AUTOMOTIVE RECYCLING PLANT OPTIMIZATION

Abdulaziz Almaktary, Noah Berti, Daniel Sayre, Salman Semy

Introduction

Pacific Recycling Incorporation (PRI) is a metal recycling company based in Eugene Oregon. PRI shreds automobiles and other heavy waste to extract out ferrous and non ferrous metals. One of the products of this process is called Auto Shredder Residue (ASR). ASR consists of foam, fabric, plastic, glass, dirt, and other materials that were not sorted out in demanufacturing process. The team was originally tasked to beneficial use for ASR that is economically feasible. Later, the scope was changed to optimize the process in order to reduce the amount of metals ending up in the ASR.

ASR Composition

As waste audit was done with the help of Nick Ibister from Innovative Recycling Group Northwest to identify the composition of the ASR currently going to the landfills. Metals making up 11% of the composition indicates a deficiency in the system and led the team to focus on methods to increase metal extraction.

| Material	Weight (lb.)	Percent Composition
Residuals (fluff)	8.60	51%
Mix plastics	2.65	16%
Ferrous metals	1.25	7%
Fibrous materials	0.95	6%
Tire rubber	0.90	5%
Foam (LDPE)	0.70	4%
Non-ferrous metals	0.65	4%
Non tire rubber	0.55	3%
Wood debris	0.60	4%
Polystyrene	0.15	1%
Total	**17.00**	

PLANT OPTIMIZATION

The primary goal of the project swapped to optimizing the current existing process used by PRI. The car shredding process creates roughly 140 tons of waste per hour. This amount however is not consistent, it fluctuates and the 140 is in fact an average. This means that there are points in which the system lulls in productivity. Therefore, through the usage of a software called Arena, we hope to optimize this process, so it is always operating at maximum capacity
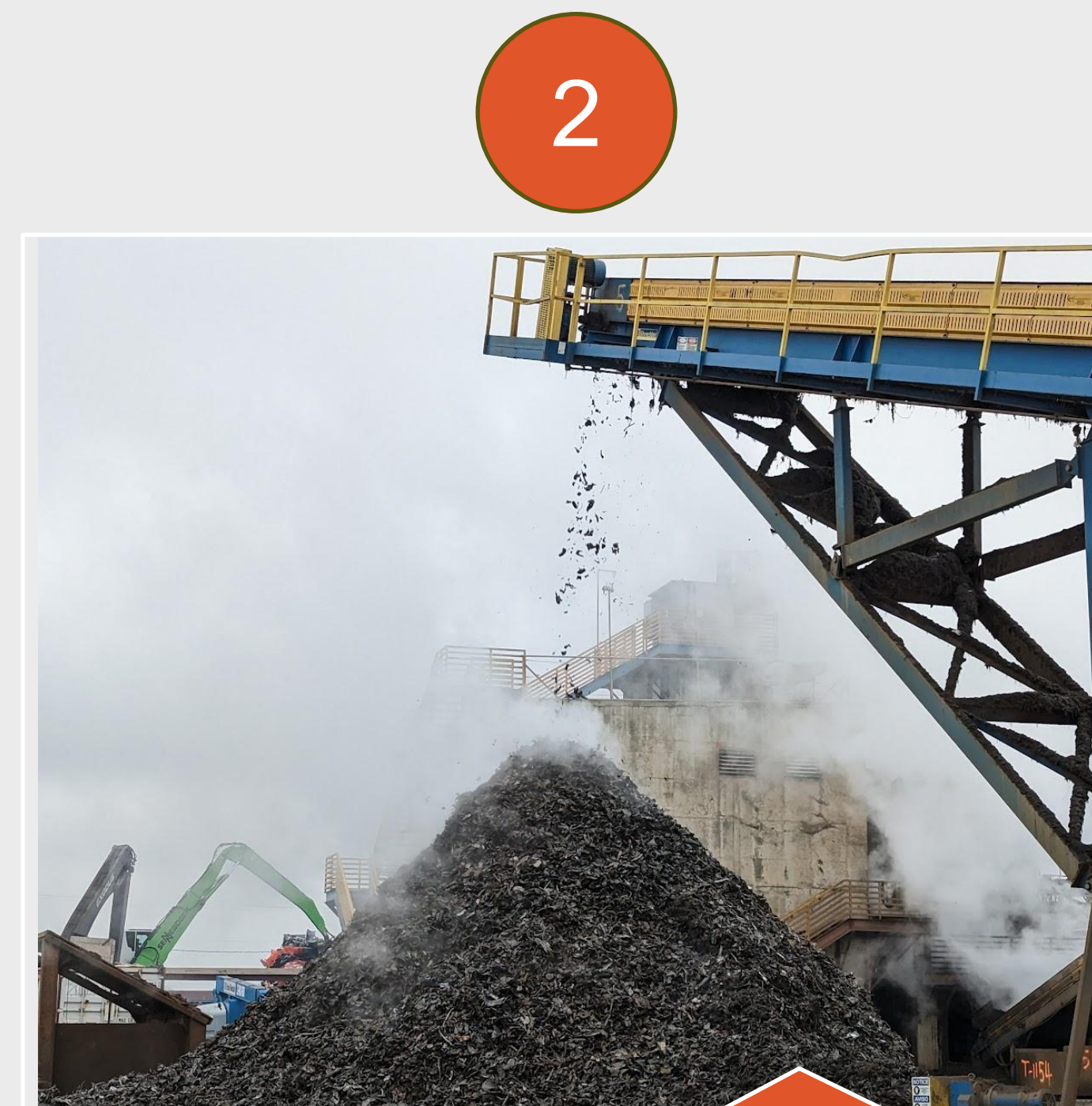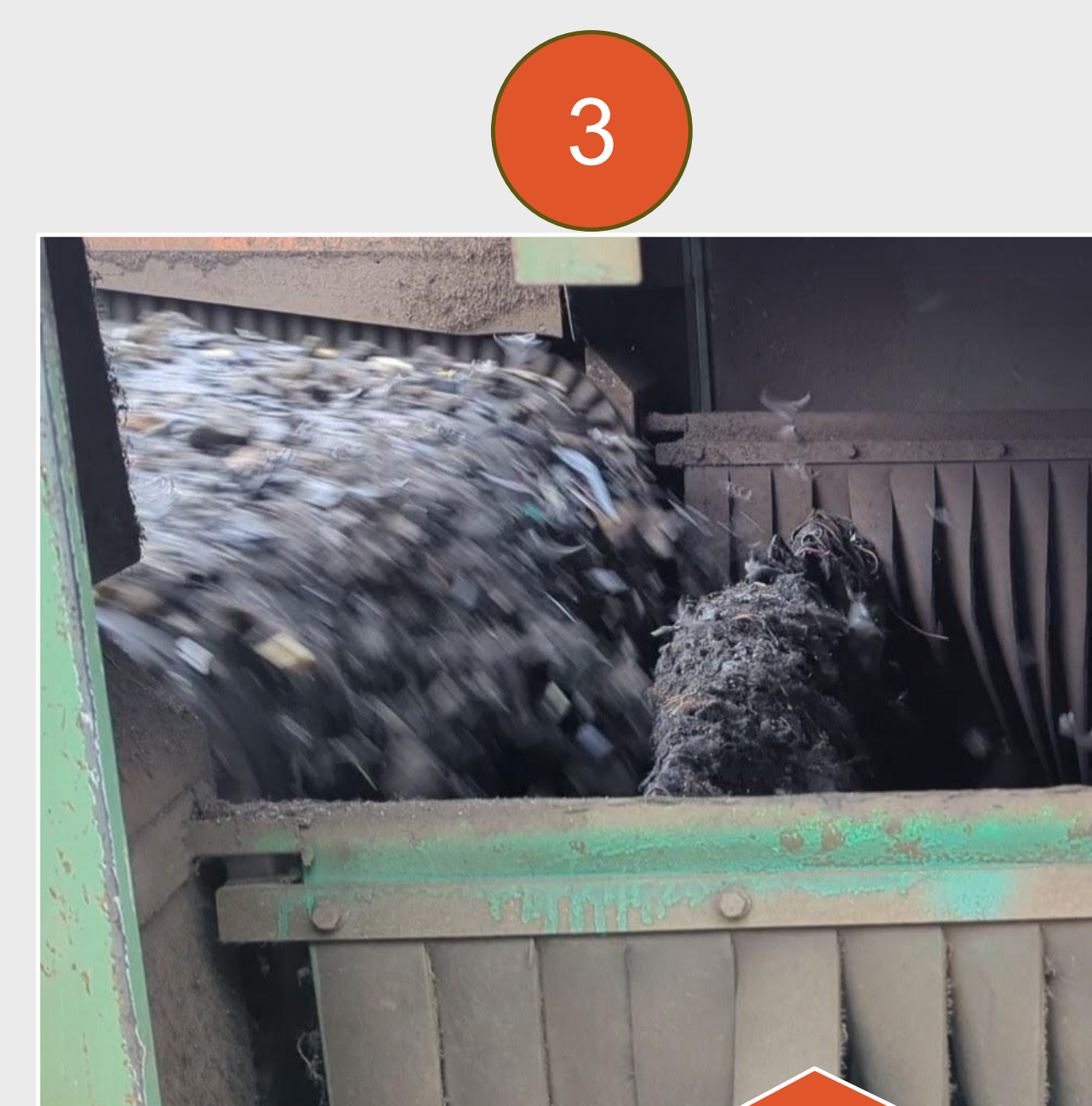
`
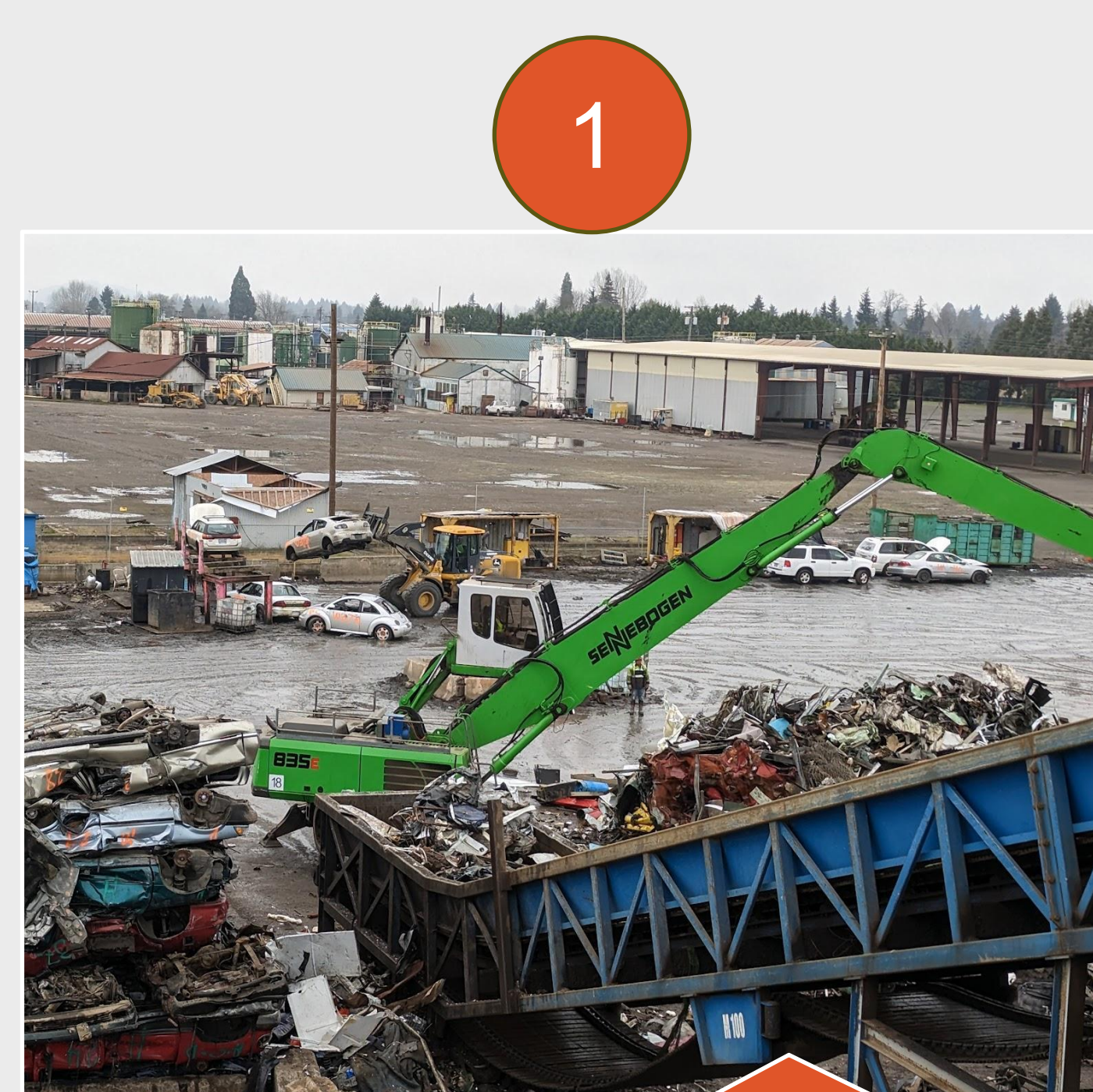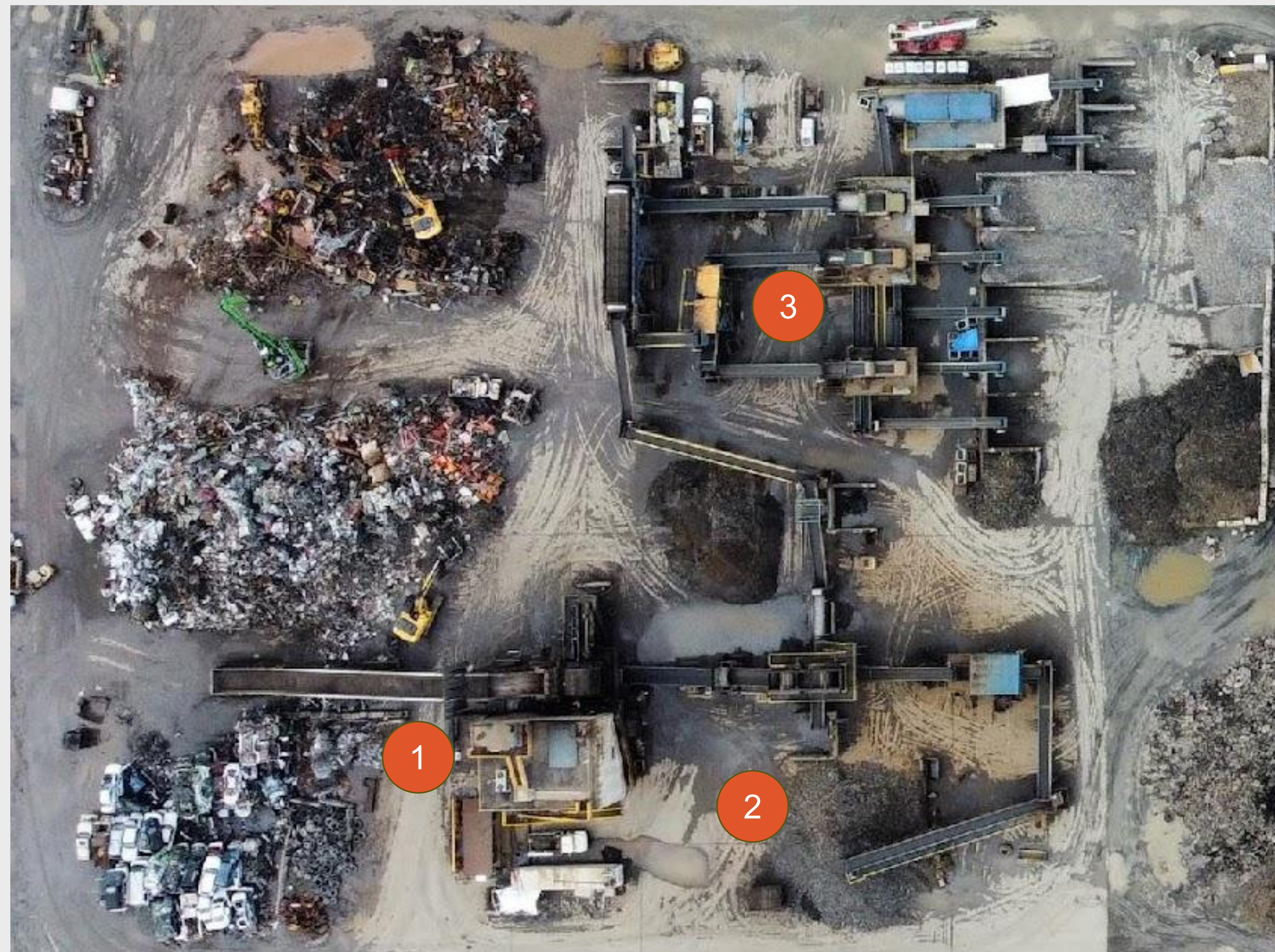
Solutions Explored	Reason not implemented
Send ASR to cement kilns.	Processing costs 150% higher than current landfill costs. Results not guaranteed due to possibility of contaminants.
Acquisition of an optical sorting machine to supplement current process.	PRI is currently working with other companies to explore machine upgrades.
Send ASR to an energy-from-waste facility.	The processing costs would greatly exceed the current cost to send to landfill.
Remove bumpers before shredding to send to a plastic recycler.	Bumpers would need to be free of metals. Processing costs may cancel out profits from plastic recovery.

Digital Twin using Arena

- Flowchart is created using four different modules: Decide, Process, Record, and Dispose.

- Each module serves a different purpose and represent the various stages of the waste creation and value extraction.

- Lots of data is necessary to determine the optimal speed of operation, but this flowchart will help maintain high levels of efficiency.

- Greater efficiency in the process means less ASR creation, therefore greater benefits for the environment.

Conclusion

Although the search for potential alternative use cases for ASR has been handed off to the client, there was still a lot of information learned from our attempts. After having provided a recommendation to add a sorting machine, PRI is in talks with an optical sorter company to improve their yields and reduce the volume of waste produced. Moving forward, PRI will also be looking at solutions involving density sorters.

As an additional cost and ASR reduction, Denton Plastics hopes to move forward with acquiring bumpers taken from cars at the beginning of the process.

Finally, using a simulation software, a tool will be created to assist PRI in evaluating bottlenecks, throughput, the addition or subtraction of processes, and plant optimization. This may be used by PRI long after the conclusion of this project.

A crane feeds automobiles and other metal waste into a 4,000hp shredder that can process up to 140 net tons per hour.

Most of the ferrous metals are the first to be sorted out using a magnet.

The non ferrous materials are then sorted by size and fed into three sorters that use eddy currents to pick out non ferrous materials.

Oregon State University