

US EPA ARCHIVE DOCUMENT

Preliminary Estimate of Number of Wells

The Ramsey plant is located near several previously CO₂ flooded fields in the Delaware and Permian Basins. Among these are four that are closest to the plant:

- Ford Geraldine (average well depth 2,680 ft)
- E Ford (average well depth 2,580 ft)
- Two Freds (average well depth 4,900 ft)
- N. Elmar (average well depth 4,500 ft)

Technical Issues

The four fields listed above already have additional CO₂ stored in them after the floods were ended or are ending, which reduces the available capacity.

Other factors that have to be considered include:

- 1- The status of pressure in the fields above to inject this gas
- 2- Presence of pipeline to connect to the field for injection
- 3- Presence of a competent injection well(s) to use or drilling new wells
- 4- The status of the fields to use for storing the small amount of CO₂ is unknown,

Status of Two Freds field- the field already CO₂ flooded in the Delaware zone starting in 1974 with 9 injectors and 32 producing wells. The CO₂ was injected in the Delaware and the Ramsey zones at a depth of 4900 ft. The field was water flooded with an estimated oil saturation of 50%. The CO₂ flood was economically successful and ended in the 1980's. This means that we have to set pipe line to the field and test all 9 injectors (1974 vintage) for use in the 10.3 MMSCF/d CO₂ injection. If they are not competent we need to workover or drill new well(s). In addition, a pipeline will be needed and depending on the reservoir pressure a compressor needed to pressure the CO₂ to miscibility pressure of the 35 API oil still in the field.

Elmar field is in Loving Co, Texas. CO₂ was started in 4/1994 in Delaware zone with 20 injectors and 16 producers. The flood was unsuccessful and discontinued a few years later as it proved uneconomic. This means that the field would need the most testing of wells completions and zone isolation. Pressures required to determine the size of compressor needed and for pipe line would also be required.

E. Ford Field: the field is in Reeves Co. Flooding with CO₂ started in the Delaware and Ramsey zones in 7/1995 through 4 injectors and 8 producers at average depth of 2580 ft. The flood was discontinued due to low economic benefits, despite the fact that tests show the 40 API oil was displaced from an oil saturation of 49% to 35% at the end of the injection. Like the case for Elmar field, careful testing of the test data needed before disposing the CO₂ in this field.

Ford Geraldine Field: the field extends in Reeves and Culberson County. The CO₂ injection started in February 1981 after staged water flooding. CO₂ was injected in Bell Canyon group of Reeves and the old zones. The two zones are separated by the Ford Shale. Water flood started in 1956 after primary production. Original pressure was 1493 psig and the field produced by solution gas drive until water flood started in 1972-1980 in 3-4 stages. Once again the wells were drilled and completed starting in 1956 to 1981 with some injectors drilled before CO₂ flooding in 1981. A total of 69 injection wells and 92 producers were completed in the two zones for CO₂ flooding.

The CO₂ flood started after waterflooding with the pressure raised to a level exceeding 900-1100 psig miscibility pressure needed for the CO₂ to be in solution in the oil to displace it. Due to CO₂ supply problems CO₂ injection was erratic with reduced rates until the end of 1985. CO₂ rates increased to 20-25 MMSCF/D in 69 injection wells.

Number of wells needed for injection:

To inject the remaining 10.83 MMSCF/D a number of wells will be needed. To find that assuming CO₂ storage in one of the four fields, we assumed the Ford Geraldine field average well. At the highest level we needed 69 wells to inject 20-25 MMSCF/D. Therefore:

The CO₂ rate per injection well = $23000/69 = 334$ MSCF/D.

This then means that the injection rate per well in the four Delaware basin fields is in range of 400 MSCF/D. Taking that total CO₂ injection rate in the four fields are as follows:

Reservoir	# Injection wells	# Producing wells	total CO ₂ MMSCF/D
Two Freds	9	32	3.6
Elmar	20	16	8.0
E.Ford	4	8	3.2
FordGeraldine	69	92	23.0 -27.5

These total rates are representative of the total CO₂ injected. So, to inject 10.83 MMSCF/d of CO₂ we will need:

No. of wells = $10830/400 = 27$ wells.

It could be possible to increase the injectivity by as much as 100%, through the use of deviated or horizontal wells. Although there are addition costs associated with these types of wells, including the need to frac the formation. Even if horizontal wells were used, we would still need 14 improved wells.