TETRA TECH

MEMO

To:	Roxanne Wienkes, Allison Rathsack, Robert Regan
Cc:	Tom Bilgri
From:	Lee Daigle
Date:	June 15, 2021
Subject:	Dane County Landfill Gas and Hydrogen Sulfide Generation Projections

Tetra Tech has compiled a revised Landfill Gas (LFG) recovery projection for Phases 1-12 and Phases 9-12 in conjunction with projections of the anticipated hydrogen sulfide (H2S) loading for these portions of the disposal area with two (2) different waste acceptance compositions. The objective of this effort is to determine the long-term loading requirements for the design of an H2S removal system. It is understood that approximately 5.8% of the currently incoming waste in this area is composed of Construction and Demolition (C&D) fines, which are largely the source of H2S generation. The 2020-2021 projections of H2S generation compare well to the field data provided as noted in the attached Figures.

As requested by Dane County after review of the initial draft Memo, Phases 1-8 were incorporated into the estimation of both landfill gas and H2S recovery. It should be noted that it is likely that the actual generation of both landfill gas and H2S from Phases 1-8 will likely be lower than the projected generation rates as the first-order decay rate model conservatively continues calculations beyond the closure year. This model was developed for actively operating sites and has a larger variance when the site has been closed and ceases waste acceptance.

Tetra Tech also calibrated the model to reflect the production of H2S from the waste mass, again utilizing Cells 9-12 field date primarily from 2020 as it was deemed by your office to be more representative that the available 2021 data, during the May 25, 2021 conference call.

A summary of the modeling projections is provided in the Tables below. Graphic representations of the results are provided as Attachments to this Memo.

Table 1. LFG/H2S Modeling Milestones - Existing Conditions

Parameter	Year	Low Range	High Range
Cells 1-8 Peak LFG	2013	1320 scfm	1730 scfm
Cells 1-8 Peak H2S	2013	120 T/yr	160 T/yr
Cells 9-12 Peak LFG	2031	1680 scfm	2230 scfm
Cells 9-12 Peak H2S	2031	175 T/yr	230 T/yr
Cells 1-12 Peak LFG	2031	2130 scfm	2850 scfm
Cells 1-12 Peak H2S	2031	195 T/yr	260 T/yr

Dane County also presented an option to increase the amount of fines being accepted from approximately 5.8% of the incoming waste stream to 11.6%, effectively doubling the intake of C&D fines. This change was applied with the assumption that it would occur in 2023. The impact of this change on Phases 9-12 and the site as a whole are

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presented below. Note that the projected conditions in Phases 1-8 are not changed and the overall LFG generation/recovery projections are not anticipated to change.

Table 2. H2S Modeling Milestones – Modified Conditions

Parameter	Year	Low Range	High Range
Cells 9-12 Peak H2S	2031	305 T/yr	405 T/yr
Cells 1-12 Peak H2S	2031	325 T/yr	435 T/yr

The relative concentration of H2S in the LFG stream is expected to vary as the generation rate of LFG and H2S are not equivalent. It was previously reported that the aggregate concentration of H2S from Phases 9-12 is approximately 5,000 ppmv. It is anticipated that this rate will degrade over time, as the sulfur-bearing substrate is consumed more rapidly than the organic components in the MSW.

Based upon these projections, and the operating conditions previously defined, Tetra Tech recommends exploring options for an H2S removal system with a loading capacity of approximately 500 tons per year and the ability to operate at a lower range of approximately 200 tons per year. An alternative to this would be to stage in the development of the system components, to increase capacity as the waste mass is further developed. This option has the added benefit of spacing capital expenditures across a longer period to reduce the initial financial burden of a full system installation.

These design options have pros and cons and depend on the type of treatment system implemented, available funding mechanisms, regulatory ease for permitting and various other aspects of capital expenditure management. Tetra Tech has conducted a number of these evaluations previously and would be please to assist Dane County in exploring viable options for long-term H2S treatment. It is recommended that this analysis be performed prior to issuing a Request for Bids for an H2S treatment system as it will provide you the best approach for Dane County rather than relying on a Contractor on a bid-based system design.

Att: Figure 1 – Dane County Phases 1-8 - LFG and H2S Recovery Projection

Figure 2 – Dane County Phases 9-12 - LFG and H2S Recovery Projection (Current Loading)

Figure 3 – Dane County Phases 1-12 - LFG and H2S Recovery Projection (Current Loading)

Figure 4 – Dane County Phases 9-12 - LFG and H2S Recovery Projection (Modified Loading)

Figure 5 – Dane County Phases 1-12 - LFG and H2S Recovery Projection (Modified Loading)

Figure 6 – Dane County Phases 1-12 - H2S Concentration Projection (Current and Modified Loading)

Figure 1
Dane County Phases 1-8 - LFG and H2S Recovery Projection

FIGURE 1

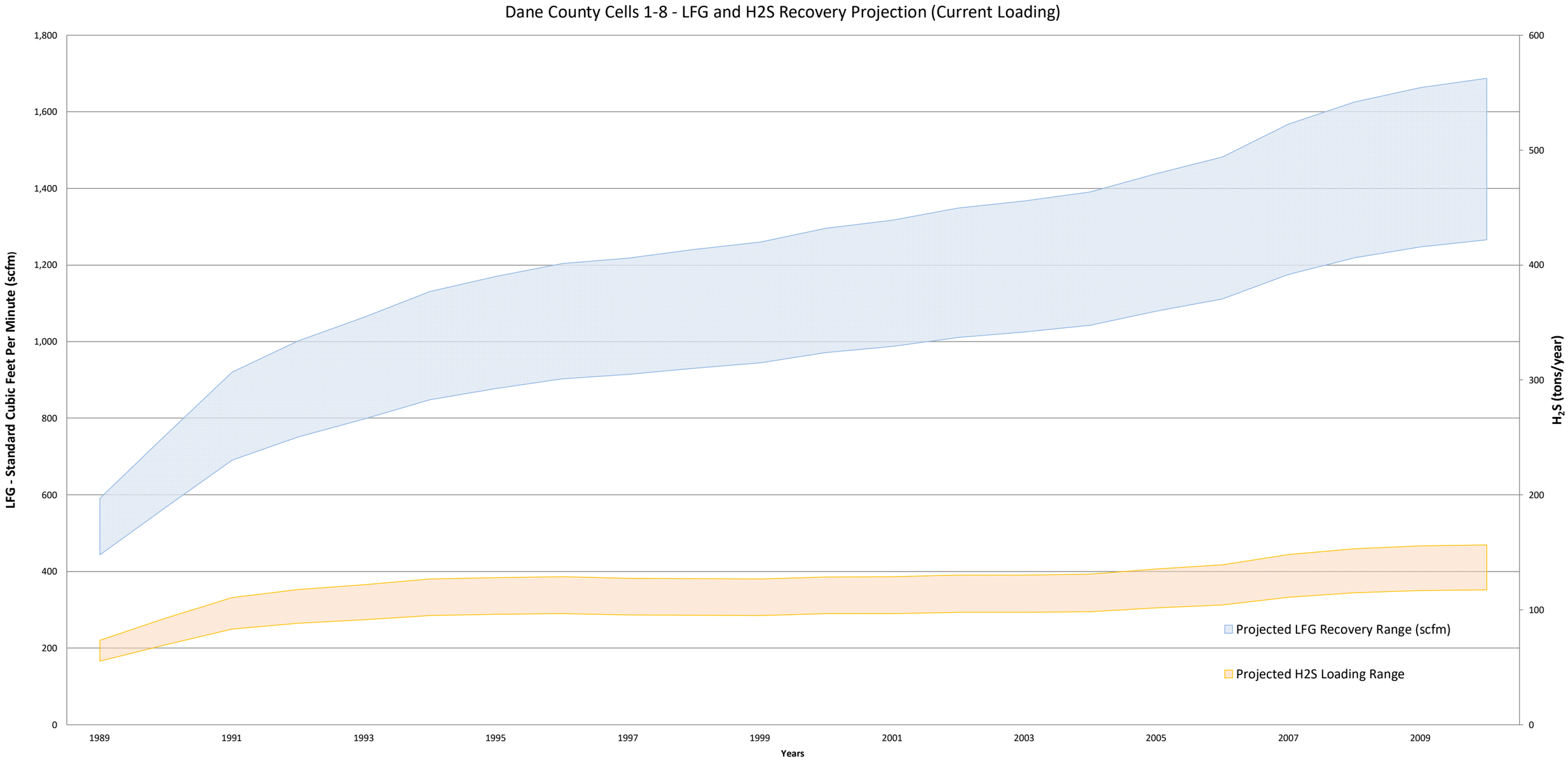

Dane County Cells 1-8 - LFG and H2S Recovery Projection (Current Loading)
LFG - Standard Cubic Feet Per Minute (scfm)
H2S (tons/year)
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
600
500
400
300
200
100
0
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
Years
Projected LFG Recovery Range (scfm)
Projected H2S Loading Range

Figure 2

Dane County Phases 9-12 - LFG and H2S Recovery Projection

(Current Loading)

FIGURE 2

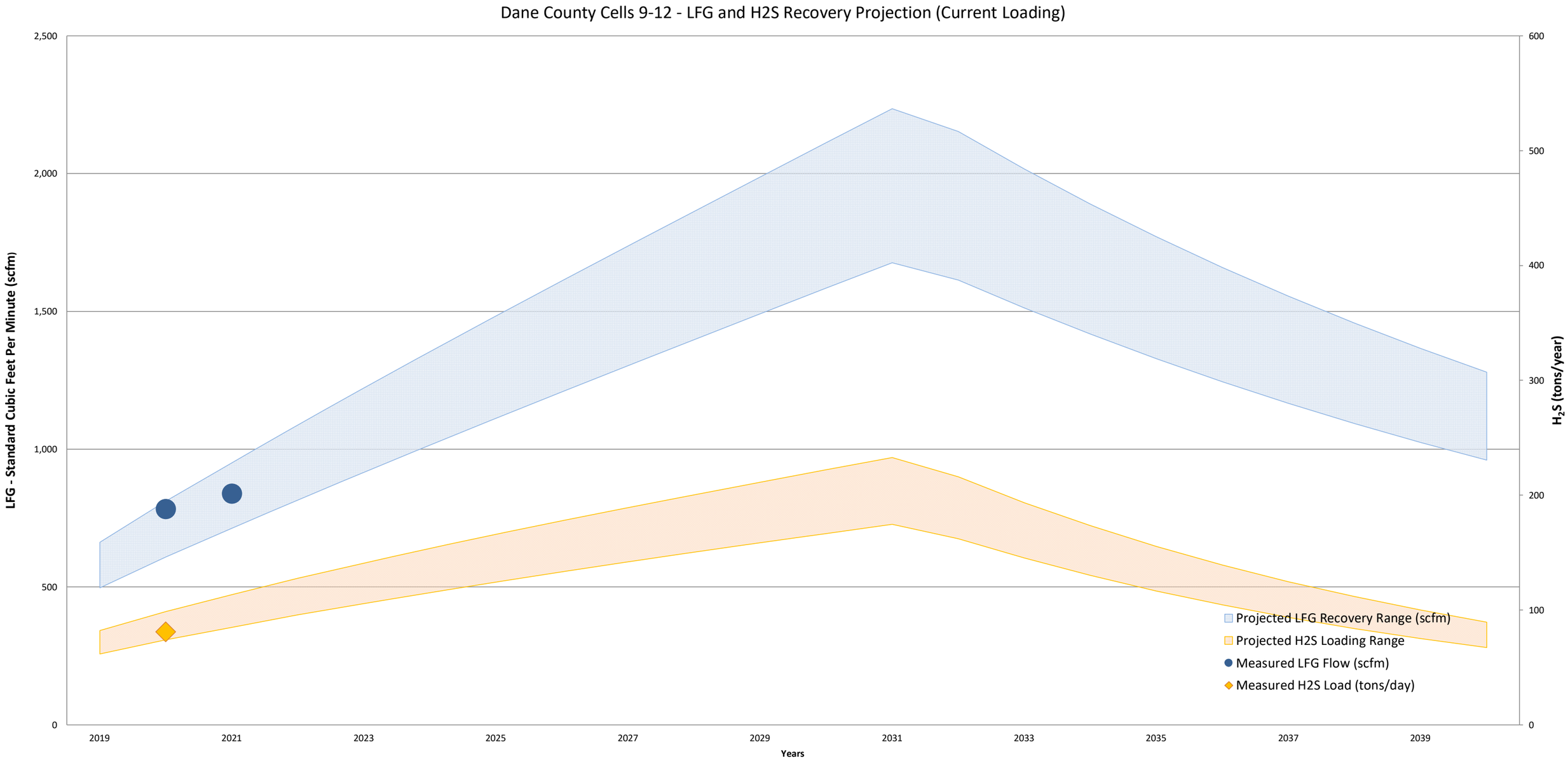

Dane County Cells 9-12 - LFG and H2S Recovery Projection (Current Loading)
LFG - Standard Cubic Feet Per Minute (scfm)
H2S (tons/year)
2,500
2,000
1,500
1,000
500
0
600
500
400
300
200
100
0
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
Years
Projected LFG Recovery Range (scfm)
Projected H2S Loading Range
Measured LFG Flow (scfm)
Measured H2S Load (tons/day)

Figure 3
Dane County Phases 1-12 - LFG and H2S Recovery Projection
(Current Loading)

FIGURE 3

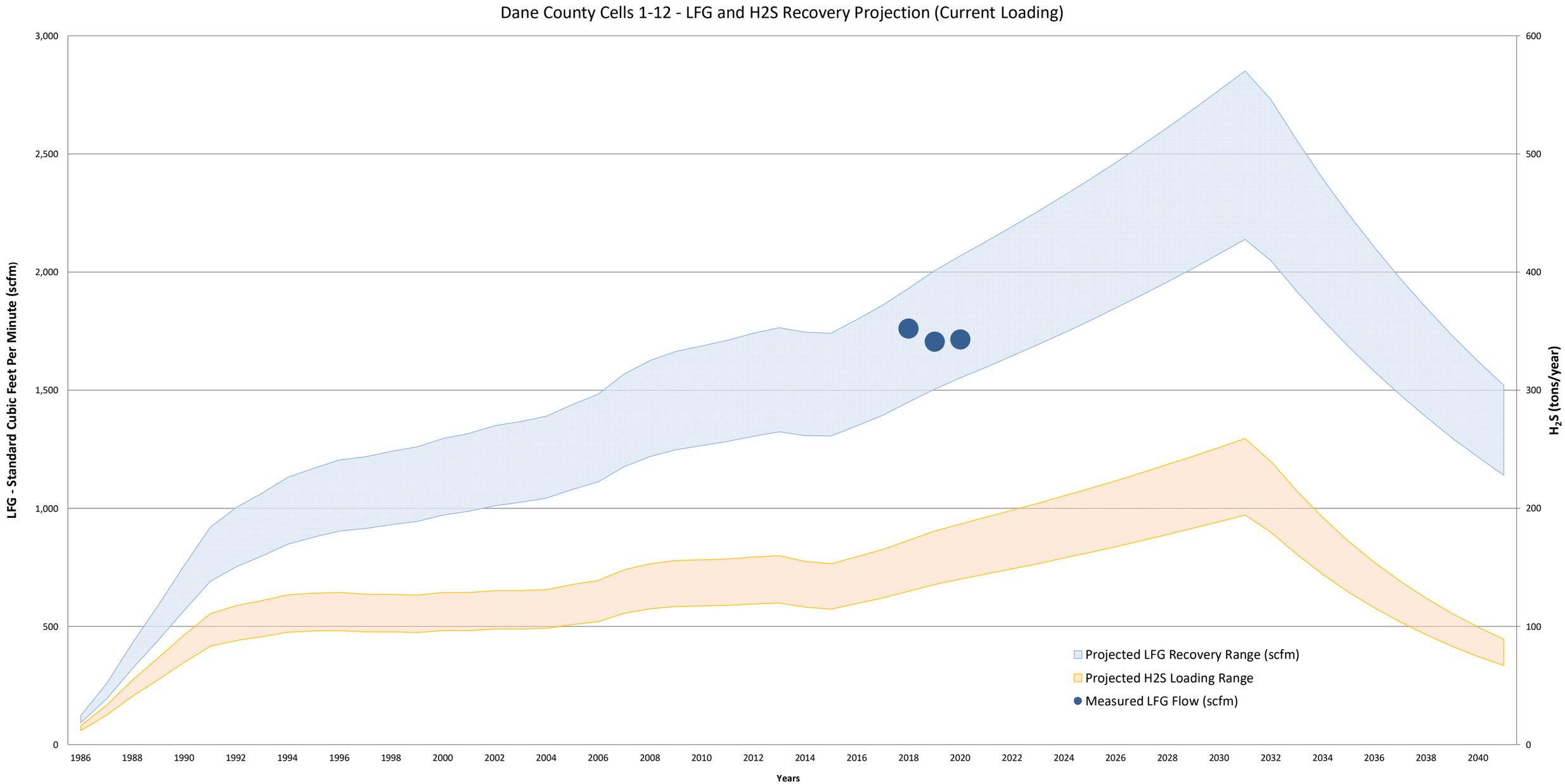

Dane County Cells 1-12 - LFG and H2S Recovery Projection (Current Loading)
LFG - Standard Cubic Feet Per Minute (scfm)
H2S (tons/year)
3,000
2,500
2,000
1,500
1,000
500
0
600
500
400
300
200
100
0
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
Years
Projected LFG Recovery Range (scfm)
Projected H2S Loading Range
Measured LFG Flow (scfm)

Figure 4
Dane County Phases 9-12 - LFG and H2S Recovery Projection
(Modified Loading)

FIGURE 4

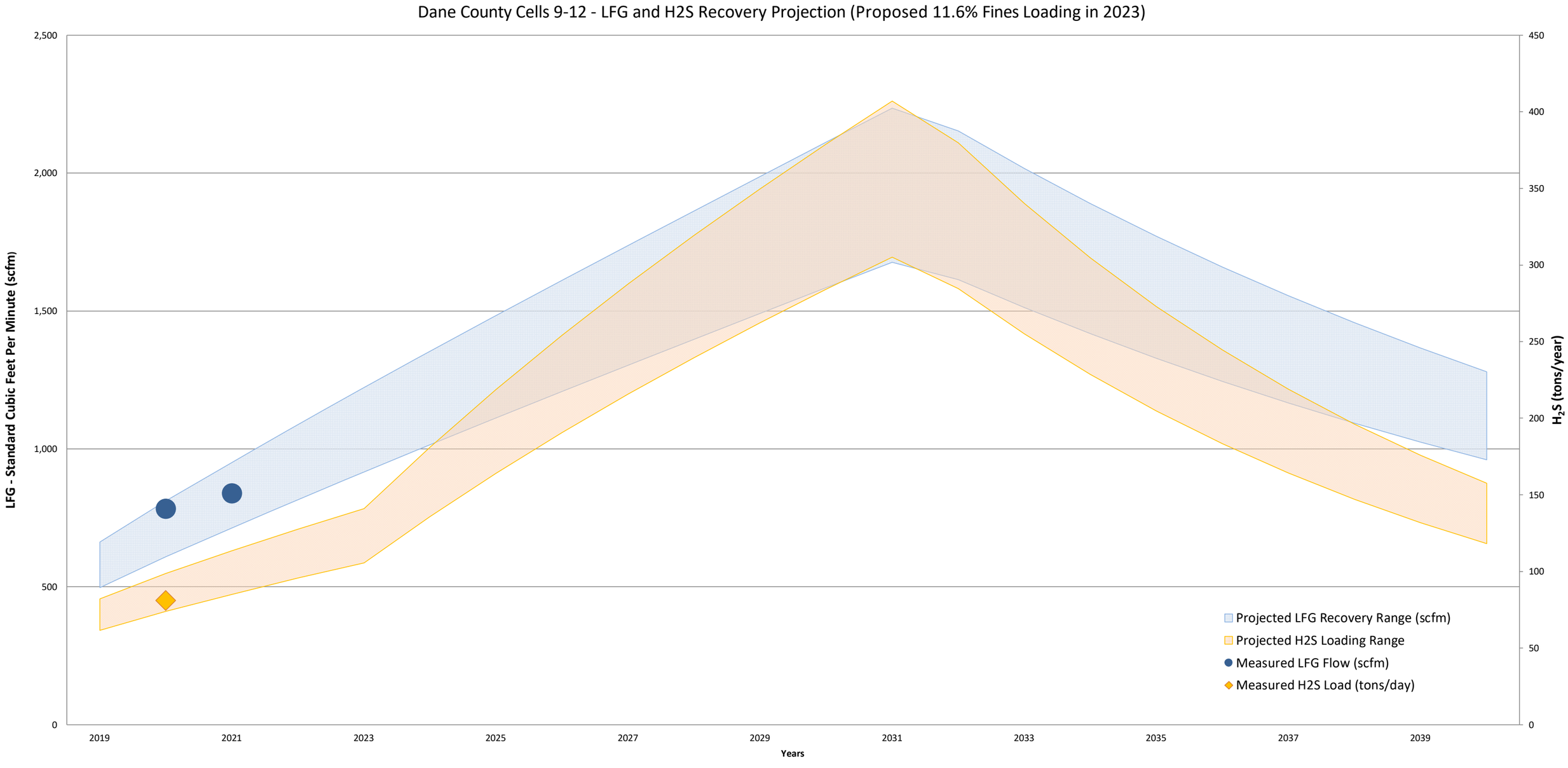

Dane County Cells 9-12 - LFG and H2S Recovery Projection (Proposed 11.6% Fines Loading in 2023)
LFG - Standard Cubic Feet Per Minute (scfm)
H2S (tons/year)
2,500
2,000
1,500
1,000
500
0
450
400
350
300
250
200
150
100
50
0
2019
2021
2023
2025
2027
2029
2031
2033
2035
2037
2039
Years
Projected LFG Recovery Range (scfm)
Projected H2S Loading Range
Measured LFG Flow (scfm)
Measured H2S Load (tons/day)

Figure 5
Dane County Phases 1-12 - LFG and H2S Recovery Projection
(Modified Loading)

FIGURE 5

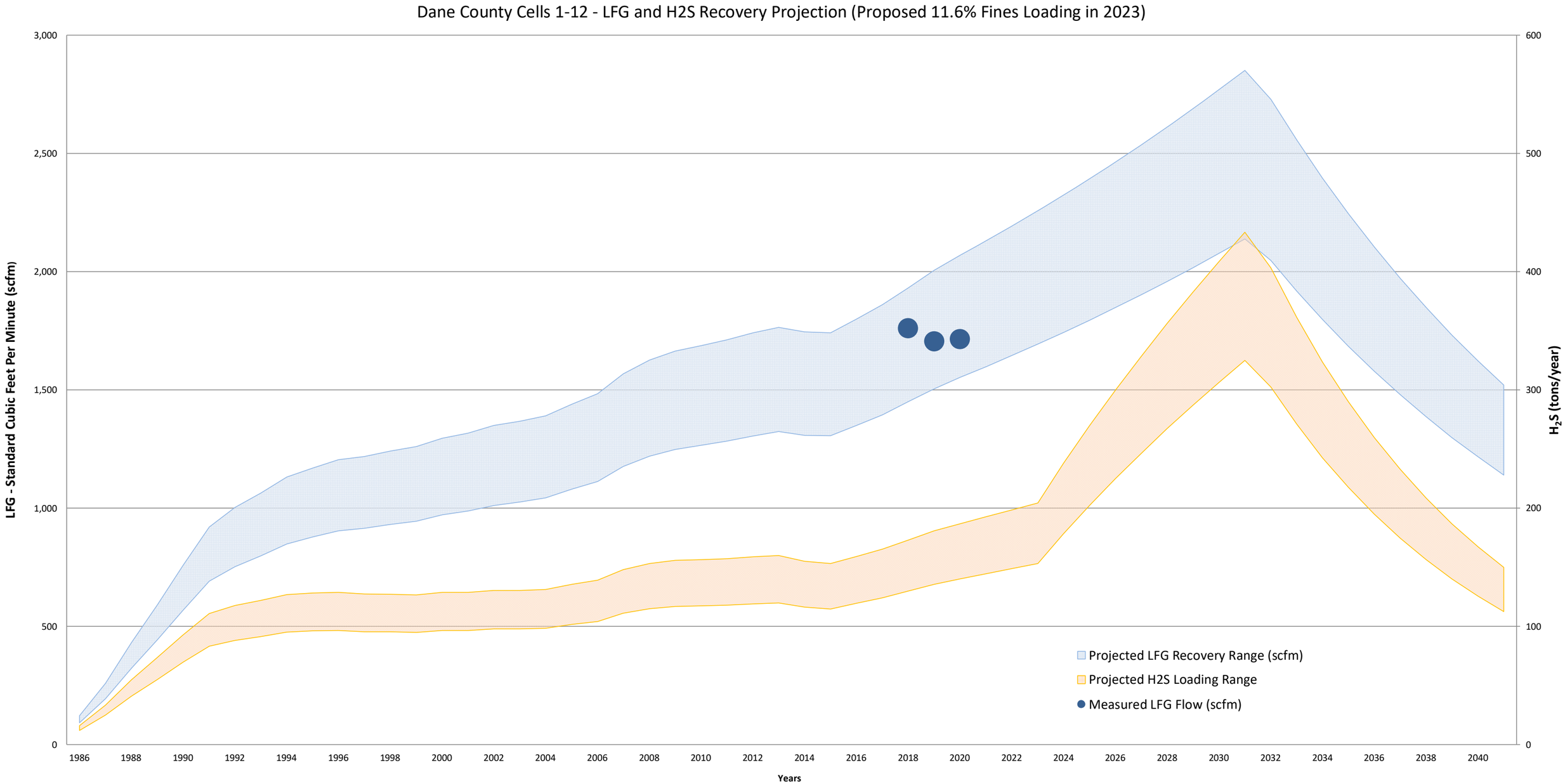
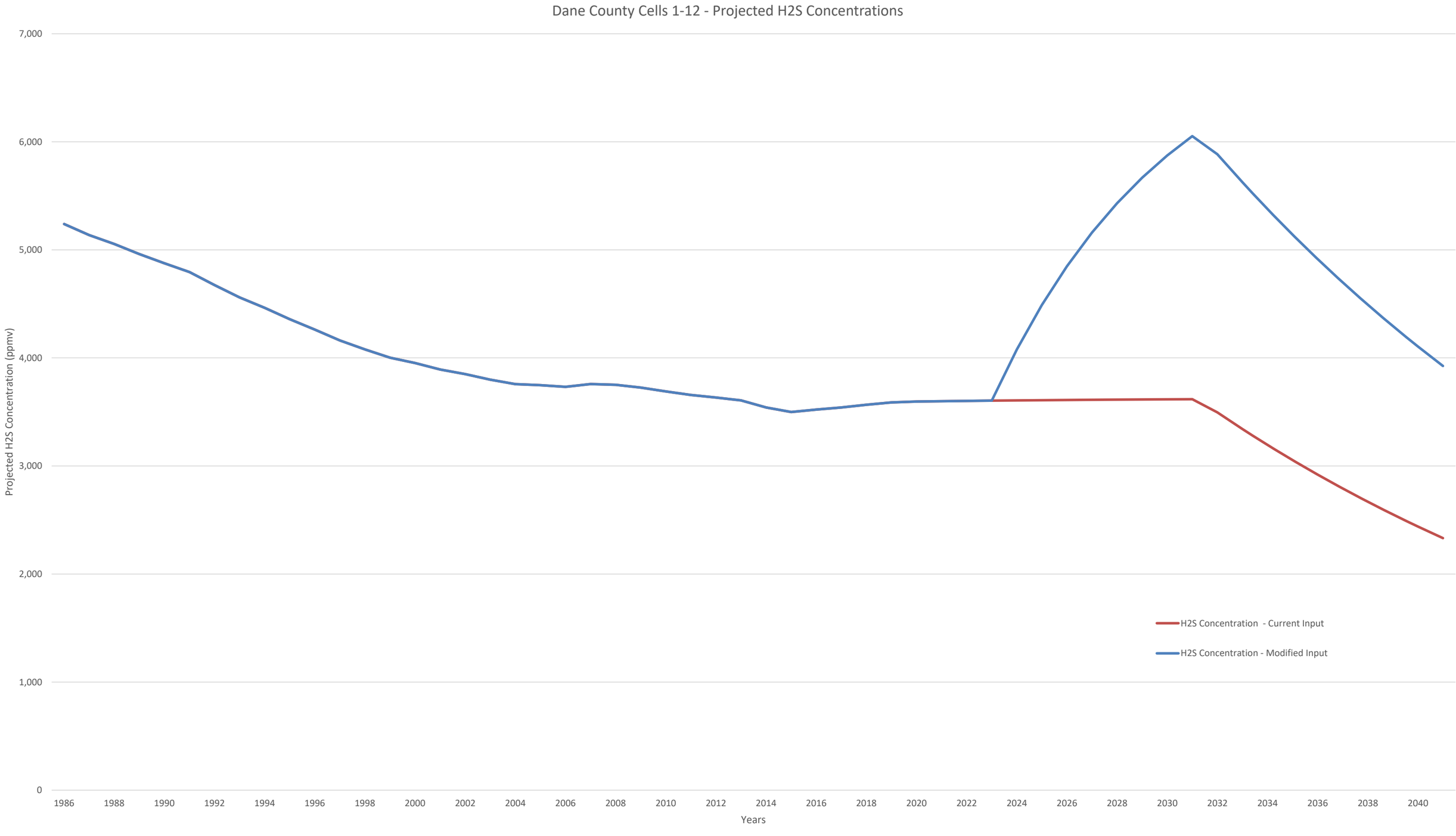

Dane County Cells 1-12 - LFG and H2S Recovery Projection (Proposed 11.6% Fines Loading in 2023)
LFG - Standard Cubic Feet Per Minute (scfm)
H2S (tons/year)
3,000
2,500
2,000
1,500
1,000
500
0
600
500
400
300
200
100
0
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
Years
Projected LFG Recovery Range (scfm)
Projected H2S Loading Range
Measured LFG Flow (scfm)

Figure 6

Dane County Phases 1-12 - H2S Concentration Projection

(Current and Modified Loading)

FIGURE 6


Dane County Cells 1-12 - Projected H2S Concentrations
Projected H2S Concentration (ppmv)
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
2024
2026
2028
2030
2032
2034
2036
2038
2040
Years
H2S Concentration - Current Input
H2S Concentration - Modified Input