MSUM Recycling Audit Write-Up

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Introduction

As a Sustainability Intern and a UMACS Fellow, I conducted a recycling audit; the audit consisted of collecting recycling from bins around our campus, sorting and weighing the bags, then calculating the percentage of improperly recycled goods on campus. This data was valuable to us not just for the numbers, but also to help identify where confusion is occurring in the post-consumer recycling process. What we found allowed our office to make suggestions on improving our recycling system on campus and identifying areas to focus on with recycling education. These areas include combating wishful thinking, how to properly prepare materials for recycling, and what can be recycled on our campus. Our project was created to be easily replicable for other universities and organizations.

Supplies and Budget

Waste Audit Supplies and Budget

|  |  |  |  |
| --- | --- | --- | --- |
| 5-gallon White Bucket | $7.00 | [Bucket](https://www.amazon.com/EconoHome-5-Gallon-Container-Carrying-Heavy-Duty/dp/B0DDM2D71P?crid=9U4PJL60F1H&dib=eyJ2IjoiMSJ9.mkA2KblYZtMdW92_fmwhIBANfSKwYYYvHNJMmoSH7lbj_NwSDwdSdyIKvPTuW-U8UXb6h2opKdW8Bs0ZdbmSoZqx0AEH2nFyWlHTiBg0ZAJT880edK0lDJZvd15vnkpCDa1tpb9gpauuYG6gJEF5mPOOZXPC_1mCH9y2qjdBUoLt4nhgvlBBH6Uy2im7tSUaMcAALnsNJwwOXdcLblz0ORU2L7xAb8w4E9rb2pIgEwk.d33lNHtrZZ5jjaN7w1fhU3cOWXcyCsBL4DDsCQnKl_I&dib_tag=se&keywords=5%2Bgallon%2Bbucket&qid=1733417749&sprefix=5%2Bgallon%2Bbucket%2Caps%2C202&sr=8-5&th=1) | Easy to buy in bulk with many options |
| Nitrile Gloves | $10.00 | [Gloves](https://www.amazon.com/MedPride-Powder-Free-Nitrile-Gloves-Medium/dp/B00GS8W3T4?crid=22E7G4PHB6MHW&dib=eyJ2IjoiMSJ9.WrSsoWMnlCsvdIlAnbFvvIpZKIgyxsuY5z6xgvNxH0ONS1BNuEOtmubVXpHHMZT27zj_4f4JHeQ3pKlm17WfBhSwdIIx06lci3DwE5Uw2QcHD7IUhwlrv8cmNwosWGmS47KUyOSQGQKApNoSklc-FwtvQh8FQjNHhamx1GGvVVEAiuxJ2KhLSOJ4V31q92uwCMgWnDNK6nKfZb_lIJR3W4MnMtBOAsVzvsJtrhHUTlI.aJ_iFQq2IOz9vUC8EtHMIjqO0_wJgF0uGzjqCRQK7ZM&dib_tag=se&keywords=nitrile+gloves&qid=1733418177&sprefix=nitr%2Caps%2C223&sr=8-3) | 100 count |
| Safety Goggles | $10.00 | [Goggles](https://www.amazon.com/Honmein-Chemistry-Woodworking-Construction-Industrial/dp/B0CGX9MFWZ?crid=11JULWS4IMHIG&dib=eyJ2IjoiMSJ9.pJrpx5kvIOwwehTUFS1qBBPx1C9dgGuOJ6pYzUM2yToZlqDOFbB-mlyrNleRm6qI4BokTHMW94VM5EJ4I7xpIFBjEYpjCIwky4zo6-YZXP3O9fFEjxEejKknybh6CsHPeTJ9xmYyyRNCuLt9qvpkClX91TDLqMJZWPVuM655LHQnir3hK-u-P4nihe5Rj8NNQxBliM56sMs9NViNaAKXGiq387NJIb7JK0f6MwKqodwexOtSKBYO254x4TvMo4-SVjAxzS4P7x_9qDerT3zNgPAbYQoScy5FdxvL-JqxvL0.Z7YmSCerkA0htjPf4xYleV6I5PE9w8mxP_CGfsi53D4&dib_tag=se&keywords=safety%2Bgoggles&qid=1733418441&sprefix=safety%2Bgoggles%2Caps%2C166&sr=8-6&th=1) | 2 count |
| Grabber Tool | $10.00 | [Grabber Tool](https://www.amazon.com/Reacher-Foldable-Lightweight-Reaching-Extension/dp/B078RMCFWQ?crid=1NS0CMD7PJ4GJ&dib=eyJ2IjoiMSJ9.n-M6yOyGBkO0LabFPen0ahohyAKFrTzwODYEK8tH0fTdycI2fX7BMS15CHm6VEgtgDNFXOYT5-VYHqK6BGTkaAp_93bvRlwhaL-dbTwijeWHaktRd4EsyPB5CpSR7r6xvwDVtXs0M5iKmjri0XtmysO3CscRsUcZ99ofc1whPPURbb9mtq9aB08WKhu-idS7wgnGCQwzhEJzhKYRb_3up3n3zw8RvvtVuUcN7dnc1ADqPY-qXFSM93tRGzFpUya0Zhq5J9ivPDgBCT1VMxT80jr2-wK723WWA02CltaLAek.w2BsUImaqp-fJSdkAU95G8kohHnPPkUXzocLfcOklyg&dib_tag=se&keywords=grabber+reacher+tool&qid=1733418597&sprefix=grabber%2Caps%2C192&sr=8-8) |  |
| Disinfecting Wipes | $15.00 | [Disinfecting Wipes](https://www.amazon.com/Clorox-Disinfecting-Bleach-Cleaning-Packaging/dp/B08BKR9YT6?crid=23CY9CE0UKFPP&dib=eyJ2IjoiMSJ9.6MBpdvKQXGX7CqX_1-VtQ5fM9T2zpZ8ctCsRP6Be1HecCRRihr8_ZhO0RHZXoOoAwWYDeS3ebRZobu8MmO4qohAUOtjbHSUMn_Islv4xVluDZdNQENkT9cVCEBUTuStCjDkmjYGv0brPjkwSirRVZaoBIWE7d18sOEzo039E4CWzta_ASLZ3qFIYVdy4rjyY79U1lO4wt5QJMizp_K9zwu55MrAangldS1tuoH-QgWq51FlJuLfpg1yXpFBd5vg8Y5ft0AC0a2FAyBx-9KX_HsT2ve5Cybf7ilm3CAn_jZw.nrv9RO90QMkyH4Zjj_O-pdhPPcmb9DxSKraOZyW6iDo&dib_tag=se&keywords=disinfecting+wipes+no+scent&qid=1733418828&sprefix=disinfecting+wipes+no+scent%2Caps%2C132&sr=8-8) | No scent, 3 pack |
| Clear Trash Bag | $12.00 | [Clear Trash Bag](https://www.amazon.com/Hefty-Trash-Bags-Recycling-Bin/dp/B01MXEU7YM?crid=1FWE7UNBWLXC4&dib=eyJ2IjoiMSJ9.A0VPLyS7Rctbwn2LfqH1cIbHb0rtyM9SCCRKRuzfaBTlio699wwVF3yqPX99yvkJZ87Pgay7UQ44f48u49EPpn1LwkjH9ZfnxifBXEzSKBAQUNOHjyQvcYMkjHR3WBPRdKGQLGfxv-PTZ10gkYzpSknYgpEVDp91VgpIUyZiym3mf2rxrwF1ohCeLkEf8tVtFbUBBHWf-g-bQaAHo4SsY3VYFjygvDcqre_o8xz4rxbRI-sUtKmrtt13vZtVuZPcQiICCVanfZX0kJcM8_DVq1lEybYAdILjB0zXep5FQng.7FxHjgJiaTzZQySmf2wFOcveIV_GGSyUyyzYFvzCLSw&dib_tag=se&keywords=clear%2Btrash%2Bbags&qid=1733419040&sprefix=clear%2Btrash%2Bbags%2Caps%2C170&sr=8-5&th=1) | 60 count |
| Black Trash Bag | $16.00 | [Black Trash Bag](https://www.amazon.com/Hefty-Ultra-Strong-Kitchen-Drawstring/dp/B01BZ0MR54?crid=3KZUGCM0DKBZF&dib=eyJ2IjoiMSJ9.gUIkNyE0-27xzx-3kY-NnE8Jx7Rdu-7ZXCtbaJFKYXbSfuGchkah7mDuJMhMKT5z_JquC3UTWlRxj9xdmwY9CWyvYuzfRn7-pPnDtrQRunBMOzAYisoDG0ud2D2eFPrHeHcpms6a3ZHc-ycxcyCafl4kPDXQM-8vZcCZjJoXumICZyGbahQrTEZnYHa1xypAFHX-yWrwqmSgORkFSkFkyb4EhNJeE04rceX5ld8XAxuVAg00JzBKXHViGgQVXNqh2pr3XFBmd5FYxNrQRTHqnyqIUdIt1oJY20qFggPjCTY.Q0q7LbLMdJ-wVedr7UzYz7VnvjlKp7QUPZocUVE71gQ&dib_tag=se&keywords=black%2Btrash%2Bbags&qid=1733419147&sprefix=black%2Btras%2Caps%2C150&sr=8-5&th=1) | 80 count |
| Hanging Scale | $20.00 | [Scale](https://www.amazon.com/Outmate-Digital-Handheld-Hanging-Hunting/dp/B09V89K7PQ?crid=206TXVJYWYHQG&dib=eyJ2IjoiMSJ9.ZrxqzX-Yb3UffzNOi7rJLWVc_J_cq611MDNAnyTieq11xUq3bDezvHKkqVeuVkmqzi5naLYDj3bnLZ3CPNeSYnHqdaqADKs_4-Wjdz8527C13wuxa3G9k64lGsn56xF5DJVnIbZu1LanreCSNksnVMHgcjmuFuIfa6BCnTNKt1msoI0V5DyWZd-3S9SLNEebdes2fi6TtMpOQ9q_wzkGdlZQjTSme8FuYSIHtcCzf74.qVzZ717GR9j27KqWRM0a898RqDpWNWnRUB1AnrurfrE&dib_tag=se&keywords=hanging%2Bscale&qid=1733419301&sprefix=hanging%2Bscale%2Caps%2C137&sr=8-4&th=1) |  |
| Total | $100 |  |  |

Project Design

First, we created guidelines for personal safety and identified which solid waste disposal stations on campus could be audited. Then, we planned the dates we would collect the data.

The general steps used to conduct our research are as follows.

1. At a designated recycling receptacle, we collected the recycling materials in the bin/dumpster. If there were no items to collect, then we made note of that and moved on, as that is still valuable information. Then we labeled the bags of recycled materials with sharpie and moved to the next location.
2. After collecting all the bags from the planned locations, we brought them to a classroom lab to weigh and sort. We first weighed the bag in its entirety, to get a baseline weight. We used a hanging scale to weigh the bags and highly recommend that method if you decide to adapt this project to your own campus.
3. After establishing a baseline weight, we then sorted through the bags, adhering to the safety guidelines, and removed any non-recycling items. The items removed will vary based on what is recyclable on your campus, so it is crucial to understand what is recyclable, and what is not.
4. After removing all non-recycling materials, we weighed the bags again, recording the overall weight of the bag, as well as the weight in improperly recycled materials only.

Results

 Our results show an average cross-contamination rate of 9.4% (trash into recycling) which is slightly more than the average reported by our recycling servicer at 9%. This rate was less than I was expecting, but in using this data, we found ways to improve our successful recycling rates even more. By focusing on wishful recycling and education, I believe that we could lower our rates of cross-contamination even more. I think this project is a worthwhile investment from campuses because it can teach students and staff where to focus time and energy on specific areas of recycling for improvement. I think that any data collected would be beneficial, even if your resulting rate is low. Below is a sample of how we set up our data table.

|  |  |  |  |
| --- | --- | --- | --- |
| Location | Total Bag Weight (lbs) | Weight of Improperly Disposed Trash (lbs) | Percentage of Waste in Recycling Bags |
| Building A Bag 1 | 2.2 | 0 | 0% |
| Building A Bag 2 | 1.68 | 0.01 | 0.60% |
| Building B Bag 1 | 2.2 | 0.71 | 32.27% |
| Building C Bag 1 | 1.57 | 0 | 0% |
| Building C Bag 2 | 1.1 | 0 | 0% |
| Building D Bag 1 | 3.35 | 0.64 | 19.10% |
| Building D Dag 2 | 1.95 | 0.11 | 5.64% |

$$Weight of Improperly Disposed Trash÷Total Bag Weight×100 $$

The equation used to calculate cross-contamination rates is based on the weights collected during the project (above).

Though we did our best to eliminate error and increase reliability in our data through this project, there are limitations in what we could achieve. I would advise future researchers to avoid some mistakes that we made during our project. Due to severe winter and spring weather, we had to conduct the sorting portion of this project indoors. This caused some problems, including automatically locking doors, the mess sorting could cause, and the potential smell, so I would recommend doing this outside. I would also recommend having extra tools on-hand in case of failure; our grabber tool broke on our second day of data collection, which made for a more challenging procedure. Another limitation was that we only sorted trash out of recycling. A future researcher might have better and more accurate data if they sorted recycling out of trash waste, too.

Attached below is our full procedure with details not included here. Though this is what worked for us, we understand that your recycling regulations and budget may be different, so feel welcome to make adjustments to our framework as needed.

Waste Audit Procedure

**Recyclables and Landfill Waste Categories**

|  |  |
| --- | --- |
| **Recyclable** | **Landfill** |
| Plastic numbers 1, 2, and 5Includes bottles, jugs, and tubsCardboardClear or brown glassAluminum cansPaperSteel and tin cans | Plastic numbers 3, 4, 6, and 7Colored glassPlastic cups, trays and plastic film (plastic wrap)Freezer cardboard boxesFood wrappers/ bagsAnything else not listed in the recycling column |

**Safety**

Everyone in the group is responsible for ensuring that the waste audit is conducted safely. The following rules need to be carefully followed and will be strictly enforced:

* You must wear gloves and goggles. Use grabber tool and heavy-duty gloves if needed
* Use grabber tool to take out recycling bags. **Do not enter the dumpster.**
* Move slowly and methodically. Always be aware of your surroundings. Once your gloves are contaminated do not touch people or personal items.
* If your nitrile gloves rip or tear, discard them and get a new pair.
* Scan for dangerous items like biohazard or sharp objects. **If something looks unusual or you see anything that concerns you, stop immediately.**
* Wash your hands after data collection as well as anytime you feel you need to.

**Preparing the Audit Area and Gathering Bags to Sort**

* Put on safety gear. ***All group members handling waste must wear nitrile gloves and safety glasses.*** *Disinfect the safety glasses with a disinfectant wipe prior to use.*
	+ Grab two trash bags from the recycling dumpster.
	+ If the bags are difficult to obtain from the dumpster, use a grabber tool. **Do not enter the dumpster.**
	+ If the dumpster is empty, make note of it and move to another dumpster.

*Do not use trash or recyclable material that is not in a bag.*

**Sorting Recycling Bags**

* As you proceed with the following steps, be sure to record all required information in the table below.
* Using the hanging scale, weigh the bag. Record in Total Weight of Bag
	+ Carefully untie the bag. If the knot does not untie, cut the bag open carefully.
	+ If a bag appears to be from a restroom or from lab activity **do not sort it**. Re-tie the bag or place the entire bag into a new one, weigh it, and record that bag as entirely **improperly disposed** **landfill items**. Wash your hands and obtain new gloves if needed.
* Begin sorting. Remove any true waste items and place them into a new, black trash bag. You can use the grabber tool and heavy-duty gloves for added safety if needed. Any remaining recyclables should be left in the recyclables bag. *Refer to the table above for help with sorting.*
* Once everything is sorted, gather up the clear recyclables bag and use the hanging scale to weigh the recyclable items. Record this in Total Weight of Properly Recycled Items
* Similarly, carefully gather up the black trash bag and use the hanging scale to weigh the improperly placed landfill items. Record this in Total Weight of Improperly Disposed Landfill Items
* Clean any equipment that was used during sorting as needed using disposable disinfectant wipes.
* Place the used nitrile gloves and disinfectant wipes into the trash bag and place the newly tied bags into the appropriate dumpsters.
* Make sure to clean up. There should be no leftover trash/recyclables on the tarp.
* When you are done sorting, you should wash your hands at a nearby restroom.