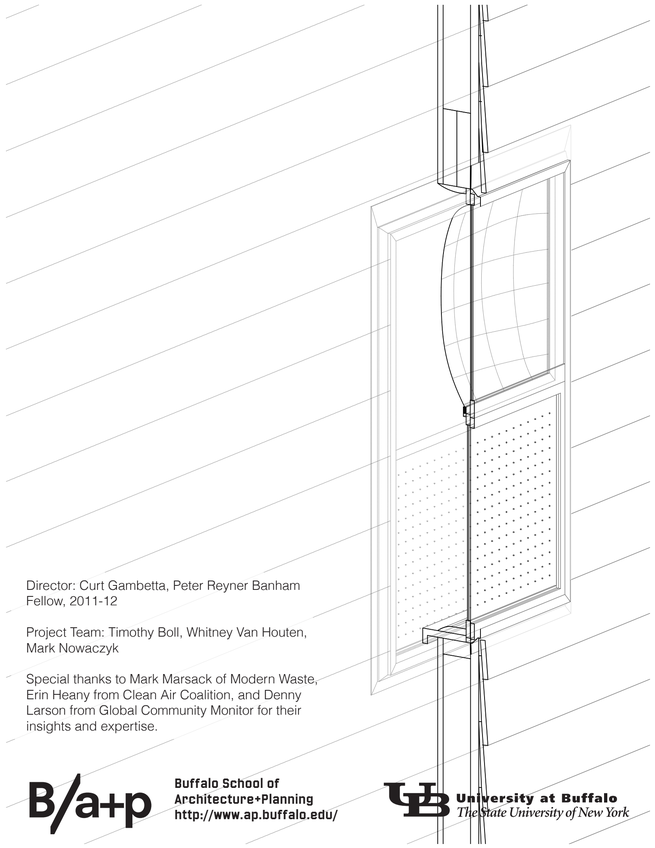
Assembly Manual: Window Lung & Particle Screen



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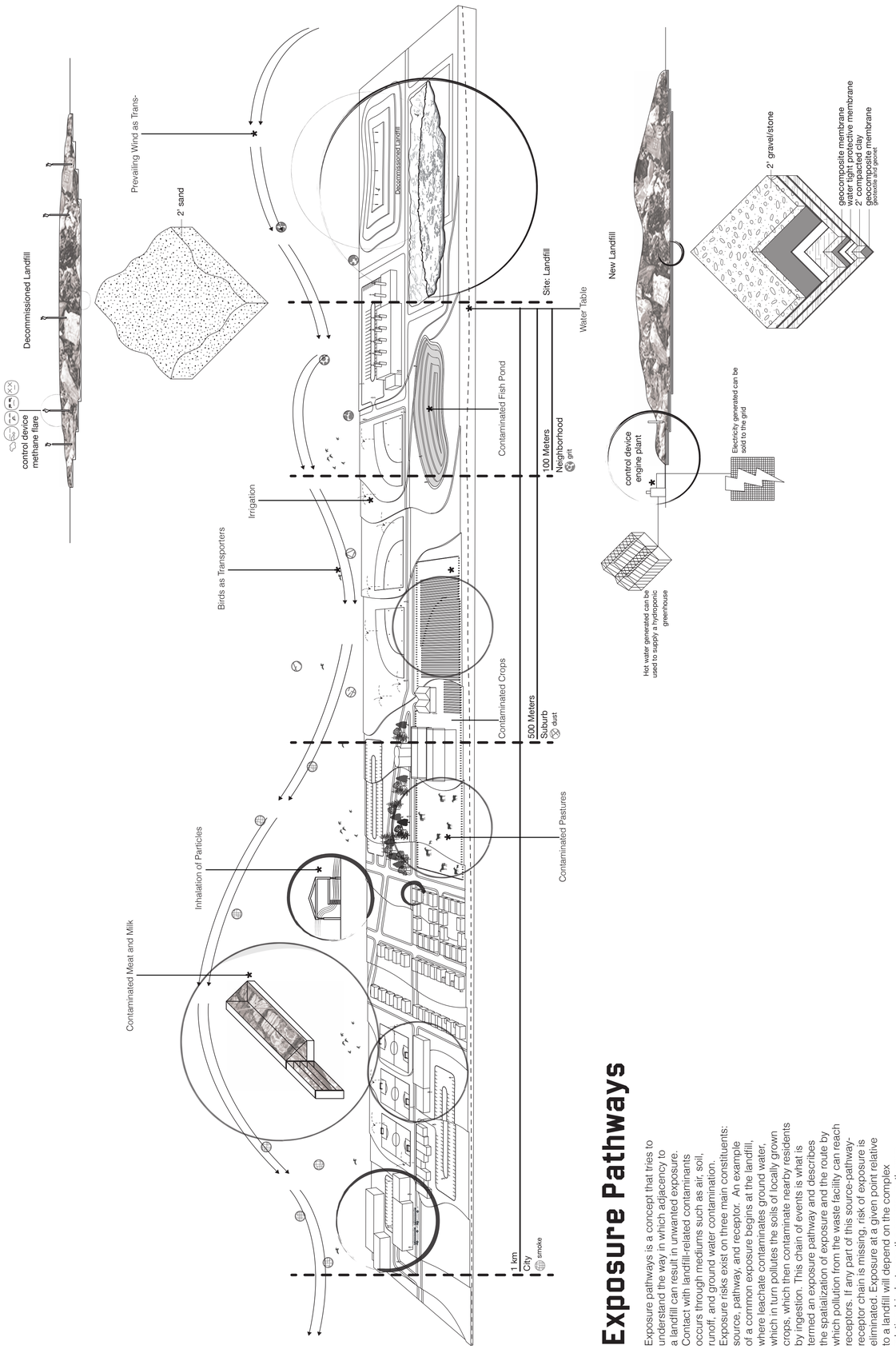
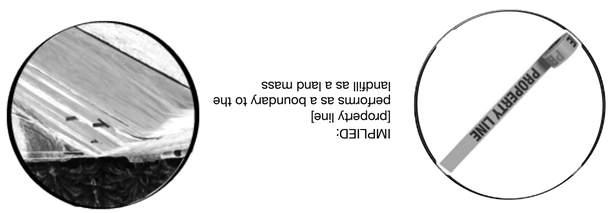


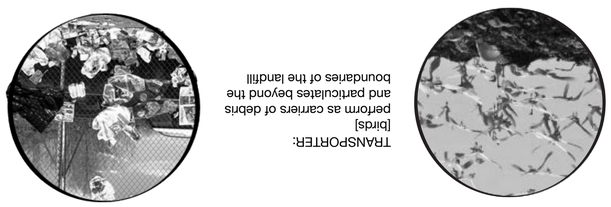
Exposure Pathways

Exposure pathways is a concept that tries to understand the way in which adjacency to a landfill can result in unwanted exposure. Contact with landfill-related contaminants occurs through mediums such as air, soil, runoff, and ground water contamination. Exposure risks exist on three main constituents: source, pathway, and receptor. An example of a common exposure begins at the landfill, where leachate contaminates ground water, which in turn pollutes the soils of locally grown crops, which then contaminate nearby residents by ingestion. This chain of events is what is termed an exposure pathway and describes the spatialization of exposure and the route by which pollution from the waste facility can reach receptors. If any part of this source-pathway-receptor chain is missing, risk of exposure is eliminated. Exposure at a given point relative to a landfill will depend on the complex relationship between the source, pathways, and receptor. The most important factor in exposure risk is distance between source and receptor. Particles are subject to aerodynamic and gravitational effects, among others, that influence the distance which they travel.

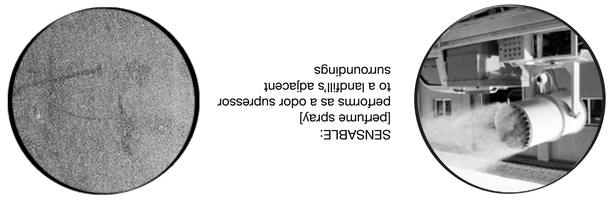


Thresholds

IMPLIED:
[property line]
performs as a boundary to the landfill as a land mass



TRANSPORTER:
[birds]
perform as carriers of debris and particulates beyond the boundaries of the landfill



SENSABLE:
[perfume spray]
performs as a odor suppressor to a landfill's adjacent surroundings

FILTER:
[membrane]
performs as a threshold for contaminants contained within the layers of the landfill

PERMEABLE:
[chain link fence]
performs as a threshold for debris which detatches itself from the landfill

NON-PERMEABLE:
[window]
performs as a threshold for particulates which travel past the barriers of the landfill

Thresholds

Though levels of pollution are heavily monitored at the landfill site through sensors and other instruments, such feedback is exclusive to the technicians and engineers who are in charge of the public's well-being. We propose that feedback about the migration of pollution from landfills be accessibly communicated on a daily basis through the creation of communicating thresholds that surround private domestic realm. Such communicating thresholds exist as a "coupled" condition, engrained in the experience and use of a particular space or environment.

The site of this research is at the thresholds where landfill air pollution leaves the landfill and travels into public spaces and private domains. These research interventions are designed to be coupled with traditional thresholds, such as a fence, window, garbage can etc., in order to provide visual information of the hidden dangers of that specific place. In the long term, these communicating devices could become a permanent component of everyday space as the pollution issue escalates.

Assembly: Window Lung & Particle Screen

Gas Emission

Phases of Gas Production

Landfills produce different gases in relation to different phases of decomposition.

Phase I: Aerobic bacteria break down long molecular chains of complex carbohydrates, proteins, and lipids found in organic waste. The primary byproduct is carbon dioxide, with nitrogen production high at the beginning and diminishing as the phases progress.

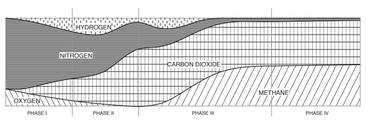
Phase II: Begins when oxygen runs out and aerobic processes cease. Anaerobic bacteria create acetic, lactic, and formic acids, as well as alcohols such as methanol and ethanol. The landfill becomes highly acidic, and acids and moisture begin to dissolve nutrients, making nitrogen and phosphorus. Gaseous byproduct consists of carbon dioxide and hydrogen.

Phase III: Certain anaerobic bacteria species consume acids and form acetate, leading to a more neutral, balanced environment. Methanogenic bacteria begin to establish themselves, and a symbiotic relationship begins between the methane-producing and acid-producing bacteria.

Phase IV: A classification of the state of the landfill when production rate and composition of landfill gas each remains constant. Landfill will usually continue to produce gas for at least 20 years, and emit gas for 50+ years. Phase IV gas usually consists of 40-60% CO_2 and 2-9% other gases.

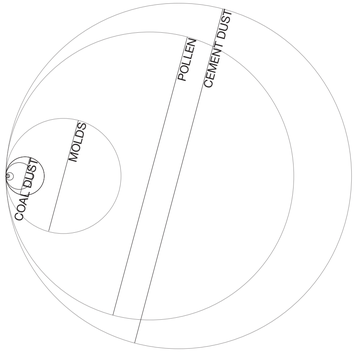
VOCs

VOC content in landfills conjointly stems from waste which emits the chemicals into leachate and surrounding air, and waste which chemically volatilizes into these chemicals at the landfill. Generally the VOC-containing waste primarily leaches chemicals into leachate–which ultimately may lead to groundwater contamination. The volatilization of chemicals in waste at the landfill emits VOCs in the form of gases. Emissions are contingent on other factors such as temperature and sun exposure.



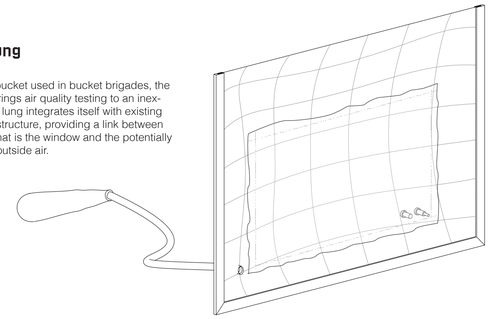
Particulates

Particulate matter is generally classified based on certain specific properties. Size, chemica/biological makeup, and hazard potential are a few properties among the sorting order. Information about particulate size, makeup and hazard potential attests to the importance of the thresholds involved in the landfill and general waste stream. The distance of travel of particulate matter from sites of waste treatment is directly correlated to particulate diameter. The smaller a particle is, the more easily it is transported from its origin. Chemical/biological makeup of particles tells us about the potential hazards associated with exposure, and potential hazard tells us why exposure pathways are relevant. The Particulate Screen intervention exposes--both at a visible (easily visualized) and microscopic (scientific/professional/expert) level--the exposure of a home (window) to particulate matter in the air. The diagram below illustrates in relative scale particulates that are commonly associated with landfills. Because of their scale, the following particulates are not shown in relation to each other below: organics, wood smoke, bacteria, grease smoke, paint dust, soot, household dust, fumes, carbon, black, smog.



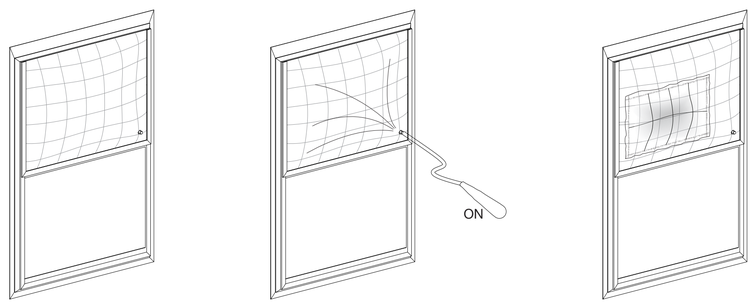
Window Lung

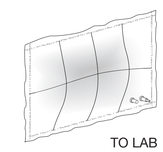
Much like the bucket used in bucket brigades, the window lung brings air quality testing to an inexpert level. The lung integrates itself with existing threshold infrastructure, providing a link between the threshold that is the window and the potentially contaminated outside air.



The Bucket

The Bucket is an activist and advocacy tool used to place air quality in the hands of individual citizens, and is used by groups such as Global Community Monitoring and the Clean Air Coalition. Bucket Brigades comprise groups of citizens who use the Bucket technology to monitor air quality, typically around industrial sites. The bucket works by evacuating air from a sealed bucket, in which lies a plastic bag that is hooked up to a valve. The valve, when opened, breathes in air outside of the bucket, due to the negative pressure in the bucket. This technology is used as a starting point to thinking about how its process could be appropriated into an architectural threshold.



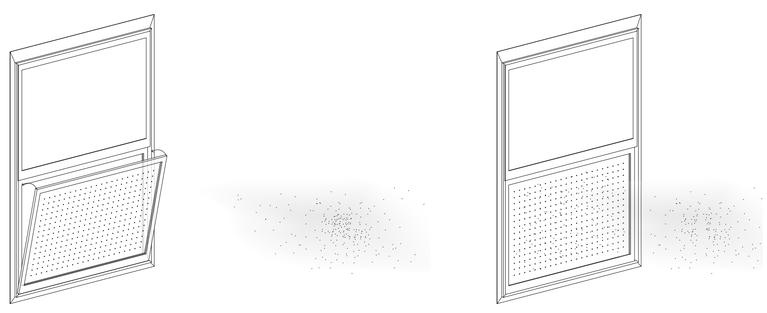


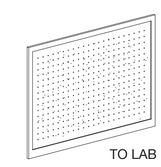
[1] VOCs in outside air

[2] Air is removed from the lung to create a vaccuum

[3] Outside valve is released and air sample bag fills

[4] Air sample bag is removed and sent for lab testing





[1] Particulate matter in outside air

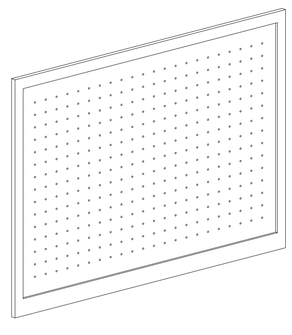
[2] Particulate matter adheres to screen

[3] Particulate matter fills screen to capacity

[4] Screen is removed and sent for lab testing

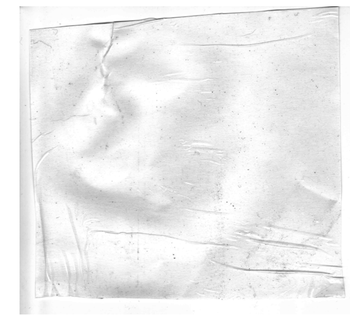
Particle Screen

The particle screen serves as a window screen replacement. By existing at the threshold between the inside of a house and the potentially particulate-ridden outside air, it collects everything from visible to microscopic particulate matter. The screen serves as a visual display of the visible particulates as well as a collection medium for lab testing of the collected sample.



Sticky Thresholds

To explore and visualize the contents or air that infiltrates interior environments, sticky "thresholds" were placed within typical points of entry (windows, doors, etc.) in order to establish a discernible buildup of particulate air pollution, a critical residue. This was conducted as study prior to the proposal for a window unit. This technique is also sometimes used by landfills to measure the kind and amount of particulates being released by the landfill.



Expertise

At every level of monitoring, expertise is an important dilemma. In the domain of advocacy and activism, expertise is a critical issue. Technical training about how to use basic technologies such as The Bucket is important to maintain the quality of samples, for instance. Do it yourself methods of constructing buckets and air quality monitoring devices are important for disseminating access to air quality monitoring to new users and publics. But these methods remain imperfect and, like any method of testing, are subject to variation. Around landfills, air quality monitoring is required by law. Trained engineers comprise another form of expertise, overseeing the monitoring of control devices, together with other forms of containment such as the performance of liner. Such feedback is typicaly exclusive to the technicians and engineers who are in charge of the public's well-being, or buried in language and spaces which are out of reach or unknown to a layperson. The window lung and particle screen propose a more rudimentary level of testing that both engages the user in testing and readily displays test results as a part of the apparatus. In this case, the results of testing are more accessibly communicated, and the level of expertise needed for engaging with testing is sited in the ebb and flow of daily habit. What might the consequences of this distributed knowledge be, considering that the systems being proposed draw monitoring in from public and open spaces and reposition it in the domestic sphere?

> **Competent Designer.** Engineering knowledge and experience in sanitary landfill site selection, design, and operation are essential requirements of the individual or agency chosen to develop the sanitary landfill. If the planning or operating agency does not have this engineering experience and competence, every effort should be made to obtain the services of the best engineering consultant available.

From: Sanitary Landfill Facts, Sorg and Lanier, US Bureau of Solid Waste Management, 1970.

Landfill ≠ Industry

Since the early 1970s, landfills and waste treatment facilities have been subject to a set of regulations directly borrowed from their industrial counterparts. However, landfills and waste treatment plants run differently than typical industrial facilities and cannot be subject to the same regulations. One such regulation that clearly cannot be implicated in the waste treatment facility's operation is the requirement of a "start-up–shut-down–malfunction–plan," or an SSMP, which requires industrial businesses to have a plan for shutting down all processes in the case of an emergency. Landfill owners, however, cannot stop or prevent the landfill from producing its gases.