



REX2024
PRCI Research Exchange

Aerial Right of Way Patrol using Automated Threat Detection

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San Diego, California
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Pipeline Research Council International

ROW-3-1 Airborne Automated Threat Detection System

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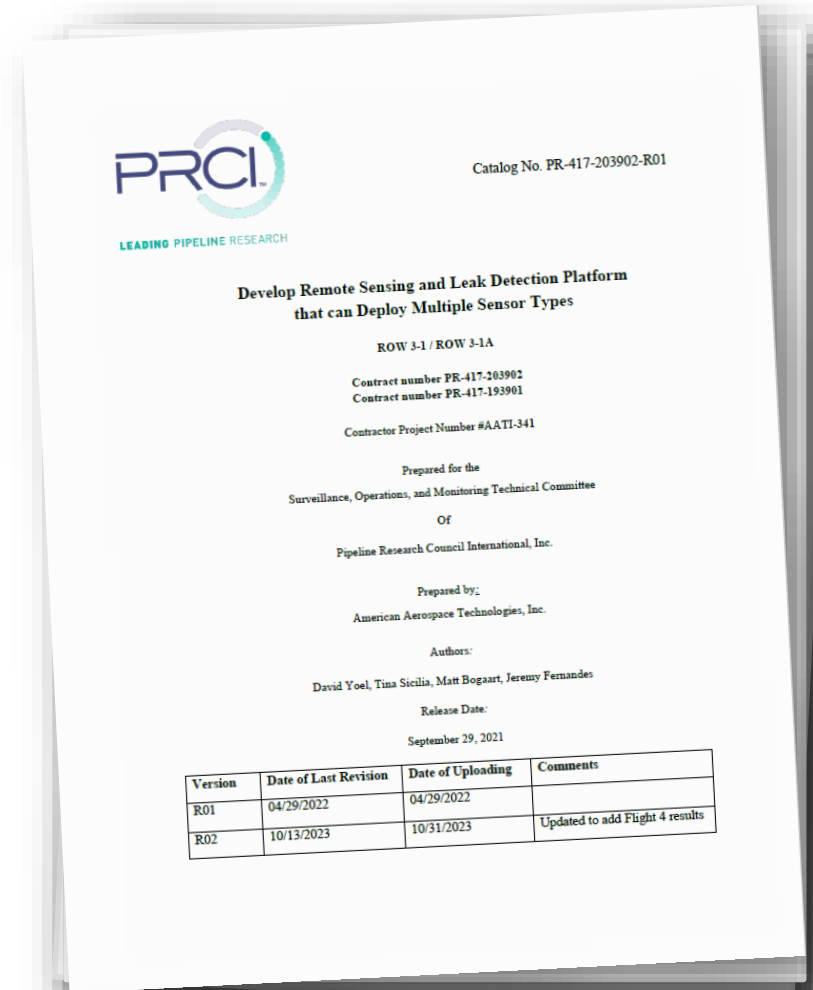
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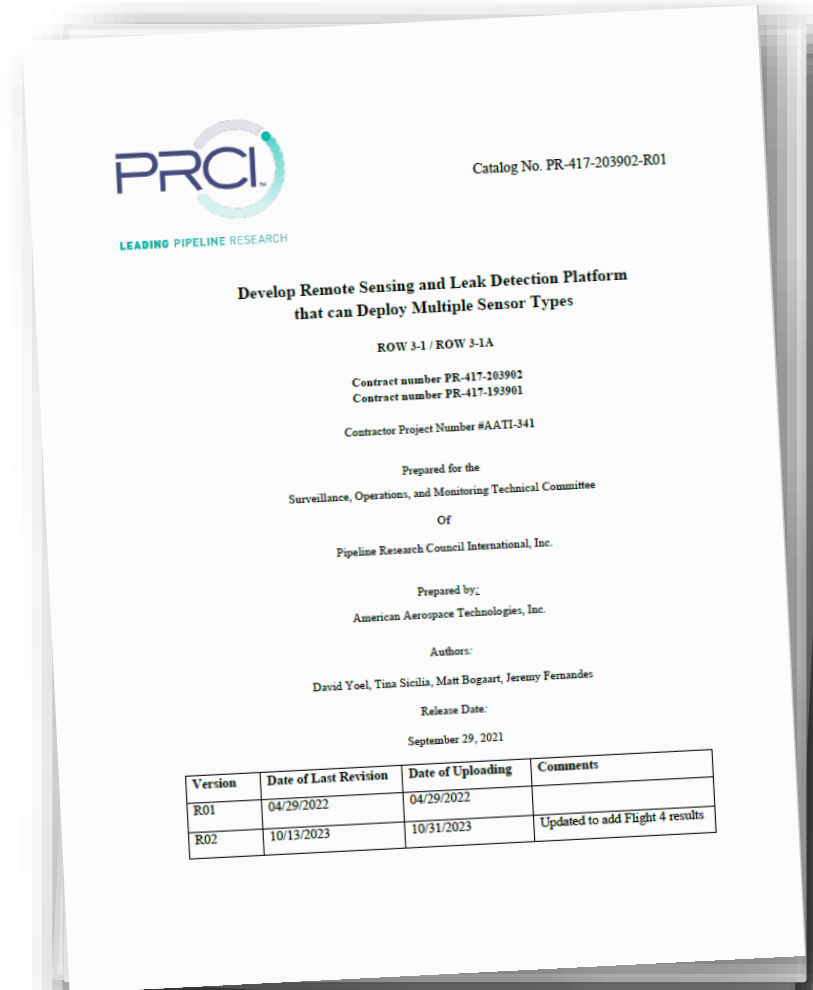
Email: david@americanaerospace.com



ROW-3-1 Airborne Automated Threat Detection System

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- **PR-417-203902-R01 Develop Remote Sensing and Leak Detection Platform That Can Deploy Multiple Sensor Types**
- Automated Threat Detection
- Suitable for medium altitude long endurance unmanned aircraft capable of beyond visual line of sight (BVLOS)
- Quantify acceptable detection limits
- Identify sensors to meet requirements



Using Advanced Technology for Golf

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- In Golf One Number can indicate the success or failure of a hole
- Much more information can be collected using technology
- Similar information is now readily available to the public
- This information allows for more analysis and informed decisions

HOLE	1	2	3	4
BLUE	598	366	174	570
GOLD	531	336	144	522
RED	497	321	125	486
Chris	6	6	4	7
Cale	6	6	4	7
Kent	8	5	4	7

Using Advanced Technology for Golf

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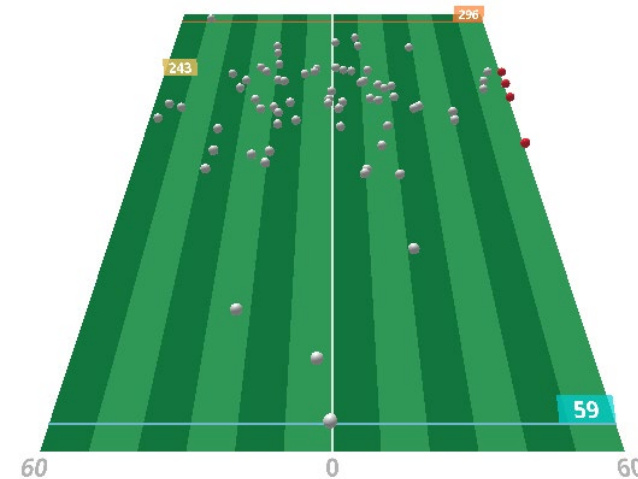
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Using Advanced Technology for Golf

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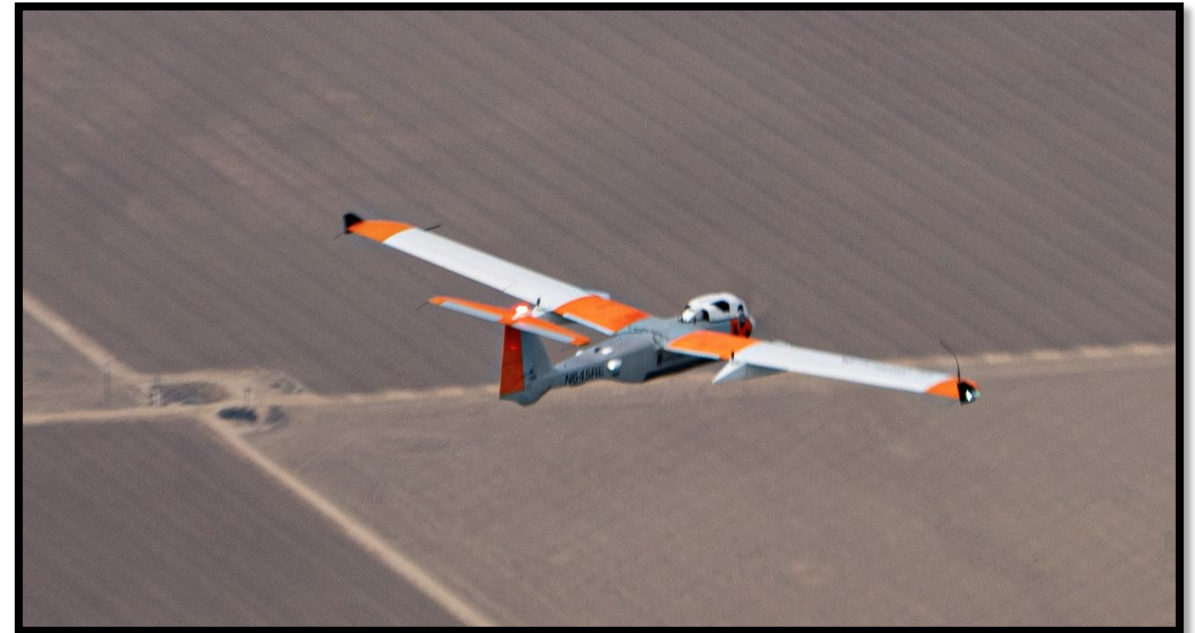
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Using Advanced Technology for Right of Way Monitoring

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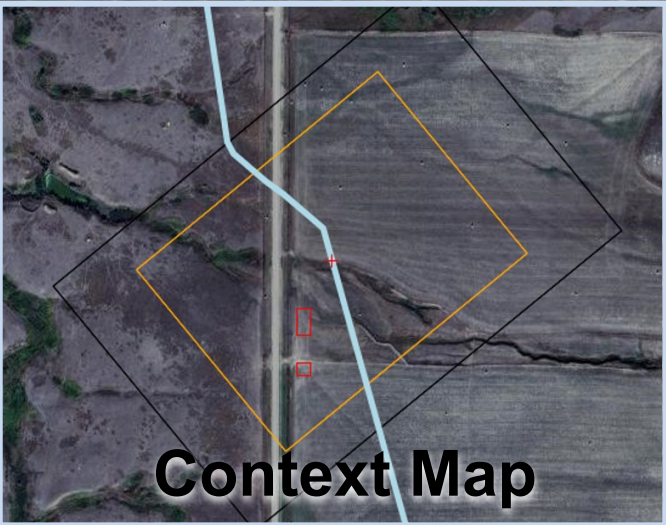
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AiRanger UAS in flight

Using Advanced Technology for Right of Way Monitoring

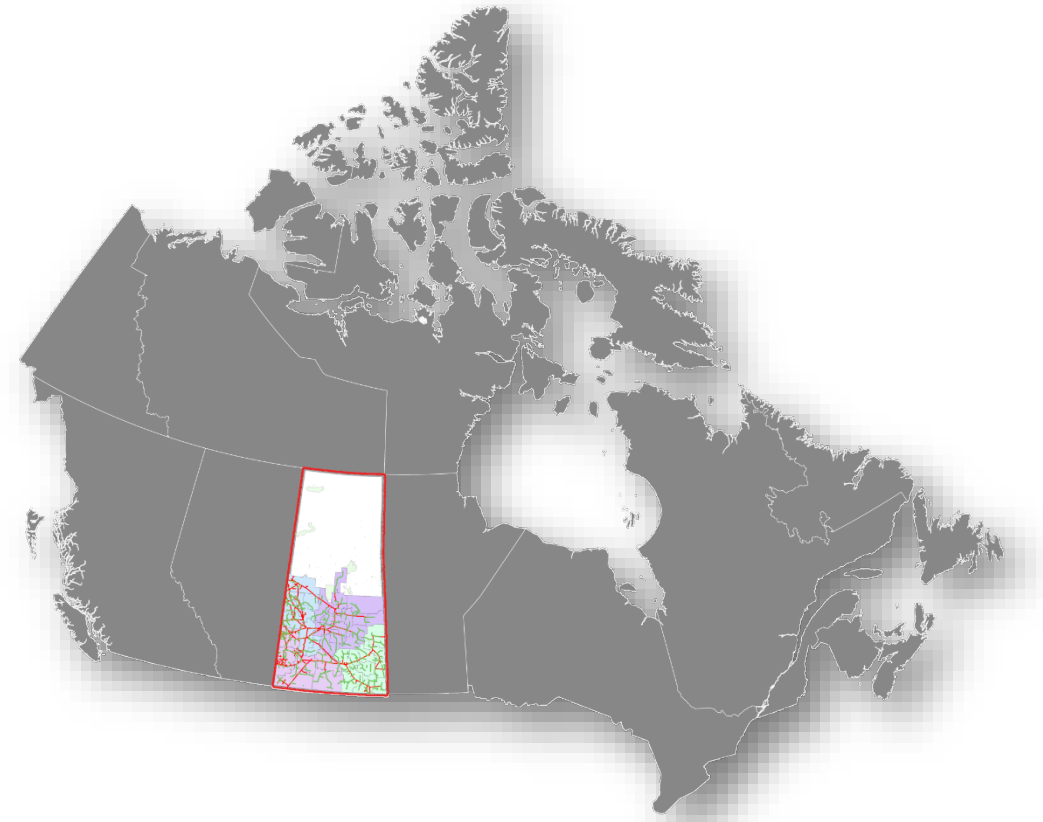
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TransGas System Overview

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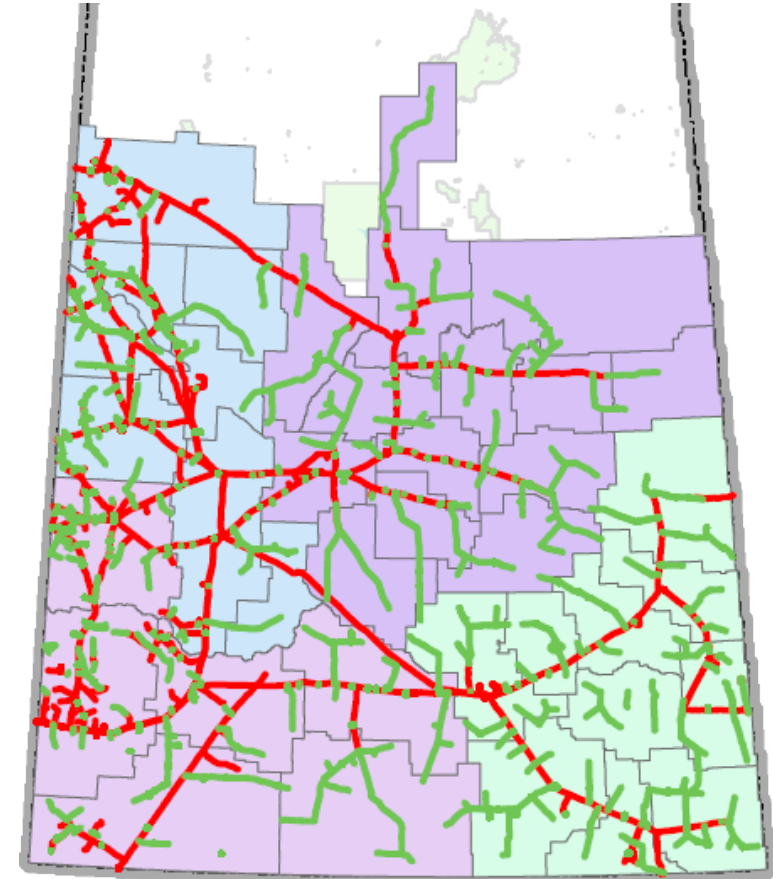
- **TransGas operates an “Expansive” system in Saskatchewan**
- **15,000 km (10,000 miles) of Transmission Pipelines**
- **A distribution focus, serving 93% of the communities in the province**
- **Over half of the system is small diameter (less than $\varnothing 4''$) low volume**
- **Higher cost data products have not been feasible most of our system**



TransGas System Overview

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TransGas System Overview

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Urban - 1%

Rural – 99%



Implementation of the Research

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- Easier due to integration with existing Aerial Patrol inspections
- Cost is lower due to integration with existing Aerial Patrol inspections
- The pilot and spotter continue to notify operations of extreme threats
- Annual inspection to supplement
- Integration with the company GIS system allows for extra value



Improved Threat Detection

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- Better identifications where pipeline alignment is not obvious
- There seems to be a perception that old threats are not reportable
- Automated threat detection reports findings unnoticed in the past
 - Expansion of Urban Areas
 - Animal activity / erosion
 - Excavators



Improved Threat Detection



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Aerial Pipeline Patrol / Encroachment Control Report

#	Dir Name	File Name	Condition	Severity	Latitude	Longitude	Description
20	202307191545	HR1500	OT	Low	52 0 27 N	106 58 51 W	Agriculture to Commercial

ROW Image

Zoomed Threat

Google Street Map

Created with AATI Reporter Ver. 19.3.1.1

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Improved Threat Detection

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Improved Threat Detection - Excavators

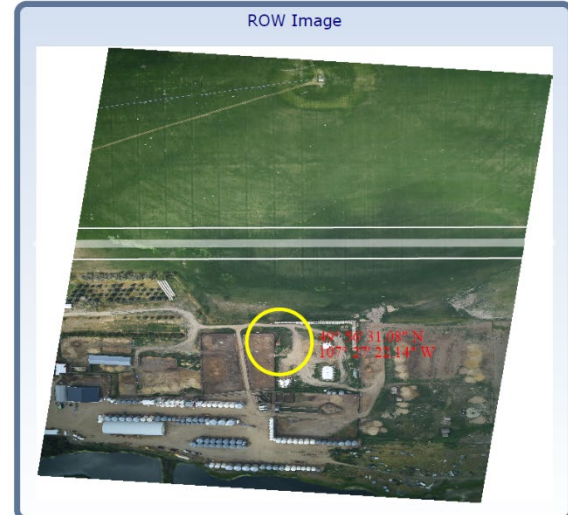
17



Aerial Pipeline Patrol / Encroachment Control Report

#	Dir Name	File Name	Condition	Severity	Latitude	Longitude	Description
70	202307192102	HR1500	EQ	Low	49 56 31 N	107 27 22 W	Equipment

ROW Image



Zoomed Threat



Google Street Map



Improved Threat Detection

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Flight – 19 July 2023 00438_Sask_TGL_20230719 Minute 1,453 to Minute 1,742	Patrol Name Sask TGL	Images Scored	Total Threat Count	True Positive	False Positive	False Negative	True Negative	Raw Score (Recall)	F1 Score	Precision
	00438_Sask_TGL_20230719	1,835	448	350	126	98	1,700	0.78	0.76	0.74

- **382-mile patrol scored**
- **351 miles of corridor was issue free**
 - 1,700 images
 - True Negative score 92%
- **31 miles of corridor contained threats**
 - Most False Negatives were in clusters where one vehicle was missed
- **Similar results to PRCI Report**
 - Entirely different terrain
 - Much larger data set (382 vs 87 miles)

Encroachment Monitoring

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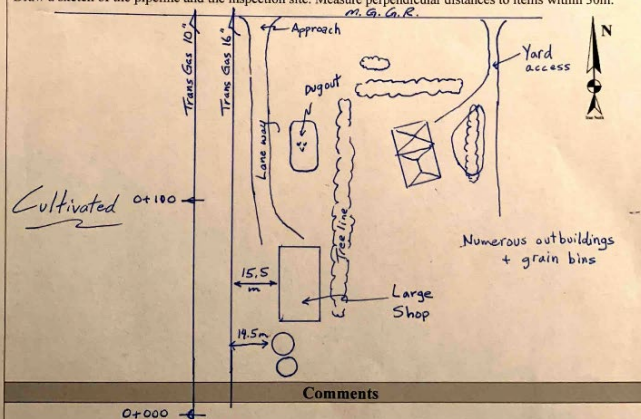
- **Monitoring developments for 10 yrs. with annual aerial photos**
- **Follow up inspections added for higher risk encroachments and new developments**
- **High resolution imagery improves desktop assessments**
- **Pipe location shown by Aerial Marker**
- **Crossing process is improved for proposed developments**



Encroachment Monitoring

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Encroachment ID	549	OD	273.1 m 406.4 m	Pipeline #	10 th 15 th 0100189 14-23-0450.100	Location	NW 8-21-15-W3M
Investigator	J. Hopper P. Mack	Date	Dec. 19 2018	TGL or MIPL(C/L)?	T.G.L.		
Land Use (definitions on back of form)		Questions					
Remote uninhabited		Are there any encroachments on the ROW?					
Parkland or grazing land		Are there any safety concerns? Describe in comments					
Cultivated agriculture Land	<input checked="" type="checkbox"/>	Does the landowner have permits?					
Low density residential or commercial		Depth of Cover Survey - 10'					
Medium density residential or commercial		Perform a Depth of Cover Survey in 10m intervals and record data on the back of this sheet. Label on map where the start point is located (use back of form if required)					
High density residential or commercial							
Alignment Markers		0 10 20 30 40 50 60 70 80 90 100					
No identifying markers or structures on surface		1.32 1.40 1.59 1.45 1.45 1.35 1.45 1.45 1.86 1.96 1.9					
Locate and Label existing Markers on the photo:		Class Location (use back of form if required)					
<ul style="list-style-type: none"> • Danger signs with "D" • Aerial Markers with "AM" • Any other markers, barriers, fences, indicating ROW with description 		Number of dwellings in 200m corridor on both sides of pipeline, up and down stream for 200m from encroachment					
		← 20					
Structure Offset							
Draw a sketch of the pipeline and the inspection site. Measure perpendicular distances to items within 30m.							
							
Comments							

Encroachment Monitoring

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- Monitoring developments for 10 yrs. with annual aerial photos
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Conclusion

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- **Sensors can effectively detect major threats to the pipeline system**
- **Much more information is now available to manage the Right of Way**
- **Information enables better analysis and more informed decisions**



Thank you



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