Proposed SoCalGas H2 System Historical Successes and Failures Analysis

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prepared with the assistance of

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August 2021

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Environmental Scientists | Planners | Engineers
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Executive Summary

This Hydrogen (H2) Pipeline Historical Successes and Failures Analysis (current analysis/current study) has been completed for SPEC Services, Inc (SPEC) by D. Edwards, Inc. (DEI) with the assistance of Rincon Consultants, Inc. (Rincon) in support of the Southern California Gas Company (SoCalGas) H2 System Pre-Feasibility Study (pre-feasibility study). The overarching pre-feasibility study explores five preliminary alternative hydrogen pipeline systems throughout California and into Utah and identifies an efficient environmental permitting strategy to deliver hydrogen gas to potential customers in Southern California's Los Angeles Basin (current project).The purpose of this study is to analyze historical successes and failures associated with infrastructure projects that are similar in design to the current project and have already been through the permitting process as a basis for understanding the potential future success or failure of the current project. This study included a high-level review of approximately 33 infrastructure projects and an in-depth review of 12 infrastructure projects identified as being similar enough to the current project in design to provide a basis for comparison in terms of potential constraints, cost and schedule implications and opportunities for success.

The analysis presented herein identified six environmental issue areas that are shared to varying degree among the projects explored; these are: ecosystem threats, climate change, water quality concerns, tribal concerns, failure to demonstrate need, inadequacy of environmental review. The applicability of these environmental issue areas to the current project represents a potential constraint of the project. As indicated by the research conducted for this study, the fewer of these issue areas are applicable to a given project, the more likely the project is to be successful. Additionally, it appears as though the more geographic area covered by a particular project, the more likely it is that these issue areas would be applicable. Generally speaking, the implications associated with the applicability of these issue areas to a particular project including increased project costs and timelines, often a result of litigation.

The current analysis indicates that many of the environmental issue areas discussed in this study may be applicable to the current project. However, it is worth noting that while the current project is similar to those explored herein in its design, its type differs; it will transport hydrogen gas as opposed to natural gas, crude oil, or water and will be part of a larger hydrogen gas. For this reason, some of the environmental issue areas discussed in this study may not be applicable to the current project.

1 Introduction

This Hydrogen (H2) Pipeline Historical Successes and Failures Analysis (current analysis/current study) has been completed for SPEC Services, Inc (SPEC) by D. Edwards, Inc. (DEI) with the assistance of Rincon Consultants, Inc. (Rincon) in support of the Southern California Gas Company (SoCalGas) Hydrogen Pipeline Pre-Feasibility Study. The overarching pre-feasibility study explores five preliminary alternative hydrogen pipeline systems throughout California and into Utah and identifies an efficient environmental permitting strategy to deliver hydrogen gas to potential customers in Southern California's Los Angeles Basin (current project). The purpose of the analysis presented herein is to identify trends associated with both successful and unsuccessful infrastructure projects that are similar to the current project and, as such, may help inform the success of the current project. The resulting analysis may be used to inform the permitting process and estimated costs associated with the current project based on the constraints historically experienced by other similar infrastructure projects.

This report is divided into three sections. The *Methods* section describes in detail a two-step review process performed by Rincon in preparation of this analysis. A list of the 12 projects analyzed, along with project characteristics, is included in the *Methods* section (Table 1). This study identified six environmental issue areas shared to varying degree among the 12 projects; these are: ecosystem threats, climate change, water quality concerns, tribal concerns, failure to demonstrate need, and inadequacy of environmental review. These six environmental issue areas are listed in the *Results* section (Table 2), followed by a characterization of each. The *Results* section also includes a summary discussion that described the projects that were ultimately successful and where appropriate a general discussion of costs associated with these successful projects. A summary of the findings of this analysis are presented in the *Conclusions* section.

2 Methods

The current analysis is focused on the construction of a hydrogen pipeline and does not consider the constraints associated with the reuse of existing gas or water delivery system pipelines or with the construction of any other portions of a hydrogen gas delivery system, for example hydrogen production, storage, or any other ancillary facilities. It additionally does not consider the constraints associated with the operation of such a system. At the direction of SoCalGas, only projects located within the United States were reviewed, and the presence of hydrogen pipeline systems in the United States is limited. Therefor this study focused on the analysis of other similar projects, for example water, natural gas, and crude oil pipeline delivery systems.

The current study encompassed a two-step review process. To inform the current analysis, Rincon performed a high-level review of a variety of infrastructure projects including but not limited to the following: water pipeline and delivery system projects, crude oil and natural gas pipeline and delivery system projects, and transportation system (including rail and road) projects. The purpose of this high-level review was to identify projects similar enough in design to the current project that they may provide a basis for identifying potential constraints, cost implications and opportunities for success. Environmental issue areas associated with unsuccessful and ultimately successful projects were explored. Rincon's high-level review consisted of desktop review of approximately 33 infrastructure projects (listed in Appendix A, Table 1), drawing on a variety of sources including but not limited to the following secondary digital sources:

- Websites and marketing material associated with infrastructure projects
- Websites and marketing material associated with groups in opposition or support of infrastructure projects
- Media coverage related to the construction of infrastructure projects
- Media coverage related to litigation associated with the construction of infrastructure projects
- Publicly accessible environmental documents associated with infrastructure projects
- Publicly accessible court documents associated with litigation related to infrastructure projects
- Scholarly material associated with infrastructure projects (thesis statements, research publications and essays)

Following the high-level review described above, 12 projects were chosen for an in-depth analysis. These projects were chosen because they exemplified the current project design as well as common issue areas. These projects along with their associated location, type and an indication of their ultimate success or failure, are listed in Table 1. The current project encompasses the construction of a hydrogen pipeline that may extend through multiple states including California, ultimately terminating within the Los Angeles Basin. To increase the probability that the potential constraints identified by this study are applicable to the current project, all of the projects analyzed in depth are linear in nature, in particular crude oil, natural gas, and water pipeline projects. Several (five) of the projects traverse multiple states. Additionally, several of the projects are located in California (three), or in other western states (four).

Table 1 Linear Pipeline Projects Analyzed

Project Name	Project Proponent	Project Location	Project Type	Status
Pipeline Safety and Reliability Project Natural Gas Line 3602 and De-rating Line 1600 (PSRP)	San Diego Gas and Electric and SoCalGas	San Diego County, California	Natural Gas Pipeline	Failure
Southern California Gas Company North-South Pipeline	SoCalGas	Riverside/San Bernardino County, California	Natural Gas Pipeline	Failure
Keystone XL Pipeline	TC Energy	Alberta, Canada to Gulf Coast, Texas	Crude Oil Pipeline	Failure (8% constructed at time of cancellation)
Atlantic Coast Pipeline	Dominion	West Virginia, Virginia and North Carolina	Natural Gas Pipeline	Failure (6% constructed at time of cancellation)
New York Constitution Pipeline	Subsidiaries of Williams, Cabot Oil and Gas Corporation, Duke Energy Corporation and AltaGas Ltd..	Pennsylvania and New York	Natural Gas Pipeline	Failure
Las Vegas Groundwater Pipeline	Southern Nevada Water Authority	Nevada	Water Pipeline	Failure
Dakota Access Pipeline	Energy Transfer	North Dakota and Illinois	Crude Oil Pipeline	Not Yet Resolved
The Cadiz Water Project (Cadiz Water)	Cadiz, Inc.	Throughout Southern California	Includes construction of wells, pipeline and treatment facilities	Not Yet Resolved
Trans Pecos Pipeline	Energy Transfer Partners, LP.	Texas	Natural Gas Pipeline	Success
Southern Delivery System (SDS)	Colorado Springs Utilities	Colorado Springs, Colorado	Includes construction of pump station, treatment plan and 50 miles of water pipeline	Success
Ute Water Pipeline	Eastern New Mexico Water Utility Authority	Eastern New Mexico	Water Pipeline	Success

Project Name	Project Proponent	Project Location	Project Type	Status
Ruby Pipeline	Ruby Pipeline, LLC (Kinder Morgan and El Paso Holdco LLC	Wyoming, Utah, Nevada and Oregon	Natural Gas Pipeline	Success

*Along with the other projects listed in Appendix A, Table 1, the Kern River Pipeline, Apex Expansion (of the Kern River Pipeline), and SoCalGas's Line 2000 and 2001 were subject to high-level review by the current study. However, due to the absence of available digital source material, these projects were not selected for the in-depth analysis presented in the following.

3 Results

The current analysis identified six environmental issue areas common to varying degree among the 12 projects explored. Table 2 lists each of the identified environmental issue areas, along with the number and percentage of projects that they were applicable to. The rate of success/failure column corresponds to the percentage of projects that were successful given the applicability of each of the issue areas. Each of these environmental issue areas is characterized in further detail following Table 2.

Table 2 Environmental Issue Areas

Issue Area	Number of Projects Affected	Percentage of Projects Affected	Projects Affected	Rate of Success/Failure
Ecosystem Threats	6	50%	Keystone KL Atlantic Coast New York Constitution Trans-Pecos Las Vegas Groundwater Ruby	Success: 33% Failure: 67% Unresolved: 0%
Climate Change	5	42%	PSRP Keystone XL Dakota Access New York Constitution Trans-Pecos	Success: 20% Failure: 60%% Unresolved: 20%
Water Quality Concerns	4	33%	Keystone XL Dakota Access New York Constitution Las Vegas Groundwater	Success: 0% Failure: 75%% Unresolved: 25%
Inadequacy of Environmental Review	4	33%	Cadiz Water Las Vegas Groundwater Dakota Access Keystone XL	Success: 0% Failure: 50% Unresolved: 50%
Tribal Concerns	3	25%	Dakota Access Trans-Pecos Las Vegas Groundwater	Success: 33% Failure: 33%% Unresolved: 33%
Failure to Demonstrate Need	2	17%	PSRP North-South	Success: 0% Failure: 100% Unresolved: 0%

3.1 Issue Areas

Ecosystem Threats

In six of the projects explored for the current analysis (Keystone XL, Atlantic Coast, New York Constitution, Trans-Pecos, Las Vegas Groundwater, Ruby), ecosystem threats were cited as a primary issue area by those who opposed the project. This issue area typically encompasses concerns related to the destruction of natural habitat that may occur as a result of pipeline construction. The following ecosystem threats are those noted in literature related to the projects explored: destruction of Nebraska's Sand Hills, the largest intact natural habitat remaining in the Great Plains ecosystem (Keystone XL)[1]; disruption of critical spawning and nursery habitat for endangered fishes, such as the Atlantic and Shortnose Sturgeon (Atlantic Coast)[2]; disruption of ecosystems in the 250 streams and rivers the pipeline would cross (New York Constitution)[3]; habitat disturbance of native flora and disruption of ephemeral desert streams (Trans-Pecos)[4]; the drying of hundreds of springs and thousands of acres of wetlands, including two national park units and several national wildlife refuges on which some of Nevada's rarest species rely (Las Vegas Groundwater)[5]; impacts to key sagebrush habitat (Ruby Pipeline)[6].

Of the projects where ecosystem threats were a relevant issue area, two were successful (Tran-Pecos and Ruby). The research conducted for this study indicates that in the case of Ruby Pipeline, the establishment of a Sagebrush Habitat Conservation Fund (SHC Fund) to account for the project's potential ecosystem-related impacts largely contributed to its ultimate success. The establishment of the SHC Fund was the result of a settlement between Western Watersheds Project (WWP) and Ruby Pipeline LLC. WWP is a conservation organization working to protect and restore western watersheds and wildlife and Ruby Pipeline LLC is a subsidiary of El Paso Corporation, who constructed Ruby Pipeline. Under the settlement, WWP agreed not to oppose or delay the Ruby Pipeline. In exchange, Ruby Pipeline LLC agreed to pay $15 million over 10 years into the independent non-profit SHC Fund to be used for voluntary conservation projects in sagebrush habitat.[7] The research conducted for this analysis was unable to definitively identify the reason for the success of Trans-Pecos.

Climate Change

In five of the projects explored for the current analysis (PSRP, Keystone XL, Dakota Access, New York Constitution, Trans-Pecos,) concerns related to climate change were integral to the argument in opposition to the projects. This issue area primarily encompasses concerns related to fossil fuel reliance and its impact on climate change. Of the five projects where this issue area was prominent, three are natural gas pipelines and two are crude oil pipelines. Of those, three (PSRP, Keystone XL,

[1] Center for Biological Diversity. N.d. "Keystone XL Pipeline." Accessed online at: https://www.biologicaldiversity.org/programs/public lands/energy/keystone xl pipeline/. August 13, 2021.
[2] NRDC. "Developer Abandon the Atlantic Coast Pipeline for Good. June 6, 2020. Accessed online at: https://www.nrdc.org/experts/nrdc/developers-abandon-atlantic-coast-pipeline-good. August 13, 2021.
[3] *City & State New York*. September 9, 2019. "Will the Constitution Pipeline get Built." Accessed online at: https://www.cityandstateny com/policy/2019/09/will-the-constitution-pipeline-get-built/176944/. August 13, 2021.
[4] Sierra Club Lone Star Chapter. N.d. "The Trans-Pecos Pipeline: Concerns and Complacency. Accessed online at: https://www.sierraclub.org/texas/big-bend/trans-pecos-pipeline-concerns-and-complacency. August 13, 2021.
[5] Center for Biological Diversity. May 21, 2020. "Decades-long Campaign Forces Nevada Board to Kill Huge Las Vegas Groundwater Pipeline." Accessed online at: https://biologicaldiversity.org/w/news/press-releases/decades-long-campaign-forces-nevada-board-kill-huge-las-vegas-groundwater-pipeline-2020-05-21. August 17, 2021.
[6] Advocates for the West. N.d. "Ruby Pipeline." Accessed online at: https://advocateswest.org/case/ruby-pipeline/. August 18, 2021.
[7] Sagebrush Habitat Conservation Fund. 2000."History." Accessed online at: https://sagebrushfund.org/history.html. August 18, 2021.

New York Constitution) were unsuccessful, one was successful (Trans-Pecos), and one has yet to be fully resolved (Dakota Access).

In the case of PSRP, review of the California Public Utilities Commission (CPUC) rejection of the project noted the project's inconsistency with California's climate objectives.[8] Similarly, in the case of New York Constitution, the written decision of the New York State Department of Environmental Conservation (NYSDEC) states that "…the continued long-term use of fossil fuels is inconsistent with the State's laws and objectives and with the actions necessary to prevent the most severe impacts from climate change."[9] In 2021, Keystone KL was denied a permit by President Biden. At that time, the President issued the Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, which states:

> The Keystone XL pipeline disserves the U.S. national interest. The United States and the world face a climate crisis. That crisis must be met with action on a scale and at a speed commensurate with the need to avoid setting the world on a dangerous, potentially catastrophic, climate trajectory. At home, we will combat the crisis with an ambitious plan to build back better, designed to both reduce harmful emissions and create good clean-energy jobs. Our domestic efforts must go hand in hand with U.S. diplomatic engagement. Because most greenhouse gas emissions originate beyond our borders, such engagement is more necessary and urgent than ever. The United States must be in a position to exercise vigorous climate leadership in order to achieve a significant increase in global climate action and put the world on a sustainable climate pathway. Leaving the Keystone XL pipeline permit in place would not be consistent with my Administration's economic and climate imperatives.[10]

While the battle over Dakota Access is still underway, opponents of the project state that "the pipeline would contribute to man-made climate change by building up the country's oil infrastructure. They insist that fossil fuels—including the vast reserves in the Bakken Shale—need to be kept in the ground to protect the world from the worst effects of climate change."[11] Trans-Pecos is the only of the five projects that grappled with this issue area to be successful. The research conducted for this analysis was unable to definitively identify the reason for the success of Trans-Pecos.

[8] Proposed decision of Alj Kersten. May 2, 2018. Accessed online at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M216/K622/216622543.PDF. August 17, 2021.
[9] Notice of denial of Water Quality Certification. May 15, 2020. Accessed online at: https://www.dec.ny.gov/docs/permits ej operations pdf/nesewqcdenial05152020.pdf. August 17, 2021.
[10] Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis. January 20, 2021. Accessed online at https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/. August 17,2021.
[11] *TIME*. October 28, 2016. "What to Know About the Dakota Access Pipeline Protests." Accessed online at: https://time.com/4548566/dakota-access-pipeline-standing-rock-sioux/. August 18, 2021.

Water Quality Concerns

In four of the projects explored for the current analysis (Keystone XL, Dakota Access, New York Constitution, Southern Delivery System [SDS]), concerns related to potential impacts to water quality were cited as a primary issue area by those opposed to the project. This issue area primarily encompasses concerns related to water contamination. In the case of Keystone XL and Dakota Access, water quality concerns appear to have been related to the potential for water contamination to occur as a result of a pipeline rupture and successive oil spill. For example, in the case of Keystone XL, project opponents noted the project's potential impacts as a result of an oil spill on Ogallala Aquifer, which provides drinking water for millions.[12] Among several other issue areas, Dakota Access was opposed based on the project's potential to contaminate the Missouri River, a major source of drinking water for the Standing Rock Sioux Reservation.[13]

This issue area additionally appears to include concerns related to temporary impacts associated with pipeline construction. For example, in the case of New York Constitution, the project was denied a critical permit under the Clean Water Act by the NYSDEC. The NYSDEC found that New York Constitution would have significant negative impacts on several streams and wetlands and would fail to meet state water quality standards for those waterbodies.[14] In addition to 50 miles of pipeline, the SDS included construction of three pump stations, a water treatment plant and modifications to the Pueblo Dam outlet works. Water quality concerns associated with the SDS appear to be related to stormwater control and do not appear related directly to the construction or operation of the system's pipeline.

While the future of Dakota Access remains unknown, both Keystone XL and New York Constitution were unsuccessful. Construction of the SDS was ultimately successful and is later discussed in the *Summary of Successes* section of this study.

Tribal Concerns

In three of the projects explored for the current analysis (Dakota Access, Trans-Pecos, Las Vegas Groundwater), tribal concerns were cited as a primary area of concern by those opposed to the project. This issue area generally encompasses potential impacts to tribal lands or lands considered by tribes to be sacred. In the case of Dakota Access, tribal concerns were primary those of the Standing Rock Sioux Tribe (SRST). In addition to the concerns related to water quality and noted above, the SRST oppose Dakota Access because the proposed pipeline would traverse a sacred burial ground, resulting in potential impact to a site considered by the tribe to be sacred. The research conducted for this analysis indicates that indigenous activists opposed to Trans-Pecos were inspired by the SRST's fight against Dakota Access. In the case of Trans-Pecos, indigenous activists opposed to the project sited concerns generally related to the environment, in addition to those related to sacred indigenous sites.[15] The protest of pipelines such as Dakota Access and Trans-Pecos appears to have led to the formation of the Society of Native Nations, an organization dedicated to

[12] NRDC. January 20, 2021. "What is the Keystone XL Pipeline." Accessed online at: https://www.nrdc.org/stories/what-keystone-pipeline. August 20, 2021.
[13] INSIDER. November 1, 2016. "People at the front lines of the battle over Dakota Access Pipeline are calling it a 'death sentence.'" Accessed online at: https://www.businessinsider.com/north-dakota-access-pipeline-protest-drinking-water-2016-10. August 20, 2021.
[14] Sive-Paget-Riesel. May 16, 2018 "New York Denies Water Quality Permit for Another Natural Gas Pipeline." Accessed online at: https://sprlaw.com/new-york-denies-water-quality-permit-for-another-natural-gas-pipeline/. August 17, 2021.
[15] *The Guardian*. January 9, 2017 "Native Americans fight Texas pipeline using 'same model as Standing Rock.' Accessed online at: https://www.theguardian.com/us-news/2017/jan/09/trans-pecos-pipeline-texas-protest-two-rivers-standing-rock. August 18, 2021.

advocating for indigenous people and the earth by helping to protect and preserve native culture, spirituality, teachings, medicine, and way of life.[16]

Las Vegas Groundwater was proposed to traverse White Pine County's Spring Valley, in northeastern Nevada, an area considered sacred by the Shoshone people. Spring Valley is a location where the soils nurture swamp cedars, under which the Shoshone gather to celebrate and pray. Additionally, the area commemorates a series of 19th century massacres for the Shoshone people. If Las Vegas Groundwater were to be constructed, it would deplete the valley of water, leading to the death of extant swamp cedars.[17] Ultimately, the Southern Nevada Water Authority backed out of the project following a 31-year battle and several rejections by the court system on the grounds that the project would deplete the Great Basin's aquifers. Opposition to the project united Native American communities, ranchers and environmentalists.

Failure to Demonstrate Need

The research conducted for this analysis indicates that the failure of project proponents to adequately demonstrate the need for a particular project may have contributed to the failure of two (PSRP, North-South) of the projects explored. Both these projects were natural gas pipelines which were ultimately unsuccessful. The CPUC's proposed decision to deny PSRP states that the utility has not "shown why it is necessary to build a very costly pipeline to substantially increase gas pipeline capacity in an era of declining demand and at a time when the state of California is moving away from fossil fuels."[18] Similarly, in the case of North-South, in opposition to North-South, CPUC commissioner Mike Florio stated: "There's a long history here of adequate service, and it just doesn't seem sensible to me that at a time when we're looking at decreasing our reliance on fossil fuels, including natural gas, that we would spend $621 million on a new pipeline."[19]

Inadequacy of Environmental Review

In four of the projects explored (Cadiz Water, Las Vegas Groundwater, Dakota Access, Keystone XL), the inadequacy of the project's supportive environmental review was cited as a concern by project opponents. In the case of Cadiz Water, the project involves the repurposing of existing oil and gas pipelines and does not include new construction. A lawsuit filed in March 2021 by several environmental groups stated that the Bureau of Land Management (BLM)'s approval in the final days of the Trump administration violated federal laws by ignoring requirements to first conduct a full environmental analysis.[20] An additional lawsuit was filed by the Native American Land Conservancy and the National Parks Conservation Association. That suit alleges that the BLM failed to consult with Native American tribes before granting the pipeline approval.[21] These lawsuits are currently working their way through the federal court system and it remains unknown whether the

[16] Society of Native Nations. "About Us." Accessed online at: http://societyofnativenations.org/about.html. August 18, 2021.
[17] *Reno Gazette Journal*. November 13, 2019. "Las Vegas water pipeline battle is life-or death fight for Shoshone sacred site. Accessed online at: https://www.rgj.com/story/news/2019/11/13/las-vegas-southern-nevada-water-pipeline-fight-shoshone-native-tribes-sacred-land/2524475001/. August 18, 2021.
[18] Proposed decision of Alj Kersten. May 2, 2018. Accessed online at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M216/K622/216622543.PDF. August 17, 2021.
[19] *The San Diego Tribune.* July 14, 2016. "CUPC rejects North-South pipeline." Accessed online at" https://www.sandiegouniontribune.com/sdut-northsouth-pipeline-rejected-2016jul14-story.html. August 17, 2021.
[20] Center for Biological Diversity. March 23, 2021. "Lawsuit Targets Trump Administration's Last-minute Pipeline Approval for California Desert Water Grab." Accessed online at: https://biologicaldiversity.org/w/news/press-releases/lawsuit-targets-trump-administrations-last-minute-pipeline-approval-for-california-desert-water-grab-2021-03-23/. August 18, 2021.
[21] *Los Angeles Business Journal*. April 12, 2021. "Cadiz Faces New Suit Over Water Pipeline." Accessed online at https://labusinessjournal.com/news/2021/apr/12/cadiz-faces-new-lawsuits-water-pipeline/. August 18, 2021.

project will prevail. In the case of Las Vegas Groundwater, in 2017, a federal court judge rejected the BLM's environmental impact statement for the project's right-of-way. The judge said the BLM failed to show how the water authority would compensate for significant losses to wetlands and wildlife habitat from the project. In 2013, as the result of litigation spearheaded by the Great Basin Water Network, a Nevada state court ruled that the project would harm water-rights holders and be detrimental to the public interest.[22] The project has since been canceled.

Dakota Access has been plagued by litigation since it was issued critical approvals from the Army Corps of Engineers (ACOE) in 2016. Two of the lawsuits resulted in federal district court decisions against the project, concluding that the ACOE violated the National Environmental Protection Act in both its original and supplemental analysis of the pipeline's potential impacts.[23] The fate of the project remains uncertain. In the case of Keystone XL, several organizations filed a federal lawsuit challenging the BLM's approval to construct the project on approximately 44 miles of federally controlled public lands in Montana. The complaint also stated that the project's environmental reviews (by the BLM and U.S. Fish & Wildlife Service) were flawed with errors and omissions. The lawsuit is currently working its way through the federal court system.

3.2 Summary of Successful Projects

Of the 12 projects explored in detail for this analysis, four (SDS, Ute Water, Trans-Pecos, Ruby) were successful. In exploring these successful projects, several common characteristics become apparent. When compared with the projects that were ultimately unsuccessful, successful projects were opposed on fewer issue areas. For example, projects such as Keystone XL, Dakota Access, Atlantic Coast and New York Constitution were opposed on several issue areas, typically more than three. However, successful projects faced less opposition on a fewer number of issue areas. When exploring the successful projects, the following were their primary issue areas: water quality concerns (SDS)[24]; Ute Water (land acquisition issues)[25]; Trans-Pecos (ecosystem threats, climate change, tribal concerns)[26] Ruby (ecosystem threats).[27] Of the four successful projects, two are water pipeline project (SDS, Ute Water), and two are natural gas pipelines (Trans-Pecos, Ruby). Neither of the crude oil pipelines explored (Dakota Access, Keystone XL) were successful. Generally speaking, the successful projects traversed less geographic area than those that were unsuccessful. For example, SDS, Ute Water and Trans Pecos are all confined to one state and are not interstate projects.

[redacted]

[22] Center for Biological Diversity. May 21, 2020. "Decades-long Campaign Forces Nevada Board to Kill Huge Las Vegas
[23] Bloomberg Law. November 4, 2020. "Dakota Access Pipeline Fate Uncertain After Court Hearing." Accessed online at https://news.bloomberglaw.com/environment-and-energy/dakota-access-pipeline-fate-unclear-after-d-c-circuit-hearing. August 22, 2021.
[24] WATER ONLINE. April 28, 2016. "Historic Southern Delivery System Water Project Starts Water Delivery Today." Accessed online at: https://www.wateronline.com/doc/historic-southern-delivery-system-water-delivery-today-0001. August 18, 2021.
[25] *The Eastern New Mexico News*. April 23, 2018. "Landowner still refusing pipeline payment." Accessed online at: https://www.easternnewmexiconews.com/story/2018/04/24/news/landowner-still-refusing-pipeline-payment/157338.html. August 18, 2021.
[26] Sierra Club. N.d. "The Trans-Pecos Pipeline: Concerns and Complacency." Accessed online at: https://www.sierraclub.org/texas/big-bend/trans-pecos-pipeline-concerns-and-complacency. August 18, 2021.
[27] Advocates for the West. N.d. "Ruby Pipeline." Accessed online at: https://advocateswest.org/case/ruby-pipeline/. August 18, 2021.

[redacted] As noted previously in the *Ecosystem Threats* Section, Ruby appears to owe much of its success to the establishment of the SHC Fund to be used for voluntary conservation projects in sagebrush habitat.[29] In the case of Ute Water, the project appears to have been ultimately successful due to its demonstrated need and the support of many of the communities on which it would have an impact.[30] The research conducted for this analysis was unable to definitively identify the reason for the success of Trans-Pecos.

3.3 Summary of Cost and Schedule Implications

The research conducted for this study indicates that the environmental issue areas presented above are those commonly associated with infrastructure projects, in particular those that traverse multiple states and/or are located in the western United States. This study did not include an in-depth analysis of the cost or schedule implications associated with these issue areas. However, it is clear from the research performed for this analysis that the applicability of these issue areas to a particular project has direct implications on its cost and timeline, primarily due to delays associated with litigation.

The estimated cost and timeline associated with the construction of Atlantic Coast was approximately five billion dollars and four years (2014-2019). However, at the time of its cancelation, the project had spent eight billion dollars, an inflation attributed primarily to environmental lawsuits.[31] Similarly, New York Constitution was initially projected to cost $700 million. However, at the time of its cancelation in 2020, delays and legal challenges had driven its cost up nearly 40 percent.[32]

A recent study conducted by the University of Colorado Boulder found that the company involved in construction Dakota Access lost a minimum of $7.5 billion. The study stated: "These losses show how important it is for companies to fully account for environmental, social and governance risks before projects get going" and that "social risks are clearly overlooked in the market."[33] The legal battles faced by Dakota Access additionally significantly impacted the project's timeline. Permitting for the project began in 2014 and it received necessary approvals from the ACOE in 2016. The project has since been litigated several times and remains pending.

Keystone XL was first proposed in 2008. Following various legislative and executive orders related to the project, President Obama vetoed the project in 2015, "acknowledging its pervasive threats to climate, ecosystems, drinking water sources, and public health, and advancing a national commitment to decreasing our reliance on dirty energy." President Obama's veto was reversed by President Trump, following which point the project was extensively litigated. At the time of its

[redacted]

[29] Sagebrush Habitat Conservation Fund. 2000."History." Accessed online at: https://sagebrushfund.org/history.html. August 18, 2021.
[30] *Water Matters.* N.d. "Eastern New Mexico Rural Water System (Ute Pipeline Project)." Accessed online at: https://uttoncenter.unm.edu/resources/research-resources/eastern-nm-rural-water-systems.pdf. August 18, 2021.
[31] The Appalachian VOICE. July 21, 2021. "The End of the Atlantic Coast Pipeline." Accessed online at: https://appvoices.org/2020/07/21/the-end-of-the-atlantic-coast-pipeline/. August 18, 2021.
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termination, due to the cancelation of its cross-border permit by President Biden in 2021, 8 percent of the pipeline had been constructed and the project had cost a reported $8 billion. [34]

Table 3 Cost and Schedule Implications*

Project Name	Impact on Project Cost	Impact on Project Schedule
Keystone XL Pipeline	$2.6 billion increase[35]	Delayed approximately 10 years and ultimately canceled[36]
Atlantic Coast Pipeline	$3.5 billion increase[37]	Delayed approximately 6 years and ultimately canceled[38]
New York Constitution Pipeline	$3 million increase[39]	Delayed approximately 6 years and ultimately canceled
Las Vegas Groundwater Pipeline	$1.5 billion increase[40]	Delayed approximately 30 years and ultimately canceled[41]
Dakota Access Pipeline	$7.5 billion in losses[42]	Delayed since 2015; not yet resolved[43]
Southern Delivery System (SDS)	Completed $160 million under budget[44]	Project was completed on time

*The cost and schedule implications presented above are those identified during the research conducted for this study. Although it may be implied that these implications may be the result of the applicability of the environmental issue areas discussed in this study, the scope of this study did not allow for the verification of this assumption. Additionally, the information presented above is that which is readily available via publicly accessible digital sources and was not available for the following projects: PSRP, North South, Cadiz, Trans-Pecos, Ute Water, Ruby.

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4 Conclusion

Rincon prepared the current analysis is support of the SoCalGas Hydrogen Pipeline Pre-Feasibility Study, which will explore five preliminary alternative hydrogen pipeline systems (Systems 1 through 5), one of which may be constructed to deliver gas to potential customers in Southern California's Los Angeles Basin. In support of the study, Rincon performed a high-level review of approximately 33 infrastructure projects and an in-depth review of 12 infrastructure projects identified as being similar enough to the current project in design to provide a basis for comparison in terms of potential constraints, cost implications and opportunities for success. The analysis presented in this memo is high-level in nature and is primarily based on the review of a variety of publicly accessible digital sources. It is focused on the construction of a pipeline and does not explore the construction of other facilities such as reservoirs or treatment or processing plants, nor does it focus on the operation of a utility system.

The current analysis identified six environmental issue areas that are shared to varying degree among the projects explored; these are: ecosystem threats, climate change, water quality concerns, tribal concerns, failure to demonstrate need, inadequacy of environmental review. This analysis indicates that the fewer of these issue areas are applicable to a given project, the more likely the project is to be successful. It also appears as though these issue areas are more likely to be applicable to longer projects that cross multiple states. Generally speaking, the implications associated with the applicability of these issue areas to a particular project include increased project costs and timelines, often a result of litigation.

The current analysis suggests that many of the environmental issue areas discussed in this study may be applicable to the current project. However, it is worth noting that while the current project is similar to those explored herein in its design, its type differs; it will transport hydrogen gas as opposed to natural gas, crude oil, or water and will be part of a larger hydrogen gas delivery system. For this reason, some of the environmental issue areas discussed in this study may not be applicable to the current project. While ecosystem threats, water quality and tribal concerns, demonstrated need and environmental document adequacy may apply to the current project, concerns related to climate change and water quality may not directly apply. Climate change concerns primarily relate to fossil fuel dependence and many of the water quality concerns identified by this study relate to the potential for an oil spill, although temporary constructions impact related to water quality were also noted. As these concerns are associated with oil, they may not be applicable to a hydrogen gas delivery system reliant on renewable energy sources.

Additionally, there may be other environmental issue areas that did not present themselves within the current analysis of linear project that may be applicable to the current project. As with the case of Las Vegas Groundwater, the project was ultimately rejected on the grounds that the project would deplete the Great Basin's aquifers. Even though this environmental concern ultimately came from the extraction of the water and not the pipeline itself per say, often litigants will attack a project at every opportunity. As a result, although the construction of a hydrogen pipeline may not directly relate to environmental concerns related to the production of hydrogen gas, such as the need for large amounts of water and energy, these environmental concerns may still present themselves during the environmental and permitting process of the pipeline. Ergo water consumption and energy availability may be an environmental issue area applicable to the current project that is not discussed in detail in this study.

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Appendix A Infrastructure Projects Subject to High-Level Review

Project Name	Project Location	Project Type
Kern River Pipeline	Wyoming, Utah, Nevada, California	Natural Gas Pipeline
Apex Expansion (of Kern River Pipeline)	Utah	Natural Gas Pipeline
Southern California Gas Company Line 2000/2001	California	Natural Gas Pipeline
Pipeline Safety and Reliability Project Natural Gas Line 3602 and De-rating Line 1600	San Diego County, California	Natural Gas Pipeline
Southern California Gas Company North-South Pipeline	Riverside/San Bernardino County, California	Natural Gas Pipeline
Keystone XL Pipeline	Alberta, Canada to Gulf Coast, Texas	Crude Oil Pipeline
Atlantic Coast Pipeline	West Virginia, Virginia and North Carolina	Natural Gas Pipeline
New York Constitution Pipeline	Pennsylvania and New York	Natural Gas Pipeline
Las Vegas Groundwater Pipeline	Nevada	Water Pipeline
Dakota Access Pipeline	North Dakota and Illinois	Crude Oil Pipeline
The Cadiz Water Project	Throughout Southern California	Includes construction of wells, pipeline and treatment facilities
Trans Pecos Pipeline	Texas	Natural Gas Pipeline
Southern Delivery System	Colorado Springs, Colorado	Includes construction of pump station, treatment plan and 50 miles of water pipeline
Ute Water Pipeline	Eastern New Mexico	Water Pipeline
Ruby Pipeline	Wyoming, Utah, Nevada and Oregon	Natural Gas Pipeline
Mojave Pipeline	Arizona and California	Natural Gas Pipeline
Weber Siphon Complex	Washington	Water Siphons
Lewis and Clark Regional Water System	South Dakota, Minnesota, Iowa	Water supply system including pipelines and reservoirs
Northern Integrated Supply Project	Colorado	Water supply system including reservoir s and delivery ditches and canals
Uvalde Water Project	Southwest Texas	Water Pipeline
PennEast Pipeline	Pennsylvania	Natural Gas Pipeline
Mariner East 2 Pipeline	Pennsylvania	Liquified Natural Gas Pipeline
Atlantic Sunrise Project	Northeastern States	Natural Gas Pipeline

Project Name	Project Location	Project Type
Pacific Connector Gas Pipeline	Oregon	Natural Gas Pipeline
Atlantic Coast Pipeline	West Virginia, Virginia, North Carolina	Natural Gas Pipeline
Northeast Energy Direct Project	New Hampshire, Massachusetts to Southeastern States	Natural Gas Pipeline
Palmetto Pipeline	South Carolina, Georgina, Louisiana, Florida, Mississippi	Gas and Diesel Pipeline
Tongue River Railroad	Montana	Railroad
California High Speed Rail	California	Railroad
West Santa Ana Branch Transit Corridor	California	Railroad
Sound Transit 3 (ST3) Construction Project	Seattle, Washington	Intermodal Transit System
Second Avenue Subway Construction Project	Manhattan, New York	Subway
Interstate(I)39/I-90 Reconstruction	Wisconsin	Road Reconstruction