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May 1, 2018

Oregon Public Utility Commission  
Attn: Filing Center  
P.O. Box 1088  
Salem, OR 97308-1088

**RE: Cascade Natural Gas Corporation's Response Comments regarding LC 69 2018 Integrated Resource Plan**

Attention: Filing Center

Attached is Cascade Natural Gas Corporation's Response Comments regarding LC 69 2018 Integrated Resource Plan ("IRP").

If there are any questions regarding this request, please contact me at (509) 734-4589 or via email at [mark.sellers-vaughn@cngc.com](mailto:mark.sellers-vaughn@cngc.com) or Brian Robertson at (509) 734-4546 or via email at [Brian.Robertson@cngc.com](mailto:Brian.Robertson@cngc.com).

Sincerely,  
CASCADE NATURAL GAS CORPORATION

Mark Sellers-Vaughn  
Manager, Supply Resource Planning

**BEFORE THE  
PUBLIC UTILITY COMMISSION OF OREGON**

In the Matter of

CASCADE NATURAL GAS COMPANY  
dba CASCADE NATURAL GAS, 2018

2018 Integrated Resource Plan (LC 69)

Cascade Natural Gas Response  
Comments

**CASCADE NATURAL GAS CORPORATION**

**May 1, 2018**

## **Introduction**

Cascade Natural Gas (Cascade, CNG or Company) files these response comments regarding the Cascade 2018 Integrated Resource Plan (IRP or Plan), filed in Docket No. LC 69 as well as in response to opening comments received by Oregon Public Utility Commission (OPUC, Commission Staff, or Staff), Oregon Citizens' Utility Board (CUB), and Alliance of Western Energy Consumers (AWEC). Cascade will also file an amended four-year action plan as recommended by Commission Staff in their opening comments on May 1, 2018.

## **Opening Remarks**

Cascade appreciates all of the feedback the IRP stakeholders have provided, not only in opening comments, but during the entire IRP process as well. The ultimate goal of the IRP process is to produce a plan with the best combination of expected costs and associated risks and uncertainties for the utility and its customers. This is best accomplished with inputs from all stakeholders.

Please note that as confirmed by Staff during a teleconference on April 9, some of Staff's comments were developed prior to Staff submitting several data requests related to LC 69. Please be aware that some of our responses to Staff's initial LC 69 comments may reference those DR responses.

Additionally, Cascade gives thanks to Staff for noting the amount of work Cascade has put in to complete the 2018 IRP as well as the many improvements the Company has made since the 2014 IRP. Cascade appreciates CUBs notation of the expanded narrative on how Cascade performs statistical analysis on the customer and demand forecast. The Company believes it has responded to CUBs recommendation regarding the action plan with the amended action plan filing. Also, Cascade appreciates AWEC noting that even though cost allocations are not decided in the IRP, there are many important future impacts resulting from the analysis done in the 2018 IRP.

## **Cascades Response to Staff's Opening Comments**

The following bullets are recommendations made by Commission Staff in Staff's opening comments along with the Company's response to each recommendation:

- Replace the 30-year historical coldest day with a statistical analysis of coldest days in CNG's 2020 IRP.

Cascade agrees with Staff that the Company should look at an alternative method to determine the peak day HDD. Cascade will consider new methodologies for its peak day analysis to incorporate into the 2020 OR IRP. This will also be included in the four-year action plan.

- Explain the rationale and factual basis of using Price Elasticity of Demand to calculate historical usage; and price data to calculate Price Elasticity of Demand for its customers.

Cascade has produced a document to respond to Price Elasticity. This has been provided as an attachment named *Price Elasticity.pdf*.

- Provide Staff requested information regarding the Company's confidence in the final model's ability to forecast load over the next 20 years, particularly with respect to its handling of customer sensitivity to price during poor economic conditions.

Cascade believes the Company has provided an adequate response regarding the confidence in the final model's ability to forecast load over the next 20 years in the attachment DR 26.

- Provide Staff with workpapers showing model inputs and outputs for each forecast in future IRPs during the initial filing.

Cascade provided workpapers showing model inputs in response to DR 1. The Company agrees with staff and will provide model inputs and outputs in Appendix B for future IRP Filings.

- Staff recommends that the Company acquire additional literature, data, and resources to support their carbon tax calculations.

The Company has provided a response to this recommendation in attachment *Carbon Tax Analysis Narrative.pdf*.

- Staff recommends that the Company include distribution system costs in future IRP avoided cost calculations.

Cascade has included this recommendation in the four-year action plan. The Company will work on developing a methodology for quantifying its distribution costs for inclusion in its 2020 IRP. The Company will provide a progress report with Cascade's annual IRP update filing. Cascade will continue participating in UM 1893, Staff Investigation of Methodology and Process of Energy Efficiency Cost-Effectiveness.

- Staff recommends that the Company work with Energy Trust of Oregon to describe model assumptions, particularly those regarding non-cost effective savings, and to provide calculations showing what energy efficiency savings would be without these non-cost effective savings.

The Company has provided a response to this recommendation in attachment DR 37.

- Staff recommends that the Company work on developing a methodology for quantifying its distribution costs for the purposes of avoided cost calculation.

Cascade will follow the recommendations resulting from UM 1893 for how to incorporate distribution system costs in future IRP avoided cost calculations.

- Staff recommends that the Company provide calculations and a narrative for how resource acquisition and integration needs will change if energy efficiency savings are lower than expected.

Please reference the earlier attachment regarding Cascade's carbon tax analysis. This confirms that there would be no change to upstream resource acquisition needs in the next four years if energy efficiency savings are lower than expected in one scenario, in large part because of the 10,000 dth/day acquired on GTN on 12/1/2017. Cascade will include an action item to perform additional analysis related to the integration impact of a range of energy efficiency savings in the 2020 IRP.

- Staff recommends that the Company provide more data and detail in its distribution planning section on how the Company evaluates cost-effectiveness and alternatives to the proposed infrastructure repairs/replacements.

Cascade believes it has provided more data and detail in responses to DR 32, 47-50. Cascade will include in its four-year action plan a commitment to expand on the narrative related to the cost-effectiveness evaluation of proposed infrastructure repairs/replacements in the 2020 IRP.

- Staff recommends that the Company include its proposed distribution system costs in its Action Plan.

Cascade has provided proposed distribution system costs in the amended four-year action plan.

- Staff recommends that the Company amend its initial IRP filing to include an action plan with resource activities the utility intends to undertake over the next four years, to bring the IRP filing into compliance with IRP Guideline 4(n).

Cascade has included with this filing an amended action plan which lists all distribution system projects that Cascade plans to undertake in the next four years. After the successful acquisition of 10,000 dth/day of additional GTN capacity on 12/1/2017, Cascade does not anticipate any further upstream resource acquisition needs in the next four years to satisfy forecasted demand growth. Cascade respectfully believes it's filed action plan was in compliance with IRP Guideline 4n: "An action plan with resource activities the utility intends to undertake over the next two to four years to acquire the identified resources, regardless of whether the activity was acknowledged in a previous IRP, with the key attributes of each resource specified as in portfolio testing."

- Staff recommends that Company revise and resubmit its 2018 Action Plan so that it explicitly lists the proposed four-year resource investments in the Action Plan itself.

As mentioned in the previous recommendation Cascade has included with this filing an amended action plan which lists all distribution system projects that Cascade plans to undertake in the next four years. After the successful acquisition of 10,000 dth/day of additional GTN capacity on 12/1/2017, Cascade does not anticipate any further upstream resource acquisition needs in the next four years to satisfy forecasted demand growth.

This concludes Cascade's comments.

Dated at Kennewick, Washington, this 1<sup>st</sup> day of May, 2018.

A handwritten signature in black ink that reads "Mark Sellers-Vaughn". The signature is written in a cursive, flowing style.

Mark Sellers-Vaughn  
Manager, Supply Resource Planning

**Staff Recommendation:**

Staff recommends that the Company acquire additional literature, data, and resources to support their carbon tax calculations.

**Response:**

Creating an accurate forecast for the cost of potential carbon compliance costs is challenging due to the speculative nature of accounting for state, regional, and/or national policy. Cascade chose to base its forecast on the 2013 Northwest Economic Regional Center (NERC) study (<https://www.pdx.edu/nerc/sites/www.pdx.edu/nerc/files/carbontax2013.pdf>) because of its applicability to the state of Oregon and its conservative projections, and its continued use as a regional standard. The NERC forecast starts at \$10/ton, and ramps up by \$10/ton to a cap of \$60/ton. This is twice the tax currently seen in British Columbia, and in line with Washington's failed measure I-732, which would have called for a tax starting at \$15/ton, then rising to \$25/ton in the next year, and continuing to increase by 3.5% plus inflation. The NERC study is also cited in Oregon HB 3252 (<https://olis.leg.state.or.us/liz/2015R1/Downloads/MeasureDocument/HB3252/Introduced>) as the basis of Oregon's proposed carbon tax legislation in 2015.

After conversations with Staff and further analysis of the regulatory environment in Oregon, Cascade recognizes that there are additional potential carbon scenarios that, while still uncertain, need to be analyzed for their potential impact on Cascade's resource decision. The Company will use Oregon LC 176 ([https://www.oregonlegislature.gov/helm/workgroup\\_materials/LC0176\\_DRAFT\\_2018\\_Regular\\_Session.pdf](https://www.oregonlegislature.gov/helm/workgroup_materials/LC0176_DRAFT_2018_Regular_Session.pdf)) as the basis for further analysis, which recommends a cap and investment program that Cascade models as a marketplace similar to California's CO<sub>2</sub>E pricing. Cascade uses the inflation adjusted mid-price from the revised 2017 IEPR Carbon Price Projections to calculate the percentage change in the avoided cost from this new carbon tax versus the methodology outlined above. For years 2018-2021, the percentage change is equal to 100% of the carbon tax Cascade modeled, as LC 176 sets 2021 as the target date for the cap and investment program to begin. Cascade then used these percentage changes to modify its DSM at its Oregon citygates. This provides a reasonable picture of the impact of a new carbon tax, although Cascade recognizes the actual percentage change may not be a perfect one to one ratio. The Company did reach out to the Energy Trust of Oregon to inquire if it would be feasible to rerun their DSM model with the new avoided cost inputs. Cascade was advised that such modeling would be challenging given the time frame that results would be needed in, and ETO's current workload on IRP modeling for the other regional LDCs.

Cascade regrets that we are be unable to provide this level of analysis at this time. In the future, Cascade will encourage stakeholders to request analysis of this level earlier in the IRP process in order to allow sufficient time to work with external parties such as ETO to obtain more accurate results.

By 2021, Cascade's cumulative therm saving projection in the GTN area would be approximately 85 dekatherms lower, with a total cumulative dekatherm adjustment of approximately 234 by 2037. Since Cascade acquired an additional 10,000 dth/day of capacity on GTN effective 12/1/2017, no additional action would be required over the 4-year action plan window. The magnitude of additional capacity needed in the GTN region may be different over the full 20-year planning horizon, but this analysis confirms Cascade's conclusion that it will need to acquire additional upstream transportation on GTN by

2037, as detailed in the IRP. This analysis with formulae intact can be found in the workpaper *Carbon Tax Analysis Workpaper.Xlsx*



**Staff Recommendation:**

Explain the rationale and factual basis of using Price Elasticity of Demand to calculate historical usage; and price data to calculate Price Elasticity of Demand for its customers.

**Response:**

Cascade generally concurs with Staff's comments at Page 4 that state: "When gas prices are low, customers may be less responsive to changes in price." The Company also agrees with the Staff's comments that its cited studies are dated and "may not be an accurate indicator of price elasticity today."

Cascade has similar concerns about the veracity of price elasticity in a historically low price environment. This is shown by Cascade's statements at pages 3-18 and 3-19 of the IRP including:

- "Several attributes of the regulated utility environment cause price elasticity calculations to be difficult to calculate with precision."
- "Additionally, regulatory protocols may reduce direct signals because the annual purchased gas adjustment (PGA) may result in price increases or decreases of unknown magnitude."
- "Further, customers assume general rate cases and price changes will occur annually or biannually. As a result, customers are more likely to be uncertain of future pricing than to have the preconception that prices will rise."
- "Several items reduce load growth over time, regardless of price elasticity and price signals. Changes in economic conditions, added conservation, revised building codes and appliance standards, and advances in technology lead to reduction in usage irrespective of pricing."
- "This makes it difficult for customers to react to meaningful price signals and difficult for utilities to isolate primary factors for long supply term price elasticity calculations (other than inflation)."
- "Given Cascade's diverse geographical territory, the statistical significance of price elasticity coefficients is uncertain"

This is supported by recent studies. Vipin Arora of the U.S. Energy Information Administration disaggregates historic natural gas prices into the pre-shale period (circa before 2008) and afterwards. In his paper, "Estimates of the Price Elasticities of Natural Gas Supply and Demand in the United States" (March 6, 2014), he states:

"... it appears that the elasticity estimates when shale is included fully into the sample get larger, i.e. there is less responsiveness to price both in the short and long-run. One possible explanation for this is a well-known issue when using elasticity estimates, that the percentage changes in price after 2008 reflect level changes that are smaller in size than before. For example, the nominal Henry Hub price drops from a high of over 12 dollars per MMBtu in early 2008 to around 4 dollars per MMBtu for the remainder of the sample period. And the responses of households in a low-price environment may simply be different than a higher-price one, in that they are less concerned with price changes when prices are low."

The rationale and factual basis of using Price Elasticity of Demand is described on page 3-17 of the 2018 IRP. Cascade intends to monitor the contemplated impacts of price elasticity of demand in its next IRP but anticipates making no associated adjustments.

**CASCADE NATURAL GAS CORPORATION**  
**Oregon Public Utility Commission**  
**LC 69**  
**2018 IRP**

Due Date: 03-29-2018

Request No. 26

Date prepared: 3/20/2018

Preparer: Devin McGreal

Contact: Mark Sellers-Vaughn

Telephone: (509) 734-4589

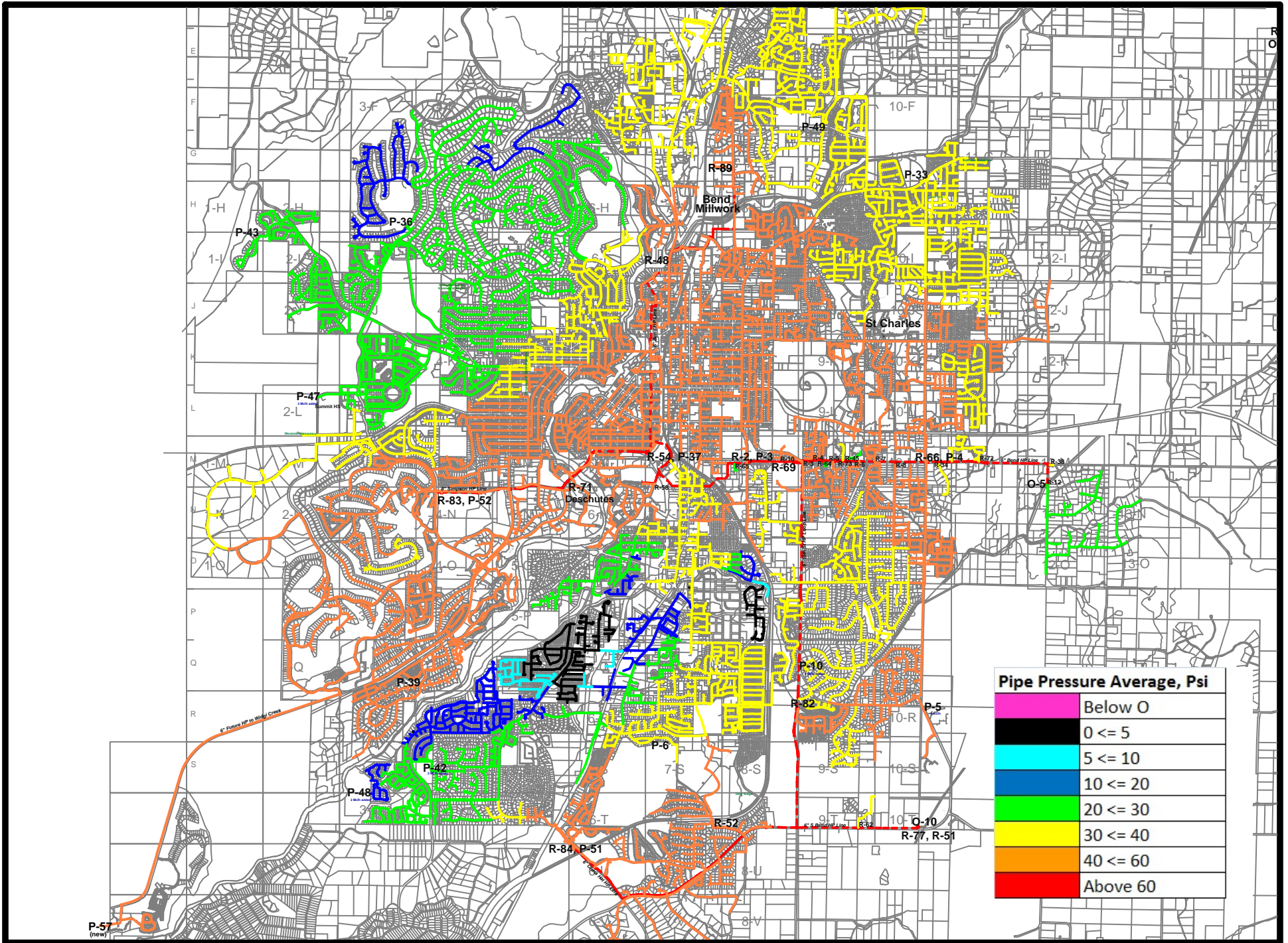
26. Page 3-16: CNG asserts 1.3% growth in poor economic conditions
- a. Please provide data showing load data in any of the Oregon Zone during the two most recent economic downturns that corroborate such an assertion for past downturns.

**Response:**

As discussed on page 3-8 of the 2018 OR IRP, Cascade derived its high and low growth load projections by using the confidence intervals of its ARIMA models. This allows for a low growth scenario that, statistically speaking, captures an extreme low growth environment as it is one that only occurs 2.5% of the time. This model was discussed during Cascade's first TAG meeting for the 2018 OR IRP with no objections.

Additionally, the forecast of 1.3% growth in poor economic conditions assumes that, similar to recent economic downturns, conditions will eventually improve. The attachment DR 25, 26 - Historic Customer & Therm.xlsx provides an example of this. Even when including poor economic conditions in 2008-2009 (0.59%) and 2011-2012 (0.79%), growth over the entire ten-year horizon was approximately 1.6%.

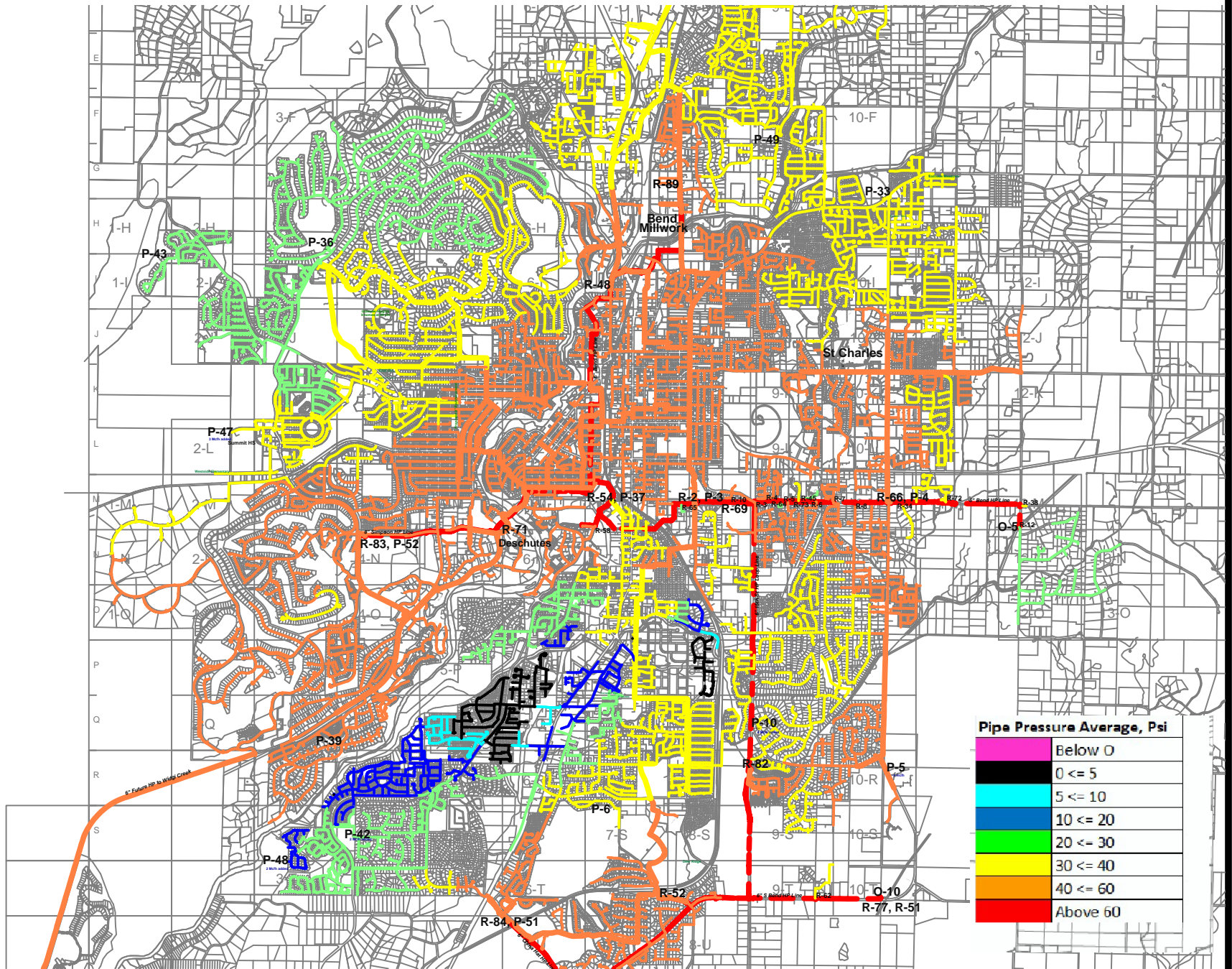
# 2012 Bend Design Day Model



c:\users\kathleen.chirgwin\documents\kc docs\engineering\bend\modeling\bendD10 - backup - Approximate Scale 1 in = 5500 feet

Modeled 1-24-2012

2012 Bend Design Day Model with Bend Pipe Replacement Sizing for all PRE-CNG pipe



c:\users\kathleen.chirgwin\documents\kc docs\engineering\bend\modeling\bend10 - backup\_6in\_galveston\_8\_Delaware - Approximate Scale 1 in = 5500 feet

Modeled 10-31-2011

Pressure Limit Report		
Node Name		
	Current Pressure (psig)	Pressure Prior to Project (psig)
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161800158_136681143	20.75	19.83
161804854_136707942	20.97	20.07
161840241_136746961	21.11	20.21
161850913_136680623	20.07	19.12
161856902_136501686	21.98	21.13
161857181_136681299	20.07	19.12
161880186_136681219	19.72	18.76
161880918_136615480	19.72	18.75
161909212_136706760	19.46	18.48
161909808_136681879	19.46	18.48

**CASCADE NATURAL GAS CORPORATION**  
**Oregon Public Utility Commission**  
**LC 69**  
**2018 IRP**

Due Date: 03-26-2018

Request No. 32

Date prepared: 03-23-2018

Preparer: Jeremy Ogden

Contact: Mark Sellers-Vaughn

Telephone: (509) 734-4589

32. In CNG's most recent Safety Project Plan (UM 1899) the Company reported a need for investments to replace corroding pipelines in Oregon, the estimated cost of which exceeds a cumulative 15 million dollars. Could these infrastructure replacements impact the future cost of expansions and/or limit the Company's ability to expand its distribution system in the future? Has the Company considered cost mitigation strategies such as accelerated DSM? Please provide any model calculations and inputs that address these issues.

**Response:**

When the infrastructure replacements mentioned above are planned, flow modeling is performed to ensure that the new pipelines will have sufficient capacity for future growth in the area. Usually, these projects are in well established residential areas that have been fully built out, and any future growth would be minimal. Attachments DR 32 - 2012 Bend Design Day Pressure.PDF, DR 32 - 2012 Bend Model Design Day Pressure with Bend Replacement Sizing for all PRE-CNG pipe.PDF, and DR 32 - Pressure Comparison Pendleton Phase I.PDF show the before and after modeling outputs for two different projects, one in Pendleton and one in Bend. The Pendleton project is shown in tabular format, demonstrating the increased pressures available at the nodes after the pipe has been replaced. The Bend project is shown in a graphical format.

Cascade discussed the cost mitigation impact of accelerated DSM in its 2014 IRP Annual Update. The impact of accelerated DSM with regards to reducing or delaying distribution system enhancements was concluded to be immaterial. The Company will produce a new accelerated DSM study for the 2020 OR IRP.

**CASCADE NATURAL GAS CORPORATION**  
**Oregon Public Utility Commission**  
**LC 69**  
**2018 IRP**

Due Date: 03-29-2018

Request No. 37

Date prepared: 3/28/18

Preparer: Energy Trust of Oregon

Contact: Mark Sellers-Vaughn

Telephone: (509) 734-4589

37. Please provide an explanation of the amount on non- cost-effective EE in the Company's forecast. Include analysis and an Excel document provided the forecasted total for cost-effective and non-cost-effective savings. The analysis should describe the drivers behind this level of non-cost-effective savings, such as blending of avoided costs, etc.

**Response:**

Energy Trust's resource assessment model includes a feature referred to as the cost-effectiveness (CE) override switch. This is used for measures that are not found to be cost effective in the model, but which are offered to customers by our program. This can happen for two different reasons. 1. When measures are found to be not cost effective in the model due to differences in utility-specific avoided costs used in IRP and Energy Trust blended avoided costs, which are used in programs and consist of a weighted average of avoided costs provided by the three gas utilities whose customers Energy Trust serves. 2. The override is applied to measures that are not cost effective in the resource assessment model or in programs, but for which an exception has been granted by the OPUC and that Energy Trust expects to be cost effective in the future.

Attachment DR 37\_38\_42\_43 - Energy Trust Data for CNG\_OPUC\_DRs\_3.28.2018.XLSX, tab 'Q37.' contains an analysis identifying what portion of the total 20-year cumulative cost-effective savings identified by the model are not cost-effective but are included in the potential due to the use of the cost-effective override feature in the model. The analysis identifies the source of these savings at the measure level and identifies which of the two reasons that the CE override feature was applied. Note: the savings amounts shown are outputs taken directly from the model, and represent cost effective savings prior to annual deployment aligned with program goals. This view is consistent with how the impacts of the CE override have previously been communicated, both in the DSM chapter of the CNG IRP and in the IRP presentation delivered at CNG's TAG 3 meeting on September 7, 2017.

**CASCADE NATURAL GAS CORPORATION**  
**Oregon Public Utility Commission**  
**LC 69**  
**2018 IRP**

In summary, 6.54 million of the 20.42 million cost-effective therms identified in the model (32%) are included in the cumulative cost-effective savings potential due to the use of the CE Override. Of the 6.54 million therms, 2.44 million therms (12%) are from measures with an OPUC exception and 4.10 million therms (20%) are from measures that are cost-effective using blended avoided costs, but not CNG-specific avoided costs.

**CASCADE NATURAL GAS CORPORATION**  
**Oregon Public Utility Commission**  
**LC 69**  
**2018 IRP**

Due Date: 03-30-2018

Request No. 47

Date prepared: 3/29/2018

Preparer: Jeremy Ogden

Contact: Mark Sellers-Vaughn

Telephone: (509) 734-4589

47. CNG lists several distribution system planning projects in Appendix I. Please explain what alternative analyses the Company has performed to determine whether the projects are cost effective.
- a. Did the Company evaluate the use of portable compression stations or regulators?

**Response:**

Alternate analysis includes modeling new piping and new\modified regulator stations. Pipe enhancements can consist of replacements, reinforcements, or loops.

At the pressure of many of our distribution systems, the costs of compressor stations outweigh the benefit that could be provided.

**CASCADE NATURAL GAS CORPORATION**  
**Oregon Public Utility Commission**  
**LC 69**  
**2018 IRP**

Due Date: 03-30-2018

Request No. 48

Date prepared: 3/29/2018

Preparer: Jeremy Ogden

Contact: Mark Sellers-Vaughn

Telephone: (509) 734-4589

48. Please describe how GIS and Synergi are integrated for modeling purposes.

**Response:**

The Synergi software can utilize the information stored in GIS to help build models. It can take pipe size, material and location to build a pipe network. GIS can also help identify new pipeline that is not in the Synergi model, so it can be properly added.

**CASCADE NATURAL GAS CORPORATION**  
**Oregon Public Utility Commission**  
**LC 69**  
**2018 IRP**

Due Date: 03-30-2018

Request No. 49

Date prepared: 3/29/2018

Preparer: Jeremy Ogden

Contact: Mark Sellers-Vaughn

Telephone: (509) 734-4589

49. What are the cutoff criteria for when distribution system reinforcements are needed?
- a. Is it related to anticipated flow rates of the pipeline? Age? Safety?

**Response:**

Reinforcements are projects that increase the capacity of the system. From a growth perspective, we take a look at pressure and flow to determine need. Pressure under about 15-20 psi usually will identify an area of our system that may be in need of an upgrade. Many factors play into this and depending on the size and current conditions of the system, this pressure threshold could be different.

Replacements of pipeline due to the integrity (age and safety) are generally separate from projects due to capacity.

**CASCADE NATURAL GAS CORPORATION**  
**Oregon Public Utility Commission**  
**LC 69**  
**2018 IRP**

Due Date: 03-30-2018

Request No. 50

Date prepared: 3/29/2018

Preparer: Jeremy Ogden

Contact: Mark Sellers-Vaughn

Telephone: (509) 734-4589

50. Please provide the Synergi model data (including current distribution system infrastructure, operating pressures, etc) and maps for the three near-term projects described in 8-10.

**Response:**

Please see attached pdf.

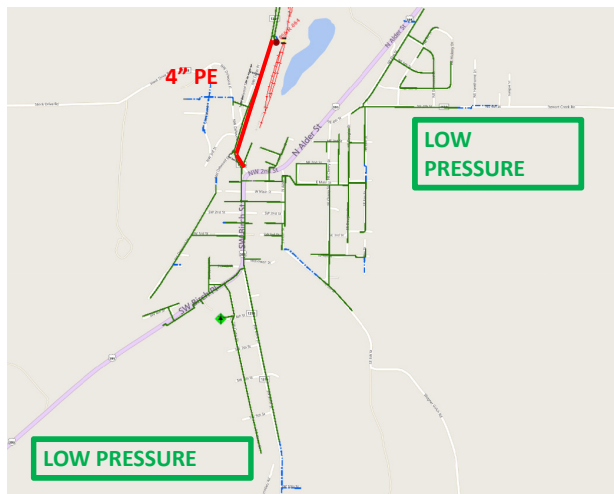


# CNG FUTURE PROJECTS

➤ EXAMPLE UPCOMING GROWTH PROJECTS

Location	2017	2018	2019
Pilot Rock 6" IP PE Reinforcement	\$ 219,566		
Bend 6" HP Steel Reinforcement		\$ 1,930,648	
Bend 4" IP PE Reinforcement			\$ 185,210

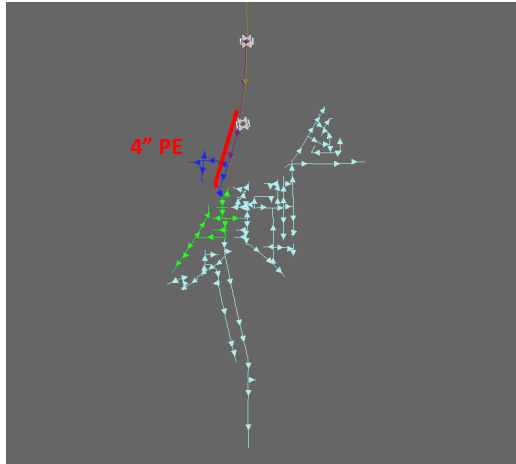
## PILOT ROCK 6" IP PE REINFORCEMENT



- 2017 PROJECT
- 1,950' OF 4" PE
- HAVE EXPERIENCED LOW PRESSURE DURING PEAK HEATING
- ALLOW FOR GROWTH IN SYSTEM

# PILOT ROCK 6" IP PE REINFORCEMENT

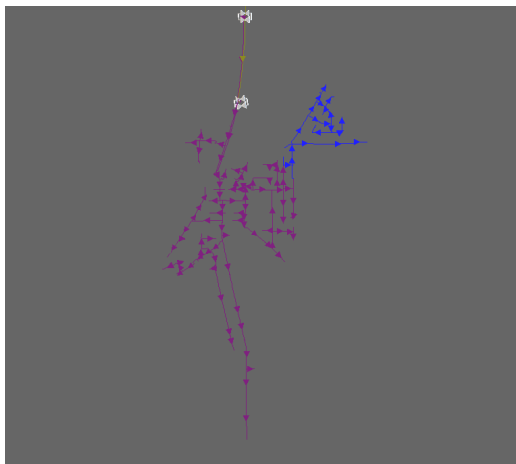
➤ DESIGN DAY PRESSURE BEFORE/AFTER



- Facilities Color By
- Pressure (Primary Only) (psig)
- Not Applicable (72)
- < 0.00 (17)
- 0.00 - 10.00 (158)
- 10.00 - 20.00 (283)
- 20.00 - 30.00 (2044)
- 30.00 - 60.00 (3956)
- 60.00 - 250.00 (285)
- > 250.00 (93)

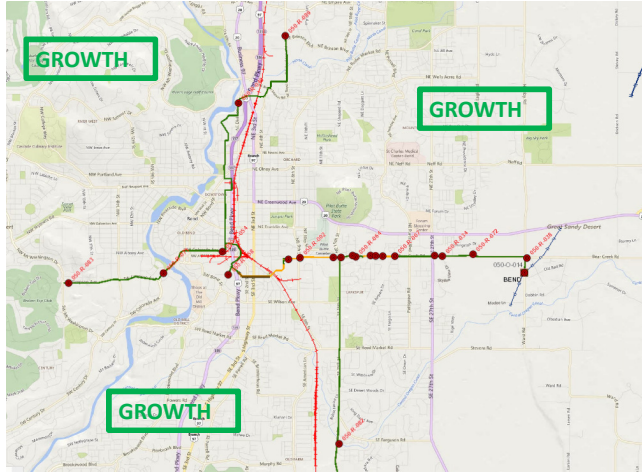
# PILOT ROCK 6" IP PE REINFORCEMENT

➤ DESIGN DAY PRESSURE BEFORE/AFTER



- Facilities Color By
- Pressure (Primary Only) (psig)
- Not Applicable (72)
- < 0.00 (17)
- 0.00 - 10.00 (158)
- 10.00 - 20.00 (283)
- 20.00 - 30.00 (2044)
- 30.00 - 60.00 (3956)
- 60.00 - 250.00 (285)
- > 250.00 (93)

## BEND 6" HP STEEL REINFORCEMENT



- 2018 PROJECT
- 6,400' OF 8" HP STEEL
- PRESSURE LOSS IN HIGH PRESSURE LINES
- ALLOW FOR GROWTH IN THE ENTIRE DISTRICT

## BEND 6" HP STEEL REINFORCEMENT

➤ DESIGN DAY PRESSURE BEFORE/AFTER



- ☑ Facilities Color By
- Pressure (Primary Only) (psig)
- Not Applicable (84)
- < 60.00 (58318)
- 60.00 - 80.00 (12)
- 80.00 - 100.00 (9)
- 100.00 - 150.00 (59)
- 150.00 - 200.00 (33)
- 200.00 - 250.00 (77)
- > 250.00 (213)

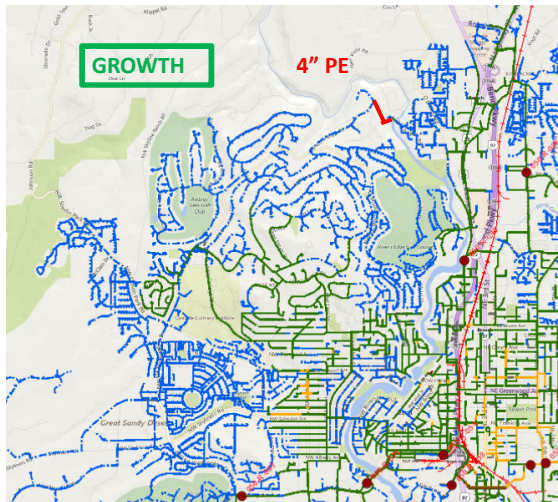
## BEND 6" HP STEEL REINFORCEMENT

➤ DESIGN DAY PRESSURE BEFORE/AFTER



- Facilities Color By
- Pressure (Primary Only) (psig)
- Not Applicable (84)
  - < 60.00 (58318)
  - 60.00 - 80.00 (12)
  - 80.00 - 100.00 (9)
  - 100.00 - 150.00 (59)
  - 150.00 - 200.00 (33)
  - 200.00 - 250.00 (77)
  - > 250.00 (213)

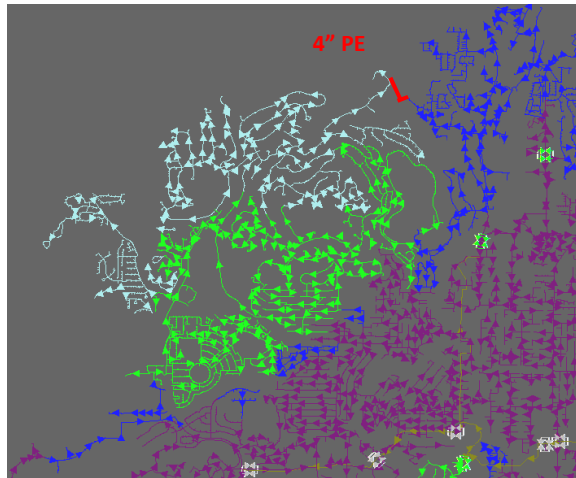
## BEND 4" IP PE REINFORCEMENT



- 2019 PROJECT
- GROWTH ALL OVER THE BEND AREA
- SHORT REINFORCEMENT WILL ENHANCE CAPACITY TO NW AREA

# BEND 4" IP PE REINFORCEMENT

➤ MODEL PRESSURE BEFORE/AFTER PROJECT



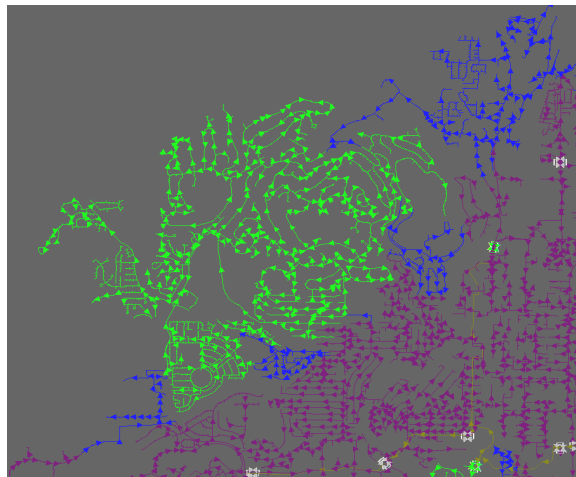
Facilities Color By

Pressure (Primary Only) (psig)

Not Applicable (72)
< 0.00 (17)
0.00 - 10.00 (158)
10.00 - 20.00 (283)
20.00 - 30.00 (2044)
30.00 - 60.00 (3956)
60.00 - 250.00 (285)
> 250.00 (93)

# BEND 4" IP PE REINFORCEMENT

➤ MODEL PRESSURE BEFORE/AFTER PROJECT



Facilities Color By

Pressure (Primary Only) (psig)

Not Applicable (72)
< 0.00 (17)
0.00 - 10.00 (158)
10.00 - 20.00 (283)
20.00 - 30.00 (2044)
30.00 - 60.00 (3956)
60.00 - 250.00 (285)
> 250.00 (93)