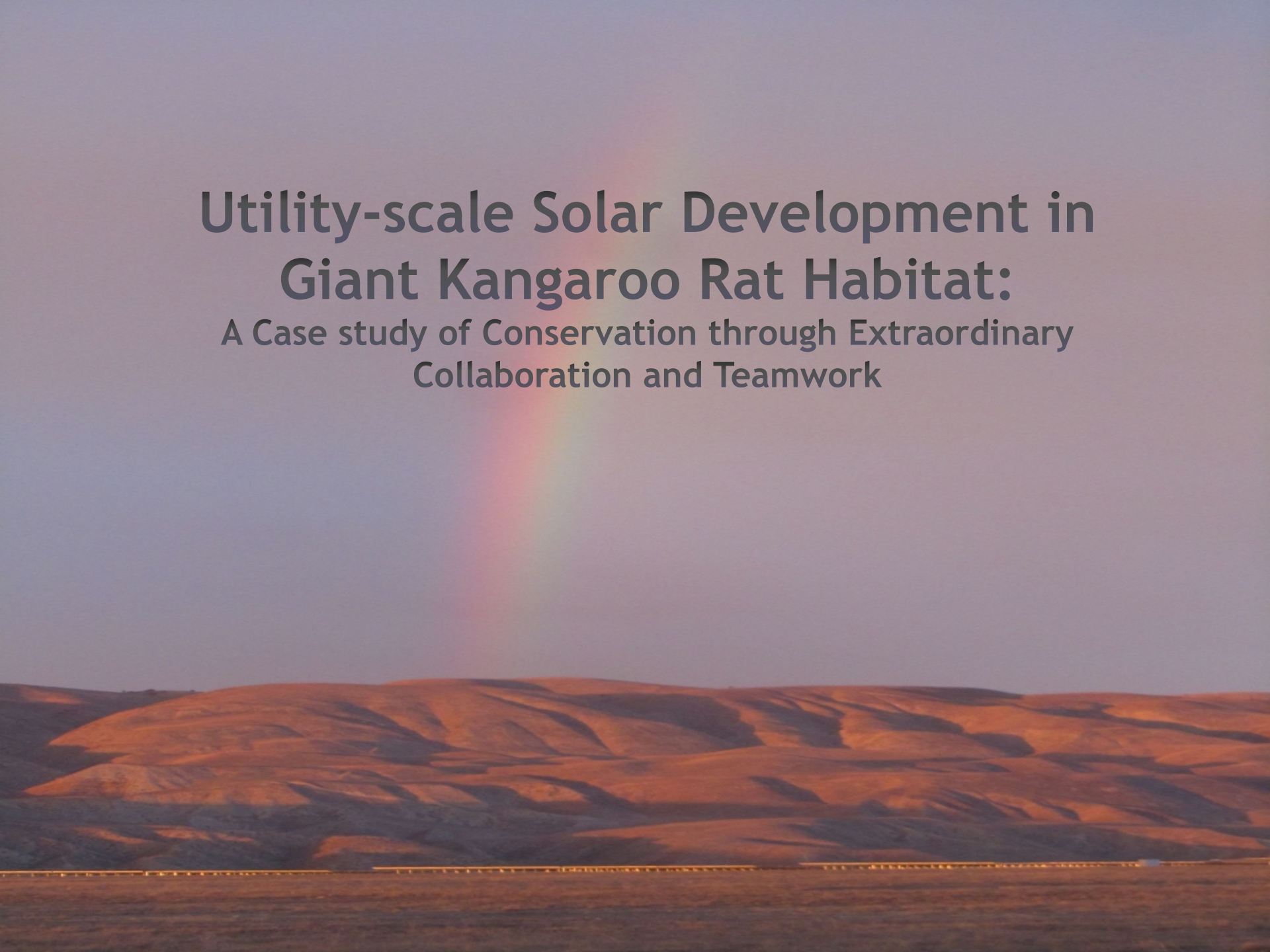
Utility-scale Solar Development in Giant Kangaroo Rat Habitat:

A Case study of Conservation through Extraordinary Collaboration and Teamwork



A few thoughts from past Presidents

“It is not what we have that will make us a great nation; it is the way in which we use it.”

Hunting Trips of a Ranchman and The Wilderness Hunter

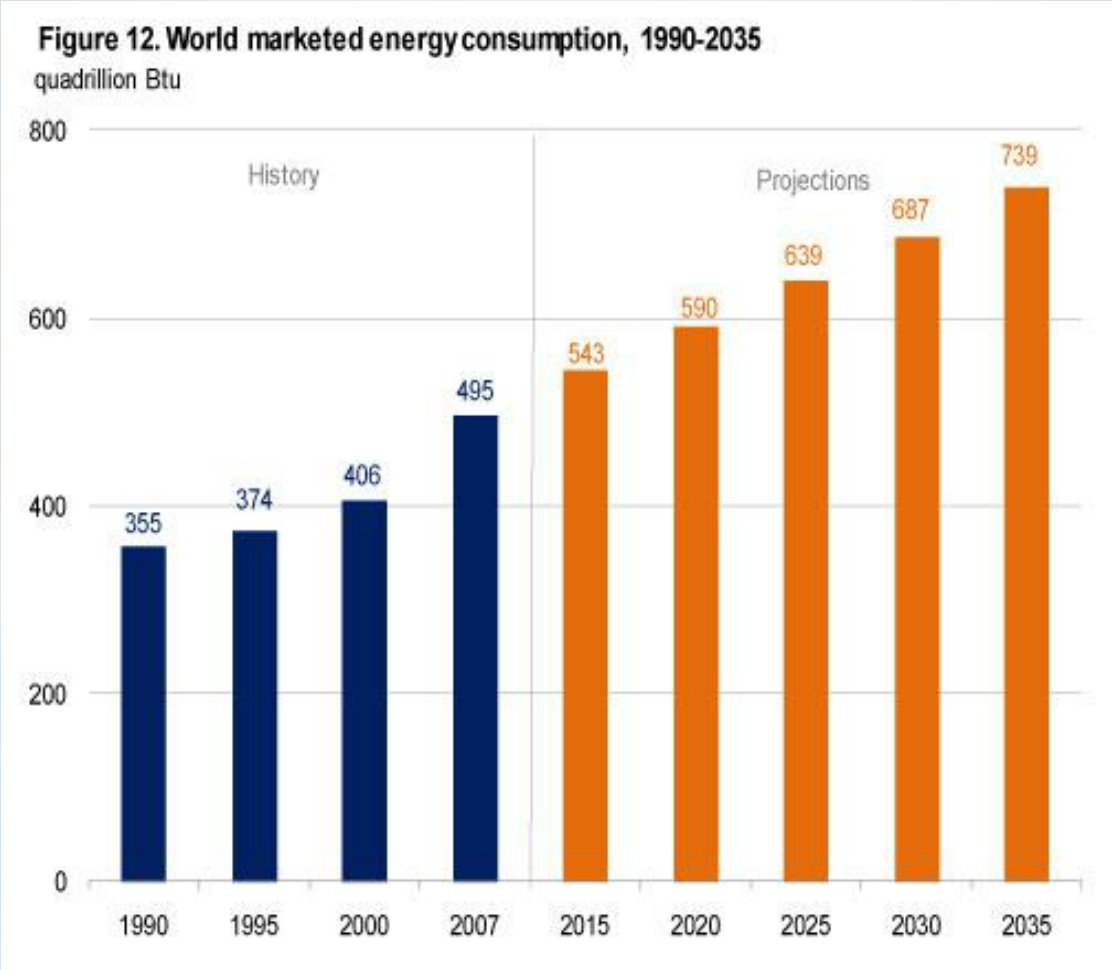
— *Theodore Roosevelt*

“Our world is more interdependent than ever. … There are three big challenges with our interdependent world: inequality, instability and unsustainability.”

The Case for Optimism

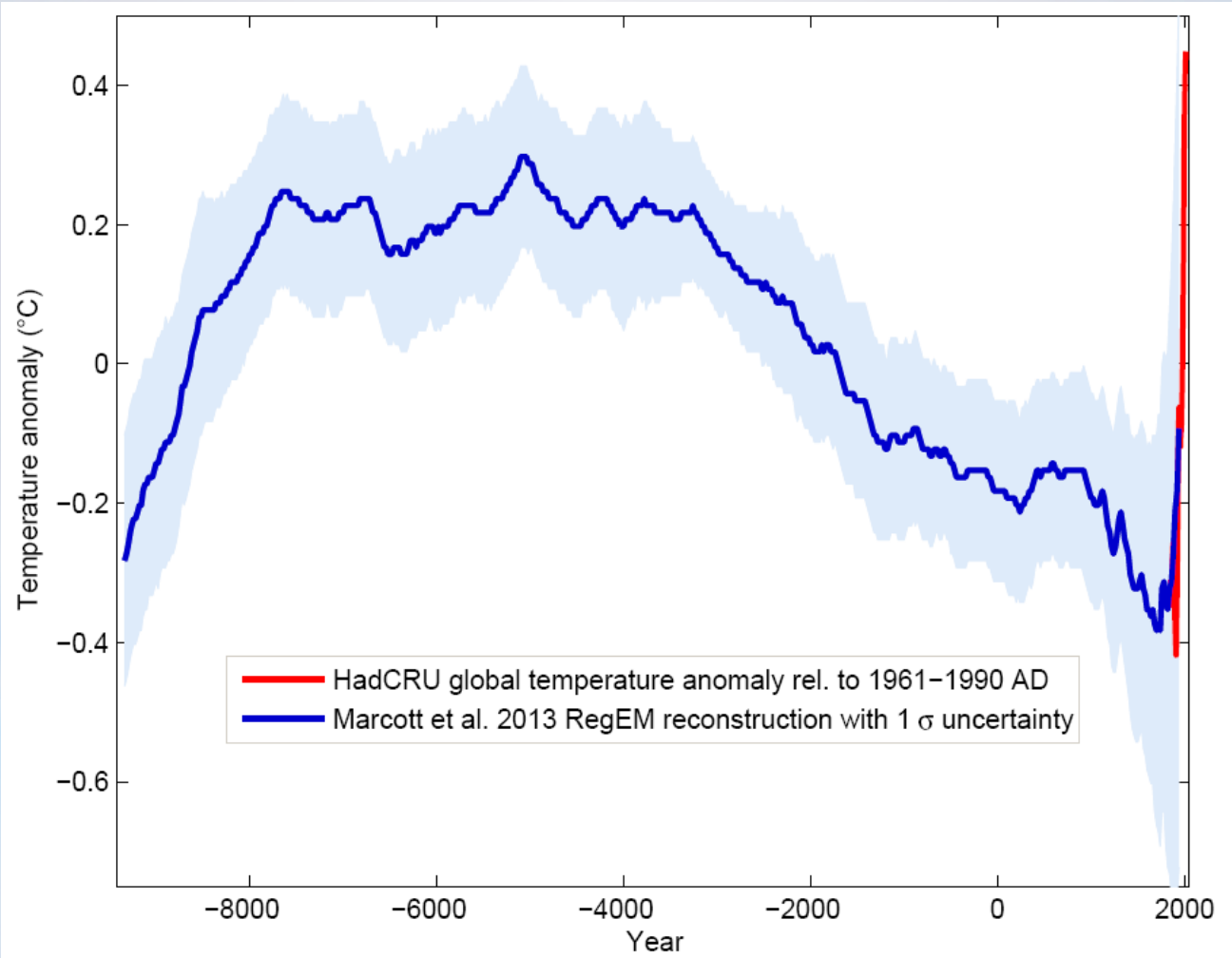
— *Bill Clinton*

Energy Consumption Rising



Source: http://www.eia.doe.gov

Setting of Climate Change



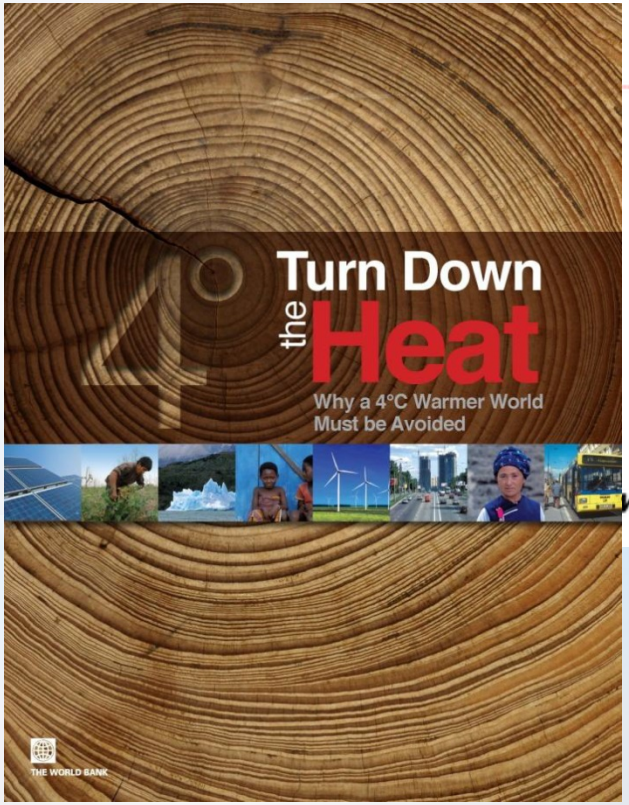
“Hold the increase in global temperature below 2 degrees Celsius and take action to meet this objective consistent with science and on the basis of equity.”

Copenhagen Accord (2009)

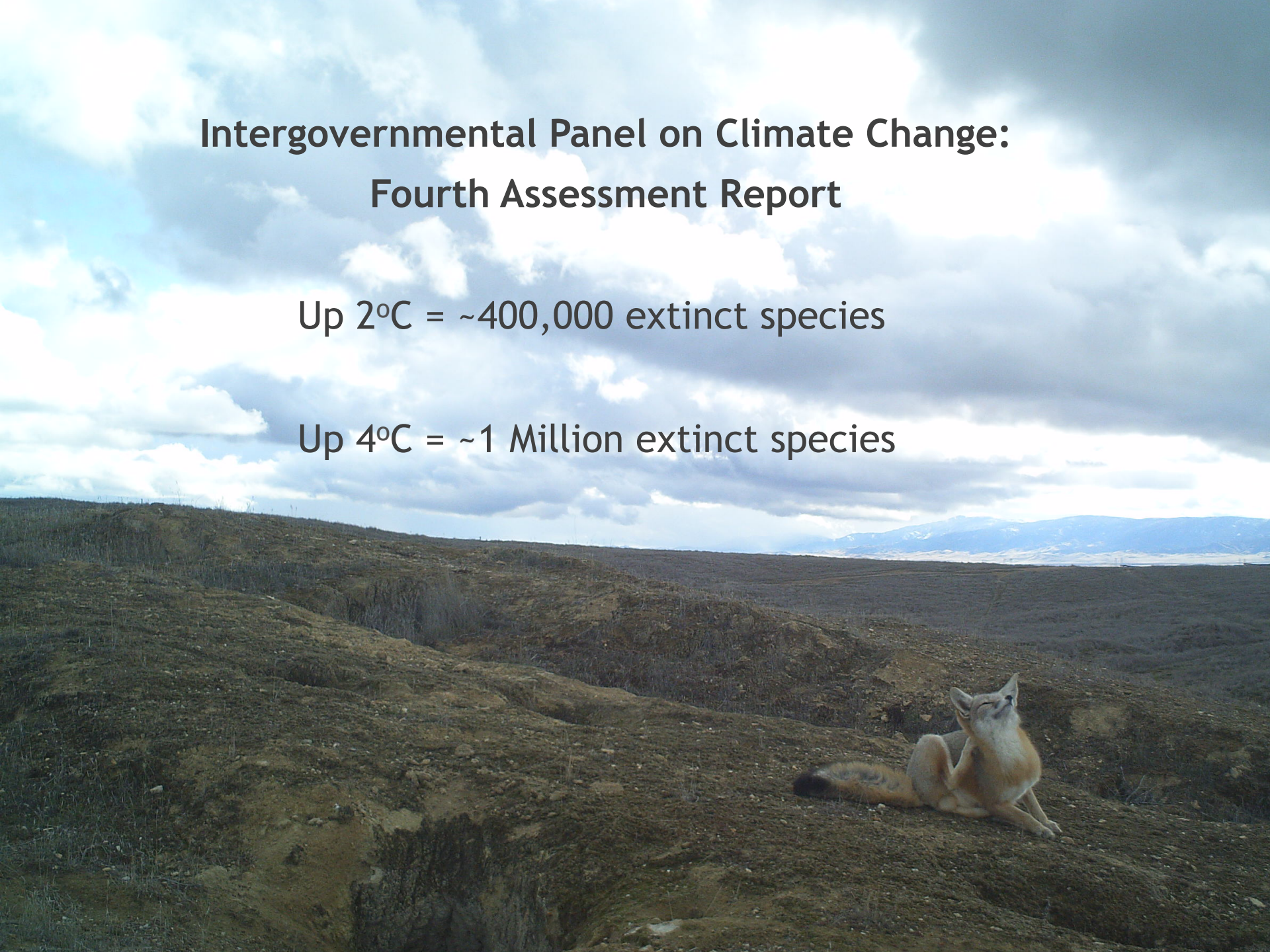
Growing Concern of a 4° C Change

The Royal Society
2011

The World Bank
2012



Price Waterhouse
Coopers
2012

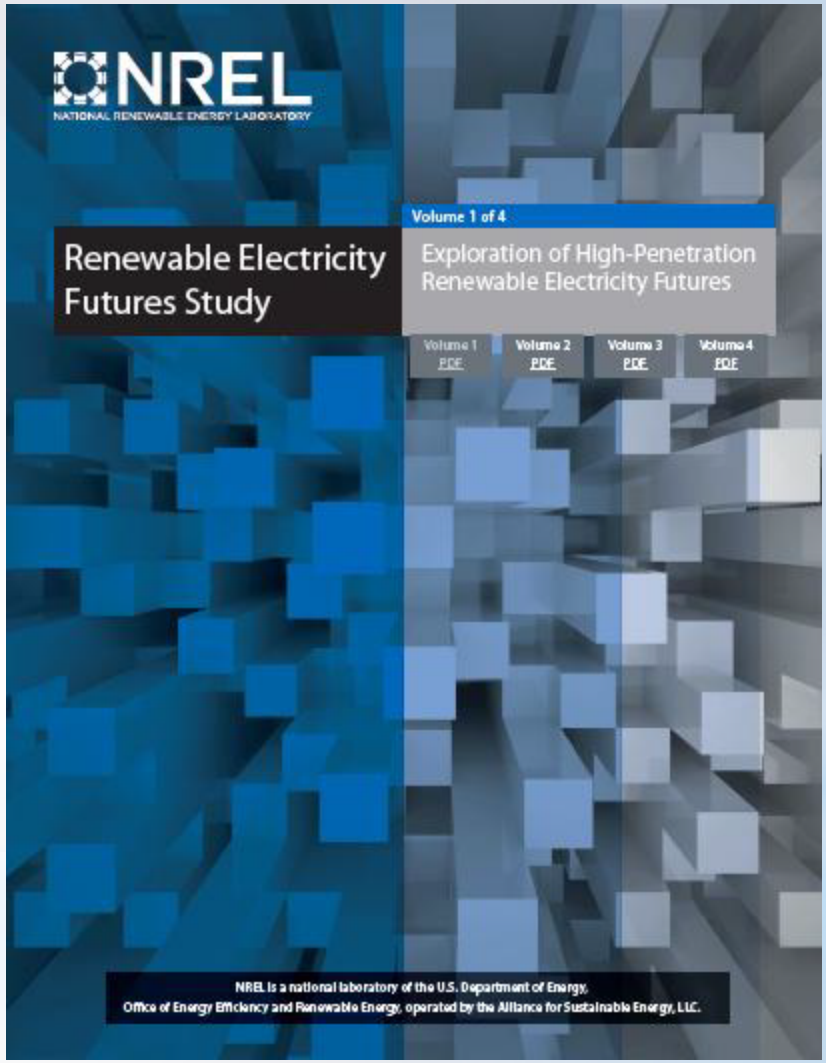

Intergovernmental Panel on Climate Change:
Fourth Assessment Report
Up 2°C = ~400,000 extinct species
Up 4°C = ~1 Million extinct species

There is an urgent need for U.S. action to realize the practical potential for near-term emissions reductions through energy efficiency and low-emission energy sources.

Limiting the Magnitude of Future Climate Change (2010)

This will require massive shifts in energy production, including the rapid and large scale-development of renewable energy.

It is possible for renewable energy to generate 80% of U.S. electricity by 2050 reducing annual emissions by nearly 81%.



Modeled installed capacity needed in gigawatts to meet proposed 2012-2050 U. S. Carbon Budget (170 Gt; NRC 2010) under different scenarios (Clemmer et al. 2013)

	BAU	CCS/Nuclear	Carbon Budget	Efficiency/ Renewable
Wind: Land-based	118	329	442	331
Wind: Offshore	2	27	102	51
Solar: PV	150	200	260	160
Solar: CCS	5	20	80	20
BioPower	4	2	70	130

Equivalent to replicating the solar development on the Carrizo Plain 187 to 325 times.

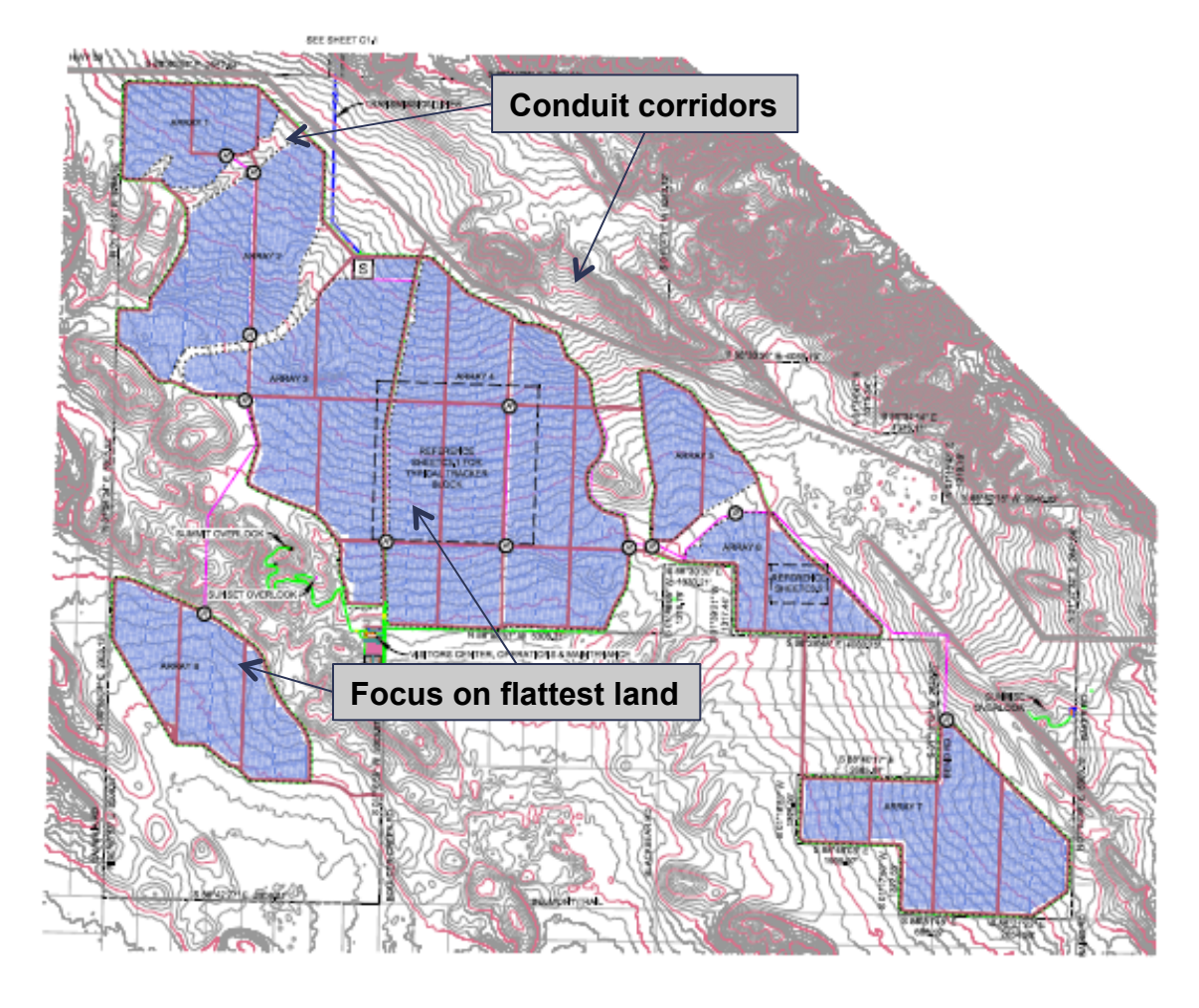
Our Challenge!

Reduce global biodiversity loss from high magnitude warming while addressing the potential for harm to individuals and local populations from renewable energy siting during a period of rapid renewable energy expansion

The California Valley Solar Ranch is a photovoltaic solar power production facility currently developed on approximately 1700 acres along the northern edge of the Carrizo Plain.

The site supports a population of the endangered giant kangaroo rat (*Dipodomys ingens*).

Original Design Prior To Mapping Distribution of Endangered Giant Kangaroo Rat (GKR)



Date: Q1 2009

Arrays & Bldg – 1,935 acres

Design emphasis:

- Maximize use of flat areas
- Minimize grading
- Incorporate wildlife conduit corridors

GKR impacts:

- Distribution assessment incomplete
- Level of avoidance not quantified

A Culture Develops

Reduce environmental impacts

Meet or exceed applicable environmental laws and instill in every team member the responsibility to do so

Promote stewardship of, and conserve the biodiversity at, the site and within the region

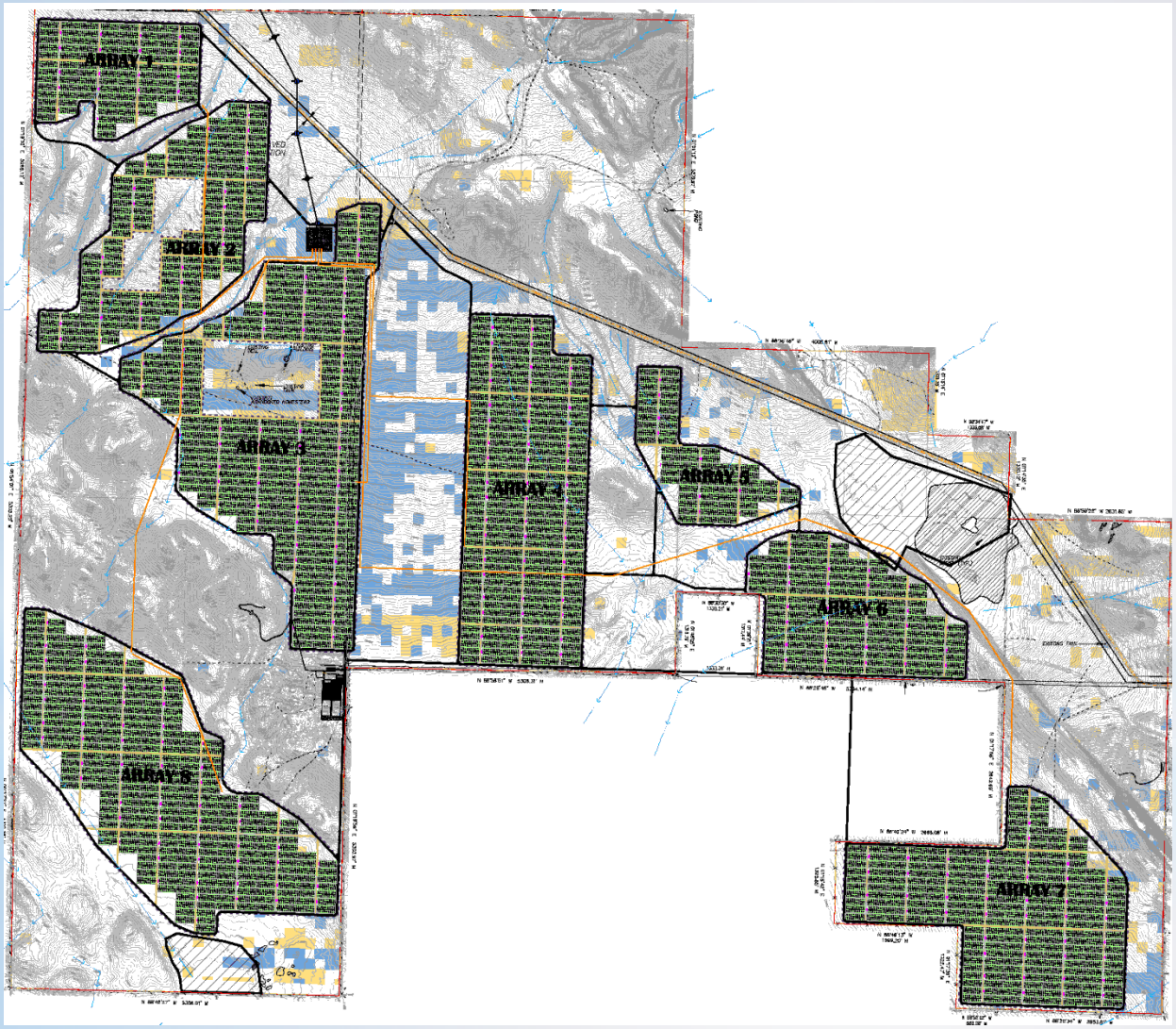
Engage constructively during the regulatory process as well as with environmental stakeholders through honest, respectful, and responsible dialogue

Intensive Data Collection and Broad Collaboration

Two years of full coverage surveys

Special two-day workshop focused on GKR ecology, avoidance, impacts, and relocation

Redesign With New Trackers After Mapping Distribution of GKR



Date: Q1 2010

Arrays & Bldg – 1,793 acres

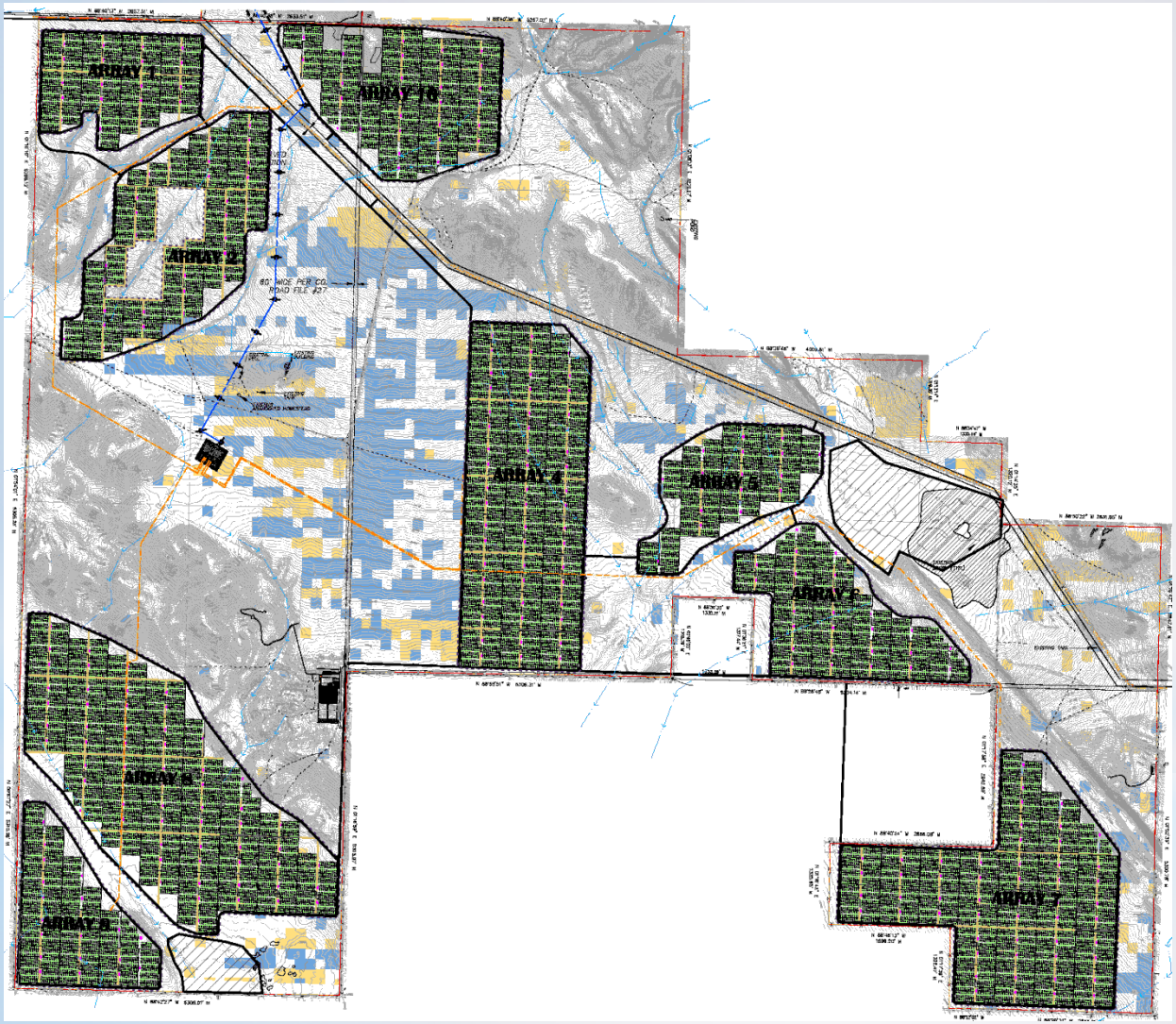
Design emphasis:

- Reduce impact on presence of GKR
- Widen wildlife corridors
- Reduce visual impacts from SR 58

GKR impacts:

- Approx. half of active precincts impacted

Redesigned to Increase Avoidance



Date: Q2 2010

Array & Bldg – 1,977 acres

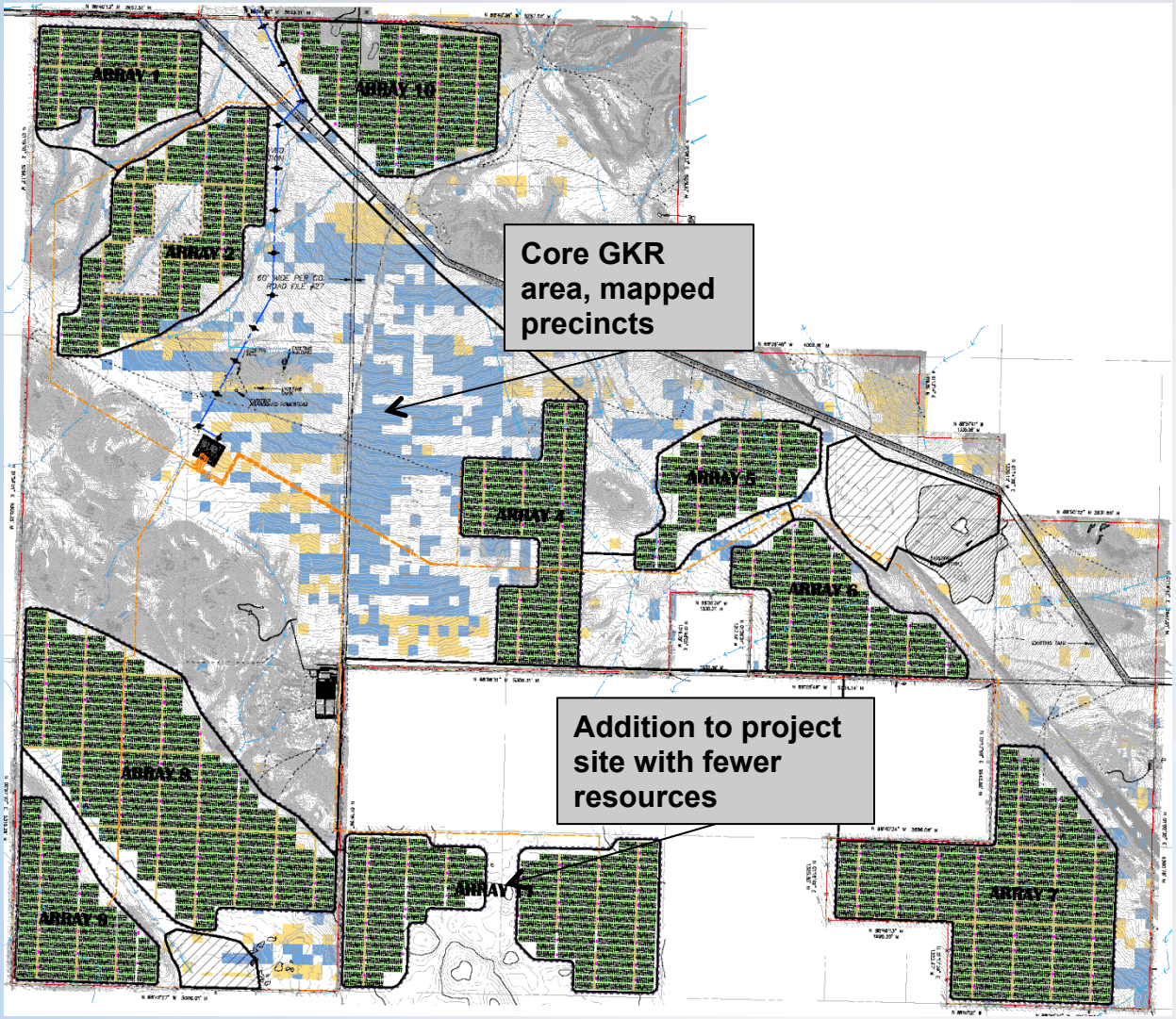
Design emphasis:

- Reduce impact on presence of GKR
- Create functional habitat corridors

GKR impacts:

- Approx. 25% of active precincts impacted

Broadened Land Area to Increase Avoidance



Date: Q2 2010

Arrays & Bldg – 2,231 acres

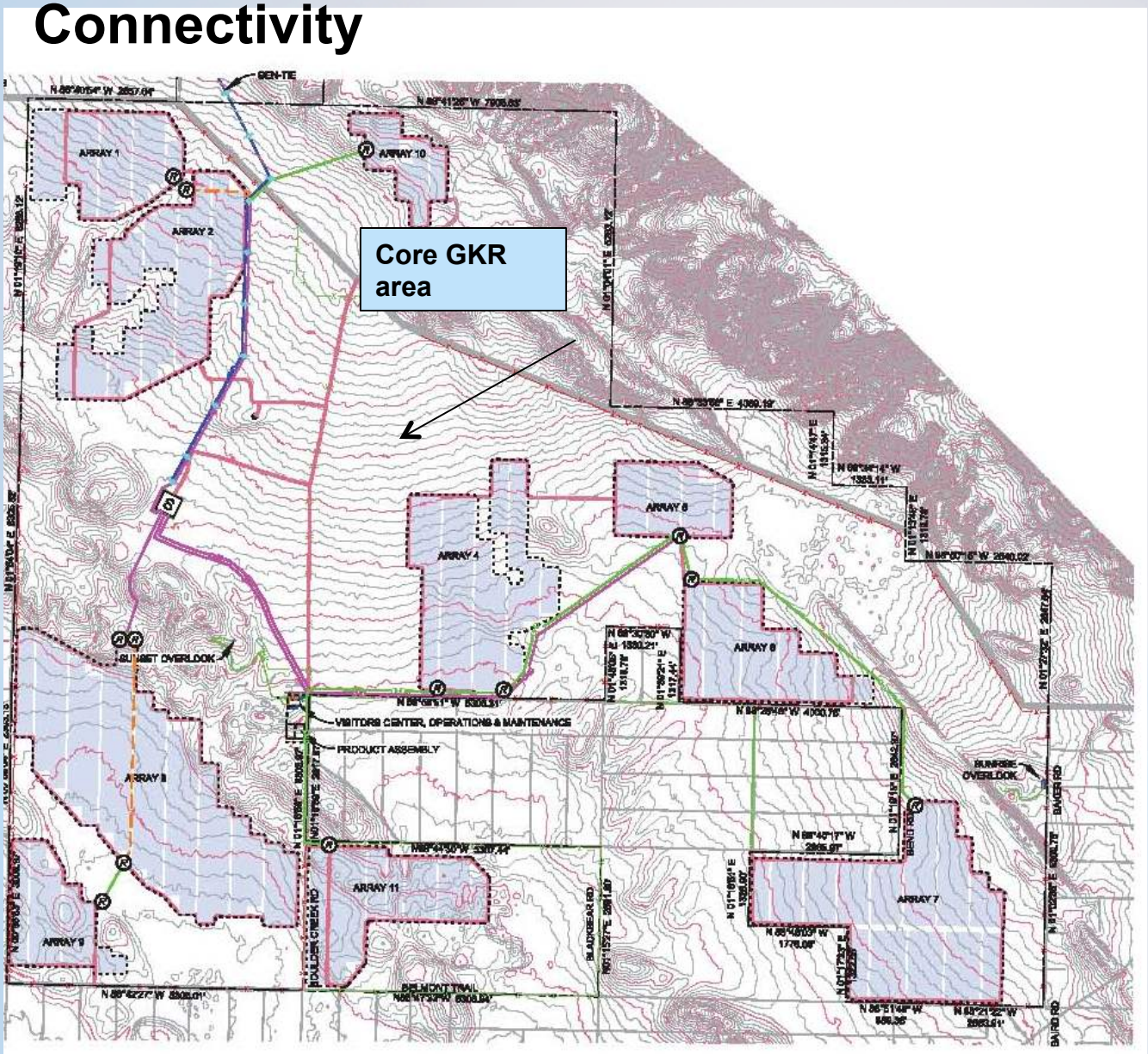
Design emphasis:

- Acquire more land of degraded habitat value to increase avoidance

GKR impacts:

- Reduce potential impacts again by about half

Final Permitted Design Avoiding Highest Concentration of Sensitive Resources and Facilitating Wildlife Connectivity



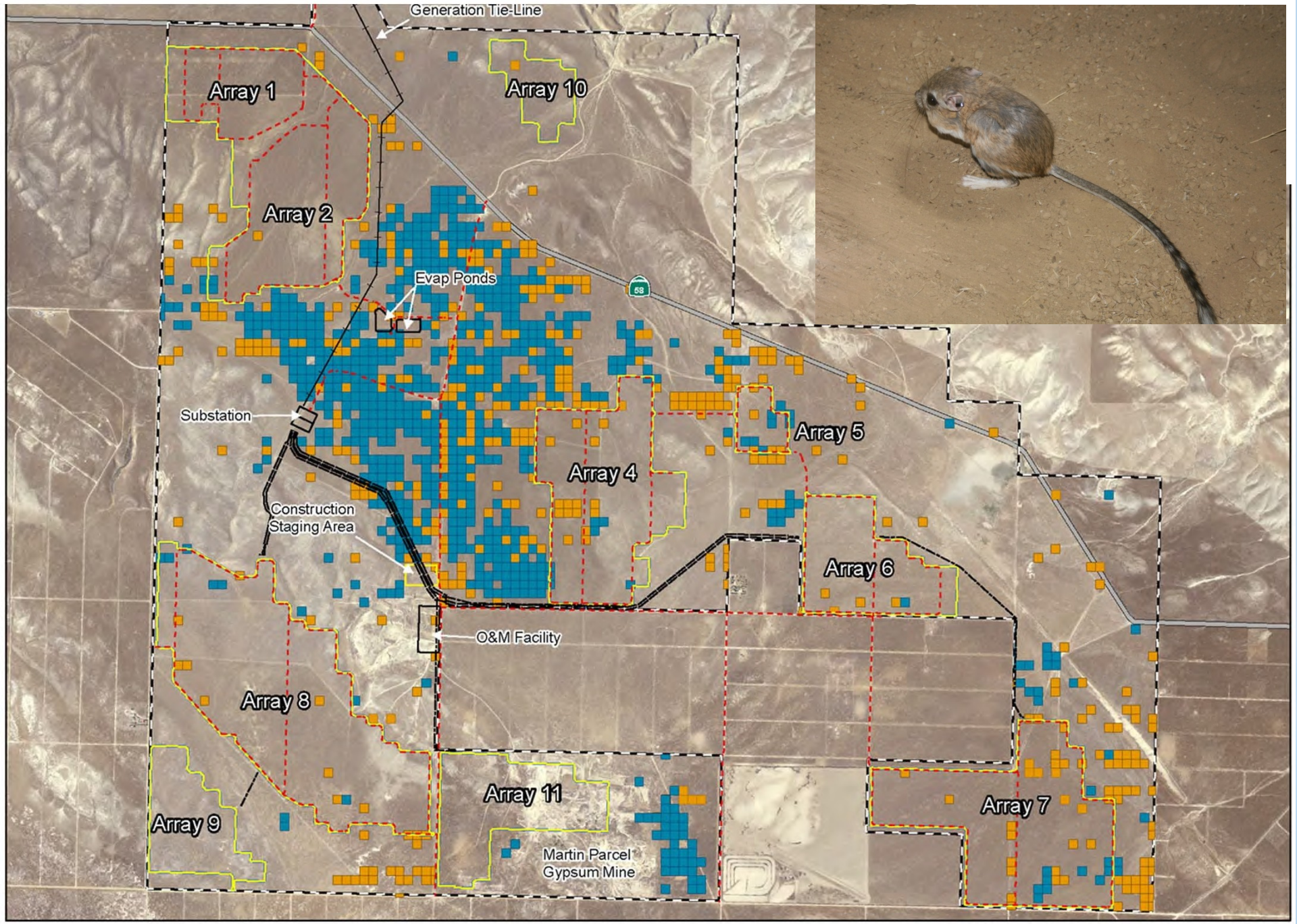
Date: Q4 – 2010

Design emphasis:

- Maximize GKR avoidance
- Increase slope tolerance
- Refine borders for efficiency
- Retain full MW capacity

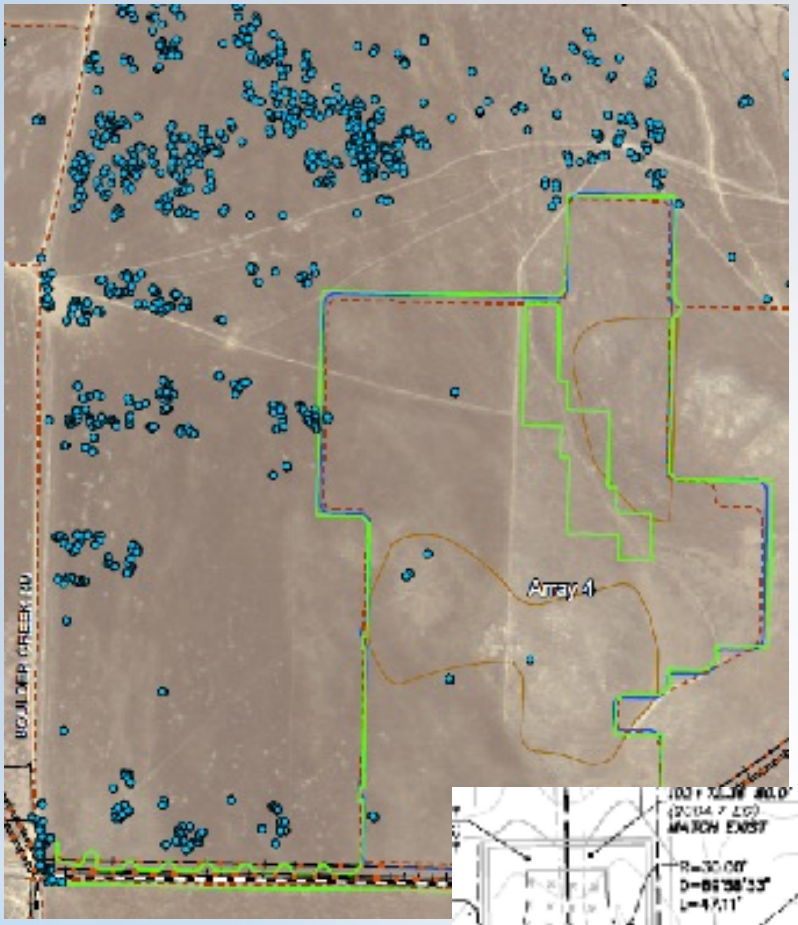
GKR impacts:

- Greatest degree of avoidance
- Integrated connectivity objectives


Generation Tie-Line
Array 1
Array 10
Array 2
Evap Ponds
58
Substation
Array 5
Array 4
Construction
Staging Area
Array 6
O&M Facility
Array 8
Array 11
Array 7
Array 9
Martin Parcel
Gypsum Mine

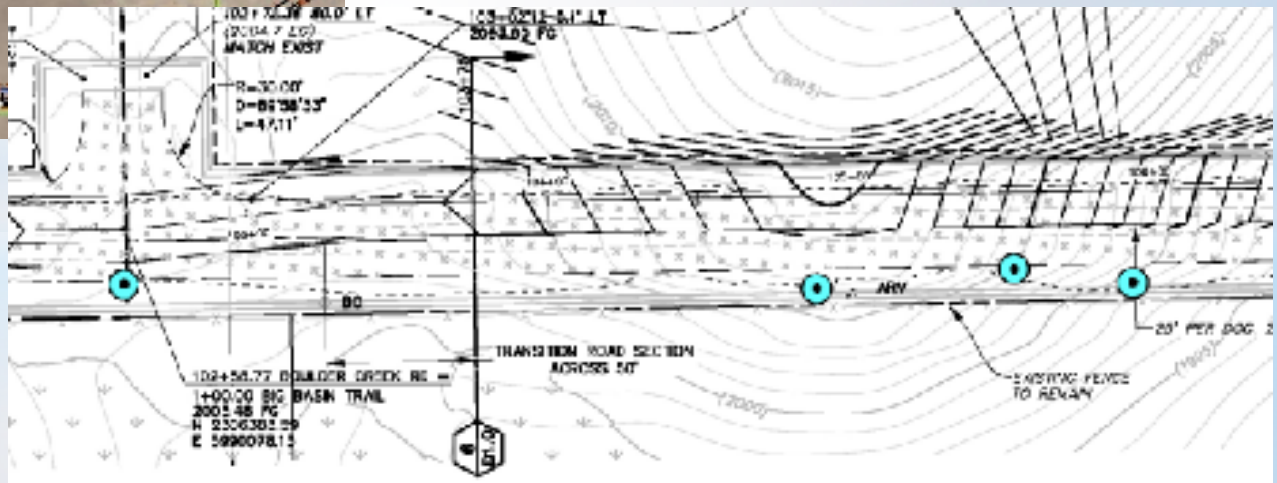
HPR II

N



Once the affect to the population is minimized,

avoid individuals!



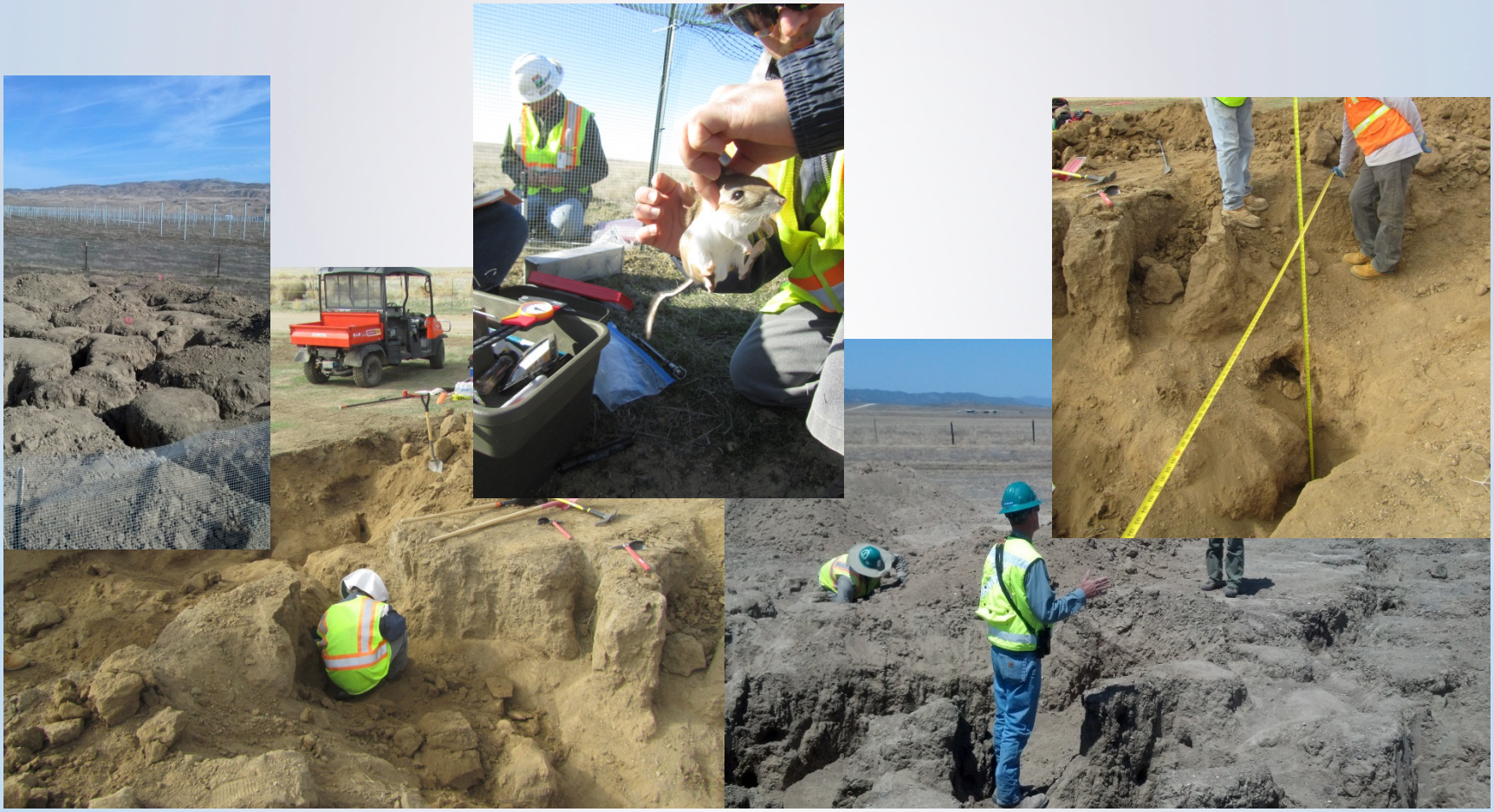
The Federal Biological Opinion issued in 2011 authorized the relocation of up to 304 giant kangaroo rats.

The number of mapped precincts on the onsite conservation lands surrounding the solar development area more than tripled between 2011 and 2012, increasing from 1,575 to 4,908.

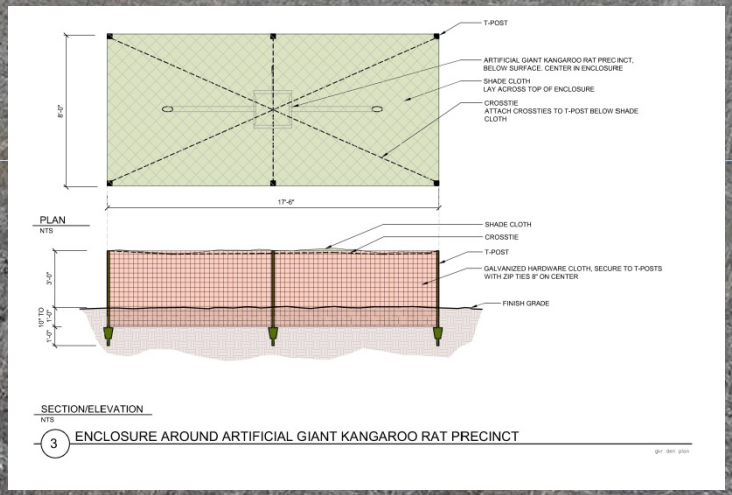
229 precincts were avoided during active construction through engineered redesigns or by finding a solution in the field.

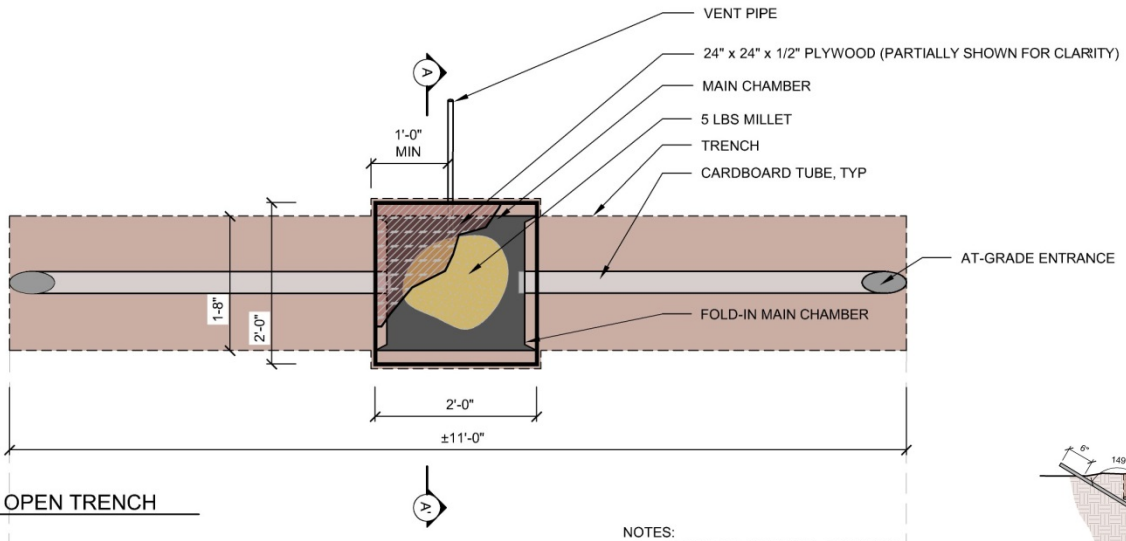
225 giant kangaroo rats were relocated to onsite conservations areas, 74% of that Federally permitted.

Each affected precinct was thoroughly and carefully inspected to find the occupant or confirm the precinct was empty



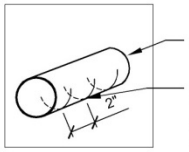
Individuals that could not be protected in place were relocated to artificial precincts





PLAN OF OPEN TRENCH
NTS

NOTES:
1. SCATTER A HANDFULL OF MILLET AROUND BOTH AT-GRADE ENTRANCES TO PRECINCT

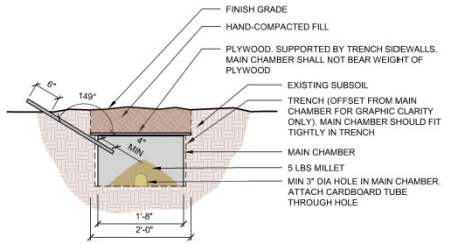


INSET:
PERFORATION

SECTION/ELEVATION
NTS

1 ARTIFICIAL GIANT KANGAROO RAT PRECINCT

gkr den plan



SECTION/ELEVATION
NTS

2 SECTION A-A' ARTIFICIAL GIANT KANGAROO RAT PRECINCT

gkr den plan


Typically plug the artificial chamber entrances.

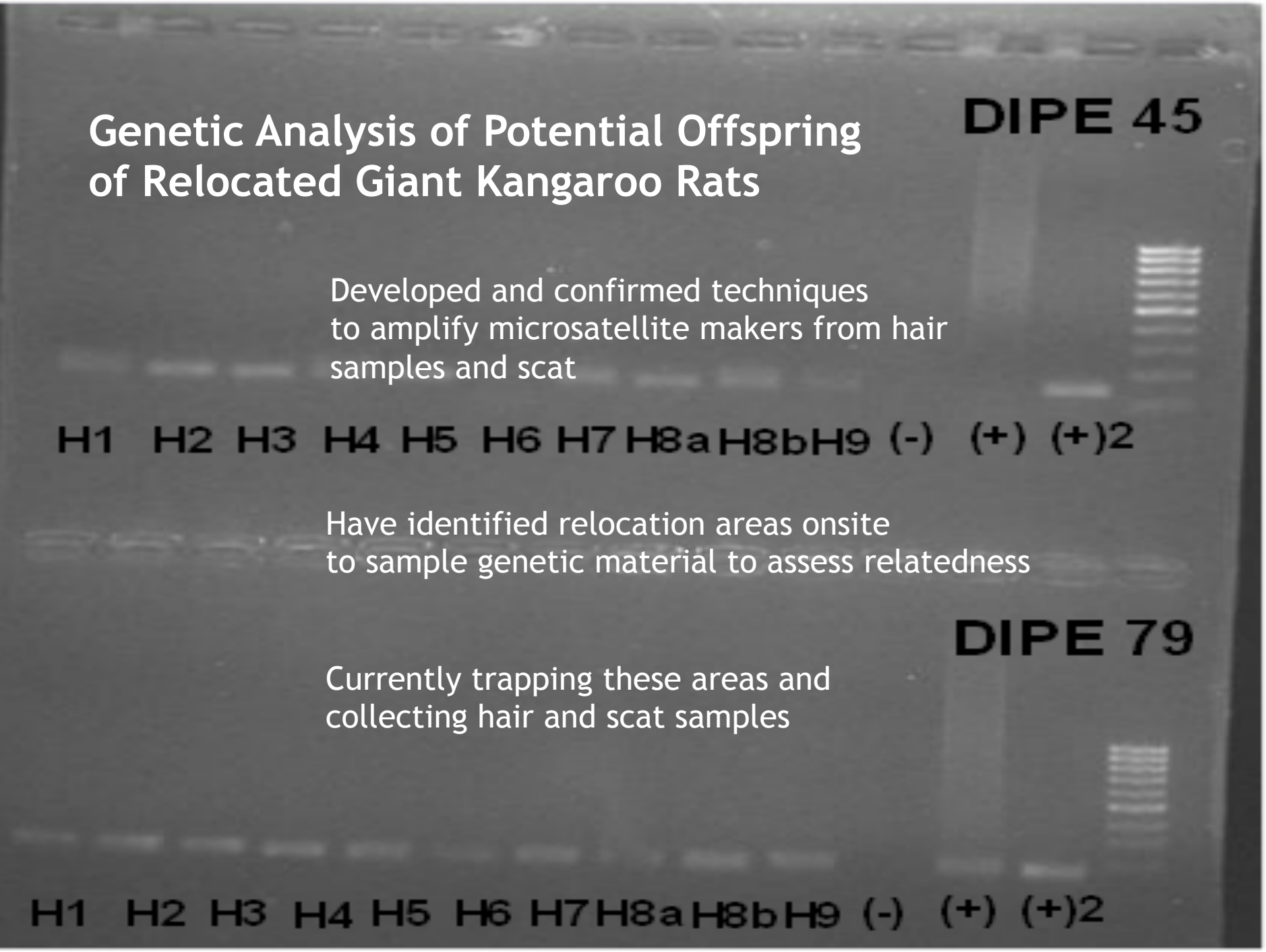

Start excavating new tunnels

Over time they excavated out of the enclosure

Generally remaining in the vicinity of the release site


Monitoring of pit tag transponders has documented some relocated animals persisting for at least 721 days.
Bushnell
03-27-2011 18:37:18

Genetic Analysis of Potential Offspring of Relocated Giant Kangaroo Rats



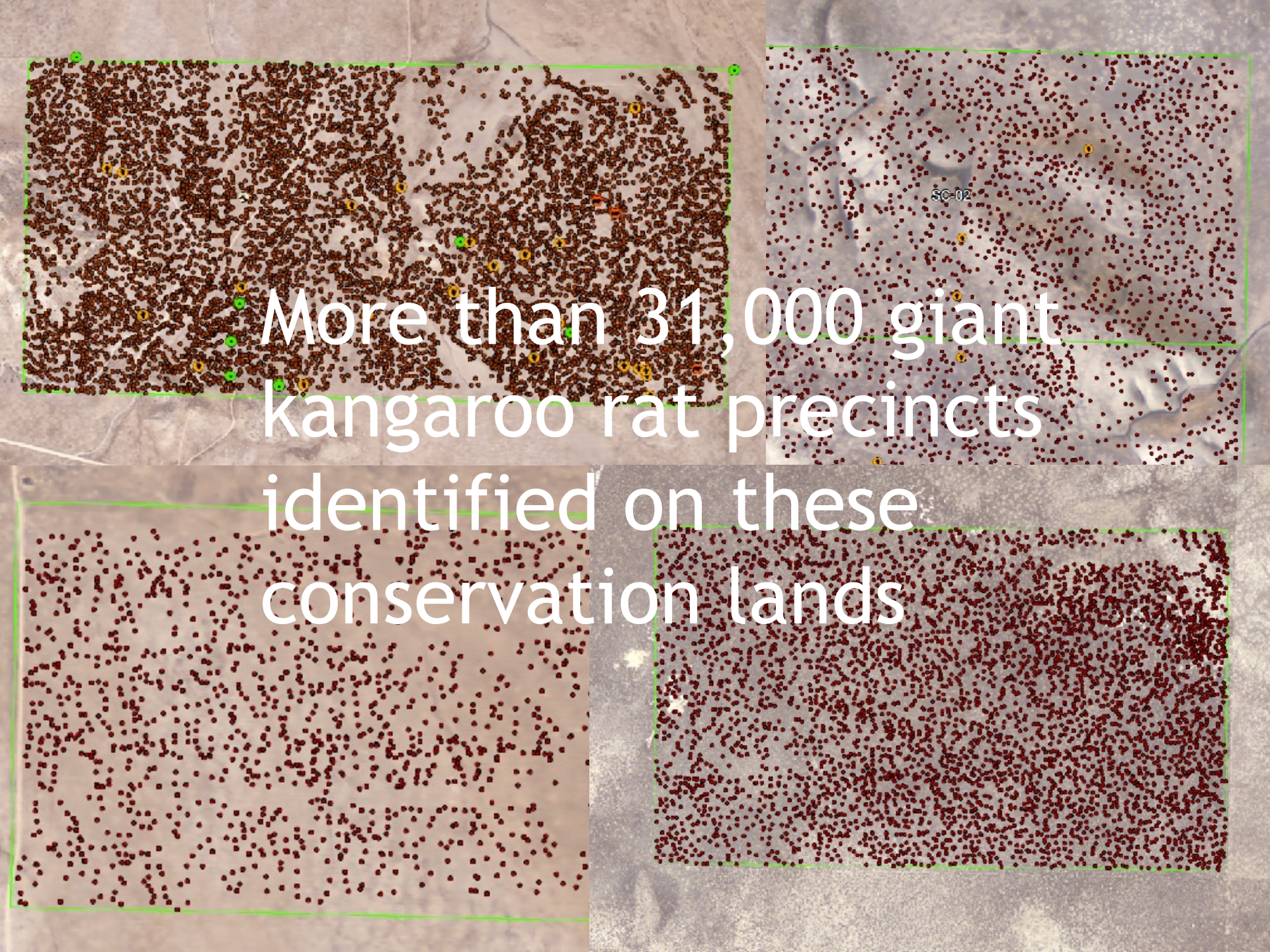
Developed and confirmed techniques to amplify microsatellite makers from hair samples and scat

Have identified relocation areas onsite to sample genetic material to assess relatedness

Currently trapping these areas and collecting hair and scat samples

Regional Conservation Benefits

Approximately 12,000 acres
to be preserved and managed
in perpetuity



More than 31,000 giant kangaroo rat precincts identified on these conservation lands


Our Challenge!
Reduce global biodiversity loss from high magnitude warming while addressing the potential for harm to individuals and local populations from renewable energy siting during a period of rapid renewable energy expansion

YES!

Through extraordinary collaboration and teamwork within a culture of positivity

nrg

SUNPOWER

H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS