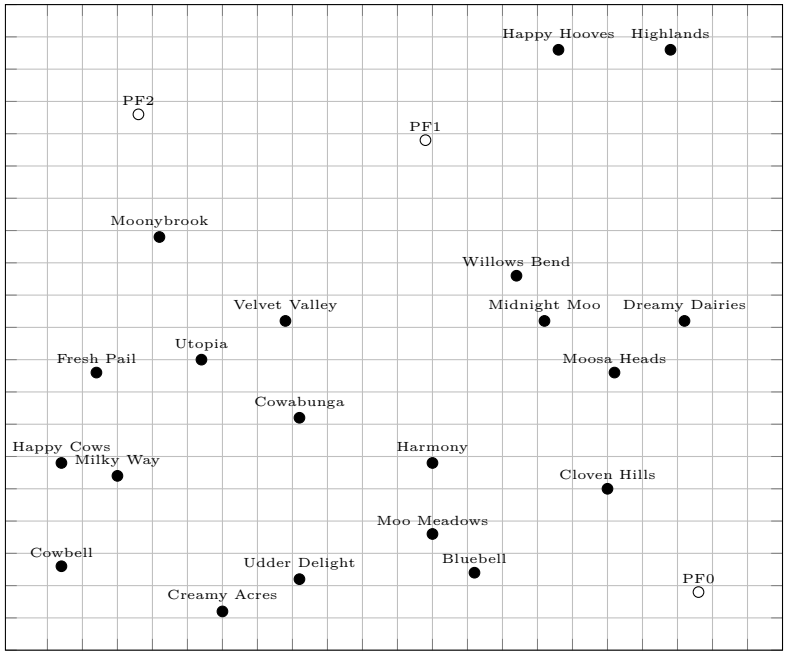
Section A: Internal Report

We were once again consulted by Teal Cow Dairy to maximise the profit of their business subject to certain constraints. An outline of the problem and our resultant mathematical formulations are given in this report. We have also made the Python code available for your perusal.

Problem Summary

Teal Cow Dairy are in the process of expanding their operations since their previous communcation. They now have additional farms and processing facilities which are depicted in the below map:



Each of processing facilities has a fleet of 5 tanker trucks which are used to transport collect milk from the supplying farms and transport it to the processing facilities. The client aims to optimise the use of these tankers in consideration of the cost of running them.

Communication 7

Communication 10

Section B: Report to the client

Communication 6

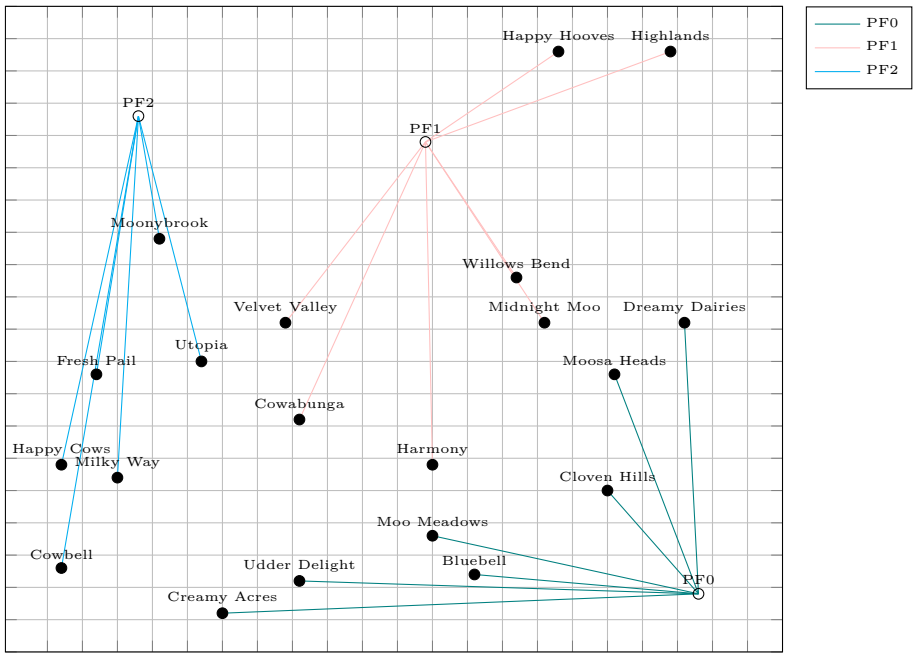
Based on the communicated information, the minimum total cost of travel such that the supply of all dairy farms is collected and transported to processing facilities is $4555. This minimum cost assumes an average speed of 60 km/h for each tanker and an average travel cost of 5 $/km. Additional considerations are the maximum daily capacities of the processing facilities and the minimum processing requirements to keep the facilities running.

Broken down by processing facility, the cost of collection is as follows:

Table 1 - Breakdown of transport costs per processing facility

	Cost ($)
Processing Facility 0	1590
Processing Facility 1	1445
Processing Facility 2	1520

Graphically, farms should be assigned to processing facilities as follows:



Key Insights

Communication 7

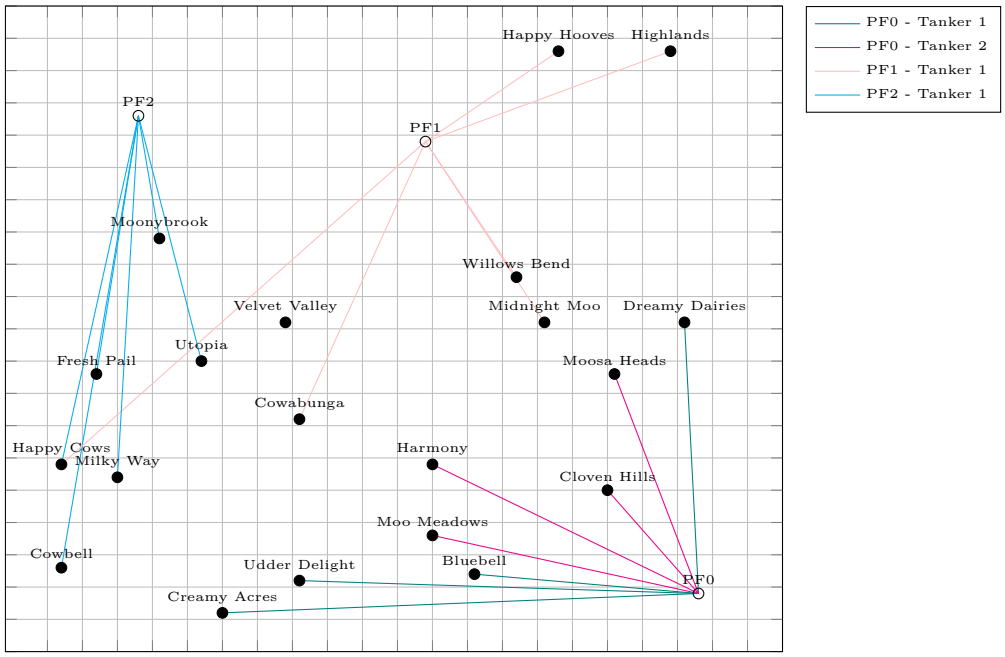
Considering restrictions on the maximum number of operational hours per day for each tanker and the important factor of maintenance costs, the minimum cost of collections becomes $6680. This is an increased cost from the previous estimate, which is to be expected as additional costs have been introduced.

The revised cost of collection for each facility is as follows:

Table 2 - Breakdown of transport costs per processing facility

	Travel ($)	**Maintenance ($)**	**Total ($)**
Processing Facility 0	1845	970	2815
Processing Facility 1	1420	500	1920
Processing Facility 2	1445	500	1945

The revised assignment of farms to processing facilities is as follows:



Key Insights

Communication 8

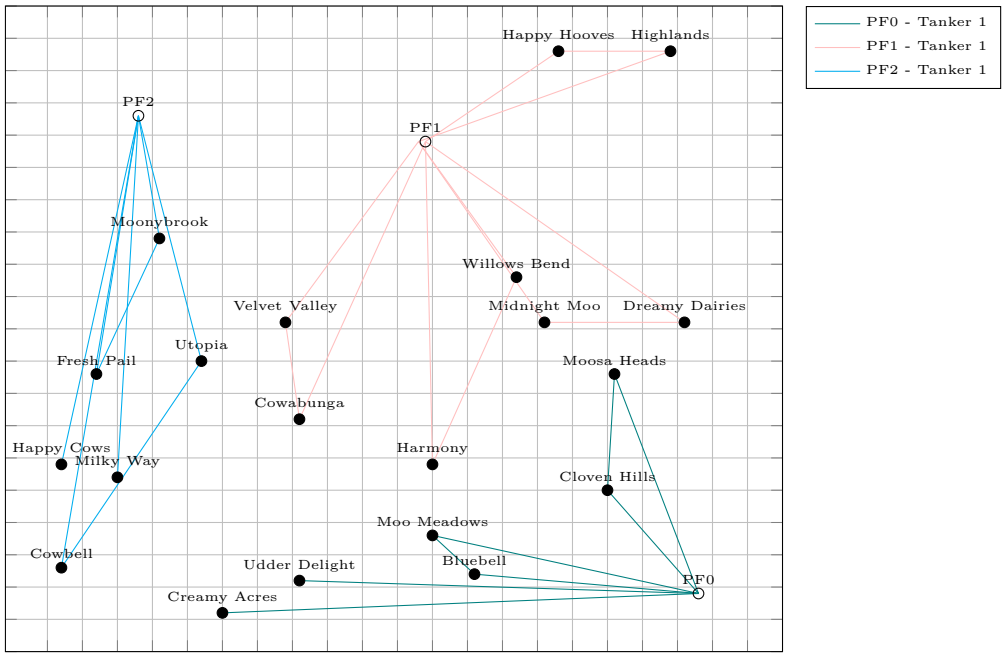
Allowing a tanker to visit multiple farms before returning to the processing facility provides an opportunity for decreasing the total distance travelled by the tanker fleets of each processing facility and hence, the total cost of collections. Reevaluating the model taking into account the provided possible routes for each tanker gives a revised minimum cost of collections of $4686.

Broken down by processing facility, the cost of collections is as follows:

Table 3 - Breakdown of transport costs per processing facility

	Travel ($)	**Maintenance ($)**	**Total ($)**
Processing Facility 0	960	500	1460
Processing Facility 1	980	500	1480
Processing Facility 2	1246	500	1746

This revised model takes into account all of the previously provided constraints while substituting distance data for the information included in the milk runs data. As less distance needs to be travelled, only a single tanker from each processing facility needs to be utilised which reduces the cost of maintenance. A map of the runs that should be taken from each processing facility is given below:


PF0 - Tanker 1
PF1 - Tanker 1
PF2 - Tanker 1
Happy Hooves
Highlands
PF2
PF1
Moonybrook
Willows Bend
Velvet Valley
Midnight Moo
Dreamy Dairies
Utopia
Fresh Pail
Moosa Heads
Cowabunga
Happy Cows
Milky Way
Harmony
Cloven Hills
Moo Meadows
Cowbell
Udder Delight
Bluebell
PF0
Creamy Acres