Harris County, Tx.

Houston Metropolitan Area

The Houston Ship Channel has one of the highest air pollution emissions in the nation. In 2018, industries here reported more than 150 pollution releases that exceed the state's emission permits, equivalent to over 1.5 million pounds of harmful gases.

Bodies of Water in Harris County

The Houston Ship Channel

400 Petrochemical Facilities

2 of the largest 4 Refineries in the U.S.

Source: Houston-Galveston Area Council GIS Datasets
1800-1850

Houston is established by brothers John Kirby and Augustus Chapman Allen near Buffalo Bayou.

1851-1900

The port is dredged from the Galveston Bay till present day Clinton.

1901-1950

U.S. government purchases the dredged channel.

The discovery of Spindletop causes a rapid growth in the petroleum industry.

The Houston ship channel is further dredged and inaugurated.

WWII increases the demand on synthetic rubber, chemicals and explosives for Houston’s petrochemical industry.

1951-2000

Texas supplies 40 percent of all basic petrochemicals produced in the U.S.

Clean Air Act is passed.

DuPont, Texaco and Dow are forced to settle lawsuits charging them with the release of toxic carcinogenic gases, which affected plant employees and residents in the nearby communities.

2001-2018

Harris County releases report identifying main sources of Benzene pollution and creates 5 year emissions reduction plan.

Houston violates pollution emission laws at least 405 times within the year.

Correlations between Air Pollution, Disease Prevalence and Socioeconomic Vulnerability

Fence-Line Community:
Community living in close or direct proximity to industrial facilities

Manchester Neighborhood

Source: T.E.J.A.S.

Source: Rice University Disparity Atlas

*PM 2.5 = Particulate Matter Size 2.5 (fine)
Houston Mayor Bill White created a task force in 2005 dedicated to identifying high-risk air pollutants within Harris county. The study identified 176 air pollutants present, and created five categories based on the risk that each pollutant presented towards health.

Definite Risk Pollutants in Harris County

Pollutants with, “compelling and convincing evidence [that the substances] represent significant risk to the general population or vulnerable subgroups at current ambient concentrations”

(Houston Mayor Task Force Report, pp. 6, 2005)
A Possible Solution: Bio-filters

Research Sources: Devinny et al.

The Chart compares the ability of bio-filters to degrade different kinds of air pollutants. The pollutants highlighted in orange are the ones found on site. As shown, bio-filters have a moderate to high ability to degrade them.
Plants enhance the bio-filter’s performance by providing nutrients for the air pollutant-degrading organisms. This is due to the generation of exudates on plant roots—substances that ooze out of plant tissue pores and provide beneficial nutrients for bacteria and fungi.
Design Concept: Softening the Edge

Blocks 1 and 2 consist of empty lots and parking; block 3 is a community center. The design concept is to implement bio-filters here in a way that is engaging with residents and creates a buffer between industry and housing.
Connecting the Gas Tanks to the Bio-filters

The diagram shows the series of underground pipes that connect the pollution tanks to the horizontal and vertical bio-filters in blocks 1 and 2. The section displays a design for incorporating the community center in block 3 into a cohesive park.
The vertical bio-filters receive air pollution through underground pipes, where they pass through a humidifier and filtering system underground before entering the air influent chamber.
Perspective over the viewing platform, looking out past the bio-filters and the refinery into the waterfront.
1. Horizontal Bio-filter
2. Overhead Bridge
3. Grass Mound with Playground
4. Grass Mound with Seating

Scale: 1-1/2" = 1'-0"
The Horizontal Bio-filter is connected through underground pipes to the air pollution source. The cover is made of translucent, reinforced glass so that people can walk over it and look at the planting design in the bed media.
In a possible future where the refinery stops production, the bio-filters could be phased out of their original use into unique spaces. The glass floor on the bio-filter could be removed to turn the space into a playground, plaza or garden.
<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Height (Feet)</th>
<th>Status in Texas</th>
<th>Moisture Conditions</th>
<th>Temperature Tolerance</th>
<th>Ph Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purple Waffle</td>
<td><em>Hemigraphis alternata</em></td>
<td>0.50</td>
<td>Exotic Non-Invasive</td>
<td>Constantly Moist Soil</td>
<td>16°C to 24°C</td>
<td>Withstands wide range</td>
</tr>
<tr>
<td>Purple Heart</td>
<td><em>Tradescantia pallida</em></td>
<td>0.50 to 0.75</td>
<td>Native</td>
<td>Moist Soil</td>
<td>18°C to 24°C</td>
<td>Prefers Slightly Acidic Soils</td>
</tr>
<tr>
<td>Sprenger’s Asparagus Fern</td>
<td><em>Asparagus densiflorus</em></td>
<td>2.00 to 3.00</td>
<td>Exotic Non-Invasive</td>
<td>Moist Soil</td>
<td>16°C to 24°C</td>
<td>6.5 to 7.5</td>
</tr>
<tr>
<td>Variegated Wax</td>
<td><em>Hoya carnosa</em></td>
<td>2.00 to 4.00</td>
<td>Exotic Non-Invasive</td>
<td>Moist Soil</td>
<td>16°C to 29°C</td>
<td>6.0 to 6.5</td>
</tr>
<tr>
<td>Crassulaceae</td>
<td><em>Crassula portulacea</em></td>
<td>0.75</td>
<td>Exotic Non-Invasive</td>
<td>Moist Soil</td>
<td>18°C to 24°C</td>
<td>6.0 to 6.5</td>
</tr>
<tr>
<td>French Hydrangea</td>
<td><em>Hydrangea macrophylla</em></td>
<td>7.00 to 8.00</td>
<td>Exotic Non-Invasive</td>
<td>Moist Soil</td>
<td>18°C to 21°C</td>
<td>5.5 to 6.5</td>
</tr>
<tr>
<td>Golden Elf Orchid</td>
<td><em>Cymbidium ‘Golden Elf’</em></td>
<td>1.00 to 1.50</td>
<td>Exotic Non-Invasive</td>
<td>Moist Soil</td>
<td>16°C to 25°C</td>
<td>6.1 to 7.5</td>
</tr>
<tr>
<td>Chrysanthemum morifolium</td>
<td><em>Dendranthera morifolium</em></td>
<td>2.00 to 3.00</td>
<td>Exotic Non-Invasive</td>
<td>Moist Soil</td>
<td>15°C to 24°C</td>
<td>6.5 Optimal</td>
</tr>
<tr>
<td>Giant dumbcane</td>
<td><em>Dieffenbachia amoena</em></td>
<td>Up to 6.00</td>
<td>Exotic Non-Invasive</td>
<td>Moist Soil</td>
<td>18°C to 23°C</td>
<td>6.5 to 7.5</td>
</tr>
<tr>
<td>Peace Lily Supreme</td>
<td><em>Spathiphyllum Supreme</em></td>
<td>1.50 to 2.00</td>
<td>Exotic Non-Invasive</td>
<td>Moist Soil</td>
<td>20°C to 26°C</td>
<td>Acidic to Neutral</td>
</tr>
<tr>
<td>Sword Fern</td>
<td><em>Nephrolepis exaltata</em></td>
<td>2.00 to 3.00</td>
<td>Exotic Non-Invasive</td>
<td>Moist Soil</td>
<td>21°C or above</td>
<td>5.6 to 6.0</td>
</tr>
<tr>
<td>Striped dracena</td>
<td><em>Dracaena deremensis</em></td>
<td>0.50 to 0.75</td>
<td>Exotic Non-Invasive</td>
<td>Constantly Moist Soil</td>
<td>21°C to 26°C</td>
<td>Withstands wide range</td>
</tr>
</tbody>
</table>

Plant list was selected through research of species with a high tolerance to Volatile Air Compounds and particulate matter, and then narrowed based on the condition requirements of a bio-filter: temperature (15-30 Celcius), Ph of material (6-8) and moisture conditions.