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Incorporating spatial insight for evidence-based data analysis and modelling

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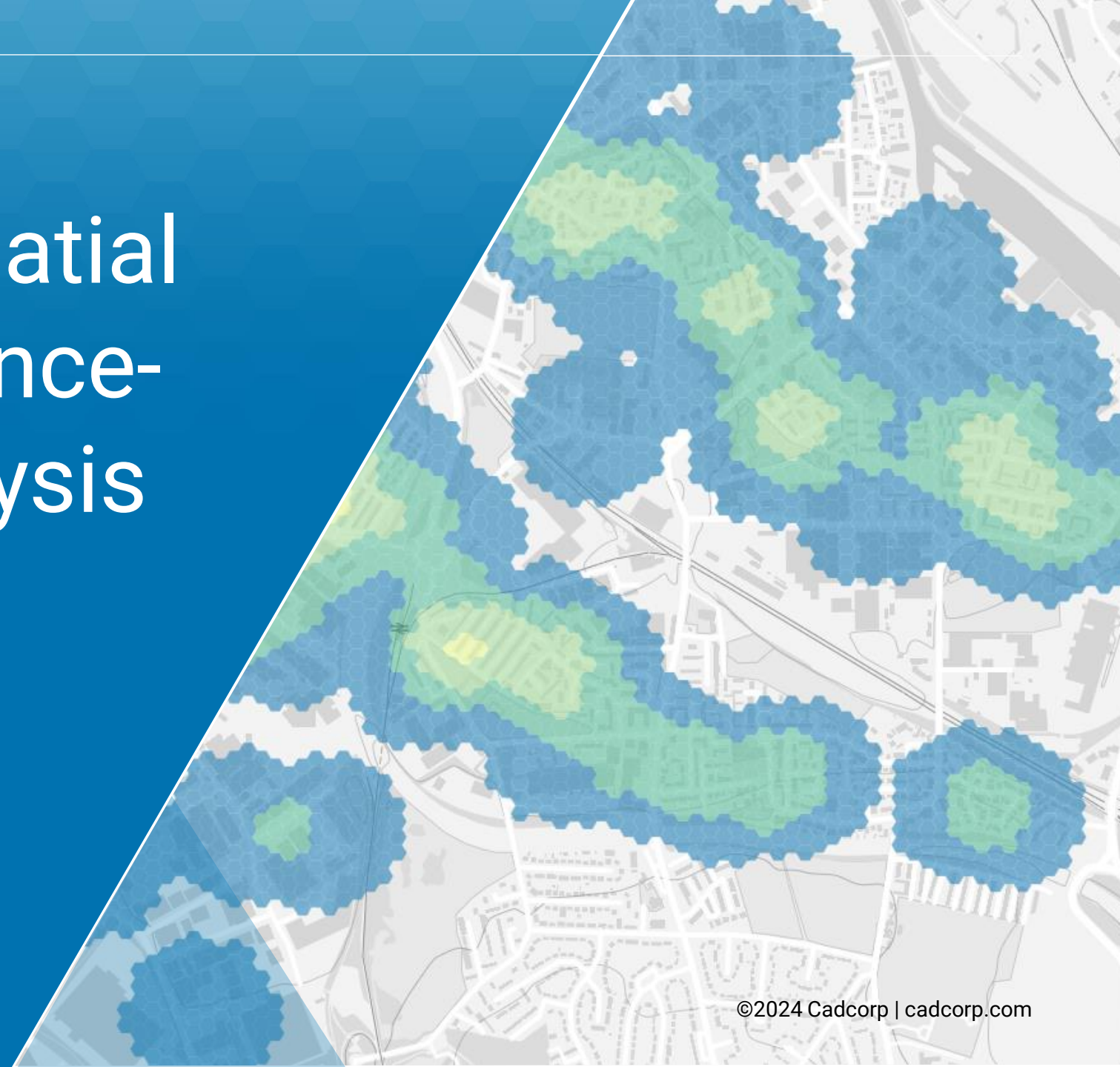
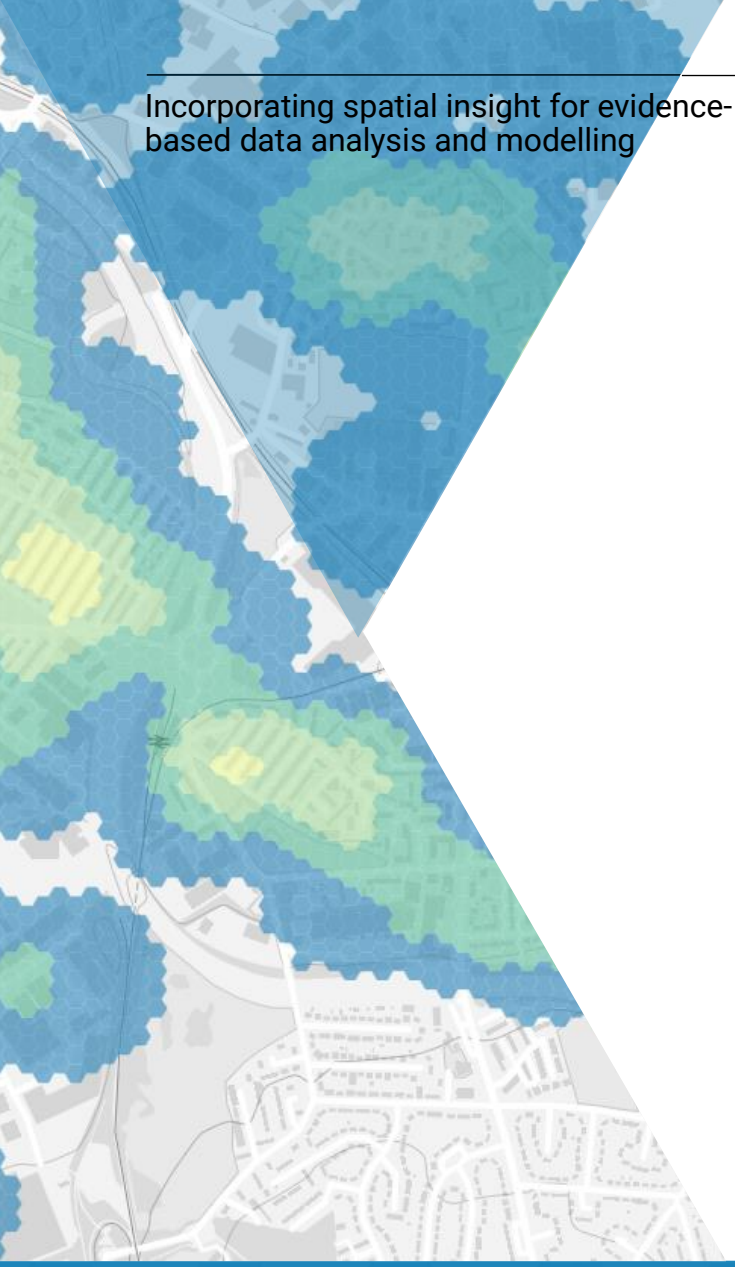
Cadcorp®





Spatial Insight

- **The location of frontline resources is fundamental to attendance times**
- **Time is critical for emergency response performance**
- **Spatial insight is a key element of risk analysis, resource planning and strategic management**

Software and Services for Data-Driven Modelling

- **Cadcorp tools and software**
  - SIS Desktop
    - Workload Modeller
    - Risk Modeller
- **Project consultancy services**
  - Workload Modelling
  - Risk Modelling, NFCC National Definition of Risk
  - Response and coverage modelling
  - Tailored work packages

Project Case Study

- **Asset Strategy Project**
- **Emergency Cover Review**
  - Data and analyses to support decision making
  - Ensure resources are being used as efficiently as possible
    - Review current resources, understand current cover and limitations
  - Assess the impact of reducing resources
    - Single pump station model
  - Consider the relocation of resources to improve performance and coverage of high risk areas
    - Create station location value ranking

Evaluation of a single pump station model

- **Leaving every station with just their “main” fire appliance**
- **Modelled 5 year Base Case – Workload Modeller**
  - Allows for direct comparison between scenario model and current resources
  - Two route cost databases
    - Decision making replicates Control Room
    - Travelling uses OS Average Speed Data

Evaluation of a single pump station model

- **Single Pump Station Model run with same assumptions and parameters as Base Case**
  - Road speeds, turnout times, turnout rules, availability
  - Any differences observed can be attributed only to the changes in resources
  - Reducing appliances from 34 to 25
- **Impact on distribution of callouts – responding stations**

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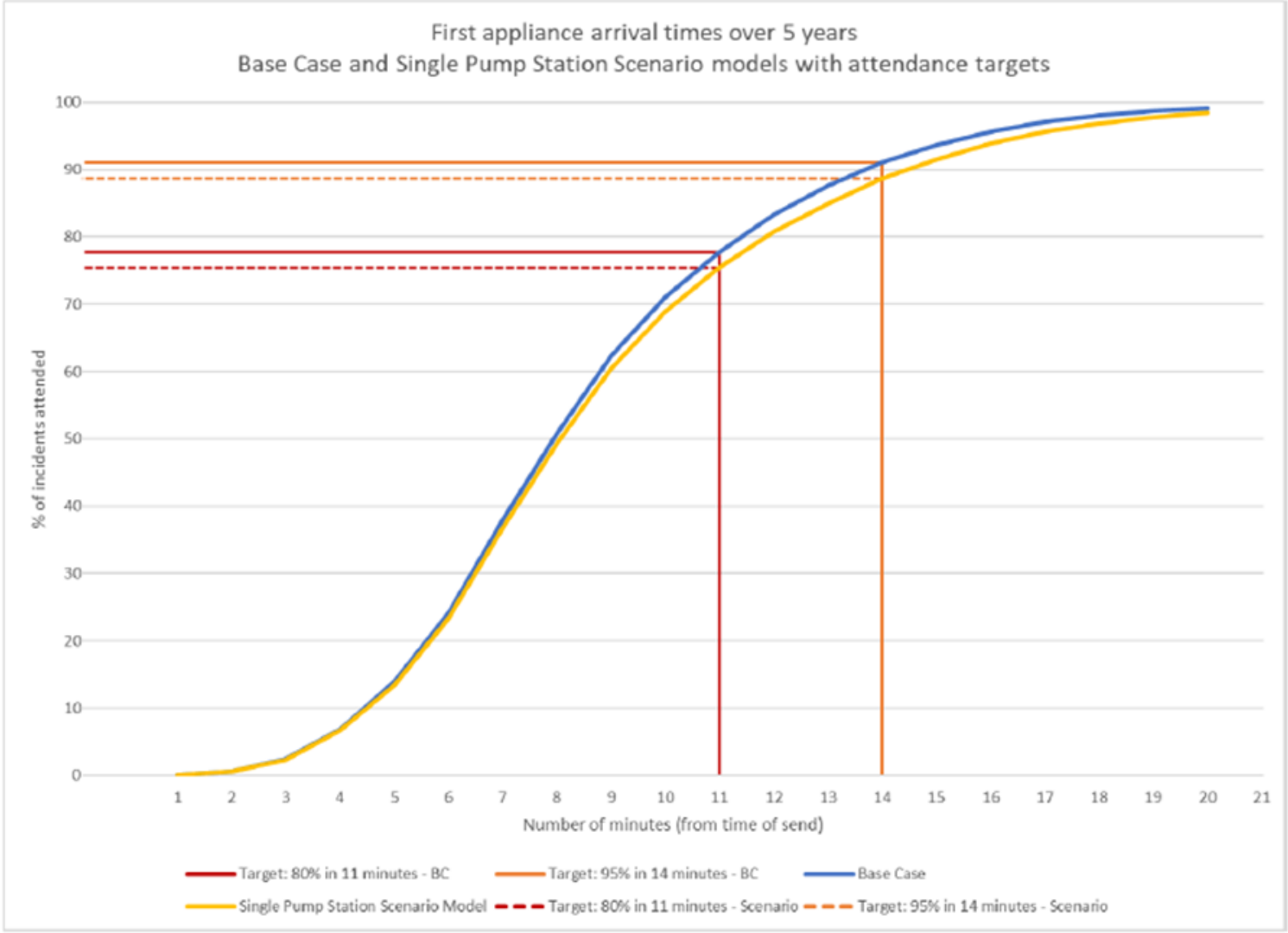
Station ID	% of Callouts - Base Case	% of Callouts - Single Pump Stations Model	Change
9	4.7%	7.1%	2.3%
33	14.1%	15.4%	1.3%
11	1.2%	2.3%	1.0%
31	1.5%	2.1%	0.6%
12	1.0%	1.5%	0.5%
15	1.5%	1.9%	0.4%
25	7.3%	7.6%	0.3%
5	0.7%	0.9%	0.2%
34	2.3%	2.5%	0.2%
8	0.7%	0.9%	0.2%
32	1.7%	1.9%	0.2%
27	2.7%	2.8%	0.1%
7	1.3%	1.4%	0.1%
28	1.7%	1.7%	0.1%
6	1.7%	1.7%	0.1%
26	2.3%	2.4%	0.0%
14	1.3%	1.4%	0.0%
17	1.0%	1.1%	0.0%
29	2.6%	2.6%	0.0%
30	2.6%	2.3%	-0.3%
35	5.9%	5.4%	-0.6%
13	4.4%	3.6%	-0.8%
10	6.5%	5.3%	-1.2%
4	8.9%	7.7%	-1.2%
24	20.2%	16.7%	-3.5%

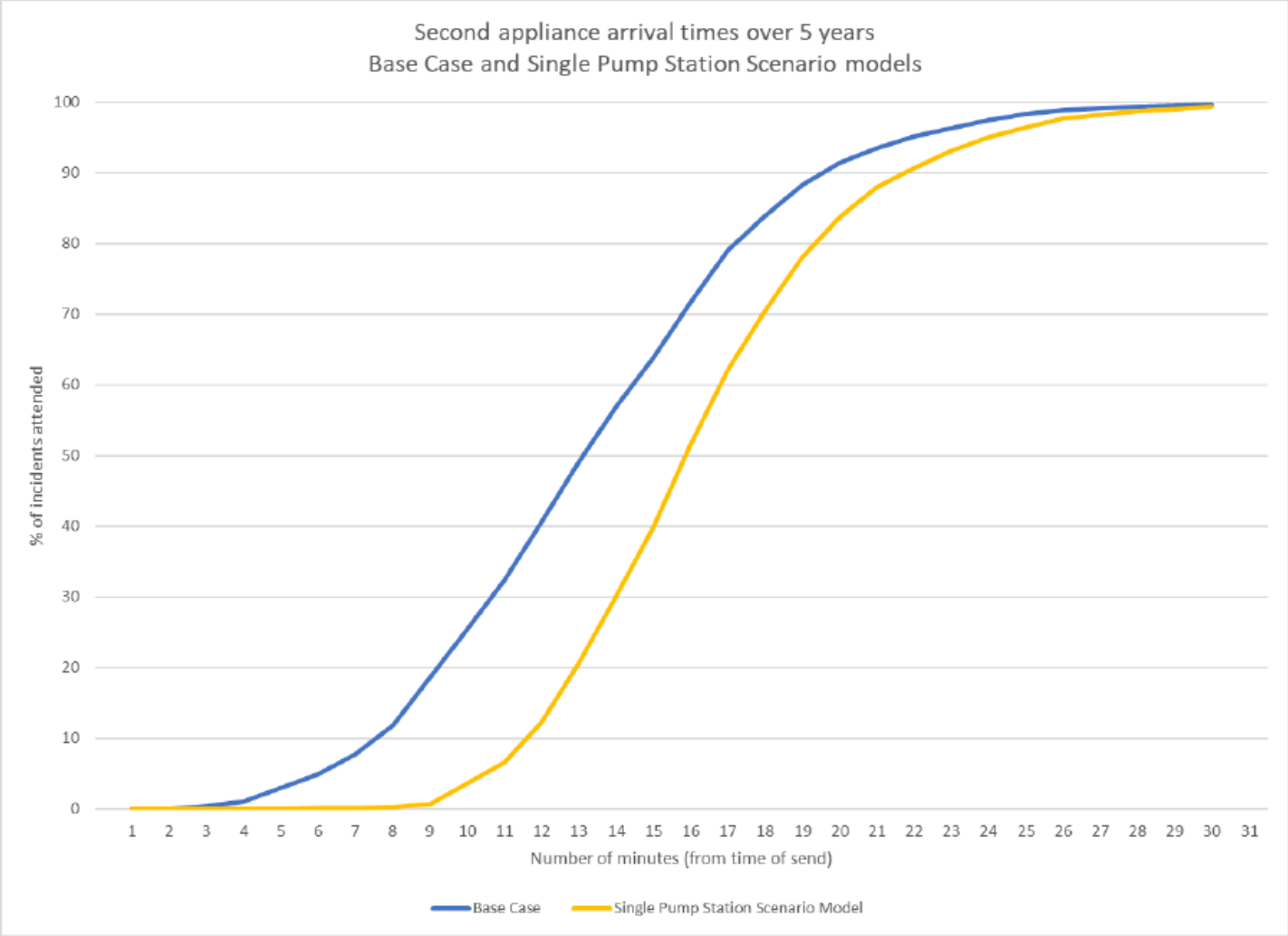
Evaluation of a single pump station model

- **Single Pump Station Model run with same assumptions and parameters as Base Case**
  - Road speeds, turnout times, turnout rules, availability
  - Any differences observed can be attributed only to the changes in resources
  - Reducing appliances from 34 to 25
- **Impact on distribution of callouts – responding stations**
- **Impact on attendance performance against two targets**
  - 80% of first pump attendances within 11 minutes from Time of Send
  - 95% of first pump attendances within 14 minutes from Time of Send



Evaluation of a single pump station model

- **Single Pump Station Model run with same assumptions and parameters as Base Case**
  - Road speeds, turnout times, turnout rules, availability
  - Any differences observed can be attributed only to the changes in resources
  - Reducing appliances from 34 to 25
- **Impact on distribution of callouts – responding stations**
- **Impact on attendance performance against targets**
- **Impact on second appliance performance**



% of 2nd Pump Arrivals Within	Base Case	Single Pump Station Scenario	Difference
10 minutes	25.4	3.6	-21.8
15 minutes	63.9	40.0	-24.0
20 minutes	91.4	83.7	-7.7
25 minutes	98.3	96.4	-1.9
30 minutes	99.7	99.4	-0.4

Assessing Station Value by Location

- **Aiming to rank each station based only on the value of its location, not its current resources**
  - Equalised Station Model – one wholetime appliance at each of the 25 existing stations
- **Analysing contribution to overall attendance performance**
  - 25 individual scenario models, based on the Equalised Station Model, each with one of the stations removed
  - Examine performance of each scenario compared to full Equalised Station Model, to determine which removals have the most detrimental impact
    - Overall attendance against targets
    - Attendance to high risk areas

Model	Incidents in High Risk Areas			Difference		
	Mean 1st Pump Attendance Time (mins)	% of Incs in 11 minutes Target: 80	% of Incs in 14 minutes Target: 95	Mean 1st Pump Attendance Time (mins)	% of Incs in 11 minutes Target: 80	% of Incs in 14 minutes Target: 95
Base Case: tblMO_Equalised_All_Stations	5.9	**87.0**	94.3	-	-	-
Station 4 removed	7.0	74.9	87.9	1.1	-12.1	-6.4
Station 5 removed	6.0	**86.8**	93.8	0.1	-0.2	-0.6
Station 6 removed	6.9	78.3	89.9	1.0	-8.7	-4.4
Station 7 removed	6.0	**86.7**	94.2	0.0	-0.3	-0.1
Station 8 removed	6.0	**86.4**	94.4	0.1	-0.6	0.1
Station 9 removed	6.0	**86.8**	94.1	0.0	-0.2	-0.2
Station 10 removed	5.9	**87.0**	94.3	0.0	0.0	0.0
Station 11 removed	6.2	**86.5**	94.0	0.2	-0.5	-0.4
Station 12 removed	6.0	**86.8**	94.2	0.0	-0.2	-0.1
Station 13 removed	6.0	**86.8**	94.2	0.0	-0.2	-0.1
Station 14 removed	6.9	78.3	88.3	1.0	-8.7	-6.0
Station 15 removed	6.0	**86.7**	93.9	0.0	-0.3	-0.5
Station 17 removed	6.0	**86.8**	94.2	0.0	-0.2	-0.1
Station 24 removed	8.3	66.0	78.1	2.3	-21.0	-16.2
Station 25 removed	5.9	**87.1**	94.3	0.0	0.1	0.0
Station 26 removed	6.2	**84.1**	90.9	0.3	-2.8	-3.4
Station 27 removed	6.2	**85.7**	93.5	0.2	-1.2	-0.8
Station 28 removed	6.0	**86.5**	94.1	0.0	-0.5	-0.3
Station 29 removed	5.9	**87.0**	94.3	0.0	0.0	0.0
Station 30 removed	7.1	75.9	93.3	1.2	-11.0	-1.0
Station 31 removed	6.0	**86.6**	93.2	0.1	-0.4	-1.1
Station 32 removed	6.0	**86.9**	94.2	0.0	-0.1	-0.1
Station 33 removed	6.3	**84.1**	91.2	0.4	-2.8	-3.1
Station 34 removed	6.1	**85.8**	93.0	0.1	-1.1	-1.3
Station 35 removed	7.9	69.8	86.3	2.0	-17.2	-8.0

Assessing Station Value by Location

- **Ranking stations based on the two performance measures**

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Value Rank	Performance Measure	
	% of incidents in High Risk Areas attended within 11 minutes	% of incidents in High Risk Areas attended within 14 minutes
	Station Code	Station Code
1 (Most Valuable)	24	24
2	35	35
3	4	4
4	34	30
5	6	6
6	30	14
7	14	26
8	26	33
9	8	27
10	33	34
11	25	8
12	15	11
13	31	28
14	27	31
15	28	15
16	5	7
17	7	5
18	9	9
19	11	12
20	12	13
21	13	17
22	17	32
23	32	10
24	10	29
25 (Least Valuable)	29	25

Station Code	Highest Rank	Lowest Rank	Rank Range
25	11	25	14
34	3	10	7
27	9	14	5
11	12	17	5
31	9	14	5
17	17	22	5
28	13	17	4
33	8	11	3
15	12	15	3
9	17	20	3
13	17	20	3
29	22	25	3
30	4	6	2
14	6	8	2
8	9	11	2
5	15	17	2
10	22	24	2
4	3	4	1
26	7	8	1
7	16	17	1
32	22	23	1
24	1	1	0
35	2	2	0
6	5	5	0
12	17	17	0

Assessing Station Value by Location

- **Ranking stations based on the two performance measures**
  - Using 11 minute measure as primary and 14 minute measure as secondary, there were a lot of joint rankings
  - A third measure was introduced to create final rankings

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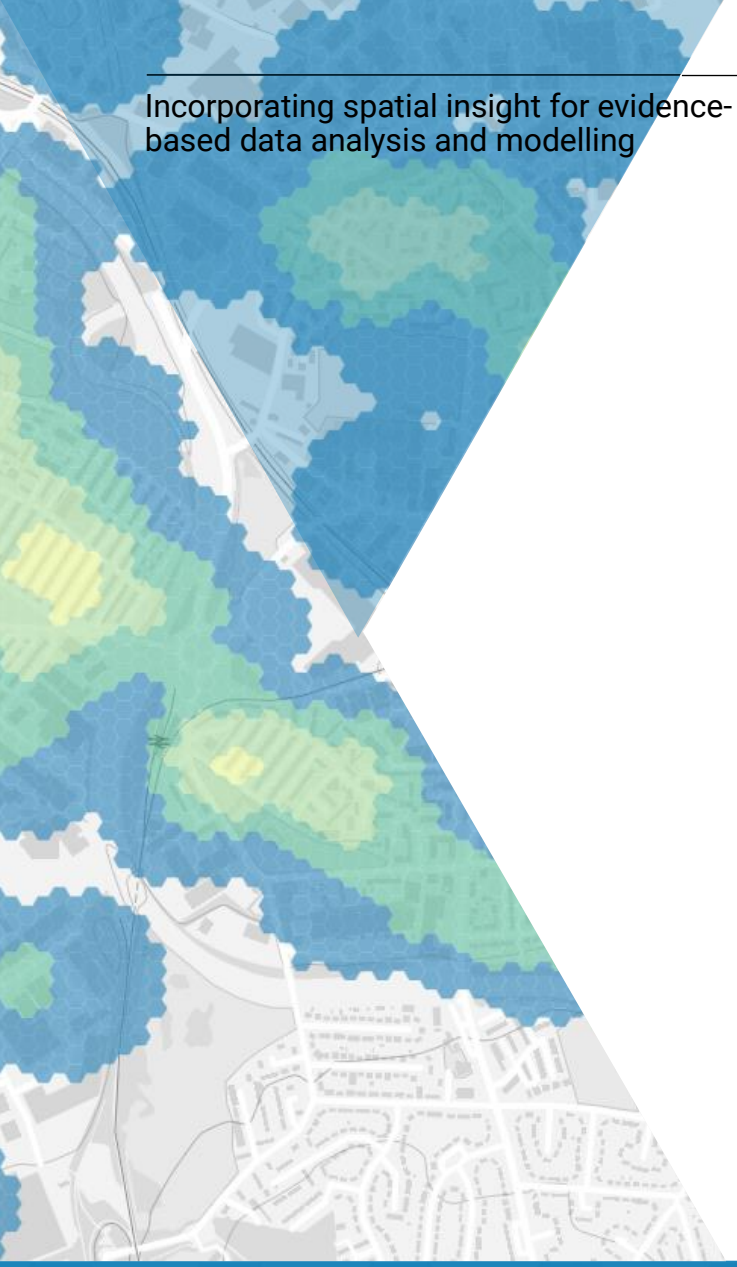
Station Code	Primary Ranking	Secondary Ranking	Tertiary Ranking	Overall Ranking
	% of incidents in High Risk Areas attended within 11 minutes	% of incidents in High Risk Areas attended within 14 minutes	Mean 1st Pump attendance time to incidents in High Risk areas (mins)	
24	66.0	78.1	8.3	1
35	69.8	86.3	7.9	2
4	74.9	87.9	7.0	3
34	75.9	93.3	7.1	4
6	78.3	89.9	6.9	5
30	78.3	88.3	6.9	6
14	84.1	90.9	6.2	7
26	84.1	91.2	6.3	8
8	85.7	93.5	6.2	9
33	85.8	93.0	6.1	10
25	86.4	94.4	6.0	11
31	86.5	94.0	6.2	12
15	86.5	94.1	6.0	13
27	86.6	93.2	6.0	14
28	86.7	93.9	6.0	15
5	86.7	94.2	6.0	16
11	86.8	93.8	6.0	17
7	86.8	94.1	6.0	18
12	86.8	94.2	6.0	19=
9	86.8	94.2	6.0	19=
13	86.8	94.2	6.0	19=
17	86.9	94.2	6.0	22
32	87.0	94.3	5.9	23
10	87.0	94.3	5.9	24
29	87.1	94.3	5.9	25



Assessing Station Locations Value by Time of Day

- Looking at each station’s share of mobilisations at different times of day and days of the week
- Equalised Station Model
- Relative importance of each station location throughout the day
- Separate analysis performed for weekdays and weekends
- Crossover point of top 2 stations

Week Days	Percentage of Time Period's Mobilisations Assigned to each Station																							
Time	4	5	6	7	8	9	10	11	12	13	14	15	17	24	25	26	27	28	29	30	31	32	33	34	35	
00:00:00	6.5%	1.1%	2.1%	1.9%	2.2%	5.8%	4.5%	3.2%	2.4%	4.5%	1.2%	1.7%	1.1%	18.3%	6.3%	2.2%	2.4%	1.7%	2.1%	1.9%	3.2%	2.2%	14.1%	2.6%	4.9%	100%
01:00:00	6.4%	0.8%	2.2%	1.7%	1.7%	5.5%	5.0%	3.0%	1.7%	3.5%	1.2%	1.6%	1.5%	21.2%	6.0%	2.1%	2.2%	1.3%	2.1%	1.9%	3.1%	1.8%	15.3%	2.7%	4.3%	100%
02:00:00	5.0%	0.9%	2.3%	2.2%	1.5%	5.5%	4.2%	2.8%	1.8%	3.3%	2.0%	1.5%	1.4%	19.7%	5.8%	2.0%	3.1%	1.9%	1.9%	2.2%	3.9%	2.3%	15.0%	2.7%	4.9%	100%
03:00:00	5.6%	0.7%	1.9%	1.6%	2.1%	6.0%	4.7%	1.7%	2.0%	3.6%	1.7%	1.3%	0.9%	19.9%	6.7%	2.5%	3.2%	2.2%	3.1%	1.9%	3.1%	2.3%	13.8%	2.8%	4.7%	100%
04:00:00	5.2%	0.6%	2.2%	1.6%	2.8%	7.1%	5.8%	2.3%	2.2%	4.2%	1.9%	2.1%	1.0%	18.1%	5.4%	2.8%	2.8%	2.2%	2.9%	2.2%	2.9%	2.2%	12.9%	2.0%	4.8%	100%
05:00:00	6.7%	0.7%	1.8%	1.4%	3.1%	7.1%	5.6%	3.1%	2.3%	4.2%	1.3%	1.4%	1.1%	17.2%	6.6%	2.0%	2.4%	1.2%	2.6%	2.3%	3.1%	3.1%	11.6%	2.4%	5.6%	100%
06:00:00	7.8%	0.6%	1.9%	1.2%	2.1%	5.7%	5.9%	3.1%	1.7%	3.5%	1.5%	1.2%	0.9%	18.1%	5.8%	2.2%	2.5%	1.5%	3.0%	2.7%	2.7%	2.5%	13.5%	3.1%	5.1%	100%
07:00:00	8.5%	1.4%	1.5%	1.3%	2.1%	5.7%	5.5%	3.2%	1.6%	2.9%	1.1%	1.2%	0.9%	17.2%	7.5%	2.3%	3.0%	1.8%	2.7%	2.5%	2.9%	1.9%	12.8%	3.2%	5.4%	100%
08:00:00	7.0%	1.5%	1.9%	1.4%	2.1%	4.9%	4.5%	3.1%	1.8%	3.8%	1.3%	1.6%	1.7%	15.2%	7.8%	2.9%	2.9%	2.0%	2.5%	2.4%	2.8%	1.9%	13.7%	3.2%	6.0%	100%
09:00:00	7.2%	0.9%	2.3%	1.5%	2.6%	6.1%	5.1%	3.5%	2.5%	3.7%	1.3%	1.6%	1.6%	14.0%	7.1%	2.5%	3.0%	1.8%	2.2%	2.0%	3.3%	1.9%	13.1%	3.3%	5.9%	100%
10:00:00	7.6%	1.1%	2.3%	1.2%	2.2%	5.4%	5.7%	3.1%	1.8%	3.4%	1.4%	2.0%	1.2%	14.2%	7.9%	2.9%	3.5%	2.2%	3.0%	2.2%	3.0%	2.3%	12.9%	2.5%	5.0%	100%
11:00:00	6.3%	0.9%	2.0%	1.5%	2.4%	5.7%	5.0%	3.1%	2.2%	3.6%	1.7%	1.9%	1.7%	13.8%	7.2%	2.3%	3.5%	2.3%	3.6%	1.8%	2.5%	2.5%	14.4%	2.6%	5.4%	100%
12:00:00	6.9%	1.1%	2.4%	1.3%	2.8%	5.6%	5.6%	2.7%	2.4%	3.0%	1.8%	2.2%	1.6%	12.8%	6.9%	2.4%	3.2%	1.6%	3.4%	2.5%	3.2%	2.4%	14.0%	2.8%	5.5%	100%
13:00:00	6.3%	1.2%	2.8%	1.8%	2.5%	6.1%	5.9%	2.8%	2.4%	3.8%	1.6%	2.1%	1.4%	12.3%	6.2%	2.7%	3.3%	1.5%	3.0%	2.3%	3.7%	2.3%	13.5%	3.1%	5.3%	100%
14:00:00	6.4%	1.3%	2.4%	1.6%	2.8%	5.4%	5.8%	3.1%	2.3%	3.9%	1.9%	2.5%	1.3%	11.1%	6.8%	2.7%	3.5%	1.9%	2.6%	2.6%	3.2%	2.7%	12.9%	3.5%	5.8%	100%
15:00:00	6.3%	1.3%	2.4%	1.7%	2.4%	5.6%	5.8%	3.6%	2.6%	3.6%	1.8%	2.1%	1.4%	11.6%	6.3%	2.4%	3.5%	2.2%	2.5%	2.6%	4.1%	2.8%	12.5%	3.1%	5.8%	100%
16:00:00	7.1%	1.5%	2.2%	1.6%	2.5%	6.0%	6.4%	3.6%	2.7%	4.2%	1.9%	2.1%	1.5%	11.3%	6.4%	2.3%	3.2%	1.9%	2.2%	2.5%	3.7%	1.9%	12.8%	3.0%	5.2%	100%
17:00:00	6.9%	1.3%	2.1%	1.6%	2.5%	5.3%	5.5%	3.7%	2.7%	4.5%	1.9%	2.6%	1.5%	12.0%	7.1%	3.0%	3.2%	2.1%	2.4%	2.4%	3.1%	1.9%	12.7%	3.0%	5.1%	100%
18:00:00	6.9%	1.4%	2.2%	1.6%	2.2%	5.3%	5.7%	3.0%	2.1%	4.8%	1.7%	2.4%	1.3%	12.9%	6.5%	2.9%	3.4%	2.1%	2.3%	2.4%	3.5%	2.0%	13.7%	3.0%	5.0%	100%
19:00:00	5.9%	1.3%	1.7%	1.8%	2.5%	5.7%	5.9%	2.6%	2.1%	4.4%	1.7%	2.3%	1.6%	13.6%	6.7%	2.9%	3.0%	2.3%	2.7%	2.4%	3.2%	1.9%	13.6%	3.3%	4.8%	100%
20:00:00	5.9%	1.1%	1.6%	1.5%	2.7%	5.8%	5.5%	2.6%	2.2%	3.1%	1.4%	2.0%	1.4%	15.2%	7.4%	2.4%	2.8%	1.8%	2.1%	2.6%	3.7%	1.9%	14.8%	3.2%	5.2%	100%
21:00:00	7.0%	1.1%	1.6%	1.4%	2.1%	5.2%	5.0%	2.7%	2.4%	3.3%	1.2%	2.1%	1.3%	14.7%	6.9%	2.5%	3.0%	1.6%	2.4%	2.3%	3.3%	2.0%	16.4%	3.1%	5.3%	100%
22:00:00	6.0%	1.1%	1.7%	1.6%	1.8%	5.2%	5.1%	3.3%	2.2%	4.1%	1.5%	2.6%	1.1%	15.7%	6.0%	2.7%	3.0%	1.8%	3.0%	2.2%	3.2%	2.4%	15.1%	3.0%	4.5%	100%
23:00:00	5.9%	1.1%	1.9%	1.8%	2.2%	5.1%	4.5%	3.0%	2.5%	4.5%	1.4%	2.1%	0.8%	17.4%	5.7%	2.7%	3.0%	2.1%	2.4%	2.0%	3.5%	2.1%	15.5%	2.7%	4.3%	100%

Assessing Station Location Value by Time of Day

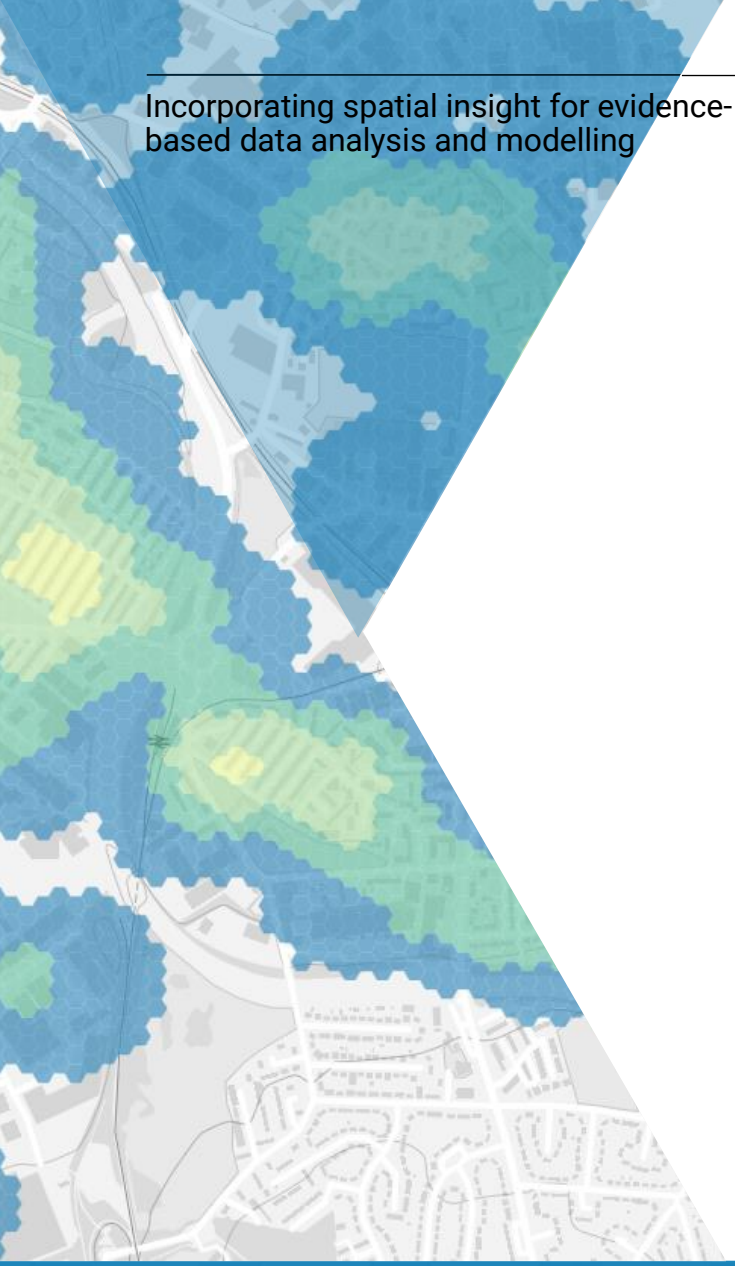
- **Looking at each station's share of mobilisations at different times of day and days of the week**
- **Equalised Station Model**
- **Relative importance of each station throughout the day**
- **Separate analysis performed for weekdays and weekends**
- **Crossover point of top 2 stations**
- **Rankings for three named time periods**
  - Week Day – Day Time
  - Week Day – Night Time
  - Weekend

Station Code	Week Day: 08:00 - 18:00 Mon - Fri		Week Night: 18:00 - 08:00 Mon PM - Fri AM		Weekend: 18:00 Fri - 08:00 Mon	
	% of Mobilisations	Rank	% of Mobilisations	Rank	% of Mobilisations	Rank
4	6.67%	4	6.69%	3	6.32%	4
5	1.25%	25	1.15%	25	1.03%	25
6	2.33%	18	1.89%	19	1.68%	21
7	1.60%	23	1.68%	22	1.25%	24
8	2.56%	15	2.08%	18	2.23%	17
9	5.59%	5	5.47%	5	5.70%	5
10	5.58%	6	5.19%	6	5.64%	6
11	3.23%	11	2.97%	11	3.10%	11
12	2.41%	17	2.13%	17	2.13%	18
13	3.89%	8	3.82%	8	3.69%	8
14	1.71%	22	1.52%	23	1.42%	22
15	2.22%	20	1.82%	21	1.99%	20
17	1.51%	24	1.32%	24	1.28%	23
24	12.45%	2	16.32%	1	15.04%	1
25	6.83%	3	6.44%	4	6.86%	3
26	2.65%	14	2.47%	14	2.92%	12
27	3.31%	10	2.85%	12	3.39%	9
28	1.94%	21	1.82%	20	2.02%	19
29	2.72%	13	2.63%	13	2.43%	16
30	2.43%	16	2.22%	15	2.72%	14
31	3.37%	9	3.19%	9	3.24%	10
32	2.25%	19	2.14%	16	2.48%	15
33	13.12%	1	14.40%	2	13.49%	2
34	2.97%	12	3.10%	10	2.86%	13
35	5.43%	7	4.70%	7	5.14%	7

Station Code	Week Day Rank
33	1
24	2
25	3
4	4
9	5
10	6
35	7
13	8
31	9
27	10
11	11
34	12
29	13
26	14
8	15
30	16
12	17
6	18
32	19
15	20
28	21
14	22
7	23
17	24
5	25

Station Code	Week Night Rank
24	1
33	2
4	3
25	4
9	5
10	6
35	7
13	8
31	9
34	10
11	11
27	12
29	13
26	14
30	15
32	16
12	17
8	18
6	19
28	20
15	21
7	22
14	23
17	24
5	25

Station Code	Weekend Rank
24	1
33	2
25	3
4	4
9	5
10	6
35	7
13	8
27	9
31	10
11	11
26	12
34	13
30	14
32	15
29	16
8	17
12	18
28	19
15	20
6	21
14	22
17	23
7	24
5	25



Methodology Recommendations

- **Improvements to modelling**
  - Road speeds and routing
  - Turnout times
  - Incident location recording
- **Alternative models**
  - Over border resources
  - Day and night Static Response Models
- **Deeper analysis**
  - Second appliance attendance times
  - Pre Determined Attendances (pumps and specialist appliances)
  - Profiling of incident types hitting/missing targets
  - Interaction effects of removing more than one station together

Questions?

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