The National Academies of
SCIENCES • ENGINEERING • MEDICINE

TRANSPORTATION RESEARCH BOARD

Runway Protection Zone Risk Assessment Tool

Wednesday, February 7, 2018
2:00pm to 3:30pm ET

Purpose

Discuss research from the Airport Cooperative Research Program (ACRP)'s Research Report 168: Runway Protection Zones (RPZs) Risk Assessment Tool Users' Guide.

Learning Objectives

At the end of this webinar, you will be able to:

- Understand the developed risk assessment framework that serves as the basis for the tool
- Understand how to use the tool

ACRP is an Industry-Driven Program

- Managed by TRB and sponsored by the Federal Aviation Administration (FAA).
- Seeks out the latest issues facing the airport industry.
- Conducts research to find solutions.
- Publishes and disseminates research results through free publications and webinars.

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Opportunities to Get Involved!

- ACRP's Champion program is designed to help early- to mid-career, young professionals grow and excel within the airport industry.
- Airport industry executives sponsor promising young professionals within their organizations to become ACRP Champions.
- Visit ACRP's website to learn more.

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ACRP | INSIGHT EVENT

Airport Roles in Reducing Transmission of Communicable Diseases

March 6–7, 2018 • Washington, D.C.

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Featured speakers:

- CAPT Martin Cetron, MD – Director, CDC's Division of Global Migration and Quarantine (DGMQ)
- Dr. Ansa Jordaan – Chief, Aviation Medicine Section, International Civil Aviation Organization
- Dr. Petra Illig – Aviation Medical Services, Alaska
- Dr. Kamran Khan – St. Michael's Hospital, Toronto

Register for FREE:
bit.ly/ACRPMarchEvent

Moderated discussion by outbreak responders from Dallas-Fort Worth, New York City, Phoenix, and Portland.

Award-winning *Unseen Enemy* movie screening and interactive exercise included in registration.

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Challenges to Implementing Successful Land Use Strategies at Airports

April 10-11, 2018 | Washington, D.C.

FREE Registration: tinyurl.com/land-use-insight-event

Featuring interactive breakout sessions, networking opportunities, and keynote addresses. Speakers include:

- **Thella Bowens,** (retired) President/CEO, San Diego County Regional Airport Authority
- **Dr. Stephen Van Beek,** Director & Head of North American Aviation, Steer Davies Gleave
- **John Terrell,** Vice President Commercial Development, DFW International Airport

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Economic and Social Sustainability at Airports

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With interactive breakouts, networking opportunities, and plenary presentations, this engaging and groundbreaking forum will help airports and their stakeholders frame, plan, communicate, implement, and report social and economic initiatives to fully realize triple bottom line sustainability benefits.

Featuring…

- Dr. Davina Durgana – *anti-human trafficking expert*
- Dr. Steve Nakana – *airport social equity expert*
- Ted Howard – *community wealth building expert*

FREE Registration: tinyurl.com/sustainability-insight-event

Upcoming ACRP Webinars

February 28

Considerations for Pavement Applications and Maintenance at Airports

March 8

Assessing Community Annoyance with Helicopter Noise

March 21

Interpreting the Results of Airport Water Monitoring

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Additional ACRP Publications Available on this Topic

Report 3: Analysis of Aircraft Overruns and Undershoots for Runway Safety Areas

Report 50: Improved Models for Risk Assessment of Runway Safety Areas (expands on the research presented in Report 3 above)

Report 107: Development of a Runway Veer-Off Location Distribution Risk Assessment and Reporting Template and Lateral Runway Safety Area Risk Analysis (LRSARA) Tool (Tool is available on CD-ROM)

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Today's Speakers

Hamid Shirazi

Applied Research Associates

Presenting

Report 168: Runway Protection Zones Risk Assessment Tool Users' Guide

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ACRP Report 168: Runway Protection Zone (RPZ) Risk Assessment Tool

Hamid Shirazi, P.E.
Applied Research Associates (ARA)

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Hamid Shirazi
Principal Civil Engineer, ARA

- ACRP 04-18 (Report 168) Project Manager
- Professional Engineer
- Master of Science in Civil Engineering

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ACRP Report 168 Oversight Panel

David Bannard, Foley & Lardner LLP, Panel Chair
Paul Esposito, STAR Consultants, Inc.
Jennifer Fuller, North Carolina DOT
Dawn Mehler, DHL
Jorge E. Panteli, McFarland-Johnson, Inc.
Roger Studenski, Jacksonville Aviation Authority
Steve Debban, FAA Liaison
Richard Marchi, ACI North America
Stephen F. Maher, TRB Liaison
Marci A. Greenberger, ACRP Program Officer
Joseph J. Snell, TRB Liaison
Rick Etter, FAA Liaison

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ACRP Report 168:
RPZ Risk Assessment Tool Features

- Airport specific movement and weather data
- Airport specific runway and land use data
- RPZ ranking
- Land use ranking
- Assists with prioritization and mitigation strategies in dealing with incompatible land uses
- A Users' Guide and a Technical Report were published in 2016

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Runway Protection Zone: Background and FAA Policy

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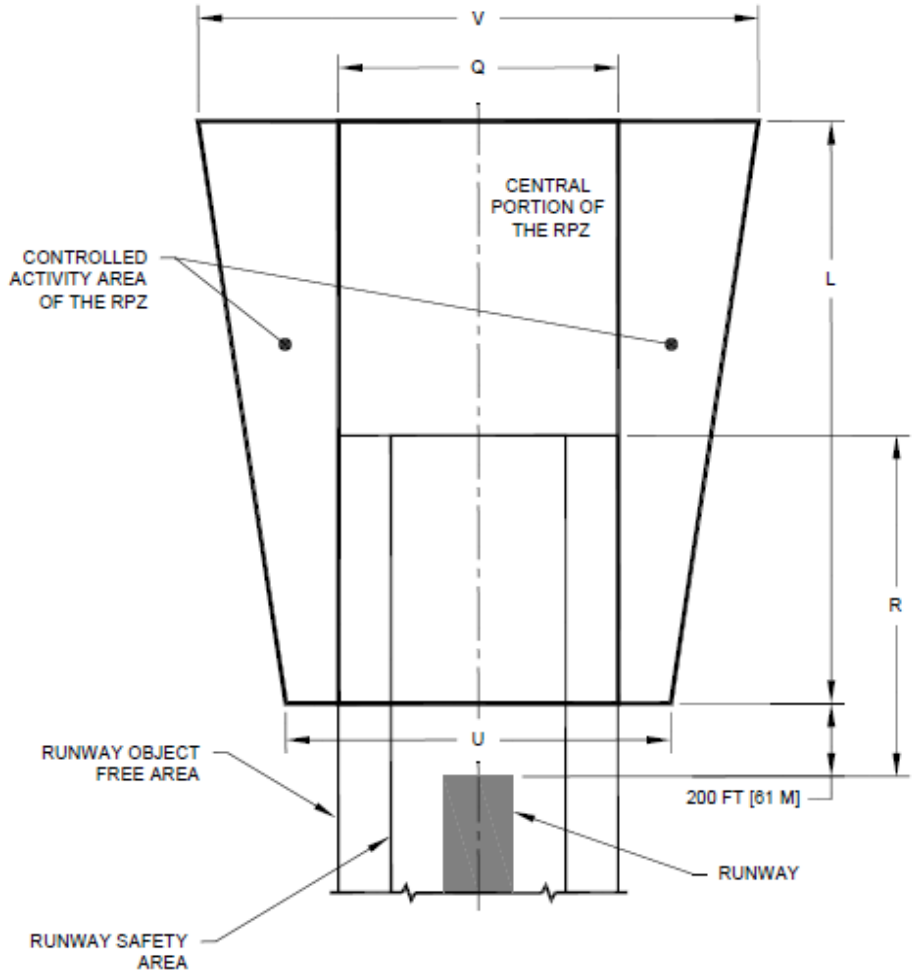
RPZ Standards

- Enhance the protection of people and property on the ground
- RPZ dimensions depend on aircraft approach category and runway visibility minimums
- Approach RPZs are larger than departure RPZs when the visibility minimums are less than 1 mile; otherwise they are equal in size
- Desirable to clear the entire RPZ of all above-ground objects



FAA Guidance on RPZ Land Use

- FAA interim policy guidance on land uses within RPZs, 2012
- Common incompatible land uses:
  - ✓ Transportation facilities
  - ✓ Buildings and structures
  - ✓ Recreational land uses
- RPZ analysis trigger examples:
  - ✓ An airfield project (e.g. runway extension, runway shift)
  - ✓ A change in the critical aircraft that increases the RPZ dimensions
  - ✓ A local development proposal in the RPZ (either new or reconfigured)
- RPZ Analysis:
  - ✓ Develop a full range of alternatives
  - ✓ Field staff consult with the FAA Airport Planning and Environmental Division (APP-400)

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RPZ Risk Assessment Modeling Framework

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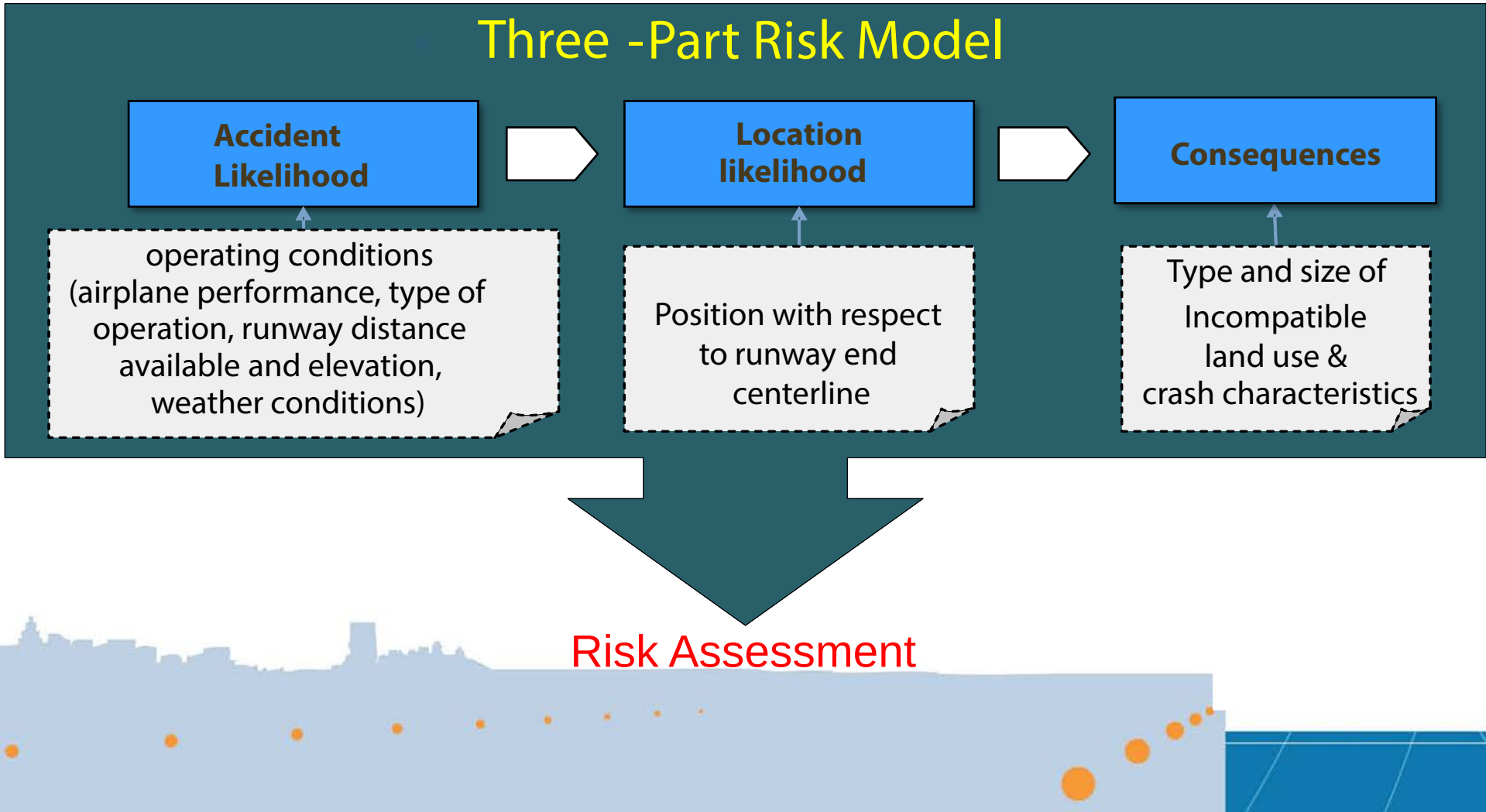
Risk Modeling Framework

Risk : Likelihood of fatality of people on the ground



Types of Events (Accidents & Incidents)

- Landing Overrun (LDOR)
- Takeoff Overrun (TOOR)
- Takeoff Overshoot (TOOS)
- Landing Undershoot (LDUS)

Source: NLR (Netherlands Aerospace Center)

First Part: Accident Likelihood Models

- Models require airport operation data and weather characteristics over one representative year of airport

- Models estimate the likelihoods of events for every operation during the year given the following inputs:
  - ✓ Hub/non-hub airport
  - ✓ Runways declared distances
  - ✓ Operation type
  - ✓ Aircraft performance characteristics
  - ✓ Hourly weather condition

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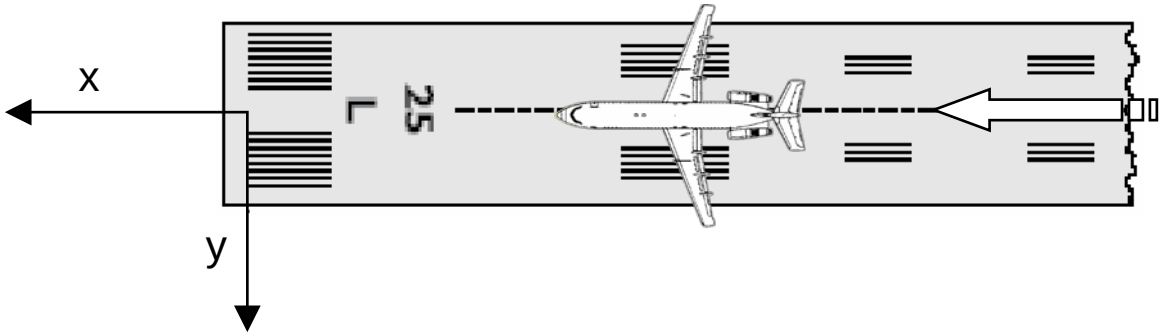
Second Part: Location Models

- Quantify the likelihood of an event at a given location beyond a runway and within an RPZ



Third Part: Consequence Models

- Quantify the likelihood of fatality within a land use involved in an event
  - ✓ Population density of land use (PD)
  - ✓ Size of consequence area (A)
  - ✓ Mortality rate (M_r)

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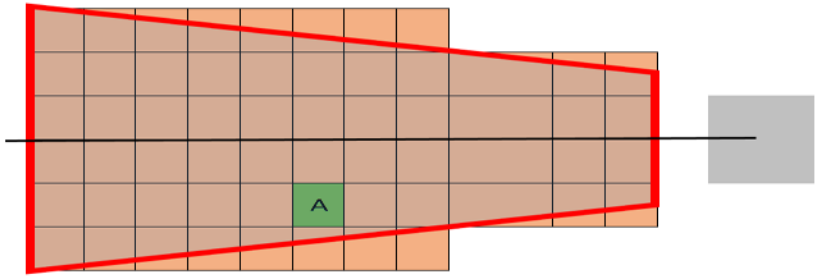
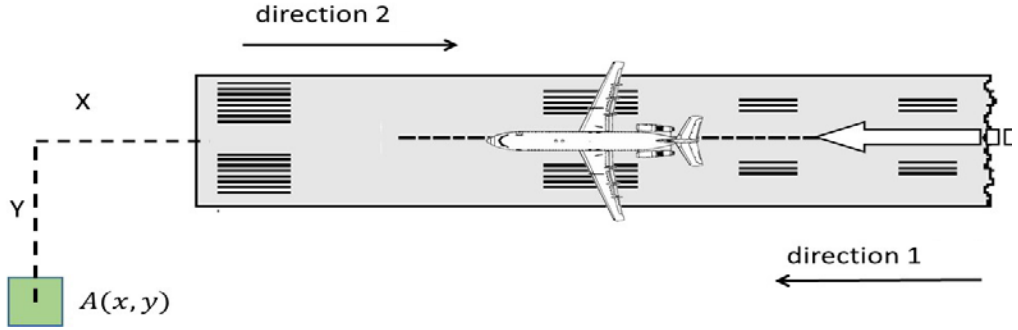
RPZ Crash Likelihood

- Convert area inside RPZ to a mesh



- Calculate the crash likelihood for every cell inside the RPZ factoring in every accident type



- Add up the crash likelihoods of all cells to achieve RPZ crash likelihood

RPZ Risk Assessment Tool (RPZ_RAT)

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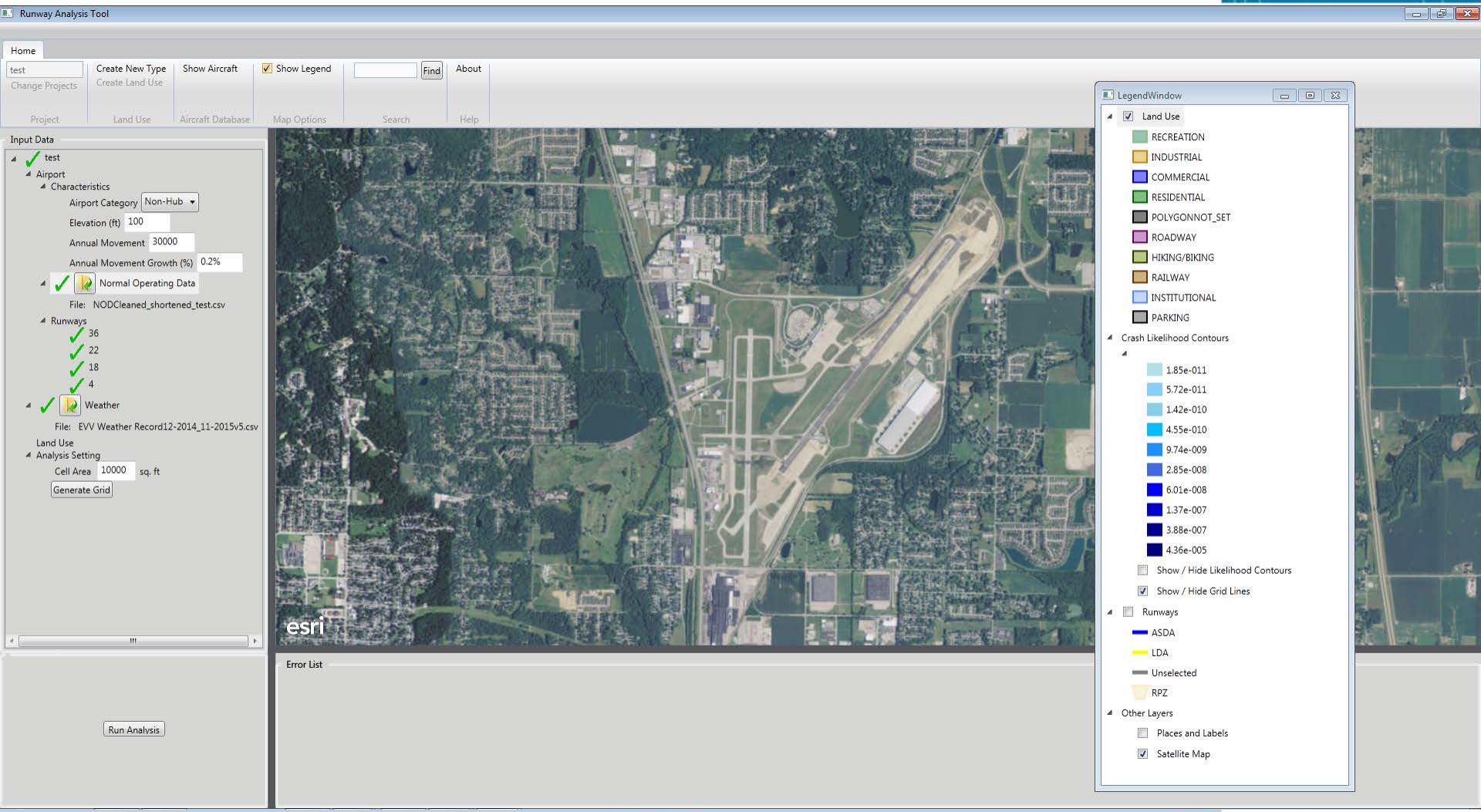
Overview of RPZ_RAT



RPZ_RAT Input Files

- **Movement Input File**
  - ✓ Date and time of operation
  - ✓ Runway designation
  - ✓ Arrival or departure
  - ✓ Operation type
  - ✓ Aircraft code
  - ✓ Domestic/International
- **Weather Input File**
  - ✓ Date and time
  - ✓ Visibility
  - ✓ Ceiling
  - ✓ Temperature
  - ✓ Rain
  - ✓ Fog
  - ✓ Icing
  - ✓ Etc.

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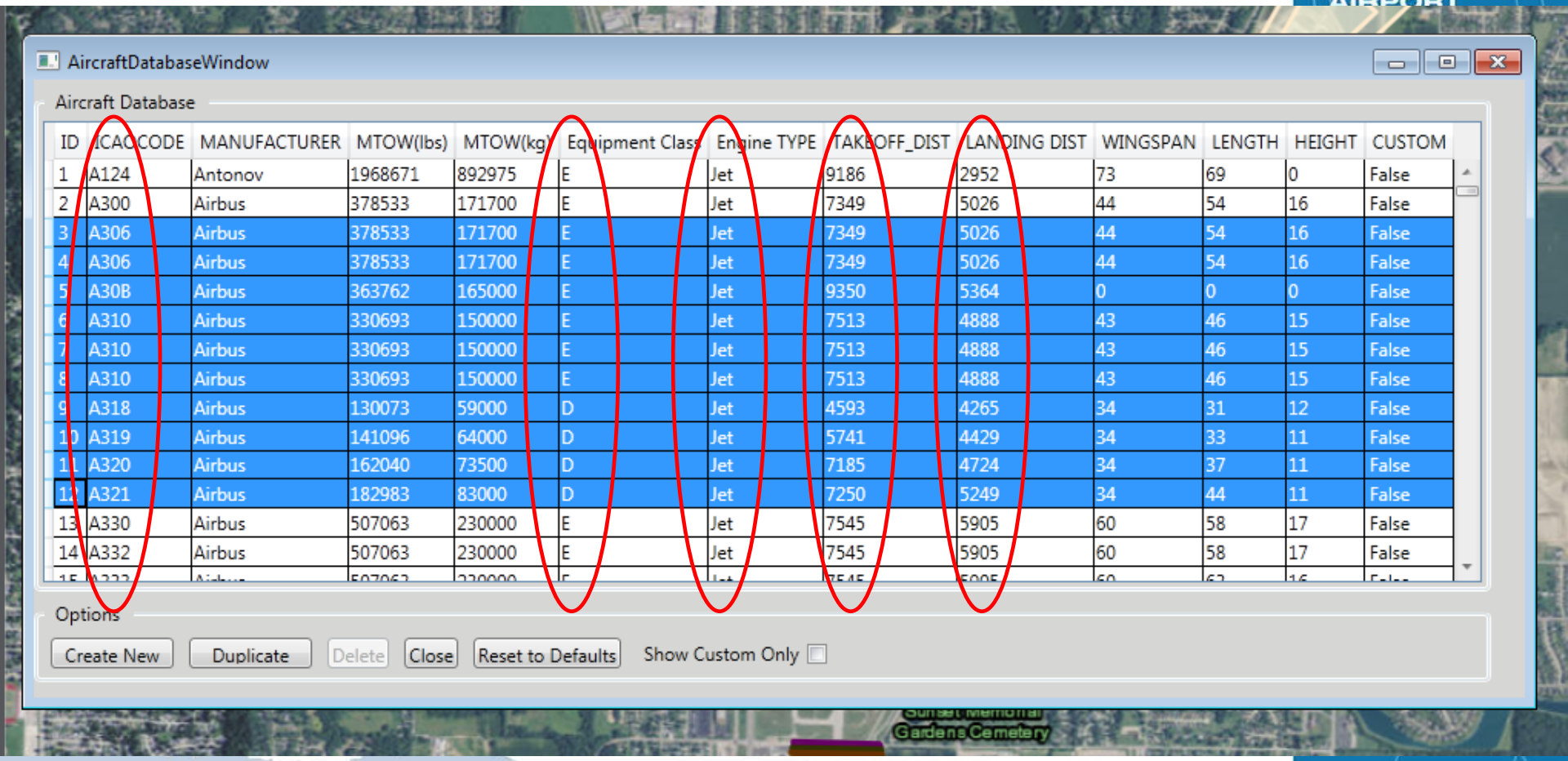
Sample Movement Input File

HOD_ID	DATE&TIME	RUNWAY_DESIGNATION	BOUND	FLIGHT_NO	FAA_Code	FLIGHT_Category	FLIGHT_Type
1	2013-08-01 0:00:33	15R	A	AAL1554	B738	COM	D
2	2013-08-01 0:04:28	15R	A	SWA2354	B737	COM	D
3	2013-08-01 0:07:11	15R	A	ATN510	B752	CAR	D
4	2013-08-01 0:09:09	15R	A	SWA2699	B737	COM	D
5	2013-08-01 0:11:53	15R	A	UAL1575	B739	COM	D
6	2013-08-01 0:14:49	15R	A	AAL406	B738	COM	D
7	2013-08-01 0:17:06	15R	A	TRS1092	B737	COM	D
8	2013-08-01 0:19:48	15R	A	SWA611	B737	COM	D
9	2013-08-01 0:35:29	15R	A	SWA1641	B737	COM	D
10	2013-08-01 1:11:05	15R	A	SWA3509	B737	COM	D
11	2013-08-01 1:50:24	15R	A	UAL1608	B738	COM	D
12	2013-08-01 1:58:35	15R	A	N310ME	LJ35	GA	D
13	2013-08-01 2:01:10	15L	A	LBQ792	PC12	CAR	D
14	2013-08-01 2:12:32	15R	D	ATN510	B752	CAR	I
15	2013-08-01 2:21:35	15L	D	LBQ792	PC12	CAR	D
16	2013-08-01 2:27:46	15L	D	N310ME	LJ35	GA	D
17	2013-08-01 3:43:09	15L	A	RAX81	BE10	AIR	D
18	2013-08-01 4:02:03	15L	D	RAX81	BE10	AIR	D
19	2013-08-01 4:26:07	15L	A	MTN8308	C208	AIR	D
20	2013-08-01 5:08:15	15L	A	MTN8305	C208	AIR	D
21	2013-08-01 5:23:41	15R	A	UPS1216	B752	CAR	D
22	2013-08-01 5:25:01	15R	D	AWE1851	A319	COM	D
23	2013-08-01 5:36:50	15R	A	UPS1214	B763	CAR	D
24	2013-08-01 5:55:05	10	A	FDX1730	A306	CAR	D
25	2013-08-01 5:56:01	15R	D	UAL1411	B739	COM	D
26	2013-08-01 6:00:52	15R	D	EGF2986	E145	COM	D
27	2013-08-01 6:07:00	10	A	FDX1482	A306	CAR	D
28	2013-08-01 6:10:52	15R	D	UAL1059	B738	COM	D
29	2013-08-01 6:12:44	15R	D	JIA4601	CRJ2	AIR	D
30	2013-08-01 6:14:57	15L	D	JZA7927	DH8A	COM	I

Embedded Aircraft Types Database

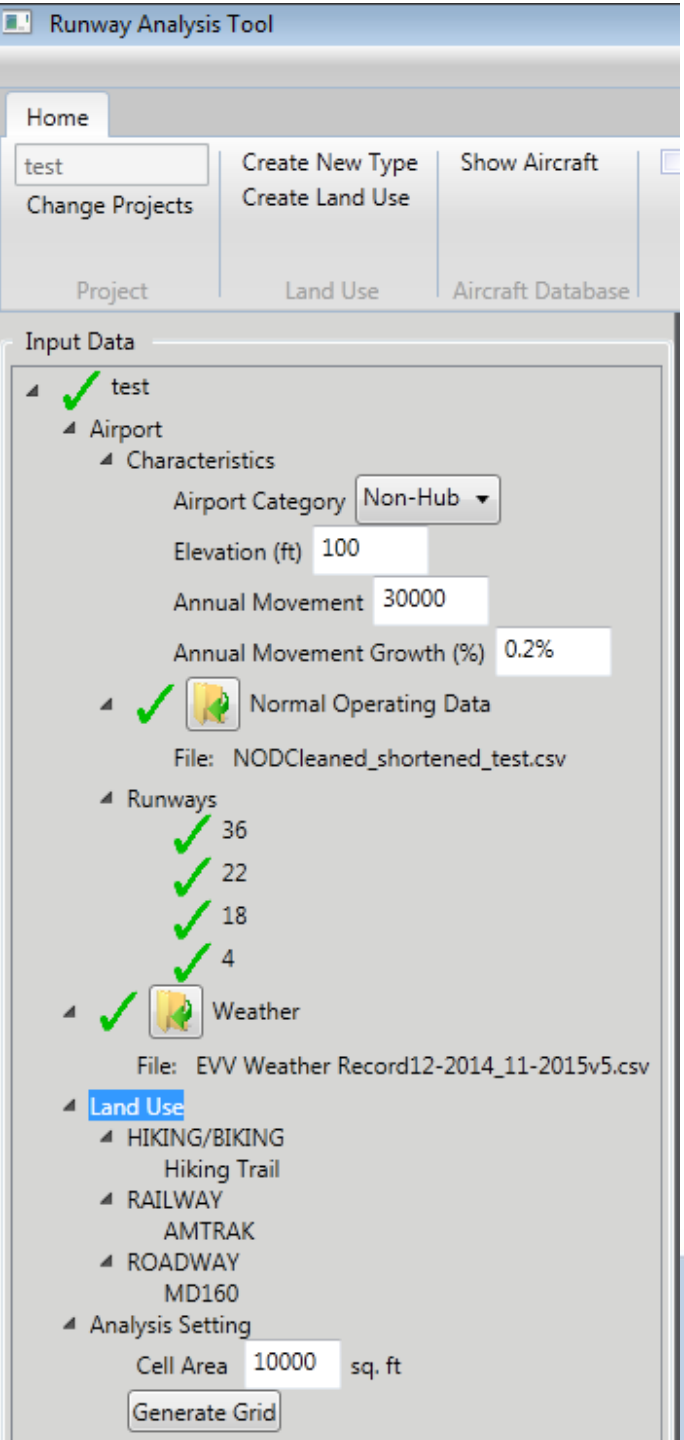


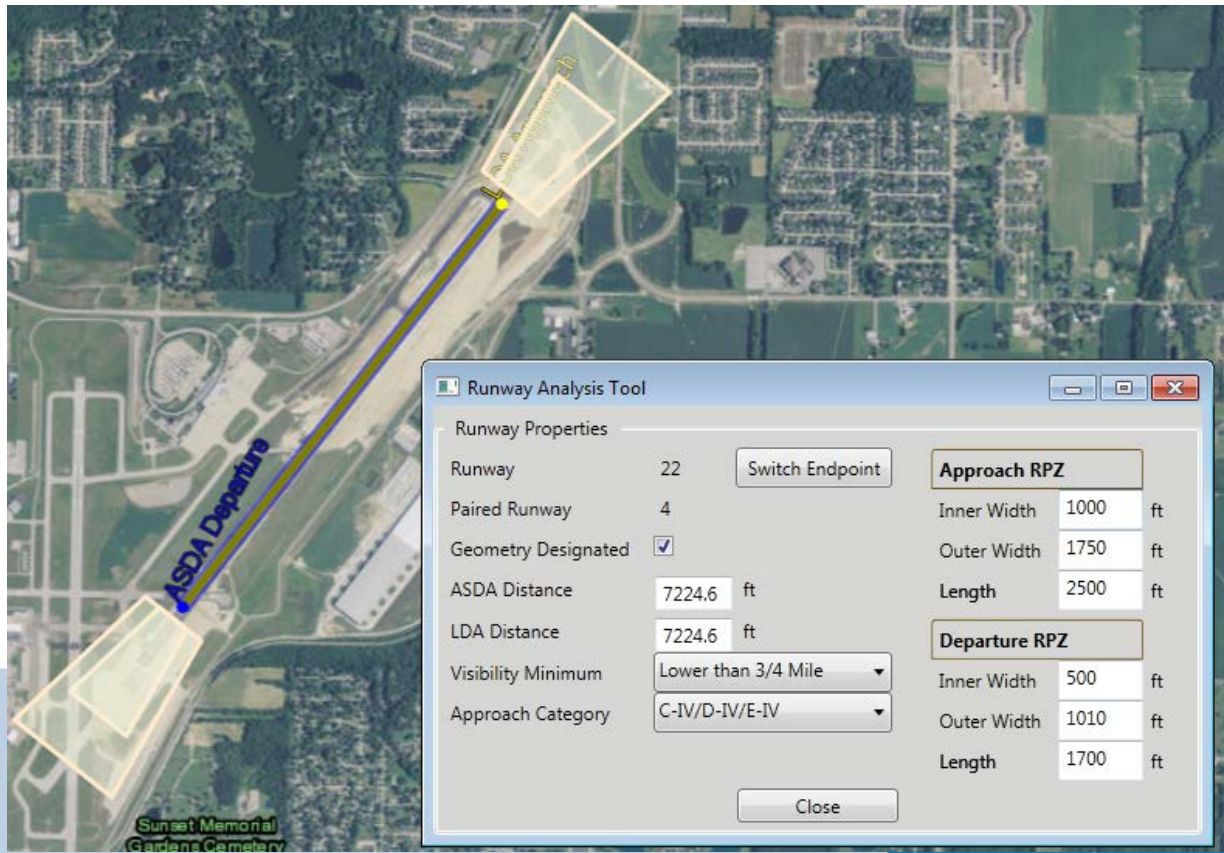
Sample Weather Input File

Date&Time	Visibility _SM	Wind Direction_deg	Wind Speed_knots	Air Temp_F	Ceiling_ft	Thunder storms	Rain	Rain Showers	Freezing Rain	Freezing Drizzle	Snow	Snow Pellets	Ice Crystals	Snow Showers	Ice Pellets	Ice Pellet Show	Fog	Gusts	Night
8/1/2013 0:00	8	0	0	71	10000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 1:00	10	210	5	71	6500	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 2:00	10	190	4	72	1200	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 3:00	7	190	3	68	5000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 4:00	4	170	3	68	3300	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 5:00	8	120	4	68	2700	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 6:00	2	110	4	68	4000	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 7:00	2	0	0	68	600	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 8:00	2.5	0	0	70	1100	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 9:00	4	230	5	72	800	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 10:00	1.5	230	5	72	800	FALSE	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 11:00	4	230	5	72	800	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 12:00	6	240	6	73	1700	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 13:00	8	210	3	73	900	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 14:00	10	160	5	77	5000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 15:00	10	160	4	78	6000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 16:00	10	200	4	80	10000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 17:00	10	210	5	79	10000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 18:00	10	210	3	78	10000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 19:00	10	0	0	77	10000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
8/1/2013 20:00	10	0	0	75	10000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 21:00	10	0	0	74	10000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 22:00	10	100	3	74	7000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE
8/1/2013 23:00	10	0	0	73	10000	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE

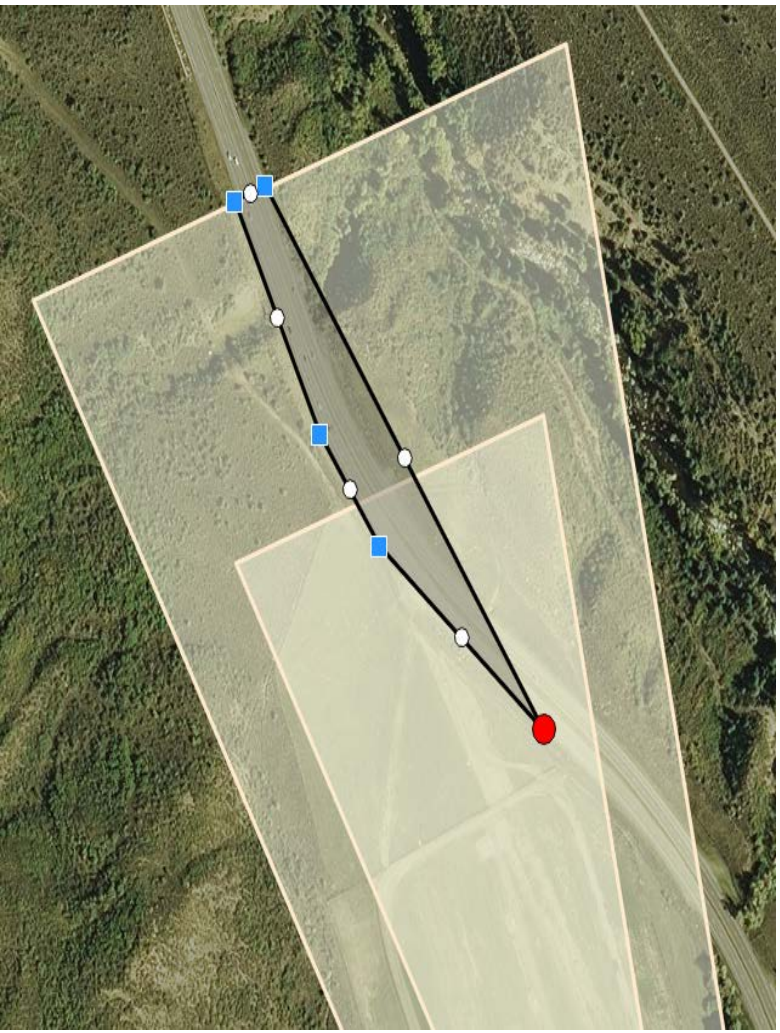
Sidebar Navigation Tree

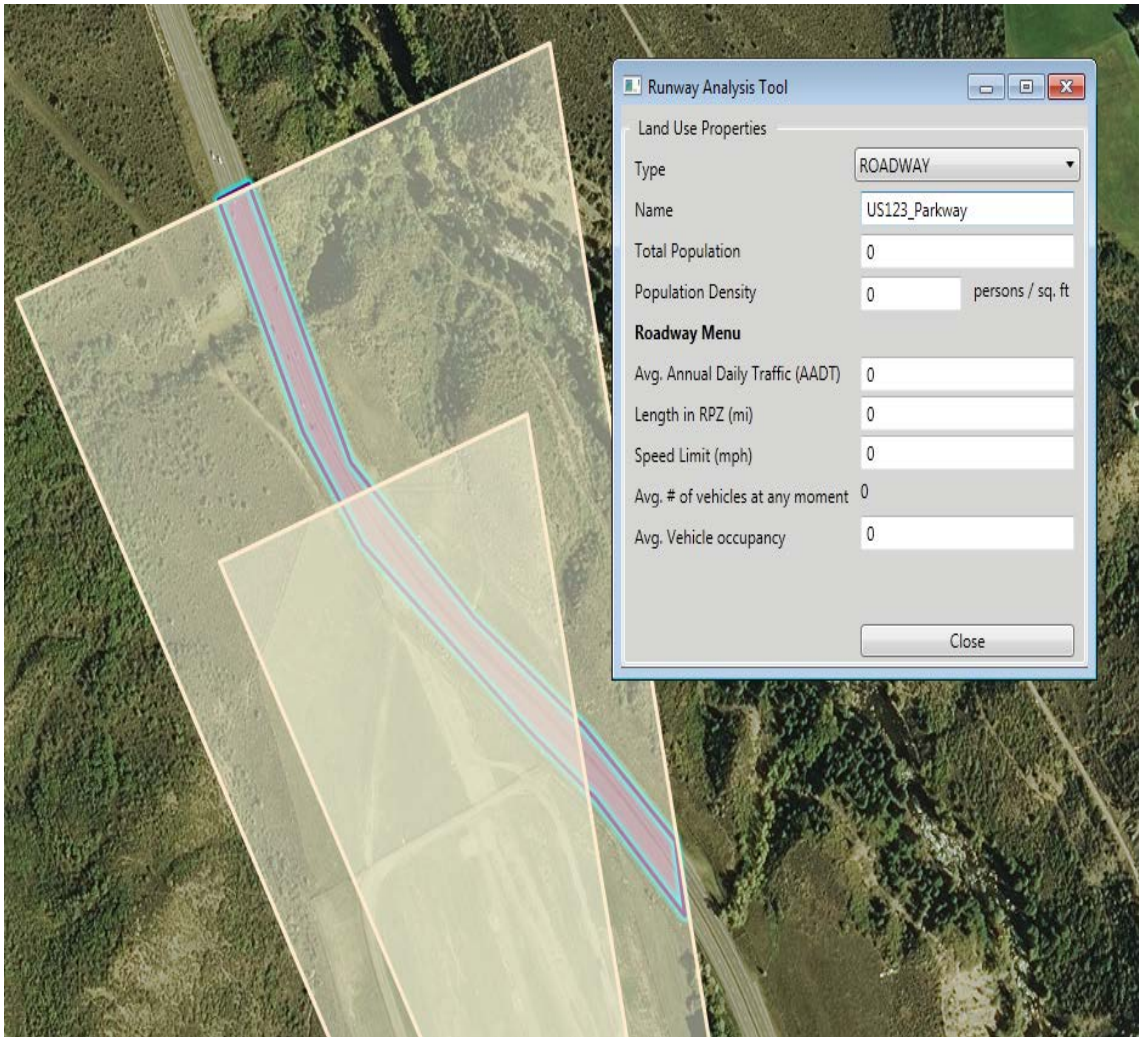
Inputting a Runway





Inputting A Land Use





RPZ Risk Assessment Case Study Airport

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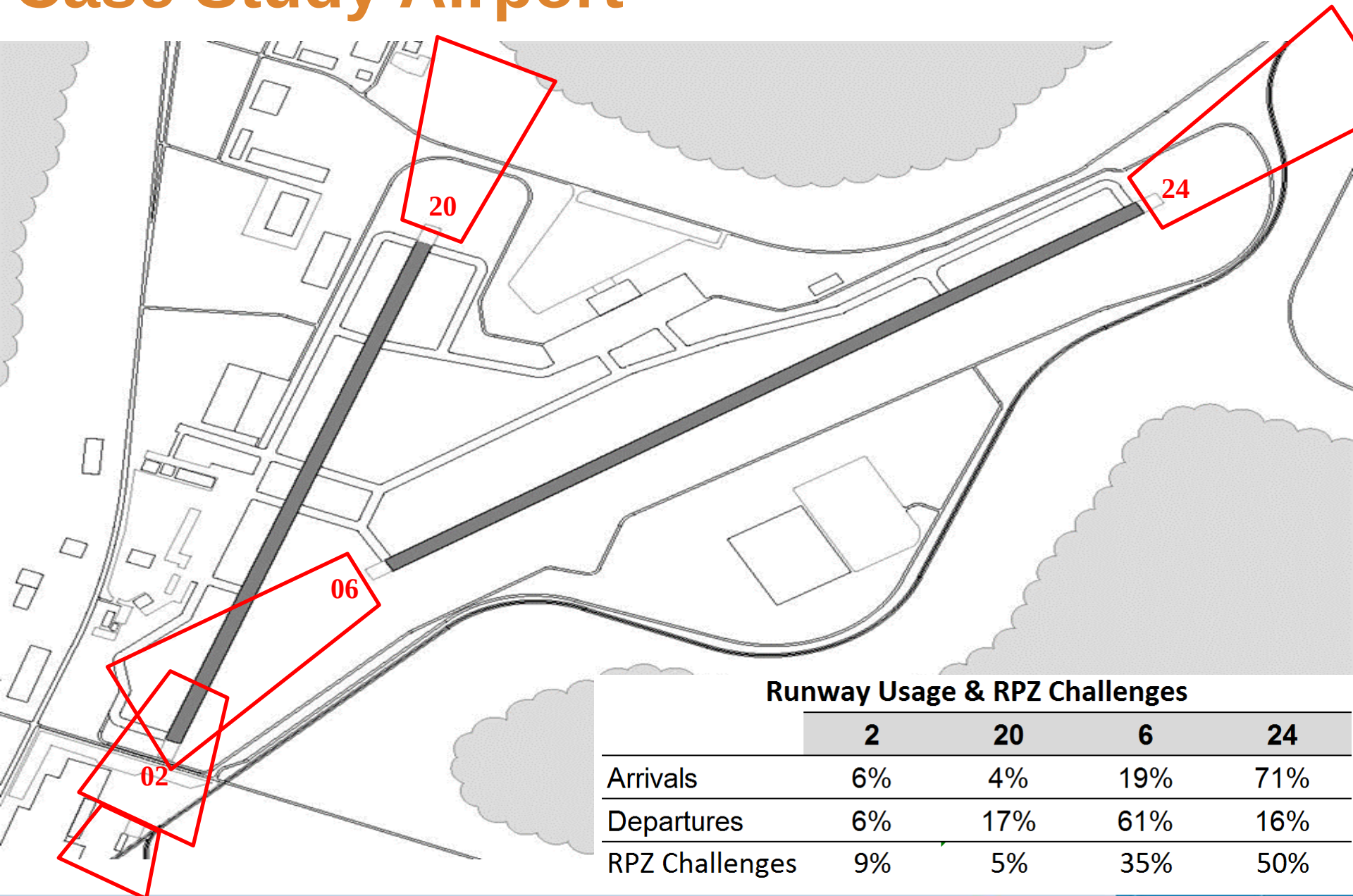
Case Study Airport

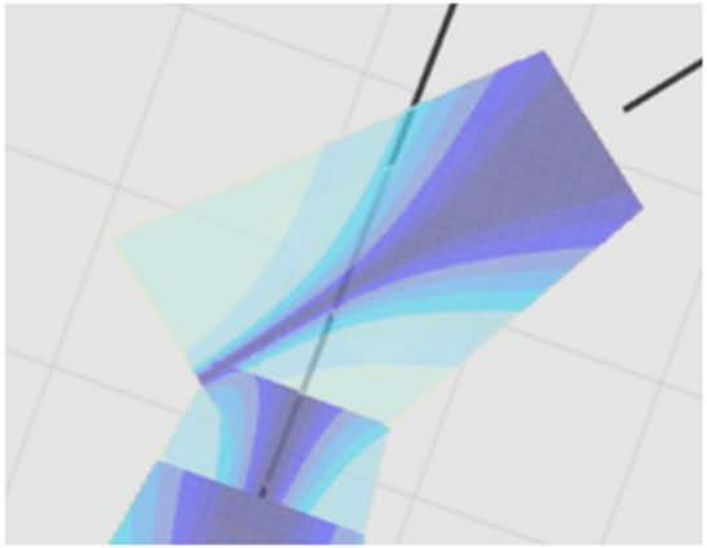


Runway Usage & RPZ Challenges

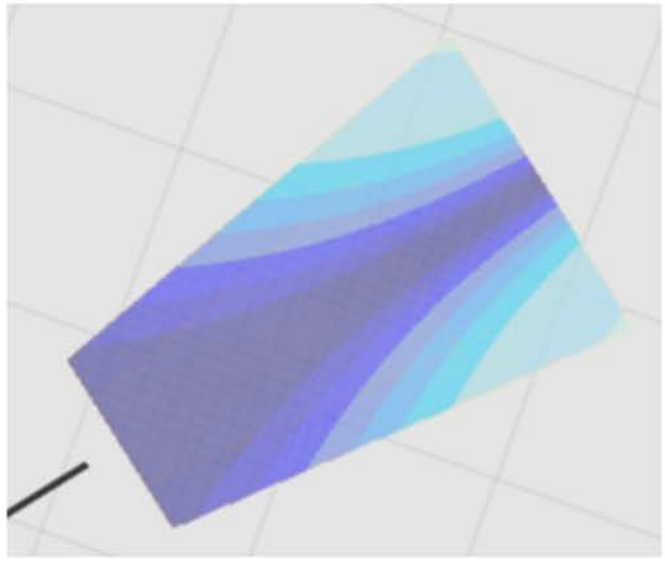
	2	20	6	24
Arrivals	6%	4%	19%	71%
Departures	6%	17%	61%	16%
RPZ Challenges	9%	5%	35%	50%

Crash Likelihood Contours

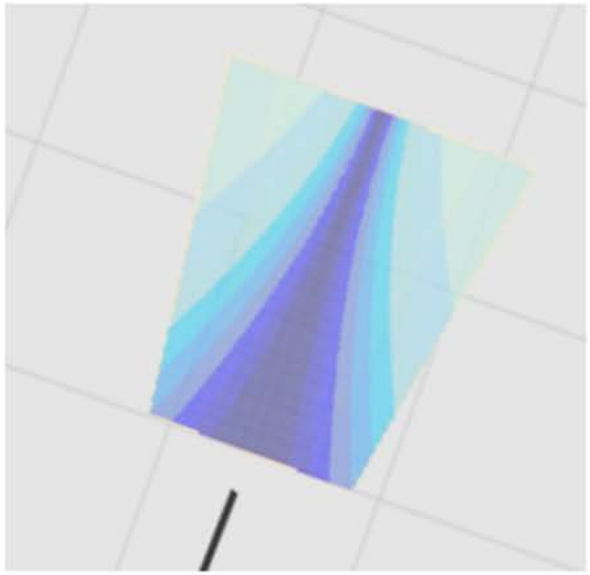
- 1.43e-008
- 2.33e-008
- 3.35e-008
- 4.73e-008
- 6.59e-008
- 9.44e-008
- 1.45e-007
- 2.46e-007
- 5.51e-007
- 2.39e-004



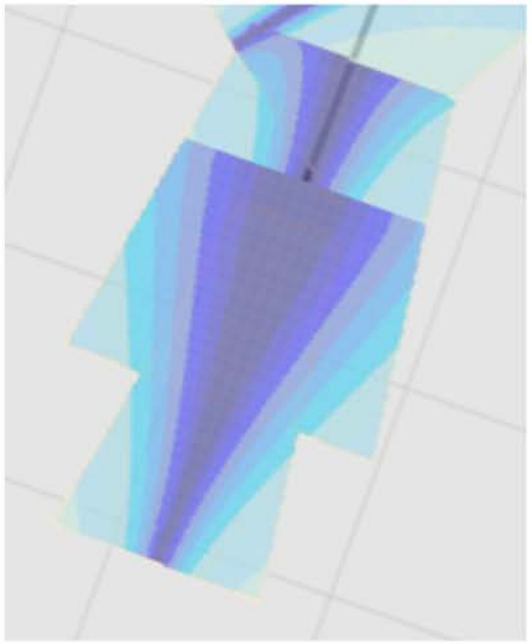
Runway 6 RPZ



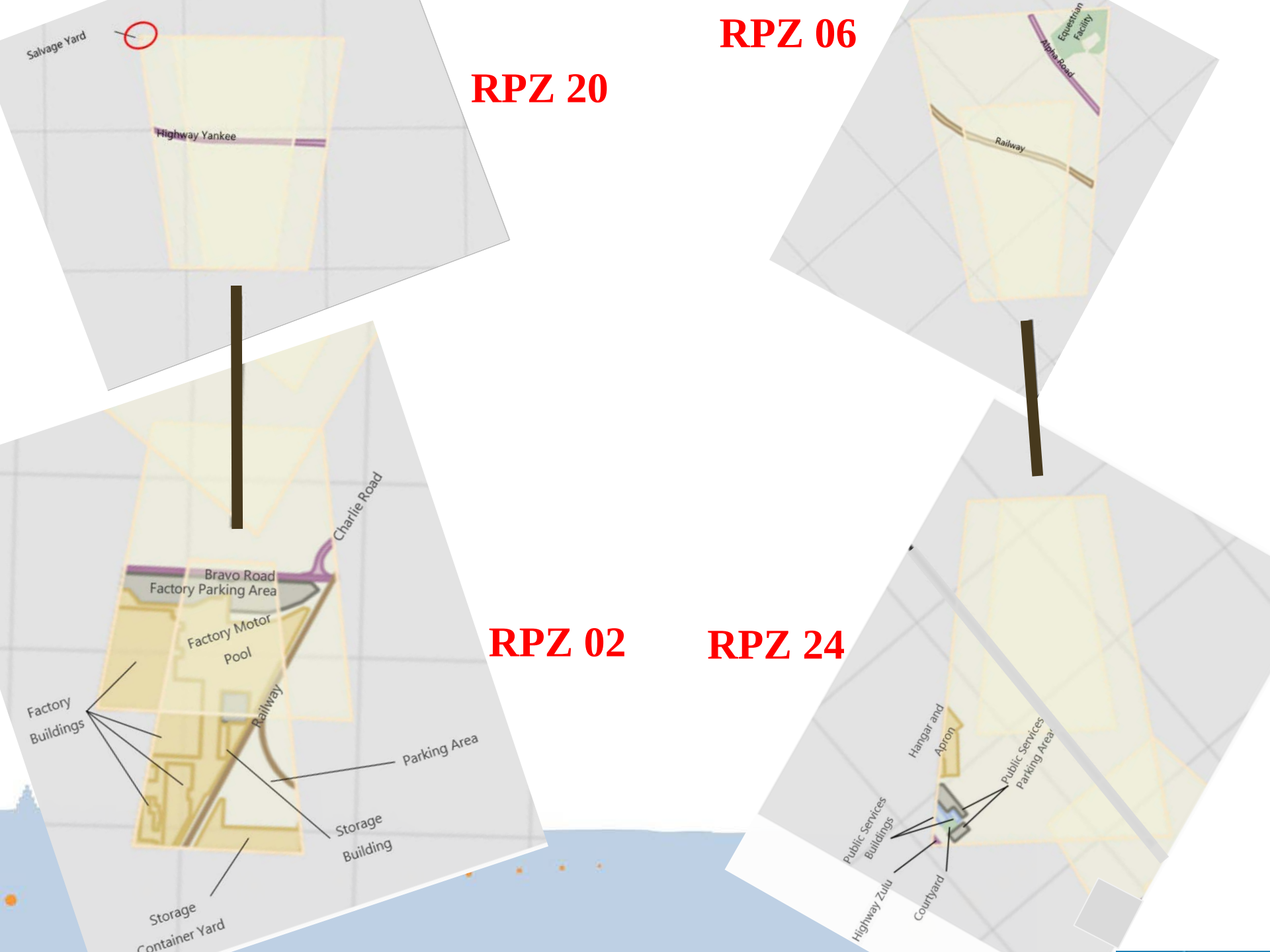
Runway 24 RPZ



Runway 20 RPZ



Runway 2 RPZ


RPZ 20
Salvage Yard
Highway Yankee
RPZ 06
Equestrian Facility
Alpha Road
Railway
RPZ 02
Charlie Road
Bravo Road
Factory Parking Area
Factory Motor Pool
Railway
Factory Buildings
Parking Area
Storage Building
Storage Container Yard
RPZ 24
Hangar and Apron
Public Services Parking Area
Public Services Buildings
Highway Zulu
Courtyard

Land Use Population Densities

Land use category	Site-specific land uses	Population density assumption, persons per acre
Industrial (Indoor)	Factory buildings 1-5 (factory/processing)	144 p/a
Industrial (Indoor)	Factory storage facility, hangar building	44 p/a
Industrial (Outdoor)	Motor pool, storage container yard, salvage yard	11 p/a
Institutional	Public service buildings	205 p/a
Parking	All parking areas	5 p/a
Recreation (indoor)	Equestrian training facilities and wash rack	87 p/a
Recreation (outdoor)	Outdoor equestrian area	5 p/a
Recreation (outdoor)	Courtyard	11 p/a

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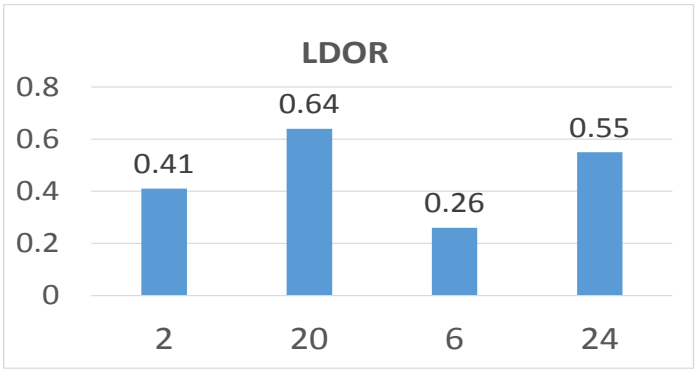
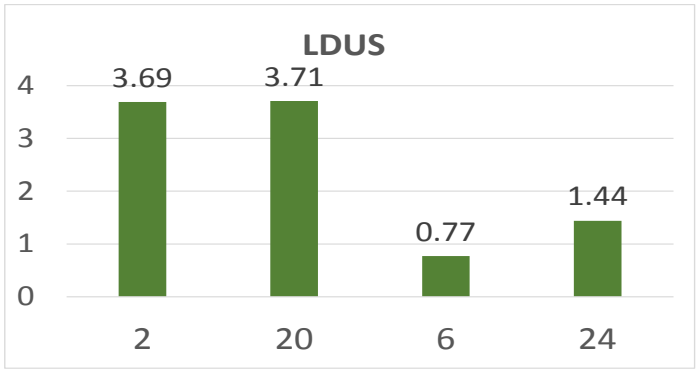
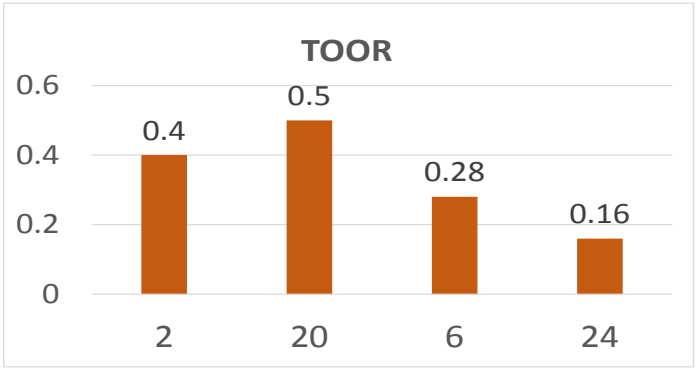
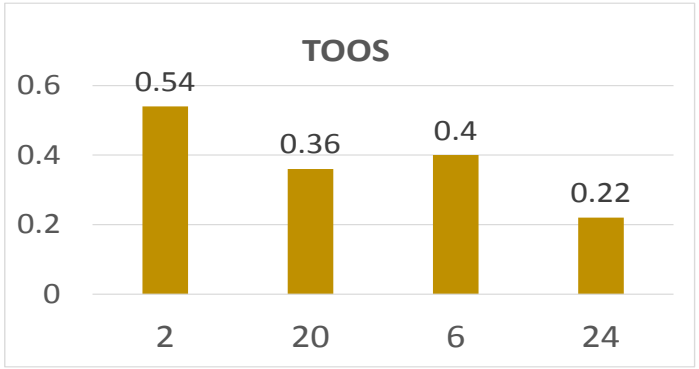
Part 1- Accident Likelihood Models

Average Estimated Excursions in Every 10 Million Movements









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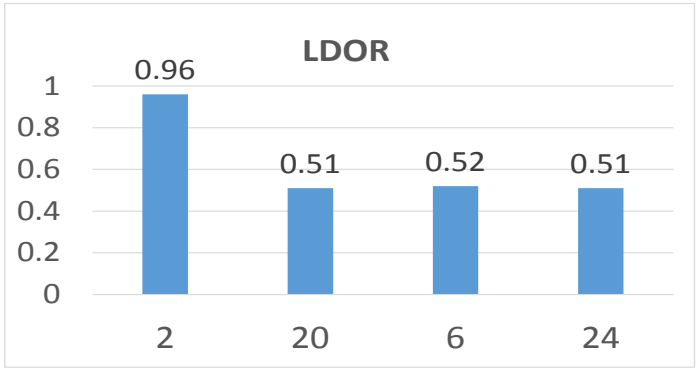
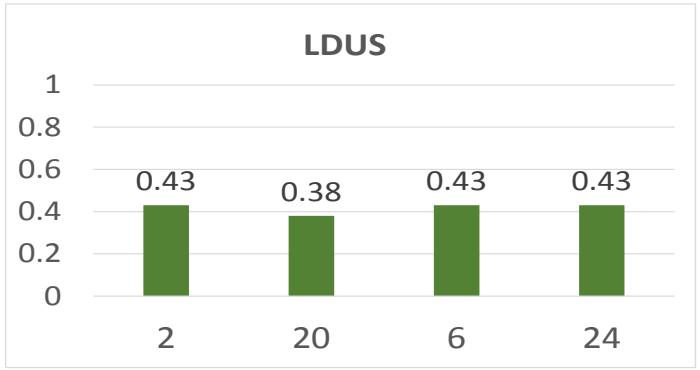
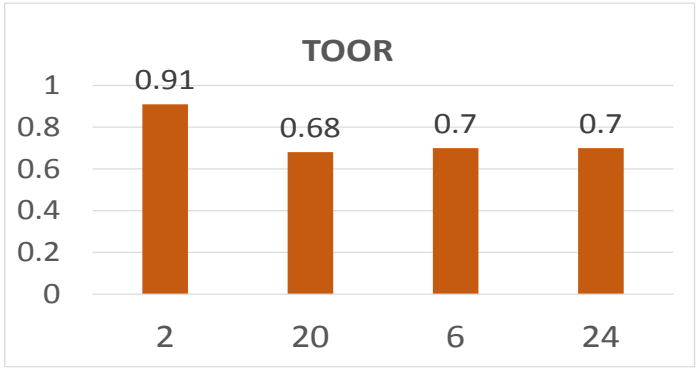
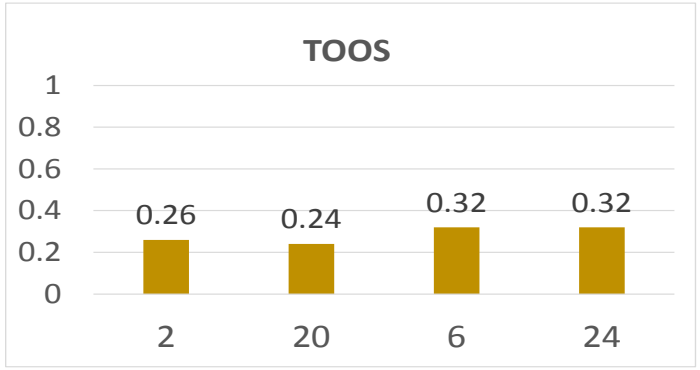
Part 2- Location Model

Likelihood of an **occurred** excursion entering the RPZ









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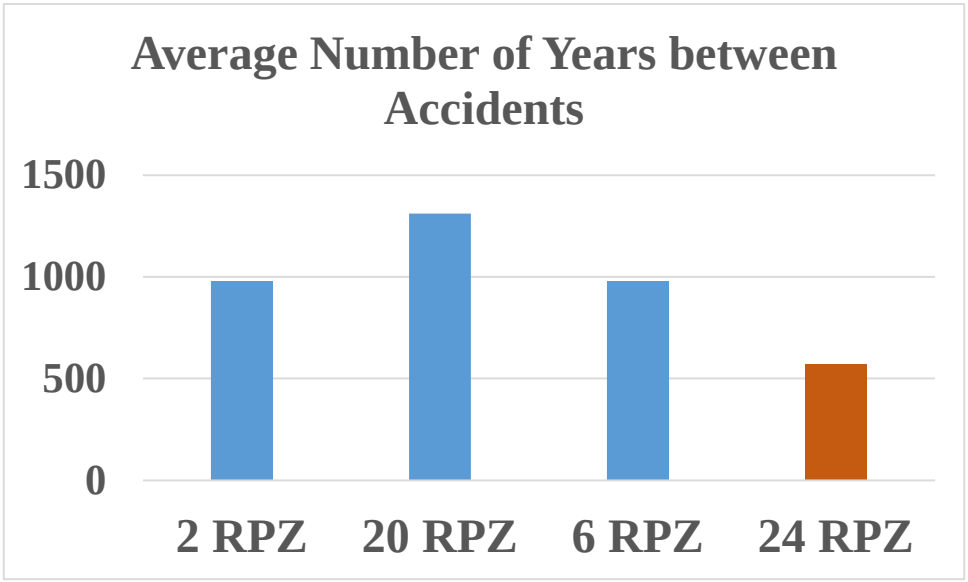
RPZ Crash Likelihoods
(Parts 1 and 2 of Models Results)



RPZ	Rank
2	3
20	4
6	2
24	1

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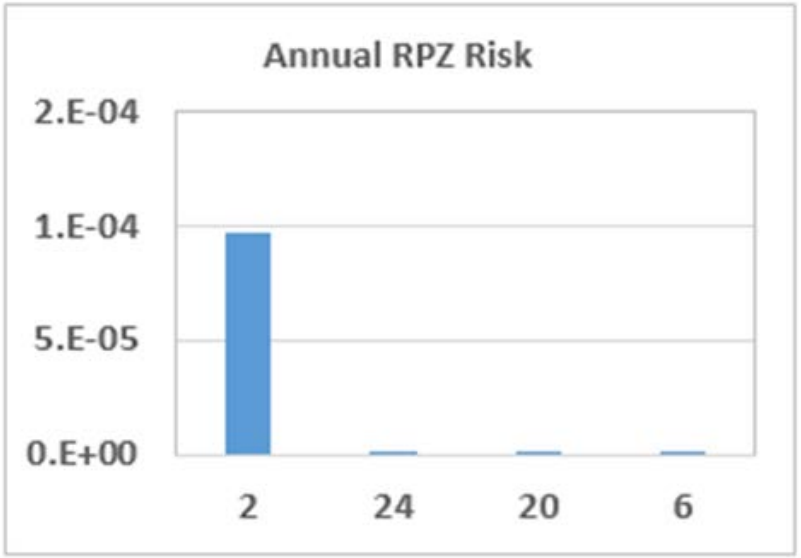
RPZ Risk Rankings

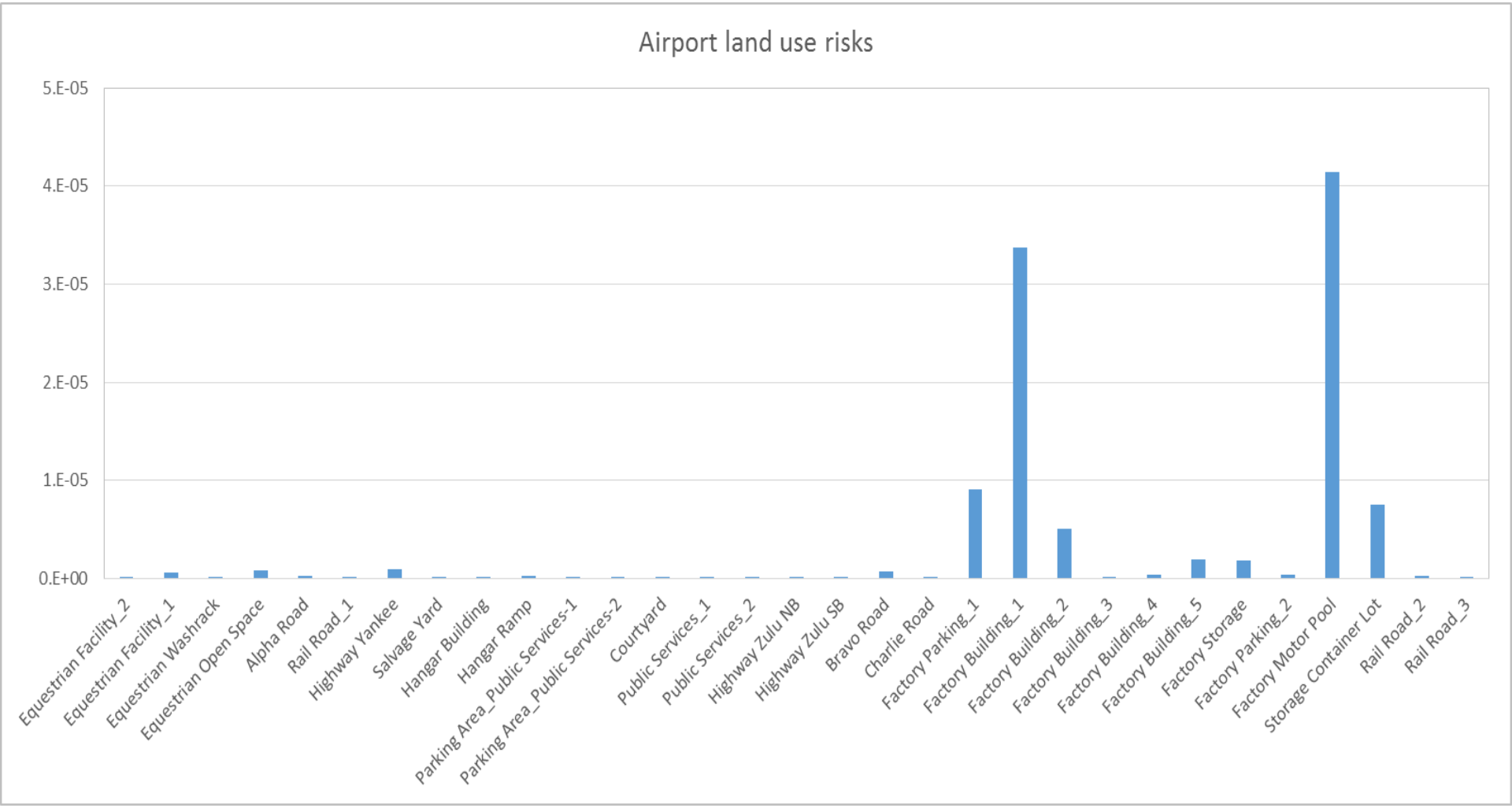
Runway 2 RPZ had the highest risk. Contributing factors included:

- Relatively intense developments
- Relative proximity of the developments to the runway end and around the extended runway centerline
- Operation type on the runway

RPZ	Annual RPZ Risk	Avrg Years btwn fatal accidents	Risk Rank
2	9.7E-05	1,539	1
24	1.4E-06	3,634	2
20	9.1E-07	3,853	3
6	5.5E-07	4,101	4



Case Study Airport Land Use Risks



Q & A

Q: Relocation of the landing threshold to clear the RPZ from an incompatible land use is often viewed as a solution. Does it always reduce airport risk?

A: It always reduces the risk of the RPZ of the landing runway. However, it may have adverse effects on the RPZ of the paired runway end.

L&B and ARA Hershey Presentation, 2015.

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For additional information:

ACRP Report 168

Runway Protection Zone Risk Assessment Tool

- Hamid Shirazi

  hshirazi@ara.com

http://www.trb.org/Publications/Blurbs/174951.aspx

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Questions?

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Today's Participants

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- Hamid Shirazi, *Applied Research Associates*, hshirazi@ara.com

Panelists Presentations

http://onlinepubs.trb.org/onlinepubs/webinars/180207.pdf

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