewater treatment facility (Slide 8). They have an interesting situation where they decided to put the airport right beside the lagoons. You have 1300 acres of water within a half a nautical

mile of the centreline of their main airport runway. In addition to that there is a feedlot to the north that the farmer decided that french fries were a great thing to start to feed to his cattle. So now you have perfect feed, you have a great place for them to rest in probably one of the most dangerous areas that you can find. One of the interesting things about the Grand Forks International Airport is that while they only have about 100,000 to 150,000 passengers per year, they are the training school for the University of North Dakota's aerospace program. They do anywhere from 300,000 to 350,000 operations per year. A lot of those are right-hand turns and touchdowns, but being a training school there are days when they're in the top 10 busiest airports in the U.S. which as everyone knows is not an easy feat. You couple that with when we started this project there was a resident gull population about 10,000 gulls. When we first got out there some of those ponds were white and we thought they were trying some sort of a tactic with styrofoam balls to keep them from landing. No, that was the gulls, predominantly ring-bills and Franklins and a few Californias. They were resting and loafing there. Before we got started the USDA has also been involved. They started this project last spring and have done an incredible job of keeping the birds away. So we built up a relationship with them to enhance what they were doing on a day-to-day basis finding how to be more effective. A lot of these lagoons are half a mile wide. When you are looking at that, pyrotechnics and standard tactics stop working which is again where Rover came in because of the distances it was able to travel.

When we start to look at the data itself, again it is a snapshot into what we have seen as a positive correlation and the impact of Rover presence (Slide 9). There was also a positive correlation that we saw between Rover and a decrease in the birds at an

airport, but we actually discounted that information due to just having two impacting factors that we talked about earlier: number of eyes in the sky, how many repeat counts were there? At the end of the day we are all worried about strikes, we are trying to reduce strikes so when we did this analysis we kept to just looking at the strike data itself. When you are looking at the international airport and this is a bit of a snapshot and just where we are, we will be publishing this as an internal paper so by the end of August you should all have access to the actual data itself. We will look further into what we did and why we did it. From the data findings to date what we have been able to see is that, and this is specific to ducks and gulls which at Edmonton is one of the worst species that they have strikes with. As you can see you started to get a decrease 2015 being the worst year especially in July but we noticed that in our observation periods especially in that month when they had a lot of increase, we started having a decrease in that time frame and the trending has been that decrease over the past 3 years (Slide 10). It will be interesting to see how that decrease works this year because it was a very wet season. There are a lot of worms out so there has been increased gull species activity so we are going to continue to monitor (inaudible) to see how weather factors affect the results.

One of the questions the airport itself actually wanted us to find out was of those strikes that we have which their average is in the 30 to 35 mark, how many were during the time that you were operating versus other times of the day (Slide 11). When we go further into that data where we found that the majority or 34 of the strikes reported were actually done after operational hours which as a lot of us know if you don't have that constant presence it is going to be more, but there was a randomization that occurred in the (inaudible) this year. We had a crow

struck at midnight right off the runway which for Edmonton is incredibly bizarre and never really happened before. You started seeing a lot of changes in when the strikes were occurring based on historical averages.

We flip over to the Grand Forks data and as we did on this analysis, as I mentioned their problem really started back in 2016, turns out that was related to draining of a gulch that was nearby that they thought would help decrease the gull activity at the airport. Unfortunately it had the adverse opposite effect and brought them closer. In 2016 they had a massive increase in the number of strikes. What you see in Slide 12 is by year, by damaging bird species as we defined, by non-damaging species and then by unknown. In 2016 the FAA actually got involved and basically went to the city and the airport said okay you have to do something you have to try something new. It is time to get this problem under control before, heaven forbid, something worse than a smashed windshield or a dent on the edge of a wing happens which is again when we came in. What we looked at was during the operational year itself and between us and, of course, the USDA did as well, we noticed that there was a substantial drop in the amount of strikes that occurred not only by damaging species, but total overall (Slide 13). The one thing that was interesting which we are going to delve further into is - why was there an increase in non-damaging bird species? So a lot of sparrows, a lot of meadowlarks. Smaller birds were getting hit more often and that's something that today we haven't been able to answer as to why. So that came up, but it is important to realize that overall total strikes went down for the time frame. We took a further dive into this and there are the year of date numbers, and there is also what happens during the timeframe we are operating. You can see from 2016 to 2018 there was an average

decrease but there was a substantial decrease during the time we actually operated. We went from 12 strikes in 2017 down to only four strikes in 2018 which was a 75% decrease in the number of strikes during the timeframe in which we operated. We talk to air traffic control a lot even the airport started to notice less presence on the runways and the taxiways because there just wasn't the birds on the water. They were not moving over to the airport where the higher risk was happening. By keeping the larger species away it started to push them away further and further is what we anecdotally believe was starting to happen.

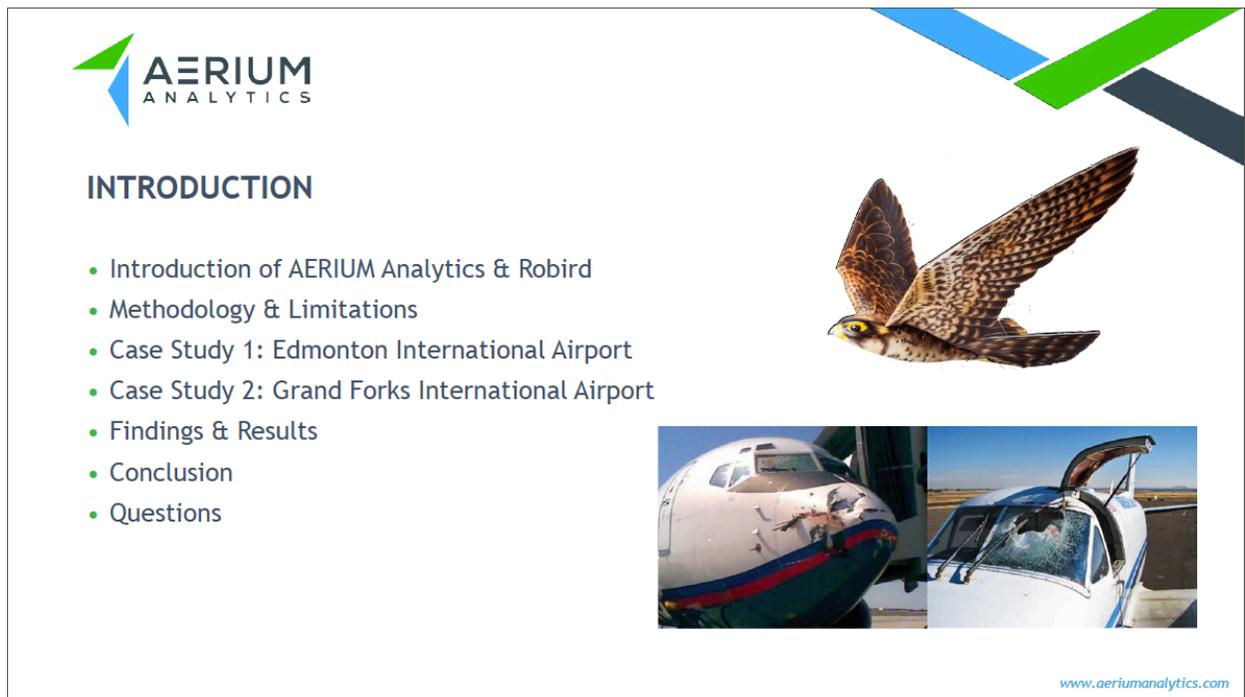
In conclusion from what we have seen so far to date there is a correlation that we are seeing between the activities and the decrease in bird strikes at the airports that we have been operating at (Slide 14). More importantly is a stronger correlation between the activities and the damaging bird species themselves and that would make sense because that is where we are targeting. We are focussing on gulls, Canada Geese, crows, pigeons, birds that tend to be of higher risk and are in that normal flocking attitude which peregrine falcons tend to go out after the flocking species as well since we are working on bio-mimicry, the higher hazard that was what we were aiming at. We have also observed the sensitization - opposite of habituation. You are noticing that the birds are becoming more jittery. They are becoming a lot more agitated a lot sooner. Some of that has to do with the Pavlovian Effect. If you have a certain truck with a certain (inaudible) in the engine, looks a certain way, they are stating to associate that vehicle with the robotic falcons which will be coming next. In future years we are going to be mixing up what vehicles we are using, the appearance of them, seeing if that has a positive effect because at the end of the day we want to ensure that we are triggering the fight or

flight response as quick as possible and the best way to do that is with a falcon itself rather than with a secondary tool that is being associated with it.

What is next? As any good study would do it brings up more questions than it does answers. We are noticing that positive effect. We are noticing with the airports we are working at that it is working in the right direction. But now the challenge becomes with the specific species - has there been an effect in and around that. We are actively working on actual white papers, more scientific studies with specific species one of them which was mentioned this morning is we are doing a (inaudible) in a study right now in Ohio with Turkey Vultures and the effectiveness of ornithopters, quadcopters and fixed-wing drones on the Turkey Vultures themselves. We are about halfway through that study so we don't have the results yet, but those should be published in the fall. I know a lot of people were interested to know if a smaller falcon can actually deal with a larger bird that a lot of airports seem to have some heartburn with. We are still continuing our Edmonton project. We are in year three, and are in talks for year four. As someone who is in the business world, the best results are if you're getting repeat business from that same client they are very happy with it and we are showing an effective result. And then with Grand Forks our three periods study is going to be coming to an end after this fall session that we are going back for. We are in discussions for making this a year-long project. Any questions?



Slide 1



Slide 2



### ABOUT AERIUM ANALYTICS

- Head office in Calgary, Canada
- Fully integrated, comprehensive RPAS service provider
- Leader in RPAS wildlife management solutions
- Founded in 2014, conducting operations since 2017



[www.aeriumanalytics.com](http://www.aeriumanalytics.com)

### Slide 3



### ABOUT ROBIRD

- Based in Enschede, Netherlands
- Formerly known as Clear Flight Solutions
- Founded in 2012
- Developed RoBird ornithopter drone in 2015

**ROBIRD**

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### Slide 4



## METHODOLOGY

**Definition:** *Damaging bird species, for this report, have been determined to be any species that has a body mass that is similar or greater than that of a Gull. Less-damaging bird species have been determined to be those species with a body mass less than that of a gull.*

- Focus around impacts of Robird on Bird Strike data reported
- Daily rounds around the vicinity of the airport
- Safety concerns & risk level assessment performed
- Set-up & safety procedures completed
- Bird / Flock is engaged, herded, chased
- Details recorded



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### Slide 5



## LIMITATIONS OF DATA

- Not a scientific study
- Observational and reported data gathered during operations
- Secondary data
- Imprecision in bird strike reporting



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### Slide 6



### **CASE STUDY: EDMONTON INTERNATIONAL AIRPORT**

- Data collected over 2-year period 2017-2018
- Work area of appx. 5000 acres
- Focus on all roosting and loafing areas on airport property
- Active area up to 150' from runway centerline
- Wildlife management support using the Robird & supporting equipment
- Integration with EIA wildlife team



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Slide 7



### **CASE STUDY: GRAND FORKS INTERNATIONAL AIRPORT & WASTEWATER TREATMENT FACILITY**

- Data collected during fall of 2018 & Spring 2019
- Manage local gull population - ~10,000 birds
- Symbiotic relationship with USDA
- Substantial decrease in resident gull population
- Substantial decrease in bird strikes at Grand Forks International Airport



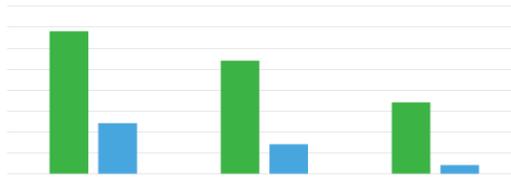
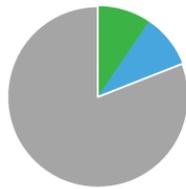
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Slide 8



## RESULTS

- Data is a snapshot into what appears to be a positive correlation and impact of AERIUM and RoBird presence on a decrease in bird strikes
- There is the appearance of a positive correlation between the presence of Robird and a decrease in bird observations (Data Analysis was discounted due to too many impacting factors)

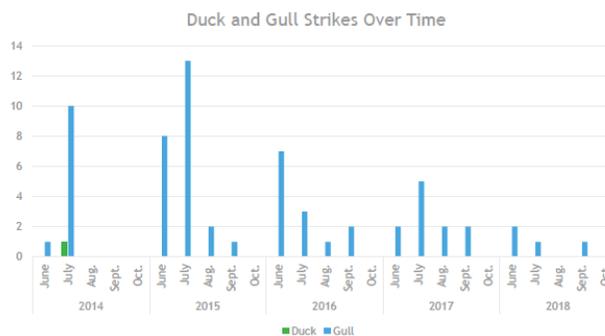


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Slide 9



## Edmonton International Airport Data



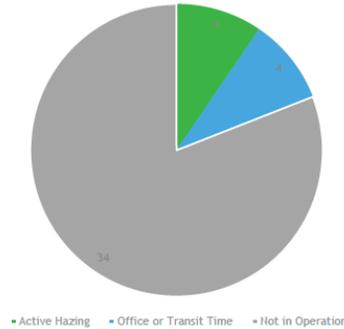
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Slide 10



## Edmonton International Airport Data

BIRD STRIKES ANALYZED BY AERIUM OPERATIONAL TIMES - 2018



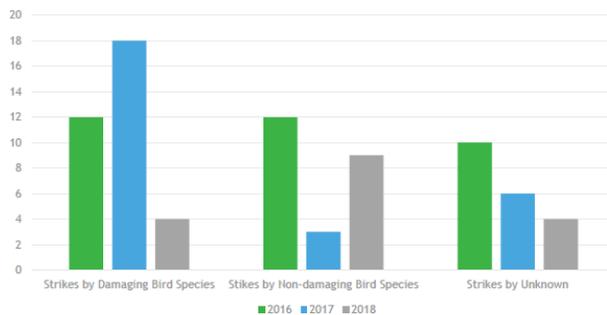
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### Slide 11



## Grand Forks Data

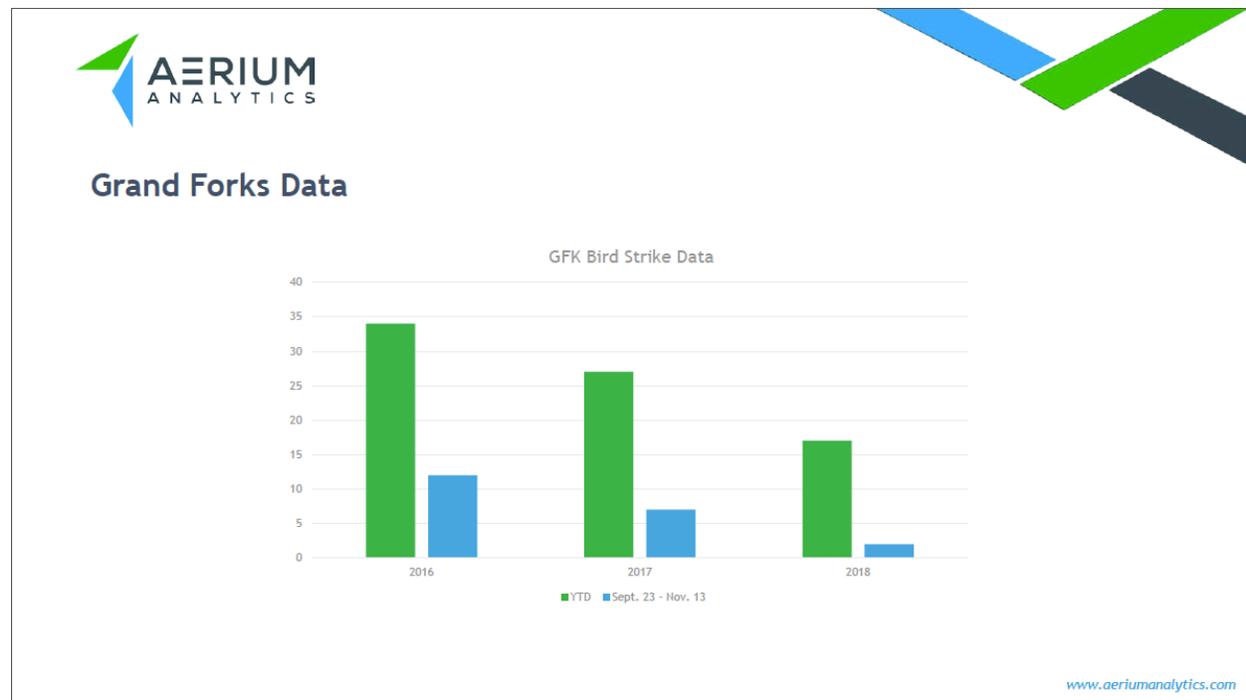
Strikes by Damaging Bird Species



DAMAGING BIRD STRIKES BY YEAR			
	2016	2017	2018
STRIKES BY DAMAGING BIRD SPECIES	12	18	4
STRIKES BY NON-DAMAGING BIRD SPECIES	12	3	9
STRIKES BY UNKNOWN SPECIES	10	6	4

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### Slide 12



Slide 13

### CONCLUSION

- Correlation between activities and decrease in bird strikes at airports
- Correlation between activities and decrease in damaging bird species
- Sensitization observed over multiple seasons & migratory periods
- Next Steps
  - Additional Studies required
  - Effectiveness against larger species such as Turkey Vultures
  - Continuation of Edmonton Project
  - Continuation of Grand Forks Project

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