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# A SAFETY ASSESSMENT OF DRIVER FEEDBACK SIGNS AND DEVELOPMENT OF FUTURE EXPANSION PROGRAM

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Summary of Project Findings and Contributions

## Phase I: Traffic Safety Assessment of DFSs

- **Evaluation of DFSs and its impact on traffic safety.** A before-and-after Empirical Bayes (EB) evaluation of DFSs was conducted on urban roads using data provided by the City of Edmonton. Statistically significant reductions were observed for all of collision severities (i.e., PDO, Injury and Severe) and types (i.e., Speed-related, Rear-end and Improper lane changing). The reductions ranged from 32.5% to 44.9%, with the highest percentage reduction in collisions being observed for severe speed-related collisions, followed by the total speed-related collisions. As the initial purpose of installing DFS was to improve compliance to speed limits, these findings are both intuitive and expected. Previous studies only showed that DFSs were effective in reducing speed in specific locations, while the results of this study confirmed their effectiveness for improving overall road safety. Collision reductions for each collision severities and/or types can be found in **Table 1**.

**Table 1 Overall Before-and-After Evaluation Results**

| Collision Severity or Type | Collision Reduction (%) |
|---|---|
| Total | 36.10 |
| DFS only | 33.34 |
| DFS and MPE | 41.61 |
| Arterial | 36.96 |
| Arterial with DFS only | 34.70 |
| Arterial with DFS and MPE | 41.29 |
| Collector | 36.84 |
| Collector with DFS only | 31.02 |
| Collector with DFS and MPE | 87.62 |
| PDO | 34.30 |
| Injury | 36.46 |
| Severe | 36.74 |
| Speed-related | 38.19 |
| Speed-related PDO | 34.69 |
| Speed-related Severe | 44.87 |
| Rear-end | 38.00 |
| Improper lane-changing | 32.52 |

Note: DFS is Driver Feedback Sign; MPE is Mobile Photo Enforcement.

- The EB evaluation of DFSs was repeated on urban arterial and collector roads in the City of Edmonton. A comparison investigation was also conducted between sites treated with only DFSs and those with both DFSs and mobile photo enforcements (MPEs). The results verified that DFSs were able to reduce collisions at all categories of treated sites. The reduced number of collisions were estimated to be 31.02% on collector segments utilizing only DFS, and 41.61% on segments treated with both DFS and MPE. The Total and Arterial categories saw higher reductions when both DFSs and MPEs were used together as compared to using only DFSs. Also, the previous study suggested MPEs can lead to around 14.5% overall reduction in collision frequency on urban arterials by itself. As a result, it can be concluded that the combined use of these two treatments is more effective for improving traffic safety than using only either DFS or MPE. Overall, the results strongly indicate that DFSs were more effective for improving safety on arterial roads as compared to collector roads.

- **Economic analysis of the DFS program.** The economic analysis indicated that it is worthwhile to invest in installing citywide DFSs in urban cities. The benefit-to-cost ratios (BCR) out of the economic analysis using three different collision costing methods are summarized in **Table 2**.
  (Note: BCR being greater than 1 indicates the collision savings are greater than the program cost. Higher the BCR is, more benefits the DFS program can produce.)

**Table 2 Results of the Economic Analysis**

| Criterion | Severity | 2-year Service Life | | 5-year Service Life | |
|---|---|---|---|---|---|
| | | **Benefits** | **BCR*** | **Benefits** | **BCR*** |
| Direct Costs | PDO | $2,805,823.91 | 5.44 | $6,819,440.25 | 13.22 |
| | Severe | $1,405,263.93 | 2.72 | $3,415,436.50 | 6.62 |
| | Overall | $4,211,087.84 | 8.16 | $10,234,876.76 | 19.84 |
| Human Capital | PDO | $2,805,823.91 | 5.44 | $6,819,440.25 | 13.22 |
| | Severe | $4,486,816.00 | 8.70 | $10,905,022.78 | 21.13 |
| | Overall | $7,292,639.91 | 14.13 | $17,724,463.04 | 34.35 |
| Willingness-To-Pay | PDO | $2,805,823.91 | 5.44 | $6,819,440.25 | 13.22 |
| | Severe | $7,610,167.83 | 14.75 | $18,496,201.65 | 35.85 |
| | Overall | $10,415,991.74 | 20.19 | $25,315,641.91 | 49.06 |

- **Identification of the influencing factors of DFS installation.** By exploring the factors that might influence the selection of future DFS locations, number of observed collision frequencies, traffic volume, presence of a shoulder, and segment length were identified as significant factors influencing the selection of future DFS locations.

**Phase II: Development of Citywide DFS Implementation Strategies**

- **Investigation on interpolating the unmeasured traffic volume data.** Missing traffic volume data in each year (except for 2017 because of limited available observed data) were interpolated using geostatistical techniques for the entire city network. Interpolated maps can be found in **Figure 1**.

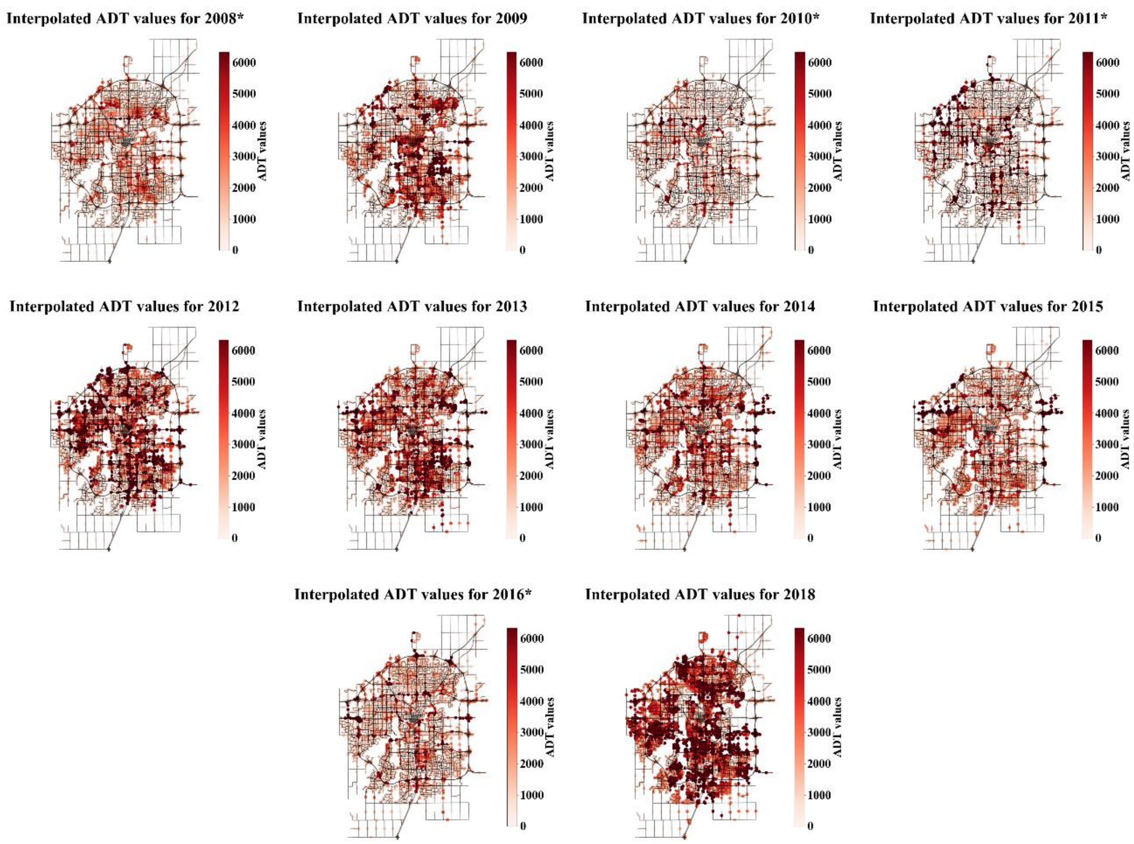
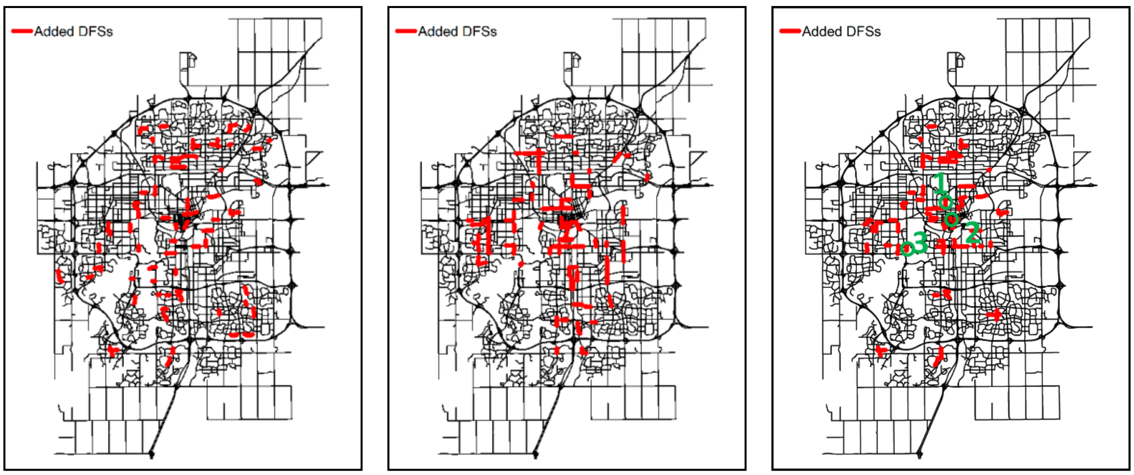


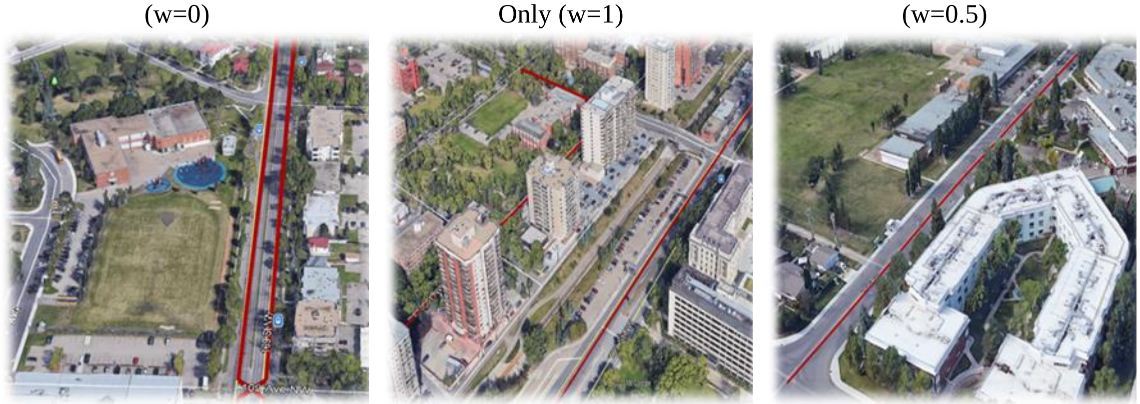

**Figure 1 Interpolated Traffic Volumes**

- **Development of a new DFS location allocation framework.** A location-allocation framework for optimizing the spatial design was proposed for DFS. The method developed provide decision makers with the freedom to simulate and optimize their DFS network by balancing the needs of the road users, vulnerable facilities, and traffic safety in locating DFS over an urban road network.
- **Establishment of DFS sitting guidelines.** Two distinct optimization scenarios with three weighting schemes for each were considered and optimal deployment strategies were provided accordingly. The all-new scenario results benchmark the

system optimal implementation strategies and expansion to assess the current deployment work. The expansion scenario results provide the optimal sites for installing additional future DFSs to improve the overall collision reductions and coverage of vulnerable road users/facilities. Proposed weight values can be adjusted by transportation authorities to study the tradeoffs between the two factors. Results of all-new and expansion scenarios can be found in **Figure 2** and **Figure 3** respectively.

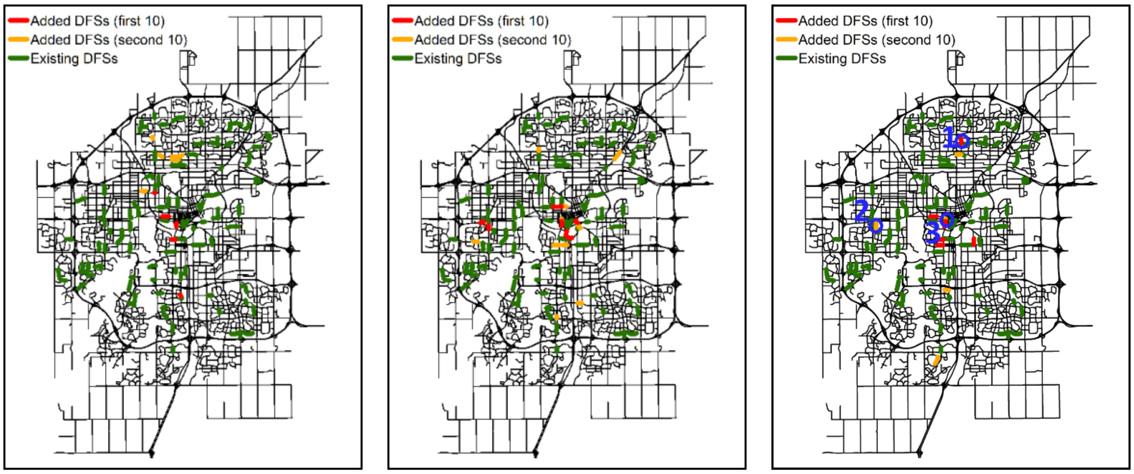



Considering Coverage Only (w=0) | Considering Collision Reduction Only (w=1) | Equally considering both (w=0.5)

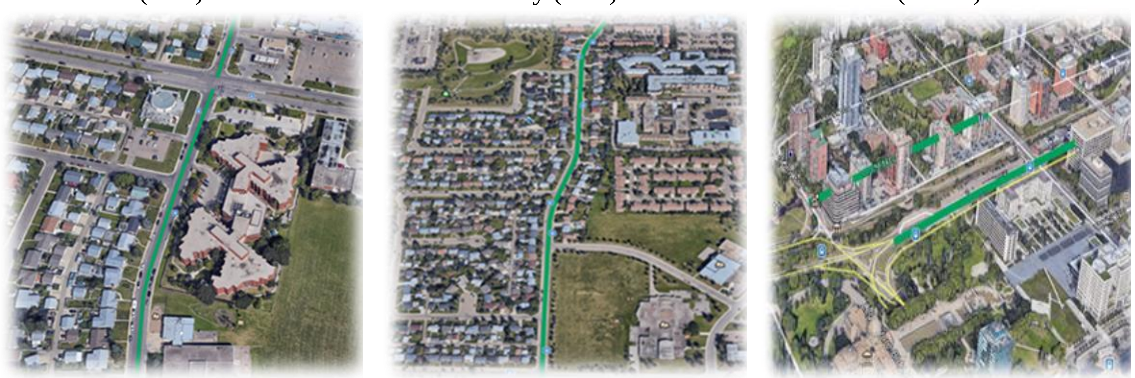


Site 1 | Site 2 | Site 3

**Figure 2 Selected sites of all-new scenario**




Considering Coverage Only (w=0) | Considering Collision Reduction Only (w=1) | Equally considering both (w=0.5)



Site1 | Site2 | Site3

**Figure 3 Sites selected for 10/20 future DFSs**