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Lesson 2a: Landfill Wellfield and Project Components

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Outline

- Objectives of LFG Collection/Control
- Elements of a LFG collection System
- LFG Destruction/ Utilization Options

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Objectives

- Recover and utilize LFG
- Minimize potential environmental impacts
- Control off-site migration
- Control odors
- Comply with regulatory requirements

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Elements of an LFG Collection System

- Network of interconnecting piping
- LFG collection points
  - Vertical extraction wells
  - Horizontal collectors/trenches
  - Connection to existing vents, wells, etc.

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Elements of an LFG Collection System (continued)

- Elements of condensate management
- Flow control
- LFG blower/combustion device (flare, engine, etc.)

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Vertical Extraction Wells

- Most common approach for recovering LFG
- Install in existing or operational disposal areas
- Waste depth preferable >10 meters

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Vertical Extraction Wells

- Install approx 2.5 wells per hectare(~ 1 well per 0.4 hectare)
- May lose efficiency or not work in landfills with elevated leachate levels

Vertical Extraction Wells Design Features

- In-refuse wells: 75% of the refuse depth
- Depth of in-soil wells varies
  - Groundwater level
  - Bottom of refuse
  - Depth of gas migration

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Vertical Extraction Wells - Design Features (continued)

- Boreholes typically 60 cm to 90 cm in diameter
- Casing is generally PVC or HDPE
- Bottom perforated - start 6 meters below ground surface
- Spacing depends upon “radius of influence” (typical 60 m - 122 m)

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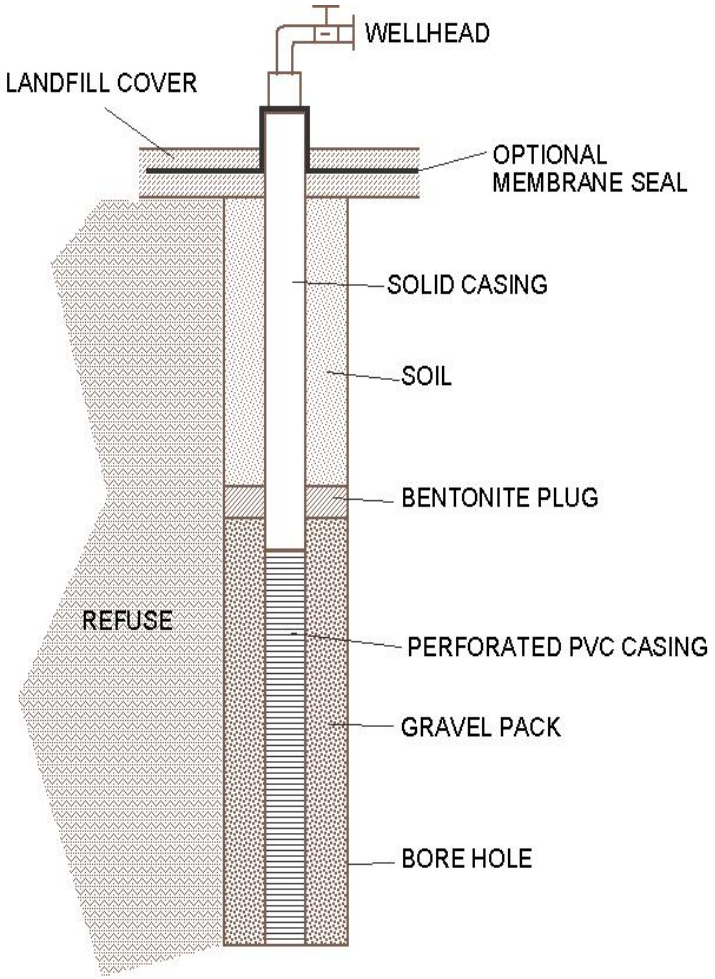
Typical Vertical Extraction Well



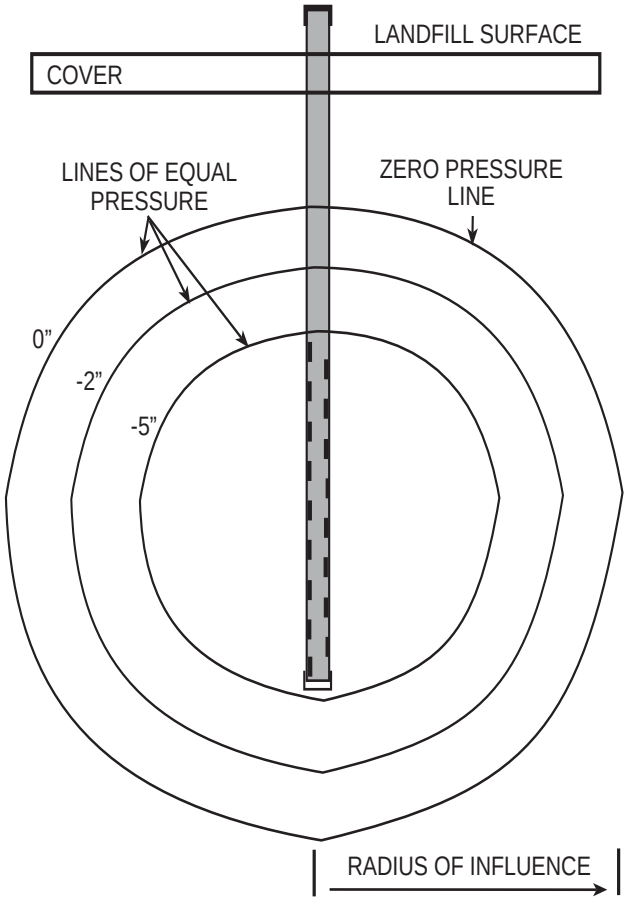
- Bentonite seal prevents air infiltration
- Wellhead incorporates:
  - Flow control valve
  - Pressure monitoring port
  - Flow monitoring device (optional)
  - Thermometer (optional)

Vertical Extraction Wells - Examples

- **Auckland, New Zealand**

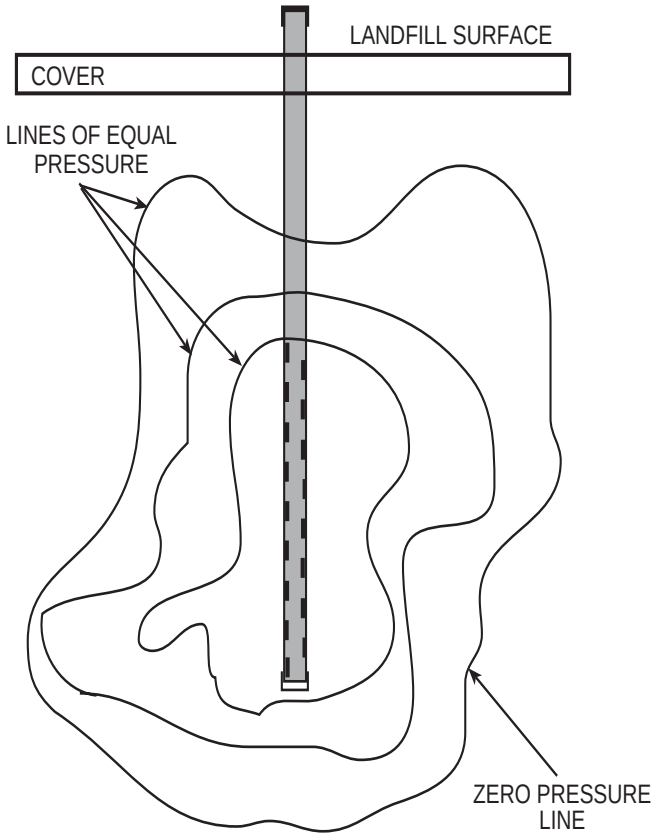
- **Los Angeles, California**

Theoretical Radius of Influence of a Landfill Gas Well



- Radius of influence 2 to 2.5 times well depth
- Increase vacuum to increase the radius of influence
- Variations in vacuum are the operator's only control tool

Actual Radius of Influence of a Landfill Gas Well



- **A well's radius of influence is unlikely to be ideal:**
  - Variations in waste characteristics
  - Interim cover and cell configuration
  - Presence of leachate

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Horizontal Collectors

- Alternative approach for LFG recovery
- Install in shallow areas
- Install in existing or operational disposal areas

Horizontal Collectors (continued)

- Install at a spacing of approx. 30 to 100 meters
- Can be used in landfills with elevated leachate levels

Horizontal Collectors - Design Features

- Install in trenches or place on grade and cover with gravel and waste

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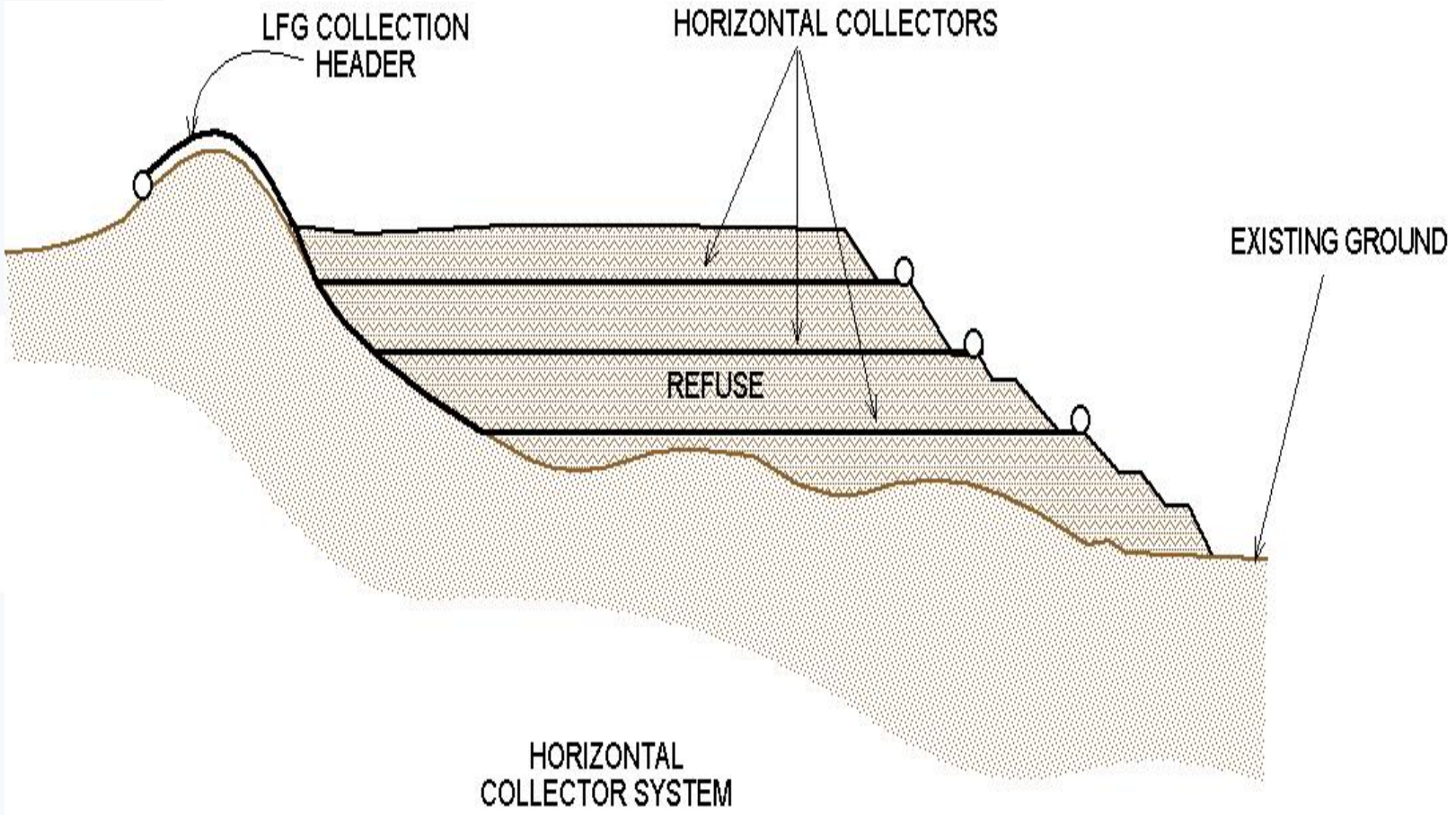
Horizontal Collectors - Design Features (continued)

- Construct out of approx 100 mm slotted PVC or HDPE pipe

- Alternatively construct out of “nested” 100 mm an 150 mm pipes

Typical Horizontal Collector Arrangement



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Examples

- **Bangkok, Thailand**

- **Los Angeles, California**

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Laterals and Headers

- Pathway for LFG from wellheads to blowers
- Can be above-grade or underground
- Generally HDPE - PVC sometimes used above-grade
- Sized on flow rate and pressure drop

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Laterals and Headers (continued)

- Pipe configuration often "looped" to provide alternative flow paths
- Pipe sloped to promote condensate drainage
- Unusual drops in vacuum normally due to condensate blockages

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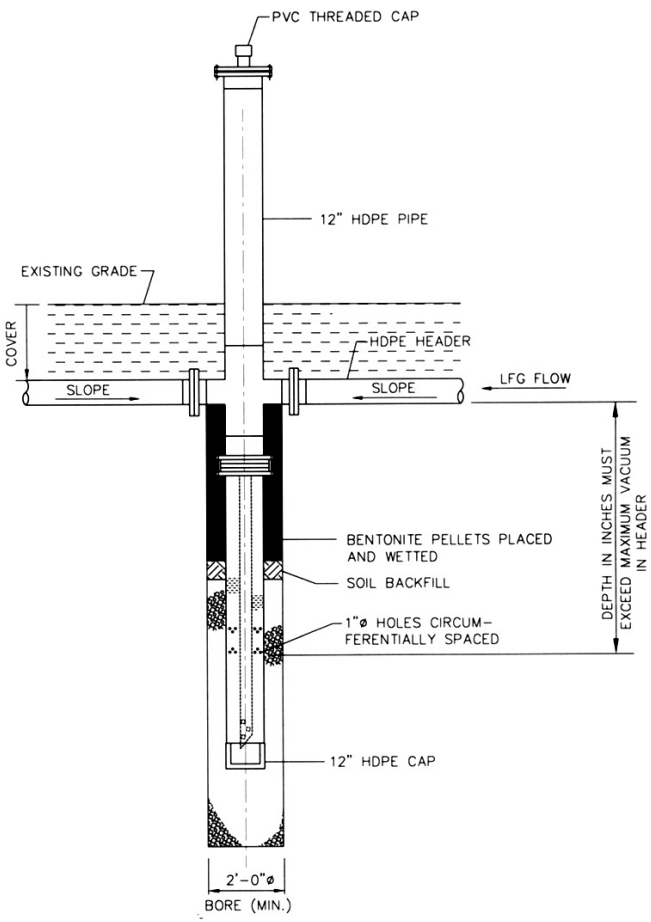
Condensate System

- Condensate volume depends on LFG temperature and flow
- LFG is assumed to be 100% saturated with water
- LFG temperature is typically 32° to 54° C

Condensate Removal - Design Features

- LFG cools in the LFG collection piping and the moisture condenses out into the piping
- Piping designed to allow condensate to drain
- Traps allow for drainage by gravity
- Sumps collect condensate



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LFG Destruction

- Destruction
  - Open flares (aka: candle-stick flares)
  - Enclosed flares (aka: ground flares)

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Blower/Flare Station

- Combusts methane gas
- Open or enclosed flame

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Blower/Flare Station (continued)

- May be used in combination with beneficial use system
- Needed during utilization system startup and downtime

Blower/Flare Station - Design Features

- Location should be central to collection system, close to potential end user or utility service, away from trees

- Design with flexibility to handle future gas flows

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Blower/Flare Station – Typical Elements

- Moisture separator
- Blowers
- Flare (open or enclosed)
- LFG piping and flame arrestor
- Flow meter
- Pilot fuel supply
- Control panel (controls both blower and flare)
- Auto shutoff valve

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Example

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Enclosed Ground Flares

- Flare body usually circular: 9 to 12 meters high
- LFG combusted close to ground
- Flame not visible from outside
- Air louvers near stack base

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Enclosed Ground Flares (continued)

- Typical operating temperature range:
  760 °C to 870 °C
- Typical destruction of 98 to 99 percent (or greater)
- More expensive than candlestick flares

Open (Candlestick) Flare Components

- Vertical pipe
- Flare tip at top of pipe - flame visible
- Smaller than enclosed flare

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Summary

- LFG collection system design - site specific
- Basic Concept
  - Provide path for LFG collection
  - Manage condensate
  - Burn or utilize the gas
- Always consider your operating goals