Appendix A
Electric and Magnetic Fields

Electric and Magnetic Fields

The California Public Utilities Commission (CPUC) and the California Department of Health Services (CDHS) have not concluded that exposure to magnetic fields from utility electric facilities is a health hazard. Many reports have concluded that the potential for health effects associated with electric and magnetic field (EMF) exposure is too speculative to allow the evaluation of impacts or the preparation of mitigation measures.

EMF is a term used to describe electric and magnetic fields that are created by electric voltage (electric field) and electric current (magnetic field). Power frequency EMF is a natural consequence of electrical circuits, and can be either directly measured using the appropriate measuring instruments or calculated using appropriate information.

Electric Fields

Electric fields are present whenever voltage exists on a wire, and are not dependent on current. The magnitude of the electric field is primarily a function of the configuration and operating voltage of the line and decreases with the distance from the source (line). The electric field can be shielded (i.e., the strength can be reduced) by any conducting surface, such as trees, fences, walls, buildings, and most types of structures. The strength of an electric field is measured in volts per meter (V/m) or kilovolts per meter (kV/m).

Magnetic Fields

Magnetic fields are present whenever current flows in a conductor, and are not dependent on the voltage present on the conductor. The strength of these fields also decreases with distance from the source. However, unlike electric fields, most common materials have little shielding effect on magnetic fields.

The magnetic field strength is a function of both the current on the conductor and the design of the system. Magnetic fields are measured in units called Gauss. However, for the low levels normally encountered near power systems, the field strength is expressed in a much smaller unit, the milligauss (mG), which is one thousandth of a Gauss.

Power frequency EMF is present where electricity is used. This includes not only utility transmission lines, distribution lines, and substations, but also the building wiring in homes, offices, and schools, and in the appliances and machinery used in these locations. Typical magnetic fields from these sources can range from below 1 mG to above 1,000 mG (1 Gauss).

Magnetic field strengths diminish with distance. Fields from compact sources (i.e., those containing coils such as small appliances and transformers) decrease in inverse proportion to the distance from the source cubed. For three-phase power lines with balanced currents, the

magnetic field strength drops off inversely proportional to the distance from the line squared. Fields from unbalanced currents, which flow in paths such as neutral or ground conductors, fall off inversely proportional to the distance from the source. Conductor spacing and configuration also affect the rate at which the magnetic field strength decreases.

The magnetic field levels of PG&E's overhead and underground transmission lines will vary depending upon customer power usage. Magnetic field strengths for typical PG&E transmission line loadings at the edge of rights-of-way are approximately 10 to 90 mG. Under peak load conditions, the magnetic fields at the edge of the right-of-way would not likely exceed 150 mG. There are no long-term, health-based state or federal government EMF exposure standards. State regulations for magnetic fields have been developed in New York and Florida (150 mG and 200 mG at the edge of the right-of-way). However, these are based on limiting exposure from new facilities to levels no greater than existing facilities.

The strongest magnetic fields around the outside of a substation come from the power lines entering and leaving the station. The strength of the magnetic fields from transformers and other equipment decreases quickly with distance. Beyond the substation fence, the magnetic fields produced by the equipment within the station are typically indistinguishable from background levels.

Possible Health Effects

The possible effects of EMF on human health have come under scientific scrutiny. Concern about EMF originally focused on electric fields; however, much of the recent research has focused on magnetic fields. Uncertainty exists as to what characteristics of magnetic field exposure need to be considered to assess human exposure effects. Among the characteristics considered are field intensity, transients, harmonics, and changes in intensity over time. These characteristics may vary from power lines to appliances to home wiring, and this may create different types of exposures. The exposure most often considered is intensity or magnitude of the field.

There is a consensus among the medical and scientific communities that there is insufficient evidence to conclude that EMF causes adverse health effects. Neither the medical nor scientific communities have been able to provide any foundation upon which regulatory bodies could establish a standard or level of exposure that is known to be either safe or harmful. Laboratory experiments have shown that magnetic fields can cause biologic changes in living cells, but scientists are not sure whether any risk to human health can be associated with them. Some studies have suggested an association between surrogate measures of magnetic fields and certain cancers while others have not.

California Public Utilities Commission Decision Summary

Background

On January 15, 1991, the CPUC initiated an investigation to consider its role in mitigating the health effects, if any, of electric and magnetic fields from utility facilities and power lines. A working group of interested parties, called the California EMF Consensus Group, was created by the CPUC to advise it on this issue. It consisted of 17 stakeholders representing citizens groups, consumer groups, environmental groups, state agencies, unions, and utilities. The Consensus Group's fact-finding process was open to the public, and its report incorporated concerns expressed by the public. Its recommendations were filed with the Commission in March 1992.

In August 2004 the CPUC began a proceeding known as a “rulemaking” (R.04-08-020) to explore whether changes should be made to existing CPUC policies and rules concerning EMF from electric transmission lines and other utility facilities.

Through a series of hearings and conferences, the Commission evaluated the results of its existing EMF mitigation policies and addressed possible improvements in implementation of these policies. The CPUC also explored whether new policies are warranted in light of recent scientific findings on the possible health effects of EMF exposure.

The CPUC completed the EMF rulemaking in January 2006 and presented these conclusions in Decision D.06-01-042:

- The CPUC affirmed its existing policy of requiring no-cost and low-cost mitigation measures to reduce EMF levels from new utility transmission lines and substation projects.

- The CPUC adopted rules and policies to improve utility design guidelines for reducing EMF, and provides for a utility workshop to implement these policies and standardize design guidelines.

- Despite numerous studies, including one ordered by the Commission and conducted by the California Department of Health Services, the CPUC stated “we are unable to determine whether there is a significant scientifically verifiable relationship between EMF exposure and negative health consequences.”

- The CPUC said it will “remain vigilant” regarding new scientific studies on EMF, and if these studies indicate negative EMF health impacts, the Commission will reconsider its EMF policies and open a new rulemaking if necessary.

In response to a situation of scientific uncertainty and public concern, the decision specifically requires PG&E to consider “no-cost” and “low-cost” measures, where feasible, to reduce exposure from new or upgraded utility facilities. It directs that no-cost mitigation measures be undertaken, and that low-cost options, when they meet certain guidelines for field reduction and cost, be adopted through the project certification process. PG&E was directed to develop, submit and follow EMF guidelines to implement the CPUC decision. Four percent of total project budgeted cost is the benchmark in implementing EMF mitigation, and mitigation measures should achieve incremental magnetic field reductions of at least 15%.

Reviews of EMF Studies

Hundreds of EMF studies have been conducted over the last 20 years in the areas of epidemiology, animal research, cellular studies, and exposure assessment. A number of nationally recognized multi-discipline panels have performed comprehensive reviews of the body of scientific knowledge on EMF. These panels’ ability to bring experts from a variety of disciplines together to review the research gives their reports recognized credibility. It is standard practice in risk assessment and policymaking to rely on the findings and consensus opinions of these distinguished panels. None of these groups have concluded that EMF causes adverse health effects or that the development of standards were appropriate or would have a scientific basis.

Reports by the National Research Council/National Academy of Sciences, American Medical Association, American Cancer Society, National Institute of Environmental Health Sciences, World Health Organization, International Agency for Research on Cancer, and California Department of Health Services conclude that insufficient scientific evidence exists to warrant the adoption of specific health-based EMF mitigation measures. The potential for adverse health effects associated with EMF exposure is too speculative to allow the evaluation of impacts or the preparation of mitigation measures.

National Institute of Environmental Health Sciences

In June of 1999, the federal government completed a $60-million EMF research program managed by the National Institute of Environmental Health Sciences (NIEHS) and the Department of Energy (DOE). Known as the EMF RAPID (Research And Public Information Dissemination) Program. In their report to the U.S. Congress, the NIEHS concluded that:

> The NIEHS believes that the probability that ELF-EMF exposure is truly a health hazard is currently small. The weak epidemiological associations and lack of any laboratory support for these associations provide only marginal, scientific support that exposure to this agent is causing any degree of harm.

The NIEHS report also included the following conclusions:

> The National Toxicology Program routinely examines environmental exposures to determine the degree to which they constitute a human cancer risk and produces the 'Report on Carcinogens' listing agents that are 'known human carcinogens' or 'reasonably anticipated to be human carcinogens.' It is our opinion that based on evidence to date, ELF-EMF exposure would not be listed in the 'Report on Carcinogens' as an agent 'reasonably anticipated to be a human carcinogen.' This is based on the limited epidemiological evidence and the findings from the EMF-RAPID Program that did not indicate an effect of ELF-EMF exposure in experimental animals or a mechanistic basis for carcinogenicity.
>
> The NIEHS agrees that the associations reported for childhood leukemia and adult chronic lymphocytic leukemia cannot be dismissed easily as random or negative findings. The lack of positive findings in animals or in mechanistic studies weakens the belief that this association is actually due to ELF-EMF, but cannot completely discount the finding. The NIEHS also agrees with the conclusion that no other cancers or non-cancer health outcomes provide sufficient evidence of a risk to warrant concern.
>
> Epidemiological studies have serious limitations in their ability to demonstrate a cause and effect relationship whereas laboratory studies, by design, can clearly show that cause and effect are possible. Virtually all of the laboratory evidence in animals and humans and most of the mechanistic work done in cells fail to support a causal relationship between exposure to ELF-EMF at environmental levels and changes in biological function or disease status. The lack of consistent, positive findings in animal or mechanistic studies weakens the belief that this association is actually due to ELF-EMF, but it cannot completely discount the epidemiological findings.
>
> The NIEHS suggests that the level and strength of evidence supporting ELF-EMF exposure as a human health hazard are insufficient to warrant aggressive regulatory actions; thus, we do not recommend actions such as stringent standards on electric appliances and a national program to bury all transmission and distribution lines. Instead, the evidence suggests passive measures such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. NIEHS suggests that the power industry continue its current practice of siting power lines to reduce exposures and continue to explore ways to reduce the creation of magnetic fields around transmission and distribution lines without creating new hazards. We also encourage technologies that lower exposures from neighborhood distribution lines provided that they do not increase other risks, such as those from accidental electrocution or fire.

U.S. National Research Council/ National Academy of Sciences

In May 1999, the National Research Council/ National Academy of Sciences, an independent scientific agency responsible for advising the federal government on science, technology, and medicine, released its evaluation of the scientific and technical content of research projects conducted under the U.S. EMF RAPID Program, concluding that:

> The results of the EMF-RAPID program do not support the contention that the use of electricity poses a major unrecognized public-health danger. Basic research on the effects of power-frequency magnetic fields on cells and animals should continue, but a special research-funding effort is not required. Investigators should compete for funding through traditional research-funding mechanisms. If future research on this subject is funded through such mechanisms, it should be limited to tests of well-defined mechanistic hypotheses or replications of reported positive effects. If carefully performed, such experiments will have value even if their results are negative. Special efforts should be made to communicate the conclusions of this effort to the general public effectively.

The following specific recommendations are made by the committee:

1. The committee recommends that no further special research program focused on possible health effects of power-frequency magnetic fields be funded. Basic research on the effects of power-frequency magnetic fields on cells and animals should continue but investigators should compete for funding through traditional research funding mechanisms.

2. If, however, Congress determines that another time-limited, focused research program on the health effects of power-frequency magnetic fields is warranted, the committee recommends that emphasis be placed on replications of studies that have yielded scientifically promising claims of effects and that have been reported in peer-reviewed journals. Such a program would benefit from the use of a contract-funding mechanism with a requirement for complete reports and/or peer-reviewed publications at program's end.

3. The engineering studies were initiated without the guidance of a clearly established biologic effect. The committee recommends that no further engineering studies be funded unless a biologic effect that can be used to plan the engineering studies has been determined.

4. Much of the information from the EMF-RAPID biology program has not been published in peer-reviewed journals. NIEHS should collect all future peer-reviewed information resulting from the EMF-RAPID biology projects and publish a summary report of such information periodically on the NIEHS Web site.

5. The communication effort initiated by EMF-RAPID is reasonable. The two booklets and the telephone information line are useful, as is the EMF-RAPID Internet site. There are two limitations to the effort. First, it is largely passive, responding to inquiries and providing information, rather than being active. Second, much of the information

produced is in a scientific format not readily understandable by the public. The committee recommends that further material produced to disseminate information on power-frequency magnetic fields be written for the general public in a clear fashion. The Web site should be made more user-friendly. The booklet *Questions and Answers about EMF* should be updated periodically and made available to the public.

World Health Organization

The World Health Organization (WHO) established the International EMF Project in 1996 to investigate potential health risks associated with exposure to electric and magnetic fields (EMF). A WHO Task Group recently concluded a review of the health implications of extremely low frequency (ELF) EMF.

A Task Group of scientific experts was convened in 2005 to assess any risks to health that might exist from exposure to ELF electric and magnetic fields. Previously in 2002, the International Agency for Research on Cancer (IARC) examined the evidence regarding cancer; this Task Group reviewed evidence for a number of health effects, and updated the evidence regarding cancer. The conclusions and recommendations of the Task Group are presented in a WHO report titled: "Extremely Low Frequency Fields Environmental Health Criteria Monograph No.238" and Factsheet No 322.

> "New human, animal and in vitro studies, published since the 2002 IARC monograph, do not change the overall classification of ELF magnetic fields as a possible human carcinogen."
>
> "A number of other diseases have been investigated for possible association with ELF magnetic field exposure. These include cancers in both children and adults, depression, suicide, reproductive dysfunction, developmental disorders, immunological modifications and neurological disease. The scientific evidence supporting a linkage between ELF magnetic fields and any of these diseases is much weaker than for childhood leukaemia and in some cases (for example, for cardiovascular disease or breast cancer) the evidence is sufficient to give confidence that magnetic fields do not cause the disease."
>
> "the epidemiological evidence is weakened by methodological problems, such as potential selection bias. In addition, there are no accepted biophysical mechanisms that would suggest that low-level exposures are involved in cancer development. Thus, if there were any effects from exposures to these low-level fields, it would have to be through a biological mechanism that is as yet unknown. Additionally, animal studies have been largely negative. Thus, on balance, the evidence related to childhood leukaemia is not strong enough to be considered causal."
>
> "Policy-makers should establish an ELF EMF protection programme that includes measurements of fields from all sources to ensure that the exposure limits are not exceeded either for the general public or workers."

> “Government and industry should monitor science and promote research programmes to further reduce the uncertainty of the scientific evidence on the health effects of ELF field exposure.”
>
> “Policy-makers, community planners and manufacturers should implement very low-cost measures when constructing new facilities and designing new equipment including appliances.”
>
> “Changes to engineering practice to reduce ELF exposure from equipment or devices should be considered, provided that they yield other additional benefits, such as greater safety, or little or no cost.”
>
> “When changes to existing ELF sources are contemplated, ELF field reduction should be considered alongside safety, reliability and economic aspects.”

International Agency for Research on Cancer

In June of 2001, the International Agency for Research on Cancer (IARC), a branch of the World Health Organization (WHO), evaluated the carcinogenic risk to humans of static and extremely low-frequency EMF. In October of 2001, the WHO published a Fact Sheet that summarized the IARC findings. Below is an excerpt from the fact sheet:

> In June 2001, an expert scientific working group of IARC reviewed studies related to the carcinogenicity of static and ELF electric and magnetic fields. Using the standard IARC classification that weighs human, animal and laboratory evidence, ELF magnetic fields were classified as possibly carcinogenic to humans based on epidemiological studies of childhood leukaemia. Evidence for all other cancers in children and adults, as well as other types of exposures (i.e. static fields and ELF electric fields) was considered not classifiable either due to insufficient or inconsistent scientific information.
>
> "Possibly carcinogenic to humans" is a classification used to denote an agent for which there is limited evidence of carcinogenicity in humans and less than sufficient evidence for carcinogenicity in experimental animals.
>
> This classification is the weakest of three categories ("is carcinogenic to humans", "probably carcinogenic to humans" and "possibly carcinogenic to humans") used by IARC to classify potential carcinogens based on published scientific evidence. Some examples of well-known agents that have been classified by IARC are listed below:

Classification	Examples of Agents
Carcinogenic to humans (usually based on strong evidence of carcinogenicity in humans)	Asbestos Mustard gas Tobacco (smoked and smokeless) Gamma radiation
Probably carcinogenic to humans (usually based on strong evidence of carcinogenicity in animals)	Diesel engine exhaust Sun lamps UV radiation Formaldehyde
Possibly carcinogenic to humans (usually based on evidence in humans which is considered credible, but for which other explanations could not be ruled out)	Coffee Styrene Gasoline engine exhaust Pickled Vegetables ELF magnetic fields

DO ELF FIELDS CAUSE CANCER?

ELF fields are known to interact with tissues by inducing electric fields and currents in them. This is the only established mechanism of action of these fields. However, the electric currents induced by ELF fields commonly found in our environment are normally much lower than the strongest electric currents naturally occurring in the body such as those that control the beating of the heart.

Since 1979 when epidemiological studies first raised a concern about exposures to power line frequency magnetic fields and childhood cancer, a large number of studies have been conducted to determine if measured ELF exposure can influence cancer development, especially leukaemia in children.

There is no consistent evidence that exposure to ELF fields experienced in our living environment causes direct damage to biological molecules, including DNA. Since it seems unlikely that ELF fields could initiate cancer, a large number of investigations have been conducted to determine if ELF exposure can influence cancer promotion or co-promotion. Results from animal studies conducted so far suggest that ELF fields do not initiate or promote cancer.

However, two recent pooled analyses of epidemiological studies provide insight into the epidemiological evidence that played a pivotal role in the IARC evaluation. These studies suggest that, in a population exposed to average magnetic fields in excess of 0.3 to 0.4 μT, twice as many children might develop leukaemia compared to a population with lower exposures. In spite of the large number data base, some uncertainty remains as to whether magnetic field exposure or some other factor(s) might have accounted for the increased leukaemia incidence.

Childhood leukaemia is a rare disease with 4 out of 100,000 children between the age of 0 to 14 diagnosed every year. Also average magnetic field exposures above 0.3 or

> 0.4 μT in residences are rare. It can be estimated from the epidemiological study results that less than 1% of populations using 240 volt power supplies are exposed to these levels, although this may be higher in countries using 120 volt supplies.
>
> The IARC review addresses the issue of whether it is feasible that ELF-EMF pose a cancer risk. The next step in the process is to estimate the likelihood of cancers in the general population from the usual exposures and to evaluate evidence for other (non-cancer) diseases. This part of the risk assessment should be finished by WHO in the next 18 months.

American Cancer Society

In the journal, *A Cancer Journal for Clinicians*, the American Cancer Society (ACS) reviewed EMF residential and occupational epidemiologic research in an article written by Dr. Clark W. Heath, Jr., ACS's vice president of epidemiology and surveillance research. Dr. Heath reviews 13 residential epidemiologic studies of adult and childhood cancer. Dr. Heath wrote:

> Evidence suggesting that exposure to EMF may or may not promote human carcinogenesis is mostly based on...epidemiologic observations.... While those observations may suggest such a relationship for leukemia and brain cancer in particular, the findings are weak, inconsistent, and inconclusive.... The weakness and inconsistent nature of epidemiologic data, combined with the continued dearth of coherent and reproducible findings from experimental laboratory research, leave one uncertain and rather doubtful that any real biologic link exists between EMF exposure and carcinogenicity.

American Medical Association

The AMA adopted recommendations of its Council on Scientific Affairs (CSA) regarding EMF health effects. The report was prepared as a result of a resolution passed by AMA's membership at its 1993 annual meeting. The following recommendations are based on the CSA's review of EMF epidemiologic and laboratory studies to date, as well as on several major literature reviews:

- Although no scientifically documented health risk has been associated with the usually occurring levels of electromagnetic fields, the AMA should continue to monitor developments and issues related to the subject.

- The AMA should encourage research efforts sponsored by agencies such as the National Institutes of Health, the U.S. Department of Energy, and the National Science Foundation. Continuing research should include study of exposures to EMF and its effects, average public exposures, occupational exposures, and the effects of field surges and harmonics.

- The AMA should support the meeting of an authoritative, multidisciplinary committee under the auspices of the National Academy of Sciences or the

National Council on Radiation Protection and Measurements to make recommendations about exposure levels of the public and workers to EMF and radiation.

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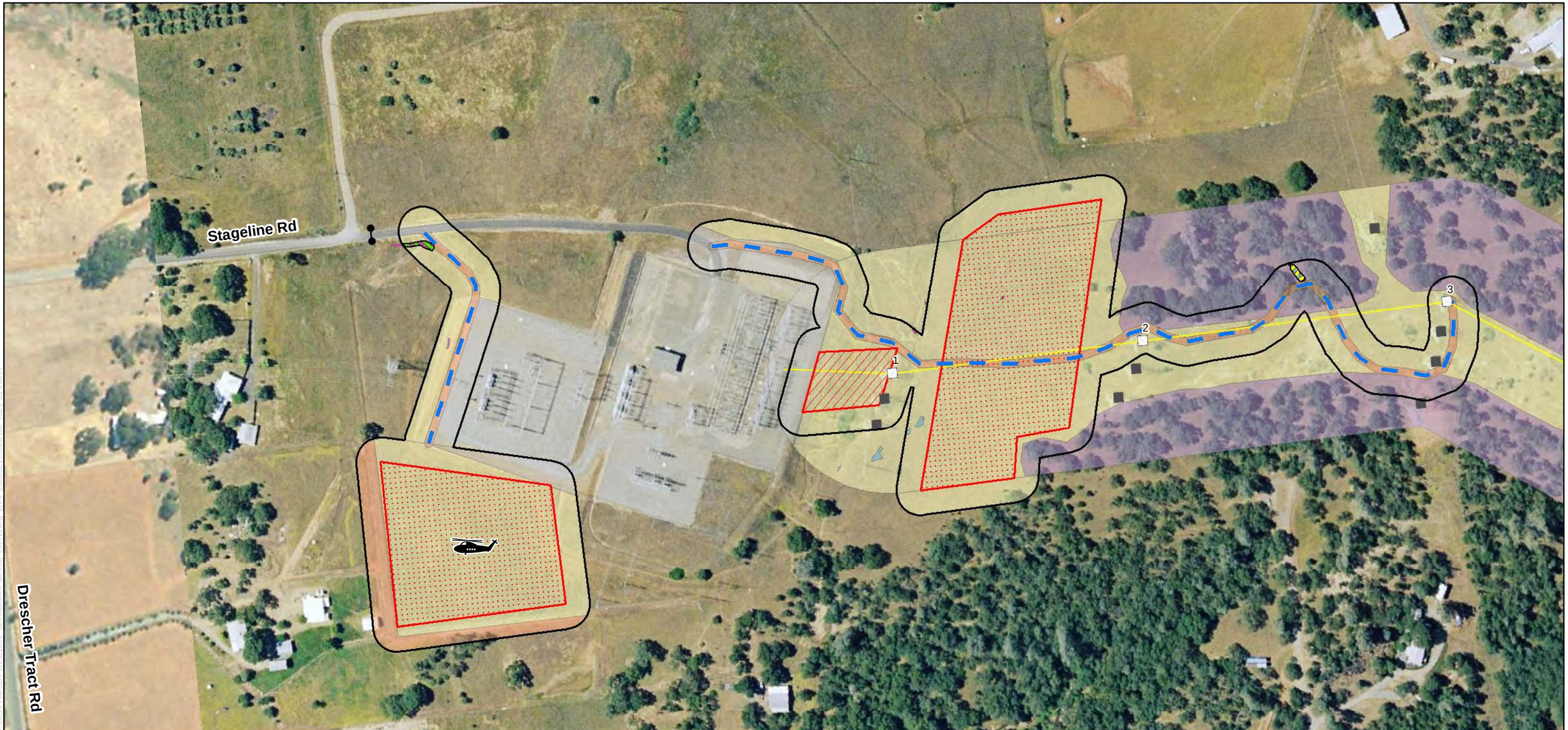
Appendix B-1
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



Project Activities

- New Pole
- Replace Existing Tower
- Work Area
- Special Work Area
- Pull Site
- Material Staging
- Landing Zone
- Temporary Access Road
- Rice Temporarily Removed
- Project Area

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
- Transmission Line
- Existing Access Road
- Gate

Special-Status Species

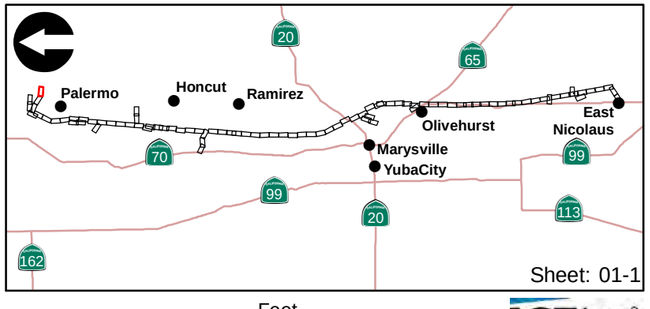
- Brown Fox Sedge
- Vernal Pool Tadpole Shrimp
- Elderberry Shrub
- Elderberry Shrub Cluster

Vegetation Communities Legend only

- Non-native Grassland
- Valley Oak Savanna Woodland
- Interior Live Oak Woodland
- Foothill Pine / Oak Woodland
- Urban
- Urban Park
- Rural Residential
- Irrigated Pasture
- Orchard
- Rice
- Row Crops
- Riparian Forest
- Riparian Scrub
- Open Water
- Valley Freshwater Marsh
- Non-JD Seasonal Wetland
- Non-JD Northern Hardpan Vernal Pool

Potentially Jurisdictional Waters of the U.S.

- Freshwater Marsh
- Seasonal Wetland
- Stock Pond
- Vernal Pool
- Vernal Swale
- Intermittent Stream
- Irrigation Canal
- Non-Vegetated Ditch
- Vegetated Ditch



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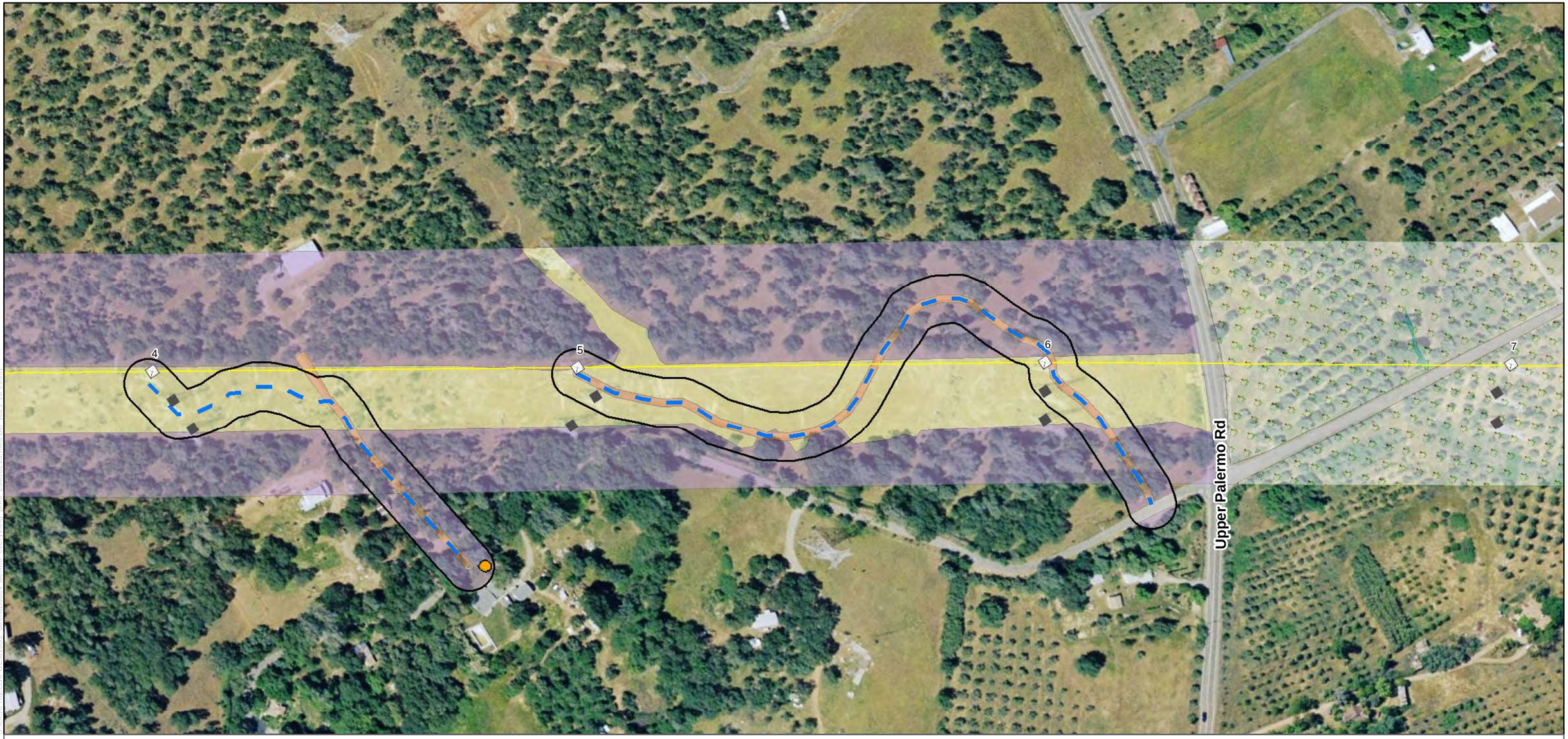
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



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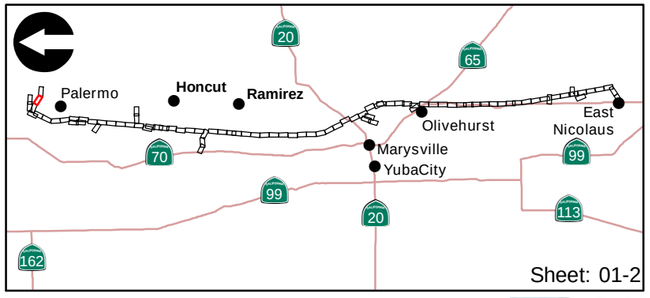

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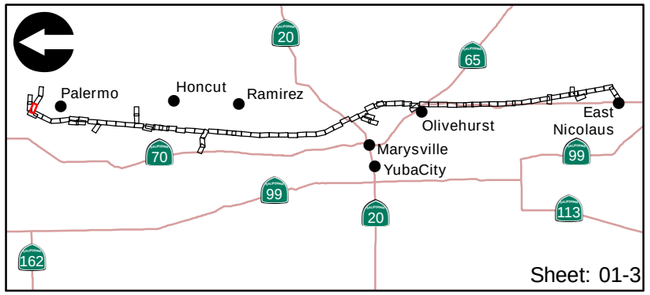

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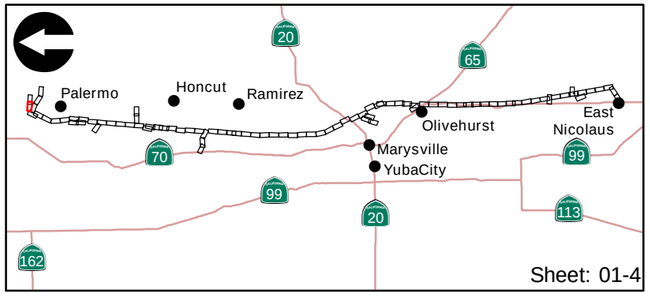

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Potentially Jurisdictional Waters of the U.S.

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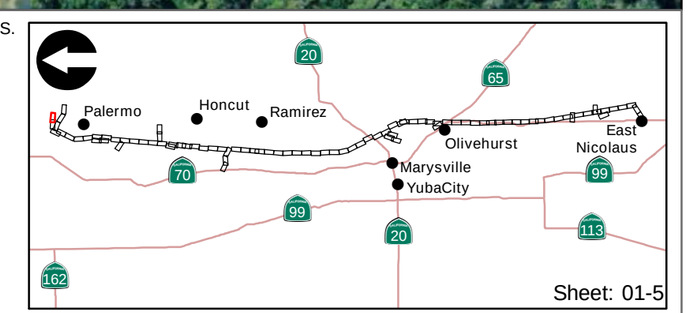

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Appendix B-1
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.

Project Activities

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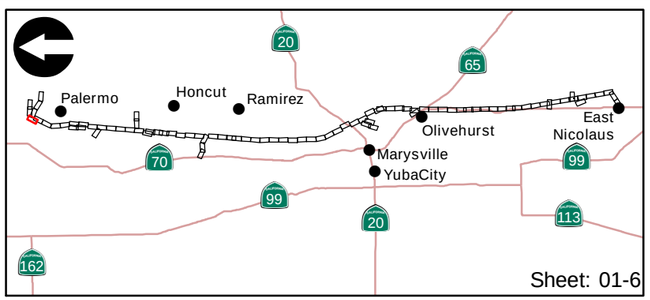

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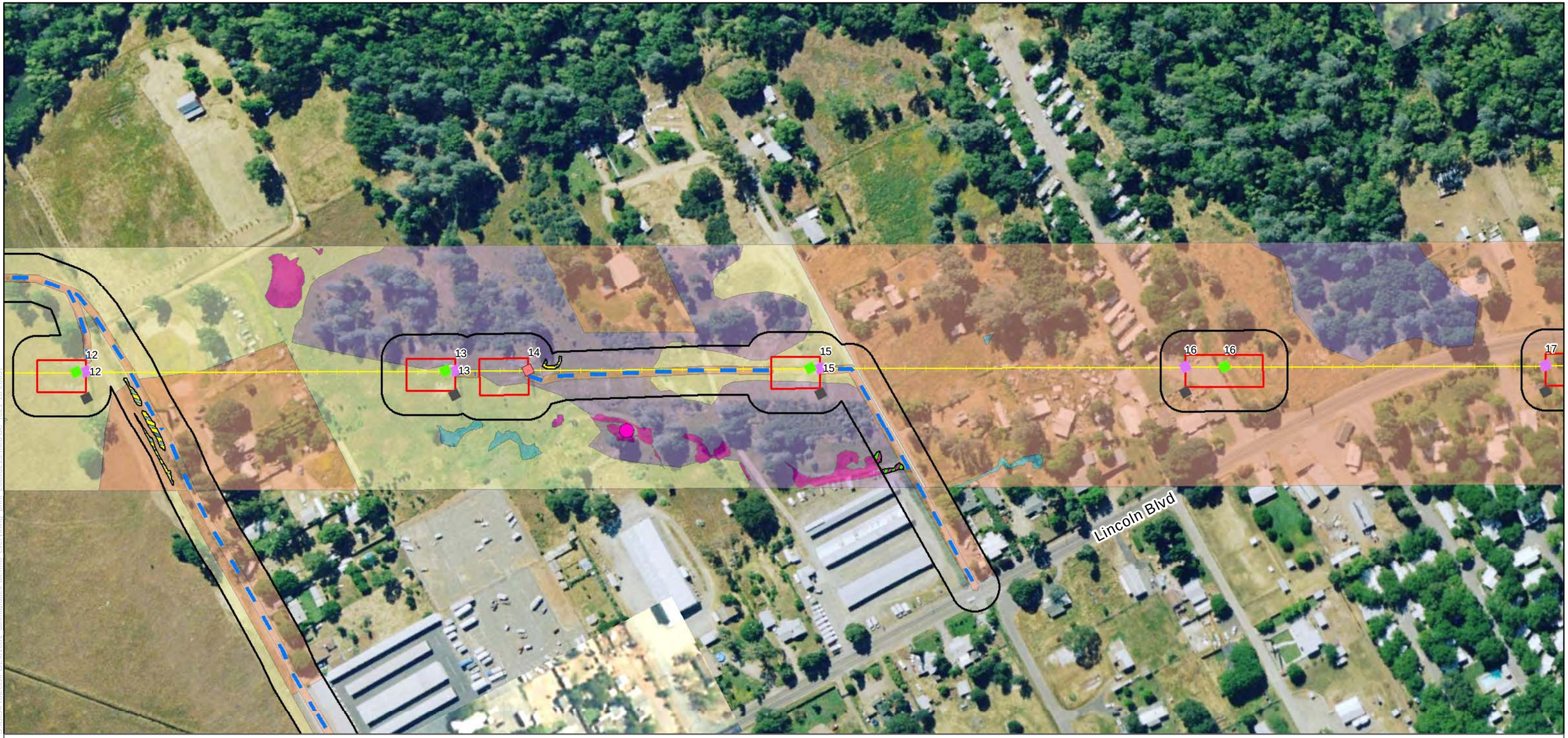

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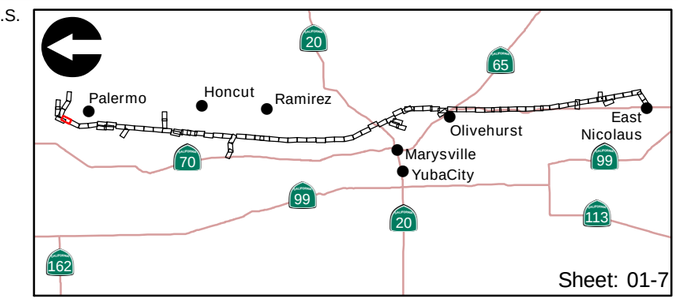

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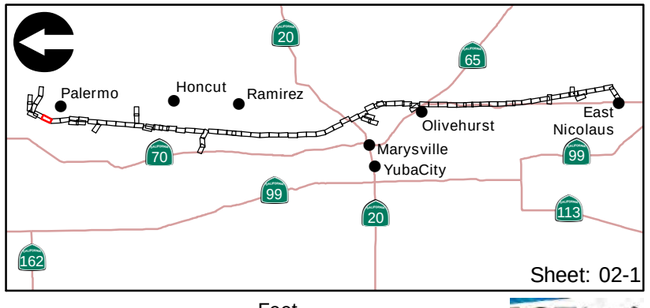

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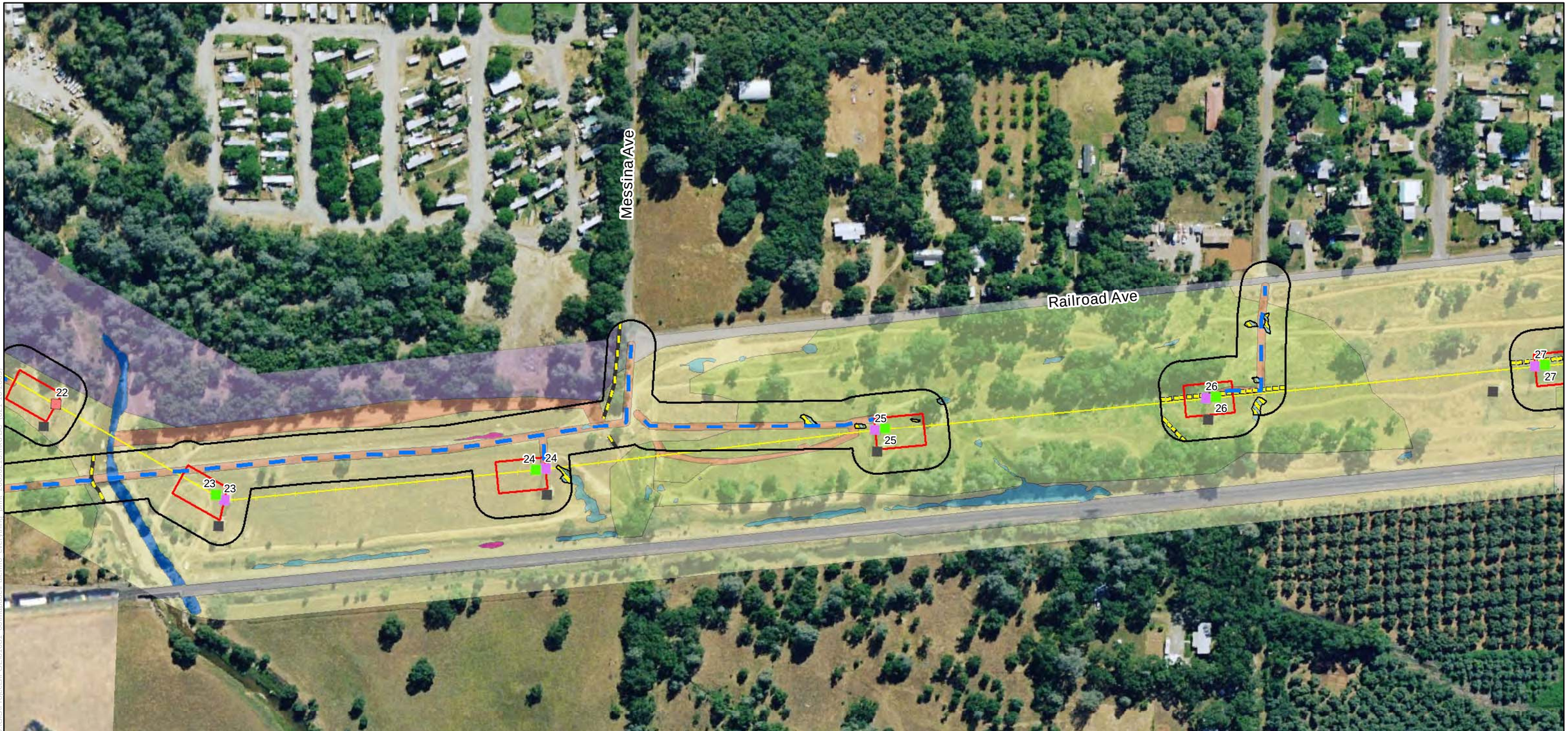

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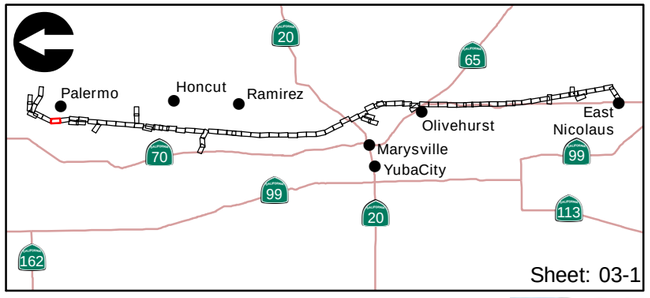

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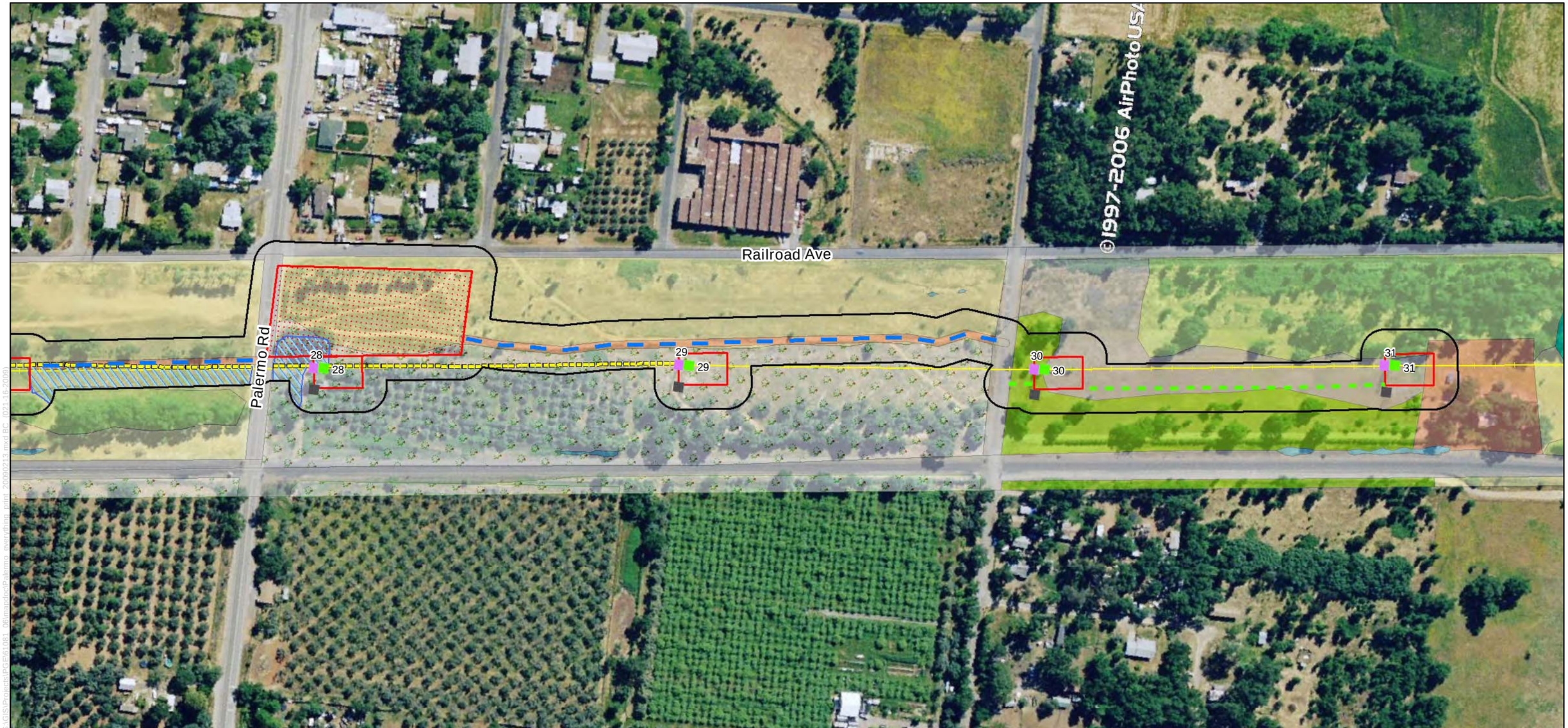

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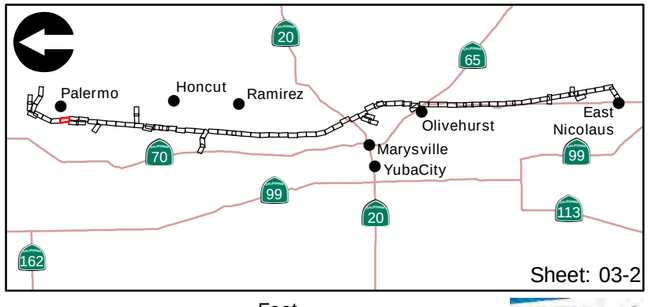

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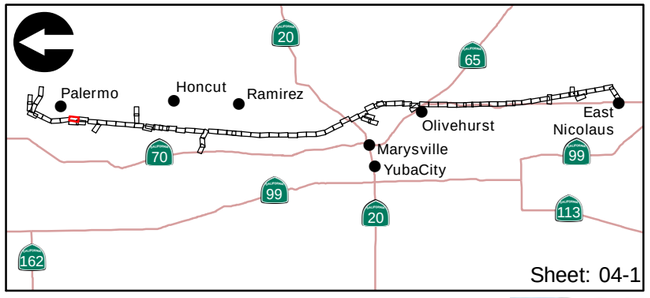

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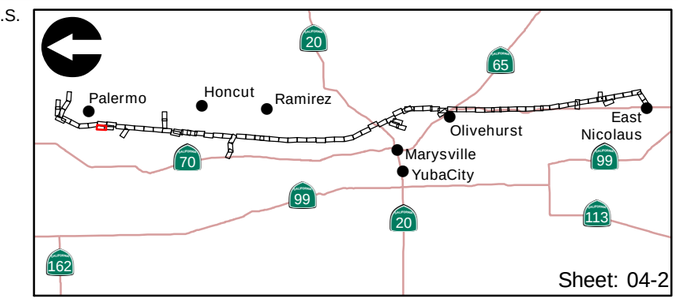

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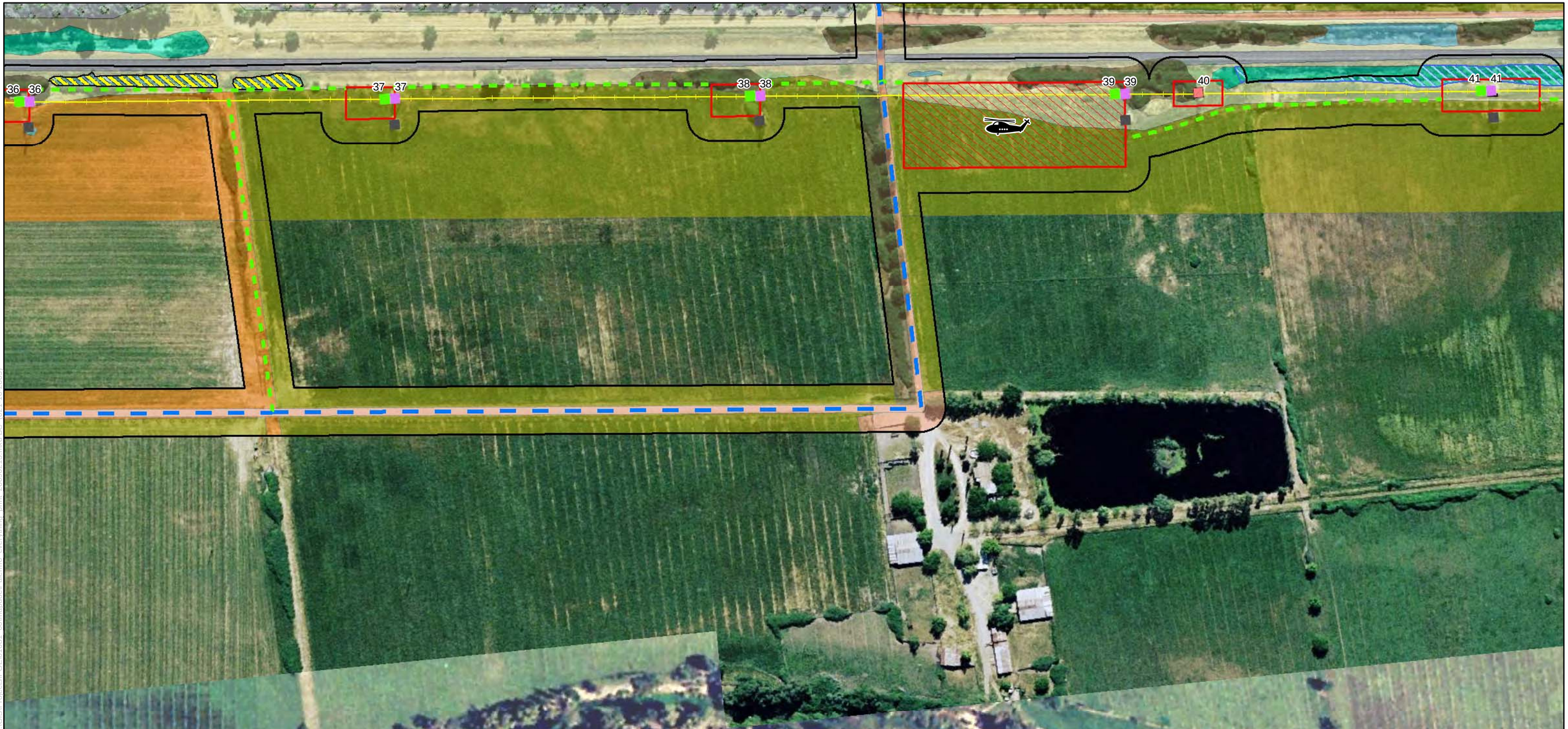

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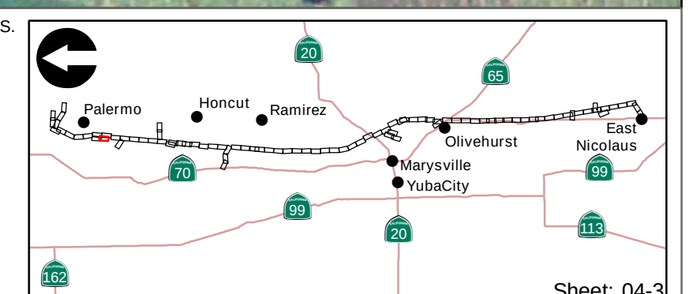

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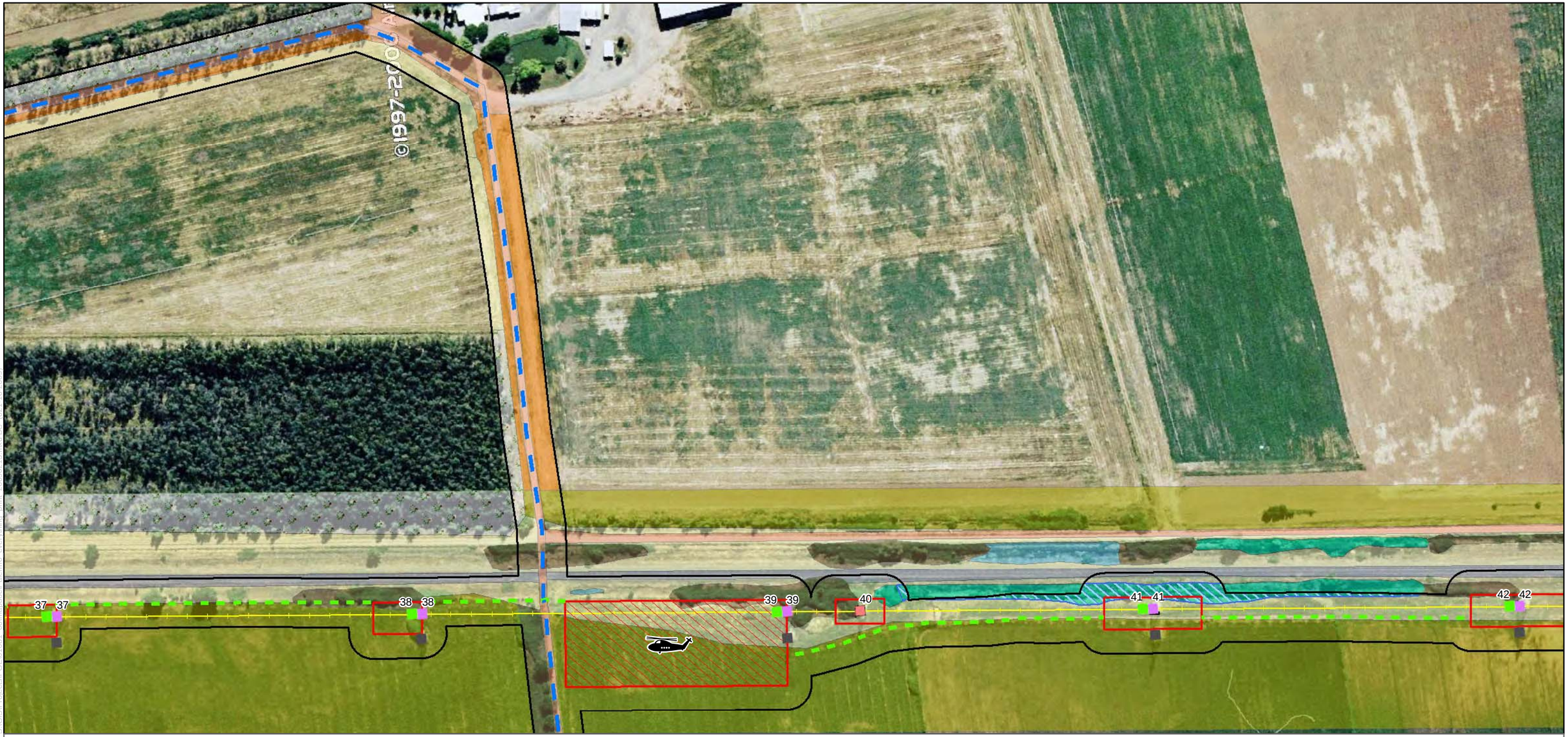

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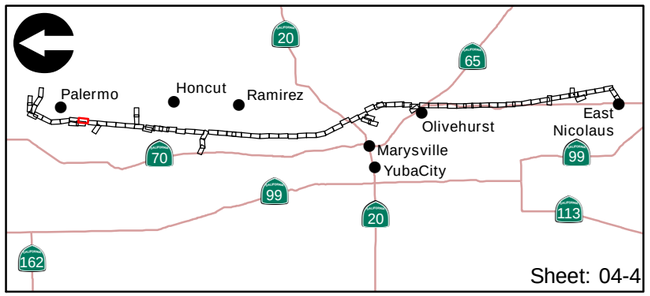

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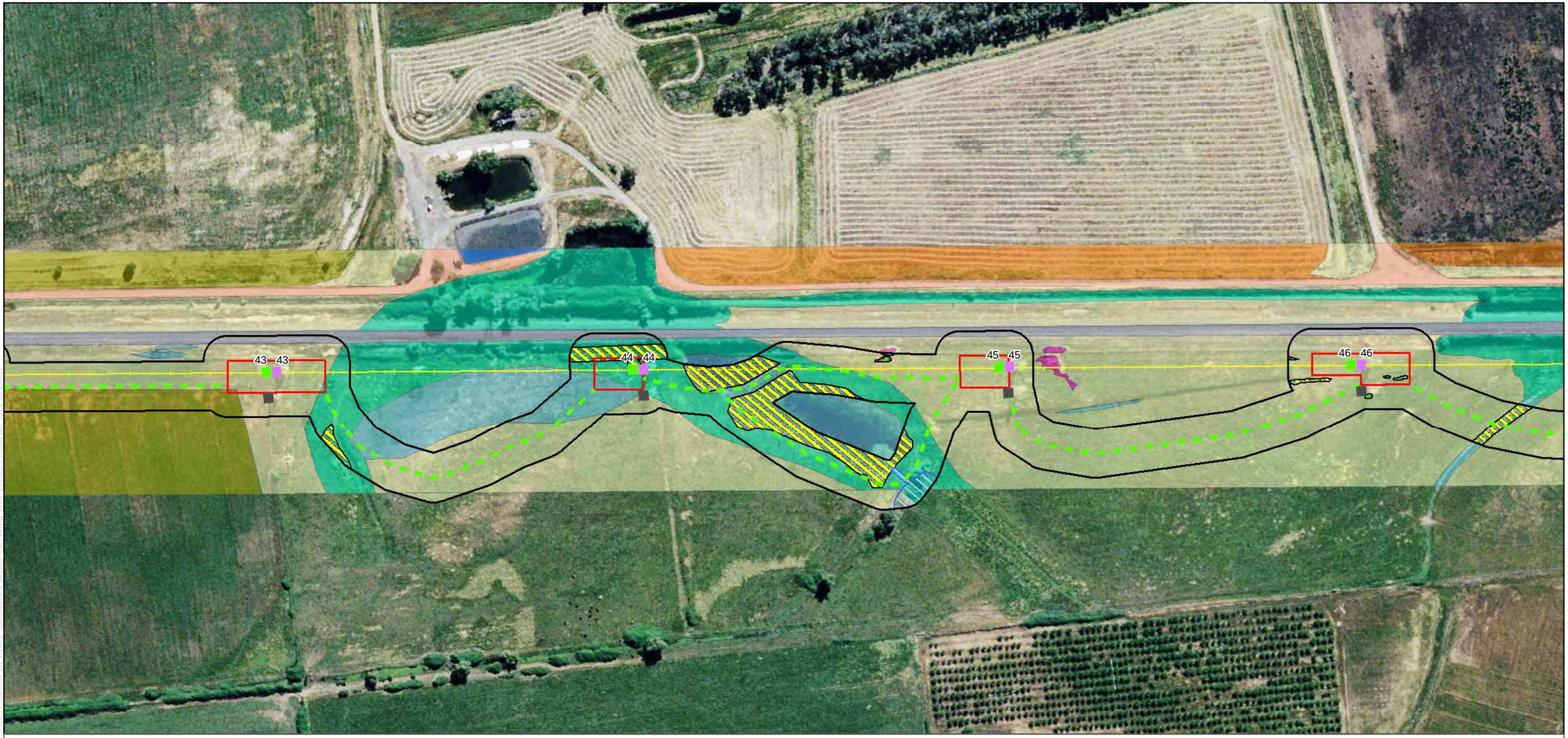

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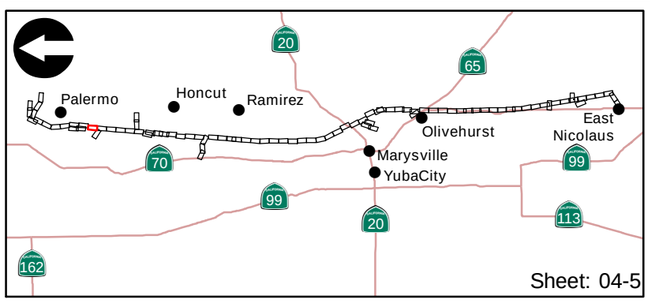

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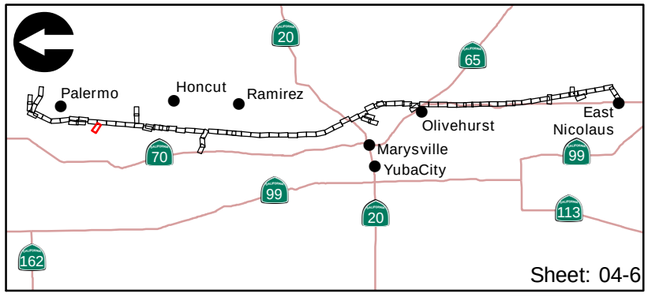

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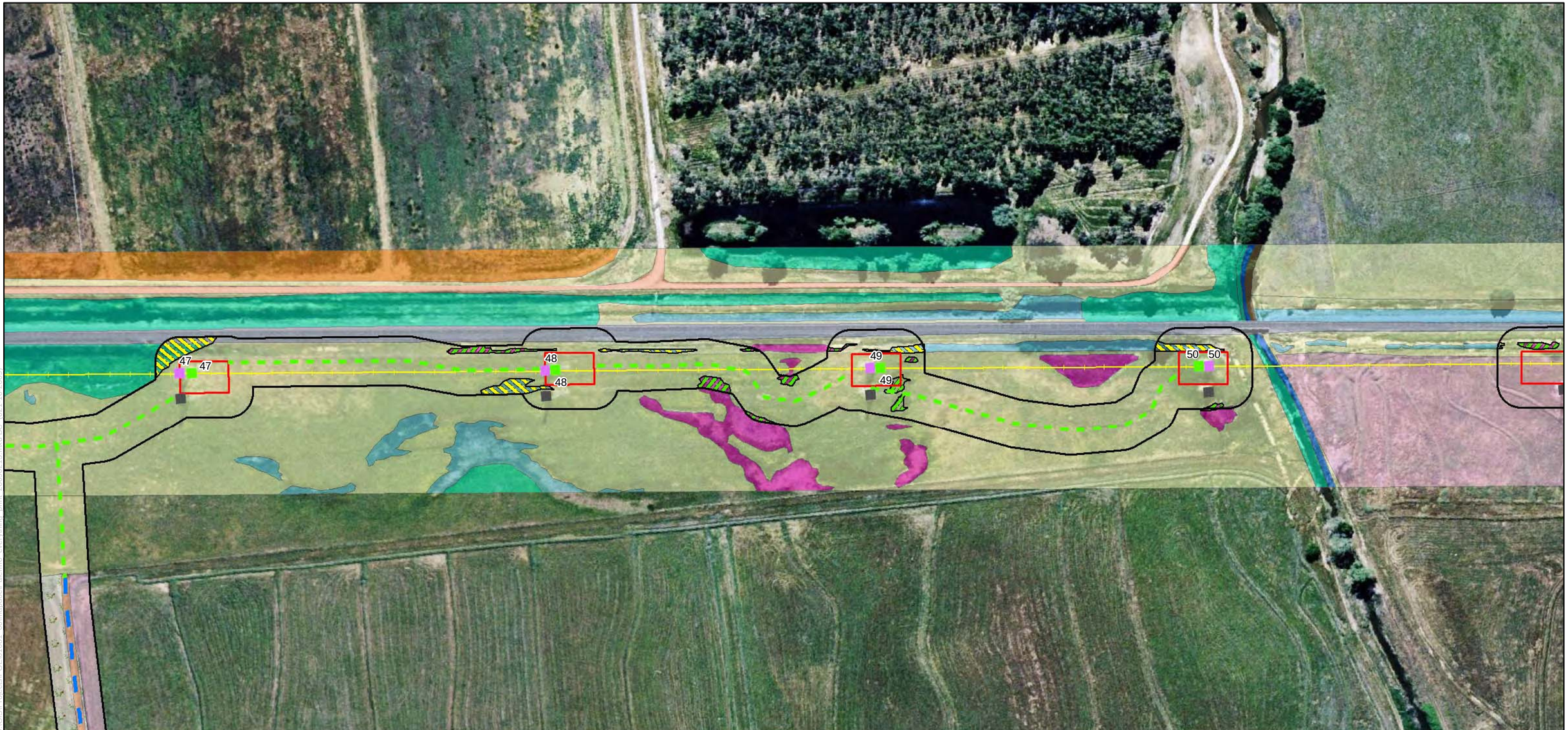

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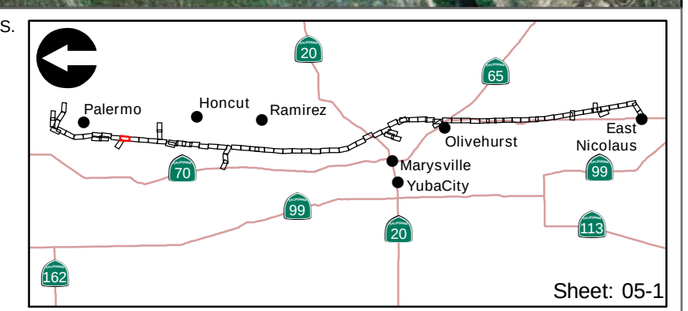

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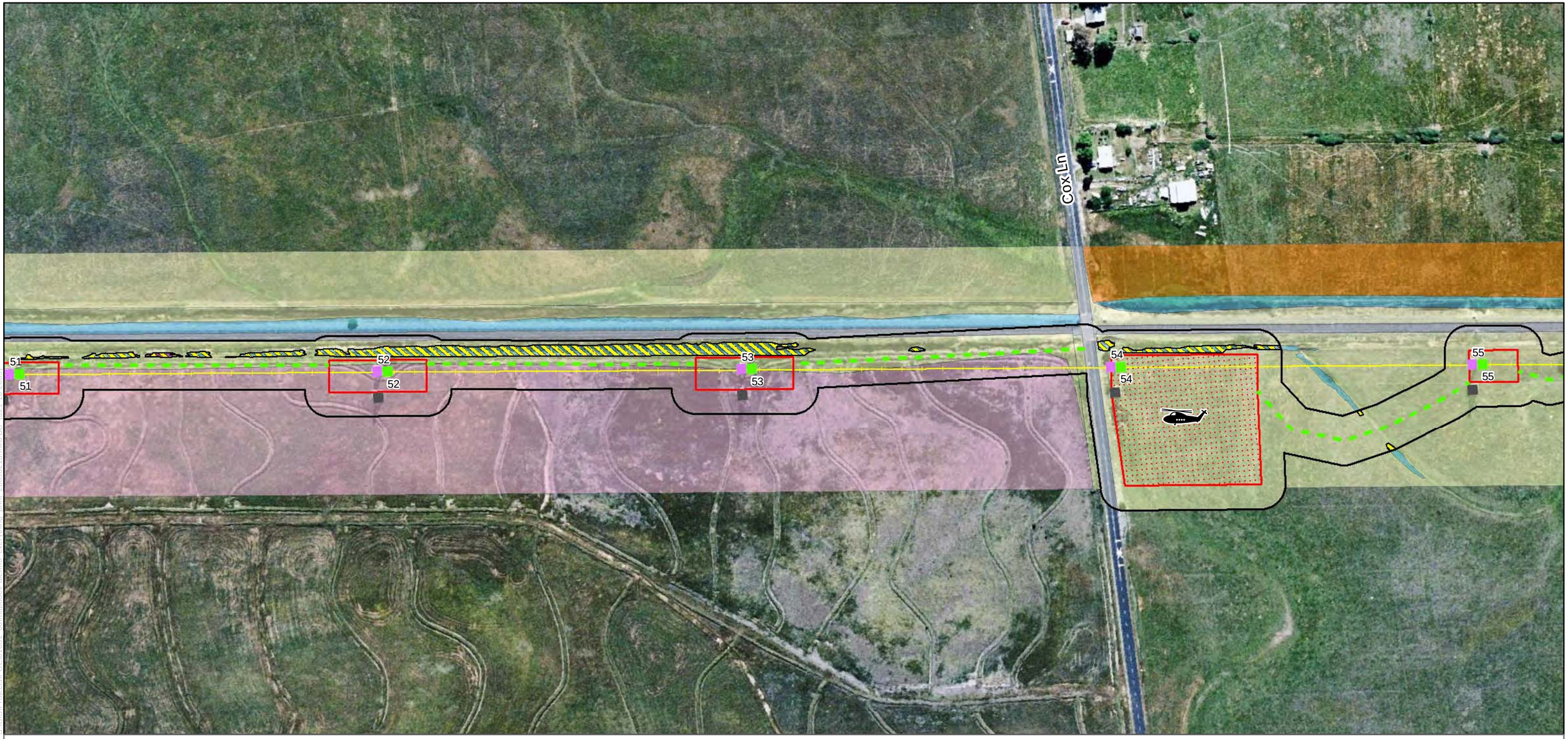

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- Vernal Pool Tadpole Shrimp
- Elderberry Shrub
- Elderberry Shrub Cluster

Vegetation Communities Legend only

- Non-native Grassland
- Valley Oak Savanna Woodland
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- Rural Residential
- Irrigated Pasture
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- Rice
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- Riparian Forest
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- Non-JD Seasonal Wetland
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Potentially Jurisdictional Waters of the U.S.

- Freshwater Marsh
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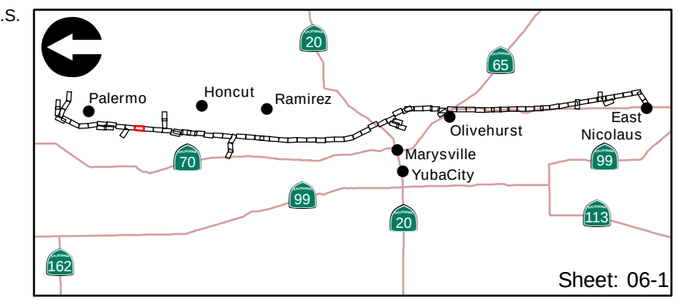
- Stock Pond
- Vernal Pool
- Vernal Swale
- Intermittent Stream
- Irrigation Canal
- Non-Vegetated Ditch
- Vegetated Ditch



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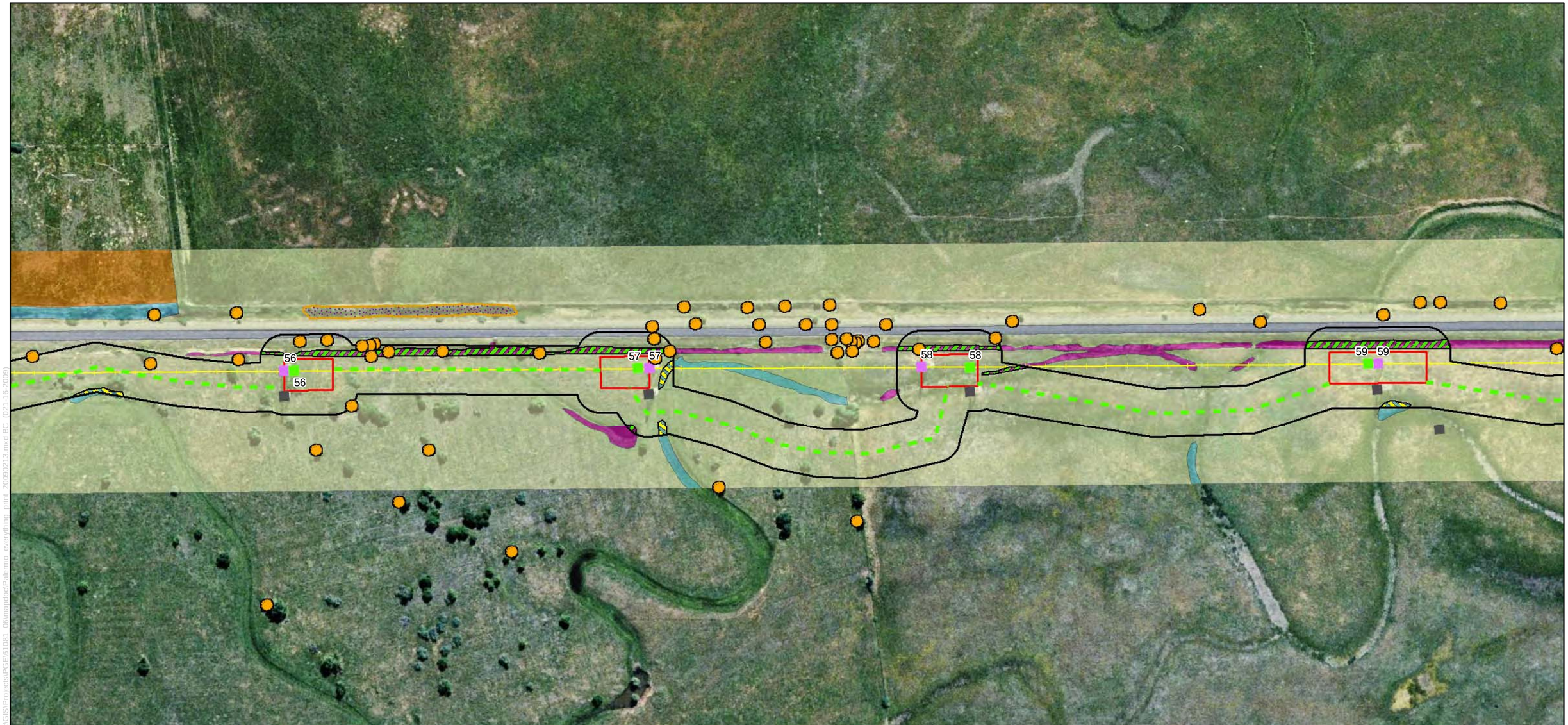
Appendix B-1
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



Project Activities

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- Landing Zone
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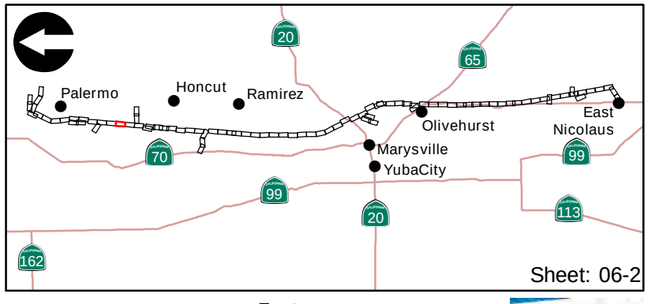

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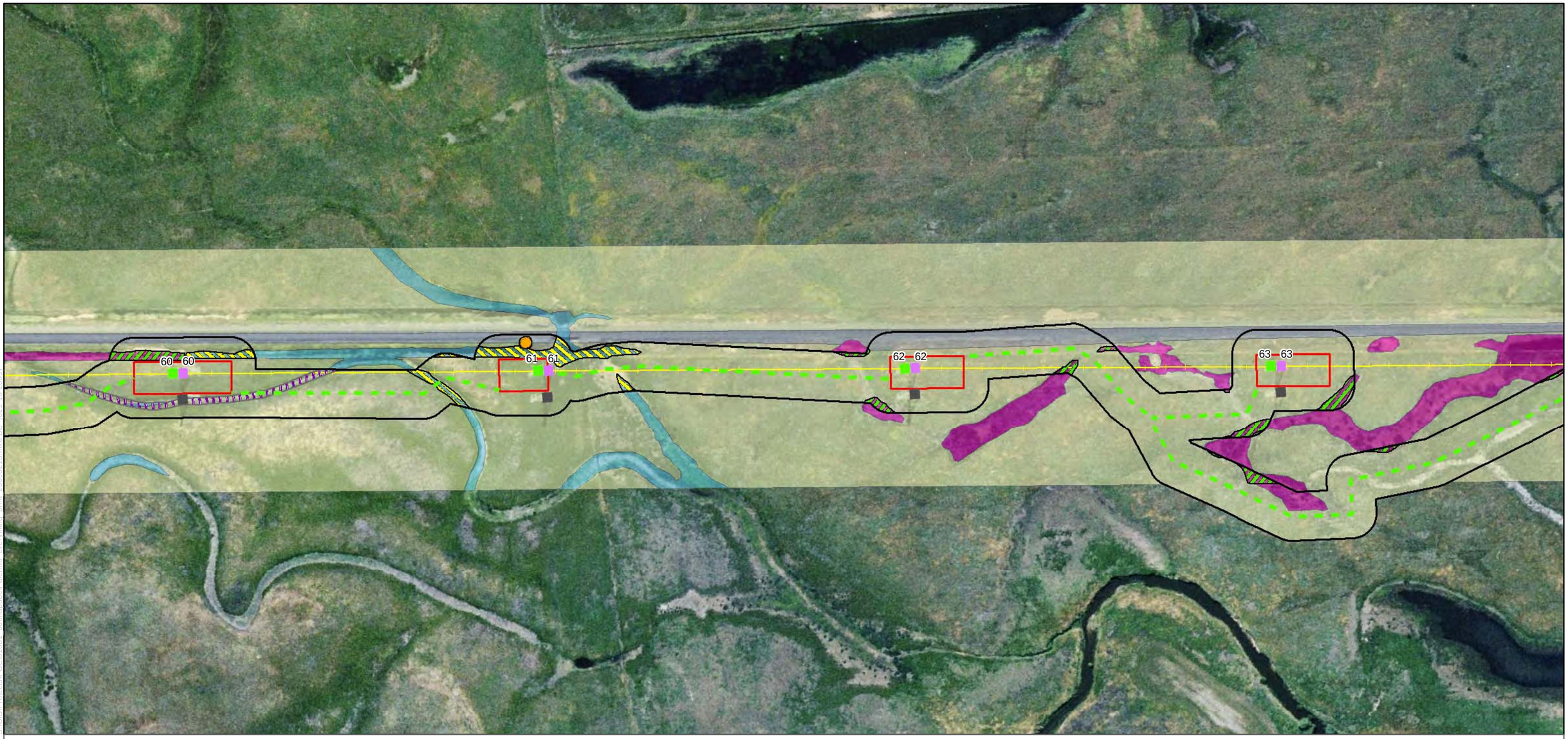

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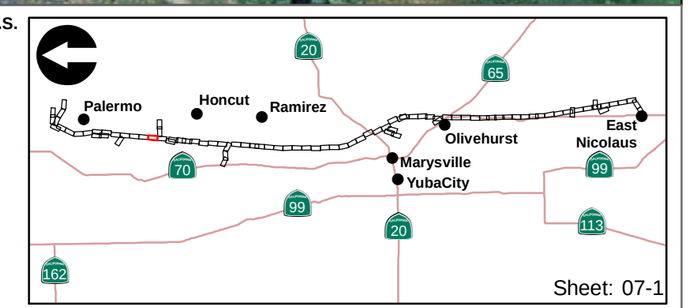

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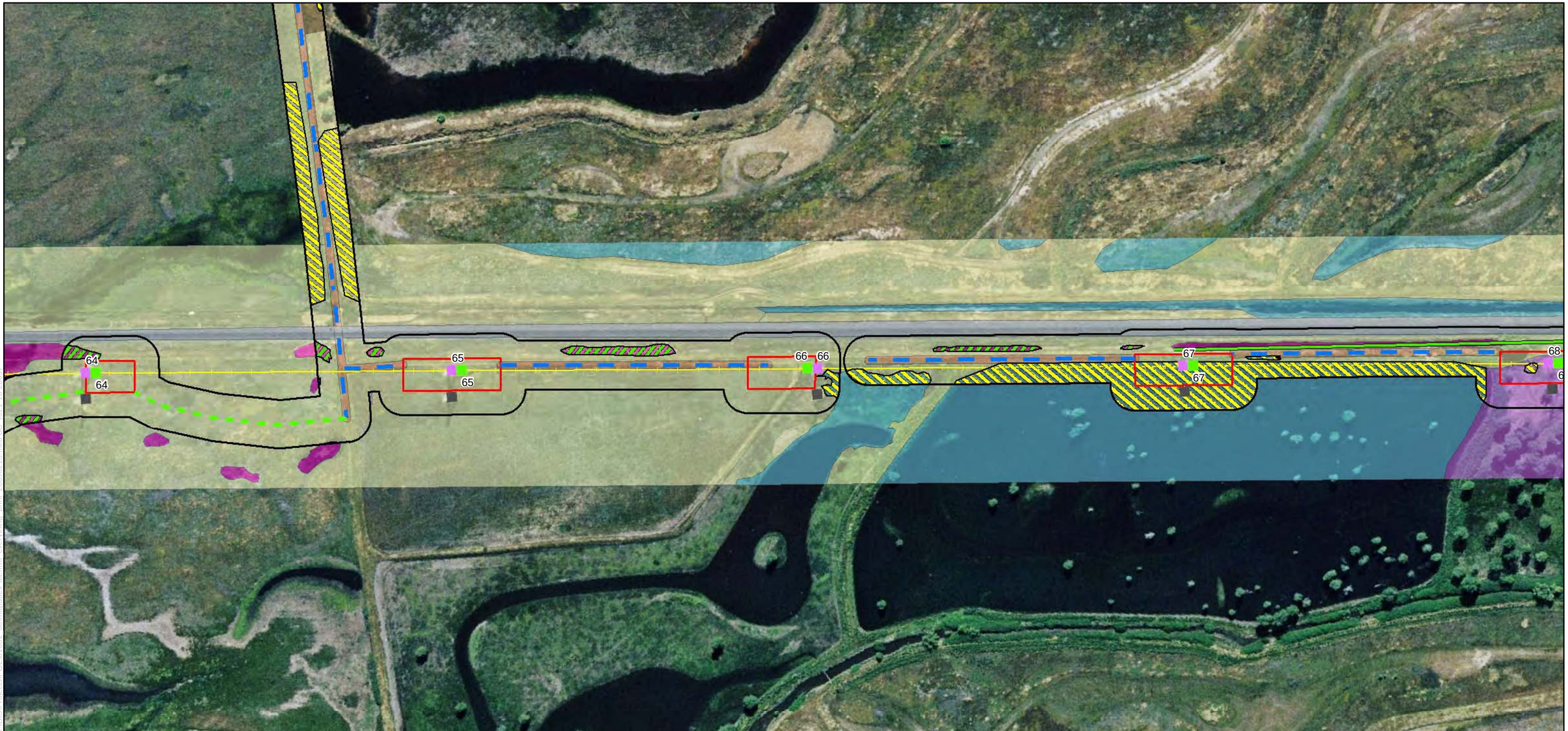

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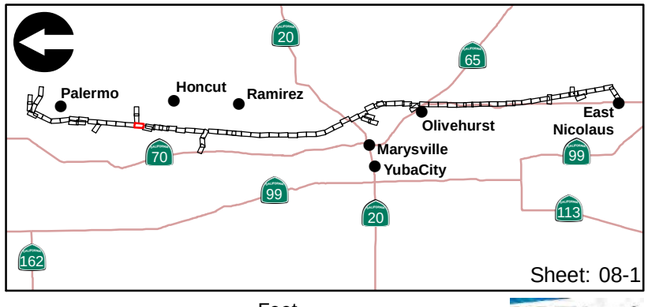

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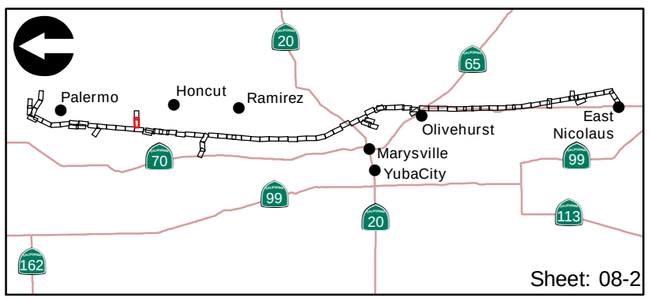

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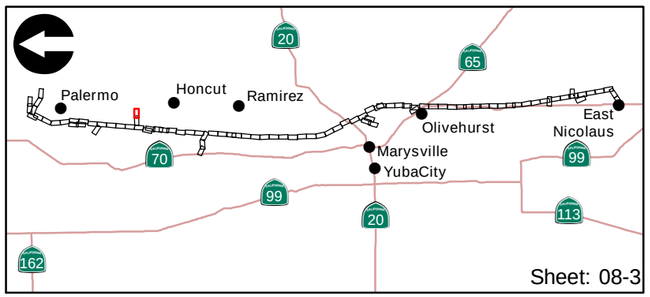

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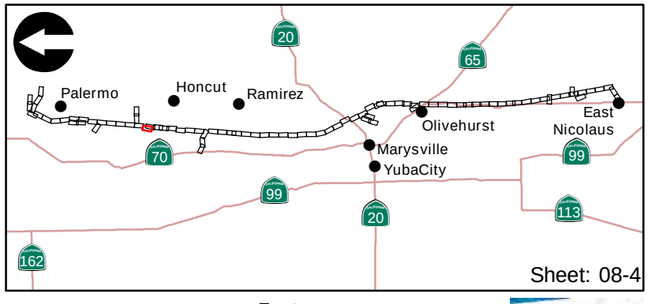

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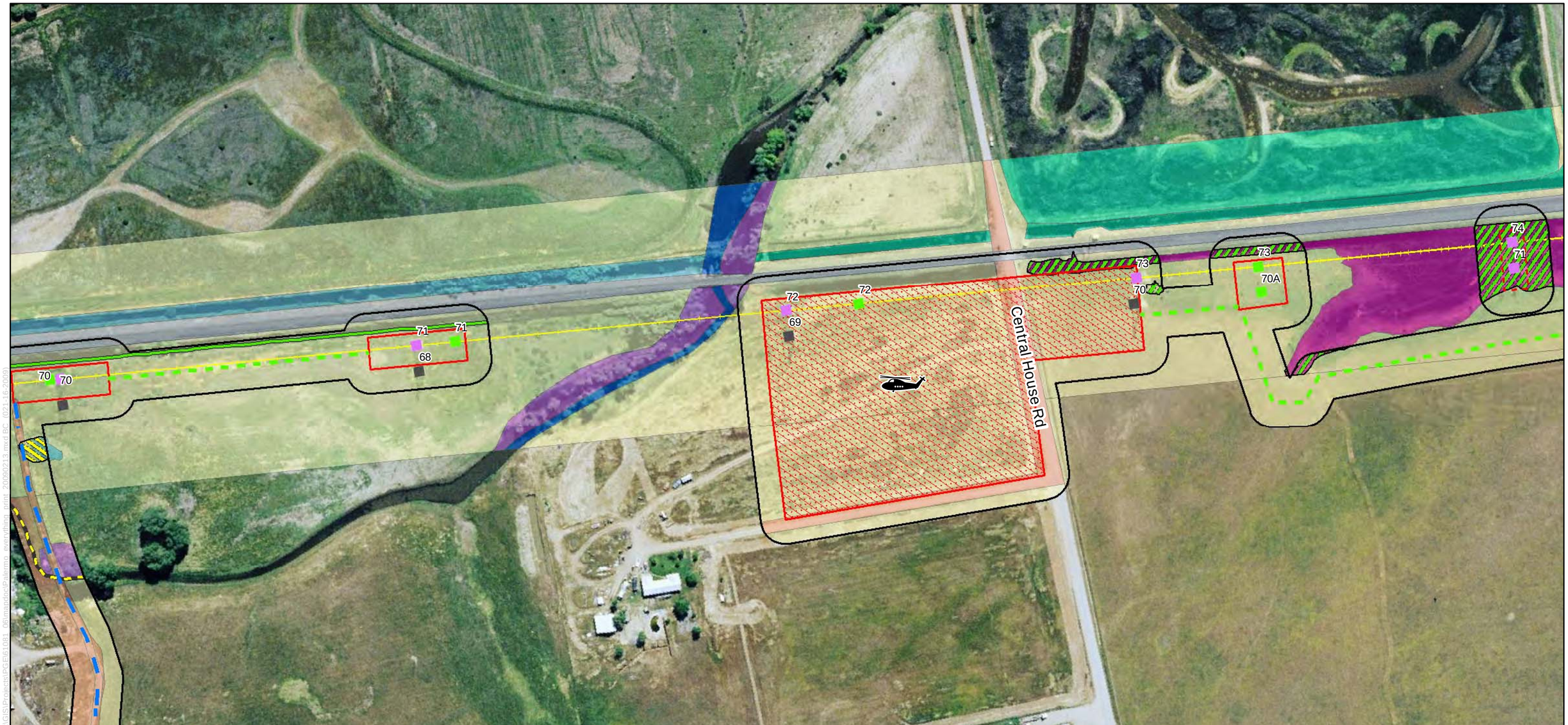

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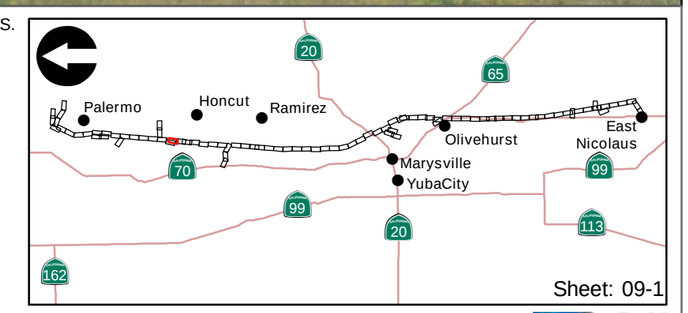

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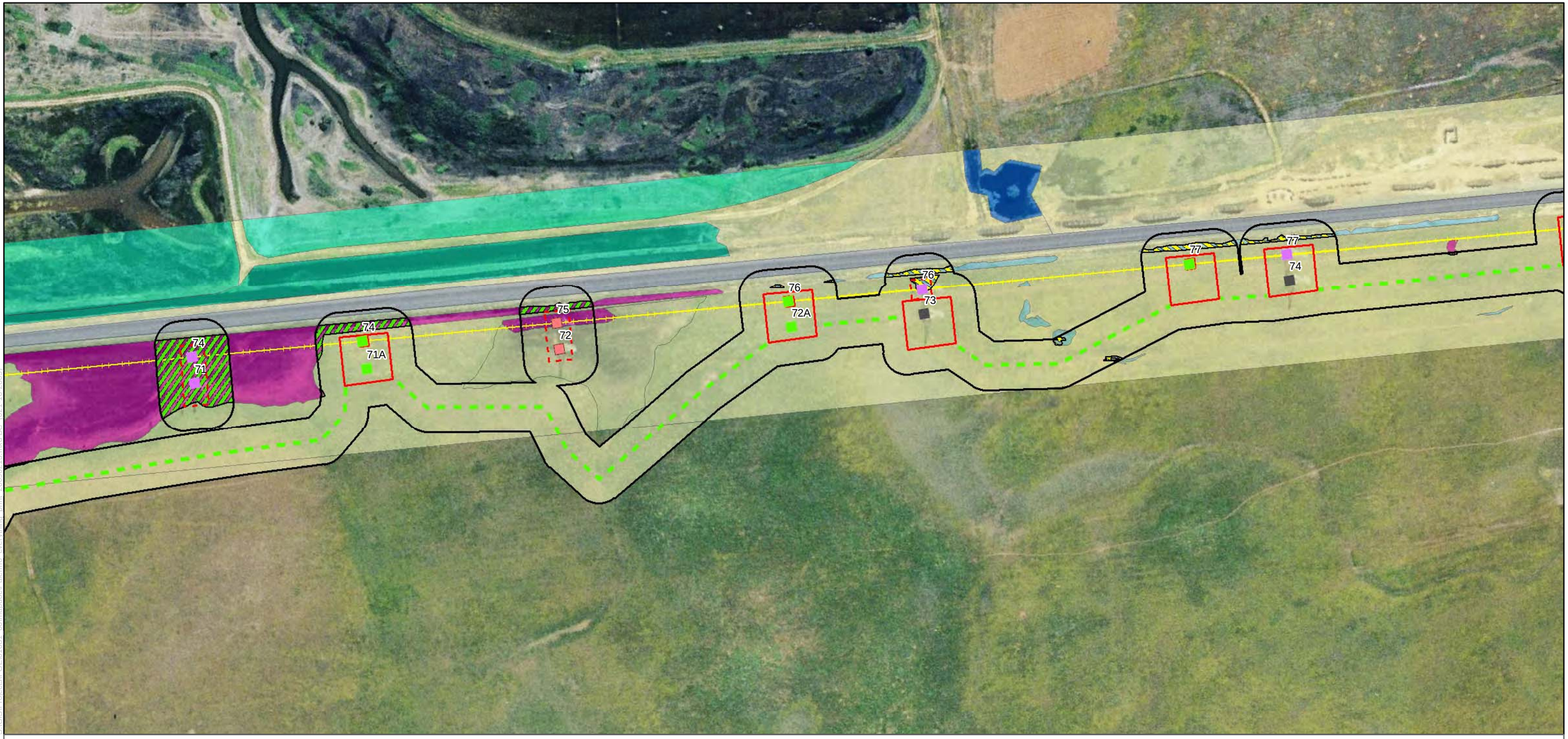

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Project Activities

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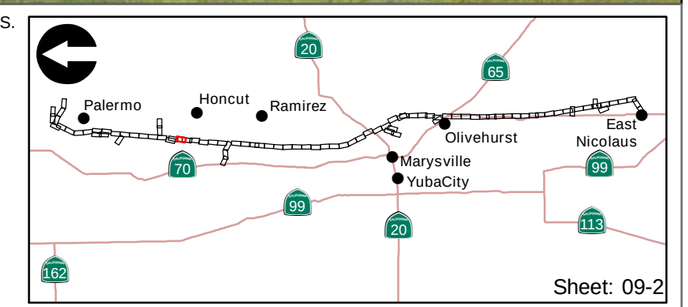

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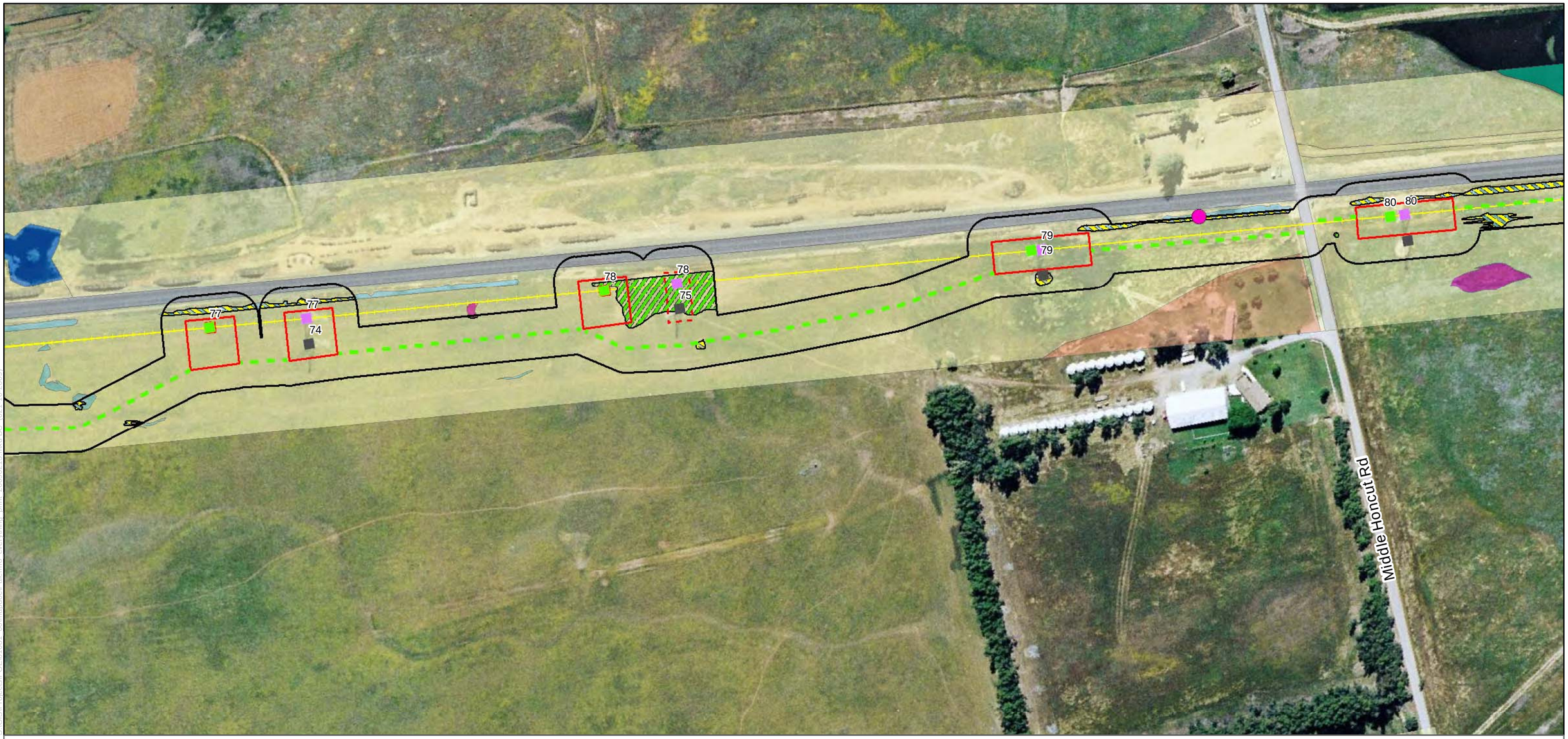

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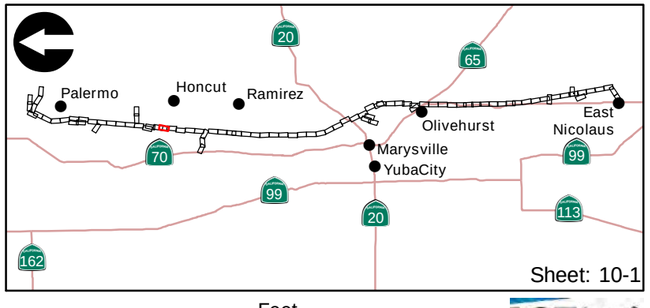

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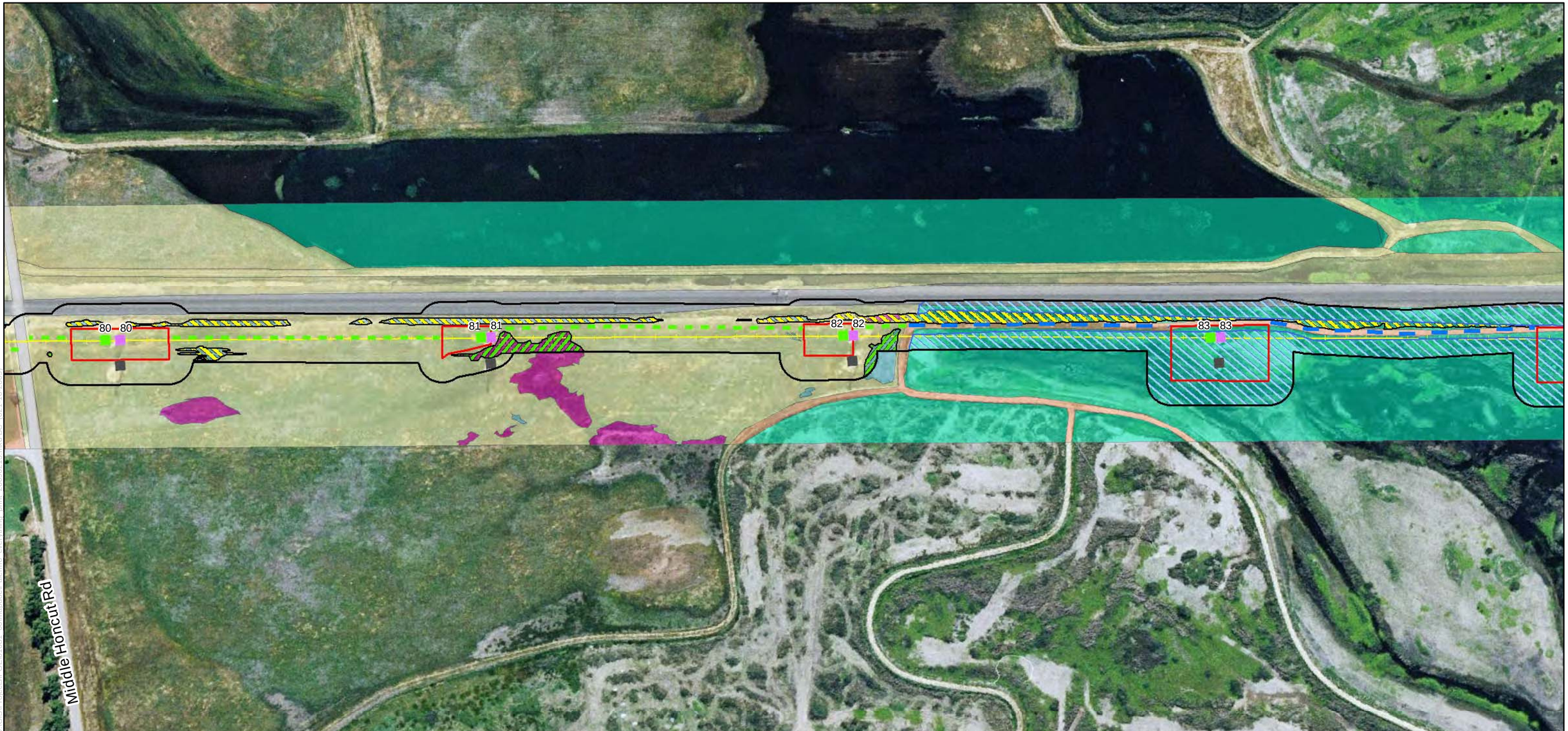

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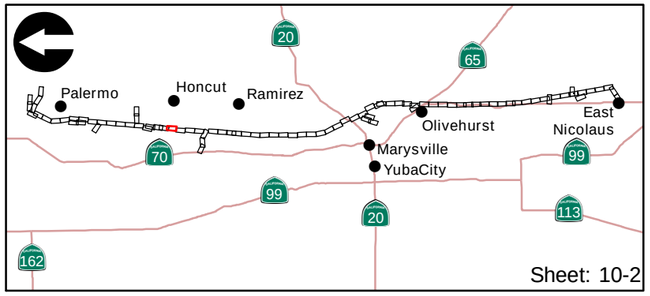

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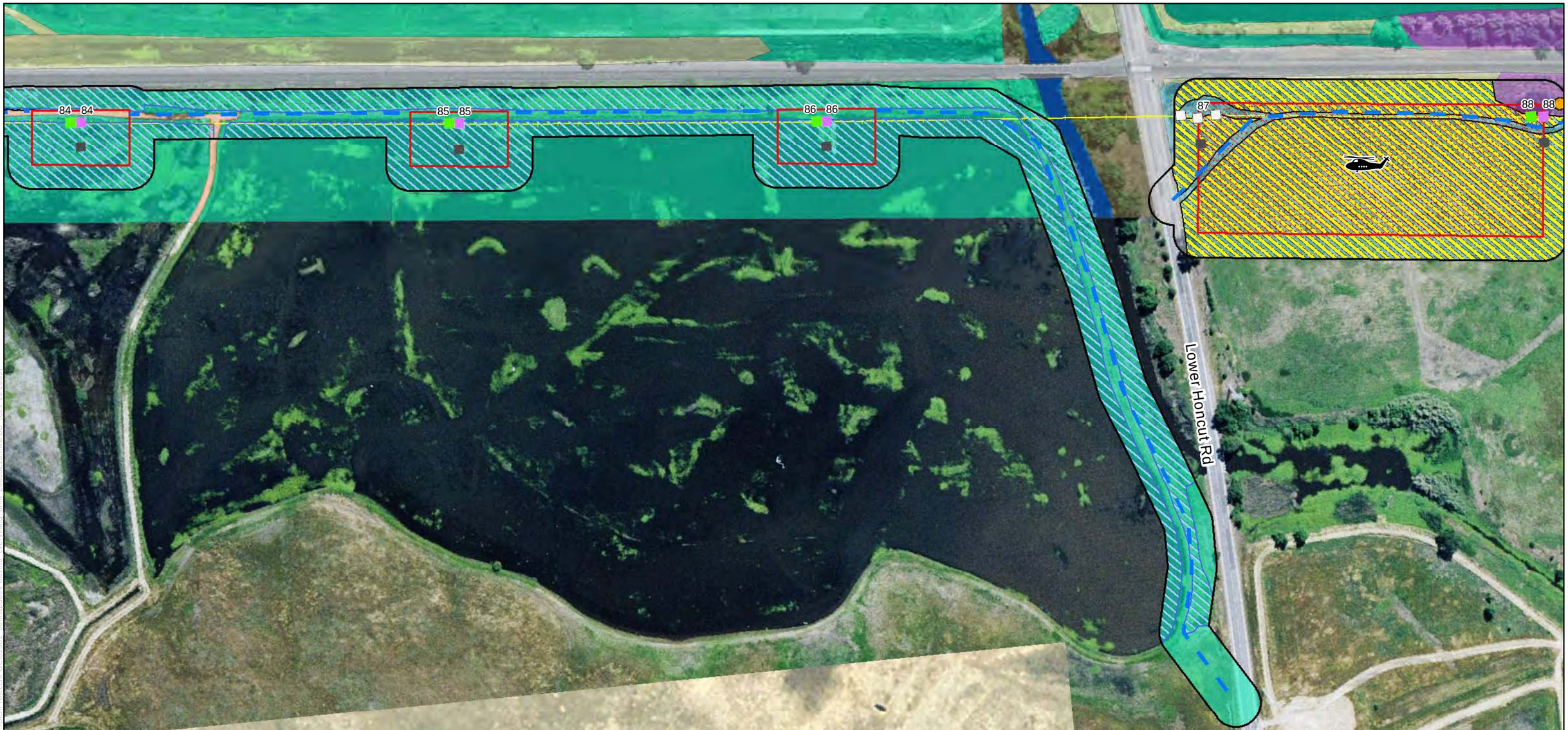

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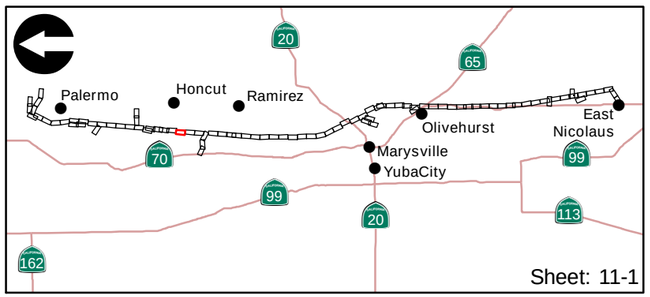

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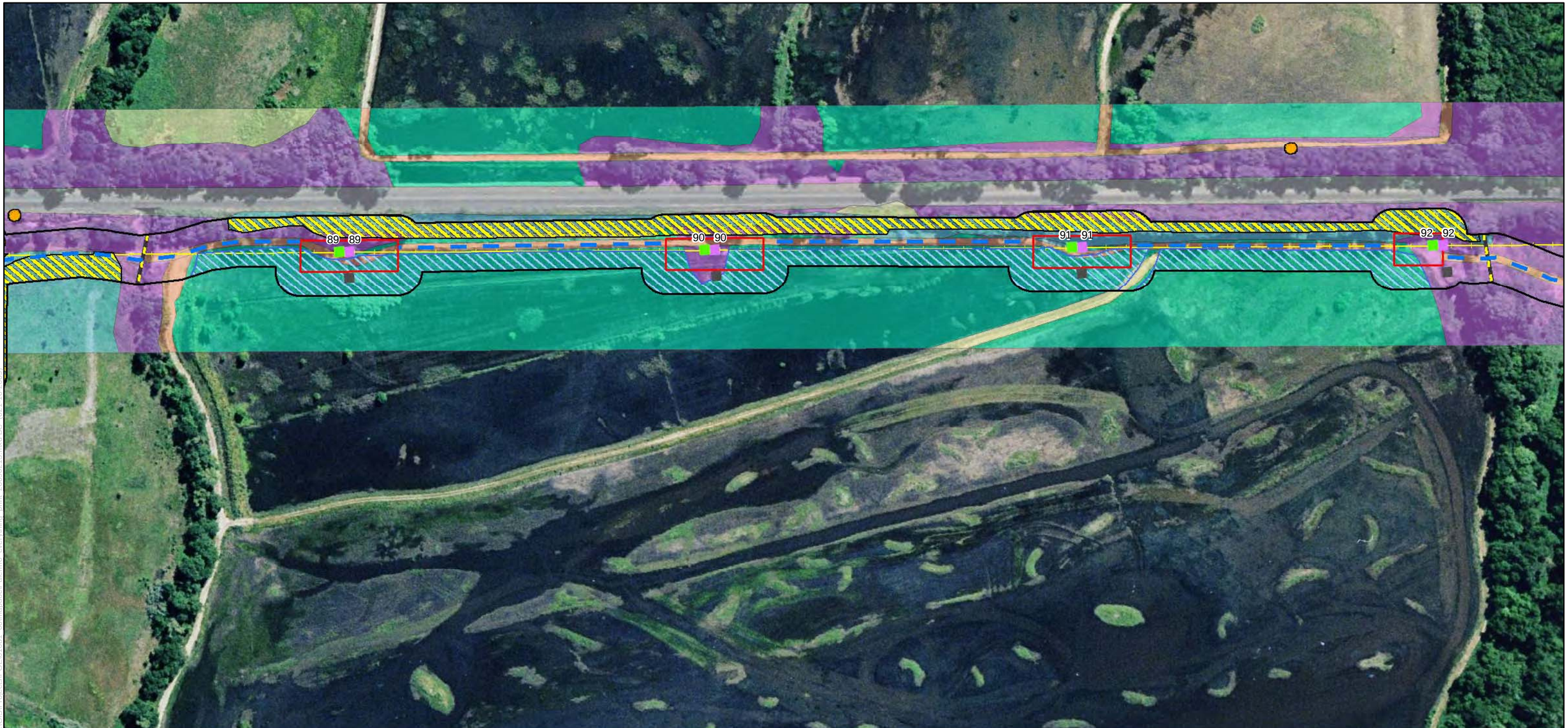

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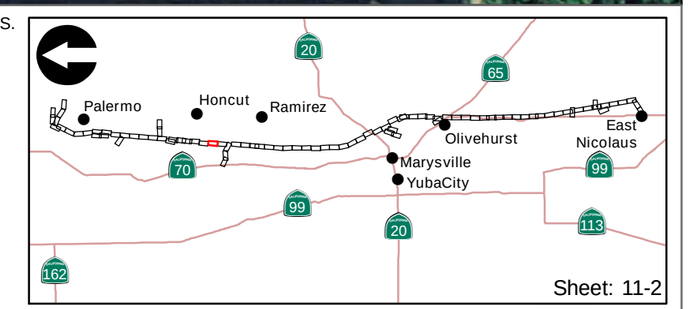

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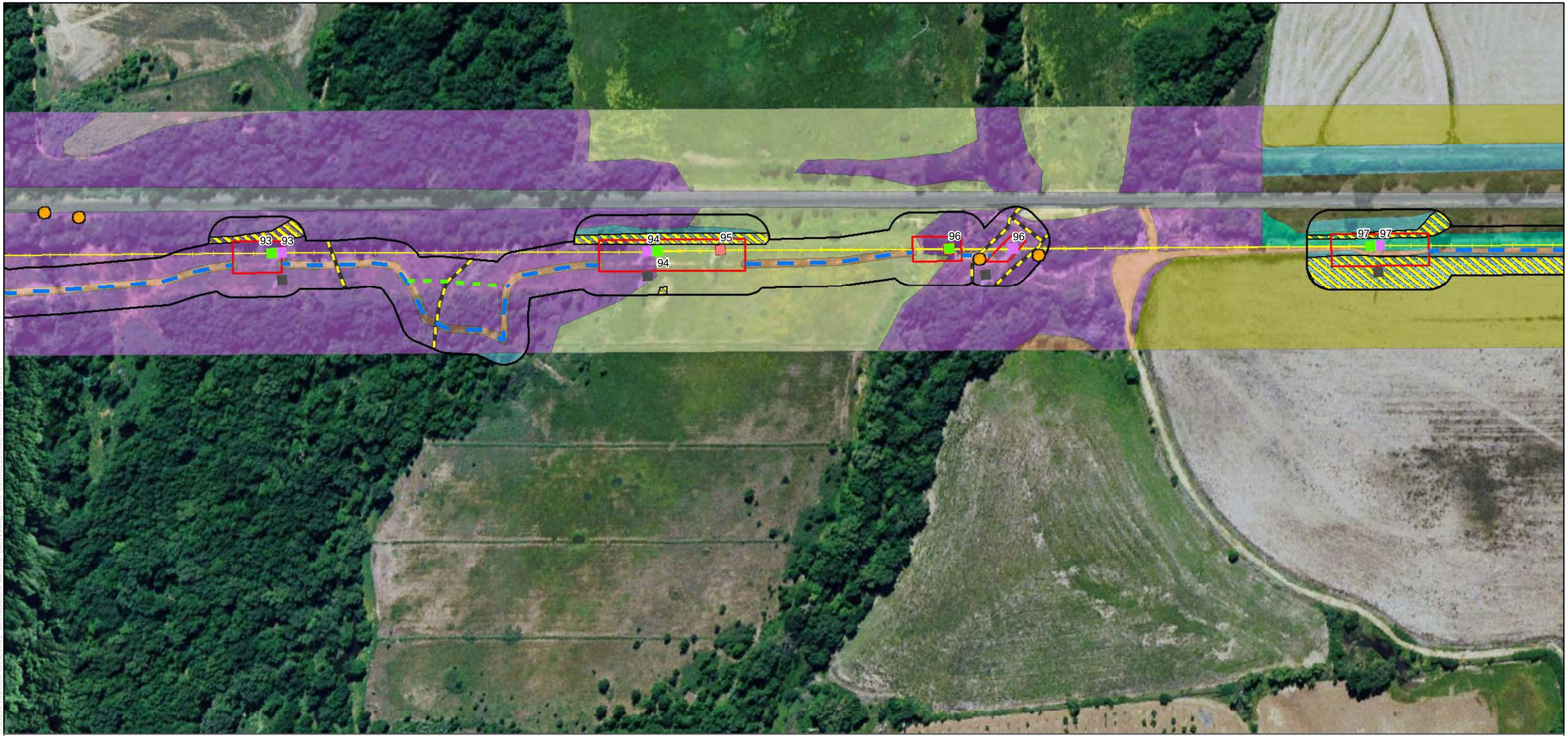
Appendix B-1
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



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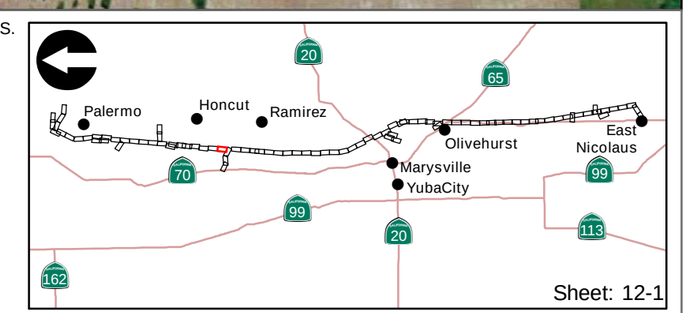

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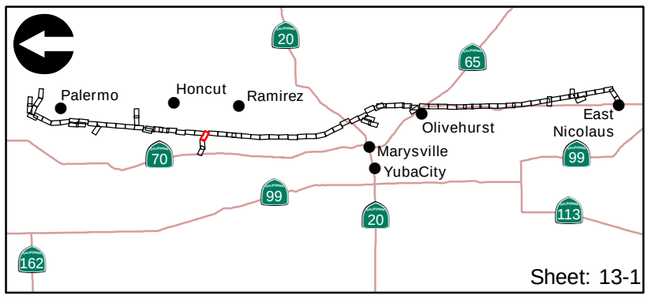

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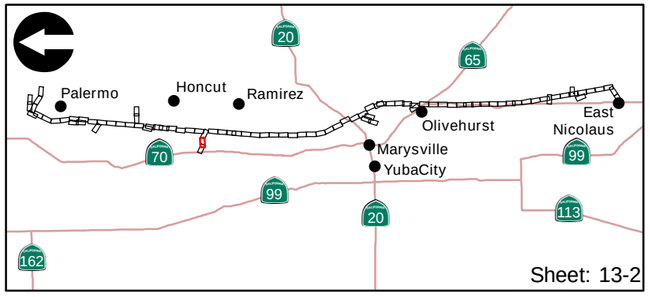

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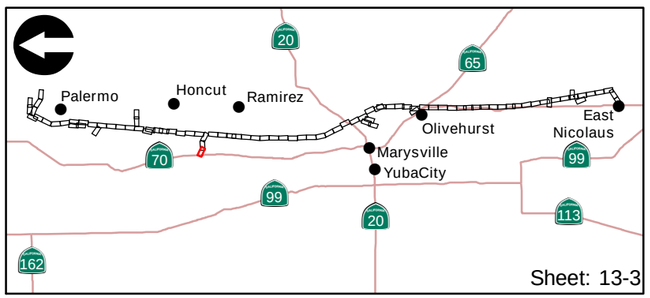

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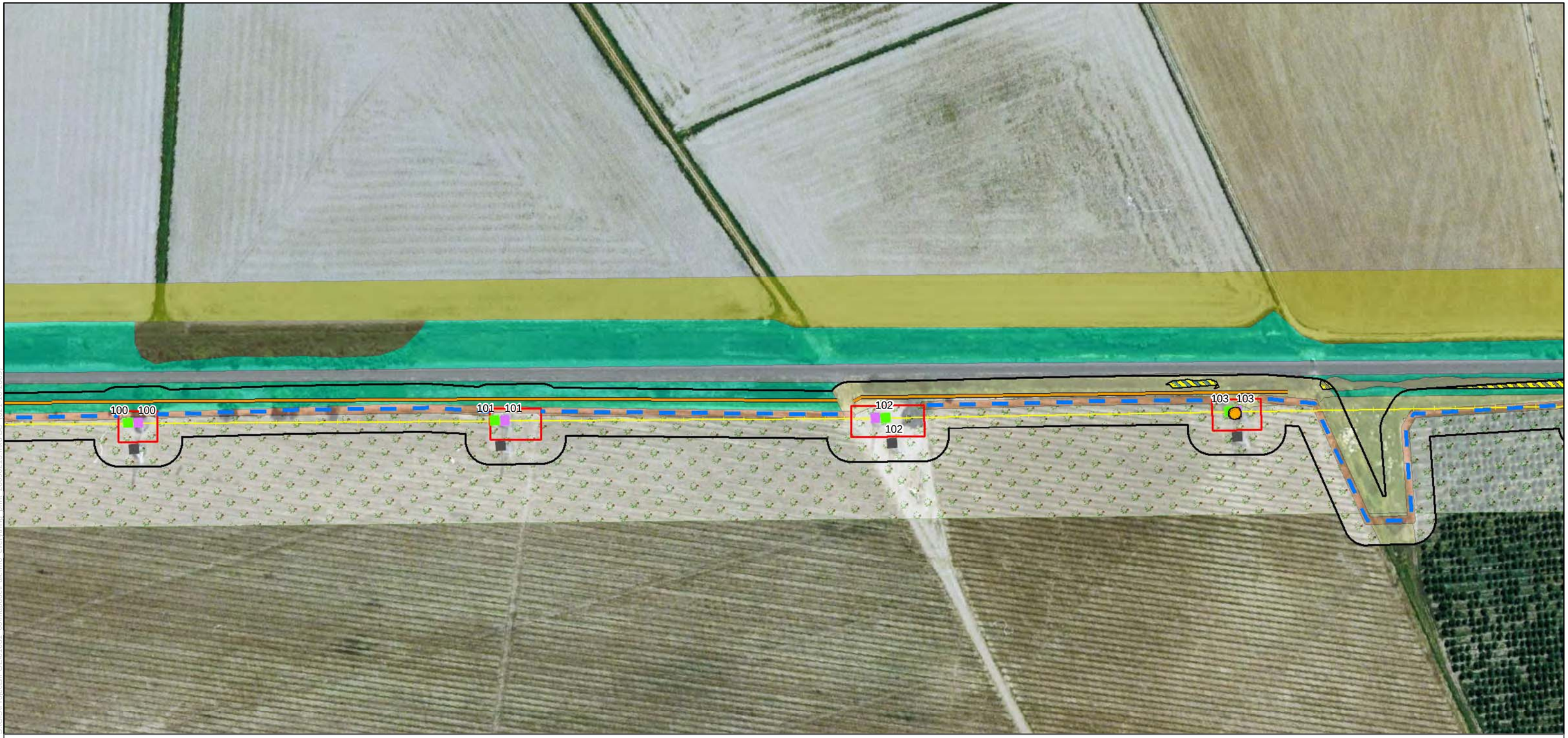

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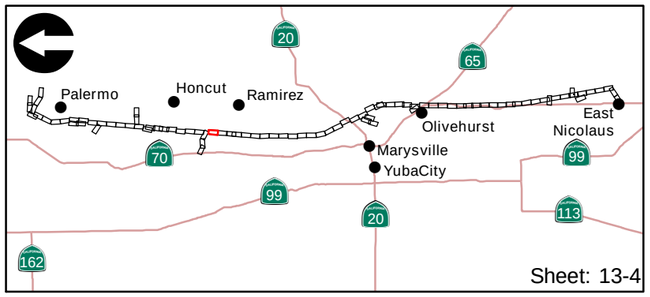

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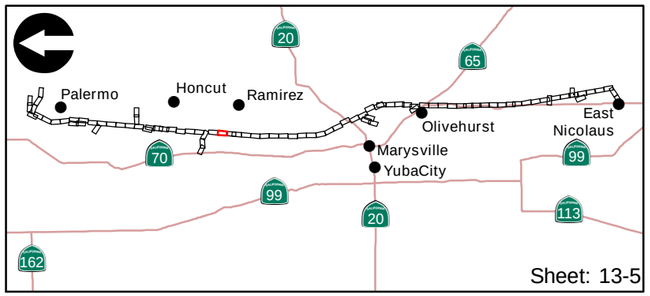

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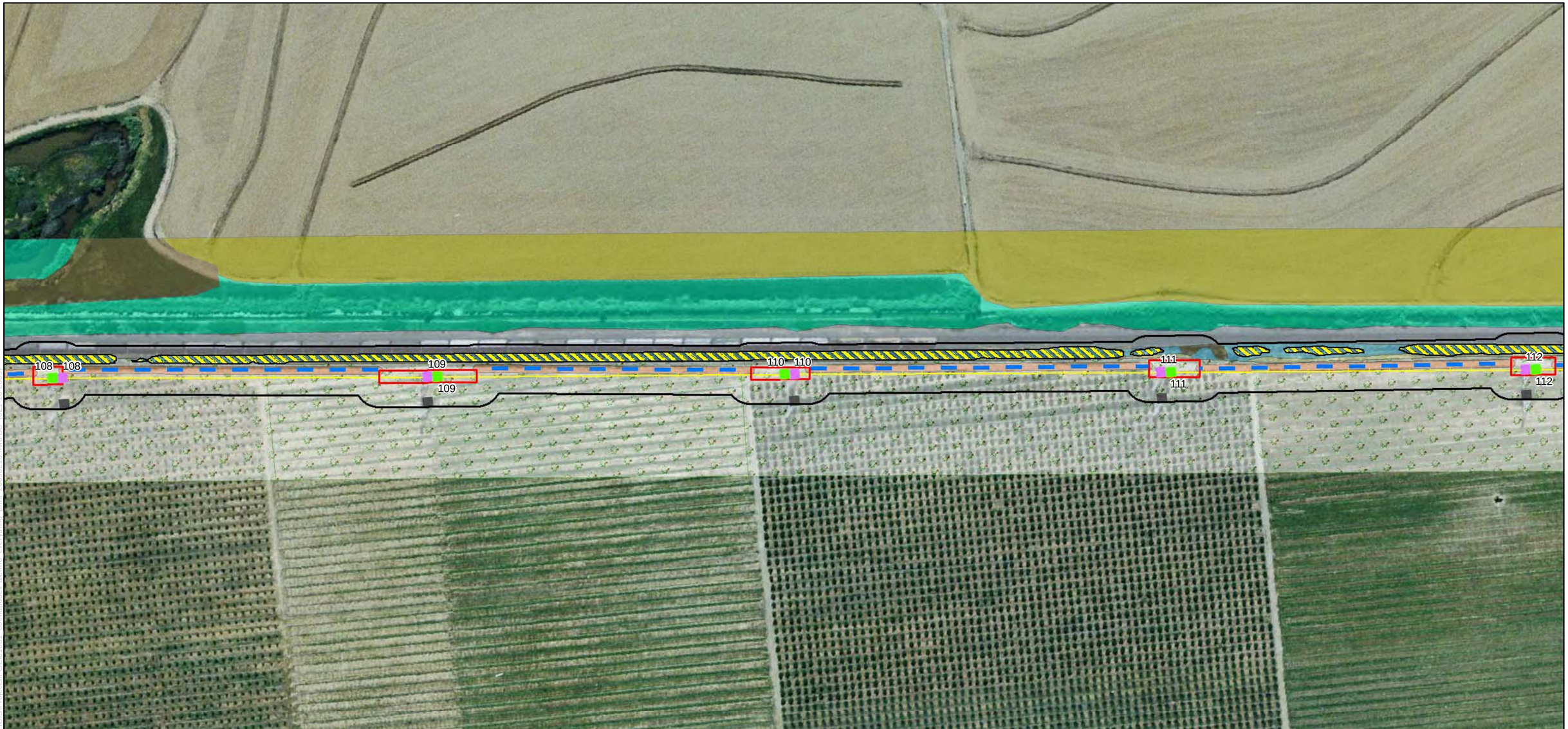

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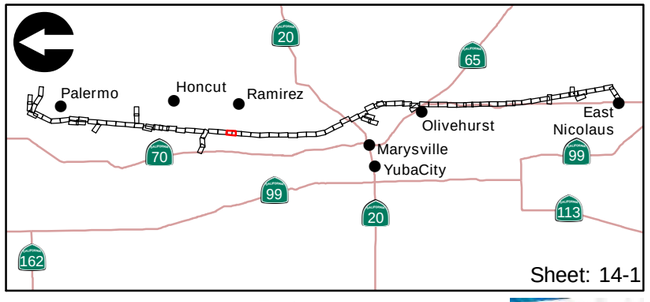

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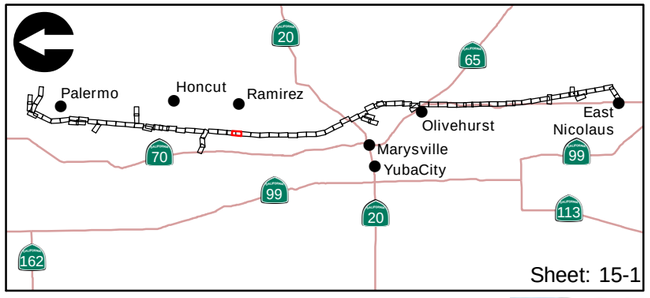

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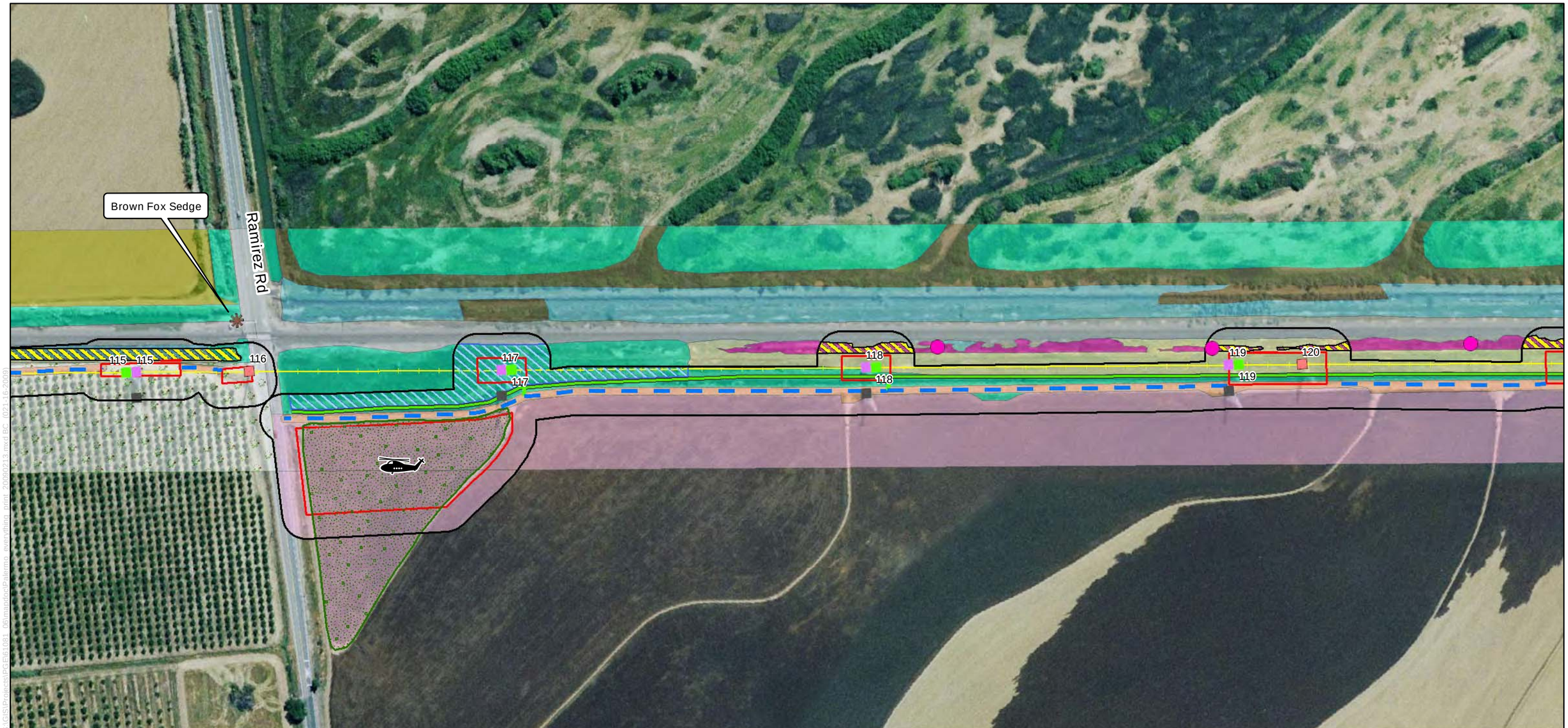

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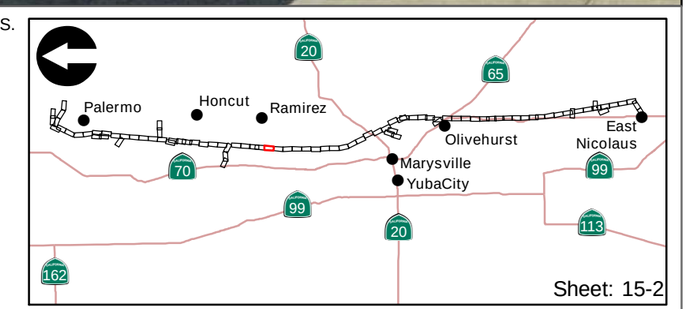

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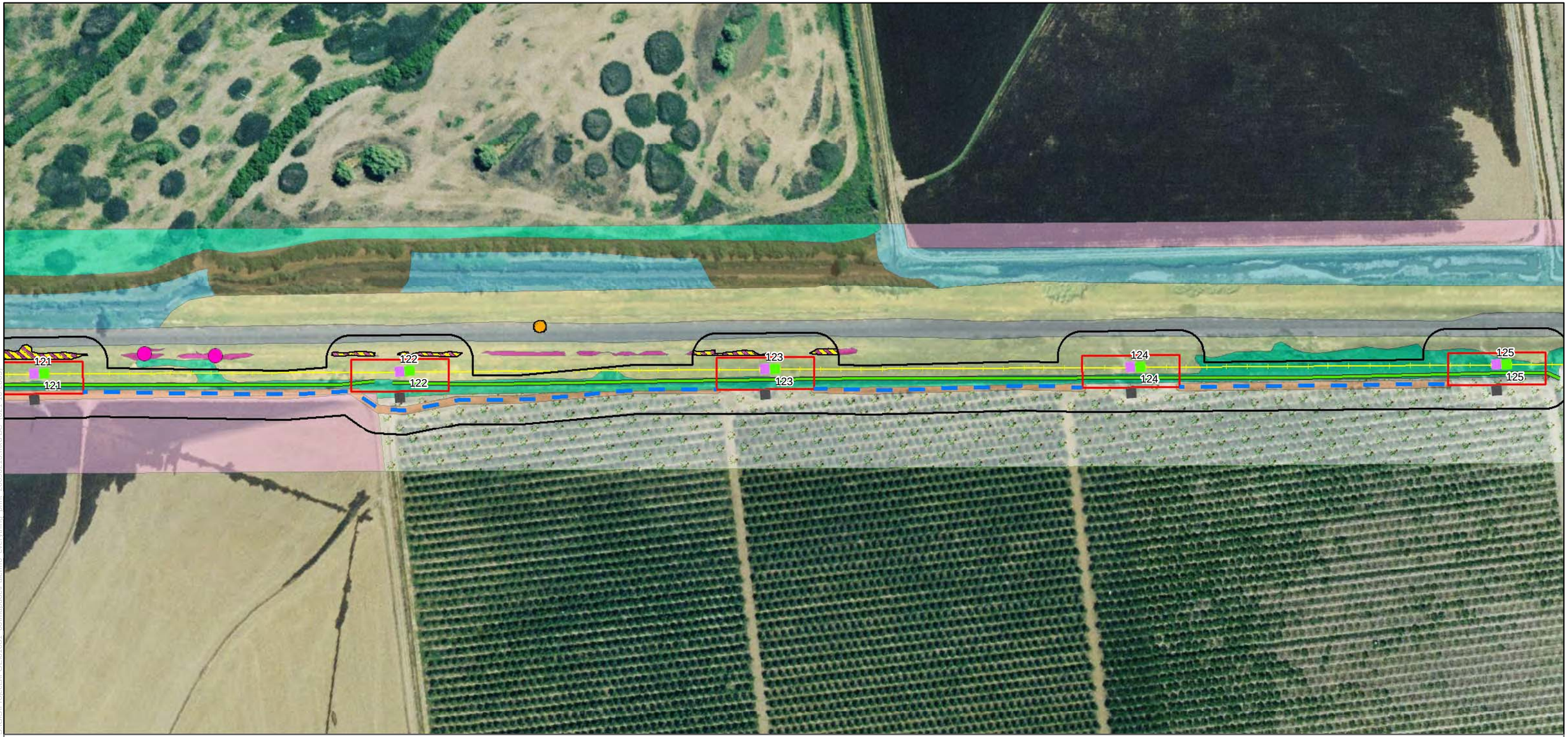

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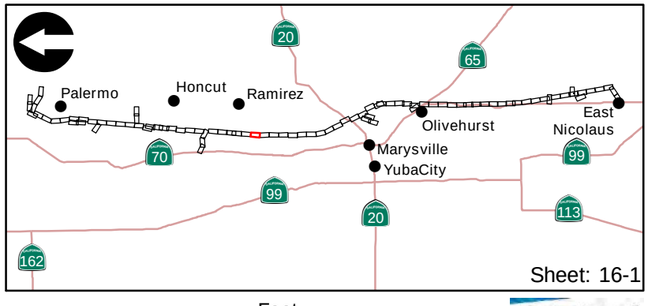

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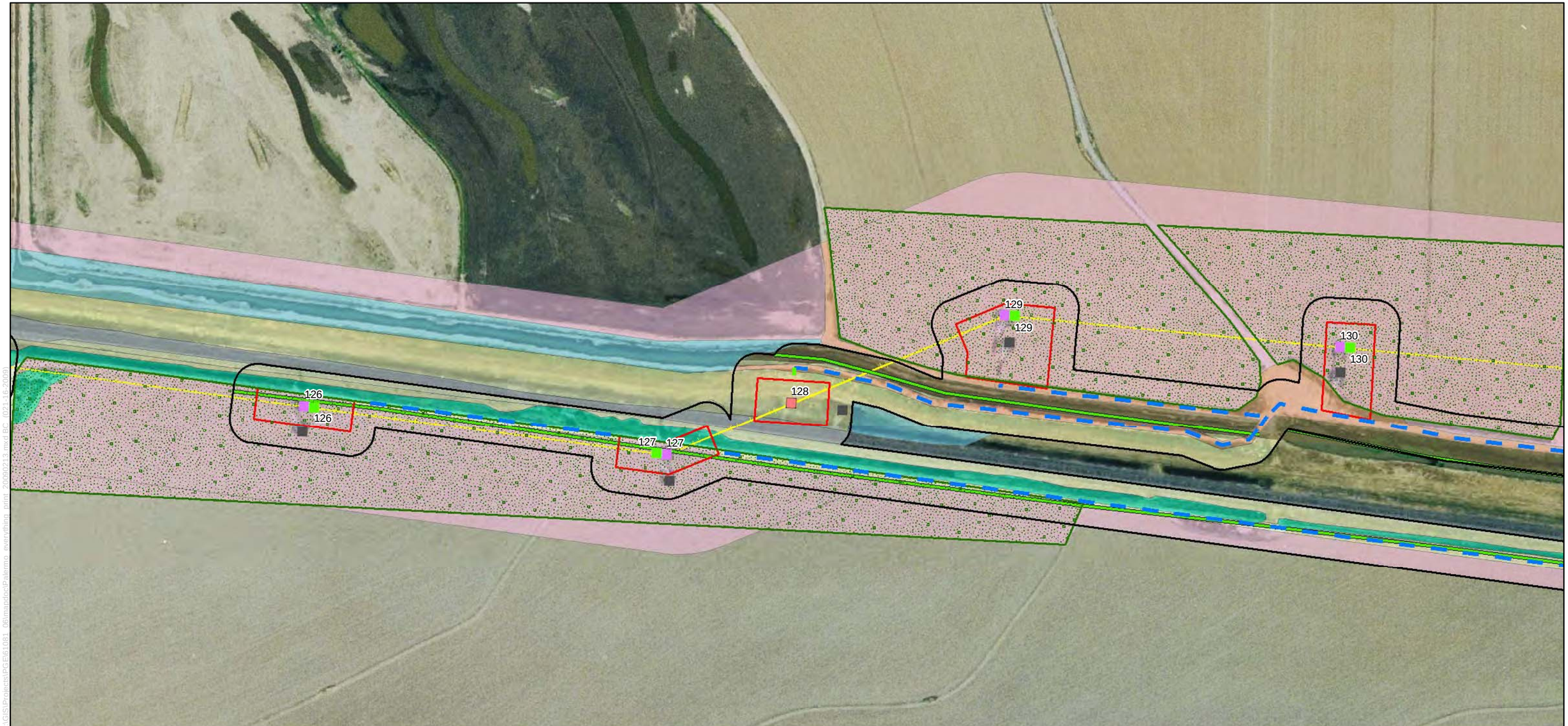

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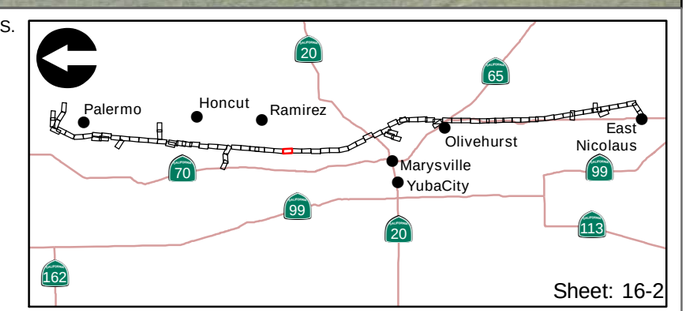

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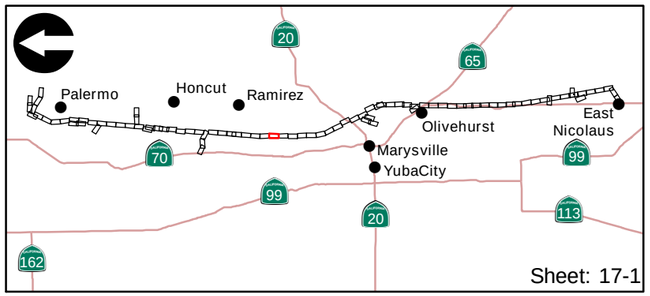

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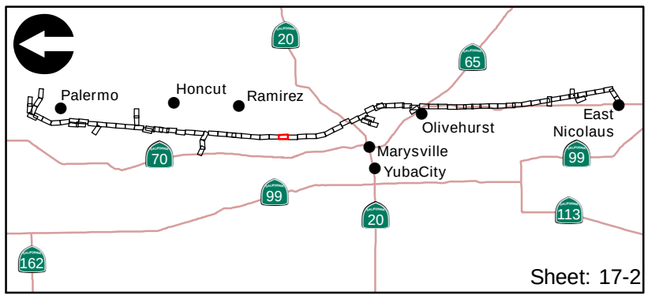

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Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
- Transmission Line
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Special-Status Species

- Brown Fox Sedge
- Vernal Pool Tadpole Shrimp
- Elderberry Shrub
- Elderberry Shrub Cluster

Vegetation Communities Legend only

- Non-native Grassland
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Potentially Jurisdictional Waters of the U.S.

- Freshwater Marsh
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- Stock Pond
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- Vernal Swale
- Intermittent Stream
- Irrigation Canal
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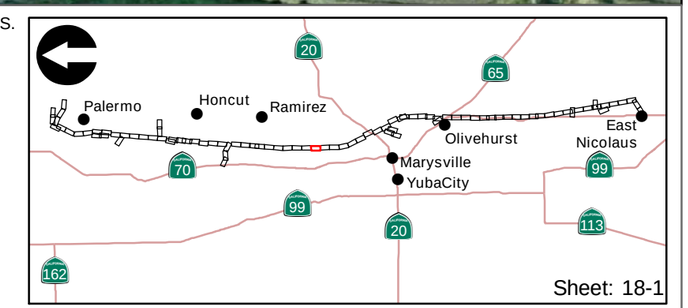

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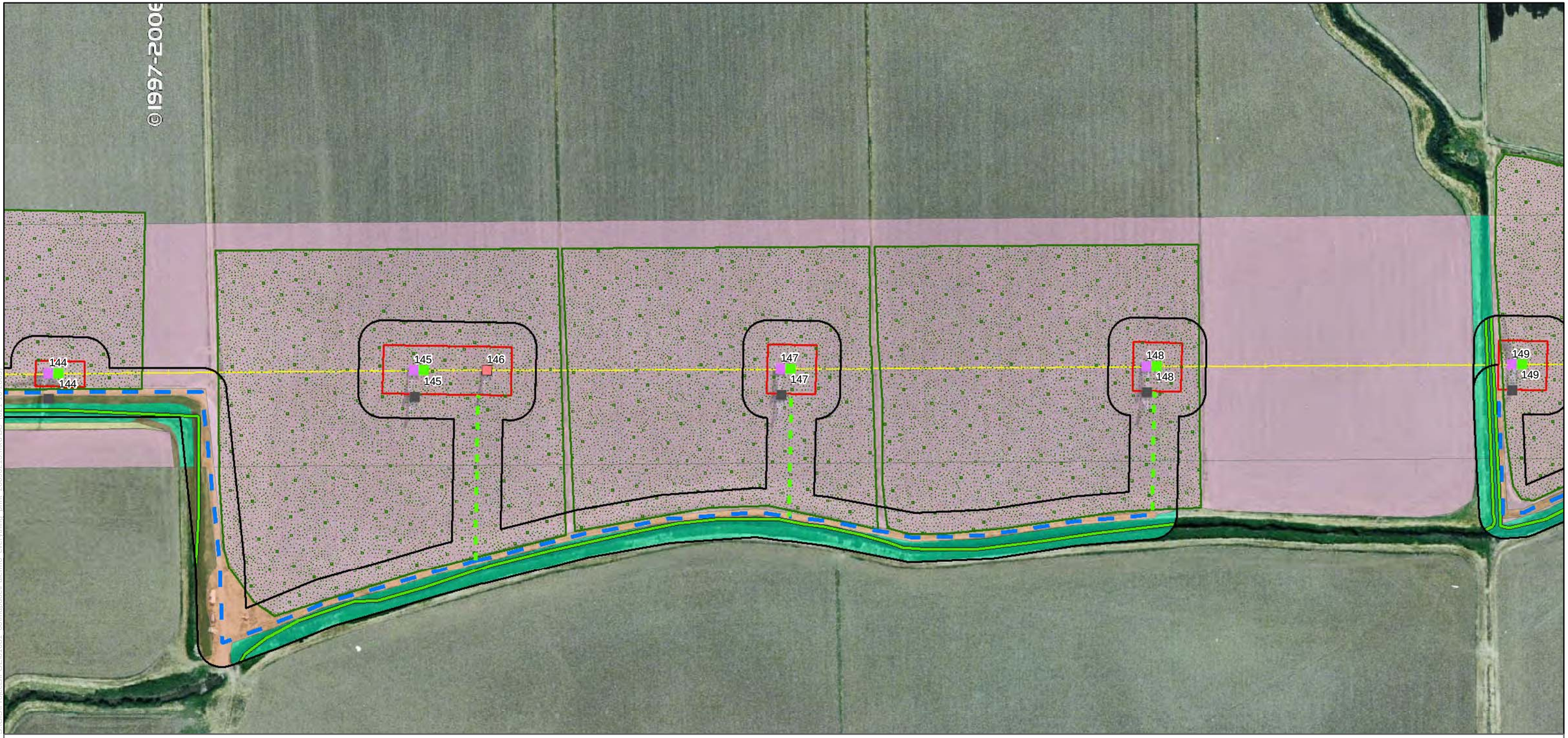
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



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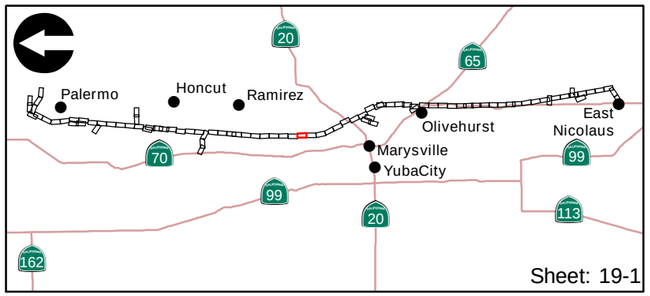

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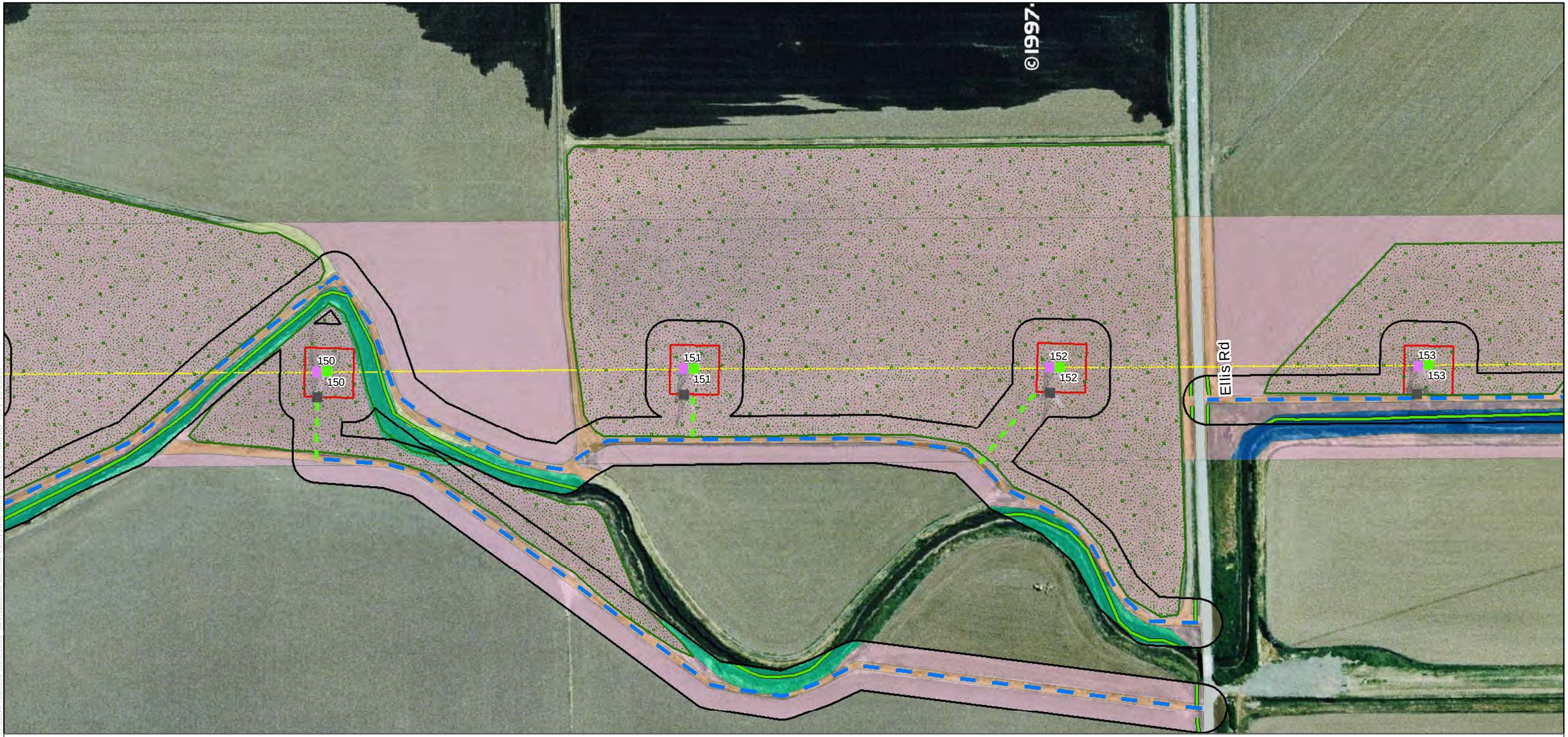

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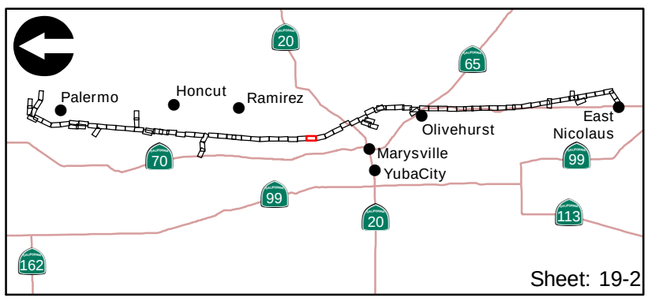

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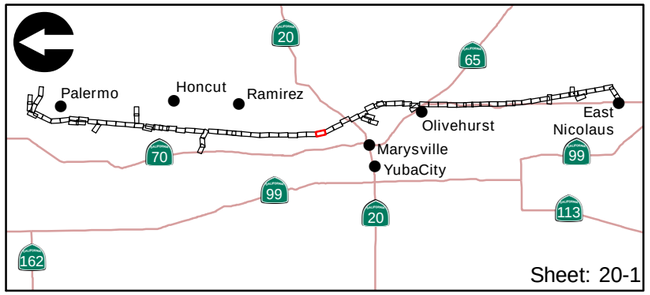

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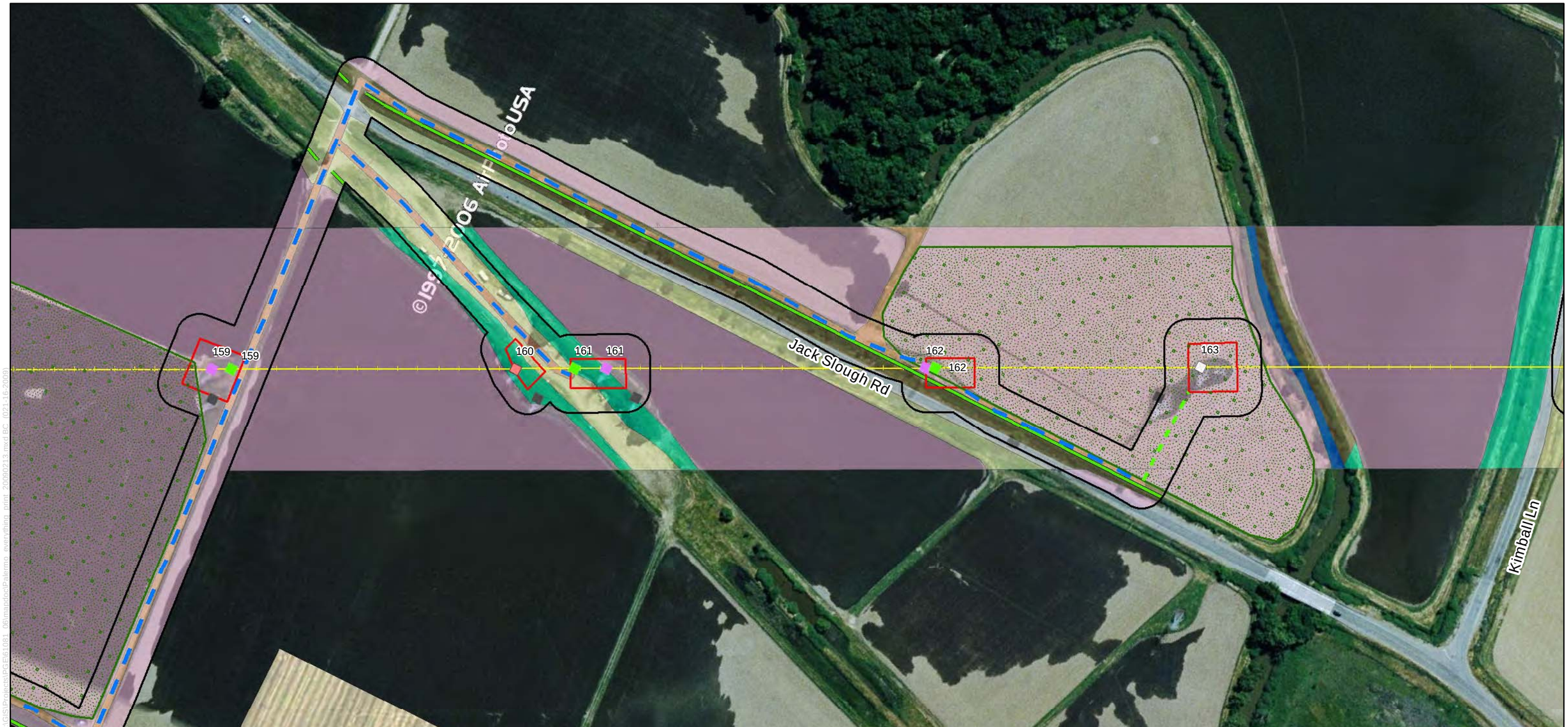

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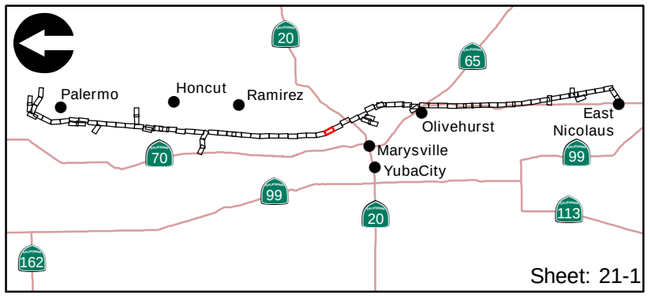

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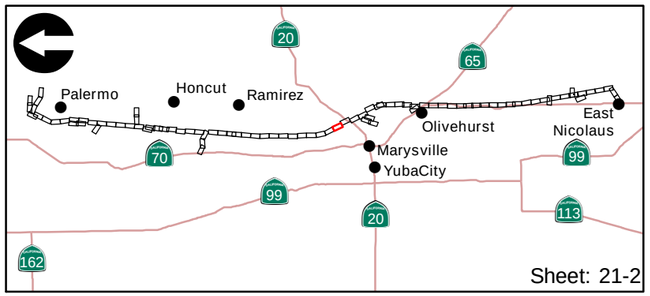

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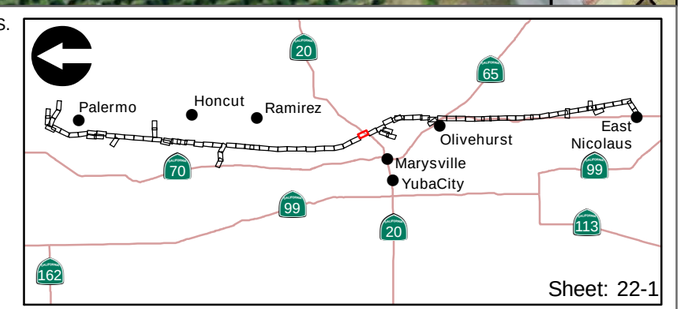

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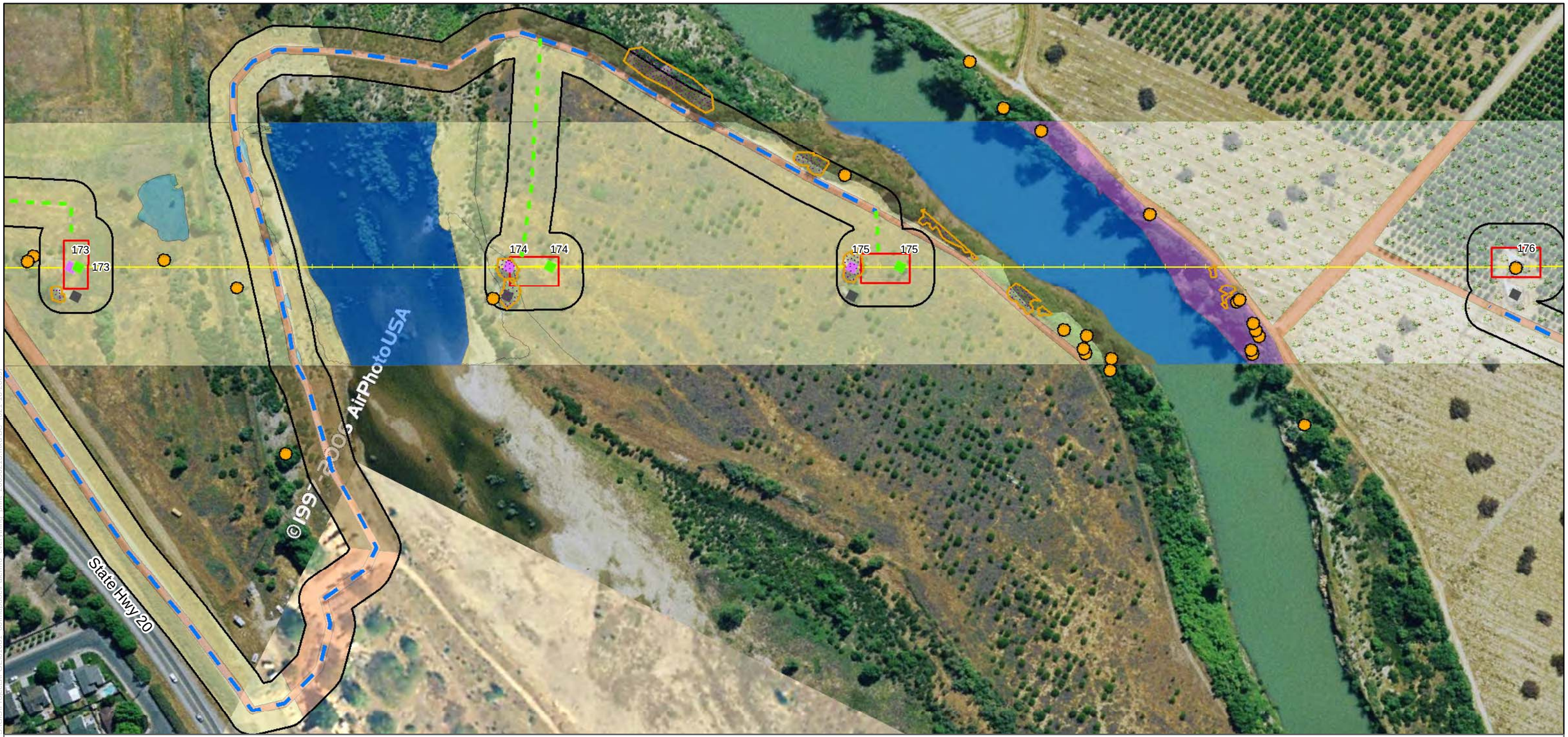

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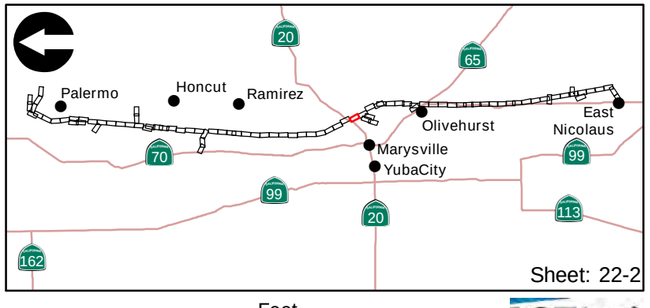

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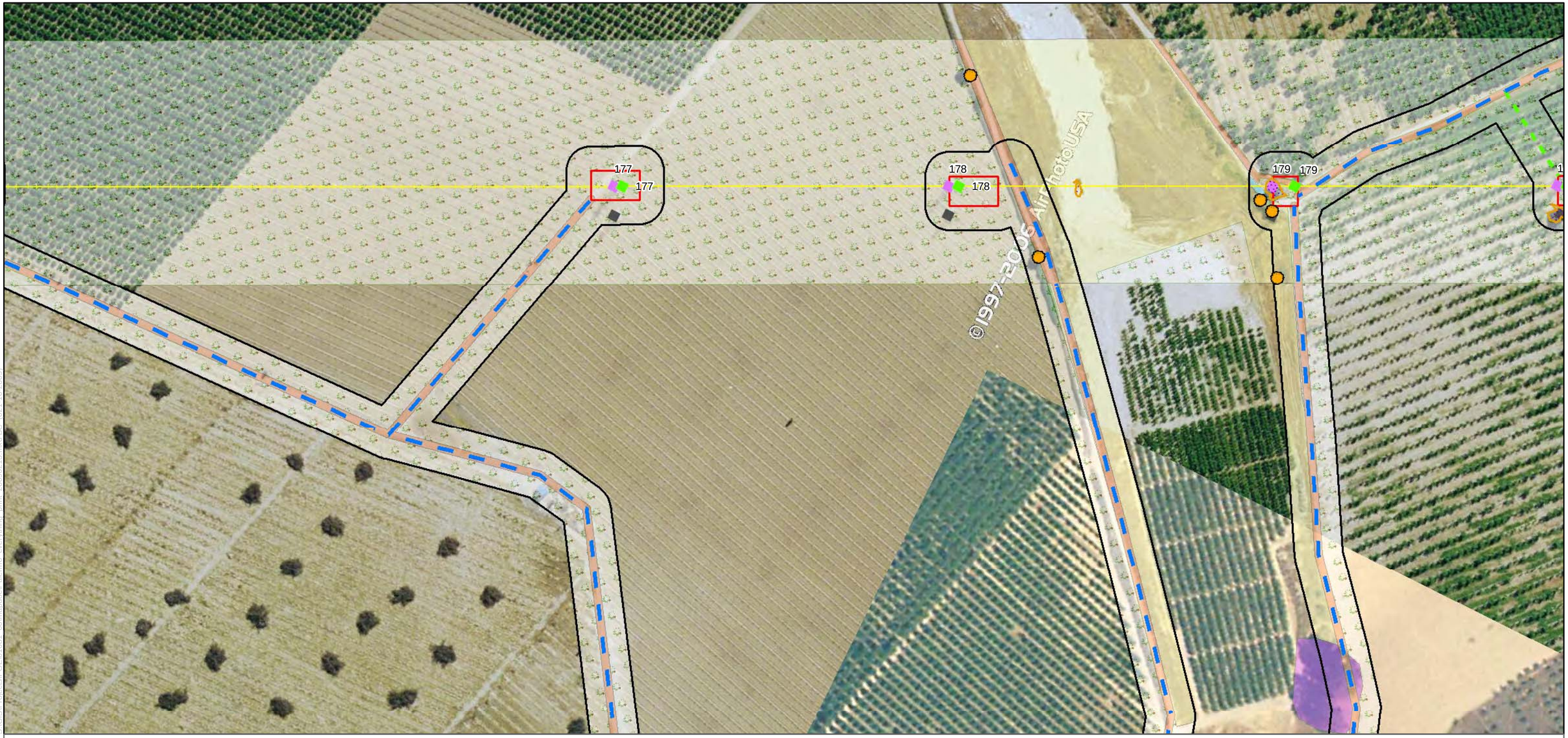

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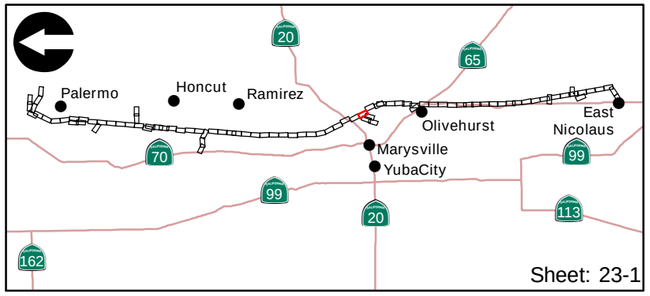

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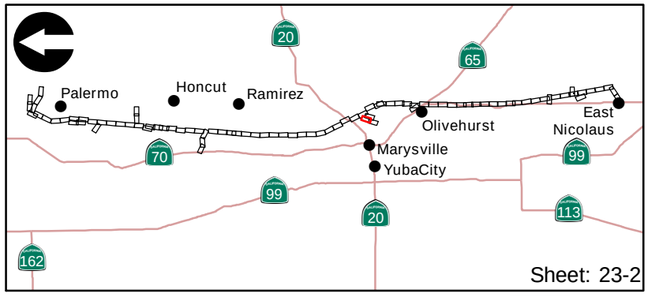

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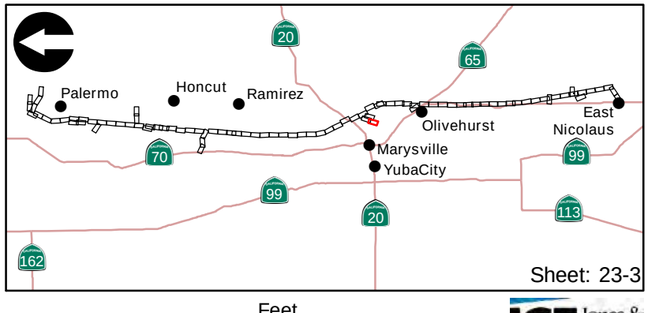

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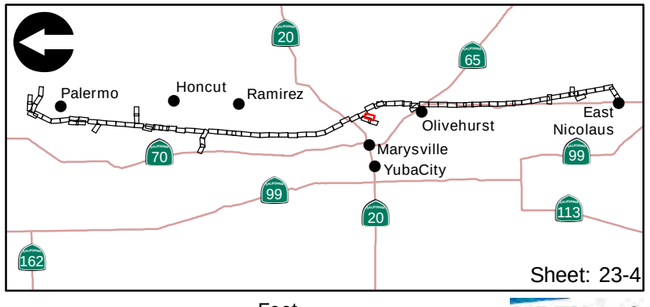

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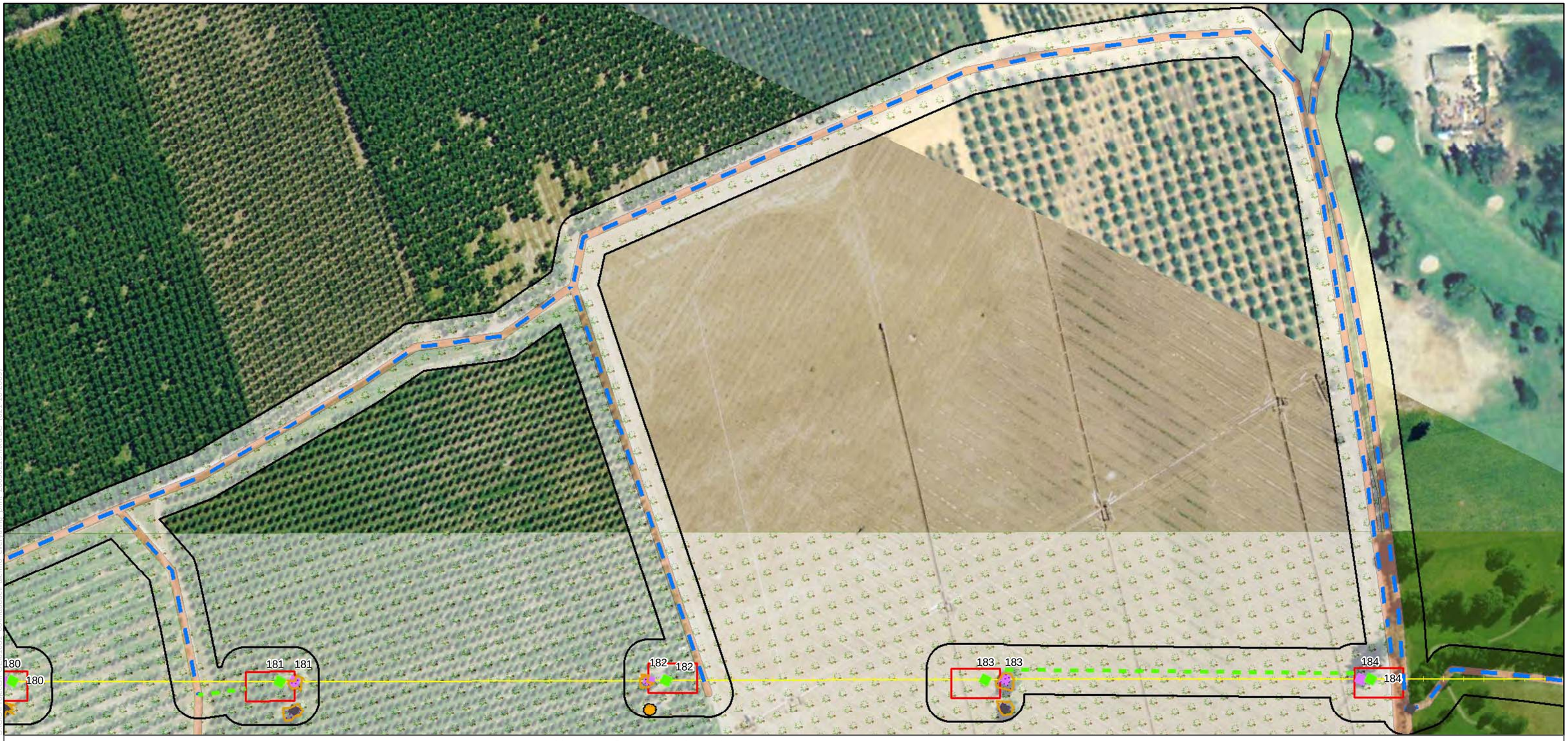

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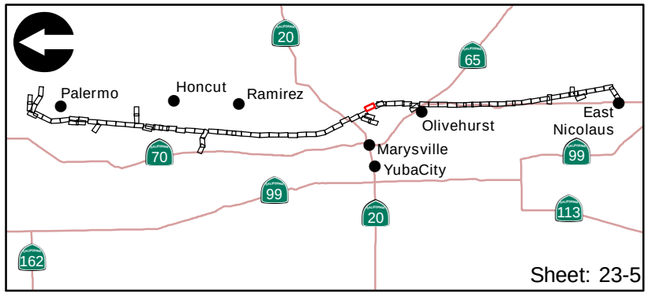

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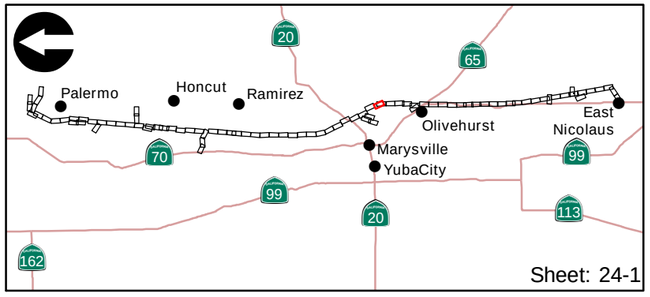
- Vernal Swale
- Intermittent Stream
- Irrigation Canal
- Non-Vegetated Ditch
- Vegetated Ditch



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Appendix B-1
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.

Project Activities

- New Pole
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Special-Status Species

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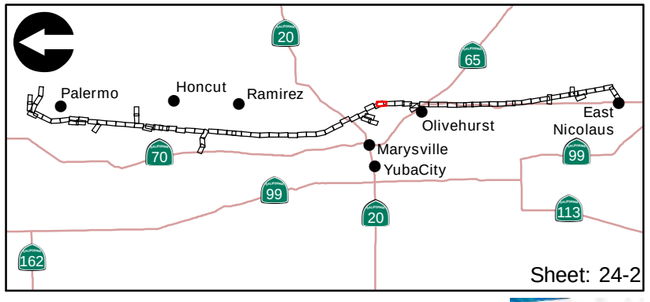

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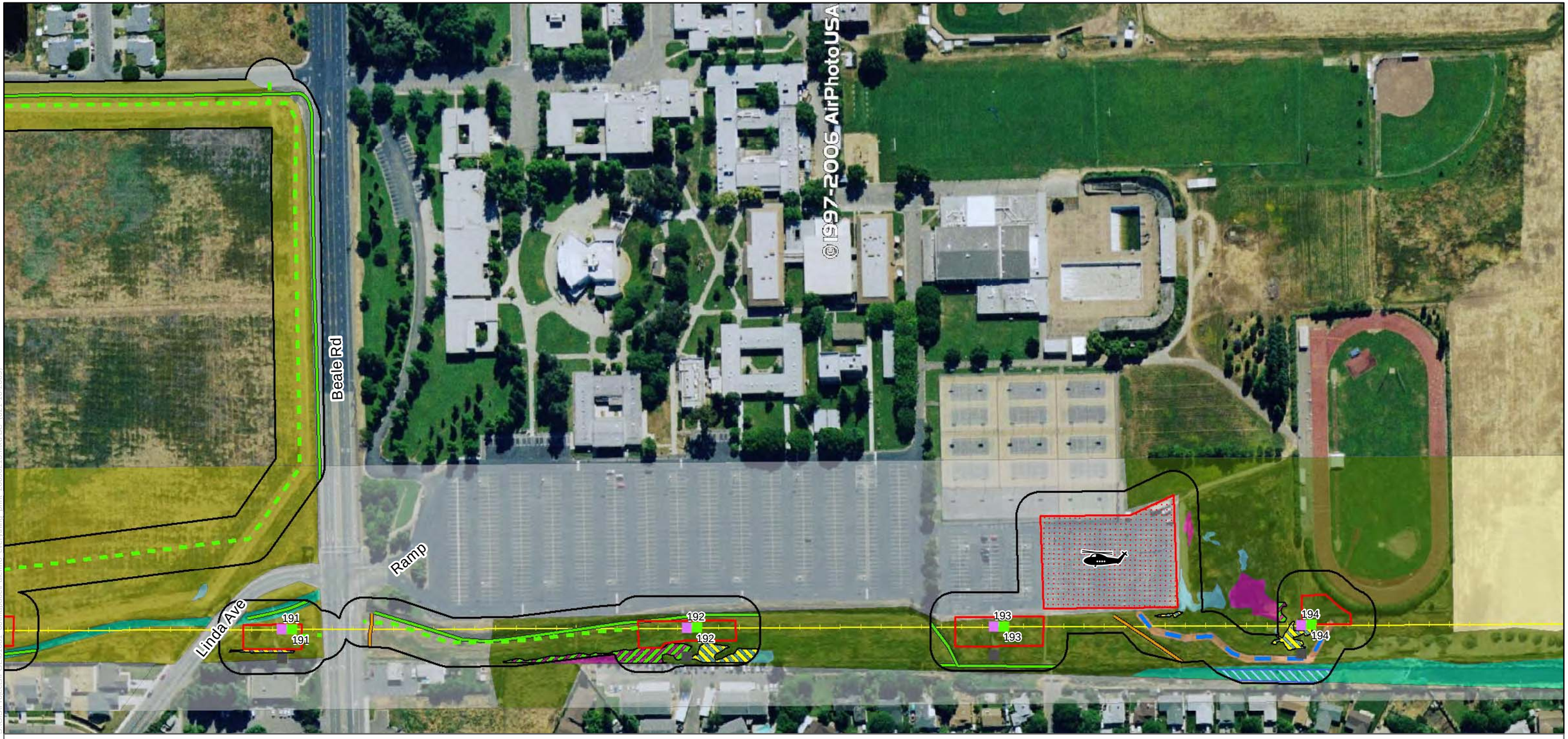

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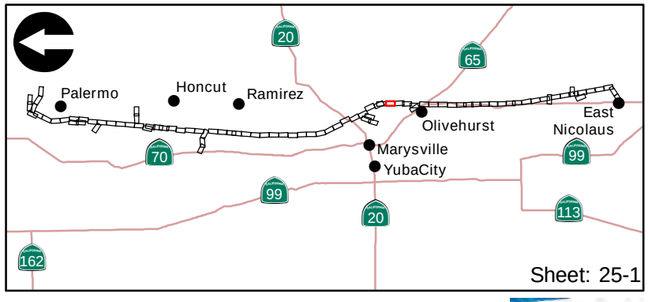

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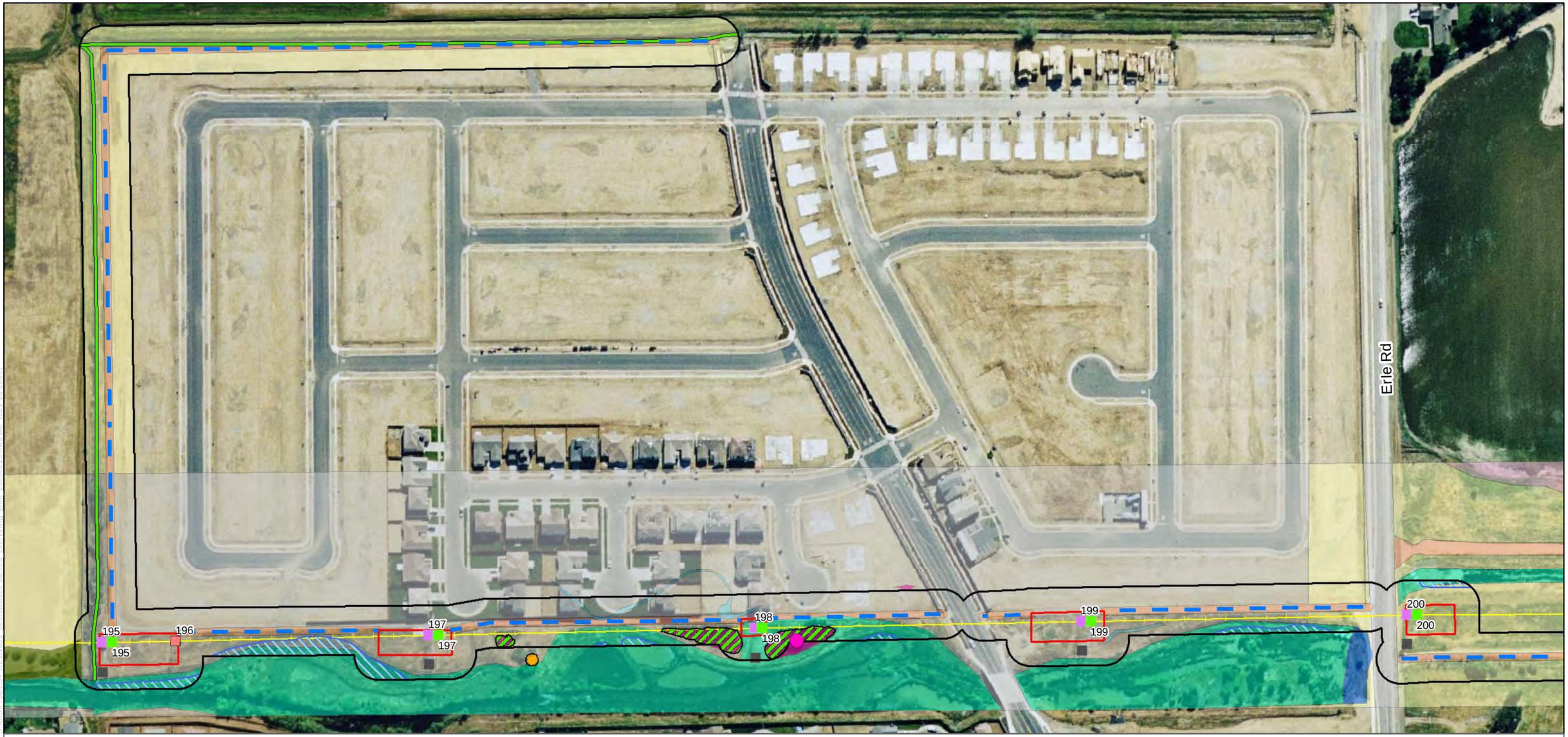

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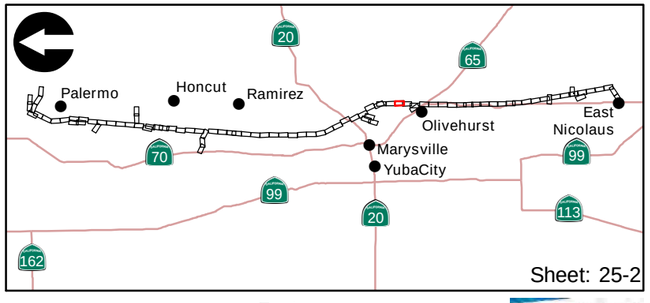

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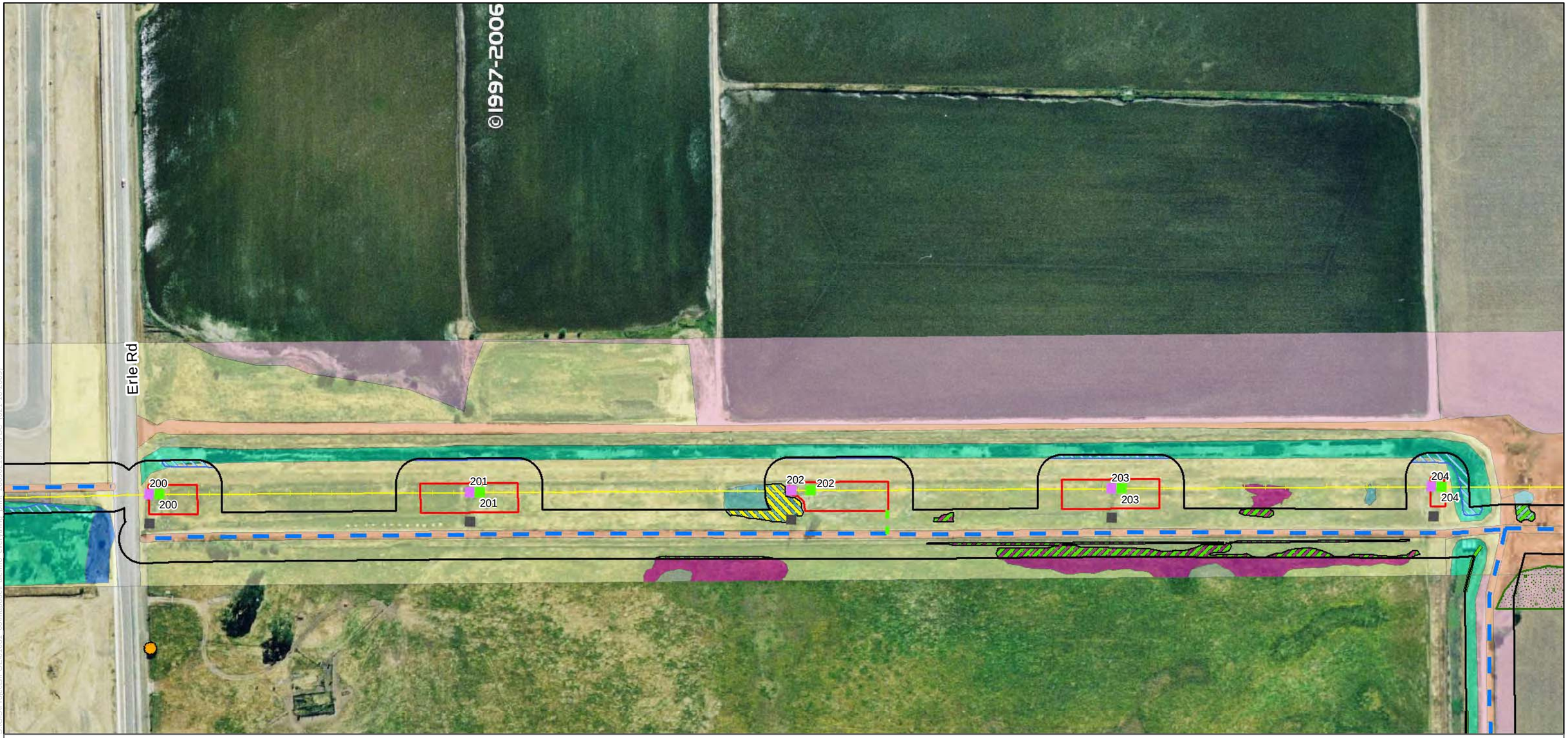

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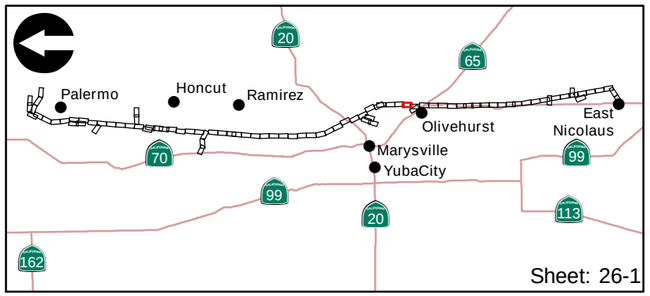

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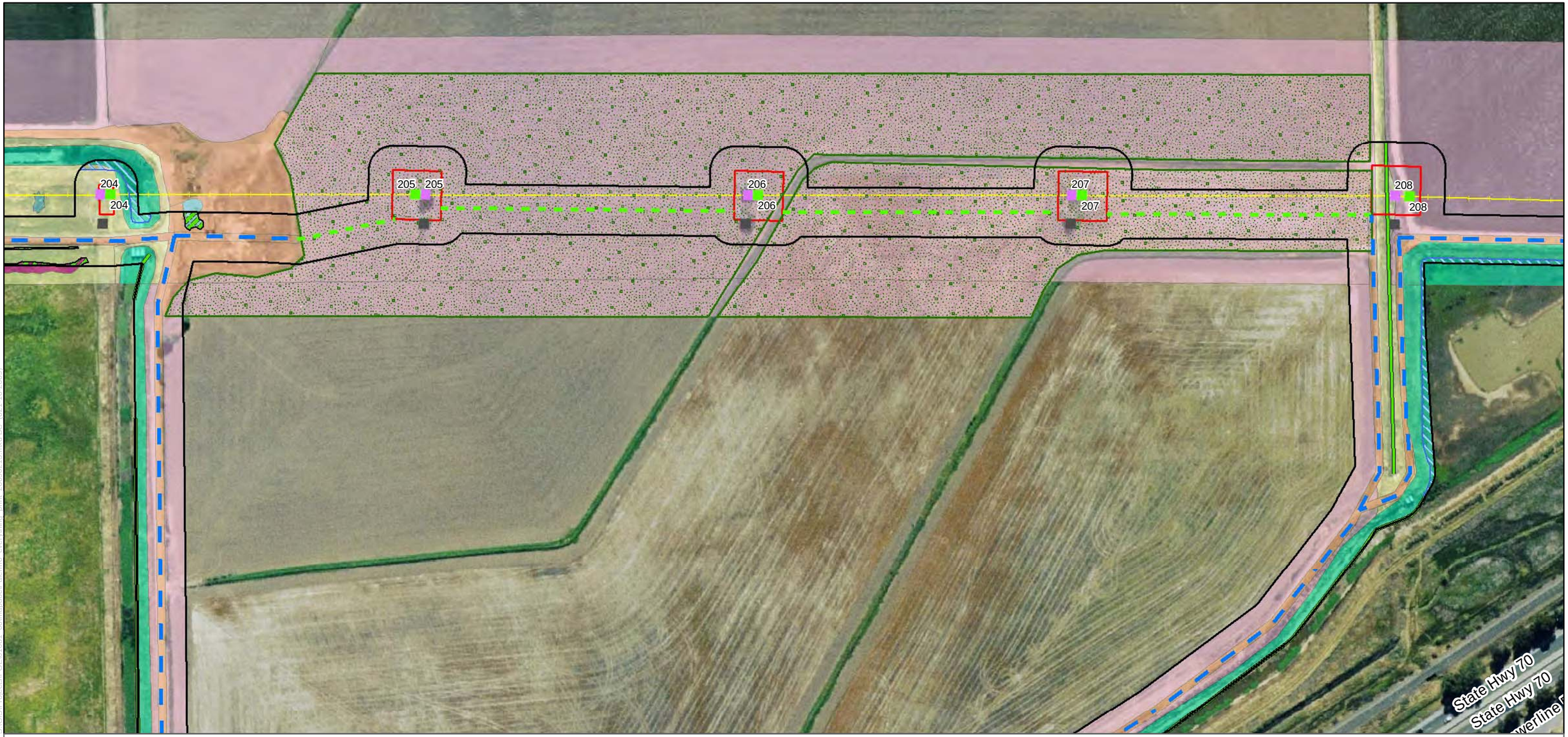
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



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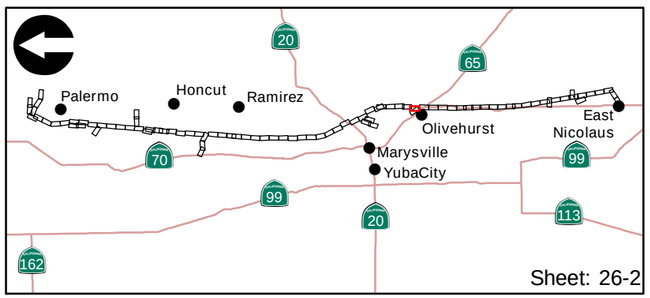

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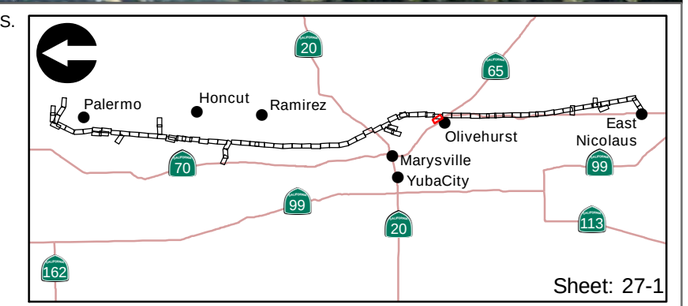

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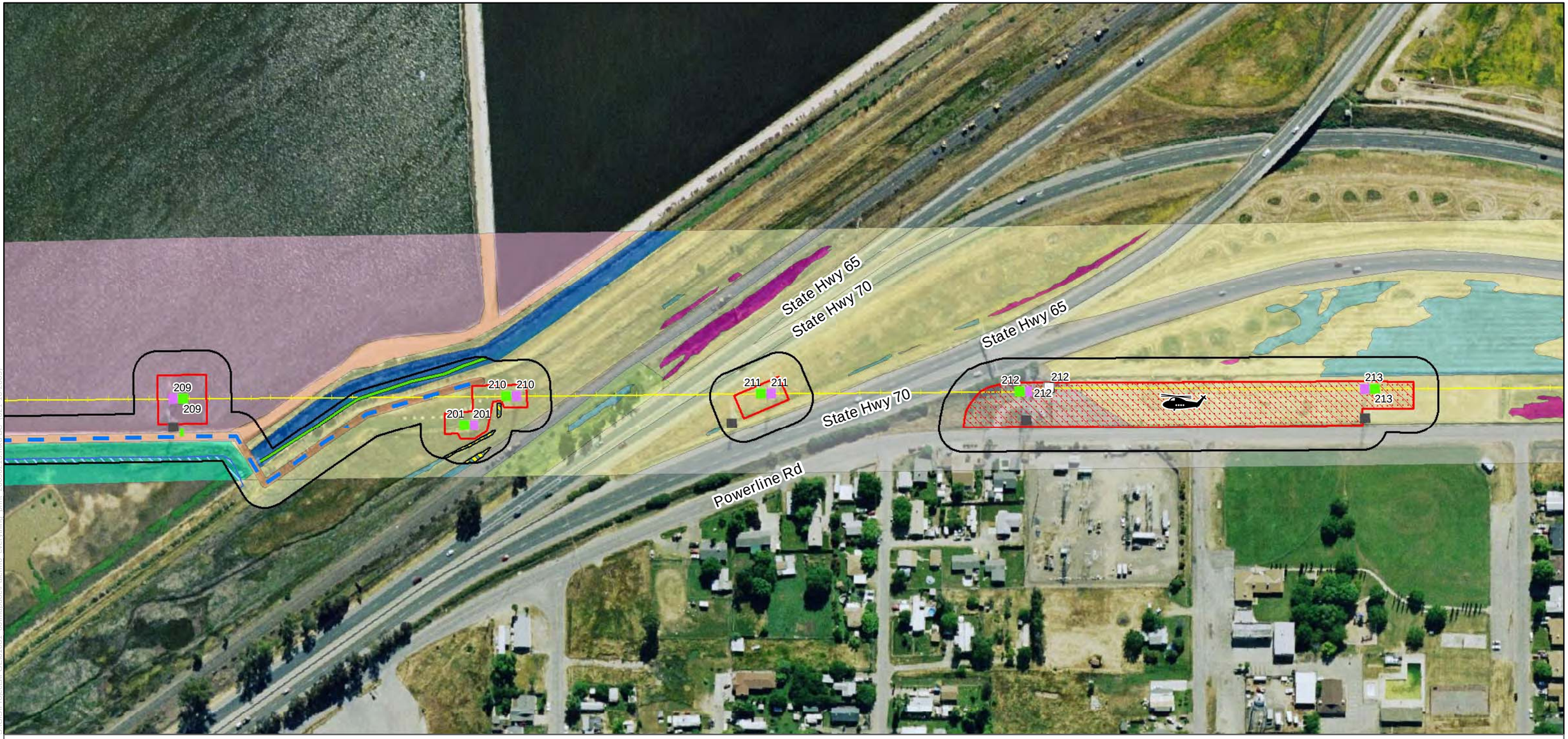

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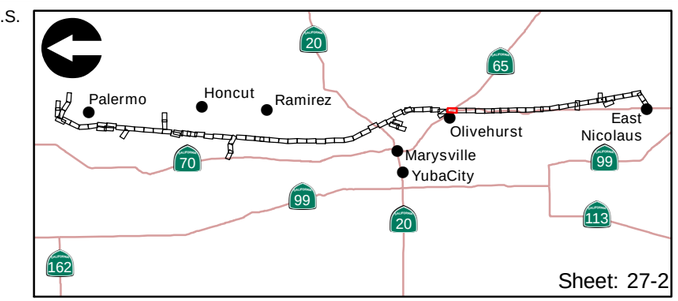

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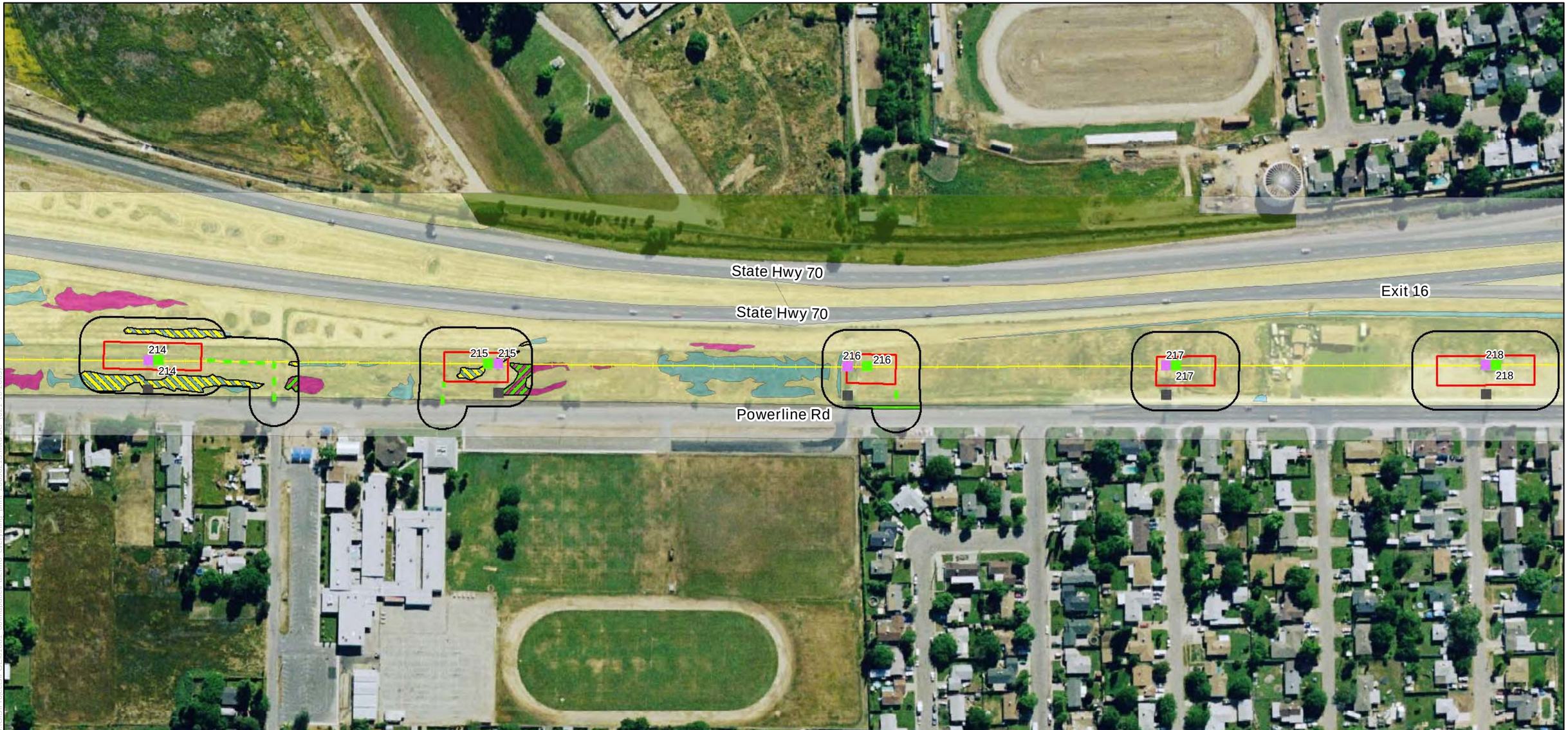

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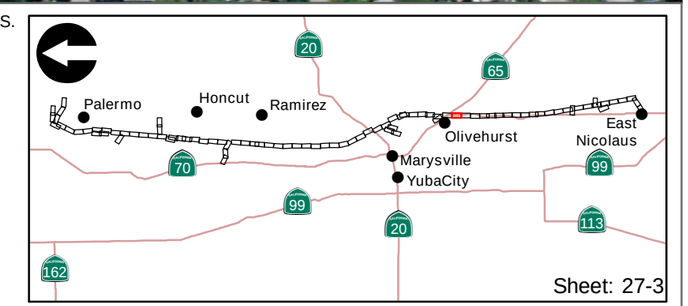

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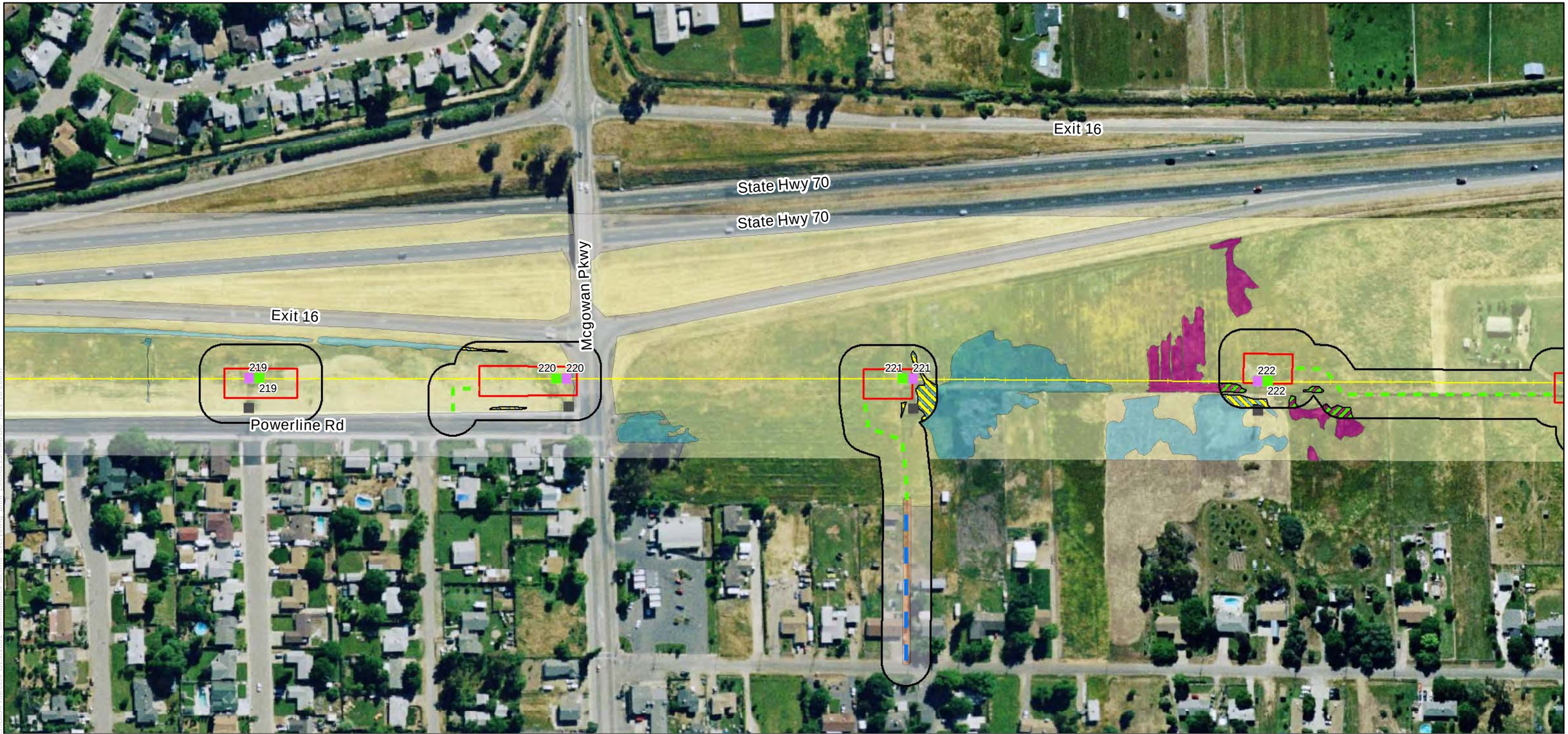

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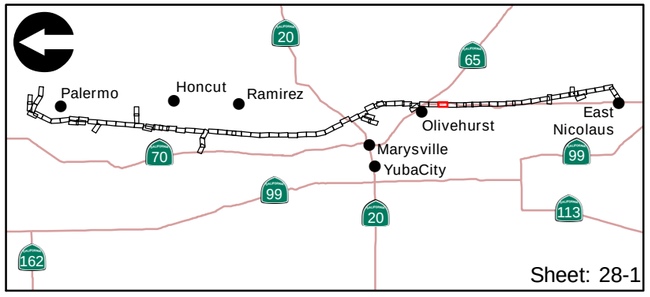

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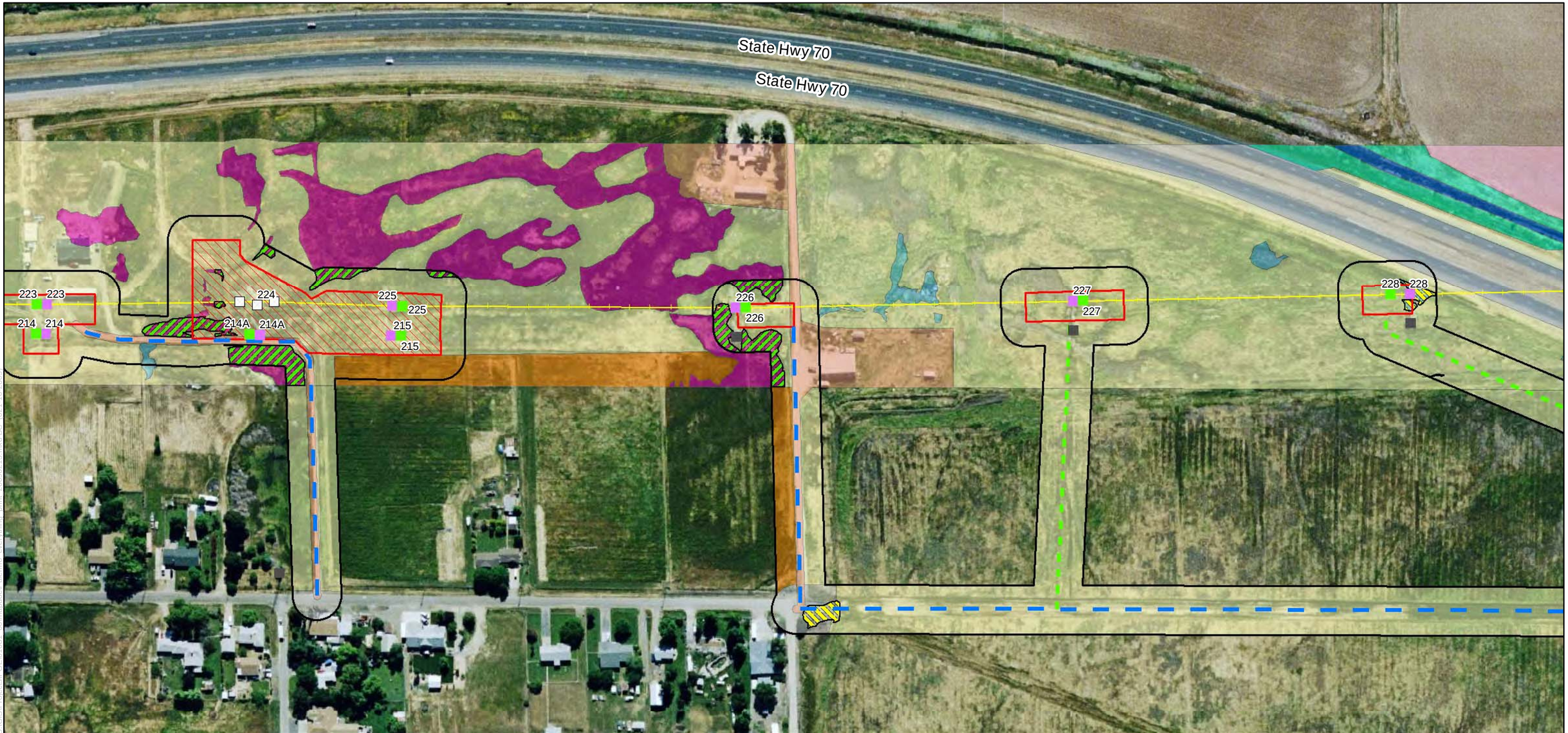

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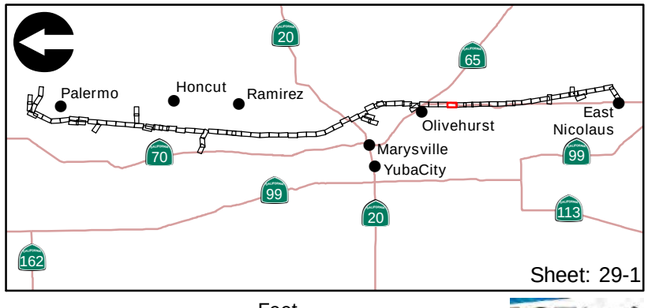

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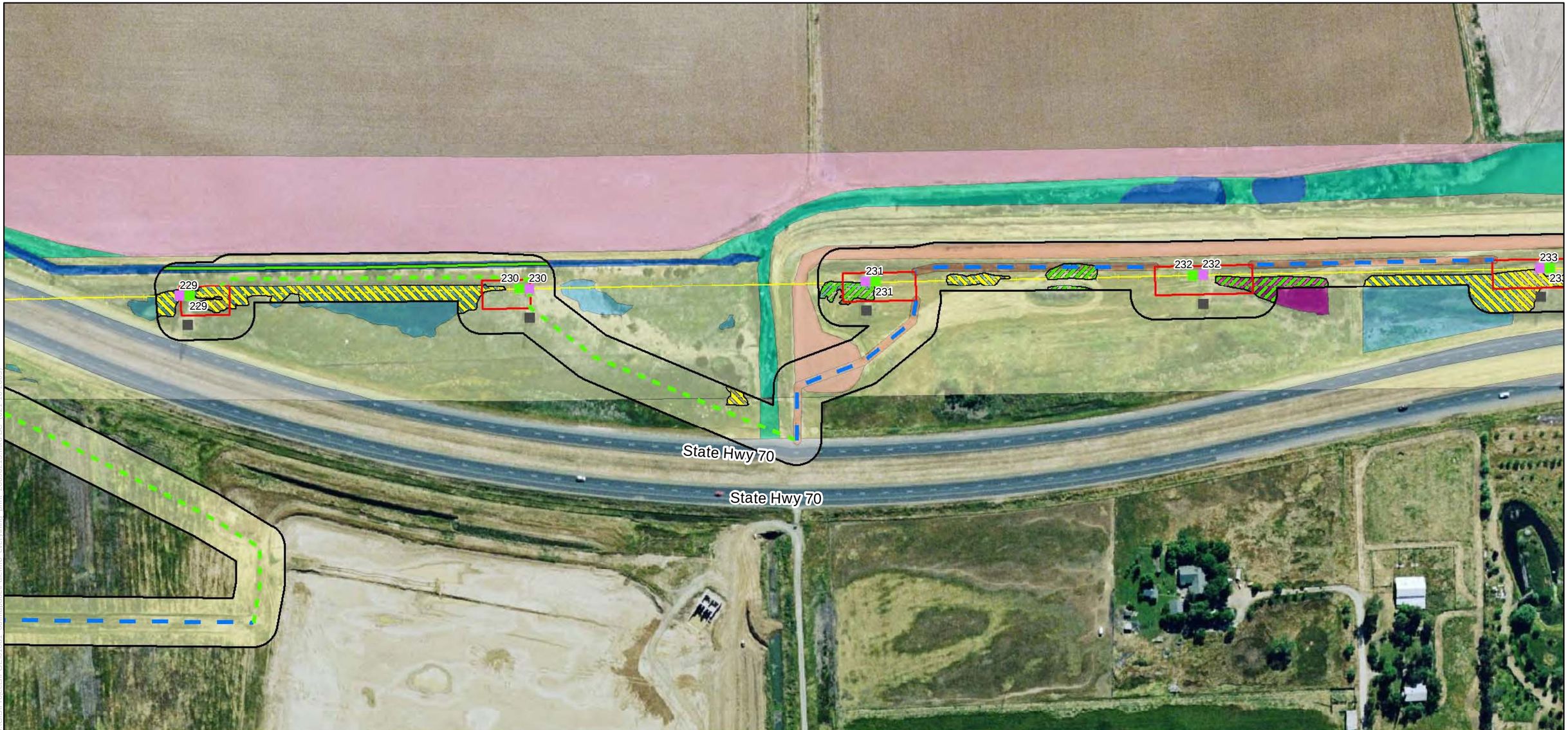

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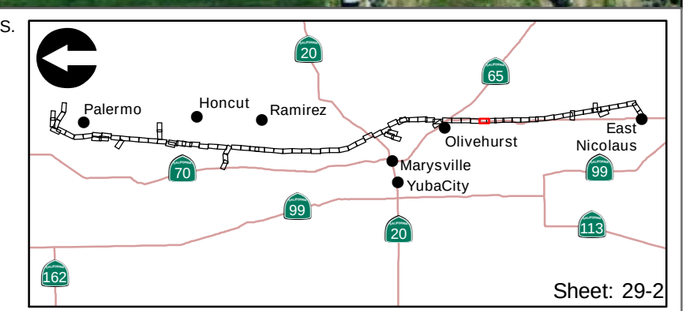

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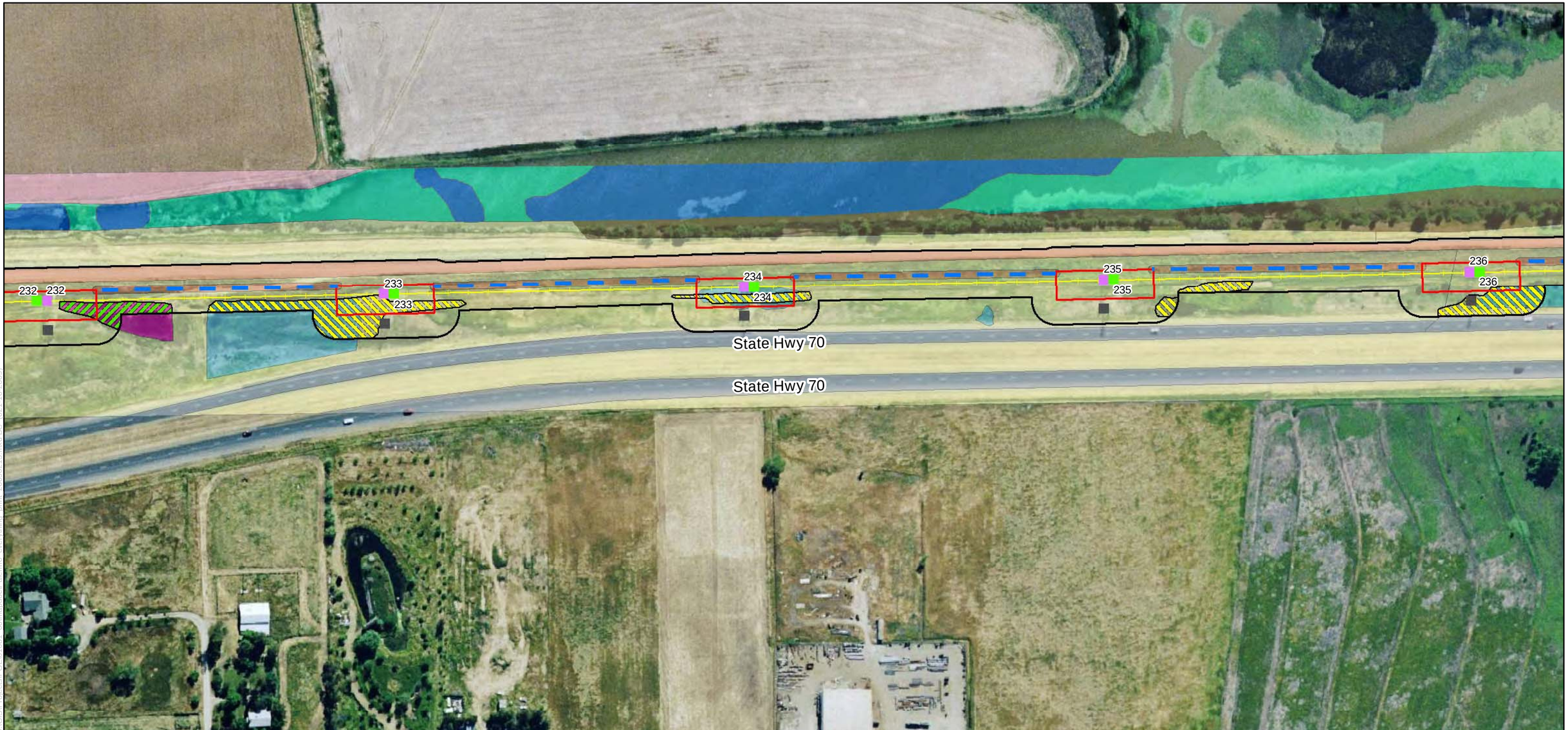

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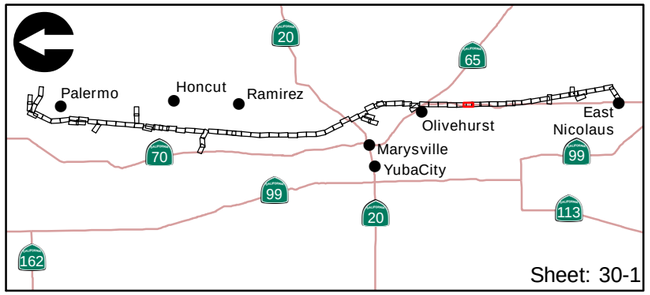

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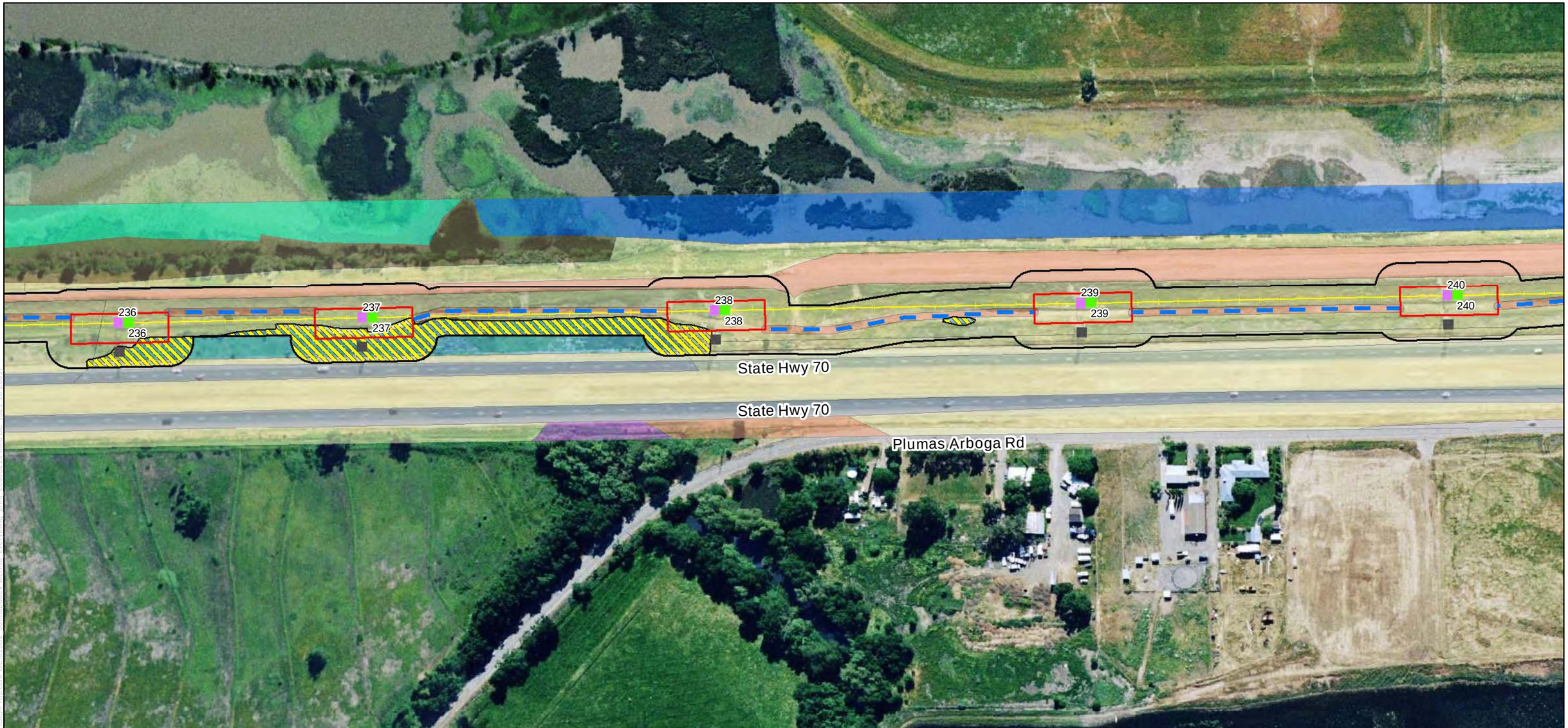

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Special-Status Species

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- Elderberry Shrub
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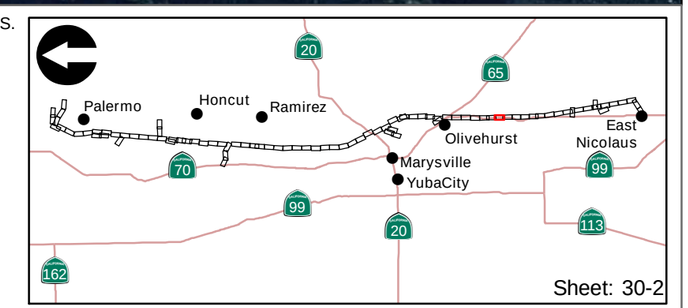

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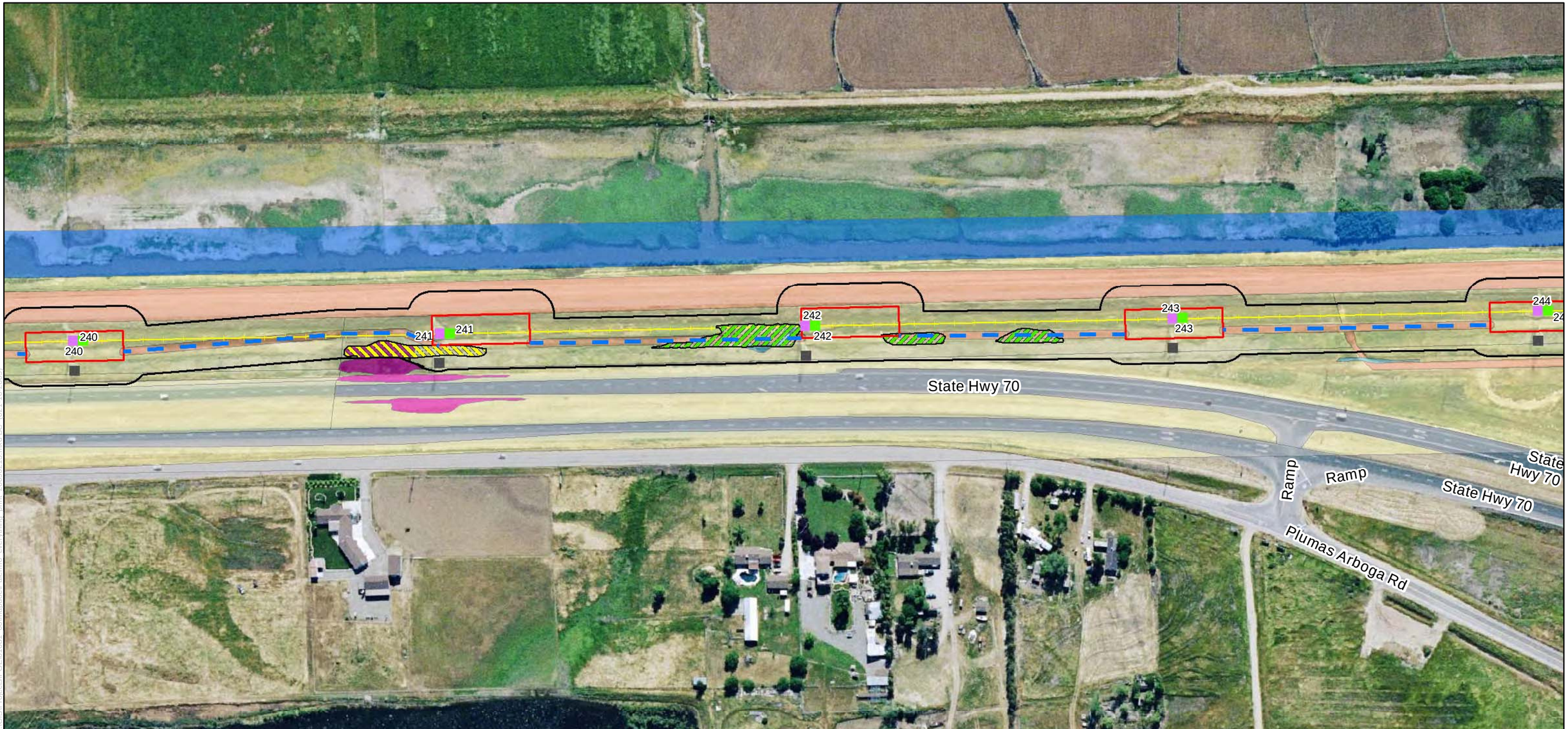

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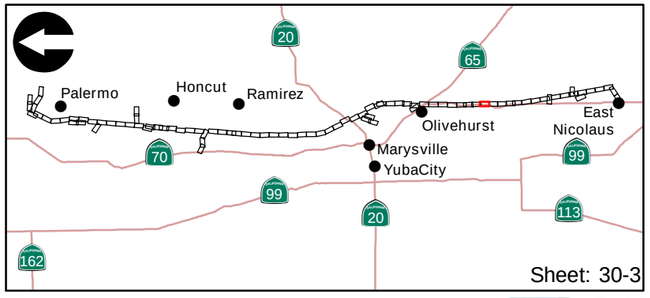

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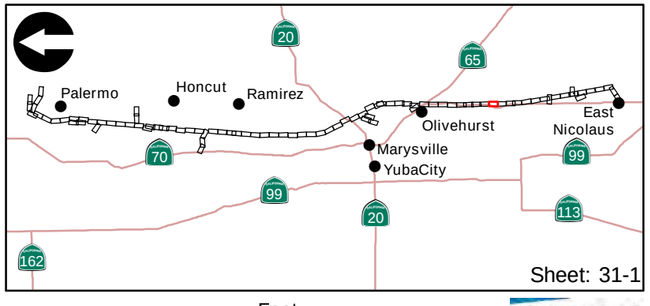

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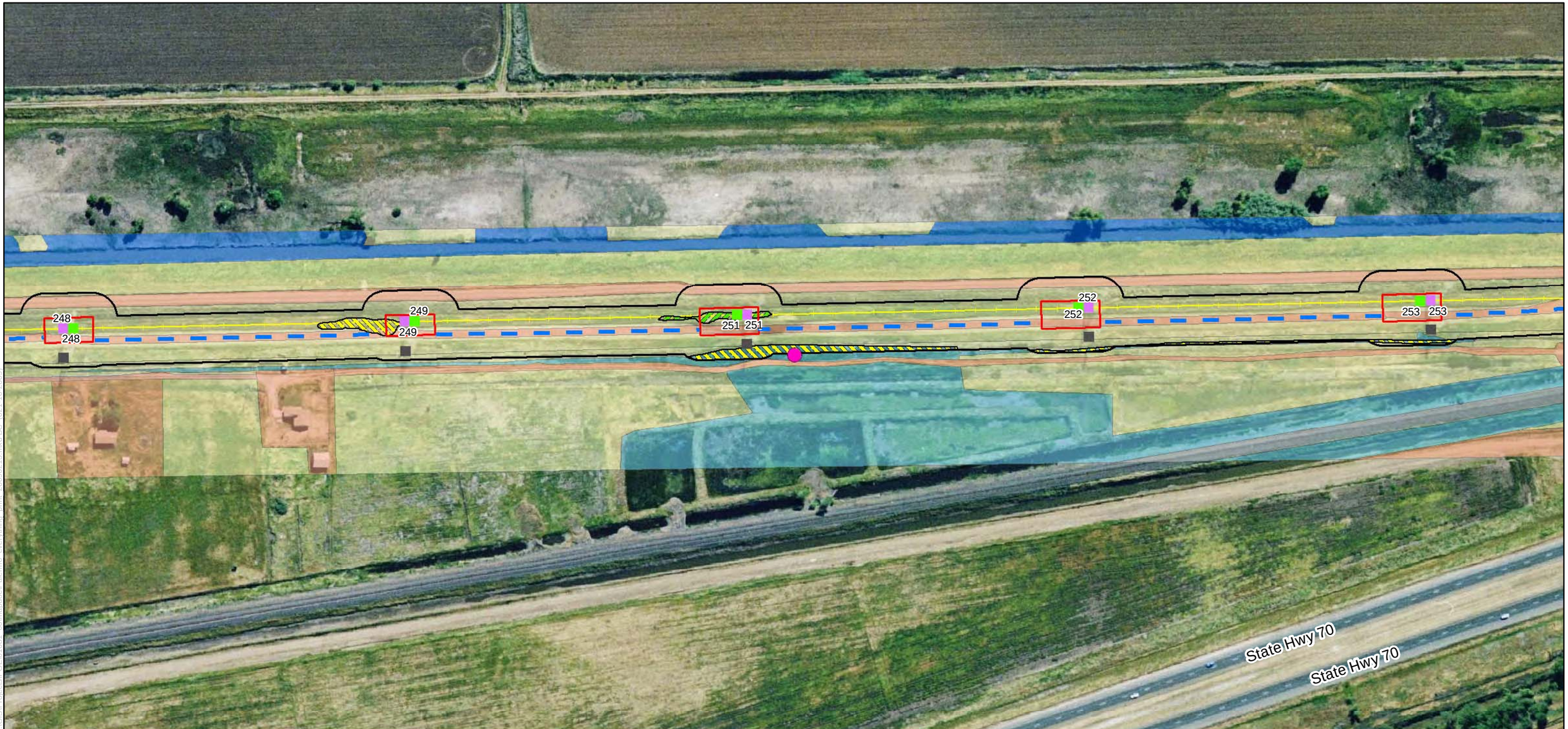

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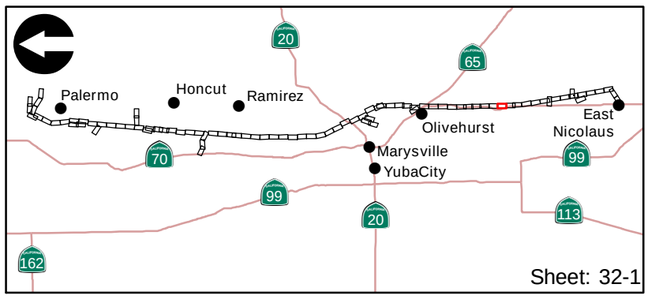

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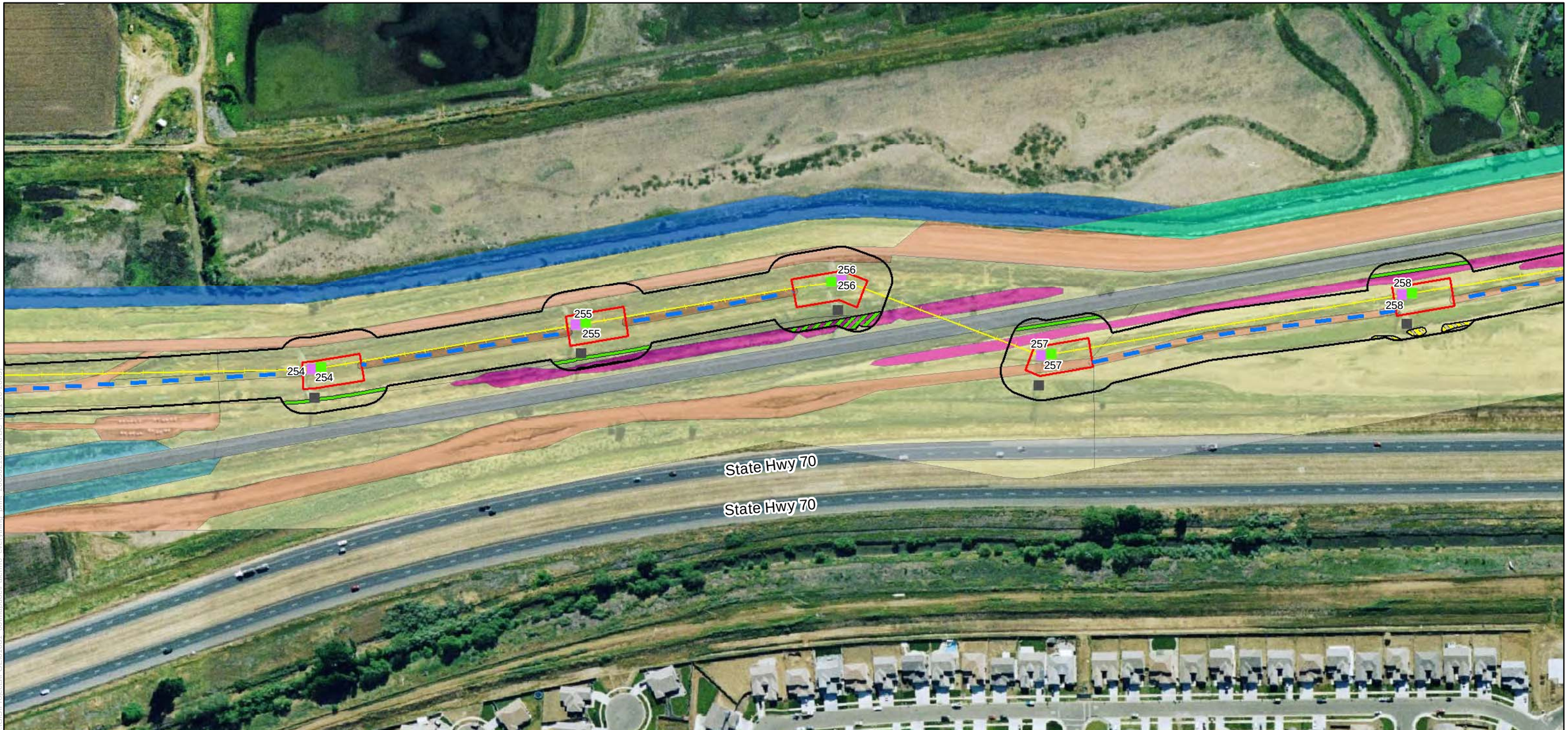

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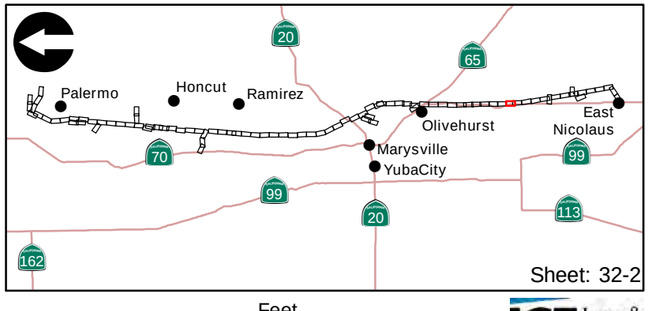

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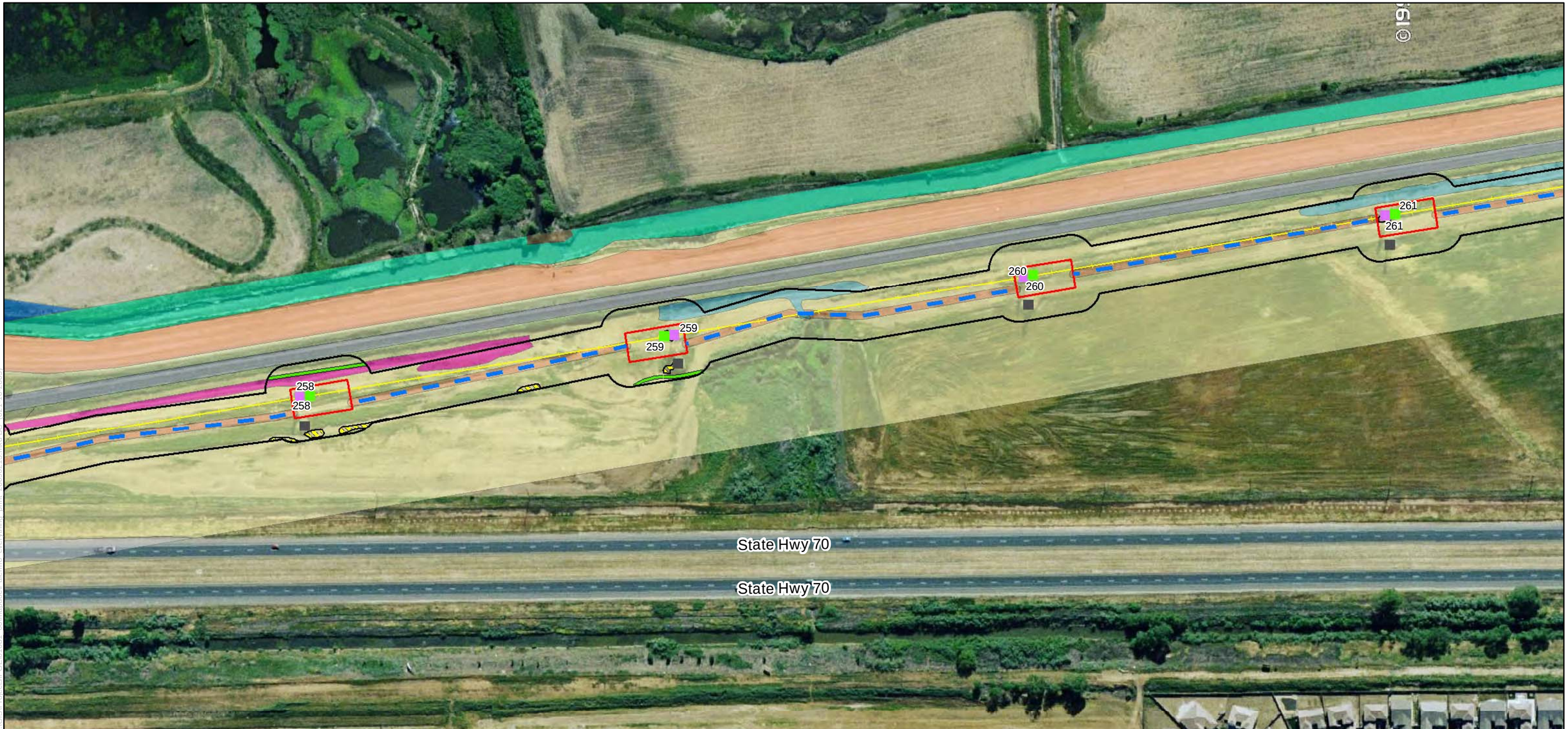

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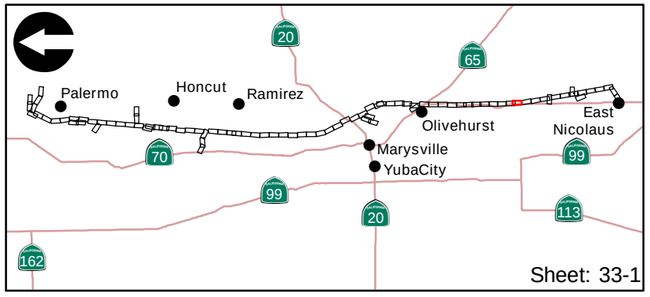

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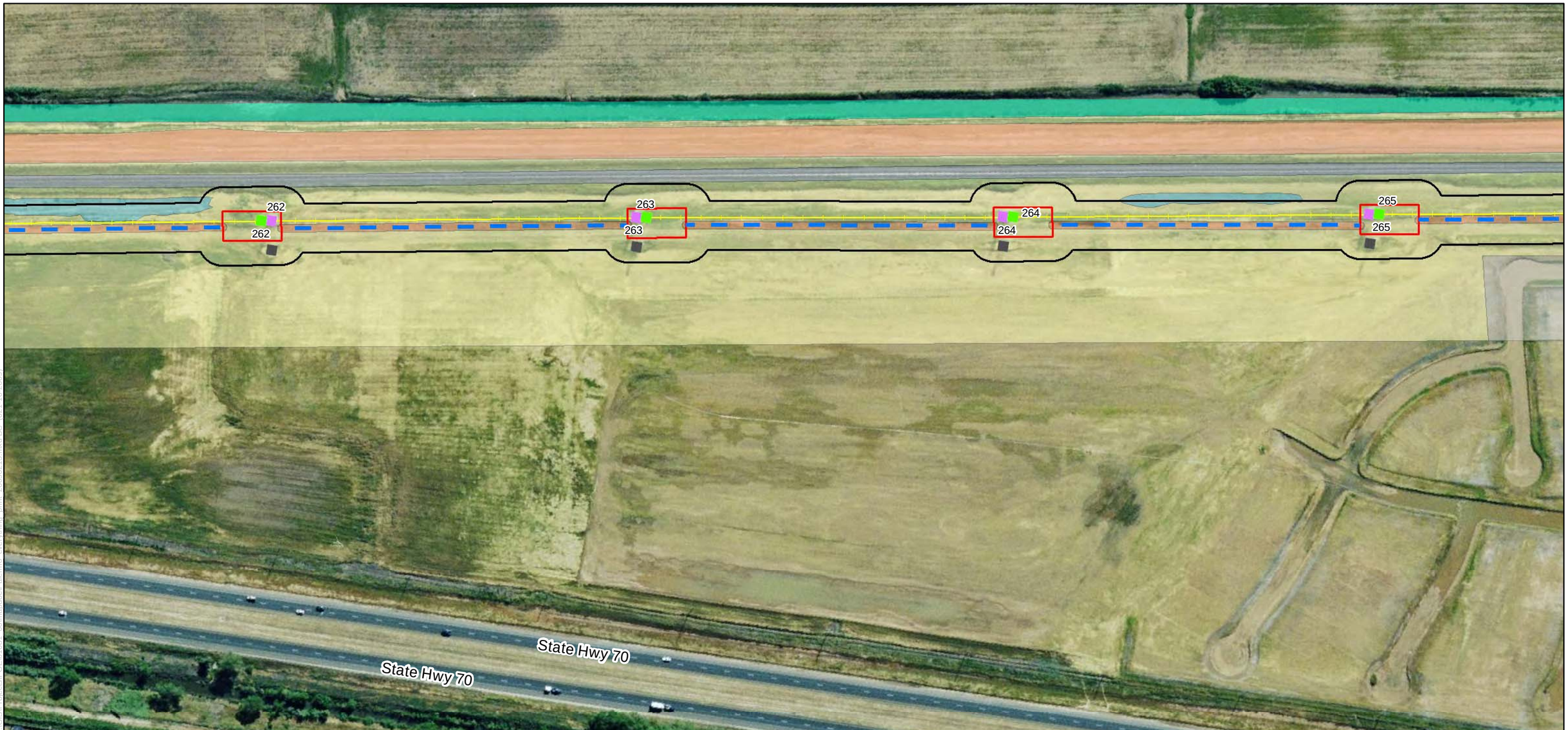

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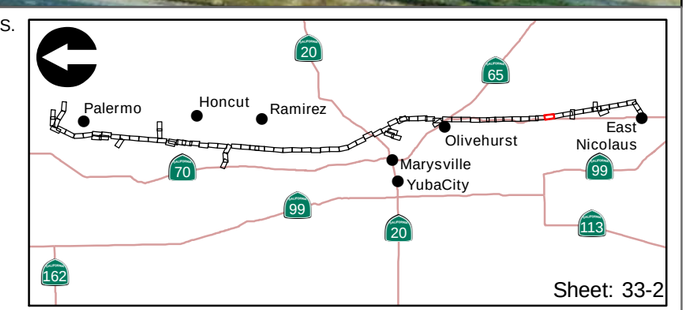

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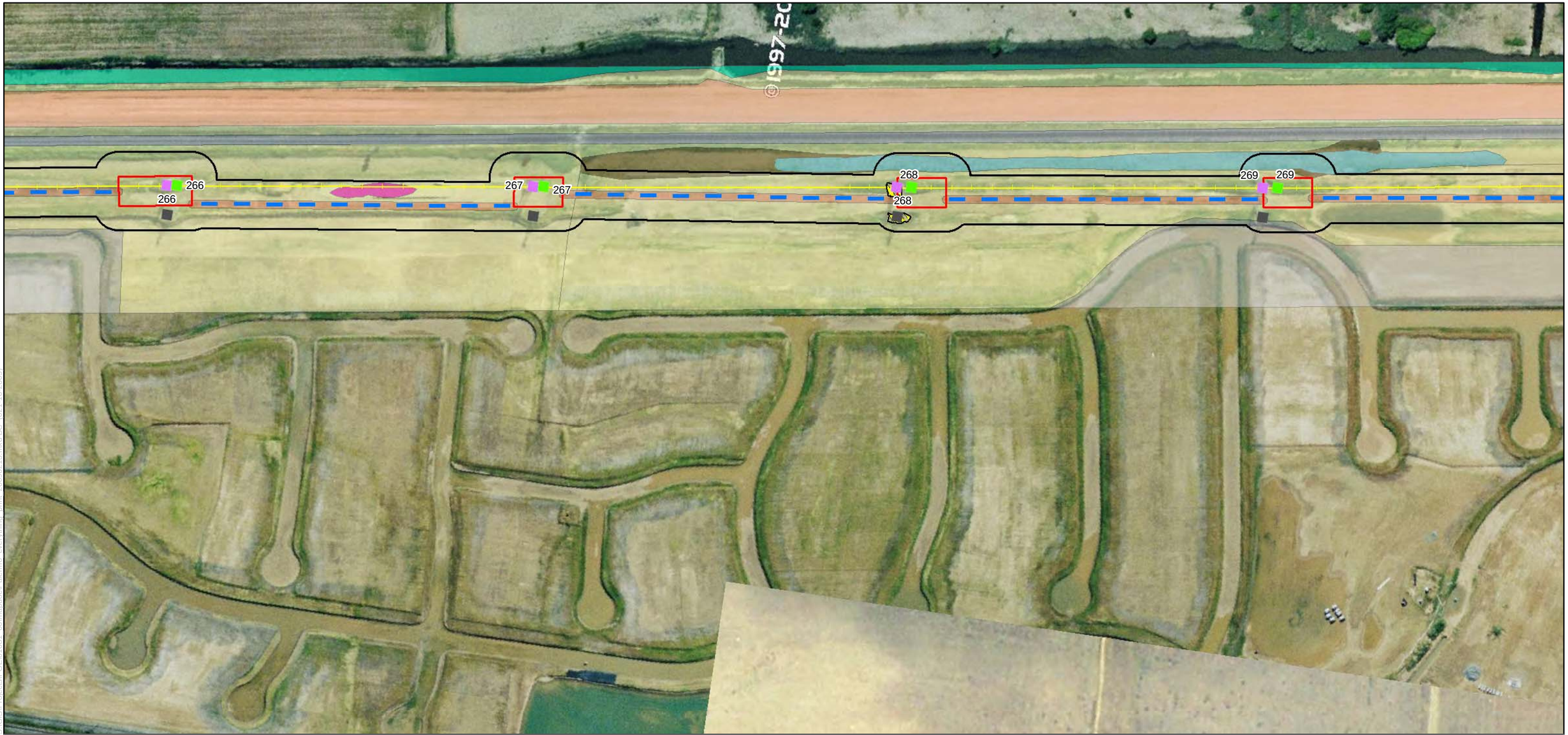

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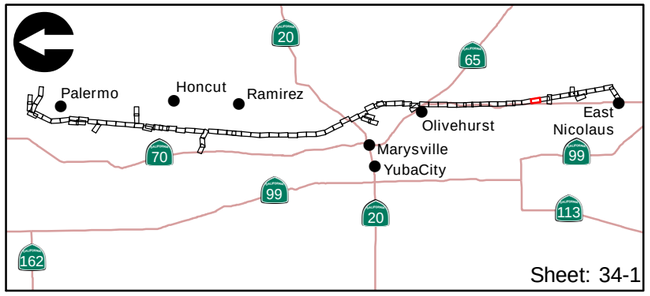

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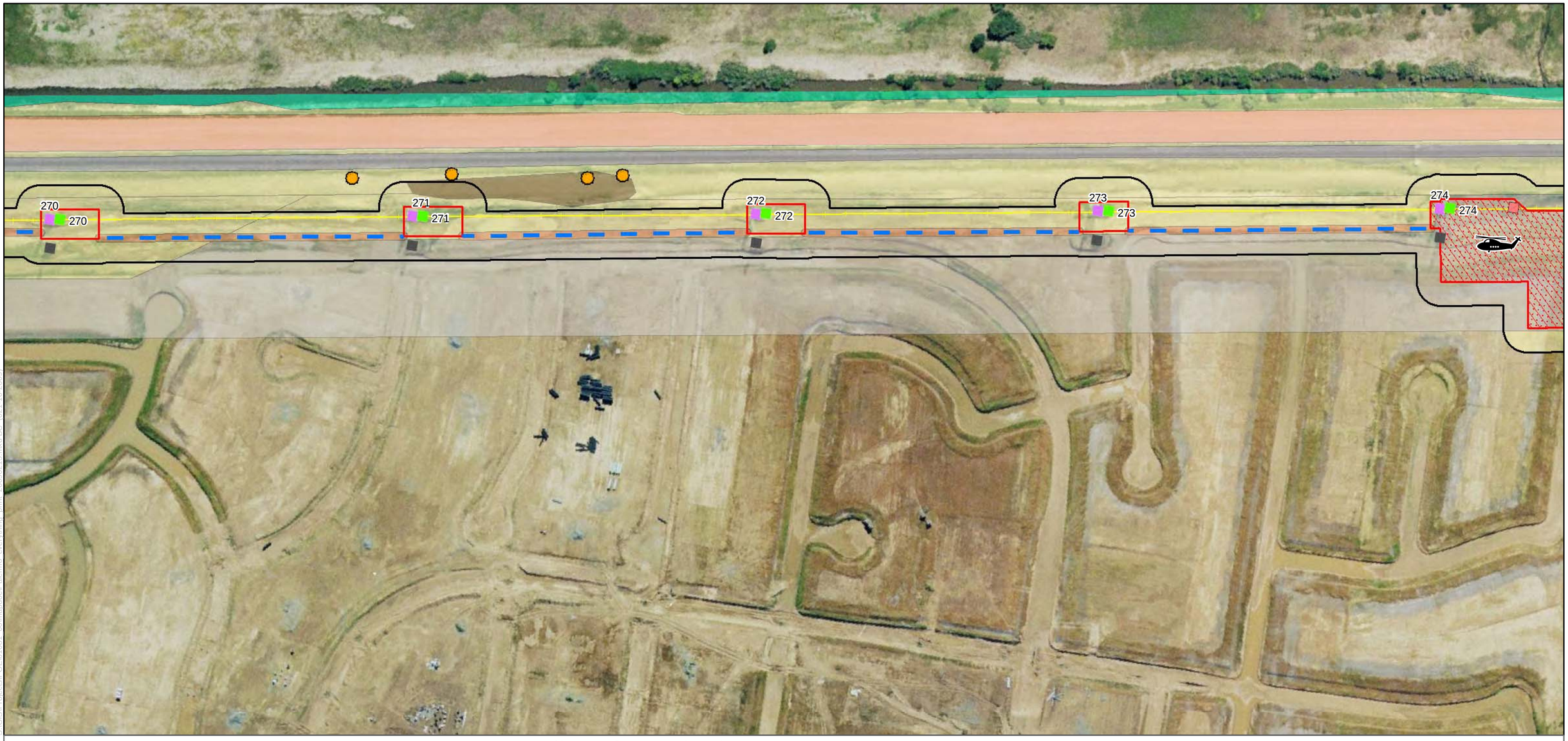

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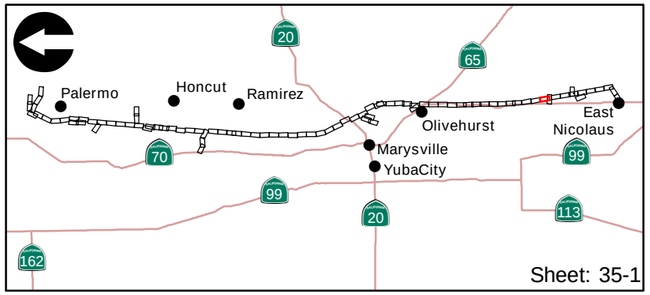

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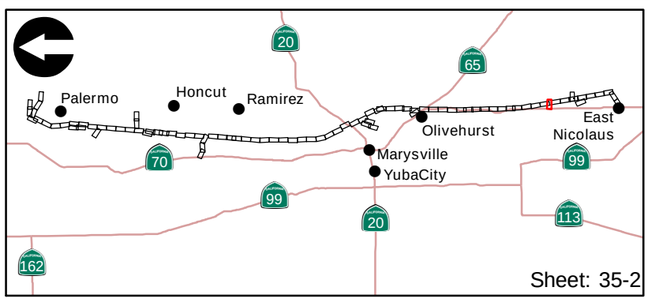

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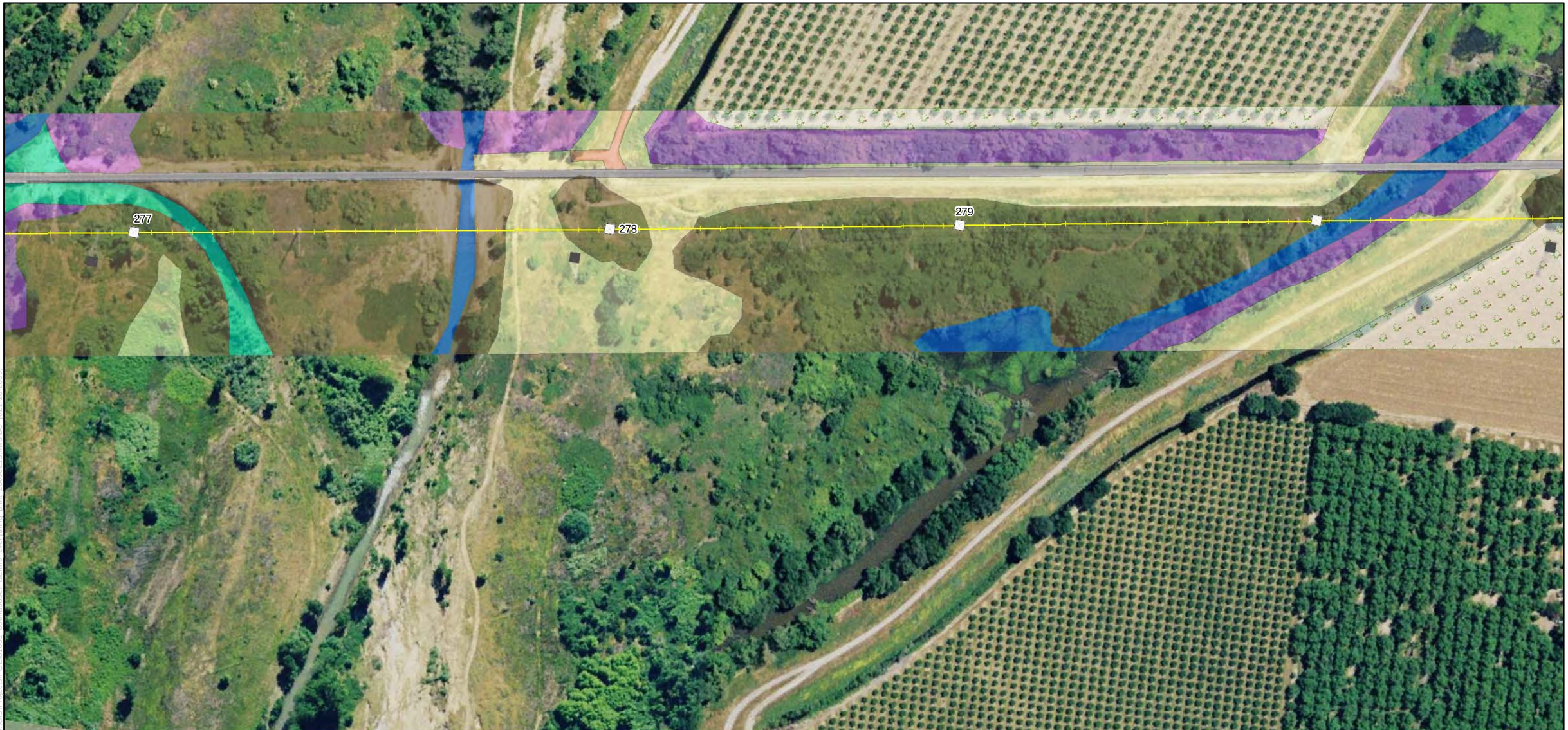

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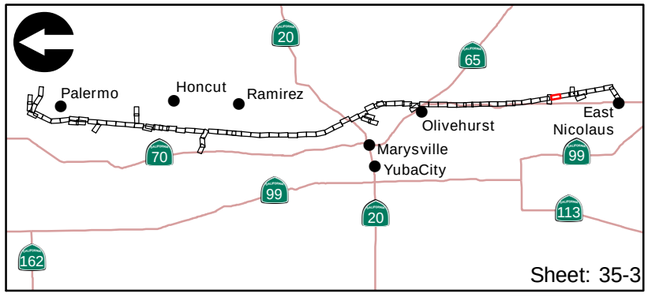

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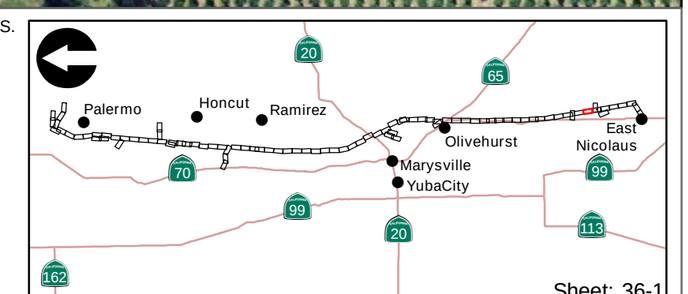

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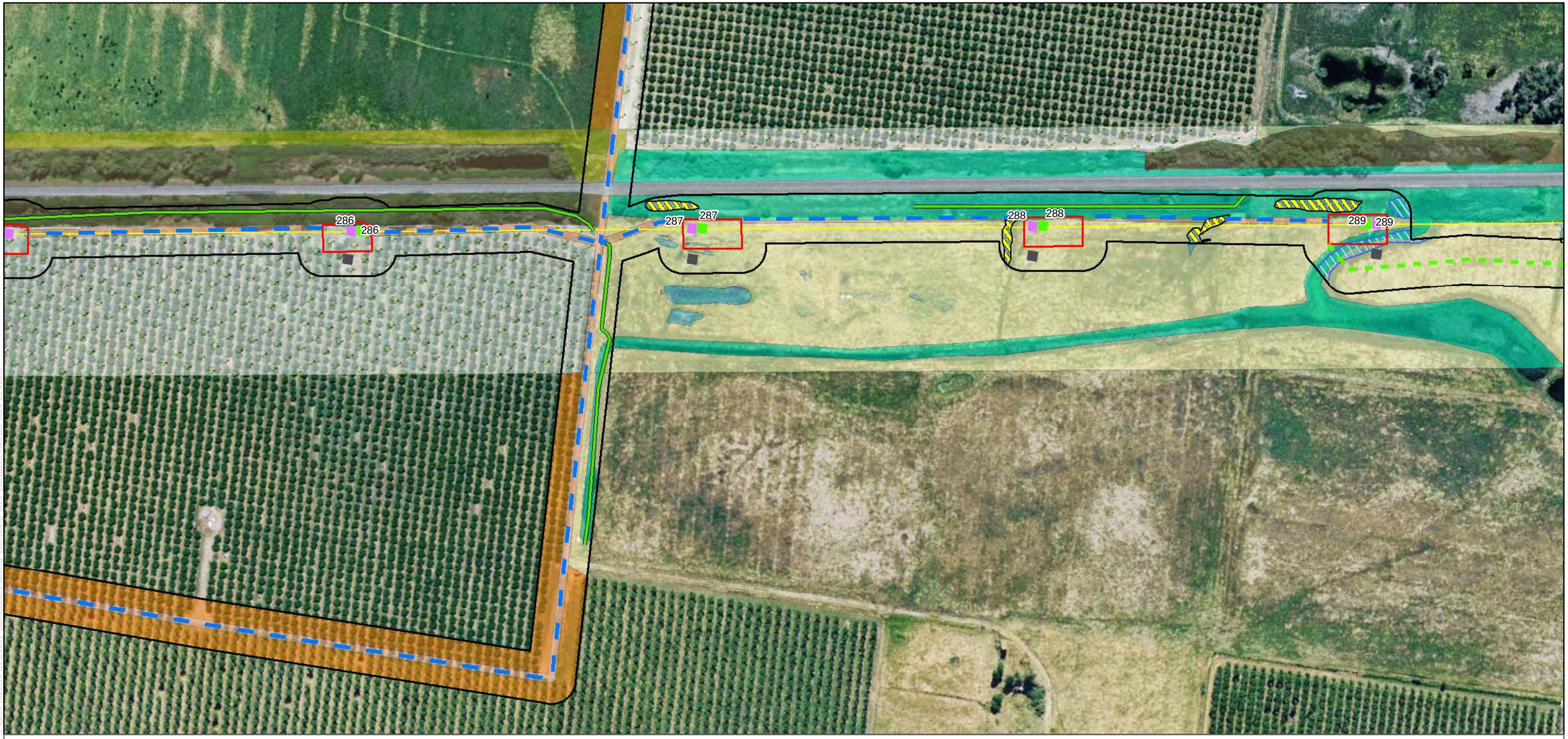

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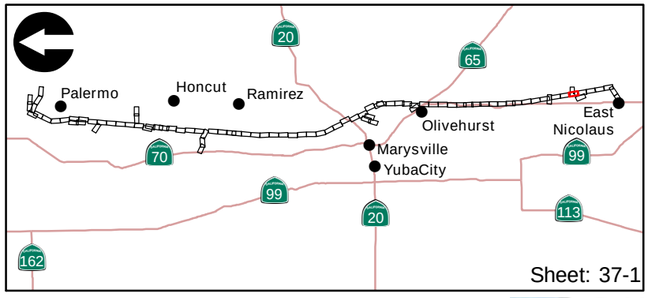
- Non-JD Seasonal Wetland
- Non-JD Northern Hardpan Vernal Pool

Potentially Jurisdictional Waters of the U.S.

- Freshwater Marsh
- Seasonal Wetland
- Stock Pond
- Vernal Pool
- Vernal Swale
- Intermittent Stream
- Irrigation Canal
- Non-Vegetated Ditch
- Vegetated Ditch



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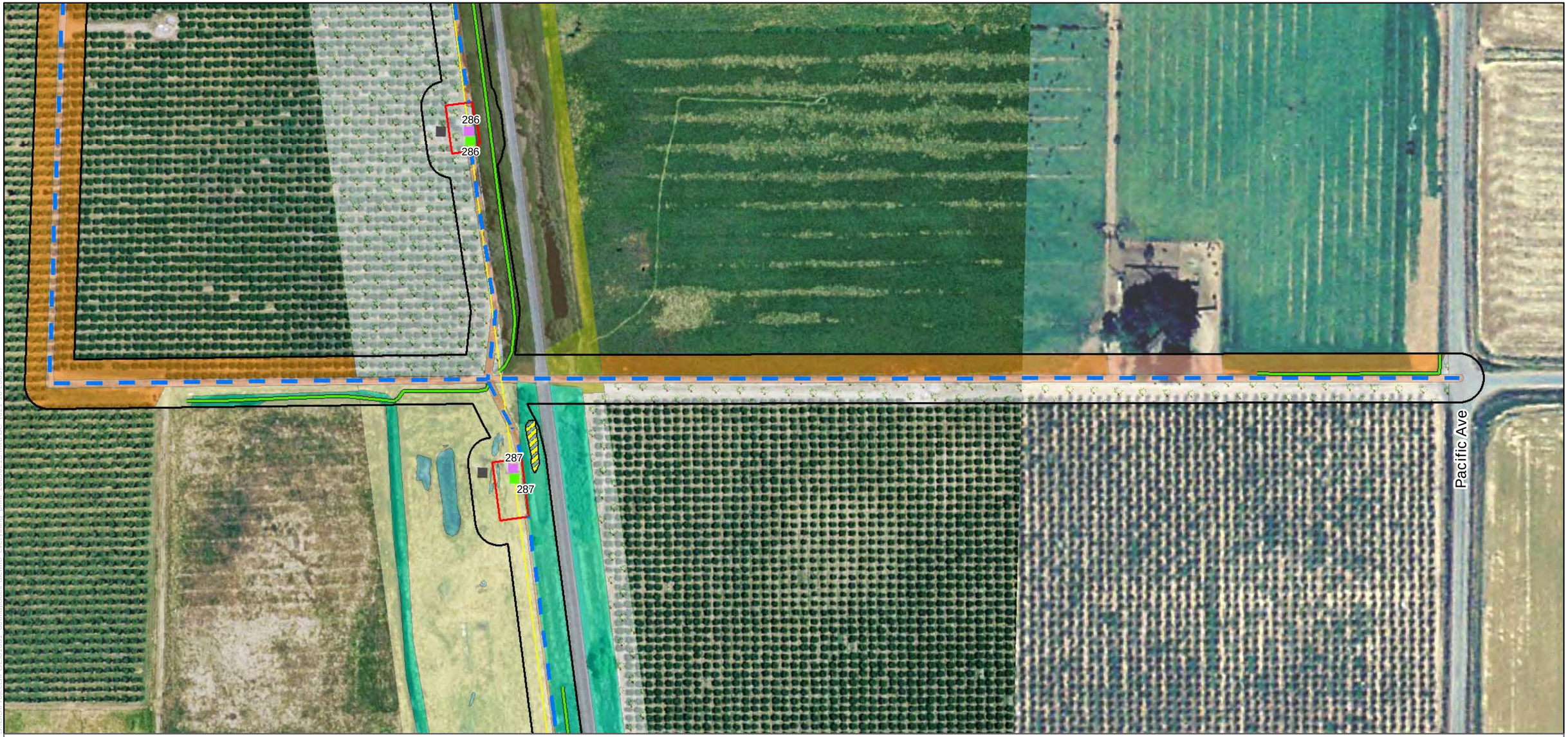
Appendix B-1

Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



Project Activities

- New Pole
- Replace Existing Tower
- Work Area
- Special Work Area
- Pull Site
- Material Staging
- Landing Zone
- Temporary Access Road
- Rice Temporarily Removed
- Project Area

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
- Transmission Line
- Existing Access Road
- Gate

Special-Status Species

- Brown Fox Sedge
- Vernal Pool Tadpole Shrimp
- Elderberry Shrub
- Elderberry Shrub Cluster

Vegetation Communities Legend only

- Non-native Grassland
- Valley Oak Savanna Woodland
- Interior Live Oak Woodland
- Foothill Pine / Oak Woodland
- Urban
- Urban Park
- Rural Residential
- Irrigated Pasture
- Orchard
- Rice
- Row Crops
- Riparian Forest
- Riparian Scrub
- Open Water
- Valley Freshwater Marsh
- Non-JD Seasonal Wetland
- Non-JD Northern Hardpan Vernal Pool

Potentially Jurisdictional Waters of the U.S.

- Freshwater Marsh
- Seasonal Wetland
- Stock Pond
- Vernal Pool
- Vernal Swale
- Intermittent Stream
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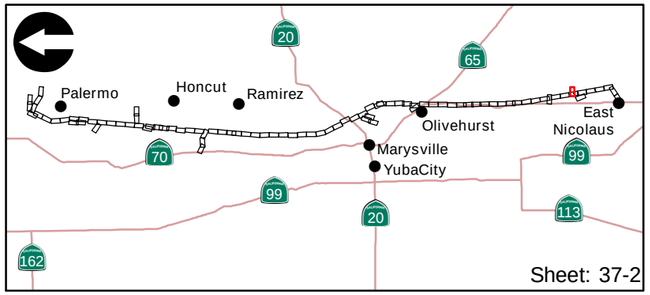
- Non-Vegetated Ditch
- Vegetated Ditch



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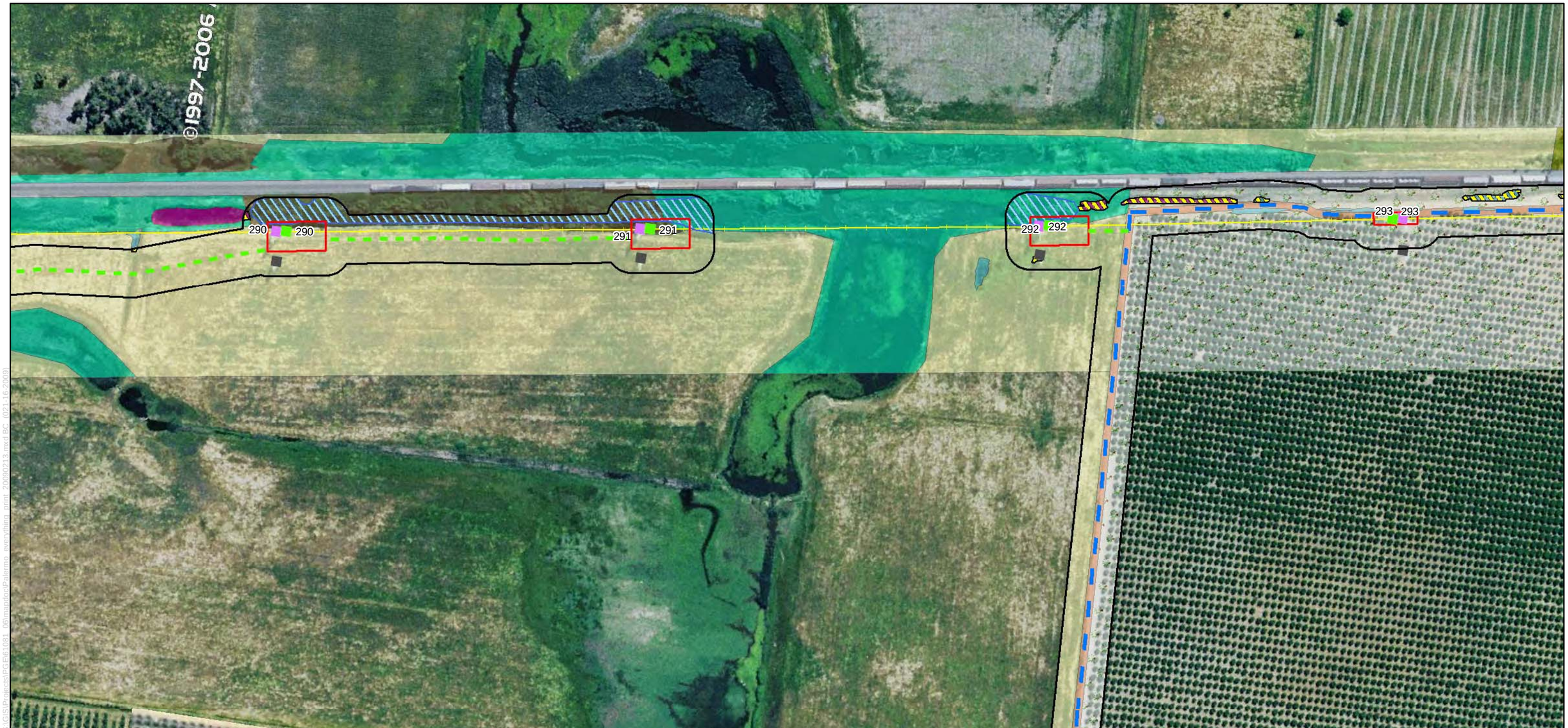
Appendix B-1
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



Project Activities

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- Work Area
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Potentially Jurisdictional Waters of the U.S.

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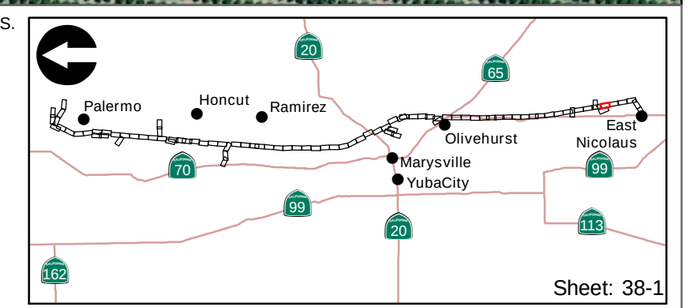

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Appendix B-1
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.

Project Activities

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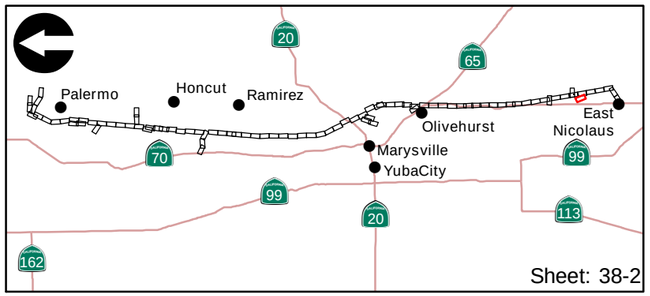

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Appendix B-1
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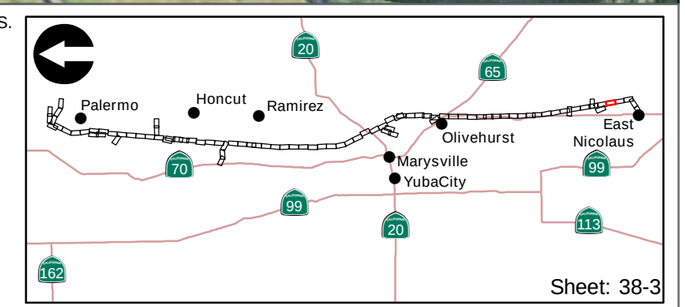

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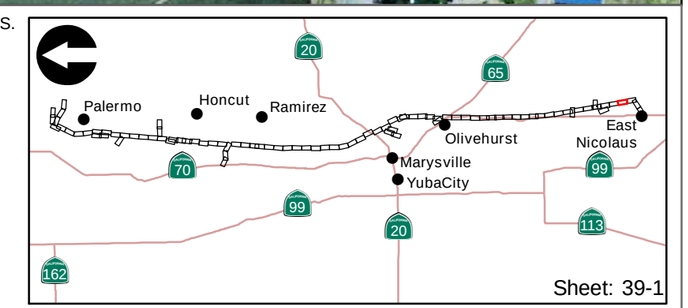

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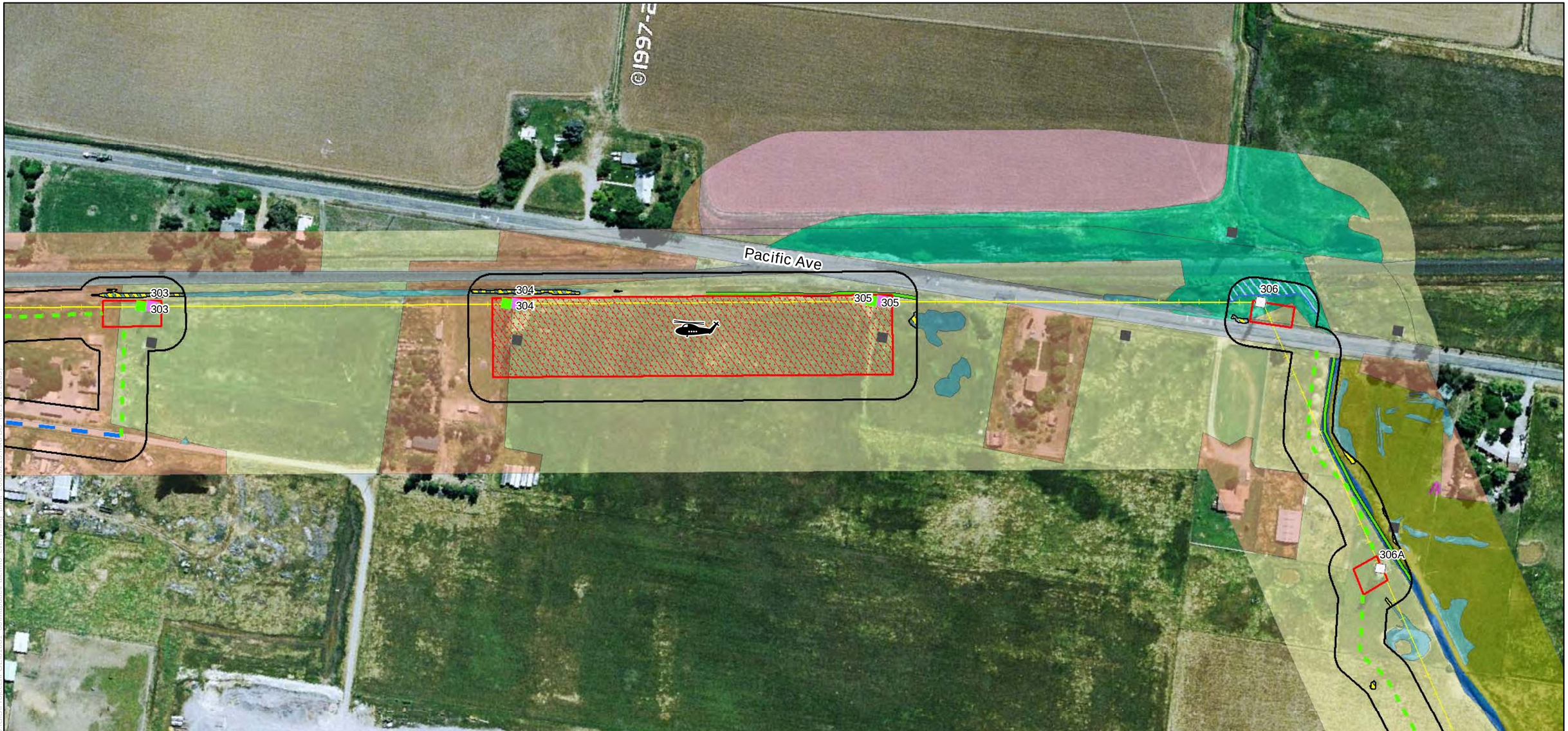
Appendix B-1
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



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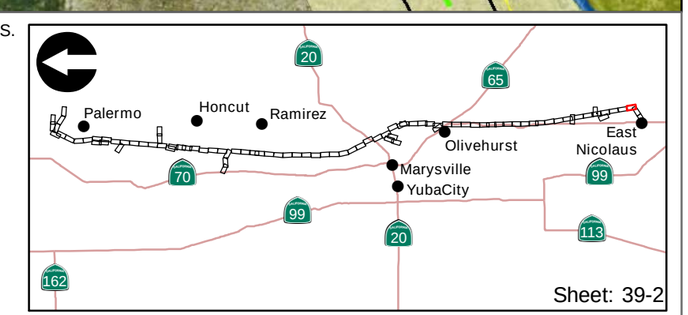

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Appendix B-1
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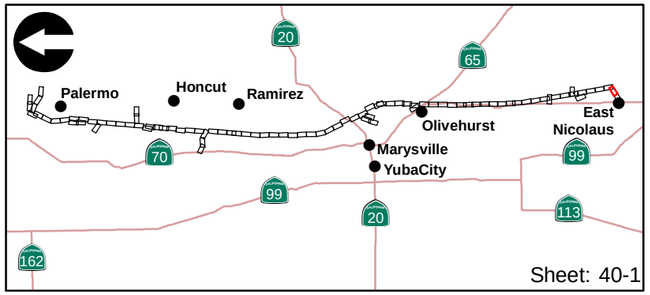

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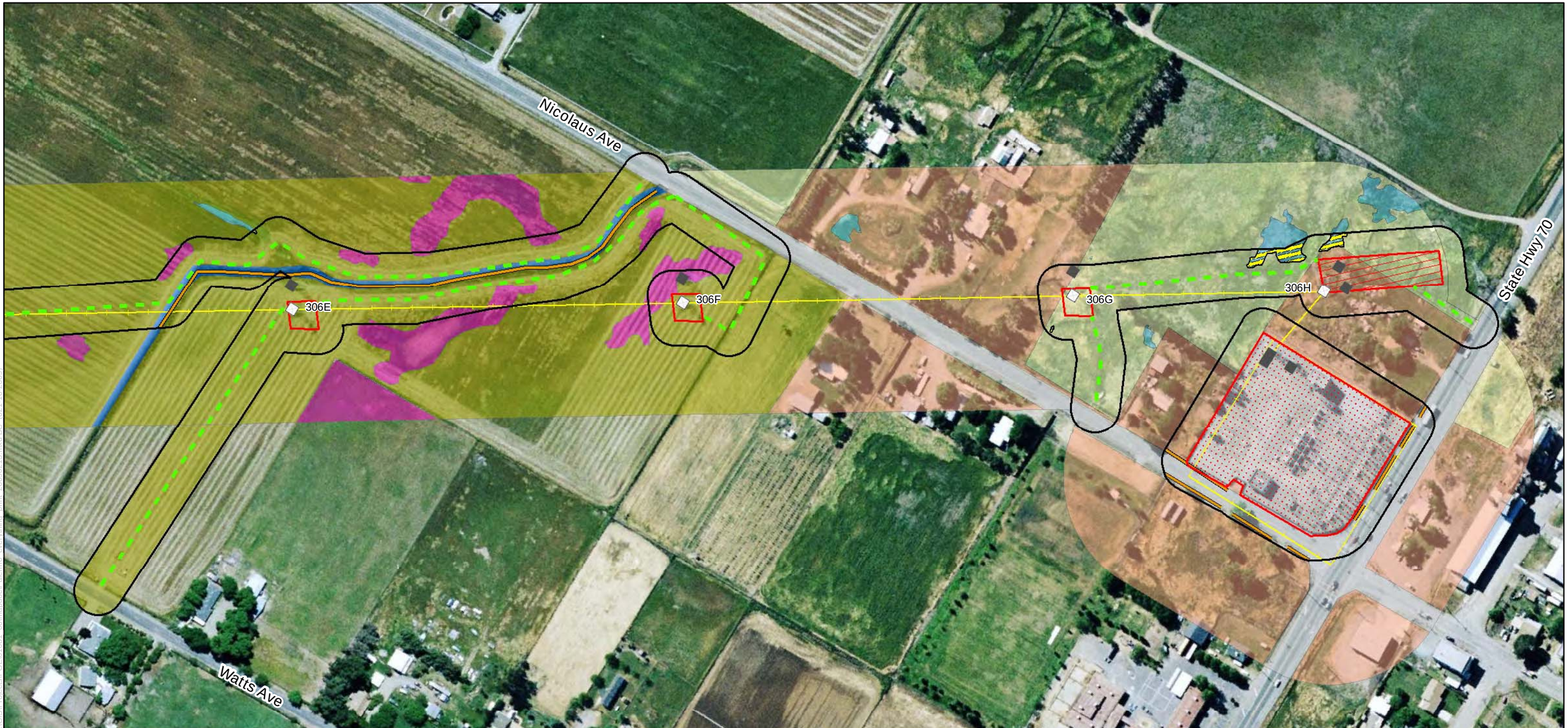
Appendix B-1
Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.



Project Activities

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- Replace Existing Tower
- Work Area
- Special Work Area
- Pull Site
- Material Staging
- Landing Zone
- Temporary Access Road
- Rice Temporarily Removed
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Potentially Jurisdictional Waters of the U.S.

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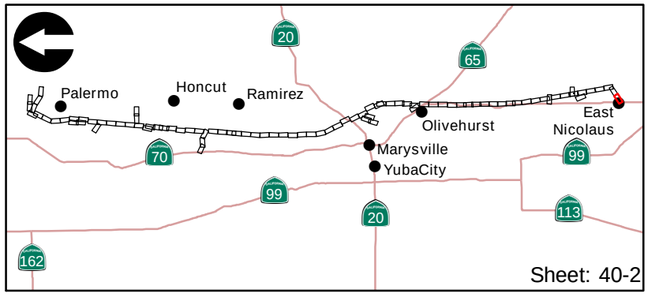
- Seasonal Wetland
- Stock Pond
- Vernal Pool
- Vernal Swale
- Intermittent Stream
- Irrigation Canal
- Non-Vegetated Ditch
- Vegetated Ditch



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Appendix B-1

Vegetation Communities, Land Cover Types, Threatened and Endangered Species Observations, and Wetlands and Waters of the U.S.

Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

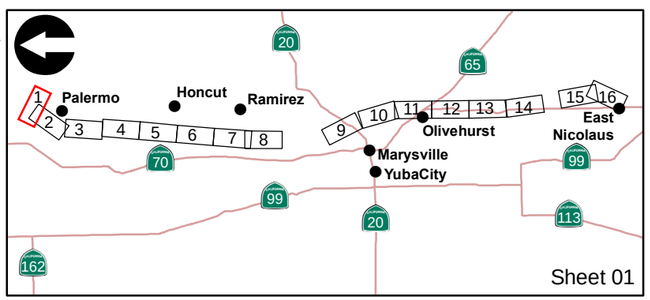
- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
- Transmission Line
- Existing Access Road

Potential Habitat for Vernal Pool Plant and Wildlife Species

- Suitable Habitat for Vernal Pool Fairy Shrimp or Vernal Pool Tadpole Shrimp
- Other Vernal Pool
- Seasonal Wetland



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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

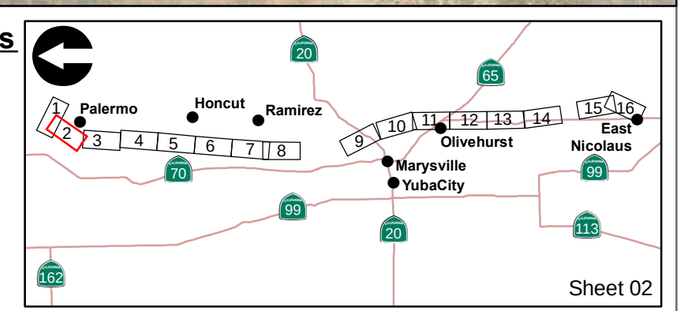
- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
- Transmission Line
- Existing Access Road

Potential Habitat for Vernal Pool Plant and Wildlife Species

- Suitable Habitat for Vernal Pool Fairy Shrimp or Vernal Pool Tadpole Shrimp
- Other Vernal Pool
- Seasonal Wetland



Sheet 02

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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

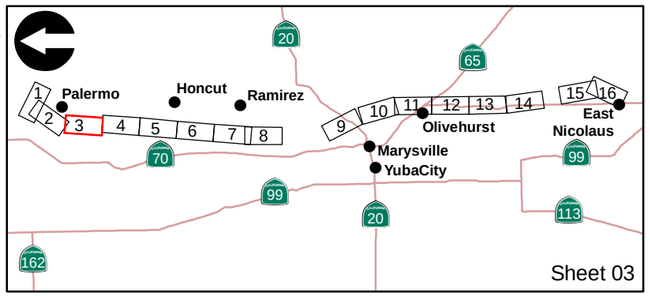
- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
- Transmission Line
- Existing Access Road

Potential Habitat for Vernal Pool Plant and Wildlife Species

- Suitable Habitat for Vernal Pool Fairy Shrimp or Vernal Pool Tadpole Shrimp
- Other Vernal Pool
- Seasonal Wetland



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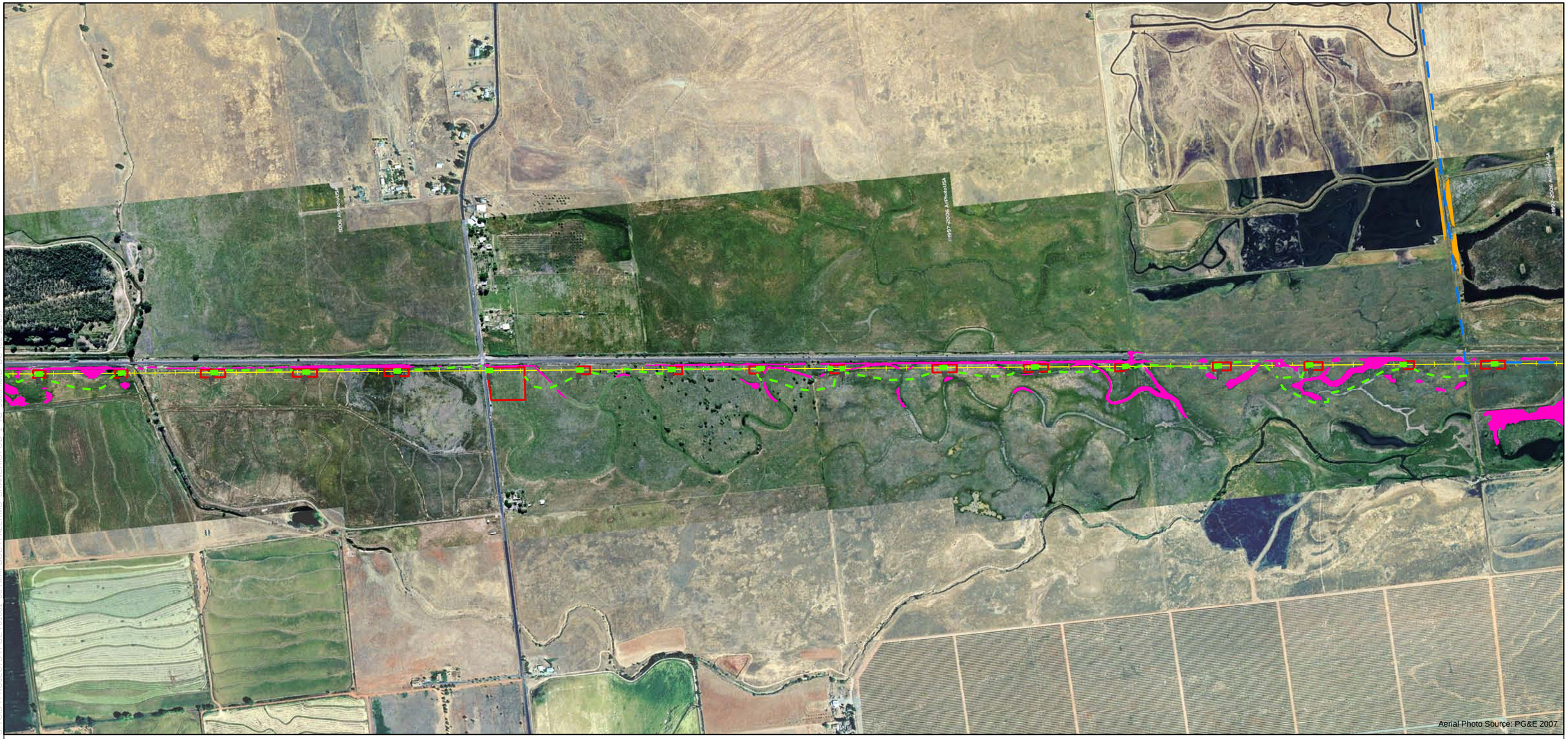
Appendix B-2
Potential Habitat for Listed Vernal Pool Species



Project Activities

- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
- Transmission Line
- Existing Access Road

Potential Habitat for Vernal Pool Plant and Wildlife Species

- Suitable Habitat for Vernal Pool Fairy Shrimp or Vernal Pool Tadpole Shrimp
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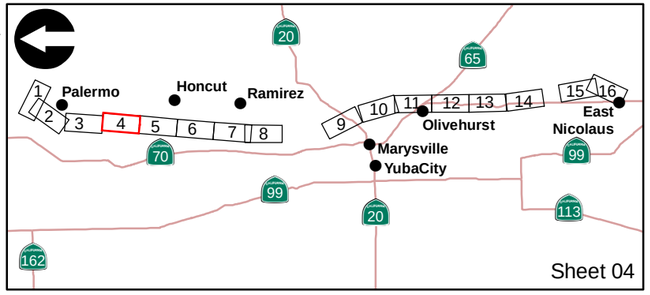
- Seasonal Wetland



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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

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Potential Habitat for Vernal Pool Plant and Wildlife Species

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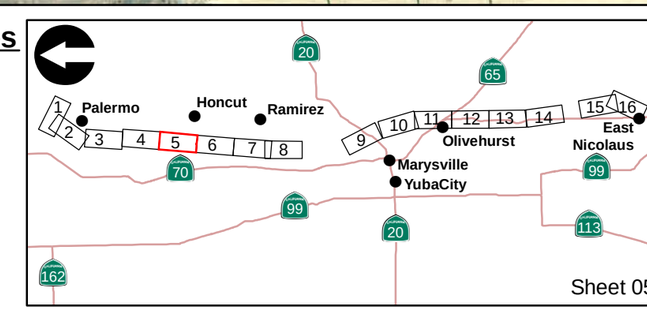

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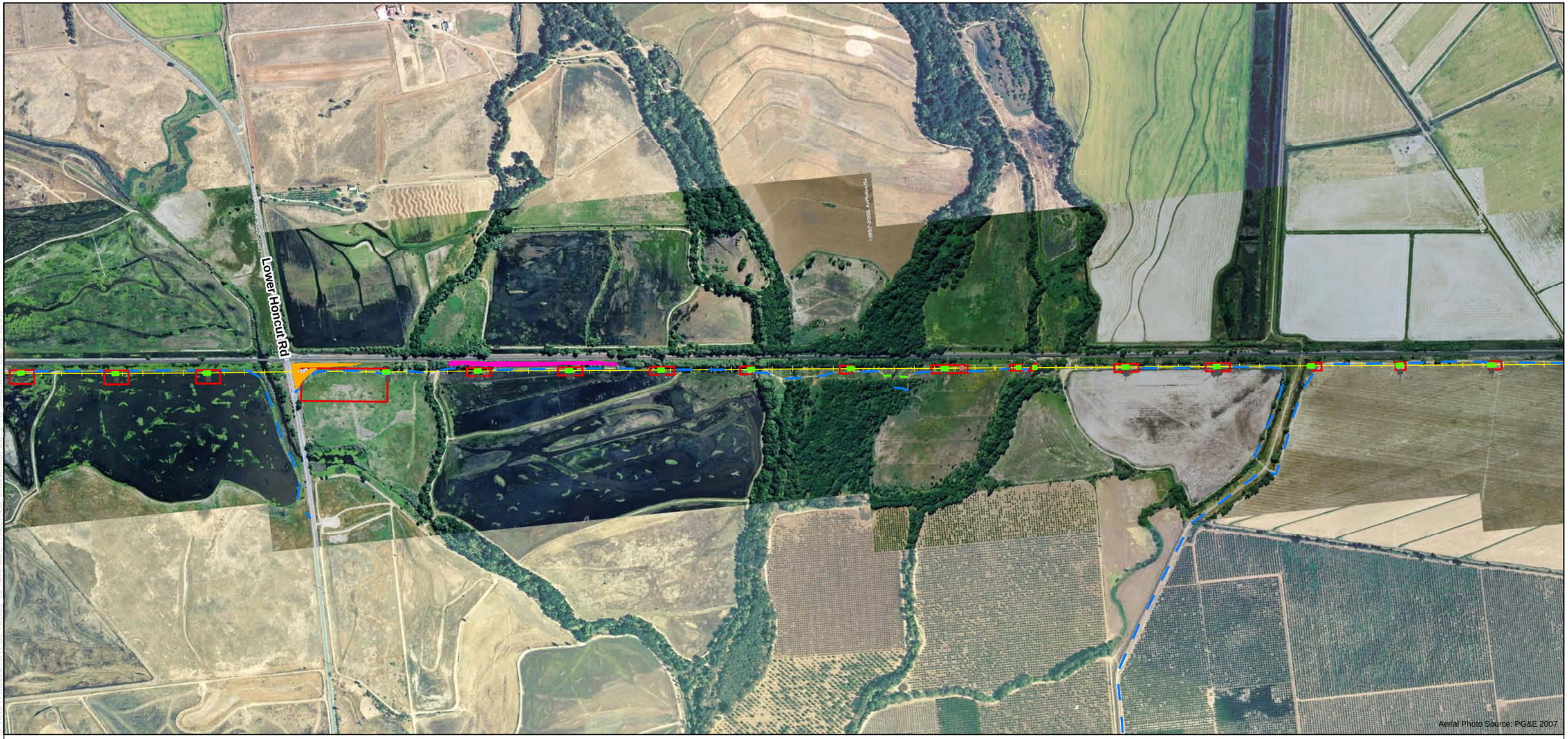
Appendix B-2
Potential Habitat for Listed Vernal Pool Species



Project Activities

- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
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- Tower on Adjacent Line - No Structure Work
- Transmission Line
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Potential Habitat for Vernal Pool Plant and Wildlife Species

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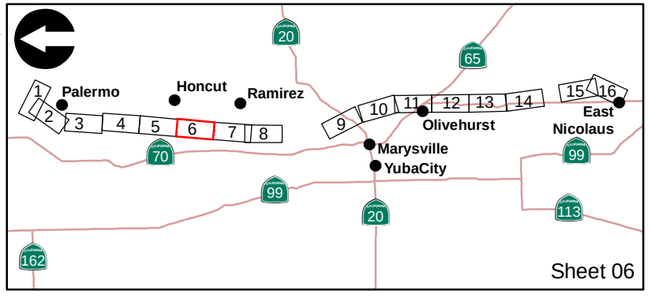
- Seasonal Wetland



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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
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Potential Habitat for Vernal Pool Plant and Wildlife Species

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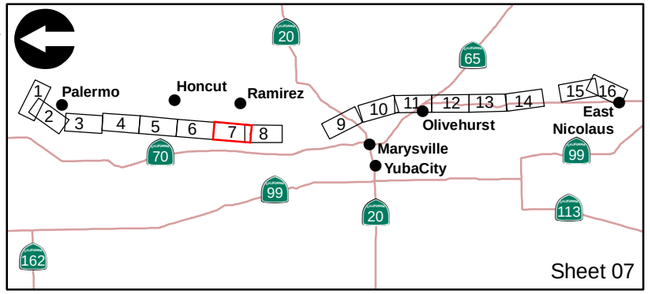
- Other Vernal Pool
- Seasonal Wetland



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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

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Project Activities

- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
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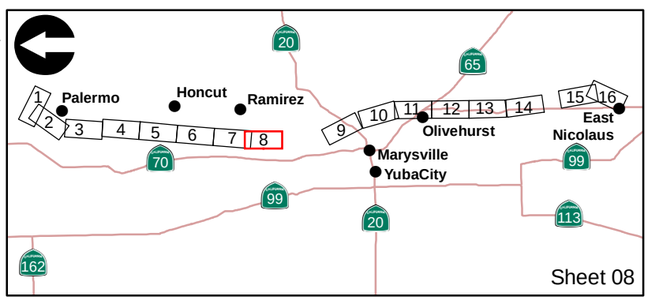

Sheet 08

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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
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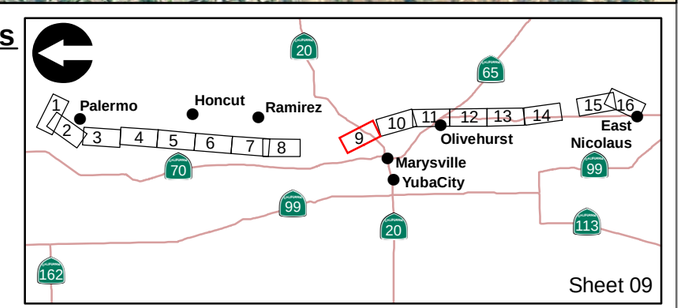
Potential Habitat for Vernal Pool Plant and Wildlife Species

- Suitable Habitat for Vernal Pool Fairy Shrimp or Vernal Pool Tadpole Shrimp
- Other Vernal Pool
- Seasonal Wetland



Feet
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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

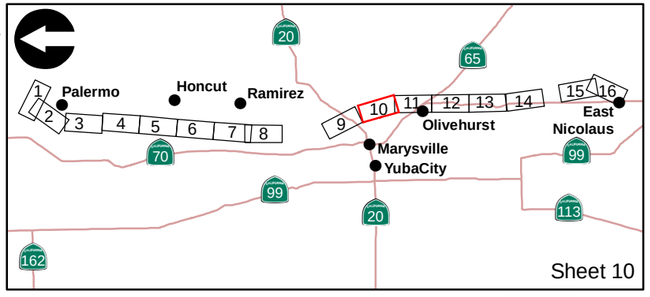
- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
- Tower on Adjacent Line - No Structure Work
- Transmission Line
- Existing Access Road

Potential Habitat for Vernal Pool Plant and Wildlife Species

- Suitable Habitat for Vernal Pool Fairy Shrimp or Vernal Pool Tadpole Shrimp
- Other Vernal Pool
- Seasonal Wetland



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ICF Jones & Stokes
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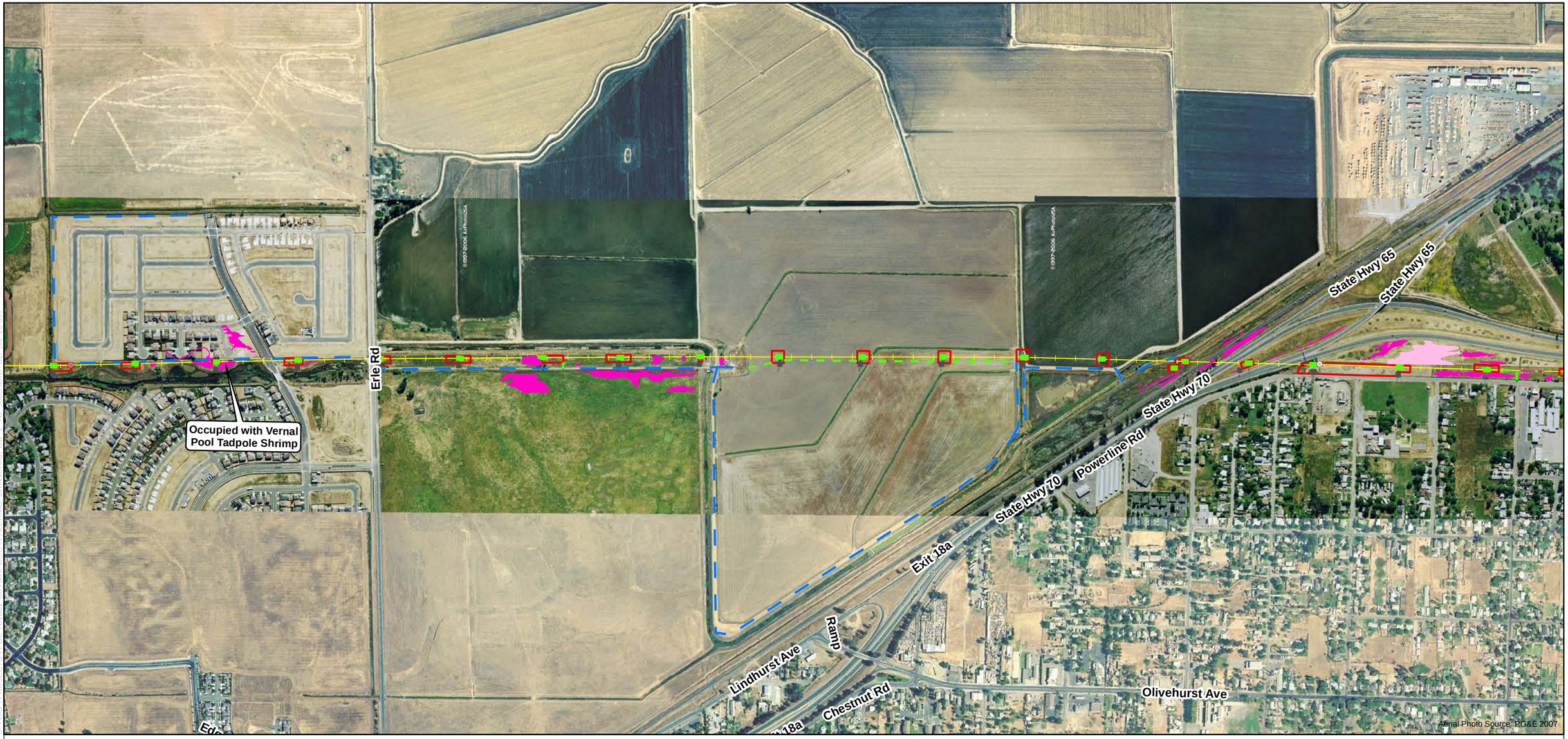
Appendix B-2
Potential Habitat for Listed Vernal Pool Species



Project Activities

- Work Area
- Tower Site
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Existing Facilities

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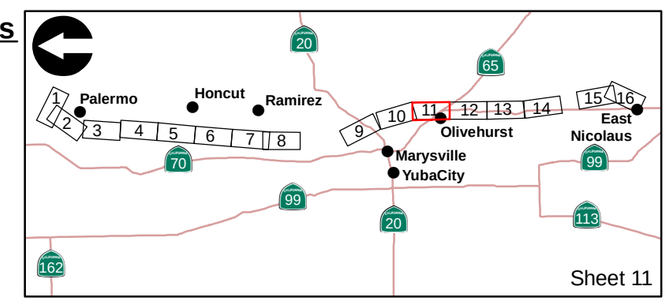

Feet
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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

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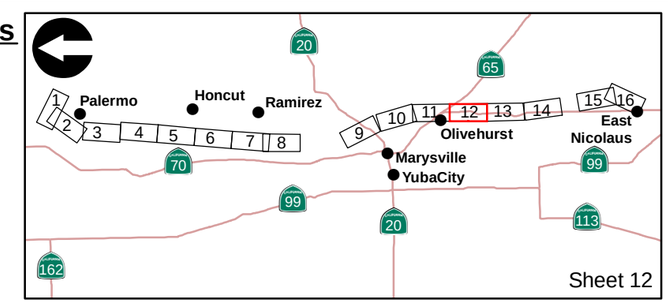

Feet
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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

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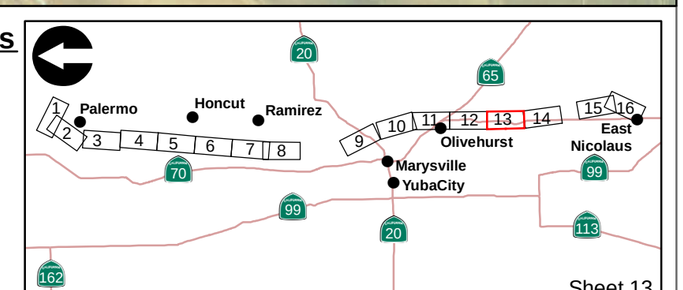

Feet
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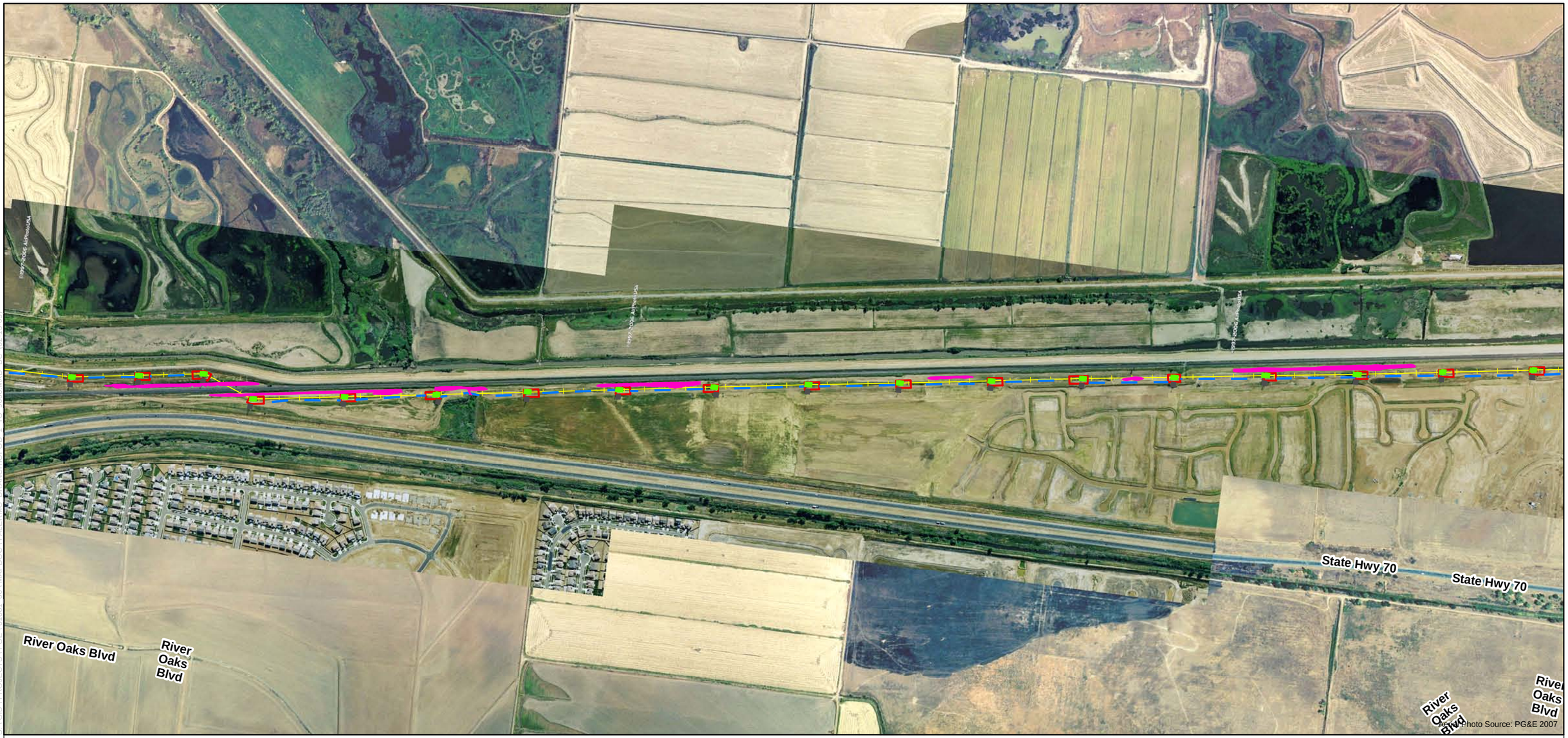
ICF Jones & Stokes
an ICF International Company

Appendix B-2
Potential Habitat for Listed Vernal Pool Species



Project Activities

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- Tower Site
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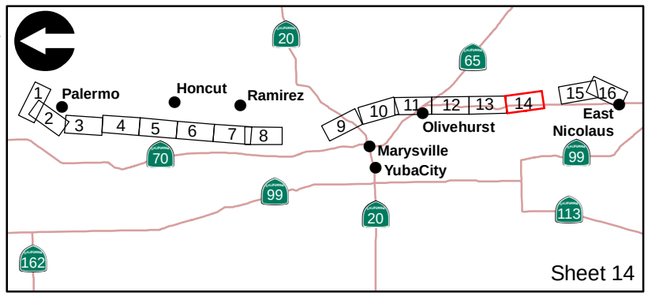

Feet
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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

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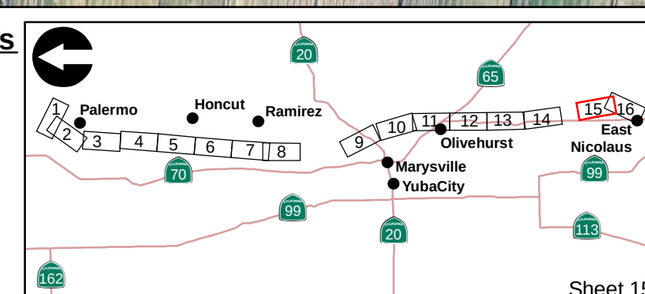

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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Project Activities

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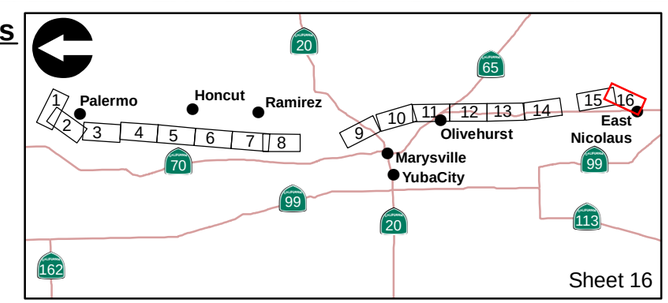

Feet
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Appendix B-2
Potential Habitat for Listed Vernal Pool Species

Appendix B-3
Suitable Habitat for Giant Garter Snake

Project Activities

- Work Area
- Tower Site
- Temporary Access Road
- Rice Temporarily Removed

Existing Facilities

- Eliminate Tower
- Existing Tower - No Structure Work
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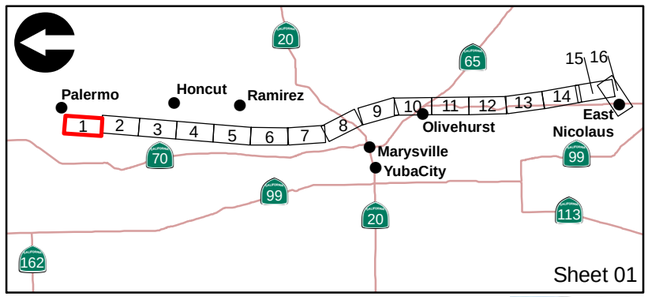
- Transmission Line
- Existing Access Road

Giant Garter Snake Suitable Habitat

- Suitable Upland Habitat
- Suitable Rice Habitat
- Suitable Aquatic Habitat



Feet

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Appendix B-3
Suitable Habitat for Giant Garter Snake

Project Activities

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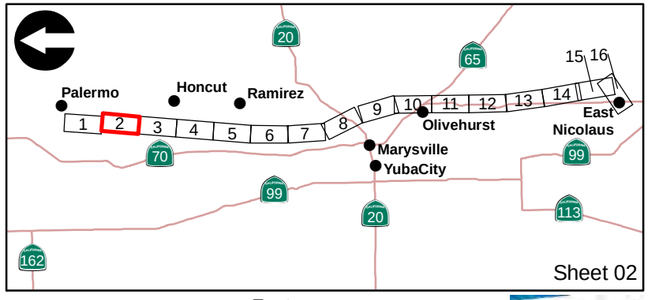

Feet
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Appendix B-3
Suitable Habitat for Giant Garter Snake

Project Activities

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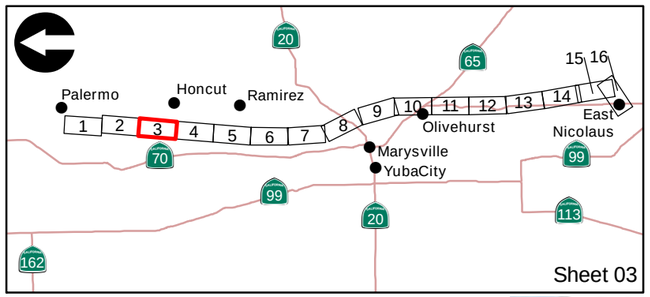

Feet
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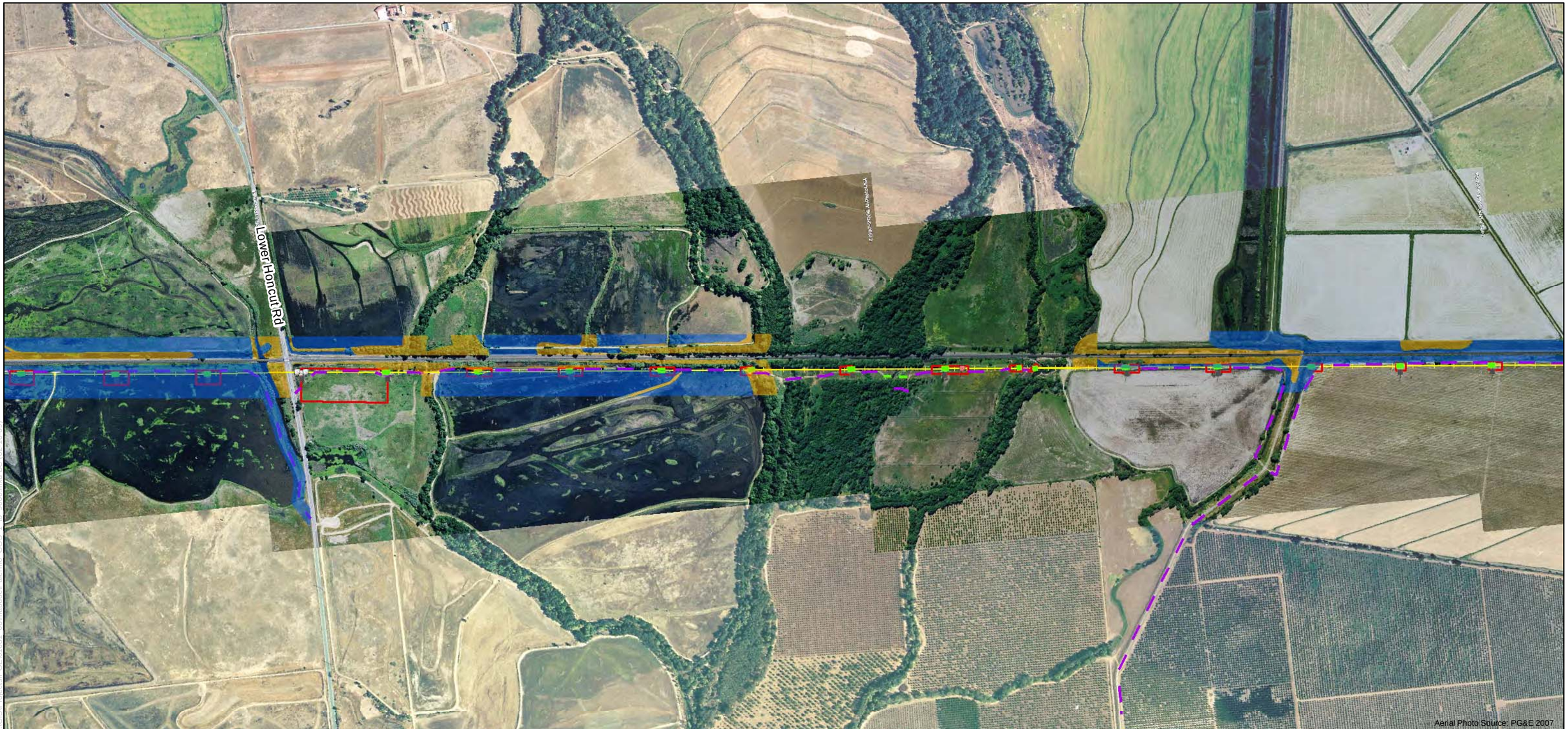
ICF Jones & Stokes

Appendix B-3
Suitable Habitat for Giant Garter Snake



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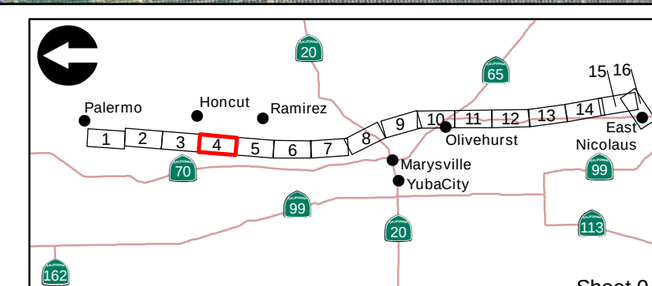

Feet
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Appendix B-3
Suitable Habitat for Giant Garter Snake

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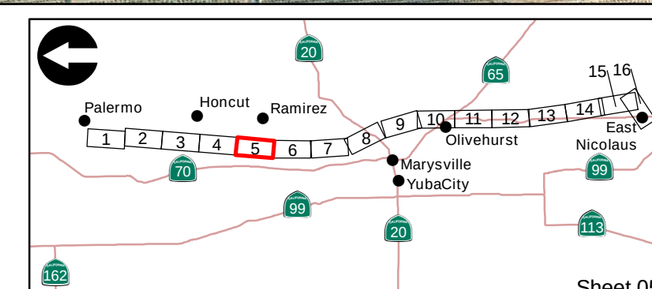

Feet
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Appendix B-3
Suitable Habitat for Giant Garter Snake

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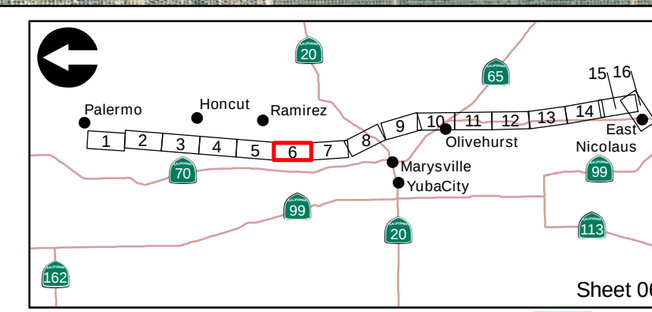

Feet
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Appendix B-3
Suitable Habitat for Giant Garter Snake

Project Activities

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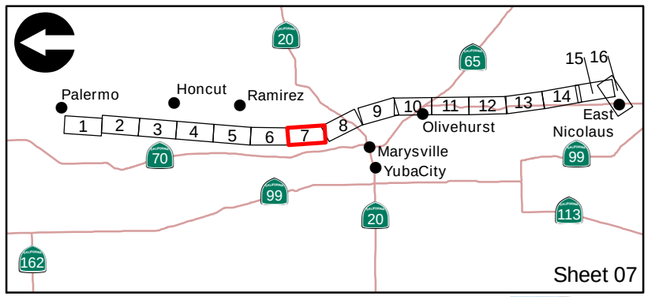

Feet

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Appendix B-3
Suitable Habitat for Giant Garter Snake

Project Activities

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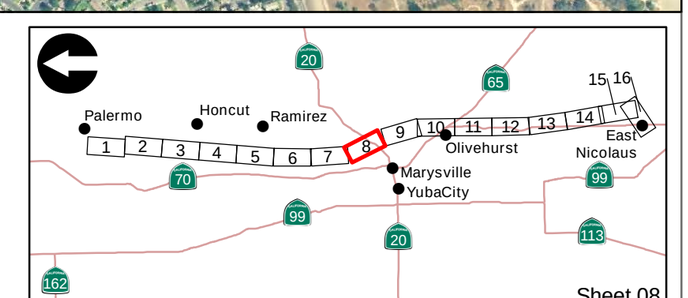

Feet
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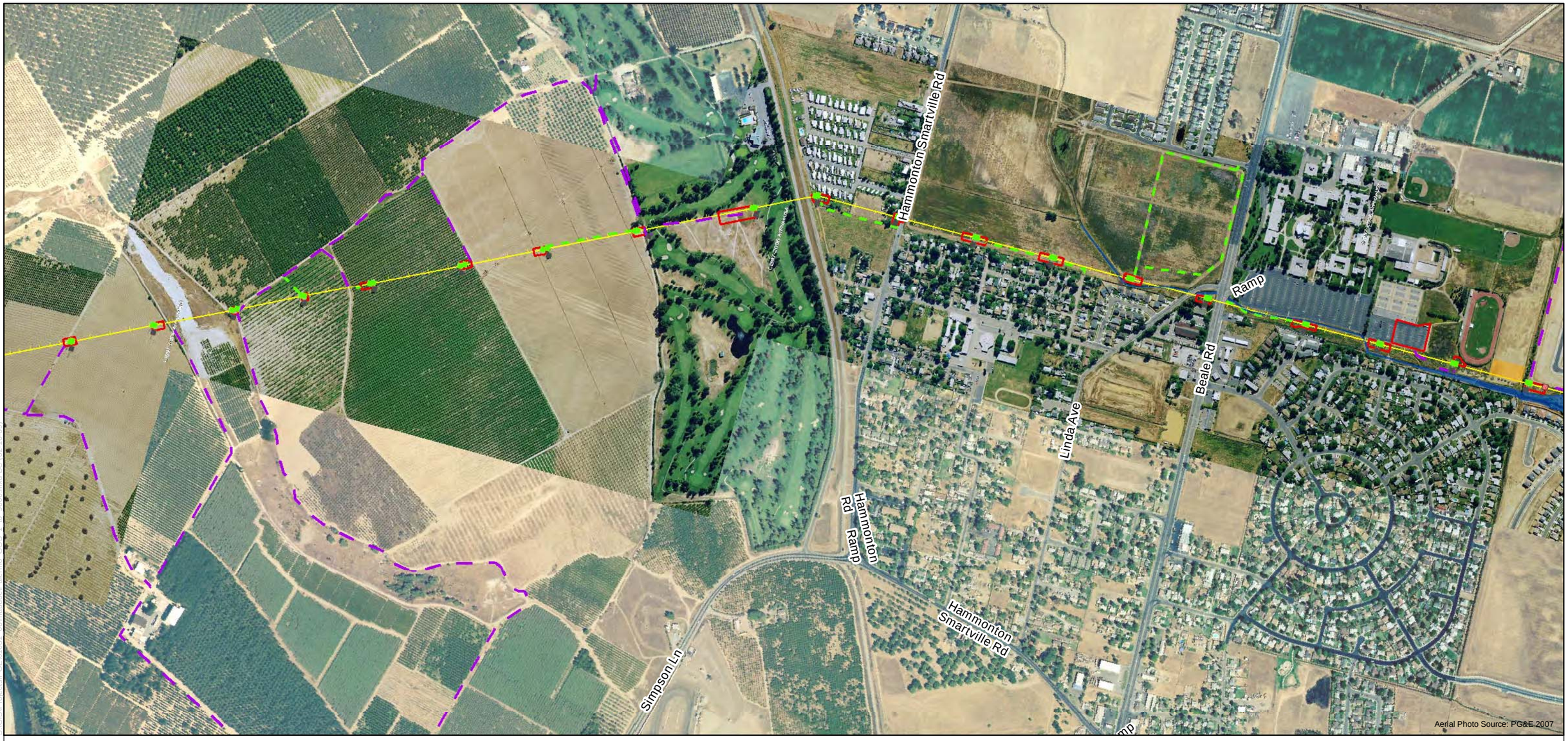
ICF Jones & Stokes

Appendix B-3
Suitable Habitat for Giant Garter Snake



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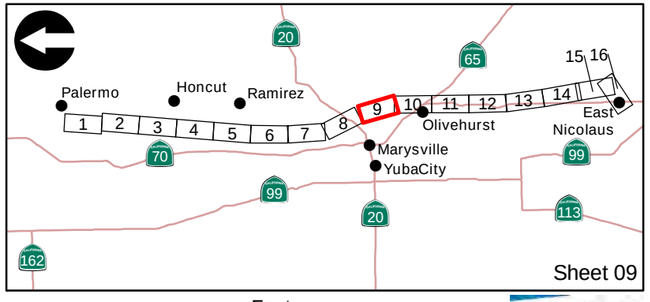

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ICF Jones & Stokes

Appendix B-3
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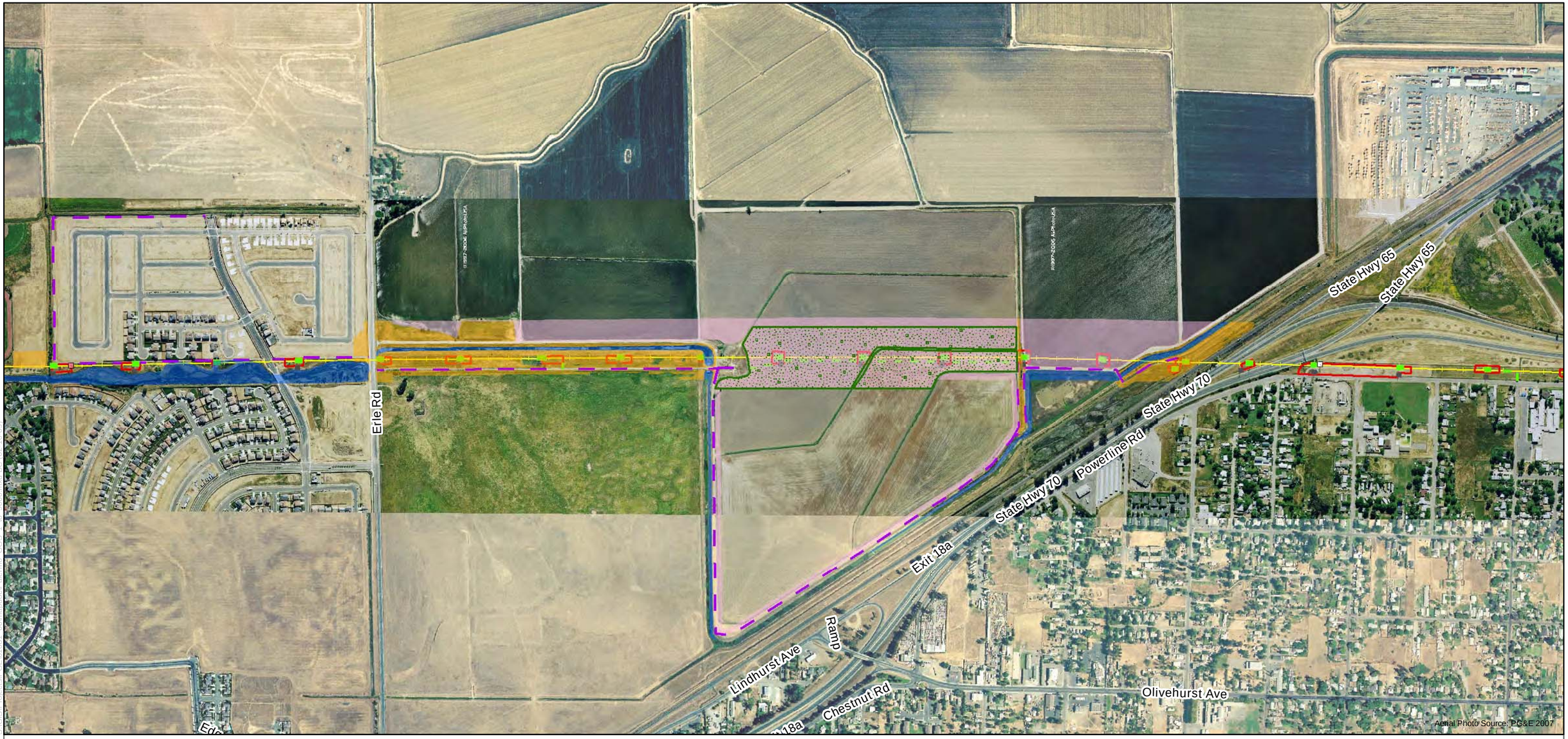

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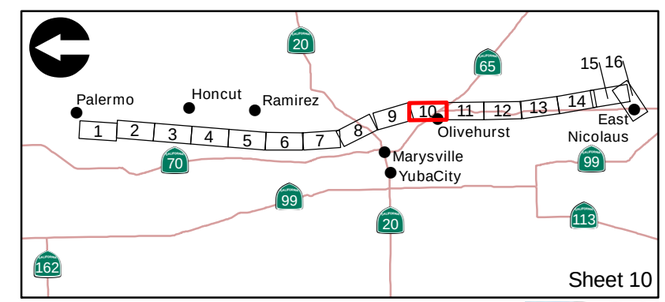

Feet
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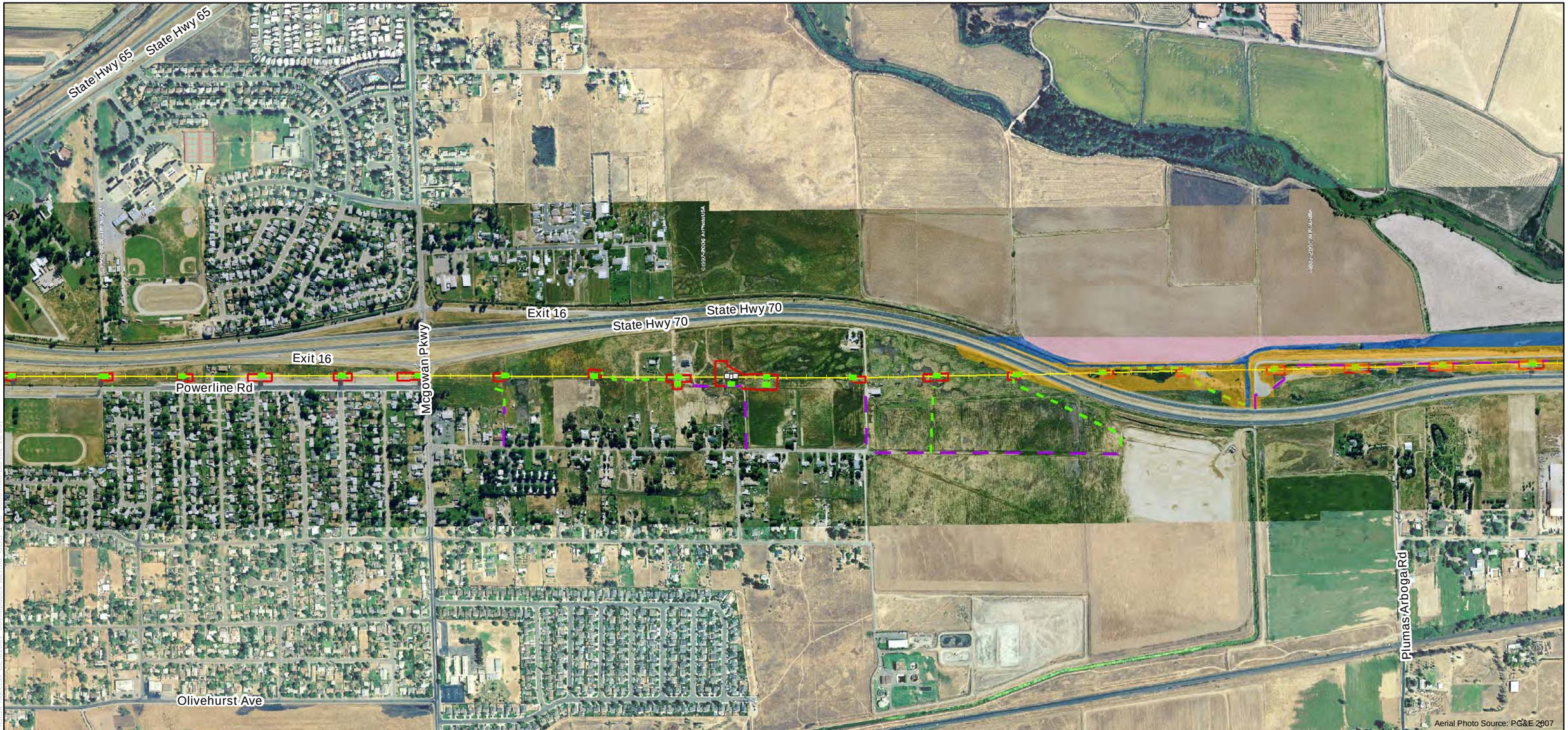
ICF Jones & Stokes

Appendix B-3
Suitable Habitat for Giant Garter Snake



Project Activities

- Work Area
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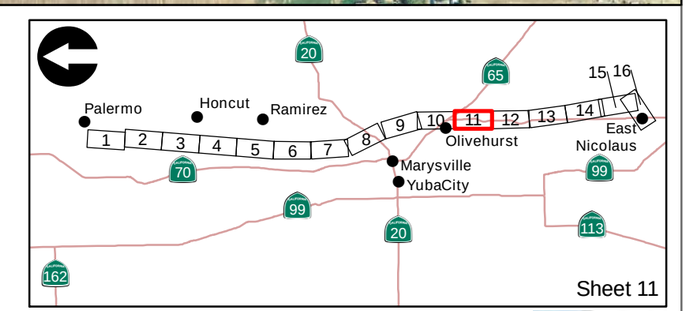

Feet

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Appendix B-3
Suitable Habitat for Giant Garter Snake

Project Activities

- Work Area
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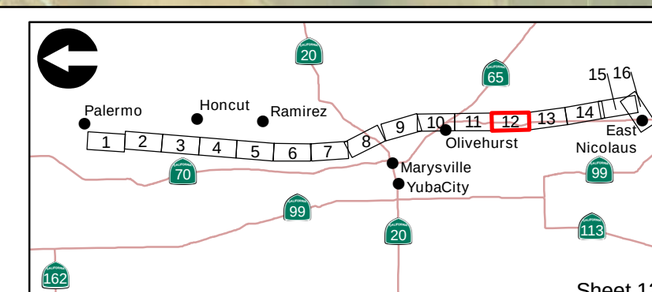

Feet

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Appendix B-3
Suitable Habitat for Giant Garter Snake

Project Activities

- Work Area
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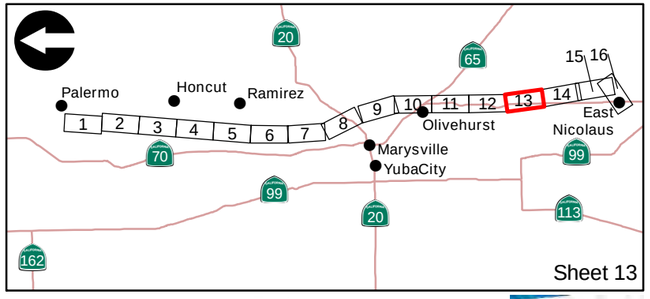

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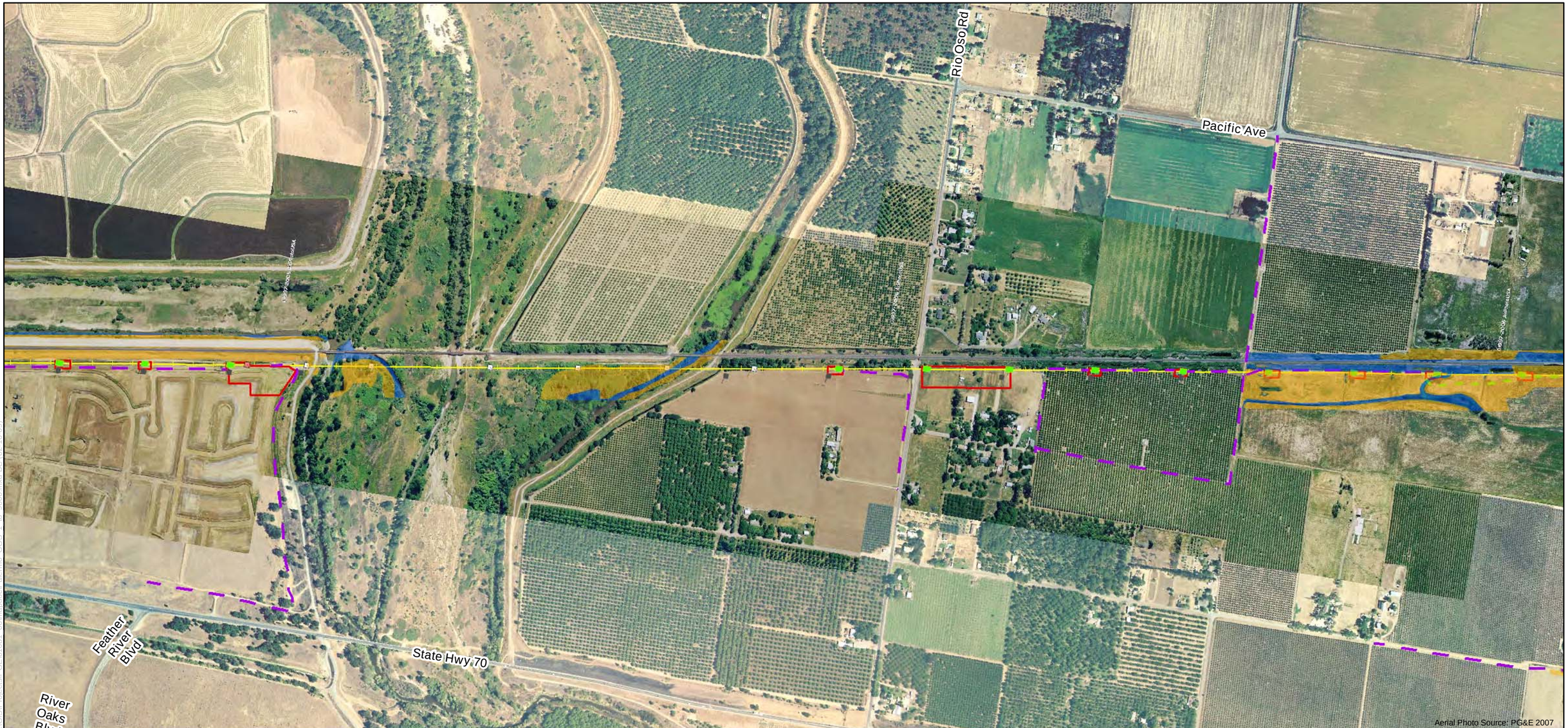
ICF Jones & Stokes

Appendix B-3
Suitable Habitat for Giant Garter Snake



Project Activities

- Work Area
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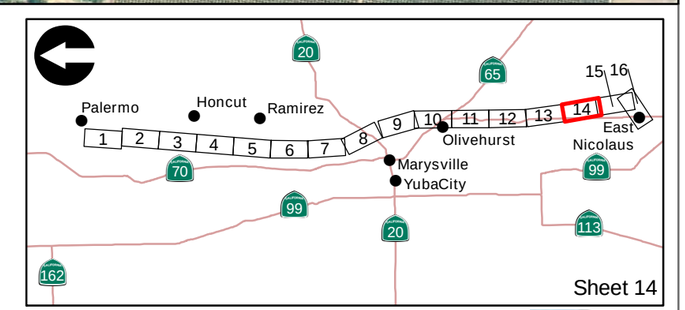

Feet
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ICF Jones & Stokes

Appendix B-3
Suitable Habitat for Giant Garter Snake

Project Activities

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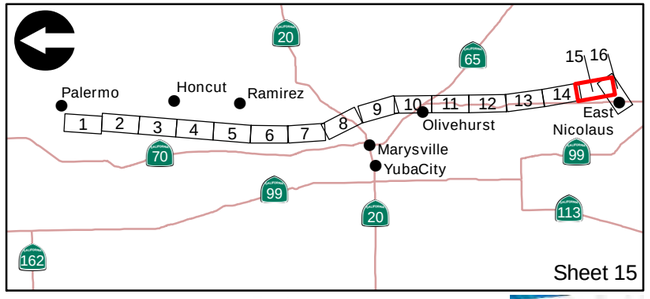

Feet

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ICF Jones & Stokes

Appendix B-3
Suitable Habitat for Giant Garter Snake

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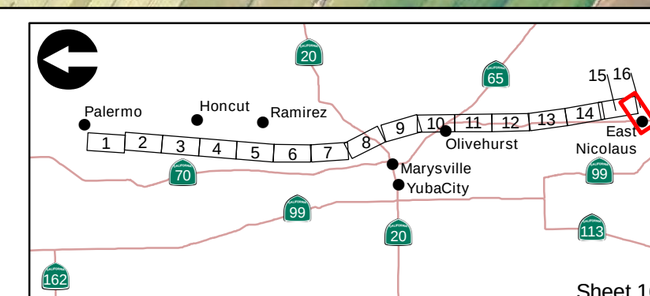

Feet
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Appendix B-3
Suitable Habitat for Giant Garter Snake

Appendix C
Palermo-East Nicolaus Transmission Line
DPR 523 Form: History, Description, and Full Significance Evaluation

State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **PRIMARY RECORD**	Primary # HRI # Trinomial NRHP Status Code
Other Listings Review Code	Reviewer Date

 ***Resource Name or #:** Palermo-East Nicolaus Transmission Line

P1. Other Identifier:

***P2. Location:** ☐ **Not for Publication** ■ **Unrestricted** ***a. County:** Butte, Yuba, Sutter

and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad:** Palermo, Honcut, Yuba City, Olivehurst, Nicolaus **Date:** **T** ; **R** ; **¼ of ¼ of Sec** ; M.D. **B.M.**

c. Address: City: Zip:

d. UTM: Zone: 10 ; mE/ mN (G.P.S.)

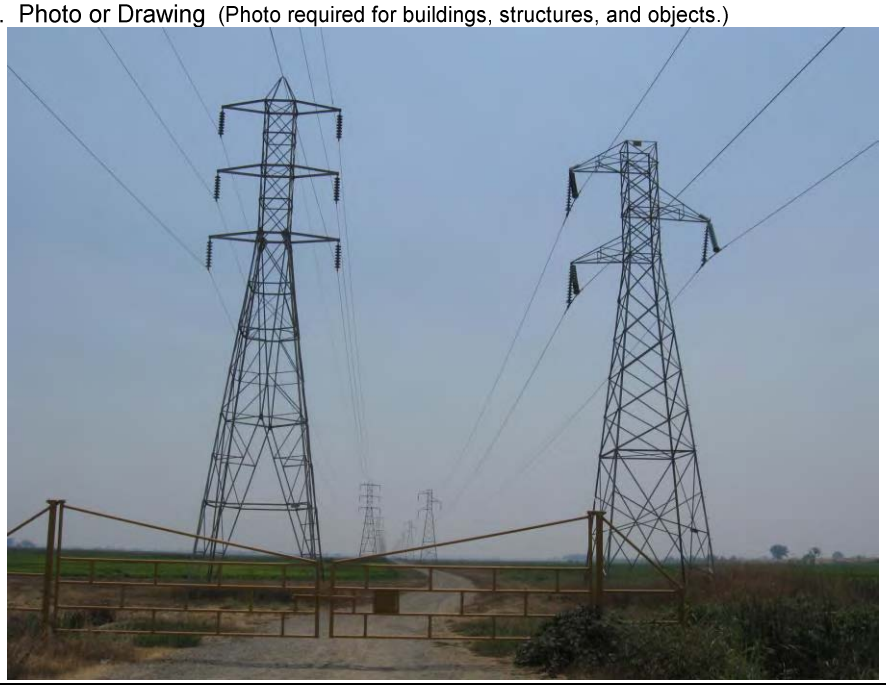
e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate) Elevation: The Palermo-East Nicolaus Transmission line stretches from the Pacific Gas and Electric Company (PG&E) Palermo Substation, northwest of Palermo, Butte County, in a predominantly southerly direction (much of it paralleling the Western Pacific Railroad alignment) to Trowbridge, where it branches in a southwesterly direction to the PG&E East Nicolaus Substation in Sutter County.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries) The double-circuit Palermo-East Nicolaus Transmission Line is supported by steel lattice towers. It extends approximately 38 miles on a predominately north-south alignment between PG&E's Palermo and East Nicolaus Substations. The line carries PG&E's Palermo-Nicolaus-Rio Oso 115kV and Palermo-Bogue-Rio Oso 115kV circuits. The tower alignment of this double-circuit line parallels the single-circuit Palermo-Rio Oso No. 2 transmission line from Palermo south to Trowbridge.

***P3b. Resource Attributes:** (List attributes and codes) HP9 Public Utility

***P4. Resources Present:** ☐Building ■Structure ☐Object ☐Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)



P5b. Description of Photo: (View, date, accession #): View of parallel transmission lines and tower alignments near Woodruff Road, Palermo-East Nicolaus double-circuit line and towers on left, camera facing south, July 23, 2008

***P6. Date Constructed/Age and Sources:** ■Historic ☐Prehistoric ☐Both
1908

***P7. Owner and Address:**
Pacific Gas and Electric
5555 Florin Perkins Road
Room 137
Sacramento, CA 95826

***P8. Recorded by:** (Name, affiliation, and address)
Mark Bowen/Tim Yates
ICF Jones & Stokes
630 K Street, Suite 400
Sacramento, CA 95814

***P9. Date Recorded:** July 23, 2008

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") Cultural Resources Inventory Report for the Proposed Palermo-East Nicolaus 115 kV Transmission Line Reconducturing Project, Butte, Sutter, and Yub Counties, California.

***Attachments:** ☐NONE ■Location Map ■Sketch Map ■Continuation Sheet ■Building, Structure, and Object Record ☐Archaeological Record ☐District Record ■Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (List):

BUILDING, STRUCTURE, AND OBJECT RECORD

*NRHP Status Code

*Resource Name or # (Assigned by recorder) Palermo-East Nicolaus Transmission Line

B1. Historic Name: Las Plumas Transmission Line / Big Bend-Oakland Transmission Line
B2. Common Name: Palermo-East Nicolaus Transmission Line
B3. Original Use: Electricity Transmission B4. Present Use: Electricity Transmission
*B5. Architectural Style:
*B6. Construction History: (Construction date, alterations, and date of alterations): The tower alignment of the Palermo-East Nicolaus Transmission Line was constructed by Great Western Power Company (GWPC) in 1908. The line was constructed to transmit power south from GWPC's Las Plumas hydroelectric facility on the Feather River to Oakland, a distance of 155 miles. In 1930 GWPC was acquired by Pacific Gas & Electric Company (PG&E), which at some point redisignated the alignment the Big Bend-Oakland Transmission Line, and sometime later, again redisgnated it the Palermo-East Nicolaus Transmission Line. Although most of the original towers remain standing, some have been replaced, including a number which were damaged during severe winter storms in January of 1909.

*B7. Moved? ☐No ☐Yes ■Unknown Date: Original Location: the same, generally
*B8. Related Features: The single-circuit Palermo-Rio Oso Transmission Line (formerly known as the Caribou or as the Caribou-Golden Gate Line), which follows the same alignment as the Palermo-East Nicolaus Line. Most of the towers of these two lines are located at parallel points.

B9a. Architect: b. Builder: Great Western Power Company
*B10. Significance: Theme: Area:
Period of Significance: Property Type: Applicable Criteria:
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

The tower alignment of the Palermo-East Nicolaus Transmission Line was originally a segment of the Great Western Power Company's (GWPC) Las Plumas Transmission Line.

HISTORY

GWPC constructed the Las Plumas line in 1908 to transmit power from its Las Plumas hydroelectric facility at the Big Bend site on the Feather River south to Oakland. In 1909 GWPC began transmitting 100,000 volts of electricity over the 155-mile three-phase Las Plumas line. The line's 1200 original steel lattice towers were positioned 750 feet apart. 47 special towers were installed at rivers, creeks, and locations requiring suspension across longer distances. The towers were supported by steel plates sunk as much as six feet deep. During the winter of 1909 heavy storms damaged or destroyed miles of tower in the Sacramento-San Joaquin Delta and a segment in the Honcut Creek area of Yuba County. GWPC responded by adding concrete footings at locations with soft soil. The original Las Plumas Transmission Line carried two 100,000-volt circuits. (See Continuation Sheet)

B11. Additional Resource Attributes: (List attributes and codes)

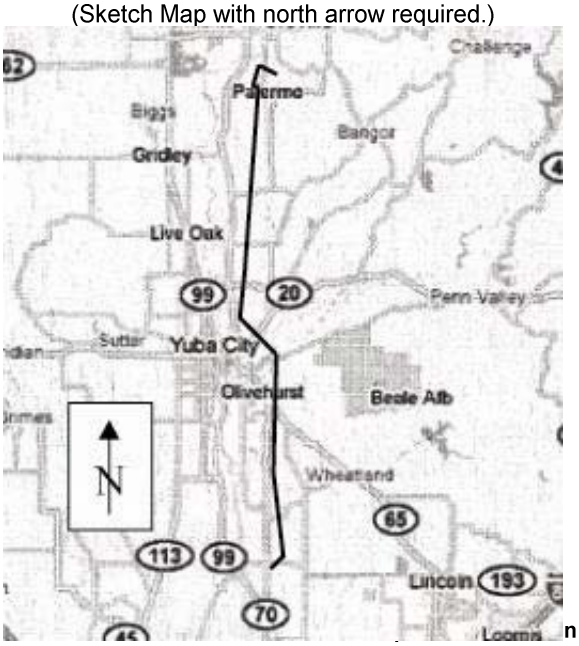
*B12. References: (See Continuation Sheet)

B13. Remarks:

*B14. Evaluator: Tim Yates

*Date of Evaluation: September 10, 2008

(Sketch Map with north arrow required.)



(This space reserved for official comments.)

*B10. Significance (Continued):

By 1920, the original long-range GWPC transmission line utilized 1,044 of the original standard towers, 42 transposition towers, 78 angle towers, 4 anchor towers, and 17 special towers. From their lowest cross arms to their third and highest cross arms, the standard towers are rectangular, with latticed sides and pyramid shapes at the top. This original Las Plumas transmission system included substations at Sacramento, Brighton (slightly east of Sacramento), Clayton (Contra Costa County), and Oakland (Jackson Research Projects 1986:110; Fowler 1923: 382-385; Great Western Power Company 1912; Teisch 2001:242).

Because GWPC had undertaken its Las Plumas project at Big Bend before securing a ready market for its electricity, the company initially sold power to Pacific Gas & Electric Company (PG&E). GWPC acquired its own San Francisco market in 1911 by purchasing City Electric Company. In 1912 the company began selling power to San Francisco residents, which was transmitted from Oakland across the Bay through underwater cable. This extended the length of GWPC's Big Bend hydroelectric transmission capacity to 165 miles. After securing a large urban market of its own, and while it continued selling its power to other utility companies, GWPC moved to develop additional hydroelectric facilities in the northern Sierra region, including the Caribou Plant (Jackson Research Projects 1986: 110, 116-119; Teisch 2001: 251).

PG&E acquired GWPC in 1930 (Coleman 1952: 291-298). At an unknown point in time thereafter, PG&E re-designated the Las Plumas line the Big Bend-Oakland line. PG&E continues to own and utilize this transmission line and tower alignment, the Palermo to Trowbridge/East Nicolaus segment of which was re-designated the Palermo-East Nicolaus 115-kV double-circuit line at an unknown point in time.

EVALUATION

The Palermo-East Nicolaus Transmission Line does not appear to be a significant historical resource. This alignment served as a segment of Great Western Power Company's (GWPC) Las Plumas Transmission Line alignment, which originally supported two 100,000-volt circuits extending approximately 155 miles.

The former segment of the Las Plumas Transmission Line (also known as the Big Bend-Oakland Transmission Line after PG&E acquired GWPC in 1930), the Palermo-East Nicolaus Transmission Line is not associated with events that have made a significant contribution to the history of the local area, region, state or nation (Criterion A and 1).

The Las Plumas Transmission Line was part of a competition and consolidation period (1905-1930) that pitted dozens of companies against each other for market share and eventually resulted in the survival of a few key suppliers recognizable today (i.e. PG&E, Southern California Edison). During this period, larger companies such as GWPC and PG&E acquired smaller entities, many of which initiated water conveyance and electrical generation operations within California watersheds during the late 19th century for the purposes of developing mining and agriculture. As a consolidation period, the span of 25 or so years reflects somewhat expected events following the earlier pioneer period of development. Like with other desirable products, once the validity of long-distance hydroelectric power development was established, intense competition and consolidation resulted.

Research indicates that this linear resource is not directly associated with a person who made significant contributions to local, state, or national history (Criterion B and 2).

Although notable as one of the longer and more powerful transmission lines of its day when it commenced transmitting electricity beginning in 1909, the Las Plumas line was not the earliest of its kind. Moreover, after completion it was neither the longest nor the highest capacity transmission line of its day. The 155-mile Las Plumas Line was one of three long-distance transmission lines which began operating at 100,000 volts-per-circuit capacity in 1909. This group of three also included Colorado Power Company's 152-mile Glenwood-Denver line and Southern Power Company's 210-mile Great Falls, South Carolina-Durham, North Carolina line (Hughes 1983:282). GWPC's 1909 Las Plumas Transmission Line did not markedly shape or change the course of technological history as it pertains to long-distance electrical transmission. The tower alignment and transmission line do not embody characteristics of a historically significant type, period, region or method of construction. They are not the works of a master and do not possess high engineering value (Criterion C and 3).

Although buildings and structures can provide information about historical methods of construction (Criterion D and 4), the tower alignment does not stand to yield significant historical information and therefore does not serve as a primary source in this regard.

(See Continuation Sheet)

*B12. References (Continued):

Coleman, Charles
1952 *P.G.& E. of California: The Centennial Story of Pacific Gas and Electric Company, 1852-1952*. McGraw-Hill Book Company, Inc. New York, NY.

Fowler, Frederick Hall
1923 *Hydroelectric Power Systems of California and Their Extensions into Oregon and Nevada*. U. S. Forest Service. Washington, D. C.

Great Western Power Company
1912 *Great Western Power: A Short Description of the Great Western Power System*. Taylor, Nash & Taylor. San Francisco, CA.

Hughes, Thomas P.
1988 *Networks of Power: Electrification in Western Society, 1880-1930*. Johns Hopkins University Press. Baltimore, MD.

Jackson Research Projects
1986 Great Western Power Company: Hydroelectric Power Development on the North Fork of the Feather River, 1902-1930. Davis, CA. For Pacific Gas & Electric Company.

Teisch, Jessica B.
2001 "Great Western Power, 'White Coal,' and Industrial Capitalism in the West." *Pacific Historical Review*, 70(May, 2001):221-253.

L1. Historic and/or Common Name: Las Plumas Transmission Line / Big Bend-Oakland Transmission Line

L2a. Portion Described: ■ Entire Resource ☐ Segment ☐ Point Observation **Designation:**

b. Location of point or segment: (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map) The Palermo-East Nicolaus Transmission line stretches from the Pacific Gas and Electric Company (PG&E) Palermo Substation, northwest of Palermo, Butte County, in a predominantly southerly direction to Trowbridge. The line runs through area represented in the Palermo, Honcut, Yuba City, Olivehurst, and Nicolaus 7.5 minute USGS quad maps. Much of the transmission line parallels the Western Pacific Railroad alignment. At Trowbridge, the line and tower alignment branches in a southwesterly direction to the PG&E East Nicolaus Substation in Sutter County.

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.) The Palermo-East Nicolaus Transmission line is a double-circuit 115kV transmission line supported by steel lattice towers. It extends approximately 38 miles on a predominately north-south alignment between PG&E's Palermo and East Nicolaus Substations. The towers were constructed in 1908 by the Great Western Power Company and originally supported a segment of the double-curcuit Las Plumas Transmission Line. The line and towers parallel and share right of way with the single-circuit Palermo-Rio Oso Transmission Line.

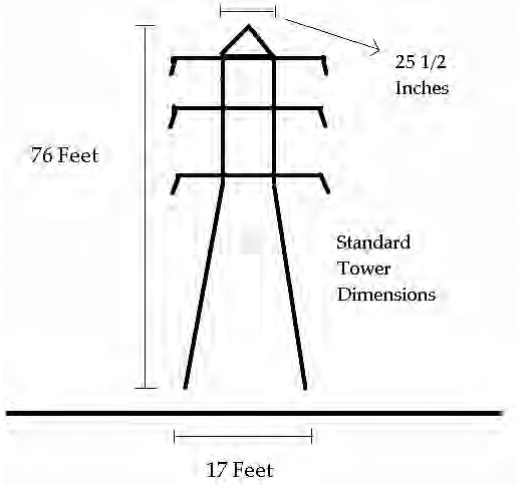
L4. Dimensions: (In feet for historic features and meters for prehistoric features) (described in Fowler 1923: 283-284)

a. Top Width: n/a
b. Bottom Width: 17 feet (standard towers)
c. Height or Depth: 76 feet (standard towers)
d. Length of Segment: 38 miles (estimate)

L5. Associated Resources: Palermo-Rio Oso Transmission Line and tower alignment

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.) The setting is predominately rural or a mix of rural land and dispersed residential property. Much of the transmission line parallels the Western Pacific Railroad alignment and/or area levees.

L4e. Sketch of Cross-Section (include scale) **Facing:** (north)



L7. Integrity Considerations: A majority of the towers appear to date from the tower alignment's 1908 construction. Some of the towers in the Honcut Creek area were replaced after heavy winter storms in 1909. The electricity equipment has been subject to continuous modification, the degree to which is unknown.

L8a. Photograph, Map or Drawing

L8b. Description of Photo, Map, or Drawing (View, scale, etc.)
Palermo-East Nicolaus Transmission Line on right (east) side of parallel tower alignment, camera facing north, July 23, 2008

L9. Remarks:

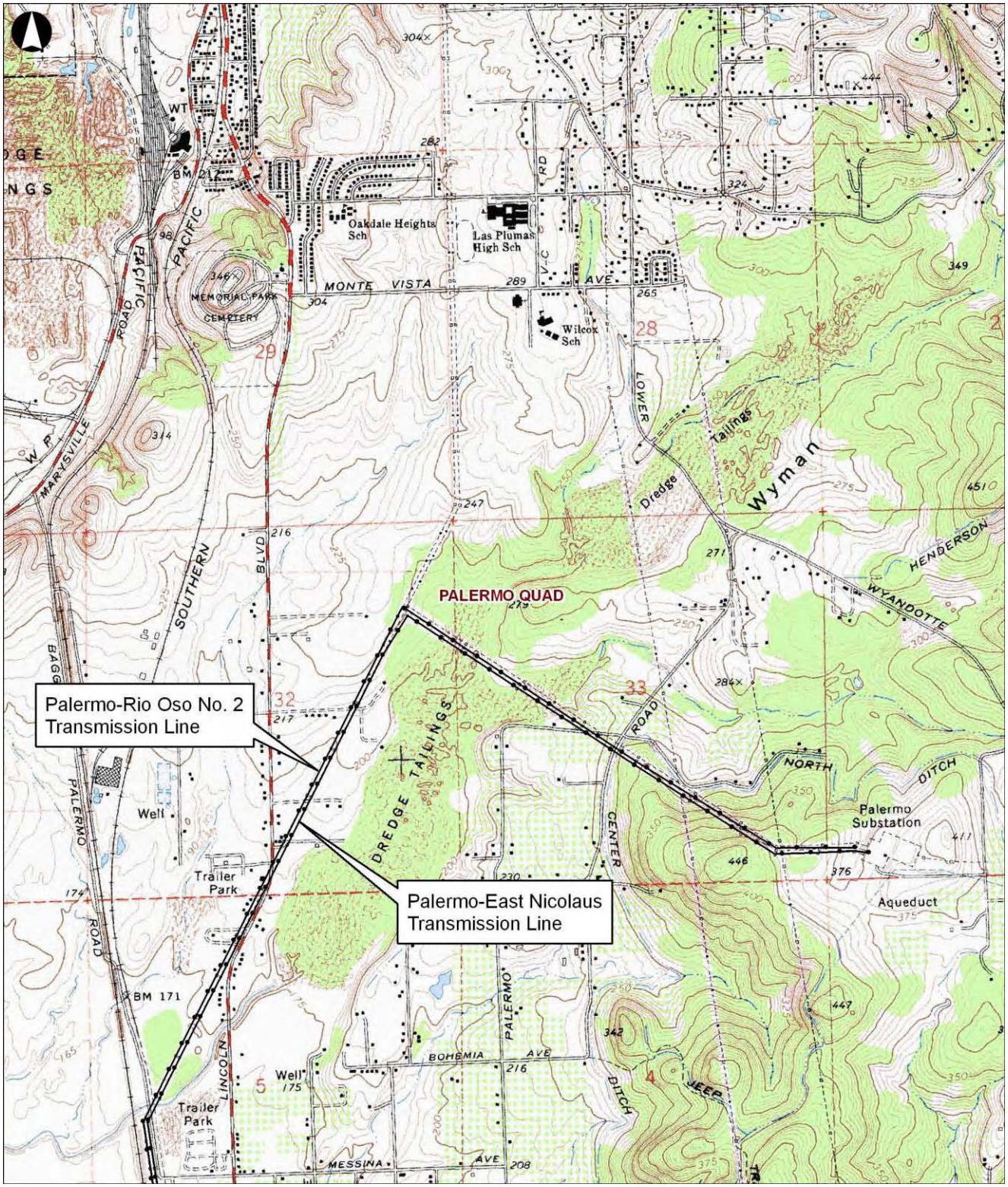
L10. Form Prepared by: (Name, affiliation, and address)
Tim Yates
ICF Jones and Stokes Associates
630 K Street, Suite 400
Sacramento, CA 95818

L11. Date: September 10, 1008

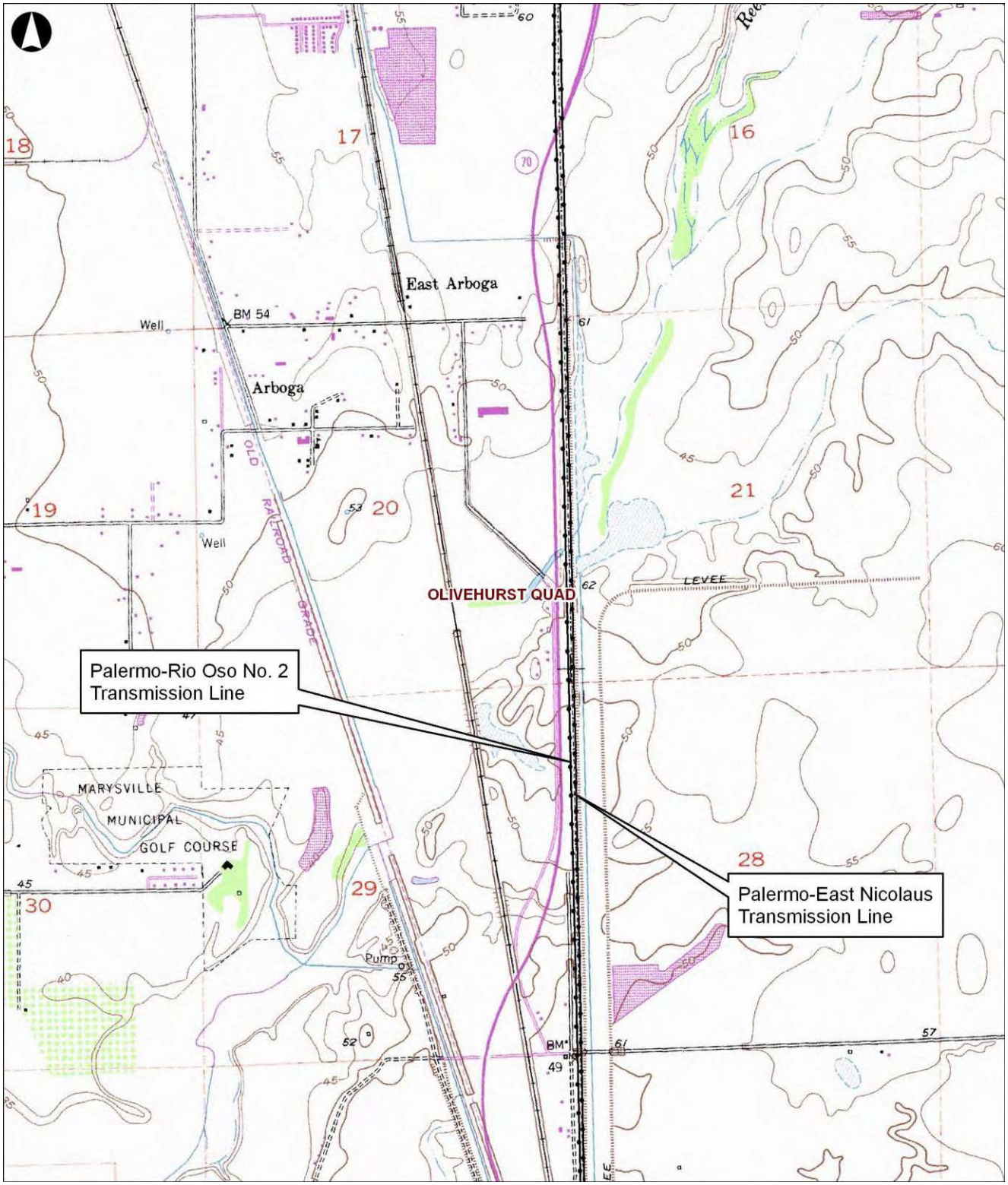
State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **LOCATION MAP**	Primary # HRI# Trinomial

 ***Resource Name or #:** Palermo-East Nicolaus Transmission Line

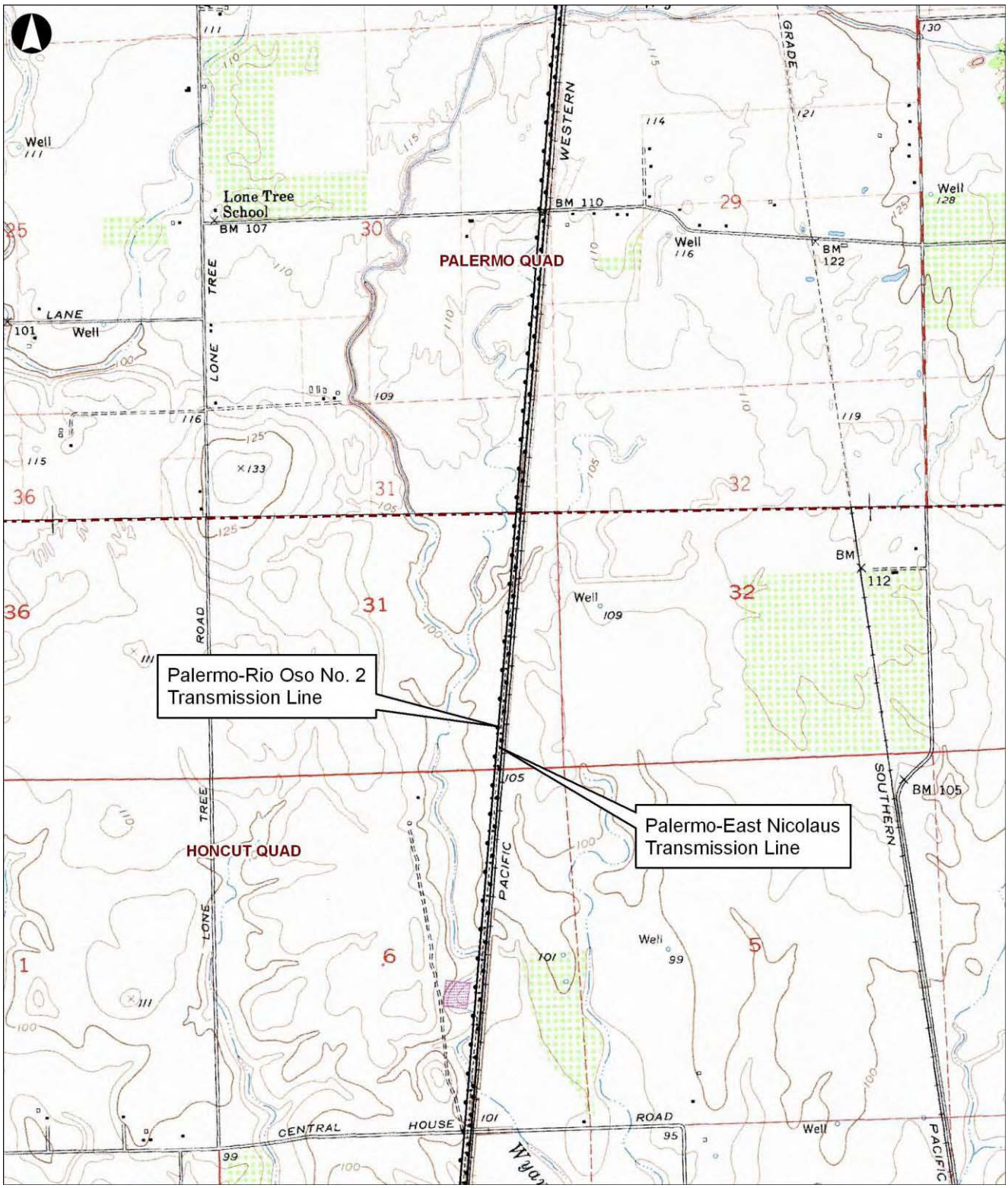
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 1 ***Scale:** 7.5 minute ***Date of Map:** 1970



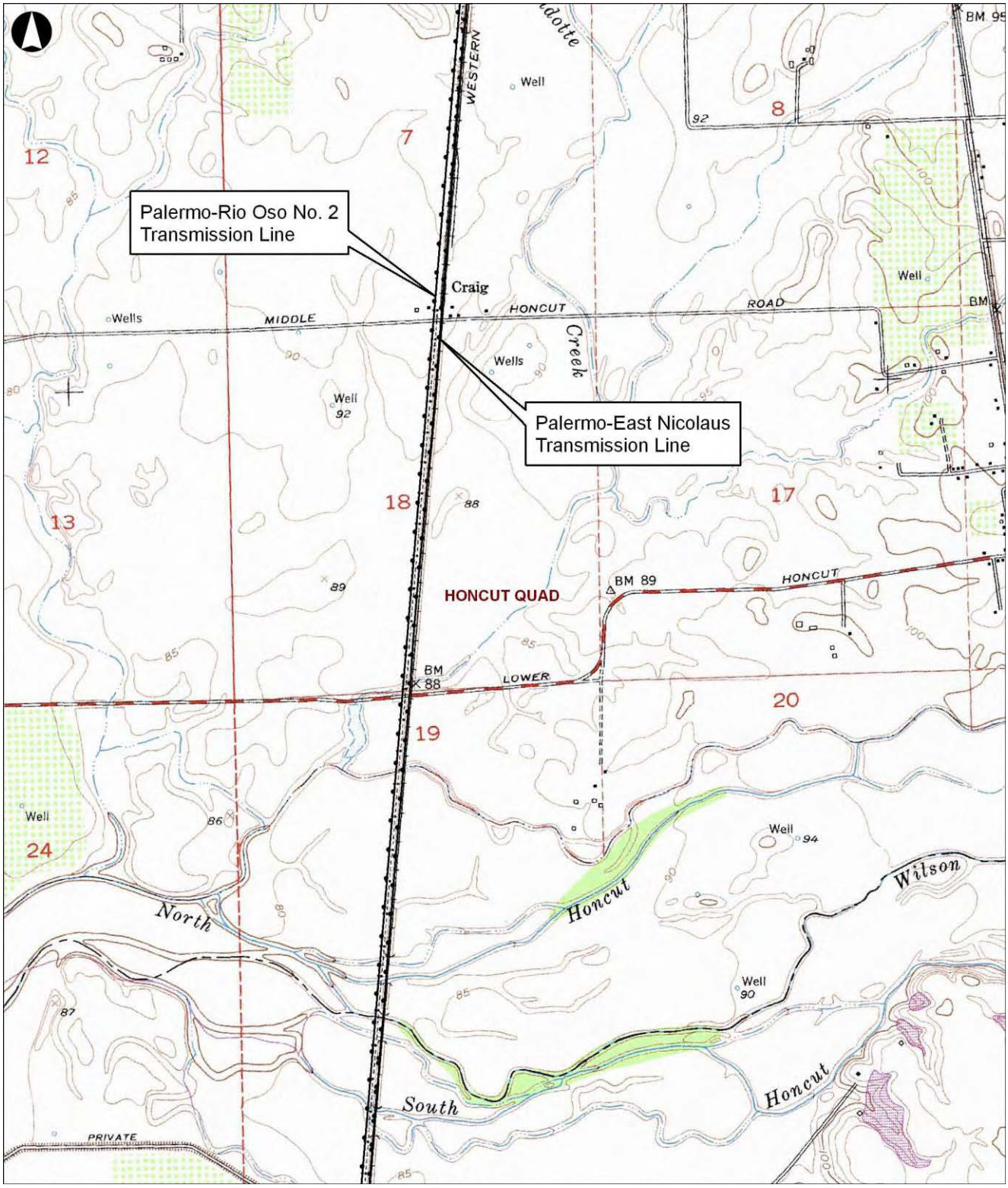
*Map Name: Palermo-East Nicolaus Transmission Line, Map 2 *Scale: 7.5 minute *Date of Map: PR 1973



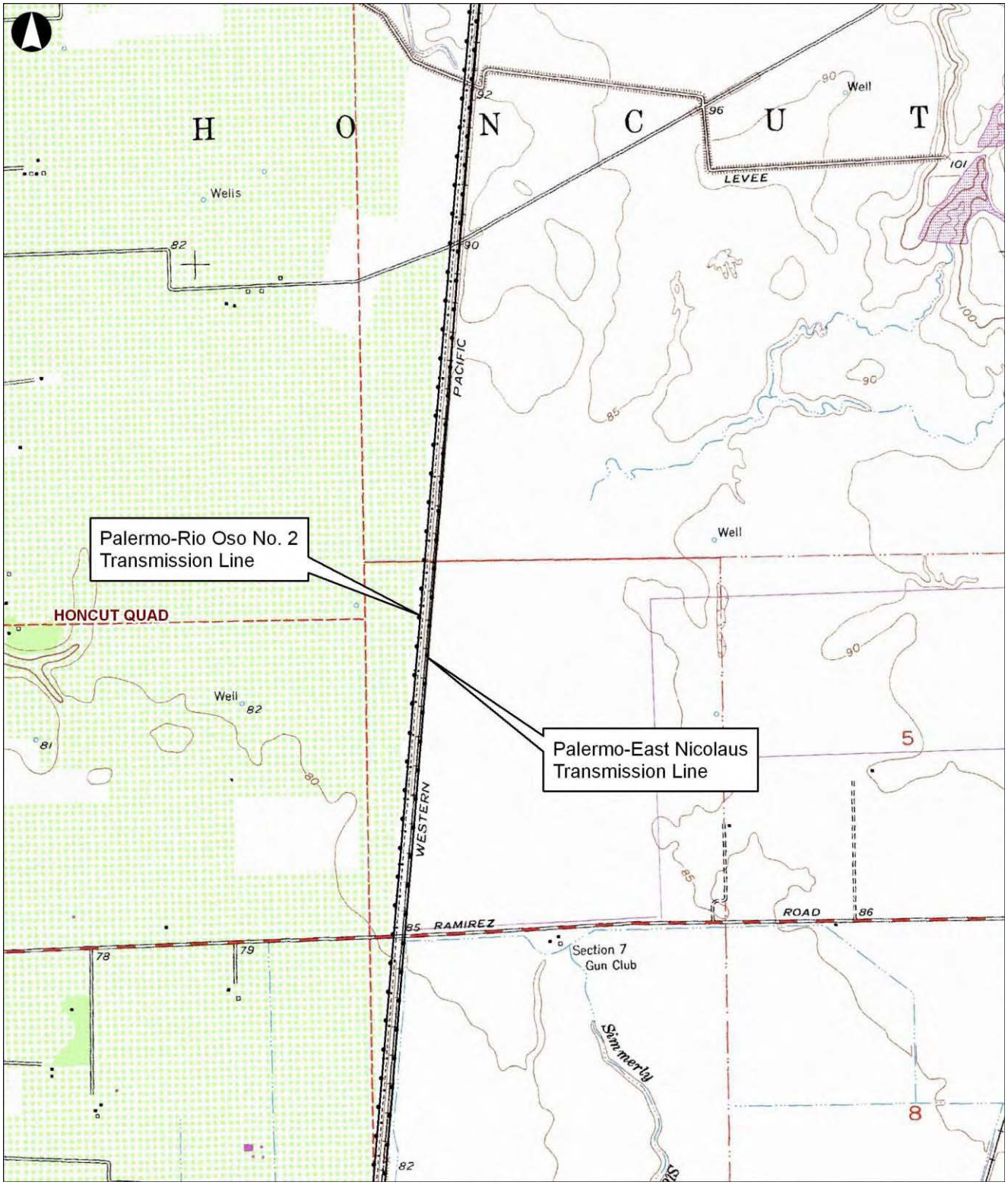
*Map Name: Palermo-East Nicolaus Transmission Line, Map 3 *Scale: 7.5 minute *Date of Map: 1970 (Palermo Quad), PR 1973 (Honcut Quad)



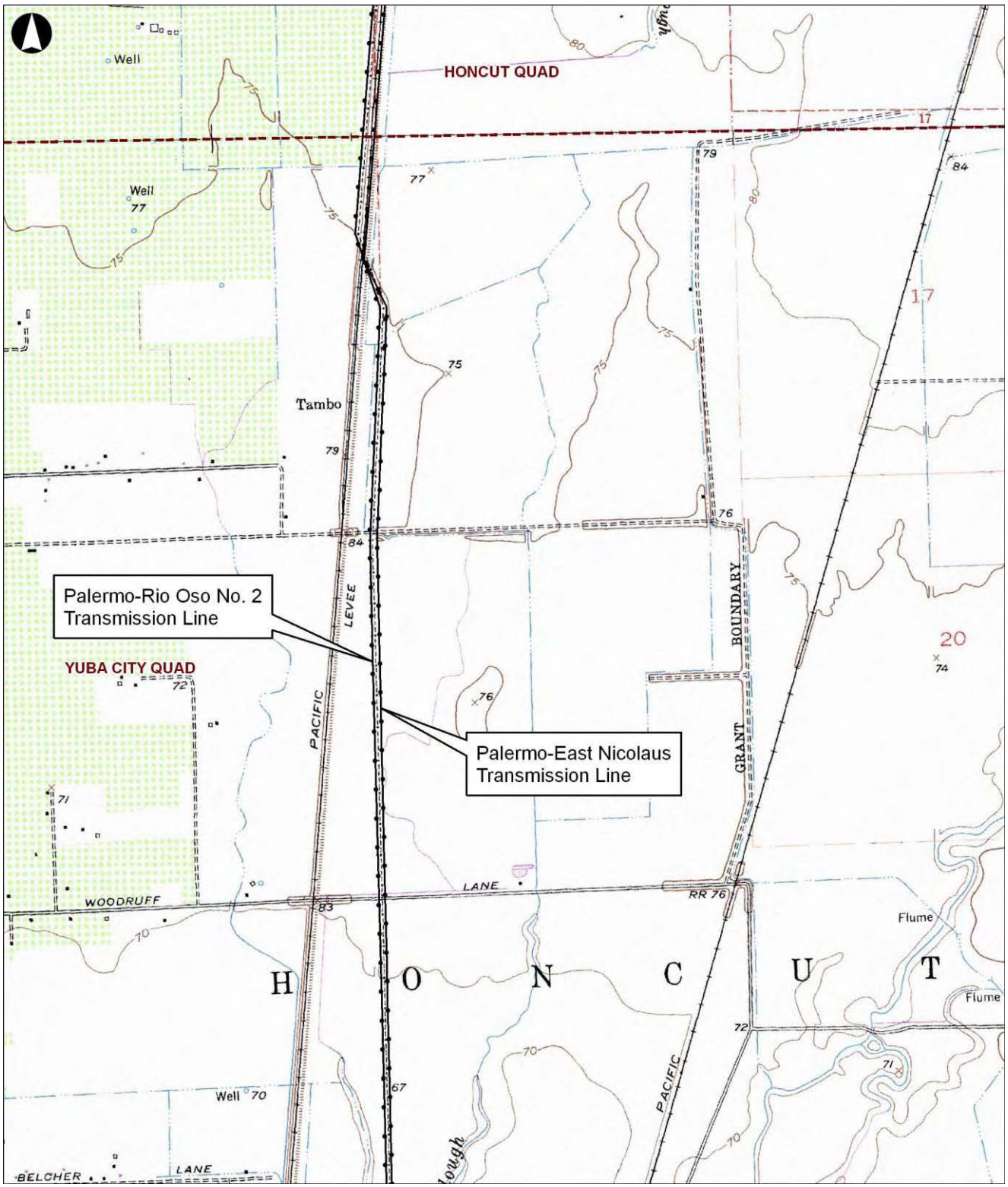
*Map Name: Palermo-East Nicolaus Transmission Line, Map 4 *Scale: 7.5 minute *Date of Map: PR 1973



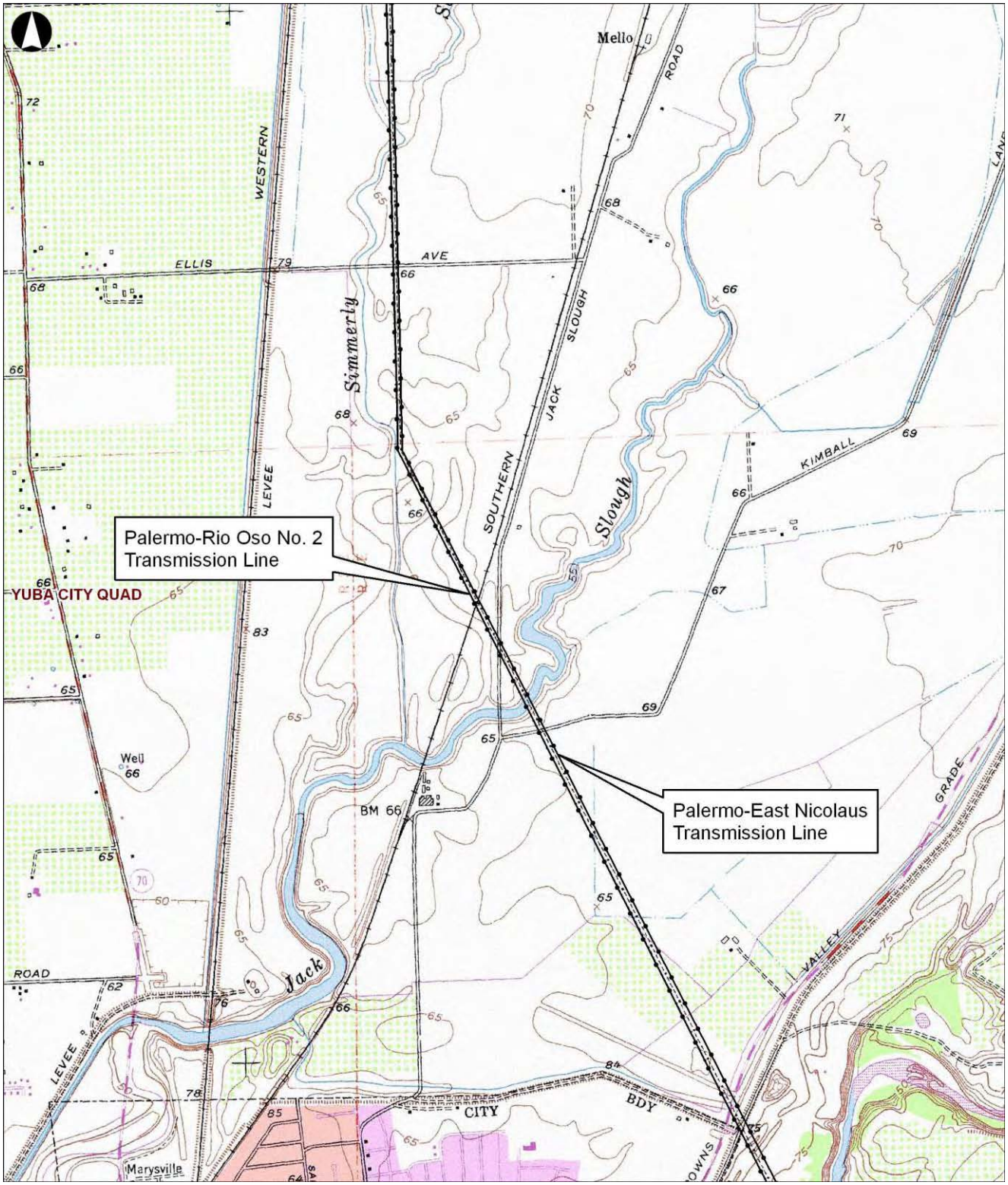
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 5 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



*Map Name: Palermo-East Nicolaus Transmission Line, Map 6 *Scale: 7.5 minute *Date of Map: PR 1973 (Honcut Quad), PR 1973 (Yuba City Quad)



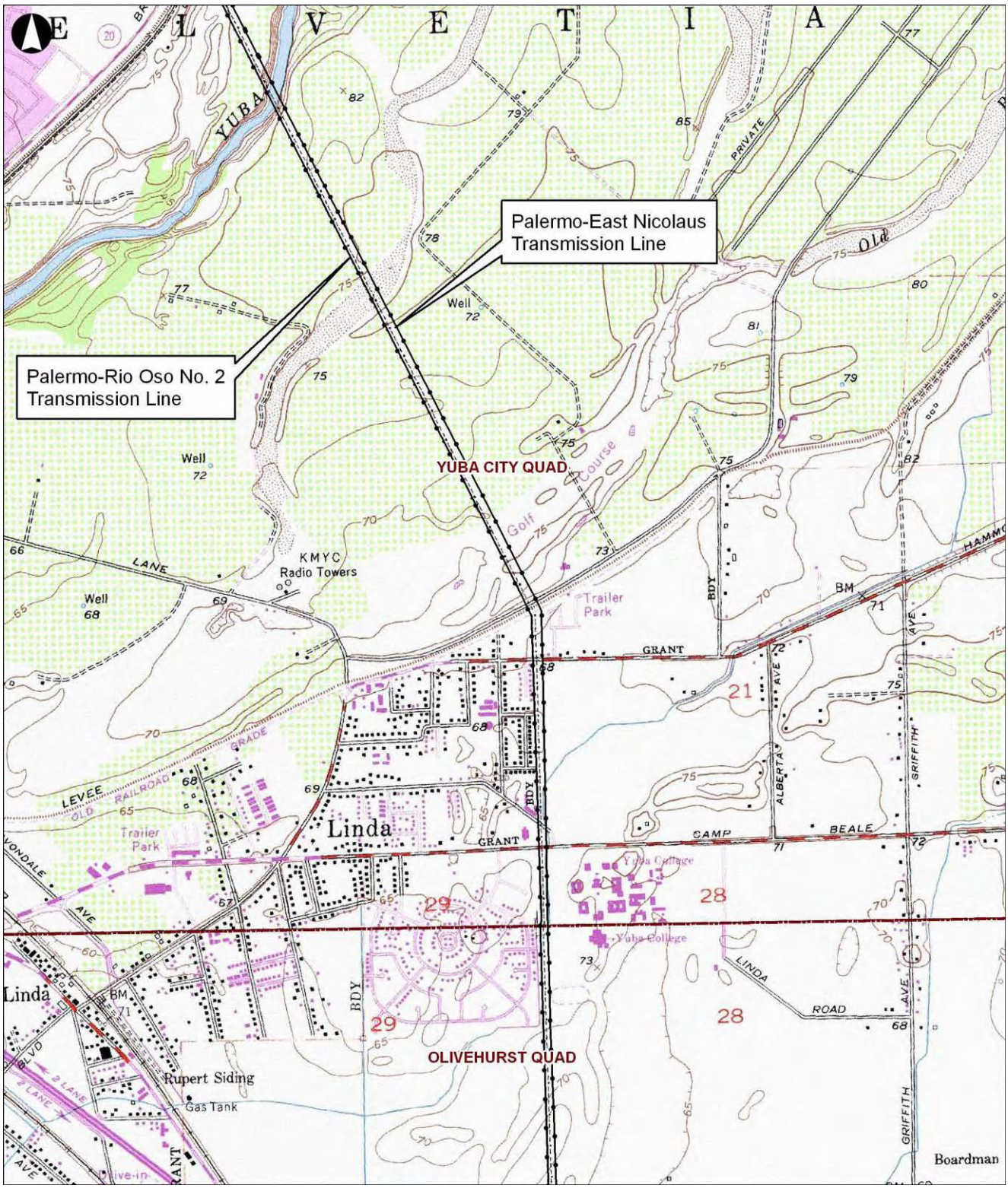
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 7 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **LOCATION MAP**	Primary # HRI# Trinomial

 ***Resource Name or #:** Palermo-East Nicolaus Transmission Line

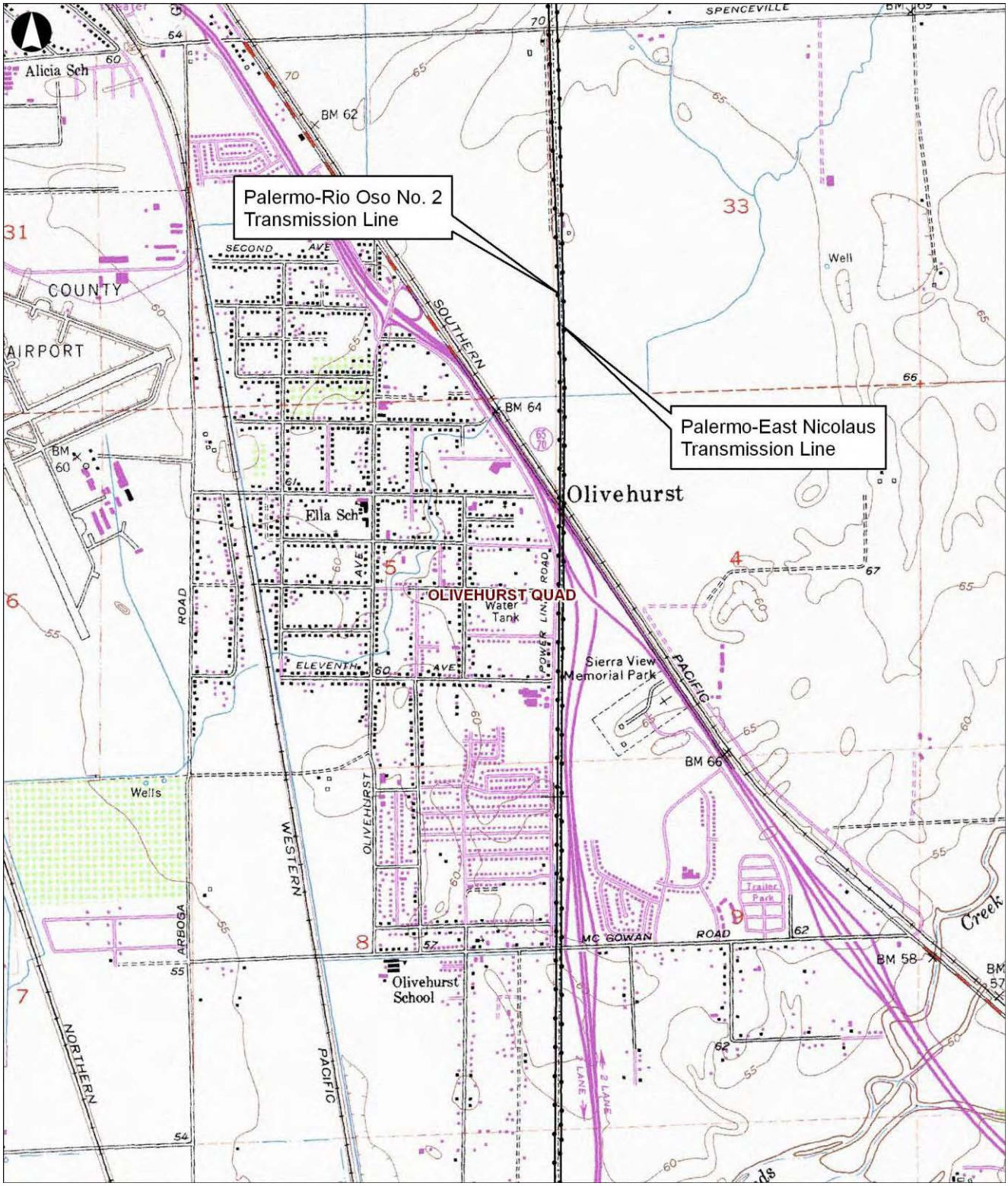
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 8 ***Scale:** 7.5 minute ***Date of Map:** PR 1973 (Yuba City Quad), PR 1973 (Olivehurst Quad)



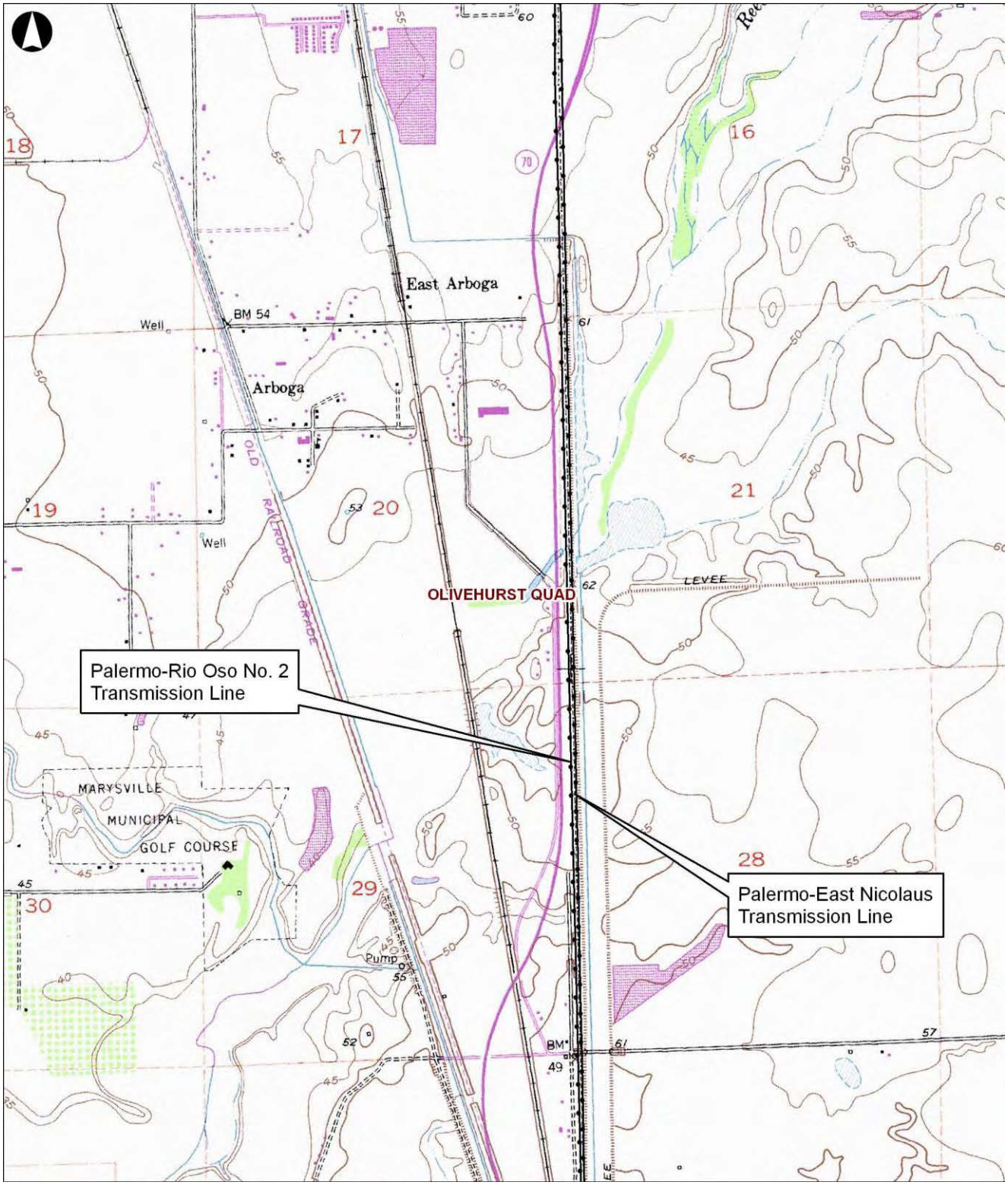
State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **LOCATION MAP**	Primary # HRI# Trinomial

 ***Resource Name or #:** Palermo-East Nicolaus Transmission Line

***Map Name:** Palermo-East Nicolaus Transmission Line, Map 9 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



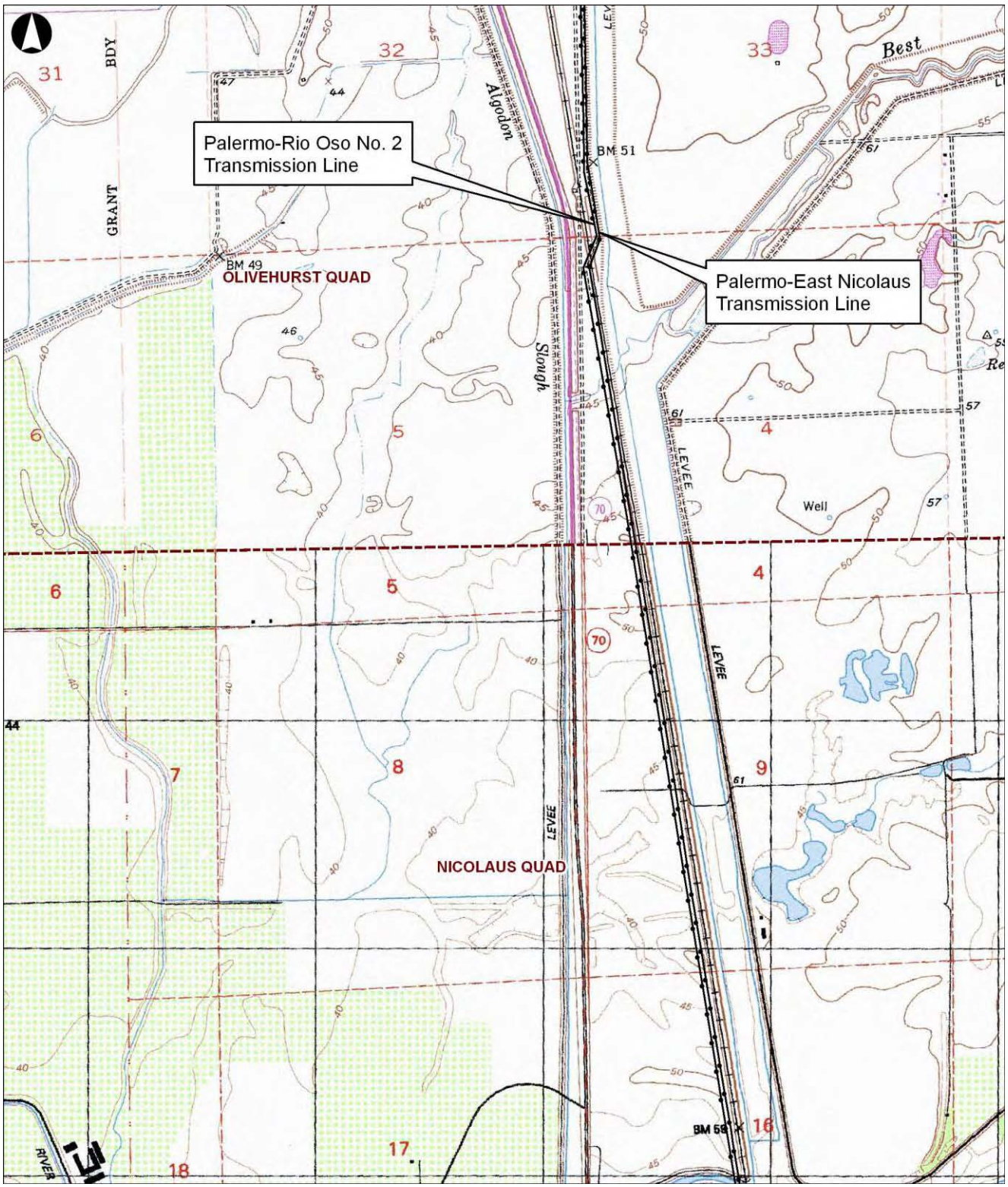
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 10 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **LOCATION MAP**	Primary # HRI# Trinomial

 ***Resource Name or #:** Palermo-East Nicolaus Transmission Line

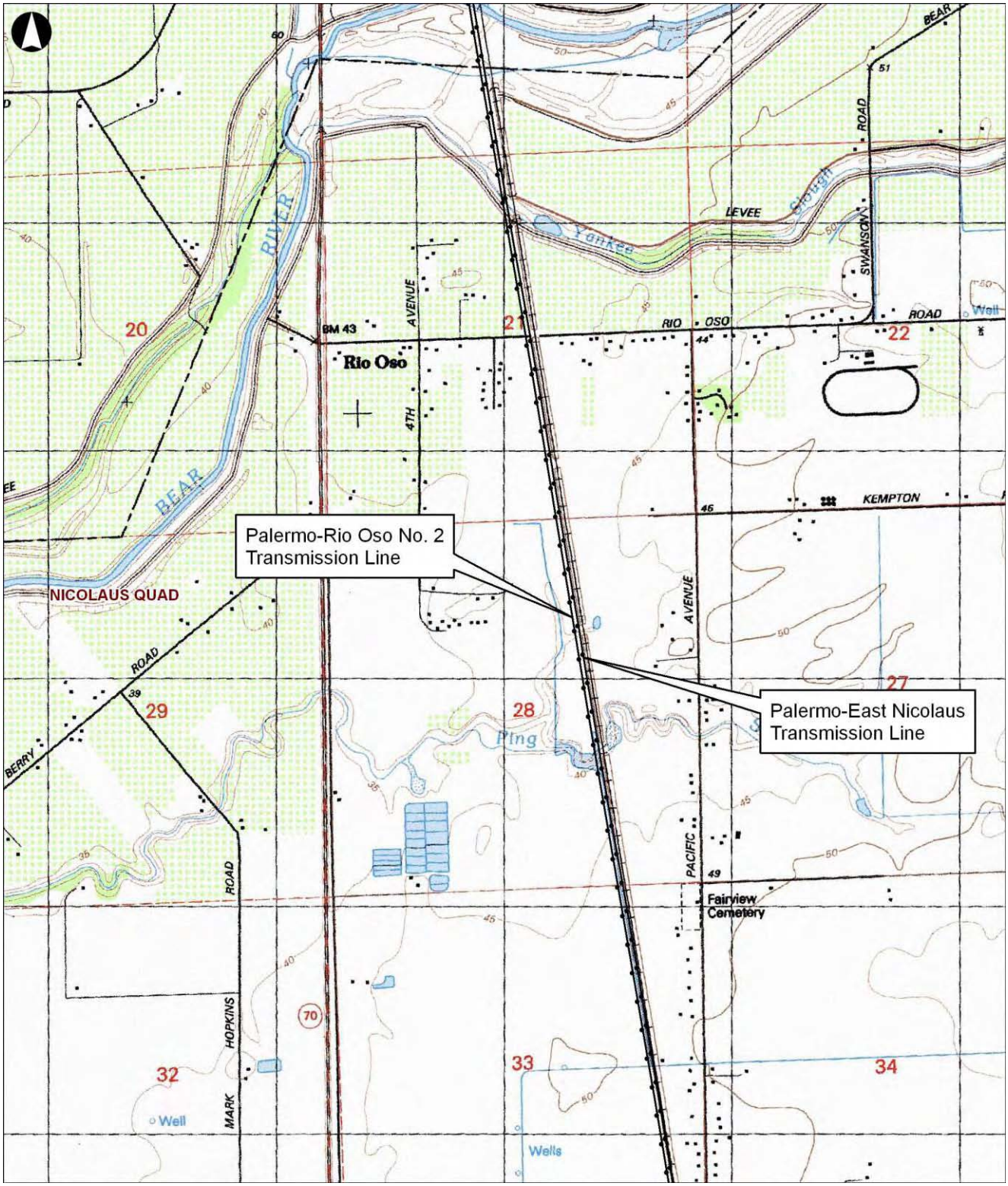
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 11 ***Scale:** 7.5 minute ***Date of Map:** PR 1973 (Olivehurst Quad), PR 1973 (Nicolaus Quad)



State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **LOCATION MAP**	Primary # HRI# Trinomial

 ***Resource Name or #:** Palermo-East Nicolaus Transmission Line

***Map Name:** Palermo-East Nicolaus Transmission Line, Map 12 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



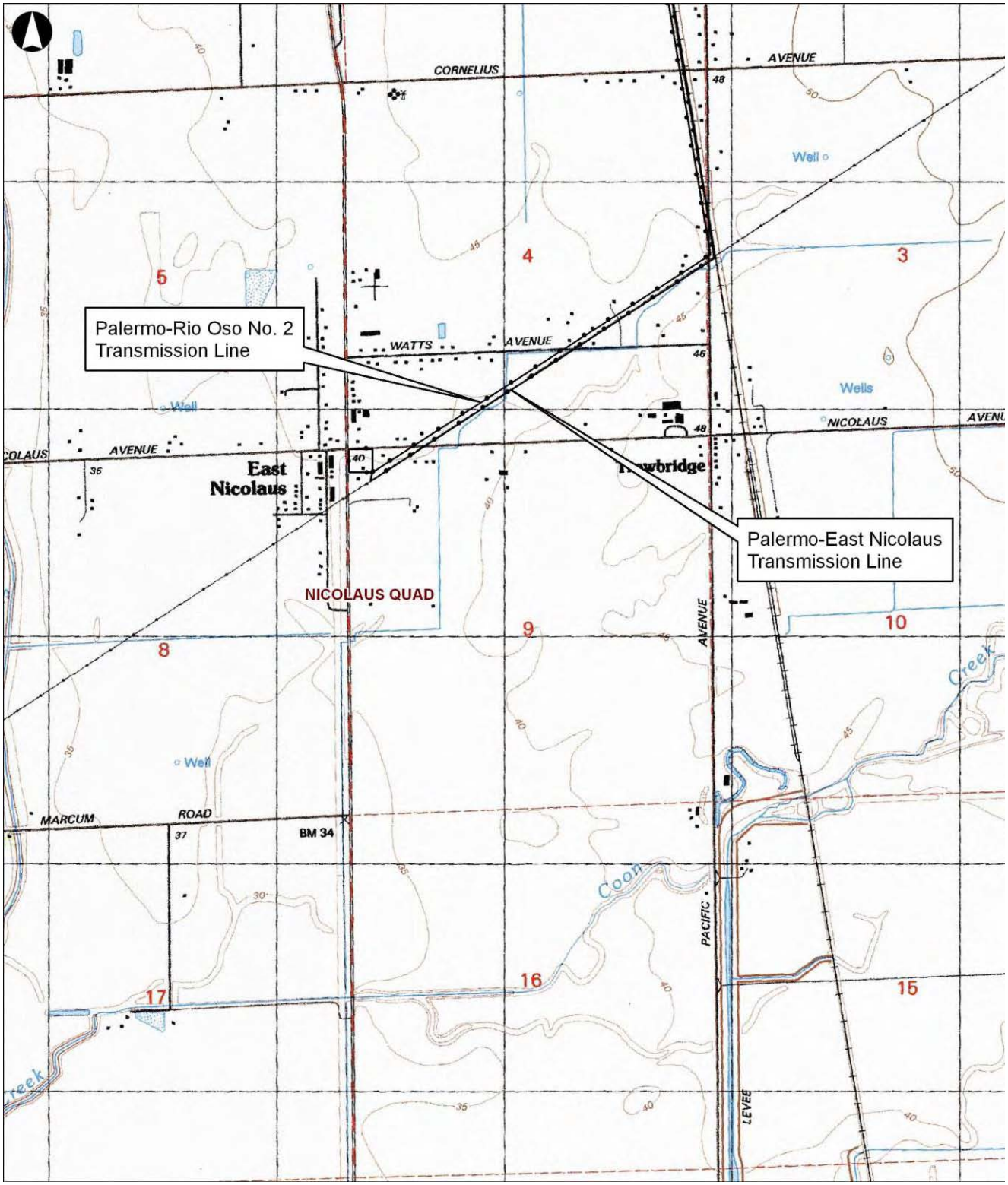
State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LOCATION MAP

Primary #
HRI#
Trinomial

 *Resource Name or #: Palermo-East Nicolaus Transmission Line

*Map Name: Palermo-East Nicolaus Transmission Line, Map 13 *Scale: 7.5 minute *Date of Map: PR 1973



 *Required information

Appendix D
Palermo-Rio Oso No. 2 Transmission Line
DPR 523 Form: History, Description, and Full Significance Evaluation

State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **PRIMARY RECORD**	Primary # HRI # Trinomial NRHP Status Code
Other Listings Review Code	Reviewer Date

 ***Resource Name or #:** Palermo-Rio Oso No. 2 Transmission Line

P1. Other Identifier: Caribou Transmission Line / Caribou-Golden Gate Transmission Line

***P2. Location:** ☐ **Not for Publication** ■ **Unrestricted** ***a. County:** Butte, Yuba, Sutter

and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad:** Palermo, Honcut, Yuba City, Olivehurst, Nicolaus **Date:** **T** ; **R** ; **¼ of ¼ of Sec** ; M.D. **B.M.**

c. Address: City: Zip:

d. UTM: Zone: 10 ; mE/ mN (G.P.S.)

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate) Elevation: This transmission line stretches from the Pacific Gas and Electric Company (PG&E) Palermo Substation, northwest of Palermo, Butte County, in a predominantly southerly direction (much of it parelling the Western Pacific Railroadalignment). The tower alignment of this single-curcuit line parallels the double-circuit Palermo-East Nicolaus line from Palermo south to Trowbridge, in Sutter County.

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries) The Palermo-Rio Oso No. 2 Transmission line is a single-circuit 115kV transmission line supported by steel lattice towers. It extends 38 miles on a predominately north-south alignment.

***P3b. Resource Attributes:** (List attributes and codes) HP9 Public Utility

***P4. Resources Present:** ☐Building ■Structure ☐Object ☐Site ☐District ☐Element of District ☐Other (Isolates, etc.)

P5a. Photo or Drawing (Photo required for buildings, structures, and objects.)

P5b. Description of Photo: (View, date, accession #): Transmission lines and tower alignment in the Rio Oso area, Palermo-Rio Oso No. 2 line on left (southwest), camera facing northeast, July 23, 2008

***P6. Date Constructed/Age and Sources:** ■Historic ☐Prehistoric ☐Both 1919

***P7. Owner and Address:** Pacific Gas and Electric Company
5555 Florin Perkins Road
Room 137
Sacramento, CA95826

***P8. Recorded by:** (Name, affiliation, and address) Mark Bowen/Tim Yates
ICF Jones & Stokes
630 K Street, Suite 400
Sacramento, CA 95814

***P9. Date Recorded:** July 23, 2008

***P10. Survey Type:** (Describe) Intensive

***P11. Report Citation:** (Cite survey report and other sources, or enter "none.") Cultural Resources Inventory Report for the Proposed Palermo-East Nicolaus 115 kV Transmission Line Reconducturing Project, Butte, Sutter, and Yub Counties, California.

***Attachments:** ☐NONE ■Location Map ■Sketch Map ■Continuation Sheet ■Building, Structure, and Object Record ☐Archaeological Record ☐District Record ■Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (List):

BUILDING, STRUCTURE, AND OBJECT RECORD

*NRHP Status Code

*Resource Name or # (Assigned by recorder) Palermo-Rio Oso No. 2 Transmission Line

B1. Historic Name: Caribou Transmission Line / Caribou-Golden Gate Transmission Line
B2. Common Name: Palermo-East Nicolaus Transmission Line
B3. Original Use: Electricity Transmission B4. Present Use: Electricity Transmission
*B5. Architectural Style:
*B6. Construction History: (Construction date, alterations, and date of alterations): The tower alignment of the Palermo-Rio Oso No. 2 Transmission Line was constructed in 1919 by Great Western Power Company (GWPC). The line entered operations in 1921, transmitting 165,000 volts of electricity 186 miles from GWPC's new Caribou hydroelectric facility on the Feather River to Vallejo. In 1930 GWPC was acquired by Pacific Gas & Electric Company (PG&E), which at some point re-disignated the Caribou line the Caribou-Golden Gate Transmission line and again re-disgnated it the Palermo-Rio Oso No. 2 Transmission Line at a subsequent unknown date.

*B7. Moved? ■No ☐Yes ☐Unknown Date: Original Location:
*B8. Related Features: The double-circuit Palermo-East Nicolaus Transmission Line (formerly known as the Las Plumas or as the Big Bend-Oakland Transmission Line), which follows the same alignment as the single-circuit Palermo-Rio Oso No. 2 Transmission Line. Most of the towers of these two lines are located at parallel points.

B9a. Architect: b. Builder: Great Western Power Company
*B10. Significance: Theme: Area:
Period of Significance: Property Type: Applicable Criteria:
(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

Great Western Power Company (GWPC) constructed the 186-mile Caribou Transmission line in the late summer and fall of 1919. A segment of the original Caribou tower alignment now carries Pacific Gas and Electric Company's (PG&E) single-circuit 115,000 kV Palermo-Rio Oso No. 2 Transmission Line.

HISTORY

In 1919, GWPC constructed the Caribou Transmission Line as part of its Caribou hydroelectricity project. Between the Caribou hydroelectric site on the Feather River and Sacramento, GWPC crews erected the tower alignment of this new transmission line along a right of way shared by the company's Las Plumas line, built in 1909. Through Butte, Yuba, and Sutter Counties, the towers of the Caribou line were erected at points parallel to the towers of the Las Plumas line. The Las Plumas line (now the Palermo-East Nicolaus line) occupied the east side of the right-of-way alignment. The Caribou line (See Continuation Sheet)

B11. Additional Resource Attributes: (List attributes and codes)

*B12. References: (See Continuation Sheet)

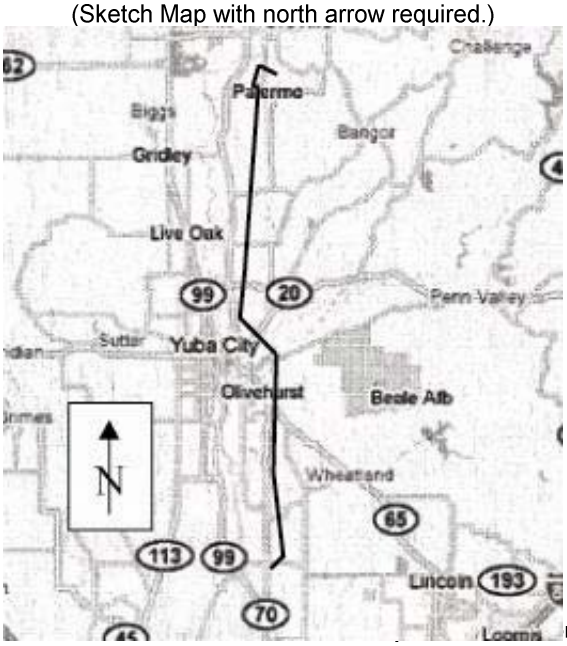
B13. Remarks:

*B14. Evaluator: Tim Yates

*Date of Evaluation: September 10, 2008

(This space reserved for official comments.)

(Sketch Map with north arrow required.)



B10. Significance (Continued):

(now the Palermo-Rio Oso No. 2 tower line) was constructed on the alignment's west side (Jackson Research Projects 1986:304, 317; *Journal of Electricity* 1919:233).

The Caribou tower line stretched 186 miles from the Caribou facility to the new Valona Substation near Carquinez Straits and began transmitting electricity in 1921. Delivering as much as 165,000 volts, GWPC's Caribou circuit transmitted more voltage than any other long distance transmission line in the world for a brief period of 20 months (*Journal of Electricity and Western Industry* 1922:296; Koontz 1921:58). PG&E acquired GWPC in 1930 (Coleman 1952: 291-298). At an unknown point in time thereafter, PG&E re-designated the Caribou line the Caribou-Golden Gate Transmission Line. The segment between Palermo and Trowbridge was later re-designated the Palermo-Rio Oso No. 2 Transmission line at an unknown point in time.

Evaluation

The Palermo-Rio Oso No. 2 Transmission Line does not appear to be a significant historical resource. As a former segment of the Caribou Transmission Line (also known as the Caribou-Golden Gate Transmission Line after PG&E acquired GWPC in 1930), the Palermo-Rio Oso No. 2 Transmission line is not associated with events that have made a significant contribution to the history of the local area, region, state or nation (Criterion A and 1).

The Palermo-Rio Oso No. 2 Transmission Line was part of a competition and consolidation period (1905-1930) that pitted dozens of companies against each other for market share and eventually resulted in the survival of a few key suppliers recognizable today (i.e. PG&E, Southern California Edison). During this period, larger companies such as GWPC and PG&E acquired smaller entities, many of which had initiated water conveyance and electrical generation operations within California watersheds during the late 19th century for the purposes of developing mining and agriculture. As a consolidation period, the span of 25 or so years reflects somewhat expected events following the earlier pioneer period of development. Like with other desirable products, once the validity of long-distance hydroelectric power development was established, intense competition and consolidation resulted.

The Palermo-East Nicolaus No. 2 Transmission Line does not appear to be eligible under other criteria. Research has indicated that this linear resource is not associated with a person who made significant contributions to local, state, or national history (Criterion B and 2).

This alignment served as a segment of the Great Western Power Company's (GWPC) Caribou Transmission Line alignment, which originally supported a single 165,000-volt capacity circuit at a distance of approximately 186 miles. From January of 1921 to September of 1922, the Caribou line had a higher voltage-transmission capacity than any other long-distance transmission line in the world. The historic notability of this distinction is lessened, however, when placed in the larger historic context of long-distance transmission technology development from the 1890s to the 1920s. Of greater historical notability was the groundbreaking utilization of alternating current (AC) technology to transmit 11,000 volts of electricity at a distance of 22 miles from the Folsom Powerhouse to Sacramento in 1895 (Williams 1997:176-177). Transmission technology was improved at a fairly rapid pace thereafter. By 1909 three transmission lines could deliver as much as 100,000 volts at distances greater than 150 miles: GWPC's Las Plumas line from Big Bend to Oakland (155 miles); Colorado Power Company's Glenwood-Denver line (152 miles); and Southern Power Company's Great Falls, South Carolina-Durham, North Carolina line (210) miles. By 1913, Pacific Light & Power was transmitting 150,000 volts from its Big Creek hydroelectricity facility in Fresno County to Los Angeles, a distance of 241 miles (Hughes 1983:282). When GWPC's 165,000-volt Caribou line began operations in 1921, its transmission capacity was 15,000 volts greater than Pacific Light & Power's Big Creek-Los Angeles line. In 1922, PG&E's Pit River Transmission Line entered operations by delivering 220,000 volts a distance of 202 miles, far surpassing the 15,000 volt advance which the 186-mile Caribou line had made over the Big Creek line 20 months earlier (*Journal of Electricity and Western Industry* 1922:296; Koontz 1921:58-59). Hence during the period from 1895 to 1922, construction of GWPC's Las Plumas Transmission Line did not markedly shape or change the course of this technological history. The tower alignment and transmission line do not embody characteristics of a historically significant type, period, region or method of construction. They are not the works of a master and do not possess high engineering value under Criterion C and 3.

Although buildings and structures can provide information about historical methods of construction (Criterion D and 4), the tower alignment does not stand to yield significant information and therefore does not serve as a primary source in this regard (See Continuation Sheet).

*B12. References (Continued):

Coleman, Charles
1952 *P.G.& E. of California: The Centennial Story of Pacific Gas and Electric Company, 1852-1952*. McGraw-Hill Book Company, Inc. New York, NY.

Hughes, Thomas P.
1988 *Networks of Power: Electrification in Western Society, 1880-1930*. Johns Hopkins University Press. Baltimore, MD.

Jackson Research Projects
1986 Great Western Power Company: Hydroelectric Power Development on the North Fork of the Feather River, 1902-1930. Davis, CA. For Pacific Gas & Electric Company.

Journal of Electricity
1919 Great Western Power Company's Issue of Stock," 43 (September 1): 233.

Journal of Electricity and Western Industry
1922 "Pit River Plant No. 1 Opened by PG&E Co," 49 (October 15): 296.

Koontz, John A.
1921 "A New Record in High Tension Transmission." *Journal of Electricity*, 46 (January 15, 1921): 58-60.

Williams, James
1997 *Energy and the Making of Modern California*. Akron, Ohio. University of Akron Press.

Resource Name or #: (Assigned by recorder): Palermo-Rio Oso No. 2 Transmission Line

L1. Historic and/or Common Name: Caribou Transmission Line / Caribou-Golden Gate Transmission Line

L2a. Portion Described: ■ Entire Resource ☐ Segment ☐ Point Observation **Designation:**

b. Location of point or segment: (Provide UTM coordinates, legal description, and any other useful locational data. Show the area that has been field inspected on a Location Map) The Palermo-Rio Oso No. 2 transmission line stretches from the Pacific Gas and Electric Company's (PG&E) Palermo Substation, northwest of Palermo, Butte County, in a predominantly southerly direction through Trowbridge. The line runs through area represented in the Palermo, Honcut, Yuba City, Olivehurst, and Nicolaus 7.5 minute USGS quad maps. Much of the transmission line parallels the Western Pacific Railroad alignment.

L3. Description: (Describe construction details, materials, and artifacts found at this segment/point. Provide plans/sections as appropriate.) The Palermo-Rio Oso Transmission line is a single-circuit 115kV transmission line supported by steel lattice towers. It extends approximately miles on a predominately north-south alignment from PG&E's Palermo Substation south through Trowbridge. The steel lattice towers were constructed in 1919 by the Great Western Power Company and originally supported a segment of the single-circuit Las Caribou Transmission Line. The line and towers parallel and share right of way with the double-circuit Palermo-East Nicolaus Transmission Line.

L4. Dimensions: (In feet for historic features and meters for prehistoric features)

a. Top Width: n/a
b. Bottom Width: n/a
c. Height or Depth: n/a
d. Length of Segment: 38 miles (estimate)

L5. Associated Resources: Double circuit Palermo-East Nicolaus Transmission Line and tower alignment

L6. Setting: (Describe natural features, landscape characteristics, slope, etc., as appropriate.) The setting is predominately rural or a mix of rural land and dispersed residential property. Much of the transmission line parallels the Western Pacific Railroad alignment and/or area levees.

L4e. Sketch of Cross-Section (include scale) **Facing:**

L7. Integrity Considerations: Many of the towers appear to date from the tower alignment's 1919 date of construction. The electricity equipment has been subject to continuous maintenance and modification, the degree to which is unknown.

L8a. Photograph, Map or Drawing

L8b. Description of Photo, Map, or Drawing (View, scale, etc.)
Palermo-Rio Oso No. 2 Transmission Line on right (west), Palermo area, camera facing south, July 23, 2008

L9. Remarks:

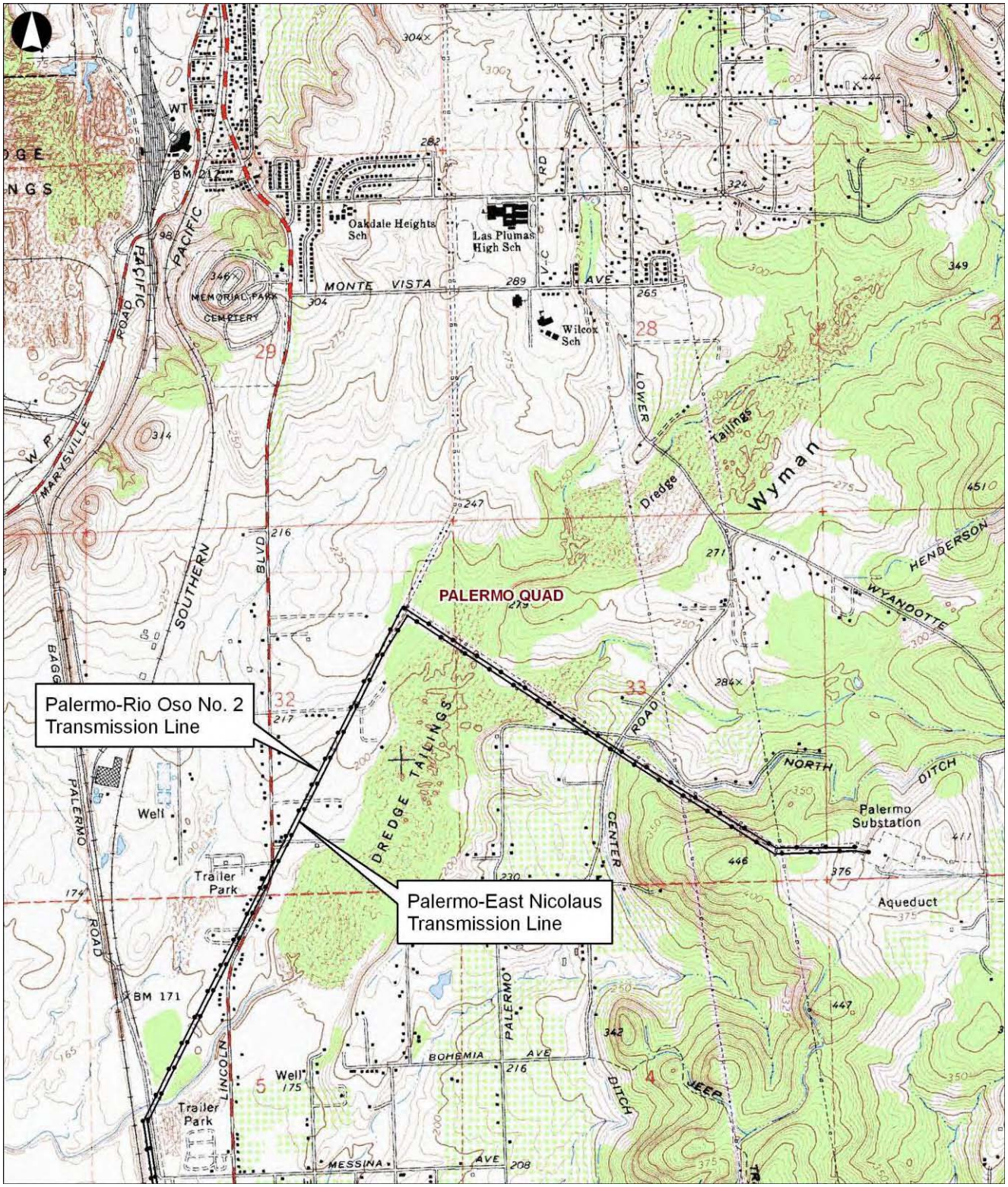
L10. Form Prepared by: (Name, affiliation, and address)
Tim Yates
ICF Jones and Stokes Associates
630 K Street, Suite 400
Sacramento, CA 95818

L11. Date September 10, 2008

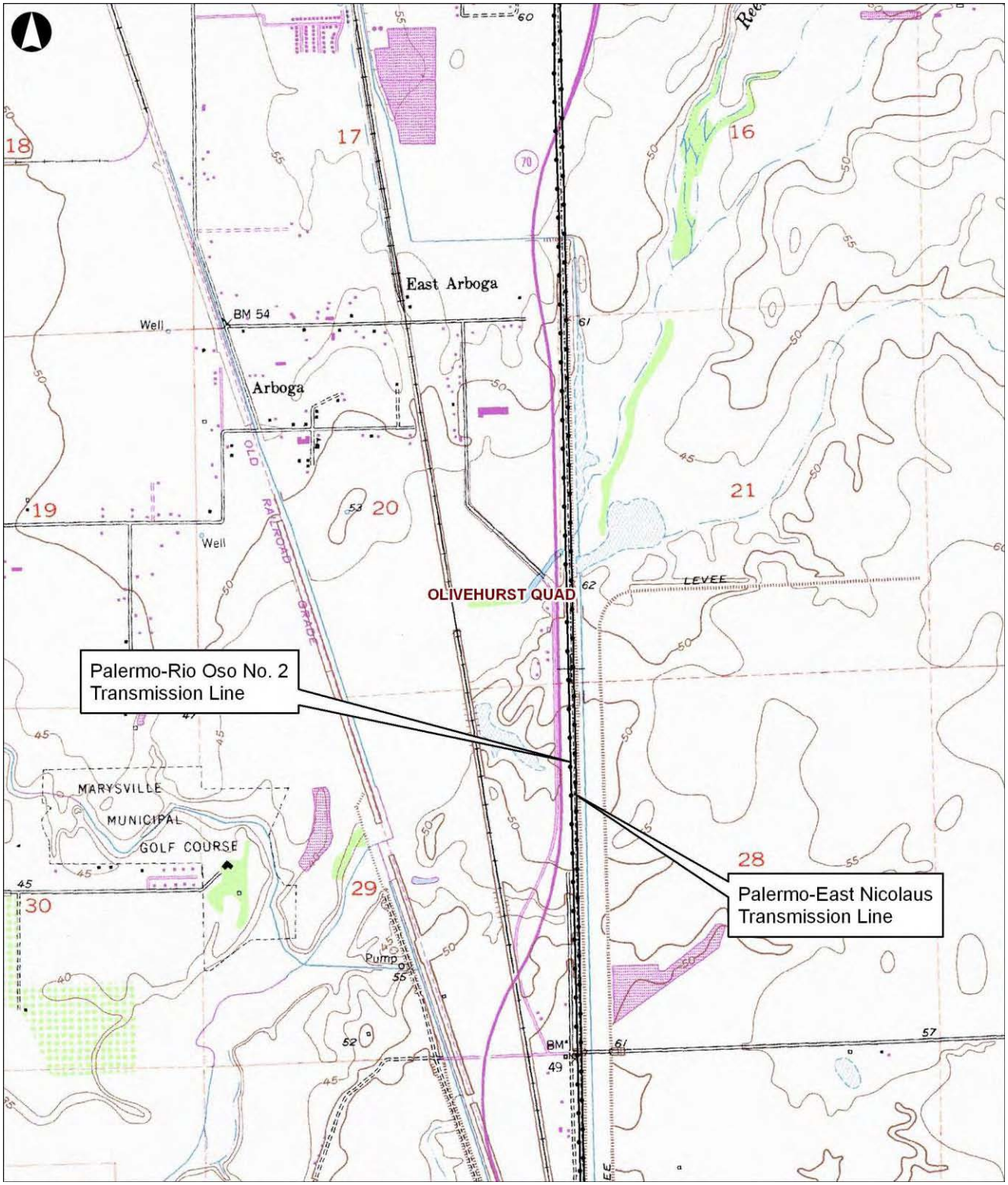
State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **LOCATION MAP**	Primary # HRI# Trinomial

 ***Resource Name or #:** Palermo-Rio Oso No. 2 Transmission Line

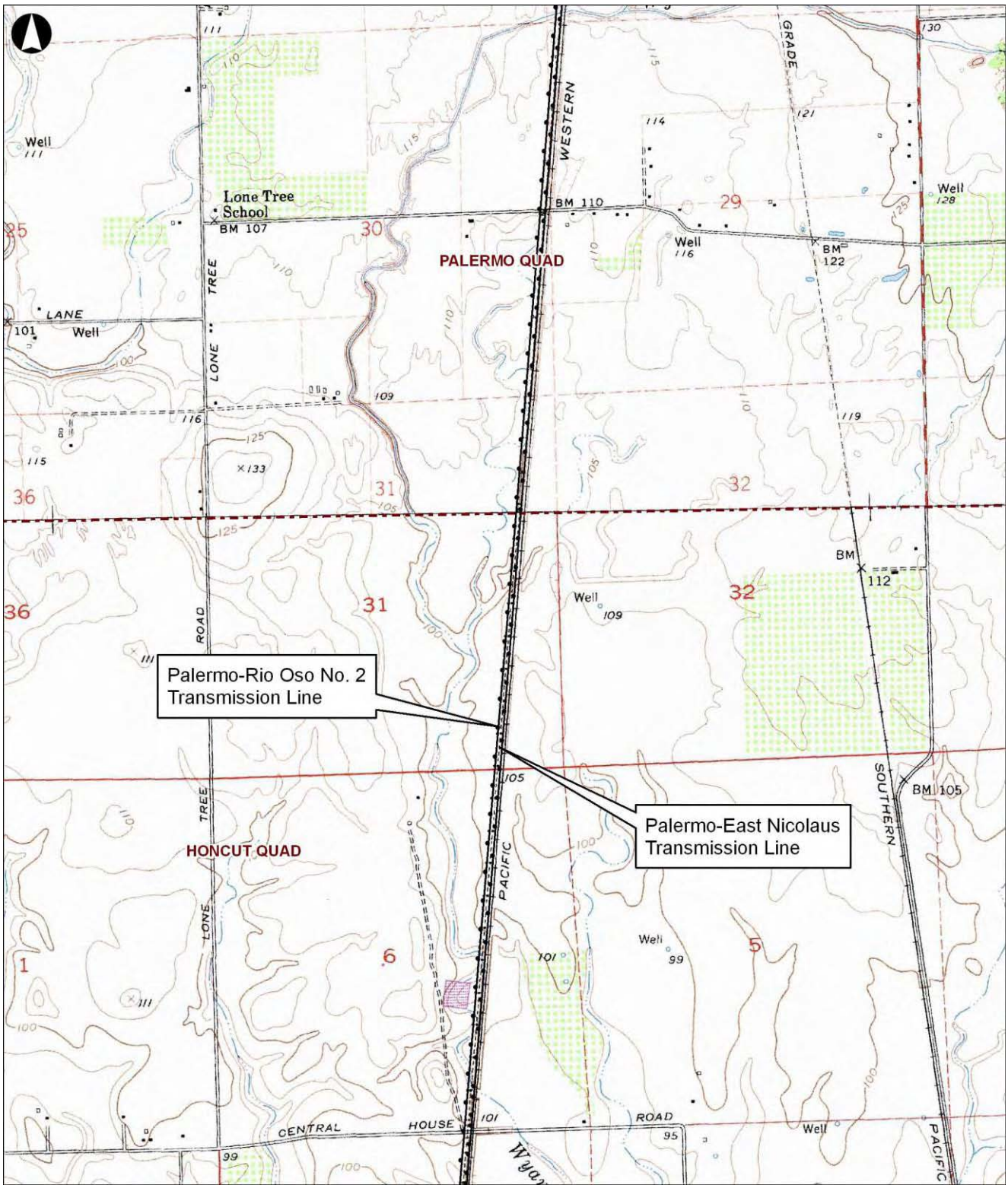
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 1 ***Scale:** 7.5 minute ***Date of Map:** 1970



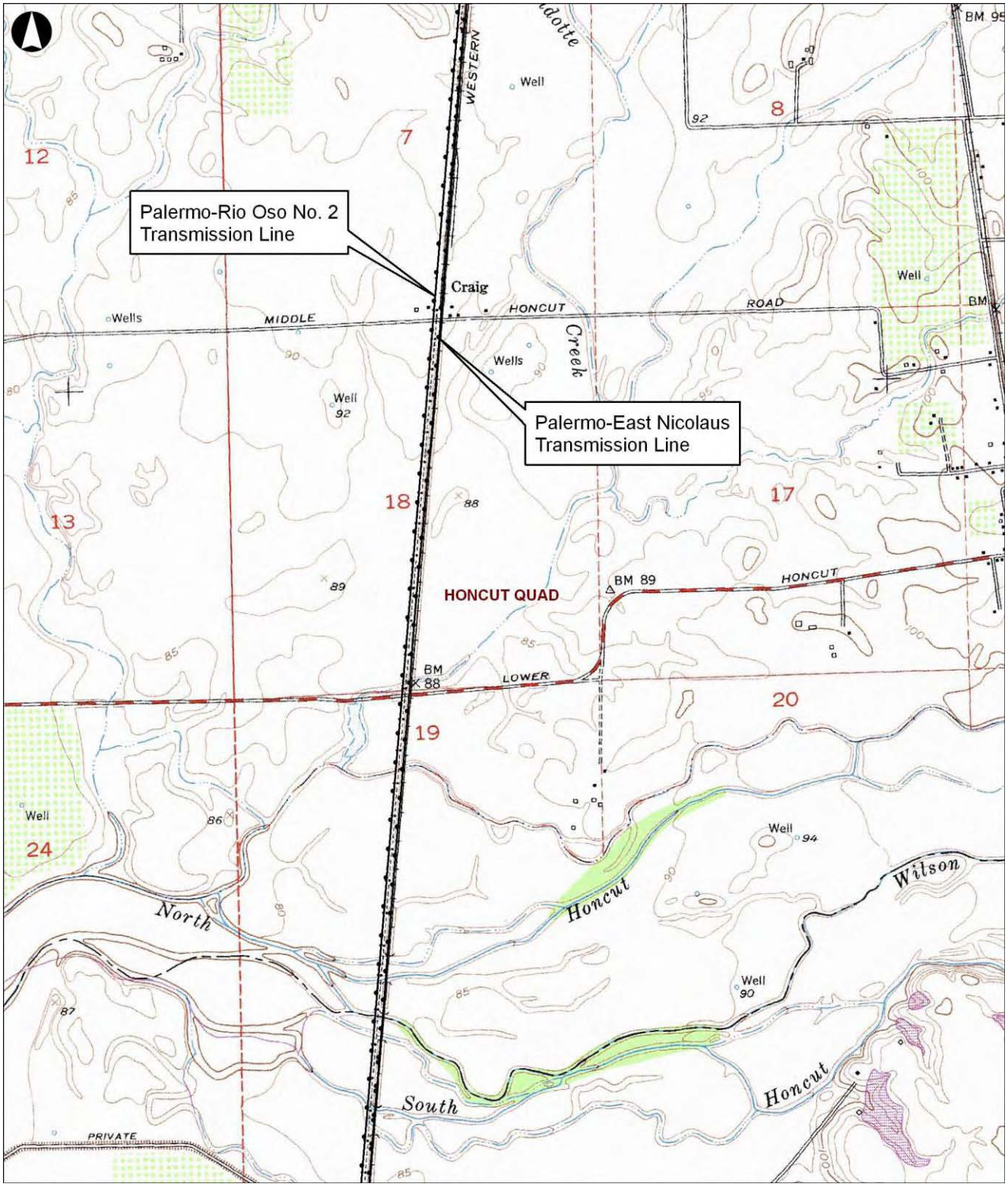
*Map Name: Palermo-East Nicolaus Transmission Line, Map 2 *Scale: 7.5 minute *Date of Map: PR 1973



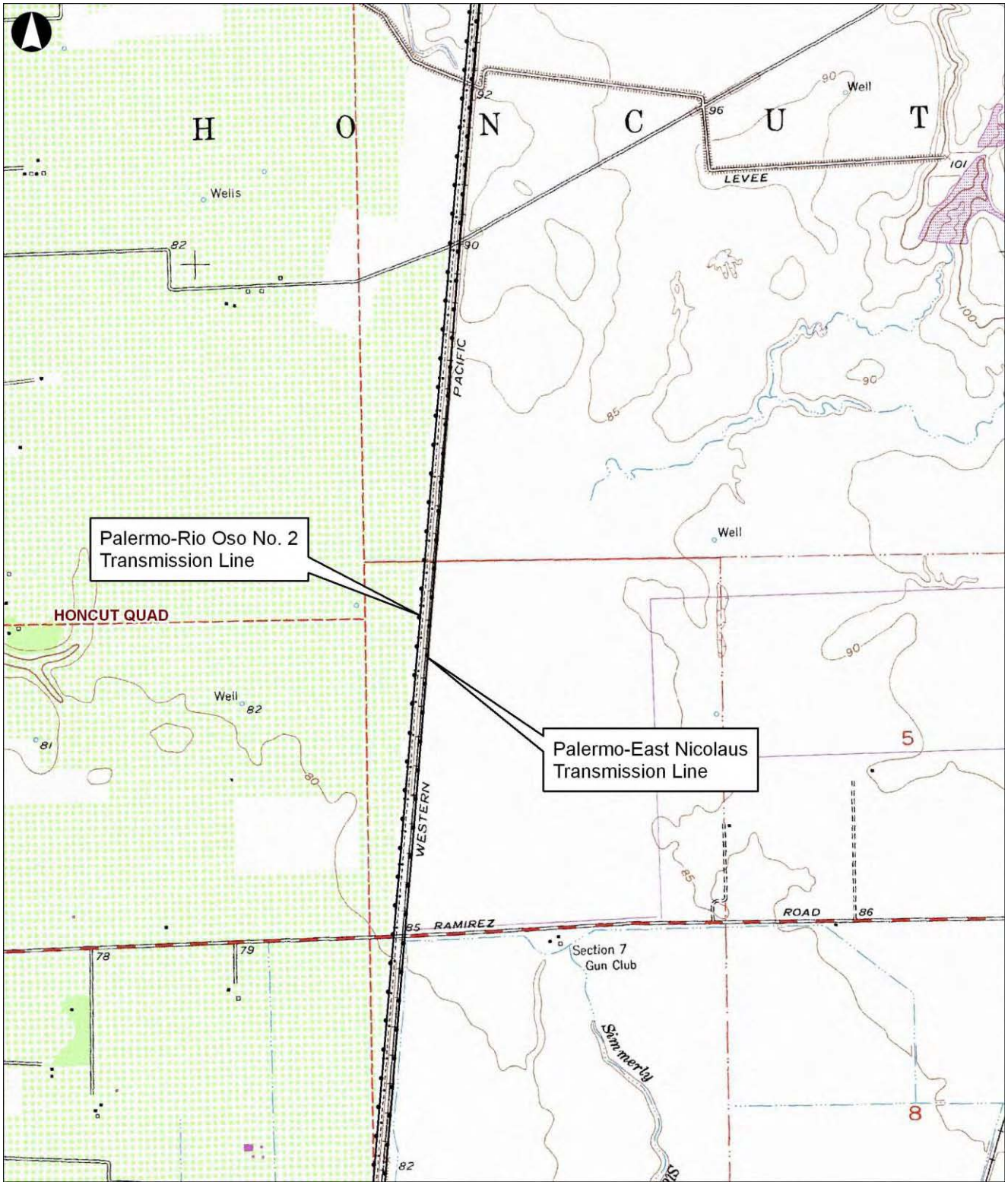
*Map Name: Palermo-East Nicolaus Transmission Line, Map 3 *Scale: 7.5 minute *Date of Map: 1970 (Palermo Quad), PR 1973 (Honcut Quad)



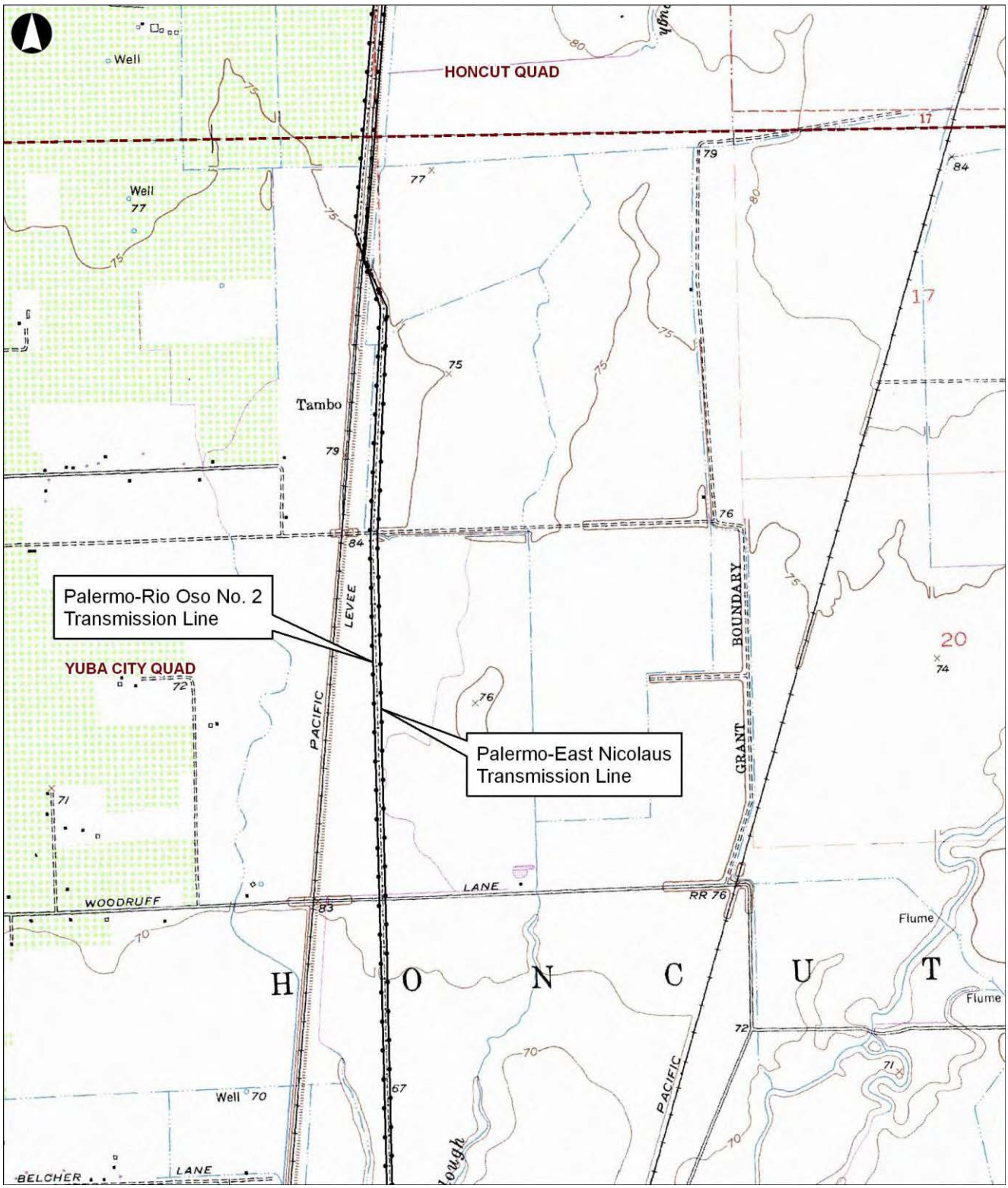
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 4 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



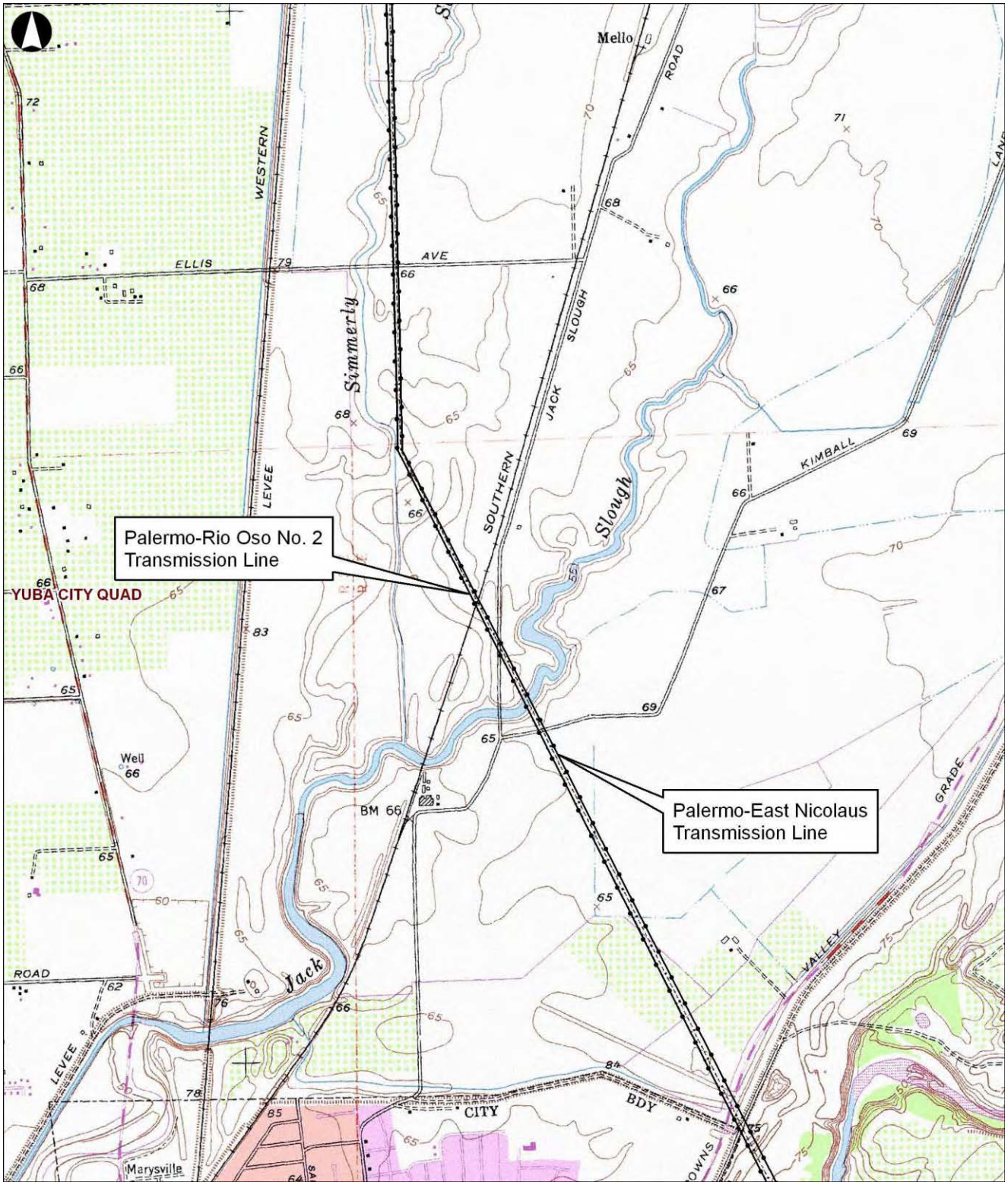
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 5 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



*Map Name: Palermo-East Nicolaus Transmission Line, Map 6 *Scale: 7.5 minute *Date of Map: PR 1973 (Honcut Quad), PR 1973 (Yuba City Quad)



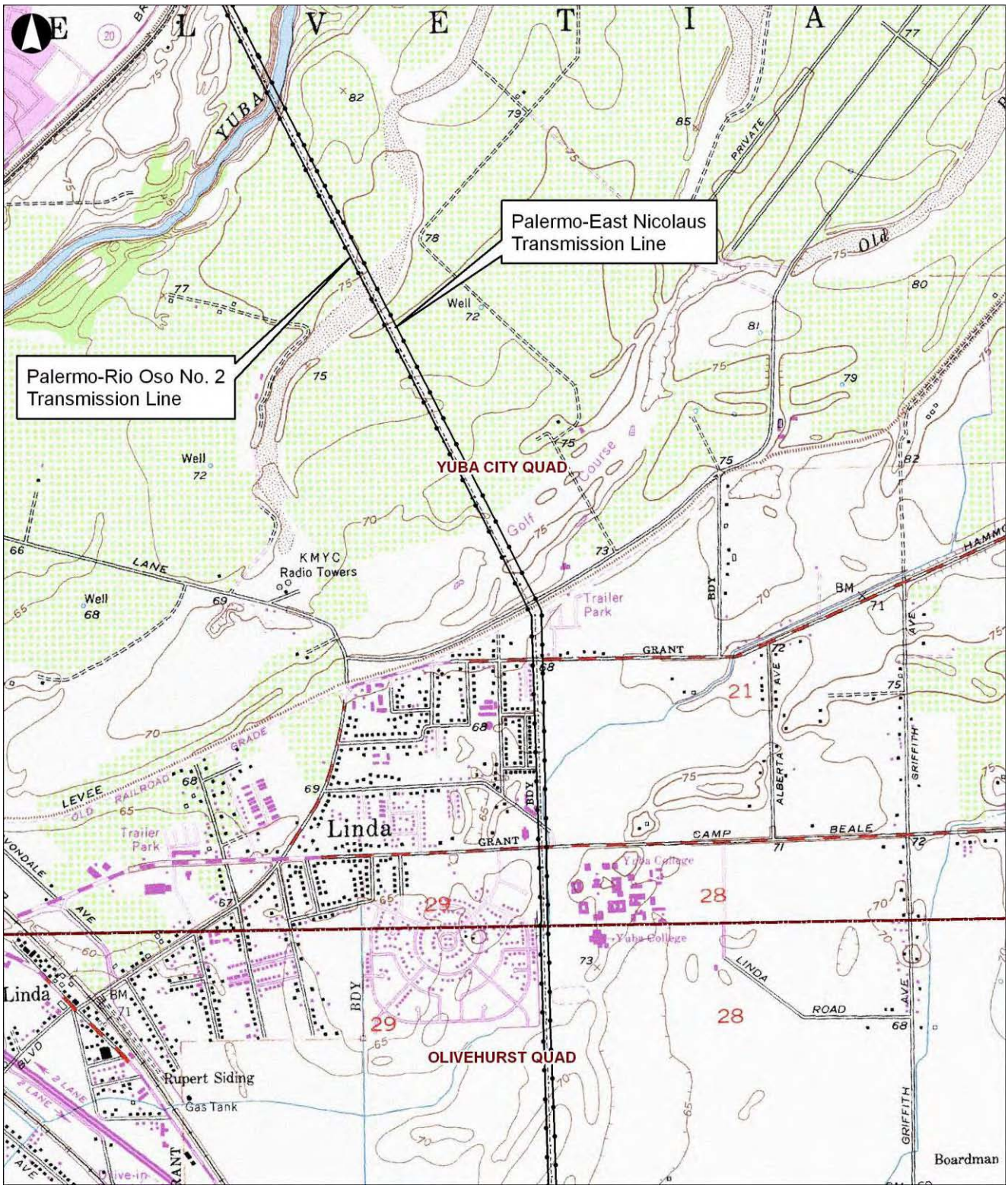
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 7 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **LOCATION MAP**	Primary # HRI# Trinomial

 ***Resource Name or #:** Palermo-Rio Oso No. 2 Transmission Line

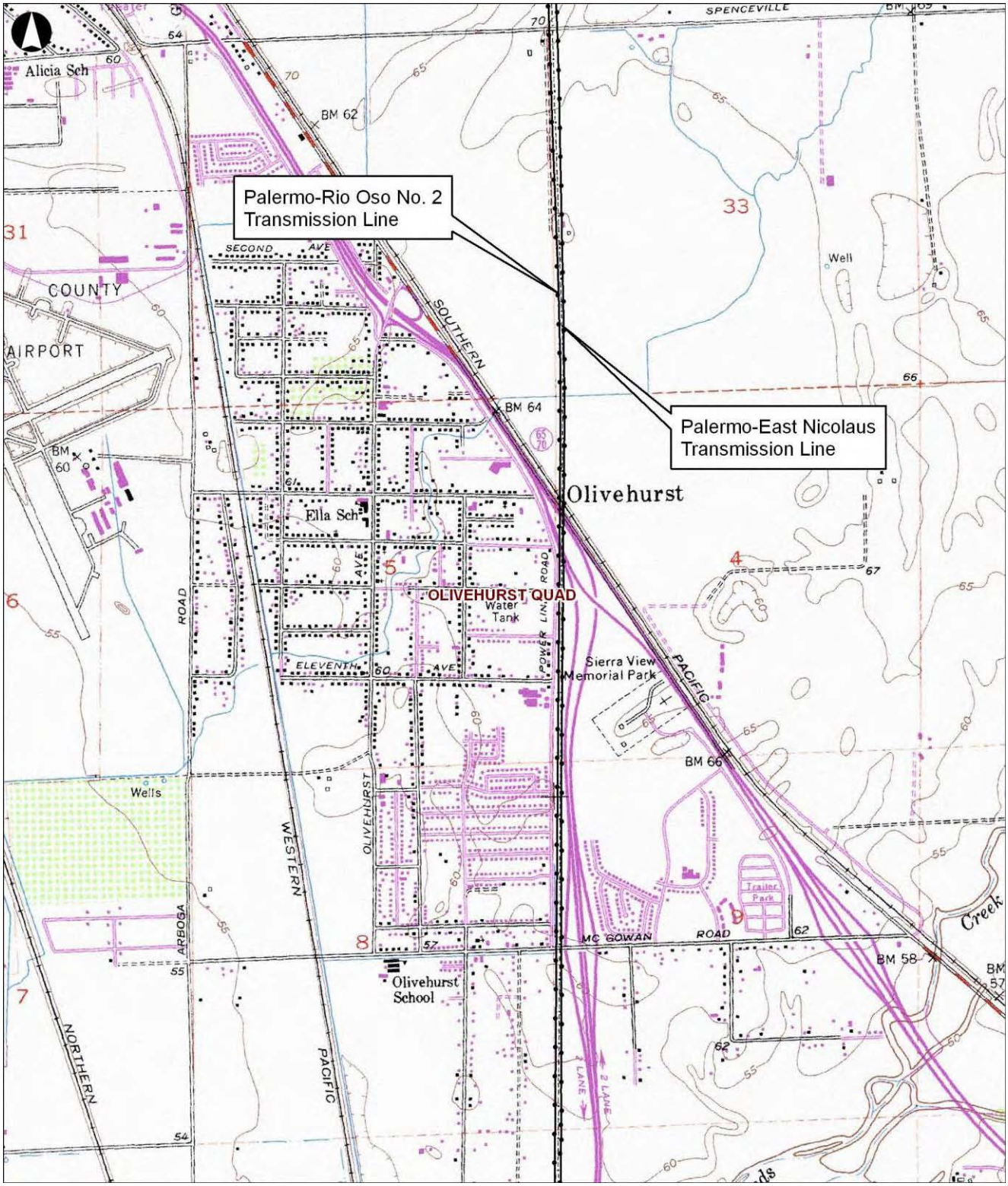
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 8 Quad), PR 1973 (Olivehurst Quad) ***Scale:** 7.5 minute ***Date of Map:** PR 1973 (Yuba City



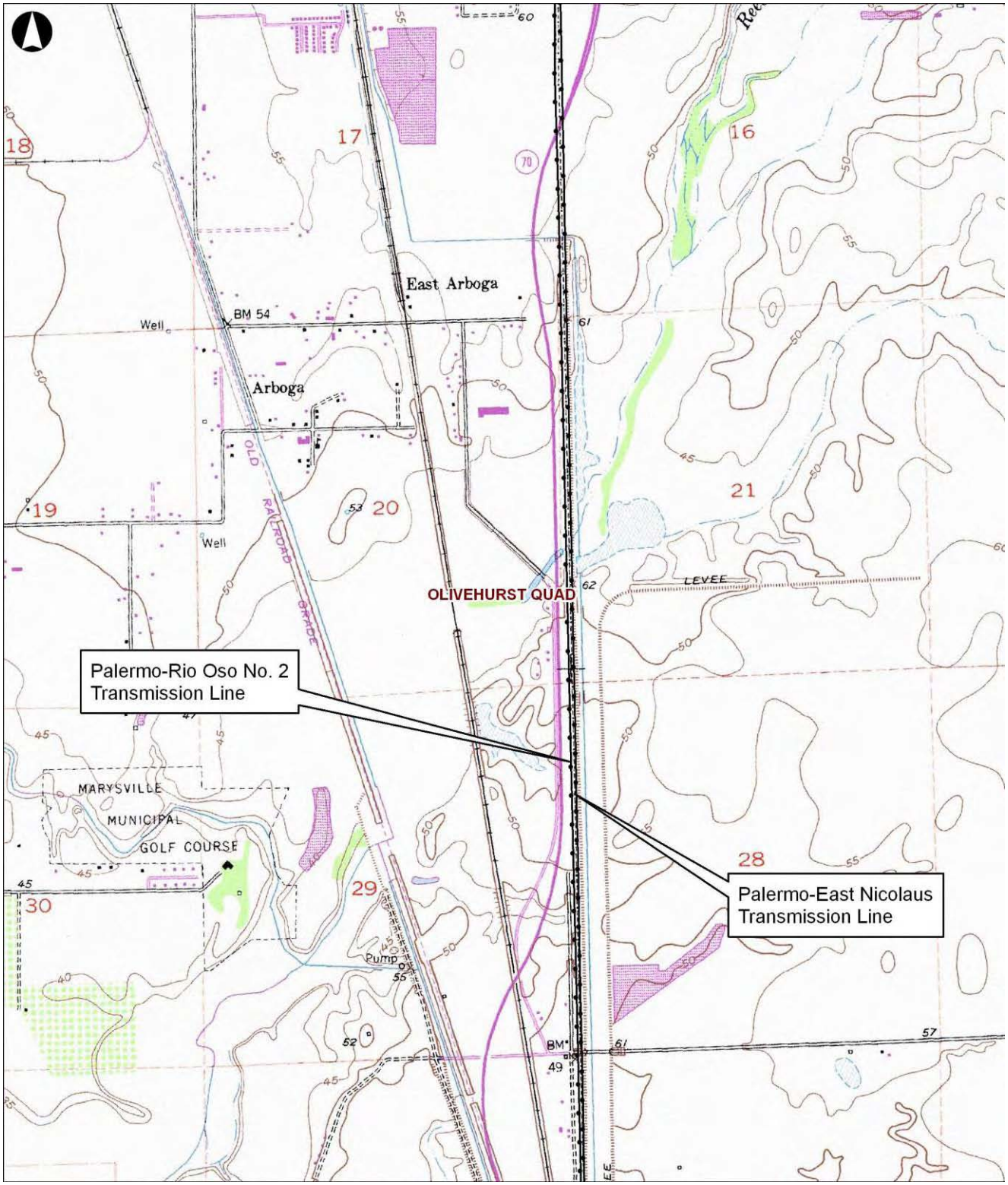
State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **LOCATION MAP**	Primary # HRI# Trinomial

 ***Resource Name or #:** Palermo-Rio Oso No. 2 Transmission Line

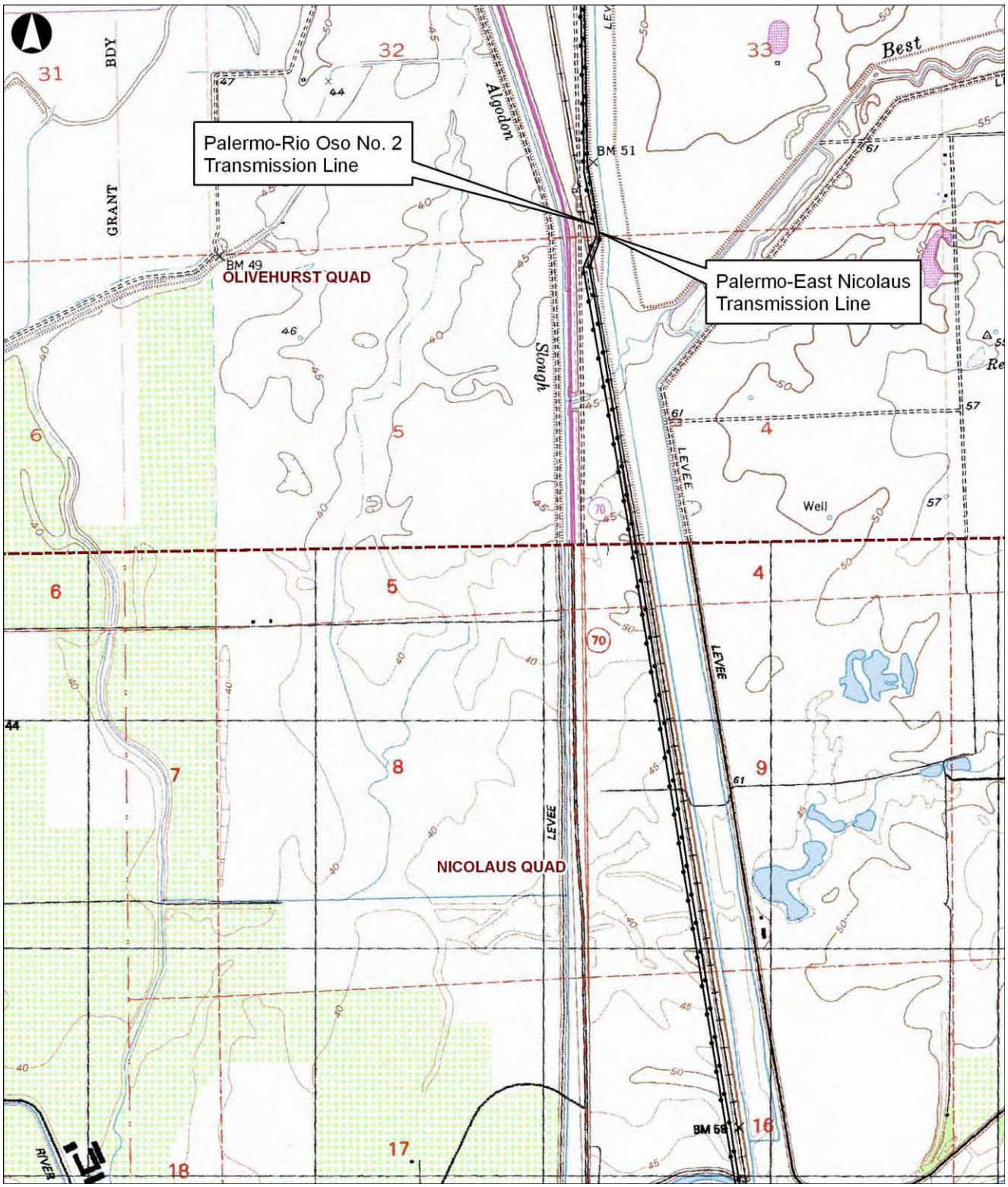
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 9 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



***Map Name:** Palermo-East Nicolaus Transmission Line, Map 10 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



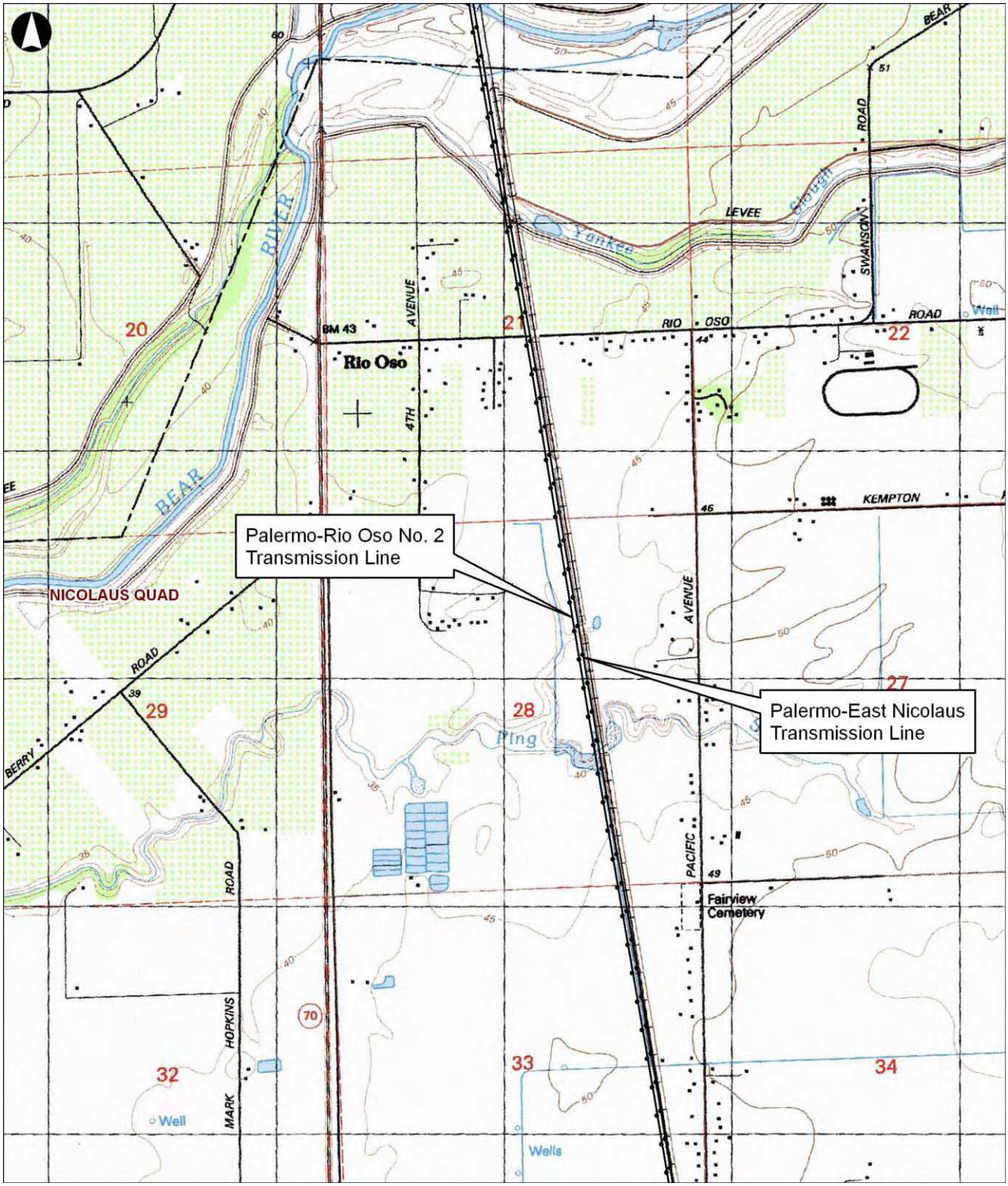
***Map Name:** Palermo-East Nicolaus Transmission Line, Map 11 Quad), PR 1973 (Nicolaus Quad) ***Scale:** 7.5 minute ***Date of Map:** PR 1973 (Olivehurst



State of California — The Resources Agency DEPARTMENT OF PARKS AND RECREATION **LOCATION MAP**	Primary # HRI# Trinomial

 ***Resource Name or #:** Palermo-Rio Oso No. 2 Transmission Line

***Map Name:** Palermo-East Nicolaus Transmission Line, Map 12 ***Scale:** 7.5 minute ***Date of Map:** PR 1973



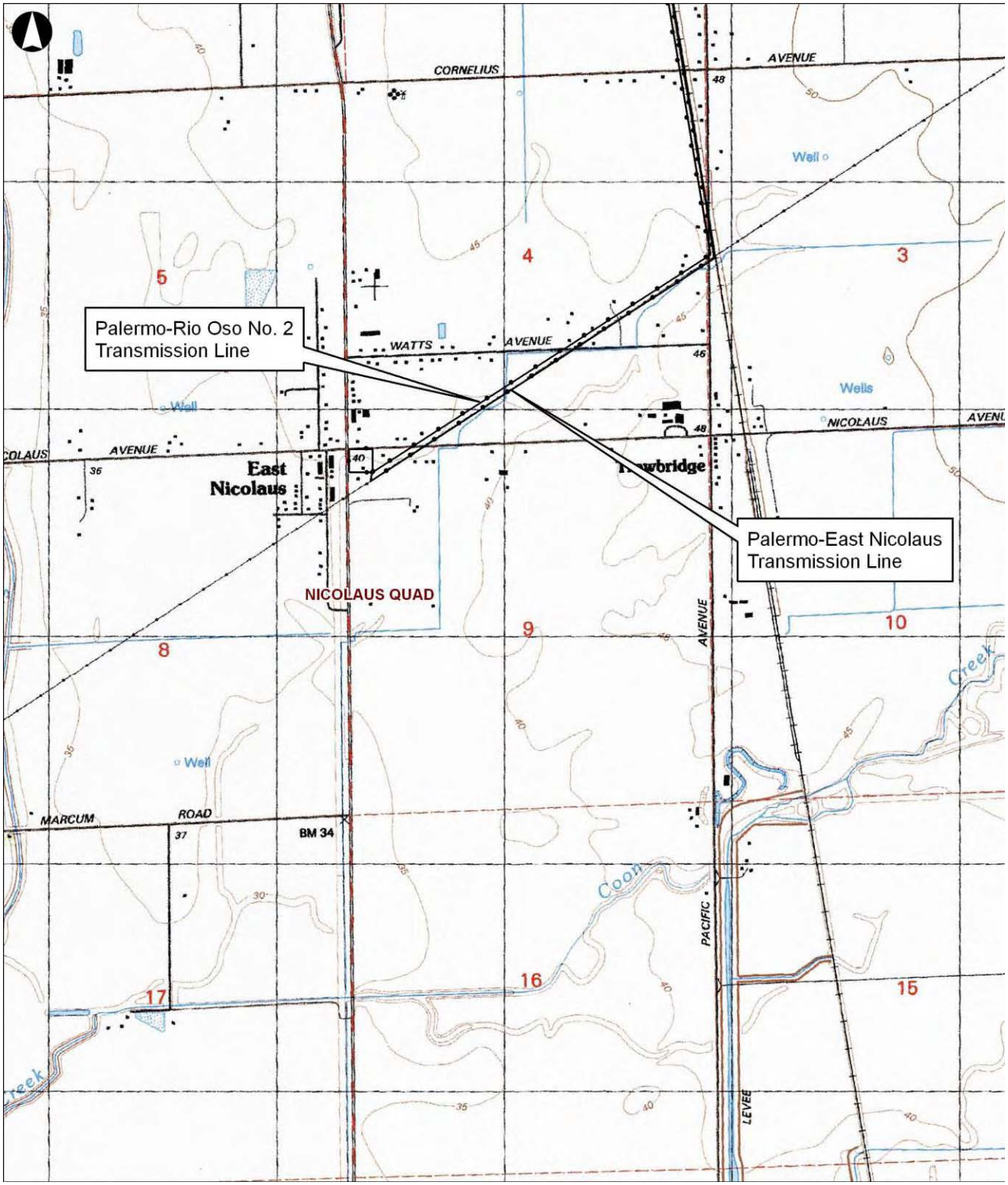
State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

LOCATION MAP

Primary #
HRI#
Trinomial

 *Resource Name or #: Palermo-Rio Oso No. 2 Transmission Line

*Map Name: Palermo-East Nicolaus Transmission Line, Map 13 *Scale: 7.5 minute *Date of Map: PR 1973



 *Required information