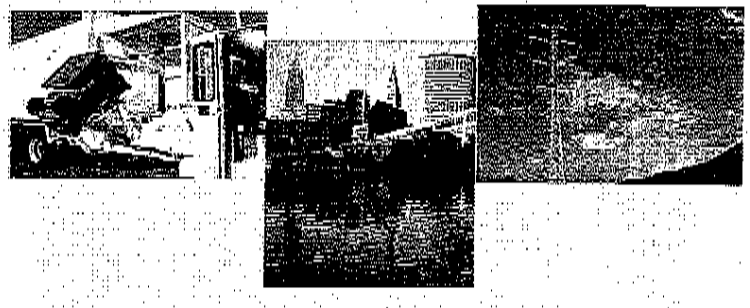
MSWE
Municipal Solid Waste to Energy

rethinkenergy
CLEVELAND



City of Cleveland MSW TO ENERGY

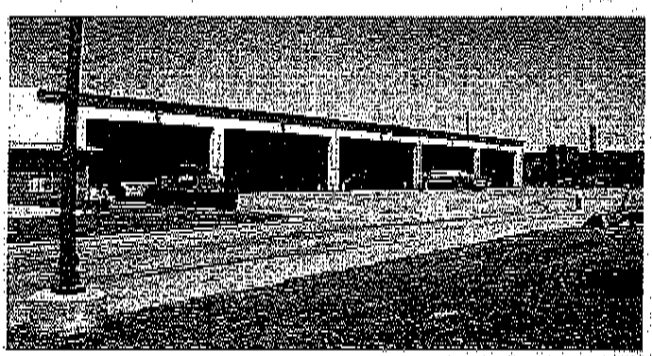
PUBLIC HEARING, February 23, 2011

CITY OF CLEVELAND
DEPARTMENT OF PUBLIC WORKS
DIVISION OF WASTE COLLECTION

Agenda

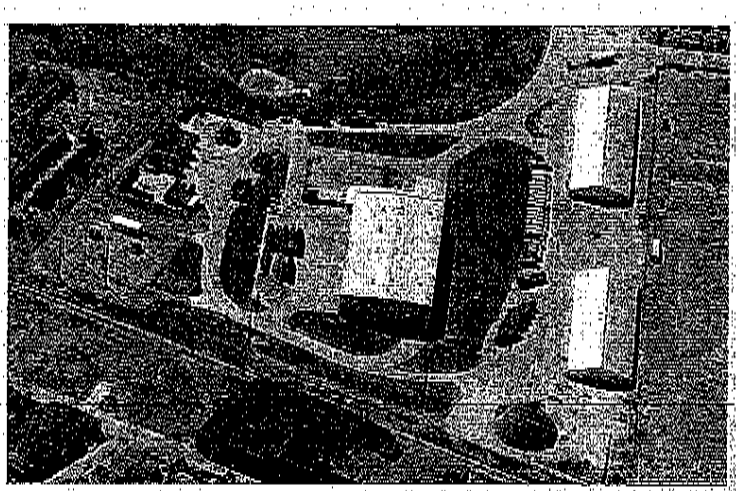
Introduction

Ridge Road Transfer Station



3741 Ridge Road, Cleveland

Ridge Road Transfer Station Aerial View



Current MSW Capacity and Collection at Ridge Road

- Cleveland's Ridge Road Transfer Station has a daily MSW capacity of 3,000 tons (253 days of operation)
- Ridge Road Transfer Station daily collection of MSW
  - On-peak 1,500 tons daily
  - Off-peak 900 tons daily
- Ridge Road unused capacity
  - On-peak 1,500 tons daily
  - Off-peak 2,100 tons daily

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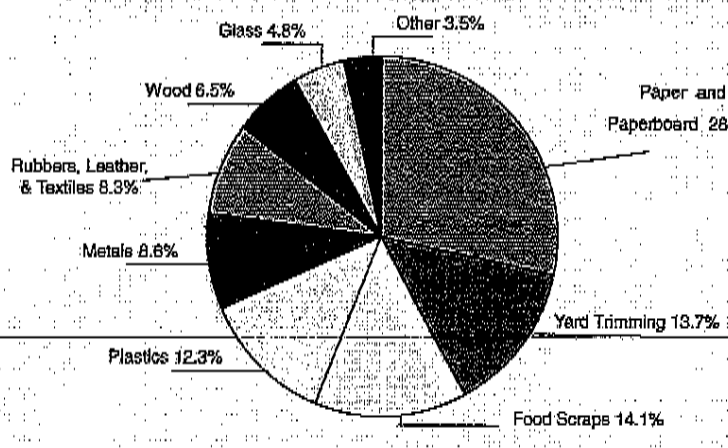
What Is In Municipal Solid Waste?

US EPA 2009*



*243 Million Tons (before recycling)

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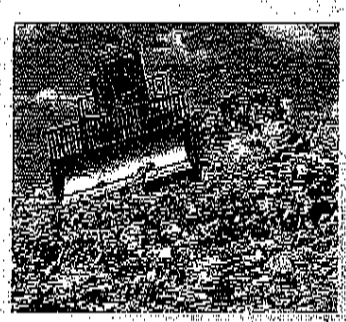
A New Way To Think About Municipal Solid Waste (MSW)

- We think of MSW as a valuable resource that can be processed, recycled and reused in new forms.
- This resource will take careful planning and investment to extract but the end result is new jobs, tax revenues, an environmentally friendly alternative energy source, and increased control of *Cleveland's energy future.*



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Long Term Waste Management Solution

Alternate Collection Method: convert the current manual process to a *fully-automated* and a *semi-automated system* for recycling utilizing carts.

Waste Sorting & Separation: invest in material recovery facility to prepare waste for processing and/or recycling.

Recyclables: *fully implement Cleveland's Waste Collection Recycling Program City-wide* and include metal collection and separation, waste paper collection and bundling and more.

Power Production: use MSW as feedstock for electric generation.

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Why This Option for Cleveland

Unlike other municipalities, Cleveland is unique in that it:

- ***Owns the MSW***
- ***Has a high volume and variety of MSW***
- ***Owns the transfer station***
- ***Has its own electric system with direct access to the electric grid***
- ***Manages its own Water System***
- ***Rail is proximate to Transfer Station***

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Why This Option for Cleveland

Local Power Production

- CPP purchases 99.9% of its power.
- Local generation would reduce dependence on the transmission grid.
- Facility Electricity Production: 20MW.
- Add Renewable energy sources

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Why This Option for Cleveland

- Traditional fuel types available in other parts of the State/Country are not available in a "non-attainment" area like Cleveland
  - "Non-attainment" means a geographic area in which the level of certain air pollutants is higher than national air quality standards
- Cleveland must find green/renewable/advanced energy options if it is to generate power locally
- Cleveland can be positioned as a national leader in MSWE technology, paving the way for manufacturing opportunities and more jobs to be created in Cleveland.

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1. Gasification Technology

The Concept and Technology is Not New

- The first waste-to-energy plant in the US was an incineration plant located in Saugus, Massachusetts.
- Today, incineration is recognized as a practical method for disposing of certain hazardous waste materials, but some consider it a more controversial method of waste disposal due to issues such as emission of harmful gaseous pollutants.
- ***Cleveland's waste-to-energy approach is not based on incineration but on a proven process called gasification.***

Three primary types of thermal gasification:

- Conventional gasification
- Plasma gasification
- Pyrolysis gasification

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Gasification Technology

- Cleveland's MSW to Energy Facility will use a variation of conventional gasification rather than incineration.
- Incineration vs. Thermal Gasification
  - Incineration of MSW is through combustion of organic materials in an oxygen rich environment that produces complex hazardous oxides in the process
  - Thermal gasification of MSW is through high temperature chemical conversion of organic materials into synthetic gas (composed primarily of H_2 and CO) in a controlled oxygen and heat environment
  - Thermal gasification breaks down hazardous organic substances such as dioxins and furans

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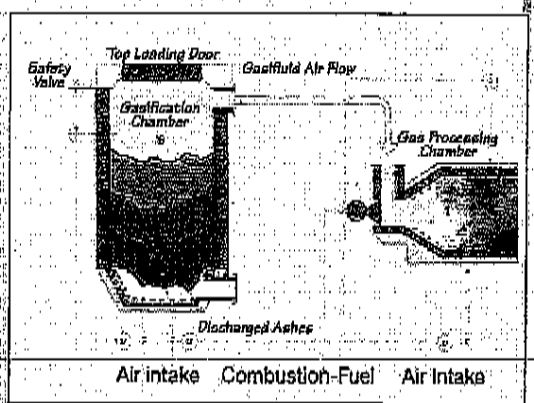
Gasification Technology

- Gasification Process: The System is ignited at 80°C and rapidly increased to 800°C. Through precision temperature and air flow control, the system restrains formation of toxins. 8-12 hr process.
- After gasification, ash remains are reduced to 5% of initial input volume. Enhanced furnace can reduce ash to 1-2%. Ash discharges are 99% non-organic and non-toxic. This "silicon" can be sold or used.



1. Gasification Processing Chamber
2. Heating Chamber
3. Fluidization Chamber
4. Heat Transfer Chamber
5. Gasification Chamber

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Gasification Technology

- The outcome of the gasification process is the production of a synthetic gas called "syngas".
- Syngas is combustible and can be used as a fuel much like natural gas.

Cleveland's MSWE facility will use syngas to fire a boiler. The boiler will produce steam that will turn a steam turbine generator to produce electricity.

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2. System Requirements And Facility Design

Top Priorities

- Minimize MSW sent to landfill
- Environmentally conscious waste-to-energy facility
- Electric power generation to reduce market dependence
- Electric generation that helps meet the City's AEPS goals for CPP
- Recycling on a City-wide basis
- Sustainable System

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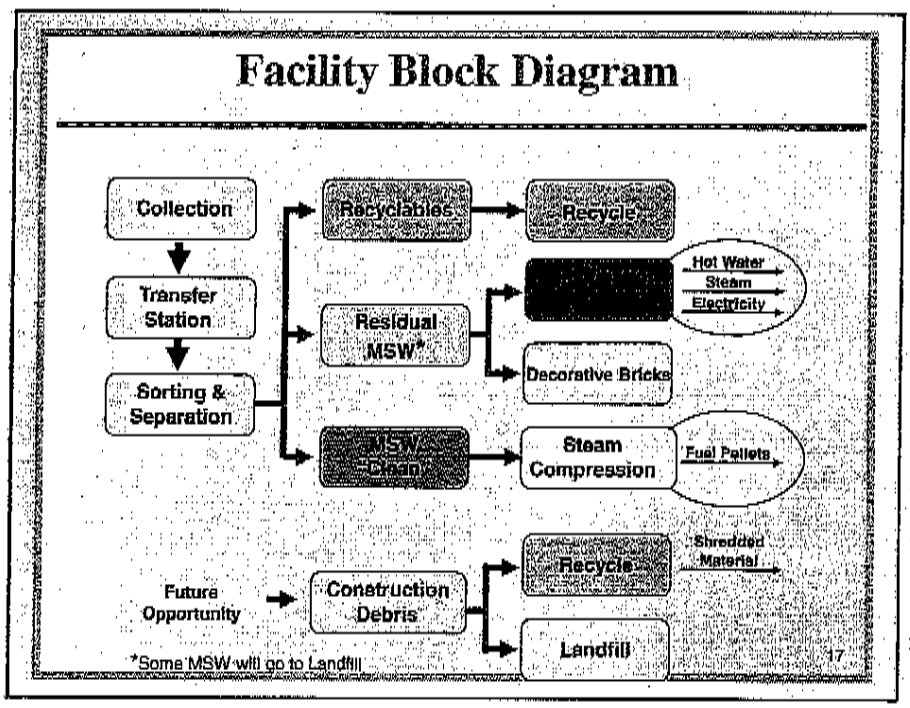
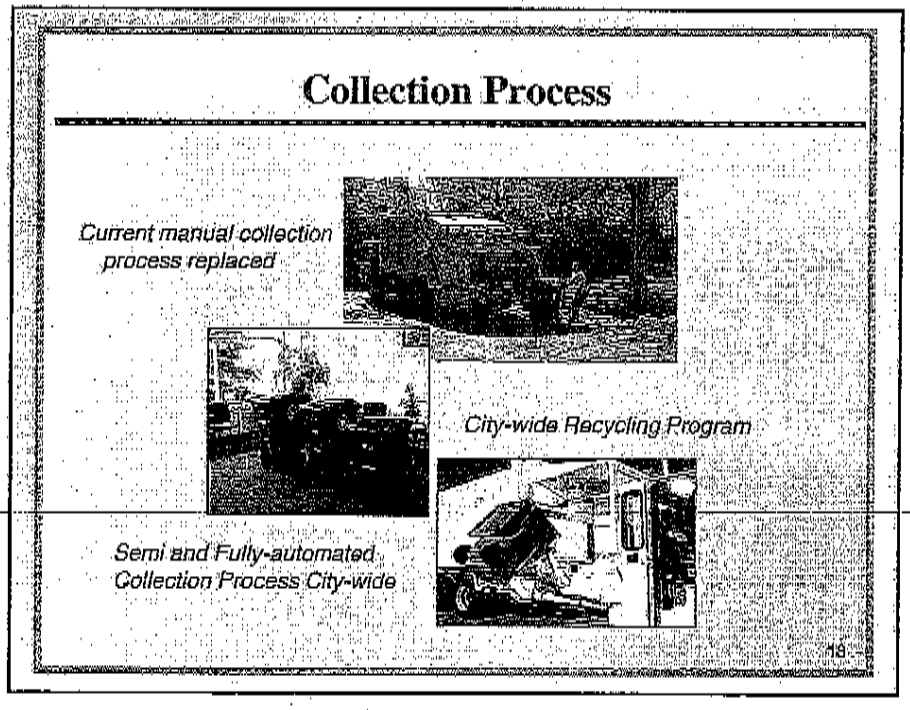
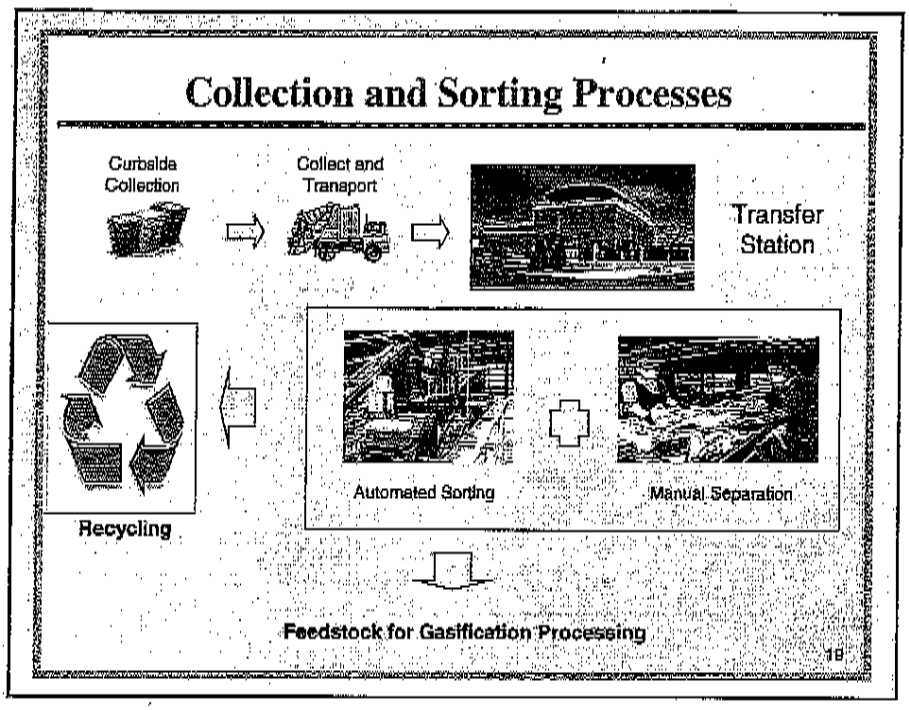
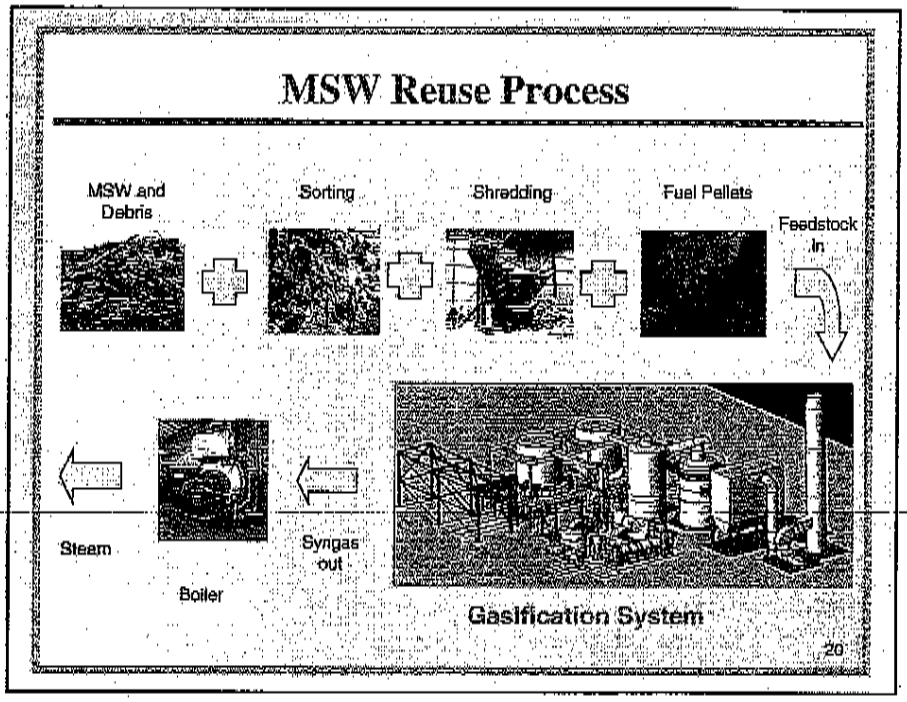

Facility Block Diagram
Collection
Transfer Station
Sorting & Separation
Recyclables
Residual MSW*
MSW Clean
Recycle
Hot Water
Steam
Electricity
Decorative Bricks
Steam Compression
Fuel Pellets
Future Opportunity
Construction Debris
Recycle
Shredded Material
Landfill
*Some MSW will go to Landfill
17


Collection Process
Current manual collection process replaced
City-wide Recycling Program
Semi and Fully-automated Collection Process City-wide
18

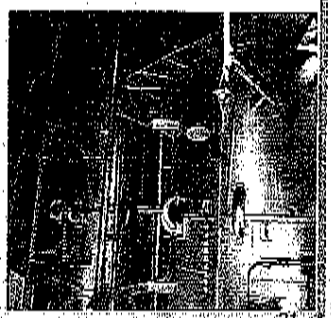

Collection and Sorting Processes
Curbside Collection
Collect and Transport
Transfer Station
Automated Sorting
Manual Separation
Recycling
Feedstock for Gasification Processing
19


MSW Reuse Process
MSW and Debris
Sorting
Shredding
Fuel Pellets
Feedstock In
Steam
Boiler
Syngas out
Gasification System
20

Gasification System Operation

The Cleveland facility will have four gasification lines with two batch gasifiers operating in tandem in each gasification line.

- **Max Operating schedule:** 12 hours per day per gasifier (365 days per year)
- **Feedstock:** 70 tons of MSW/batch.
- **Cycle:** One batch of MSW will be processed each day in each gasifier.



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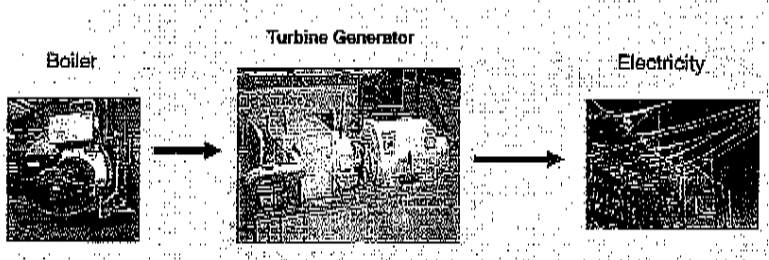
Steam Uses



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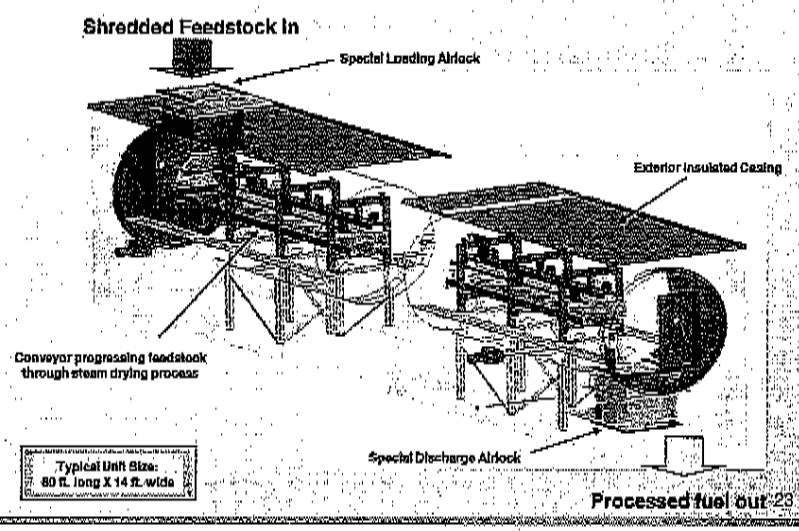
Steam Compression Technology



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3. Environmental Impacts

Best Available Technology (BAT)

- The National Source Performance Standards (NSPS) subpart AAAA applies to small municipal waste combustion units for which construction occurred after August 30, 1999.
- The NSPS subpart Eb applies to new source performance standards for large municipal waste combustors constructed after September 20, 1994.
- Cleveland's facility as proposed will emit pollutants at or below all of these levels. ***The BAT limits proposed for the CPP project are equivalent to, or more stringent than, each of the relevant benchmarks.***

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Air Quality Modeling

- Ohio EPA required that an air quality computer model analysis be performed on the proposed Cleveland facility.
- The model completed by GT Environmental predicted how different air pollutants travel away from the source of pollution.
- **Based on the modeling analysis, the predicted maximum off-site air quality impact for each pollutant emitted by the operation of the proposed CPP facility is well within the guidelines established by Ohio EPA**

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Environmental Impacts

- Although air quality modeling is not required pursuant to Ohio EPA Engineering Guide #69 for mercury or dioxin, CPP elected to include modeling for those two pollutants to demonstrate the impact from the proposed facility is far less than authorized by the Ohio EPA Air Toxic Policy "Option A".

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The Cleveland facility will operate within the OEPA NSR and HAPs guidelines

Ohio EPA New Source Review (NSR)

- Particulate Matter (PM2.5)
- Particulate Matter (PM10)
- Sulfur Dioxide (SO2)
- Nitrogen Oxide (NOx)
- Nitrogen Dioxide (NO2)
- Carbon Monoxide (CO)
- Volatile Organic Compounds (VOC)
- Lead (Pb)

Ohio EPA Hazardous Air Pollutants (HAPs)

- Hydrogen Chloride (HCl)
- Dioxin
- Cadmium
- Mercury
- Hydrogen Fluoride (HF)
- Sulfuric Acid (H2SO4)
- Ammonia

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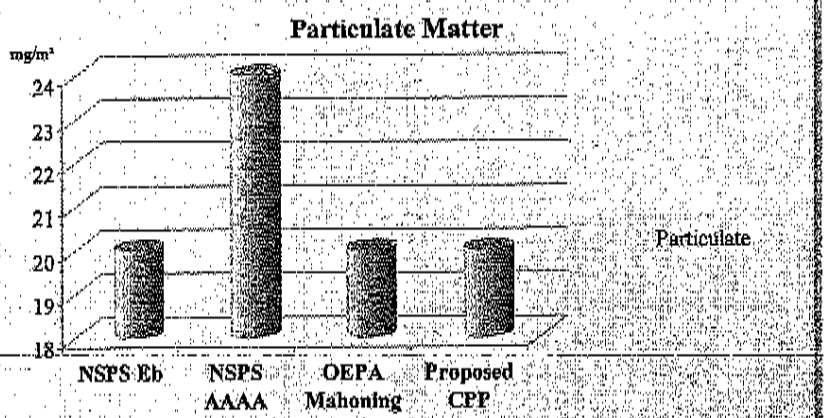
CPP BAT Emissions vs. Benchmark Rules and Permit



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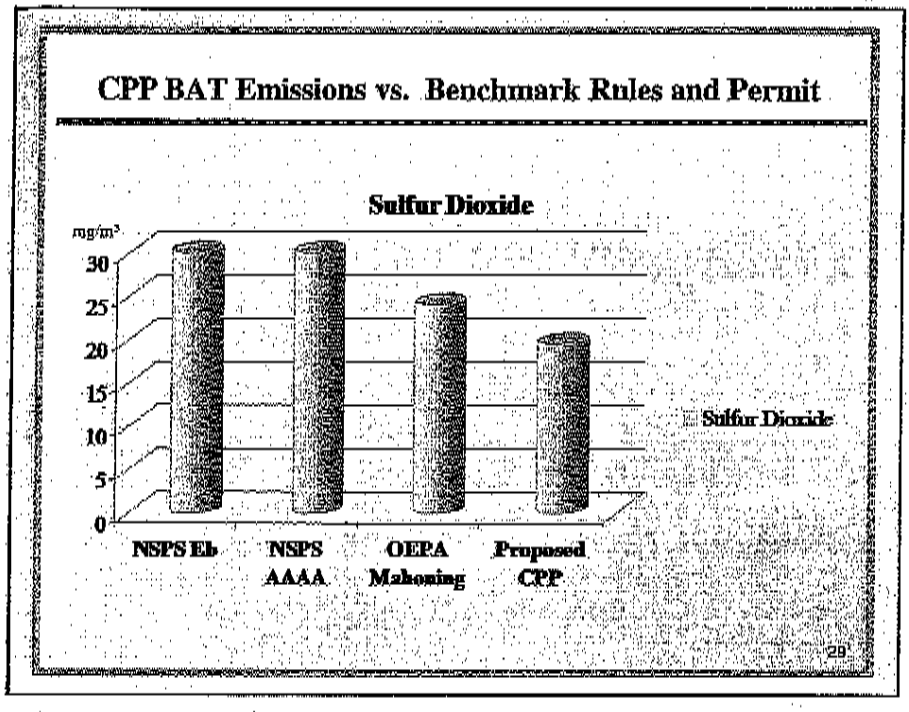
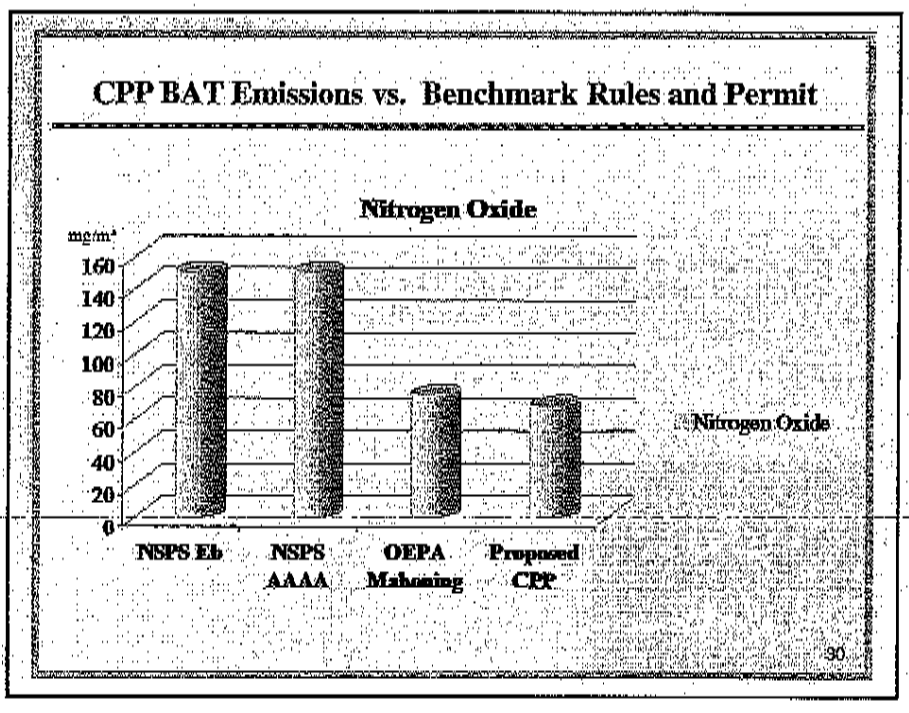
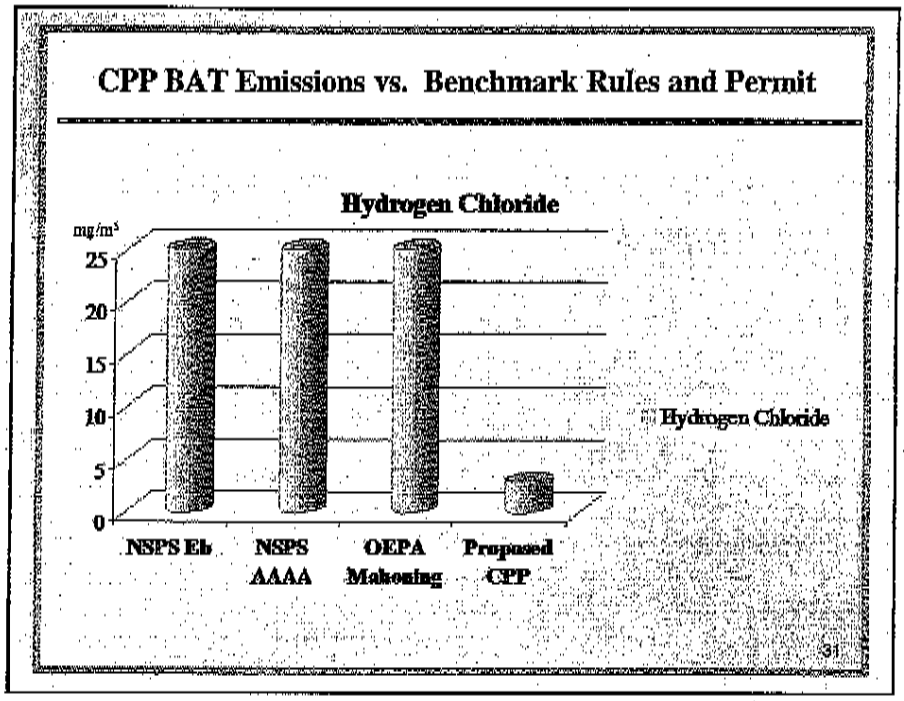
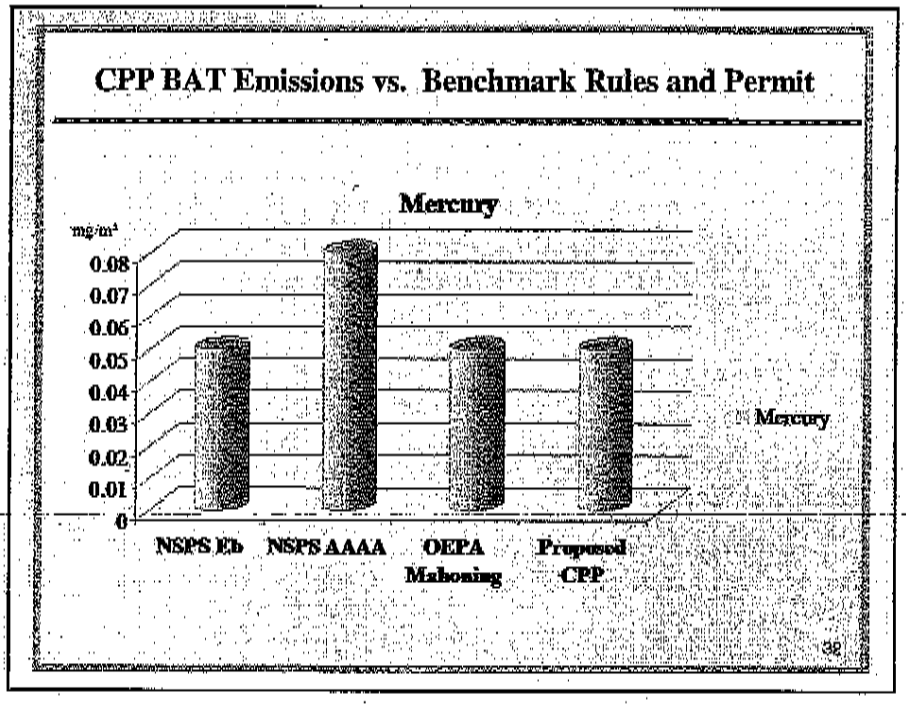

CPP BAT Emissions vs. Benchmark Rules and Permit
Sulfur Dioxide
mg/m³
30
25
20
15
10
5
0
NSPS Eb
NSPS AAAA
OEPA Mahoning
Proposed CPP
Sulfur Dioxide
29


CPP BAT Emissions vs. Benchmark Rules and Permit
Nitrogen Oxide
mg/m³
160
140
120
100
80
60
40
20
0
NSPS Eb
NSPS AAAA
OEPA Mahoning
Proposed CPP
Nitrogen Oxide
30


CPP BAT Emissions vs. Benchmark Rules and Permit
Hydrogen Chloride
mg/m³
25
20
15
10
5
0
NSPS Eb
NSPS AAAA
OEPA Mahoning
Proposed CPP
Hydrogen Chloride
31


CPP BAT Emissions vs. Benchmark Rules and Permit
Mercury
mg/m³
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
NSPS Eb
NSPS AAAA
OEPA Mahoning
Proposed CPP
Mercury
32

Sight, Smell and Noise

Sample Technology

- Gasification- Processes MSW with high temperatures in separate stages and restrains the formation of toxic substances (Dioxin, CO, NOx, Sox).

- Removes more than 97% of airborne odor
- Primarily water vapor emissions (no black/gray smoke)
- No increased or high volume noise effects
- Used abroad in residential areas
- The facility will be enclosed and will have even less odor than the current operation

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Impact on Truck Traffic

- At the current level, approximately 240 various types of trucks go in and out of the transfer station each day. (Some trucks make two or more trips, which are included in these numbers).
- A higher usage level, 2,000 and 3,000 tons per day, would result in 370 to 550 trucks per day.
- Other communities – most communities collect their waste at the same time (between 6 a.m. to 5 p.m.). *We will retain the flexibility to accept waste per our requirements.*
- Just like the current operation, MSW received will be processed each day.

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4. Sustainability

FRIDAY, NOVEMBER 30, 2007 | SECTION C

Jackson wants greener CPP

Seeks increase in advanced, renewable energy sources

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Sustainability

Cleveland's Advanced Energy Portfolio Standard ("AEPS")

- Cleveland Public Power will produce and/or purchase generation from Advanced Energy Sources to meet the following goals and time lines:

AEP	Target Year
15%	2015
20%	2020
25%	2025

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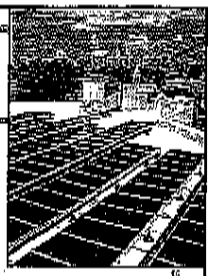
Sustainability



Health & Environment

- **Land:**
  - *Reduced land area used for MSW landfills
  - *No mining is involved in resource extraction of fuel source for energy production
- **Air:**
  - *Will not add to City's regulated emission problem
  - *Fuel pellets can be used to reduce local emission generators' air pollution
  - *Energy resource has a lower carbon footprint
  - *Reduced carbon footprint and air pollution from waste hauling to landfills. > 40 miles each way!

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Sustainability

Waste Reduction & Recycling

- Increases recycling rate
  - *The addition of an onsite-sorting will greatly increase material diversion rate
- Allows for faster deployment of curbside recycling
  - *The curbside recycling and automated pick-up is saving the city money and significantly increasing the recycling rate

For every ton of waste diverted from the landfill, the City of Cleveland saves over $40.00. With over 150,000 tons going to the landfill, this represents $6 million we no longer dump in a landfill.

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5. Economic Development

- Advanced Energy can be one basis of the region's economic turnaround as new industries in the region develop new products and services and bring more jobs to the area.
- If the desire is to attract new technologies and businesses to the region, Cleveland's MSW to Energy facility could serve as the foundation upon which we build:
  - To nurture the growth of the advanced technology industry
  - To facilitate the business development of local corporations
  - To propel Cleveland and the Region to the front of the international stage of advanced energy technology development

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Jobs Per Component

MSW to Energy facility operation 24/7 in 3 shifts

Full time staffing needs

Collection Process:	N/A
Waste Sorting:	24-36
Waste Processing:	12-18
Steam Compression:	18-24
Gasification Operation:	18-24
Power Plant Operation:	18-24

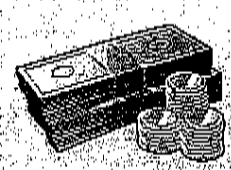
Total Direct Jobs: 90-126

40

Economic Development

Manufacturing Facilities

- Components of Cleveland's systems could be assembled, and some manufactured, locally
  - Sorting Systems (manual and/or automatic)
  - Gasification Facility
  - Steam Compression System
- This would mean more jobs and demand as Cleveland's model is duplicated nationally



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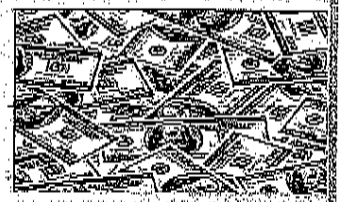
Regional Impact

Participating Municipalities will:

- Pay lower tipping fees and save money
- Experience lower MSW transportation cost since their MSW will not be trucked to a landfill
- Reduce carbon emissions caused by trucking MSW long distances to landfills



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6. Summary of Development Process and Cost

Cleveland's MSWE development process outline

- Feasibility Study
  - ✶Consultants: RNR Consulting, URS Corporation, DLZ Ohio, Inc., Cloud & Associates
  - ✶Contributors: AMP Ohio, APPA, Cleveland Foundation and Cleveland Public Power
- Visit to see technology in Japan and China
  - ✶August and December 2009
- Waste Composition Studies
  - ✶Consultants: SCS Engineers
  - ✶Contributors: Cleveland Public Power

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Summary of Development Process and Cost

- Facility Design Agreement
  - ✶Consultants: Princeton Environmental Group, subs include Kinsei Sangyo Co. LTD., GT Environmental, Ralph Tyler Companies, and PFK Associates
  - ✶Contributors: AMP Ohio, APPA, Cleveland Foundation and Cleveland Public Power
- Air Permit Application
- Preliminary Facility Design

Summary of Facility Cost

Estimated Facility Cost:

♦ City-Wide Recycling (equipment & vehicles)	$29 million
♦ MSW Receiving Station	$21 million
♦ Recycling Station	$12 million
♦ Gasification Equipment	$21 million
♦ Power Plant (20 MW)	$15 million
♦ Steam Compression Equipment	$45 million
♦ Construction	$21 million
♦ Civil Engineering*	$ 8 million
♦ Decorative Brick Equipment	$ 8 million
Total Estimated Cost	$180 million

*Cost of Facility Design: $1.5 million

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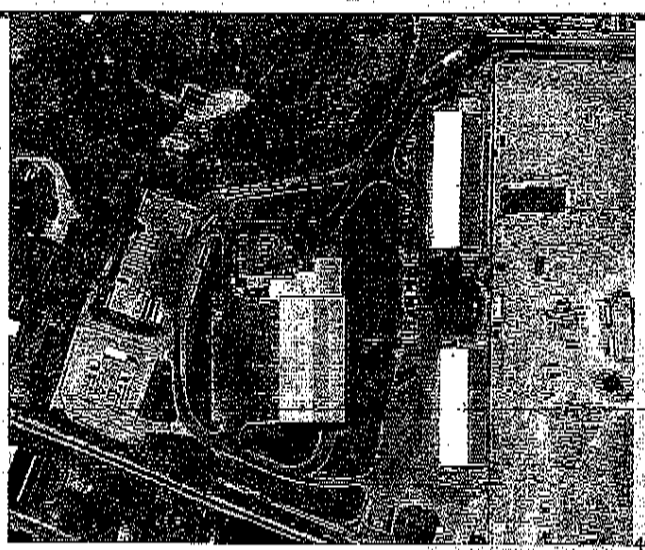
7. Visual Impact

Ridge Road Transfer Station

Existing Layout Aerial View



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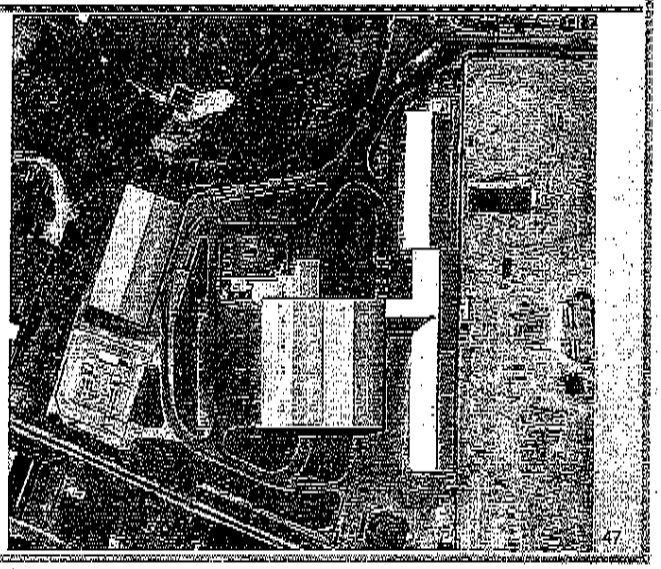
Conceptual Layout 1

Everything is enclosed



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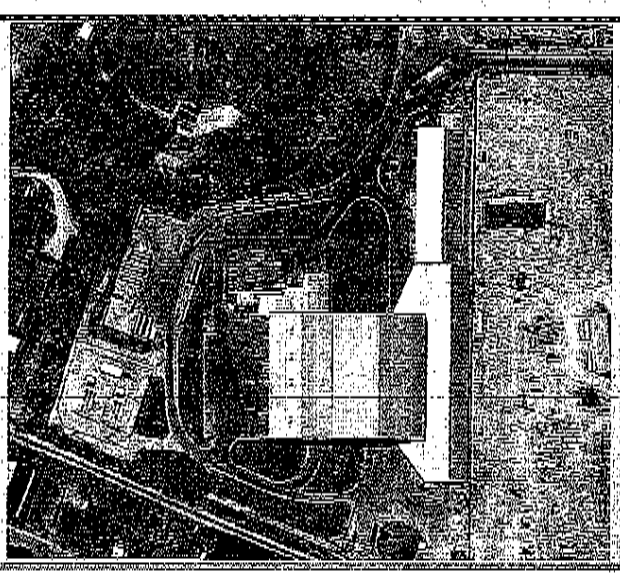
Conceptual Layout 2



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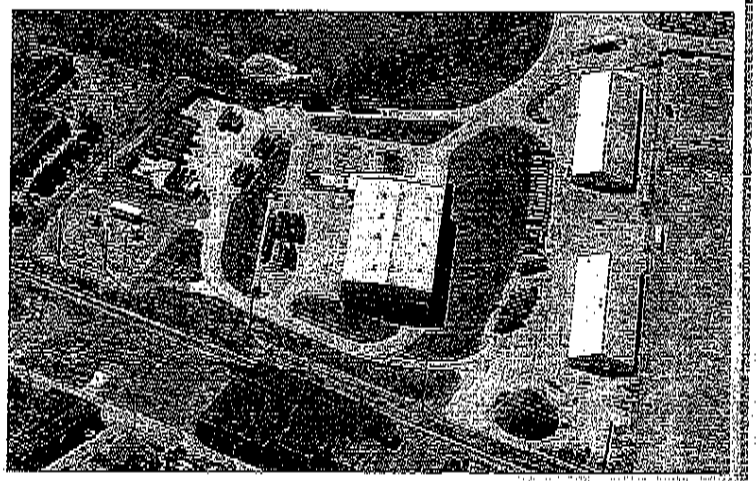
Ridge Road Transfer Station View



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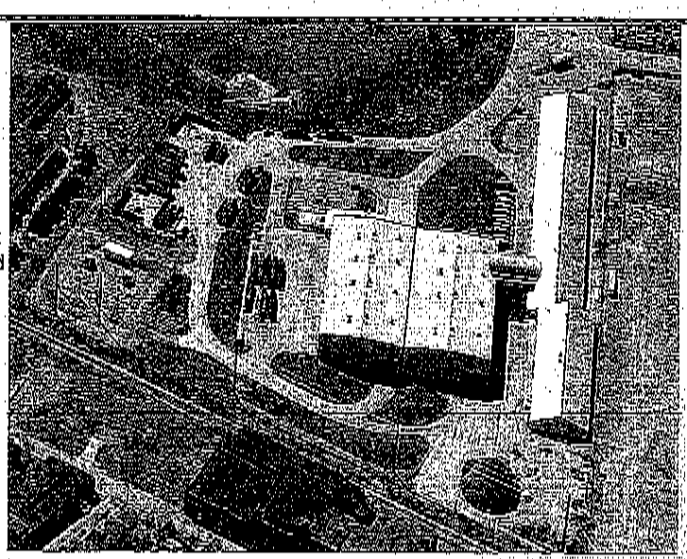
Ridge Road Transfer Station View

After

Everything is enclosed



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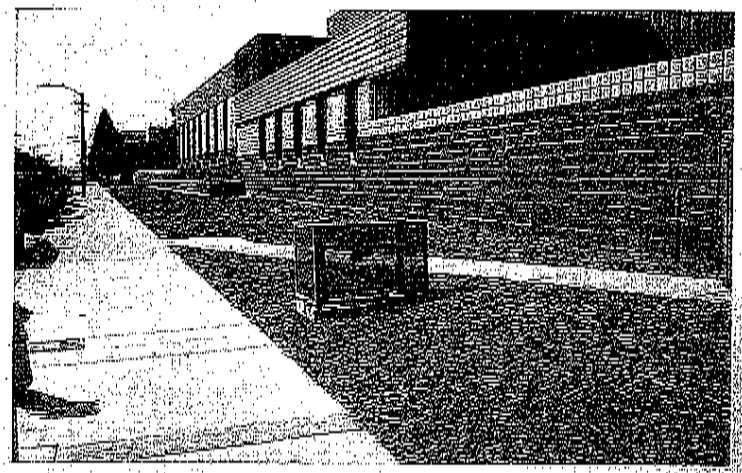
Huntington Beach, CA
Material Recovery Facility



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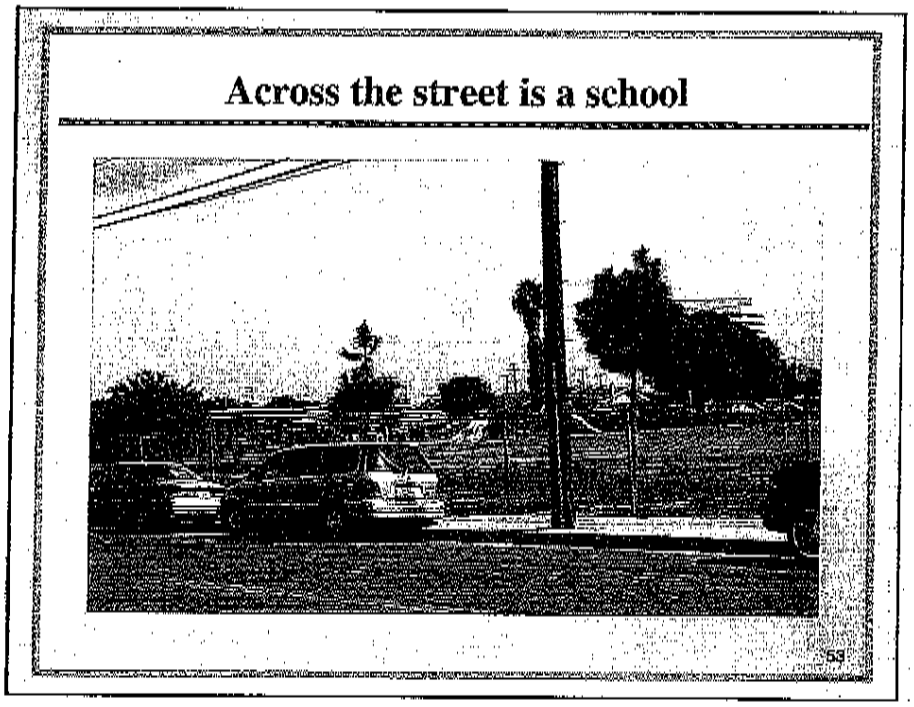
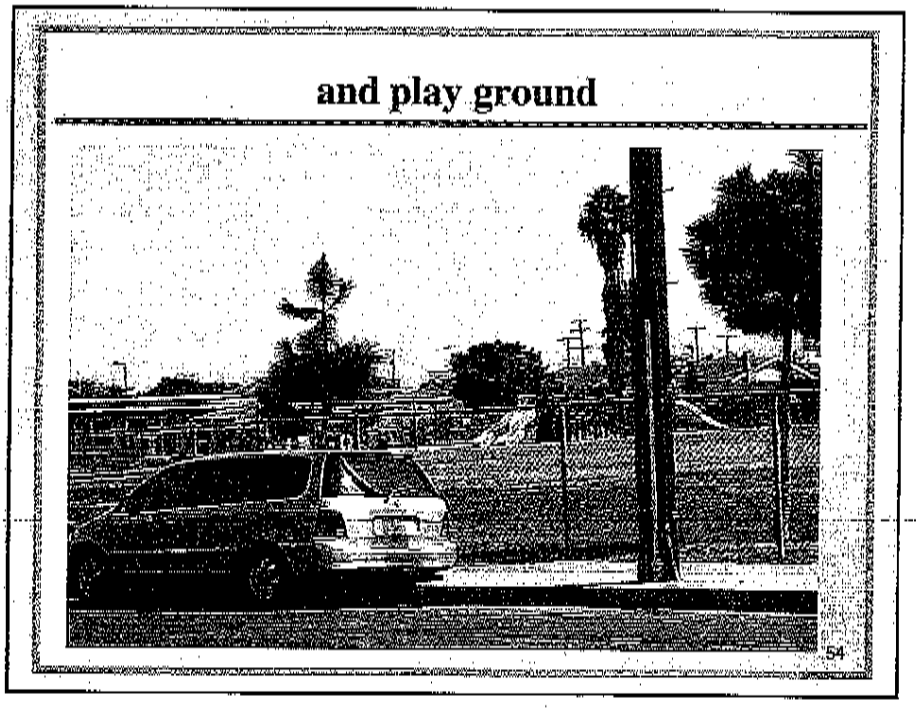
The signs are the only indication

52


Across the street is a school
53


and play ground
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Q&A

Questions?

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