BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO

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IN THE MATTER OF THE APPLICATION OF PUBLIC SERVICE COMPANY OF COLORADO FOR APPROVAL OF WILDFIRE MITIGATION PLAN AND WILDFIRE PROTECTION RIDER	**)))))**	**PROCEEDING NO. 20A-____E**

DIRECT TESTIMONY AND ATTACHMENTS OF STEVEN D. ROHLWING

ON

BEHALF OF

PUBLIC SERVICE COMPANY OF COLORADO

July 17, 2020

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OF THE STATE OF COLORADO

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GLOSSARY OF ACRONYMS AND DEFINED TERMS

Acronym/Defined Term	Meaning
CO-WRAP	Colorado Wildfire Risk Assessment Portal
GIS	Geographic Information Systems
NIFC	National Interagency Fire Center
Public Service or the Company	Public Service Company of Colorado
Verisk	Verisk Analytics, Inc
WMP or Plan	Wildfire Mitigation Plan
WRZ	Wildfire Risk Zone
WUI	Wildland-Urban Interface
Xcel Energy	Xcel Energy Inc.
XES	Xcel Energy Services Inc.

**BEFORE THE PUBLIC UTILITIES COMMISSION
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I. INTRODUCTION, QUALIFICATIONS, AND PURPOSE OF TESTIMONY

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. My name is Steven D. Rohlwing. My business address is 1800 Larimer Street, Suite 1400, Denver, Colorado 80202.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT POSITION?

A. I am employed by Xcel Energy Services Inc. ("XES") as Manager of Asset Risk Management. XES is a wholly-owned subsidiary of Xcel Energy Inc. ("Xcel Energy") and provides an array of support services to Public Service Company of Colorado ("Public Service" or the "Company") and the other utility operating company subsidiaries of Xcel Energy on a coordinated basis.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?

A. I am testifying on behalf of Public Service.

Q. PLEASE SUMMARIZE YOUR RESPONSIBILITIES AND QUALIFICATIONS.

A. As Manager of Asset Risk Management, I provide leadership for a team of four analysts, developing strategy to expand the impact and reach of Risk Analytics into the Company's Operations and Finance arm. This includes leveraging analytical tools and software to create models and simulations and provide a risk view for issues, projects, ideas, and programs. A full summary of my qualifications and responsibilities is provided in the Statement of Qualifications attached at the end of my Direct Testimony.

Q. WHAT IS THE PURPOSE OF YOUR DIRECT TESTIMONY?

A. The purpose of my Direct Testimony is to explain how the Company evaluates and determines wildfire risk, as well as the risk modeling the Company has performed in developing and implementing its updated Wildfire Mitigation Plan ("WMP" or "Plan"), provided as Attachment SLJ-1 to the Direct Testimony of Sandra L. Johnson. Among other things, I support and sponsor the Company's Wildfire Risk Model and simulation used in part to develop the WMP.

Q. ARE YOU SPONSORING ANY ATTACHMENTS AS PART OF YOUR DIRECT TESTIMONY?

A. Yes. I am sponsoring the following attachments, which were prepared by me or under my direct supervision:

- Attachment SDR-1: Wildfire Risk Model;
- Attachment SDR-2: Wildfire Risk Model Results;
- Attachment SDR-3: Map of the Wildfire Risk Zone; and
- Attachment SDR-4: Distribution Assets – CO-WRAP.

II. OVERVIEW OF PUBLIC SERVICE'S APPROACH TO WILDFIRE RISK

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR DIRECT TESTIMONY?

A. In this section of my Direct Testimony I outline the Company's approach to wildfire risk as well as risk in general.

Q. HOW DOES THE COMPANY DEFINE "RISK"?

A. Risk is a circumstance or factor that may have a negative impact on the safety, operations, or integrity of Public Service or its system. Risks can be driven by internal or external factors. It must be noted that the term "risk" can take on different meanings in different contexts. Risk is often defined as the product of the likelihood of an event and the possible consequence or impact of that event, which is generally how I use the term throughout my Direct Testimony. However, in many contexts throughout the Plan and supporting testimony, "risk" is used more generally to simply mean "consequence."

Given that a significant wildfire event, especially a utility-caused wildfire, has a very low likelihood, the Company's Wildfire Risk Model, explained later in my Direct Testimony, focuses on the most significant potential impacts (the "tail" events in the simulation's distribution of potential outcomes). In that sense, the term "risk" often refers to the possible consequence of an event, regardless of likelihood. For example: the Colorado Wildfire Risk Assessment Portal ("CO-WRAP") uses the term "risk" to describe the potential wildfire consequence due to various attributes, fuels, proximity to the wildland-urban interface ("WUI"), etc. In the wildfire mitigation context, the Company defines risk as the magnitude of potential damages that could result from a fire in a given area under existing conditions (*i.e.*, the susceptibility of the area to potential fire damage). In the Company's Wildfire Risk Model, the top 1 percent of possible wildfire impacts with and without mitigation is how the "risk" reduction (*i.e.*, the benefit of the mitigation program) is determined.

Q. HAS THE COMPANY DEFINED A LEVEL OF RISK IT IS WILLING TO ACCEPT WITH RESPECT TO WILDFIRES?

A. The Company strives to minimize the likelihood and reduce the consequences of wildfire as much as possible. However, there are limitations on what the Company can control. There are numerous variables that are not controllable with respect to wildfire risk, particularly climate impacts, human factors and variables, precipitation levels, daily weather conditions, and other environmental factors.

Risks such as utility-caused wildfire risk are considered to have a high potential impact and a low likelihood of occurring. Additionally, the Company has facilities in areas that can be impacted by wildfire or in locations where equipment could cause a wildfire. Therefore, a proactive program to limit the likelihood of a fire incident is in everyone's interest, and the Company recognizes fire risk as an inherent business risk of providing electric service. The Company therefore seeks to mitigate the aspects of wildfire risk that it can control or otherwise manage. In the case of wildfire mitigation, aspects the Company can manage include minimizing the likelihood of Company facilities or equipment creating a spark and igniting surrounding fuel sources (*e.g.*, wood poles, debris, or vegetation) that could cause a significant wildfire event. The Company seeks to reduce the likelihood of a utility-caused wildfire event, requiring a consistent, long-term plan or program.

Q. WHY IS IT IMPORTANT FOR PUBLIC SERVICE TO MITIGATE WILDFIRE RISK?

A. Wildfire activity is becoming an ever-increasing concern across much of the western United States and around the world as population growth and expansion of urban areas transitions more and more people, homes, and businesses closer to heavily-forested areas. The WUI, which refers to areas where forests meet the edges of urban areas, is under higher threat from wildfires, due to increased human interaction and activities that could result in the ignition of a fire. The consequence of a fire in these WUI areas is much greater due to the increasing number of structures and people concentrated in the WUI area along with substantial surface fuels which can also be impacted by changing climate conditions.

Q. WHAT ARE THE KEY THREATS AND POTENTIAL IMPACTS FROM WILDFIRES?

A. The primary threats of wildfires, especially in WUI areas, where population density is significantly higher, include direct impacts to human safety, fire damage to building structures and personal property, and direct and indirect ecological and environmental damage to the surrounding area. The full social and economic costs of a large-scale wildfire are difficult to measure and highly variable depending on the exact location in which a wildfire occurs. Given the significant population density of the Front Range and the numerous ecological considerations which must be taken into account, along with the recreational and tourism-related opportunities afforded by these forested areas, the negative impacts of a wildfire anywhere in Public Service's service territory could be considerable. Some of the direct and immediate impacts may include loss of human life, loss of wildlife and protected species, property damage, loss of habitat, and the potential for significant infrastructure damage, such as reservoirs and watershed areas, pipelines, electric lines, and other facilities. Wildfires can also release large amounts of greenhouse gases, such as carbon dioxide, into the atmosphere while destroying forested land that would otherwise serve to absorb carbon dioxide.

Q. ARE THERE ANY OTHER COSTS THAT SHOULD BE CONSIDERED?

A. Yes, the full social and economic costs of a wildfire are extensive and generally more difficult to estimate than the direct costs incurred during the suppression of a wildfire as they can have long-lasting economic impacts on a given area or region. Other key costs to be considered are lost business and tax revenues, decreased property values, reduced tourism, and damaged recreational areas. Figure SDR-D-1 below illustrates the impacts from two significant wildfires in Colorado – the Black Forest Fire in 2013 and the Waldo Canyon Fire in 2012. The first photograph shows the condition of the burn zone after the Black Forest Fire occurred and reflects the complete loss of structures and significant environmental impacts on the surrounding area. The second photograph contains two side-by-side images – the first showing the condition of a residential neighborhood after the Waldo Canyon Fire, and the second showing images of the fire while it occurred.

<u>Figure SDR-D-1: Wildfire Impacts</u>

Black Forest Fire

Waldo Canyon Fire

In addition to threatening human safety and property loss, wildfires can also have long-lasting environmental impacts. Large wildfires can result in long-term issues with soil erosion, increased risk of mudslides and flash flooding, water quality issues due to excessive storm water runoff, impacts to ecology and wildlife, and decreased air quality from smoke pollution.

Q. WHAT EVIDENCE IS THERE OF LONG-TERM IMPACTS FROM WILDFIRES?

A. The long-term impacts of wildfires are easily observed through images of previous wildfires that have occurred in Colorado. Figure SDR-D-2 below shows the Cheesman Lake area, located southwest of Deckers, Colorado, and the long-term effects on the surrounding landscape following the 2002 Hayman Fire, first in 2003 and again in 2017.

<u>Figure SDR-D-2: Hayman Fire Impacts (Aerial View)</u>

Cheesman Lake (Google Earth Satellite Photo – 2002, before Hayman Fire)

Cheesman Lake (Google Earth Satellite Photo – 2003, after Hayman Fire)

Cheesman Lake (Google Earth Satellite Photo – 2017, after Hayman Fire)

Below is another perspective showing two versions of the same panorama following the Hayman Fire in 2002. Figure SDR-D-3 shows a comparison of the landscape one month after the fire and 10 years later.

Figure SDR-D-3: Hayman Fire Impacts (Panoramic View)

Fig. 1 Repeat panoramas taken from a severely burned ridgetop within the Hayman Fire. Top photo by M.R. Kaufmann, 17 July 2002, approximately 1 month after the area burned. Bottom photo by P.J. Fornwalt, 11 July 2012, 10 years later.

Wildfires can affect the physical, chemical, and biological quality of streams, rivers, lakes, and reservoirs. These changes are noticeable for years and even decades after a fire.

Q. WHAT IS THE POTENTIAL THREAT TO COLORADANS FROM WILDFIRES?

A. According to Verisk Analytics, Inc. ("Verisk"), an industry-recognized data analytics and risk analysis firm, there are currently more than 2.2 million total housing units in Colorado where nearly one-third are categorized as having either 'moderate' wildfire risk (14 percent) or 'high and extreme' wildfire risk (17 percent).[1] Based on a 2019 report from Verisk, Colorado ranks as the third-

[1] *Fireline State Risk Report*, Verisk (2020), https://www.verisk.com/siteassets/media/campaigns/gated/underwriting/fireline-state-risk-report/fireline_risk_report_co_2020.pdf.

highest state in the nation for both the number of properties and percentage of properties exposed to high to extreme risk of wildfire.[2]

Further, according to the Fourth National Climate Assessment produced by the United States Global Change Research Program, "[w]ith climate change, higher temperatures and more severe drought will likely lead to increased area burned in many ecosystems of the western and southeastern United States. By the mid-21st century, annual area burned is expected to increase 200%-300% in the contiguous western United States[.]"[3] Figure SDR-D-4 below illustrates this wildfire trend in the United States.

<u>Figure SDR-D-4: Nationwide Wildfire Trend (1980-2020)</u>

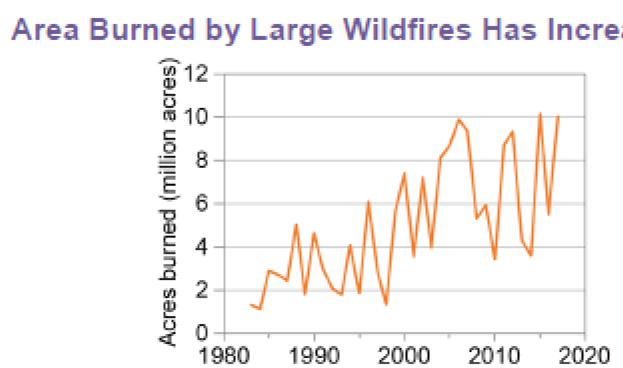

Figure A5.31: The figure shows the annual area burned by wildfires in the United States from 1983 to 2017. Warmer and drier conditions have contributed to an increase in large forest fires in the western United States and interior Alaska over the past several decades, and the ten years with the largest area burned have all occurred since 2000. Source: adapted from EPA 2016.[64]

Additionally, according to the National Interagency Fire Center ("NIFC"), since 2003 there has been an increasing trend in Colorado in the average size of

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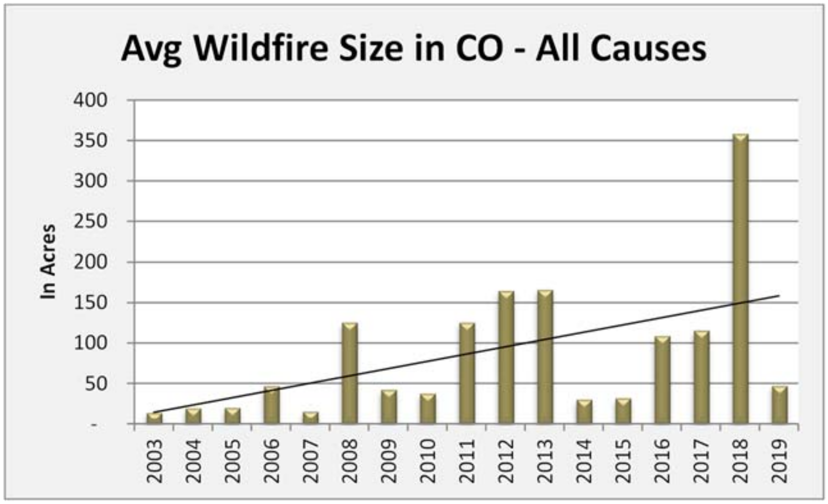
[2] *Wildfire Risk Analysis*, Verisk, https://www.verisk.com/insurance/campaigns/location-fireline-state-risk-report/.

[3] Matthew Dzaugis *et al.*, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II, Appendix 5. Frequently Asked Questions*, U.S. Global Change Research Program, at 1507 (Nov. 2018), https://nca2018.globalchange.gov/downloads/NCA4_App5_FAQ.pdf.

wildfires in acres burned.[4] Figure SDR-D-5 below illustrates this trend in Colorado specifically, based on data from the NIFC.

<u>Figure SDR-D-5: Average Colorado Wildfire Size (2003-2019)</u>



Wildfires have become an increasing risk to Coloradans. One only needs to look at the number of acres, homes, deaths, and financial losses associated with wildfires to appreciate this risk. While none of the most significant wildfires in Colorado history were considered to have been started by a utility's assets, the impact of those wildfires provides context of the reality of this risk regardless of the ignition source. Furthermore, four of the five worst wildfires in Colorado history in terms of cost (which collectively includes: acres burned, homes destroyed, loss of human life, and suppression costs) have occurred within the last decade. In order of cost impact magnitude these include:

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[4] *Wildfires by State: Current Table and Archived Tables*, Ins. Info. Inst., https://www.iii.org/table-archive/23284.

- **Waldo Canyon Fire (2012)**: 18,257 acres burned, 346 homes destroyed, 2 fatalities, costing approximately $450 million;
- **Black Forest Fire (2013)**: 14,280 acres burned, 511 homes destroyed, 2 fatalities, costing approximately $420 million;
- **Fourmile Canyon Fire (2010)**: 6,181 acres burned, 168 homes destroyed, 0 fatalities, costing approximately $217 million (within Public Service's service territory);
- **High Park Fire (2012)**: 87,284 acres burned, 259 homes destroyed, 1 fatality, costing approximately $115 million; and,
- **Hayman Fire (2002)**: 137,760 acres burned; 133 homes destroyed, 6 fatalities, costing approximately $40 million.[5]

Colorado's WUI, comprised of "any area where man-made improvements are built close to, or within, natural terrain and flammable vegetation,"[6] is also increasing. According to Silvis Lab: Spatial Analysis for Conservation and Sustainability, Colorado's total WUI space on average increased 2.5 percent annually from 1990 to 2010.[7] And according to CO-WRAP data, as of 2017 "[h]alf of all Coloradans live[d] in areas at risk to wildfires."[8]

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[5] Sources include: El Paso County Sheriff's Office, Wildfire Today, Larimer County Sheriff's Office, and USDA Forest Service.

[6] *Colorado's Wildland-Urban Interface,* Colo. St. Forest Service, https://csfs.colostate.edu/wildfire-mitigation/colorados-wildland-urban-interface.

[7] *See* Volker Radeloff *et al., Mapping Change in the Wildland Urban Interface (WUI) 1990 – 2010, State Summary Statistics* (Jun. 2018), http://silvis.forest.wisc.edu/GeoData/WUI_cp12/WUI_change_1990_2010_State_Stats_Report.pdf.

[8] *Half of Coloradans Now Live in Areas at Risk to Wildfires*, Colo. St. Forest Service (Nov. 26, 2018), https://csfs.colostate.edu/half-of-coloradans-now-live-in-areas-at-risk-to-wildfires.

Q. WHICH COUNTIES IN COLORADO HAVE THE HIGHEST PERCENTAGE OF HOUSING UNITS IN HIGH RISK WILDFIRE AREAS?

A. The counties in Colorado within the top five in terms of either the largest number or highest concentration of housing units in the "high to extreme" wildfire risk category are **Jefferson, Larimer, Boulder,** El Paso, **Summit, Gilpin, Clear Creek,** San Miguel, Hinsdale, and San Juan Counties.[9] Seven of these counties (in bold above) comprise areas within Public Service's service territory, and are either fully or partially located within the Wildfire Risk Zone ("WRZ") (which I discuss in more detail later in my Direct Testimony), representing a significant proportion of electric distribution and transmission assets serving these areas.

Q. HAVE THERE BEEN ANY SIGNIFICANT WILDFIRES CAUSED BY ELECTRIC UTILITY EQUIPMENT?

A. Yes. While the percentage of wildfires caused by electric utility equipment is low – best estimates indicate electrical equipment causes less than 2 percent of all wildfires – the consequences of such events can be extremely high. Due to recent high-profile wildfires in California, particularly since 2017, the impacts of these low probability / high consequence events have been observed on multiple occasions. 2017 was a very active wildfire season in California due to the intense drought conditions. The state experienced nearly 9,000 wildfires which

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[9] *See Fireline State Risk Report,* Verisk (2020), https://www.verisk.com/siteassets/media/campaigns/gated/underwriting/fireline-state-risk-report/fireline_risk_report_co_2020.pdf.

collectively burned 1.2 million acres, destroyed over 10,800 structures, and caused at least 46 casualties.[10]

Just a year later, in 2018, the Camp Fire in Butte County, California became the world's costliest natural disaster and is considered one of the deadliest wildfires to occur in the U.S. since 1918. The Camp Fire destroyed nearly the entire town of Paradise, California and resulted in 85 deaths and fire damage to almost 19,000 structures.[11] Fire investigators concluded that a fallen electric transmission line was the likely cause of that wildfire.

Q. HAS COLORADO OBSERVED ANY LARGE WILDFIRES CAUSED BY ELECTRIC UTILITY EQUIPMENT?

A. While the Company is aware of approximately 14 wildfire events having occurred at or near Public Service facilities in the last 10 years, in Colorado to date there have not been any wildfires reaching the extent and magnitude of the wildfires in California that were caused by electric utility equipment. The costliest historical wildfires in Colorado, as set forth in Table SDR-D-1 below, have occurred between 2000 and 2019 and none were attributed to electric utility equipment.

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[10] Lauren Tierney, *The grim scope of 2017's California wildfire season is now clear. The danger's not over.*, Wash. Post (Jan. 4, 2018), https://www.washingtonpost.com/graphics/2017/national/california-wildfires-comparison/.

[11] Jeff Daniels, *Officials: Camp Fire, deadliest in California history, was caused by PG&E electrical transmission* lines, CNBC (May 15, 2019), https://www.cnbc.com/2019/05/15/officials-camp-fire-deadliest-in-california-history-was-caused-by-pge-electrical-transmission-lines.html.

1 **Table SDR-D-1: Ten Costliest Colorado Wildfires**

Name	Year	Cause	Acres Burned	Cost ($ millions)
Waldo Canyon Fire	2012	Unknown cause	18,247	$454
Black Forest Fire	2013	Human-caused	14,280	$421
Fourmile Canyon Fire	2010	Reignited extinguished fire pit	6,181	$217
Spring Creek Fire	2018	Arson	108,045	$117
High Park Fire	2012	Lightning	87,284	$114
416 & Burro Fire Complex	2018	Embers from coal-powered train	55,000	$43
Missionary Ridge Fire	2002	Human-caused	71,739	$40
Hayman Fire	2002	Arson	137,760	$39
Coal Seam Fire	2002	Burning of underground coal seam ignited in 1910	12,209	$25
Burn Canyon Fire	2002	Lightning	30,573	$13

III. PUBLIC SERVICE'S WILDFIRE ASSESSMENT TOOLS

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR DIRECT TESTIMONY?

A. In this section of my Direct Testimony, I discuss the various wildfire risk assessment tools the Company has developed in conjunction with its WMP, which are presented in Section 4 of the Plan.

Q. PLEASE SUMMARIZE THE COMPANY'S WILDFIRE RISK MODELING EFFORTS.

A. The Wildfire Risk Model is included as Attachment SDR-1 and was developed by capturing various assumptions and inputs in order to run a simulation that estimates the potential impact of wildfire caused by the Company's assets. Attachment SDR-2 provides the outputs of the simulations run. These include with and without the WMP in order to quantify the WMP's benefit (*i.e.*, risk reduction). Attachment SDR-3 shows the WRZ, which is determined by adding a 1,000 foot radius around the assets with Wildfire Risk Scores of 3, 4, or 5. Attachment SDR-4 is an example of a distribution asset and how the Wildfire Risk Scores are determined for each asset. All of these are explained in more detail later in my Direct Testimony.

Q. WHAT IS THE PURPOSE OF THE COMPANY'S WILDFIRE RISK MODEL?

A. The purpose of the Company's Wildfire Risk Model is to effectively capture and quantify the risk of starting a wildfire from existing electrical equipment. Additionally, Public Service uses wildfire risk modeling to target specific areas or assets that have the highest risk of a significant wildfire impact.

Q. WHAT ARE THE KEY GOALS OF THE COMPANY'S WILDFIRE RISK MODEL?

A. The primary goal of our Wildfire Risk Model is to inform the discussion of where to focus the Company's wildfire mitigation efforts and to develop a tool that can reasonably estimate the potential likelihood and consequence of wildfire risk in Public Service's service territory. For the likelihood element, the focus is on determining the annual likelihood of a wildfire starting as a result of the Company's equipment and allocating the likelihood across the various possible ignition sources, namely the failure of the Company's equipment or other objects contacting the Company's equipment. For the consequence element, the focus is on determining the impact of wildfire in the Company's service territory, monetizing the impact, and assigning each asset a wildfire risk score that can be used to prioritize work. Finally, the Company strives to continuously improve and develop its Wildfire Risk Model as new data, better assumptions, and new or enhanced technologies become available.

Q. ARE THERE ANY LIMITATIONS WITH THE WILDFIRE RISK MODEL?

A. Yes, the Company's Wildfire Risk Model estimates risk based on data from a number of sources that gives us guidance into where consequence is highest and helps evaluate the effectiveness of the overall mitigation measures. As with any model, the quality and accuracy of the results are dependent on the quality and accuracy of the assumptions and inputs. These inputs include the assumed effectiveness of the various mitigation programs provided by the project/program planners and engineers. The annual likelihood of a fire event is based on the

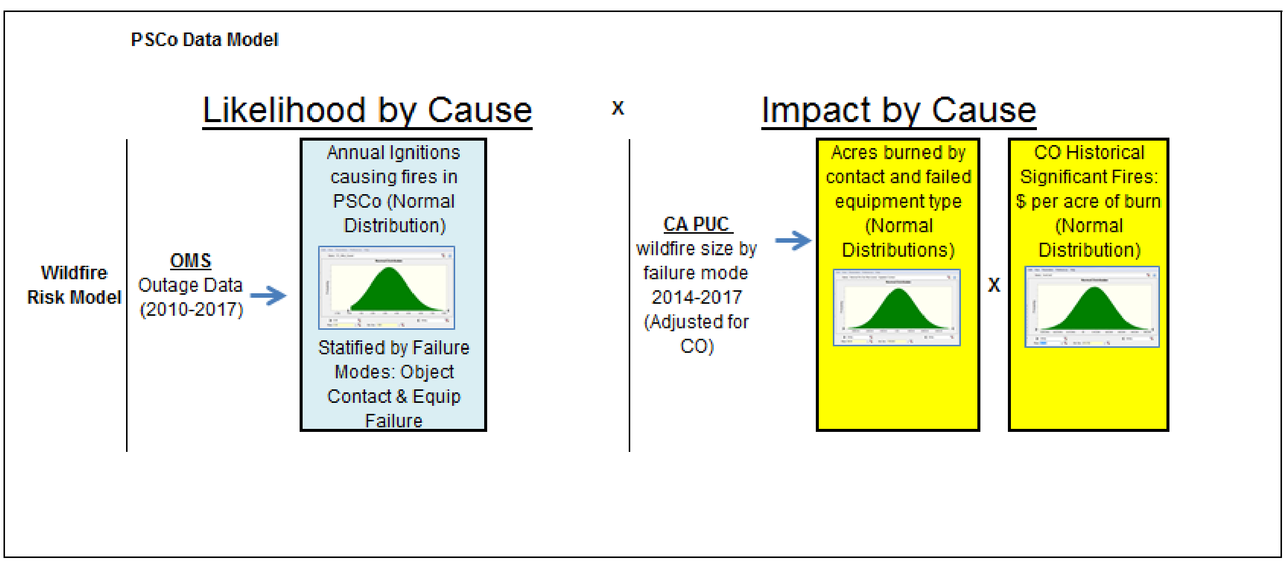
Company's outage history. However, the primary objective of the Company's outage management database is to record the details of an outage, not necessarily to gather the details of a wildfire – so there are limitations associated with using outage data to fully capture fire characteristics. Nevertheless, this data source has provided consistent results regarding fires caused either by equipment failure or as a result of other objects coming into contact with equipment. The Wildfire Risk Model is limited in that it cannot specifically model the risk of a single asset, nor can it determine the likelihood of sparks resulting in a wildfire.

Q. WHAT IS THE OVERALL ARCHITECTURE OF THE COMPANY'S WILDFIRE RISK MODEL?

A. The Wildfire Risk Model is supplied as Attachment SDR-1. The Wildfire Risk Model is an Excel based stochastic model that incorporates Oracle's Crystal Ball software for the simulation. There are various tabs in the model. The "Flowchart" and "Flowchart-Overview" tabs outline the process of the model. The "Assumptions" tab includes the foundational assumptions used by the model; note that cells in green are distributions. The "Mit-Effectiveness" tab provides distributions around the effectiveness of the programs provided by project managers and planners (the subject matter experts of the programs). The crux of the Wildfire Risk Model is on the "Probability by Asset and Object" and "Proposed Mitigations" tabs. As can be found on the "Probability by Asset and Object" tab, the Wildfire Risk Model allocates the average number of expected wildfires derived from historical outage data across various utility ignition sources. Also, each of these ignition sources has a unique distribution of potential acres burned. The distribution of acres burned are derived from California Public Utilities Commission utility wildfire data from 2014 to 2017, which are normalized for Colorado, where an average wildfire in Colorado is 20 percent smaller in terms of acres burned based on NIFC data for the same time period as shown on the "Wild Fires-By State" tab. The potential impact in dollars per acre burned is based on historically significant fires in Colorado shown on the "Assumptions" tab.

The Wildfire Risk Model assigns an estimated number of acres burned to each assumed utility ignition event and converts from acres burned to potential dollars of impact as an estimate of risk. Figure SDR-D-6 below illustrates the Wildfire Risk Model's modeling process.

Figure SDR-D-6: Wildfire Risk Model Process



Q. WHAT DO THE INITIAL RESULTS OF THE WILDFIRE RISK MODEL SHOW?

A. The Wildfire Risk Model simulates the annual potential impact with a Monte Carlo process of 10,000 trials. This simulation was completed prior to the development of the current WMP. A Monte Carlo simulation performs risk analysis by building models of possible results by substituting a range of values – a probability distribution – for any factor that has inherent uncertainty. It then calculates results over and over, each time using a different set of random values from the probability functions. The result is a distribution of potential impacts shown in Attachment SDR-2. This distribution is skewed right (has a long "tail") where most of the impacts are zero for the simulated year; however, there are outcomes in the simulation where significant impacts occur. Figure SDR-D-7 below shows the simulation, including those tail-results of the impacts.

<u>Figure SDR-D-7: Wildfire Risk Model Monte Carlo Simulation</u>

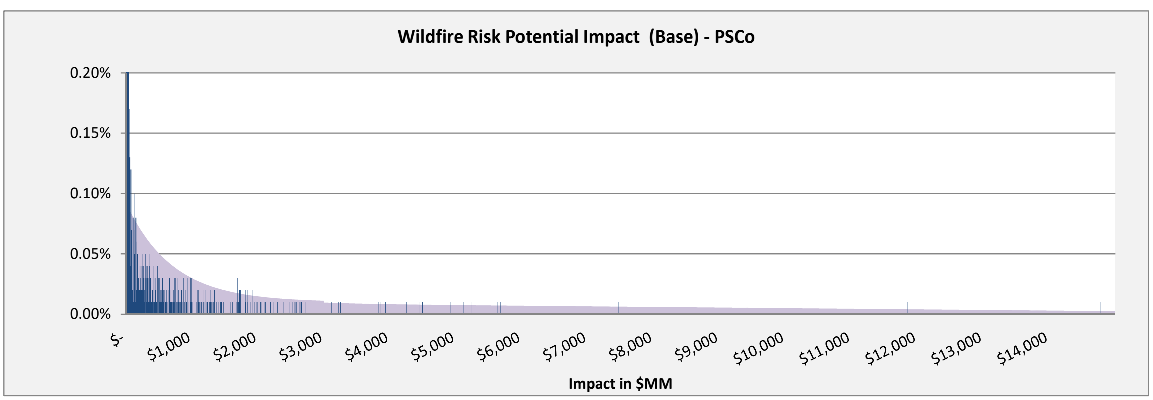


Table SDR-D-2 below breaks downs the results of the Monte Carlo Simulation, focusing on the tail-results. The effectiveness of the Wildfire Mitigation Plan is how well these significant impact years can be reduced. The goal is less about moving the average of the results, and more about minimizing the chance of a significantly high impact event.

Table SDR-D-2: Simulation Results Without WMP Implementation

Total Potential Impact (Simulation Results)	
Percentage of Results	Prior to Any Mitigation Programs
90%	Less than $9.7 million
95%	Less than $84.5 million
99%	Less than $1.24 billion
Average of Top 1%	$2.60 billion
Average	$46.1 million
Median	$0

The Monte Carlo Simulation results have a median value of $0, and 66 percent of simulated years had no impact, as shown in Attachment SDR-2 where cell B6616 is the trial where an impact is recognized. 6,613 trials out of the 10,000 result in an impact of $0. Thus, most of the time, there is an expectation that there will not be a wildfire risk impact; however, it is within the unlikely scenarios that significant impacts are possible. The average of the top one percent of results is $2.6 billion – reflecting that, akin to a 100-year flood, electric transmission and distribution equipment could cause a significant wildfire that has an expected $2.6 billion impact once in 100 years. This is the assumed risk without the proposed WMP.

Q. HOW IS THE CONSEQUENCE OF WILDFIRE ALLOCATED TO INDIVIDUAL PUBLIC SERVICE ASSETS?

A. As shown in Attachment SDR-4, the analysis in applying the CO-WRAP assigned a composite wildfire risk score to each structure/asset obtained out of Public

Service's Geographic Information System ("GIS"). The assets considered are: Distribution (overhead conductor, poles, capacitors, overhead secondary, fuses, transformers, and breakers) and Transmission (poles and conductor). Each structure/asset is ranked from 1 to 5, with 1 being the lowest and 5 being the highest wildfire potential consequence. For a 100-foot radius around each structure, six attributes from the CO-WRAP were assigned. The attributes were equally weighted and thus the rating from the CO-WRAP was normalized to assign a risk score of 1 to 5. Below are the ratings for each attribute – which were converted to a risk score of 1 to 5 or 0 to 5 (the Fire Intensity and Suppression attributes were allowed to have a value of 0, thus zeroing out the score if either of these attributes showed no wildfire risk – note that zeros in these fields were not missing values, but rather a value of no risk):

- Flame Length: 1-7 (Non-burnable to extreme)
- Fire Intensity: 1-5 (Lowest intensity to highest intensity)
- Rate of Spread: 1-7 (Non-burnable to extreme)
- Fire Extreme: 1-3 (Surface fire, passive canopy fire, active canopy fire)
- Suppression: 1-9 (Least difficult to most difficult)
- Wildland Urban Interface: 1-7 (Less than 1 house per 40 acres to more than 3 houses per acre)

The product of these attributes determined the composite Wildfire Risk Score for a given asset. In addition to the attribute data used to calculate these scores, CO-WRAP also has a Wildfire Risk Theme labeled "Wildfire Risk." This is derived by combining the Wildfire Threat and Fire Effects assessment outputs from CO-WRAP. The Wildfire Threat output incorporates historical fire occurrence, and these historical fires are from all possible ignition sources. Given that the majority of wildfire ignitions are the result of human causes, such as campfires, CO-WRAP's Wildfire Threat data[12] is skewed in populated areas where there is a greater chance of these types of ignitions. Conversely, areas with electric utility assets where there were no historical instances of wildfires, yet which have many attributes of high wildfire risk, are likely not adequately captured in CO-WRAP as a high wildfire risk with this theme. Where the CO-WRAP and Wildfire Risk scores were different, the Company selected and assigned the higher of the two scores to a given structure.

To account for the potential cascading events that could initiate in a lower-risk area and impact assets that are in a higher-consequence area, the Company added in a 1,000-foot buffer to capture the assets within a 1,000-foot radius of those assets with a Wildfire Risk Score of 3, 4, or 5 (where the score was calculated using a 100-foot radius). This is the basis for the creation of the WRZ identified in the Company's WMP and shown in Attachment SDR-3.

Q. WHAT ARE THE MONTE CARLO SIMULATION RESULTS AFTER INCORPORATING THE WILDFIRE MITIGATION PLAN?

A. In order to simulate the results after the WMP is implemented there are two aspects needed: the number of assets corrected and their corresponding Wildfire Risk Score, and the assumed effectiveness of the program. For example, the

[12] https://csfs.colostate.edu/wildfire-mitigation/colorado-forest-atlas/

Wildfire Risk Model assumes wood pole cross arms cause 1.4 percent of ignitions and are assumed to have a mean burn of 29 acres from the outage data and derived acres for this asset as described above. There is a distribution of cross arms across the wildfire risk area with Wildfire Risk Scores between 1 and 5. The total wildfire risk for cross arms is considered to be spread out across those assets. Hypothetically, if an individual mitigation program proposes to correct the cross arms of 50 percent of the assets with scores of 3, 4, and 5, then that individual mitigation program is assumed to be mitigating a percentage of the total wildfire risk from cross arms. In addition, if the program is considered to be 75 percent effective, then that percentage is applied to the percent of risk mitigated as well. The result is that each program associated with the WMP has a ratio of risk mitigated, as determined by the percentage of assets scoring 3, 4, and 5 that are corrected and an applied effectiveness percentage. Re-running the simulation creates an expected output with full WMP implementation. Table SDR-D-3 below shows those results compared to the initial simulation.

Table SDR-D-3: Comparison of Simulation Results Before and After WMP Implementation

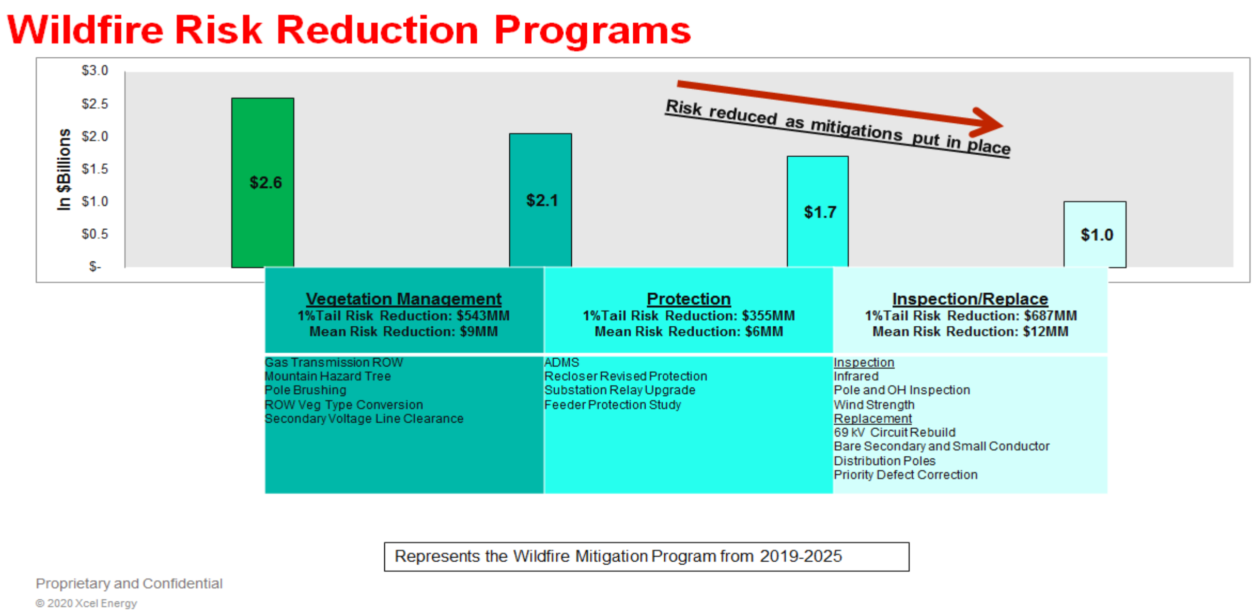
Total Potential Impact (Simulation Results)		
Percentage of Results	Prior to Any Mitigation Programs	After Full WMP Implementation
90%	Less than $9.7 million	Less than $5.4 million
95%	Less than $84.5 million	Less than $43.0 million
99%	Less than $1.24 billion	Less than $0.55 billion
Average of Top 1%	$2.60 billion	$1.01 billion
Average	$46.1 million	$19.4 million
Median	$0	$0

The tail risk (the average impact of the top 1 percent of results) decreased from $2.6 billion to $1.0 billion. Thus, the impact of a one-in-100-year wildfire event is significantly reduced.

Q. CAN THE MONTE CARLO SIMULATION RESULTS BE BROKEN UP BY GENERAL PROGRAM TYPE?

A. Yes. The WMP can be generally categorized into the following buckets in terms of risk reduction: vegetation management, protection, and inspection/replacement. The one percent tail risk reduction, as mitigated by the type of mitigation program, can be seen in Figure SDR-D-8 below.

Figure SDR-D-8: Risk Reduction by Program



Q. HOW HAS THE COMPANY USED ITS WILDFIRE RISK MODEL TO PRIORITIZE ITS WILDFIRE MITIGATION PROGRAMS?

A. The Company ran another simulation to capture the difference in the impact of possible outcomes with and without its WMP. The Company relied on this to help prioritize its wildfire mitigation programs by specifically looking to the impact of the "tail" of the distribution of possible outcomes with and without a given program. The WMP seeks to reduce the likelihood and impact of catastrophic wildfire events. Using the variance between the base case simulation results and the simulation results when mitigation programs are included estimates the benefit of a given activity, as shown in Attachment SDR-2 in columns B through F.

Q. HOW DOES THE COMPANY TEST THE EFFICACY OF ITS WILDFIRE RISK MODEL?

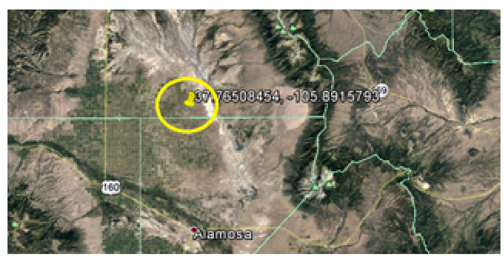
A. We have been testing the Wildfire Risk Scores of each asset in order to ensure that the appropriate risk is being assigned by visually observing the location of the asset to see the fuels present, the topography, and areas of WUI against the assessed score to provide a reasonableness check. Below are three examples of low, medium-high, and high-risk areas (Figures SDR-D-9, SDR-D-10, and SDR-D-11 respectively):

<u>Figure SDR-D-9: Example of Low-Risk Area</u>

Example – Low Risk Area

ID	HEIGHT	CLASS	MATERIAL	STATUS	INSTALL_DA	TREATMENT_	YEAR_MANUF	X	Y	City	zipcode
439758304	95	H1	Not Assigned	Existing	3/21/2014	Not Assigned	2013	-105.8915793	37.76508454	Center	81125

CO WRAP - Characteristic	Score
FlameLength	3.1
Rate of Spread	3.3
Intensity	4.3
Type Extreme	1.7
Suppression	1.3
Wildland Urban	0.6
WildFire Risk	**53.3**
	Low Risk



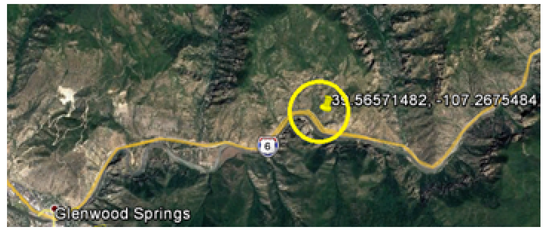
CO-WRAP characteristics and three Google Earth views are shown for a pole with a low level of wildfire risk as an example.

Figure SDR-D-10: Example of High-Risk Area

Example – High Risk Area

ID	HEIGHT	CLASS	MATERIAL	STATUS	TREATMENT	YEAR_MANUF	X	Y	City	zipcode
451955138	60	2	Wood	Existing	Pentachlorophenol	1983	-107.2675484	39.56517482	Glenwood Springs	81601

CO WRAP - Characteristic	Score
FlameLength	5.0
Rate of Spread	4.2
Intensity	4.3
Type Extreme	3.3
Suppression	2.5
Wildland Urban	0.6
WildFire Risk	**409.9**
	High



CO-WRAP characteristics and three Google Earth views are shown for a pole with a high level of wildfire risk as an example.

Figure SDR-D-11: Example of Highest-Risk Area

Example – Highest Risk Area

ID	HEIGHT	CLASS	MATERIAL	STATUS	INSTALL_DA	TREATMENT_	X	Y	City	zipcode
219086476	Unknown	Unknown	Steel	Existing	1/1/1970	Unknown	-106.9665062	39.38419765	Basalt	81621

CO WRAP - Characteristic	Score
FlameLength	5.0
Rate of Spread	4.2
Intensity	4.5
Type Extreme	5.0
Suppression	2.5
Wildland Urban	2.2
WildFire Risk	**2604.2**
	Highest

CO-WRAP characteristics and three Google Earth views are shown for a pole with the highest level of wildfire risk as an example.

Ongoing updates to the Company's assumptions are made to the Wildfire Risk Model as new data becomes available. This includes updates to wildfire distributions of acres burned by equipment failure and object contact type from California Public Utilities Commission wildfire data, including the most significant historical wildfires if applicable, adjusting the normalization for Colorado based of the most recent historical number of wildfires and number of acres burned.

Q. WHAT IMPROVEMENTS ARE PLANNED FOR THE COMPANY'S WILDFIRE RISK MODEL?

A. Areas of improvement for the Wildfire Risk Model include its wildfire consequence, likelihood, and program effectiveness aspects. In order to improve the consequence aspect of the Wildfire Risk Model, the Company is looking to an outside consultant for wildfire spread modeling. Technosylva[13] is an industry leading company focused on wildfire behavior simulation. Their wildfire modeling products (FireCast and FireSim) support the entire lifecycle of wildfire protection planning, including fuels mapping, fire behavior analysis, custom risk model development, wildfire risk assessment, fuel treatment planning, and mitigation project implementation and tracking. The Company is planning to launch a run of their predictive analytic software to predict wildfires within our highest risk wildfire areas in the WRZ.

[13] http://www.technosylva.com.

Q. HOW WILL TECHNOSYLVA SOFTWARE IMPROVE THE COMPANY'S WILDFIRE RISK MODEL?

A. The software will utilize Public Service's asset-specific location data to capture the possible wildfire impacts from an ignition along or near existing utility assets and simulate the direction and extent of a wildfire. This method is a significant improvement over the current method of using a distribution of the potential number of acres burned in a wildfire based on limited empirical data for each type of utility asset. Also, the software developed by Technosylva is a dynamic model using a simulated fire spread, as opposed to a static model using CO-WRAP output, which is updated very infrequently. The dynamic model includes weather data and a four-day weather forecast. The monetization of the wildfire impact will be determined by actual structures or square feet of actual structures, rather than a historical wildfire cost per acre average, since each asset's location can simulate a "match-drop" to see the potential impact as the extent of fire spread is simulated.

Q. WHAT OTHER DATA WILL THE COMPANY GATHER THROUGH ITS WMP?

A. The foundation of the WMP is inspections and the gathering of details when there is an outage or ignition. These additional data describing the Company's equipment can be used to begin to develop asset health characteristics and ultimately improve the likelihood aspect of the Wildfire Risk Model.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes, it does.

Statement of Qualifications

Steven D. Rohlwing

As Manager of Asset Risk Management, I provide leadership for a team of four analysts developing strategy to expand the impact and reach of Risk Analytics into Operations and Finance. This includes leveraging analytical tools and software to create models and simulations to provide a risk view for issues, projects, ideas, or programs.

I accepted a position in the Risk Analytics department in June 2018 as an analyst and was name the manager of Asset Risk Management in September 2018. I began work on improving the wildfire risk modeling in June 2018.

My career across the 17 years at Xcel Energy has included working as a manager and analyst in Business Area Finance for the Electric Distribution and Gas organization. I also worked as a manager in Business Area Finance for various shared services organizations including: Business Systems, Enterprise Security Services, Human Resources, Customer Solutions, Aviation, Property Services, Corporate Secretary, and the Chief Administrative Office. Through these roles, I was responsible for completing monthly close activities, building out the 5-year budgets (both Capital and O&M), monitoring various controls, and creating/producing financial reporting for the business areas supported.

Prior to working in Finance, I worked in Asset Risk Management responsible for developing tools, models, and analytics for the Electric Distribution, Electric Transmission, and Gas organizations. My other experience prior to working at Xcel Energy includes working as a high school math instructor and as an actuarial analyst.

In summary, I have a unique blend of skills and experience: analytics, finance, accounting, teaching, and leadership. My career in teaching and coaching refined my ability to deliver and present an understanding of the complex. The years working as an actuary developed my attention to detail and aptitude to solve difficult problems. My years as a financial and risk consultant provided an opportunity to find creative solutions for the commonly perceived "unsolvable" issues, as well as lead multi-departmental teams in the implementation of those valued solutions. A recent role combined my skills and prior experience into leading a finance team that supported multiple shared service business areas. This role expanded to the operations area, managing a team of nine and responsible for an annual capital budget. Currently, I am in a risk role, combining analytics and modeling with my experience and knowledge of utility finance. All of this experience has allowed for me to develop and construct effective models for wildfire risk.

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO**

* * * *

IN THE MATTER OF THE APPLICATION OF PUBLIC SERVICE COMPANY OF COLORADO FOR APPROVAL OF WILDFIRE MITIGATION PLAN AND WILDFIRE PROTECTION RIDER)	**PROCEEDING NO. 20A-XXXXE**

**AFFIDAVIT OF STEVEN D. ROHLWING
ON BEHALF OF
PUBLIC SERVICE COMPANY OF COLORADO**

I, Steven D. Rohlwing, being duly sworn, state that the Direct Testimony and attachments were prepared by me or under my supervision, control, and direction; that the Direct Testimony and attachments are true and correct to the best of my information, knowledge and belief; and that I would give the same testimony orally and would present the same attachments if asked under oath.

Dated at Denver, Colorado, this 15th day of July 2020.

Steven D. Rohlwing
Steven D. Rohlwing
Manager, Asset Risk Management

Subscribed and sworn to before me this 15th day of July 2020.

Dawn Moffit
Notary Public

My Commission expires 4.22.2024

DAWN MOFFIT
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20084013859
MY COMMISSION EXPIRES APRIL 22, 2024