Estimating Greenhouse Gas Reductions For a Regional Digester Treating Dairy Manure

Deborah Bartram, ERG

June 9, 2004

Presentation Overview

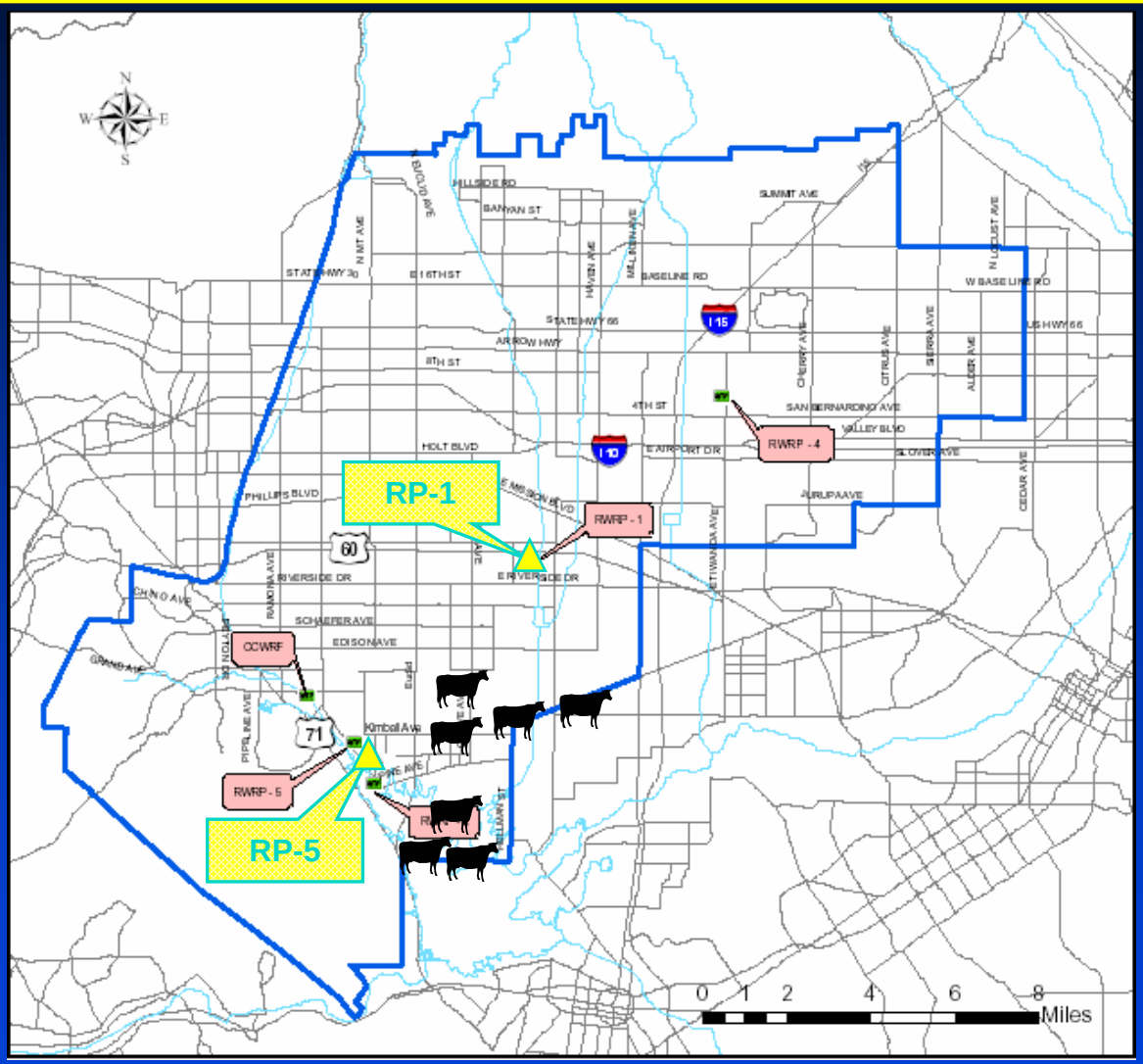
- Project Background
- Task: To develop a reproducible and verifiable method of estimating benefits, specifically greenhouse gas reductions, associated with project
- Overview
  - Definition of baseline conditions
  - Definition of project changes
  - Emission reduction calculations
  - Monitoring methodology
  - Limitations and conclusions

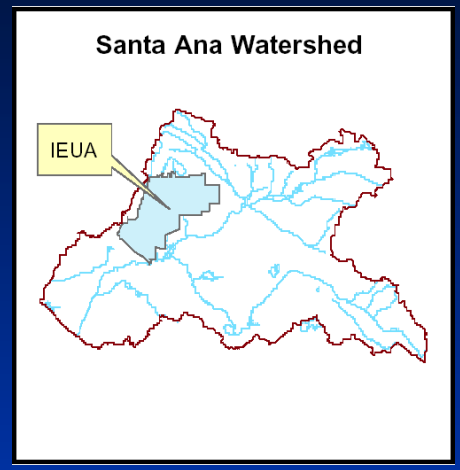
Project Background

- Inland Empire Utilities Agency
  - Municipal water district
  - Service territory covers 7 communities and 700,000 residents

- Chino Basin groundwater impacts
  - Localized areas with high nitrate and TDS
  - Concentrated in southern portion of basin
  - Severely impacted due to agricultural activity
  - Implementation of IEUA Desalter Plant

Dairies located within 1 to 5 miles from RP-1 and RP-5 Manure Digesters





LEGEND

- IEUA Boundary
- Streams
- Streets
- Regional Plant
- Manure Digester
- Partner Dairy Location

Project Background

- Organics Management Strategy program
  - Protect Basin from infiltration of salts, nutrients, and pathogens
  - Public-private partnership
    - IEUA
    - USDA, US DOE, CEC
    - Milk Producers Council
    - Synagro Technologies
  - Anaerobic digesters for treatment of dairy manure (RP1 and RP5)

Dairy Baseline Conditions

- **Corral-style dairies**
  - Dairy cattle housed in corrals
  - Bedding sometimes added
  - Cattle fed along concrete feed lanes
  - About 85% of manure deposited in corral and along feed lanes (15% deposited in milk centers)
- **Manure management**
  - Manure scraped from feed lanes into corral
  - Weekly spread and/or stacked
  - Hauled 2-3 times per year
  - On-site storage lagoons for parlor water and runoff

Dairy Baseline Conditions

Dairy Post-Project Conditions

- Manure management
  - “Honey vac” vacuum tanker truck
  - Manure collected daily from feed lanes
  - Transported to end dump trucks or nurse tank trucks
  - Hauled once per day to digester

Regional Digesters

- **RP-1**
  - **Manure delivered in nurse tanks and directly pumped into digester**
  - **Utility water added for solids content of ~12%**
  - **Complete mix digester, retention time of 20 days**
  - **Operating temperature ~ 125ºF**
- **RP-5**
  - **Manure delivered in end dump trucks**
  - **Utility water added for solids content of ~13%**
  - **Plug flow digester, retention time of 21 days**
  - **Operating temperature of 90-95ºF**

Digesters

25- ton End-Dump Truck Unloading Fresh Manure into
One of Two 55,000-gallon Receiving/Mixing Tanks for Digester

Emission Reduction Calculations

- **Sources of emission considered**
  - Enteric fermentation
  - Manure management
    - Corral/feed lanes
    - Lagoons
  - Composting
  - Land application
  - Transportation of manure
- **Pollutants considered**
  - Methane
  - Nitrous oxide
  - Ammonia

Emission Reduction Calculations

- **Methodology for emission estimates**
  - Intergovernmental Panel on Climate Change
  - US EPA Greenhouse Gas Inventory
  - US EPA National Emission Inventory
- **Emission factors**
  - National emission factors
  - Local data, where available and applicable
- **Emission calculations based on:**
  - Site visits
  - Operating records
  - Measurements
  - Emission factors

Emission Reduction Calculations

- **Sensitivity analysis**
  - **Determination of most critical variables**
  - **12 variables considered**
  - **Calculations most sensitive to:**
    - **Amount of manure managed in lagoons (from runoff)**
    - **Amount of manure processed in digesters**
    - **Methane conversion factor for corrals**
    - **Amount of nitrogen excreted**
  - **Methodology and data source reevaluated for these variables**

Emission Reduction Calculations

- **Summary of Emissions**

Summary of Baseline and Post-Digester GHG Emissions		
Pollutant	**GHG Emissions (CH_4+N20)**	
Baseline Emissions	14,245	tons CO_2-eq /yr
Post-Digester Emissions	6,221	tons CO_2-eq /yr
Reductions	8,023	tons CO_2-eq /yr

Monitoring Methodology

- Monitoring plan addresses how the data inputs required by the baseline model will be monitored

- The plan for this project is based on the current practice of:
  - Daily monitoring of all wastes received at the digester facilities
  - Regular random samples for manure characteristics such as moisture content, volatile solids, and nitrogen content
  - Periodic monitoring of dairy conditions and management practices
  - Continuous metering of biogas flow to flares, engines, and boilers
  - Regular random analysis of biogas composition

Monitoring Methodology

- **Example of data input sheets**

RP-1 Data Entry Worksheet

Date	Estimated tons received at AMD	% Total Solids	% Volatile Solids	Manure processed at AMD (Kgal/day)	Biogas Production at Digester #4 (1000 ft#/day)

RP-5 Data Entry Worksheet

Date	Manure Processed	% Total Solids	% Volatile Solids	Biogas Production (scfd)	Biogas Production at Digester #4 (1000 ft#/day)	% CH4 content	Hours of Flare Operation	LPG consumption (gallons)

Limitations

- Unquantifiable benefits
  - Improved dairy conditions
  - Improved herd health
  - Improved milk production
- Emissions unable to be fully quantified
  - Enteric fermentation emissions
  - Milk parlor emissions
  - Effect of changing nutrient application rates

Conclusions

- Baseline analysis estimated air emissions associated with dairy manure management both before and after implementation of the IEUA digester project
- Greenhouse gas and ammonia air emissions related to dairy housing, manure management, and land application, as well as manure composting off site
- Criteria air pollutants associated with the transport of manure to off site land application areas
- Transfer approach to other systems and locations