Non-Technical Barriers to Geothermal Development in California and Nevada

Aaron Levine, Ligia E.P. Smith, Jody Robins, Erik Witter, Caity Smith, and Clare Haffner

National Renewable Energy Laboratory

NREL is a national laboratory of the U.S. Department of Energy
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Photos (clockwise) by Dennis Schroeder, NREL 36653; Alaska Center for Energy and Power, NREL 32760; Dennis Schroeder, NREL 48223 and 48223; John W. Lund, NREL 13101; Robb Williamson, NREL 13033

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List of Acronyms

AFC	Application for Certification
APCD	Air Pollution Control District
AQMD	Air Quality Management District
ATB	Annual Technology Baseline
BGEPA	Bald and Golden Eagle Protection Act
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
BWWTP	Brawley Wastewater Treatment Plant
CAA	Clean Air Act
CalGEM	California Geological Management Division
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CCD	Carson City District
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CPUC	California Public Utilities Commission
CSLC	California State Lands Commission
CTR	Controlled Thermal Resources
CUP	Conditional Use Permit
CWA	Clean Water Act
CX	Categorical Exclusion
DNA	Determination of NEPA Adequacy
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
EA	Environmental Assessment
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FLPMA	Federal Land Policy and Management Act
FONSI	Finding of No Significant Impact
FP	Forest Plan
FSM	U.S. Forest Service Manual

GDP	Geothermal Drilling Permit
GETEM	Geothermal Energy Technology Evaluation Model
GSA	Geothermal Steam Act of 1970
GTO	Geothermal Technologies Office
GW	gigawatt
HR-2	Hudson Ranch II
ICAPCD	Imperial County Air Pollution Control District
ICPDS	Imperial County Planning and Development Services
IID	Imperial Irrigation District
kV	kilovolts
LCOE	Levelized Cost of Electricity
LUP	Land Use Plan
MBTA	Migratory Bird Treaty Act
MND	Mitigated Negative Declaration
MOA	Memoranda of Agreement
MOU	Memorandum of Understanding
MW	megawatt
MWh	megawatt-hour
NDCNR	Nevada Department of Conservation and Natural Resources
NDEP	Nevada Division of Environmental Protection
NDOM	Nevada Division of Minerals
NDOT	Nevada Department of Transportation
NDSL	Nevada Division of State Lands
NDWR	Nevada Division of Water Resources
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act
NOD	Notice of Determination
NOI	Notice of Intent
NOP	Notice of Preparation
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NPUC	Nevada Public Utilities Commission
NREL	National Renewable Energy Lab
OEC	Ormat Energy Converter
POU	Plan of Utilization
PPA	Power Purchase Agreement
RMP	Resource Management Plan
ROW	Right-of-Way
RTO	regenerative thermal oxidizer

RWQCB	Regional Water Quality Control Board
SEAT	Socioeconomic Assessment Tool
SHPO	State Historic Preservation Officer
SWRCB	State Water Resources Control Board
UEPA	Nevada Utility Environmental Protection Act
UIC	underground injection control
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WOTUS	Waters of the United States

Executive Summary

In the United States, geothermal project development may be subject to numerous permits, authorizations, and other regulatory requirements at the federal, state, and local (e.g., county/municipal) level (Levine and Young 2018). In addition, different permits and regulatory processes are required at different phases of geothermal development (e.g., leasing, exploration, well drilling, and utilization) (Levine and Young 2018; Young et al. 2014). These permitting and regulatory requirements are necessary to address potential impacts to land use, water quality and usage, biological species, cultural resource, recreation, and other natural resources at geothermal project sites. However, these regulatory requirements may act as non-technical barriers to geothermal project development, which may negatively impact development timelines and potentially raise the costs and risks associated with geothermal development (DOE 2019).

Previous studies such as the 2019 *GeoVision* analysis have focused on non-technical barriers to geothermal development mostly at a national level with a heavy focus on federal regulatory requirements (DOE 2019). This report presents the results of our study of non-technical barriers that may influence geothermal project development in California and Nevada, including an analysis of federal, state, and local geothermal regulatory and permitting processes and considerations, case studies analyzing attributes at specific project locations, an analysis of cost and timeline implications for geothermal project development, and a qualitative analysis conducted through a series of semi-structured interviews with regulatory agencies and geothermal project developers in California and Nevada.

Regulatory and Permitting Considerations

Through our analysis, we found that in California, project development timelines may be impacted by federal, state, and local regulatory permitting and environmental review requirements as well as coordination efforts between federal, state, and local agencies. For example, geothermal projects in California are potentially subject to environmental review processes at the federal (i.e., National Environmental Policy Act (NEPA)) and state level (i.e., California Environmental Quality Act (CEQA)). In particular, the state CEQA process is inconsistent (e.g., each state agency has its own separate, compartmentalized CEQA process) and time consuming, which may lead to geothermal permitting and project development delays. However, use of the California Energy Commission's Application for Certification process provides an option for projects 50 megawatts (MW) or greater to use a single process that can cover permitting requirements from multiple agencies and includes statutorily mandated processing timelines. The opportunity for developing a streamlined, integrated, and holistic environmental review process for projects less than 50 MW may exist for other agencies, which could potentially decrease permitting timelines.

Geothermal projects in California may also be subject to federal (e.g., Endangered Species Act (ESA)) and state (e.g., California Endangered Species Act (CESA)) endangered species act consultation depending on site-specific biological species concerns. Moreover, depending on project location, geothermal projects in California often need federal, state, and local level permits and authorizations, requiring coordination amongst multiple federal, state, and local authorities prior to project development. By contrast, Nevada has a more centralized approach in which authority over geothermal projects is shared by federal and state agencies, allowing for

efficiency in coordinating between federal and state permitting authorities. However, geothermal project development timelines in Nevada may be impacted by duplicative federal and state permitting requirements. For example, in Nevada, geothermal project developers must obtain geothermal drilling permits from both federal (i.e., Bureau of Land Management (BLM)) and state (i.e., Nevada Division of Minerals (NDOM)) agencies for projects located on federally managed land. In addition, these federal and state drilling permit processes do not occur concurrently and require the submittal of different forms, which may potentially increase the time and effort required to permit the same well.

Resource- and Site-Specific Environmental Considerations

Projects in both California and Nevada may face site-specific environmental challenges that can cause permitting and project delays. For example, in California, projects located in Imperial County may have a nexus to Waters of the United States (WOTUS), requiring a Clean Water Act (CWA) 404 Permit from the U.S. Army Corps of Engineers (USACE) as a pre-requisite to project development. In addition, the California Water Board must issue a CWA Section 401 water quality certification or waive the certification requirement prior to USACE issuing a CWA Section 404 permit, which can lead to further permitting delays. However, the use of a USACE general permit rather than an individual CWA 404 Permit for certain qualifying projects has the potential to provide for a more expedited review process.

In Imperial County, California, geothermal projects may also face challenges due to the presence of sensitive and endangered species located in the Sonny Bono Salton Sea National Wildlife Refuge as well as unique environmental conditions present at the Salton Sea. For example, degraded water quality due to water recession and loss at the Salton Sea has led to competing water interests, which may present challenges for geothermal development in Imperial County.

Similarly, in Nevada, certain projects have experienced delayed development and construction timelines due to the presence of endangered species and areas of cultural and/or Tribal significance near project boundaries. For example, in Dixie Valley, Nevada, the presence of the Dixie Hot Springs, which have cultural significance to local federally recognized Tribes and ecological value for the Dixie Valley toad—currently subject to an emergency listing by the U.S. Fish and Wildlife Service (USFWS)—has led to litigation and project construction delays for the Dixie Meadows Utilization Project.

Permitting Timeline Cost Implications

Our study results also indicated that protracted geothermal development timelines caused by delays in acquiring necessary permits and environmental reviews may drive up project costs and increase economic uncertainty. Specifically, delay of project construction and completion timelines may result in loss of generated electricity revenue and additional financing costs. Our analysis indicated that when project delays occur, the levelized cost of electricity (LCOE) may become higher for produced electricity due to compounding interest that may accrue over long periods of time while construction of the geothermal power plant is on hold. Other cost factors incurred by project delays resulting from lengthened permitting timelines may include potential penalties incurred for failure to deliver electricity pursuant to power purchase agreements (PPAs).

Best Practices to Reduce Permitting and Project Development Delays

Through our qualitative analysis, we found that utilizing best practices like tiering to existing environmental review documents and using Memoranda of Understanding (MOUs) may reduce overall project timelines, costs, and uncertainties associated with geothermal project development. Tiering to existing environmental review documents, such as NEPA and CEQA documents, could create efficiencies in the environmental review processes by aiding agency staff in developing mitigation measures. In addition, tiering to recently conducted baseline resource studies may save time and resources for federal and state agencies during environmental reviews of projects, which are closely located and/or near the same type of resources.

Moreover, the use of MOUs—which clearly delineate agency roles and responsibilities and align agency permitting processes—could reduce duplication and impacts to geothermal permitting timelines in Nevada and California. For example, in 2021, the U.S. Department of the Interior (DOI), U.S. Department of Agriculture (USDA), U.S. Department of Defense (DoD), U.S. Department of Energy (DOE), and U.S. Environmental Protection Agency (EPA) entered into an MOU (2021 MOU) to improve public land renewable energy project permit coordination. The MOU implements the direction of the Energy Act of 2020, which established a National Renewable Energy Coordination Office (National RECO) within BLM headquarters and five RECOs in the western states to improve federal permit coordination. The 2021 MOU may assist in streamlining federal agency review and permitting decisions to support national renewable energy goals for federal agency administered lands. In addition, in Nevada, the development of an MOU between the BLM and NDOM that specifically addresses agency roles and responsibilities and aligns the federal and state drilling permit procedure could potentially reduce duplication and permitting timelines for geothermal exploration and drilling.

Table 1 provides a summary of identified challenges and potential impacts for geothermal project development in California and Nevada. Table 2 provides a summary of identified best practices for geothermal project development in California and Nevada.

Table 1. Identified Challenges for Geothermal Project Development in California and Nevada

Identified Challenges	Potential Impacts
California and Nevada Geothermal Projects	
Staff shortages and heavy workloads	Increase environmental review process and permitting timelines through limited staff resources that may create permitting delays
California Geothermal Projects	
Dual federal and state environmental review requirements (e.g., National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA)	Increase project permitting and development timelines through lengthy, in-depth, concurrent federal and state environmental review processes
Lengthy CEQA environmental review process	Increase project permitting and development timelines through compartmentalized, costly, and time-consuming state environmental review process

Identified Challenges	Potential Impacts
Individual agency jurisdictional determinations and interagency coordination issues	Increase project permitting and environmental review process due to interagency coordination and permitting delays associated with U.S. Army Corps of Engineers (USACE) individual jurisdictional determinations and issuance of Clean Water Act Section 401 and 404 permits
Presence of sensitive and endangered species	Increase project costs and risks due to presence of sensitive and/or endangered species and associated habitat
Recession of Salton Sea	Increase project costs and risks due to competing water interests associated with water reduction, decreased water quality, and loss of species habitat at the Salton Sea
Nevada Geothermal Projects	
Duplicative federal and state drilling permitting requirements	Increase project development timelines and costs due to duplicative and compartmentalized federal and state drilling permit processes
Presence of endangered species and cultural resources	Increase project costs and risks due to presence of cultural resources (e.g., Dixie Valley Hot Springs) and sensitive and/or endangered species (e.g., Dixie Valley toad) and associated habitat

Table 2. Identified Best Practices for Geothermal Project Development in California and Nevada

Identified Best Practices	Potential Impacts
California and Nevada and Geothermal Projects	
Tiering to existing environmental review documents (e.g., NEPA) documents, baseline studies	Create cost and time efficiencies for agency staff and project developers through use of applicable prior studies and previously implemented mitigation measures
California Geothermal Projects	
Developing a holistic, integrated environmental review process	Decrease project development delays through streamlining environmental review and permitting process
Leveraging federal and state regulatory working groups	Decrease project permitting delays through increasing inter-agency coordination and communication
Leveraging the California Energy Commission (CEC) Application for Certification process for projects 50 MW or greater	Decrease project environmental review timelines through consolidating state and local permitting requirements

Identified Best Practices	Potential Impacts
	Provide greater certainty to developers regarding costs and risks associated with permitting timelines through CEC mandatory processing timelines
Developing interagency Memoranda of Understanding (MOUs	Decrease project permitting and development timelines through increasing transparency and outlining agency roles and responsibilities
Issuing USACE Clean Water Act Section 404 general permit instead of individual permit	Decrease project permitting timelines for smaller projects by providing a streamlined permitting approach
Issuing a jurisdictional determination evaluating the Salton Sea	Decrease project development timelines time associated with jurisdictional determination by reducing individual case-by-case decisions
Nevada Geothermal Projects	
Leveraging and updating existing interagency MOUs	Decrease project permitting and development timelines through increasing transparency and outlining agency roles and responsibilities
Aligning federal and state drilling permit application process	Decrease permitting timelines by reducing duplication of efforts necessary to permit the same drilling well

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1 Introduction

Geothermal resources have vast domestic energy potential that could provide a flexible and reliable source of electricity and contribute an essential element to the United States' clean energy infrastructure goals and energy demands (DOE 2019). In addition to being present in large quantities on a nationwide scale, geothermal resources are available "around the clock" and may be used in a variety of applications including electric power generation as well as residential and commercial building heating and cooling (DOE 2019). Currently, the United States' geothermal power capacity is approximately 3.673 gigawatts-electric (GWe) (Robins et al. 2021). However, to increase geothermal capacity, the geothermal energy sector must overcome both technical and non-technical barriers, including permitting and regulatory processes that impact the costs and risks associated with geothermal development (DOE 2019). Non-technical barriers may cover multiple aspects of geothermal project development, including land access (e.g., leasing and rights-of-way), project permitting, and other environmental regulatory requirements (DOE 2019). The U.S. Department of Energy's (DOE) Geothermal Technologies Office (GTO) has posited that if the impacts of non-technical barriers can be minimized through optimizing permitting and regulatory processes, the United States could increase installed geothermal electricity generation capacity to 13 GWe by 2050 (DOE 2019).

In the United States, geothermal project development may be subject to numerous permits, authorizations, and other regulatory requirements at the federal, state, and local (e.g., county/municipal) level. In addition, different permits and regulatory processes are required at different phases of geothermal development (e.g., leasing, exploration, well drilling, and utilization). These permitting and regulatory requirements are necessary to address different considerations such as land use, water quality and use, species protection, cultural resource impacts, recreation, and other natural resources at geothermal project sites. However, these regulatory requirements may act as non-technical barriers to geothermal project development, which may negatively impact development timelines and potentially raise the costs and risks associated with geothermal development (DOE 2019).

The time involved in acquiring necessary permits for a geothermal project may vary depending on project location and site-specific environmental and cultural considerations (Levine and Young 2018). Moreover, the level and intensity of environmental analysis required for a project may vary depending on the phase of geothermal development (Levine and Young 2018). For example, the level of environmental analysis required to study temporary impacts caused by exploration/resource confirmation drilling may be less involved than the environmental analysis necessary to study the potential impacts of the construction and operation of a permanent structure, such as a geothermal power plant and associated transmission lines. Over time, protracted permitting timelines may drive up project costs and increase economic uncertainty.

In 2020, GTO funded this study through the National Renewable Energy Laboratory (NREL) to investigate non-technical barriers that may impact geothermal development in California and Nevada. Specifically, this report focuses on interactions and coordination between federal, state, and local authorities regarding environmental management, land access, and other permitting requirements to better understand the challenges that may impact project development and illuminate best practices to optimize geothermal development timelines. In the United States, all geothermal power plants are located in the western states where geothermal energy resources are

close to the earth's surface (EIA 2022). Accordingly, for the purposes of this report, we focused on challenges and opportunities for selected geothermal resource areas located in California and Nevada. The results are based on quantitative and qualitative analysis, leveraging information provided by federal, state, and local level permitting authorities as well as geothermal developers.

The analysis within this report may provide federal and state policymakers, regulators, and other geothermal industry stakeholders (e.g., developers, consultants, utilities) with information to potentially increase efficiencies within the permitting process as well as interagency coordination and collaboration. This report does not propose any specific recommendations but instead seeks to provide an objective evaluation of the current federal, state, and local regulatory process, timelines, costs, and benefits related to geothermal permitting approvals. This report is divided into the following sections, which provide both quantitative and qualitative data and analysis:

Section 2 provides a comprehensive regulatory overview of the federal, state, and local geothermal permitting and authorization processes for geothermal projects located in California and Nevada. Section 2 includes federal, state, local, and Tribal agency jurisdictional roles in geothermal permitting.

Section 3 provides a case study analysis of non-technical barriers for three projects located in Imperial County, California, and one project located in Dixie Meadows, Nevada. Section 3 includes an analysis of site-specific attributes to determine project readiness using the Geothermal Resource Portfolio Optimization and Reporting Technique (GeoRePORT) Socioeconomic Assessment Tool (SEAT).

Section 4 examines how the geothermal permitting process may impact development timelines and projected costs. Section 4 includes analysis of how permitting may impact project costs using NREL's Annual Technology Baseline (ATB)[1] to understand the implications of development timeline impacts on geothermal levelized cost of electricity (LCOE).

Section 5 provides a summary of stakeholder perspectives on challenges, best practices, and opportunities within the geothermal permitting process. These perspectives were obtained through video and phone interviews with stakeholders involved in the geothermal permitting process including federal, state, and local agencies with primary permitting roles or interests in social, cultural, biological, recreational, and environmental resources as well as geothermal project developers.

Section 6 discusses the results from Sections 2–5 to synthesize the findings and provide key takeaways regarding the geothermal permitting process in California and Nevada.

[1] The ATB is a populated framework used to identify technology-specific cost and performance parameters or other investment decision metrics across a range of fuel price conditions and site-specific conditions for electric generation technologies and is available at https://atb.nrel.gov/.

2 Regulatory Overview of Geothermal Projects in California and Nevada

Geothermal exploration and development activities must comply with a variety of federal, state, and local licenses, permits, and authorizations depending on the location of the resource, including:

- Land use plans and land access (e.g., rights-of-way)
- Geothermal leasing, exploration, drilling, and utilization permits
- Environmental, biological, and cultural resources review processes
- Water quality permits
- Air quality permits.

Section 2.1 contains a summary of federal licenses, permits, and authorizations that may be required for geothermal projects depending on the location of the resource.[2] Section 2.2 contains a summary of state and local licenses, permits, and authorizations that may be required for geothermal projects located in Imperial County, California (and California more broadly). Section 2.3 contains a summary of state licenses, permits, and authorizations that may be required for geothermal projects located in Nevada.

2.1 Federal Licenses, Permits, and Authorizations for Geothermal Permits

The BLM manages most federal mineral estates, and under most circumstances[3] is the primary federal permitting authority,[4] which works with other federal agencies as well as state, local, and Tribal government, and the public to issue licenses and permits for geothermal projects. The following section provides an overview of federal permits, licenses, and authorizations that may be required for geothermal projects. Figure 1 provides an overview of geothermal permits and authorizations applicable at different phases of geothermal development.

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[2] Within this section, the general descriptions, and regulatory requirements of certain federal licenses, permits, and authorizations required for geothermal projects first appeared within the 2021 report: An Examination of the Hydropower Licensing and Federal Authorization Process. Levine, Aaron, Brenda Pracheil, Taylor, Curtis, Ligia Smith, Jesse Cruce, Matt Aldrovandi, Christa Brelsford, Heather Buchanan, Emily Fekete, Esther Parish, Rocio Uria-Martinez, Megan Johnson, and Debanji Singh. 2021. *An Examination of the Hydropower Licensing and Federal Authorization Process*. Golden, CO: National Renewable Energy Laboratory. October 2021. NREL/TP-6A20-79242. https://www.nrel.gov/docs/fy22osti/79242.pdf. However, discussion and analysis of the application and potential impacts of federal licenses, permits, and authorizations to geothermal development is original to this report.

[3] In certain circumstances, the U.S. Forest Service (USFS) may administer permit approvals for unleased parcels of National Forest System Lands (FSM 2800, Minerals and Geology § 2822.04; Levine and Young 2018).

[4] The Geothermal Steam Act of 1970 (30 U.S.C. § 1001) authorized the Secretary of the Department of the Interior (DOI) to issue leases for the development and utilization of geothermal resources on lands managed by the DOI. The BLM is required to manage the impacts of geothermal operations on public lands pursuant to the Federal Land Policy and Management Act (FLPMA) 43 U.S.C. §§ 1701 – 1787 as well as the National Environmental Policy Act of 1969 (NEPA) 42 U.S.C. §§ 4331 – 4370m – 12.

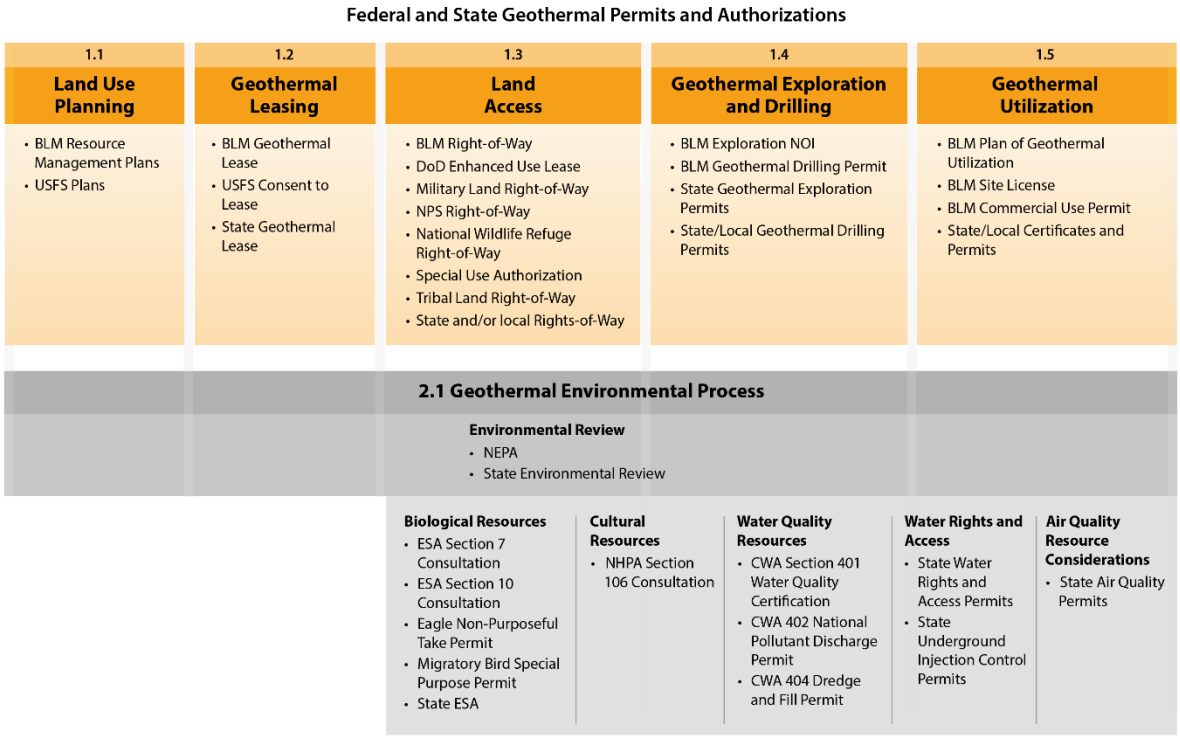

Figure 1. Federal and state geothermal permits and authorizations per development phase

As depicted in Figure 1, numerous federal and state permits are required at different stages of geothermal project development, including land use planning (1.1), geothermal leasing (1.2), land access (1.3), geothermal exploration and drilling (1.4), and geothermal utilization (1.5). For example, during the land use planning stage, geothermal projects must conform to the applicable BLM Resource Management Plan (RMP) and U.S. Forest Service Plan. The geothermal environmental process (i.e., 2.1) may include NEPA and/or state environmental review as well as review and permitting required for protection of resources (e.g., biological, cultural, water, and air resources). Each stage of geothermal development (land use planning, leasing, land access, exploration, drilling, and utilization) may trigger a separate NEPA review. As such, NEPA and/or state environmental review processes may be required at all stages of geothermal project development including land use planning (1.1), geothermal leasing (1.2), land access (1.3), geothermal exploration and drilling (1.4), and geothermal utilization (1.5). Geothermal leases (1.2) may contain stipulations put in place to protect resources (e.g., biological, cultural resources) through mitigation or restrictions on surface use. By contrast, other environmental processes and resource permits (e.g., ESA Section 7 Consultation) may be required (if applicable) for land access (1.3), geothermal exploration and drilling (1.4), and geothermal utilization (1.5).

2.1.1 Land Use Planning

Geothermal activities conducted on federally managed lands must conform to federal land use plans (LUPs). Federal LUPs are used to allocate resources, develop strategies to appropriately manage multiple uses for public lands, and monitor the effectiveness and status of resources and management practices. The federal agency with jurisdiction must determine whether a

geothermal project conforms with applicable LUPs. If the project does not conform to a current LUP, the project must be restructured or the LUP must be amended or revised.

- **Bureau of Land Management Resource Management Plans:** A geothermal project located on BLM managed land must conform with the applicable Resource Management Plan (RMP) pursuant to the Federal Land Policy and Management Act (FLPMA) (43 U.S.C. § 1712; 43 C.F.R. § 1610). If the project does not conform to the RMP (e.g., the development of geothermal projects had not previously been considered within an RMP), the project must be restructured or the RMP must be amended or revised (43 U.S.C. § 1712; 43 C.F.R. § 1610.2). Revising an RMP involves rewriting an existing LUP, while amending an RMP involves modifying one or more parts of an existing LUP. Development of an amendment or revision to an RMP requires compliance with NEPA through appropriate NEPA review. A revision to an RMP requires that the BLM prepare an Environmental Impact Statement (EIS), while an amendment to an RMP may require the BLM to prepare an Environmental Assessment (EA) or EIS depending on how wide-ranging the effects are of the proposed amendment (Levine and Young 2018).
- **U.S. Forest Services Forest Plans:** A geothermal project located on U.S. Forest Service (USFS) managed land must conform with the applicable Forest Plan (FP) pursuant to the National Forest Management Act of 1976 (16 U.S.C. § 1604). If the project does not conform to the FP (e.g., the development of geothermal projects had not previously been considered within an FP), the project must be restructured, or the FP must be amended or revised (36 C.F.R. §§ 219.7, 219.13). Revising an FP creates a new plan for an entire area, while amending an FP involves modifying one or more parts of an existing FP (36 C.F.R. §§219.7, 219.13). A revision to an FP requires the USFS to prepare an EIS, while an amendment to an FP may require the BLM to prepare an EA or EIS, depending on how wide-ranging the effects are of the proposed amendment (Levine and Young 2018).

2.1.2 Geothermal Leasing

Geothermal projects located on federal land must comply with federal leasing requirements prior to developing geothermal resources. Leasing gives a developer the exclusive right to develop and utilize geothermal resources on a given parcel. A lease is required prior to initiating all later stage work (e.g., geothermal drilling, utilization), and the lease contract specifies terms for development and payment of royalties and rents to the government. Surface rights for approved activities are included in the lease. Stipulations may be placed on leases to protect other resources through mitigation or restrictions on surface use.

- **BLM Geothermal Lease:** A geothermal developer must obtain a geothermal lease from the BLM prior to developing geothermal resources on federal lands. Leasing federal geothermal resources grants a geothermal developer the right to future development of geothermal resources within a lease area; however, it does not confer the right to conduct ground-disturbing activities (BLM 2021a). The BLM may conduct a leasing analysis for an individual parcel or multiple parcels. An interested developer may nominate a parcel for a lease by submitting a lease nomination application with a description of the land to

the BLM, or the BLM may lease parcels on its own initiative (43 C.F.R. § 3203.5).[5] Leasing analysis requires compliance with NEPA review that focuses on whether the land is available for leasing, the type of lease stipulations required for the parcels, and environmental, cultural, and other potential resource impacts (BLM 2021a).

- **Forest Service Consent to Lease:** The BLM must obtain consent from the USFS prior to leasing geothermal resources on National Forest System lands (Geothermal Steam Act of 1970, 30 U.S.C. § 1014(b); U.S. Forest Service Manual (FSM) 2820 § 2822.31). If the USFS determines that the geothermal lease nomination meets the goals of the applicable FP, the USFS provides the BLM with a consent decision and lease stipulations (Geothermal Steam Act of 1970, 30 U.S.C. § 1014(b); 43 C.F.R. § 3201.10). The BLM may add additional terms, conditions, or stipulations but cannot lease National Forest System lands without USFS consent (Geothermal Steam Act of 1970, 30 U.S.C. § 1014(b); FSM 2820 § 2822.31).

2.1.3 Land Access

Geothermal projects may require rights-of-way, easements, leases, or other approvals under federal law from the agency with jurisdiction for access through, under, or over federally managed land or some Tribally managed land. Land access is a key consideration for siting geothermal projects, as well as ancillary equipment and facilities (e.g., pipelines, transmission lines, and access roads located outside of the geothermal lease). Agencies with jurisdiction have authority to grant land access rights for geothermal projects if the use is compatible with the agency-managed land or resource and the public interest.

- **Bureau of Land Management Right-of-Way:** A geothermal developer may need a Right-of-Way (ROW) from BLM to access BLM-managed lands that are not covered under a geothermal lease. The Federal Land Policy and Management Act of 1976 gives the BLM authority to grant ROWs for a term of years appropriate for the life of the project (43 U.S.C. § 1761(a)).
- **Bureau of Reclamation Right-of-Way:** A geothermal developer may need a ROW from the Bureau of Reclamation (BOR) to access BOR-managed land, facilities, or waterbodies for the development of infrastructure such as utility crossings and transmission lines. The BOR has authority to grant a ROW for a term of years the BOR deems appropriate (43 C.F.R. § 429.3).

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[5] Historically, the Geothermal Steam Act of 1970 (GSA) required an assessment to establish areas with geothermal resource potential as Known Geothermal Resource Areas (KGRAs). The GSA also established two types of leasing: (1) competitive leasing in the KGRAs and (2) non-competitive leasing outside of the KGRAs. In 2005, the EPAct amended the regulatory framework by doing away with the KGRAs and requiring that geothermal leases be awarded competitively to the highest qualified bidder, with a few exceptions (30 U.S.C. § 1103(c); 43 C.F.R. § 3203; Statement of Michael Nedd, Bureau of Land Management, Testimony on H.R. 5350 Enhancing Geothermal Production on Federal Lands Act, July 19, 2022). Lands that do not receive a bid at a competitive lease sale are available for non-competitive leasing for two years following a lease sale (43 C.F.R. § 3204.5). In addition, lands subject to a locatable minerals mining claim with a federally approved plan of operations may be available to the mining claim holder for non-competitive geothermal leasing; however, if the non-competitive right is not exercised, these lands may be nominated for competitive lease sale (43 C.F.R. § 3204.12).

- **Department of Defense Enhanced Use Lease:** A geothermal developer may need an Enhanced Use Lease from the DoD to use real or personal property that is under the control of a military department. The DoD has authority to grant an Enhanced Use Lease for a term of five years or longer if the DoD determines a longer lease period is in the public interest (10 U.S.C. § 2667(a)).
- **Military Land Right-of-Way:** A geothermal developer may need a ROW from the DoD to gain access to public lands permanently withdrawn or reserved for the use of the military department. The DoD has authority to grant a Military Land ROW for any term of years that the DoD considers appropriate (10 U.S.C. § 2668(a)).
- **National Park System Right-of-Way**: A geothermal developer may need a ROW from the National Park Service (NPS) to obtain access over, across, or through a National Park System Unit. The NPS may grant a National Park System Right-of-Way for a maximum term of 50 years (43 U.S.C. § 959; 54 U.S.C. §§ 100902(a)-(b); 54 U.S.C. § 100501).
- **National Wildlife Refuge Right-of-Way or Easement:** A geothermal developer may need a ROW from the U.S. Fish and Wildlife Service (USFWS) to access areas within the National Wildlife Refuge System. The USFWS has authority to grant a National Wildlife Refuge ROW for a term of years that the USFWS considers appropriate (16 U.S.C. § 668dd(d)(1)(B)). USFWS may not initiate or permit a new use of a refuge or expand, renew, or extend an existing use of a refuge, unless they have determined that the use is a compatible use and that the use is not inconsistent with public safety (16 U.S.C. § 668dd(d)(3)(A)(i)).
- **Special Use Authorization:** A geothermal developer may need a Special Use Authorization from the USFS to access USFS-managed lands (e.g., National Forest System lands, other than those designated as wilderness areas) that are not covered under a geothermal lease. Pursuant to FLPMA, the USFS may grant Special Use Authorizations for a term that the USFS deems appropriate and reasonable, with a recommended maximum term of 30 years (43 U.S.C. § 1761(a), (d)); 36 C.F.R. § 251.52(l); USFS 2003, Chapter 2771; USFS 2011).
- **Tribal Land Right-of-Way**: A geothermal developer may need a ROW from the Bureau of Indian Affairs (BIA) to access any lands held in trust by the United States for individual Indians or Indian Tribes, communities, bands, or nations, or any lands now or hereafter owned. The BIA may grant ROWs on Tribal land for any term of years an Indian Tribe deems reasonable. For individually owned Indian land, the BIA may grant a ROW for a maximum term of 20 years for oil and gas purposes and 50 years for any other purpose (25 U.S.C. § 323; 25 C.F.R. § 169.201).

2.1.4 Environmental Review

NEPA requires all major federal actions to be reviewed for their impacts on human health and the environment (e.g., impacts to natural resources, biological resources, cultural resources, socioeconomic resources) prior to commencement (42 U.S.C. § 4332(2)(C)). Major federal actions include new and continuing activities, including projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies (40 C.F.R. §§ 1506.8, 1508.17). Each phase of geothermal development (land use planning, leasing, exploration, drilling, and utilization) may trigger a separate NEPA review (Young et al. 2014; BLM 2021a). The level and scope of NEPA review varies depending on the nature of the project. NEPA review may result in a NEPA document, including a Determination of NEPA Adequacy

(DNA), Categorical Exclusion (CX), Environmental Assessment (EA), or Environmental Impact Statement (EIS) (BLM 2021a).

- **National Environmental Policy Act of 1969 Environmental Review Process**: A federal agency must evaluate the impacts of major federal actions significantly affecting the quality of the human environment pursuant to NEPA (42 U.S.C. § 44332(2)(C)). The purpose of NEPA is to establish a national environmental policy and goals for the protection, maintenance, and enhancement of the environment and provide a process for implementing these goals. NEPA review is managed by a lead federal agency, which is responsible for preparing the main NEPA document analyzing project impacts and alternatives and coordinating review with any other cooperating agencies[6] (40 C.F.R. § 1508.16). Each of the four stages of geothermal development (i.e., leasing, exploration, wellfield drilling, and utilization) requires compliance with NEPA when ground disturbing activities are proposed (BLM 2021a). NEPA review may result in a NEPA document (i.e., an EA or EIS), a CX, or a DNA. An EA or an EIS analyze the impacts of a project, any project alternatives, and may provide measures to avoid and/or mitigate any impacts to resources (40 C.F.R. § 1508.16). A DNA may be used if the project has already been analyzed in an existing NEPA document. The level and scope of NEPA review varies depending on the nature of the project. Environmental impact evaluations result in either a CX (and in some cases a record of consideration), a final EA and finding of no significant impact (FONSI), or a final EIS and record of decision.

2.1.5 Geothermal Exploration and Drilling Permits

Geothermal projects may require permits from the BLM to conduct exploration operation and drilling activities for geothermal resources.[7] Completion of NEPA review analyzing the potential impacts of exploration and drilling is required prior to commencing the activity and may result in a NEPA document (DNA, CX, EA, or EIS) depending on the scope of the project.

- **BLM Notice of Intent to Conduct Geothermal Resource Exploration Operations (NOI):** A geothermal developer must submit a Notice of Intent to Conduct Geothermal Resource Exploration Operations (NOI) to the BLM for approval prior to commencing exploration operations (43 C.F.R. § 3251.10 – 3251.15). An NOI may cover geophysical operations, drilling temperature gradient wells, drilling holes used for explosive charges for seismic exploration, core drilling, or any other drilling method, provided the well is not used for geothermal resource production (43 C.F.R. §§ 3200.1; 3250.14).[8]

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[6] Cooperating agency means any Federal agency other than a lead agency that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment. A state or local agency of similar qualifications, or—when the effects are on a reservation, an Indian Tribe—may by agreement with the lead agency become a cooperating agency (40 C.F.R. § 1508.5).

[7] Exploration operations means any activity relating to the search for evidence of geothermal resources including drilling temperature gradient wells, drilling holes used for explosive charges for seismic exploration, core drilling, or any other drilling method. Geothermal exploration operations do not include the direct testing of geothermal resources or the production or utilization of geothermal resources (43 C.F.R. § 3200.1).

[8] BLM regulations authorize the issuance of a CX for geothermal exploration, which applies to exploration activities covered under an NOI. CXs are applicable for all geophysical activities and temperature gradient wells if the activity

- **BLM Geothermal Drilling Permits:** A geothermal developer must obtain a Geothermal Drilling Permit (GDP) from the BLM prior to commencement of drilling and testing of a geothermal resource (43 C.F.R. § 3261.10). Completion of a NEPA review analyzing the potential impacts of drilling and testing of geothermal resources may require the completion of a DNA, EA, or EIS, depending on the scope of the project. Geothermal drilling permits are required for geothermal wells and related activities to perform flow tests, produce geothermal fluids, or inject fluids into the geothermal reservoir (43 C.F.R. § 3260.10).

2.1.6 Geothermal Utilization Permits

Geothermal projects may require permits from the BLM to conduct geothermal resource utilization activities. In addition, if a proposed plant is sited on federal land, a geothermal developer must also obtain a site license from the BLM. A geothermal developer must also obtain a commercial use permit from the BLM prior to commencing commercial operations from a federal lease, unit, or utilization facility (43 C.F.R. § 3274). Completion of the NEPA environmental review process analyzing the potential impacts of utilization is required prior to commencing the activity and may result in a NEPA document (DNA, CX, EA, or EIS).

- **BLM Plan of Geothermal Utilization:** A geothermal developer must submit a Plan of Utilization (POU) to the BLM for approval that describes how the project will develop the geothermal resource for electric generation prior to construction of a power plant (43 C.F.R. § 3270-74). Utilization may include production and injection wells, power plant and transmission line construction, and ancillary support facilities. NEPA review analyzing the potential impacts of utilization may require the completion of an EA or EIS, depending on the scope of the project.
- **Site License**: A geothermal developer must obtain a site license from the BLM for a facility sited on federal land prior to commencing construction of a power plant (43 C.F.R. § 3273). Site licenses are not required for facilities located on private land, split estate land where the surface is privately owned, or federal land not leased for geothermal resources (43 C.F.R. § 3273).
- **Commercial Use Permit**: A geothermal developer must obtain a commercial use permit from the BLM prior to commencing commercial operations from a federal lease, unit, or utilization facility (43 C.F.R. § 3274).

2.1.7 Biological Resource Considerations and Requirements

Project developers must consider the potential impacts of geothermal projects on biological resources and habitat pursuant to federal laws including the Endangered Species Act (ESA), Migratory Bird Treaty Act (MBTA), and Bald and Golden Eagle Protection Act (BGEPA). Accordingly, a geothermal project may require one or more of the following permits, authorizations, or other approvals:

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does not include new surface disturbance or include temporary or new road construction (516 DM 11.9(B)(6); Levine and Young 2018).

- **Endangered Species Section 7 Consultation:** A federal agency (potentially with assistance of a designated non-federal representative) must consult or confer with USFWS if an agency action is likely to jeopardize the continued existence of any listed endangered or threatened species or result in the destruction or adverse modification of designated critical habitat pursuant to the ESA Section 7 (16 U.S.C. § 1536(a)(2)). ESA Section 7 consultation may result in the issuance of a Biological Opinion from the USFWS containing an Incidental Take Statement.
- **Endangered Species Section 10 Consultation:** A geothermal developer must consult or confer with USFWS if a non-federal action is likely to jeopardize the continued existence of any listed endangered or threatened species or result in the destruction or adverse modification of designated critical habitat pursuant to ESA Section 10 (16 U.S.C. § 1538). ESA Section 10 consultation may result in the issuance of an Incidental Take Permit.
- **Eagle Non-Purposeful Take Permit:** A geothermal project developer may need an Eagle Non-Purposeful Take Permit from USFWS for any incidental take of bald or golden eagles pursuant to the BGEPA (16 U.S.C. §§ 668-668d; 50 C.F.R. § 22.26).
- **Migratory Bird Special Purpose Permit:** A geothermal developer may need a Special Purpose Permit from the USFWS to conduct an activity that results in the take, possession, import, export, sale, purchase, barter, or offer for sale, purchase, or barter, of any migratory bird, or their parts, nests, or eggs pursuant to the MBTA (16 U.S.C. §§ 703-712; 50 C.F.R. § 21.11).

2.1.8 Cultural Resource Considerations

Federal agencies must consider the potential impacts of geothermal projects on cultural and Tribal resources pursuant to the National Historic Preservation Act (NHPA). Accordingly, a geothermal developer may need to comply with the following:

- **NHPA Section 106 Consultation Process:** A federal agency must consider the effect of a federal undertaking[9] on historic properties or resources that are either eligible for listing or are listed on the National Register of Historic Places pursuant to Section 106 of the NHPA (54 U.S.C. § 306108). NHPA Section 106 consultations may result in a memorandum of agreement containing a summary of the views of consulting parties and the public as well as an evaluation of any measures considered to avoid or minimize the project's effects on historic properties (36 C.F.R. § 800.6(b)-(c)). State agencies or Tribes with jurisdiction may be required to consult on culturally or historically important state or Tribal sites, respectively, that may be affected by a hydropower project (54 U.S.C. § 306108).

2.1.9 Water Quality Resource Considerations and Requirements

A geothermal developer must consider the potential impacts of geothermal projects to water quality and water resources pursuant to the Clean Water Act (CWA). The U.S. Environmental

[9] "Federal undertaking" means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of an agency, those carried out with federal financial assistance, and those requiring a federal permit, license, or approval and those subject to state or local regulation administered pursuant to a delegation or approval by a federal agency (54 U.S.C. § 300320).

Protection Agency (EPA) and state resource agencies with EPA-delegated authority have primary authority to issue permits related to water quality.[10] In addition, the U.S. Army Corps of Engineers (USACE) has authority to issue permits for projects that may discharge dredged or fill material into navigable Waters of the United States (WOTUS). Accordingly, geothermal developers with projects that discharge materials or pollutants[11] into navigable WOTUS[12] may require one or more of the following permits:

- **Clean Water Act Section 401 Water Quality Certification:** A geothermal developer may need a Section 401 Water Quality Certification from the EPA (where the EPA has retained authority) to evaluate impacts on state water quality when applying for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities that may result in any discharge into the navigable waters of the United States (33 U.S.C. § 1341(a)(1).
- **Clean Water Act Section 402 National Pollutant Discharge Elimination Permit:** A geothermal developer may need a Section 402 National Pollutant Discharge Elimination System (NPDES) Multi-Sector General Permit from the EPA (where the EPA has retained authority) to discharge a pollutant or any combination of pollutants into navigable waters of the United States (33 U.S.C. § 1341(a)(1).
- **Clean Water Section 404 Section 404 Dredge and Fill Permit:** A geothermal developer may need a Section 404 Dredge and Fill Permit from USACE to discharge dredged or fill material into navigable waters of the United States (33 U.S.C. § 1344(a)).

2.1.10 Air Quality Resource Considerations

Geothermal developers must consider the potential air quality impacts of a project pursuant to the Clean Air Act of 1970 (CAA) (42 U.S.C. §§ 7401-7671q). The EPA and state resource agencies with EPA-delegated authority have primary authority issue permits related to air quality pursuant to the CAA (42 U.S.C. §§ 7401-7671q). The EPA has delegated air quality permitting authority to state agencies in California and Nevada; accordingly, see Sections 2.2.9 and 2.3.7 for a summary of air quality permits that may be required for geothermal projects located in California and Nevada.

See Table 3 for a summary of federal and Tribal geothermal regulatory roles.

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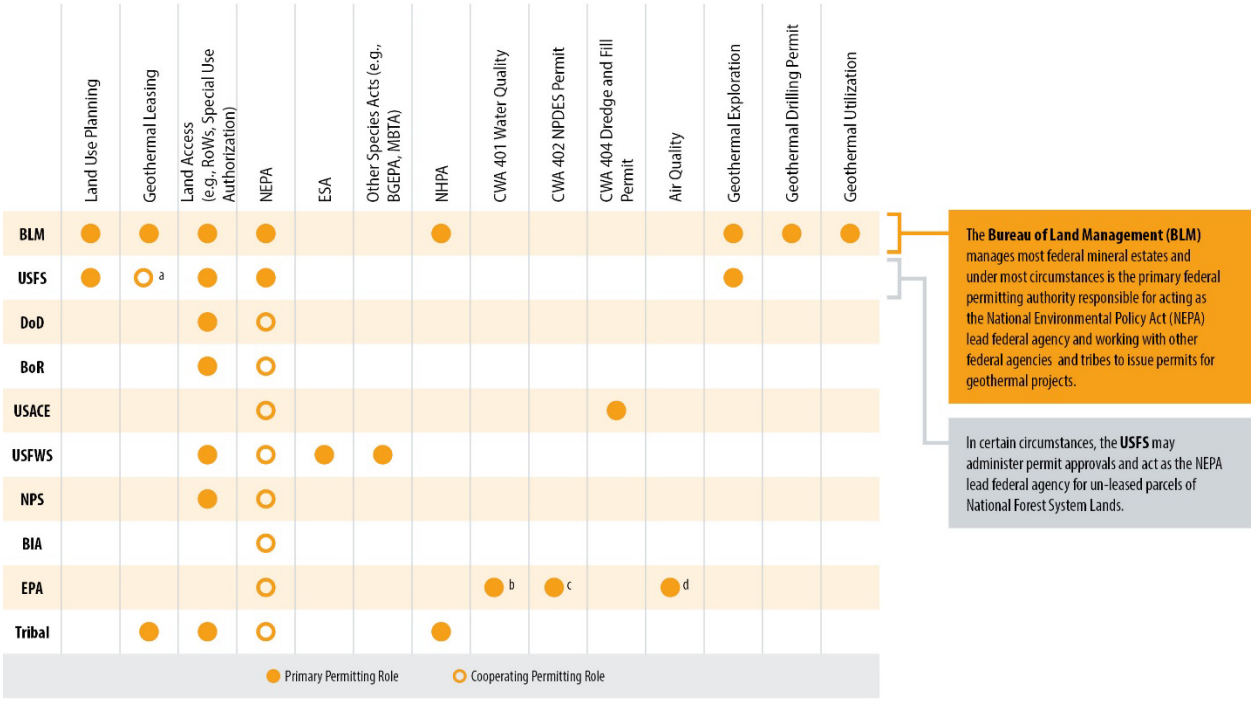
[10] The EPA has delegated authority to state agencies in California and Nevada to issue CWA Section 401 and CWA Section 402 permits. See sections 2.2.8 and 2.3.6 below for a summary of CWA permits that may be required for geothermal projects located in California and Nevada from the applicable state agencies with permitting authority.
[11] "Pollutant" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water (33 U.S.C. § 1362 (6)).
[12] "Navigable Waters" means waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce (33 C.F.R. § 329.4).

Table 3. Federal and Tribe Geothermal Regulatory Roles



a The BLM must obtain consent to lease from the USFS prior to issuing leases for geothermal resources on National Forest System Lands (Geothermal Steam Act of 1970, 30 U.S.C. § 1014(b); U.S. Forest Service Manual (FSM) 2820 § 2822.31).

b The EPA retains primary authority over CWA 401 Water Quality Certification; however, it may delegate CWA Section 401 authority to state resource agencies that meet EPA qualifications.

c A Clean Water Act (CWA) Section 402 NPDES general permit may be required for discharges related to construction activities. The EPA retains primary authority over CWA 402 NPDES Permits; however, it may delegate CWA Section 402 authority to state resource agencies that meet EPA qualifications.

d The EPA retains primary authority over air quality permits; however, it may delegate authority to state resource agencies that meet EPA qualifications.

As depicted in Table 3, at the federal level, a variety of federal agencies may be involved in geothermal project permitting at different phases of geothermal development, depending on project location. For example, typically, BLM has a primary permitting role for federal geothermal leasing; however, depending on project location, the BLM may be required to obtain consent from the USFS prior to issuing a lease for geothermal resources located on NFS lands. In addition, Tribes may have a role in geothermal leasing on lands they hold in fee or lands held in trust by the BIA.

2.2 California State and Local Licenses, Permits, and Authorizations for Geothermal Projects

The following section provides an overview of state permits, licenses, and authorizations that may be required for geothermal projects located in California along with local permits, licenses, and authorizations that may be required for geothermal projects located in Imperial County, California.

2.2.1 Land Use Planning

In California, a geothermal developer should consult local land use planning ordinances to determine if a project conforms with applicable local land use plans.[13]

- **Imperial County Land Use Ordinance**: A geothermal developer with a project located in Imperial County must make sure that the project conforms with the Imperial County General Plan and Land Use Ordinance (Imperial County Land Use Ordinance tit. 9 §§ 90508 – 90508.12).

2.2.2 Geothermal Leasing

In California, a geothermal project must comply with state leasing requirements prior to developing geothermal projects.

- **California Geothermal Lease**: A geothermal developer must obtain a geothermal lease from the California State Lands Commission (CSLC) prior to developing geothermal resources on state lands (Cal. Pub. Res. Code § 6911). An interested developer may nominate a parcel for a lease by submitting a lease nomination application to the CSLC or the CSLC may select lands for competitive bidding on its own initiative (Cal. Pub. Res. Code § 6911).
- **Imperial Irrigation District Lease**: A geothermal developer may need a lease from the Imperial County Irrigation District (IID) prior to developing geothermal resources on IID-owned lands.[14]

2.2.3 Land Access

In California, a geothermal developer should determine whether any state or local permits may apply to geothermal construction or operation activities on property managed by state and/or local jurisdictional entities.[15]

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[13] For the purposes of this report, only local land use ordinances related to geothermal projects situated in Imperial County, California are identified and discussed. However, land use planning ordinances and requirements applicable to geothermal development projects may differ by county. Accordingly, a geothermal developer should consult ordinances within the specific county to determine requirements that may be required for geothermal project development.

[14] Staff, IID, teleconference, March 30, 2021.

[15] For example, a geothermal developer may need an encroachment permit for geothermal construction and operation activities on Imperial Irrigation District property (IID 2020).

- **California State Land Right-of-Way**: A geothermal developer may need a State Land ROW from the CSLC if any portion of the project (e.g., access roads, power lines) will cross over or occupy state land under the jurisdiction of the CSLC (Cal. Pub. Res. Code § 6224.3).
- **California State Encroachment Permit**: A geothermal developer may need an Encroachment Permit from the California Department of Transportation (Caltrans) if any portion of the project (e.g., ancillary structure, power lines) will encroach within, under, or over a California highway (Cal. Sts. And High. Code § 660(b)).
- **Imperial County Encroachment Permit**: A geothermal developer may need an Encroachment Permit from the Imperial County Road Commissioner to place, build, construct, or erect any structure, thing, or contrivance to excavate, cut, fill in, upon, over, across, along, above or under any public street, road, or highway under the jurisdiction of Imperial County (Imperial County Land Use Ordinance tit. 12 § 12.12.010)
- **Imperial Irrigation District Encroachment Permit**: A geothermal developer may need an Encroachment Permit from the IID if any construction or operation activities associated with the project takes place on property under the jurisdiction of the IID or within its ROWs or easements (IID 2020).

2.2.4 Environmental Review

In California, geothermal projects that may have a direct or reasonably foreseeable indirect impact on the environment are subject to environmental review pursuant to the California Environmental Quality Act (CEQA) (Cal. Pub. Res. Code § 21605; Cal. Code Regs. tit. 14 § 15378(a)). Leasing on state lands, as well as exploration, drilling, and utilization activities may trigger a separate CEQA review (Young et al. 2014). Depending on the project stage, different state or local agencies may be the designated lead agency pursuant to CEQA. The California Geologic Management Division (CalGEM) (formerly the California Division of Oil, Gas, and Geothermal Resources) is the lead CEQA agency for geothermal exploratory projects on state and private lands except for geothermal projects conducted on private lands in Imperial County, California (Cal. Pub. Res. Code § 3715.5; Cal. Code Regs. tit. 14 § 1683.7). In 1985, the California Division of Oil, Gas, and Geothermal Resources (now CalGEM) determined that Imperial County's General Plan met the criteria necessary to warrant delegation of authority for geothermal exploratory projects conducted on private lands (CEC 2007). Accordingly, Imperial County is the lead CEQA agency for geothermal projects conducted on private lands in Imperial County, California (Cal. Code Regs. tit. 14 § 1683.7; CEC 2007). In addition, the California Energy Commission (CEC) is the primary licensing authority, which approves Applications for Certification (AFCs) for thermal energy projects capable of generating more than 50 megawatts (MW). The AFC process is certified pursuant to the CEQA and is equivalent to CEQA's Environmental Impact Report (EIR) process (CEC 2007).

- **California Environmental Quality Act Review Process**: Unless otherwise exempt, the designated lead agency must evaluate the impacts of any activity that has the potential to cause a direct or reasonably foreseeable indirect physical change in the environment of the state of California, pursuant to CEQA (Cal. Pub. Res. Code § 21605; Cal. Code Regs. tit. 14 § 15378(a)). The purpose of CEQA is to develop and maintain a high-quality environment and require governmental agencies at all levels to consider qualitative, technical, and economic factors as well as long-term and short-term benefits and costs,

and to consider alternatives to proposed actions affecting the environment (Cal. Pub. Res. Code § 21001). CEQA review is managed by a lead agency, which is responsible for preparing the main CEQA document analyzing project impacts and alternatives and coordinating review with any other cooperating agencies (Cal. Pub. Res. Code § 21067). CEQA review may result in a CEQA document (e.g., Negative Declaration, Mitigated Negative Declaration (MND), EIR) that analyzes the impacts of a project, any project alternatives, and may provide measures to avoid and/or mitigate any impacts to resources (Cal. Pub. Res. Code § 21061). The level and scope of CEQA review varies depending on the nature of the project. Environmental impact evaluations result in either a Negative Declaration, MND, or an EIR (Cal. Pub. Res. Code §§ 21061, 21604, 12604.5).

2.2.5 Geothermal Exploration and Drilling Permits

In California, geothermal projects may require permits from state and/or local agencies to conduct geothermal exploration and drilling activities. Completion of a state CEQA environmental review analyzing the potential impacts of exploration and drilling activities is required prior to commencing exploration and drilling and may result in a CEQA document (Negative Declaration, MND, EIR).

- **Notice of Intention to Drill**: A geothermal developer must submit a Notice of Intention to Drill to CalGEM for approval prior to commencing exploration and/or drilling activities on state or private lands where a permit is not administered by the county (e.g., Imperial County Conditional Use Permit) (Cal. Code Regs. tit.14 § 1931).
- **Nonexclusive Geothermal Exploration Permit**: A geothermal developer may need a nonexclusive geothermal exploration permit from the CSLC prior to commencing geophysical surveying, geophysical testing, or exploratory testing conducted on state lands (Cal. Code Regs. tit. 2 § 2100).
- **Geothermal Resources Prospecting Permit**: A geothermal developer may need a Geothermal Resources Prospecting Permit from the CSLC to explore a potential geothermal resource on state lands, including surveying and testing of the resource as well as exploration drilling (Cal. Pub. Res. Code § 6910; Cal. Code Regs. tit. 2 § 2201). Geothermal Resources Prospecting Permits give a geothermal developer the exclusive right to prospect for geothermal resources for a two-year period, which may be extended for an additional two years (Cal. Pub. Res. Code § 6910). Geothermal Resources Prospecting Permits are suitable in areas where geothermal resources are poorly understood and require additional verification (CSLC 2017).
- **Imperial County Conditional Use Permit**: A geothermal developer with a project located within the Renewable Energy Overlay Zone in Imperial County must obtain a Conditional Use Permit from the Imperial County Planning and Development Services prior to commencing drilling operations (Imperial County Land Use Ordinance tit. 9 § 91701.03).

2.2.6 Geothermal Utilization Permits

In California, geothermal projects may require permits from state and/or local agencies to conduct geothermal resource utilization activities. Completion of a state (i.e., CEQA) environmental review analyzing the potential impacts of utilization is required prior to

commencement of the activity and may result in a CEQA document (e.g., Negative Declaration, MND, EIR).

- **Application for Certification:** A geothermal developer may need an AFC from the CEC prior to construction or modification of a thermal power plant[16] with a capacity of 50 MW or greater (Cal. Pub. Res. Code §§ 25120, 25500).
- **Certificate of Public Convenience and Necessity**: A geothermal developer may need a Certificate of Public Convenience and Necessity from the California Public Utilities Commission (CPUC) to construct a transmission line 200 kilovolts (kV) or more (Cal. Pub. Util. Code § 201; Cal. Gen. Order No. 131-D).
- **Permit to Construct**: A geothermal developer may need a Permit to Construct from the CPUC to construct an electric power line or substation between 50 kV and 200 kV (Cal. Gen. Order No. 131-D)
- **Imperial County Conditional Use Permit**: A geothermal developer with a project located within the Renewable Energy Overlay Zone in Imperial County must obtain a Conditional Use Permit (CUP) from the Imperial County Planning and Development Services prior to commencing construction and operation of a geothermal power plant (Imperial County Land Use Ordinance tit. 9 § 91701.03).[17]

2.2.7 Biological Resource Considerations and Requirements

In California, project developers must consider the potential impacts of geothermal projects to protect listed endangered, threatened, and candidate plants and animals pursuant to the California Endangered Species Act (CESA). Accordingly, a geothermal project may require the following approval:

- **California Endangered Species Act Incidental Take Permit**: A geothermal developer may need an Incidental Take Permit from the California Department of Fish and Wildlife (CDFW) if a project may result in the take[18] of a listed endangered, threatened, or candidate species protected pursuant to CESA, which is not addressed through a federal Incidental Take Statement or Incidental Take Permit (Cal. Fish and Game Code § 2081.1). The CESA includes species which are listed by the CDFW as threatened or endangered, and may include species not listed by USFWS (Cal. Fish & Game Code, § 2068).

2.2.8 Water Quality and Resource Considerations and Requirements

In California, project developers must consider the potential impacts of geothermal projects to water quality and water resources pursuant to the CWA and Safe Drinking Water Act. A

[16] Thermal power plant means any stationary or floating electrical generating facility using any source of thermal energy, with a generating capacity of 50 MW or more, and associated facilities (Cal. Pub. Res. Code § 25120).
[17] An Imperial County Conditional Use Permit is only applicable if the CEC does not have jurisdiction over the project (e.g., if the project has a capacity under 50 MW).
[18] "Take" means hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (Cal. Fish and Game Code § 1-89.5(86)).

geothermal project that discharges materials or pollutants[19] into navigable waters of the United States[20] may require a Section 401 Water Quality Certification or Section 402 NPDES pursuant to the CWA. In addition, a geothermal project may require an Underground Injection Control Permit to ensure that injection activities will not endanger underground sources of drinking water pursuant to the Safe Drinking Water Act.

- **Clean Water Act Section 401 Water Quality Certification**: A geothermal developer may need a Section 401 Water Quality Certification from the Regional Water Quality Control Board (RWQCB) with jurisdiction to evaluate impacts on state water quality when applying for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities that may result in any discharge into the navigable waters of the U.S. (33 U.S.C. § 1341(a)(1); Cal. Water Code § 13160).
- **Clean Water Act Section 402 National Pollutant Discharge Elimination Permit**: A geothermal developer may need a Section 402 NPDES General Permit from the State Water Resources Control Board (SWRCB) or RWQCB with delegated jurisdiction to discharge a pollutant or any combination of pollutants into navigable waters of the U.S. (33 U.S.C. § 1341(a)(1); Cal. Water Code §§ 13160; 13370 – 13389).
- **Underground Injection Control Permit**: A geothermal developer may need an Underground Injection Control Permit from CalGEM to construct and operate Class V geothermal energy injection wells to inject geothermal fluids and supplemental waters back into the underground source (42 U.S.C. § 300h; Cal. Code Regs. tit. 14 § 1724.6; MOU 1991).
- **Water Access Right**: A geothermal developer may need to apply for a water right from the SWRCB to appropriate surface water or water from a subterranean stream (Cal. Water Code §§ 1200, 1250).[21]

2.2.9 Air Quality Resource Considerations and Requirements

In California, project developers must consider the potential impacts of geothermal project construction on air quality pursuant to the Clean Air Act of 1970 ((CAA) (42 U.S.C. §§ 7401-7671q). Accordingly, the following permit may be required for power plant project construction and operation:

- **Authority to Construct Permit**: A geothermal developer may need an Authority to Construct permit from the local Air Pollution Control District (APCD) or Air Quality Management District (AQMD) to construct, modify, or operate a facility (42 U.S.C. §§ 7401-7671q; Cal. Health and Safety Code §§ 39620, CARB 2010).

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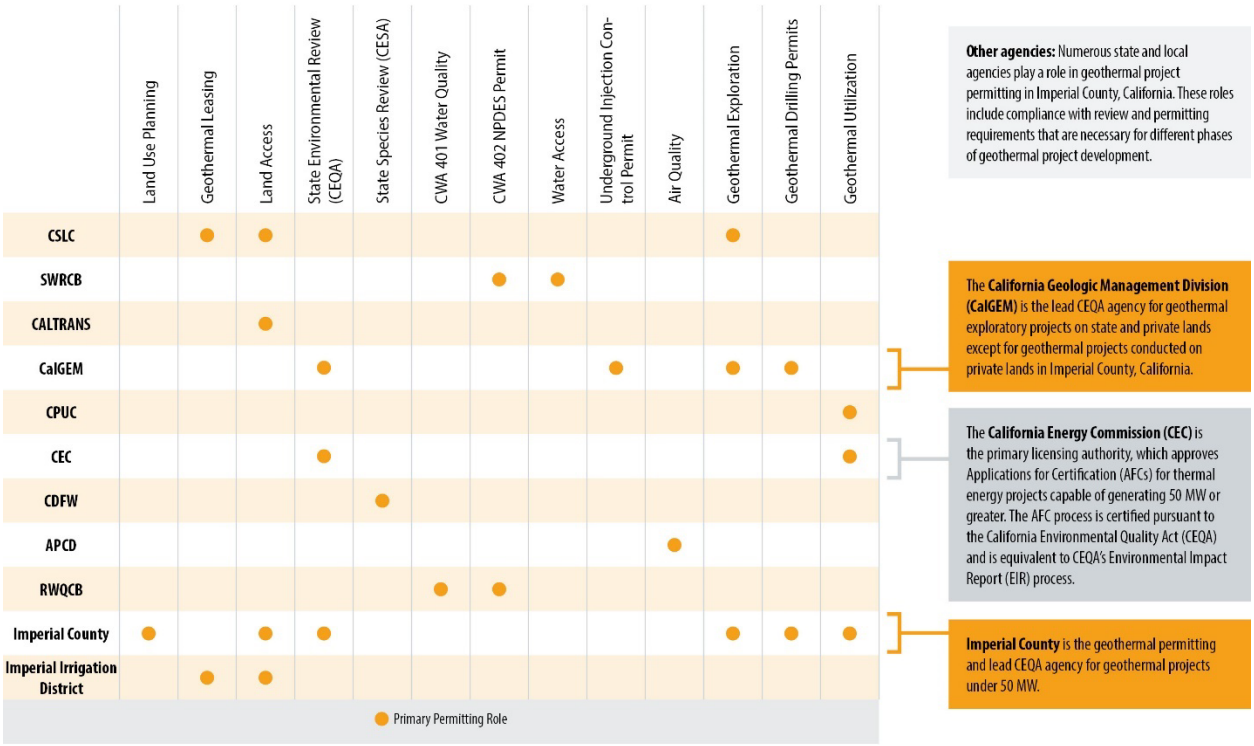
[19] "Pollutant" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water (33 U.S.C. § 1362 (6)).
[20] "Navigable Waters" means waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce (33 C.F.R. § 329.4).
[21] California defines "geothermal resources" as the natural heat of the earth resulting from or created by naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth (Cal. Pub. Res. Code § 6903). Accordingly, geothermal resources found within subterranean streams may require a water access right.

Table 4 provides a high-level summary of state agency and local agency geothermal regulatory roles for geothermal projects located in Imperial County, California.

Table 4. Summary of State and Local Agency Geothermal Regulatory Roles in Imperial County, California



As depicted in Table 4, multiple state and local agencies may have a primary permitting role for geothermal project development in California depending on project size or location. For example, both the CSLC and/or local authorities (e.g., IID) may have a role in geothermal leasing depending on project location. In addition, for CEQA review, the CEC is the primary permitting agency for projects capable of generating 50 MW or greater, while CalGEM may be the lead CEQA agency for exploration and drilling projects on state and private lands. However, Imperial County is the lead CEQA agency for geothermal exploration, development, and utilization for projects under 50 MW located on private lands in Imperial County.

2.3 Nevada State Licenses, Permits, and Authorizations for Geothermal Projects

The following section provides an overview of state permits, licenses, and authorizations that may be required for geothermal projects located in Nevada.

2.3.1 Land Access

In Nevada, a geothermal developer should determine whether any state permits may apply to geothermal construction or operation activities on property managed by state jurisdictional entities.

- **Nevada State Land Right-of-Way**: A geothermal developer may need to obtain a State Land Right-of Way from the Nevada Division of State Lands (NDSL) to access state lands to site a road or transmission line (Nev. Rev. Stat. § 322.050).
- **Nevada State Land Lease**: A geothermal developer may need to obtain a State Land Lease from NDSL to site and construct a facility on state lands (Nev. Rev. Stat. § 321.335).
- **Nevada Occupancy Permit**: A geothermal developer may need an Occupancy Permit from the Nevada Department of Transportation (NDOT) if a project requires a permanent encroachment (an encroachment of one year or longer) on Nevada streets, highways, or other rights-of-way (Nev. Rev. Stat. §408.423(1)).

2.3.2 Geothermal Leasing

In Nevada, a geothermal project must comply with state leasing requirements prior to developing geothermal projects.

- **Nevada Geothermal Resource Lease**: A geothermal developer must obtain a geothermal resource lease from the Nevada Department of Conservation and Natural Resources (NDCNR) prior to developing a geothermal resource on state lands (Nev. Rev. Stat. § 322.010).

2.3.3 Environmental Review

In Nevada, geothermal power plants that may exceed 70 MW or above-ground electric transmission lines that operate at 200 kV or more are subject to an environmental review process and may require a permit from the Nevada Public Utilities Commission (NPUC) pursuant to the Nevada Utility Environmental Protection Act (UEPA) (Nev. Rev. Stat. § 704.860).

- **Nevada Utility Environmental Protection Act**: A geothermal developer must comply with the Nevada Utility Environmental Protection Act (UEPA) review process and obtain a UEPA permit from NPUC prior to constructing a geothermal power plant exceeding 70 MW or aboveground electric transmission lines that operate at 200 kV or more and are constructed outside any incorporated city (Nev. Rev. Stat. § 704.860). The purpose of UEPA is to minimize any adverse effects that the construction of new electric facilities may cause to the environment (Nev. Rev. Stat. § 704.825).

2.3.4 Geothermal Exploration and Drilling Permits

In Nevada, geothermal projects may require permits from a state agency to conduct geothermal resource exploration and drilling activities.[22]

- **Nevada Permit to Drill or Operate Geothermal Wells or Exploratory Wells**: A geothermal developer must obtain a permit from the Nevada Division of Minerals (NDOM) prior to drilling or operating a geothermal well or drilling an exploratory well in Nevada (Nev. Rev. Stats. § 534A.060).

2.3.5 Geothermal Utilization Permits

In Nevada, geothermal projects may require permits from state agencies to conduct geothermal resource utilization activities. Completion of state (i.e., UEPA) environmental review processes analyzing the potential impacts of utilization is required prior to commencing the activity and may result in a UEPA permit.

- **Certificate of Public Convenience and Necessity:** A geothermal developer may need a Certificate of Public Convenience and Necessity from the NPUC prior to operation or construction of any power line, plant, or system within Nevada (Nev. Rev. Stats. § 704.330). Any corporation or person who sells geothermal energy to the public constitutes a public utility subject to the jurisdiction of the NPUC (Nev. Rev. Stats. § 704.669).

2.3.6 Water Quality Resource Considerations and Requirements

In Nevada, project developers must consider the potential impacts of geothermal projects to water quality and water resources pursuant to the CWA and Safe Drinking Water Act. A geothermal project that discharges materials or pollutants[23] into navigable waters of the United States[24] may require a Section 401 Water Quality Certification or Section 402 NPDES pursuant to the CWA. In addition, a geothermal project may require an Underground Injection Control Permit to ensure that injection activities will not endanger underground sources of drinking water pursuant to the Safe Drinking Water Act.

- **Clean Water Act Section 401 Water Quality Certification**: A geothermal developer may need a Section 401 Water Quality Certification from the Nevada Department of Environmental Protection (NDEP) Bureau of Water Quality Planning to evaluate impacts on state water quality when applying for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities that may result in any discharge into the navigable waters of the United States (33 U.S.C. § 1341(a)(1).

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[22] As noted above in Section 2.1, each phase of geothermal development for projects located in Nevada may trigger a separate NEPA review.

[23] "Pollutant" means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water (33 U.S.C. § 1362 (6)).

[24] "Navigable Waters" means waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce (33 C.F.R. § 329.4).

- **Clean Water Act Section 402 National Pollutant Discharge Elimination Permit**: A geothermal developer may need a Section 402 NPDES Multi-Sector General Permit from the NDEP Bureau of Water Pollution Control to discharge a pollutant or any combination of pollutants into navigable waters of the United States (33 U.S.C. § 1341(a)(1).
- **Waiver for Temporary Use of Groundwater for Geothermal Exploration**: A geothermal developer may need a waiver from the Nevada Division of Water Resources (NDWR) to use groundwater to explore for geothermal resources or for drilling monitoring wells (Nev. Admin. Code. § 534.441).
- **Consumptive Use of Water Right**: A geothermal developer may need to obtain an appropriative right from the NDWR for the consumptive use of water brought to the surface outside of a geothermal well (Nev. Rev. Stat. § 533.372). However, geothermal water[25] that is removed from an aquifer or geothermal reservoir to develop and obtain geothermal resources and returned or reinjected back into the same aquifer or reserve does not require an appropriative right for the consumptive use of water (Nev. Rev. Stat. § 534A.040(1)). In addition, an appropriative right is not required for the reasonable loss of water during a test of a geothermal well or from the temporary failure of a system that removes water from an aquifer or geothermal reservoir, removes the heat, and then reinjects the water back into the same aquifer or reservoir (Nev. Rev. Stat. § 534A.040(2)).
- **Underground Injection Control Permit:** A geothermal developer may need an Underground Injection Control Permit from the NDEP Bureau of Water Pollution Control for the construction and operation of injection wells to prevent degradation of underground sources of drinking water (42 U.S.C. § 300h; Nev. Rev. Stat. § 445A.300; Nev. Admin. Code § 443A.810).
- **DeMinimis Clean Water Discharge General Permit**: A geothermal developer may need a DeMinimis Clean Water Discharge General Permit from the NDEP Bureau of Water Pollution Control to discharge small amounts of water related to drilling of geothermal wells, rehabilitation or maintenance of geothermal wells, water supply quantity or quality evaluations, well aquifer test pumping or purging, and discharges from any borehole not fully developed (Nev. Rev. Stat. § 445A.465).
- **Stormwater Drainage Well General Permit**: A geothermal developer may need a Stormwater Drainage Well General Permit from the NDEP Bureau of Water Pollution Control for subsurface disposal of stormwater by injection to waters of the State (Nev. Rev. Stat. § 445A.465).
- **Temporary Permit for Discharges to Groundwaters of the State:** A geothermal developer may need a Temporary Discharge to Waters of the State Permit from the NDEP Bureau of Water Pollution Control to discharge waters from remediating and disinfection activities, well pump testing, aquifer drawdown testing, dewatering, dust suppression and other discharges of a temporary nature that may affect directly or indirectly waters of the state (Nev. Rev. Stat. §§ 445A.475; 445A.485).

[25] Nevada statutes use the term "geothermal water" as opposed to geothermal brine. Accordingly, for the purposes of accuracy, when applicable, this report uses the term "geothermal water" rather than geothermal brine in reference to Nevada regulatory requirements.

2.3.7 Air Quality Resource Considerations and Requirements

In Nevada, project developers must consider the potential impacts of geothermal project construction on air quality pursuant to the (CAA (42 U.S.C. §§ 7401-7671q). Accordingly, the following permits are required for power plant project construction and operation.

- **Surface Area Disturbance Permit for Fugitive Dust:** A geothermal developer may need a Surface Area Disturbance Permit for fugitive dust from the NDEP Bureau of Air Pollution Control if an activity unrelated to agriculture may disturb five or more acres of surface area (Nev. Rev. Stat. § 445B.300).
- **Air Quality Operating Permit:** A geothermal developer may need an Air Quality Permit from the NDEP Bureau of Air Pollution Control for the construction and operation of a source of any air contaminant (Nev. Rev. Stat. § 445B.300; Nev. Admin. Code §§ 445B.287, 445B.3497).

Table 5 provides a high-level summary of state agency and local agency geothermal regulatory roles for geothermal projects located in Nevada.

Table 5. Summary of State Agency Geothermal Regulatory Roles in Nevada

As depicted in Table 5, state geothermal regulatory roles in Nevada generally fall under the purview of seven state agencies. Generally, most projects will have to acquire permits from the Nevada Division of Minerals for exploration and drilling, while environmental permitting, including underground injection control permits are administered by the Nevada Division of Environmental Protection.

2.4 Comparison of Federal, State, and Local Geothermal Regulations in California and Nevada

In addition to federal requirements, both California and Nevada have state and/or local licenses, permits, and authorizations related to land access, environmental and natural resource protection, cultural resource protection and geothermal exploration, drilling, and utilization. These various approvals require coordination between federal, state, and location agencies (as applicable) prior to geothermal project development. Geothermal projects in California may require coordination between a variety of federal, state, and/or local agencies, which may impact project development timelines. By contrast, Nevada has a more centralized regulatory structure in which authority over geothermal projects is shared predominantly by federal and state agencies depending on the project location.

This section provides a comparison of the statutory and regulatory frameworks governing geothermal development in California and Nevada, including:

- The division of state and local regulatory authority over geothermal projects in California versus Nevada
- Geothermal leasing and land access requirements
- Environmental review and resource protection requirements.

Following this section are Table 6 and Table 7, which provide an overview of the federal, state, and local frameworks.

2.4.1 State and Local Authority Over Geothermal Projects

In California, unlike Nevada, state regulatory authority over geothermal projects may vary depending on the size/capacity of the project and/or the project location. For example, the CEC is the primary licensing authority, which approves AFCs for geothermal projects capable of generating 50 MW or more. Notably, the AFC process is certified pursuant to the CEQA and is equivalent to CEQA's EIR process (CEC 2007). The AFC is granted in lieu of any other permit that would be required by other state and local agencies; accordingly, the AFC process covers all state, local, and regional agencies' requirements necessary to construct a geothermal plant. Pursuant to regulation, the CEC must issue a written decision on the AFC no later than 12 months after the notice of the AFC is filed (Cal. Pub. Res. Code § 25516.6). Any decision issued after the 12-month period must be mutually agreed upon between the applicant and the CEC (Cal. Pub. Res. Code § 25516.6). During the AFC process, the CEC may coordinate its review with federal agencies with permitting authority over the project. State and local agencies with jurisdiction or a special interest in the project may review all AFC documents and provide comments and recommendations on the project during the AFC process; however, the CEC has exclusive permitting authority over projects that fall under its jurisdiction.

If the CEC does not have jurisdiction (e.g., the project is not 50 MW or greater), then typically, the CalGEM is the primary state regulatory authority for geothermal projects conducted on state and private lands (Cal. Pub. Res. Code § 3715.5; Cal. Code Regs. tit. 14 § 1683.7; CEC 2007). However, in 1985, the California Division of Oil, Gas and Geothermal Resources (i.e., CalGEM) determined that Imperial County's General Plan met the criteria necessary to warrant delegation of authority for geothermal exploratory projects conducted on private lands (CEC 2007).

Accordingly, for projects located in Imperial County, Imperial County is the responsible agency for state (e.g., CEQA review) as well as local regulatory requirements (Cal. Code Regs. Tit. 14 § 1683.7; CEC 2007). By contrast, in Nevada, the NDOM is the state's regulatory authority for all geothermal wells drilled in Nevada.

2.4.2 Land Access Requirements

Depending on the location of the project, geothermal projects in California and Nevada may require land access permits, rights-of-way, and authorizations from a variety of federal agencies including the BLM, BOR, DoD, NPS, USFWS, USFS, and BIA. In addition, geothermal projects in both California and Nevada may also be subject to state land access requirements (e.g., California State Land ROW, Nevada State Land ROW). However, in California, in addition to federal and state land access requirements, geothermal projects may also be subject to multiple local land access authorizations depending on the location of the project. For example, geothermal projects in Imperial County, California may require an Imperial County Encroachment Permit and/or an Imperial Irrigation District Encroachment Permit.

2.4.3 Geothermal Leasing Requirements

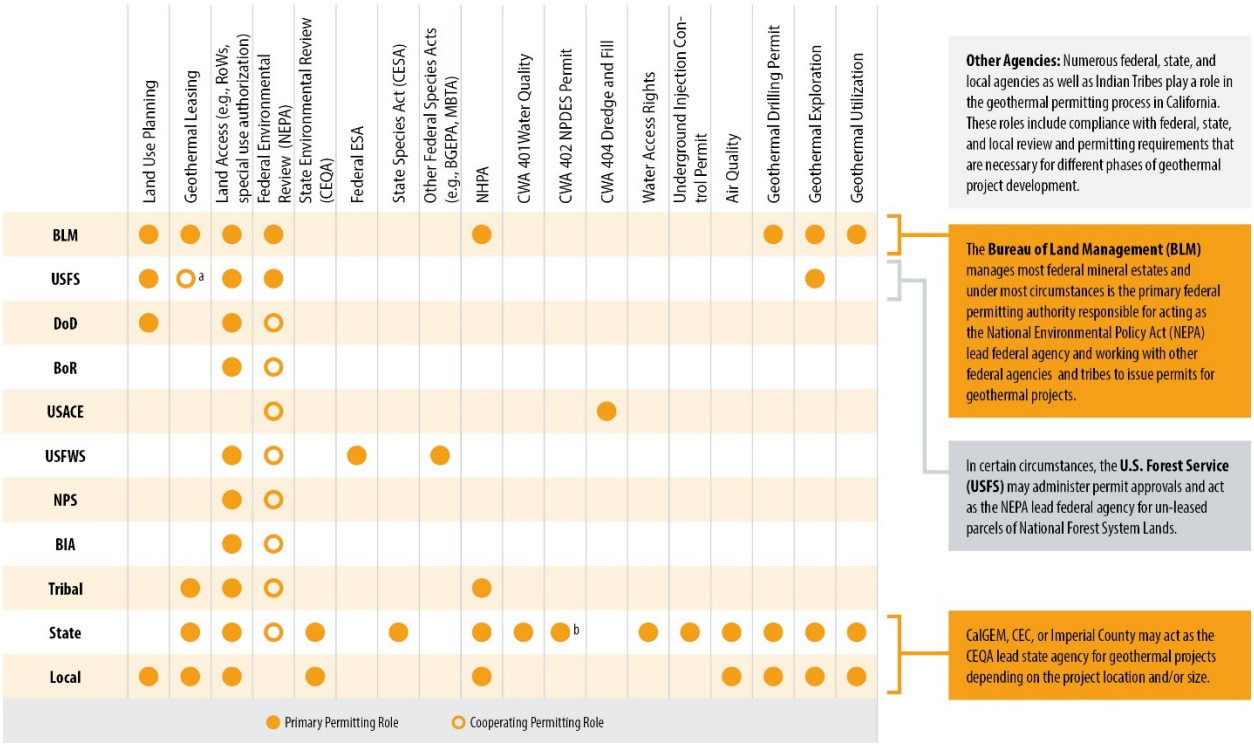
Depending on the project location, geothermal projects in California and Nevada may require a lease from federal, state, local, or Tribal authorities. In both California and Nevada, a BLM geothermal lease is required prior to developing geothermal resources on BLM-managed federal lands. In addition, geothermal projects on NFS lands require a consent to lease from the USFS prior to the BLM being able to issue a geothermal lease. Projects located on state lands in Nevada require a Nevada Geothermal Resource Lease, and projects located on state lands in California require a California Geothermal Lease.

2.4.4 Environmental Review and Resource Protection Requirements

In addition to federal environmental review pursuant to NEPA, both California and Nevada have state environmental review processes that apply to geothermal projects. Accordingly, geothermal projects in California and Nevada may be subject to state (i.e., CEQA in California and UEPA in Nevada) and federal (i.e., NEPA) environmental review processes. For example, in California, unless otherwise exempt, geothermal projects that have the potential to cause a direct or reasonably foreseeable indirect physical change in the environment are subject to CEQA. Like NEPA, CEQA may apply to different phases of geothermal development (e.g., leasing on state land, exploration, drilling, and utilization). By comparison, in Nevada, a geothermal power plant that exceeds 70 MW or aboveground electric or transmission lines that operate at 200 kV or more and are constructed outside any incorporated city are subject to an environmental review and permitting process pursuant to UEPA. In California, unlike Nevada, geothermal projects may also be subject to state endangered species act consultation and permitting pursuant to CESA if a project may result in the take of a listed endangered, threatened, or candidate species protected under California law. The requirements of CESA and in addition to generally applicable requirements for Section 7 or Section 10 consultation under the ESA, which applies in both California and Nevada.

Table 6 and Table 7 provide a high-level summary of federal agency, state agency, local agency, and Tribal geothermal regulatory roles in California and Nevada.

Table 6. Federal Agency, State Agency, Local Agency and Tribal Geothermal Regulatory Roles in Imperial County, California

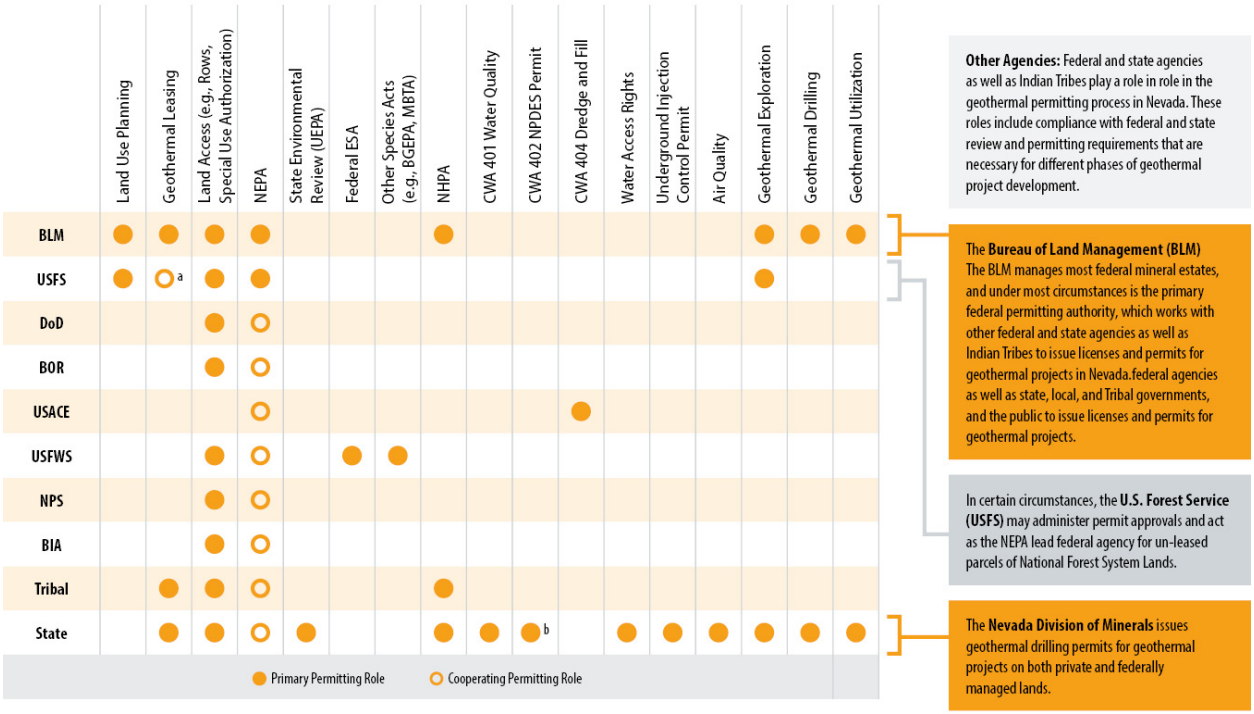


a The BLM may need consent to obtain a geothermal lease from the USFS prior to developing geothermal resources on National Forest System Lands (Geothermal Steam Act of 1970, 30 U.S.C. § 1014(b); U.S. Forest Service Manual (FSM) 2820 § 2822.31)

b A Clean Water Act (CWA) Section 402 NPDES general permit may be required for discharges related to construction activities.

As depicted in Table 6, a wide variety of federal, state, and local agencies, as well as Tribes may have a primary or cooperating role at different phases of geothermal development in Imperial County, California. Various federal, state, Tribal and/or local agencies may have a primary permitting role in geothermal leasing and land access. Federal, state, and/or local agencies may also have a primary role in land use planning, as well as geothermal exploration, drilling, and utilization activities. State and/or local entities have a primary permitting role over state environmental review and state species statutes, as well as water quality, water access, and air quality concerns. Federal entities have a primary permitting role over exploration, drilling, and utilization on federal lands, as well as federal environmental review under NEPA and federal endangered species act review under the ESA.

Table 7. Federal Agency, State Agency, and Tribe Geothermal Regulatory Roles in Nevada



a The BLM may need consent to obtain a geothermal lease from the USFS prior to developing geothermal resources on National Forest System Lands.

b A Clean Water Act (CWA) Section 402 NPDES general permit may be required for discharges related to construction activities.

As depicted in Table 7, federal and state agencies as well as Tribes may have a primary or cooperating role at different phases of geothermal development in Nevada. Federal, state, and Tribal entities may have a primary permitting role in geothermal leasing and land access. Federal and state entities also have primary permitting roles for geothermal exploration, drilling, and utilization activities. State agencies have a primary permitting role over state environmental review, as well as water quality, water access, and air quality concerns. Federal agencies have a primary permitting role over federal environmental review and federal endangered species act statutes.

3 Case Studies Analyzing California and Nevada Geothermal Projects

This section contains case studies analyzing land access and permitting issues at selected sites in California (Salton Sea/Imperial County) and Nevada (Dixie Meadows) using the Geothermal Resource Portfolio Optimization and Reporting Technique (GeoRePORT) Socioeconomic Assessment Tool (SEAT), which provides an analysis of certain attributes including potential constraints on the geothermal resource to determine project readiness. The included SEAT analysis encompasses two of the tool's four attributes: Land Access and Permitting.[26] Both of these attributes include sub-attributes that, when combined, provide a character grade ranked on a scale of A through E, with A indicating the most favorable values for that attribute. The sub-attributes used to generate a cumulative character grade for permitting include: federal and state regulatory requirements, environmental review processes, and potential ancillary permits. The sub-attributes used to generate a cumulative character grade for land access include: cultural and Tribal resources, environmentally sensitive areas, biological resources, land ownership, federal and state lease queue, and proximity to military installations. Data used in this analysis was predominately gathered from NEPA and CEQA environmental review documents. Some information was gleaned from a series of interviews NREL (and other national laboratories' staff) held with regulators and developers on geothermal environmental and permitting issues.

3.1 California Geothermal Project Analysis

This section contains grading/analysis of environmental and permitting issues at sites in the Salton Sea/Imperial County geographic region of California, including Truckhaven, Hudson Ranch II, and East Brawley. Figure 2 provides a map of the Salton Sea and Truckhaven, Hudson Ranch II, and East Brawley geothermal projects located in Imperial County, California.

[26] A traditional SEAT analysis typically includes four attributes: Land Access, Permitting, Transmission, and Market, and includes sub-attributes for each. However, for the purposes of this report, only attributes and sub-attributes related to land access and permitting were analyzed and ranked.

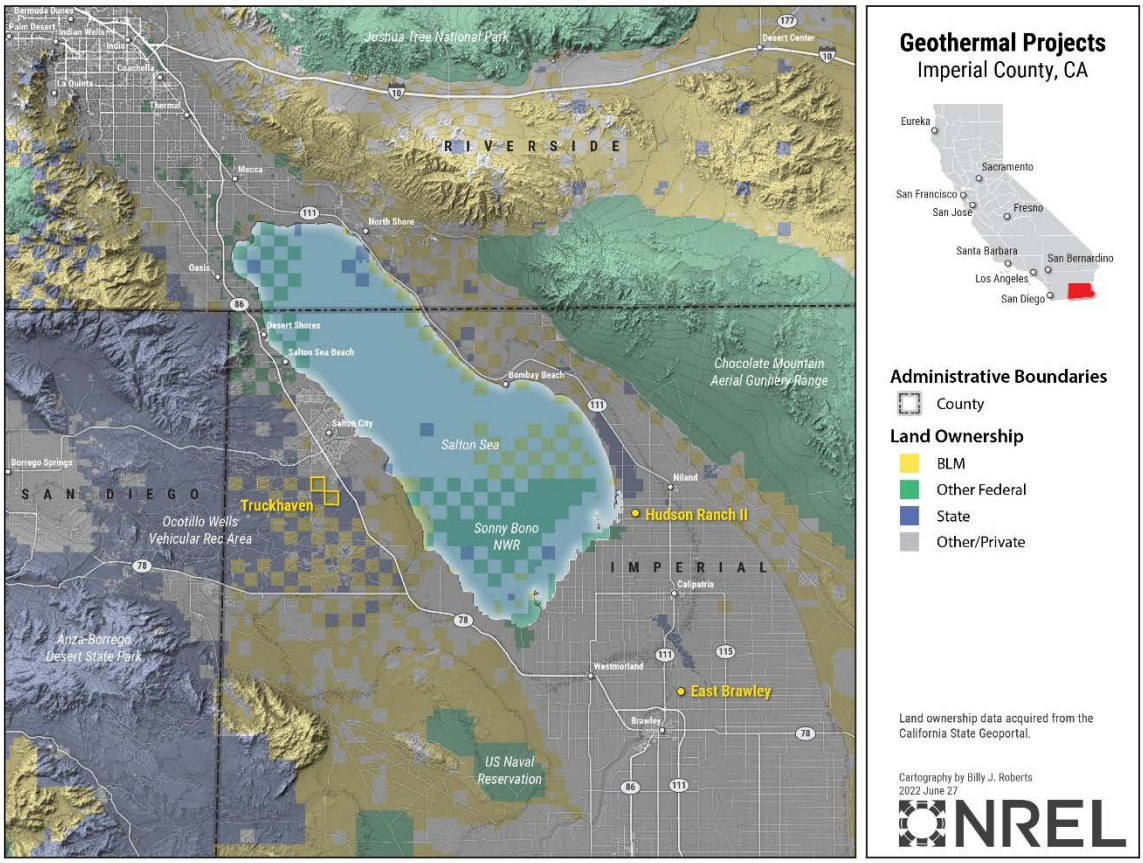


Figure 2. Map of geothermal projects in Imperial County, California

Figure 2 depicts the Salton Sea; the locations and project boundary lines for the Truckhaven, Hudson Ranch II, and East Brawley geothermal projects; federal, state, and private land boundaries; areas of environmental significance (e.g., Sonny Bono National Wildlife Refuge (NWR)); and other identifying locations (e.g., Ocotillo Wells Vehicular Recreation Area; U.S. Naval Reservation; Chocolate Mountain).

3.1.1 Truckhaven Exploration Well Project (Active)

The proposed action at the Truckhaven Exploration Well Project consisted of ORNI 5 LLC (Ormat company) drilling up to four geothermal exploratory wells on BLM land and up to six geothermal exploration wells on private and state lands in the Truckhaven Geothermal Exploration Area, located south-southwest of Salton Sea in western Imperial County, California. The purpose of the proposed project is to conduct a geophysical survey and drill, complete, test, and monitor the proposed geothermal resource wells. The geophysical survey would construct a high-resolution image of the subsurface geologic features within the Truckhaven Geothermal Lease area to identify potential geothermal reservoirs of commercial quantity. The exploratory geothermal wells would drill into and flow test the anticipated underlying geothermal reservoir to confirm the characteristics of the geothermal reservoir and detect if the geothermal resource is commercially viable (BLM 2019; ICPDS 2019).

Figure 3 depicts the permitting and environmental review timeline for the Truckhaven Exploration Well Project.

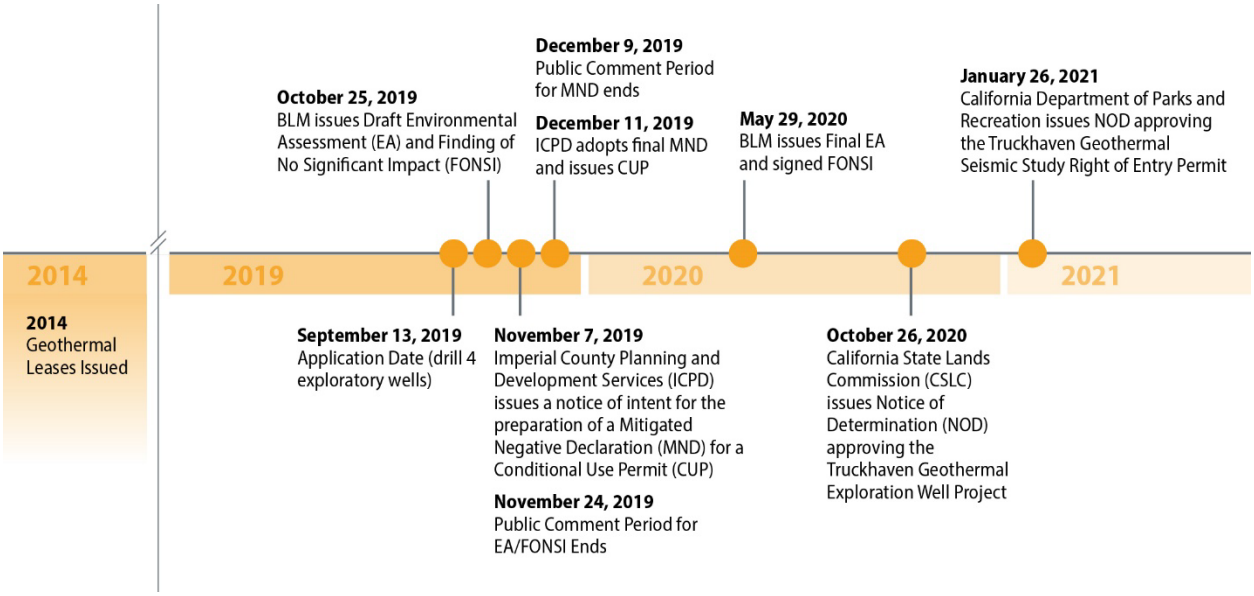


Figure 3. Truckhaven Exploration Well Project timeline

1. Permitting
   a. Regulatory Framework
      1) Federal

      Grade: B

      Explanation: The project site is a BLM-administered mineral estate in an area with experience permitting geothermal exploration and development projects. BLM does not have a Memorandum of Understanding (MOU) with the state.

      2) State

      Grade: B

      Explanation: The CalGEM within the Department of Conservation has experience successfully permitting geothermal projects. In addition, Imperial County has geothermal regulations, and Imperial County Planning and Development Services (ICPDS) has experience successfully permitting projects.

   b. Environmental Review

      Grade: C

      Explanation: The project involves drilling up to four geothermal exploratory wells on BLM-managed land and up to six geothermal exploration wells on private and state lands and is therefore subject to two environmental review processes, CEQA and NEPA.

   c. Ancillary Permits

Grade: C

Explanation: The project will potentially require 7–8 ancillary permits, including an encroachment permit from the Imperial County Public Works Department, a Permit to Operate from the Imperial County Air Pollution Control Board (ICAPCD), a permit from the RWQCB for Waste Discharge Orders, a permit for diesel engines under the California Air Resources Board (CARB), a CDFW Lake and Streambed Alteration Agreement, a Section 404 permit from USACE, a 401 certification from the RWQCB, and a BLM Fieldwork Authorization Permit. Certain ancillary permits (e.g., CWA Section 404) are contingent upon federal regulatory processes, which have not been completed.

d. Cumulative Permitting Character Grade: B. See Figure 4 for a description of the cumulative permitting character grade for the Truckhaven project.

		Character		Activity	
Sub-Attribute	**Wt**	**Grade**	**Wt Product**	**Grade**	**Wt Product**
State Regulatory Framework	2	B (4)	8	C (3)	6
Federal Regulatory Framework	2	B (4)	8	C (3)	6
Environmental Review Process	3	C (3)	9	C (3)	9
Ancillary Permits	1	C (3)	3	C (3)	3
	0	Character	28/B	Activity	24/C

Figure 4. Cumulative permitting character and activity grading for the Truckhaven Exploration Well Project

2. Land Access

a. Cultural and Tribal Resources

Grade: B

Explanation: Surveys have identified numerous archaeological and cultural resources in the project area. However, potential impacts to these resources are manageable and would be reduced using the appropriate mitigation measures including monitoring of all ground-disturbing work by a qualified archaeologist and BLM review of any activities that will result in new surface disturbance not previously surveyed.

b. Environmentally Sensitive Areas

Grade: C

Explanation: Complications are posed by the environmentally sensitive project area. The Salton Sea and Sonny Bono National Wildlife Refuges are in the project vicinity. In addition, there is a possible nexus with WOTUS, which would require an additional permit from USACE.

c. Biological Resources

Grade: C

Explanation: Complications are posed by sensitive species that have the potential to occur within the project area. There are no threatened or endangered species located within the project area, but there is moderate potential for nine CDFW special status plant species and five CDFW special status wildlife species to occur within the project area. The burrowing owl and the flat-tail horned lizard are species of particular concern with potential to occur. Constructing the project would cause a net loss in functional habitat for these special status species. In addition, there is potential for nesting birds to occur within the project area. If construction activities are to occur during bird breeding season, nesting bird surveys will be required in accordance with the MBTA.

d. Land Ownership

Grade: E

Explanation: The project site is located on federal, state, and private lands with multiple landowners (federal, state, and private), which may increase project complexity. There are well-defined geothermal leasing regulations.

e. Federal and State Lease Queue

Grade: A

Explanation: The Truckhaven Geothermal Leasing Area has already been approved and issued by the BLM. The CSLC has likewise approved and prepared a lease for the project.

f. Proximity to Military Installation

Grade: A

Explanation: The project site is not located near military installations.

g. Cumulative Land Access Character Grade: C. See Figure 5 for a description of the cumulative land access character grade for the Truckhaven project.

		Character		Activity	
Sub-Attribute	Wt	Grade	Wt Product	Grade	Wt Product
Cultural and Tribal Resources	2	B (4)	8	A (5)	10
Environmentally Sensitive Areas	3	C (3)	9	A (5)	15
Biological Resources	3	C (3)	9	A (5)	15
Land Ownership	2	E (1)	2	A (5)	10
Federal Lease Queue	1	A (5)	5	A (5)	5
State Lease Queue	1	A (5)	5	A (5)	5
Millitary Installation	1	A (5)	5	A (5)	5
		Character Sum:	43/C	Activity Sum:	65/A

Figure 5. Cumulative land access character and activity grading for the Truckhaven Exploration Well Project

Figure 6 provides a rose diagram depicting the land access and permitting grade and index totals per attribute as calculated by the GeoRePORT SEAT for the Truckhaven Exploration Well Project. This report only analyzes the SEAT Land Access and Permitting attributes; accordingly, the Market and Transmission attribute areas depicted within the rose diagram are blank.

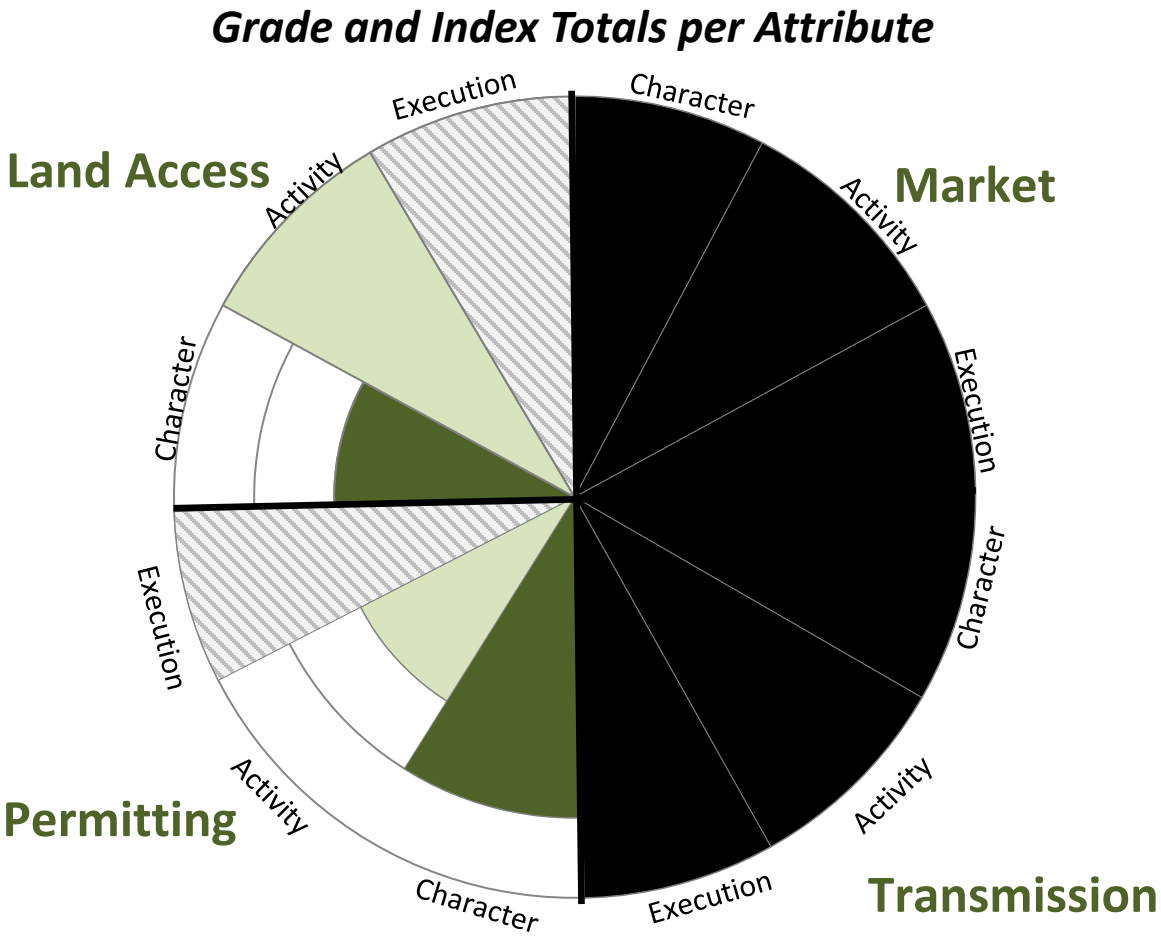


Figure 6. Truckhaven Exploration Well Project rose diagram

3.1.2 Hudson Ranch II Geothermal Project (Inactive)

Hudson Ranch Power II, LLC proposed to construct and operate a 49.9-MW geothermal power plant in Imperial County. Simbol, Inc. proposed to construct and operate the Simbol Calipatria Plant II, a commercial lithium carbonate production plant, adjacent to the Hudson Ranch Power II (HR-2) site, using geothermal brine from the HR-2 plant.

For the HR-2 Project, Hudson Ranch Power II, LLC proposed to drill and test up to eight geothermal wells. Up to three wells would be drilled as geothermal production wells from a production well pad located along the western edge of the HR-2 Project site. If needed, a fourth production well would have been drilled on the power plant site. Up to three injection wells

would have been drilled from two injection well pads near the eastern edge of the HR-2 Project site for the injection of geothermal brine. A fourth injection well would have been drilled on the northern injection well pad for the injection of geothermal steam condensate cooling tower blowdown and aerated geothermal brines.

The purpose of the geothermal well drilling and testing program, previously approved by the Imperial County under Conditional Use Permit #G11-0001, was to locate, sample, drill, complete, test and monitor potential geothermal resource development target zones to confirm the characteristics of the geothermal reservoir and determine if the geothermal resource was commercially viable (ICPDS 2012b).

Figure 7 depicts the permitting and environmental review timeline for the Hudson Ranch II Geothermal Project.

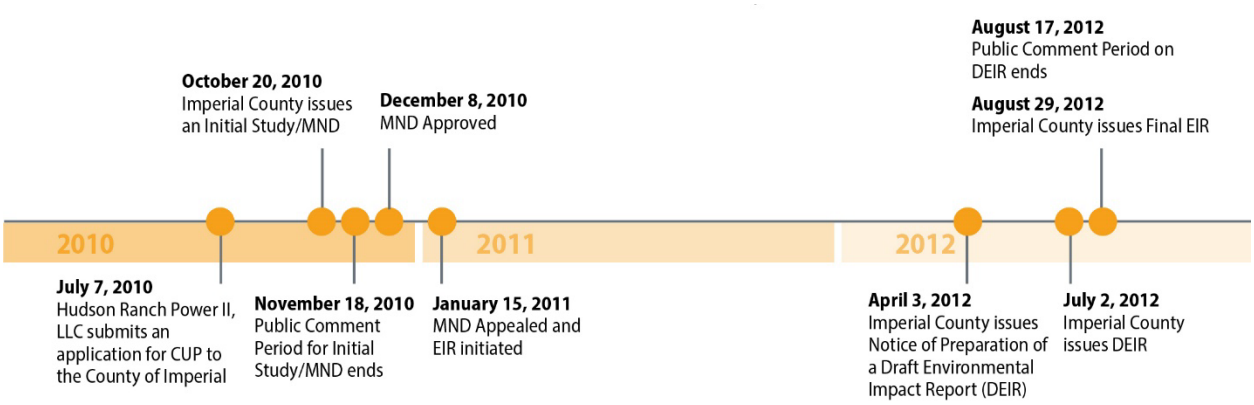


Figure 7. Hudson Ranch II geothermal project timeline

1. Permitting
   a. Regulatory Framework
      1) Federal

      Grade: N/A

      Explanation: The project is not on BLM-administered land.

      2) State

      Grade: B

      Explanation: The CalGEM within the Department of Conservation has experience successfully permitting geothermal projects. In addition, Imperial County has geothermal regulations, and ICPDS has experience successfully permitting projects.

   b. Environmental Review

      Grade: D

Explanation: The project required the preparation of an EIR pursuant to CEQA.[27]

c. Ancillary Permits

Grade: C

Explanation: The project requires several permits, including but not limited to: a Grading Permit from the ICPDS, a Permit to Operate from ICAPCD, an Encroachment Permit from the Public Works Department and/or IID, a permit for potable water treatment facilities from the Department of Environmental Health Services, and a General Permit for Stormwater Discharges from the RWQCB. In addition, an encroachment permit will be required for any work within a Caltrans Right-of-Way.

d. Cumulative Permitting Character Grade: C. See Figure 8 for a description of the cumulative permitting character grade for the Hudson Ranch II project.

		Character		Activity	
Sub-Attribute	**Wt**	**Grade**	**Wt Product**	**Grade**	**Wt Product**
State Regulatory Framework	2	B (4)	8	C (3)	6
Federal Regulatory Framework	2	-	-	C (3)	6
Environmental Review Process	3	D (2)	6	C (3)	9
Ancillary Permits	1	C (3)	3	C (3)	3
	0	Character	17/C	Activity	24/C

Figure 8. Cumulative permitting character and activity grading for the Hudson Ranch II Project

2. Land Access

a. Cultural and Tribal Resources

Grade: B

Explanation: Ground-disturbing activities associated with the project during construction would have the potential to cause substantial adverse changes to resources that escaped detection on the survey and/or buried prehistoric and historic resources. However, implementing mitigation measures would avoid damaging previously unrecorded historical resources and would thereby reduce impacts on cultural resources. Mitigation measures include requiring a cultural resources construction monitor and a Native American construction monitor, evaluating the significance of unanticipated discoveries, and implementing an unanticipated discoveries historic treatment plan.

b. Environmentally Sensitive Areas

Grade: C

[27] Preparation of an EIR is required if there is substantial evidence that a project may have a significant effect on the environment (Cal. Code Regs. tit. 14 § 15064).

Explanation: There are manageable environmental sensitivities. Project construction would require excavation and grading that may result in soil erosion and loss of topsoil. Relevant RWQCB best management practices would be adopted as necessary to prevent soil erosion, and a fugitive dust plan would be implemented to reduce dust and fugitive emissions from construction and other operational activities. Impacts to soil erosion and loss of topsoil would thus be reduced with these mitigation practices. However, the project is located 2.75 miles southwest of the Sonny Bono and Salton Sea National Wildlife Refuges, which may create complications.

c. Biological Resources

Grade: C

Explanation: The project could result in potentially significant impacts to populations or essential habitat for the western burrowing owl and the American badger, both California species of special concern. Implementation of mitigation measures, including pre-construction surveys, relocations, management plans, establishment of artificial burrows, and training for all construction personnel would reduce impacts to less than significant.

d. Land Ownership

Grade: A

Explanation: The project is located on private land with a single owner.

e. Federal and State Lease Queue

Grade: A

Explanation: The project area is not on BLM-administered lands. The project area is located within the Geothermal Overlay Zone that has already been approved by the state.

f. Proximity to Military Installation

Grade: A

Explanation: The project is not located near military installations.

g. Cumulative Land Access Character Grade: B. See Figure 9 for a description of the cumulative land access character grade for the Hudson Ranch II project.

		Character		Activity	
Sub-Attribute	Wt	Grade	Wt Product	Grade	Wt Product
Cultural and Tribal Resources	2	B (4)	8	A (5)	10
Environmentally Sensitive Areas	3	C (3)	9	A (5)	15
Biological Resources	3	C (3)	9	A (5)	15
Land Ownership	2	A (5)	10	A (5)	10
Federal Lease Queue	1	-	-	A (5)	5
State Lease Queue	1	A (5)	5	A (5)	5
Millitary Installation	1	A (5)	5	A (5)	5
		Character Sum:	46/B	Activity Sum:	65/A

Figure 9. Cumulative land access character and activity grading for the Hudson Ranch II Project

Figure 10 provides a rose diagram depicting the land access and permitting grade and index totals per attribute as calculated by the GeoRePORT SEAT for the Hudson Ranch II Project. This report only analyzes the SEAT Land Access and Permitting attributes; accordingly, the

Market and Transmission attribute areas depicted within the rose diagram are blank.

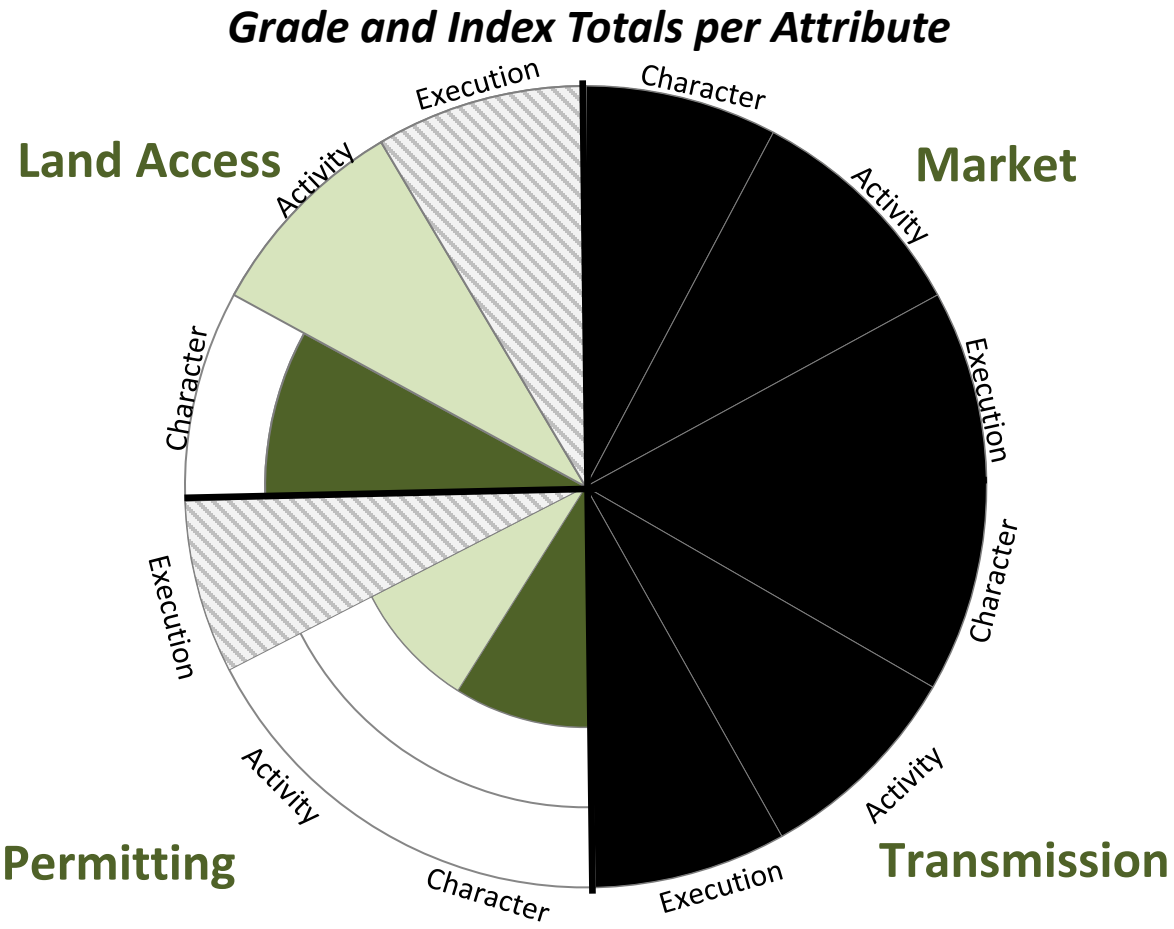


Figure 10. Hudson Ranch II Geothermal Project rose diagram

3.1.3 East Brawley Geothermal Project (Inactive)

The East Brawley Geothermal Development project was proposed to include the following:

- A 49.9-MW net geothermal power plant consisting of up to six Ormat Energy Converter (OEC) binary generating units (16 MW gross each) with vaporizers, turbines, generators, condensers, preheaters, pumps and piping, motive fluid (isopentane) storage, a motive fluid vapor recovery system, a gas scrubber, and a regenerative thermal oxidizer (RTO) and related ancillary equipment.
- Two cooling tower batteries with a total of 14–20 cell counter flow, induced draft with drift eliminators.
- A control room, office, maintenance shop, parking, and other facilities located at the power plant site.
- Approximately 36 total wells, with approximately half for production and half for injection. Each well would average 4,500 feet in depth. Six of these wells were already

approved and constructed by the County under the East Brawley Exploration permit (CUP 07-0029), while two wells are approved (not constructed) and the remaining 28 wells would be new.

- Piping from production wells to the power plant and from the power plant to the individual injection wells. Blowdown wells (2–4) at the power plant site to provide for injection of the cooling tower blowdown.
- Pumps, tank, valves, controls, flow monitoring, and other necessary equipment to the wells and pipelines.
- Piping, canals or ditches, and pumps to bring water from IID's Rockwood Canal to the power plant.
- A substation with a 2-mile-long double-circuit 13.8- and 92-kV transmission line with 66-foot-high poles to interconnect to the IID at the North Brawley 1 substation at Hovley and Andre roads.
- Improvements to the existing Brawley Wastewater Treatment Plant (BWWTP) to include a tertiary treatment system in order to provide reclaimed water to the proposed power plant as well as the construction of a pipeline to convey the water from the BWWTP to the power plant (ICPDS 2012a).

Figure 11 depicts the permitting and environmental review timeline for the East Brawley Geothermal Project.

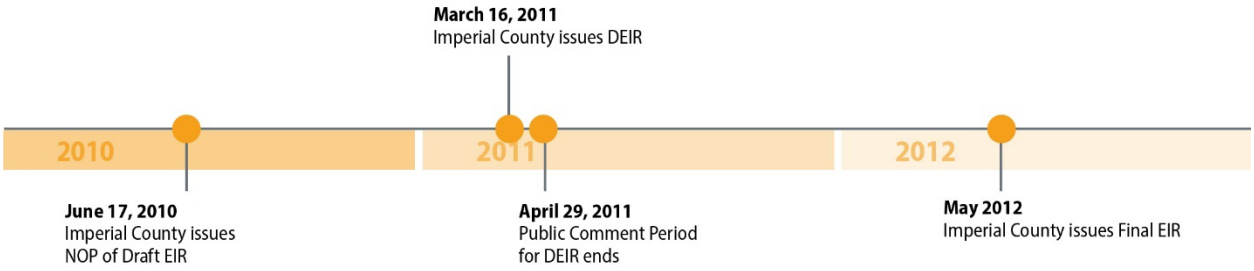


Figure 11. East Brawley Geothermal Project timeline

1. Permitting
   a. Regulatory Framework
      1) Federal

      Grade: N/A

      Explanation: The project is not located on BLM-administered lands

      2) State

      Grade: B

      Explanation: The CalGEM within the Department of Conservation has experience successfully permitting geothermal projects. In addition, Imperial County has geothermal regulations, and ICPDS has experience successfully permitting projects.

b. Environmental Review

Grade: D

Explanation: The project required preparation of an EIR pursuant to CEQA.[28]

c. Ancillary Permits

Grade: B

Explanation: The project would require several permits, including but not limited to: a Section 404 permit from USACE, a Streambed Alteration Agreement permit approved by CDFW, a Section 401 permit from the RWQCB, a Permit to Operate from the ICAPCD, and an encroachment permit from the Imperial County Department of Public Works for placement of any utilities within the county road rights-of-way.

d. Cumulative Permitting Character Grade: C. See Figure 12 for a description of the cumulative permitting character grade for the East Brawley project.

		Character		Activity	
Sub-Attribute	**Wt**	**Grade**	**Wt Product**	**Grade**	**Wt Product**
State Regulatory Framework	2	B (4)	8	C (3)	6
Federal Regulatory Framework	2	-	-	C (3)	6
Environmental Review Process	3	D (2)	6	C (3)	9
Ancillary Permits	1	B (4)	4	C (3)	3
	0	Character	18/C	Activity	24/C

Figure 12. Cumulative permitting character and activity grading for the East Brawley Project

2. Land Access

a. Cultural and Tribal Resources

Grade: B

Explanation: There are manageable cultural and Tribal resources in the project area. Implementation of the project could result in impacts to prehistoric resources, historic resources, human remains, and paleontological resources (e.g., fossils and fossil formations). However, impacts would be reduced by implementing appropriate mitigation measures including requiring a Native American Tribal monitor or representative be present during excavation or earth-moving activities and retaining a qualified archaeologist and/or paleontologist if cultural and/or paleontological remains are inadvertently discovered.

b. Environmentally Sensitive Areas

[28] Preparation of an EIR is required if there is substantial evidence that a project may have a significant effect on the environment (Cal. Code Regs. tit. 14 § 15064).

Grade: C

Explanation: The project site is located in a seismically active area; however, the risk of seismically induced liquefaction is low due to the depth of groundwater underlying the project site. Even so, some seismically induced settlement of the dry sands could occur. Developing the proposed project may require excavation and grading that could result in soil erosion and loss of topsoil during construction, necessitating appropriate mitigation measures. Such measures could include preparing a stormwater pollution and prevention control plan and implementing a stormwater retention basin and sumps for collection and removal of pollutants of concern (e.g., sediment, oil/grease). In addition, there is a nexus with WOTUS and a permit from USACE is required, as is a Streambed Alteration Agreement from the CDFW.

c. Biological Resources

Grade: C

Explanation: Implementing the proposed project could result in the loss of populations or essential habitat for the western burrowing owl, a California species of concern; it could also result in disturbance, degradation, and/or removal of sensitive biological communities. It is also possible that migratory birds protected under the MBTA would be located within the project area.

d. Land Ownership

Grade: A

Explanation: The project is on unincorporated private land in Imperial County.

e. Federal and State Lease Queue

Grade: A

Explanation: The project is not located on BLM-administered land. The project is in a known geothermal resource area, meaning the state has already approved the geothermal lease.

f. Proximity to Military Installation

Grade: A

Explanation: The project is not located near a military installation.

g. Cumulative Land Access Character Grade: B. See Figure 13 for a description of the cumulative land access character grade for the East Brawley project.

		Character		Activity	
Sub-Attribute	Wt	Grade	Wt Product	Grade	Wt Product
Cultural and Tribal Resources	2	B (4)	8	A (5)	10
Environmentally Sensitive Areas	3	C (3)	9	A (5)	15
Biological Resources	3	C (3)	9	A (5)	15
Land Ownership	2	A (5)	10	A (5)	10
Federal Lease Queue	1	-	-	A (5)	5
State Lease Queue	1	A (5)	5	A (5)	5
Millitary Installation	1	A (5)	5	A (5)	5
		Character Sum:	46/B	Activity Sum:	65/A

Figure 13. Cumulative land access character and activity grading for the East Brawley Project

Figure 14 provides a rose diagram depicting the land access and permitting grade and index totals per attribute as calculated by the GeoRePORT SEAT for the East Brawley Project. This report only analyzes the SEAT Land Access and Permitting attributes; accordingly, the Market and Transmission attribute areas depicted within the rose diagram are blank.

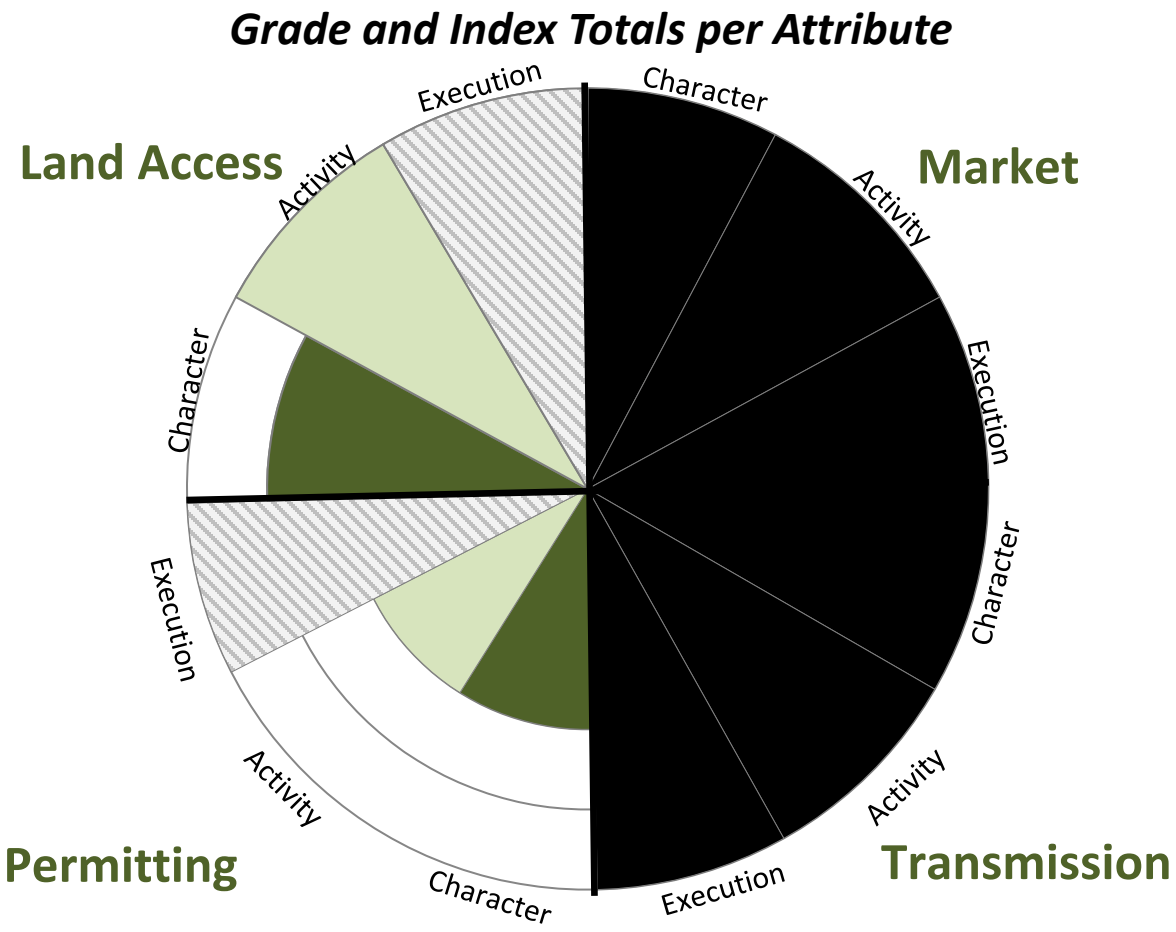


Figure 14. East Brawley Project rose diagram

3.2 Nevada Geothermal Project Analysis

This section contains site grading/analysis of environmental and permitting issues at sites in the Dixie Meadows geographic region of Nevada. See Figure 15 for a map of the Dixie Meadows Geothermal Project located in Churchill County, Nevada.

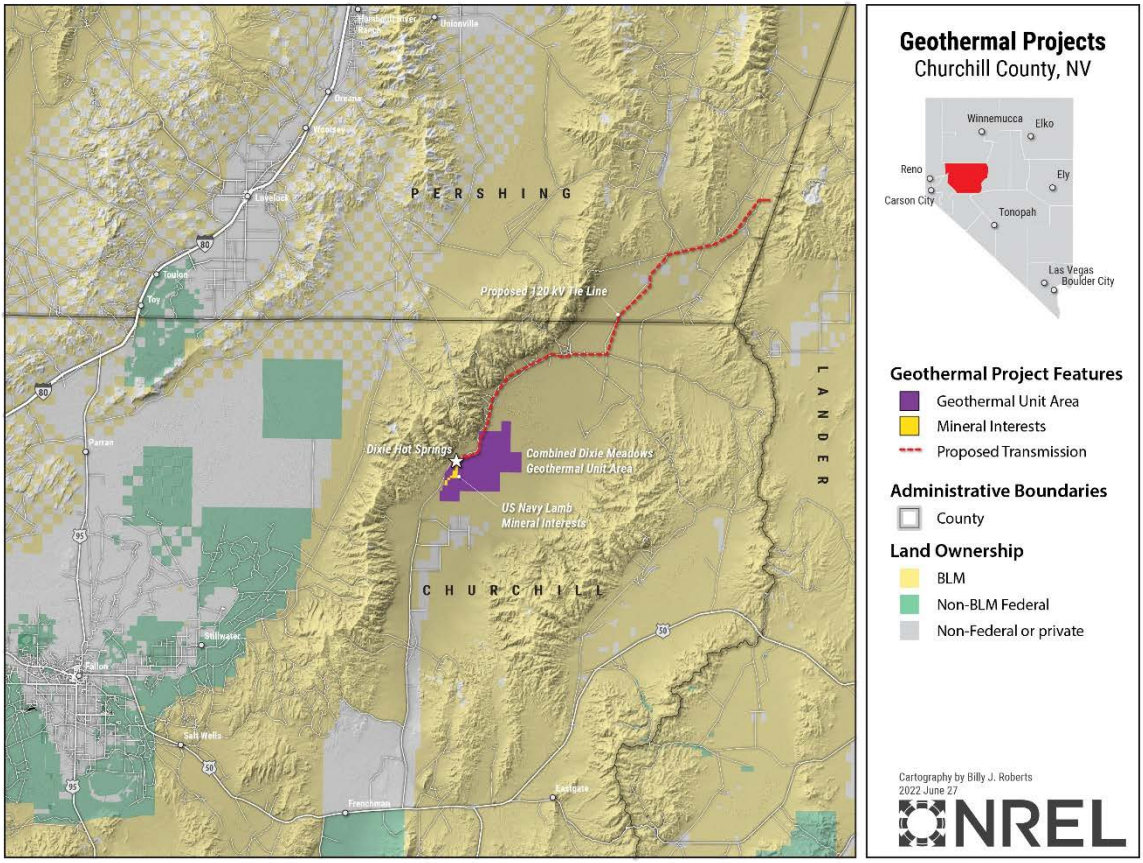


Figure 15. Map of geothermal projects in Imperial County, California

Figure 15 provides a map depicting the location and project boundary lines for the Dixie Meadows geothermal project, including the proposed 120-kV gen-tie line, federal, state, and private land boundaries, areas of environmental and project significance (e.g., Dixie Hot Springs, U.S. Navy Lamb Mineral Interests).

3.2.1 Dixie Meadows Geothermal Project (Active)

The Dixie Meadows Geothermal Project has consisted of two phases: An exploration project initiated in 2011 and a utilization project initiated in 2017 (BLM 2011; BLM 2017; BLM 2021b). In 2021, the BLM issued a Final EA and signed FONSI for the utilization project (BLM 2021b).

Phase 1 – Exploration Project 2011

Ormat Technologies, Inc. proposed to explore the geothermal resources that potentially exist within the Dixie Meadows Lease Area by:

- Constructing up to 20 well pads and up to 60 geothermal exploration wells. One of each of three different types of geothermal exploration wells would be constructed on each pad: temperature gradient wells, observation wells, and production wells.
    - Potential Land Disturbance: 82 acres

- Constructing new gravel access roads of a maximum combined length of approximately 75,665 feet and utilizing and repairing existing roads for access to the project area. Gravel would be obtained from an existing mineral material site that Ormat would expand and from a new mineral material site that Ormat would construct.
    - Potential Land Disturbance: 35 acres

- Drilling up to two groundwater wells on one or two of the proposed well pads or at the proposed new gravel source area. Ormat would install an aboveground water distribution pipeline, within the project boundary as described in the EA, between the groundwater wells and well pads actively being drilled.

- Expanding the existing mineral material site and constructing a new site, including installing the necessary ancillary facilities in support of drilling activities, such as a temporary personnel "camp" for active drilling crews.
    - Potential Land Disturbance: 20 acres

Note: Maximum Total Land Disturbance for the Dixie Meadows Exploration Project (Approximate): 137 acres (BLM 2011).

Phase 2 – Utilization Project 2017

ORNI 32 (Ormat) proposed the Dixie Meadows Geothermal Utilization Project in Dixie Valley to allow for the development of the geothermal resources within the Dixie Meadows Geothermal Unit Area. The project includes:

- Constructing up to two 30-MW net rated geothermal power plant facilities and associated electrical substations
- Drilling, testing, and operating up to 15 geothermal production and injection well pads
- Constructing up to eight core hole well pads and two water well pads
- Constructing and operating geothermal production and injection wells, pipelines to carry geothermal fluid between well fields and the power plants, access roads, and support facilities
- Constructing a 120-kV gen-tie line ("Northern Gen-Tie Route" or "Proposed Action") and associated structures or, in the alternative, a 230-kV gen-tie line ("Southern Gen-Tie Route") and associated structures.

Total Area of Disturbance for Proposed Action: 1,982 approximate acres
Amount of Disturbance to Be Reclaimed: 1,860 approximate acres
Amount of Disturbance that Would Not Be Reclaimed: 122 approximate acres

Total Area of Disturbance for Alternative Southern Gen-Tie Route: 1,354 approximate acres
Amount of Disturbance to Be Reclaimed: 1,242 approximate acres
Amount of Disturbance that Would Not Be Reclaimed: 112 approximate acres (BLM 2017; BLM 2021b).

Figure 16 depicts the permitting and environmental review timeline for the Dixie Meadows Geothermal Project.

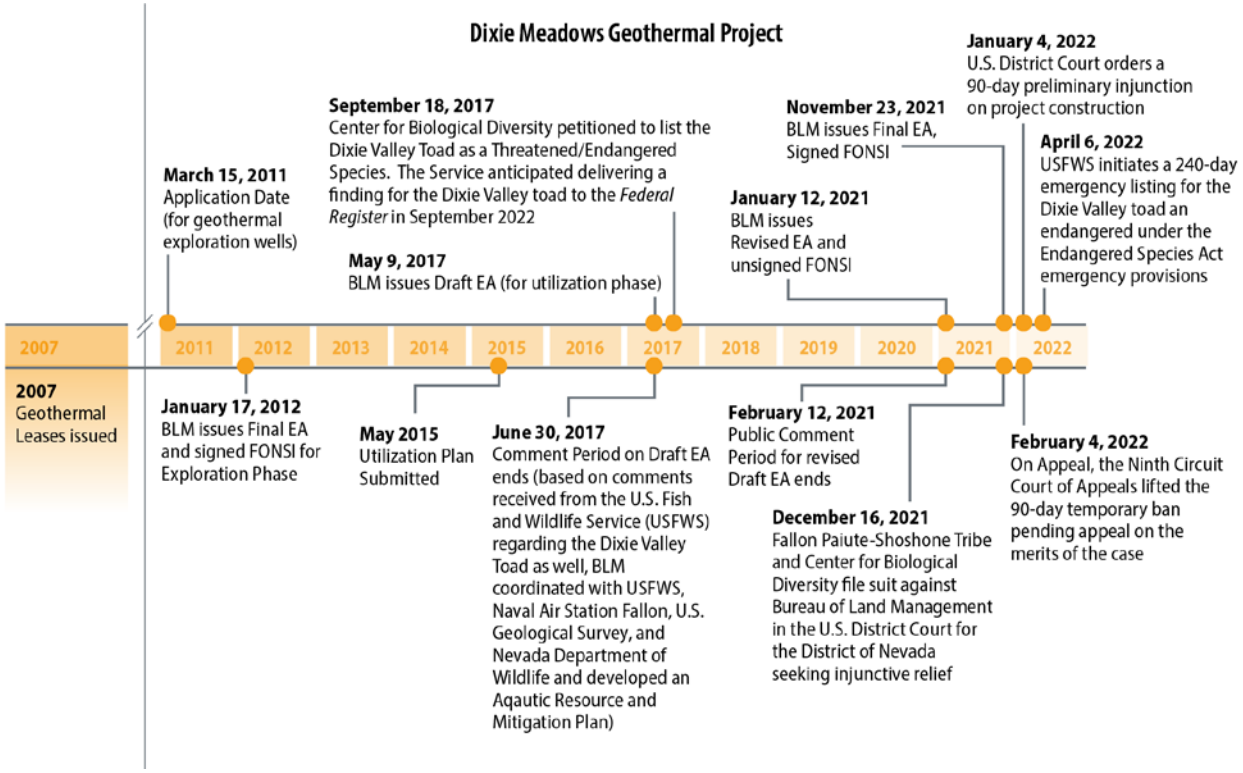


Figure 16. Dixie Meadows Geothermal Project timeline

1. Permitting
   a. Regulatory Framework
      1) Federal

      Grade: A

      Explanation: BLM-administered mineral estate in an area with experience permitting geothermal exploration and development projects. BLM has an MOU with the state.

      2) State

      Grade: B

      Explanation: State/county has geothermal regulations and experience successfully permitting projects.

   b. Environmental Review

      Grade: C

      Explanation: The project is subject to one federal environmental review process under NEPA and may potentially be subject to one state environmental review process under UEPA if a 230-kV gen-tie line is selected.

c. Ancillary Permits

Grade: B

Explanation: The project potentially requires six ancillary permits, including: (1) Right-of-Way from the U.S. Navy, (2) construction stormwater permit and underground injection control (UIC) permit from the NDEP, (3) temporary consumptive water use permit from the NDWR, (4) surface area disturbance permit from the Nevada Bureau of Air Pollution Control, (5) special use permit from Churchill County, and (6) special use permit from Pershing County.

d. Cumulative Permitting Character Grade: B. See Figure 17 for a description of the cumulative permitting character grade for the Dixie Meadows project.

		Character		Activity	
Sub-Attribute	**Wt**	**Grade**	**Wt Product**	**Grade**	**Wt Product**
State Regulatory Framework	2	B (4)	8	C (3)	6
Federal Regulatory Framework	2	A (5)	10	C (3)	6
Environmental Review Process	3	C (3)	9	C (3)	9
Ancillary Permits	1	B (4)	4	C (3)	3
	0	Character	31/B	Activity	24/C

Figure 17. Cumulative permitting character and activity grading for the Dixie Meadows Project

2. Land Access

a. Cultural and Tribal Resources

Grade: C

Explanation: There are Tribal/cultural resources located in the project area that may present potential complications. The Dixie Hot Springs, which are located immediately adjacent to the project area, have important significance to federally recognized Tribes and are being treated as property eligible for listing pursuant to the NHPA. The BLM has made a finding of adverse effect on the Dixie Hot Springs site based on the project's potential impacts. However, the following proposed measures are expected to minimize any adverse impacts to the hot springs: (1) avoiding archaeological resources during construction activities, (2) keeping the location of rare medicinal plants of significance to Tribes confidential, and (3) allowing and improving Tribal access to the Dixie Hot Springs during construction, operation, and maintenance of the project. In September 2021, a Memorandum of Agreement for Resolution of Adverse Effects to the Dixie Meadows Hot Springs (MOA) was finalized and signed by the BLM, Department of the Navy, and Nevada SHPO (State Historic

Preservation Officer). Representatives of the Fallon-Paiute-Shoshone Tribe declined to sign the MOA.

b. Environmentally Sensitive Areas
   Grade: C
   Explanation: Biological resource complications are present. The Dixie Valley toad, which occurs within the proposed project area and has the potential to be impacted by the project, is currently the subject of a USFWS emergency listing[29] to designate the toad as an endangered species. Migratory bird species are potentially present within the lease area; however, any impacts from the project are expected to be minimal. No known Greater Sage Grouse occur within the project area.

c. Biological Resources
   Grade: C
   Explanation: There are some biological resource complications. The Dixie Valley toad is a federally protected species that occurs within the proposed project area and has the potential to be impacted by the project. On April 4, 2022, the USFWS listed the Dixie Valley toad as an endangered species under the ESA's emergency provisions, granting the toad a 240-day protection period. In addition, migratory bird species are potentially present within the lease area; however, any impacts from the project are expected to be minimal. No known Greater Sage Grouse occur within the project area.

d. Land Ownership
   Grade: C
   Explanation: The project is located on public lands administered by the BLM, Carson City District (CCD), and a segment of U.S. Navy lands.

e. Federal and State Lease Queue
   Grade: A
   Explanation: The Dixie Meadows Geothermal Leasing Area has already been approved and issued by the BLM. NDOM has also approved and permitted the project.

f. Proximity to Military Installation
   Grade: D
   Explanation: Approximately 16 miles of gen-tie route are located on a U.S. Navy installation and the U.S. Navy performs training operations at the Dixie Valley training area, which is located south of the project site. However,

[29] The USFWS is listing the Dixie Valley toad as an endangered species pursuant to the ESA's emergency listing provisions. On April 6, 2022, the USFWS initiated an emergency listing procedure, which provides immediate protections under the ESA for 240 days. Concurrently, the USFWS is issuing a proposed rule to list the Dixie Valley toad as an endangered species and taking public comment to inform the decision on whether ESA protections should continue beyond the 240-day emergency listing period.

the proposed action would not exceed or conflict with any training operations or existing ROWs or uses granted within them.

g. Cumulative Land Access Character Grade: C. See Figure 18 for a description of the cumulative land access character grade for the Dixie Meadows project.

		Character		Activity	
Sub-Attribute	**Wt**	**Grade**	**Wt Product**	**Grade**	**Wt Product**
Cultural and Tribal Resources	2	C (3)	6	A (5)	10
Environmentally Sensitive Areas	3	C (3)	9	A (5)	15
Biological Resources	3	C (3)	9	A (5)	15
Land Ownership	2	C (3)	6	A (5)	10
Federal Lease Queue	1	A (5)	5	A (5)	5
State Lease Queue	1	A (5)	5	A (5)	5
Millitary Installation	1	D (2)	2	A (5)	5
		Character Sum:	42/C	Activity Sum:	65/A

Figure 18. Cumulative land access character and activity grading for the Dixie Meadows Project

Figure 19 provides a rose diagram depicting the land access and permitting grade and index totals per attribute as calculate by the GeoRePORT SEAT for the Dixie Meadows Project. This report only analyzes the SEAT Land Access and Permitting attributes; accordingly, the Market and Transmission attribute areas within the rose diagram are blank.

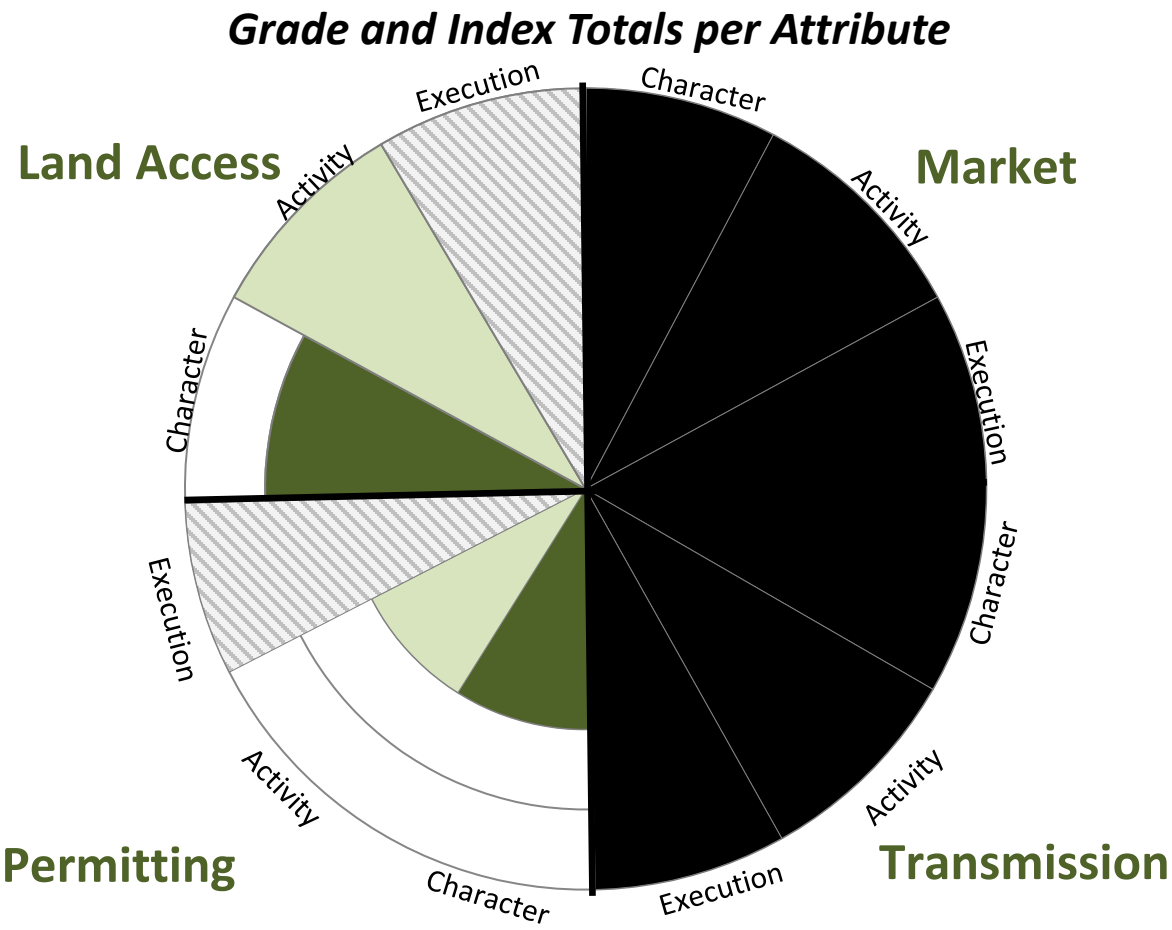


Figure 19. Hudson Ranch II Geothermal Project rose diagram

4 Geothermal Permitting and Time Cost Implications

This section contains a summary of techno-economic analysis to assist in understanding the cost impacts of non-technical barriers to geothermal development in California and Nevada. As part of this analysis, the project team used the NREL Annual Technology Baseline (ATB)[30] to understand the implications of development timeline impacts on geothermal levelized cost of electricity (LCOE) and refine previous assumptions from the Non-Technical Barriers Task Force Report[31] developed as part of the *GeoVision* analysis.

4.1 Data Collection and Methodology

The project team collected geothermal project timeline information from NEPA and CEQA documents prepared for projects in Imperial Valley, California, and Dixie Meadows, Nevada. Information collected from NEPA and CEQA documents (i.e., permitting and environmental review timelines from scoping through date of final document) mainly provided data related to when environmental reviews occurred and, in some cases, may underestimate regulatory, permitting, and overall project development timelines which extend beyond environmental review processes.

In addition, the project team collected general permitting cost information for the California CEC process, which, when applicable, encompasses most state and local permitting requirements. In general, these costs were in line with the previously established Geothermal Electricity Technology Evaluation Model (GETEM)/ATB default of $1.5 million for the project baseline, so no changes to those cost assumptions were made. Project-specific costs at each site reviewed in California and Nevada may be highly variable based on specific considerations related to the type of regulatory process or permits required as well as technical aspects of developing the resource. Accordingly, rather than calculating LCOE by project location, the project team opted to analyze LCOE based on development timeline intervals of 4, 6, 8, 10, and 12 years to allow for a general understanding of timeline impacts on LCOE.

4.2 Findings

Delays in permitting timelines impact construction and project completion and may result in both increased financing charges and loss of generated electricity revenue. As seen in Figure 20 and Figure 21, when project delays occur, LCOE values may become higher for produced electricity due to the increase in compounding interest associated with project financing.

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[30] The ATB is a populated framework used to identify technology-specific cost and performance parameters or other investment decision metrics across a range of fuel price conditions and site-specific conditions for electric generation technologies and is available at https://atb.nrel.gov/.

[31] Young, Katherine, Aaron Levine, Jeff Cook, et al. *GeoVision Analysis Supporting Task Force Report: Barriers, An Analysis of Non-Technical Barriers to Geothermal Deployment and Potential Improvement Scenarios*. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-71641. May 2019. https://www.nrel.gov/docs/fy19osti/71641.pdf.

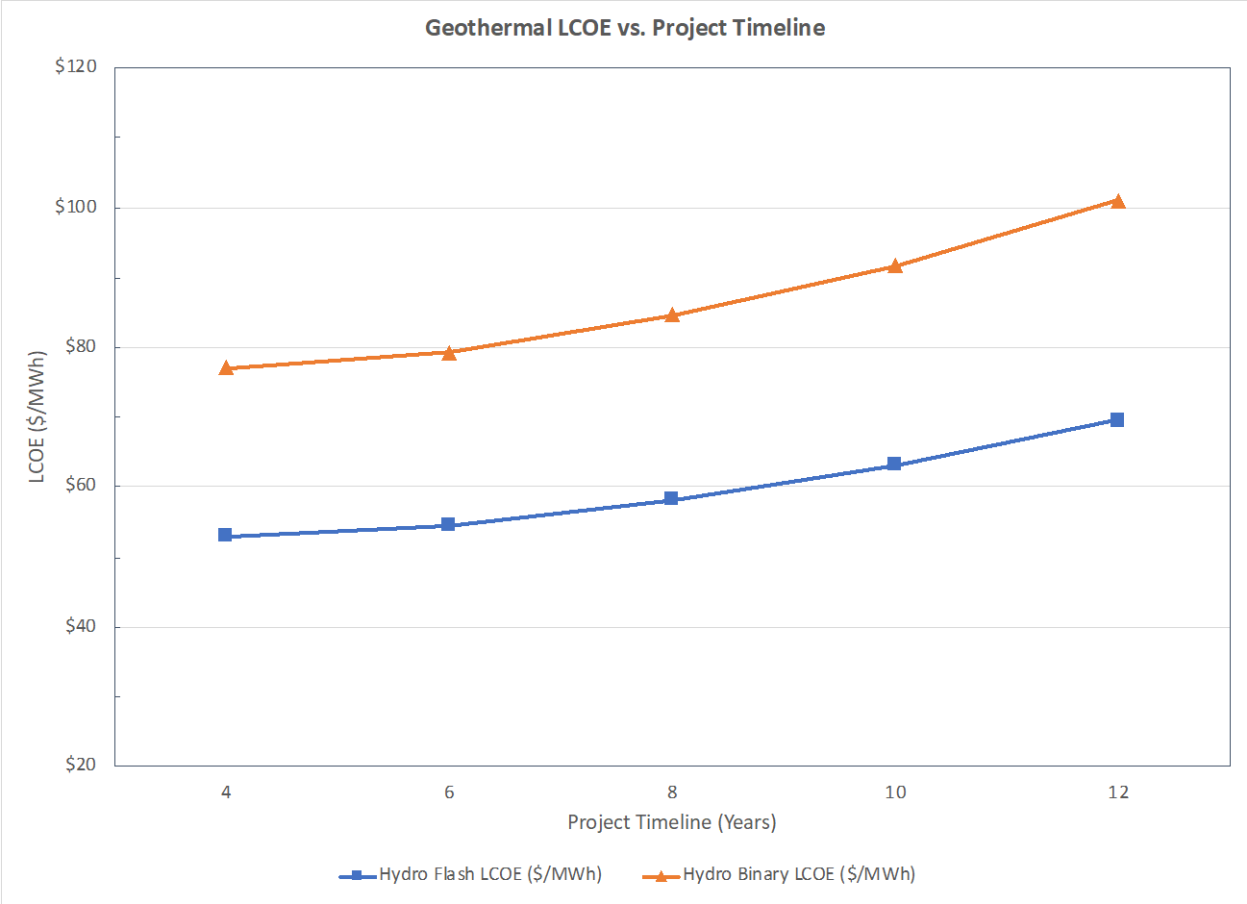

Figure 20. Geothermal hydrothermal flash and binary LCOE values vs. project timelines

		Project Timeline (yrs)				
		4	6	8 (ATB)	10	12
Hydro Flash	Construction Finance Factor	1.289	1.347	1.481	1.659	1.894
	CAPEX ($/kW)	$5,800	$6,059	$6,662	$7,461	$8,517
	Construction Financing Cost ($/kW)	$1,302	$1,561	$2,165	$2,963	$4,019
	LCOE ($/MWh)	$53	$55	$58	$63	$70
Hydro Binary	Construction Finance Factor	1.289	1.347	1.481	1.659	1.894
	CAPEX ($/kW)	$7,427	$7,759	$8,532	$9,555	$10,907
	Construction Financing Cost ($/kW)	$1,667	$1,999	$2,772	$3,795	$5,147
	LCOE ($/MWh)	$77	$79	$85	$92	$101

Figure 21. Hydrothermal flash and hydrothermal binary plant costs vs. project timelines

As Figure 20 demonstrates, for flash steam plants, if a project is completed within 4 years, LCOE value is calculated at $53/megawatt-hour (MWh). By comparison, a 10-year project timeline raised the LCOE to $63/MWh. For binary cycle plants, if a project is completed within 4 years, LCOE value is calculated at $77/MWh. By comparison, a 10-year project timeline raised the LCOE to $92/MWh

Compounding interest that accrues on capital that has been spent while project development is on hold due to permitting and development delays increases overall project costs and LCOE values for produced electricity. As noted in Figure 22, all projects ranging from a 4-year timeline to a 12-year timeline spent 30% of the capital fraction of project costs within the first year of project development, 22% at the end of year one, and 26% at the end of year 3. However, for projects with development timelines extending more than four years, spending ceased after year 3 and the remaining project costs were spread out over the final three years of project development. Notably, however, projects accrued interest on the capital that had already been spent even during periods of time with 0% project spending. Accordingly, although project development was on hold during years with 0% project spending, project costs were still accruing, which ultimately increases overall development costs. For example, a project with a 4-year development timeline spent all of the capital fraction of project costs by the end of year 3. By comparison, a project with a 10-year timeline spent 0% of the capital fraction during years 3–6, during which time interest was accruing on the 78% of project costs—which had already been spent.

Construction Length: (Years)	Capital Fraction				
	4	6	8 (ATB)	10	12
0	30%	30%	30%	30%	30%
1	22%	22%	22%	22%	22%
2	26%	26%	26%	26%	26%
3	22%	10%	0%	0%	0%
4		2%	0%	0%	0%
5		10%	10%	0%	0%
6			2%	0%	0%
7			10%	10%	0%
8				2%	0%
9				10%	10%
10					2%
11					10%

Figure 22. Capital fraction of project costs vs. construction length

In addition to compounding interest that accrues as a result of development delays, other cost factors like loss of generated electricity revenue and potential penalties for failure to deliver electricity under a power purchase agreement (PPA) may also add to overall project costs. For example, in 2017, Ormat entered into a PPA with the Southern California Public Power Authority that allows Ormat to sell power from projects coming online before the end of 2022 at a fixed price of $75/MWh, which is approximately $15 per MWh above current market rates. Ormat has stated that project completion delays at Dixie Meadows due to litigation over BLM's final 2021 environmental assessment approving the project, may result in up to $30 million in lost revenue over 20 years.[32]

[32] *Fallon Paiute-Shoshone Tribe v. U.S. Dep't of the Interior, et al.*, No. 3:21-cv-00512-RCJ-WGC, 2022 U.S. Dist. WL 137069, at *2 (D. Nev. Jan. 14, 2022).

5 Challenges, Best Practices, and Opportunities From Federal, State, Local Agency, and Developer Perspectives

In furtherance of the analysis of land access, environmental, and permitting barriers to geothermal development, the project team conducted a series of interviews with federal, state, and local agency staff involved in permitting and oversight of geothermal projects in California and Nevada as well as project developers at selected project sites located in California and Nevada. Federal agency participants included BLM, BOR, USACE, and USFWS. State agency participants included the CDFW, CEC, CalGEM, ICPDS, IID, and NDOM. Developer participants included Ormat Technologies Inc. (Ormat), Energy Source, CalEnergy Resources Ltd. (CalEnergy), and Controlled Thermal Resources (CTR). The topics discussed in the following section are illustrative of permitting and environmental challenges that geothermal regulators and developers may encounter that may increase project complexity, development timelines, and project delays. In addition, this section discusses opportunities and best practices that may increase efficiencies and decrease project development timelines in California and Nevada.

5.1 Challenges to Geothermal Project Development in California and Nevada

The following section discusses challenges that may lead to increased permitting complexity and project development timelines for geothermal projects located in California and Nevada.

In California, geothermal projects are potentially subject to two environmental review processes (i.e., NEPA and CEQA) and may require coordination among multiple federal, state, and local agencies, which are often insufficiently staffed. In addition, geothermal projects located in Imperial County, California, may face environmental review and permitting challenges due to WOTUS determinations, water quality issues, as well as the presence of migratory bird and sensitive aquatic species and habitat.

By comparison, in Nevada, regulatory review of geothermal projects is consolidated between federal and state agencies, which are able to coordinate more efficiently. However, insufficient agency staffing as well as conflicts and concerns over species and cultural resources may impact project development timelines in Dixie Meadows and create costly delays for project developers. Depending on project location, geothermal projects may face additional challenges due to the presence of protected species and/or areas of cultural significance.

Federal agency staff noted that one of the biggest challenges for geothermal project development in California and Nevada is insufficient staffing resources. Ground disturbing activities conducted during exploration, drilling, and utilization phases of geothermal development may impact water, biological, and cultural resources. Accordingly, agency staff must conduct baseline studies and inventories to identify the locations of these resources and potential impacts within the project area. Staffing shortages and heavy workloads, particularly for biological and cultural resource specialists, can create bottlenecks in reviewing and preparing environmental review documents and other required reviews. In addition, certain baseline studies, such as biological assessments, must be conducted during specific times of the year (e.g., plant studies must be

conducted in the spring, studies during mating and migration seasons). In addition to staff shortages, agency staff may face difficulties in coordinating baseline studies that must take place during specific seasons (e.g., wildlife mating or migration seasons) with project timelines as proposed by project developers.[33]

5.1.1 Challenges for Geothermal Project Development in California

This section is illustrative of challenges for geothermal project development in California and is divided into three sections: (1) Agency and Regulatory Coordination Challenges; (2) Economic Challenges; and (3) Resource Management Challenges.

Agency and Regulatory Challenges

As noted, geothermal projects in California are potentially subject to two environmental review processes pursuant to CEQA and NEPA, which require analysis of potential project impacts to biological, water, and cultural resources. Some project activities may require CEQA and NEPA review to occur concurrently depending on whether project location triggers state and federal review. In addition, due to the phased nature of geothermal project development, CEQA and NEPA review may be triggered at different phases of geothermal development (e.g., exploration phase, drilling phase, and utilization phase). CEQA, similar to NEPA, requires that state and local agencies evaluate environmental impacts of proposed projects and adopt mitigation measures to reduce or eliminate impacts. Both CEQA and NEPA review require in-depth analysis of impacts to resources and coordination with many different federal, state, and local resource agencies, which can cause delays in processing environmental review documents (e.g., an EIS or EA pursuant to NEPA; an EIR or MND pursuant to CEQA).[34]

The CEQA process is often time consuming and may lead to permitting and project development delays. The ICPDS noted that an EIR can take 12–18 months to prepare and an MND can take 4–6 months on average, and in some cases longer.[35] The IID has also noted that although CEQA provides a regulatory "umbrella," in practice every state agency has their own separate process, and coordination between state and local agencies is minimal.[36] Some local agencies have noted that often, time-consuming EIRs are prepared rather than MNDs to fend off any potential legal challenges even if an MND would have been sufficient. For example, the ICPDS noted that an EIR was prepared for the Hudson Ranch II geothermal project to protect against potential litigation, even though a CEQA analysis had already been completed for the Hudson Ranch I project using an EA/MND analyzing potential project impacts on resources within the same geographic area.[37]

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[33] Staff, U.S. Fish and Wildlife Service (USFWS), teleconference, April 22, 2021.
[34] Staff, Imperial Irrigation District (IID), teleconference, March 30, 2021.
[35] Staff, Imperial County Planning and Development Services (ICPDS), teleconference, May 25, 2021. The projects analyzed in this report varied in terms of EIR and MND completion times. For example, the Truckhaven Geothermal Project MND took one month to complete (from the date of notice of preparation of an MND until the issuance of the final MND). The Hudson Ranch II project EIR took 4 months to complete (from the date of notice of preparation of an EIR until the issuance of the final EIR). By comparison, the East Brawley Geothermal Project EIR took 23 months to complete (from the date of notice of preparation of an EIR until the issuance of the final EIR).
[36] Staff, IID, teleconference, March 30, 2021.
[37] Staff, ICPDS, teleconference, May 25, 2021.

In addition, the CDFW has noted that insufficient staffing is an issue affecting all agencies in California, which may increase CEQA timelines, creating permitting and environmental review bottlenecks that may lead to project development delays.[38]

Economic Challenges

Developers have noted that economic barriers, such as procuring a PPA, present challenges for geothermal project development in Imperial County, California. Geothermal energy is more expensive than other forms of renewable energy.[39] Accordingly, developer Energy Source noted that getting a PPA for geothermal energy is challenging due to competition with lower-cost solar and wind energy.[40] IID also stated that transmission congestion is a challenge for getting a PPA for geothermal projects to export the electricity outside of Imperial County. For example, IID noted that the transmission queue for baseload power is already full, which poses a challenge for future PPA requests.[41]

Resource Management Challenges

Some of the biggest challenges to geothermal project development in Imperial County, California are related to resource management challenges, such as agency jurisdictional determinations and coordination over rapidly changing resources (e.g., changing conditions within the Salton Sea creating more wetlands), biological species concerns, and potential water quality impacts.

Agency jurisdictional determinations and coordination issues over water resources may cause permitting and environmental review process delays. For example, some projects may require that USACE make a jurisdictional determination as to whether a geothermal project will result in a discharge of dredged and fill material into WOTUS and, if applicable, issue a Clean Water Section 404 prior to project development. Pursuant to federal law, USACE has jurisdiction over discharges of dredged and fill material to WOTUS, which includes intrastate waters, wetlands adjacent to WOTUS, and tributaries (33 C.F.R. § 328.3(a); 33 C.F.R. § 336.1). In Imperial County, USACE may have jurisdiction over discharges to the Salton Sea, its wetlands, and tributaries.[42] USACE jurisdictional determinations in the Salton Sea are site-specific and made on a case-by-case basis, which can be time-consuming, particularly in light of the changes made to the definition of WOTUS through a series of rulemakings and court holdings. In addition, after USACE makes a jurisdictional determination, it may not issue a CWA 404 permit until after the California Water Board issues a Section 401 water quality certification verifying compliance with existing water quality requirements or waives the certification requirement, which can lead to further permitting delays. Local agencies have noted that coordination efforts between USACE and other federal agencies related to permitting may cause challenges. For

[38] Staff, California Department of Fish and Wildlife (CDFW), teleconference, April 5, 2021.
[39] Staff, IID, teleconference, March 30, 2021. See also, NREL. Electricity ATB Technologies and Data Overview, last visited August 25, 2022. https://atb.nrel.gov/electricity/2022/index.
[40] Staff, Energy Source, teleconference, May 25, 2021.
[41] Staff, IID, teleconference, March 30, 2021.
[42] Kyle Dahl, Cori Farrar, U.S. Army Corps of Engineers (USACE), teleconference, May 26, 2021.

example, IID has noted that discussions between USACE and other federal agencies such as USFWS over jurisdictional resource concerns are a challenging and time-consuming effort.[43]

Geothermal project development may also face challenges due to the unique biological and species concerns present at the Salton Sea. The Sonny Bono Salton Sea National Wildlife Refuge is home to a wide variety of sensitive and endangered species, including the western burrowing owl, desert pupfish, and Ridgway's rail. In addition, the Salton Sea is an important resource for many different species of migratory birds, which are protected pursuant to the MBTA. The USFWS has noted that some areas of the Salton Sea may prove problematic for development if they may impact wetlands that support sensitive species. In addition, rapidly changing conditions at the Salton Sea (e.g., sea recession), may present challenges for geothermal development. For example, the USFWS has noted that when developer CTR began environmental scoping for a proposed geothermal project, the area was dry playa. However, due to changing conditions in the Salton Sea, the area is now a wetland occupied by sensitive species and will require further environmental analysis.[44]

Water use, water quality, and loss of wetland species habitat are also concerns that may impact geothermal project development around the Salton Sea. The USFWS has noted that decreased water quality, reduction of water resources (e.g., Salton Sea recession and sea loss), and competing water interests may present challenges for project development in the Salton Sea. For example, increasing levels of selenium and salt associated with water reduction in the Salton Sea may lead to a loss of water quality in habitat that supports fish and bird populations.[45] Accordingly, geothermal projects located in sensitive areas may face challenges and scrutiny if they have the potential to negatively impact or reduce wetland habitat.

5.1.2 Challenges for Geothermal Project Development in Nevada

In Nevada, unlike California, federal and state permitting requirements and environmental reviews are consolidated between federal and state agencies. However, resource conflicts and concerns may result in permitting and project development timeline delays.

Agency and Regulatory Challenges

Project developers in Nevada are required to obtain geothermal drilling permits from both the BLM and NDOM for geothermal projects when the project is located on BLM federally managed land. Moreover, NDOM does not accept BLM drilling permit forms, and the federal and state permitting processes do not occur concurrently. Rather, NDOM issues a state well drilling permit for both exploration (e.g., temperature gradient wells) and wells that come into direct contact with the geothermal resource after which the BLM issues an NOI and/or GDP accordingly.[46] As such, the process by which project developers must obtain federal and state drilling permits is duplicative and may potentially increase the time and effort required to permit the same well.

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[43] Staff, IID, teleconference, March 30, 2021.
[44] Staff, USFWS, teleconference, April 22, 2021.
[45] Staff, USFWS, teleconference, April 22, 2021.
[46] Staff, Nevada Division of Minerals (NDOM), teleconference, February 2, 2021.

Resource Management Challenges

Project developers in Nevada have noted that conflicts over species and cultural resources may impact project development. For example, the Dixie Meadows Utilization Project is located in an area with biological species concerns and Tribal resources concerns, which have led to litigation and potentially costly project delays. The Dixie Valley toad, which is only found in Dixie Valley, is supported by surface and groundwater resources located near the Dixie Meadows project site. Currently, the USFWS is undertaking an emergency listing for the Dixie Valley toad, which provides 240 days of protection while USFWS completes a rulemaking for the species to be permanently listed species pursuant to the ESA. Concerns over listed species and their habitat may delay acquisition of necessary permits and overall project development timelines.

In addition, the Dixie Hot Springs have cultural significance to federally recognized Tribes and are being treated as property eligible for listing pursuant to the NHPA. In May of 2017, BLM issued a Draft EA for the utilization phase of the Dixie Meadows project, which analyzed potential project impacts to biological and cultural resources. On January 12, 2021, the BLM issued a revised EA to address concerns raised during the public comment period for the draft EA. On November 23, 2021, the BLM issued a final EA and signed FONSI. In 2021, concerns that the project may deplete water resources necessary to support cultural and biological resources as well as potential visual impacts to cultural resources, led the Fallon Paiute-Shoshone Tribe and Center for Biological Diversity to file suit in the U.S. District Court for the District of Nevada seeking injunctive relief against the DOI and BLM.[47] On January 4, 2022, the U.S. District Court ordered a 90-day preliminary injunction on project construction, pending a trial on the merits. However, on February 4, 2022, the injunction was lifted on appeal to the Ninth Circuit Court, allowing Ormat to commence construction. However, due to the USFWS emergency listing of the Dixie Valley toad, development at the project site is currently on hold.

5.2 Best Practices and Geothermal Project Development Opportunities

The following section discusses best practices and opportunities that may lead to decreases in permitting and project development timelines for geothermal projects located in California and Nevada.

5.2.1 Generally Applicable Best Practices and Geothermal Project Development Opportunities in California and Nevada

Agency staff and developers noted that tiering to existing environmental review documents, such as NEPA documents (e.g., EAs, EISs, Programmatic Environmental Impact Statements) and CEQA documents, where applicable (e.g., Master Salton Sea EIR) can create efficiencies and aid staff in developing mitigation measures.[48] Tiering to recent baseline studies (e.g., studies regarding federal and state sensitive, threatened, or endangered species, and hydrological resources) conducted in previous NEPA and/or CEQA documents may also save time and money

[47] *Fallon Paiute-Shoshone Tribe v. U.S. Dep't of the Interior, et al.*, No. 3:21-cv-00512-RCJ-WGC, 2022 U.S. Dist. WL 137069, at *2 (D. Nev. Jan. 14, 2022).
[48] Staff, California Geologic Energy Management (CalGEM), teleconference, May 25, 2021; Michael Chatterton, Carrie Sahagun, Dan Munger, Bureau of Land Management, teleconference, July 15, 2021.

for developers, as well as valuable resources for federal and state agencies during environmental review for projects sited in a similar or close location.[49] For example, the developer Energy Source noted that a company it had sold wells to was able to tier to a CEQA EIR, which had previously been completed for the Hudson Ranch II, and for which Energy Source had already completed environmental studies on sensitive resources and analysis, which saved the new company time and money.[50] However, both agency staff and developers noted that these documents need to be updated to reflect current resource conditions and information, which may lead to limitations on the use of pre-existing documents.[51]

5.2.2 Best Practices and Geothermal Project Development Opportunities in California

This section is illustrative of best practices and geothermal project development opportunities in California and is divided into two sections: (1) Agency and Regulatory Coordination Best Practices and Opportunities; and (2) Resource Management Best Practices and Opportunities.

Agency and Regulatory Coordination Best Practices and Opportunities

Agency staff noted that streamlining environmental review and permitting processes may decrease permitting timelines, especially in relation to CEQA review—which, as noted in Section 5.2.1, can be costly and time consuming. To decrease these impacts, the IID staff advocated for developing a streamlined, integrated environmental review process, noting that although CEQA provides an umbrella approach to permitting, every agency is compartmentalized and has its own separate process. A more holistic approach could potentially help streamline the environmental review and permitting process, which would in turn decrease project development timelines.[52]

To further aid coordination of environmental review and permitting processes, federal and state agencies could continue to leverage federal and state regulatory working groups. For example, the USFWS and CDFW sit together on a regional biological working group, which has aided and enhanced communication and coordination between the two agencies. In addition, the USFWS attends RWQCB meetings to discuss biological resource challenges in the Salton Sea.[53] Leveraging working groups made up of federal, state, and local agencies may aid in coordination and clear communication between regulators involved in permitting geothermal projects in Imperial County.

In addition, use of the CEC AFC process for projects that are 50 MW or greater consolidates state and local permitting requirements as well as CEQA review into one process and may provide a more streamlined, holistic approach to environmental review and permitting. The CEC process has been seen as a challenging process because it is a more formal process than the local permitting process and was historically more time consuming due to a long queue of projects requiring AFC approval. In addition, the CEC AFC has fees attached—some of which are non-

[49] Michael Chatterton, Carrie Sahagun, Dan Munger, Bureau of Land Management, teleconference, July 15, 2021.
[50] Staff, Energy Source, teleconference, May 25, 2021.
[51] Michael Chatterton, Carrie Sahagun, Dan Munger, Bureau of Land Management, teleconference, July 15, 2021.
[52] Staff, IID, teleconference, March 30, 2021.
[53] Staff, USFWS, teleconference, April 22, 2021

refundable—including a $30,554 compliance fee and application fees that include a $305,540 flat fee plus a fee of $610/MW. However, under the AFC process, the CEC analyzes the whole project as the lead agency under CEQA and works with state and local agencies to determine permitting requirements, which it then folds into the AFC process. In addition, the CEC must issue a written decision on an AFC no later than 12 months after a notice of an AFC is filed (Cal. Pub. Res. Code § 25516.6). The regulations note that the date for decisions made after the initial 12-month period has passed must be mutually agreed upon by both the CEC and the applicant (Cal. Pub. Res. Code § 25516.6). The benefits of the CEC process include that it is (1) a coordinated approach that folds in many requirements that a developer would normally be required to obtain from multiple local and state entities, and (2) the CEC regulations requiring the issuance of a written decision no later than 12 months after notice of an AFC is filed may result in a shorter decision period (e.g., time between the date the application was filed and the date the decision was issued), providing developers with more certainty regarding permitting processing timelines.[54] By comparison, CEQA does not have mandatory processing timelines, which may result in longer decision periods and less permitting timeline certainty for developers.

Geothermal project development may also be aided by the use of MOUs, which delineate different roles that federal, state, and local agencies have for projects that involve joint agency participation for environmental review and analysis pursuant to NEPA and CEQA. For example, the DOI, USDA, DoD, DOE, and EPA have an MOU in place to improve public land renewable energy project permit coordination between the different agencies (MOU 2022). MOUs may reduce confusion and outline specific agency roles and permitting requirements, which could increase transparency and help streamline the regulatory permitting process.

Resource Management Best Management Practices and Opportunities

A noted in Section 5.2.1, USACE jurisdictional WOTUS determinations, which are made on a case-by-case basis, may present challenges for geothermal development. However, there is potential that USACE could issue a CWA 404 general permit, rather than an individual permit for some geothermal projects within the Salton Sea, which would provide a more streamlined, expedited review as compared to the review process for individual permits. USACE issues general permits, on a nationwide, regional, or state basis for projects that result in minimal adverse effects. By comparison, individual or standard permits are issued when projects have more than minimal individual or cumulative impacts, are evaluated using additional environmental criteria, and involve a more comprehensive public interest review. USACE has stated that some smaller projects or activities (e.g., drilling exploratory wells) within the Salton Sea may fit the criteria for a general permit, rather than an individual permit, which could result in expedited review.[55]

[54] The CEC regulations requiring the issuance of a written decision no later than 12 months after notice of an AFC is filed may result in a shorter decision period (e.g., time between the date the application was filed and the date the decision was issued) and provide developers with more certainty regarding permitting processing timelines. Elisabeth de Jong, Eric Knight, Rizaldo Aldas, Chuck Gentry, Jordan Grimm, California Energy Commission (CEC), teleconference, July 28, 2021.
[55] Kyle Dahl, Cori Farrar, USACE, teleconference, May 26, 2021.

USACE could also make a jurisdictional determination evaluating the Salton Sea regarding which aquatic resources meet the definition WOTUS and are subject to USACE jurisdiction and CWA 404 permitting. A jurisdictional determination based on the entire Salton Sea could reduce time associated with determining USACE jurisdiction over projects on a case-by-case basis.

As noted above in Section 5.2.1, increased salt and selenium levels in the Salton Sea is a major environmental concern. However, geothermal desalination could provide water quality support for the Salton Sea geothermal development area by improving water quality. Reduced water quality is a major environmental challenge within the Salton Sea area due to increased salinity and selenium content associated with water reduction. If salinity and selenium levels continue to rise, the Salton Sea may fail to support biological resources including fish and migratory birds.[56] While outside of the scope of this study, geothermal desalination projects could improve water quality by incorporating desalinated water back into the Salton Sea.

5.2.3 Best Practices and Geothermal Project Development Opportunities in Nevada

In Nevada, BLM manages 48 million acres of federally managed public land, which amounts to approximately 63% of the land in Nevada (BLM 2022). As such, BLM is typically the lead agency conducting and coordinating environmental review for geothermal projects, which assists in consolidating the environmental review and permitting processes. However, additional agencies, including the USFS and USFWS must be engaged on project-specific analysis, which can result in ongoing coordination issues. To enhance federal and state agency coordination efforts and reduce duplication of agency review processes, in Nevada, there are currently several MOUs in place between federal and state agencies. These MOUs include an MOU between the BLM and USFS that is currently undergoing updates, a 2006 MOU between the BLM and NDOM that provides coordination for geothermal operations and inspections by eliminating duplication of efforts, and an MOU between the BLM and Nevada Department of Wildlife to provide guidance and procedures for coordination and cooperation. In addition, at the state level, NDOM and NDEP have an MOU to establish procedures to reduce duplication of efforts related to UIC permits (ICCA 2008).

As noted in Section 5.1.2, the processes by which project developers must obtain federal and state drilling permits for projects located on BLM managed land are duplicative and do not run concurrently, which may potentially increase the time and effort required to permit the same well. To reduce duplication and permitting timelines, the BLM and NDOM could establish a new MOU or other procedure to align federal and state drilling permits (e.g., establishment of one form and/or requirement that both agencies sign off on the same form).

[56] Staff, USFWS, teleconference, April 22, 2021.

6 Conclusions and Discussion

Increased understanding of non-technical barriers to geothermal development, such as federal, state, and local permitting and regulatory processes, may assist policymakers, regulators, and industry stakeholders in finding pathways to increase deployment of geothermal electricity in the United States. This section contains a summary and discussion of key takeaways synthesized from the report with respect to regulatory and permitting timelines, costs, challenges, and opportunities.

Geothermal Project Permitting May Negatively Impact Permitting Timelines and Project Development in California and Nevada

In California, projects are subject to multiple, time-consuming review processes (e.g., NEPA/CEQA; CESA/ESA), which may occur concurrently and require in-depth analysis. These review processes also require federal, state, and local agency coordination, which can cause delays in processing environmental review documents and lead to permitting and project development delays. Both CEQA and NEPA require in-depth analysis of potential impacts to resources as well as coordination between multiple federal, state, and local resource agencies. The CEQA process is often time consuming and state agencies have their own separate CEQA review processes. Accordingly, the lack of a streamlined and integrated approach to environmental review in California may negatively impact permitting timelines and project development.

In Nevada, unlike California, federal and state permitting requirements and environmental reviews are consolidated between federal and state agencies; however, certain permitting processes are duplicative and may potentially increase the time and effort required to obtain permits. For example, project developers in Nevada are required to obtain geothermal drilling permits from both the BLM and NDOM for geothermal projects on federally managed land. Moreover, NDOM does not accept BLM drilling permit forms and only issues a state well drilling permit after the BLM issues a GDP.

Project Development Delays Caused by Permitting Bottlenecks May Negatively Impact Construction and Project Completion Deadlines, Resulting in Higher Costs and Uncertainty for Project Developers

Delays in permitting timelines may negatively impact construction and project completion deadlines, resulting in loss of generated electricity revenue and raising the LCOE values for produced electricity. Where project development is on hold due to permitting delays, compounding interest continues to accrue on spent capital, which increases overall project costs and LCOE values for produced electricity. Notably, our analysis indicated that project costs continue to accrue even during periods of time when geothermal project development is on hold with 0% project spending. For example, all projects with a 4- to 12-year development timeline spent 78% of project costs within the first 4 years of project development. However, a project with a 4-year development timeline spent all of the capital fraction of project costs by year 4. By comparison, a project with an 8-year development timeline spent 0% of the capital fraction in years 3–5, during which time interest was accruing on 78% of project costs, which had already been spent. A project with a 10-year development timeline spent 0% of the capital fraction in

years 3–7, during which time interest was accruing on the 78% of project costs, which had already been spent. As such, project costs continued to accrue even though project development was on hold during years with 0% project spending increasing overall project costs. In addition to compounding interest accrual during project delays, overall project costs may be impacted by loss of generated electricity and potential penalties for failure to deliver electricity under a PPA.

Site-Specific Resource Management Concerns May Lead to Permitting and Project Construction Delays

Some of the largest challenges to geothermal project development in California and Nevada are related to natural and cultural resource management challenges. In Imperial County, California, jurisdictional coordination and issues over water resources may cause permitting and environmental review process delays. For example, in Imperial County, USACE may have jurisdiction over discharges of dredged and fill material to the Salton Sea, its wetlands, and tributaries. Accordingly, some projects may require that USACE make a jurisdictional WOTUS determination and issue a CWA 404 permit prior to project development. CWA 404 determinations can be time consuming as they are made on a case-by-case basis and are site specific. For example, when determining whether to issue a CWA Section 404 permit, USACE must conduct a public interest review, which evaluates the public and private need for the project and an analysis of foreseeable impacts on resources including wetlands, fish, wildlife, land use, floodplains, economics, and navigation (USACE 2022). In addition, the California Water Board must issue a CWA 401 water quality certification or waive the certification requirement prior to USACE issuing a CWA 404 permit, which can lead to further permitting delays. However, the use of general permits, rather than individual CWA 404 permits for smaller projects that may result in minimal adverse effects within the Salton Sea, could result in an expedited permitting review process. Further, a jurisdictional determination evaluating the entire Salton Sea could reduce the time associated with making a USACE jurisdictional determination on a case-by-case basis.

In addition, changing conditions in the Salton Sea as well as issues related to competing water interests and use, water quality, and loss of wetland habitat present challenges for project development. For example, changing levels of selenium and salt associated with water reduction, due to evaporation and Salton Sea recession, may lead to loss of water quality in habitat that supports many different fish and wildlife species. However, while not directly analyzed in this study, geothermal desalination could improve water quality salt within the Salton Sea and help support biological species and other water interests.

In Nevada, conflicts over species and cultural resources may negatively impact project development timelines and overall project development feasibility. For example, the Dixie Meadows Utilization Project—which the BLM received a utilization plan for in 2015—has gone through litigation and is currently on hold due to a 240-day emergency listing by the USFWS for the Dixie Valley toad, which has halted project construction. In addition, the Fallon-Paiute Shoshone Tribe, a federally recognized Tribe, has continued to voice concerns and bring litigation stating that the project could deplete water resources and cause aesthetic impacts to the Dixie Hot Springs, which is an area of cultural and historic significance to the Tribe located near the project boundaries. The BLM attempted to enter into an MOU concerning potential impacts to the Dixie Hot Springs, which the Tribe declined to sign.

Consolidating and Streamlining Environmental Review and Permitting Processes May Decrease Permitting Timelines in California and Nevada

In California, improved agency and regulatory coordination as well as streamlining environmental review and permitting processes may decrease permitting timelines. Developing an integrated, holistic CEQA environmental review process to help coordinate and delineate agency roles and responsibilities could potentially streamline the process and decrease project development timelines. Use of the CEC's AFC process, which is equivalent to CEQA's EIR process, for projects that are 50 MW or greater and may provide developers with more certainty regarding project permitting timelines as well as a timely and more holistic approach to geothermal environmental review and permitting. For example, under the CEC process, state and local requirements are consolidated into the overall project review and the CEC is subject to mandatory processing requirements, which require that the CEC issue a decision 12 months after notice of an AFC is filed or at a later date that is mutually agreed upon between the CEC and the applicant.

In addition, further use of MOUs and working groups, which delineate federal and state agency geothermal permitting roles and responsibilities and provide guidance and procedures for inter-agency coordination, may increase transparency and streamline permitting processes in California and Nevada. Numerous federal agencies have recently entered into an MOU to improve public land renewable energy project permit coordination efforts between federal agencies (MOU 2022). A similar MOU between federal, state, and local agencies in California may improve and streamline coordination efforts required for geothermal projects in the Salton Sea area.

In Nevada, there are already several MOUs in place between federal and state agencies, including the MOU between the BLM and USFS as well as a 2006 MOU between the BLM and NDOM that provides coordination guidance for geothermal operations and inspections. Moving forward, to reduce duplication and permitting timelines associated with geothermal drilling permits, the BLM and NDOM could enter into an additional MOU or other procedure, which specifically aligns the federal and state drilling permit application process.

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16 U.S.C. §§ 703 – 712, Migratory Bird Treat Act (MBTA)
16 U.S.C. §§ 1600 – 1687, National Forest Management Act of 1976
25 U.S.C. §§ 311 – 328, Rights-Of-Way Through Indian Lands
30 U.S.C. §§ 1001 – 1028, Geothermal Steam Act of 1970 (GSA)
33 U.S.C. §§ 1251 – 1388, Clean Water Act (CWA)
42 U.S.C. §§ 300f – 300j-27, Safe Drinking Water Act (SDWA)
42 U.S.C. §§ 4331 – 4370m-12, National Environmental Policy Act of 1969 (NEPA)
42 U.S.C. §§ 7401 – 7671q, Clean Air Act of 1963 (CAA)
43 U.S.C. §§ 931 – 975, Rights-Of-Way and Other Easements in Public Lands
43 U.S.C. §§ 1701 – 1787, Federal Land Policy and Management Act (FLPMA)
54 U.S.C. §§ 100101 – 104909, National Park System
54 U.S.C. §§ 300101 – 307108, National Historic Preservation Act of 1966 (NHPA)

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