

Using Graph-Clustering to produce a balanced multi-asset, multi-schedule inspection program

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- 6-year term
- Roads and Drainage Maintenance Services Contract
- Network Inspections
- Routine maintenance
- Planned maintenance
Annual Maintenance Program
(Grading Program)
- Respond to customer requests
- Emergency response
- Reporting
- Providing a seamless service to our customers
- Our teams are Brand ambassadors for DM Roads & Melton City Council



Asset Portfolio

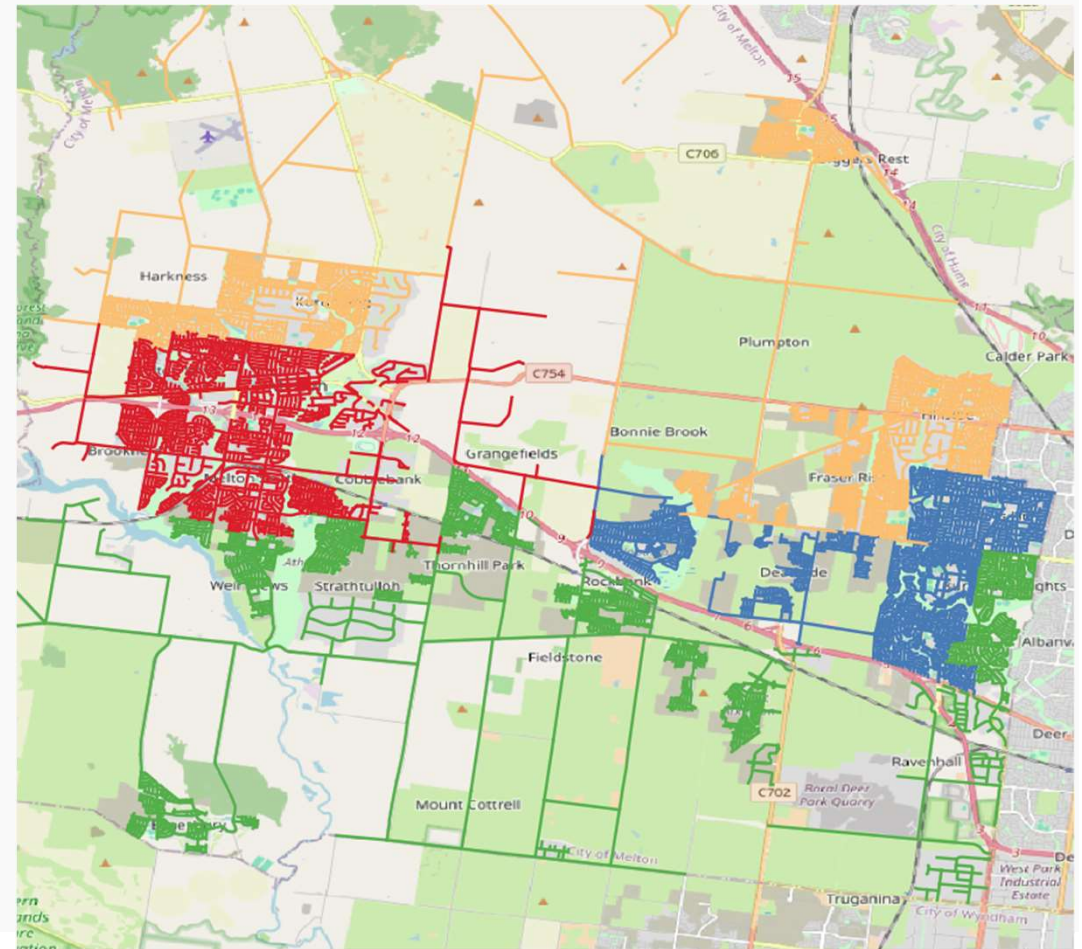
- Sealed / Unsealed Roads (~ 9,000 / ~ 6,800)
- Carparks (~ 5,500)
- Drainage Pits and Pipes (~ 122,000)
- Footpaths (~ 30,800)
- Signs (~ 23,700)
- Furniture (~ 9,500)
- Lake Caroline



Inspection Requirements

Network split into 4 regions with multiple assets types
Combination of dense suburban and rural connecting roads

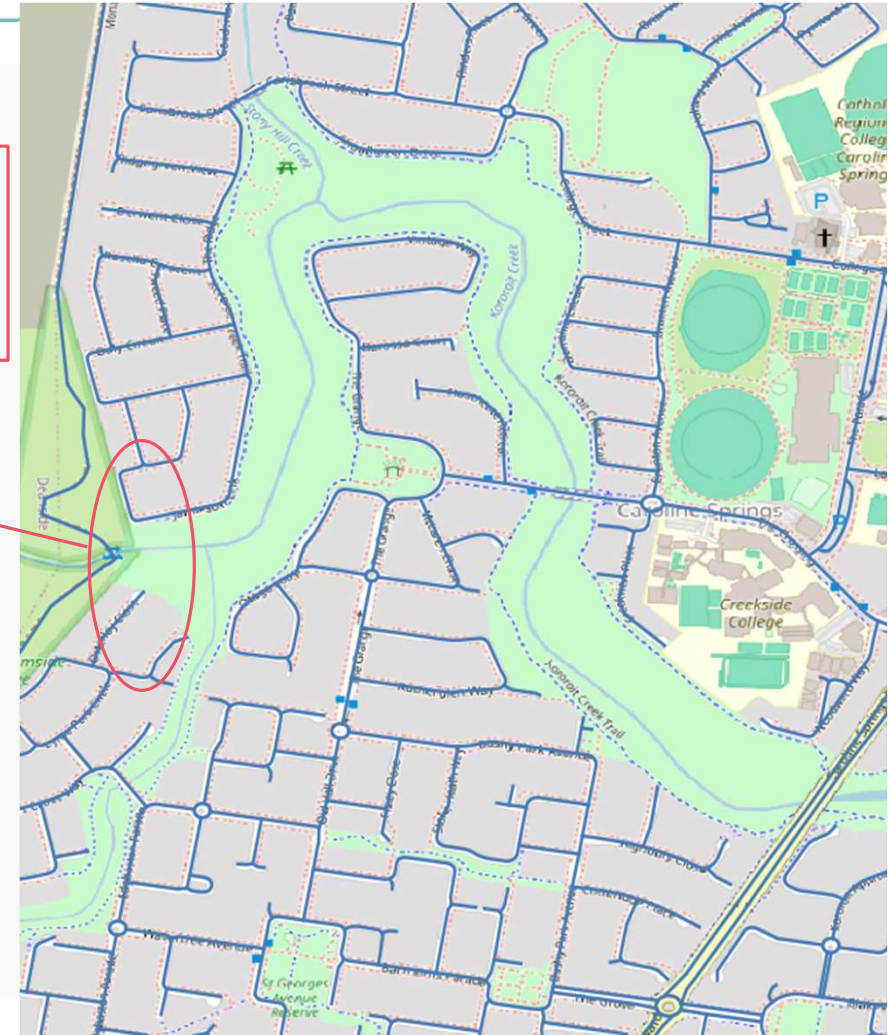
- Sealed / Unsealed Roads
 - 2 weekly, 4 weekly, 6.5 weekly, 8 weekly, 4 monthly, 6 monthly & annual inspections
- Carparks
 - 4 weekly, 8 weekly, 13 weekly, 4 monthly, 6 monthly & annual grading
- Drainage Pits and Pipes
 - 4 months or annual
- Footpaths
 - 6 months, annual or 2-year schedule
- Signs
 - Annual schedule
- Furniture
 - Annual schedule
- Lake Caroline
 - Monthly, quarterly & annual schedule



Desired Solution

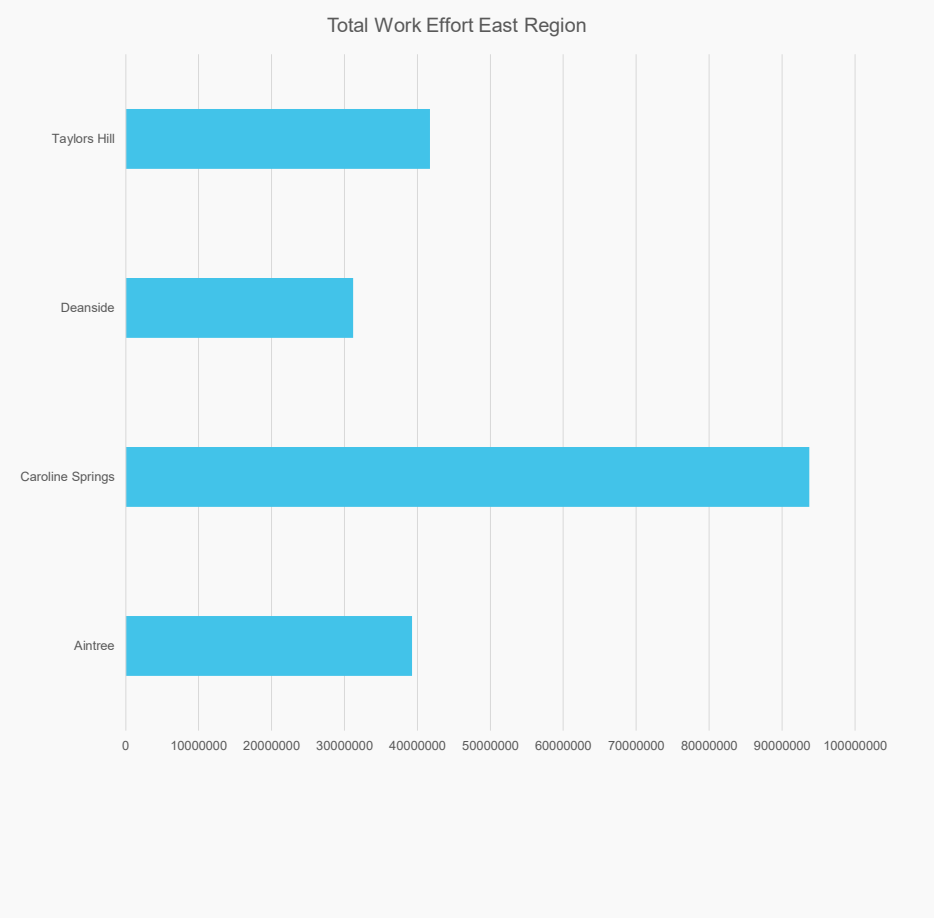
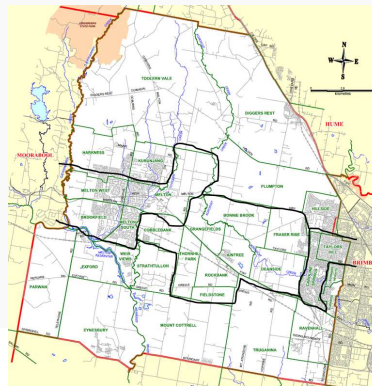
- Applies a 'Effort' (time) weighting for each of the inspections
 e.g. 1 drainage inspection \approx 2 carpark inspections
 1 m kerb inspection \approx 10m road inspection
- Entire network needs to be scheduled in 52 week long blocks
- Need to be repeated at least 4 times (contract term)
- Assets in the "same area" should be done at the same time (efficient)
- Assets in "different areas" should be done at different times
- Each block should be reasonably balanced in work effort

Nearby segments
not in same area



Original Approach

- Manually inspect network map and assign schedules according
 - Extremely time consuming
 - Unreliable in a new maintenance contract with unfamiliar network
 - Heavily reliant on existing data provided by Client
- Grouping assets by suburb name
 - Suburbs are heavily unbalanced in terms of work effort
 - Too few suburb names to provide 52 distinct groups
- Grouping assets by geographic location
 - Can group together network segments that are not in the same area



New Approach

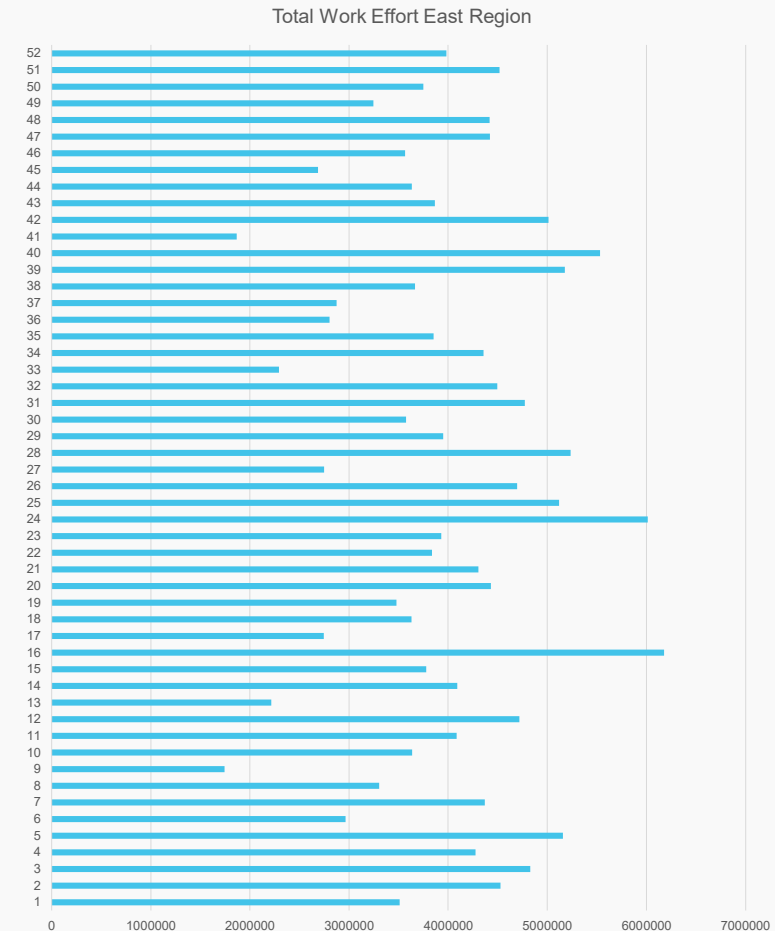
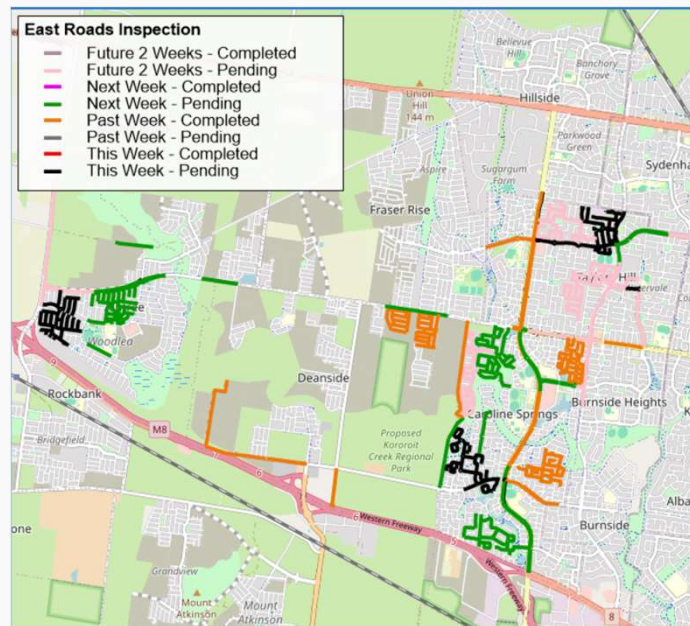
- We assign all assets a network segment as a parent ID
- To work in the “same area” requirement we build a network graph
- Network graph uses roads as nodes and intersections as segments
- Nodes are assigned a weighting by the total of the work efforts of themselves and all child assets
- 52 random nodes are initialised with a given colour
- Iteratively share colour to neighbouring nodes choosing the lowest work effort as first initial choice
- Sub annual schedules are scheduled at required intervals once annual schedule is nominated



Sample Results

- Results generated after 50,000 repetitions (total run time roughly 10 hours)
- Can see still some variation in weekly inspection effort
- Can act as a baseline for informed edits to the schedule
- Contract allows for a small variation window so Inspectors can manage their schedule

Cycle Name:	Definition:
Annual or Annually	To occur once per year and within 30 calendar days (plus or minus) of the anniversary date of the previous occurrence.
Monthly	To occur once per calendar month and within 7 calendar days (plus or minus) of the day number of the previous occurrence.
X Monthly or Every X Months	To occur the specified number of calendar months (X) after the previous occurrence, within 7 calendar days (plus or minus) of the day number of the previous occurrence.
Fortnightly	To occur 14 calendar days after the previous occurrence, plus or minus 2 calendar days.
Weekly	To occur once in every calendar week.
Every Y Weeks	To occur the specified number of weeks (Y) after the previous occurrence, plus or minus 2 calendar days.

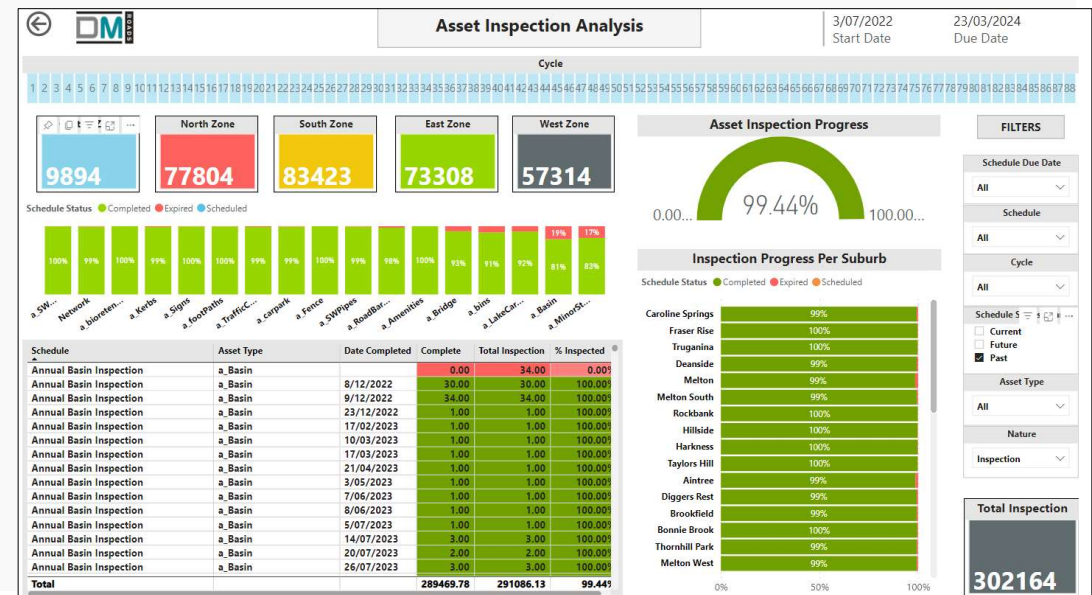
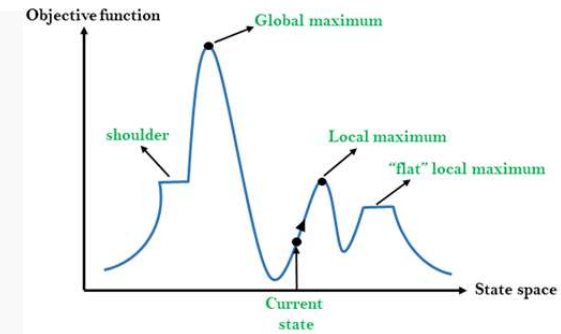


Learnings and Improvements

- Results are acceptable but not perfect
- Sample results need more processing to be considered 'ideal' (e.g. could be a local maximum)
- In theory a more ideal solution can be found with more repetitions, but improvements become harder with higher repetition counts
- Approach relies on accurately estimating work effort requirements (which can change overtime)
- Still need to handle exceptions from outside conditions

E.g.

- It is better to inspect drainage after following autumn
- Bridge inspections only being available when a Certified Bridge Inspector is available



Thank you
Questions?