Appendix A

Public Review Comments

WEBVTT

1
00:00:03.240 --> 00:00:07.470
Kathryn Lehr, Supervising Planner: Thank you, and, as you may have heard we're going to be recording this.

2
00:00:09.150 --> 00:00:16.830
Kathryn Lehr, Supervising Planner: And this For those of you who are here, hopefully know what you're here for it's the north fork ranch frost ponds project environmental hearing.

3
00:00:17.279 --> 00:00:24.270
Kathryn Lehr, Supervising Planner: The draft Dir was released in mid November, and we are currently in the midst of the public comment period.

4
00:00:24.870 --> 00:00:37.020
Kathryn Lehr, Supervising Planner: And so, with that i'm going to hand it over to Steve Rodriguez, who is the planner for this project what you will see, on your screen as a PowerPoint that will pop up and Steve will be presenting.

5
00:00:37.830 --> 00:00:46.860
Kathryn Lehr, Supervising Planner: Once we've wrapped up we're going to have time for public comment and we're asking that folks limit their comments to about three to five minutes.

6
00:00:47.400 --> 00:00:56.520
Kathryn Lehr, Supervising Planner: And we are just taking public comments, this is not going to be any back and forth we're not going to be responding to questions.

7
00:00:56.940 --> 00:01:02.370
Kathryn Lehr, Supervising Planner: And so we're going to be taking notes and, of course, feel free to submit comments.

8
00:01:03.360 --> 00:01:16.800
Kathryn Lehr, Supervising Planner: The email address where you can submit your comments or mail your comments to will be on one of the last slides and we can keep that up for those of you that need it so with that i'm going to share my screen here and get this going.

9
00:01:19.770 --> 00:01:20.550
Steve Rodriguez, Planner: Thank you Kathy.

10

00:01:25.290 --> 00:01:44.460
Steve Rodriguez, Planner: All right, well as well, good evening everybody and welcome to as Catherine mentioned it's an environmental hearing for the draft environmental impact report that was prepared for the North fork ranch frost ponds project next likely.

11
00:01:47.220 --> 00:01:56.100
Steve Rodriguez, Planner: Just by way of some quick introductions the meeting tonight is being conducted by the Santa Barbara county planning and development review.

12
00:01:56.790 --> 00:02:09.510
Steve Rodriguez, Planner: planning and development department development review division and joining us tonight we have deputy director travis the words Catherine layer supervising planner who will be facilitating.

13
00:02:10.740 --> 00:02:19.590
Steve Rodriguez, Planner: The festivities tonight and i'm Steve Roger guess on the contract planner who has been helping the county process the.

14
00:02:20.160 --> 00:02:31.530
Steve Rodriguez, Planner: Conditional use permit that is required for this project and the project applicant is Brody Dr Brody er maybe somebody can help me with that the.

15
00:02:32.040 --> 00:02:44.370
Steve Rodriguez, Planner: Correct pronunciation later and the the project age project applicant is being represented by urban planning concepts, I think they're here tonight as well next slide please.

16
00:02:45.420 --> 00:02:54.990
Steve Rodriguez, Planner: So the purpose of tonight's meeting is to obtain comments that you may have on the draft environmental impact report and those comments should.

17
00:02:56.610 --> 00:03:13.440
Steve Rodriguez, Planner: be oriented towards the adequacy of the analysis in the E ir the completeness of the analysis, the proposed mitigation measures, the alternatives in the er were no decisions about the project are going to be made tonight.

18
00:03:14.820 --> 00:03:26.520
Steve Rodriguez, Planner: So you know, if you like, the project or don't like the project, you know that's that's not what we're going to be discussing tonight, we would ask that you save those comments for.

19
00:03:27.180 --> 00:03:37.920
Steve Rodriguez, Planner: Later hearing that would be held by the Santa Barbara county planning Commission while so they way and the benefits and.

20
00:03:39.870 --> 00:03:46.590
Steve Rodriguez, Planner: The project and we'll make a determination, whether it is approved or not next slide please.

21
00:03:47.850 --> 00:04:00.780
Steve Rodriguez, Planner: So I just a quick overview of the project and the proposal is to construct and operate three water storage reservoirs on the North fork ranch.

22
00:04:01.710 --> 00:04:23.730
Steve Rodriguez, Planner: In the outline of the ranch is shown in red on on this slide but location of the reservoirs are those yellow dots I hope you can see those the reservoirs are located on the southern side of state route 166 sort of distributed throughout the property.

23
00:04:25.500 --> 00:04:29.340
Steve Rodriguez, Planner: The reservoirs would store water that would be used to.

24
00:04:31.770 --> 00:04:59.430
Steve Rodriguez, Planner: buy by an existing frost protection system, the system sprays water over the grapevines it, it allows us thin layer of ice to form and the ice axe as insulation and as the ice melts actually releases some heat and that protects the grapevines you know, during frost conditions.

25
00:05:01.170 --> 00:05:13.170
Steve Rodriguez, Planner: The three reservoirs are being proposed each would have a capacity to store about 44 acre feet of water each reservoir will occupy an area of about five acres.

26
00:05:14.940 --> 00:05:22.950
Steve Rodriguez, Planner: The reservoirs would be maintained in a full condition during the month of February and March and April.

27
00:05:28.950 --> 00:05:36.690
Steve Rodriguez, Planner: Alright, and then during the rest of the year there'll be about three feet of water stored in the reserve force next slide.

28
00:05:39.270 --> 00:05:40.410
Steve Rodriguez, Planner: Go ahead we skipped one.

29
00:05:42.270 --> 00:05:45.270
Steve Rodriguez, Planner: Oh okay September 25.

30
00:05:46.560 --> 00:05:47.220
Steve Rodriguez, Planner: The.

31
00:05:48.360 --> 00:06:06.510
Steve Rodriguez, Planner: zoning administrator for the planning and development department approved the project and accepted the mitigated negative declaration that had been prepared for the proposed project, the zoning administrators approval was appealed to the planning Commission.

32
00:06:07.560 --> 00:06:24.360
Steve Rodriguez, Planner: In October of 2017 and then in September of 2018 the planning Commission reviewed the project and requested that a focus the ir be prepared for the project, and at that he.

33
00:06:26.160 --> 00:06:46.410
Steve Rodriguez, Planner: evaluates three environmental aspects of the project and those included evaporation of water losses from the operation of the proposed frost protection system, a prompt potential impacts, the biological resources and potential flooding impacts.

34
00:06:48.810 --> 00:06:50.100
Steve Rodriguez, Planner: Next.

35
00:06:53.130 --> 00:06:58.020
Steve Rodriguez, Planner: So the planning commission's decision was then appeal to the board of supervisors.

36
00:06:59.760 --> 00:07:05.910
Steve Rodriguez, Planner: Is in September of 2018 the board heard the appeal in early.

37
00:07:07.950 --> 00:07:15.810
Steve Rodriguez, Planner: The Board concurred with the planning commission's decision that the focus the ir should be prepared for the project.

38

00:07:17.340 --> 00:07:18.120
Steve Rodriguez, Planner: Okay next slide.

39
00:07:22.350 --> 00:07:28.080
Steve Rodriguez, Planner: So the environmental impact report has been prepared the draft is now out for public review.

40
00:07:28.980 --> 00:07:35.130
Steve Rodriguez, Planner: And the conclusions rich briefly go over some of the conclusions of the E ir tonight.

41
00:07:35.520 --> 00:07:48.750
Steve Rodriguez, Planner: II II identified a variety of different potentially significant impacts related to biology flooding and groundwater use and determine that each of those identified environmental effects.

42
00:07:49.080 --> 00:07:57.120
Steve Rodriguez, Planner: can be reduced to a less than significant level with the implementation of identified mitigation measures, an expert.

43
00:07:58.680 --> 00:08:01.110
Steve Rodriguez, Planner: So we'll start with biological resources.

44
00:08:03.570 --> 00:08:15.660
Steve Rodriguez, Planner: And one of the first categories of impacts, we evaluated by the E ir what is the potential for the project to result in impacts that special status plants and animals.

45
00:08:16.170 --> 00:08:31.920
Steve Rodriguez, Planner: It was concluded that the project would not impact any special status plants, but the project could result in although unloading very unlikely would have the potential to result in impacts to send walking kit fox.

46
00:08:33.090 --> 00:08:39.060
Steve Rodriguez, Planner: And mitigation measures were proposed to reduce those impacts to less than significant level.

47
00:08:40.470 --> 00:08:42.870
Steve Rodriguez, Planner: The project would have the potential to.

48
00:08:43.980 --> 00:09:03.510

Steve Rodriguez, Planner: result in impacts to some special status reptiles that have a low potential to be on the project site and mitigation measures for those impacts were to conduct pre construction surveys and monitoring during construction.

49
00:09:04.740 --> 00:09:10.140
Steve Rodriguez, Planner: kind of similar to San Joaquin kit fox whether the project would have the potential to.

50
00:09:10.740 --> 00:09:29.430
Steve Rodriguez, Planner: Impact American badger again mitigation measures have been proposed and mitigation measures were also proposed to reduce impacts potential for impacts to nesting births that could be on or near the project site.

51
00:09:30.900 --> 00:09:32.850
Steve Rodriguez, Planner: Next, so.

52
00:09:34.140 --> 00:09:37.140
Steve Rodriguez, Planner: sort of the second category or second.

53
00:09:38.160 --> 00:09:41.160
Steve Rodriguez, Planner: types of impacts that were evaluated by the er.

54
00:09:42.270 --> 00:09:58.800
Steve Rodriguez, Planner: Were what the I are described as wildlife movement, but are really potential impacts that could result from increased human activity in the project area or impacts.

55
00:09:59.340 --> 00:10:13.350
Steve Rodriguez, Planner: To wildlife just from the presence of the reservoirs themselves and those impacts can could be reduced to a less than significant level by prohibiting the use of rodin decides primarily.

56
00:10:14.370 --> 00:10:15.990
Steve Rodriguez, Planner: In it, and that.

57
00:10:17.760 --> 00:10:34.830
Steve Rodriguez, Planner: type of impacted occur if rodents were burrowing into the D embankments that form the reserve force and then, once again, ongoing monitoring during construction activities to.

58
00:10:36.090 --> 00:10:55.740

Steve Rodriguez, Planner: to minimize the potential for impacts and then, lastly, that impact that was identified was the potential to result in the either removal or impacts to a native grassland area that was identified near proposed reservoir number three.

59
00:10:58.320 --> 00:11:20.220
Steve Rodriguez, Planner: Now those impacts could be can be reduced to a less than significant level by replacing impacted grassland area and impacted buffer area at specified ratios and implementing a habitat restoration.

60
00:11:21.960 --> 00:11:22.530
Steve Rodriguez, Planner: Next slide.

61
00:11:27.810 --> 00:11:45.660
Steve Rodriguez, Planner: One of the other environmental issue areas that was evaluated was the potential for the project to result in flooding impacts and when I say I flooding up the project is not in 100 year flood plain, it is near the quijano river, but a floodplain is.

62
00:11:46.710 --> 00:11:55.830
Steve Rodriguez, Planner: Like 100 year flood type of event is is not going to affect the reservoirs what we are.

63
00:11:57.600 --> 00:12:13.380
Steve Rodriguez, Planner: concerned about, or what was evaluated was the potential for a reservoir berm to fail and release water and failure could result from the erosion of an embankment or.

64
00:12:14.700 --> 00:12:29.130
Steve Rodriguez, Planner: Seismic event or water pressure within the resin for those types of or the excuse me, the drainage system that would be constructed around the perimeter of the reservoirs.

65
00:12:30.300 --> 00:12:34.410
Steve Rodriguez, Planner: The evaluation identified.

66
00:12:36.120 --> 00:12:49.350
Steve Rodriguez, Planner: impacts that could result mitigation measures that would reduce those impacts and those mitigation measures include things like preparing operation and maintenance plan that would.

67
00:12:51.210 --> 00:13:00.900
Steve Rodriguez, Planner: require periodic inspections of the reservoirs identify when corrective actions would be required.

68
00:13:02.100 --> 00:13:11.490
Steve Rodriguez, Planner: Either clarify the proposed drainage plans to correct some minor in consistencies in the design.

69
00:13:14.610 --> 00:13:18.330
Steve Rodriguez, Planner: items like that go to the next slide please.

70
00:13:20.970 --> 00:13:22.740
Steve Rodriguez, Planner: Once again, another.

71
00:13:24.330 --> 00:13:28.950
Steve Rodriguez, Planner: aspect of of the flooding impact again this, this was a.

72
00:13:30.600 --> 00:13:35.850
Steve Rodriguez, Planner: potential impacts from a seismic event an earthquake or.

73
00:13:37.830 --> 00:13:56.850
Steve Rodriguez, Planner: The erosion of the embankments themselves and the recommendation was that the project plans be reviewed by a geotechnical engineer, and any recommendations that the engineer has be implemented in the final grading plans for the project okay next slide please.

74
00:13:58.740 --> 00:14:11.760
Steve Rodriguez, Planner: And then the last environmental issue area that was evaluated in the E ir is the projects impacts related to its groundwater use and this evaluation was was based on.

75
00:14:12.570 --> 00:14:27.480
Steve Rodriguez, Planner: A three general principles, the first one is that the project va va project isn't the construction and operation of the proposed reservoirs and the associated operation of the frost.

76
00:14:28.710 --> 00:14:29.970
Steve Rodriguez, Planner: protection system.

77
00:14:31.710 --> 00:14:37.290
Steve Rodriguez, Planner: The second is the groundwater, that is used to irrigate the vineyard is not.

78

00:14:38.130 --> 00:14:53.490
Steve Rodriguez, Planner: Part of the project and the water that irrigate the vineyard is not counted towards the groundwater use threshold of significance that has been adopted by the county for the query Alma groundwater basis.

79
00:14:53.910 --> 00:15:05.610
Steve Rodriguez, Planner: And that threshold is 31 acre feet of water per year, so if the project, the project were to use more than 31 acre feet of water.

80
00:15:06.270 --> 00:15:22.260
Steve Rodriguez, Planner: That would be a significant environmental impact and then lastly evaporated losses from the reservoirs and the operation of the spray irrigation system provides frost protection do not irrigate the vineyards.

81
00:15:26.760 --> 00:15:36.960
Steve Rodriguez, Planner: So evaporated losses that results from the operation of the reservoirs and the operation of the frost protection system, those are counted towards the.

82
00:15:37.650 --> 00:16:01.170
Steve Rodriguez, Planner: Are or are applicable to the threshold of significance so with those basic principles as the basis for the water use impact analysis evaluation of the projects evaporated evaporated of losses considered for potential sources more potential method ways that.

83
00:16:02.220 --> 00:16:09.990
Steve Rodriguez, Planner: impacts could occur, and so the first one is that water would evaporate from the surface of the reservoirs.

84
00:16:11.640 --> 00:16:33.630
Steve Rodriguez, Planner: The second is water that is sprayed on the grapevines that subsequently drops to the ground and evaporates that water is lost and it's not benefiting the vines, so that again is counted towards the significant threshold.

85
00:16:35.100 --> 00:17:00.810
Steve Rodriguez, Planner: water that is sprayed on the on the vines drops to the ground but infiltrates and percolates deep into the ground that could be used by the vines it doesn't evaporate and so that aspect of the spray irrigation frost protection system is not counted towards the significance threshold.

86
00:17:02.340 --> 00:17:24.480

Steve Rodriguez, Planner: And then the last one, and this was a topic that was discussed in front of the planning Commission and the Board of Supervisors as water is being sprayed on the vines that leaves the nozzle that's emitting the the water travels through the air and lands on the vines.

87
00:17:25.980 --> 00:17:36.060
Steve Rodriguez, Planner: The potential for that to result in evaporated losses was evaluated and found to be negligible, and in fact so low it's basically zero.

88
00:17:38.610 --> 00:18:01.980
Steve Rodriguez, Planner: So all all of this was evaluated using data that was obtained about the operation of the of the vineyard the soil conditions at the vineyard and and long term records about atmosphere weather conditions in the vineyard, and so this table presents.

89
00:18:03.000 --> 00:18:05.070
Steve Rodriguez, Planner: Are the results of the analysis.

90
00:18:06.270 --> 00:18:07.650
Steve Rodriguez, Planner: Based on.

91
00:18:09.210 --> 00:18:20.520
Steve Rodriguez, Planner: The the weather station data that was used in the analysis, it was determined that there could be basically three.

92
00:18:21.240 --> 00:18:40.980
Steve Rodriguez, Planner: types of frost protection demand scenarios for the vineyard a light frost year a normal frost year and I haven't frost year and under each of those scenarios the projects evaporate of losses exceed 31 acre feet per year.

93
00:18:42.690 --> 00:19:03.060
Steve Rodriguez, Planner: And and there's quite a variation in and what those evaporate of losses numbers are from 35 acre feet just barely over the threshold to 272 acre feet and a heavy frost year, which is substantially over the threshold.

94
00:19:04.440 --> 00:19:05.400
Steve Rodriguez, Planner: Next slide please.

95
00:19:07.140 --> 00:19:20.550

Steve Rodriguez, Planner: So this was all presented in the E ir under the heading of impact one and impact to and mitigation measures to reduce the evaporated of losses to a lesson significant level were identified.

96
00:19:21.330 --> 00:19:41.430
Steve Rodriguez, Planner: The first one is to install and maintain covers over each of the proposed reservoirs and that reduces evaporate of losses from the reservoirs practically zero and that the second mitigation measure was to through a monitoring Program.

97
00:19:43.680 --> 00:20:00.780
Steve Rodriguez, Planner: To only allow the use of 103 acre feet of water per year to to be used for frost protection through the spray irrigation system so by limiting the projects water use evaporation losses are.

98
00:20:01.890 --> 00:20:12.960
Steve Rodriguez, Planner: Also, limited and these it was concluded these mitigation measures to reduce the project in packs to let the water loss impacts to a less than significant nothing.

99
00:20:14.280 --> 00:20:15.120
Steve Rodriguez, Planner: Next slide please.

100
00:20:16.830 --> 00:20:27.750
Steve Rodriguez, Planner: So, like all Ai ours alternatives to the proposed project are required to be evaluated and the the car has three alternatives.

101
00:20:28.260 --> 00:20:38.970
Steve Rodriguez, Planner: The first is the no project alternative, which means that the project is not constructed and and under that alternative the.

102
00:20:39.630 --> 00:20:55.050
Steve Rodriguez, Planner: Project related no project related impacts would occur, however, this alternative is not achieve any of the objectives of the project and the primary objective of course is to provide frost protection.

103
00:20:56.160 --> 00:21:00.660
Steve Rodriguez, Planner: i'll turn into number one was to only construct to have the proposed.

104
00:21:01.980 --> 00:21:05.160

Steve Rodriguez, Planner: reservoirs and eliminate reservoir number three.

105
00:21:07.770 --> 00:21:14.670
Steve Rodriguez, Planner: This alternative reduces potentially erosion and flooding and protect wildlife impacts.

106
00:21:15.930 --> 00:21:16.590
Steve Rodriguez, Planner: Because.

107
00:21:18.600 --> 00:21:21.060
Steve Rodriguez, Planner: reservoir number three would not be constructed.

108
00:21:22.500 --> 00:21:39.870
Steve Rodriguez, Planner: It eliminates the impact that would result from the construction of reserved for number three to the native grassland that's on that project site and for the reduced water use because we're only operating to reservoirs.

109
00:21:41.340 --> 00:21:45.570
Steve Rodriguez, Planner: The evaporate of losses under the light.

110
00:21:46.590 --> 00:21:57.060
Steve Rodriguez, Planner: frost year would be less than significant but mitigation measures would still be required during normal and heavy frost years.

111
00:21:58.440 --> 00:22:14.370
Steve Rodriguez, Planner: i'll turn on their number two is not substantially different but would only result in the construction of one of the post reservoirs and, similarly, we would have reductions in potential erosion and flooding and wildlife impacts.

112
00:22:15.630 --> 00:22:31.680
Steve Rodriguez, Planner: The impacts of the native grassland would not occur and evaporation losses would be reduced and a significant water use impact with only occur during a heavy frost year condition.

113
00:22:32.850 --> 00:22:39.930
Steve Rodriguez, Planner: So the er concluded that eliminating one of the reservoirs number three, which is alternative number one.

114
00:22:40.470 --> 00:22:52.560

Steve Rodriguez, Planner: Was the environmentally superior alternative because it reduces project related impacts, but it's still aligned with the objectives of the project to provide frost protection for the vineyard.

115
00:22:54.240 --> 00:22:55.170
Steve Rodriguez, Planner: Next slide was.

116
00:22:58.980 --> 00:23:05.550
Steve Rodriguez, Planner: The slides a summary of the environmental review process that has and the project processing.

117
00:23:06.270 --> 00:23:15.330
Steve Rodriguez, Planner: That has occurred, to date, and then a projection of what will be occurring in the future, and next steps in the project processing.

118
00:23:16.080 --> 00:23:32.400
Steve Rodriguez, Planner: As we mentioned before the project had has been heard by the planning Commission and the Board of Supervisors there was extensive discussion at those hearings, about the need to prepare an e ir and what that are should evaluate.

119
00:23:33.600 --> 00:23:39.120
Steve Rodriguez, Planner: The draft yaar was released in November of this year.

120
00:23:40.560 --> 00:23:44.850
Steve Rodriguez, Planner: we're having a hearing regarding the er that's tonight.

121
00:23:46.020 --> 00:24:01.560
Steve Rodriguez, Planner: The public comment period ends on January 5 of next year and we anticipate the planning Commission will be considering this project sometime early next year, probably in the spring.

122
00:24:03.750 --> 00:24:05.250
Steve Rodriguez, Planner: And then next.

123
00:24:08.130 --> 00:24:12.480
Steve Rodriguez, Planner: This is the slide that Catherine was referring to as.

124
00:24:14.490 --> 00:24:17.670

Steve Rodriguez, Planner: An address and email address.

125
00:24:19.200 --> 00:24:33.420
Steve Rodriguez, Planner: where you can submit your your comments, we will read be that excuse me, the final eir will be responding to all of the comments submitted regarding the adequacy of the eir.

126
00:24:34.140 --> 00:24:45.570
Steve Rodriguez, Planner: That will include the comments we receive tonight and the written comments, and we would just encourage you, if you're able to do it to submit your comments in writing.

127
00:24:46.920 --> 00:24:49.050
Steve Rodriguez, Planner: it's just easier to.

128
00:24:50.430 --> 00:24:55.950
Steve Rodriguez, Planner: understand what your concerns are and provide you a good response.

129
00:24:57.150 --> 00:25:05.100
Steve Rodriguez, Planner: And that concludes the presentation and I think it's time to.

130
00:25:06.540 --> 00:25:12.540
Steve Rodriguez, Planner: Open up the public participation aspect of tonight's meeting.

131
00:25:19.920 --> 00:25:22.620
Travis Seawards, Deputy Director: Thank you Steve for presentation so.

132
00:25:24.060 --> 00:25:24.990
Travis Seawards, Deputy Director: Catherine how we.

133
00:25:27.060 --> 00:25:30.720
Travis Seawards, Deputy Director: Someone want to raise do people raise their hand how.

134
00:25:31.980 --> 00:25:34.170
Kathryn Lehr, Supervising Planner: Think David, are you there.

135
00:25:34.890 --> 00:25:42.330

County PAD: yeah I mean we can do it that way, if you like, um but i'm can just go down the list and double check there's not that many people just to make sure people have.

136
00:25:42.900 --> 00:25:44.850
County PAD: Okay, so we'll do it.

137
00:25:45.120 --> 00:25:52.230
County PAD: yeah no problem i'll go down the list Alphabetically and then we do have one speaker who's joining us by phone will do you asked.

138
00:25:52.860 --> 00:26:01.320
County PAD: Just if you're on the phone just remember that you have to hit star six on your phone to unmute yourself so we'll start with honest citron to be followed by Brian tally.

139
00:26:05.220 --> 00:26:06.690
Ana Citrin: hi good evening, can you hear me.

140
00:26:07.980 --> 00:26:08.670
County PAD: Perfect go ahead.

141
00:26:09.570 --> 00:26:14.640
Ana Citrin: Great hi good evening on a citron with the law office of mark should kilo.

142
00:26:16.050 --> 00:26:19.830
Ana Citrin: Representing Roberta jaffe and Stephen policeman.

143
00:26:21.090 --> 00:26:23.160
Ana Citrin: The appellants below.

144
00:26:24.900 --> 00:26:25.980
Ana Citrin: It was.

145
00:26:27.240 --> 00:26:38.430
Ana Citrin: The result of our appeal that this matter was elevated to the board of supervisors and, ultimately, that this focused eir was required.

146
00:26:40.650 --> 00:26:41.220
Ana Citrin: and

147

00:26:42.780 --> 00:26:46.260
Ana Citrin: I know staff we've been an email communication today.

148
00:26:47.340 --> 00:26:49.590
Ana Citrin: But just you know, for the record.

149
00:26:51.900 --> 00:26:56.010
Ana Citrin: We are requesting an extension of the public comment period.

150
00:26:58.020 --> 00:27:15.150
Ana Citrin: As it happened, I was, I did not find out until yesterday evening that the draft Dir had been released and that this public hearing was occurring we didn't receive any mailed notice, although I understand it was mailed.

151
00:27:16.260 --> 00:27:20.010
Ana Citrin: But what I really take issue with is that there was no email notice.

152
00:27:21.120 --> 00:27:38.220
Ana Citrin: I submitted scoping comments by email to Mr Rodriguez miss jaffe has been in contact with Mr Rodriguez by email and has requested various updates on the status of the D R and yet I was informed.

153
00:27:38.280 --> 00:27:39.090
Travis Seawards, Deputy Director: That a tron.

154
00:27:39.540 --> 00:27:40.440
Travis Seawards, Deputy Director: tron sorry.

155
00:27:40.950 --> 00:27:44.160
Travis Seawards, Deputy Director: Do you have actually any comments on the project itself.

156
00:27:44.490 --> 00:27:52.020
Ana Citrin: Well, unfortunately I haven't had enough time to review the E ir Mr see where it's so I just wanted to reiterate that request.

157
00:27:52.320 --> 00:27:53.490
Ana Citrin: And is it.

158
00:27:53.640 --> 00:27:58.860

Ana Citrin: Important for the public to understand this as well, I will make a comment, though, thank you so.

159
00:27:59.160 --> 00:27:59.280
Ana Citrin: We.

160
00:27:59.850 --> 00:28:15.690
Travis Seawards, Deputy Director: Have hold on please if we could just keep the comments to the project itself that would be great we did receive your request, just for the record, we did notice the project appropriately, we sent it to the email that you gave or to the address that you gave us.

161
00:28:16.950 --> 00:28:20.730
Travis Seawards, Deputy Director: And so I just want to make that clear, but please proceed Thank you.

162
00:28:22.260 --> 00:28:34.680
Ana Citrin: um it was interesting to hear in your presentation, just now, that under each of three scenarios that were evaluated the evaporate of losses exceeded the.

163
00:28:35.100 --> 00:28:56.820
Ana Citrin: The 31 acre foot threshold for groundwater for a significant groundwater impact and this illustrates the importance of public review, because the M amp D that was prepared for this project accepted a much lower threshold and it took considerable work by our office to.

164
00:28:57.870 --> 00:29:15.840
Ana Citrin: to uncover that the evaporated losses were much higher which fact has been confirmed by this draft eir, so I would just again caution you and limiting public comment opportunities here, I will be submitting written comments on the substance of the draft er and I.

165
00:29:17.610 --> 00:29:30.960
Ana Citrin: look forward to hearing back from you regarding our extension request, which I do believe affects most Fiamma valley residents who did not received ml notice of the de ir and public hearing tonight, so thank you.

166
00:29:33.300 --> 00:29:34.260
County PAD: Thank you, Mr trump.

167
00:29:35.430 --> 00:29:38.130

County PAD: And our next speaker we Ryan tally to be followed by David swank.

168
00:29:42.510 --> 00:29:51.660
BRIAN TETLEY: Is Brian totally with urban planning concepts thanks for the presentation and ubc will be providing written comments by the January 5 deadline, thank you.

169
00:29:55.050 --> 00:29:58.950
County PAD: Alright, our next speaker will be David swank to be followed by Matthew new ball.

170
00:30:00.720 --> 00:30:13.170
David Swenk: Thank you, David swamp with the rural planning services we just like appreciate the work that the county's done, we have no comments as part of this hearing we will be providing written comments by the conclusion of the public comment period.

171
00:30:14.640 --> 00:30:15.690
County PAD: Thank you, Mr swank.

172
00:30:16.950 --> 00:30:17.730
County PAD: Mr new hall.

173
00:30:21.210 --> 00:30:25.350
Matthew Newhall: Yes, thank you Matthew neuharth great fan capital no comment at this time, thank you.

174
00:30:26.550 --> 00:30:27.180
Alright, thank you.

175
00:30:28.800 --> 00:30:30.600
County PAD: Our next speaker will be re shady.

176
00:30:34.440 --> 00:30:41.040
Ray Shady: Yes, this is very shady also is grapevine capital and North fork vineyard no comment at this time, thank you.

177
00:30:41.520 --> 00:30:51.570
County PAD: Great Thank you so our last speaker is our phone caller that's you your phone number is four or five one hit star six on your phone to unmute yourself.

178

00:30:54.810 --> 00:30:55.290
County PAD: perfect.

179
00:30:56.340 --> 00:30:57.660
Caller 451: If you can identify yourself for the.

180
00:30:57.660 --> 00:30:59.550
County PAD: record first, please.

181
00:31:02.730 --> 00:31:03.450
Caller 451: Can you hear me.

182
00:31:04.260 --> 00:31:05.610
County PAD: you're a little bit low.

183
00:31:09.150 --> 00:31:09.450
Caller 451: Low.

184
00:31:10.380 --> 00:31:13.590
County PAD: Low better a little bit, are you on speaker phone.

185
00:31:16.710 --> 00:31:20.310
Caller 451: I am I might i'm actually in a car.

186
00:31:21.510 --> 00:31:23.760
Caller 451: traveling and i'm on the car.

187
00:31:24.450 --> 00:31:27.330
County PAD: Okay we'll just we'll just listen really carefully go ahead.

188
00:31:29.100 --> 00:31:41.220
Caller 451: Okay, this is a British accent i'm one of the appellant my husband speed policeman is also here and, hopefully, he can just follow me and comments on the same from the same phone.

189
00:31:42.450 --> 00:31:52.650
Caller 451: i'm calling mainly to request the extension we just received a notice that the Dir we release.

190
00:31:53.880 --> 00:31:56.700
Caller 451: It did notice when we went to our P O box yesterday.

191
00:31:57.810 --> 00:32:04.470
Caller 451: I had been in email contact with Steve Rodriguez for at least five times requesting update.

192
00:32:05.700 --> 00:32:08.370
Caller 451: Through 2020 and.

193
00:32:09.480 --> 00:32:18.540
Caller 451: He in and being never received any kind of notification over email or any other way, I also checked with other.

194
00:32:20.220 --> 00:32:36.570
Caller 451: People in the valley who receive emails through their PO boxes and they actually did not even receive a notification that the Dir was released or that public comment was open, we are about to enter the.

195
00:32:38.400 --> 00:32:43.950
Caller 451: Christmas holidays and new years and then the public common is now scheduled to close.

196
00:32:45.150 --> 00:32:51.750
Caller 451: On January 5 and we will be really on a road trip to visit our children and grandchildren.

197
00:32:52.560 --> 00:33:01.470
Caller 451: Who because of the pandemic we haven't seen so we are not going to have time to adequately reducing jr and which is extremely important.

198
00:33:01.920 --> 00:33:14.490
Caller 451: To us, as neighbors of the vineyard and to the whole crew yama valley and we we hope you will consider giving us the extension extension, so we can give us the due consideration.

199
00:33:15.930 --> 00:33:19.170
Caller 451: Of the work that has already been put into it, thank you very much.

200
00:33:23.580 --> 00:33:24.270
County PAD: Thank you, if you.

201
00:33:28.260 --> 00:33:32.070

County PAD: Sir, if you could just also identify yourself, for the record, before you start your comments.

202
00:33:33.930 --> 00:33:40.110
Caller 451: Yes, my name is Steve policeman i'm also a resident of the valley and a farmer there.

203
00:33:41.490 --> 00:33:41.880
And i'm.

204
00:33:43.140 --> 00:33:52.080
Caller 451: In the same position that roberta's in haven't had the opportunity to look at the draft Dr artsy on a phone.

205
00:33:53.160 --> 00:33:59.190
Caller 451: but also because we didn't get the notice and i'm i'm really concerned about the biological survey.

206
00:34:00.360 --> 00:34:14.310
Caller 451: Knowing the importance and specialness of the plant and animal life of this region, I really want to have time to look at the SS extensive studies that were done by the ir and be able to really evaluate them call in.

207
00:34:15.810 --> 00:34:25.200
Caller 451: Evaluations from experts in the field that I that I know and be able to respond and will need the extra time of an extension to do that.

208
00:34:25.620 --> 00:34:37.770
Caller 451: With the holidays are upon us and having not been able to look at anything at this point so again I respectfully request approval on extension till until early February, thank you.

209
00:34:39.120 --> 00:34:39.900
County PAD: Thank you, Sir.

210
00:34:41.970 --> 00:34:45.840
County PAD: With with that, I believe that is the our last speaker for the evening.

211
00:34:50.340 --> 00:34:51.570
County PAD: So i'll turn it back to the staff.

212
00:34:53.010 --> 00:34:53.430
Kathryn Lehr, Supervising Planner: Okay.

213
00:34:54.450 --> 00:35:03.420
Kathryn Lehr, Supervising Planner: Thank you, David I don't have much to add Thank you all for calling in and travis was there anything you wanted to say before we wrapped up today.

214
00:35:03.960 --> 00:35:15.450
Travis Seawards, Deputy Director: No, this has been recorded and if anybody has any questions on WHO to contact you know, please reach out and we're happy to work with you thanks for participating tonight.

215
00:35:18.600 --> 00:35:19.320
Kathryn Lehr, Supervising Planner: Thank you.

216
00:35:19.740 --> 00:35:20.100
Okay.

California
Department of Conservation
Geologic Energy Management Division

Gavin Newsom, Governor
David Shabazian, Director
801 K Street, MS 18-05
Sacramento, CA 95814
T: (916) 445-9686

12/21/2021

County: Santa Barbara - Planning & Development
Kathryn Lehr
123 E. Anapamu Street, Santa Barbara, CA 93101, USA
klehr@countyofsb.org

Construction Site Well Review (CSWR) ID: 1012376

Assessor Parcel Number(s): 147020045

Property Owner(s): Matt Turrentine

Project Location Address: 7400 Highway 166 Cuyama, California 93254

Project Title: North Fork Ranch Frost Ponds Project

Public Resources Code (PRC) § 3208.1 establishes well reabandonment responsibility when a previously plugged and abandoned well will be impacted by planned property development or construction activities. Local permitting agencies, property owners, and/or developers should be aware of, and fully understand, that significant and potentially dangerous issues may be associated with development near oil, gas, and geothermal wells.

The California Geologic Energy Management Division (CalGEM) has received and reviewed the above referenced project dated 12/7/2021. To assist local permitting agencies, property owners, and developers in making wise land use decisions regarding potential development near oil, gas, or geothermal wells, the Division provides the following well evaluation.

The project is located in Santa Barbara County, within the boundaries of the following fields:

N/A

Our records indicate there are no known oil or gas wells located within the project boundary as identified in the application.

- Number of wells Not Abandoned to Current Division Requirements as Prescribed by Law and Projected to Be Built Over or Have Future Access Impeded by this project: 0

- Number of wells Not Abandoned to Current Division Requirements as Prescribed by Law and Not Projected to Be Built Over or Have Future Access Impeded by this project: 0

- Number of wells Abandoned to Current Division Requirements as Prescribed by Law and Projected to Be Built Over or Have Future Access Impeded by this project: 0

- Number of wells Abandoned to Current Division Requirements as Prescribed by Law and Not Projected to Be Built Over or Have Future Access Impeded by this project: 0

As indicated in PRC § 3106, the Division has statutory authority over the drilling, operation, maintenance, and abandonment of oil, gas, and geothermal wells, and attendant facilities, to prevent, as far as possible, damage to life, health, property, and natural resources; damage to underground oil, gas, and geothermal deposits; and damage to underground and surface waters suitable for irrigation or domestic purposes. In addition to the Division's authority to order work on wells pursuant to PRC §§ 3208.1 and 3224, it has authority to issue civil and criminal penalties under PRC §§ 3236, 3236.5, and 3359 for violations within the Division's jurisdictional authority. The Division does not regulate grading, excavations, or other land use issues.

If during development activities, any wells are encountered that were not part of this review, the property owner is expected to immediately notify the Division's construction site well review engineer in the Coastal district office, and file for Division review an amended site plan with well casing diagrams. The District office will send a follow-up well evaluation letter to the property owner and local permitting agency.

Should you have any questions, please contact me at (504) 425-7710 or via email at Miguel.Cabrera@conservation.ca.gov.

Sincerely,

Miguel Cabrera

Miguel Cabrera
Northern District Deputy

cc: Kathryn Lehr - Plan Checker

HERUM \ CRABTREE \ SUNTAG
ATTORNEYS

Steven A. Herum
sherum@herumcrabtree.com

January 25, 2022

Ms. Kathryn Lehr
Supervising Planner
Santa Barbara County Planning & Development
123 E. Anapamu Street
Santa Barbara, California 93101
klehr@countyofsb.org

Re: North Fork Ranch Frost Ponds Project
Focused Environment Impact Report
SCH# 2017061009
Santa Barbara County # 16CUP-00000-00005

Dear Ms. Lehr:

This office represents Brodiaea, Inc., and submits these comments on the Draft Environmental Impact Report (**DEIR**) prepared for the North Fork Ranch Frost Ponds Project, with particular attention devoted to section 3.9.2.3.

EXECUTIVE SUMMARY OF COMMENT ABOUT SECTION 3.9.2.3

The California Environmental Quality Act (**CEQA**) is a statute designed to disclose information relevant to potential physical changes arising from a proposed discretionary project. Therefore, an environmental impact report is a procedural - and not an action - document. CEQA provides no legal authorization to impose mitigation measures or conditions of approval on a project; such authority must derive from other laws.

In addition, CEQA applies only to discretionary - and not ministerial - projects.[1] If a project involves a mix of discretionary and ministerial characteristics, the power to mitigate potentially significant environmental impacts narrows to only those aspects of the project that are discretionary. To put a finer point on it, CEQA does not independently invest public agencies with sufficient governmental powers to impose mitigation measures on a proposed discretionary project. The government power to impose a mitigation measure must be located within another statutory scheme or common law power, and may be imposed only upon a discretionary aspect of the proposal Following the legal restrictions on a public agency's power to mitigate only ministerial portions of the project is essential in this instance.

[1] For example, the basis for the analysis and mitigation of flooding derives from a purely ministerial regulation: grading. Section 3.8.2.3 of the EIR states: "The County of Santa Barbara County Code of Ordinances includes Chapter 10, Building Regulations and Chapter 14, Grading Code. The Building Regulations are based on the CBC, with modifications specific to the County of Santa Barbara. Both of these regulations address flooding hazards and the protection of property and the public welfare from flooding impacts caused from development." Yet building regulations are ministerial. CEQA Guideline §15369. This illustrates the EIR's failed approach of collapsing ministerial and discretionary actions together. The flaw applies with equal dignity to an instance where a land use is authorized as a "mater of right".

The components of the proposed project that are discretionary and nondiscretionary are made clear by the Santa Barbara County Zoning Code (Code). The construction of a frost pond, even on agricultural land, is a discretionary action subject to use permit under the Code. Therefore, its review and approval is a discretionary action subject to CEQA and CEQA mitigation measures. Conversely, however, the Code is also clear that an agricultural use is authorized as a matter of right,[2] and additional or supplemental regulatory permission is not required to exercise and enjoy this use; vineyards and cultivated agricultural uses are allowed as a matter of right. The County has no discretionary authority to approve, deny or conditionally approve this use. Operation of the proposed frost ponds constitutes an integrated part of the vineyard operation. Indeed, the DEIR confirms our statement that frost ponds are an integrated component of the vineyard operation.

> "**The proposed reservoirs would serve** approximately 840-acres of **existing vineyards**. Piping that would deliver water to the reservoirs from existing wells is already installed." DEIR at section 2.1 page 2-1 (bolding added).
>
> "Frost protection is **generally required** during the months of March and April". DEIR at section 2.2 at page 2-1 (bolding added).
>
> "**Frost protection would be achieved** by sustained spray irrigation…**when frost has the potential to damage budding grape vines**. Temperature gauges are located in the vineyard and an alarm triggers if temperatures approach freezing." DEIR at section 2.2 at page 2-3 (bolding added).

This distinction is critical to the CEQA analysis. While the construction of frost ponds is a discretionary action subject to CEQA and CEQA mitigation measures, operating agricultural frost ponds are part and parcel of the vineyard land use, which is allowed as a matter of right and therefore is not subject to CEQA or CEQA mitigation measures.

Section 3.9.2.3 of the DEIR contains at least two fatal errors. First, rather than disclosing information, the DEIR presents a bare legal analysis that has no place in an environmental impact report. Presenting this type of legal analysis within the four corners of a draft environmental impact report is not authorized by CEQA. Second, a recent Supreme Court opinion and at least four recent appellate court opinions squarely and directly contradict the suspect legal analysis and conclusions presented in section 3.9.2.3. The remainder of this comment focuses on two topics: (1) A legal analysis stressing the lack of authority for a public agency to impose CEQA mitigation measures on the ministerial aspects of a project; and, (2) alternative language for Section 3.9.2.3.

LACK OF LEGAL AUTHORITY TO IMPOSE CEQA MITIGATION MEASURES ON A MINISTERIAL PROJECT

Cultivated agriculture and vineyard uses are permitted under the Code as a matter of right, with no requirement that a property owner obtain any discretionary permit. See County Zoning ordinance at page 2-6; Table 2-1 at page 2-14. In stark contrast, a use permit is required to construct ponds with discretion embedded therein. The use permit for the ponds, however, is required to

[2] "Zoning laws regulate land uses in two basic ways. Some uses are permitted as a matter of right if the uses conform to the zoning ordinance. Other sensitive land uses require discretionary administrative approval pursuant to criteria in the zoning ordinance." *Hewlett v. Squaw Valley Ski Corp*. (1997) 54 Cal. App. 4th 499, 531.

construct the ponds, but not to operate those ponds in conjunction with a use which is authorized as a matter of right, such as a vineyard land use.

We start by placing the Environmental Impact Report (**EIR**) process, and purpose and objectives of preparing an EIR into a proper context. An EIR is a "detailed statement … provid(ing) the information or data which is relevant" concerning potential environmental effects of a proposed project. Public Resources Code §21061. "An EIR is an information document". CEQA Guideline §15121(a).[3] The "information in the EIR does not control the agency's ultimate discretion on the project". CEQA Guideline §15121(b). Critically, the CEQA statute does not grant local agencies independent power to impose mitigation measures to lessen the significance of potential environmental effects. Instead, a "public agency may use discretionary powers provide by such other law for purposes of mitigating or avoiding a significant effect on the environment". Public Resources Code §21004 (underlining added).[4]

Why is this analysis important and relevant to the immediate question? Public Resources Code section 21004 emphasizes that CEQA does not grant power to a public agency to impose mitigation measures; rather the power must derive from "discretionary powers provided by such other law". Section 21004 is important because ministerial projects are exempt from CEQA. Public Resources Code §21080(b)(1). In Santa Barbara County, agricultural operations conducted in zoning districts classified as "Agriculture" are expressly allowed uses and thereby fall within the CEQA definition of "ministerial". CEQA Guidelines §15369. Therefore, a public agency cannot impose mitigation measures on ministerial projects. The North Fork Ranch agricultural operation is within a zoning district classified as Agriculture; hence, it constitutes a use authorized as a matter of right, without any permitting requirements.

The question posed by numerous land use disputes is what is the correct result when a project application presents both discretionary and ministerial characteristics? Does the discretionary aspect of a project application make the entire application discretionary and grant a public agency a right to impose mitigation measures on the ministerial aspect of the application? The answer is no. Numerous appellate court opinions have concluded that when a project application consists of mixed discretionary and ministerial attributes then a public agency can impose subjective conditions, or CEQA mitigation measures, on only the discretionary aspect of the application; as to the ministerial portion of the application, it can only apply objective conditions present in the ordinance authorizing the public agency to issue the ministerial permit.[5]

A brief review of the relevant appellate court cases illustrates this major point. A quartet of appellate court case explain what has come to be called the "*functionality rule*".

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[3] Neither the statute nor the guidelines authorize an environmental impact report to conduct a legal analysis in the manner presented in section 3.9.2.3.

[4] Public Resources Code section 21004 reads in full: "In mitigating or avoiding a significant effect of a project on the environment, **a public agency may exercise only those express or implied powers provided by law other than this division**. However, **a public agency may use discretionary powers provided by such other law** for the purpose of mitigating or avoiding a significant effect on the environment subject to the express or implied constraints or limitations that may be provided by law." (Bolding and underlining added.)

[5] A typical ministerial permit is a building permit. Here the County Ordinance makes the right to conduct agriculture as a "matter of right" without any permit, either discretionary or ministerial. Hence there is no legal basis to impose conditions of approval or mitigation measures on a use that by county code is authorized as "a matter of right".

1. *Sierra Club v. County of Sonom*a (2017) 11 Cal. App. 5th 11.

In *Sierra Club v. County of Sonom*a (2017) 11 Cal. App. 5th 11, the Sierra Club challenged an erosion control permit granted to plant a vineyard on land devoted to grazing cattle, asserting that because the permit process included discretionary elements CEQA compliance was required before considering the plan. While planting a vineyard was a "matter of right" under the applicable land use regulatory framework (*Id*. at 16), the Sierra Club nevertheless maintained the ordinance contained some aspect of discretionary power, and therefore compelled CEQA compliance.

The appellate court upheld the trial court's dismissal of the petition, finding that an ordinance conferring some amount of discretion did not automatically trigger CEQA requirements. Instead, the court held that a petitioner must prove a public agency has *the right kind of discretion—the ability and authority to mitigate environmental damage identified by the petition*. More specifically, the court held that simply identifying some discretion in the approval process does not mean the entire challenged action is a "discretionary project" subject to CEQA review:

> Petitioners argue that the language of these provisions is general enough to confer discretion. But even assuming we could interpret these provisions to grant some discretion to the Commissioner, we reject petitioners' argument that this alone requires us to hold that the Commissioner's issuance of the Ohlsons' permit was a discretionary act. **The argument ignores the principle, arising out of the functional test, that "'CEQA does not apply to an agency decision simply because the agency may exercise some discretion in approving the project or undertaking. Instead[,] to trigger CEQA compliance, <u>the discretion must be of a certain kind</u>; it must provide the agency with the ability and authority to "mitigate ... environmental damage" to some degree.'"** (Citation omitted.) For the reasons discussed above, **the existence of discretion is irrelevant if it does not confer the ability to mitigate any potential environmental impacts in a meaningful way**.

Id. at 28 (bolding and underline added).

2. *Sierra Club v. Napa County* (2012) 205 Cal. App. 4th 162.

The preceding reasoning and holding from *Sierra Club v. County of Sonoma* conforms to the general conclusion presented in *Sierra Club v. Napa County* (2012) 205 Cal. App. 4th 162, that CEQA:

> requires assessment of environmental consequences where government has the power through its regulatory powers to eliminate or mitigate one or more adverse environmental consequences a study could reveal.

Id. at 179.[6] The court cited a general principle that <u>the mere existence of discretion is insufficient to compel CEQA compliance</u>. Instead, the discretion must empower an agency to mitigate the environmental consequences of the discretionary aspect of the approval:

[6] Of course, as we know, CEQA "a public agency may exercise only those express or implied powers provided by law *other than* CEQA." *Sierra Club v. California Coastal Com*. (2005) 35 Cal.4th 839, 859 (italics in original). Pub.Res.Code §21004. CEQA Guideline §15040(b).

> Following *Friends of Westwood*, the court in *Leach v. City of San Diego* [citation omitted] held that a municipality was not required to prepare an environmental impact report before being permitted to draft water from a reservoir; despite environmental consequences, the municipality had little or no ability to minimize in any significant way the environmental damages that might be identified in the report. As one reviewing court recently put it, quoting from a major treatise: "'CEQA does not apply to an agency decision simply because the agency may exercise some discretion in approving the project or undertaking. Instead to trigger CEQA compliance, the discretion must be of a certain kind; it must provide the agency with the ability and authority to "mitigate … environmental damage" to some degree.' "

Id. at 179 (Citation and italics omitted; underlining added). This necessarily means that to present valid CEQA objections, an alleged environmental harm must flow from the discretionary rather than ministerial aspect of an approval. Simply stated, a project is a "discretionary project" only if a public agency has sufficient power to mitigate environmental harms flowing from the discretionary aspects of an approval. Accordingly, a public agency does not have sufficient governmental power to mitigate environmental harms flowing from a ministerial approval in a "meaningful way". *McCorkle Eastside Neighborhood Group v. City of St. Helena* (2018) 31 Cal.App.5th 80, 89 and 90 ["The 'touchstone' for determining whether an agency is required to prepare an EIR is whether the agency could meaningfully address any environmental concerns that might be identified in the EIR… . However, the discretionary component of the action must give the agency the authority to consider a project's environmental consequences to trigger CEQA."]

3. *San Diego Navy Broadway Complex Coalition v. City of San Diego* (2010) 185 Cal. App. 4th 924.

San Diego Navy Broadway Complex Coalition v. City of San Diego (2010) 185 Cal. App. 4th 924 (*San Diego Navy*), "summarized the case law" as follows:

> . . . CEQA does not apply to an agency decision simply because the agency may exercise *some* discretion in approving the project or undertaking. Instead to trigger CEQA compliance, the discretion must be of a certain kind; it must provide the agency with the ability and authority to 'mitigate … environmental damage' to some degree.

Id. at 934 (underlining added; italics in original).

4. *McCorkle Eastside Neighborhood Group v. City of St. Helena* (2018) 31 Cal.App.5th 80.

Here a neighborhood group opposed an eight-unit apartment complex on environmental grounds, including parking, traffic, safety and soil remediation. *Id*. at 86. However, the apartment complex was a permitted use in the zoning district, and needed only a design review permit. *Id*. Undeterred by this limitation, the neighborhood group latched on to the design review permit process, arguing it was discretionary in nature and therefore allowed the city to evaluate environmental issues unrelated to design standards. *Id*. at 87.

The *McCorkle* court noted that if a project involves both discretionary and ministerial actions it is considered discretionary; "[h]owever the discretionary component of the action must give the agency the authority to consider a project's environmental consequences to trigger CEQA."

Id. at 90. Thus, "the City Council found the design review ordinances prevented it from disapproving the project for non-design-related matters. This was correct." *Id*. at 92.

In sum, the methodology endorsed and followed by these four opinions involves identifying whether there is actual discretion in the regulatory approval process enacted by the relevant legislative body, and then ascertaining whether that discretion is the "certain kind" requiring a public agency to impose conditions to avoid or reduce significant adverse environmental effects. The Supreme Court recently confirmed that the *functional test* applied in these four important cases is the correct lens to determine whether a public agency has sufficient power to impose mitigation measures or conditions of approval. *Protect Our Water & Environmental Resources v. County of Stanislaus* (2020) 10 Cal.5th 479.

Section 3.9.2.3 of the DEIR must be reviewed for compliance with the *functional test* established by California Courts. Section 3.9.2.3 reads in full:

> County Land Use and Development Code (LUDC) Section 35.21.030: Table 2-1 indicates that **agricultural operations conducted on properties with agricultural zoning are an allowed use and no land use entitlements are required for such uses**. **The existing North Fork Ranch vineyard operations are located on property with agricultural zoning (AG-II-100). Thus, vineyard operations and irrigation water used do not require any County discretionary land use entitlements, and water impounded in proposed reservoirs used to support (i.e., used for crop irrigation and frost protection) the existing vineyards would not be subject to the water use threshold of significance established for the Cuyama Valley Groundwater Basin**. However, due to the area (over 50,000 square feet) of each of the proposed reservoirs, the LUDC confirms that the proposed Project's three reservoirs require approval of a discretionary Minor Conditional Use Permit. All discretionary projects are required to comply with CEQA requirements and County thresholds of significance, therefore, water impounded in the reservoirs not directly or indirectly used to irrigate the existing vineyards is subject to groundwater use thresholds. Thus, any **groundwater losses from the frost protection system that does not irrigate the vineyards or recharge the aquifer would require compliance with the County threshold of significance for groundwater use of 31 acre feet per year (AFY) adopted for the Cuyama Valley Groundwater Basin**. Groundwater impounded in the reservoirs that would not be directly or indirectly used in support of the vineyards would be groundwater lost to evaporation, either directly from a reservoir surface or due to the operation of the proposed frost protection spray irrigation system. If the amount of water that evaporates from the proposed frost protection operation throughout the year exceeds the threshold of 31 AFY, then project would result in a significant groundwater use impact.

DEIR at 3-36 (bolding added). This section of the draft EIR violates the law on numerous levels.

First, it fails the functional test. It asserts, without authority, that a grant of narrow discretion attached to a discrete aspect of a regulatory ordinance expands discretion to all other aspects of the ordinance unless cleaved from the remainder of the ordinance by language expressly limiting or prohibiting the discretion's migration. But *Sierra Club v. County of Sonoma* contradicts this

interpretation, finding that discretion was limited to specific erosion control features due to the "purpose" of the ordinance even though the ordinance did not by expressed language limit the scope of the granted discretion.[7]

The *McCorkle Eastside Neighborhood Group* conclusion that "the discretionary component of the action must give the agency the authority to consider the project's environmental consequences to trigger CEQA" conflicts with section 3.9.3.2's assertion that CEQA gives an agency power to address environmental impacts, and also clashes with its obvious implied misreading that section 21004 requires a public agency to comply with CEQA even if it lacks authority to mitigate environmental effects. The draft EIR argument cannot reconcile with *McCorkle's* conclusion that: "The 'touchstone' for determining whether an agency is required to prepare an EIR is whether the agency could meaningfully address any environmental concerns that might be identified in the EIR…. However, the discretionary component of the action must give the agency the authority to consider a project's environmental consequences to trigger CEQA."

In addition, Section 3.9.3.2 is not an information disclosure provision of a DEIR. Rather it offers legal conclusions regarding assumed Lead Agency authority to impose mitigation measures on an authorized as a matter of right land use. Most importantly, the legal opinion embedded in Section 3.9.3.2 directly and squarely conflicts with a recent Supreme Court case and earlier appellate court cases cited herein.

Third, the frost ponds are an integrated part of the agricultural operation and therefore are covered by the Agricultural Ordinance and the right to farm as a matter of right without regulatory permission. Segregating the ponds from the remainder of the remaining agricultural operation, which is authorized as a matter of right, makes no sense and Section 3.9.3.2. offers no compelling factual or legal basis to segregate components of a unified agricultural operation. While the discretionary use permit can assess potentially significant effects derived from constructing the ponds, it cannot reach potentially significant effects derived from operating the ponds, as the operation of the pond is an integrated part of a use that is authorized as a matter of right.

Finally, Section 3.9.3.2 attempts to categorize "groundwater losses from the frost protection system that does [sp] not irrigate the vineyards or recharge the aquifer" as "not directly or indirectly used to irrigate the existing vineyards," therefore concluding that it is part of the discretionary portion of the use permit. These conclusions defy logic. **All water use associated with the frost protection system is agriculture related**, including "groundwater lost to evaporation, either directly from a reservoir surface or due to the operation of the proposed frost protection spray irrigation system". Expanding on this false and unsupported conclusion, will the County argue that groundwater lost to evaporation in irrigating agricultural crops is also not an agricultural operation and could be regulated by the County? Certain levels of evaporation are essential elements of agricultural operations, which makes them not subject to discretionary County regulation.

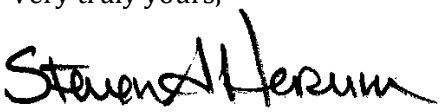
[7] "Petitioners argue that the language of these provisions is general enough to confer discretion. But even assuming we could interpret these provisions to grant some discretion to the Commissioner, we reject petitioners' argument that this alone requires us to hold that the Commissioner's issuance of the Ohlsons' permit was a discretionary act….For the reasons discussed above, the existence of discretion is irrelevant if it does not confer the ability to mitigate any potential environmental impacts in a meaningful way." *Sierra Club v. County of Sonoma* (2017) 11 Cal.App.5th 11, 28.

Because the EIR is an informational disclosure document and not a legal opinion, Section 3.9.3.2 provides no assistance in determining whether the County can impose mitigations measures on the agricultural operation. Instead the *functional test*, described in the four appellate court opinions and recently confirmed by the Supreme Court, forms the legal methodology to determine what mitigation measures if any may be lawfully imposed. Here the DEIR does not identify the "discretion of a certain kind" or "such other law for purposes of mitigating or avoiding a significant effect on the environment" to afford Santa Barbara County sufficient legal authority to impose mitigation measures on a use permitted by right under the County's zoning ordinance.

REVISION TO SECTION 3.9.2.3.

While the public does not have a duty to tell an agency how environmental studies should be conducted (*Sunstrom v. County of Mendocino* (1988) 202 Cal.App.3d 296, 311) the fatal flaws of Section 3.9.2.3 and other related sections of the DEIR compel a major revision. In particular, Section 3.9.2.3 and related sections should be revised to clearly and unambiguously segregate potential significant environmental effects to the environment between pond construction activities and pond operational activities. The significance of pond construction activities, which are discretionary activities, should be discussed and disclosed and if determined to be significant then mitigation measures should be evaluated. In contrast, potential significant environmental effects to the environment derived from all aspects of the pond operation, including "groundwater lost to evaporation, either directly from a reservoir surface or due to the operation of the proposed frost protection spray irrigation system," must be excluded from the DEIR. All aspects of pond operation are part and parcel of the vineyard; because vineyard is allowed as a matter of right in Santa Barbara County, it cannot be part of the CEQA regulation.

Very truly yours,



STEVEN A. HERUM
Attorney-at-Law

SAH:lac

LAW OFFICE OF MARC CHYTILO, APC

ENVIRONMENTAL LAW

December 16, 2021

Kathryn Lehr, Supervising Planner
Santa Barbara County Planning & Development
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Santa Barbara, California 93101

By email to klehr@countyofsb.org

RE: North Fork Ranch Vineyards Frost Protection System Focused Draft Environmental Impact Report; Request for Additional Time to Review and Provide Public Comment

Dear Ms. Lehr:

This office represents the Roberta Jaffe and Stephen Gliessman in this matter, Cuyama Valley residents and farmers of a 5-acre dry-farming operation called Condor's Hope Ranch. Our appeal of the County's Conditional Use Permit triggered the Board of Supervisor's direction to prepare a focused Draft Environmental Impact Report (DEIR) for the North Fork Ranch Frost Ponds Project (Project). We provided comments on the Scoping Document and intend to rigorously analyze and comment on the DEIR.

The 45-day comment period allocated for this important Project, particularly given its timing and method of notice, has constrained our ability to provide meaningful comments. The DEIR was released just prior to the Thanksgiving holiday, such that Thanksgiving, Christmas, and New Years all occur during the comment period. Moreover, because notice was sent by mail only, there was a considerable delay in receipt of the mailed notice. That delay was exacerbated for Cuyama Valley residents like Ms. Jaffee and Mr. Gliessman, who have to travel to the Post Office to collect mail because there is no mail delivery in the Cuyama Valley.

A longer comment period is both authorized and necessary pursuant to the CEQA Guidelines to enable the public including key stakeholders to meaningfully participate in the CEQA process. We respectfully request that you extend the comment period for an additional 30 days, to February 4, 2022.

1. CEQA Permits Longer Public Review Periods

The public review period currently established for this Project is 45 days, 15 days less than the 60-day period the CEQA Guidelines establish for projects under ordinary circumstances. (CEQA Guidelines § 15105(a)). The CEQA Guidelines further allow for public comment periods extending beyond 60 days where "unusual circumstances" are present. (Guidelines § 15105(a)). Public review and comment on environmental review documents is "an essential part of the CEQA process." (Guidelines § 15201). CEQA imposes a "responsibility" upon every citizen "to contribute to the preservation and enhancement of the environment." (Pub. Resources

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Code § 21000(e)). Planning and Development is clearly authorized to extend the comment period beyond the current 45-day period, and the unusual circumstances present in this case merit an extension of at least 30 days for reasons discussed below.

2. Unusual Circumstances Warrant a Comment Period of 75 Days

a. Complexity of Project Issues

The North Fork Project is proposed in the Cuyama Groundwater Basin, which is in a state of Critical Overdraft and the Project's processing overlapped with the Cuyama Basin Groundwater Sustainability Agency (GSA) process of finalizing the Groundwater Sustainability Plan (GSP) for the Cuyama Basin. Understanding this separate but related document, its status and applicability, introduces significant complexity into the analysis of the Project's impacts to groundwater. The Project is also proposed in an geologically complex area, in which experts disagree regarding the nature and extent of groundwater movement and availability. It is imperative that the public and responsible agencies have sufficient time to understand, analyze and provide meaningful comment on the complex issues this Project raises, and accordingly the unusually complex nature of the proposed Project warrants a 30-day extension to the comment period. (*See* Guidelines § 15105(a)).

a. Existing Public Controversy

The North Fork Project has been subject to intense public controversy since it was proposed, with numerous individuals, groups, and public agencies expressing strong opinions regarding the impacts and fundamental soundness of the proposal. Much of the controversy centers around the Project's location in the Critically Overdrafted Cuyama Groundwater Basin, and Brodiaea, Inc.'s vineyard and this project specifically figured prominently in the debate over the GSP. The proposed location of the reservoirs is also controversial due to the area's exceptional biological resources. The unusually controversial nature of the proposed Project warrants a 30-day extension to the comment period. (*See* Guidelines § 15105(a)).

b. Difficulty Accessing and Integrating Critical Documents

The DEIR's analysis relies on various Appendices with documents that are not indexed in the DEIR or clearly labeled to be accessible to public reviewers. This includes Appendix A with 13 documents containing "Applicant-Provided Information" that are not indexed in the DEIR and only labeled in short hand in the PDF titled "!App A Cover page". The 745 page Appendix B, "Past Proceedings", contains various important documents including technical reports relied on in the DEIR, which also are not indexed in the DEIR. Navigating, reviewing, and integrating these numerous additional documents relied on in the DEIR's analysis adds to the time and effort required to review and comment on the DEIR, warranting a public comment period extension (*see* Guidelines § 15105(a)).

Moreover, the links provided in the Notice of Availability to register for the public comment hearing and to access the DEIR are challenging at best or nonfunctional at worst when transcribing them from the written notice (see below). This presents an additional burden that chills public participation in the CEQA process.

c. Challenges with Emailed Notice

We understand from Staff that notice was mailed to our office PO Box and our client's PO Box on November 17, and no emailed notice was sent. When we asked why no emailed notice was provided, the response from Staff was that we did not request emailed notice. This is puzzling since our office provided scoping comments in early 2020 to Steve Rodriguez via email, and since that time Ms. Jaffe contacted Mr. Rodriguez via email numerous times inquiring as to the Draft EIR's status and anticipated release date. Based on this, we expected to receive notice by email.

Unfortunately, the release of the Draft EIR came as a complete surprise just yesterday when Ms. Jaffe found the mailed Notice of Availability in her Post Office. There is no mail delivery in the Cuyama Valley, and many residents are only able to check their Post Office Box occasionally. Given that many interested parties reside in the Cuyama Valley, more noticing effort including emailed notice is critically important to ensure Cuyama Valley residents receive actual notice of the DEIR, public hearing, and public comment period.

Our office is unable to find any record or other indication that the notice arrived at our PO Box, although we understand from Staff that it was indeed sent. Accordingly, we now have only 21 days until the DEIR comment deadline to prepare our comments, which includes Christmas and New Years, and during which time I have both childcare obligations and holiday vacations planned. In fact, tomorrow is my last official work day until January 2, which leaves only three days before the end of the public comment period to draft a comment letter.

With rampant postal service delays and the centrality of online communications during the pandemic, we're struggling to understand why only mailed notice was sent when the County has email addresses for all parties on file and has received emailed communications from our office and Ms. Jaffe within the CEQA process and in Ms. Jaffe's case, concerning the DEIR's availability specifically. **We request that all future notices be sent by email**, and that the County update its noticing procedures to provide emailed notice in addition to mailed notice where the County has access to email address for the recipient.

3. <u>The Public Requires Additional Time for Expert Analysis</u>

CEQA's public review and comment process has a number of functions detailed at Guidelines § 15200. One particular function relevant to this request is the exchange between

professionals in specific fields and the lead agency, responsible and trustee agencies. Commenting on complex environmental review documents today involves the expertise of persons with specialized qualifications to analyze and address a project's formulation, impacts and mitigation. In this case the Project has a number of elements potentially involving expert analysis including groundwater and biological resources, which is complicated by the unusual circumstances, discussed above, and adds to the reasons why an extended public review and comment period is appropriate in this case (*see* Guidelines § 15105(a)). Notably, the considerable delay in receiving mailed notice, and the intervening holidays presents a formidable challenge to securing experts to review and comment on the important technical issues this Project presents.

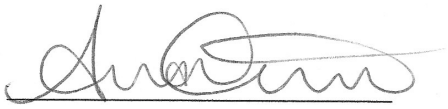
4. Conclusion

For all the above reasons, we believe that an extension of the public comment period on the DEIR for the North Fork Project is necessary to permit meaningful public review of the DEIR. We request that P&D extend the public comment period on the DEIR for at least 30 days until February 4, 2022.

Please contact this office if you have concerns or questions. We would appreciate a prompt response to our request. Thank you for your consideration and understanding.

Sincerely,

LAW OFFICE OF MARC CHYTILO, APC



Ana Citrin

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ENVIRONMENTAL LAW

January 28, 2022

Kathryn Lehr, Supervising Planner
Santa Barbara County Planning & Development
123 E. Anapamu St.
Santa Barbara, California 93101

By email to klehr@countyofsb.org

RE: North Fork Ranch Vineyards Frost Protection System Focused Draft Environmental Impact Report

Dear Ms. Lehr:

This office represents the Roberta Jaffe and Stephen Gliessman in this matter, Cuyama Valley residents and farmers of a 5-acre dry-farming operation called Condor's Hope Ranch. Our appeal of the County's Conditional Use Permit triggered the Board of Supervisor's direction to prepare a focused Draft Environmental Impact Report (DEIR) for the North Fork Ranch Frost Ponds Project (Project). We provided comments on the Scoping Document and offer the following comments on the DEIR.

1. The DEIR Fails to Comply with CEQA

"The foremost principle under CEQA is that the Legislature intended the act 'to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language.'" (*The Pocket Protectors v. City of Sacramento* (2004) 124 Cal.App.4th 903, 926.) "The EIR requirement is the heart of CEQA." (Cal. Code Regs., tit. 14[1], § 15003 (a).) An EIR identifies the significant effects a Project will have on the environment, identifies alternatives to the project, and indicates the manner in which the significant effects can be mitigated or avoided. (Public Resources Code § 21002.1(a).) Its purpose is to "inform the public and its responsible officials of the environmental consequences of their decisions *before* they are made", protecting the environment as well as informed self-government. (*Citizens for Goleta Valley v. Board of Supervisors of Santa Barbara County* (1990) 52 Cal. 3d 553, 564.) Where fundamental deficiencies are corrected or significant new information is added to the EIR after public notice is given of the availability of the draft but before certification of the EIR, the public agency is required to recirculate the EIR for additional public comment. (CEQA Guidelines § 15088.5 (a)(4).)

[1] This code section referred to hereafter as the "CEQA Guidelines" or "Guidelines."

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The North Fork Project includes three reservoirs that together would occupy an area of approximately 15.6 acres to impound water from the critically overdrafted Cuyama Groundwater Basin. The DEIR for the Project suffers for numerous material flaws and omissions that render the document inadequate to serve its informational goal. The DEIR does not accurately describe the Project that is subject to environmental review, or the environmental setting the Project would impact. The DEIR largely disregards a substantial body of information gleaned during the Cuyama Basin Groundwater Sustainability Plan (GSP) process, relying instead on vague and outdated information. The impact analysis with respect to groundwater is nearly exclusively focused on whether evaporative losses would exceed the County's antiquated 31AFY threshold for the Cuyama Groundwater Basin, ignoring the Project's actual water use, physical impacts on the environment, and consistency with the CEQA Guidelines Appendix G Thresholds. The DEIR also relies on speculative and deferred mitigation, and fails to meaningfully evaluate alternatives that would avoid the Project's significant impacts including frost protection measures that do not require groundwater impoundment. These flaws and omissions are detailed below, and supported by the technical comments prepared by Roberta Jaffe and Casey Walsh and by Steven Gliessman submitted to the County on January 28 and January 27 respectively.

2. <u>The Project Description Is Legally Inadequate</u>

"An accurate, stable and finite project description is the *sine qua non* of an informative and legally sufficient EIR." (*County of Inyo v. City of Los Angeles* (1977) 71 Cal. App. 3d 185, 193). "An accurate project description is necessary for an intelligent evaluation of the potential environmental effects of a proposed activity." (*San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal. App. 4th 713, 730). The DEIR must include "enough detail 'to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project.'" (*Sierra Club v. County of Fresno (2018)* 6 Cal.5th 502, 516.) "A curtailed or distorted project description may stultify the objectives of the reporting process. Only through an accurate view of the project may affected outsiders and public decision-makers balance the proposal's benefit against its environmental cost, consider mitigation measures, assess the advantage of terminating the proposal (i.e., the "no project" alternative) and weigh other alternatives in the balance." (*County of Inyo,* 71 Cal. App. 3d at 192-193).

The project description must describe the "whole of the action" that has the potential to impact the environment (*see* CEQA Guidelines § 15378 (a)). This definition precludes "piecemeal review which results from 'chopping a large project into many little ones—each with a minimal potential impact on the environment—which cumulatively may have disastrous consequences.' " (*Rio Vista Farm Bureau Center v. County of Solano* (1992) 5 Cal.App.4th 351, 370, quoting *Bozung v. Local Agency Formation Com*. (1975) 13 Cal.3d 263, 283–284; *Planning & Conservation League v. Castaic Lake Water Agency* (2009) 180 Cal. App. 4th 210, 235.)

Unfortunately, DEIR's Project Description fails to meet these basic standards of adequacy, which undermines the impact analysis and precludes the public and responsible agencies from meaningfully commenting on the environmental document.

a. The "Whole of the Action" Includes Elements that would Be Ministerial If Proposed Alone

The DEIR takes the unusual approach of first acknowledging that the reservoir project is discretionary and subject to CEQA, but then expressly excluding a portion of the project from the DEIR. Namely, the DEIR excludes water used for crop irrigation, reasoning that crop irrigation is not independently subject to discretionary review[2]. This approach is fundamentally inconsistent with CEQA.

CEQA identifies a three-step process:

> First, the Lead Agency, during its "preliminary review" of a project, determines whether an agency is contemplating "approval" of a "project," and whether the project is subject to CEQA or is exempt.
>
> Second, if the project is not exempt, the Lead Agency prepares an Initial Study to determine whether the project may have a significant effect on the environment, and then prepares a Negative Declaration if there is no substantial evidence of significant effect.
>
> Third, if the Initial Study shows that the project may have a significant effect on the environment, the Lead Agency prepares an Environmental Impact Report (EIR).

(California Environmental Law & Land Use Practice § 21.02 (2018)). Determining whether a project is "discretionary" or "ministerial" involves the first step. "Where a project involves an approval that contains elements of both a ministerial action and a discretionary action, the project will be deemed to be discretionary and will be subject to the requirements of CEQA." (CEQA Guidelines § 15268 (d)).

The "Project" that proceeds to step 2 is "the whole of an action, which has a potential for resulting in either a direct physical change in the environment, or a reasonably foreseeable

[2] The DEIR misleadingly suggests that CEQA itself contains an exemption for crop irrigation when it does not. In fact, the California Supreme Court recently held that well drilling permits are not necessarily ministerial, and that classifying all well permits as ministerial violates CEQA. (*See Protecting Our Water & Environmental Resources v. County of Stanislaus* (2020) 10 Cal. 5th 479.)

indirect physical change in the environment" (CEQA Guidelines § 15378 (a)). "Project"[3] refers to the underlying development proposal, not the governmental approval. (Id., subd. (c) and (d "the lead agency shall describe the project as the development proposal for the purpose of environmental analysis")). Accordingly, pursuant to CEQA Guidelines sections 15268 (d) and 15378, and applicable caselaw discussed in our September 7, 2018 letter (*see* DEIR App. B, Past Proceedings, p. 647) the "Project" analyzed in the environmental review document cannot be limited to only the discretionary elements of the proposal.

b. Failure to Adequately Describe Project Water Use

The DEIR fails to describe the "whole of the action" that has the potential to impact the environment (*see* CEQA Guidelines § 15378 (a)). The proposed reservoirs will not be solely for frost protection, but will also be used to store water to irrigate the vineyard. The Project Descriptions states "[a]ny water above a depth of three feet contained in the reservoirs after May 1 would be used for vineyard irrigation" (DEIR p. 2-1) but does not otherwise describe how the reservoirs will be used for vineyard irrigation, including whether the reservoirs would be used for irrigation beyond the initial draw-down (and the reservoirs refilled to maintain the 3 foot depth). Discussed above and in the impact analysis section below, DEIR's position that irrigation water need not be described or evaluated is plainly contrary to CEQA, and rather the DEIR must describe all uses of the reservoirs to enable an adequate impact analysis.

c. Clarification of Project Objectives

The DEIR identifies one[4] narrow Project Objective, namely to: "Construct three reservoirs with a total storage capacity of approximately 135 acre feet to store extracted groundwater to protect select vineyard areas during frost events." (DEIR p. 1.9.)

Including the number of reservoirs and approximate reservoir storage capacity in the Project Objective is troubling for several reasons. First, if the true objective is "to protect select vineyard areas during frost events", that should be the objective's focus. If frost protection can be achieved by storing less extracted groundwater in smaller reservoirs, that should be consistent – not inconsistent – with the Project Objectives. Second, the focus on storage capacity for 135

[3] Whether a particular activity constitutes a CEQA "project" is a question of law; courts do not defer to Lead Agency determinations of whether an activity is a project. (California Environmental Law & Land Use Practice § 21.02 (2018); California Environmental Law & Land Use Practice § 21.05 (2018); *Fullerton Joint Union High School Dist. v. State Bd. of Education* (1982) 32 Cal.3d 779, 795).

[4] The second Project Objective listed "Protect sensitive environmental resources adjacent to and on the reservoir sites" is not an independent objective or reason why the Project is being proposed.

acre feet of extracted groundwater suggests a different applicant objective than frost protection that was addressed in a recent scholarly article published in the journal Agriculture and Human Values[5] – namely to establish groundwater-related infrastructure that capitalizes on their water access and cements their water claims, which may at some future point be used for a different use, such as residential or commercial development. (Exhibit 1).

Given the central role of the Project Objectives in assessing the feasibility of mitigation measures and alternatives, the DEIR must ensure that they are accurately and appropriately characterized.

3. The DEIR Fails to Adequately Describe the Environmental Baseline

"An EIR must include a description of the physical environmental conditions in the vicinity of the project, as they exist at the time the notice of preparation is published, or if no notice of preparation is published, at the time environmental analysis is commenced, from both a local and regional perspective." (CEQA Guidelines § 15125 (a).) "The environmental setting will normally constitute the baseline physical conditions by which a Lead Agency determines whether an impact is significant." (*Id.*) Additionally, the CEQA Guidelines provide:

> Knowledge of the regional setting is critical to the assessment of environmental impacts. Special emphasis should be placed on environmental resources that are rare or unique to that region and would be affected by the project. The EIR must demonstrate that the significant environmental impacts of the proposed project were adequately investigated and discussed and it must permit the significant effects of the project to be considered in the full environmental context.

(CEQA Guidelines § 15125.)

"To fulfill its information disclosure function, 'an EIR must delineate environmental conditions prevailing absent the project, defining a baseline against which predicted effects can be described and quantified.'" (*Cleveland Nat'l Forest Found. v. San Diego Ass'n of Gov'ts*, 17 Cal. App. 5th 413, 439-40, 225 Cal. Rptr. 3d 591, 615 (2017) (quoting *Neighbors for Smart Rail v. Exposition Metro Line Construction Authority* (2013) 57 Cal.4th 439, 447).) "Without a determination and description of the existing physical conditions on the property at the start of the environmental review process, the EIR cannot provide a meaningful assessment of the environmental impacts of the proposed project." (*Save Our Peninsula Committee v. County of Monterey* (2001) 87 Cal.App.4th 99, 119 (citing Pub. Resources Code, §§ 21100, subd. (a),

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[5] *In vino veritas, in aqua lucrum* (Fairbairn et al., (Agriculture and Human Values, 2020); attached hereto as Exhibit 1 and available at https://lokaashwood.com/wp content/uploads/Fairbairn2020_Article_InVinoVeritasInAquaLucrumFarml.pdf.))

21060.5).) "If the description of the environmental setting of the project site and surrounding area is inaccurate, incomplete or misleading, the EIR does not comply with CEQA." (*Cadiz Land Co., Inc. v. Rail Cycle, L.P.* (2000) 83 Cal.App.4th 74, 87.)

Unfortunately the DEIR does not adequately describe the environmental setting either on the Project site or in the surrounding region to enable a meaningful assessment of the Project's environmental impacts.

a. Failure to Accurately Describe Baseline Groundwater Condition

The DEIR characterizes the Northwestern Region where the Project is located as experiencing relatively stable groundwater levels "with some declines in the areas where new agriculture is established" (DEIR p. 2-14). The DEIR also states:

> The Northwestern Threshold Region has historically supported rangeland agriculture and has had a relatively stable groundwater in shallow wells. However, based on limited information following vineyard development in 2015, water levels in deep wells have decreased up to 35 feet.

(DEIR p. 3-33). These statements are inaccurate and misleading in several respects. First, the DEIR never clearly discloses that the "new agriculture" and "vineyard development" that precipitated groundwater declines in the Northwestern Region is synonymous with the North Fork Ranch vineyard that the Project is proposed to protect from frost and supply irrigation water. Second, there is now more than limited information showing well declines associated with the vineyard development, with recent monitoring data showing much more substantial declines. Specifically, the Jaffe/Walsh Letter explains (on p. 4):

> Groundwater levels are falling far more rapidly in the Frost Ponds project area than is recognized by the DEIR. The hydrographs in Figure 5 display the periodic fall of groundwater levels in the NF vineyard area during the summer months when irrigation needs are greatest, and the recuperation of well levels when the pumps are shut down in the winter and water seeps back into the cone of depression created by summer pumping. Measured from summer low point to summer low point to control for this seasonal variance, the 5 wells display rates of depletion of 4, 9, 19, 21, and 27 feet a year, respectively; an average of 16 feet/year. Groundwater levels have plummeted correspondingly. For example, well #843 fell 85 feet between 11/15 and 10/19, and if pumping continues at the established rate groundwater levels will have fallen 150 feet by summer, 2021. Minimum thresholds, currently set at 205 ft, will be exceeded within 8 years for 4 of the 5 wells measured (Figure 4).

In addition to the data described in the Jaffe/Walsh Letter, it is important to note that the Applicant has the ability to provide detailed information about their wells to inform the DEIR's

analysis. The DEIR reliance on generalized and outdated information instead does not constitute the good faith effort at full disclosure that CEQA requires either generally, or with respect to water supplies specifically (*see County of Amador v. El Dorado County Water Agency* (1999) 76 Cal.App.4th 931, 954-955). The DEIR's description of existing groundwater conditions is inadequate and misleading, and requires substantial additional information to enable a meaningful assessment of the Project's environmental impacts (*Save Our Peninsula Committee,* 87 Cal.App.4th at 119).

b. Failure to Describe Resources In the Project Area Impacted by Increased Groundwater Depletion

As discussed in the Jaffe/Walsh letter, undesirable results of groundwater pumping in the Project area include its impact on interconnected surface water and Groundwater Dependent Ecosystems (GDEs). Discussed below, the DEIR is defective for failing to include an analysis of these physical environmental impacts. To enable an adequate impact analysis in the first instance however, the EIR must be revised to describe surface water conditions in the Project area and the location and extent of GDEs that could be affected by increased groundwater pumping in the Project area.

c. Failure to Adequately Describe the Biological Resources Baseline

Discussed at length in Dr. Gliessman's letter, the DEIR relies on inadequate baseline studies to determine what biological resources may be impacted by the Project. With respect to sensitive plant species, Dr. Gliessman explains:

> The observational methodology used to document the presence of sensitive species is questionable. Normally annual grasses and wildflowers are surveyed with a line and quadrat methodology. Multiple transects are placed across an area at frequent distances apart. Multiple small squares are chosen at distances along each transect crossing the area of concern, and all individuals and species are counted within those small quadrats. The quadrats for this type of ecosystem are normally 50x50 cm up to 100x100 cm. Taking multiple small quadrats allows for the calculation of a species/area curve, ensuring that the sample size was adequate. Just walking through identifying species in flower that could be seen while walking, is not adequate. Many species of concern are diminutive and have indistinct or hard to see flowers, such as the spineflower mentioned above, and the round leaved filaree (California macrophylla). They are easy to miss without using the methodology above.

(Gliessman Letter, p. 2.) Dr. Gliessman also identifies inadequacies the wildlife observations, stating:

> It should be noted that the biologists themselves admitted that their observation times from 10:00 to 16:00 were not ideal times for wildlife sightings, since most of these animals are nocturnal or crepuscular, and birds are primarily active in the early morning hours. This calls into question the validity of the comments regarding wildlife sightings. Any observation while driving is of minimal use since a vehicle would most likely frighten wildlife. A more widely accepted methodology for evaluating the presence of wildlife in a similar habitat nearby in western San Joaquin Valley is described in Germano et al. 2012. Staked transects 20 meters apart and 300 meters long, with specific focal points every 20 meters, were used to document the presence of very much the same list of vertebrates (amphibians, reptiles, birds, and mammals) as listed for the reservoir sites. This methodology was able to observe changes over a 10-year period due to variation in rainfall, grazing intensity, and fire. Each year was very different from one to the next, with some years showing very low presence, some showing high presence, and others showing variation in the diversity and activity of animals.

(Gliessman Letter, p. 3.)

To ensure that impacts to biological resources are adequately analyzed and mitigated, revised baseline studies are necessary.

4. The DEIR Fails to Adequately Identify and Analyze the Project's Significant Environmental Impacts

"A legally adequate EIR . . . 'must contain sufficient detail to help ensure the integrity of the process of decisionmaking by precluding stubborn problems or serious criticism from being swept under the rug.'" (*Kings County Farm Bureau v. City of Hanford* (1990) 221 Cal.App.3d 692, 733). "An EIR must include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project." (*Laurel Heights Improvement Assn. v. Regents of the University of California* (1988) 47 Cal.3d 376, 404-405). All phases of a project must be considered when evaluating its impact on the environment. (Guidelines § 15126). Agencies have a duty under CEQA to avoid or minimize environmental damage whenever feasible to do so, and must give major consideration to preventing environmental damage. (Guidelines § 15021 (a)). Agencies must make information relevant to the significant effects of a project, alternatives, and mitigation measures that substantially reduce project impacts as soon as possible in the environmental review process (Pub. Resources Code § 21003.1 (b)) and should not defer the formulation of mitigation measures to some future time (Guidelines § 15126.4 (b)).

The DEIR is inadequate pursuant to the above CEQA standards. As discussed above, the DEIR fails to include a complete Project Description, and sets forth in incomplete and misleading description of the environmental setting used as the baseline for its impact analysis.

For those reasons the DEIR's impact analysis is necessarily flawed. The DEIR's impact analysis is also flawed in the following respects.

a. Impacts to Water Resources

The DEIR's analysis of the Project's impacts to the critically overdrafted Cuyama Groundwater Basin is woefully inadequate and contrary to CEQA. The DEIR selectively applies only the County's 31 AFY threshold, when that threshold is outdated and inadequate, and other recently amended CEQA Guidelines Appendix G thresholds directly apply. The DEIR also impermissibly applies the 31 AFY threshold only to evaporative loss, when even with mitigation the Project's water use clearly exceeds the 31 AFY threshold. The DEIR also impermissibly excludes irrigation water from its analysis, when CEQA requires that the DEIR evaluate impacts from "the whole of the project" against the existing environmental baseline.

Discussed below, substantial evidence establishes that Project groundwater depletion will result in significant environmental impacts pursuant to at least four applicable thresholds of significance, even assuming proposed mitigation proves feasible and effective. The DEIR requires extensive revision and recirculation to adequately inform the public and interested agencies of the Project's groundwater impacts.

i. County reliance on the 31AFY Threshold is misplaced and inadequate.

The County's 31 AFY threshold was calculated based expressly on a lesser level of overdraft based on 1992 data showing an overdraft of 28,525 AFY, whereas the DEIR identifies a current overdraft of at least 30,000 AFY. (C.f. County Thresholds Manual p. 103 and DEIR p. 2-13.) Per the County's own CEQA Guidelines and Groundwater Resources policies, the County should have updated this threshold and erred in applying it unchanged to (and as the exclusive measure of) the Project's groundwater impacts.

The County's CEQA Guidelines[6] provide that "[t]he Environmental Thresholds and Guidelines Manual shall be periodically amended by the Board of Supervisors, as necessary to reflect new information or changed environmental circumstances" (p. 8). The County's CEQA Guidelines moreover specifically identify groundwater levels as an environmental characteristic subject to constant change for which thresholds will need to be changed to reflect changes in resource scarcity and use "to ensure reasonable significance determinations"[7]. (Id.) The failure to revise the threshold or address the baseline discrepancy in the DEIR is error.

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[6] Santa Barbara County Guidelines for implementation of CEQA, As Amended (September 2020); available at https://cosantabarbara.app.box.com/s/mlaiha851p7027uxw3ob8lpn4mqrxl7f.

[7] "Environmental characteristics such as groundwater levels and sensitive biological habitat acreage are subject to constant change due to development trends. In order to ensure

Moreover, according to the County's CEQA Thresholds and Guidelines Manual,

> Groundwater supplies are limited in terms of the annual amount of water which can be withdrawn without causing a long term drop in water levels ("Safe Yield") and in the amount of total storage of a basin which can be removed without significant environmental effects ("Available Storage"). These limits make conservative use of water a necessary policy in Santa Barbara County in order to avoid or minimize significant and lasting adverse environmental effects.

(County CEQA Thresholds Manual, pp. 67-68.)

The County also has an action item in its Groundwater Resources policies requiring that the County update its groundwater thresholds as new data becomes available and as overdraft conditions persist (Comprehensive Plan, Conservation Element Groundwater Resources **ACTION 3.10.1).**

In light of the clear guidance in the County's own CEQA Guidelines, Thresholds Manual, and Comprehensive Plan, the DEIR's reliance on the 31AFY threshold is patently inadequate. We raised the need to update the 31AFY threshold in comments to the Planning Commission and Board of Supervisors, supported by a report prepared by a Professional Hydrologist with 20 years of experience monitoring and reporting on water conditions in the Cuyama Valley, but unfortunately the DEIR continued to misapply this outdated and inadequate threshold.

ii. The DEIR fails to analyze whether the Project results in significant impacts pursuant to the State CEQA Guidelines.

As the County's own CEQA Guidelines[8] make clear "Thresholds of significance are intended to supplement provisions in the State CEQA Guidelines for determination of significant environmental effect including Sections 15064, 15065, and 15382, and Appendix G incorporated herein, and the thresholds shall be applied consistent with these State provisions." (County CEQA Guidelines p. 7) However, the DEIR analyzes the Project's impacts to groundwater solely against the County's 31AFY threshold and does not analyze whether the Project will result in significant impacts pursuant to the CEQA Appendix G Thresholds

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reasonable significance determinations, thresholds will be changed to reflect changes in environmental carrying capacity, resource scarcity and resource use. Information on such changes may come from resource managers (e.g. water purveyors, Air Pollution Control District), applicants or the public." (County CEQA Guidelines p. 8, Article V, § F.3.a.3.)

[8] Santa Barbara County Guidelines for implementation of CEQA, As Amended (September 2020); available at https://cosantabarbara.app.box.com/s/mlaiha851p7027uxw3ob8lpn4mqrxl7f

including three thresholds that directly apply to projects like North Fork that rely on groundwater. Specifically:

> CEQA Guidelines Appendix G, § X (Hydrology and Water Quality) "Would the project: … b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?"
>
> CEQA Guidelines Appendix G, § X (Hydrology and Water Quality) "Would the project: … e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?"
>
> CEQA Guidelines Appendix G, § XIX (Utilities and Service Systems) "Would the project: … b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?"

The DEIR must be revised to include an analysis of the Project's impacts to groundwater measured against these clearly applicable CEQA thresholds. This analysis must necessarily incorporate the recently approved Cuyama Basin Groundwater Sustainability Plan (GSP)[9], discussed further in the Jaffe/Walsh Letter, including the Project's potential to contribute to "undesirable results" which mirror the foreseeable environmental impacts of groundwater depletion addressed in CEQA caselaw (*see e.g. Cty. of Inyo v. Yorty* (1973) 32 Cal. App. 3d 795, 804-05, *Save Our Peninsula Committee*, 87 Cal.App.4th 99, *Preserve Wild Santee v. City of Santee* (2012) 210 Cal. App. 4th 260, 285-286.) The DEIR acknowledges that the 2021 CEQA Guidelines consider whether a project would obstruct implementation of a GSP (DEIR p. 3-37) but does not undertake the required analysis.

The third threshold addressing water supply specifically requires that the DEIR evaluate whether there will be sufficient water supplies to serve the project (and reasonably forseeable future development) during normal, dry and multiple dry years. (CEQA Guidelines Appendix G § XIX (b)). This analysis is especially critical in the Cuyama Valley where water supplies are scarce and increased groundwater pumping during multiple dry years can have dire consequences for the environment including GDEs and other Cuyama residents reliant on nearby wells. Moreover the DEIR must take the effects of climate change into account including an increase in prolonged drought periods.

iii. The DEIR Improperly Limits Thresholds to Evaporative Losses

The DEIR claims that the County's 31 AFY threshold, and the CEQA Guidelines Appendix G thresholds, do not apply to water used to irrigation crops. (*See* DEIR pp. 3-35 – 3-

[9] Cuyama Basin GSP available at: https://cuyamabasin.org/resources#final-gsp

36.) The County's Thresholds and Guidelines Manual however does not restrict application of the 31 AFY threshold to non-irrigation uses. (*See* County Thresholds Manual pp. 97-135). The CEQA Appendix G Thresholds are also not restricted to non-irrigation uses. (*See* CEQA Guidelines Appendix G, § X (Hydrology and Water Quality)). Rather, as explained above, CEQA requires that the whole project, including all water the Project will use irrespective of its ultimate destination, be analyzed against baseline water use to determine impact significance. Unfortunately here, the DEIR both failed to include adequate baseline water use information, and failed to quantify and analyze the Project's full water usage, rendering an adequate impact analysis impossible. Under these circumstances, the DEIR must be revised and recirculated. (*See Cadiz v. Rail Cycle* (2000) 83 Cal. App. 4th 74). ˆ

iv. The DEIR Understates Evaporative Losses

The Water Budget Technical Memorandum incorrectly relies on merely the number of frost hours to predictively calculate the quantities of water and its subsequent evaporation when applied during a frost event. Clough states: "…the best indicator of likely frost events is air temperature, the assumption being when below a temperature threshold, frost is likely to occur.[10]"

It is to be noted that the actual number of hours below 32 degrees do not reflect the actual number of hours frost protection sprinklers are utilized. Proper frost protection of grapevines rely on the activation of the sprinklers prior to freezing temperatures actually occurring (Exhibit 2, Evans, Robert G, 2000, The Art of Protecting Grapevines from Low Temperature Injury[11], p. 67). When sprinklers are first activated, the evaporation causes a dip in the temperatures surrounding the vines, which can exacerbate bud damage, necessitating an early start to frost protection measures. (*Id.*) The timing of sprinkler activation also depends on the relative humidity ahead of the potential frost event. Recommended starting temperatures can range from 34 degrees F to 39 degrees F, well above freezing, if the relative humidity warrants it. (*Id.*)

Merely totaling hours above or below a narrow. temperature threshold does not reflect how sprinkler frost protection systems are used in field situations. The Water Budget Technical Memorandum's numbers assume that if the temperature is below a certain point, the sprinklers will turn on, and if the temperature edges up, they will be turned off. This is counter to actual practice.

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[10] Clough et al., May 17, 2021. Water Budget Technical Memorandum, North Fork Ranch Frost Ponds Focused EIR (Case No. 16CUP-00000-00005). Cardno, Inc. p. 6

[11] Evans, Robert G, 2000, The Art of Protecting Grapevines from Low Temperature Injury Proceedings of the ASEV 50th Anniversary Meeting, Seattle, Washington June 19-23, 2000, pp 60-72. Copyright American Society for Enology and Viticulture. Attached hereto as Exhibit 2.

Once the sprinklers are activated, they must remain on to create and maintain an ice-and-water mix. If that ice-and-water mix is not maintained, the temperature of the plant tissues can drop below the critical damage point. It is recommended that the sprinklers remain on until after sunrise and melting water is running freely, sometimes well into the day if cloudy or windy. (*Id.*) These temperatures are usually well above freezing. These field operational practices would greatly increase the number of hours the sprinkler system would be required to be actively spraying water, far beyond the simple temperature-hours noted by the Water Budget Technical Memorandum. Evans states that growers should size frost protection systems "to protect for as much as 10 hours per night for three or four nights in a row." (*Id.*)

The DEIR and supporting calculations should be revised to more accurately reflect actual practice. To the extent additional water use and/or evaporation loss will occur, the DEIR's impact analysis and mitigation strategy require revision.

v. Substantial Evidence of Significant Impacts from Groundwater Depletion

"Compliance with the threshold does not relieve a lead agency of the obligation to consider substantial evidence indicating that the project's environmental effects may still be significant." (County CEQA Guidelines p. 7; citing CEQA Guidelines Section 15064(b)(2))

Discussed above, the DEIR's improper use of thresholds artificially constrained the impact analysis. Even with MM-WAT-01, the Project results in groundwater extraction above baseline levels that exceed the 31AFY threshold. Moreover, the DEIR failed to analyze the physical environmental impacts associated by groundwater depletion. Not only is this failure legal error on its own, it also impermissibly ignores substantial evidence of these physical environmental effects. For example, as explained in the Jaffe/Walsh letter, data collected by the Cuyama Basin GSA since 2015 clearly shows undesirable results of groundwater pumping in the North Fork Vineyard area. DWR's decision letter on the GSP specifically expresses concern about depletion and dewatering "in an area with the highest concentration of potential GDEs in the Cuyama Valley and with interconnected surface water" (DWR 2022, p, 10, Jaffe/Walsh Letter Appendix A). The Jaffe/Walsh Letter compiles and analyzes the available data, and concludes the Project, even as mitigated, will contribute to chronic groundwater depletion and severed groundwater-surface water connections. Further, discussed below, Dr. Gliessman's Letter explains the impacts to GDEs that result from excessive water use including in heavy frost years.

The DEIR must be revised to address this substantial evidence and fully analyze the Project's impacts to groundwater and groundwater dependent resources.

vi. Incomplete Cumulative Groundwater Impact Analysis

The DEIR states: "In order to consider impacts from development within the Cuyama Valley, this analysis also considers ministerial projects in Santa Barbara County related to existing, planned, and proposed cannabis operations in the Cuyama Valley that could result in related or cumulative impacts. These projects are listed in Table 4.1 and will be considered in this cumulative analysis. Figure 4-1 shows the geographic location of the proposed Project in relation to the projects listed in Table 4.1." DEIR p. 4-2. However, the DEIR does not include past projects approved *on the project site* that contributed most directly to related and cumulative impacts to groundwater in the Northwest Region, namely the approval of well permits by County Environmental Health Services to irrigate Harvard's vineyard. This failure renders the cumulative impact analysis misleading and incomplete.

The Jaffe/Walsh Letter uses existing data and reports to demonstrate that the Project's contribution to already significant cumulative groundwater impacts is cumulatively considerable, even assuming proposed mitigation is effective. Unfortunately the DEIR's analysis included none of this information and is fundamentally flawed as a result.

b. Impacts to Biological Resources

Discussed in section 3.c, above, the DEIR failed to conduct adequate baseline surveys to accurately determine the environmental baseline with respect to sensitive plant and animal species. Accordingly, the Project impacts to various sensitive species were overlooked, including Blakely's spineflower (Chorizanthe blakelyi), the round leaved filaree (California macrophylla), the jewel flower (Caulanthus lemmonii), the pale-yellow layia (Layia heterotricha), and the showy golden madia (Madia radiata) (Gliessman Letter, pp. 1-3.)

Further, the analysis of impacts to Biological Resources is flawed and incomplete for failing to address impacts to GDEs. Dr. Gliessman's Letter explains (on p. 4) the impacts to GDEs that result from excessive water use including in heavy frost years as follows:

> Increased pumping in this region will only increase the formation of a cone of depression associated with the declining groundwater levels already occurring in this subbasin. GDEs, shown in the figure as the orange areas in the upper left, and the wetland areas marked in blue close to well #845, are ecosystems whose roots need to be in moist soil, from a few feet down for boggy wetlands, and no more than about 40 feet down for riparian shrub and tree species. The DWR GSP consultation letter called attention to the potential negative impact of drawing down groundwater levels in the Northwest region below those needed to maintain GDE species (cottonwoods, willows, and other wetland plant species). Although none of these species were encountered on the sites of the three reservoirs, the excessive use of groundwater for frost protection, especially in heavy frost years, would further endanger these groundwater dependent ecosystems.

The DEIR requires revision and recirculation to address the full scope of the Project's biological resource impacts, and allow for the formulation of additional mitigation measures or alternatives as necessary to substantially reduce or avoid these impacts.

c. Land Use Impacts/Policy Inconsistency

The DEIR is required to identify the Project's potential inconsistencies with applicable policies, and identify any potentially significant impacts arising from this inconsistency (see CEQA Guidelines Appendix G, § IV (e) ("Would the project . . . [c]onflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?"); *see also Pocket Protectors,* 124 Cal.App.4th at 930 (policy conflicts may constitute potentially significant impacts).

The DEIR discusses a number of applicable policies, but fails to explain how the Project is "potentially consistent" with those policies, and overlooks substantial evidence showing clear inconsistencies. For example, Comprehensive Plan Land Use Element, Land Use Development Policy 4 requires that adequate resources including water are available to serve the proposed development. Discussed throughout this letter and in the Jaffe/Walsh letter, there is insufficient water to supply the Project from the overdrafted Cuyama GWB without hastening the undesirable results the GSP and SGMA's adaptive management approach is required to address through curtailments and other measures. The DEIR's failure to meaningfully address these constraints on future water supply infects the adequacy of the impact analysis as well as the policy consistency analysis.

Comprehensive Plan Hillshed and Watershed Protection Policies 1 and 2 require, among other things, that grading be minimized. The DEIR summarily states that "Grading would not be excessive" which is directly at odds with the reality that approximately 257,945 cubic yards of cut and fill would be required to construct the three proposed reservoirs (DEIR p. 2-9.) Given that MM-WAT-01 restricts water use for frost protection to 103 AFY, it appears that the Project can be carried out with less alteration of the natural terrain by constructing fewer and/or smaller reservoirs. Under these circumstances, the Project is not consistent with these policies.

The DEIR's discussion of Visual Resources Policy 2 omits consideration of the reservoir covers required by MM-WAT-01, which, as discussed above, may result in significant visual impacts to views from State Route 166. Without this evaluation the DEIR's conclusion that the Project is potentially consistent with visual resources policy is premature.

The County's Comprehensive Plan Groundwater Resources Element includes numerous policies as well as action items (which are excluded from the DEIR and should be included) that are directly applicable and for which there is overwhelming evidence of inconsistency. For example, Policy 3.5 provides "In coordination with any applicable groundwater management

plan(s), the County shall not allow, through its land use permitting decisions, any basin to become seriously overdrafted on a prolonged basis". Policy 3.6 provides "The County shall not make land use decisions which would lead to the substantial overcommitment of any groundwater basin." The DEIR includes no meaningful analysis of the Project's consistency with these policies or the Groundwater Element more broadly, Whether or not a new threshold has supplanted the 31AFY threshold is not dispositive of whether the County is making land use decisions which protect against the substantial overcommitement of any groundwater basin. Discussed above, the County has the express authority in its own CEQA Guidelines to revise this threshold to reflect current conditions in the basin, and further CEQA Appendix G includes three other thresholds that incorporate broader considerations than compliance with the 31AFY threshold. The EIR must be revised to further analyze this issue, and acknowledge inconsistencies with the Groundwater Element that further establish the significance of the Project's impacts to the Cuyama Basin and surrounding environment.

5. The DEIR's Mitigation Measures Are Legally Inadequate

An EIR must describe feasible measures which could minimize each significant adverse impact (CEQA Guidelines §§ 15123 (b)(1), 15126.4 (a)(1).) "Mitigation measures must be fully enforceable through permit conditions, agreements, or other legally binding instruments." (CEQA Guidelines § 15126.4 (a)(1)(D). Substantial evidence must show that the mitigation measures are feasible and effective in remedying the environmental impact at issue. (*See Gray v. County of Madera* (2008) 167 Cal. App. 4th 1099, 1116). "'Impermissible deferral of mitigation measures occurs when an EIR puts off analysis or orders a report without either setting standards or demonstrating how the impact can be mitigated in the manner described in the EIR.'" (*Pres. Wild Santee v. City of Santee* (2012) 210 Cal. App. 4th 260, 280-81 (quoting *Clover Valley Foundation v. City of Rocklin* (2011) 197 Cal.App.4th 200, 236).

a. Mitigation for Evaporative Losses Is Impermissibly Deferred

The DEIR relies on MM-WAT-01 to conclude that evaporation from the frost protection system will not exceed the County's 31AFY threshold. However, as discussed at length in the Jaffe/Walsh letter, the DEIR lacks information about this mitigation measure including the proposed reservoir covers and the ELRP necessary to evaluate its effectiveness and feasibility. The DEIR contains no substantial evidence that would support a conclusion that MM-WAT-01 is either feasible or effective. (*See Gray v. County of Madera* (2008) 167 Cal. App. 4th 1099, 1116 (Finding prejudicial error based on lack of substantial evidence that proposed mitigation measures are feasible or effective in remedying the potentially significant problem of decline in water levels of neighboring wells). The DEIR impermissibly defers this mitigation measure by failing to demonstrate how the Project's evaporative loss impacts (and broader impacts to groundwater levels and GDEs) can be mitigated in the manner described in the EIR. (*Pres. Wild Santee v. City of Santee* 210 Cal. App. 4th at 280-81).

The omitted information is necessary to enable the public to meaningfully comment on the adequacy of a mitigation measure relied on to reduce multiple significant impacts below significant levels, and accordingly revision and recirculation is clearly required.

b. Insufficient Mitigation for Project Impacts to Groundwater

DEIR also fails to include sufficient mitigation to reduce the Project's impact and cumulatively significant contribution to declining well levels in the Northwest Region below significant levels. Further discussed in the Jaffe/Walsh letter, the rolling 3-year average included in MM-WAT-01 would allow threshold exceedances in individual years, potentially overlapping with dryer conditions requiring more irrigation, and compounding impacts and undesirable results within the Northwest Region. (Jaffe/Walsh Letter, p. 10.) Moreover, the DEIR fails to include mitigation to address water use impacts other than evaporative losses, which as discussed above is an error that requires correction in a revised and recirculated EIR.

c. Impacts of Reservoir Cover Not Addressed

"If a mitigation measure would cause one or more significant effects in addition to those that would be caused by the project as proposed, the effects of the mitigation measure shall be discussed but in less detail than the significant effects of the project as proposed." (CEQA Guidelines § 15126.4 (a)(1)(D)). The DEIR proposes as part of MM-WAT-01 that the reservoirs be covered, but includes no information whatsoever regarding the covers themselves. The reservoirs are visible from public viewing areas including Highway 166 as the MND acknowledges, and it is reasonably forseeable that installing covers over the approximately 15.6 acre reservoir area will result in significant visual impacts, potentially including glare which could further affect the safety of traveling motorists on a roadway with known safety issues. The DEIR must describe the material and other specifications of the covers, and analyze whether they would cause new significant effects.

d. Inadequate Mitigation for Impacts to Biological Resources

Discussed above, the DEIR's analysis of biological resource impacts is incomplete and requires revision to identify additional feasible mitigation measures. Additionally, mitigation described in the DEIR for grassland impacts is inadequate. The DEIR acknowledges that the Project result in a significant long-term impact on native grasslands, impacting native grasslands in three ways: (1) permanent removal within the Project footprint, (2) disturbance or removal adjacent to the Project footprint during construction activities, and (3) loss of buffer habitat between native grasslands and developed areas. (DEIR pp. 3-18 - 3-20.) However, as discussed by Dr. Gliessman, restoration or mitigation of perennial grasses is very difficult, and rarely successful. The DEIR's conclusion that the project would have less than significant impacts to native grasslands and native grassland buffers with implementation of MM BIO-02 is not

supported by substantial evidence and the DEIR should look instead to avoiding this impact with alternatives.

6. Defective Alternatives Analysis

"A major function of an EIR 'is to ensure that all reasonable alternatives to proposed projects are thoroughly assessed by the responsible official.' (*Save Round Valley Alliance v. County of Inyo* (2007) 157 Cal. App. 4th 1437, 1456). The alternatives analysis is the core of CEQA, and forms the foundation for CEQA's "substantive mandate" which prohibits approval of projects "if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects." (*Citizens for Goleta Valley*, 52 Cal. 3d at 564-565; Pub. Res. Code § 21002.)

Specifically, the CEQA Guidelines provide that "An EIR shall describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and evaluate the comparative merits of the alternatives." (Guidelines § 15126.6 (a).) "The range of potential alternatives to the proposed project shall include those that could feasibly accomplish most of the basic objectives of the project and could avoid or substantially lessen one or more of the significant effects." (Guidelines § 15126.6 (c).) "Because an EIR must identify ways to mitigate or avoid the significant effects that a project may have on the environment [citation], the discussion of alternatives shall focus on alternatives . . . which are capable of avoiding or substantially lessening any of the significant effects of the project, even if these alternatives would impede to some degree the attainment of the project alternatives, or would be more costly." (Guidelines § 15126.6 (b).)

Accordingly, it is critically important that the EIR identify and analyze all reasonable alternatives. Unfortunately, the DEIR does not identify a reasonable range of alternatives and improperly rejects alternatives from consideration without adequate explanation (see DEIR pp. 6-13-6-14, summarily rejecting nine separate alternatives).

Given the limited supply of groundwater in the Cuyama Valley and the numerous significant impacts that using groundwater for frost protection will cause, it is imperative that the DEIR identify alternatives that accomplish frost protection by other means. Dr. Gliessman identifies two such alternatives in his comment letter, including a new which uses an electric current to generate heat (Gliessman Letter, p. 4.) Other alternatives that the DEIR summarily rejects such as barrier management and selective sink installation, because additional studies of airflow (in the case of barrier management) or microclimates and growing conditions of each varietal block (in the case of selective sinks), should be further developed. The fact that additional studies may be required does not render these alternatives infeasible.

7. Inadequate Public and Agency Review Process

"The requirement of public review has been called 'the strongest assurance of the adequacy of the EIR.'" (*Mountain Lion Coalition v. Fish & Game Com.* (1989) 214 Cal. App. 3d 1043, 1051 (quoting *Sutter Sensible Planning, Inc. v. Board of Supervisors* (1981) 122 Cal. App. 3d 813, 823).) To effectuate this public review requirement, the lead agency must prepare a legally adequate draft EIR that is circulated to the public and government agencies. (CEQA Guidelines §§ 15120 (c), 15086, 15087.) The CEQA Guidelines specifically provide that the lead agency "shall consult with and request comments on the draft EIR from: (1) Responsible Agencies, (2) Trustee agencies with resources affected by the project, and (3) Any other state, federal, and local agencies which have jurisdiction by law with respect to the project or which exercise authority over resources which may be affected by the project, including water agencies [ ]." (CEQA Guidelines § 15086 (a).)

The numerous substantive flaws and omissions in the DEIR discussed in the above sections have the effect of precluding meaningful public and agency comment on the Project's significant environmental impacts, feasible means of mitigating those impacts, and alternatives to avoid those impacts. Moreover, shortcomings in public and agency noticing deprived interested members of the public and public agencies with jurisdiction over resources affected by the Project.

Our letter to the County dated 12/16/22 (incorporated herein by reference) addressed shortcomings in the public notification process, and requested an extension of the public comment period which was granted. However, we're concerned that the County's notification process was nonetheless deficient, as several Cuyama valley residents who previously participated in the County's proceedings on this Project did not receive any notice at all.

Our 12/16/21 letter also addresses DEIR formatting and navigability issues which hindered the public's ability to access the DEIR and obtain online access to the public comment hearing. How the DEIR presents information is important to the public review process, as CEQA case law explains (*see Vineyard Area Citizens v. City of Rancho Cordova* (2007) 40 Cal. 4th 312, 442 ("The data in an EIR must not only be sufficient in quantity, it must be presented in a manner calculated to adequately inform the public and decision makers, who may not be previously familiar with the details of the project. "[I]nformation 'scattered here and there in EIR appendices,' or a report 'buried in an appendix,' is not a substitute for 'a good faith reasoned analysis ... .' ") The EIR should be revised to clearly index all documents, correct erroneous references (including those mentioned in Dr. Gliessman's comment letter), and generally improve the public's ability to understand and navigate the document.

Finally, despite our previous request in our scoping comments that the County specifically notify and include the Cuyama Basin GSA which has jurisdiction over groundwater affected by the Project in the CEQA review process, it appears the GSA was not notified. The

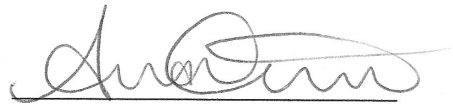
County should have consulted with and requested written comments from the State Department of Water Resources, Water Rights Division, and the Cuyama Basin GSA, to satisfy their obligation under CEQA Guidelines § 15086 (a) (3). This further underscores the DEIR's failure to address sustainable groundwater management in in the manner required by the State.

8. Conclusion

For reasons stated herein, the DEIR for the North Fork Project is significantly and extensively flawed. It requires revision and recirculation for additional public and agency review.

Sincerely,

LAW OFFICE OF MARC CHYTILO, APC



Ana Citrin

Exhibit 1: *In vino veritas, in aqua lucrum* (Fairbairn et al., (Agriculture and Human Values, 2020)

Exhibit 2: Evans, Robert G, 2000, The Art of Protecting Grapevines from Low Temperature Injury Proceedings of the ASEV 50th Anniversary Meeting, Seattle, Washington June 19-23, 2000, pp 60-72. Copyright American Society for Enology and Viticulture.

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SYMPOSIUM/SPECIAL ISSUE

In vino veritas, in aqua lucrum: Farmland investment, environmental uncertainty, and groundwater access in California's Cuyama Valley

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Abstract
This paper explores the relationship between farmland investment and environmental uncertainty. It examines how farmland investors seek to "render land investible" (Li, Trans Inst Br Geographers 39:589–602, 2014) in spite of drought, groundwater depletion, and changing regulations. To do so, we analyze a single case study: the purchase of 8000 acres of dry rangeland in California's Cuyama Valley by the Harvard University endowment for use in creating an irrigated vineyard. Drawing from interviews with Cuyama Valley farmers and community members, participant observation at community meetings, and public document analysis, we make two primary contributions to understandings of uncertain resource materiality in farmland investment. First, this case reveals that investors can turn environmental uncertainty into an advantage, exploiting both the *temporal* uncertainties associated with resource management under climate change and the *spatial* uncertainties inherent to all subsurface resources. We argue that the material and legal uncertainties of groundwater access provide investors with a potentially lucrative opening to assert their preferred land imaginaries and improve their property values. In the Cuyama Valley they did so through both participation in groundwater governance and the establishment of water-related infrastructure on their property. Second, this case highlights that the asset-making processes involved in farmland investment may be as much vertical as they are horizontal. The need to map and measure the uncertain vertical dimension of land creates an outsized role for scientific expertise in farmland assetization.

Keywords Farmland · Financialization · Assetization · Groundwater · Climate change · Environmental uncertainty

Introduction

"Managing agricultural assets with climate change in mind can be better for the planet *and* for long-term investors," asserts a recent report by the asset management branch of pension fund TIAA, which controls a 2-million-acre portfolio of global farmland (Nuveen 2018, p. 6). The report depicts climate change as a major threat to agricultural investments, arguing that "aspects of this threat—severe storms and floods, droughts and wildfires, extensive erosion—severely impact farmland and diminish value for investors" (ibid.). Yet the report also describes a silver lining; a proactive investment approach can transform climate risks into a source of above-market "alpha" returns for savvy investors. While farmers across the globe struggle to cope with increasing environmental uncertainty, institutional investors in agriculture—including pension funds, hedge funds, and university endowments—are considering how to use this uncertainty to their advantage.

That some investors in agricultural land see potential for profit in the face of increasing environmental uncertainties is not surprising. Investment, by its very nature, involves imagining and wagering upon an uncertain future (Beckert 2016). Whereas most agricultural producers must take steps to avoid or mitigate risk (or face the loss of their

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livelihoods), for the financial sector, commodifying and trading risk can itself be a foundation for profit (Zaloom 2004; Christophers 2018). The environmental uncertainty surrounding climate change has already engendered an array of financial products, from novel forms of index-based crop insurance for small farmers facing climate risks (Isakson 2015) to "catastrophe bonds" that allow investors to hedge and speculate on the likelihood of catastrophic weather events (Johnson 2014). But while finance's lucrative relationship with environmental uncertainty clearly applies to agricultural commodity derivatives and other such mobile and fungible financial assets, what about cases in which the investment *is* the agricultural operation? In such instances, how might investors ensure that environmental uncertainty will not lead to a devaluation of their property investment?

We present here a case study that reveals how one institutional investor in agriculture—Harvard Management Company (HMC)—is contending with the environmental uncertainties surrounding one of its farmland investment properties. This property, an $11 million, 8700-acre ranch in California's Cuyama Valley, is situated in a region gripped by climatic and hydrological uncertainty. HMC, the firm charged with investing Harvard's $39 billion endowment, purchased the land in 2014 with the intention of developing an irrigated vineyard (McDonald 2018). This land acquisition was steeped in environmental uncertainty from the outset. First, it occurred at the height of a prolonged California drought that increasingly appeared to be the new normal under climate change. Second, the property could hardly be seen as a safe bet for such dry times: the Cuyama Valley receives little precipitation even in non-drought years, it has almost no surface water, and years of excessive pumping for irrigation have left the groundwater basin severely depleted. Third, the government response to environmental change adds layers of political uncertainty on top of environmental uncertainty. Just months after HMC purchased the property, California responded to the drought by passing the Sustainable Groundwater Management Act (SGMA), which placed regulatory limits on groundwater extraction for the first time in the state's history. Whether SGMA was simply an unpleasant surprise for HMC's representatives or constituted, as some suspicious commentators suggested at the time, "a well-timed water play" (Fritz 2014) designed to profit from impending groundwater use restrictions is unclear. Either way, the potential success of this investment was, from the outset, closely bound up with the interrelated uncertainties of climate, hydrology, and resource governance, making it an excellent case with which to examine the complex role that environmental uncertainty can play in the production of farmland as a profitable financial asset class.

Our analysis suggests that savvy, well-capitalized, and politically powerful farmland investors can, under the right conditions, turn environmental uncertainty to their advantage. The Cuyama Valley's climatic and hydrological uncertainty—mediated through government action in the form of changing groundwater regulation—has created opportunities for investors to lock in future profits and promote the valorization of their investment property. The profound uncertainties currently surrounding groundwater in this region, including the *temporal uncertainties* of resource management under climate change and the *spatial uncertainties* inherent to subsurface resources, constituted an opening for HMC's representatives to assert a "land imaginary" (Sippel and Visser, this issue) calculated to benefit their financial interests. This case also suggests that the "asset-making" processes surrounding farmland (Ducastel and Anseeuw 2017; Visser 2017; Ouma 2020) may be as much vertical (pertaining to the subsurface) as they are horizontal (pertaining to surface characteristics). In water-strapped agricultural areas such as Southern California, physical and legal access to groundwater are the *sine qua non* of land assetization. The effort to map and enclose this vertical, subsurface dimension of land creates an outsized (and contested) role for scientific and legal expertise in farmland investment.

We begin our analysis with a brief overview of three distinct but interrelated bodies of scholarly work with a bearing on this case: research on the production of farmland as an investible asset class, on the relationship between finance and environmental risk (which relates to temporal uncertainty), and on the political ecology of the subsurface (a realm of spatial uncertainty). Next, we detail our methods and then describe the Cuyama Valley's geography and history as well as HMC's land purchase there. We then present our findings, exploring two primary means by which HMC's representatives have sought to leverage groundwater uncertainty in an effort to lock in potential future profits on their investment: (1) participation in groundwater governance processes associated with SGMA, and (2) efforts to establish water-related infrastructure on their property. We note that community members have contested these efforts by similarly making use of the ambiguities of groundwater science to present competing scientific and legal visions. We conclude by discussing the implications of these kinds of transformative agricultural investments for communities, like the Cuyama Valley, where hydrological and climate-related environmental uncertainty is the new norm.

Literature review: Farmland investment in the face of environmental uncertainty

There is a growing scholarly literature on the "financialization" of agriculture generally and of agricultural land specifically (Clapp and Isakson 2018). A new wave of farmland investors has been flocking to farmland since the 2008 financial crisis, motivated largely by the potential for land

price appreciation (Fairbairn 2014; Gunnoe 2014; Kuns et al. 2016). Some investors expect this appreciation to occur passively, the result of global population and income growth or of regional development initiatives, while many others actively transform their farm properties through land clearing, infrastructural improvements, or intensification of existing operations (Fairbairn 2020).

Yet the process of extracting investment returns from farmland is neither frictionless nor inevitably successful. Though much of the land currently targeted by the financial sector has already been through a process of commodification—i.e. it is already private property—its desirability and profitability in the eyes of finance-sector investors hinges on processes variously referred to as "rendering land investible" (Li 2014), "asset making" (Visser 2017), and "assetization" (Ducastel and Anseeuw 2017). Drawing on a growing body of scholarship on "resource materialities" (Bakker and Bridge 2006; Richardson and Weszkalnys 2014), this work sees land as "an assemblage of materialities, relations, technologies and discourses that have to be pulled together and made to align" (Li 2014, p. 589). For farmland to become a profitable financial asset requires many things to fall into place: fences for physical exclusion, property titles for legal exclusion, financial metrics that benchmark farmland returns, diagrams displaying land as scarce and rapidly appreciating, and moral narratives justifying investment (Li 2014; Ouma 2016; Ducastel and Anseeuw 2017; Visser 2017; Fairbairn 2020). These efforts at asset making are geographically uneven, varying greatly between political, social, and agro-ecological contexts (Magnan 2015; Sippel et al. 2016). They also are prone to setbacks, particularly when their moral legitimacy erodes (Kish and Fairbairn 2018; Sippel 2018; Ouma 2020). In short, farmland, as an investible and profitable financial asset class, is an undertaking, not a fact. Both its attractiveness to investors and its profitability once they do invest are, as Ouma (2016, p. 82) describes, "practical accomplishments."

The materiality of agriculture is central to both the successes and failures of the asset-making process. Visser (2017, p. 185) explores this point in detail, arguing that the material characteristics of land—including soil fertility, scarcity, and potential for yield increases—are all essential to investors' efforts at "land value creation" but that they also frequently feature in "its flipside: value erosion and stagnation." In Russia and the Ukraine, Visser finds, initial investor hopes were stymied when there turned out to be an "insufficient scarcity" of farmland to generate the desired land price appreciation. Likewise, Kuns et al. (2016), document the disappointing performance of Nordic agroholding companies in Russia and Ukraine after they failed to fully account for agroecological risk, particularly the highly variable weather in the region. These studies reveal that optimistic investor beliefs about the profit potential of a notional, standardized, and abstracted farmland asset class may falter when faced with the place-based biophysical limits of actual farms in actual locations.

While environmental uncertainty figures in these accounts primarily as an obstacle to investment success, there is reason to think that it could also be a source of profit. For the financial sector, risk is a primary source of profit (Beckert 2016; Christophers 2018), and even a source of pleasure and personal identity for traders of financial assets (Zaloom 2004).[1] In agriculture in particular, finance has a long history of profiting from the risks, delays, and seasonal credit-crunches experienced by farmers as a result of the inconvenient materiality of their nature-based production process (Henderson 1998). The agricultural risks that farmers wished to avoid, for instance, gave rise to the agricultural commodity derivatives traded by financial speculators for profit (Clapp and Isakson 2018). In recent years, climatic uncertainty has spawned a host of new financial products. As Leigh Johnson (2014, p. 155) explains in her discussion of catastrophe bonds, "the place-based physical vulnerabilities of fixed capital have been rendered into assets deemed increasingly desirable by growing blocks of financial capital." There is, however, a big difference between financial investments and direct capital investments—that is to say, between buying agricultural commodity derivatives and buying a farm. Farms are immobile and non-fungible, and farmland markets are relatively illiquid (Fairbairn 2020). These differences are likely to translate into very different relationships to the material uncertainties of agriculture. We ask, therefore: does the financial investor's ability to profit from environmental uncertainty still hold when they themselves become the owner of "place-based physical vulnerabilities" in the form of a farm?

While scholarship on the intersection of environment, finance, and uncertainty primarily emphasizes *temporal* uncertainty, there is also an important *spatial* component to the uncertain materiality of farmland investment. Land rents (and therefore values) reflect the resource endowments of a property—whether in the form of oil, timber stands, or basic soil fertility—but these endowments are fundamentally uncertain until stabilized through agreed-upon metrics. Statistical and spatial mapping play a central role in transforming such biotic and abiotic elements of the natural world into commodifiable "natural resources." By making them legible to states and private capital alike, scientific inventories enable value extraction (Scott 1998; Braun 2000; Demeritt 2001).

[1] Risk and uncertainty are related but not identical concepts. Frank Knight and John Maynard Keynes distinguished between *risk*, which refers to situations where it is possible to estimate probabilities of different future outcomes, and *uncertainty*, which refers to truly unpredictable future scenarios (Froud 2003).

Such expert interpretation is particularly necessary when it comes to subsurface resources, which are largely hidden from sight and therefore depend on scientific visualization if they are to become sites for private capital accumulation. Braun (2000), for instance, describes how the mapping of Canada's geology during the late nineteenth century—a process he describes as "producing vertical territory"—served to make mineral resources intelligible to the state as well as to mining companies and their investors. Such scientific mapping of subterranean resources frequently comes into conflict with local knowledge systems (Bebbington and Bury 2009). Work on the political ecology of groundwater reveals it as a site of political struggles, often premised on epistemic contests between local and state knowledges (Birkenholtz 2008; Budds 2009) or "dueling" scientific interpretations with vastly different implications for management (Holifield 2009). Adrienne Kroepsch (2018, p. 61) argues that, even with major advances in computer-based modeling of groundwater, the materiality of the subsurface— "its opaqueness; its vast, heterogeneous, and slow-moving nature; and the ontological politics involved in rendering its depths legible for governance"—results in "persistent inscrutability." For her and others working in the emerging subfield of "STS underground" (Kinchy et al. 2018, p. 23), "rather than existing a priori, the underground comes to be through interlinked political, economic, cultural, and technoscientific practices and processes."

Drawing insights from the political ecology of the underground, we can see that the process of rendering land investible has an essential vertical dimension—one which has so far remained unexplored in the context of the present farmland rush. Work of farmland asset making has tended to focus on horizontal factors, such as the statistical picturing devices used to imagine certain areas as "frontier" or "underutilized" (Li 2014). Yet the vertical dimension of land is also crucial to the land rush. Groundwater extraction serves as a vertical "spatial fix" (Harvey 2001) for various crises of capital: by transforming dry, uncultivable land into lush, high-value agricultural properties, it creates an outlet for over-accumulated capital. By providing additional water resources to farms in the face of the drier conditions resulting from environmental change, it offsets (partially and temporarily) the effects of a major ecological crisis of capitalism. This vertical spatial fix is accompanied by distinct land imaginaries that justify its downward (rather than outward) expansion. Such imaginaries may exploit the spatial uncertainty of the subsurface in order to performatively influence the temporal uncertainty of financial markets, as, for instance, when mining companies "conjure" the prospect of vast underground deposits in order to raise the speculative capital needed to make their discovery a genuine possibility (Tsing 2000). Here the inscrutability of the subsurface provides an opening for vertical imaginaries aimed at transforming financial risk into profit.

Mobilizing groundwater in pursuit of increasing farmland values is not a simple task. In the case study that follows, we examine how HMC's regional representatives are working within intersecting environmental uncertainties—the temporal uncertainty of climate change and related environmental regulations, and the spatial uncertainty of the invisible subsurface—in an attempt to lock in the potential future profitability of their real estate. Their vertical asset-making endeavor is taking place on two fronts simultaneously: through active participation in local groundwater governance processes the investors assert an imaginary of ample water resources conducive to their extraction plans, while their simultaneous construction of water-related infrastructure makes that extraction a material possibility. Together, these governance and infrastructural interventions seek to capitalize on environmental uncertainty, transforming it into a source of increased land rents.

Methods

Our research, which took place during 2018 and 2019, involved a qualitative extended case study (Burawoy 1998) based on interviews, participant observation, and document analysis. We conducted 24 in-depth, semi-structured interviews with growers, ranchers, land owners, and long-time Cuyama Valley community members. We recruited interview participants primarily via network sampling, with some additional interviews resulting from directly contacting knowledgeable individuals (e.g., a rural realtor active in the area). We transcribed all interviews and coded them for key themes. In addition to interviews, we attended local community meetings related to groundwater governance, taking careful notes of our observations. These included meetings of the Cuyama Basin Groundwater Sustainability Agency (GSA), the Standing Advisory Committee to the GSA, and the Cuyama Basin Water District, as well as public workshops on the Sustainable Groundwater Management Act (SGMA) process. Attending these public meetings allowed us to glean a diverse array of perspectives of community members, farmers and ranchers, investment managers, and scientists. We triangulated this data by collecting and systematically reviewing relevant public documents about Cuyama Valley land and water usage, including public meeting minutes and videos, hydrogeological reports, public comments, and permitting applications. These documents and recordings allowed us to confirm the details of governance processes that were often highly technical and therefore difficult to ascertain from interviews alone.

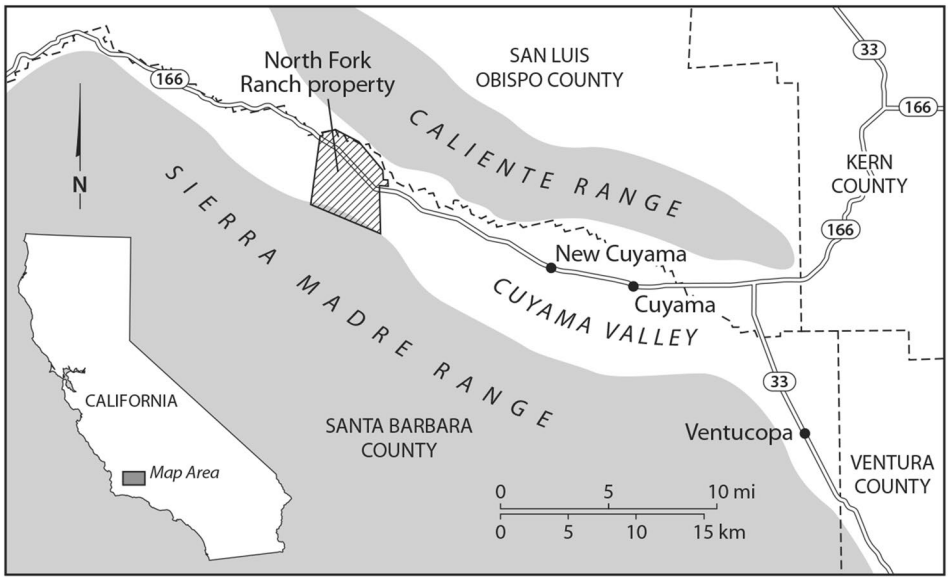

Fig. 1 The Cuyama Valley with approximate location of North Fork property. Map by Bill Nelson

Fig. 2 The Cuyama Valley satellite image with approximate location of North Fork property. Map by Bill Nelson

Background: Harvard comes to the Cuyama Valley

The sparsely populated Cuyama Valley runs northwest to southeast between two mountain ranges—the Sierra Madre to the south and the Caliente Range to the north (see Figs. 1, 2). It was originally inhabited by the Chumash people, from whom it gets its name, before they were violently dispossessed by Spanish colonizers. Today, scattered ranches dot the foothills, and three unincorporated communities—Cuyama, New Cuyama, and Ventucopa—are home to under a thousand people, mostly Anglo-American and Latinx (US Census 2018). Driving east on the single lane highway that cuts through the center of the valley, the landscape is initially dominated by rolling pastureland—parched golden yellow for much of the year—and native vegetation, with mountains on either side. As one gets close to the eastern end of the valley, however, pasture is replaced by bright green agricultural fields, frequently seen through the mist of sprinkler or center pivot irrigation. Agriculture on the eastern end of the valley is dominated by specialty crops, most notably large-scale organic carrot production by two of the country's largest carrot producers—Grimmway Farms and Bolthouse Farms.[2]

[2] Other crops grown on the valley's eastern end include barley, wheat, onions, garlic, potatoes, alfalfa, as well as an assortment of permanent crops: pistachios, olives, grapes, and apples. Other major growers in the area include Duncan Family Farms, Santa Barbara Pistachio Company, Cuyama Orchards and Sunridge Nurseries.

The growth of commercial agriculture in the eastern portion of the valley, particularly beginning in the 1980s and 1990s, created a massive demand for groundwater. The Cuyama Valley is arid; its scant average annual rainfall ranges from 7 to 15 inches (Hanson et al. 2015). Meanwhile, the only surface water, the Cuyama River, dries up during the summer. As a result, irrigated agriculture in the valley is almost entirely dependent on pumping, and the rate of groundwater extraction from the Cuyama Basin underlying the valley is roughly twice the long-term average rate of recharge, leading to steady groundwater level declines (Hanson and Sweetkind 2014). The California Department of Water Resources (DWR) considers the Cuyama Basin to be in a state of "critical overdraft" (DWR 2019).

The unsustainable extraction of the valley's groundwater resources, however, did not deter HMC from selecting this as the site for a new irrigated vineyard. In recent years, HMC has invested heavily in agricultural properties around the globe (McDonald 2018), including other parts of California (Gold 2018; Walsh 2019). In 2014, HMC purchased the North Fork Ranch, an 8700-acre expanse of rangeland on the Cuyama Valley's western end (McDonald 2018). Though HMC is the ultimate owner of the property, it is not directly involved in day-to-day operations. Instead, the property was purchased in the name of a Delaware-based subsidiary company named Brodiaea, Inc., and the management of both Brodiaea and the North Fork property are handled by San Luis Obispo-based agricultural investment advisory firm Grapevine Capital Partners, LLC. (In what follows, we will most frequently reference Grapevine Capital Partners, hereafter, "Grapevine" or "the investors," because its representatives are the most visible managers of this investment). Once the North Fork property had been purchased, Grapevine quickly set to work establishing a vineyard on 850 acres of the property (Gold 2018).

This land purchase had all the markings of a real estate play. HMC has a history of investing in California vineyards; just three years prior, in 2011, HMC had sold their stakes in two California vineyard investment funds (Silverado Premium Properties and Silverado Winegrowers Holdings) to the financial services company TIAA-CREF (Fritz 2014). This previous sale suggests that HMC's interest was not in the profits to be made from growing and selling wine grapes, but rather in the profits to be made from buying and selling vineyards. In the case of the Cuyama Valley, in particular, the establishment of an irrigated vineyard from scratch holds the potential for vast property value increases. In San Luis Obispo and Santa Barbara counties, where the vineyard is located, large parcels of dry pasture rangeland (those greater than 1500 acres) generally sell for between $300 and $1200 per acre, whereas vineyards in the same region sell for $25,000 to over $60,000 per acre (ASFMRA 2018). Though an initial report suggested that HMC had paid the slightly above-market rate of $1322 per acre for the North Fork ranch (Fritz 2014), the vineyard portion of the property could nonetheless eventually attain a valuation twenty to forty times its purchasing price.

The future success of this particular real estate venture, however, depends upon ample groundwater access, something which can no longer be taken for granted in California. The land purchase came at a moment of intertwined climatic, hydrological, and regulatory uncertainty in California. Between 2012 and 2016 the state suffered through a protracted drought, as a run of lower-than-average annual precipitation—not unusual in the state's history—was exacerbated by the higher-than-average temperatures linked to anthropogenic climate change (Diffenbaugh et al. 2015). The drought led to increased groundwater pumping by growers, which in turn led the state to pass SGMA in 2014, which mandates the creation of local-level plans limiting groundwater extraction to sustainable levels. Rather than being deterred by this environmental uncertainty, however, Grapevine has leveraged it as an asset-making opportunity. The political uncertainty of impending groundwater regulation, combined with the scientific uncertainty inherent to subsurface resources, have provided the investment firm with an opening for action aimed at ensuring future land value increases. Specifically, Grapevine has been active on two fronts: (1) working to influence the outcome of the SGMA planning process by promoting a land imaginary in which their property sits atop ample groundwater that is largely disconnected from other parts of the water basin, and (2) constructing groundwater infrastructure to ensure ongoing physical access to this purportedly plentiful water. We discuss each of these efforts in turn below.

Hydrology is not destiny: rendering land investible through groundwater governance

One major way in which Grapevine has worked to ensure the future value of its investment property, our research suggests, is through active participation in the local groundwater governance processes mandated by the brand-new SGMA legislation. Under SGMA, all groundwater basins designated by the state as either "high" or "medium priority" are required to create local-level plans for sustainable management.[3] Local public agencies in these basins must form a governing body known as a Groundwater Sustainability Agency (GSA). The GSA is charged with defining

[3] Groundwater basin boundaries used by SGMA are laid out in DWR Bulletin 118 (DWR 2019). Of the state's 515 water basins, 127 were designated high or medium priority. Of the high priority basins, 21 were deemed "critically overdrafted.".

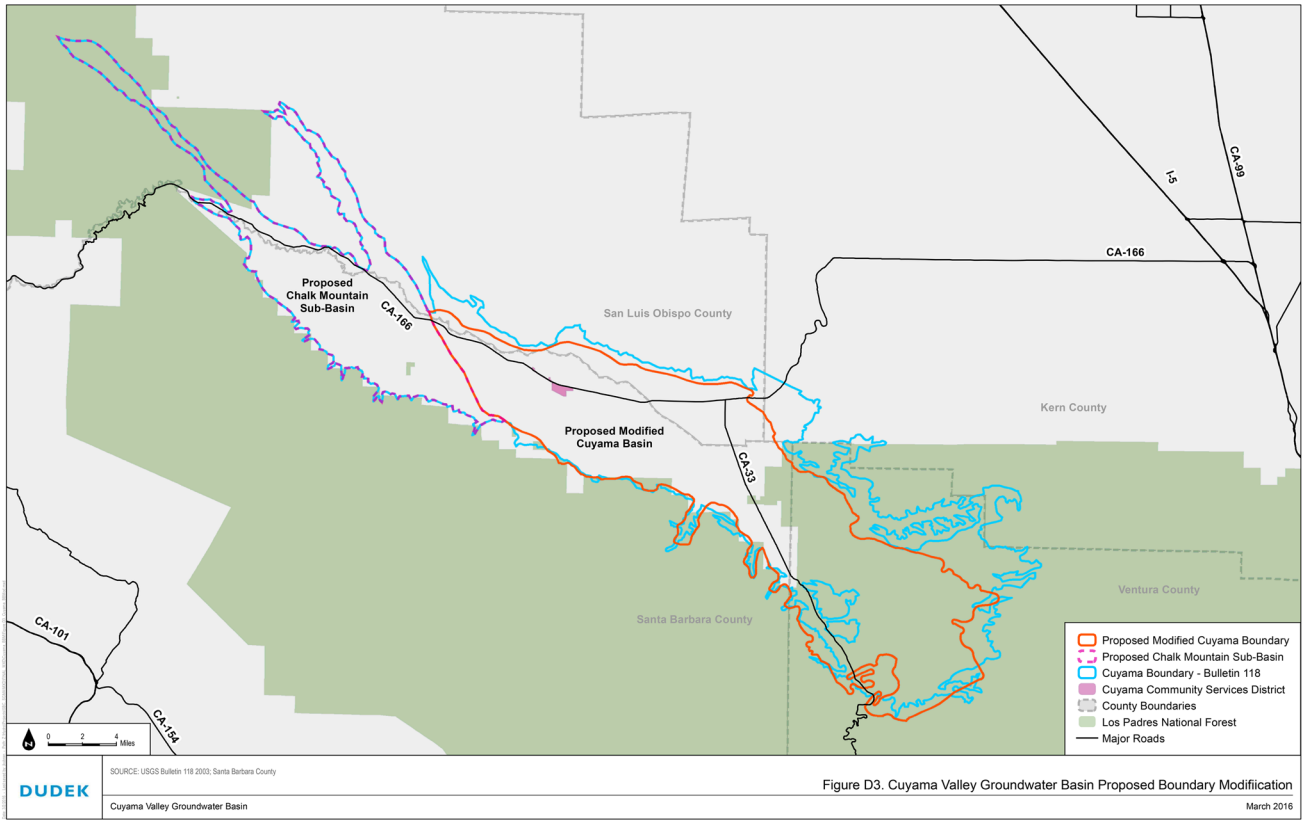

Fig. 3 Proposed boundary modification presented by Santa Barbara County in 2016 and still supported by Grapevine Capital Partners (Santa Barbara County Water Agency 2016)

how much water can sustainably be withdrawn from the basin and limiting extractions accordingly. The majority of GSAs are mandated with creating and implementing a Groundwater Sustainability Plan by 2022, while "critically overdrafted" water basins, such as the Cuyama Basin, must begin implementation by 2020. Grapevine therefore had a window of several years—from their land purchase in 2014 to the Groundwater Sustainability Plan implementation in 2020—in which to participate in the rules-crafting process that would govern their own future water access.

Land values in overdrafted water basins are generally expected to decline under SGMA, as new limits on pumping reduce agricultural productivity (ASFMRA 2018). But hydrology is not destiny. Our research suggests that the regulatory uncertainty of a newly established groundwater law, combined with the material uncertainty of subsurface structures and flows, provides an opening for well-endowed investors to actively enhance their farmland value by wading into governance debates based on contested hydrogeological science. In our study, the investors have sought to intervene in the SGMA process by advancing a land imaginary in which subsurface structures form strong barriers to water flow, leading to ample water reserves below their property. This vertical vision is central to their asset-making efforts.

Boundary politics

In its efforts to ensure the future value of its property, Grapevine promotes a subsurface imaginary in which the western end of the valley (where the vineyard is located) is hydrologically disconnected from the eastern end (where the majority of other agricultural operations are located). Grapevine's vertical vision of a separate sub-basin isolated by a largely impermeable barrier serves the political purpose of disconnecting the vineyard's extensive groundwater withdrawals from those of the carrot growers on the valley's eastern end, thereby reducing regulatory oversight.

Initially the company's hopes were pinned on a request, filed by Santa Barbara County, to exclude the western end of the valley—where the North Fork vineyard property is located—from the Cuyama Basin, renaming it the Chalk Mountain Sub-Basin (see Fig. 3). Had this proposal passed, the low population and low historical groundwater use in the western end of the valley would almost certainly have meant a "low priority" designation for the new basin, exempting it from the groundwater sustainability planning process entirely. The California DWR rejected this boundary modification request, however, leaving the original, larger basin boundaries intact as the basis for the SGMA

planning process. For Grapevine, this decision constituted a major setback: the boundary modification would have meant essentially limitless groundwater access, greatly benefiting their vineyard operation and their future land values. Though Santa Barbara County accepted the DWR's decision, therefore, Grapevine did not give up so easily. Shortly after the modification request was rejected, Grapevine retained the services of a geological consulting firm to collect hydrogeological data with the eventual goal of submitting a new request to revise the basin boundary (CBGSA 2018a).

This effort to alter the basin boundaries benefited from the uncertain materiality of subsurface geological structures. The arguments for and against the boundary modification hinge on the nature of a particular geologic fault, the Russell Fault, whose permeability to water is subject to competing scientific interpretations. The scientific uncertainty surrounding the Russell Fault is reflected in the final Groundwater Sustainability Plan (CBGSA 2019, pp. 2–18) for the Cuyama Basin, which points out that even the *type* of fault it represents is up for debate: "The [Russell] fault is referred to as strike-slip by several authors, and normal fault by others, and is sometimes referred to as both strike-slip and normal within the same document."[4] The plan also chronicles a history of changing scientific interpretations of the fault's permeability to groundwater, most notably by the US Geological Survey, which concluded that "the Russell fault did not appear to be acting as a barrier to groundwater flow" in a 2013 report (Everett et al. 2013) before treating it as a "no flow boundary" and using it to delimit the western boundary of the basin in a 2015 study (Hanson et al. 2015). The Russell Fault, in short, is a perfect example of subterranean uncertainty. This uncertainty could be reduced (though not entirely abolished) through further research. A report commissioned by the Cuyama water district recommended "investigations of the conductivity and vertical extent of the Russell fault zone, as well as mapping of local groundwater gradients on both sides of the fault line" (EKI 2017, p. 12). In the continued absence of this research, the fault remains open to interpretation.

Grapevine seized upon the lack of scientific consensus about the Russell Fault to advance their preferred vision of the subsurface. In ruling against the boundary modification, the DWR had cited a lack of evidence for the impermeability of the Russell Fault, and so Grapevine hired geological consultants with the express intention of collecting that evidence. In 2018, a year and a half after the DWR's unfavorable ruling, the geologists submitted a report to the Cuyama Basin GSA. This report not only presented research to support the fault's limited permeability, it further asserted that the proposed Chalk Mountain Sub-Basin is highly compartmentalized, allowing Grapevine to argue that extensive groundwater withdrawals by the new vineyard would be unlikely to affect the smaller wells of their neighbors (Cleath-Harris Geologists 2018; Grapevine Capital Partners 2018).

Though this boundary modification effort has been unsuccessful thus far, it underscores that scientific data collection and modeling can be central to farmland asset making. Farmland's vertical attributes, because they are invisible to the naked eye, are generally imagined through scientific modeling. Yet hydrogeological models are not simply unbiased representations of an external reality (Budds 2009). Kroepsch (2018, p. 59) suggests that, "Rather than viewing groundwater models as simplified pictures of nature with which to make policy decisions, we are better off understanding them as 'world builders'—as tools that embed, enact, and circumscribe subsurface politics as they produce subsurface knowledge and shape socio-ecological outcomes." In our case, the scientific uncertainty surrounding the Russell Fault provided an opening for Grapevine's vertical asset-making enterprise. Their "world building" efforts, buttressed by a made-to-order geological study, were singularly focused on the valorization of their property and the production of investment returns.

Advocating for deeper drawdown

The success of the investors' asset-making endeavor depends on the water below their property being not only disconnected but also ample.[5] Grapevine Capital Partners has therefore assiduously promoted the view that—despite being located in one of the most critically overdrafted water basins in the state—their property sits atop plentiful groundwater which can easily support the enormous withdrawals required by a large vineyard. Though not officially represented on the Cuyama Basin GSA board—the primary decision-making body for SGMA implementation—Grapevine has promoted this interpretation to the board, influencing its decisions.

One of the primary tasks of the Cuyama Basin GSA is to determine the appropriate range for future groundwater levels in the basin. The GSA divided the valley into various "threshold regions" and assigned to each a "measurable objective" (MO)—basically a goal groundwater level—as well as a "minimum threshold" (MT)—a floor below which groundwater levels should not fall because it would cause negative environmental consequences known in SGMA

[4] Strike-slip faults occur when two pieces of the Earth's crust slide past each other horizontally, while normal faults occur when they pull apart.

[5] Alatout (2009) argues that, while scarcity narratives tend to receive more scholarly attention, resource abundance can play an equally pivotal role in environmental politics.

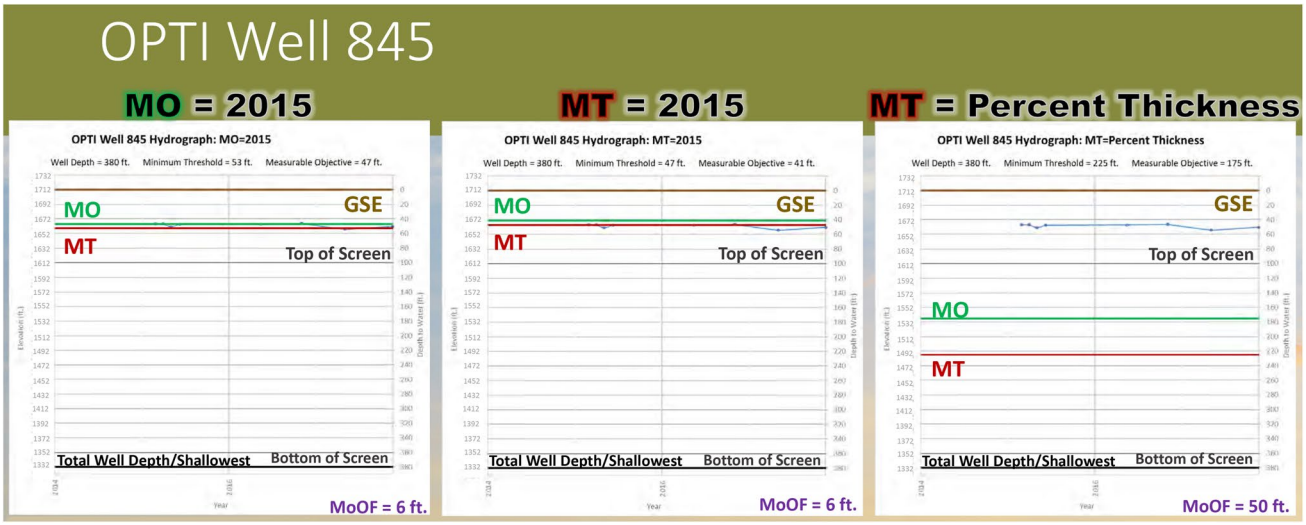

Fig. 4 The three proposals for establishing MOs and MTs in the Northwestern threshold region that were ultimately presented to the Cuyama Basin GSA as they would operate at one monitoring well. The option to the right was based on input from Grapevine Capital Partners (CBGSA 2018c)

parlance as "undesirable results." The environmental consulting firm hired by the GSA board to assist in developing the Cuyama Basin's groundwater sustainability plan originally intended to propose two options for setting thresholds in the "Northwestern" threshold region where the vineyard is located: (1) using the water level when SGMA went into effect in 2015, the height of the drought, as the MT, and five years of storage above that as the MO, (2) using the 2015 level as the MO and five years of storage below that as the MT. These "threshold rationales" translate into different depths for each of the monitoring wells in the region; under the first scenario, the MTs for the various wells would have ranged between 12 and 72 feet below the surface; in the second scenario the MTs would have ranged between 35 and 101 ft below the surface (CBGSA 2018c).

However, here again, Grapevine stepped in with their own bespoke hydrogeological studies and governance recommendations. The day before the public meeting at which the consultants hired by the GSA had prepared to propose these two alternatives, Grapevine's own hydrogeology consultants presented them with an argument that the water table could be drawn down much deeper before any undesirable results occurred. Although official GSA meetings are open to the public, this interchange happened at a closed-door meeting of the "Technical Forum," a committee of the various hydrogeological consultants hired by Cuyama Basin interest groups. At this private meeting, and based on their own hydrogeological data (which was not made available to the public), Grapevine's hydrogeological team proposed a third option for setting thresholds in their region: (3) basing the MT on a percentage of the aquifer's "saturated thickness" (the distance from the water table to the base of the aquifer) with an MO of five years storage above (CBGSA 2018b). Figure 4 shows what these three proposals looked like for a single monitoring well in this threshold region: the third scenario, proposed by Grapevine, allows for significantly deeper drawdown. The GSA's consultants took this suggestion under advisement and proposed all three scenarios to the GSA board.

Grapevine's proposal ultimately prevailed. At a December 2018 meeting, the Cuyama Basin GSA board voted to set the MT for all monitoring wells in the region at 15% of saturated thickness for the aquifer, or 203 feet below the surface, roughly twice the depth of the deepest MT under consideration before Grapevine weighed in. Grapevine representatives were present at this meeting and participated in reaching this outcome. At one point in the meeting a GSA board member simply asked the Grapevine representative what threshold levels he would feel comfortable working within (CBGSA 2018d).[6] Grapevine's success at influencing the GSA process is evidence of how environmental uncertainty can work to investor advantage. The unsettled state of California groundwater regulation,

[6] This was not a particularly unusual moment. At a GSA board meeting we attended on December 3, 2018, one of the presenting environmental consultants stated explicitly to the board: "My job as a technical person is to bring you choices that we can defend in front of the state. What you choose within that is entirely up to you and I'm very purposefully trying not to advocate very hard one way or the other. So, if you think it's important to lower this [proposed threshold] a certain amount, I think that is plausible and it's not my decision." For much of the GSA process, hydrogeological models simply set the outer bounds for what were essentially political decisions made by a board dominated by representatives of large growers and landowners from the local water district.

combined with the ongoing "inscrutability" of groundwater resources, made this a risky investment at the outset. However, those uncertainties also provided the opening for Grapevine to lock in far more ample groundwater with which to irrigate—and valorize—its property.

In places where agricultural productivity depends on sustained groundwater access, hydrogeological data and modeling are essential to efforts at rendering land investible. Two aspects make them particularly powerful asset-making tools. First, hydrogeological models are ostensibly neutral and framed as unbiased representations of the natural world even though they are deeply embedded in social relations (Budds 2009; Kroepsch 2018). The hydrogeological modeling of the Cuyama Basin took place within a SGMA planning process that was, from the beginning, dominated by representatives of large growers and landowners. The Cuyama Valley's largest agricultural operators were involved in *creating* those models, including contributing data from their operations and assisting with selection of the "representative wells" used for groundwater monitoring. They were also involved in *applying* those models because their representatives dominated the GSA board. Behind a patina of scientific objectivity, the most powerful and vocal actors, including but by no means limited to Grapevine Capital Partners, were able to sway the process to their benefit.

Second, hydrogeological models are effective at rendering land investible because they are incomprehensible to most non-experts, thereby creating a barrier to participation in groundwater politics (cf. Budds 2009). In the Cuyama Basin, the groundwater science used in the SGMA planning process was made even more impenetrable by the fact that the major growers, including Grapevine, all refused to make public the monitoring well data they had contributed to the modeling effort. As a result, Cuyama Valley residents were confronted with scientific claims about the subsurface but given no possible way to verify them. That the last-minute proposal to drastically lower water thresholds in the Northwestern region was first made in a closed-door, scientific forum underscores how hydrological expertise can serve to bolster the "powers of exclusion" that enable ongoing commodification of land (Hall et al. 2011).

This case suggests that the vertical processes involved in farmland asset-making may be particularly suited to enabling accumulation by dispossession (Harvey 2003). Vertical imaginaries are crucial to mobilizing the subsurface for the purposes of land valorization, but they may also be peculiarly difficult to contest.

Community contestation of investor proposals for groundwater governance

Yet despite these difficulties, Grapevine's asset-making efforts have met with considerable contestation. A diverse coalition of Cuyama Valley residents has formed to resist what they see as an unsustainable water grab. This community opposition stems from both general concern about the unsustainability of Grapevine's water-use plans and more specific fears about how the vineyard's water use might affect neighboring residents. While further declines in the water table will not affect the vineyard's extremely deep irrigation wells, they could devastate smaller neighbors who may not be able to afford the $25,000 or more required to deepen an existing well (Walsh 2019).

Like the investors, this community opposition leverages environmental uncertainty—both the regulatory uncertainty of the SGMA process and the material, hydrogeological uncertainty of the subsurface—but unlike the investors it does so in support of a precautionary approach to groundwater use. In response to the initial boundary modification request, fifty people, almost all Cuyama Valley residents, signed a letter requesting that the DWR reject this proposal. The letter made a case against the modification on grounds of subterranean uncertainty, arguing that there was insufficient baseline data about the western portion of the basin and that the impermeability of the Russell Fault had not been scientifically established in prior hydrological studies (Jaffe et al. 2016).

The opposition projects a very different vision of the subsurface. Where the investors conjure an imaginary of abundance, the community opposition deploys evidence of sub-surface scarcity. At public meetings, vineyard opponents frequently reaffirm the basin's drastic groundwater declines and state of critical overdraft. Additionally, during interviews, several community members questioned Grapevine's depictions of water abundance under the North Fork property. In a typical example, one local landowner and farmer explained,

> The wells that are down here… on the Harvard property, [a Grapevine representative] said those are refilled by the water flowing down the river. Well that's a little scary because there's no water that flows down the river. Once in a great while. Now, there's probably some underground water that's going through… but there's not a lot. When you look at rainfall and especially the further down in the valley you get, it is really a desert.

Other vineyard opponents voiced doubts about water abundance based on the lack of interest shown by corporate vegetable growers in the valley. As another local landowner and farmer put it,

> [Speaking about a local rancher with a long history in the valley.] I've talked to him a lot of times and he just shakes his head when he sees this thing going on. He says, "There's just not enough water there, period. If

there was enough water there," and you hear this from other people, too, "if there was enough water down here to farm, folks like Grimmway and Bolthouse would have bought it a long time ago.

These community members use their own place-based expertise, or reference that of others, to question Grapevine's hydrological assessments of their property's groundwater resources. They exploit the inherent uncertainty of subsurface resources in order to render the North Fork property incrementally *less* investible. Though unlikely to affect property values directly, this counternarrative subtly challenges the vertical imaginary of water abundance upon which the vineyard's resale price depends.

The battle of the frost ponds: rendering land investible through groundwater infrastructure

At the same time as Grapevine representatives were engaged in the Cuyama Basin SGMA process, they were also moving forward with establishing water-related infrastructure on the North Fork property. The company rapidly drilled twelve wells for groundwater irrigation and made plans to construct above-ground reservoirs that would provide a readily available source of water for spraying on the vines to prevent frost damage. However, like the investor efforts at rendering land investible through groundwater governance, this process of establishing infrastructure has not been frictionless. In fact, the frost protection reservoirs ("frost ponds") have become a significant front in the struggle over the vineyard's water consumption.

The frost pond project

Water access can only be capitalized into property values if the right infrastructure is in place to secure its extraction and utilization. Water-related infrastructures, such as dams, wells, and irrigation canals, serve to stabilize resource access by engineering water claims into the built environment itself. In the case of groundwater, this infrastructure takes an uncertain subterranean resource and brings it to the surface where it becomes more visible and dependable. Once on the surface, the water becomes an incrementally less vertical and more horizontal resource. The shift from subsurface to surface, and from vertical to horizontal, brings material advantages to landowners. Once on the surface, groundwater sheds its uncertainty—teams of hydrologists and lawyers are no longer needed to assert its existence and claim ownership—and it can more easily and rapidly be used to protect permanent crops and the economic value they embody.

Storing groundwater on the surface, however, introduces new material complications with which investors must grapple. First, water on the surface suddenly has a large and visible footprint, which invites additional regulatory oversight and creates openings for contestation. As a large vineyard, North Fork requires a lot of water to protect against frost. But any reservoir containing over 50 acre-feet of water storage is considered a "dam" by the California DWR and is subject to strict, state-level permitting and ongoing regulation. Grapevine addressed this problem by proposing instead to construct three separate reservoirs of 49 ac-ft, each just a hair under the regulatory threshold. Thanks to this subdivision, they had only to go through the significantly less demanding county-level ministerial permitting process. Even with the reservoirs sized to ensure minimal regulation, however, Grapevine still had to comply with the California Environmental Quality Act (CEQA), which requires project planners to either complete an Environmental Impact Report (EIR) or submit a much briefer Mitigated Negative Declaration (MND) asserting that an EIR is unnecessary because the project will have no significant environmental impact once certain mitigating steps have been taken. Grapevine submitted an MND for the frost pond proposal (Brodiaea 2018), a move which, as we will see, was hotly contested by neighboring landowners.

A second material difficulty associated with the shift from subsurface to surface is that the water becomes vulnerable to evaporation. The extent of evaporation likely to occur from the surface of the three frost ponds became a major point of contention during the permitting process. In their MND, the investors asserted that the construction of the three reservoirs would not have a significant impact on water resources. They were aided in reaching this conclusion by the fact that regular agricultural activities are exempt from CEQA, and so they had only to consider the evaporative water loss from the surface of the reservoirs—not the pumping of groundwater to fill the ponds in the first place, nor its spraying onto the crops to protect from frost, nor its use for irrigation at the end of the winter, all of which will eventually be covered by SGMA. Grapevine calculated that evaporative water loss from the pond surfaces would amount to 26 ac-ft per year, just comfortably under the county threshold for a significant environmental impact of 31 ac-ft per year, which would have triggered the need for an EIR (Brodiaea 2018). While the materiality of water—its uncertain flows between different parts of the basin—posed challenges and opportunities for asset-making when it was below ground, its shift to the surface introduced new volatilities. As water became a horizontal resource with surface area exposed to sun and air, evaporation became a serious consideration, one which neighboring landowners seized upon in their opposition to the vineyard.

Community opposition to the vineyard's groundwater infrastructure plans

The investor efforts to establish groundwater-related infrastructure on their property were adroit, but they nonetheless encountered considerable resistance, the physicality of the frost ponds providing a rallying point for the local opposition. The frost ponds project was initially approved by the Santa Barbara zoning administrator in September of 2017, but neighboring farmer-landowners—along with a law firm they hired—appealed this decision to the Santa Barbara Planning Commission, arguing that the minimal environmental studies conducted by Grapevine Capital Partners were insufficient and that the company should be required to conduct an EIR for the project. In September of 2018, the Planning Commission sided with the neighbors, requesting a focused EIR from the company. Grapevine Capital Partners appealed this decision to the Santa Barbara Board of Supervisors where they lost once again in February of 2019, leaving them with no choice but to conduct the EIR. This was a major success for the community coalition opposing the vineyard's water use plans.

The opposition once again mobilized scientific and regulatory uncertainties to contest Grapevine's asset-making endeavor. Their case hinged largely on a rival hydrogeological interpretation. They hired a hydrologist, who presented an alternative calculation of evaporative water loss which came to 44 ac-ft per year, well over the 31 ac-ft significance threshold requiring an EIR (Chytilo 2019).[7] The opposition also emphasized the current moment of rapid regulatory and climatic change to make the case for a more stringent assessment of water impacts. In written and oral arguments, they repeatedly pointed to the impending SGMA implementation and the ever-increasing groundwater overdraft as reasons for the authorities to use their discretionary ability to require more than the lowest thresholds for environmental impact.

Community members also sought to discredit the vineyard investors by exposing their intention to use groundwater as a means to ensure increasing ground rents rather than as an agricultural input for agriculture's sake. It was striking, for instance, that throughout the frost pond hearings, those opposing the vineyard's water consumption plans insisted on calling the landowners "Harvard." They did not refer to the vineyard by the property name (North Fork vineyard) nor by the name of the landowning entity (Brodiaea) nor by the name of the agricultural investment management organization which calls the shots (Grapevine Capital Management). Instead they relentlessly connected the vineyard to the elite, east coast university-cum-institutional investor who will ultimately profit or lose from whatever water-related decisions are made regarding the property. This repeated emphasis on the institutional investor behind the vineyard served to problematize the beneficial treatment the vineyard received under CEQA by virtue of its status as an agricultural producer. At the Santa Barbara Planning Commission (2018, 3:31:18) meeting, where the case was heard, one local resident stated:

> I'm concerned that we don't have the groundwater to support this particular operation. That ten thousand (sic) acres purchased by the Harvard institution and the planting of almost a thousand of those acres is all a fairly obvious extractive endeavor. I support farmers' rights to farm. I don't believe that this is about farming. I believe it's about financial extraction.

Meanwhile, at the Santa Barbara Board of Supervisors (2019, 6:52:03) hearing where the frost pond case was finally decided, a neighboring landowner stated this argument very plainly:

> Our major concern with this whole project is this is a real estate deal masquerading as an agricultural project, and we're afraid that the next round of discussions we're going to have before the board is how they're going to split this property up and subdivide it off into little ranchettes so that none of us have any water… This thing is just a real estate deal and I think that the environment impact review on all of this should be handled in the way of what you would do with any other real estate project instead of trying to hide it as an agricultural venture.

This repeated reminder that the vineyard is a real estate investment backed by a financial institution has not succeeded in changing the vineyard's legal standing as an agricultural producer, but it may have chipped away at the project's perceived legitimacy in the eyes of this relatively conservative, rural community. The battle of the frost ponds is still being waged, and the outcome is undetermined.

Conclusion

A recent article on the website *Agri Investor* warns that "Water scarcity presents risk for investors," but adds that "…tackl[ing] water scarcity is a 'big opportunity' for investors, too, especially in agriculture" (Kemp 2020). Our case study analysis of HMC's farmland investment in the Cuyama Valley demonstrates some of the ways in which investors may use this "big opportunity" to increase the value of their

[7] The opposition made other arguments as well. They rejected the biological surveys conducted by Grapevine Capital Partners, which were done at the height of the drought and after the property had already been disked for cultivation. They also amplified concerns expressed by the California Department of Transportation that the reservoirs could pose a flood risk to Route 166 (Chytilo 2019, Santa Barbara Board of Supervisors 2019).

farmland investments. In the Cuyama Valley, Grapevine has worked assiduously to turn the uncertainties associated with climate change and groundwater depletion into a source of profit. Through active participation in the SGMA groundwater governance process, they have turned a declining water table into a source of scarcity rents that will be capitalized into the value of their property. Through their ongoing efforts to construct reservoirs and other groundwater-related infrastructure, they cement their water claims into the built environment.

This case suggests that agricultural investors are clearly attuned to climate change, groundwater depletion, and other long-term environmental threats. However, it does not follow that investors will seek to counter those threats (through divestment from fossil fuels, for instance, or by avoiding regions where water is being withdrawn at unsustainable levels). Instead, if HMC's investment in the Cuyama Valley is any indication, investors may see environmental threats as a lucrative source of first mover advantage, a chance to extract resource rents, even if it means compounding environmental problems in the process. HMC's efforts to render its property investible—through the planting of water-intensive permanent crops, the pursuit of deeper drawdown levels under SGMA, and the effort to store groundwater on the surface where it will be subject to constant evaporation—all tend towards exacerbating the already highly unsustainable groundwater situation in the Cuyama Valley. This is particularly noteworthy because HMC explicitly frames itself as a "long-term investor" that "focuses on environmental, social, and governance (ESG) factors that may impact the performance of our investments" (HMC 2019). Yet in the case of the North Fork vineyard, it seems clear that "sustainable investing" means ensuring that ESG factors are leveraged for profit, rather than working to foster sustainable practices on the land.

Though the investors' asset-making efforts remain contingent and contested, at present they appear likely to succeed. Through intensive engagement with groundwater regulatory processes and major capital investments in water-related infrastructure, HMC seems poised to profit from relatively unfettered groundwater access in a region where such access is increasingly restricted. Just a few months after the groundwater sustainability plan for the Cuyama Basin was finally submitted, Grapevine was issued construction permits to drill three additional irrigation wells on their property. At the same time, however, this aggressive strategy for pursuing land valorization through uncertainty also carries inherent risks. Expensive investments in the built environment—including wells, reservoirs, and even vines—are themselves at risk for devaluation in the event that this wager on environmental uncertainty goes south. The sunk costs of this physical and biological infrastructure may lock the investors out of more ecologically adaptive management practices in the future, potentially increasing their vulnerability to climate impacts. In general, the Cuyama Valley case reveals that, although uncertainty can lead to speculative profits, it also creates openings for political change. Even the largest, most deep-pocketed institutions are vulnerable to community opposition, something that in the Cuyama Valley shows no signs of waning.

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References

Alatout, S. 2009. Bringing abundance into environmental politics: Constructing a Zionist network of water abundance, immigration, and colonization. *Social Studies of Science* 39 (3): 363–394.

ASFMRA (American Society of Farm Managers and Rural Appraisers). 2018. Trends in agricultural land and lease values: California and Nevada. https://www.calasfmra.com/db_trends/Trends2018_Ebook.pdf. Accessed June 24, 2020.

Bakker, K., and G. Bridge. 2006. Material worlds? Resource geographies and the 'matter of nature'. *Progress in Human Geography* 30 (1): 5–27.

Bebbington, A., and J. Bury. 2009. Institutional challenges for mining and sustainability in Peru. *PNAS* 106 (41): 17296–17301.

Beckert, J. 2016. *Imagined futures: Fictional expectations and capitalist dynamics*. Cambridge, MA: Harvard University Press.

Birkenholtz, T. 2008. Contesting expertise: The politics of environmental knowledge in northern Indian groundwater practices. *Geoforum* 39 (1): 466–482.

Braun, B. 2000. Producing vertical territory: Geology and governmentality in late Victorian Canada. *Ecumene* 7 (1): 7–46.

Brodiaea, Inc. 2018. Final mitigated negative declaration: North Fork Ranch frost ponds. August 1, 2018. https://cosantabarbara.app.box.com/s/q97rv82305oyfnbdjhcyxrrdhu3dgkqy/file/392545753182. Accessed 10 July 2019.

Budds, J. 2009. Contested H_20: Science, policy and politics in water resources management in Chile. *Geoforum* 40 (3): 418–430.

Burawoy, M. 1998. The extended case method. *Sociological Theory* 16 (1): 4–33.

CBGSA (Cuyama Basin Groundwater Sustainability Agency). 2018a. Cuyama Basin Groundwater Sustainability Agency Board of Directors meeting. May 2, 2018. Meeting minutes. https://cuyamabasin.org/assets/pdf/2018-05-02-CBGSA-Board-Minutes.pdf. Accessed 11 April 2020.

CBGSA (Cuyama Basin Groundwater Sustainability Agency). 2018b. Joint meeting of Cuyama Basin Groundwater Sustainability Agency Board of Directors and Standing Advisory Committee. December 3, 2018. Agenda and packet. https://cuyamabasin.org/assets/pdf/2018-12-03-CBGSA-Board-Packet-rev1.pdf. Accessed 5 July 2019.

CBGSA (Cuyama Basin Groundwater Sustainability Agency). 2018c. Special joint meeting of Cuyama Basin Groundwater Sustainability Agency Board of Directors and Standing Advisory Committee. December 18, 2018. Agenda and packet. https://cuyamabasin.org/assets/pdf/2018-12-18-Special-Joint-Board-Packet.pdf. Accessed 5 July 2019.

CBGSA (Cuyama Basin Groundwater Sustainability Agency). 2018d. Special joint meeting of Cuyama Basin Groundwater Sustainability Agency Board of Directors and Standing Advisory Committee. December 18, 2018. Meeting minutes. https://cuyamabasin.org/assets/pdf/2018-12-18-CBGSA-Special-Minutes-final.pdf. Accessed 23 Mar 2020.

CBGSA (Cuyama Basin Groundwater Sustainability Agency). 2019. Groundwater Sustainability Plan. December, 2019. Prepared by Woodard and Curran. https://cuyamabasin.org/resources#final-gsp. Accessed 23 June 2020.

Christophers, B. 2018. Risking value theory in the political economy of finance and nature. *Progress in Human Geography* 42 (3): 330–349.

Chytilo, M. 2019. Re: Harvard appeal of the planning commission's action requiring a focused environmental impact report for the North Fork Ranch frost ponds project. Letter and exhibits sent to the Santa Barbara County Board of Supervisors. February 1, 2019. https://santabarbara.legistar.com/View.ashx?M=F&ID=7063202&GUID=01060A39-E7AB-4FB8-9174-8F8FB14BF8E1. Accessed 12 July 2019.

Clapp, J., and R. Isakson. 2018. *Speculative harvests: Financialization, food, and agriculture*. Halifax, NS: Fernwood.

Cleath-Harris Geologists. 2018. Cuyama Valley Groundwater Basin (3–13) boundary modification request: Technical memorandum. Report prepared for Grapevine Capital Management. https://cuyamabasin.org/assets/pdf/Russell-Fault-BBMR-Report-Final.pdf. Accessed 26 June 2019.

Demeritt, D. 2001. Scientific forest conservation and the statistical picturing of nature's limits in the Progressive-era United States. *Environment and Planning D* 19: 431–459.

Diffenbaugh, N., D. Swain, and D. Touma. 2015. Anthropogenic warming has increased drought risk in California. *PNAS* 112 (13): 3931–3936.

Ducastel, A., and W. Anseeuw. 2017. Agriculture as an asset class: Reshaping the South African farming sector. *Agriculture and Human Values* 34 (2017): 199–209.

DWR (Department of Water Resources). 2019. Bulletin 118. https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118. Accessed 25 March 2019.

EKI. 2017. Preliminary findings from review of the USGS study of the Cuyama Valley groundwater basin. EKI B70069.00. Prepared for Cuyama Basin Water District. https://cuyamabasin.org/assets/pdf/EKI-Review_of_USGS_Study_2017-10-27_final.pdf. Accessed 23 June 2020.

Everett, R., D. Gibbs, R. Hanson, D. Sweetkind, J. Brandt, S. Falk, and C. Harich. 2013. Geology, water-quality, hydrology, and geomechanics of the Cuyama Valley Groundwater Basin, California, 2008–12. U.S. Geological Survey Scientific Investigations Report 2013–5108. https://pubs.usgs.gov/sir/2013/5108/pdf/sir2013-5108.pdf. Accessed 26 June 2019.

Fairbairn, M. 2014. 'Like gold with yield': Evolving intersections between farmland and finance. *Journal of Peasant Studies* 41 (5): 777–795.

Fairbairn, M. 2020. *Fields of gold: Financing the global land rush*. Ithaca, NY: Cornell University Press.

Fritz, M. 2014. Harvard pushing further into farm sector with California Central Coast vineyard play. March 14, 2014. *Farmland Investor Center*. https://www.farmlandinvestorcenter.com/?p=722&option=com_wordpress&Itemid=171. Accessed 5 June 2019.

Froud, J. 2003. The private finance initiative: Risk, uncertainty and the state. *Accounting, Organizations and Society* 28: 567–589.

Gold, R. 2018. Harvard quietly amasses California vineyards—and the water underneath. *Wall Street Journal*. December 10. https://www.wsj.com/articles/harvard-quietly-amasses-california-vineyardsand-the-water-underneath-1544456396. Accessed 6 June 2019.

Grapevine Capital Partners. 2018. Cuyama Basin—North Fork Vineyard: Company background plus data insights to support GSP development for the Cuyama Basin. Presentation to the Cuyama Basin GSA, April 26, 2018. https://cuyamabasin.org/assets/pdf/2018-04-26-Cuyama_NorthForkVineyard.pdf. Accessed 27 June 2019.

Gunnoe, A. 2014. The political economy of institutional landownership: Neorentier society and the financialization of land. *Rural Sociology* 79 (4): 478–504.

Hall, D., P. Hirsch, and T. Li. 2011. *Powers of exclusion: Land dilemmas in Southeast Asia*. Honolulu: University of Hawai'i Press.

Hanson, R., and D. Sweetkind. 2014. Cuyama Valley, California hydrologic study: An assessment of water availability. *US Geological Survey Fact Sheet*. https://doi.org/10.3133/fs20143075.

Hanson, R., L. Flint, C. Faunt, D. Gibbs, and W. Schmid. 2015. Hydrologic models and analysis of water availability in Cuyama Valley, California. US Geological Survey Scientific Investigations Report 2014–5150. Version 1.1, May 2015. https://pubs.usgs.gov/sir/2014/5150/pdf/sir2014-5150.pdf. Accessed 26 June 2019.

Harvey, D. 2001. Globalization and the spatial fix. *Geographische Revue* 2: 23–30.

Harvey, D. 2003. *The new imperialism*. Oxford: Oxford University Press.

Henderson, G. 1998. *California and the fictions of capital*. Philadelphia: Temple University Press.

HMC (Harvard Management Company). 2019. Investing for the long-term. https://www.hmc.harvard.edu/sustainable-investing/. Accessed 16 March 2020.

Holifield, R. 2009. How to speak for aquifers and people at the same time: Environmental justice and counter-network formation at a hazardous waste site. *Geoforum* 40: 363–372.

Isakson, R. 2015. Derivatives for development? Small-farmer vulnerability and the financialization of climate risk management. *Journal of Agrarian Change* 15 (4): 569–580.

Jaffe, R. et al. 2016. Re: Opposition to 3–13 Cuyama Valley Groundwater Basin boundary change proposal. Letter dated April 28, 2016.

Johnson, L. 2014. Geographies of securitized catastrophe risk and the implications of climate change. *Economic Geography* 90 (2): 155–185.

Kemp, D. 2020. Water scarcity presents risk for investors, but opportunity too. *Agri Investor*. February 5, 2020. https://www.agriinvestor.com/water-scarcity-presents-risk-for-investors-but-opportunity-too/

Kinchy, A., R. Phadke, and J. Smith. 2018. Engaging the underground: An STS field in formation. *Engaging Science, Technology, and Society* 4: 22–42.

Kish, Z., and M. Fairbairn. 2018. Investing for profit, investing for impact: Moral performances in agricultural investment projects. *Environment and Planning A* 50 (3): 569–588.

Kroepsch, A. 2018. Groundwater modeling and governance: Contesting and building (sub)surface worlds in Colorado's Northern San Juan Basin. *Engaging Science, Technology, and Society* 4: 43–66.

Kuns, B., O. Visser, and A. Wastfelt. 2016. The stock market and the steppe: The challenges faced by stock-market financed, Nordic farming ventures in Russia and Ukraine. *Journal of Rural Studies* 45: 199–217.

Li, T. 2014. What is land? Assembling a resource for global investment. *Transactions of the Institute of British Geographers* 39 (4): 589–602.

Magnan, A. 2015. The financialization of agri-food in Canada and Australia: Corporate farmland and farm ownership in the grains and oilseed sector. *Journal of Rural Studies* 41: 1–12.

McDonald, M. 2018. Harvard spent $100 million on vineyards. Now it's fighting with the neighbors. *Bloomberg*. November 15, 2018. https://www.bloomberg.com/news/articles/2018-11-15/harvard-spent-100-million-on-vineyards-some-neighbors-complain. Accessed 16 March 2020.

Nuveen. 2018. Nuveen knows responsible investing. https://www.tiaa.org/public/pdf/addressing_the_climate_change.pdf. Accessed 8 Feb 2020.

Ouma, S. 2016. From financialization to operations of capital: Historicizing and disentangling the finance-farmland-nexus. *Geoforum* 72: 82–93.

Ouma, S. 2020. This can('t) be an asset class: The world of money management, 'society', and the contested morality of farmland investments. *Environment and Planning A* 52 (1): 66–87.

Richardson, T., and G. Weszkalnys. 2014. Introduction: Resource materialities. *Anthropological Quarterly* 87 (1): 5–30.

Santa Barbara Board of Supervisors. 2019. Santa Barbara Board of Supervisors meeting of February 5, 2019. https://sbcounty.granicus.com/MediaPlayer.php?view_id=3&clip_id=3475&meta_id=392601. Accessed 24 June 2020.

Santa Barbara County Water Agency. 2016. Santa Barbara County Water Agency - 3-013 CUYAMA VALLEY. California DWR SGMA Portal – Basin Boundary Modification Request System. https://sgma.water.ca.gov/basinmod/basinrequest/preview/31. Accessed 15 Oct 2020.

Santa Barbara Planning Commission. 2018. Santa Barbara Planning Commission meeting of September 12, 2018. https://sbcounty.granicus.com/MediaPlayer.php?view_id=11&clip_id=3369. Accessed 24 June 2020.

Scott, J. 1998. *Seeing like a state*. New Haven, CT: Yale University Press.

Sippel, S.R. 2018. Financialising farming as a moral imperative? Renegotiating the legitimacy of land investments in Australia. *Environment and Planning A* 50 (3): 549–568.

Sippel, S.R., N. Larder, and G. Lawrence. 2016. Grounding the financialization of farmland: Perspectives on financial actors as new land owners in rural Australia. *Agriculture and Human Values* 34: 251–265.

Tsing, A. 2000. Inside the economy of appearances. *Public Culture* 12 (1): 115–144.

U.S. Census. 2018. 2018 American Communities Survey 5-year estimates. https://www.census.gov/data.html. Accessed 22 June 2020.

Visser, O. 2017. Running out of farmland? Investment discourses, unstable land values and the sluggishness of asset making. *Agriculture and Human Values* 34: 185–198.

Walsh, C. 2019. Water to wine: Industrial agriculture and groundwater regulation in California. In *In defense of farmers: The future of agriculture in the shadow of corporate power*, ed. Jane W. Gibson and Sara E. Alexander, 175–204. Lincoln, NE: University of Nebraska Press.

Zaloom, C. 2004. The productive life of risk. *Cultural Anthropology* 19 (3): 365–391.

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The Art of Protecting Grapevines From Low Temperature Injury

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Frost protection or protecting plants from cold temperatures where they could be damaged must be a consideration in vineyard planning. Cold protection events commonly occur during "radiation" frost conditions when the sky is clear, there is little wind and strong temperature inversions can develop. These conditions can happen during spring, fall or winter when it is necessary to keep canes, buds, flowers, small berries, or foliage above "critical" temperatures. The best frost protection technique is always good site selection. Use of water for frost protection in *V. vinifera* blocks is often not recommended when it is necessary to carefully manage soil water levels. Under-canopy sprinkling systems are usually not an option. Wind machines or "fans" rely totally on the strength of the temperature inversion for their effectiveness in warming the vineyard and may also be helpful in pushing cold air out of a vineyard. The placement of multiple wind machines must be carefully coordinated to maximize the areal extent and net effectiveness. Currently available fossil fuel-fired (oil and propane) heaters can be a big asset in frost protection activities, but are very inefficient and costly to operate. While there is no perfect method for cold temperature protection, quite often combinations of methods are advantageous. Wind machines have been found to work well with properly placed fossil fuel heaters and is probably the most appropriate combination for winter time cold protection in vineyards. A well-maintained and calibrated frost monitoring (thermometers and alarms) network will always be required. Knowledge of the current critical temperatures and the latest weather forecast for air and dew point temperatures are important because they tell the producer if heating may be at any stage of development and how much of a temperature increase should be required to protect the crop.

KEY WORDS: cold temperature injury, frost protection methods, grapevines

Attempts to protect grape vines from cold temperature injury began at least 2000 years ago when Roman growers scattered burning piles of prunings, dead vines and other waste to heat their vineyards during spring frost events [3]. The protection of vines against cold temperature injury is still a crucial element in commercial viticulture in many areas of the world. It is estimated that 5% to 15% of the total world crop production is affected by cold temperature injury every year. However, because of the extreme complexity of the interactions between the physical and biological systems, our current efforts to protect crops against cold temperature injury can be appropriately characterized as more of an art than a science.

The need to protect against cold injury can occur in the spring, fall and/or winter depending on the location and varieties [9]. Frost protection activities on grapes in the spring are to protect new leaves, buds, and shoots (and later the flowers) from cold temperature injury. However, it is often necessary to frost-protect *V. vinifera* vineyards in the fall in areas like the inland Pacific Northwest (PNW) to prevent leaf drop so that sugar will continue to accumulate in the berries. Sometimes protection measures must be initiated during very cold temperature events during the winter periods on *V. vinifera* vines and some perennial tree crops (*i.e.,* peaches, apricots) in colder regions. Winter cold temperatures can injure roots and trunk/cane injuries (splits, wounds, tissue damage). Injuries can also increase the incidence of certain diseases such as crown gall. Usually, only a couple of degrees rise in air temperature is sufficient to minimize cold injury at any time of year.

The terms frost and freeze are often used interchangeably to describe conditions where cold temperature injury to plants result as a consequence of subfreezing temperatures. This discussion will generally refer to frost and to frost protection systems for the wide variety of countermeasures growers may use to prevent cold temperature injury to plant tissues.

Types of frosts. There are basically two dominant types of frost situations which will be encountered. These are radiant frosts and advective freezes. Both types will usually be present in all frost events, but the type of frost is usually characterized by the dominant type.

Radiation frosts: A radiation frost is probably the most common in grape growing areas around the world. It is also the easiest type of frost to protect against and is the main reason that site selection is so important. Almost all frost protection systems/methods available today are designed to protect against radiant-type frost/freezes.

There are two sources of heat loss under radiative conditions: radiative losses and *advection* (wind) that must be counteracted in radiative frost conditions. All objects radiate heat into the environment in proportion to their relative temperature differences. For example, exposed objects will lose heat at a faster rate when exposed to a clear night sky which has an effective temperature around -20°C, but will not lose heat as rapidly to clouds which are relatively much warmer than the sky depending on cloud type and height. With

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respect to the plant, heat is lost by upward long-wave radiation to the sky, heat is gained from downward emitted long-wave radiation (*e.g.,* absorbed and re-emitted from clouds), air-to-crop (advective) heat transfers, and heat can either be gained or lost soil-to-plant (radiative) heat transfers.

Radiant frosts occur when large amounts of clear, dry air moves into an area and there is almost no cloud cover at night. During these times, the plants, soil, and other objects which are warmer than the very cold night sky will "radiate" their own heat back to space and become progressively colder. In fact, the plants cool (by radiating their heat) themselves to the point that they can cause their own damage. The plant tissues which are directly exposed to the sky become the coldest.

These radiation losses can cause the buds, blossoms, twigs, leaves, etc. to become 1°C to 2°C colder than the surrounding air which radiates very little of its heat. The warmer air then tries to warm the cold plant parts and it also becomes colder. The cold air settles toward the ground and begins slowly flowing toward lower elevations. This heavier, colder air moves slowly ("drifts") down the slope under the influence of gravity (technically called "katabatic wind"), and collects in low areas or "cold pockets." Drift, typically moving 1 to 2 meters per second (m/sec), can carry heat from frost protection activities out of a vineyard and replace it with colder air. It can also carry heat from higher elevation heating activities into a vineyard. The amount of heat lost to wind drift is often at least equal to radiative heat losses that are in the range of 10 to 30 watts per square meter (W/m^2) or more. Consequently, the replacement heat must be greater than the sum of both radiative and advective heat losses during "successful" frost protection activities (*i.e.,* ≥ 20 to 60 W/m^2 depending on climatic variables and time of year).

Concurrent with the radiative processes and with very low wind speeds (< 1.5 - 2 m/sec), a *thermal inversion* condition will develop where the temperature several tens of meters above the ground may be as much as 5°C to 8°C warmer than air in the vineyard. Springtime temperature inversions will often have a 1.5°C to 3°C temperature difference (moderate inversion strength) as measured between two and 20-meters above the surface. Many frost protection systems such as wind machines, heaters and under-vine sprinkling rely on this temperature inversion to be effective.

The general rate of temperature decrease due to radiative losses can be fairly rapid until the air approaches the *dew point temperature* when atmospheric water begins to condense on the colder plant tissues (which reach atmospheric dew point temperature first because they are colder). The *latent heat of condensation* (when water condenses from a gas to a liquid, it releases a large amount of heat (2510 KiloJoules per liter at 0°C compared to 335 KJ/L released when water freezes) is directly released at the temperature of condensation, averting further temperature decreases (at least temporarily). Thus, the exposed plant parts will generally equal air temperature when the air reaches its dew point. At the dew point, the heat released from condensation replaces the radiative heat losses. Because the air mass contains a very large amount of water which produces a large amount of heat when it condenses at dew point, further air temperature decreases will be small and occur over much longer time periods. A small fraction of the air will continue to cool below the general dew point temperature and drift down slope.

Thus, having a general dew point near or above critical plant temperatures to govern air temperature drops is important for successful, economical frost protection programs. Economically and practically, most cold temperature modification systems must rely on the heat of condensation from the air. This huge latent heat reservoir in the air can provide great quantities of free heat to a vineyard. Severe plant damage often occurs when dew points are below critical plant temperatures because this large, natural heat input is much too low to do us any good and our other heating sources are unable to compensate. There is little anyone can do to raise dew points of large, local air masses.

Advective freezes: Advective freezes occur with strong, cold (below plant critical temperatures), large-scale winds persisting throughout the night. They may or may not be accompanied by clouds and dew points are frequently low. Advective conditions do not permit inversions to form although radiation losses are still present. The cold damage is caused by the rapid, cold air movement which convects or "steals" away the heat in the plant. There is very little which can be done to protect against advective-type freezes. However, it should be pointed out that winds greater than about 3 m/sec that are above freezing temperatures are beneficial on clear-sky radiative frost nights since they keep the warmer, upper air mixed into the vineyard, destroying the inversion and replacing radiative heat losses.

Critical temperatures: The critical temperature is defined as the temperature at which tissues (cells) will be killed and determines the cold hardiness levels of the plant. Other presentations at this symposium deal with critical temperatures and supercooling; however, this is a poorly understood phenomenon by many growers, and it is surrounded by a substantial body of myths.

Critical temperatures vary with the stage of development and ranges from below -20°C in midwinter to near 0°C in the spring. Shoots, buds, and leaves can be damaged in the spring and fall at ambient temperatures as high as -1°C. Damages in the winter months can occur to dormant buds, canes and trunks and will vary depending on general weather patterns for 7 to 14 days preceding the cold temperature event and physiological stages. Cold hardiness of grapes (and their ability to supercool) can be influenced by site selection, variety, cultural practices, climate, antecedent cold temperature injuries and many other factors [18,19].

Critical temperatures are most commonly reported for the 10%, 50%, and 90% mortality levels, and very often there is less than one degree difference between the values. These are not absolute values, but they give the grower confidence in implementing frost protection activities and can reduce unnecessary expenses. Knowledge of the current critical temperatures and the latest weather forecast for air and dew point temperatures are important because they tell the producer how necessary heating may be at any stage of development and how much of a temperature increase should be required to protect the crop.

It is important to note that critical temperatures determined in a laboratory are done in carefully controlled freezers with slow air movement. The air temperature in the freezer is lowered in small predetermined steps and held there for 20 to 30 minutes or more to allow the buds to come into equilibrium. This practice has given rise to the common misconception that buds have to be at a temperature for 20 to 30 minutes or so before damage will occur. The truth is that whenever ice forms in the plant tissue, there will be damage regardless of how long it took to reach that point. Plant tissues cool at a rate dependent on the temperature difference between it and its environment. Thus, if the air suddenly drops several degrees (as may be the case with "evaporative dip" when over-vine sprinklers are first turned on) the tissues can rapidly cool below critical and cold injury will occur. In addition, mechanical shock from falling water droplets or agitation of the leaves and buds by wind machines can stop supercooling and quickly initiate ice crystal formation resulting in damage even if the tissues are above the laboratory-determined critical temperature values. However, the laboratory values (if available for a site and variety) provide a good ballpark figure as to when and what frost protection measures need to be implemented.

General cold temperature protection strategies: The objective of any crop cold temperature protection program is to keep plant tissues above their critical temperatures. Programs for protection of grape vines from cold temperature injury can be characterized as combinations of many *small measures* to achieve relatively *small increases* in ambient and plant tissue temperatures.

Any crop can be protected against any cold temperature event if economically warranted. The selection of a frost protection system is primarily a question of economics. Fully covering and heating a crop as in a greenhouse are the best and also the most expensive cold protection systems, but they are usually not practical for large areas of vineyards, orchards and many other small fruit and vegetable crops, unless other benefits can also be derived from the installation.

The questions of how, where, and when to protect a crop must be addressed by each grower after considering crop value, expenses, and cultural management practices. These decisions must be based on local crop prices plus the cost of the equipment and increased labor for frost protection activities. They must be balanced against both the annual and longer term costs of lost production (including lost contracts and loss of market share) and possible long-term vine damage.

Avoidance of cold temperature injury to vines can be achieved by passive and/or active methods [29]. Passive methods include site selection, variety selection, and cultural practices. Active methods are necessary when passive measures are not adequate and include wind machines, heaters and sprinklers that may be used individually or in combination. Most successful frost protection programs include both passive and active measures.

Passive frost protection strategies: Passive or indirect frost protection measures are practices that decrease the probability or severity of frosts and freezes or cause the plant to be less susceptible to cold injury. These include site selection, variety selection and cultural practices, all of which influence the type(s) and management of an integrated passive and active frost protection program. Full consideration of several potential passive and active scenarios in the initial planning before planting will make active frost protection programs more effective and/or minimize cost of using active methods while not significantly increasing the cost of vineyard establishment.

Site selection: The best time to protect a crop from frost is before it is planted. The importance of good site selection in the long term sustainability of a vineyard operation cannot be over emphasized [33]. It will influence the overall health and productivity of the vines through: soil depth, texture, fertility and water holding capacities; percent slope, aspect (exposure), subsurface and surface water drainage patterns; microclimates; elevation and latitude; and, disease/pest pressures and sources.

In windy (advective) sites, lower lying areas are protected from the winds and are usually warmer than the hillsides. However, under radiative frost conditions, the lower areas are cooler at night due to the collection of cold air from the higher elevations. Good deep soils with high water holding capacities will minimize winter injury to roots. In short, a good site can minimize the potential extent and severity of cold temperature injury and greatly reduce frost protection expenses and the potential for long term damage to vines.

Good site selection to minimize cold temperature injuries from radiation frost events must include evaluation of the irrigation (and frost protection) water supply, cold air drainage patterns and sources, aspect (exposure), and elevation. Long-term weather records for the area will provide insight to the selection of varieties and future management requirements. Rainfall records will indicate irrigation system and management requirements. Assessment of historic heat unit accumulations and light intensities will help select varieties with appropriate winter cold hardiness characteristics that will mature a high quality crop during the typical growing season. Prevailing wind directions during different seasons will dictate siting of windbreaks,

locations of wind machines, sprinkler head selection and spacings, and other cultural activities. Sometimes it is necessary to install the necessary weather stations and collect these data for several years prior to the installation of a vineyard.

Air drainage: The importance of air drainage in defining frost protection strategies is poorly understood by many vineyard planners and is often neglected. This ignorance leads to numerous potentially avoidable frost problems. Cold air movement (drift) into and out of a vineyard during radiative frost events is absolutely critical to the long term success of the operation. Obtaining a good site with good air drainage, especially in a premier grape growing area, can be very expensive, but it is an investment with a high rate of return.

Cold air movement during radiative conditions can often be visualized as similar to molasses flowing down a tilted surface: thick and slow (1 to 2 m/sec). Air can be dammed or diverted like any other fluid flow. Row orientation must be parallel to the slope to minimize any obstruction to cold air as it flows through the vineyard. A relatively steep slope will help minimize the depth of cold air movement and reduce potential cold injury with height.

The major source of cold air movement in a vineyard is usually either up slope or down slope from the site. All the sources of cold air and their flow patterns must be determined early in the planning process. As explained above, the cold air density gradients flow down slope and collect in low areas. Air temperatures in depressions can be 6°C to 8°C cooler than adjacent hill tops [3]. Consequently, a vineyard site at the bottom of a large cold air drainage system may experience severe frost problems. A study of past cropping patterns and discussions with local residents will usually provide insight for defining the coldest areas.

The potential vineyard site must also be evaluated for impediments (natural and man-made) to cold air drainage both within and down-slope of the vineyard that will cause cold air to back up and flood the vineyard. There is little than can be done for most natural impediments, however, the placement of man-made barriers may be either beneficial or extremely harmful. It is possible to minimize cold air flows through a vineyard, reduce heat losses (advective) and heating requirements with proper siting or management of man-made obstructions. Conversely, improper locations of barriers (windbreaks, buildings, roads, tall weeds or cover crops, *etc.*) within as well as below the vineyard can greatly increase frost problems.

Windbreaks are often used for aesthetic purposes, to reduce effects of prevailing winds or to divide blocks with little or no thought about their frost protection consequences. They can be advantageous in advective frost conditions, but they often create problems in radiative frosts. Windbreaks, buildings, stacks of bins, road fills, fences, tall weeds, *etc.* all serve to retard cold air drainage and can cause the cold air to pond in the uphill areas behind them. The size of the potential cold air pond will most likely be four to five times greater than the height of a solid physical obstruction, depending on the effectiveness of the "dam" or diversion. Thus, the proper use and placement of tree windbreaks and other barriers (buildings, roads, tall weeds, cover crops, *etc.*) to air flow in radiative (most common) frost protection schemes is very important.

The basal area of large tree windbreaks at the downstream end of the vineyard/orchard should be pruned (opened) to allow easy passage of the cold air. Windbreaks at the upper end should be designed and maintained, if possible, divert the cold air into other areas or fields that would not be harmed by the cold temperatures.

Aspect: Aspect or exposure is the compass direction that the slope faces. A north facing slope in the northern hemisphere is usually colder than a south facing slope in the same general area (opposite in the southern hemisphere). A northern exposure will tend to have later bloom which can be an advantage in frost protection, but conversely may have fewer heat units during the season and there may be problems maturing the crop with some varieties.

A southern exposure is usually warmer causing earlier bloom and a longer growing period. However, winter injury may be accentuated in southern exposure due to rapidly fluctuating trunk and cane temperatures throughout warm winter days followed by very cold nights. Desiccation of plants due to heat and dry winds may be problematic on south facing slopes depending on the prevailing wind direction. A southwest facing slope will have the highest summer temperatures and may be desirable for varieties that are difficult to mature in some areas.

Elevation and latitude: Air temperature is inversely related to altitude. Temperatures also decrease about 10°C for every kilometer of elevation. Higher elevations and higher latitudes both have a lower thickness of atmosphere above them and have higher nocturnal radiative cooling rates. Due to day length fluctuations throughout the year, higher latitudes will be colder. Thus, both higher elevations and high latitudes generally bloom later and have shorter growing seasons than lower altitudes and lower latitudes. The cooler environment may be offset by a warmer (southern) exposure, however, these factors will have tremendous influence on variety selection and irrigation/soil water management as well as the type and extent of frost protection strategies.

Natural heat sources: Nearby large bodies of water will tend to moderate extremes in temperature throughout the year as well as reducing the frequency and severity of frost events. The "lake effect" is evident in western Michigan which is affected by Lake Michigan as well as the Napa-Sonoma grape growing areas in California which are moderated by "coastal effect" from the cold waters of the Pacific Ocean. Large cliffs, buildings or outcroppings of south facing rock will ab-

sorb heat from direct solar radiation in the day and release it at night thereby warming nearby vegetation.

Variety selection: Fitting the best variety to the site is often more a matter of luck than science. It is known that some varieties will perform better under certain exposures, slopes and soils than others in the same area, but this information is lacking for most varieties in most areas [2,14,33]. However, selecting a variety which will consistently produce high yielding and high quality grape is every bit as important as (and dependent on) site selection. Different varieties will behave differently under the same circumstances. It is known that the sensitivity to frost for many deciduous trees is greatly influenced by root stocks, but this has not been demonstrated in the literature on grapes. Johnson and Howell [19] detected small, but consistent, differences in cold resistance from three varieties at the same stages of development.

Considerations will include evaluations of varietal differences in the tendency to break dormancy or deharden too early to avoid the probability of frost injury. The susceptibility of a variety to potential winter damage in the region must be assessed. A variety with a long growing season (high heat unit requirement) may require more frost protection activities in the autumn. Based on the literature, *V. vinifera* appears relatively insensitive to photoperiod with respect to cold hardiness, but some hybrids and other cultivars may have a large response.

Cultural practices: Proper cultural practices are extremely important in minimizing cold injury to vines [12,13,34,37]. Cultural practices generally only provide a 1°C to 1.5°C increase in air temperature. They must be carefully and thoughtfully integrated into a complete package of passive and active frost control measures, and they include: soil fertility, irrigation water management, soil and row middle management (cover crops), pruning and crop load, canopy management, spray programs, and cold temperature monitoring networks.

Fertility: High soil fertility levels by themselves have little effect on cold hardiness of vines. However, when high fertility is combined with high soil water levels late in the season *V. vinifera* vines may fail to harden-off early enough to avoid winter injury. This does not appear to be a problem in Concord and some other American cultivars or French hybrid varieties.

***Irrigation*:** Irrigation has been used for frost protection since the early part of the 20th century [20]. Selecting the proper irrigation system is crucial in frost protection strategies, disease management strategies, and long term production. In arid areas, irrigation management is the largest single controllable factor in the vineyard operation that influences *both* fruit quality and winter hardiness of vines. Additional detail on irrigation system design and management considerations for grapes is presented in Evans [10].

Irrigation management can play a major role in preparing (harden-off) *V. vinifera* vines for cold winter temperatures in some arid, high latitude regions. For example, in the inland arid areas of the PNW, the primary reason that they can successfully and consistently grow high quality *V. vinifera* grapes, as compared to other "high latitude" areas like Michigan and New York, is that they can and do control soil moisture throughout the year. Early season regulated deficit irrigation techniques as well as late season controlled deficit irrigations have both been effective in hardening-off vines in arid areas [10].

Over-vine sprinkler systems have been used for bloom delay (evaporative cooling in the spring) on deciduous fruit trees such as apples and peaches in the spring which ostensibly keeps the buds "hardy" until after the danger of frost has passed. It does delay bloom, however, it has not been successful as a frost control measure on deciduous trees because of water imbibition by the buds which causes them to lose their ability to supercool. This results in critical bud temperatures that are almost the same as those in non-delayed trees. In other words, although bloom is delayed, critical bud temperatures are not and, thus, no frost benefit. However, if the buds are allowed to dry during a cool period when the bloom delay is not needed or after a rain, they can regain some of their cold hardiness. There are no data on this practice in grapes.

After harvest irrigation: In areas with cold winters (*i.e.,* temperatures below -10°C) it is advisable to refill the soil profile to near field capacity after harvest in the fall to increase the heat capacity of the soils so that vine roots are more protected from damage from deep soil freezing and reduce the incidence of crown gall and other diseases through injury sites. This practice also helps inhibit vine desiccation from dry winter and spring winds.

Soil and row middle management (cover crops): Management of the soil cover and row middles in a vineyard can significantly affect vineyard temperatures during a frost event. Weed control can have a significant impact on vineyard temperatures [8]. Cover crops and mulches can offer advantages of lower dust levels, provide habitats for beneficial insects and reduce weed populations. However, historically, it has been recommended that cover crops not be used in frost prone vineyards. The guide was to keep soil surfaces bare, tilled and irrigated to make it darker so as to absorb more heat from the sun during the day and release it at night. Some of this heat is then released during the night into the vineyard and may provide 0.6°C to 1°C of protection only if the grower is not using sprinklers for frost protection (where bare soils may actually be a detriment). But, additional irrigations with cold water (less than the soil temperature) are unlikely to be beneficial.

Current information, however, is that soil with cover crops will still contribute about 0.6°C as long as they are kept mowed fairly short (< 5 cm). Snyder and Connell [31] found that the surface of bare soils was 1°C to 3°C warmer than soils with cover crops (higher

than 5 cm) in almonds at the start of a cold period. However, after several days of low solar radiation and/or strong dry winds, the areas with cover crops were warmer. There was no difference in covered soil surface temperatures once the cover crop exceeded 5 cm in height.

Tall cover crops (and weeds) will have a soil heat insulating effect and, more importantly, may hinder cold air drainage and increase the thickness of the cold air layer resulting in more cold temperature injury to the vines. However, taller cover crops will provide a greater freezing surface under sprinkler frost protection systems and additional heat in the vineyard, but should be kept no more than 25 to 30 cm in height during the frost season.

Pruning and crop load: It is well known that pruning too early can accelerate bud break resulting in more frost damage than later pruning [32,43]. Likewise, heavy crop loads may reduce carbohydrate accumulations, weaken the vines and reduce cold hardiness.

There is usually not complete crop loss on grapes from severe frosts. Unlike tree fruit species, grape vines have secondary and tertiary buds that are fruitful and produce a partial crop [22,24,43]. Grape buds include primary buds and secondary buds as well as latent buds from previous seasons. However, secondary and tertiary buds are not as fruitful; their berries take longer to mature than primaries, and mixtures of fruit from both primaries and secondaries will be significant concerns in both harvesting and juice quality. In addition, maturation of berries from secondary and/or tertiary buds may be problematic in areas with short growing seasons. The removal of injured shoots after frost injury is not beneficial in improving yields [22].

Less severe pruning and fruit thinning to desired crop loads resulted in increased cold hardiness of Concord grapevines [32]. Because buds at the end of a cane will open first, another option that delays basal bud break by 7 to 10 days is to delay pruning (if there is time) until the basal buds are at the "fuzzy tip" stage (just starting to open). Thus, a general recommendation for grape vines in a spring frost prone area is to delay pruning as late as possible and to prune lightly. Crop load adjustments can be made later by additional pruning or thinning clusters after the danger of frost is past.

Growers in some warm areas with hot summer nights may not care about loss of primary buds to frost and some managers may actually plan to use secondary buds to delay harvests until cooler fall periods for better juice balance. In these cases, it may be advisable to delay pruning (or even knocking off primary buds) to get desired crop loads and juice character.

Canopy management: Controlling the size and density of a canopy by pruning and soil water management can have substantial benefits on the cold hardiness of the vines during the following winter. Early season regulated deficit irrigation and alternate row irrigation techniques potentially result in reduced vegetative to reproductive growth ratios and better light penetration into the canopy. In addition, canes exposed to direct solar radiation during the growing season were more cold hardy [14].

Spray programs: The use of chemical sprays (*e.g.,* zinc, copper, *etc.*) to improve frost "hardiness" of vines has been found to offer no measurable benefit in limited scientific investigations. Likewise, sprays to eliminate "ice nucleating" bacteria have not been found beneficial because of the great abundance of "natural" ice nucleators in the bark and dust which more than compensate for a lack of bacteria. There is no reported research on grapes using cryoprotectants or antitranspirants for prolonging cold hardiness or delay bud break.

There is very little information on the use of sprays to delay bloom in grapes and thus reduce the potential for frost injury. Some chemical sprays (such as spring-applied AVG, an ethylene inhibitor) have been reported to delay budbreak on some fruit crops with exact timing [6,7]. Fall-applied growth regulators (ethylene releasing compounds: ethephon or ethrel) have also been reported to delay bloom the following spring and increase flower hardiness on *Prunus* tree fruits, but there were some phytotoxic effects on the crop [25,26,28]. Gibberellic acid (GA) was less successful on deciduous fruit trees in delaying bloom [27].

One report [35] found that GA prolonged dormancy in *V. vinifera.* Applications of a growth retardant (paclobutrazol) showed promise in improving hardiness on Concord grapes with applications of 20 000 ppm applied the previous spring and summer. [1].

New research on the use of alginate gel (Colorado on peaches and grapes) and soy oil (Tennessee on peaches) coatings that are sprayed on the plants six to 10 weeks prior to budbreak shows promise in prolonging hardiness and delaying bloom by several days. It is hypothesized that the coatings retard respiration and thus inhibit bud break, providing a frost benefit. However, the coatings need to be reapplied after rain fall events and the economics is unknown.

Frost monitoring systems: Reliable electronic frost alarm systems are available that alert the grower if an unexpected cold front has moved into the area. These systems can ring telephones from remote locations, sound an alarm or even start a wind machine or pump. The sensor(s) should be placed in a regular thermometer shelter and its readings correlated with other "orchard" thermometers that have been placed around the block(s) to set the alarm levels (after considering the critical bud temperatures). It is important to have enough thermometers and/or temperature sensors to monitor what is actually happening across the entire vineyard.

Thermometers and sensors should be placed at the lowest height where protection is desired (*e.g.,* cordon height in grapes). They should be shielded from radiant heat from fossil-fuel fired heaters (a very common prob-

lem that gives misleading high readings). Thermometers and alarm systems should be checked and recalibrated each year. Thermometers should be stored upright inside a building during the non-protection seasons.

Active frost protection strategies: Active or direct frost protection systems are efforts to modify vineyard climate or inhibit the formation of ice in plant tissues. They are implemented just prior to and/or during the frost event. Their selection will depend on the dominant character of an expected frost event(s) as well as passive measures used in the vineyard establishment and operation.

Active frost protection technologies will use one or more of three processes: *(1)* addition of heat; *(2)* mixing of warmer air from the inversion (under radiative conditions); and *(3)* conservation of heat. Options for active frost protection systems include covers, fogging systems, various systems for over-crop and under-canopy sprinkling with water, wind machines, and heaters.

In selecting an active system to modify cold air temperatures that may occur across a block, a vineyard manager must consider the prevailing climatic conditions which occur during the cold protection season(s). Temperatures and expected durations, occurrence and strength of inversions, soil conditions and temperatures, wind (drift) directions and changes, cloud covers, dew point temperatures, critical bud temperatures, vine condition and age, land contours, and vineyard cultural practices must all be evaluated. The equipment must be simple, durable, reliable, inexpensive and nonpolluting.

Covering a vineyard (conservation of heat) with a woven fabric for frost protection is very expensive ($20 000 to $30 000 per hectare) and will not be discussed further. Likewise, there are also some soy oil-based, gelatin-based, and starch-based spray-on foams [4] that will not be addressed, but are being investigated as temporary thermal insulators for plants. Thus far these have had limited success in tall crops like vineyards and orchards.

The total calculated radiant heat loss expected from an unprotected vineyard is in the range of 2 to 3 million KJ/ha per hour (60-80 W/m^2). The "heating" or frost protection system must replace this heat *plus* heat lost to evaporation. It is estimated that to raise air temperature 1°C in a 2-meter high vineyard will require that about 25 W/m^2 after all losses (or at 100% efficient). Artificial (active) vineyard and orchard heating systems will supply anywhere from 1.3 to 18.2 million KJ/ha per hour (36 - 510 W/m^2) of heat although it is usually about 7.8 to 13 million KJ/ha per hour (220 to 360 W/m^2). Table 1 presents some relative heat values for oil, propane, and water. These show that a 2.0 mm/hr application of water releases a total of 190 W/m^2 (3.35 million KJ per mm of water per hectare) if it *all* freezes. However, unless this water freezes directly on the plant, very little of this heat is available for heating the air and thereby the plant. By comparison, a system of 100 return stack oil heaters per hectare supplies a total of about 315 W/m^2 (11.3 million KJ/ha/hr) which can potentially raise the temperature as much as 12°C with a strong inversion at 100% efficiency (however, conventional heaters are only 10% to 15% efficient and much of the heat is lost leaving about 30 to 50 W/m^2 which would raise the whole vineyard temperature only about 2°C).

Table 1. Approximate relative heat values of water in KiloJoules (KJ), #2 diesel heating oil and liquid propane (0.2778 KJ = 1 watt-hr; 10 000 m^2 per hectare).

Condensation (latent heat) of water at 0°C releases	2510 KJ/L
Evaporation of water at 0°C absorbs/takes	2510 KJ/L
Freezing or fusion of water (latent heat) to ice releases	335 KJ/L
10°C temperature change of water releases/take	41.4 KJ/L
Oil burning produces	9 302 kilocalories/L or 39 800 KJ/L No. 2 diesel
100 oil heaters/ha @ 2.85 l/hr/heater releases	11 343 000 KJ/hr/ha 3 151 KW/ha
Liquid Propane produces	6 081 kilocalories/L or 25 500 JJ/L LP
160 LP heaters/ha @ 2.85 l/hr/heater releases	11 343 000 KJ/hr/ha 3 151 KW/ha

Over-vine sprinkling: Over-crop or over-vine sprinkler systems (addition of heat) have been successfully used for cold temperature protection by growers since the late 1940s. Many systems were installed in the early 1960s; however, cold temperature protection by over-vine sprinkling requires large amounts of water, large pipelines, and big pumps. It is often not practical because of water availability problems and, consequently, is not as widely used as other systems. Most of these systems are used for both irrigation and cold temperature injury (frost) protection. Traditional "impact" type sprinklers as well as microsprinklers can be used as long as adequate water is uniformly applied.

Over-crop sprinkling is the field system which can provide the highest level of protection of any single available system (except field covers/green houses with heaters), and it does it at a very reasonable cost. However, there are several disadvantages and the risk of damage can be quite high if the system should fail in the middle of the night. It is the only method that does not rely on the inversion strength for the amount of its protection and may even provide some protection in advective frost conditions with proper design and adequate water supplies.

The level of protection with over-vine sprinkling is directly proportional to the amount (mass) of water applied. The general recommendation for over-vine systems in central California calls for about 7 L/sec/ha or 2.8 mm/hr which will protect to about -2.5°C [21]. In colder areas, such as the Pacific Northwest in the USA, adequate levels of protection require that 10 to 11.5 L/sec/ha (3.8 - 4.6 mm/hr) of water (on a total area basis) be available for the duration of the heating period which protects down to about -4°C to -4.4°C as long as

the dew point in not less than -6°C. Water application rates should be increased by 0.5 mm/hr for every dew point degree (°C) lower than -6°C.

"Targeting" over-vine applications to only the vine canopy (*e.g.,* one microsprinkler per vine or every other vine) can reduce overall water requirements down to about 5 to 5.7 L/sec/ha in warmer areas to 7 to 8 L/sec/ha, but the water applied on the vine must still be ≥ 2.8 mm/hr or ≥ 3.8 mm/hr, respectively [16,17]. Protection under advective conditions may require application rates greater than 2.6 L/sec/ha depending on wind speeds and air temperatures. The entire block must be sprinkled at the same time when used for cold temperature protection.

The application of water to the canopy must be much more uniform than required for irrigation so that no area receives less than the designated amount. A uniformity coefficient (UCC) of not less than 80% is usually specified. The systems for frost protection must be engineered for that purpose from the beginning. Mainlines, pumps and motors (7.5 to 12 BHP/ha) must be sized so that the entire vineyard or block can be sprinkled at one time. A smaller pump is often installed for irrigation purposes and the block watered in smaller sets.

Impact sprinkler heads should rotate at least once a minute and should not permit ice to build up on the actuator spring and stop the rotation. Pressures are typically 370 to 400 kPa and should be fairly uniform across the block (*e.g.,* less than 10% variation). Many sprinkler heads will fail to operate correctly at temperatures below -7°C.

Large amounts of water are required for over-vine (and under-vine) sprinkling, so that many vineyard managers in frost prone areas are drilling wells and/or building large holding ponds for supplemental water. There are extra benefits to these practices in that the well water can be warmer than surface waters plus the ponds tend to act as solar collectors and further warm the water. If economically possible, growers should try to size the ponds to protect for as much as 10 hours per night for three or four nights in a row.

When applied water freezes, it releases heat (heat of fusion) keeping the temperature of an ice and water "mixture" at about -0.6°C. If that mixture is not maintained, the temperature of the ice-covered plant tissues may fall to the wet bulb temperature, which could result in severe damage to the vine and buds. The applied water must supply enough heat by freezing to compensate for all the losses due to radiation, convection, and evaporation. Water should slowly but continuously drip from the ice on the vine when the system is working correctly. The ice should not have a milky color, but should be relatively clear.

There may be an "evaporative dip," a 15- to 30-minute drop in the ambient air temperature, due to evaporative cooling of the sprinkler droplets when the sprinkler system is first turned on. This dip can push temperatures below critical temperatures and cause serious cold injury. The use of warm water, if available, can minimize the temperature dip by supplying most of the heat for evaporation. The recovery time and the extent of this dip are dependent on the wet bulb temperature. A low wet bulb temperature (low dew point temperature) requires that the over-crop sprinklers be turned on at higher ambient temperatures. Table 2 presents suggested system turn-on temperatures based on wet bulb temperatures.

Table 2. Suggested starting temperatures for over-vine sprinkling for frost protection based on wet bulb temperatures to reduce the potential for low temperature bud damage from "evaporative dip."

Wet bulb temperature		Starting temperature	
°F	°C	°F	°C
≥ 26	≥ -3.3	34	1.1
24 to 25	-4.4 to -3.9	35	1.6
22 to 23	-5.6 to -5.0	36	2.2
20 to 21	-6.7 to -6.1	37	2.8
17 to 19	-8.3 to -7.2	38	3.3
15 to 16	-9.4 to -8.9	39	3.9

Since the heat taken up by evaporation at 0°C is about 7.5 times as much as the heat released by freezing, at least 7.5 times as much water must freeze as is evaporated. And, even more water must freeze to supply heat to warm the vineyard and to satisfy heat losses to the soil and other plants. Evaporation is happening all the time from the liquid and frozen water. If the sprinkling system should fail for any reason during the night, it goes immediately from a heating system to a very good refrigeration system and the damage can be much, much worse than if no protection had been used at all. Therefore, when turning off the systems, the safest option on sunny, clear mornings is to wait (after sunrise) until the melting water is running freely between the ice and the branches or if ice falls easily when the branches are shaken. If the morning is cloudy or windy, it may be necessary to keep the system on well into the day.

Because of insufficient water quantities, some vineyard managers and orchardists have installed over-crop microsprayer "misting" systems (not to be confused with very high pressure (≥ 1500 kPa) systems that produce thick blankets of very small suspended water droplets that fill a vineyard with "fogs" several feet thick that have other problems) for frost protection. These are not recommended because of the very low application rates (*e.g.,* ≥ 0.8 mm/hr or 2.25 L/sec/ha). There is absolutely no scientific evidence that these misting systems trap heat, reflect heat or "dam" cold air away from a block. They do not apply adequate water amounts to provide sufficient latent heat for bud/flower protection that is necessary for over-vine sprinkling conditions and some local irrigation dealers are facing significant legal problems as a result.

Under-vine sprinkling: Below-canopy (under-vine) sprinkling is usually not an option with grapes crops, depending on the trellising system, because of

the density of interference from trunks and trellis posts. However, one method that may have some promise is the use of heated water [11,23] applied under the vine canopy (never over-vine) at application rates greater than 1 mm/hr (3 L/sec/ha) at temperatures around 40°C to 45°C.

Fogs: Special "fogging" systems which produce a 6- to 10-meter-thick fog layer that acts as a barrier to radiative losses at night have been developed. However, they have been marginally effective because of the difficulty in attaining adequate fog thickness, containing and/or controlling the drift of the fogs and potential safety/liability problems if the fogs crossed a road.

Fogs or mists which are sometimes observed with both under-crop and over-crop sprinkler systems are a result of water that has evaporated (taking heat) and condenses (releasing heat: no "new" heat is produced) as it rises into cooler, saturated air. As the "fog" rises, into ever colder and unsaturated air, it evaporates again and disappears. The duration of fogs or mists will increase as the ambient temperature approaches the dew point temperature. Thus, the "temporary" fogging is a visual indicator of heat loss that occurs under high dew point conditions and does not represent any heating benefit. It has been shown that the droplet size has to be in the range of a 100-nanometer diameter to be able to affect radiation losses, and the smallest microsprinkler droplets are at least 100 times larger [5].

Heaters: Heating for frost protection (addition of heat) in vineyards has been practiced for centuries with growers using whatever fuels were available. This is still true today in many areas of the world (*i.e.,* Argentina) where oil prices are prohibitive. There are numerous reports of growers using wood, fence rails, rubbish, straw, saw dust, peat, paraffin wax, coal briquets, rubber tires, tar, and naphthalene since the late 1800s. However, these open-fire methods are extremely inefficient because heating the air by convection due to the rising hot exhaust gases is very inefficient with most of the heat rising straight up with little mixing with cooler air in the vineyard. Therefore, current fossil-fueled heater technology which was developed in the early 1900s through the 1920s, was designed to maximize radiant heating by greatly increasing the radiating surface area. Since that time there have been relatively minor refinements and improvements to the return stack, cone and other similar designs. New technologies such as electric radiant heaters have not proved economical.

Heaters were once the mainstay of cold temperature protection activities but fell into disfavor when the price of oil became prohibitive, and other alternatives were adopted. They have made a minor comeback in recent years, particularly in soft fruits and vineyards where winter cold protection may be required, but are plagued by very low heating efficiencies, high labor requirements, and rising fuel costs. In addition, air pollution by smoke is a significant problem and the use of oil-fired heaters have been banned in many areas.

Table 3. Estimated initial costs of installed frost protection systems common to Washington vineyards and orchards.

Method	Estimated cost/hectare
Wind Machine (4-4.5 ha)	$ 3700 - $ 4500
Overvine Sprinkler	$ 2200 - $ 3000
Undervine Sprinkler	$ 2200 - $ 3000
Overvine Covers	$ 20000 - $ 37000
Undervine Microsprinklers	$ 2500 - $ 3700
Return Stack Oil Heat (100/ha)-used	$ 1000 - $ 1100
Return Stack Oil Heat (100/ha)-new	$ 2500 - $ 3000
Pressurized Propane Heaters (160/ha)-new	$ 6200 - $ 10000

Radiant heating is proportional to the inverse square of the distance. For example, the amount of heat 3 meters from a heater is only one-ninth the heat at 1 meter. Consequently, conventional return stack and other common oil and propane heaters have a maximum theoretical efficiency of about 25% (calculated as the sum of the convective and radiative heat reaching a nearby plant). However, field measurements reported in the literature (*e.g.,* Wilson and Jones [36]) indicate actual efficiencies in the range of 10% to 15%. In other words, 85% to 90% of the heat from both conventional oil and propane heaters is lost, primarily due to buoyant lifting and convective forces taking the heat above the plants ("stack effect"). Typically there are about 100 return stack oil heaters (without wind machines) or 160 propane heaters per hectare which produce about 11.3 million KJ of heat. If heaters were actually as much as 25% efficient, then only about 5.7 million KJ of heat would be required, a 50% savings in fuel.

Heaters are "point" applications of heat that are severely affected by even gentle winds. If all the heat released by combustion could be kept in the vineyard, then heating for cold protection would be very effective and economical. Unfortunately, however, 75% to 85% of the heat may be lost due to radiation to the sky, by convection above the plants ("stack effect") and the wind drift moving the warmed air out of the vineyard. Combustion gases may be 600°C to over 1000°C and buoyant forces cause most of the heat to rapidly rise

Table 4. Estimated approximate annual per hectare/hour operating costs (including amortization of investment, but with 0% interest and before taxes) for selected cold temperature (frost) protection systems used 120 hours per year.

Method	Estimated costs/ha/hr
Return Stack Oil Heaters (100/ha)*	$ 93.08
Standard Propane Heaters (154/ha)*	103.98
Wind Machine (130 BHP propane)	33.36
Overcrop Sprinkling	4.10
Under Canopy Sprinkling	4.25
Frost-free site	0.00

* equal total heat output

above the canopy to heights where it cannot be recaptured. There is some radiant heating, but its benefit is generally limited to adjacent plants and only about 10% of the radiant energy is captured. New heater designs are aimed at reducing the temperature of the combustion products when they are released into the orchard or vineyard in order to reduce buoyancy losses.

Many types of heaters are being used, the most common probably being the cone and return stack oil burning varieties. Systems have also been designed which supply oil or propane through pressurized PVC pipelines, either as a part of or separate from the irrigation systems. Currently, the most common usage of heaters in the Pacific Northwest appears to be in conjunction with other methods such as wind machines or as border heat (two to three rows on the upwind side) with under-vine sprinkler systems.

The use of heaters requires a substantial investment in money and labor. Additional equipment is needed to move the heaters in and out of the vineyards as well as refill the oil "pots." A fairly large labor force is needed to properly light and regulate the heaters in a timely manner. There are usually 80 to 100 heaters per hectare, although propane systems may sometimes have as many as 170. A typical, well-adjusted standalone heating system will produce about 11.3 million KJ/ha per hour.

Based on the fact that "many small fires are more effective than a few big fires" and because propane heaters can usually be regulated much easier than oil heaters, propane systems often have more heaters per acre but operate at lower burning rates (and temperatures) than oil systems. It is sometimes necessary to place extra heaters under the propane gas supply tank to prevent it from "freezing up."

Smoke has never been shown to offer any frost protection advantages, and it is environmentally unacceptable. The most efficient heating conditions occur with heaters that produce few flames above the stack and almost no smoke. A too-high burning rate wastes heat and causes the heaters to age prematurely. The general rule-of-thumb for lighting heaters is to light every other one (or every third one) in every other row and then go back and light the others to avoid puncturing the inversion layer and letting even more heat escape. Individual oil heaters generally burn two to four liters of oil per hour.

Propane systems generally require little cleaning; however, the individual oil heaters should be cleaned after every 20 to 30 hours of operation (certainly at the start of each season). Each heater should be securely closed to exclude rain water, and the oil should be removed at the end of the cold season. Oil floats on water and burning fuel can cause the water to boil and cause safety problems. Escaping steam can extinguish the heater, reduce the burning rate, and occasionally cause the stack to be blown off.

The combination of heaters with wind machines not only produces sizeable savings in heater fuel use (up to 90%), but increases the overall efficiency of both components. The number of heaters is reduced by at least 50% by dispersing them into the peripheral areas of the wind machine's protection area. Heaters should not be doubled up (except on borders) with wind machines and are not usually necessary within a 45- to 60-meter radius from the base of the full-sized machine. Heat which is normally lost by rising above the vine canopy may be mixed back into the vineyard by the wind machines. At the same time heat is also added from the inversion. The wind machines are turned on first and the heaters are used only if the temperature continues to drop.

Wind machines: The first use of wind machines (mixing heat from the inversion) was reported in the 1920s in California; however, they were not generally accepted until the 1940s and 1950s. They have gone through a long evolutionary process with wide ranges in configurations and styles.

Wind machines, or "fans" as they are often called, are used in many orchard and vineyard applications. Some are moved from orchards after the spring frosts to vineyards to protect the grapes against late spring, fall and winter cold temperature events.

Wind machines, large propellers on towers which pull vast amounts of warmer air from the thermal inversion above a vineyard, have greatly increased in popularity because of energy savings compared to some other methods, and they can be used in all seasons. Wind machines provide protection by mixing the air in the lowest parts of the atmosphere to take advantage of the large amount of heat stored in the air. The fans or propellers minimize cold air stratification in the vineyard and bring in warmer air from the thermal inversion. The amount of protection or temperature increases in the vineyard depends on several factors. However, as general rule, the maximum that the air temperature can be increased is about 50% of the temperature difference (thermal inversion strength) between the 2- and 20-meter levels. These machines are not very effective if the inversion strength is small (*e.g.,* 1.3°C).

Wind machines that rotate horizontally (like a helicopter) and pull the air down vertically from the inversion rely on "ground effects" (term commonly used with helicopters, *etc*.) to spread and mix the warmer air in the vineyard. In general, these designs have worked poorly because the mechanical turbulence induced by the trees greatly reduces their effective area. In addition, the high air speeds produced by these systems at the base of the towers are often horticulturally undesirable.

A general rule is that about 12-15 BHP is required for each acre protected. A single, large machine (125-160 BHP) can protect 4 to 4.5 ha or a radial distance of about 120 m under calm conditions. The height of the head is commonly 10 to 11 m in height in orchards and vineyards. Lower blade hub height for shorter crops is generally *not* advantageous since warmer air in the

inversion still needs to be mixed with the cold surface air. Propeller diameters range from 3.6 to 5.8 m, depending on machine age and engine power ratings. The propeller assembly also rotates 360° about its vertical axis every four to five minutes parallel to the ground. The blade assembly is oriented with approximately a 6° downward angle for maximum effectiveness over an area.

The current "standard" is a stationary vertical fan that is usually powered by gasoline or liquid propane engines that produce about 130 to 160 HP. Two 5.8-m blades rotate at about 590 rpm producing 400 to 475 m^3/sec mass air flows. Improved blade design and the use of space age materials in their construction have resulted in major performance improvements in recent years.

Modern machines rely on the principle that a large, slow-moving cone of air to produce the greatest temperature modification is the most effective (propeller speed of about 590 - 600 rpm). A wind machine that does not rotate about its axis has an effective distance of about 180 m under calm conditions. The amount of air temperature increase decreases rapidly (as the inverse of the square of the radius) as the distance from the fan increases. In actuality, the protected area is usually an oval, rather than a circle, due to distortion by wind drift with the upwind protected distance about 90 to 100 m and the downwind distance about 130 to 140 m. Several wind machines are often placed in large orchard or vineyard blocks with synergistic benefits by carefully matching the head assembly rotation direction with spacing.

Many growers turn on wind machines at about 0°C which is appropriate for many radiative frost situations. However, if the forecast is for temperatures to drop well below critical temperatures and/or accompanied by low dew points (*e.g.,* < -7°C), it is advisable to turn on the wind machines at +2°C to +3°C to start moving the warmer air through the vineyard even with weak inversions. This will serve to at least partially replace radiative losses and strip cold air layers away from the buds. Buds and other sensitive tissues will be kept relatively warmer for a longer period of time since they have more heat to dissipate. Hopefully, the cooling process can be delayed under these conditions long enough for the sun to come up and avoid reaching critical temperatures.

In response to the chronic need to increase cold temperature protection capability, several attempts have been made over the past 40 years to design or adapt wind machines so that the wind plume would distribute large quantities of supplemental heat throughout a vineyard. These efforts have been uniformly unsuccessful. The high temperatures (*e.g.,* 750°C) of the added heat caused the buoyant air plume to quickly rise above the tops of the vines and mixing with the colder vineyard air was minimal. These designs have ranged from "ram jets" on the propeller tips to the use of large propane space heaters at the base of the wind machine. The added heat actually causes the jet to quickly rise above the tops of the trees and substantially decreases the radius of the protected area due to the increased buoyancy of the wind plume. These problems could be circumvented if large amounts of heat could be introduced/mixed at low temperatures (*e.g.,* 3°C above ambient temperature) within 30 m of the wind machine.

Wind machines apparently work well when used in conjunction with other methods such as heaters and under-vine sprinkling. They should *never* be used with over-vine sprinkling for frost protection. If they are used by themselves, bare soil may be somewhat beneficial by providing about 0.6°C additional temperature rise.

A grower planning on installing a wind machine will need detailed information on inversions in their locale. They may want to put up a "frost pole" or tower to measure the temperatures with height in the vineyard during springtime inversions. The wind machine should be located only after carefully considering the prevailing drift patterns and topographic surveys. Wind machines may also be located so as to "push" cold air out of particularly cold problem areas.

Helicopters: Helicopters are an expensive (and sometimes dangerous) variation of a wind machine which can also be used under radiation frost conditions. They can be very effective, since they can adjust to the height of an inversion and move to "cold spots" in the vineyard. The amount of area protected depends on the thrust (down draft) generated by the helicopter. Generally, the heavier (and more expensive) the helicopter, the better their protection capability. A single large machine can protect areas greater than 20 hectares in size under the right conditions. However, due to the large standby and operational costs, the use of helicopters for frost protection is limited to special cases or emergencies.

Helicopters should work from the upwind side of the vineyard making slow passes (2 - 5 m/sec). One technique used with helicopters is to have thermostatically controlled lights in problem areas which turn on at a preset cold temperature. The helicopter then flies around the block "putting out the lights." There should also be two-way radio communications between the plane and the ground. A rapid response thermometer in the helicopter helps the pilot adjust the flying height for best heating effect.

Costs of frost protection systems: It is quite difficult to present representative cost figures for frost protection systems since the installations are site-specific. Table 3 presents some "ball park" cost estimates for complete installed systems not including land value. The addition of wells and/or ponds is not included since these costs are extremely variable. The costs are additive if two or more systems are used. Economic comparison of estimated annual operating costs of the various frost protection systems are presented in Table 4 on a cost/hectare/hour basis.

Conclusions

The objective of any crop cold temperature protection program is to keep plant tissues above their critical temperatures. Programs for protection of grape vines from cold temperature injury consist of many *small measures* to achieve relatively *small increases* in ambient and plant tissue temperatures. These will be a mixture of passive and active measures that will cumulatively provide adequate protection levels, however, our ability to economically and practically protect crops during cold temperature events is more an art than a science.

Worldwide, vineyards are often severely affected frost damage to the canes, trunks, buds, shoots, flowers, and leaves. In addition to lost production for that year, cold temperature injuries can also shorten vineyard life through increased incidence of crown gall and other diseases at injury sites on the plant. Frost protection systems are expensive due to purchases of supplemental equipment, labor and operation. Prevention of cold temperature injury is a significant part of annual vineyard production costs in many areas around the world.

There is no perfect method for field protection of crops against cold temperature injury. However, a blend of preplanned passive and active frost protection measures will be the most successful. The most important passive measure is good site selection, but it must be complemented by proper variety selections and cultural practices. Quite often combinations of active methods such as heaters and wind machines are advantageous. However, the capacity of any system or combination of systems will always be exceeded at some point. In addition, a well-maintained and calibrated frost monitoring (thermometers and alarms) network will always be required.

Protection against advective (windy) freezes is much more difficult to achieve than protection against radiative freezes. Consequently, most of the methods/systems are practical and effective only under radiation situations. The formation of inversion layers is a benefit and many methods take advantage of an inversion to furnish, trap and/or recirculate heat.

A high dew point is probably the most powerful and effective mechanism available for reducing freeze damage to plants. This is due to the "heat pump" effect which replaces radiation losses with the latent heat of condensation. Any frost protection method which increases the water vapor content of the air is generally beneficial (but this is very difficult to accomplish!). Heat from water is more efficient than some other sources because it is released at low temperatures, is less buoyant (no "stack" effect), and may selectively warm the coldest plant parts.

In selecting a vineyard heating system to protect vines against cold injury, the manager/owner must consider the prevailing climatic conditions which occur during the cold protection season. Temperatures and expected durations, occurrence and strength of inversions, soil conditions and temperatures, wind (drift) directions and changes, cloud covers, dew point temperatures, critical bud temperatures, vine condition and age, grape variety, land contours, and vineyard cultural practices must all be evaluated. Both passive and active methods to protect against cold injury may be required. The equipment for active measures must be simple, durable, reliable, inexpensive and essentially non polluting. Timing is critical.

There is a general need in agriculture, as in all natural resource industries, to conserve energy and other resources, and frost protection activities must also move in that direction. Current technology for active frost protection is wasteful and inefficient in energy (*i.e.,* heaters) and other resources. Development of new heater technologies (presently underway) that are at least 60% efficient (compared to 15% maximum now) would provide the same amount of heat in the vineyard as current heaters (i.e., return stacks) with one-fourth as much fuel—a substantial savings in energy and expenses. Another example is that sprinkler systems used for frost protection require large amounts of water at times when plant needs are very low causing water logged soils and leaching nutrients and other chemicals out of the root zone.

Conservation efforts will have to be aided by the improved ability to predict the severity and timing of frost events. Automated weather stations and a detailed knowledge of critical temperatures for different varieties in different areas throughout the year will be necessary. Mathematical models that combine accurate prediction of climatic conditions, plant physiology, and resulting critical temperatures at any stage of growth will have to be developed and used to give growers more confidence in developing frost protection strategies and reducing expenses.

Literature Cited

1. Ahmedulla, M., A. Kawakami, *et al.* Effect of paclobutrazol on the vegetative growth, yield, quality, and winter hardiness of buds of *Concord* grape. HortScience 21:273-274 (1986).

2. Anderson, J. A., G. S. Howell, and J. A. Wolpert. Phenological development of different *Vitis* cultivars. Fruit Var. J. 34:5-7 (1980).

3. Blanc, M. L., H. Geslin, *et al.* Protection against frost damage. World Meteorological Org. Technical Note 51 (1963).

4. Choi, C. Y., W. Zimmit, and G. Giacomelli. Freeze and frost protection with aqueous foam development. HortTechnology 9(4):654-661 (1999).

5. de Boer, H. J. Comparison of water vapour, water and water drops of various sizes, as a means of preventing night frost. Agricultural Meteorology. Elsevier 2:247-258 (1964).

6. Dekazos, E. E. Effects of aminoethoxyvinylglycine (AVG) on bloom delay, fruit maturity and quality of 'Tifblue' and 'Woodard' rabbiteye blueberries. Proc. Fla. State Hortic. Soc. 92:248-252 (1979).

7. Dennis, F. G., C. E. Crews, and D. W. Buchanan. Bloom delay in stone fruits and apple with rhizobitoxine analogue. HortScience 12:386 (abstr.) (1977).

8. Donaldson, D. R., R. L. Snyder, *et al.* Weed control influences vineyard minimum temperatures. Am. J. Enol. Vitic. 44:431-434 (1993).

9. Evans, R. G. Frost protection techniques for trees in the Northwest. Proc. Frost Protection Strategies for Trees and Grapevines. Fresno, CA. Calif. Agr. Technol. Inst. Publ. 91 11104:85-103 (1991).

10. Evans, R. G. Irrigation choices for growing *V. vinifera* grapes in central Washington. pp. 57-74. *In:* Proceedings of Growing Grapes in Eastern Washington. J. Watson (Ed.). 5 March 1998, Richland, WA. The Good Fruit Grower, Yakima, WA (1999).

11. Evans, R. G., M. O. Mahan, and M. W. Kroeger. Utilization of Heated Water for Orchard Frost Protection. ASAE Tech. Paper 96-2041, Presented at Annual Meeting of ASAE. Phoenix, AZ. July 14-18. 15 pp. (1996).

12. Howell, G. S. Cultural manipulation of vine cold hardiness. *In:* Proc. 2nd Intl. Cool Climate Vitic. and Enol. Symp. pp 98-102 (1988).

13. Howell, G. S. Approaches to solving the problem of low temperature damage to grapevines. Proc. Frost Protection Strategies for Trees and Grapevines. Califl Agr. Technol. Ins. Publ. 91 11104:115-127 (1991).

14. Howell, G. S., and N. Shaulis. Factors influencing within-vine variation in the cold resistance of cane and primary bud tissues. Am. J. Enol. Vitic. 31(2):158-161 (1980).

15. Howell, G .S., and J. A. Wolpert. Nodes per cane, primary bud phenology, and spring freeze damage to *Concord* grapevines. Am. J. Enol. Vitic. 29:229-232 (1978).

16. John, P. H. Overhead Targeted Frost Protection. New Zealand Agricultural Engineering Institute, Lincoln College, Canterbury, New Zealand, Project Report Number 33 (1985).

17. John, P. H., P. Carran, and I. Woodhead. Targeted Frost Protection-Orchard Trails. New Zealand Agricultural Engineering Institute, Lincoln College, Canterbury, New Zealand, Project Report Number 39 (1986).

18. Johnson, D. E., and G. S. Howell. Factors influencing critical temperatures for spring freeze damage to developing primary shoots on *Concord* grapevines. Am. J. Enol. Vitic. 32:144-149 (1981).

19. Johnson, D. E., and G. S. Howell. The effect of cane morphology and cultivar on the phenological development and critical temperatures of primary buds on grape canes. J. Am. Soc. Hortic. Sci. 106(5):545-549 (1981).

20. Jones, E. H. Irrigation as frost protection in a citrus grove. Calif. Citrogr. 9(7):260 (1924).

21. Jorgensen, G., B. M. Escalera, *et al.* Microsprayer Frost Protection in Vineyards. Ca Agr. Technol. Inst. Publ. No. 960803. 12 pp. Fresno, CA (1996).

22. Kasimatis, A. N., and J. J. Kissler. Responses of grapevines to shoot break-out following injury by spring frost. Amer. J. Enol. Vitic. 25:17-20 (1974).

23. Martsolf, J. D. Heated Irrigation Cold Protection. Proc. Fla. State Hortic. Soc. 102:64-69 (1989).

24. Proebsting, E. L., Jr., and V. P. Brummund. 1978. Yield and maturity of *Concord* grapes following spring frost. HortScience. 13(5):541-543 (1978).

25. Proebsting, E. L., and H. H. Mills. Effect of growth regulators on fruit bud hardiness in *Prunus.* HortScience 4:254-255 (1969).

26. Proebsting, E. L., and H. H. Mills. Bloom delay and frost survival in ethephon-treated sweet cherry. HortScience 8:46-47 (1973).

27. Proebsting, E. L., and H. H. Mills. Time of giberellin applications determines hardiness of response of 'Bing' cherry buds and wood. J. Am. Soc. Hortic. Sci. 99:464-466 (1974).

28. Proebsting, E. L., and H. H. Mills. Ethephon increases cold hardiness in sweet cherry. J Am. Soc. Hortic. Sci. 101:31-33 (1976).

29. Rieger, M. Freeze protection for horticultural crops. Hort. Rev. 11:45-109 (1989).

30. Schultz, H. B., and R. J. Weaver. Preventing frost damage in vineyards. Ca. Agr. Expt. Sta. Ext. Serv. Leaflet 2139 (1977).

31. Snyder, R. L., and J. H. Connell. Ground cover height affects predawn orchard floor temperatures. California Agriculture 47(1):9-12 (Jan-Feb 1993).

32. Stergios, B. G., and G. S. Howell. Effects of defoliation, trellis height, and cropping stress on cold hardiness of *Concord* grapevines. Am. J. Enol. Vitic. 28:34-42 (1977).

33. Stergios, B. G., and G. S. Howell. Effect of site on cold acclimation and deacclimation of *Concord* grapevines. Am. J. Enol. Vitic. 28:43-48 (1977).

34. Swanson, F., P. Christensen, P., and F. Jensen. Preventing vineyard frost damage. Coop. Ext. Univ. California (1973).

35. Weaver, R. J. Prolonging dormancy in *Vitus vinifera* with gibberellin. Nature. 183:1198-1199 (1959).

36. Wilson, E. B., and A. L. Jones. Orchard Heater Measurements. Circular 511. Washington State University, Washington Agricultural Experiment Station. 18 pp. (1969).

37. Winkler, A. J., J. A. Cook, *et al.* General Viticulture (2nd ed.). University of California Press, Berkeley, CA (1975).

RURAL PLANNING SERVICES
AGRICULTURAL LAND USE CONSULTANTS

January 28, 2022

Ms. Kathryn Lehr, Supervising Planner
Planning & Development Department
County of Santa Barbara
123 East Anapamu Street
Santa Barbara, CA 93101

RE: Comment Letter
North Fork Frost Ponds Draft Focused Environmental Impact Report
SCH No. 2017061009, 21EIR-00000-00002, 16CUP-00000-00005

Dear Ms. Lehr:

Thank you for the opportunity to comment on the Draft Environmental Impact Report for the North Fork Frost Ponds Project. We commend the County on the thorough analysis for the project which effectively analyzed the potential environmental impacts. We have reviewed the document and are pleased to provide the following comments.

Section 1 - Executive Summary

1. Section 1.3 - Project Background, first sentence, Brain Tetley should be corrected to Brian Tetley

2. Section 1.4 - Project Objectives, Bullet Item Number 2, should reflect water stored to protect vineyard also be used for irrigation of vineyards once frost protection function is complete.

Section 2 - Project Description

1. Section 2.2 - Proposed Reservoir and Frost Protection System Details, third through fifth sentences. The referenced sentences should be stricken. Assuming the applicant chooses to implement mitigation measure WAT-01, which includes installing covers on the frost ponds, language referencing minimizing water levels within the frost ponds during non-frost time periods would be rendered moot.

Section 3.7 - Biological Resources

1. Section 3.7.1 - California glossy snake section, discussion conflicts with its description as the species tends to be in areas that are undisturbed where burrowing rodents are present. Vineyard as in other row crop agricultural development, proactively control rodent population so the site would not be proficient in the species' food source. The DEIR states the use would not alter small prey habitat which is incorrect.

2. Impact Bio-3 Grassland and Native Grassland Buffer indicates the permanent removal of 0.01 acres (430 sf) of native curly bluegrass grassland and proposes as mitigation in MM BIO-2. The amount is *de minimus* and constitutes significantly less than a quarter acre in size stipulated in the Thresholds. The DEIR does not quantify the size and character of any native grassland in proximity, so no nexus is provided in relation to the qualifiers provided in the Thresholds. The DEIR's description of a potential 0.42 acre of additional impact is conjecture and not based on engineering design. Any such additional disturbance, if it actually occurs, would be temporary in nature and restored to original condition.

Due to the large acreage of the property, there are large areas of grassland area. A suitable mitigation could also be the protection of an existing grassland area, a biological benefit in lieu of a small patch of fragmented grassland planted on site.

3. MM BIO-1 - There is concern as to the language of the mitigation based on conversations with the USFWS. The species in question is a federally listed species of which the USFWS is the jurisdictional authority, not the County. The USFWS has maintained it is not in support of the County requiring studies and actions subject to local approval as it can create a potential scenario in conflict with their actions or direction. Requiring preconstruction surveys is expected. However, for any federal or state listed species, the county needs to develop mitigation that requires the applicant provide proof of consultation and concurrence from the federal or state agency the project is in conformance with the applicable Endangered Species Act. The applicant agrees a Protection Plan be developed for the species which would then be submitted to the USFWS for approval, if requested.

Section 3.8 – Frost Pond Reservoir Flooding

1. No comments

Section 3.9 – Frost Protection System Groundwater Use

1. The DEIR should recognize that the reservoir capacity management described in Section 2.2 would be unnecessary in the event that the applicant chose to cover the reservoirs, as the capacity management seeks to mitigate evaporative surface loss, which is eliminated through the use of covers.

2. Section 3.9.2.3 references Land Use and Development Code (LUDC) Section 35.21.030, Table 2-1, to show that "Cultivated Agriculture, Orchard, Vineyard" in land zoned AG-II-100 is exempt from permit requirements and water thresholds of significance, before concluding that "*any groundwater losses from the frost protection system that does* [sic] *not irrigate the vineyards or recharge the aquifer would require compliance with the County threshold of significance for groundwater use of 31 acre feet per year (AFY) adopted for the Cuyama Valley Groundwater Basin.*" There is no basis in the LUDC for limiting protected water use to that which "irrigate[s] the vineyards". On the contrary, the Definitions Section of the LUDC, beginning on page 11-15, defines "Cultivated Agriculture, Orchard, Vineyard" as:

> Commercial agricultural production field and orchard uses, including the production of the following, primarily in the soil on the site and not in containers, other than for initial propagation prior to planting in the soil on the site. Examples of this land use include the following: field crops, ornamental crops, flowers and seeds, tree nuts, fruits, trees and sod, grains, vegetables, melons, wine and table

> grapes. Also includes associated crop preparation services and harvesting activities, such as mechanical soil preparation, irrigation system construction, spraying, and crop processing. Does not include agricultural processing or greenhouses which are separately defined. Does not include non-commercial home gardening, which is allowed as an accessory use without County approval in all zones that otherwise allow residential uses. Activities that constitute grading are separately regulated under Chapter 14 of the County Code.

If the LUDC had intended to exclude frost water protection from the definition of "Cultivated Agriculture, Orchard, Vineyard Land Use", it would have positively done so, in the same way it excluded containerized production, home gardening, and grading activities. Frost protection, as a critical element of "commercial agricultural production", is exempt from permit requirements and the water use threshold of significance established for the Cuyama Valley Groundwater Basin.

3. Section 3.9.2.3 applies contradictory definitions of agriculturally exempt activities (emphasis added below):

- "[W]ater impounded in the reservoirs not directly or indirectly used to **irrigate the existing vineyards** is subject to groundwater use thresholds."
- "Groundwater impounded in the reservoirs that would not be directly or indirectly used **in support of the vineyards** would be groundwater lost to evaporation…"

These cannot both be true at the same time and highlight the fluid and speculative nature of the DEIR's reasoning. Frost water, while arguably not "irrigation" (although we would contend otherwise), is undeniably "support", and if the DEIR defines away that portion of "support" water that evaporates, there is no stopping the same argument being levied against evaporated irrigation water. Fortunately, this is a moot point, as neither of these definitions appear in the County LUDC. As noted in Comment 1, the LUDC, in its unwillingness to limit "commercial agricultural production" to specific activities, left it open to all commercial agricultural production activities other than those it expressly excluded. The DEIR has no basis in law for excluding frost water support from the LUDC exemptions.

4. Mitigation Measure Reference Correction - Page 3-38, fourth paragraph, second sentence, bolded 'Mitigation Measure WAT 02' should be corrected to 'Mitigation Measure WAT 01', as there is no mitigation measure WAT 02.

5. Impact WAT-02 Evaporative Water Loss - The DEIR points out on several occasions water used by plant uptake is not included in the analysis. On Page 3-40 it states "*The frost protection system groundwater used to satisfy crop requirements does not count toward the water use threshold*". The study, however, later indicates evaporation from water on the soil surface is in fact included in the calculations. This is a contradictory statement for two reasons.

First, any water applied as frost protection is used as such to preserve and protect the crop from catastrophic loss. Any water present on the ground surface after the vineyard thaws is there because it was used to support and, in this case, protect the crop and the vines.

Second, once frost protection water drips onto the ground, its utility to the vineyard is as pre-season irrigation, replenishing soil moisture profile in preparation for when the vines emerge from dormancy. The DEIR does not differentiate this nuance in water utility to the vineyard operations.

Water deposited on the ground should not be included in the DEIR's evaporative loss analysis.

6. Mitigation Measure Reference Correction - Page 3-41, next to last paragraph, second sentence, bolded 'Mitigation Measure WAT 02' should be corrected to 'Mitigation Measure WAT 01', as there is no mitigation measure WAT 02.

7. The applicability of Mitigation Measure WAT-01 is dependent on the full buildout of the project with the three reservoirs as designed. In the event the project moves forward with the environmentally superior alternative (two reservoirs) or the applicant decides to value engineer the project at a lesser scale, the 31 AFY threshold would be met by default due to lesser evaporative loss. In these two cases, the nexus for WAT-01 would be eliminated. The mitigation, if approved, should be revised to state it would be no longer required if the project is downscaled.

8. Mitigation Measure WAT-01.2 establishes a water budget for the project inconsistent with County Thresholds and Policies for agricultural uses. The DEIR states evaporative loss at time of frost events is minimal but relies on an assumption there will be pooled water not permeating into the ground over a 48 hour period that will evaporate. The inclusion of potential evaporative loss of frost protection water which, after striking the ground is permeating like regular irrigation water is erroneous. Once water meets the ground it is considered irrigation water and thus should not be evaluated in the analysis.

9. Policy Analysis – The DEIR should include more reference to the guidance of the Santa Barbara County Comprehensive Plan Agricultural Element in addition to the cursory policy consistency review within the table on Page 5-6. Since the mitigations and limitations being placed on the project could be deemed as precedent setting, the Agricultural Element Policies section is inadequate. A more detailed discussion on the mitigation impacts to the project need to reflect its consistency with Policies I.B and I.G. The mitigation in essence, requires a water budget for a use never regulated before by the County. This reference should include a citation of Agricultural Element Policy I.B as the critical, relevant policy describing the deference afforded agricultural operations as to the methods employed for agricultural cultivation.

10. The DEIR should reference the Santa Barbara County Right to Farm Ordinance as part of the local policy setting. This ordinance was promulgated by the Board of Supervisors to clarify that: *'…it is in the public's interest to preserve and protect agricultural land and operations within the County of Santa Barbara and to specifically protect these lands for exclusive agricultural use.' The ordinance goes on to state that: '…residential development adjacent to agricultural land and operations often leads to restrictions on farm operations to the detriment of the adjacent agricultural uses and economic viability of the county's agricultural industry as a whole…' The key purpose of the ordinance is to: '…to preserve and protect for exclusive agricultural use those lands zoned for agricultural use, to support and encourage continued agricultural operations in the county, and to forewarn prospective purchasers or residents of property adjacent to or near agricultural operations of the inherent potential problems associated with such purchase or residence.'*

11. Separate from all preceding points about agricultural water needing to remain exempt from the County's threshold calculation, the Technical Memorandum referenced by the DEIR as Appendix D.3 (North Fork Ranch Frost Pond Project – Water Budget Technical Memorandum) is flawed in its assumptions.

Key assumptions, to which the FAO calculations are highly sensitive, include the local ET values, soil mechanics on the subject property, including capillary forces at multiple depths, and cropping methods such as cultivation, berm work and cover cropping.

In Appendix D.3, these key data are all extractions or derivations of information not relevant to the subject property. Therefore, any calculations or efforts to derive “an answer” do not result in a representation of what occurs on the North Fork Vineyard.

The calculations do not use ETo values from the property nor ETc values from the vineyards growing conditions. ETo could have been estimated at the property at some point over the two years that the DEIR was conducted. The CIMIS station in New Cuyama, used in the memo, is simply not representative of local conditions at the vineyard.

Likewise, the daily crop ET in the memo is misguided. The DEIR acknowledges that the growing region is region 10 but chooses Region 6 and with 40% canopy and without cover crop. The vineyard uses cover crop, achieves greater than 40% canopy and the growing conditions are substantially different from Region 6. Using the same approach as the memo but with growing Region 15 (Kern) variables, sourced from the same ITRC data set, would produce a materially different frost water threshold. This rational shift in growing region and conditions would change the results significantly, which undermines its utility for management. The model is too sensitive to its underlying assumptions, which do not have a rational basis in the reality of conditions on North Fork Vineyard, and we request that the model be revised to apply assumptions derived either from on-site observations or, if this is not practical, from more appropriate publicly available data.

Soil assumptions, which are key to calculating readily evaporable water and total evaporable water after rainfall or frost water application, cannot rely on USGS estimates from previous years. During development, the vineyard ground was deep ripped, amended and disced prior to planting. The soil composition is simply different. Additionally, the mechanical work done to the soil, whether prior to planting or cultivation since then, causes larger diameter gravels and sediments to migrate closer to the surface, facilitating drainage and decreasing water holding time in the upper layers. The appropriate approach would have been for the consultant to visit the property and test soil mechanics in the different blocks, and we request that the DEIR be revised to include this on-site testing.

Separate from active soil preparation and amendment, active and ongoing cultivation between the vine rows changes the exposed soil surface area and drainage potential, negating any assumptions of unaltered soil mechanics. We request that the DEIR provide alternate water thresholds for different soil management scenarios, rather than attempting a one-size-fits-all analysis.

In conclusion, we politely request that if the County is going to take the unprecedented step of managing evaporative losses from frost water usage, it not attempt to do this with a single calculation based on flawed assumptions. Rather, the County should consider the array of conditions and farming practices that are or could be implemented and include the real and measurable conditions that are present at the subject property. Such a method would provide invaluable guidance for future projects. Unfortunately, in its current state, this one-off approach will fail as a rigid management framework in a subject matter that is highly variable, site-specific, and subject to tailored operational practices.

12. Finally, Appendix D.3 and its use in the DEIR are written in such a way as to presume authority and usefulness to the County in managing agricultural water practices. However, active management of agricultural water practices by the County will have the undesirable result of incentivizing non-beneficial farming practices.

First, the North Fork Vineyard uses cover crop in between vine rows to maintain soil health and avoid erosion. Because the DEIR's calculations ignore this fact, they both utilize flawed ETc values and incentivize the vineyard management to reduce or eliminate this environmentally beneficial practice in order to align vineyard practices with the narrow environmental documents that control them.

Second, attempting to apply the County's 31 AFY threshold of significance to frost protection water also has the potential to incentivize far less environmentally friendly practices. Frost damage is a real threat to most farms in California, and the preferred mitigation technique in this region is through overhead sprinkling, which employs water and electricity. The alternatives to this method (specifically wind machines, helicopters, and smudge pots), all employ combustion engines, generating harmful emissions and greenhouse gasses. If growers are penalized for using water to frost protect, regardless of actual groundwater resources and SGMA management, they will be forced to employ far less desirable methods.

Therefore, we respectfully request that the DEIR remove all sections analyzing and referring to management of the operational use of water after it has left the reservoirs contemplated in the original permit application.

We appreciate the opportunity to comment on this document and look forward to the final approval of the project.

Sincerely,

David Swenk, Principal Planner

Kathryn Lehr, Supervising Planner
Santa Barbara County Planning & Development
123 E. Anapamu St.
Santa Barbara, California 93101

By email to klehr@countyofsb.org

RE: North Fork Ranch Vineyards Frost Protection System Focused Draft Environmental Impact Report

Dear Ms. Lehr:

I am a farmer and resident in the Cuyama Valley where our family has dry farmed winegrapes and olives since 1995. I am also a retired ecologist with degrees in Botany and Ecology from UC Santa Barbara where I received a PhD in California Plant Ecology. I taught California Natural History for 32 years at UC Santa Cruz, and have extensive experience with native plants and vegetation studies. I have reviewed the Draft EIR for the North Fork frost pond project, and list my various questions and concerns below.

1. Critical issue: Presence of sensitive plant species.

On page 41 of the DEIR, there is the statement: *A search of the CNDDB in 2019 identified 14 recorded special status plant species within a five-mile radius of the proposed reservoir sites. KMA 2020, Appendix G, Table 1 (included in EIR Appendix A.3) lists the special status plants identified by the CNDDB. Based on the habitat requirements of the identified plants, existing conditions at the Project site, and the results of seasonally timed surveys in 2019, it was determined that none of the identified sensitive plants are likely to be located on or near the proposed reservoir sites.*

Importantly, the lists referred to are practically impossible to find in the DEIR or in the multiple sets of appendices attached to the report. The referenced Appendix A.3 is confidential and locked from view, and refers to cultural resources, not plants). The DEIR's vague index and incorrect references makes the review process difficult.

The KMA 2020 BRA (actually listed in Appendix A.8) shows that the special status plant species were not adequately identified. Such lists should be based on broad surveys of the region, not just the specific area of the reservoir project. Not all of the species they mention have habitat requirements that would exclude them from the undisturbed habitats that occurred before discing started in 2016, such as Blakely's spineflower (*Chorizanthe blakelyi*), the round leaved filaree (*California macrophylla*), the jewel flower (*Caulanthus lemmonii*), the pale-yellow layia (*Layia heterotricha*), and the showy golden madia (*Madia radiata*).

The discing has created conditions that, in the near term, result in very few native species of concern being observed at the reservoir sites. Such disturbance, especially when a cover crop is planted as well, promotes the invasion of the non-natives listed in the observations – plants like red-stemmed filaree (*Erodium circutarium*) and various invasive non-native grasses (red brome-*Bromus rubens*, soft chess-*Bromus hordeaceus*, and hare barley-*Hordeum murinum* ssp. *Leporinum*).

The statement that none of the CNDDB species were "likely" to appear in the sites, is not because they don't or couldn't grow there, but because of the discing that began in 2016 has destroyed their habitat. Research has shown that grazing can actually enhance the presence of native annual wildflowers, increasing the likelihood that such species should have been able to occupy the sites of the reservoirs (for example see Robertson 2004, Barry et al. 2015).

It is known that it would take many years after discing disturbance were stopped for the recovery of the native species that might have originally occurred in the sites. The only useful way to determine if the sites had sensitive species is really a post-humous analysis of areas surrounding the reservoir sites that are fenced and left undisturbed for many years, with annual documentation of species recovery. But this could take many years, and the damage has been done. More extensive studies of areas nearby that were not disturbed should have been done in order to determine what the presence of important native species might have been before disturbance. It might even have been possible to do studies of the seed bank in the soil to determine the presence of species that had been present before discing disturbance, and that they might be able to recolonize if the reservoirs were not constructed.

Claiming that the discing was part of the vineyard planting, hence an agricultural activity that did not require any biological surveys, seems disingenuous since frost sprinklers were installed throughout the vineyard before the reservoir permits were filed with the County, and the reservoir areas were obviously part of an intentional long-term plan of the vineyard managers, so it should have been possible (if not required) to do pre-disturbance surveys.

The observational methodology used to document the presence of sensitive species is questionable. Normally annual grasses and wildflowers are surveyed with a line and quadrat methodology. Multiple transects are placed across an area at frequent distances apart. Multiple small squares are chosen at distances along each transect crossing the area of concern, and all individuals and species are counted within those small quadrats. The quadrats for this type of ecosystem are normally 50x50 cm up to 100x100 cm. Taking multiple small quadrats allows for the calculation of a species/area curve, ensuring that the sample size was adequate. Just walking through identifying species in flower that could be seen while walking, is not adequate. Many species of concern are diminutive and have indistinct or hard to see flowers, such as the spineflower mentioned above, and the round leaved filaree (*California macrophylla*). They are easy to miss without using the methodology above. Ideally, these lines and quadrats would have been measured and staked in the surveys of 2015 so they could be repeated in the surveys of 2019.

As an additional note, during the springs of 2020 and 2021, the listed sensitive species of spineflower (Blakely's spineflower (*Chorizanthe blakelyi*) was observed in several locations in Cottonwood Canyon, within a mile or so from Reservoir #3. This shows the potential for this sensitive species to appear in the reservoir area if left undisturbed.

2. The discussion in the DEIR of the perennial grass (curly bluegrass, *Poa secunda*) is insufficient. Native perennial grasslands are considered sensitive ecosystems in California due to disturbance, over grazing, introduction of invasive non-native annual grasses, lack of fire, and

agriculture (Barry et al. 2020). A very small percentage of the original perennial grasslands that were dominant in California before the arrival of Europeans exist today. Once land is cultivated, the perennials usually disappear and rarely return on their own. Restoration or mitigation of perennial grasses is very difficult, and rarely successful. Finding quality seed of native grasses and planting by seed is very difficult and unpredictable (Stromberg and Kephart 1996). Reservoir #3 should not be allowed to move forward due to the presence of this important native grassland species, since research has shown how difficult it is to mitigate by moving or planting the species. Just the disturbance caused during any replanting is enough to open this sensitive ecosystem to invasion by aggressive non-native plant species (Brown and Rice 2000). Irrigation is a challenge, and weeding of the invasive non-native species that would become even more dominant can be very costly and difficult, and both are rarely successful in such an extreme desert climate as the Cuyama Valley. Native perennial grasses have very specific habitat requirements, hence transplanting individuals to an inappropriate habitat (especially disturbed by cultivation or grazing) is most likely destined to failure.

3. Section 2.5 Flora/Fauna.

This section examines plant and animal biological resources, and refers to a threshold for assessing impacts on plants It is not explained what this threshold is, especially in terms of number of plants, area covered, and habitat in which they occur. I struggled to find the actual list of species of concern, which apparently was based on the CNPDB data base. The establishment of the baseline conditions for the DEIR described in 3.3 were set for Jan 10, 2020. What does this mean? It should be an earlier date in order to capture pre-disturbance conditions.

Kit fox- the DEIR states that the last records of a sighting of the endangered kit fox is from 1975. I saw one on the evening of September 1, 2021, along upper Cottonwood Canyon Road. Several other residents in Cottonwood Canyon reportedly saw the same one around this same time. I used the Guide to the Mammals of California (UC Natural History Series) to verify its identity. Tall rather large upright pointed ears, long skinny legs, grey-brown color, and a thin body. During the late summer and into early winter of 2021 we have also seen tracks and/or scat of black bear, mountain lion, bobcat, gray fox, spotted skunk, kangaroo rat, and other small rodents in Cottonwood Canyon. No mention of tracks was made in the DEIR.

It should be noted that the biologists themselves admitted that their observation times from 10:00 to 16:00 were not ideal times for wildlife sightings, since most of these animals are nocturnal or crepuscular, and birds are primarily active in the early morning hours. This calls into question the validity of the comments regarding wildlife sightings. Any observation while driving is of minimal use since a vehicle would most likely frighten wildlife. A more widely accepted methodology for evaluating the presence of wildlife in a similar habitat nearby in western San Joaquin Valley is described in Germano et al. 2012. Staked transects 20 meters apart and 300 meters long, with specific focal points every 20 meters, were used to document the presence of very much the same list of vertebrates (amphibians, reptiles, birds, and mammals) as listed for the reservoir sites. This methodology was able to observe changes over a 10-year period due to variation in rainfall, grazing intensity, and fire. Each year was very different from one to the next, with some years showing very low presence, some showing high presence, and others showing variation in the diversity and activity of animals.

4. Impacts of reservoir filling and frost protection applications on Groundwater Dependent Ecosystems (GDE).

Although this was not called out specifically in the DEIR, GDEs in the Cuyama River section of the Vineyard property, especially those just downstream of the vineyard's agricultural pumping wells as shown in the attached Figure 1, stand to be severely negatively impacted if the additional water used for frost protection is allowed to happen. The GSP of the GSA, as well as the consultation letter from DWR on the draft GSP that was submitted to DWR, call attention to this problem, especially in the northwest region of the Cuyama Basin where the vineyard is located. Increased pumping in this region will only increase the formation of a cone of depression associated with the declining groundwater levels already occurring in this subbasin. GDEs, shown in the figure as the orange areas in the upper left, and the wetland areas marked in blue close to well #845, are ecosystems whose roots need to be in moist soil, from a few feet down for boggy wetlands, and no more than about 40 feet down for riparian shrub and tree species. The DWR GSP consultation letter called attention to the potential negative impact of drawing down groundwater levels in the Northwest region below those needed to maintain GDE species (cottonwoods, willows, and other wetland plant species). Although none of these species were encountered on the sites of the three reservoirs, the excessive use of groundwater for frost protection, especially in heavy frost years, would further endanger these groundwater dependent ecosystems.

5. Possible alternatives to sprinkler applied water for frost protection.

To avoid significant impacts to biological resources, and allow the recovery of native plant species, especially those considered to be sensitive, threatened, or endangered, the DeiR should have more thoroughly describe other frost protection measures other than those dependent on the critically over drafted ground water of the Cuyama Basin so that the reservoirs would not have to be constructed. Sprinkler applied water works well for frost protection, but only if there is an unlimited supply of water. This is not the case in the Cuyama Valley. Based on the hydrographs of the wells being used for the North Fork Vineyards, this is also not the case in the vineyard sub-region. Groundwater levels are falling even before the frost protection reservoirs are constructed and put into operation. The applicant claims that no other frost protection works adequately, and that they have tested several alternatives. There is a new system that is now available where a resistance wire is stretched the length of the vine rows just above the cordons, and an electric current sent through them (www,Danfoss.com, www.hemstedt.de/en/products/agriculture-and-gardening/frostprotection-wire-frost-control//, Lamb 2008). The heat that is generated offsets frost damage. In the limited groundwater basin of the Cuyama Valley, such a system should be considered.

From the beginning, our family vineyard chose varieties that leaf out as late in the season as possible. We also prune as late in the spring as possible to delay budbreak. Unfortunately, it appears that Northfork Vineyard planted a large percentage of its vineyard to early varieties, probably before they realized their location can have late frosts. We have one variety (a Shiraz clone) that tends to break bud earlier than the rest, so we use a well-known practice in frost prone areas called long-pruning. This practice has protected our Shiraz in almost all years. Such practices can offset the need to install water-demanding sprinkler systems.

I look forward to your responses regarding my concerns and questions.

Sincerely

Steve Gliessman
Condor's Hope Ranch, Cottonwood Canyon, Cuyama Valley
Professor Emeritus of Agroecology and Natural History, UCSC

References

Barry, S., S. Larson, and M. George. 2020. California Native Grasslands: A Historical Perspective. A Guide for Developing Realistic Restoration Objectives. Grasslands 30:5-10.

Barry, S., L. Bush, S. Larson, and L. Ford. 2015. Understanding working rangelands: The benefits of grazing. Livestock grazing: a conservation tool on California annual grasslands. ANR Publication 8517, Agriculture and Natural Resources (ANR), University of California.

Brown, C.S., and K.J. Rice. 2000. The mark of Zorro. Effects of the exotic annual grass *Vulpia myuros* on California native perennial grasses. Restoration Ecology 8:10-17.

Germano, D.J., G.B. Rathbun, and L.R. Saslaw. 2012. The effects of grazing and invasive grasses on desert vertebrates in California. *The Journal of Wildlife Management* 76:670-682.

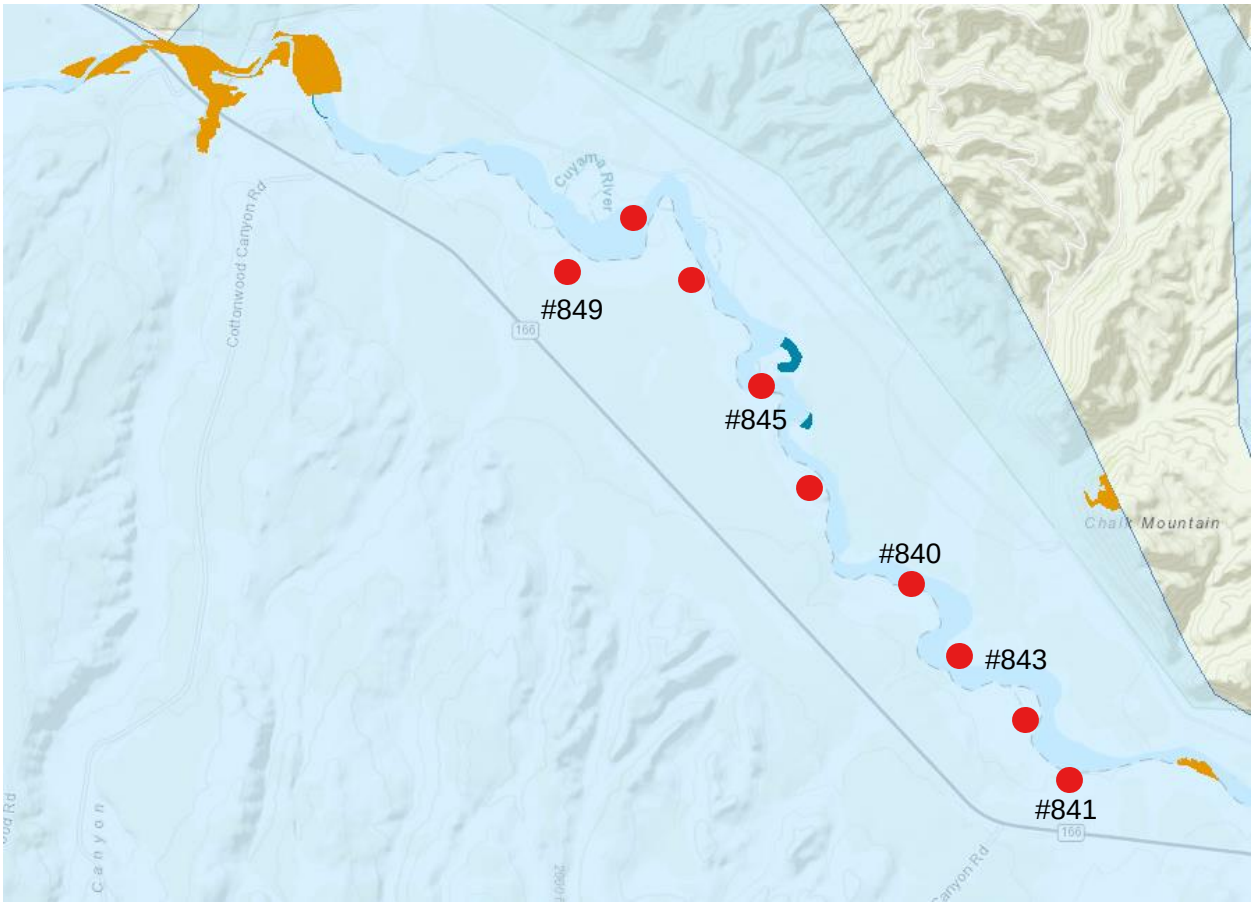
Lamb, D.W. 2008. Electrically. Heated cables protect vines from frost damage at early flowering. *Australian Journal of Grape and Wine Research* 15(1):79-84.

Robertson, J.M. 2004. Relationships Between Historic Land Use, Plant Species Composition and Environmental Factors in the Foothills South of Mount Diablo, California. Masters of Science Thesis, Department of Range Management, UC Berkeley, CA.

Stromberg, M.R., and P. Kephart. 1996. Restoring native grasses in California old fields. *Restoration Management Notes* 14:102-111.

Figure 1, Caption: Location of Northfork Vineyard's primary production wells along the Cuyama River, as well as the downstream location of riparian Groundwater Dependent Ecosystems (GDEs) of trees and shrubs (in orange) and herbaceous wetlands (in blue). Source: Cuyama Basin Groundwater Sustainability Plan (GSP).

Vegetation, GDEs, Surface Water, and Optiwell monitoring wells
North Fork Vineyard



Subject: **Fwd: Kathryn Lehr of county of Santa Barbara, from Walking U Ranch LLC, by Ranch's managing member, Kathleen P. March, Esq: Walking U Ranch LLC makes Ranch's public comment, OPPOSING North Fork Vineyards being allow to build 3 large "frost ponds", wh...**

Date: 1/18/2022 5:55:47 PM Pacific Standard Time

From: klehr@countyofsb.org

To: rodriguezaicp@aol.com

FYI..

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From: K. P. March <kmarch@bkylawfirm.com>
Sent: Tuesday, January 18, 2022 5:54 PM
To: Lehr, Kathryn
Subject: Kathryn Lehr of county of Santa Barbara, from Walking U Ranch LLC, by Ranch's managing member, Kathleen P. March, Esq: Walking U Ranch LLC makes Ranch's public comment, OPPOSING North Fork Vineyards being allow to build 3 large "frost ponds", which will

011822

To Kathryn Lehr of County of Santa Barbara
From Walking U Ranch LLC, by Ranch's managing member, Kathleen P. March, Esq:

Re: Walking U Ranch LLC makes Ranch's **public comment, OPPOSING** North Fork Vineyards being allow to build 3 large "frost ponds", which will need to be constantly refilled, as the water evaporates.

Ms. Lehr:

I am the sole managing member of Walking U Ranch LLC. Ranch is a 1000 acre cattle ranch **located approximately 5 miles west** of the 840 acres (estimated to be 500,000 grape vines) which Harvard University has planted, in the past 3-4 years. I don't know what legal name of the 840 acres of grape vines, maybe "North Fork Vineyards", but it's the vineyard the EIR is on. I'll refer to the 840 acres of vineyards as "North Fork Vineyards" or "Harvard's Vineyards" in this email.

This is the public comment of Walking U Ranch LLC **OPPOSING North Fork Vineyards being allowed to build the 3 LARGE "frost ponds" (each holding 44 to 49 square acre feet of water), because of the damage those 3 ponds would cause to the water table, which will damage Ranches downstream (ie WEST) of the Vineyards, including damaging Walking U Ranch LLC.**

It was ecologically unsound, from the start, for Harvard to plant 840 acres of grape vines on what, up to that point, had only been cattle grazing land, not agricultural use land. Harvard knew, when it planted the 849 acres of grape vines, that the 840 acres of grape vines would have to be irrigated, vastly increasing the water use, from cattle grazing, which used very little water.

Cattle ranching was and is ecologically sustainable in the Cuyama Valley, where Vineyard, and Walking U Ranch LLC are both located, because cattle ranching uses very little water, and does NOT cause the water table to

drop. Harvard's huge, 840 acre vineyard is NOT ecologically sustainable, because irrigating the 840 acres of grape vines is causing the water table to drop unsafely, and filling and refilling the 3 proposed "frost ponds" **would make the water depletion much much worse**.

North Fork Vineyards, aka Harvard Vineyards, should NOT be allowed to build the 3 giant "frost ponds" that Vineyards propose to build, to keep the 840 acres of grapes from freezing. The whole 840 acre Vineyard project was ecologically unsound, from the start, because the 840 acres of grape vines require irrigation, which has already caused the water table level to drop, where the Vineyard is located, and will continue to cause the water table to drop. The water level has been falling dangerously, where the 840 acres of grape vines have been planted, since Harvard planted, and started irrigating its grape vines, starting approximately 3 years ago. **That irrigation is worsening the water depletion problem in the Cuyama Valley (where Vineyard, and Walking U Ranch LLC are located)**.

The water in the Cuyama Valley is already seriously overdrafted. The Cuyama Valley Groundwater Sustainability Agency ("GSA") has proposed a Groundwater Sustainability Plan ("GSP") which has been submitted to the California Department of Water Resources for approval, as required by SGMA . The GSP seeks to REDUCE pumping. Instead of REDUCING pumping, these 3 additional "frost ponds" would seriously INCREASE pumping, contrary to GSP. Moreover, North Fork Vineyards, and additional big agricultural water users, in the Cuyama Valley, have filed a lawsuit in Superior Court, seeking to PREVENT (enjoin) the GSA/GSP from implementing pumping reductions. They should not be rewarded for trying to end run GSA/GSP.

At 49 acre feet each, the 3 proposed "frost ponds" are each only 1 acre foot less than what would require state approval. Putting 3 of these frost ponds in close proximity to each other is 147 acre feet of water, which should be deemed to require state approval, because 147 acre feet of water is 3 times the 50 acre feet of water that requires state approval. I have heard now Vineyards is suggesting it will only build three "frost ponds" of 44 acre feet each. That is still 132 acre feet of water, which should be deemed to require state approval, which Vineyards has neither sought nor approved, so far as Walking U Ranch LLC is aware.

Worse yet, 147 acre feet, or 132 acre feet of water, to fill the 3 "frost ponds" when they are built, is just the start of how much water will have to be pumped out of the water table for those 3 "frost ponds". This is because water in the "frost ponds" will evaporate, **and will have to be refilled, constantly**. Refilling the "frost ponds" as water evaporates, will take many times more than 132 to 147 acre feet of water per year. That will make the water overdrafting situation in the Cuyama Valley much worse.

Walking U Ranch LLC , and other ranches immediately west of the Vineyard, will be adversely affected by the large drop in the water table these 3 frost ponds would cause. Our wells, and the wells of other Ranches west of Vineyards, **may run dry**, from the depletion in the water table that filling, and constantly refilling, these 3 proposed "frost ponds" will cause.

Moreover, the water it would take to build, and constantly refill ,the 3 proposed "frost ponds" will NOT ONLY drain the water table of water that is needed for nearby Ranches, such as Spanish Ranch, Russell Ranch, and Walking U Ranch LLC. It would drain the water table of water that would otherwise flow west, all the way to the Twitchell reservoir, which is located just east of the city of Santa Maria. **Everyone downstream (ie WEST) of the Vineyards will be adversely affected**. I don't know if there are any salmon left in the Cuyama River (there used to be), and I thought that one goal of "water sustainability" pursuant to SGMA—i.e, ending water overdrafting--was to try to restore salmon, and other species, to the Cuyama River. But the vastly increased pumping that Vineyards would do, to fill and continually refill, their 3 proposed "frost ponds" would indisputably be detrimental to all forms of wildlife that depend on water from the Cuyama River to survive.

Harvard, aka North Fork Vineyards, can keep its vines and grapes from freezing by other means, instead of building, and then constantly pumping additional water to refill, the 3 proposed, ecologically damaging, "frost

ponds". **Harvard can use wind turbines, or smudge pots, or other means, to keep the grapes from freezing, instead of using "frost ponds". I believe t Vineyard has some wind turbines now. They can install more wind turbines.**

I don't know if smudge pots are allowed, as they cause some air pollution, but maybe Harvard can get an exemption to use smudge pots. Ranch's view is that smudge pots would be less ecologically damaging than draining the water table.

One further point: Harvard University has a huge endowment, and researched before it planted the 840 acres of grape vines. Harvard knew full well it was planting the 840 acres of grape vines in an area where it should NOT have planted them, because the Cuyama Valley does not have enough water to irrigate 840 acres of grape vines, without causing the water table to drop precipitously. Plus Harvard knew full well that building, filling, and refilling, the 3 very large "frost ponds", it now wants to build, would cause **extremely damaging further overdrafting of the water table**. But Harvard proceeded with planting its 840 acres of grape vines, knowing it would be causing ecological damage to everyone WEST of the vineyard. A VERY rich University, damaging people who are trying to make a living from cattle ranching, is despicable. Harvard should NOT be allowed to build any "frost ponds". It can use wind turbines.

A further point about Harvard: Harvard has a history of building large projects, and then selling them. Harvard is damaging, and seeking to further damage, everyone WEST of Harvard, just so Harvard can try to turn a profit by selling its Vineyard, thereupon leaving the Cuyama Valley, and leaving the rest of the valley residents to suffer permanently, from the damage Harvard has already caused to the water table, and from the additional damage that Harvard now proposes to cause to the water table, by building, filling, and constantly refilling, the 3 proposed "frost ponds". Shame on you, Harvard!

Do NOT approve Harvard building ANY "frost ponds". Harvard's Vineyard can use wind turbines, instead of "Frost Ponds".

Please REPLY to kmarch@bkylawfirm.com to confirm receipt. Please keep me informed of when any public hearings which will be held on these 3 "frost ponds", or on whatever else Harvard is requesting to do in the Cuyama Valley. Thank you.

KPMarch

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"Have a former bankruptcy judge for your personal bankruptcy attorney"

January 28, 2022

Kathryn Lehr, Supervising Planner
Santa Barbara County Planning & Development
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By email to klehr@countyofsb.org

RE: North Fork Ranch Vineyards Frost Protection System Focused Draft Environmental Impact Report

Dear Ms. Lehr:

Thank you for the opportunity to comment on the North Fork Frost Ponds Focused DEIR. Attached to this letter you will find 7 figures and one appendix that are all referenced in the letter. We write as two people who have been studying and involved with groundwater issues in the Cuyama Valley for over seven years.

Casey Walsh is a Professor in the Anthropology Department at UC Santa Barbara, and a resident of Santa Barbara County. He has published books and articles on the history of agriculture and the social organization of water use and management in northern Mexico and the western U.S, and is editor of the Journal of Political Ecology. Since 2015 Walsh has been conducting field research on the SGMA process as it takes shape on the ground in the Cuyama and Paso Robles groundwater basins.

Roberta Jaffe is a resident and farmer in the western area of the Cuyama Basin in Santa Barbara County. Since 2015 she has actively participated in the implementation of SGMA in the Cuyama Basin. She has been a member of the Cuyama Basin's Groundwater Sustainability Agency's Stakeholder Advisory Committee since its founding and was its first Chair from 2017-2020. In 2021 she was appointed to be a community representative on the Cuyama Valley Cannabis Advisory Committee by SBC's First District Supervisor's Office to develop guidelines for the impact on groundwater on cannabis growing.

Our comments will focus on the third component of this Focused Draft EIR: Evaporative Groundwater Losses. Our response consists of five parts:

1) SGMA Management is in effect in Project Area
2) Depletion and Undesirable Results in the Project Area
3) Incorrect Impact Classification
4) Cumulative Impacts in Project Area
5) Needed Revisions to Mitigation Measures.

1) SGMA MANAGEMENT IS IN EFFECT IN PROJECT AREA. California's Sustainable Groundwater Management Act (SGMA) applies to the application for North Fork Frost Ponds (NF). The Cuyama Basin's Groundwater Sustainability Plan (CBGSP) is relevant in conjunction with CEQA and Santa Barbara County (SBC) land use policies and environmental thresholds. SGMA is an 'adaptive' form of management, with iterative planning, and the Cuyama Basin Groundwater Sustainability Agency (CBGSA) adapts its Groundwater Sustainability Plan to address undesirable effects of groundwater pumping.

2021 CEQA thresholds establish that projects may not substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project impedes sustainable groundwater management of the basin. CEQA 2021 also requires consideration of SGMA, and Counties must consider whether a project will obstruct implementation of a GSP. The NF project will directly impact and potentially obstruct the adaptive management process by which the GSP is implemented. Thus SBC needs to consider the GSP in relation to the project area of NF when making this decision.

SGMA, passed in late 2014, exercises jurisdiction over all groundwater use in the State, and is currently in effect in the Cuyama groundwater basin. From the outset of SGMA, the California State Department of Water Resources (DWR) identified Cuyama as one of 21 "critically overdrafted" groundwater basins in California, based on multiple prior peer-reviewed scientific studies noting the chronic and severe depletion of the Cuyama groundwater basin (SBCWA 1977; USGS 2015; EKI 2017). Defined as such, the groundwater users in the Cuyama Valley formed a Groundwater Sustainability Agency in 2017 and submitted a Groundwater Sustainability Plan on 12-9-19. On 6-3-21 the CBGSA received a consultation letter from the DWR requiring various clarifications, and the CBGSA submitted its responses to DWR on 11-3-21. In its decision letter of 1-21-22 the DWR reiterated its previous comments that the CBGSP is incomplete, and required the CBGSA to deliver a satisfactory GSP by 7-21-2022, or regulation of the basin would be taken over by the state government.

The DEIR claims that SBC has stated that no management actions have been established by the GSP in the North Fork project area, and so the frost ponds project need not consider SGMA. However, SGMA, and the GSP, are very much in effect in the frost pond project area. SGMA is based on the principle of adaptive management, which means that the policies and measures of the CBGSP are continuously refined and adapted to new data about changing conditions. The CBGSP is required to identify "undesirable results'' of groundwater pumping and set "minimum thresholds'' (MTs) of lowest acceptable groundwater levels to ensure that those undesirable results are avoided. The undesirable results that are relevant in the case of Cuyama are: 1) chronic groundwater declines; 2) land subsidence; 3) groundwater storage reductions; 4) interconnected surface-water depletions; 5) water-quality degradation. Each year the CBGSA produces a report analyzing new data from the monitoring system, and every 5 years must use those annual reports to adjust minimum thresholds and management actions to avoid undesirable results.

Current GSP rules for the entire basin hold that if 30% of the monitoring wells in the basin decline below the established "minimum thresholds" for 2 years, management actions in the entire Basin will be implemented. When the GSP was drafted no wells were below their MTs, but by the time the GSP was accepted by the Board of Directors of the GSA, about 15% of

the wells were below their MTs. As of January 2022, two years after the draft of the GSP was submitted to DWR, nearly 30% of the wells are below the MTs (Figure 1), and the GSA is considering what management actions should be taken (CBGSA Board Packet, item 11). The adaptive management strategy means that the GSP is in effect everywhere in the Basin, groundwater levels are being monitored everywhere in the basin, and management actions are being considered everywhere in the Basin, even if they are currently implemented in selected areas of the Basin.

Below, in point #2, we show that depletion and undesirable results in the North Fork project site are already recognized by DWR, and the GSA is formulating an adaptive response. The CBGSP and its management actions are already in effect in the Northwestern region of the Cuyama groundwater basin, despite the claims of the DEIR, and groundwater use for the frost ponds project must be considered in light of the rules and regulations of SGMA and the CBGSP, and the authority of the CBGSA and DWR. CEQA 2021 requires this. Santa Barbara County in fact recognizes the role of SGMA in managing groundwater, and has ceded all its well monitoring functions to the GSA within the Cuyama Basin. SBC must therefore consider the way its planning and permitting decisions will obstruct the policies and actions taken by the GSA and the DWR to achieve sustainable groundwater management as mandated by SGMA.

2) DEPLETION AND UNDESIRABLE RESULTS IN THE PROJECT AREA. Data produced by the Cuyama Basin GSA show that the predicted evaporative loss from the North Fork Frost Ponds project will contribute to existing undesirable results of groundwater pumping in the project area, namely: 1) chronic groundwater declines; 2) impact on interconnected surface water and GDEs. The DEIR does not recognize these undesirable results because it is based on incomplete data.

Under the mitigated, "environmentally superior" scenario proposed in the DEIR (DEIR 3-38), frost protection will contribute an additional 7% to existing, unsustainable groundwater depletion in the NF vineyard project area (Figure 2). Current irrigation pumping needs for the vineyard range from 1380 to 1500 afy (DEIR 3-34) - an average of 1440 afy - and In normal and heavy frost years, the mitigated frost pond irrigation system will extract an additional 103.1 afy of groundwater to stay within the maximum limit allowed by SBC of 31 afy limit of evaporative loss.

Data collected by the Cuyama Basin GSA since 2015 clearly shows undesirable results of groundwater pumping in the North Fork Vineyard area. The geological matrix in the project area is composed of dense clays, with relatively little groundwater content compared to regions with thick strata of gravels and sands, such as the Central Basin of the Cuyama Valley (USGS 2014; Cleath Harris 2018). The extraction of groundwater to support the needs of North Fork's 840 acres of grape vines has therefore resulted in a rapid depletion of the aquifer. Figure 3 is a map of the North Fork vineyard from the DEIR ("Figure 2-2"), to which have been added the locations of GSA monitoring wells #840, #841, #843, #845, and #849. Figure 4 is a chart that presents data from 2015 to 2020 for those monitoring wells in the vineyard area, and Figure 5 shows hydrographs of falling groundwater levels in these wells. The data in Figures 4 and 5 are provided by the Optiwell system that gathers information from the GSA's network of monitoring wells throughout the Cuyama Valley. These data are used for adaptive

management by the GSA, which identifies and addresses trends of groundwater depletion and associated undesirable results throughout the Cuyama Basin, including the NF project area.

Groundwater levels are falling far more rapidly in the Frost Ponds project area than is recognized by the DEIR. The hydrographs in Figure 5 display the periodic fall of groundwater levels in the NF vineyard area during the summer months when irrigation needs are greatest, and the recuperation of well levels when the pumps are shut down in the winter and water seeps back into the cone of depression created by summer pumping. Measured from summer low point to summer low point to control for this seasonal variance, the 5 wells display rates of depletion of 4, 9, 19, 21, and 27 feet a year, respectively; an average of 16 feet/year. Groundwater levels have plummeted correspondingly. For example, well #843 fell 85 feet between 11/15 and 10/19, and if pumping continues at the established rate groundwater levels will have fallen 150 feet by summer, 2021. Minimum thresholds, currently set at 205 ft, will be exceeded within 8 years for 4 of the 5 wells measured (Figure 4).

Taken together, Figures 3, 4 and 5 show that the established baseline water needs of the vineyard, which will continue to expand until the vines reach maturity in 2023, are already causing "chronic groundwater declines", an undesirable result by California law (SGMA and CEQA). However, the DEIR claims that project area wells have fallen only 35 feet (DEIR 3-33), an error generated by utilizing limited and outdated information about groundwater in the Santa Barbara County Groundwater Report (SBC 2020). Thus the position taken in the DEIR to rely on County policy and data, and ignore SGMA, the GSA and its data (point #1, discussed above), results in a serious misrepresentation of the current state of depletion in the project area, and the failure to recognize the undesirable result of chronic groundwater depletion.

In addition, pumping by the North Fork vineyard is a grave threat to connected surface waters, wetlands, vegetation and groundwater dependent ecosystems (GDEs), another undesirable result under SGMA. Figure 6 is a DWR map that identifies wetlands and areas of vegetation in the NF vineyard project area, as well as the wells from the GSA monitoring network (see also Figure 4). Figure 7 is a map of predicted depletion in the NF vineyard area that characterizes groundwater levels when MTs are reached for GSA monitoring wells #841 and #845. This map clearly depicts both the wide cone of depression anticipated, and the existence of surface water in 2015 before NF pumping began. Particularly serious is the effect this depletion is certainly having on the wetlands at the center of the NF area, which appear on the DWR map (Figure 6). The DEIR does not apply the GSAs existing calibrated groundwater model to understand surface-groundwater interaction in the North Fork vineyard frost ponds project area. In addition, there are shallow domestic and ranch wells to the west and south of North Fork Vineyard. Wells to the west have shown depletion with one monitoring network well identified as being below the Minimum Threshold (GSA Board Packet, 1/5/22, p.91).

DWR's letter of comment on the proposed Cuyama Basin GSP identifies these issues in the NW threshold region - 1) chronic depletion and 2) reduction of surface water - to be of crucial importance for the GSP (DWR 2022). DWR has the power to approve or reject a GSP, and in this letter of comment the agency questions the current MTs in the NW area that allow for 140-160 feet of depletion, a drawdown that threatens one of the last gaining stretches of the Cuyama River in the Valley and lowers water far below the root zone of riparian vegetation. These MTs were proposed by the same company that was hired by North Fork/Brodiaea to prospect for groundwater before the vineyard was installed. The process by

which the GSA abandoned its intended use of 2015 groundwater levels as a baseline for MTs, and adopted these much deeper MTs based on saturated thickness of aquifer deposits is unclear, as the decision was made in a closed-door Technical Committee meeting closed to the public.

North Fork/Broadiaea's proposal to set MTs at 15% of saturated thickness (205 feet below surface) was based on only two criteria - "(1) avoiding infrastructure damage from land subsidence; and (2) ensuring adjacent pumpers have access to groundwater" (Cleath-Harris 2018, p. 2). These MTs do not address the "chronic lowering of groundwater levels indicating a significant and unreasonable depletion of supply" or "groundwater-related surface water depletions that have significant and unreasonable adverse impacts on beneficial uses of surface water" (CBGSA 2019, p. 3-1). Both of the latter are identified by DWR in their comments on the draft GSP as undesirable results of pumping that should be addressed by the MTs in the final GSP, and it is probable they will be a factor in the decision the DWR will make by July 21, 2022, whether to approve or reject the draft Cuyama Basin GSP.

In the "environmentally superior" mitigation scenario proposed by the DEIR, the NF Vineyard Frost Ponds project will contribute an additional 7% to the existing, unsustainable groundwater depletion In the project area (Figure 2). Current average pumping needs for the vineyard are 1440 afy, and the frost pond irrigation system will extract 103 additional acre-feet per year.

3) INCORRECT IMPACT CLASSIFICATION. The DEIR assumes that groundwater pumping and evaporation resulting from the NF frost ponds are Class II impacts, but does not provide evidence for this definition. Data shows that pumping depletion and evaporation losses are Class I "significant and adverse effects", causing unmitigable undesirable results of 1) chronic depletion of groundwater and 2) severing groundwater-surface water interconnections.

The DEIR bases its evaluation of the current conditions of the NF project area on the 2020 Santa Barbara County Groundwater Basins Summary Report (SBC 2020). They estimate "deep wells have decreased up to 35 feet" (DEIR 3-33), but do not recognize this depletion as an ongoing process, and do not accurately represent actual declines of 85 feet or more. Dewatering the aquifer below 60 feet from surface effectively cuts off water to all vegetation. The Frost Ponds project will increase this dewatering by 7% even if mitigation measures described vaguely in the DEIR are successful.

The DWR's decision letter on the CBGSP (DWR 2022) specifically expresses concern about depletion and dewatering "in an area with the highest concentration of potential GDEs in the Cuyama Valley and with interconnected surface water" (DWR 2022, p, 10). The letter requires the CBGSA to address this problem in the GSP by 7-21-22, part of the iterative process of SGMA.

The DEIR asserts that the frost pond project impacts are "Class II" which it defines as "a significant adverse effect that can be reduced to a less-than-significant level through the application of feasible mitigation measures presented in this Focused EIR" (DEIR 1-11). However, the NF frost ponds, even with mitigation measures, will not halt the depletion of the aquifer, but rather contribute to the undesirable results of 1) chronic groundwater depletion and 2) severed groundwater-surface water interconnections. The mitigated frost ponds will

thus clearly have a "significant adverse effect" under the CEQA Appendix G Guidelines (regardless of compliance with the County's 31 AFY threshold).

> The correct classification of impacts of the NF frost ponds project is Class I: "Class I impacts are significant and adverse effects that cannot be mitigated below a level of significance through the application of feasible mitigation measures. Class I impacts are significant and unavoidable" (DEIR 1-11).

4) CUMULATIVE IMPACTS IN PROJECT AREA. In this section we address the cumulative impact that the reservoirs would have on the depletion of groundwater in this region. SGMA is based on change in groundwater levels and the addition of the reservoirs (even with mitigation) will increase the groundwater depletion by 7% - 14% leading to potential undesirable results in less time for groundwater level, groundwater storage and impact on groundwater dependent ecosystems.

The DEIR states:

> " 4.1 CEQA Guidelines § 15130 requires EIRs to discuss cumulative impacts when the project's incremental effects are significant when viewed in connection with the effects of past, current, and probable future projects. CEQA further states that such discussion must reflect the severity of the impact and the likelihood of occurrence, but not in as great a level of detail as that necessary for the impacts of the project alone. CEQA Guidelines § 15355 defines cumulative impacts to be "two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts." (DEIR p. 4-1)

(1.) Based on this definition we think this EIR needs to take into consideration the Cuyama Basin Groundwater Sustainability Plan (GSP) and consider the cumulative impact of the reservoirs on the current depletion taking place due to the irrigation of the North Fork Vineyards. As demonstrated in Figure 2 the hydrographs for wells 840, 841, 843, 845, and 849 in the Northwest Threshold region clearly show this area's groundwater level decreasing an average of 16 feet per year since irrigation began (Figure 1).

Thus, if you look at the reservoirs as a cumulative project being added to the Northwest Threshold Region where the region is currently being dewatered, the following would need to be considered:

1. Groundwater pumping to irrigate 828 acres of grapes (1380 afy - 1500 afy) (DEIR 3-33, 3-34)
2. According to the DEIR a normal frost year could require 206 AFY for frost protection. In order for the evaporation rate to stay below the SBC threshold of 31 AF, this project would only be able to extract 103 AFY to stay within this limit.

Using normal frost year estimates according to the DEIR, we considered the percent increase of groundwater use with the frost pond project and determined that with 3 reservoirs as proposed in the project, a normal frost year would increase water use by 14% and the

recommended Alternative 1 would increase water use by 9%. Even with mitigations in place and not exceeding 103.1 AFY, this would increase groundwater depletion by 7%.

Table 4-1: Reservoir Groundwater use in Normal Frost Year

Frost Pond Scenario	Reservoir Surface Evaporation	Soil Surface Evaporation	Total Evap Loss in AF	Extra Groundwater Diversion AF
Full Project (3 reservoirs)	21.5*	39.6*	61*	227.2**
Alt 1: (2 reservoirs)	14.4*	26.5*	40.7*	126.94***
Mitigation (31 AFY evap loss)	0	31	31	103.1

* from DEIR tables 3-1 and 6-1

** DEIR Appendix D Table 7 sum of reservoir evap

***based on DEIR Appendix D nomograph regression line

Table 4-2: Impact of Frost Pond project added onto irrigation

	Irrigation of Vineyard AFY	Additional Water use for Reservoirs and Frost System AFY	Total Groundwater Use AFY	Percent increase with Reservoirs
With 3 reservoirs	1440*	202.87	1642.87	14%
With 2 reservoirs	1440*	135.36	1575.36	9%
mitigation (31 AFY evap loss)	1440*	103.1	1543.1	7%

* average of 1380 afy - 1500 afy used for vineyard irrigation (DEIR 3-33, 3-34)

Using the current use of an average of 1440 AFY to irrigate 828 acres, the average drawdown based on the hydrographs for the five wells is 16 feet per year (Figure 4). According to the above, 3 reservoirs would cause an estimated groundwater level drawdown of 14.36 feet per year (14% increase); and 2 reservoirs 13.73 feet per year (9% increase). This 9-14% increase in groundwater pumping will have commensurate impacts on groundwater levels, groundwater storage and to GDEs and interconnected surface water. The Cuyama Basin GSP for this area will reach its minimum threshold in less time. According to CEQA this establishes the cumulative impact of “two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts.”

This is further evidenced by DWR's statements in their review of the Cuyama Basin GSP released on 1/21/22 where concern for the Northwestern Region was specifically identified (See Appendix A for the full letter):

> " D. …basin that was not identified as a management area (the Northwestern threshold region) was, nonetheless, projected to experience more than 140 feet of groundwater level decline, relative to 2015, during implementation of the GSP. The GSP did not describe how the apparently allowable overdraft in this region would affect beneficial uses and users of groundwater and avoid undesirable results."
>
> "3.1.2.2 Minimum Thresholds
> However, the Northwestern region is the only region in the Basin where the sustainable management criteria indicate a plan to substantially lower groundwater levels, relative to conditions at the time of GSP preparation (i.e., the minimum thresholds for groundwater levels are up to 140 to 160 feet lower 48), in an area with the highest concentration of potential GDEs 49 in Cuyama Valley and with interconnected surface water, which is evidenced by a gaining reach of the river."
>
> "3.4.2 Deficiency Details
> …the GSP does not discuss why projects and management actions were not considered in the Northwestern threshold region, where, as noted above in Corrective Action 1 (Section 3.1), it appears that overdraft will occur for some time and the allowable groundwater-level decline is over 100 feet in some representative wells.86"

In conclusion, the cumulative impact of the addition of the reservoirs will impact the sustainability goals of SGMA and create undesirable results of increased dewatering of the basin in this region impacting interconnected surface water and potentially increasing the loss of groundwater dependent ecosystems. Even if the frost pond system operated within the mitigated 31AFY, it would increase depletion of the groundwater by 7% and at the same time would not provide sufficient frost protection in normal and high frost years.

5) NEEDED REVISIONS TO MITIGATION MEASURES. The mitigation measures described in the DEIR lack details necessary to determine how they would be implemented and whether they can effectively mitigate the Project's significant impacts.

From the DEIR:

> "3.9.6 Mitigation Measure WAT—01 Frost Protection System Evaporative Loss Reduction Plan. The applicant shall submit an Evaporative Loss Reduction Plan

(ELRP) designed to reduce evaporative groundwater loss impacts resulting from operation of the frost protection system to below the County's Groundwater Threshold of Significance for the Cuyama Groundwater Basin. The adopted significance threshold is 31-acre feet per year (AFY). The ELRP shall include two components: 1) Installation and use of reservoir covers to reduce evaporative loss from each of the proposed reservoirs and 2) A limitation on the amount of groundwater used for frost protection." (DEIR pp.3-42)

There are major concerns as to whether the ELRP could be implemented to truly mitigate the use of groundwater and meet the frost protection needs of the vineyard. The 31 AFY threshold is difficult to stay below for just evaporative loss in all alternative scenarios and mitigations in the DEIR.

(1) Use of reservoir covers year-round: Each pond will occupy approximately 5 acres. This vast expanse will need to be permanently covered in an area of intense UV radiation from the sun coupled with high winds from various directions. The specifications listed do not include addressing the extreme climate conditions of the Cuyama Valley and whether the covers could withstand intense solar radiation, temperatures over 100 degrees as well as below freezing, and high winds. Furthermore, the reservoirs would vary from full capacity to holding only 3 feet of water. How will the covers be adapted to be effective with varying amounts of water volume? Additionally, the DEIR assumes that the covers will bring the reservoir evaporation rate to zero. This would need to assume that the covers are fully operational every day to their full capacity. It seems there should be some variance for maintenance and days when the covers are not functional. Much more information is needed.

(2) As stated above, the DEIR assumes zero evaporation from covered ponds stating this allows for 103.1 acre feet of flow from the sprinkler system. Allowing the full limit to flow through the sprinkler system does not account for inefficiencies in the cover system. However even with assuming this, according to Tables 3-1 and 6-1 in the DEIR, under most circumstances the amount of water needed for frost protection would exceed this.

As the DEIR explains:

"With the reservoir covers, the project could use up to 103.1 AFY of water for frost protection and stay under the threshold amount of 31 AFY for evaporative loss. Application of this mitigation measure would require no curtailment in light frost year, an approximate 22 percent curtailment in a moderate frost year, and an approximate 88 percent curtailment in a heavy frost year." (DEIR 3-41)

Thus, North Fork Vineyard would not have the capacity to fully protect their vineyard from late season frosts.

(3) Monitoring and Reporting: While the report requirements are outlined, these are all self-reports with no third-party verification taking place with site visits, etc. In addition, the DEIR states the ELRP is due prior to Zone Clearance. (p. 3-43) However, since these mitigations

lack detail, specifically in regard to the covers' functionality in these climatic conditions, it is important for an ELRP to be included in a revised EIR. There is not enough information in the DEIR to assess whether the mitigation measure is feasible or effective so it is premature for the DEIR to rely on it to justify Class II (as opposed to Class I) impacts. Finally, these reports should be required to be submitted to the Cuyama Basin GSA which has jurisdiction over groundwater use as well as SBC.

(4) Three-year average: The DEIR recommends "the vineyard operator may monitor frost protection groundwater use based on a 3-year rolling average." (DEIR p.3-43) This seems inappropriate for several reasons:

a) Table 3-1 in the DEIR shows that in both a normal and a high frost year just the Frost Protection Soil Evaporation Loss would exceed the 31 AFY threshold (39.6 AFY in a normal frost year and 249.5 AFY in a high frost year. This does not include evaporative loss from the reservoirs which would add an additional 21.5 and 23.1 AFY respectively.)

b) With climate change, extended droughts are predicted for this region, leading to more water needed for irrigation. It would also mean there is less soil moisture which can lead to increased cold temperatures and frost days.

c) No data about the frequency of light normal and heavy frost years is provided in the DEIR, and while the average frost days across the years is calculated at 11 days, there is no data about the average total hours of frost protection needed per year. Overall, it is not appropriate to allow for a 3-year average due to the greater potential impact of normal and heavy frost years.

In summary, the mitigations proposed in the DEIR are not sufficient to protect the groundwater or the GDE's in the area. There is not enough detail provided and the climate conditions and size of the ponds make the effective functionality of covers problematic. Even if these mitigations were as effective as described, the overall need for frost protection will still exceed the 31 AFY allowed by SBC's threshold.

The final sentence of the DEIR states: "The challenges associated with limiting the extraction and use of groundwater resources to below the County's threshold may be more difficult than addressing impacts sensitive biological resources, where mitigation can ensure that residual impacts are less than significant." (p. 6-19) The impact of further extracting groundwater from the critically overdrafted Cuyama Basin in an expressed area of concern by the DWR creates a severe negative impact while accelerating undesired results. We recommend the consideration of the above five factors in your review of the DEIR. Thank you.

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REFERENCES

DWR (California Department of Water Resources). 2022. "Incomplete" Determination of the 202 Cuyama Valley Basin Groundwater Sustainability Plan. (1-21-2022).

CEQA. 2021.

Cleath-Harris Geologists, Inc. 2018. Sustainability Thresholds for Northwestern Region, Cuyama Valley Groundwater Sustainability Plan (12-7-2018).

CBGSA (Cuyama Basin Groundwater Sustainability Agency). 2019. Cuyama Basin Draft Groundwater Sustainability Plan.

CBGSA Board Packet. January 5, 2022.

Cardno. 2021. North Fork Ranch Frost Ponds Project Focused Environmental Impact Report.

EKI. 2017. Preliminary Findings from Review of the USGS Study of the Cuyama Valley Groundwater Basin.

SBC (Santa Barbara County). 2020. County of Santa Barbara 2020 Groundwater Basins Summary Report. Santa Barbara: Public Works Department, Water Resources Division, Water Agency (8-25-2020).

USGS (US Geological Survey). 2015. Hydrologic Models and Analysis of Water Availability in Cuyama Valley, California

FIGURES

Figure 1: "Summary of October 2021 Groundwater Well Levels as Compared to Sustainability Criteria." CBGSA Board Meeting Packet (1-5-20212), p. 84.

Figure 2: "Frost Protection System, Estimated Groundwater Evaporative Losses, Original and Alternatives"

Figure 3: "North Fork Vineyard with GSA Monitoring Wells"

Figure 4: "Groundwater Depletion, North Fork Frost Ponds Project Area, Cuyama Basin"

Figure 5: "Hydrographs. North Fork Frost Ponds Project Area, Cuyama Basin"

Figure 6: "Vegetation, GDEs, Surface Water and Optiwell monitoring wells"

Figure 7: "Change in Groundwater Levels in NW Region from CBWRM Test Simulation"

APPENDICES

A. DWR's letter RE: "incomplete" Determination of the 2020 Cuyama Valley Basin Groundwater Sustainability Plan, January 21, 2022