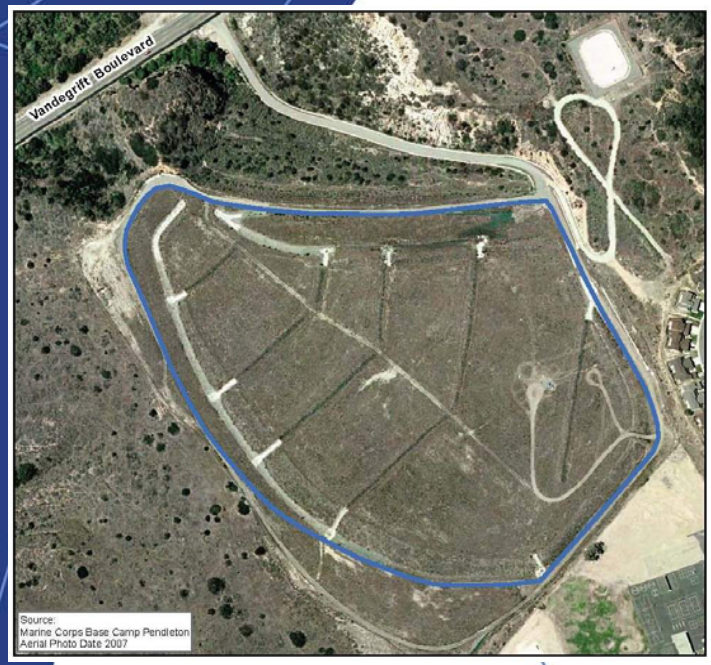
An Innovative Low-Energy Technology Application at MCB Camp Pendleton



May 13, 2010

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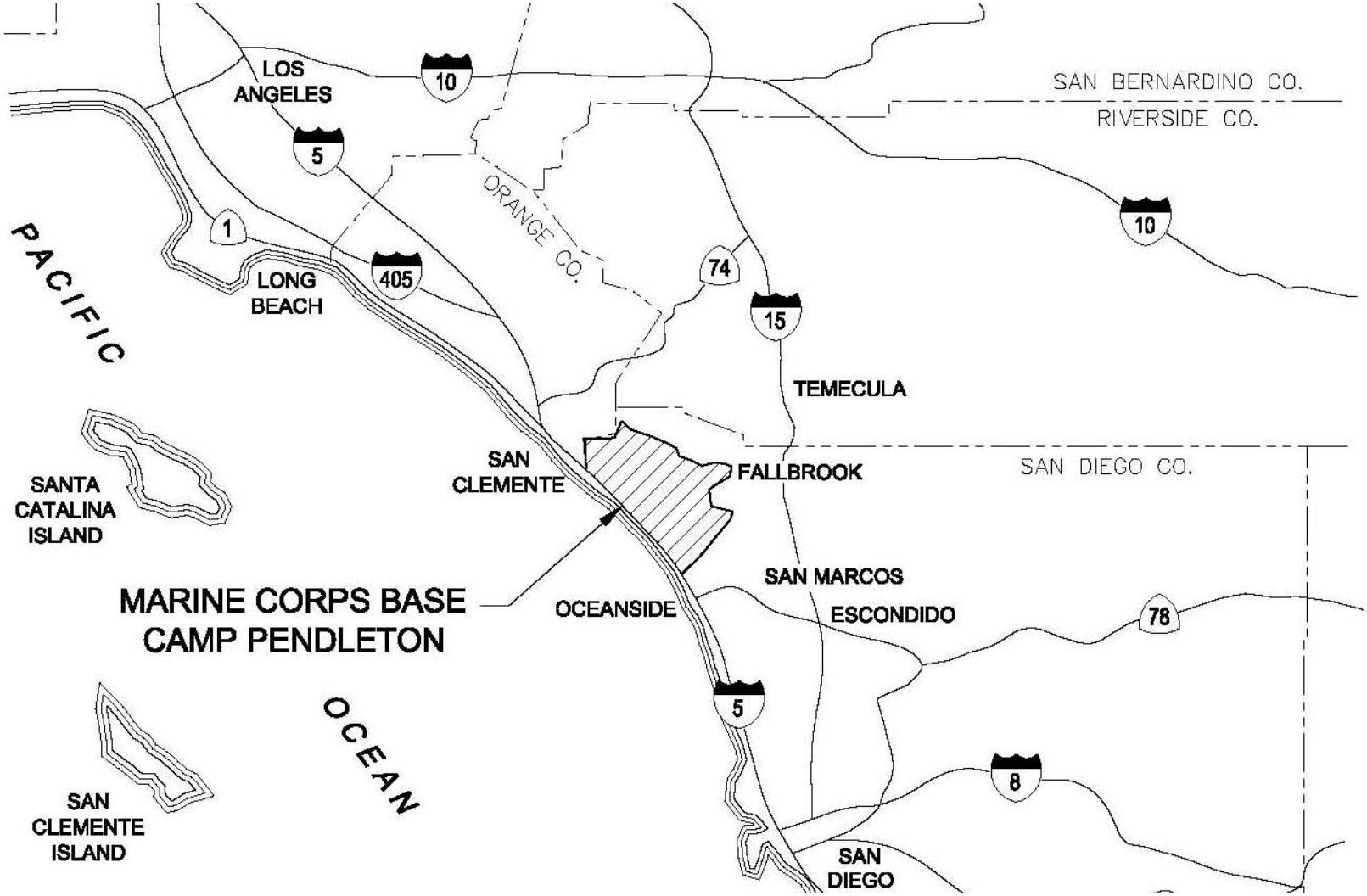
*** Primary Project Lead**

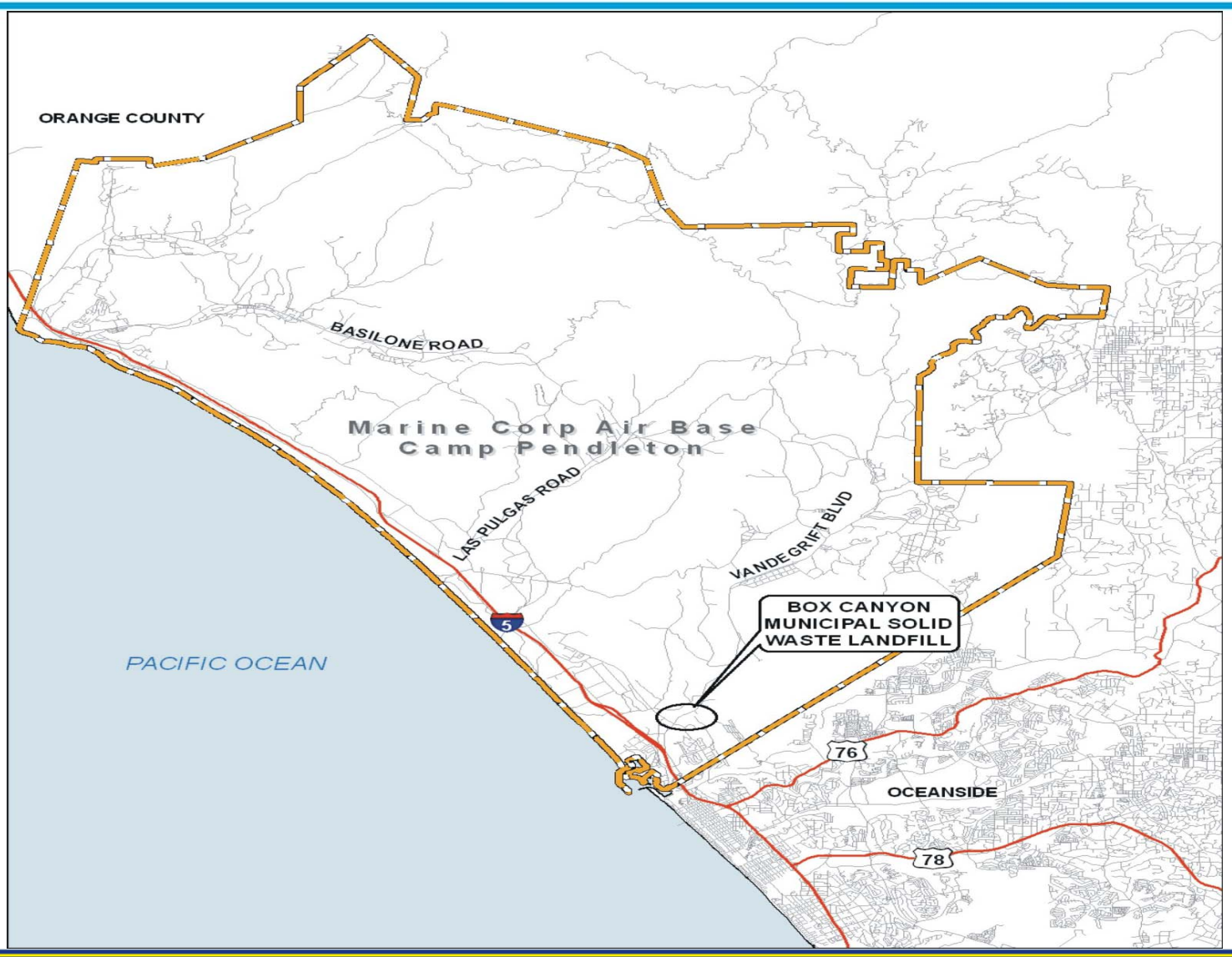
Overview of the Box Canyon Landfill GSR Project

- Location of Box Canyon (Site 7) Landfill
- History of Site 7 Landfill
- Laying the Groundwork to Use GSR
- Challenges to Incorporating GSR Projects
  - Regulatory Acceptance
  - Construction on Existing Landfill Cap
- GSR Projects at MCB Camp Pendleton's Landfill, Site 7
  - Photovoltaic Project
  - Methane Micro-turbine Project

Regional Location of MCB Camp Pendleton



Specific Location of Box Canyon (Site 7) Landfill



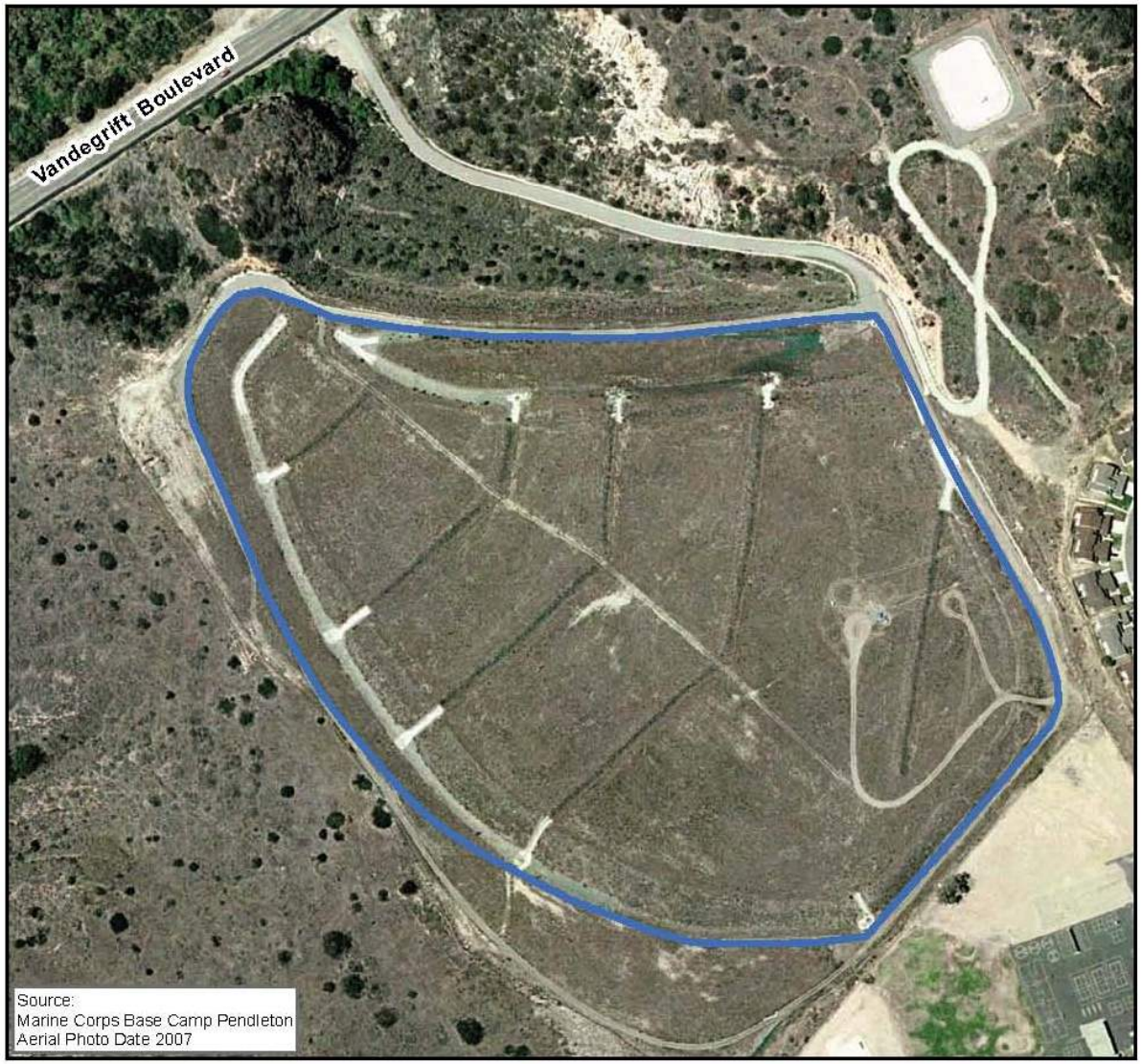
History of the Box Canyon (Site 7) Landfill

- Landfill encompasses a 28-acre open area
- CAMU built next to a housing and elementary school on open municipal landfill
- Later lawsuit resulted in the only toxic tort case in Navy's history
- Area continues to be a source of constant concern to State agencies
- Monitored methane gas levels fluctuate in and out of compliance
- Ongoing activities:
  - Landfill gas monitoring
  - Groundwater monitoring
  - Site maintenance

Laying the Groundwork for GSR Projects at the Site 7 Landfill

- Idea for photovoltaic (PV) panels onsite came from Mike Montgomery (Region IX Branch Chief) on a site tour
- MCB Camp Pendleton submitted request for $10M from the American Recovery and Reinvestment Act (ARRA)
  - Many strings attached, including an expedited schedule
  - Design complete, construction must start no later than 6 months after award
- Met with legal counsel, base, EPA and their attorneys to negotiate an ESD instead of a ROD Amendment
- Presented concept to the remaining Federal Facilities Agency (FFA) members supported by the EPA – important to note – resulting in a change in land use, not a remedy

Aerial View of Site 7 Landfill

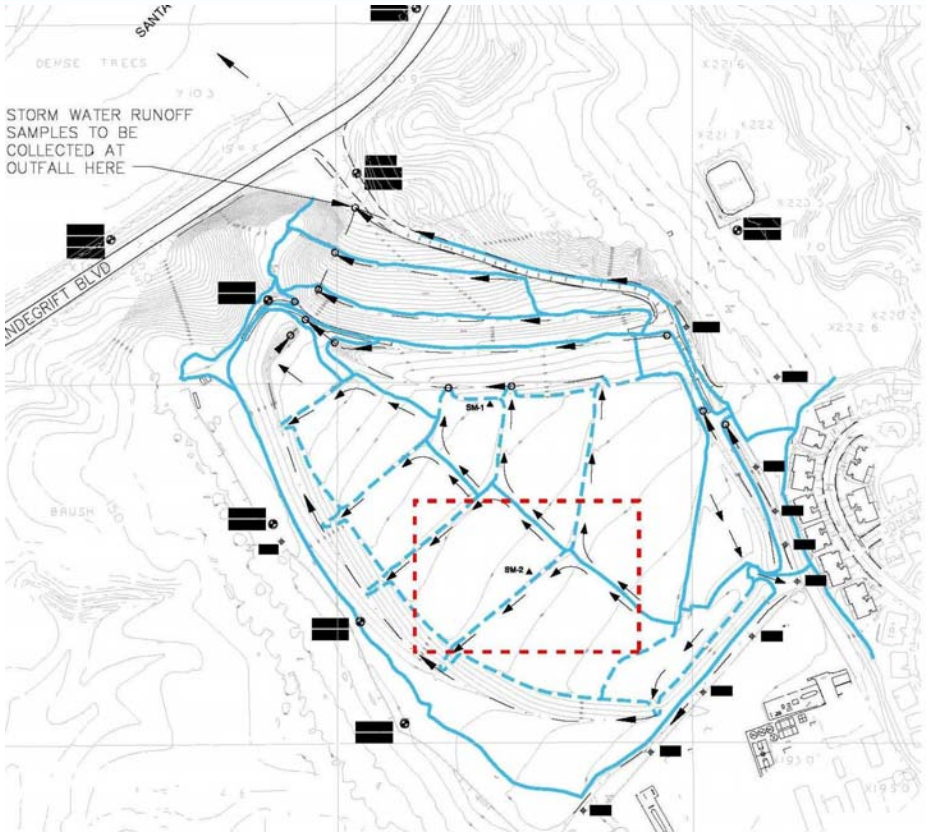


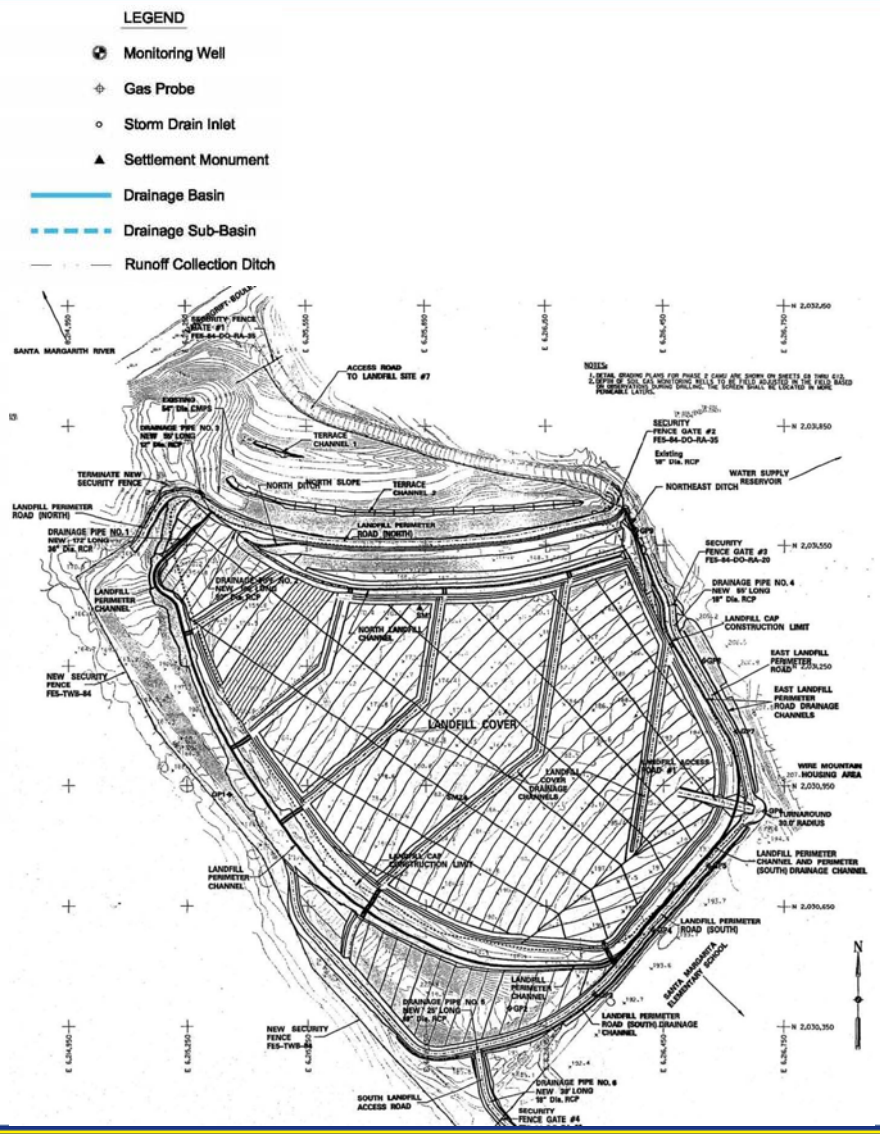
Agency Concerns to Incorporating GSR

Construction on an Existing Landfill Cap

- Settlement
- Bearing capacity of soil
- Stability
- Displacement
- Controlling erosion/soil loss
- Drainage control
- Infiltration
- Site access
- Landfill gas control system (not affected by design)

Site 7 Landfill Cap Drainage Plan





Design Specifications to Address Agency Concerns

Infiltration

- Approved vegetation list provided by NAVFAC SW biologist
  - Array area: short growth (<3 ft tall) & shade tolerant
  - In-between rows: “hearty” vegetation
- During construction, minimize disturbance to existing vegetation
- Conduct system O&M every 6 months, including vegetation checks

Site Access

- Existing improved surfaces will remain
- No additional improvements will be needed

Photovoltaic (PV) System Design Specs

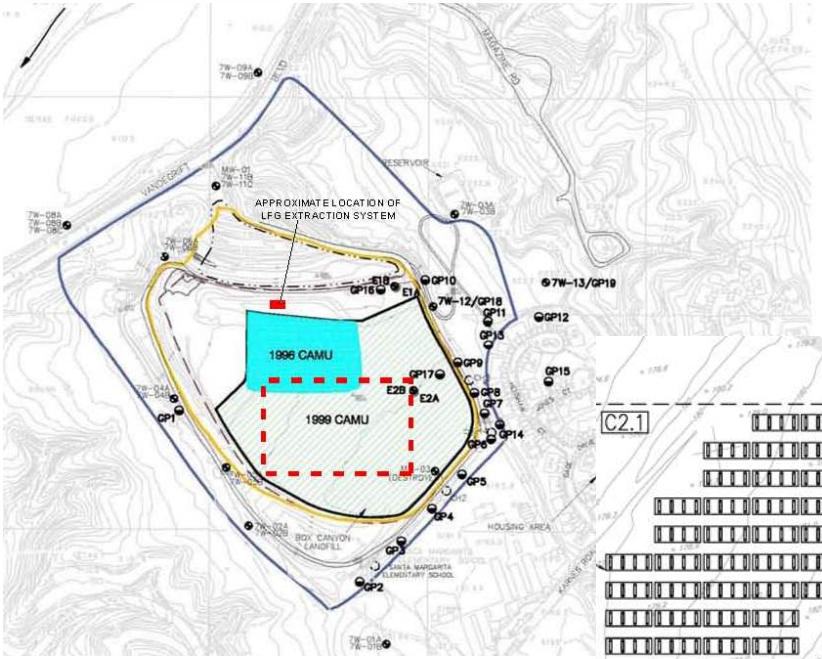
Photovoltaic Design Specifications

- 1.48 MW (DC) capacity
- System made up of 220, 28-module 6.6 kW building blocks
- Each panel has a fixed 15° tilt, 190° orientation

Construction Specifications

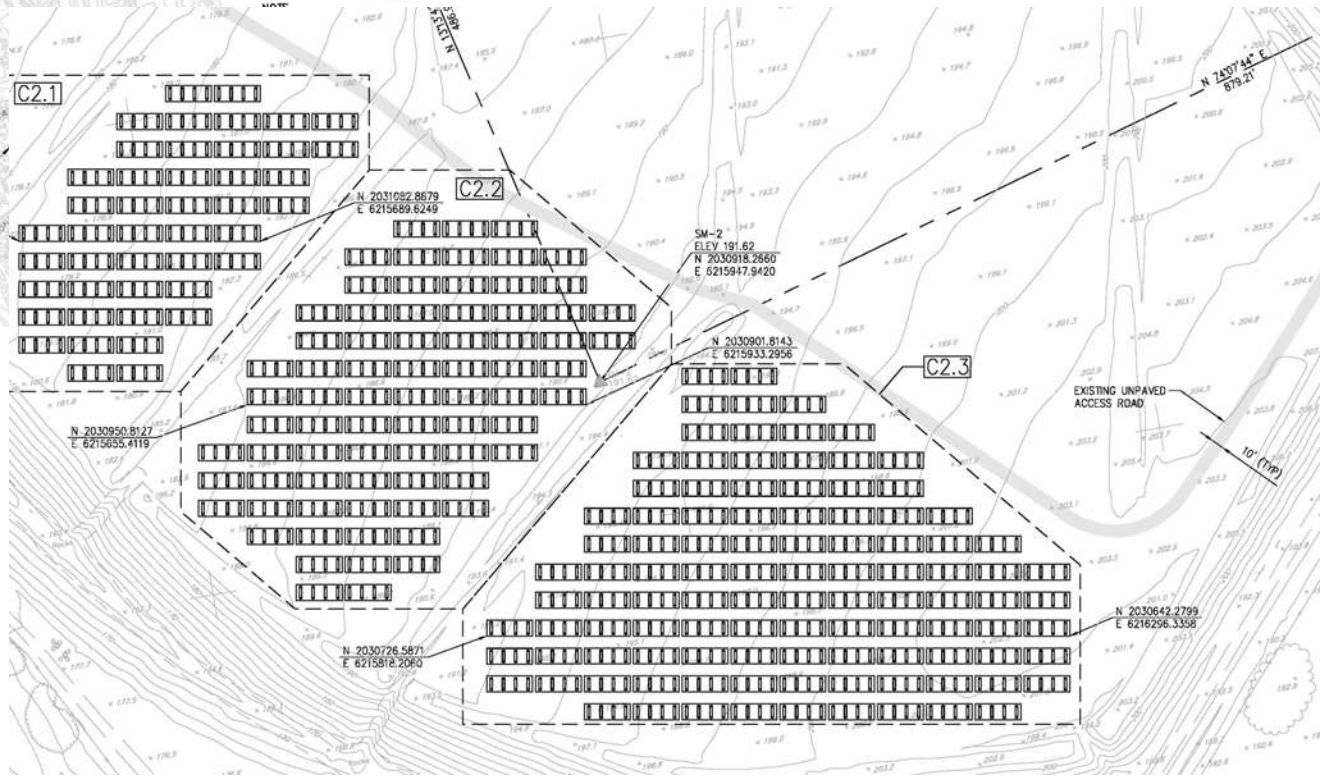
- Units are built on self-ballasted, non-penetrating foundations
- Gravel interface between ballasts and landfill cover
- Adjustable system structure components
- Spacing between modules (maintenance)
- No excavation of the existing ET cover

Photovoltaic Layout Plan (~50% Design)



LEGEND

- GROUNDWATER MONITORING WELL LOCATION
- GAS MONITORING PROBE
- CORE HOLE
- EXTRACTION WELL
- LANDFILL EXTENT
- ALTERNATIVE COMPLIANCE BOUNDARY
- EXTENT OF 1996 AND 1999 CAMUs
- EXTENT OF FRONT FACE
- EXTENT OF CLOSURE COVER
- EXISTING CONTOURS
- Proposed Photovoltaic Solar Panel Array



Site 7 Landfill P/V & Transmission Plan

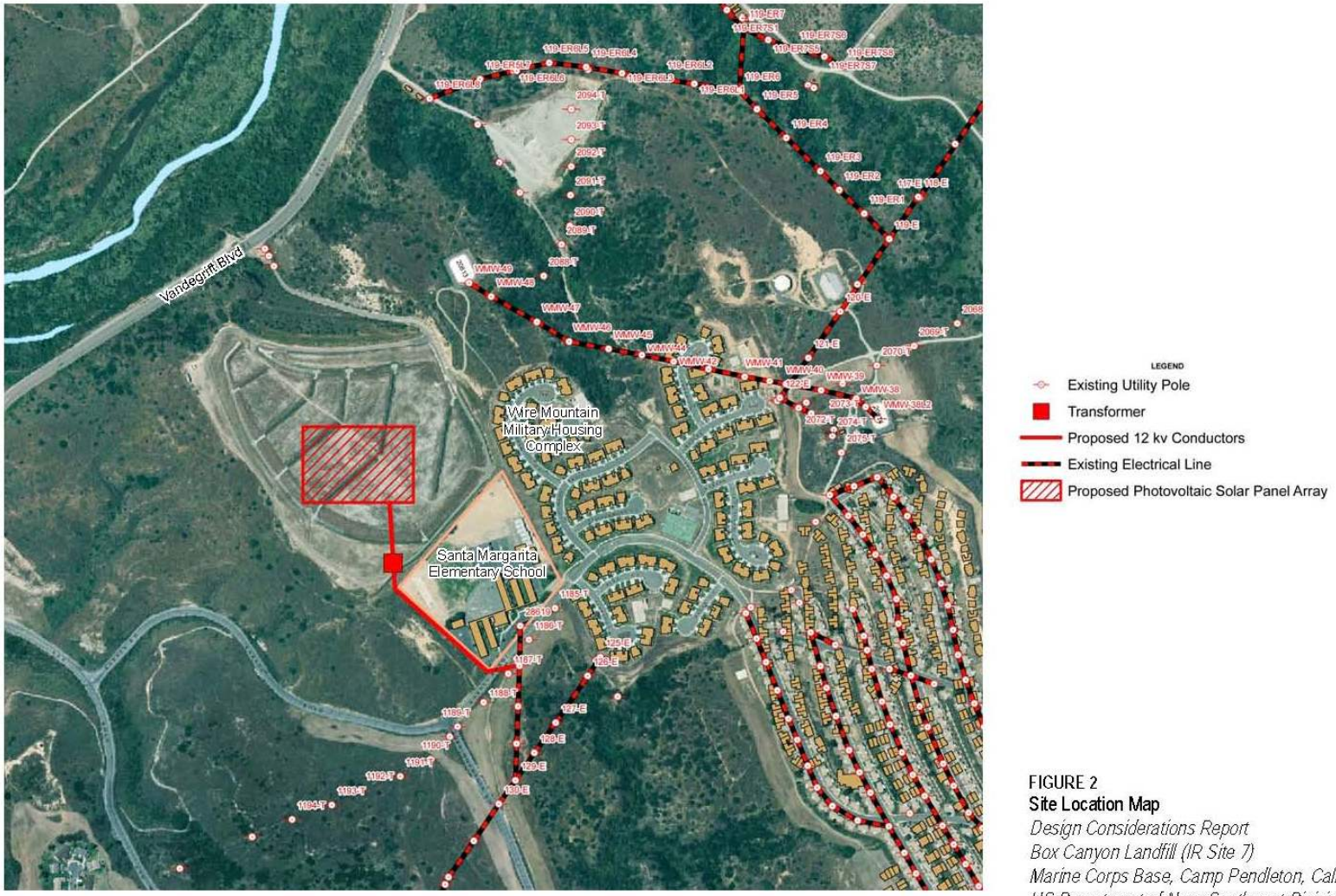


FIGURE 2
Site Location Map
Design Considerations Report
Box Canyon Landfill (IR Site 7)
Marine Corps Base, Camp Pendleton, California
US Department of Navy Southwest Division
Naval Facilities Engineering Command

FIGURE REFERENCE:
PRELIMINARY DESIGN PROVIDED BY MCB CAMP PENDLETON
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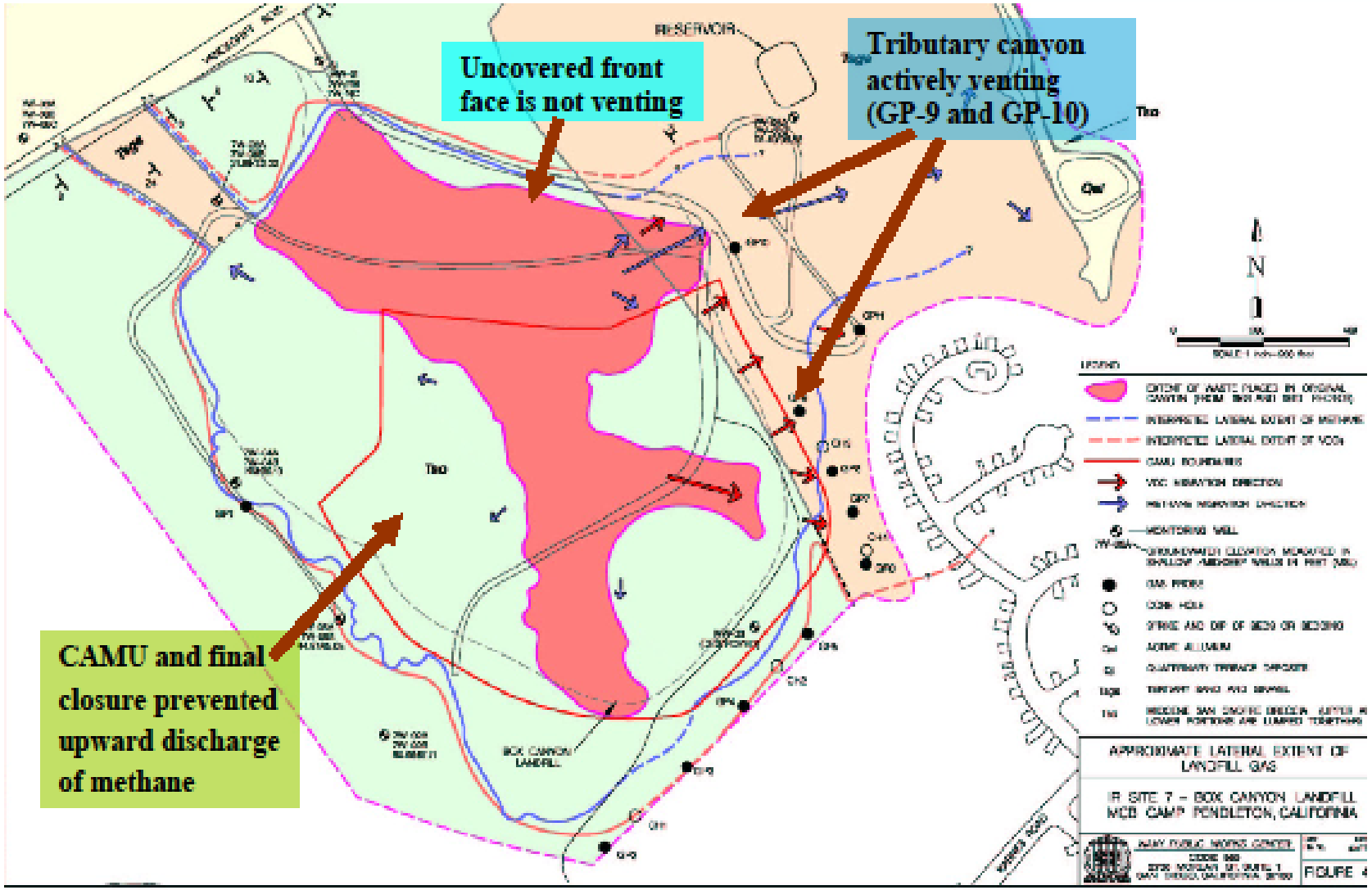
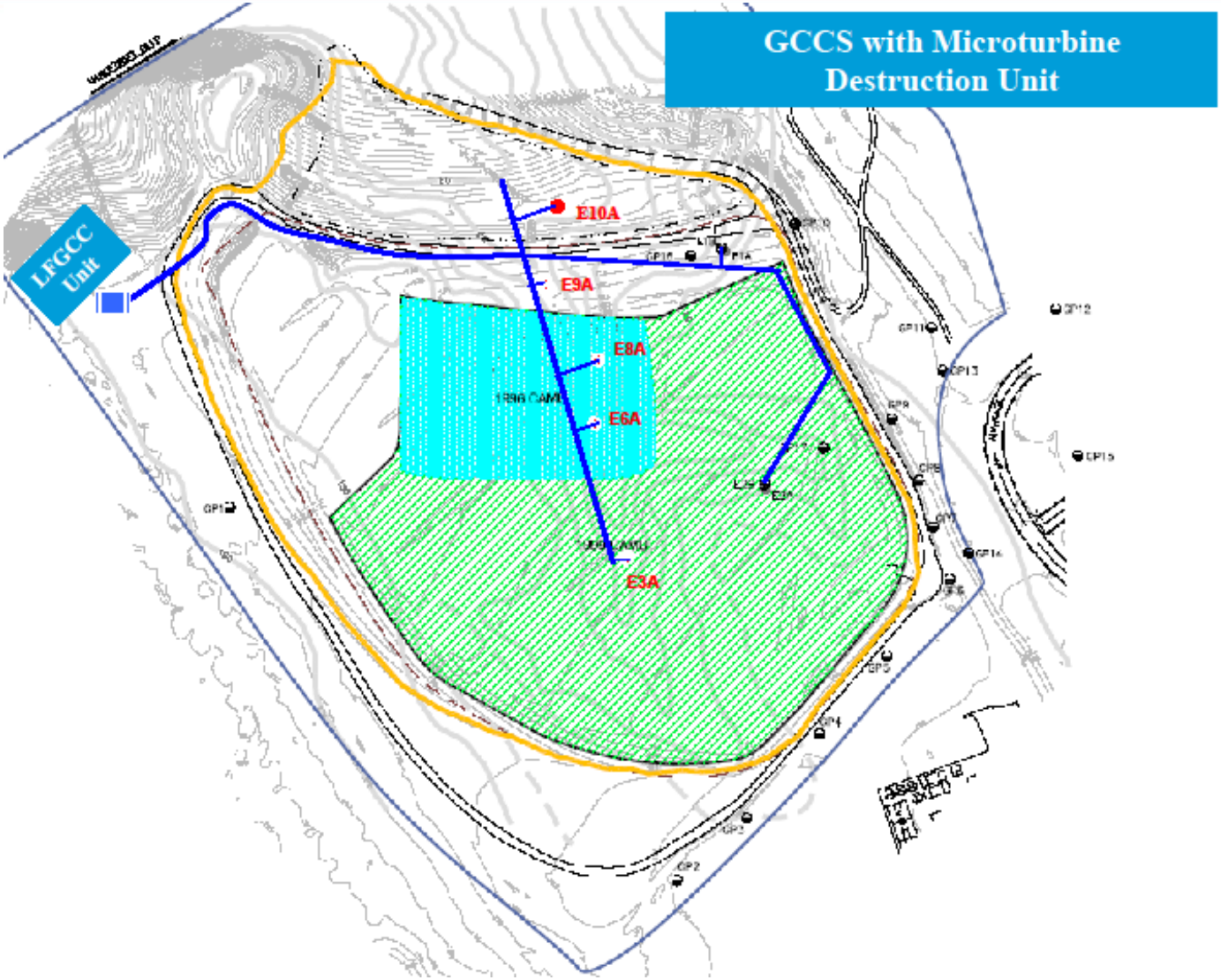
Methane Gas Collection: Microturbine System Design Specs

- GeoSyntec approached the Navy with GSR solution for continuing methane problem
- Proposed a 30kW microturbine connected to methane gas collection wells and energy produced fed into PV panel system
- Microturbine is the size of an industrial refrigerator
  - Cannot see unit from the housing complex or school
  - Unit runs quiet w/o a flare; optional night operation
- System most adaptable to low methane production and fluctuations in gas volumes

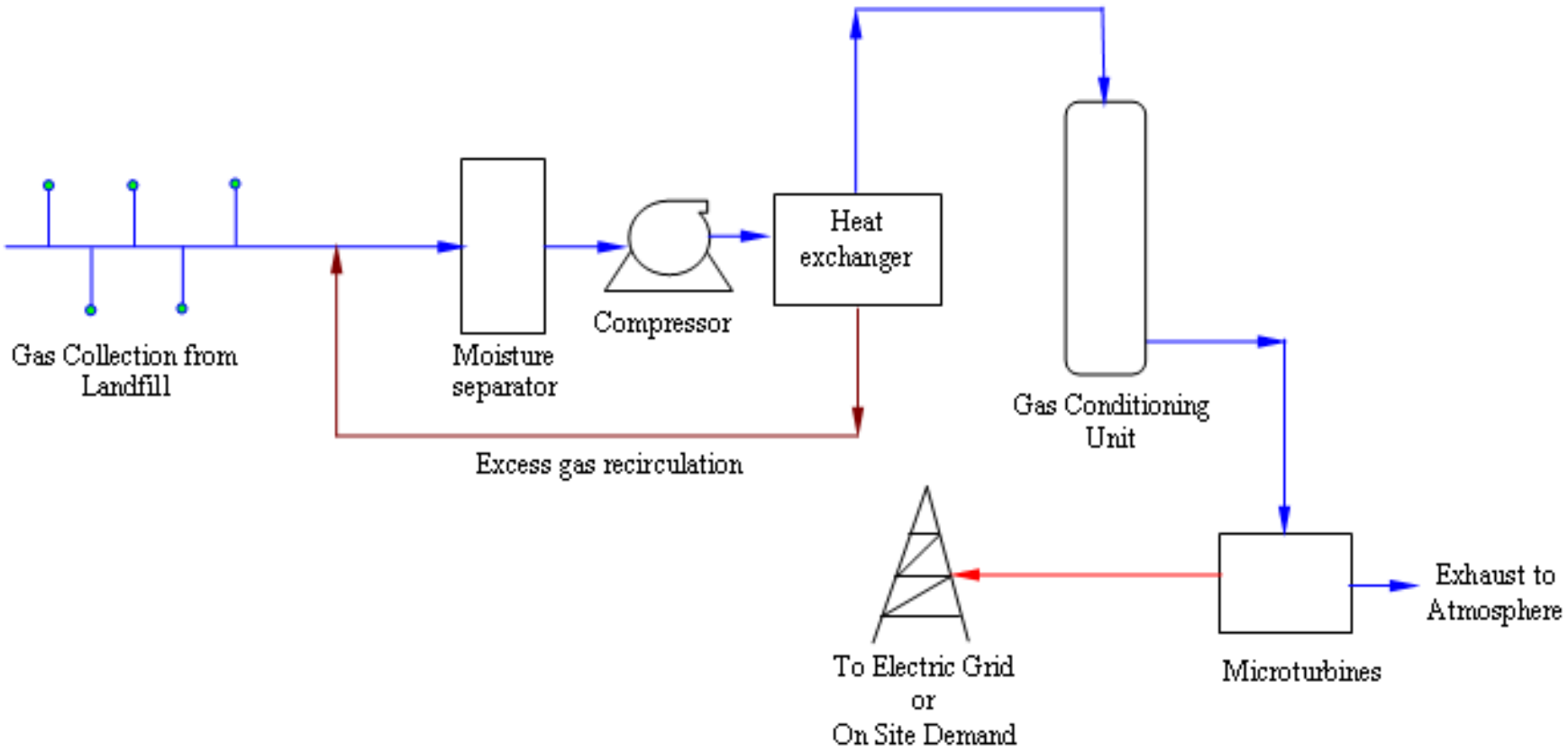
Methane Gas Flow



Proposed Gas Collection Layout



Proposed Gas Collection and Energy Production Schematic



Summary

- **Exciting opportunity to incorporate GSR on an existing, open IR site, i.e., 'clean slate'**
- **Key to success was working with other agencies to meet Navy sustainability goals**
- **Key design criteria critical to success:**
  - Counter-balanced, non-penetrating foundations will avoid construction into the existing landfill cap
  - High efficiency, fixed orientation, and modular PV cell units
  - Incorporating appropriate vegetation for use around PV cells
  - State-of-the-art microturbine capable of running efficiently at low methane concentrations (~7%)
  - Utilizing two GSR technologies at the same facility

Solar Power – General Issues to Consider

- **Disturbs pristine desert environments (not an issue with landfills)**
- **May require cooling water, which is hard to find in deserts (the sunniest areas)**
- **A single solar panel generates very little electricity, so vast array is required**
- **Mechanical system required to keep panels adjusted towards the sun at all times**
- **Maintenance costs, weathering of expensive panels under the impact of the elements will need to be studied**
- **Need supplemental source of power during cloudy days, nights**
- **Carbon neutrality needs to be established on the basis of life cycle analysis. Specialty chemicals that go into solar panel manufacture have their own carbon footprint.**

Microturbines – General Issues to Consider

- 11 operational projects (land fill gas microturbines)) in California, utilizing 50 turbines, generating 2.7 MW of power
- Microturbines use 35% more fuel per kWH produced, compared to standard reciprocating engines and conventional turbines (US EPA, 2002)
- Energy produced may be sporadic, supplemental sources of power needed
- Maintenance requirements need to be tracked in the future
- Compressed landfill gas projects may also be worth looking at

Follow-up Contacts

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