Potter, Andrew

To: FGG, Public Comment
Subject: FW: Thanks for meeting with me yesterday.
Attachments: Cova Letter - Final.pdf; 2017 - 0613 Rahn Report Final.pdf

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From: JP Theberge <jp@culturaledge.net>
Sent: Thursday, August 21, 2025 11:30 AM
To: Lawson-Remer, Terra <Terra.Lawson-Remer@sdcounty.ca.gov>; Yuen, Jeffrey <Jeffrey.Yuen@sdcounty.ca.gov>
Subject: [External] Thanks for meeting with me yesterday.

Hi Terra and Jeff:

Thanks for taking the time to meet with me yesterday. I've included the independent expert reports, but also a bunch of other stuff that Jeff may want to review. Happy to jump on the phone to further discuss. Most of this has been submitted before.

The question we should be asking is not whether this meets fire code standards from 2018 to meet some sort of CEQA cover for the developer and county staff. It should be "does this project make the community genuinely less safe?" And "Does our community deserve the same level of protection that every other community gets?" It is indisputable that it makes the community less safe as the evacuation routes are already over capacity and Dr. Cova makes this case very well. As such, the developer should be required to give us the same courtesy that every other development in the fire district requires: secondary access, a second emergency exit in the case the primary is blocked. This is a 100% discretionary decision and as such the supervisors have the power to make something safer or reject it outright.

This developer has made zero effort to work with us in coming up with a solution. No negotiations, no offers. Nothing. None of the neighbors with easements along a potential route have been asked to grant an easement to the developer for secondary access. The Del Dios option, while probably expensive, has never been disproven as a potential alternate route. I assume they just don't want to spend the money.

When the next fire comes along, and the inevitable entrapment and possible death of community members occurs, it will be very difficult to reconcile the role everyone played in this eventuality. I don't want that on my conscience which is why I am fighting so hard for this.

-JP

INDEPENDENT EXPERTS

I've attached the two reports by independent experts, Dr. Cova (University of Utah) who did the most recent analysis (2024), and Dr. Rahn who did the assessment in 2017. And the CalPoly study commissioned by CalFire to analyze dead end road standard and the secondary access requirement. The appellate court essentially said that when experts are in disagreement, it is up to the decision-maker to decide. The previous Republican / developer-funded board chose to side with the developer consultants.

Dr. Cova Report (attached):

- Subpar road network with minimal improvements.
- Two lane roads leading out of the community, only one is viable during extreme fire scenario: Country Club Drive to Auto Park Way. Elfin Forest Road to the West is a fire hazard due to vegetation and would never be recommended during a wildfire. Harmony Grove Road to the east is also unlikely during a wildfire event due to vegetation and the limited 2 lanes.
- CC Dr. is long, straight and leads directly to Escondido / Auto Park Way. It is the road that the developer uses in its analysis.
- The evacuation Scenario 2 is the realistic scenario because it includes evacuation of the entire community, not just the development.
- It would take between 5.2 hours and 10 hours to evacuate the community (depending on number of vehicles per household).
- At 2 vehicles per household (likely given lack of transportation options), it would take **6.9 hours to evacuate.** This contradicts the developer's analysis because it actually includes all the legacy homes as well.

Dr. Rahn Report (attached):

- *"The proposed Project would thus be constructed despite being noncompliant with emergency access standards where catastrophic losses are not only probable, but expected."*
- Underdeveloped road network with limited capacity.
- The developer admits that HGVS cannot be fully protected (hence Shelter in place "philosophy").
- Not officially a shelter in place community (which require higher standards).
- The legacy homes would be trapped and not have any safety benefits from the project.

CalPoly San Luis Obispo Study on Dead End Road Standards (link)

- The current Dead End Road Standard (requiring secondary access on dead end roads longer than 800 feet) is not adequate and should be revised
- The intent is to provide additional means of ingress and egress for apparatus and residents if the main egress is blocked by fire.
- Adding a third lane does not meet the intent of a secondary exit.
- Secondary access itself may not be enough. Three or more exits may sometimes be required.

SOME ADDITIONAL POINTS

I'd like to make a few more points about why secondary access is so important to us.

- HGVS would be the only large development in the fire district that has only one way in and out. Why is HG being excluded from this crucial safety requirement?

- Other developments in the district like Cielo, the Crosby, the Bridges, Lakes among others are much smaller yet they all have multiple ways of escaping a fire coming from different directions. The RSF Fire District website provides evacuation maps with multiple secondary routes for all these developments (link, page 4). HGVS will have only one.
- Why would HGVS residents (and surrounding community) not have access to this simple safety code requirement?
- RSF Fire's "Getting Out Alive" document stresses to residents that they should have at least two different ways to evacuate (link, pages 5 and 6). Why would HG residents not deserve that?
- RSF Fire requires secondary access on all developments, practically a non-negotiable.
- RSF Fire Marshall routinely rejects projects in VHSZ that lack secondary access (Del Dios Ranch, for example).
- They recently turned down a lot split (just TWO units) because it did not have secondary access (link page 7, link page 38)
- Why is secondary access important? Because it gives people a fighting chance of getting out when the fire is coming from a direction that impedes the primary access. None of the mitigations offered are equivalent to meeting that intent.
- CalPoly study on dead-end road (secondary access) standards commissioned by CalFire clearly states that the intent of a secondary access requirement is to provide another way to exit and access the site in the case of a fire blocking the primary access.
- The study indicates that widening the only access road (the only significant mitigation offered by the developer) is not sufficient (link highlights, page 6)
- We negotiated with other developers and obtained secondary access (Valiano, for example). This developer will not budge on this.

JOHNSTON ROAD IS ESSENTIAL TO THE PROJECT SAFETY

And one last bit about Johnston Road which the EIR references numerous times as a back up / emergency measure (which is needed):

- Staff's latest Planning Commission report says that the EIR (and appellate court decisions) did not rely on the "alternative" Johnston Road unimproved trail for the project's safety. **This is patently false.** It appears repeatedly throughout and was specifically relied upon by the appellate court. The road is 100% unusable without major improvements (link to video here). Even the fire chief acknowledges that.

Here are some of the references:

EIR CHAPTER 7 - MITIGATIONS

The EIR itself lists Johnston Road as a mitigation measure under "Design Considerations for Hazards and Hazardous Waste" (page 7-27 @ link (highlighted) or link (original at County website):

Harmony Grove Village South Project
Draft Final Environmental Impact Report

5. Existing access for several residences east of the (Figure 3.1.43-1). Such access would continue to be after development, but via improved, code conformir the evacuation situation to the west for those off-site east is accessible by typical passenger vehicles, does and would be available in an emergency situation wh and the primary access route (Country Club Drive) is

FIRE PROTECTION PLAN - APPENDIX L

The Fire Protection Plan clearly lists it as a bullet point under a heading "Additional Provided Measures and Project Features That Reduce Risk and **Are Integral Components of the Fire Protection System**" (link, page 40, point 5)

Additional Provided Measures and Project Features Tha
Components of the Fire Protection System

Access and Roads

- **Availability of Alternative Evacuation Route.** Cur
access rights across the HGVS site (Appendix G) that
Country Club Drive. The current road does not m
surface, and grade. This road is accessible by typical
Johnston Road to the east, but includes a gate at
Access for these residences will continue to be pro
development, but via an improved code conforming
have reciprocal access rights through these adjacent
access from the project site to Johnston Road to the ea
using this road to provide secondary access from the
roadway would be available for use to connect to Jo
east) in an emergency situation should Country Club D

ORIGINAL PLANNING COMMISSION REPORT

County staff's original planning commission report mentions it under "Emergency Evacuation" P.39 @ link (highlighted) or link (original at County website).

iv. Kauana Loa Drive to Harmony Grove Road, and
v. Emergency-Only: Johnston Road Connection – not a
exposure to fuels, but may be an alternative acces
unforeseen scenario where other routes are consider

DEVELOPER'S APPELLATE COURT REPLY BRIEF

The developer argues that while Johnston Road doesn't qualify for general access, it "can and will be used to escape in an emergency" essentially admitting that it may be the last recourse for people entrapped. The appellate court relied on to diminish the safety argument we had previously won on. P.34 @ link (highlighted)

> [6] Plaintiffs misstate the value of Johnston (sometimes called Johnson) Road for emergencies. [RB 45-46/54-55] Johnston Roa does not qualify for general access, and specifically access for firefighting equipment ("to accommodate emergency vehicle turning radii"), because of terrain and private ownership; but i exists, is in use, and therefore can and will be used to escape in an emergency. [AR 1423, 1576] In fact, it has been used in the past in emergencies. [AR 1808 {response H-19}] The EIR, FPP, and evacuation plan were being conservative when they did no simply assume its availability.
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> 34

APPELLATE COURT ORAL ARGUMENTS

The developer's attorney argues that Johnston road is an option in case of emergency and that it is *in the record* meaning it is relied upon to increase the safety of the project. P.4 @ link (highlighted transcript) and 7:38 @ link (video)

> requirements. This is even before you get to the fact that there additional evacuation routes for an emergency. They weren't se a road that could be built for one reason or another, such as pri everybody uses them. Johnson Road, and that's also in the rec that the trial court found was supposedly not addressed was th

APPELLATE COURT WRITTEN OPINION

Appellate court ultimately rules that because the EIR addresses emergency evacuation through Johnston Road, that this mitigates the dangers and concerns of the community. p.47 Appellate Court Opinion D077611 (link) highlighted relevant passage on p.47.

that "all existing and proposed resi

approximately one hour."

Additionally, the EIR and fir

alternative evacuation route conne

emergency situations "where peopl

primary access route (Country Clu

residents could not use the road for

be available for use to connect to Jo

east) . . . ." The Wildfire Risk Anal

evacuation routes (Harmony Grove

FIRE CHIEF FRED COX EMAIL SPECIFICALLY ASKS TO REMOVE JOHNSTON ROAD
Chief Cox (Deputy Chief at the time) was asked to review the FPP and debunked the mitigation for lack of secondary egress (adding a third lane) and notes that Johnston Road should be removed from the plan.

From: Fred W.
Sent: Tuesday,
To: Tony Mi
Subject: HGVS -

Tony,

It's hard to tell from the small map provide

1. With only one way out, even thoug
   Vegetation management zones alo
2. While they give traffic flow studies
   ingress/egress points – what is the
   that area.
3. Potential emergency access (Johns
   would be a good option if its impro
4. The fire mitigation zones, especiall

The rest of plan looks OK

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Website • Facebook • Twitter • LinkedIn

For frequently updated articles and tweets relevant to the multicultural and Hispanic space, follow us on Twitter.

COVA Consulting
1906 Westminster Ave.
Salt Lake City, UT 84108

Prepared by Thomas J. Cova, Ph.D.
Dated: September 19, 2024

Subject: Harmony Grove Village South would compromise wildfire public safety

Please accept these comments on the Harmony Grove Village South community regarding current and proposed new development. I was retained by *Shute, Mihaly & Weinberger LLP* to evaluate the impact of new development on wildfire public safety as it pertains to evacuation egress. The greater Harmony Grove community is slated to grow from 1322 to 2018 housing units (+696) with minor change to its evacuation egress system. As this community is in a CALFIRE very high fire hazard severity zone (VHFHSV), additional development represents a threat to public safety, as extreme wildfires may not allow enough time to safely evacuate community residents if the community is not designed to support rapid evacuation.

I have been a professor at the University of Utah for 25 years conducting research on wildfire evacuation analysis and modeling (See attached CV). My original inspiration for pursuing community evacuation egress as a research topic was the 1991 Oakland Fire, and I have published articles on topics that include community egress (Cova et al. 2013), evacuation traffic simulation, and wildfire public safety. I proposed a set of community egress codes in the *Natural Hazards Review* for improving public safety in fire-prone communities that the National Fire Protection Agency adopted in their document *NFPA 1141: Standard for Fire Protection Infrastructure for Land Development in Wildland, Rural and Suburban Areas* (Cova, 2005).

Background

The Harmony Grove Village South (HGVS) is a 111-acre project site southwest of Escondido in San Diego County about 3 miles west of I-15 and 3 miles south of SR-78. The site is bounded by Escondido Creek to the north, Country Club Drive to the west, and the Del Dios Highland Preserve to the south. The HGVS project consists of 453 residential units and an estimated 1400 residents. The immediately surrounding area of HGVS includes the communities of Harmony Grove, Eden Valley and Elfin Forest which together have 1500 homes and 4050 residents. HGVS will be in a box canyon surrounded by chaparral open space.

Harmony Grove, Eden Valley, and adjacent areas are classified by CALFIRE as a Very High Fire Hazard Severity Zone (VHFHSZ). This area has a storied fire history that includes 12 named fires since 1980 ranging in size from 46 acres (1980 Elfin Forest Fire) to 197,990 acres (2007 Witch

Creek Fire). The 2014 Cocos Fire is the most recent major wildfire which burned 1995 acres and destroyed 36 homes including part of the HGVS site. The problematic Cocos Fire evacuation served to highlight the poor egress in this area due to very limited low-capacity exit roads to move residents to safety. Many residents reported traffic gridlock and frustration in this evacuation and stated that it took an hour or more to get out, and some residents reported being arrested for attempting to rescue family members in the evacuation zone (Figueroa, 2014). Problems in evacuating Harmony Grove were also exacerbated by San Elijo Hills residents who were directed to evacuate using Harmony Grove Road along with Elfin Forest residents. Residents and others also criticized the lack of personnel to manage traffic intersections and provide evacuation route guidance.

Evacuation road network

The initial exit from HGVS will be a single 800-foot access road to the intersection of Country Club Drive and Harmony Grove Road (CCD/HGR). The safest direct route out of the community from this intersection is to travel north on Country Club Drive to SR-78. While there is an additional exit road to the west (toward Elfin Forest), it is not a safe means of egress for Harmony Grove communities given that it is lined with heavy wildland fuels and lacks a viable fire shelter or safety zones as a back-up plan should evacuation become infeasible. Harmony Grove Road to Citracado Parkway represents a third exit to the east but it is also lined with wildland fuels along Escondido Creek and risks becoming impassable during a wildfire.

Travel demand scenarios

The estimated travel demand during a wildfire evacuation depends primarily on the evacuation zone boundary, number of households, and vehicle use. If the evacuation zone was solely the 453 HGVS homes, this would represent about 680 to 1359 vehicles depending on the number of residents at home and their associated vehicle use (i.e. 1.5 to 3.0 vehicles per household). If surrounding communities were also evacuating including Harmony Grove Village (742 homes) and Valiano (243 homes), the number of departing vehicles could range from 2157 to 4314 (1.5 to 3.0 vehicles per household). Including more communities in the zone would add more vehicles including Eden Valley rural (80 homes), Hidden Hills (100 homes), and Harmony Grove rural (100) which would lead to 1718 households and a range of 2577 to 5154 evacuating vehicles (1.5 to 3.0 vehicles per household). The evacuation of this area would also include horse trailers which can prolong household preparation times and cause traffic delays (NFPA, 2024).

Travel demand is the rate that the evacuating vehicles depart from households in vehicles per hour (vph) over time, and this rate depends primarily on the urgency of the scenario (i.e. time available to evacuate) and the response of the public to public warnings and direct perception of flames and smoke (i.e. household decision making and preparation). Given the few available exiting roads in the HGVS area, it is likely that road capacities (vehicles per hour) will have a greater influence in determining the evacuation time than the household departure rate. In areas with greater exit road capacity than travel demand, household departure rates would have a greater influence on evacuation times (i.e. the sooner households leave the shorter the evacuation time if the roads are not a significant constraint).

Estimated evacuation time

Given that the roads are likely to be the binding constraint in a Harmony Grove evacuation, the exit road capacities can be used to estimate minimum evacuation times. DUDEK (2018) used traffic engineering standards to estimate that Country Club Drive could serve 500 vehicles per hour (8.3 vehicles per minute). This rate assumes continuous (uninterrupted) vehicle flow at key intersections, for example Country Club Drive and Harmony Grove Road, as well as Country Club Drive and Auto Park Way. This is possible if the intersections are manually controlled by public safety personnel to favor residents heading north on Country Club Drive from HGV/HGVS. If the key intersections are not manually controlled and operating under normal control (stop sign or signalization), then their capacity could be much lower under the extreme vehicle loads presented by an evacuation.

Scenario 1

The initial scenario is evacuating the HGVS households. In this case, traversing the 800-foot access road would be the sole means of egress and 'safety' would be defined as crossing Harmony Grove Road and heading north on Country Club Drive. For simplicity, we can assume that warning time and household preparation time are not a major constraint. In other words, households receive a warning and depart at a relatively rapid rate such that the intersection at CCD/NHR is the binding constraint. If the capacity of this intersection is 500 vph then the minimum evacuation time would range from 1.4 hours (1.5 vehicles per household) to 2.7 hours (3 vehicles per household). Note that the evacuation times in this table are minimums (lower bounds) on evacuation time and not actual evacuation times. Actual times could be much longer given other critical evacuation time phases including: 1) the time it takes for officials to decide whom to evacuate (decision time), 2) the time to notify residents (warning time), and 3) the time for households to gather their belongings and decide when to evacuate (preparation time). In other words, realistic evacuation time estimates would be greater than the ones shown in Table 1, possibly twice as long in duration.

veh/home	vehicles	Evacuation time (hours)
1.5	680	1.4
2.0	906	1.8
2.5	1133	2.3
3.0	1359	2.7

Table 1. HGVS minimum evacuation time varying the vehicles per household for 453 households leaving the access road via the intersection of CCD/NHR (500 vph capacity).

Scenario 2

The second scenario to consider is an evacuation a combination of Harmony Grove communities around HGVS including Harmony Grove Village, Valiano, Hidden Hills, Eden Valley, and Harmony Grove rural, which all-together total 1718 households. This example assumes that Country Club Road is the sole exit, and the key intersection at CCD and Auto Park Way has a capacity of 500 vph (DUDEK 2018). Table 2 shows the range of minimum evacuation times varying household vehicle use. Similar to scenario 1, these are minimums that do not take into account other critical time phases. All of the aforementioned communities evacuating north on CCD could take at least 5.2 hours (1.5 vehicles per household) to 10.3 hours (3.0 vehicles per household).

veh/house	vehicles	Evacuation time hours)
1.5	2577	5.2
2.0	3436	6.9
2.5	4295	8.6
3.0	5154	10.3

Table 2. Harmony Grove minimum evacuation time (hours) varying the vehicles per household (v/h) and whether the key intersection at Country Club Drive and Auto Park Way is controlled or uncontrolled (assuming 500 vph capacity at CCD/NHR).

Available Time for Evacuation

Table 3 provides a range of available (lead) times for ignition distances ranging from 2 to 10 miles from Harmony Grove and fire spread rates ranging from 2.0 to 6.0 mph. With the extended scenarios, the time available could range from 5.0 hours (i.e. an ignition location 10 miles from HG with a 2.0 mph rate-of-spread to as little as 0.3 hours (i.e. an ignition location 2 miles from HG with a 6.0 mph rate-of spread). Lead times that are less than evacuation time for a given scenario represent a case where public safety would be compromised. Table 3 has many cases that would not offer enough time for evacuation scenarios shown Table 2 (all of Harmony Grove) and a few of the ones shows in Table 1 (HGVS). For example, the red square where a wildfire ignites 8 miles from Harmony Grove traveling at 2 mph would offer 4.0 hours of time to evacuate, which is not sufficient for any of the scenarios shown in Table 2.

Available Lead Time (hours)		Fire spread rate (mph)		
		2.0	4.0	6.0
Ignition distance from HGVS (miles)	2	1.0	0.5	0.3
	4	2.0	1.0	0.7
	6	3.0	1.5	1.0
	8	4.0	2.0	1.3
	10	5.0	2.5	1.7

Table 3. Available time to evacuate Harmony Grove (hours) based on the ignition distance from Harmony Grove (miles) and the fire-spread rate (miles per hour).

Shelter-in-Place viability

Shelter-in-place (SIP) has received increasing attention in the wildfire context due to the increasing number of scenarios (current and potential) whereby residents may not be able to safely evacuate. SIP usually comes in two forms: 1) remaining in a structure without any travel, and 2) traveling a short distance to a refuge within a wildfire risk area (e.g. structure, bunker, or refuge area). Examples of the first type of SIP include: 1) the 2003 Cedar Fire, where 300 occupants remained in the Barona Casino in lieu of attempting to evacuate and being exposed to the fire on exit roads, and 2) the 2008 Tea Fire in Montecito, where 900 students sheltered in the Westmont College gymnasium rather than attempting to evacuate during the fire. These examples show that when the right conditions are met, SIP with no travel can offer sufficient life safety protection in a wildfire. The 2018 Camp Fire in Paradise provides an example of the second type of SIP. In that instance, residents evacuating in vehicles were redirected to take shelter in a commercial parking lot free of fuel and defended by fire fighters.

Section 3.3.3. of the DUDEK (2018) HGVS evacuation plan mentions SIP as a possible protective action. Several factors undermine the viability of SIP for HGVS. First, the DUDEK plan involves sheltering people in their home if they are not directly impacted by the path of a wildfire to reduce transportation demand. This can lead to late household evacuations if the residents ordered to stay in their homes become at-risk to a wildfire. We have little to no experience with a mass in-home SIP in the U.S. because one has never been ordered (i.e. no jurisdiction has ever ordered residents in a designated area proximal to a wildfire to stay in their homes during a wildfire). DUDEK's suggested approach for HGVS remains untested. Second, the plan mentions HGVS's ignition-resistant construction and fuel-modification zones as features that could facilitate SIP, but these are defined to protect structures from ignition and not occupants. There are currently no standards or codes in the U.S. regarding the construction of homes to protect occupants remaining inside those homes during a wildfire. Moreover, because the HGVS evacuation plan focuses on HGVS residents, it does not analyze what this means for the existing community surrounding HGVS whose homes are not fire hardened. Third, there is no way for officials to know the mental and physical health conditions of residents in a wildfire area to level sufficient enough to order defined groups to stay in their homes while prioritizing others to evacuate.

In addition to in-home SIP, DUDEK's HGVS fire evacuation plan also proposes the idea of a temporary refuge area (TRA). While this has been done successfully for a small number of evacuees that were unable to clear the risk area (e.g. 2014 Camp Fire), we do not have any examples of a mass assignment of residents to a TRA on the order of thousands. There are many issues that might arise from overestimating the level of protection offered by the TRA as well as its capacity. For example: 1) what level of protection will the TRA offer its occupants from radiant heat, 2) how many residents can the TRA accommodate, 3) how long might it take residents to reach the TRA, 4) is the TRA handicap accessible, and 5) how would the TRA be defended by fire fighters? There are currently no standards or codes in the U.S. for designing a TRA to a level where it would guarantee a level of protection similar to evacuating the risk area.

Potential Additional Evacuation and Wildfire Factors

There are a number of additional proposed projects in the area surrounding HGVS that could complicate evacuations if approved and constructed. One is the Solaris Business Park (500,000 square feet of building space) which will be located at the end of Country Club and Autopark Way. In event of a wildfire, employees from this facility will share the same egress on Country Club Drive as HGVS and the communities surrounding it, potentially increasing the number of vehicles on the road and evacuation times.[1] The second proposed project is the Harmony Grove Village Yoz Community Center, a 1.85-acre site located in Harmony Grove Village at 2625 HG Village Parkway, which could also generate additional evacuation traffic demand on Country Club Drive.[2] Thirdly, the Seguro Battery Storage Facility—proposed for a site along Country Club Drive which burned in the 2014 Cocos Fire—could potentially create an additional fire hazard and evacuation complication due its storage of lithium batteries.[3]

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[1] *See* City of Escondido, "Initial Study Part II," PHG20-0035 Solaris Business Park Project, at 5 ("Country Club Way serves as an emergency access for the project onto Country Club Drive.")

[2] *See* Item L (Major Use Permit: PDS2024-MUP-24-005), San Dieguito Planning Group Meeting Agenda, May 9, 2024 at 3, available at: https://www.sandiegocounty.gov/content/dam/sdc/pds/Groups/sandieguito/2024/SD240509AG.pdf.

[3] *See* "Seguro energy storage project," available at https://www.aes.com/california/project/seguro-energy-storage-project (accessed Oct. 1, 2024).

Fire Protection Plan Guidelines

In March 2024, San Diego County's Fire Protection District and Land Use & Environmental Group, Planning & Development Services adopted revised Fire Protection Plan Guidelines for Staff ("2204 FPPG").[4] Under the 2024 FPPG, Goal S-4 (Minimize injury, loss of life, and damage to property resulting from structural or wildland fire hazards), Section S-4.5 (Access Road) requires a development to, "… provide additional access roads where feasible to provide for safe access of emergency equipment and civilian evacuation concurrently."[5] Given that HGVS will house over a thousand residents in 453 households, this raises the question of whether one access road will meet this requirement, even if widened to three lanes in some places. If firefighter ingress must be maintained, then only one to two lanes of egress to the intersection of the access road with Harmony Grove Road will be available to the residents of HGVS. This highly limited single road egress would not meet this requirement for "additional access roads" to allow concurrent civilian evacuation and emergency equipment use.

Summary

Harmony Grove Village South would be difficult to evacuate in an urgent wildfire (i.e. one that offers less than one hour to clear the community). A scenario that offers little time is entirely possible because HGVS would be situated in a very high fire hazard zone that is surrounded on three sides by hills covered in dense fuels (chaparral). This is due to the fact that the estimated 900 vehicles (454 homes) departing HGVS would have one safe exit north to the intersection of Country Club Drive and Harmony Grove Road. The time to evacuate HGVS alone ranges from 1.4-2.7 hours, depending on household vehicle use, so any scenario in Table 3 that offers less than this time would compromise the safety of the HGVS residents and the residents already living in the surrounding communities.

In evacuation scenarios that also include neighboring communities, HGVS would face additional background traffic from New Harmony Village, Valiano, Elfin Forest, and others. Conversely, if HGVS was ordered to evacuate first, then traffic departing from HGVS would also represent a challenge to neighboring communities, as the HGVS traffic could congest the primary exit of Country Club Drive. Given the very-high wildfire hazard in the HGVS area, there is not a sufficient number of safe exit roads with sufficient capacity and that lead in multiple directions to add 453 additional housing units without compromising the safety of prospective HGVS residents as well as the residents of existing communities in an urgent wildfire scenario that offers under two hours of lead time.

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[4] Available at https://www.sandiegocounty.gov/content/dam/sdc/pds/docs/2024%20County%20of%20San%20Diego%20Fire%20Protection%20Plan%20Guidelines.pdf.

[5] 2024 FPPG at 18.

References

Cova, T.J., Theobald, D.M, Norman, J., and Siebeneck, L.K. (2013) Mapping wildfire evacuation vulnerability in the western US: the limits of infrastructure. *Geojournal*, 78(2): 273-285.

Cova, T.J. (2005) Public safety in the urban-wildland interface: Should fire-prone communities have a maximum occupancy? *Natural Hazards Review*, 6(3): 99-108.

DUDEK (2018) *Wildland fire evacuation plan for the Harmony Village South Community*. Prepared for Rancho Santa Fe Fire Protection District. San Diego, May.

Figueroa, T. (2014) *Cocos fire traffic jam to be reviewed.* San Diego Tribune. June, 7. URL: https://www.sandiegouniontribune.com/2014/06/07/cocos-fire-traffic-jams-to-be-reviewed/ (accessed: 8/27/24).

Rohde & Associates (2016) Harmony Grove Village South wildfire risk analysis. Prepared for the Fire Marshal, San Diego County Fire Authority, April.

National Fire Protection Agency (NFPA). *Evacuation for household pets and horses.* URL: https://www.nfpa.org/education-and-research/wildfire/household-pets-and-horses (accessed 9/25/24).

ATTACHMENT 1

Thomas J. Cova

Department of Geography, University of Utah
GC 4730, Salt Lake City, Utah 84112-9155
cova@geog.utah.edu, 801-581-7930, FAX: 801-581-8219

Education

1999	Ph.D., Geography, University of California Santa Barbara.
1995	M.A., Geography, University of California Santa Barbara.
1986	B.S., Computer & Information Science, University of Oregon.

Research and Teaching Interests

Environmental Hazards, Emergency Management, Geographic Information Science, Transportation, Warning & Evacuation.

Professional Experience

2012 –	Professor, Department of Geography, University of Utah.
2005 – 2012	Associate Professor, Department of Geography, U. of Utah.
1999 – 2005	Assistant Professor, Department of Geography, U. of Utah.
1993 – 1996	Research Assistant, National Center for Geographic Information and Analysis (NCGIA), UC Santa Barbara.
1992 – 1997	Teaching Assistant, Department of Geography, UCSB.
1987 – 1992	Systems Analyst, Matthew Bender & Co., Oakland, California.

Other Professional Activities

2016 – 2023	Director, Environmental Track, *Professional Master of Science & Technology*, The Graduate School, University of Utah.
2003 – 2018	Director, *Center for Natural & Technological Hazards*, College of Social & Behavioral Science, University of Utah.
2014 – 2018	Director, *Certificate in Environmental Hazards & Emergency Management*, Department of Geography, University of Utah.
2001 – 2016	Director, *Certificate in Geographic Information Science*, Department of Geography, University of Utah.
2011 – 2013	Chair, Hazards, Disasters & Risk Specialty Group, Association of American Geographers, Washington, D.C.
2007 – 2008	Program Chair, 5^{th} International Conference in Geographic Information Science (GIScience 2008), Park City, Utah.
2005 – 2008	Chair (and Vice Chair, Past Chair), GIS Specialty Group, Association of American Geographers, Washington, D.C.
2005 – 2008	Chair, Research Projects Committee, University Consortium for Geographic Information Science (UCGIS).
2004 – 2006	Secretary/Treasurer, GIS Specialty Group, Association of American Geographers, Washington, D.C.

2001 – 2003	Academic Councilor, GIS Specialty Group, Association of American Geographers, Washington, D.C.
1999 – 2003	Associate Director for Research, Center for Natural & Technological Hazards, Department of Geography, U of Utah.

Editorial Board Memberships

2023 –	Associate Editor, *Natural Hazards Review*
2020 –	*International Journal of Geographical Information Science*
2018 –	*Journal of Applied Geography*
2011 – 2014	*Journal of Geography & Natural Disasters*.
2011 – 2014	*Journal of Spatial Science*
2009 – 2011	*Professional Geographer*
2001 – 2004	*Computers, Environment & Urban Systems*

Professional Honors and Awards

2016	Excellence in Mentoring Award, College of Social & Behavioral Science (CSBS), University of Utah.
2014 – 2016	Advisor, *Enabling the Next Generation of Hazards Researchers*, D. Thomas, S. Brody, & B. Gerber (PIs), National Science Foundation, CMMI-IMEE.
2008 – 2010	Mentor, *Enabling the Next Generation of Hazards Researchers*, Tom Birkland (PI), National Science Foundation, CMMI-IMEE.
2005	John I. Davidson Award for Practical Papers, American Society for Photogrammetry & Remote Sensing – with P. Sutton and D. Theobald.
2005	Leica Geosystems Award for Best Scientific Paper in Remote Sensing, American Society for Photogrammetry & Remote Sensing (ASPRS) – with P. Sutton and D. Theobald.
2003 – 2005	Fellow, *Enabling the Next Generation of Hazards Researchers*, Raymond Burby (PI), National Science Foundation, CMMI-IMEE.
2003	University Consortium for Geographic Information Science (UCGIS) Young Scholar's Award.
1996 – 1999	Dwight D. Eisenhower Doctoral Fellowship, National Highway Institute, Federal Highway Admin., Dept. of Transportation.
1995	International Geographic Information Foundation (IGIF) Award for Best Student Paper, GIS/LIS '95, Nashville, TN.
1995	Outstanding Student in Transportation, UC Santa Barbara, Western Coal Transportation Association.

RESEARCH AND SCHOLARSHIP

Edited volumes and special issues

2021	Curtin, K.M. and Cova, T.J. *Spatial Optimization and GIS*. ISPRS International Journal of Geo-Information (ISSN 2220-9964).
2017	Cova, T.J. and Tsou, M., *GIS Methods and Techniques*. Vol 1. in *Comprehensive Geographic Information Systems, B. Huang (EIC).* Oxford:Elsevier.
2011	Cova, T.J. and Miles, S.B. (Eds). *Disaster Risk Reduction and Sustainable*, Sustainability (ISSN 2071-1050).
2008	Cova, T.J., Miller, H., Beard, K., Frank, A., Goodchild, M. (Eds.), *Geographic Information Science: 5th International Conference (GIScience 2008),* Park City, Utah. Lecture Notes in Computer Science 5266, Springer-Verlag, Berlin.

Journal articles
(Student advisees underlined)

2024	Zhang, X., Zhao, X., Baldwin, D., McBride, S., Bellizzi, J., Cochran, E.S., Luco, N., <u>Wood, M.</u>, Cova, T.J. Modeling protective action decision-making in earthquakes by using explainable machine learning and video data. *Scientific Reports*, 14(1), 5480.
2024	Forrister, A., Kuligowski, E.D., Sun, Y., Yan, X., Lovreglio, R. Cova, T.J., Zhao, X. Analyzing risk perception, evacuation decision and delay time: a case study of the 2021 Marshall Fire in Colorado. *Travel Behaviour and Society* 35, 100729
2023	Kuligowski, E.D., Waugh, N.A, Sutton, J., Cova, T.J. Ember alerts: assessing wireless emergency alert (WEA) messages in wildfires using the Warning Response Model. *Natural Hazards Review*, 24(2), 04023009.
2023	<u>Riyadh, A.M</u>., Cova, T.J., Medina, R.M., Collins, T.W. Comparing GIS-based flood resilience models in a developing nation: a case study in Bangladesh. *Natural Hazards Review*, 24(4).
2023	Xu, N., Lovreglio, R., Kuligowski, E.D., Cova, T.J., Nilsson, D., Zhao, X. Predicting and assessing wildfire evacuation decision making using machine learning: Findings from the 2019 Kincade Fire. *Fire Technology*, 59, 793-825.
2022	<u>Bhattarai, A.</u>, Cova, T.J., Brewer, S. Perceived recovery trajectories in post-earthquake Nepal – a visual exploration with self-organizing maps. IEEE Open Journal of the Computer Society, 3, 111-121.
2022	Wu, A., Yan, X., Kuligowski, E., Lovreglio, R., Nilsson, D., Cova, T.J., Xu, Y., Zhao, X. Wildfire evacuation decision

modeling using GPS data. International Journal of Disaster Risk Reduction, 83.

2022 — Xu, Y. Zhao, X., Lovreglio, R., Kuligowski, E., Nilsson, D., Cova, T.J., Yan, X. A highway vehicle routing dataset during the 2019 Kincade Fire evacuation. *Scientific Data*, 9, 608.

2022 — Zhao, X., Xu, Y., Lovreglio, R., Kuligowski, E. Nilsson, D., Cova, T.J., Wu, A., Yan, X. Estimating wildfire evacuation decision and departure timing using large-scale GPS data. Transportation Research Part D: Transport and Environment, 107.

2022 — Kar, A., Wan, N., Cova, T.J., Wang, H., Lizotte, S.L. Using GIS to understand the influence of Hurricane Harvey on spatial access to primary care. *Risk Analysis*, Online: https://doi.org/10.1111/risa.13806.

2021 — Cova, T.J., Li, D., Drews, F.A., Siebeneck, L.K. Toward simulating dire wildfire scenarios. *Natural Hazards Review*, 22(3): August.

2021 — Siebeneck, L.K. and Cova, T.J. The disaster return-entry process: a discussion of issues, strategies, and further research. *Disaster Prevention and Management: an International Journal*. https://doi.org/10.1108/DPM-07-2020-0243.

2019 — Li, D., Cova, T.J., Dennison, P.E. Why do we need a national address point database to improve wildfire public safety in the US? *International Journal of Disaster Risk Reduction, https://doi.org/10.1016/j.ijdrr.2019.101237*

2018 — Li, D., Cova, T.J., Dennison, P.E. Setting wildfire evacuation triggers by coupling fire and traffic simulation models: a spatio-temporal GIS approach. *Fire Technology, 55: 617-642*.

2017 — Li, D., Cova, T.J., Dennison, P.E. Setting wildfire evacuation triggers using reverse geocoding. *Applied Geography*, 84: 14-27.

2017 — Cova, T.J., Dennison, P.E., Li, D., Drews, F.A., Siebeneck, L.K., Lindell, M.K., Warning triggers in environmental hazards: who should be warned to do what and when? *Risk Analysis*, 37(4): 601-611.

2016 — Nicoll, K.A., Cova, T.J., Siebeneck, L.K., Martineau, E. Assessing "preparedness elevated": seismic risk perception and household adjustment in Salt Lake City, Utah. *Journal of Geography & Natural Disasters, 6: 168.*

2015 — Li, D., Cova, T.J., Dennison, P.E., A household-level approach to staging wildfire evacuation warnings using trigger modeling. *Computers, Environment, & Urban Systems,* 54:56-67.

2015 — Drews, F.A., Siebeneck, L.K., Cova, T.J., Information search and decision making in computer based wildfire simulations.

Journal of Cognitive Engineering and Decision Making. 9(3): 229-240.

2015 Hile, R. and Cova, T.J. (2015) Exploratory testing of an artificial neural network classification for enhancement of the social vulnerability index. *ISPRS International Journal of Geo-Information,* 4(4): 1774-1790.

2014 Drews, F.A., Musters, A., Siebeneck, L.K., and Cova, T.J. Environmental factors that affect wildfire protective-action recommendations. *International Journal of Emergency Management,* 10(2): 153-168*.*

2014 Siebeneck, L.K., and Cova, T.J. Risk communication after disaster: re-entry following the 2008 Cedar River Flood. *Natural Hazards Review,* 15: 158-166.

2014 Dennison, P.E., Fryer, G.K., and Cova, T.J., Identification of fire fighter safety zones using lidar, *Environmental Modelling and Software*, 59: 91-97.

2013 Fryer, G., Dennison, P.E. and Cova, T.J. Wildland firefighter entrapment avoidance: modeling evacuation triggers. *International Journal of Wildland Fire,* 22(7): 883-893.

2013 Cova, T.J., Theobald, D.M, Norman, J., and Siebeneck, L.K., Mapping wildfire evacuation vulnerability in the western US: the limits of infrastructure. *Geojournal*, 78(2): 273-285.

2012 Siebeneck, L.K. and Cova, T.J., Spatial and temporal variation in evacuee risk perception throughout the evacuation and return-entry process. *Risk Analysis*, 32(9), 1468-1480*.*

2011 Cova, T.J., Dennison, P.E., Drews, F.A., Modeling evacuate versus shelter-in-place decisions in wildfires. *Sustainability,* 3(10): 1662-1687.

2011 Cao, L., Cova, T.J., Dennison, P.E., and Dearing, M.D., Using MODIS imagery to predict hantavirus risk. *Global Ecology and Biogeography,* 20: 620-629.

2011 Kobayashi, T., Medina, R., and Cova, T.J., Visualizing diurnal population change in urban areas for emergency management. *Professional Geographer*, 63: 113-130.

2011 Larsen, J.C., Dennison, P.E., Cova, T.J., Jones, C. Evaluating dynamic wildfire evacuation trigger buffers using the 2003 Cedar Fire. *Applied Geography,* 3: 12-19.

2010 Pultar, E., Cova, T.J., Yuan, M., and Goodchild, M.F., EDGIS: a dynamic GIS based on space-time points. *International Journal of Geographical Information Science*, 24: 329-346.

2010 Moffatt, S.F. and Cova, T.J., Parcel-scale earthquake loss estimation with HAZUS: a case-study in Salt Lake County, Utah. *Cartography and Geographic Information Science*, 37: 17-29.

2010 Anguelova, Z., Stow, D.A., Kaiser, J., Dennison, P.E., Cova, T.J., Integrating fire behavior and pedestrian mobility models to assess potential risk to humans from wildfires within the

US-Mexico border zone. *Professional Geographer*, 62: 230-247.

2009 Cova, T.J., Drews, F.A., Siebeneck, L.K. and Musters, A., Protective actions in wildfires: evacuate or shelter-in-place? *Natural Hazards Review*, 10(4): 151-162.

2009 Pultar, E., Raubal, M., Cova, T.J., Goodchild, M.F. Dynamic GIS case studies: wildfire evacuation and volunteered geographic information. *Transactions in GIS*, 13: 84-104.

2008 Siebeneck, L.K., and Cova, T.J., An assessment of the return-entry process for Hurricane Rita 2005. *International Journal of Mass Emergencies and Disasters*, 26(2): 91-111.

2007 Goodchild, M.F., Yuan, M., and Cova, T.J., Towards a theory of geographic representation. *International Journal of Geographical Information Science*, 21(3): 239-260.

2007 Kim, T.H., and Cova, T.J., Tweening grammars: deformation rules for representing change between discrete geographic entities. *Computers, Environment & Urban Systems,* 31(3): 317-336.

2007 Dennison, P.E., Cova, T.J., and Moritz, M.A., WUIVAC: A wildfire evacuation trigger model applied in strategic scenarios. *Natural Hazards*, 40, 181-199.

2007 VanLooy, J. and Cova, T.J., A GIS-based index for comparing airline flight path vulnerability to volcanoes. *Professional Geographer*, 59(1): 74-86.

2006 Sutton, P.C., Cova, T.J., Elvidge, C., Mapping "Exurbia" in the conterminous U.S. using nighttime satellite imagery. *Geocarto International*, 21(2): 39-45.

2006 Kim, T.H., Cova, T.J., and Brunelle, A., Exploratory map animation for post-event analysis of wildfire protective action recommendations. *Natural Hazards Review*, 7(1): 1-11.

2005 Cova, T.J., Dennison, P.E., Kim, T.H., and Moritz, M.A., Setting wildfire evacuation trigger-points using fire spread modeling and GIS. *Transactions in GIS*, 9(4): 603-617.

2005 Cova, T.J., Public safety in the urban-wildland interface: Should fire-prone communities have a maximum occupancy? *Natural Hazards Review*, 6(3): 99-108.

2004 Cova, T.J., Sutton, P.A, Theobald, D.M., Exurban change detection in fire-prone areas with nighttime satellite imagery. *Photogrammetric Engineering & Remote Sensing,* 70: 1249-1257.

2003 Cova, T.J., and Johnson, J.P., A network flow model for lane-based evacuation routing. *Transportation Research Part A: Policy and Practice*, 37: 579-604.

2002 Cova, T.J. and Johnson, J.P., Microsimulation of neighborhood evacuations in the urban-wildland interface. *Environment and Planning A,* 34: 2211-2229.

2002 Cova, T.J. and Goodchild, M.F., Extending geographic representation to include fields of spatial objects.

	International Journal of Geographic Information Science, 16: 509-532.
2000	Cova, T.J., and Church, R.L., Contiguity constraints for single-region site search problems. *Geographical Analysis*, 32: 306-329.
2000	Church, R.L., and Cova, T.J., Mapping evacuation risk on transportation networks with a spatial optimization model. *Transportation Research Part C: Emerging Technologies*, 8: 321-336.
2000	Cova, T.J., and Church, R.L., Exploratory spatial optimization in site search: a neighborhood operator approach. *Computers, Environment, & Urban Systems*, 24: 401-419.
2000	Radke, J., Cova, T.J., Sheridan, M.F., Troy, A., Lan, M., and Johnson, R., Application challenges for GIScience: implications for research, education, and policy for risk assessment, emergency preparedness and response, *Urban and Regional Information Systems Association (URISA) Journal*, 12: 15-30.
1997	Cova, T.J., and Church, R.L., Modeling community evacuation vulnerability using GIS. *International Journal of Geographical Information Science*, 8: *763-784.*

Book Chapters and Sections

2024	Cova, T.J. and Drews, F.A. Wildfire protective actions and collective spatial cognition. *Collective Spatial Cognition,* D.M. Montello and K.M. Curtin (eds).
2019	Cova, T.J., *Evacuation*. Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires.
2017	Cova, T.J., Data model: o-fields and f-objects. The International Encyclopedia of Geography, 1-5.
2016	Cova, T.J., Evacuation Planning, in *Encyclopedia of Transportation*, SAGE Publications, M. Garrett (ed.), pp.
2004	Cova, T.J., and Conger, S., Transportation hazards, in *Handbook of Transportation Engineering*, M. Kutz (ed.), pp. 17.1-17.24.
1999	Cova, T.J., GIS in emergency management. In *Geographic Information Systems: Principles, Techniques, Applications, and Management*, Longley, P., Goodchild, M.F., Maguire D., Rhind D. (eds), pp. 845-858.

Conference Papers and Posters

2022	Wood M, Zhang X, Zhao X, McBride S, Luco N, Baldwin D, Cova T., Earthquake Early Warning: Toward Modeling Protective Actions. *Proceedings of the 12th National Conference in Earthquake Engineering, Earthquake Engineering Research Institute*, Salt Lake City, UT. 2022.

2019	Cova, T.J., Geosimulating hazard warning triggers: geometry, dynamics, and timing. *GeoCompuation '19*, September 19, Queenstown, New Zealand.
2015	Li, D., Cova, T.J., Dennison, P.E., An open-source software system for setting wildfire evacuation triggers. ACM SIGSPATIAL EM-GIS'15, November 3, 2015, Seattle, WA.
2013	Cova, T.J., Dennison, P.E., and Drews, F.A. Protective-action Triggers: Modeling and Analysis. *Natural Hazards Workshop*, University of Colorado, Boulder, July (poster).
2012	Cova, T.J., Dennison, P.E., and Drews, F.A. Protective-action Triggers. *Natural Hazards Workshop*, University of Colorado, Boulder, July (poster).
2012	Cova, T.J., Dennison, P.E., and Drews, F.A. Protective-action Triggers. National Science Foundation-CMMI Innovation Conference, Boston, July (poster).
2009	Siebeneck, L.K. and Cova, T.J. Current Research at the Center for Natural and Technological Hazards. *Natural Hazards Workshop*, U. of Colorado, Boulder, July (poster).
2008	Cova, T.J. et al., Protective actions in wildfire: the incident commander perspective. *Pacific Coast Fire Conference*, San Diego, November (poster).
2005	Yuan, M., Goodchild, M.F., Cova, T.J., Towards a general theory of geographic representation in GIS (poster*). Conference on Spatial Information Theory (COSIT) 2005*, Ellicottville, New York, September (poster).
2005	Kim, T.H., and Cova, T.J., Tweening Grammars: Deformation Rules for Representing Change between Discrete Geographic Entities*. Geocomputation 2005,* Ann Arbor, MI, August*.*
2001	Cova, T.J. and Johnson, J.P., Evacuation analysis and planning tools inspired by the East Bay Hills Fire, *California's 2001 Wildfire Conference: 10 years after the 1991 East Bay Hills Fire*, Oakland, October.
2001	Hepner, G.F., Cova, T.J., Forster, R.R., and Miller, H.J., Use of remote sensing and geospatial analysis for transportation hazard assessment: an integrated university, government and private sector consortium, *IEEE/ISPRS Joint Workshop on Remote Sensing and Data Fusion over Urban Areas Proceedings*, IEEE-01EX482,Rome, Italy, pp.241-244.
2000	Atwood, G., and Cova, T.J., Using GIS and linear referencing to analyze the 1980s shorelines of Great Salt Lake, Utah, USA. *4th International Conference on Integrating GIS and Environmental Modeling (GIS/EM4): Problems, Prospects and Research Needs*. Banff, Alberta, Canada, September 2-8.
1997	Cova, T.J., and Church, R.L., An algorithm for identifying nodal clusters in a transportation network. *University Consortium for Geographic Information Science (UCGIS) Summer Retreat*, Bar Harbor, Maine, June 15-21.

1995 Cova, T.J., and Church, R.L., A spatial search for neighborhoods that may be difficult to evacuate, *Proceedings GIS/LIS '95*, ACSM/ASPRS, Nashville, TN, vol. 1, 203-212.

1995 Goodchild, M.F., Cova, T.J. and Ehlschlaeger, C., Mean geographic objects: extending the concept of central tendency to complex spatial objects in GIS, *Proceedings GIS/LIS '95*, ACSM/ASPRS, Nashville, TN, vol. 1, 354-364.

1994 Cova, T.J. and Goodchild, M.F., Spatially distributed navigable databases for intelligent vehicle highway systems, *Proceedings GIS/LIS '94*, ACSM, Phoenix, AZ, 191-200.

Other Publications

2018 Wei, R., Golub, A., Wang, L., Cova, T.J. *Evaluating and enhancing public transit systems for operational efficiency and access equity.* TREC Final Report, NITC-RR-1024.

2018 Wei, R., Golub, A., Wang, L., Cova, T.J. *Integrated performance measures: transit equity & efficiency*. TREC Final Report, NITC-RR-1024.

2008 Siebeneck, L.K. and Cova, T.J. Risk perception associated with the evacuation and return-entry process of the Cedar Rapids, Iowa flood. Quick Response Research Report, Natural Hazards Center, University of Colorado, Boulder.

2006 Cova, T.J., *Concerning Stonegate and Public Safety*. North County Times, San Diego, California, Nov. 3.

2002 Cova, T.J., Like a bat out of hell: simulating wildfire evacuations in the urban interface, *Wildland Firefighter Magazine*, November, 24-29.

2000 Cova, T.J., When all hell breaks loose: firestorm evacuation analysis and planning with GIS, *GIS Visions Newsletter*, August, The GIS Cafe.

2000 Cova, T.J. (2000) Wildfire evacuation. *New York Times letter to the Editor*, June 6.

1996 Church, R., Cova, T., Gerges, R., Goodchild, M., Conference on object orientation and navigable databases: report of the meeting. *NCGIA Technical Report 96-9.*

1994 Church, R., Coughlan, D., Cova, T., Goodchild, M., Gottsegen, J., Lemberg, D., Gerges, R., Caltrans Agreement 65T155, Final Report, *NCGIA Technical Report 94-6*.

Invited Lectures, Presentations and Participation

2024 "On timing wildfire evacuations." Risk Communication Workshop. National Academy of Sciences. Virtual. Feb. 5.

2024 "Wildfire public safety under climate change: preparing for the unprecedented." GROW Colloquium. Department of Geography. University of Utah.

2023	"Public safety in the wildland-urban interface." Earth Lab, University of Colorado, Jan. 31 (virtual).
2020	"Evacuation planning for dire scenarios." Preparing for Disaster: Workshop on Advancing WUI Resilience. National Fire Protection Agency (NFPA), San Francisco, CA
2019	"Public safety in the wildland-urban interface." Department of Geography, University of Alabama, Tuscaloosa, November.
2019	"Public safety in the wildland-urban interface." Department of Geography, Texas A&M (TAMU), College Station, February.
2018	"ESRI Science Symposium." Panelist, ESRI Conference, San Diego, July.
2018	"Public safety in the wildland-urban interface." Living with Fire in California's Coast Ranges, Sonoma, May.
2017	"Improving situational awareness in wildfire evacuations with volunteered geographic information." NSF IBSS/IMEE Summer Workshop, San Diego, August.
2014	"Modeling adaptive warnings with geographic trigger points." Department of Geography, SDSU, San Diego, CA, April 18.
2013	"Wildfires and geo-targeted warnings." Geo-targeted Alerts and Warnings Workshop. *National Academy of Sciences*, Washington DC, February 21-22.
2012	"Evacuation planning in the wildland-urban interface." California Joint Fire Science Program, Webinar Speakers Series, September.
2010	"Evacuating threatened populations in disasters: space, time & information." University of Minnesota, Spatial Speakers Series (Geography/CS/CE), April.
2009	"The art and science of evacuation modeling." Utah Governor's Conf. in Emergency Management, Provo, May.
2008	"GIScience and public safety." Brigham Young University, November.
2007	"Fire, climate and insurance." Panel Discussion. Leonardo Museum, Salt Lake City, November.
2007	"GIScience and public safety." University of Northern Iowa, April.
2006	"Evacuation and/or Shelter in Place." Panel Discussion, Firewise Conference: Backyards & Beyond, Denver, CO, Nov.
2006	"Evacuation modeling and planning." Colorado Springs Fire Department, Colorado Springs, CO, October.
2006	"Evacuation modeling and planning." Sante Fe Complexity Institute, Sante Fe, NM, August.
2006	"Evacuation modeling and planning." Colorado Wildfire Conference. Vail, CO, April, $1000.
2006	"Dynamic GIS: in search of the killer app." Center for Geocomputation, National U. of Ireland, Maynooth, April.
2006	"Setting wildfire evacuation trigger points with GIS." University Consortium for Geographic Information Science, Winter meeting, Washington, DC.

2005	"Setting wildfire evacuation trigger points with GIS." Pennsylvania State University, State College, PA, November.
2004	"The role of scale in ecological modeling," NSF PI meeting for Ecology of Infectious Diseases, Washington D.C., September.
2004	"The 2003 Southern California wildfires: Evacuate and/or or shelter-in-place," Natural Hazards Workshop, Boulder, CO.
2004	"When all hell breaks loose: new methods for wildfire evacuation planning," colloquium, Department of Geography, University of Denver, February.
2004	"When all hell breaks loose: new methods for wildfire evacuation planning," Colorado Governor's Conference and Colorado Emergency Management Association (CEMA) Conference, Boulder, CO, February.
2004	"When all hell breaks loose: new methods for wildfire evacuation planning," colloquium, Department of Geography, University of California Los Angeles, February.
2003	"When all hell breaks loose: new methods for wildfire evacuation planning," colloquium, Natural Resources Ecology Lab (NREL), Colorado State University, April.
2003	"When all hell breaks loose: new methods for wildfire evacuation planning," Departmental colloquium, Department of Geography, University of Arizona, January.
2002	"When all hell breaks loose: new methods for wildfire evacuation planning," Departmental colloquium, Department of Geography, Western Michigan University, November.
2001	"Regional evacuation analysis in fire-prone areas with limited egress," Departmental colloquium, Department of Geography, University of Denver, May.
2000	"Integrating Site Search Models and GIS," Colloquium, Department of Geography, Arizona State University, Feb.
1999	"Site Search Problems and GIS," Colloquium, Department of Geography, University of Utah.
1996	"A spatial search for neighborhoods that may be difficult to evacuate," Colloquium, Department of Geography, UC Santa Barbara.
1995	"A spatial search for neighborhoods that may be difficult to evacuate," Regional Research Lab, Bhopal, India.
1995	"A spatial search for neighborhoods that may be difficult to evacuate," Indian Institute of Technology, Bombay. India.

Papers Presented at Professional Conferences

2021	Cova, T.J., Planning for dire wildfire scenarios. Association of American Geographers Annual Meeting, April (virtual).
2020	Cova, T.J, Public safety in the wildland-urban interface. Association of American Geographers Annual Meeting, Denver, CO, April.

2018	Cova, T.J., GIScience & Emergency Management: where do we go from here? Association of American Geographers Annual Meeting, New Orleans, LA, April.
2017	Cova, T.J., Simulating warning triggers. Association of American Geographers Annual Meeting, Boston, MA, CA, April.
2016	Cova, T.J., Spatio-temporal representation in modeling evacuation warning triggers. Association of American Geographers Annual Meeting, San Francisco, CA, March.
2015	Cova, T.J. and Jankowski, P., Spatial uncertainty in object-fields: the case of site suitability. Association of American Geographers Annual Meeting, Chicago, IL, April.
2014	Cova, T.J. and Jankowski, P., Spatial uncertainty in object-fields: the case of site suitability. International Conference on Geographic Information Science (GIScience '14), Vienna, Austria, September.
2013	Cova, T.J., Dennison, P.E. and Drews, F.A., Protective-action triggers: modeling and analysis. *Association of American Geographers Annual Meeting*, Los Angeles, CA, April.
2012	Cova, T.J., Dennison, P.E. and Drews, F.A., Protective-action triggers. Poster presented at the Natural Hazards Workshop, University of Colorado, Boulder, July.
2012	Cova, T.J., Dennison, P.E. and Drews, F.A., Protective-action triggers. Poster presented at the NSF CMMI Innovation Conference, Boston, July.
2012	Cova, T.J., Dennison, P.E. and Drews, F.A., Protective-action triggers, *Association of American Geographers Annual Meeting,* New York, NY, February.
2011	Cova, T.J., Modeling stay-or-go decisions in wildfires, *Association of American Geographers Annual Meeting,* Seattle, WA, April.
2010	Cova, T.J., Theobald, D.M. and Norman, III, J., Mapping wildfire evacuation vulnerability in the West, *Association of American Geographers Annual Meeting,* Wash. D.C., April.
2010	Cova, T.J., and Van Drimmelen, M.N., Family gathering in evacuations: the 2007 Angora Wildfire as a case study. *National Evacuation Conference*, New Orleans, February.
2010	Siebeneck, L.K., Cova, T.J., Drews, F.A., and Musters, A. Evacuation and shelter-in-place in wildfires: The incident commander perspective. *Great Basin Incident Command Team Meetings*, Reno, April.
2009	Cova, T.J. et al., Protective action decision making in wildfires: the incident commander perspective. *Association of American Geographers Annual Meeting,* Las Vegas, March.
2009	Siebeneck, L.K. and Cova, T.J. Using GIS to explore evacuee behavior before, during and after the 2008 Cedar Rapids Flood. *Association of American Geographers Annual Meeting*, Las Vegas, March.

2009 Lindell, M.K., Prater, C.S., Siebeneck, L.K. and Cova, T.J. Hurricane Ike Reentry. *National Hurricane Conference*, Austin, March.

2008 Cova, T.J., Simulating evacuation shadows, *Association of American Geographers Annual Meeting,* Boston, April.

2007 Cova, T.J., An agent-based approach to modeling warning diffusion in emergencies, *Association of American Geographers Annual Meeting,* San Francisco, March.

2006 Cova, T.J., New GIS-based measures of wildfire evacuation vulnerability and associated algorithms. *Association of American Geographers Annual Meeting,* Denver, March.

2005 Cova, T.J., Dennison, P.E., Kim, T.H., and Moritz, M.A., Setting wildfire evacuation trigger-points using fire spread modeling and GIS. *Association of American Geographers Annual Meeting,* Denver, March.

2004 Cova, T.J., Sutton, P.C., and Theobald, D.M. Light my fire proneness: residential change detection in the urban-wildland interface with nighttime satellite imagery, *Association of American Geographers Annual Meeting*, Philadelphia, March.

2004 Cova, T.J. and Johnson, J.P., A network flow model for lane-based evacuation routing. *Transportation Research Board (TRB) Annual Conference*, Washington, D.C., January.

2003 Cova, T.J. Lane-based evacuation routing, *Association of American Geographers Annual Meeting*, New Orleans, March.

2002 Cova, T.J., Extending geographic representation to include fields of spatial objects, *GIScience 2002*, Boulder, September.

2002 Husdal, J. and Cova, T.J., A spatial framework for modeling hazards to transportation systems, *Association of American GeographersAnnual Meeting,* Los Angeles, March.

2001 Cova, T.J. and Johnson, J.P., Evacuation analysis and planning tools inspired by the East Bay Hills Fire, *California's 2001 Wildfire Conference: 10 years after the 1991 East Bay Hills Fire*, Oakland, October.

2001 Cova, T.J., Husdal, J., Miller, H.J., A spatial framework for modeling hazards to transportation networks, *Geographic Information Systems for Transportation Conference (GIS-T 2001*), Washington DC, April.

2001 Cova, T.J., Miller, H.J., Husdal, J., A spatial framework for modeling hazards to transportation systems, *Association of American Geographers Annual Meeting*, New York, New York, February.

2000 Cova, T.J., Church, R.L., Goodchild, M.F., Extending geographic representation to include fields of spatial objects, *GIScience 2000,* Savannah, Georgia, November.

2000 Cova, T.J. Microscopic simulation in regional evacuation: an experimental perspective, *Association of American*

	Geographers Annual Meeting, Pittsburgh, Pennsylvania, March.
1999	Cova, T.J., and Church, R.L., "Exploratory spatial optimization and site search: a neighborhood operator approach," *Geocomputation '99*, Mary Washington College, Fredricksburg, Virginia.
1999	Cova, T.J., and Church, R.L., "Integrating models for optimal site selection with GIS: problems and prospects," *Association of American Geographer Annual Meeting*, Honolulu, Hawaii, March 29.
1998	Cova, T.J., and Church, R.L., "A spatial analytic approach to modeling neighborhood evacuation egress," *Association of American Geographers Annual Meeting,* Boston, Massachusetts.
1997	Church, R.L., and Cova, T.J., "Location search strategies and GIS: a case example applied to identifying difficult to evacuate neighborhoods," *Regional Science Association Annual Meeting*, November, Buffalo.
1997	Cova, T.J. and Church, R.L., "An algorithm for identifying nodal clusters in a transportation network," *University Consortium for Geographic Information Science (UCGIS) Summer Retreat*, Bar Harbor, June.
1996	Cova, T.J., Church, R.L., "A spatial search for difficult neighborhoods to evacuate using GIS," *GIS and Hazards Session*, *Association of American Geographers Annual Meeting*, Charlotte, April.
1995	Cova, T.J., Church, R.L., "A spatial search for neighborhoods that may be difficult to evacuate," *GIS/LIS '95*, Nashville, November.
1995	Goodchild, M.F., Cova, T.J. and Ehlschlaeger, C., "Mean geographic objects: extending the concept of central tendency to complex spatial objects in GIS," *GIS/LIS '95*, Nashville, November.
1994	Cova, T.J. and Goodchild, M.F., "Spatially distributed navigable databases for intelligent vehicle highway systems," *GIS/LIS '94*, Phoenix, November.

Grants

Externally funded

2024 -	Cova, T.J. (Collaborative research) *Household Response to Wildfire: Integrating Behavioral Science and Evacuation Modeling to Improve Community Wildfire Resilience.* NSF, Division of Civil, Mechanical & Manufacturing Innovation (CMMI): Humans, Disasters & the Built Environment (HDBE), $20,260.

2021 - 2023	Zhao, X. and Cova, T.J. (PI). *Determining Optimal Protective Actions in Earthquakes with Data Science Techniques*. National Science Foundation and USGS. $146,137.
2021 - 2023	Collins, T.W., Grineski, S.E., Cova.T.J (PI), REU Supplemental Funds (Grant: Enabling the Next Generation of Hazards Researchers). NSF, Division of Civil, Mechanical & Manufacturing Innovation (CMMI): Humans, Disasters & the Built Environment (HDBE), $16,000.
2019 –2023	Cova, T.J. (PI), Collins, T.W., Grineski, S.E., Norton, T., *Enabling the Next Generation of Hazards Researchers*. National Science Foundation. Division of Civil, Mechanical & Manufacturing Innovation (CMMI): Humans, Disasters & the Built Environment (HDBE), $480,634.
2018 –2023	Smith, K. (PI), Cova, T.J., Waitzman, N., Perlich, P., Kowaleski-Jones, L. Research Data Center: Wasatch Front Research Data Center. National Science Foundation, Division of Social Economic Sciences, $298,625.
2017 – 2019	Shoaf, K. (PI) and Cova, T.J. *RAPID: Evacuation Decision-making process of Hospital Administrators in Hurricane Harvey*. National Science Foundation, Civil Mechanical and Manufacturing Innovation – Infrastructure Management and Extreme Events, $49,301.
2011 – 2015	Cova, T.J. (PI), Dennison, P.E. and Drews, F.A., *Protective action triggers*. National Science Foundation, Civil Mechanical and Manufacturing Innovation – Infrastructure Management and Extreme Events, $419,784.
2012 – 2014	Cova, T.J. (PI), *State Hazard Mitigation Mapping II.* Utah Division of Emergency Management, $51,608.
2011 – 2012	Cova, T.J. (PI), *State Hazard Mitigation Mapping.* Utah Division of Emergency Management, $51,608.
2007 – 2010	Cova, T.J. (PI) and Drews, F.A. *Protective-action decision making in wildfires.* National Science Foundation, Civil Mechanical and Manufacturing Innovation – Infrastructure Management and Extreme Events, $288,438.
2004– 2006	Yuan, M. (PI), Goodchild, M.F., and Cova, T.J. *Integration of geographic complexity and dynamics into geographic information systems,* National Science Foundation, Social and Behavioral Science—Geography and Spatial Sci., $250,000.
2003– 2004	Cova, T.J. (PI) *Mapping the 2003 Southern California Wildfire Evacuations*, National Science Foundation, Small Grants for Exploratory Research (SGER), CMMI-IMEE, $14,950.
2003 –2008	Dearing, M.D. (PI), Adler, F.R., Cova, T.J., and St. Joer, S. *The effect of anthropogenic disturbance on the dynamics of Sin Nombre*, National Science Foundation and NIH, Ecology of Infectious Diseases, $1,933,943.
2000–2004	Hepner, G.F. (PI), Miller, H.J., Forster, R.R., and Cova, T.J. *National Consortium for Remote Sensing in Transportation:*

	Hazards (NCRST-H), U.S. Department of Transportation, $437,659.
2000–2001	Cova, T.J. (PI) *Modeling human vulnerability to environmental hazards*, Salt Lake City and Federal Emergency Management Agency (FEMA)*,* $20,000.

<u>Internally funded</u>

2004	Cova, T.J. (PI) and Sobek, A. *DIGIT Lab GPS Support*, U. of Utah Technology Instrumentation Grant, $15,000.
2003	Cova, T.J. (PI) *New methods for wildfire evacuation analysis*, Proposal Initiative Grant, College of Social and Behavioral Science, University of Utah, $4000.
1999	Cova, T.J. (PI) *Microscopic traffic simulation of regional evacuations: computational experiments in a controlled environment*, Faculty Research Grant (FRG), University Research Committee, University of Utah, $5980.
1999	Cova, T.J. (PI) *Regional evacuation analysis in fire prone areas with limited egress*, Proposal Initiative Grant, College of Social and, Behavioral Science, University of Utah, $4000.

Media Outreach

2023	Simon, M. "Cities Aren't Supposed to Burn Like This Anymore—Especially Lahaina." WIRED Magazine. Aug 15.
2023	Nyce, C.M. "Maui's Fire Risk Was Glowing Red." The Atlantic, Aug 19.
2023	Cagle, S. "The quest to build wildfire-resistant homes." Technology Review. April 18.
2023	Hirji, Z. "Protective steps could help reduce wildfires." Star Advertiser in Hawaii, Sept 2.
2022	Chen, I. "The terrifying choices created by wildfires." *The New Yorker*. September 6.
2022	Nyce, C.M. "The world needs to start planning for the fire age. *The Atlantic*. July 28.
2022	Staff. "Human remains found near suspected origin of Colorado Wildfire." *The Guardian*, Jan. 5th.
2022	Prentzel, O. and Najmabadi, S. "After-action report finds numerous shortcomings in Marshall Fire emergency communications. *The Colorado Sun*, June 21.
2022	Najmabadi, S. and Prentzel, O. "Emergency alerts were a problem long before the Marshall Fire, reports show." *The Colorado Sun.* Feb. 21.
2022	Miller, J. "In a major wildfire: how would Park City evacuate?" *Salt Lake Tribune*, July 28.
2022	Anderson, S.S. and Geiger, G. "Planned Greek refugee camp is in high-risk fire zone next to landfill." *OpenDemocracy.net*, Feb. 15.

2022	Peipert, T. "Remains found, yet most people escaped Colorado fire." *ABC news*, Jan. 5.
2021	Beck, M. "Community wildfire plans don't reflect stronger, faster wildfires." May 26.
2021	Najmabadi, S. "4000 cars, one exit: residents in growing neighborhoods worry their new neighbors could crowd wildfire escape routes." The Colorado Sun, Nov. 30.
2021	Glen, S. "Think outside the box: U of U researchers look at wildfire evacuations." May 25.
2021	Williams, C. "Is Utah prepared for a major wildfire?" KSL news, June 5.
2021	Shinn, M. "Long wildfire evacuation delays for parts of Colorado Springs shown in models." Colorado Springs Gazette, Nov 22.
2020	Harris, J. "Dangerous conditions, stretched resources worry firefighters in the West." Sep 11.
2020	Carlson, C. "COVID-19: With wildfires, California evacuation shelters may look more like a campground." Ventura County Star, May 14.
2019	Loenard, D. "As Australian bushfires rage: country offers lessons for the wildfire prone western U.S." Washington Post, Nov 23.
2019	Marshall, A. "The Delicate Art—and Evolving Science—of Wildfire Evacuations." WIRED magazine, Oct. 31.
2019	Cagle, S. "California's fire season has been bad. But it could have been much worse." The Guardian, Nov. 1.
2019	Mooallem, J. "We have fire everywhere." NY Times, July 31.
2019	Krieger, L., "Camp Fire: when survival means shelter." *San Jose Mercury News*, Feb. 3.
2018	Romero, S., Arango, T., and Fuller, T. "A frantic call, a neighbor's knock, but few official alerts as wildfire closed in." *New York Times*, Nov. 21.
2018	Serna, J., St. John, P., Lin, R-G. "Disaster after disaster, California keeps falling short on evacuating people from harm's way." *Los Angeles Times*, Nov. 28.
2018	Simon, M. "How California needs to adapt to survive future fires." *Wired Magazine*, Nov. 15.
2018	O'Neill, S. "Year-round wildfire season means always living evacuation ready." Morning Addition, *National Public Radio*, Sep. 25.
2017	Mortensen, M. "System used for Amber Alerts can also warn of other emergencies." Utah Public Radio, Dec. 19.
2013	Ryman, A. and Hotstege, S. "Yarnell evacuation flawed and chaotic, experts say." *Arizona Republic and USA Today*, Nov.
2013	Bryson, D., and Campoy, A. "Quick fire response pays off: Colorado credits early alerts with limiting deaths from state's worst-ever blaze." *The Wall Street Journal*, June 17.

2013	Beri, A. "Due to the sequester: people are going to be unsafe, homes are going to burn." *Tampa Bay Times*, Feb.
2012	Zaffos, J. "What the High Park Fire can teach us about protecting homes." *High Country News*, July.
2012	Meyer, J.P. and Olinger, D., "Tapes show Waldo Canyon fire evacuations delayed two hours." *The Denver Post*. July.
2011	Siegel L, and Rogers, N. "Monitoring killer mice from space." *USA Today*, *SLTribune, Fox 13 News, KCPW*, Feb. 15.
2010	Cowan, J., "Esplin defends stay or go policy." *Australian Broadcast Corporation (ABC)*, April 30.
2010	Bachelard, M., "Should the fire-threatened stay or go? That is still the question." *The Age*, Australia, May 2.
2008	Boxall, B., "A Santa Barbara area canyon's residents are among many Californian's living in harm's way in fire-prone areas." *Los Angeles Times*, July 31.
2007	Welch, W.M. et al., "Staggering numbers flee among fear and uncertainty." *USA Today*, Oct. 24.
2007	Krasny, M., "Angora Wildfire Panel Discussion." *KQED Radio*, San Francisco, June 27.
2004	Wimmer, N., "Growing number of communities pose fire hazard." *KSL Channel 5,* Salt Lake City, July 22.
2004	Disaster News Network, "The face of evacuation procedures might be changing as a result of lessons learned from last year's fierce wildfires in California."
2004	Perkins, S., "Night space images show development." *Science News*, Week of April 3rd, 165 (14): 222.
2003	Keahey, J., "Canyon fire trap feared." *SL Tribune*, June.

TEACHING AND MENTORING

Undergraduate Courses

Geoprogramming (~30 students)
Introduction to Geographic Information Systems (~60 students).
Human Geography (~40 students).
Geography of Disasters and Emergency Management (~20 students).
Methods in GIS (~40 students).
Business & Disaster Management (~70 students)

Graduate Courses

GIS & Python (~20 students)
Spatial Databases (~30 students)
Seminars: Hazards Geography, Transportation, Vulnerability, GIScience.

Graduate Student Advising

Chaired Ph.D. Committees

2021-	Mojtoba, A.R.	Hazard resilience.
2020-	Bhattari, A.	Disaster recovery for the Nepal earthquake.
2023	Wood, M.	Cascading/compound hazards and disasters.
2013	Coleman, A.	Geographic data fusion for disaster management (defended).
2016	Li, D.	Modeling wildfire evacuation triggers as a coupled natural-human system (Asst. Professor South Dakota State University)
2010	Siebeneck, L.	Examining the geographic dimensions of risk perception, communication and response during the evacuation and return-entry process. (Assoc. Professor, U. of North Texas)
2010	Cao, L.	Anthropogenic habitat disturbance and the dynamics of hantavirus using remote sensing, GIS, and a spatially explicit agent-based model. (Postdoc, Kelly Lab, UC Berkeley)

Chaired M.S. committees

2023	Roberts, S.	Wildfire evacuation routing.
2021	Mojtoba, A.	Flood resilience in Dhaka, Bangladesh
2020	Huang, Z.	Autonomous vehicles in hurricane evacuation.
2019	Kar, A.	Optimal vehicle routing in disasters
2017	Yi, Y.	A web-GIS application for house loss notification in wildfires
2017	Latham, P.	Evaluating the effects of snowstorm frequency and depth on skier behavior in Big Cottonwood Canyon, Utah
2016	Bishop, S.	Spatial access and local demand for emergency medical services in Utah
2015	Hile, R.	Exploratory testing of an artificial network classification for enhancement of a social vulnerability index
2015	Unger, C.	Creating spatial data infrastructure to facilitate the collection and dissemination of geospatial data to aid in disaster management
2014	Klein, K.	Tracking a wildfire in areas of high relief using volunteered geographic information: a viewshed application

2012	Amussen, F.	Greek island social networks and the maritime shipping dominance they created (technical report)
2012	Martineau, E.	Earthquake risk perception in Salt Lake City, Utah
2010	Smith, K.	Developing emergency preparedness indices for local government
2010	VanDrimmelen, M.	Family gathering in emergencies: the 2007 Angora Wildfire as a case study
2007	Pultar, E.	GISED: a dynamic GIS based on space-time points
2007	Siebeneck, L.	An assessment of the return-entry process for Hurricane Rita, 2005
2007	Johnson, J.	Microsimulation of neighborhood-scale evacuations
2004	Chang, W.	An activity-based approach to modeling wildfire evacuations

Membership on Ph.D Committees

2024	Choi, M.	Agent-based modeling of crowds.
2023	Xiong, N.	Inequality in China.
2017	Campbell, M.	Wildland firefighter travel times
2016	Zhang, L.	Economic geography of China
2015	Huang, H.	Spatial analysis and economic geography
2014	Lao, H.	Spatial analysis, GIS, and economic geography
2013	Burgess, A.	Hydrologic implications of dust in snow in the Upper Colorado River Basin
2012	Davis, J.	
2012	Li, Y.	
2011	Hadley, H.	Transit sources of salinity loading in the San Rafael River, Upper Colorado River Basin, Utah
2009	Medina, R.	Use of complexity theory to understand the geographical dynamics of terrorist networks
2008	McNeally, P.	Holistic geographical visualization of spatial data with applications in avalanche forecasting
2008	Sobek, A.	Generating synthetic space-time paths using a cloning algorithm on activity behavior data
2007	Clay, C.	Biology
2006	Backus, V.	Assessing connectivity among grizzly bear populations near the U.S.-Canada border
2006	Atwood, G.	Shoreline superelevation: evidence of coastal processes of Great Salt Lake, Utah
2006	White, D.	Chronic technological hazard: the case of agricultural pesticides in the Imperial Valley, California

2005	Ahmed, N.	Time-space transformations of geographic space to explore, analyze and communicate transportation systems
2004	Shoukrey, N.	Using remote sensing and GIS for monitoring settlement growth expansion in the eastern part of the Nile Delta Governorates in Egypt (1975-1998)
2004	Hernandez, M.	A Procedural Model for Developing a GIS-Based Multiple Natural Hazard Assessment: Case Study-Southern Davis County, Utah
2003	Wu, Y-H.	Dynamic models of space-time accessibility
2003	Hung, M.	Using the V-I-S model to analyze urban environments from TM imagery
2002	Baumgrass, L.	Initiation of snowmelt on the North Slope of Alaska as observed with spaceborne passive microwave data

Membership on M.S. Committees

2015	Farnham, D.	Food security and drought in Ghana
2015	Fu, L.	Analyzing route choice of bicyclists in Salt Lake City
2014	Li, X.	Spatial representation in the social interaction potential metric: an analysis of scale and parameter sensitivity
2013	Johnson, D.	Parks, Recreation & Tourism
2012	Fryer, G.	Wildland firefighter entrapment avoidance: developing evacuation trigger points utilizing the WUIVAC fire spread model.
2011	Groeneveld, J.	An agent-based model of bicyclists accessing light-rail in Salt Lake City
2011	Matheson, D.S.	Evaluating the effects of spatial resolution on hyperspectral fire detection and temperature retrieval
2010	Larsen, J.	Analysis of wildfire evacuation trigger-buffer modeling from the 2003 Cedar Fire, California.
2010	Smith, G.	Development of a flash flood potential index using physiographic data sets within a geographic information system
2010	Song, Y.	Visual exploration of a large traffic database using traffic cubes
2010	Evans, J.	Parks, Recreation & Tourism
2008	Naisbitt, W.	Avalanche frequency and magnitude: using power-law exponents to investigate snow-avalanche size proportions through time and space.
2008	Kim, H.C.	Civil Engineering

2007	Gilman, T.	Evaluating transportation alternatives using a time geographic accessibility measure
2004	Baurah, A.	An integration of active microwave remote sensing and a snowmelt runoff model for stream flow prediction in the Kuparak Watershed, Arctic Alaska
2004	Bosler, J.	A Development Response to Santaquin City's Natural Disasters.
2004	Bridwell, S.	Space-time masking techniques for privacy protection in location-based services
2004	Deeb, E.	Monitoring Snowpack Evolution Using Interferometric Synthetic Aperture Radar (InSAR) on the North Slope of Alaska, USA
2004	Sobek, A.	Access-U: a web-based navigation tool for disabled students at the University of Utah
2003	Barney, C.	Locating hierarchical urban service centers along the Wasatch Front using GIS location-allocation algorithms
2002	Koenig, L.	Evaluation of passive microwave snow water equivalent algorithms in the depth hoar dominated snowpack of the Kuparuk River Watershed, Alaska, USA
2002	Larsen, C.	Family & Consumer Studies
2002	Krokoski, J.	Geology & Geophysics
2000	Granberg, B.	Automated routing and permitting system for Utah Department of Transportation
2000	Bohn, A.	An integrated analysis of the Tijuana River Watershed: application of the BASINS model to an under-monitored binational watershed

Graduate student awards

2015	R. Hile., M.A. Geography: Jeanne X. Kasperson Award, Hazards, Risk & Disasters Specialty Group, Association of American Geographers.
2015	D. Li, Ph.D. Geography: Jeanne X. Kasperson Award, Hazards, Risk & Disasters Specialty Group, Association of American Geographers.
2012	K. Klein, M.A. Geography: *Jeanne X. Kasperson Award*, Hazards, Risk & Disasters Specialty Group, Association of American Geographers.
2010	L. Cao, Ph.D. Geography: *Student Paper Award*, Spatial Analysis and Modeling (SAM) Specialty Group, Association of American Geographers.
2008	L. Siebeneck, M.A. Geography: *Jeanne X. Kasperson Award*, Hazards Specialty Group, Association of American Geographers.

2007	E. Pultar, M.A. Geography: *Best Paper*, GIS Specialty Group, Association of American Geographers.
2006	J. VanLooy (not primary advisor): *Best Paper*, Rocky Mountain Regional Meeting, Association of American Geographers.

Undergraduate Mentoring and Advising

2015	Mentor, Marli Stevens, Undergraduate Research Opportunity Program: "Margin of Licensed Dog and Cat Populations and Adoptions from Animal Shelters in Utah in 2013-2014."
2015—	Advisor, Undergraduate Hazards & Emergency Management Certificate students (~10 students so far).
2006—2010	Advisor, Stewart Moffat, Honor's B.S. in Undergraduate Studies: Disaster Management (published journal article).
2005—2007	Advisor, Brian Williams, B.S. in Undergraduate Studies: Comprehensive Emergency Management.
2001—	Advisor, Undergraduate GIS Certificate Students (> 100 students).

Junior Faculty Mentoring

2017—	Andrew Linke, Department of Geography, University of Utah
2014—2017	Ran Wei, Department of Geography, University of Utah
2011—2014	Steven Farber, Department of Geography, University of Utah
2009—2011	Scott Miles, Dept. of Geography, Western Washington U.
2009—2011	Timothy W. Collins, Department of Sociology, UT El Paso

SERVICE

Referee Duties

Journals
Applied Geography
Annals of the Association of American Geographers
Cartographica
Computers Environment & Urban Systems
Disasters
Environmental Hazards: Policy and Practice
Geographical Analysis
Geoinformatica
International Journal of Geographical Information Science
Journal of Geographical Systems

Journal of Transport Geography
Natural Hazards
Natural Hazards Review
Networks and Spatial Economics
Photogrammetric Engineering and Remote Sensing
Professional Geographer
Society & Natural Resources
Transportation Research A: Policy & Practice
Transportation Research B: Methodological
Transportation Research C: Emerging Technologies
Transactions in GIS

National Science Foundation Panels
Decision Risk and Uncertainty (1)
Geography and Spatial Science, Doctoral Dissertation Improvement Grant (4)
Civil & Mech. Systems – Infrastructure Management and Extreme Events (2)
Civil & Mech. Systems - Rural Resiliency (1)
NSF and NIH: Big Data (1)
Hazards SEES: Type 2 (1)

Proposals
Center for Disaster Management & Humanitarian Assistance
Faculty Research Grants, University of Utah (3)

External Promotional Reviews
Full Professor (5), Associate Professor (12)

Activities at Professional Conferences

2000 – 2020	**Paper session co-organizer, chair,** "Hazards, GIS and Remote Sensing" session, Annual Meeting of the Association of American Geographers.
2002 – 2003	**Paper session organizer, chair, and judge, "**GIS Specialty Group Student Paper Competition," Association of American Geographers Annual Meeting.
1999	**Paper session organizer**, "Location Modeling and GIS," Annual Meeting of the Association of American Geographers, Honolulu, Hawaii, March.

University Service

2023 -	Member, Career Line Enhancement Committee. Office of the AVP for Faculty.
2016 – 2023	Director, Environmental Track, Professional Master in Science & Technology. The Graduate School.
2019 – 2023	Member, RPT Standards Committee, Office of the AVP for Faculty.
2014 – 2017	Member, Academic Senate

2014 – 2017	Member, University Promotion & Tenure Advisory Committee (UPTAC)
2011 –	Member, Social Science General Education Committee
1999 – 2009	Delegate, University Consortium for GIScience
2013	Member, Graduate Research Fellowship (GRF) Committee
2010 – 2012	Member Student Evaluations Committee, Undergrad. Studies
2009 – 2012	Member, Graduate Council, College of Soc. and Beh. Science
2003 – 2004	Member, Instit. Review Board (IRB) Protocol Committee
2001 – 2004	Member, Social Science General Education Committee

College Service: Social & Behavioral Science

2014	Chair, Review, Promotion & Tenure Committee
2012 – 2014	Member, College Review, Promotion, & Tenure Committee
2015	Member, Superior Teaching Committee
2011 – 2012	Chair, Superior Teaching Committee
2007	Member, Search Committee, Inst. of Public and Intern Affairs
2005, 2006	Member, Superior Research Committee
2002, 2004	Member, Superior Teaching Committee

Departmental Service: Geography

2023 -	Chair, Review Promotion & Tenure Committee
2019 - 2020	Leadership Committee
2015 –	Member, Undergraduate Committee
2014 –2017	Representative, University Academic Senate
2014 –	Director, Certificate in Hazards & Emergency Management
2014	Author, Proposal for Cert. in Hazards & Emergency Manage.
2012 – 2022	Chair, Review, Promotion & Tenure Committee
2013	Chair, Search Committee for GIScience Position
2012	Co-author, proposal for MS in GIScience
2011 – 2012	Director of Graduate Studies
2010	Search Committee Chair, Human Geography Position
2004 – 2015	Member, Graduate Admissions Committee
2004 – 2008	Member, Colloquium Committee
2000 –	Chair, Geographic Information Science Area Committee

To: Carmen Borg, Urban Planner, Shute, Mihaly & Weinberger LLP
From: Matthew Rahn, PhD, MS, JD
Re: Harmony Grove Village South – Draft EIR, Wildfire Risk Analysis and Mitigation Measures
Date: June 13, 2017

Ms. Borg:

The following analysis is provided on behalf of Rahn Conservation Consulting ("RCC") at the request of Shute, Mihaly & Weinberger LLP. Our firm was retained to evaluate the Draft Environmental Impact Report ("DEIR"), Fire Protection Plan ("Plan"), and other associated documents related to wildfire risk and community protection for the Harmony Grove Village South Project ("Project" or "HGVS"), San Diego County, California (April 2017). For over twenty years, I have worked in the fields of environmental science and policy, with an emphasis on wildfires, land management, and planning (qualifications are provided in Appendix A).

As proposed, the Project is located within the unincorporated area of San Diego County, which is classified as a "very high fire severity zone" by CAL FIRE. This area has a regular occurrence of wildfires with the most recent incident occurring in 2014. Given the fire history of the site, the complex topography, access issues, and surrounding vegetation, this area should be considered an extremely high-risk development zone. The proposed Project and its mitigation measures do not provide long-term assurances that adequate wildfire protection and community safety will occur. The DEIR and the Plan also fail to address increased risks under future climatic and vegetative conditions. Finally, the Plan fails to adequately address community risk and protection standards related to fire brands and structure fires within the community.

If recent wildfire events in the area are any indication of the future, HGVS and surrounding communities are not only susceptible during "average" wildfire events, but are at considerable, and arguably catastrophic risk during higher intensity events (which are becoming more common in our region). Given that the backcountry is expected to experience drier climates, increased Santa Ana wind events, hotter temperatures, longer droughts, and increased abundance of invasive species, the risk of wildfire hazards will only increase in the future. In this case, the risk to the proposed community is so high that it is seemingly not a question of whether this area will experience a catastrophic loss, but when. Even more alarming is that alternative routes and access were dismissed without evidence that they are not feasible. The proposed Project would thus be constructed despite being noncompliant with emergency access standards where catastrophic losses are not only probable, but expected.

In summary, the following issues were identified in our review of the DEIR, Fire Protection Plan and supporting materials:

1) The DEIR and Plan fail to adequately describe the fire history and existing setting of the area;
2) Current understanding of fire branding and structure loss during a wildfire event is not adequately addressed in the DEIR and the Plan;
3) Evacuation plans, community design, and shelter in place measures proposed in the DEIR provide inadequate protection and assurance that the community can safely respond to severe wildfires;
4) The DEIR and Plan fail to adequately address future changes in precipitation, temperature, and wind;
5) The DEIR and Plan fail to consider how future land use change scenarios, invasive species, and habitat succession are expected to alter fire frequency and intensity;
6) The Plan as proposed does not adequately address actual wildfire community risks.

A detailed review of the Project is provided on the following pages, along with supporting references. If you have any questions, please feel free to contact me at any time.

Respectfully submitted,

Matthew Rahn, PhD, MS, JD

Partner, Principal Scientist
Rahn Conservation Consulting, LLC
(619) 846-1916
mattrahn@me.com

Table of Contents

1.0 Introduction

There is always an inherent danger in placing an urban development in what is currently an undeveloped wildland area located within an historic fire corridor. Although the DEIR and the related Wildfire Risk Assessment claim that the HGVS Project meets or exceeds fire and building code requirements, the Project does not comply with standards related to emergency access. Furthermore, the DEIR proposes modifications to local and currently accepted standards related to dead end roads and evacuation routes, but the proposed measures are untested and have not been evaluated under real-world scenarios. The DEIR provides no evidence that during an emergency these measures will provide the same or higher level of community protection and safety. If anything, based on the high risks at the Project site, the County should apply more stringent standards that have a proven record of success.

Given that the proposed development is located in such a high risk wildfire area, it is incumbent on the County to integrate a prospective approach to decision-making and risk analysis. Unfortunately, the modified mitigation measures proposed in this Plan are tantamount to a community-level experiment, where untested measures are assumed to provide the same level of public safety that current code provides.

2.0 Fire History

Given the topography, climate, and vegetation, the Plan mischaracterizes the extreme wildfire risk of the proposed site. As recognized throughout the DEIR and supporting documents, wildfires are regular occurrences in and around the project area. However, the analysis fails to adequately describe the modern risk, diluting the modern history of the site with data from before 1950, when records and fire assessments were spotty at best. Modern history shows that the fire return interval within three miles of the site is not seven years. Rather, the local area has had eighteen fires from 1980-2014, suggesting a modern fire frequency of less than two years. Furthermore, the characteristics of wildfires are underestimated with regard to wind-driven events, with the analysis suggesting average and peak wind velocities that are lower than the documented conditions that occurred during recent wildfires (including the Witch Fire in 2007). Finally, while the data used are from actual recorded wildfire events, the numbers of actual ignitions is likely much higher. The analysis should have provided an assessment of *all* the known ignitions and areas for high historic wildfire risk. This underestimate (and lack of assessment of future climatic and vegetative scenarios described later) creates a faulty foundation on which the analysis and subsequent mitigation measures are based.

The DEIR and the Plan suggest that the development of the Project actually reduces wildfire risk because the project will result in the conversion of high risk fuels into an area of developed land with ignition resistant structures and landscaping. While there is no doubt that the development will remove existing habitat, simply placing a community within a high risk fire area does not reduce fire risk. To be certain, the risks still exist from the surrounding area, and the addition of a dense development into a high fire prone area has a long and demonstrated history of creating an environment where wildfires become

Wildland Urban Interface ("WUI") fires, posing an even higher risk to our first responders, residents, and infrastructure.

Today we are experiencing a shift in our natural fire regimes due to a multitude of anthropogenic factors, including man-made fires, increases in the wildland-urban interface, invasive species, and climate change. Since the 1970s the frequency and intensity of wildfires has increased across the United States, expanding from three million to an overwhelming eight million acres burned each year, with further increases projected.[1] A critical factor associated with wildfires is the current and continuing urbanization and the expansion of the wildland urban interface (WUI). As our region grows in the coming decades, decisions on where to locate future development and how to manage the WUI will determine our vulnerability and potential increases in wildfire risk.

There are now 44 million homes in 50,000 communities at risk within the WUI in the US, and the annual cost of WUI fires nationwide exceeds $14 billion.[2] California, not surprisingly, has the highest number of WUI housing units of any state (5.1 million). Expansion of the WUI is particularly alarming in California, where half of the twenty largest wildfires in California's recorded history have occurred in only the past decade. Many of these events have had an unprecedented physical and financial impact to the state.[3] For example, the 2003 wildfire event that consumed much of San Diego County cost the region nearly $2.5 billion. More recently, the 2008 wildfires in northern California burned over 1.2 million acres, destroyed over 500 structures, and killed 15 people.

Modern catastrophic wildfires are significantly different from the historic fire regime. Fires once started by lightning strikes or Native Americans would ignite smaller burn areas that created a heterogeneous vegetated landscape[4] whose patchiness created "natural fuel breaks" that prevented today's larger fire events.[5] Currently, only a fraction of the wildfires we experience in California are caused by natural events, with nearly ninety-five percent started by human activities. Future wildfire risk is not the exclusive result of human negligence or accidents. Rather, it highlights the concerns of firefighting agencies throughout the country: wildfire response and management must anticipate and adapt its practices and policies to deal with changing circumstances.

3.0 Problems with Modeling and Planning

With regard to traditional modeling, the type of data used to generate models is extremely important. Given the limited amount of weather data used and and lack of consideration for modern trends in wind, temperature, and precipitation patterns, the amount of error and uncertainty is a concern. With weather records covering a questionable temporal and spatial distribution, it is not clear whether the extent of the records used is sufficient to

[1] National Interagency Fire Center. 2007. Fire information: Wildland fire statistics, 1960-2006). Boise, ID.
[2] Nelson Bryner. 2012. National Institute of Standards and Technology, Wildfire Research Program. Personal Communication.
[3] Rahn , M.E. 2009. Wildfire Impact Analysis: 2003 Wildfires in Retrospect. San Diego State University. Wildfire Research Report No. 1. Montezuma Press. San Diego, CA.
[4] Bonnicksen, T. M. 2000. America's Ancient Forests: from the Ice Age to the Age of Discovery. John Wiley & Sons, Inc., New York. 594 p.
[5] Bonnicksen, T. M. and E. C. Stone. 1981. The giant sequoia-mixed conifer forest community characterized through pattern analysis as a mosaic of aggregations. Forest Ecology and Management 3(4): 307-328.

make decisions or inferences about historical climatology or determine long-term trends and future conditions. There is a meaningful need to assess the effectiveness of the Plan across a range of WUI community types and exposure conditions, as the assumptions for modeling must be meaningful, justified, and appropriate.[6] Overall, the modeling provided in the DEIR and supporting documents does not adequately address future conditions, nor does it address actual worst-case scenarios. As noted by the Wildfire Risk Analysis, the modeling conducted by Helix is deficient in its scope, characterization of the vegetative communities, fuel modeling, and weather data.[7] The DEIR needs to update its analysis to reflect our best understanding of wildfire modeling and a more realistic assessment of risk that addresses rate of spread, indefensible areas, and overall community hazards.

3.1 Fire Branding, Modeling, and Community Risk

The Fire Protection Plan asserts that "fires from off-site would not have continuous fuels across this site and would therefore be expected to burn around and/or over the site via spotting." The Plan further states that burning vegetation embers may land on structures, but are "not likely to result in ignition based on ember decay rates that would not impact the types of non-combustible and ignition resistant materials that will be used on site."[8] Yet the Wildfire Risk Analysis acknowledges that because branding may "travel a minimum of 1/4 mile and as much as 1 mile ahead, the entire proposed development site would therefore be subject to significant fire branding."[9] These statements are contradictory.

As demonstrated by post-fire assessments by the National Institute of Standards and Technology (NIST), it is simply not true that embers and fire brands do not pose a significant risk to the proposed community. In fact, some of the most recent and devastating fires in our communities, including the nearby 2007 Witch Fire, were the result of impacts from fire brands and spotting that ignited homes within the interior of the community, and in some cases left homes at the perimeter unscathed. Current concepts of defensible space do not account for hazards of burning primary structures, hazards presented by embers, and the hazards outside of the home ignition zone, which is a serious deficiency in identifying actual risk.[10]

The Fire Protection Plan asserts that the potential for "off-site wildfire encroaching on, or showering embers on the site is considered moderate to high, but risk of ignition from such encroachments or ember showers is considered low based on the type of construction and fire protection features that will be provided for the structures."[11] However, given our current state of understanding about wildfires and how embers and brands actually lead to structure loss, this is an unsubstantiated and spurious assertion. Hardening of structures (e.g. building homes with materials or design features that reduce fire risk) is just one factor in structure risk and ignition. It is well documented that the actual operations and management of the community is just as important with regard to wildfire risk.

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[6] Mell, W.E. et al. 2010. The wildland-urban interface fire problem – current approaches and research needs. International Journal of Wildland Fire. 19: 238-251.
[7] Rhode and Associates, 2016. Pg 3.
[8] Dudek. 2017. Fire Protection Plan. Harmony Grove Village South. Appendix L, Draft Environmental Impact Report, April 2017. Pg. 19.
[9] Rhode and Associates. 2016. Harmony Grove Village South. Wildfire Risk Analysis. April 2016. Pg. 13.
[10] Maranghides, A. et al. 2015. A Case Study of a Community Affected by the Waldo Fire. Nist Technical Note 1910.
[11] Dudek. 2017. Pg 27.

Examples throughout the recent literature show that even hardened structures can be lost when residents install ornamental landscaping, build attached decks, have outdoor furniture adjacent to the home, stack firewood next to the wall, allow plant material to build up in the eaves and gutters, or allow landscaping to dry out during droughts. These are just a few examples of how an average community functions. It is dangerous and irresponsible to assume that any community built in this area will maintain a level of vigilance, operations, and maintenance for wildfire protection; this level of dedication and oversight is simply improbable and unrealistic. Moreover, history has demonstrated time and again that any community placed within a high risk area can suffer catastrophic losses, regardless of planning, design, or best intentions.

In fact (and as described below), it is recognized throughout the DEIR, the Plan, and other supporting documents that portions of HGVS would not be adequately protected. According to the Wildfire Risk Analysis, many of the existing properties in the area "generally lack defensible space" or safety zones and are "likely un-defendable" against critical fire behavior. In addition, the loss of these homes could "significantly contribute to fire intensity and fire branding," resulting in an estimated 15% of the homes being indefensible.[12] In addition, the report states that there exists critical exposure to chaparral fuels across two-thirds of the HGVS project site, creating a risk of impacts from direct flame, radiant energy, and heavy branding on the Project site.[13] The DEIR is obliged to evaluate and analyze the impacts of the Project, identify feasible measures to minimize, and mitigate the risks of severe fire, and consider alternatives that would reduce any significant impacts from the Project rather than just provide a triage of anticipated and acceptable losses. The Risk Analysis fails to meet this mandate and only further highlights how at-risk this community actually is and that losses are expected, if not inevitable.

The modeling for the Project's fire hazard impacts does not adequately characterize the structure exposure conditions (heat flux from flames and firebrands generated by burning vegetation or burning structures) for a range of WUI fire settings (e.g. housing density, terrain, vegetative fuels, winds, wildland fuel treatments). The Plan is also deficient in failing to assess the vulnerability of structure design and proposed building materials when subjected to a given level of exposure or wildfire incident. Not all materials are rated the same and not all materials have been put through appropriate testing and rigorous assessments by which to compare benefits (if any) of the design elements or materials chosen.

According to the National Institute of Standards and Technology (NIST), there is an urgent need to conduct a systematic, science-based, research effort to characterize how wildland fuel treatments alter the fire behavior, firebrand, and smoke generation from wildland fires. This must be done for wildland fires[14] and WUI communities,[15] and unfortunately has

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[12] Rhode and Associates, 2016.
[13] Rhode and Associates, 2016. Pg. 12.
[14] Carey H, Schumann M (2003) Modifying wildfire behavior – the effective- ness of fuel treatments, the status of our knowledge. National Community Forestry Center, Southwest Region Working Paper 2. Available at http: // maps.wildrockies.org / ecosystem_defense / Science_Documents/ Carey_Schumann_2003.pdf

not been assessed for this Project. No real effort was made to address or quantify community exposure to ignitions from firebrands for this Project. Firebrands, from both vegetation and structures, are often a major source of structure ignition in WUI fires.[16] NIST has been actively engaged in WUI/firebrand research; results from this research should be included in modern planning. This is particularly important for the Project, since the majority of houses lost during local fires were not from direct flame contact, but rather from the intrusion of embers driven by winds.

Current wildfire research supports the need to augment and improve existing modeling and actual causes of structure loss as a high priority. Recently, NIST conducted a post-fire study of a community burned by the nearby Witch and Guejito fires during the October 2007 southern California firestorm.[17] Those fires destroyed 30% of the structures within the fire line, 40% of the structures on the perimeter (in closest proximity to wildland fuels), and 20% in the interior were destroyed. Firebrands were responsible for at least two out of every three structures lost. More worrisome is that the fire during this event spread up to 500 meters into the interior of the community. This demonstrates the importance of modeling for firebrands and of implementing protection measures during the planning process rather than relying solely on heat flux radiation or direct flame contact. Understanding the impact of firebrands and embers is a serious consideration for modern planning, and our current understanding of the causes of structure loss should be incorporated into the DEIR and supporting documents. This is particularly important for this Project, as much of the most insightful research on this topic was conducted on 2007 fires near the Project site.

3.2 Inadequate Emergency Access and Evacuation

The Fire Protection Plan states that secondary access for the project site is infeasible, citing challenges with biological resources, topography, and land-owner agreements/easements. Secondary access is not something that can be dismissed due to logistical constraints – it is a development standard for very important reasons. For example, the National Fire Protection Association 2016 standards provide guidelines for disaster planning, mitigation and evacuation, with experts roundly stressing that people should have multiple evacuation routes, if possible, as fire conditions can change rapidly.[18] Similarly, as described in the Plan, local and state standards emphasize multiple access routes for communities in high risk wildfire areas.[19] Ignoring this long-established and necessary requirement may potentially be acceptable in areas with low risk, but extreme fire risk areas, such as the HGVS site, should arguably never be approved without adequate secondary access.

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[15] Mell et al.
[16] Maranghides A, Mell WE (2009) A case study of a community affected by the Witch and Guejito fires. National Institute of Standards and Technology, Technical Note 1635. (Gaithersburg, MD) Avail- able at http://www2.bfrl.nist.gov/userpages/wmell/PUBLIC/TALKS_ PAPERS/NIST_Witch_Fire_TN1635.pdf [Verified 22 February 2010]
[17] Maranghides and Mell.
[18] National Fire Protection Association. 2016. 1600-Standard on Disaster/Emergency Management and Business Continuity/Continuity of Operations Programs.
[19] California Building Code (Chapter 7a) and County of San Diego Consolidated Fire Code (2014).

A single access road is also problematic because such access does not allow efficient and safe movement of residents out of the area in a timely manner. With an estimated 1,500 to 1,800 vehicles (for just this community – depending on the analysis and report cited) attempting evacuation during a wildfire, a best-case evacuation time would take at least one hour and thirty minutes.[20] Given that the modeling predicts that wildfires can result in spread rates of 17 mph, the development and its evacuation route can become encircled by a wildfire in less than five minutes. Moreover, wind speed and direction of wildfires can change in unpredictable and rapid ways (something that is not accounted for in traditional modeling or this risk assessment).

It is widely recognized that evacuations can result in traffic jams, traffic collisions, nervousness and panic, which can cause harm to people during fire events and result in a breakdown of the best designed plans. Evacuation is further complicated when having to evacuate large and small animals and residents with special needs. The DEIR as well as supporting documentation should be revised to address these issues. The DEIR should also include a comprehensive worst case evacuation scenario accounting for the total time that would be required to evacuate the entire surrounding community that ultimately uses Country Club Drive to Auto Park Way that addresses the population of Harmony Grove, Eden Valley, Hidden Hills and Elfin Forest. Unfortunately, none of this analysis was performed in the DEIR.

Widening the road should be discussed not just for the section contemplated in the DIER, but also to ensure that residents are able to get "all the way out" to safety. It is not enough to simply address widening the section of road directly at the point of egress from the proposed development without a comprehensive analysis of broader evacuations and potential needs for extending the road widening to ensure full evacuation. Furthermore, direct flame impingement, radiant heat, heavy smoke, and limited visibility can significantly contribute to evacuation breakdowns. Having a single point of entry/exit only exacerbates an already tenuous and dangerous situation. Given the propensity of both interior and perimeter homes to ignite during a wildfire, excessive evacuation times, and single evacuation route, the potential for catastrophic losses cannot be overlooked.

Compounding the community emergency response and overall risk is the applicant's request that the County approve a modification of the dead end road length rules in County Fire Code section 503.1.3. Again, the request is being made because of the alleged constraints due to topography, geology, and environmental conditions that make this infeasible (although the request appears to also be driven by a lack of agreement with landowners for access and easements). The standards of care regarding maximum dead end road lengths are established to ensure adequate opportunity for emergency vehicle access, turn around, and ease of evacuation. The fact that there are alleged conditions that may make meeting the existing regulations unattainable only emphasizes the unsuitability of this location because public safety and community protection cannot be assured. Ultimately, failure to secure secondary access results in significant Project-related impacts

[20] Dudek 2017.

related to wildfire hazards and public safety the extent of which have been inadequately addressed and mitigated in the Fire Protection Plan and DEIR.

It is worth repeating: the proposed modifications to currently acceptable standards related to dead end roads and evacuation routes have never been adequately tested or evaluated under real-world scenarios. The current standards exist for a reason and modifications should only be approved if it can be clearly demonstrated that they meet the intent of the code. The DEIR and the Plan provide no empirical evidence to demonstrate that the proposed measures provide the same or higher levels of community protection and safety during an emergency as the required secondary access. The following issues highlight the faulty assumptions made in asserting the mitigation measures meet or exceed existing code and should therefore be approved as meeting the intent of the code:

- The third travel lane provides a widened road, but simply widening a road does not address issues where the only way to enter or exit the community is limited by unforeseen factors including fire impingement, vehicle collisions, etc.
- While fuel management zones are an important aspect of community protection, the plan still fails to address fire embers and branding that enter the community during a wildfire
- Current research has shown that ember resistant vents provide limited protection during a wildfire. Reducing the size of the mesh can simply cause the embers to burn down to a smaller size before entering the attic, and can still result in a structure ignition.[21] In fact, current ASTM standards for vents do not address the ability of these vents to completely exclude entry of flames of firebrands.[22] And while requiring 1/8th inch vents screening (rather than ¼ inch) seems to improve protection, no clear evidence suggests that this is the case, and has the problem of adding a maintenance burden on the homeowner (related to clogged vents, over spraying and clogging during painting, etc.).[23]
- While increasing parking within the community may assist in minimizing potential obstructions and emergency vehicle access, it does not contribute to addressing the single access road issue. Furthermore, restricting parking may seem like a good idea, and while there may be requirements for single residence events over 10 persons to park off site and shuttle to the residence, a serious parking situation could occur when several homes (on a holiday for instance) all have up to nine visitors, and avoid parking mitigation measures yet still create a dangerous situation for emergency vehicle access and community evacuation.
- Restricting landscaping adjacent to structures 1-3 feet away is another untested strategy to reduce risk. In fact, any vegetation adjacent to the home would still carry flame lengths sufficient to ignite the wall, particularly during a wind driven fire.

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[21] Manzello SL, Park SH, Suzuki S, Shields JR, Hayashi Y. Experimental investigation of structure vulnerabilities to firebrand showers. Fire Safety Journal 2011;46: 568-578.

[22] ASTM Standard E2886/E2886M – 14, 2014, "Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement," ASTM International, West Conshohocken, PA, 2014.

[23] Quarles, T. and TenWolde, A. 2004. Attic and Crawlspace Ventilation: Implications for homes located in the Urban-Wildland Interface. Woodframe Housing Durability and Disaster Issues Conference, Las Vegas, NV.

- Structure spacing and density is widely recognized and a critical component in WUI fires, influencing how firefighters can respond. Community design can significantly reduce effectiveness and their ability to respond quickly to stop fire spread in a community. As with so many protection plans, no empirical evidence or evaluation is provided to address defensibility from structure to structure fire spread, or defensibility from dangerous topographic configurations. Further, the DEIR and Fire Protection Plan provide no clear evaluation or analysis to identify exposure and structure vulnerabilities, including an assessment for high and low fire and ember exposure risk, nor are the fuel treatment standards assessed to quantify exposure reduction for different topographical and weather conditions.

3.3 Shelter in Place

Recognizing that there may be serious deficiencies in ingress/egress during an emergency, the planning documents for Harmony Grove discuss a "shelter in place" philosophy for the community. In fact, the Wildfire Risk Analysis states that the shelter in place requirement is "derived primarily from either high intensity wildfire threats to escape routes, or the rapid onset of high intensity wildfire which denies civilians an opportunity for escape."

While this is seen as a last resort option, confusingly the community is not seeking an official shelter in place status. Arguably, the standards for obtaining this status are significant, and likely are triggered when there is no other option available to the community. However, as a newly planned community, appropriate evacuation options should be designed into the project. The community center building is proposed as an evacuation center, yet again the Plan and DEIR acknowledge that is it not actually "planned as an evacuation center."[24] While this may seem to be a suitable option, the risk that the facility, like all others within HGVS, may ignite due to fire brands or ignition by adjacent structures is not adequately addressed.

Shelter in place is not only a dangerous strategy, it has a long history of catastrophic failures and can be terribly tragic. In 2009, wildfires in Australia cost the lives of 173 individuals who chose to stay in the community rather than evacuate. The results of a review by the Royal Commission asserted that abandoning the philosophy entirely is not appropriate, yet the policy should not apply in severe fire conditions, stating that leaving early is still the safest option, and there needs to be an emphasis on education and qualifications for those that stay behind.[25]

In contrast, the DEIR emphasizes a shelter in place scenario during the most extreme conditions. While we refer to this philosophy as "shelter-in-place" in California, communities like those in Australia use the "Stay and Defend" terminology. A significant distinction between these two philosophies highlights the challenges in adopting and promoting this community protection standard. Unlike shelter-in-place, stay-and-defend connotes residents actively patrolling the community, putting out small spot fires, keeping rooftops and vegetation wet, and potentially combating actual fires. The issue is that

[24] Dudek 2017. Pg. 39.
[25] http://www.nfpa.org/news-and-research/publications/nfpa-journal/2011/september-2011/features/stay-or-go

residents lack the proper training, equipment, and resources necessary, giving a false sense of security and faulty assumption that homeowners are as capable as firefighters. Another key distinction is that a shelter-in-place strategy may place residents at risk if (for instance) entry by first responders into the community is cut off or significantly delayed. In that scenario, homes are then at risk for catching on fire and having fire spread throughout the community as the homes have been largely left unprotected and un-monitored.

The simple fact that this Project is even contemplating a shelter-in-place option (due to threats along evacuation routes among other factors) only serves to highlight the risk to the proposed Project area and the existing community; it is an acknowledgement that evacuation may not only be infeasible, but impractical in certain (unspecified) conditions. Given the propensity for fire branding and the spread of fire within the community, shelter-in-place is even more worrisome. Additionally, current research on smoke exposure and the significant health risks associated with fires within the WUI places residents in a serious situation where the short term benefits of sheltering in place are potentially outweighed by the long-term risks associated with cancer, respiratory, and cardiac issues. Those engulfed in WUI fires are exposed to unsafe levels of high-risk contaminants including trace metals, polycyclic aromatic hydrocarbons (PAHs), benzene, carbon monoxide (CO), nitrogen and sulfur oxides, cyanide, volatile organic compounds (VOCs), airborne acids, and particulates. When extreme physiological conditions exist in an environment where ambient heat, smoke, and high-risk exposures are commonplace, a WUI fire can exceed the limits of what the human body should withstand. The DEIR fails to evaluate these impacts.

Furthermore, under this plan, the DEIR and the Wildfire Risk Analysis acknowledge that extreme wildfire events may require those who shelter in place to "reposition" themselves during an incident to avoid radiant heat.[26] Not only are individuals in this scenario not adequately prepared to protect themselves from the threats of radiant heat (among other risks), but they are also being asked to know when to move and respond to changing circumstances and safely navigate what is arguably one of the most intense and risky environments on the planet. This is a dangerous strategy and a substantial expectation of residents that could have extreme consequences on the health and welfare of the community.

4.0 The Future of Wildfires

4.1 Climate Change

There is consensus within the scientific community that climate change will generally increase fire risk due to its effects on fuel loads and weather,[27] and in fact we have seen a dramatic shift in the frequency and intensity of wildfires throughout North America. Shifting climatic conditions and land use change are combining to produce more frequent

[26] Rhode and Associates 2016. Pg 16.
[27] Moritz, M.A. and S.L. Stephens. 2008. Fire and sustainability: Considerations for California's altered future climate. Climatic Change (2008) 87 (Suppl 1):S265–S271

and intense wildfires while also expanding the overall annual wildfire season.[28] California is considered a climate change hotspot likely to experience higher than average impacts when compared to the rest of the United States.[29] In fact, we may already be seeing these effects. Compounding this risk is the prediction that large fires (defined as 500 acres or more) will increase nearly 35% by 2050, and an alarming 55% by the end of the century.[30] If our population expands into and increases the WUI, there is a concomitant increase in the probability of property losses due to wildfires. All of these high risk factors describe the HGVS Project.

4.1.1 Temperature Changes

Climate change has broad implications for wildfires, spanning both the physical and natural environment. Recent research suggests that regional temperatures in California may increase from 1.7 C to 5.8 C by 2100, depending on the climate model used and the emissions scenarios assumed.[31] This of course leads to an increase in the number of days of high or extreme fire risk (as assessed by CAL FIRE in their daily wildfire risk warning system). In fact, recent research suggests that the fire seasons are already longer than they were historically.[32]

4.1.2 Changes in Wind

As identified in the Plan, fires in the area were historically wind driven. In the modeling of the planning area, winds were calculated at variable speeds up to 50 mph. Ultimately the fire season is predicted to become longer in California, with predicted increases in the number of Santa Ana wind days under future climate scenarios.[33] Therefore, wind driven fires are predicted to change in the future. Wind modeling can assist fire managers in estimating local wind patterns and the potential for wind-based increases in fire spread rate and intensity.[34] Recurrent wind patterns, such as those that arise during Santa Ana wind events, can be modeled to help identify local areas that have high potential for Santa Ana wind-based increases in fire spread and intensity. Unfortunately, the limited analysis performed to evaluate this Project introduces considerable uncertainty into efficacy of the mitigation measures and the Fire Protection Plan.

The ability to model fire intensity spread is of utmost importance in planning. However, the planning process is only as good as the modeling used and the availability of suitable data. Without this, creating hazard maps and identifying indefensible areas is problematic. Given what we know about wind modeling and the lack of empirical data for the HGVS planning area, there are inherent problems for developing an effective fire plan for the HGVS project. The lack of data can lead to a serious misrepresentation and underestimation of onsite conditions, wind events, temperature, and fuel moisture. Planning done under this scenario can lead to an inaccurate model that does not truly represent onsite conditions. When it

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[28] A.L. Westerling, H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam, *Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity*, 313 Science 940 (2006).

[29] Diffenbaugh, N. S., F. Giorgi, & J.S. Pal (2008). Climate change hotspots in the United States. Geophys. Res. Lett. 35: L16709.

[12] Westerling, A, et al. 2006. Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity, 313 Science 940.

[31] D. Cayan, A. L. Luers, M. Hanemann, G. Franco, and B. Croes, *Scenario of Climate Change in California: Overview*, CEC-500-2005-186-SF (2006).

[32] *Id*.

[33] Running, S.W., 2006. Is Global Warming Causing More, Larger Wildfires? Science 313: 927-928.

[34] Butler, B.W., M. Finney, L. Bradshaw, J. Forthofer, C. McHugh, R. Stratton, and D. Jimenez. 2006. WindWizard: A new tool for fire management decision support. USDA Forest Service Proceedings RMRS-P-41.

comes the health and safety of the HGVS residents, it is important to either provide the type of project-specific data needed, or introduce significantly larger estimates of uncertainty in establishing larger buffer areas for community protection and mitigation measures.

4.1.3 Changes in Precipitation

Most studies suggest that there may be considerable changes in inter-annual and decadal fluctuations in precipitation.[35] Studies also suggest that the availability of water for vegetation communities will be significantly reduced during the dry seasons (spring through fall) leading to decreased fuel moisture and increased fire risk.[36] Live fuel moisture, an important determinant of fire danger in southern California's Mediterranean climate, is affected by environmental variables such as late spring rain delay and dry winters.[37] There is an increasing trend in regional drought dieback, with increased fuel loads creating firestorm conditions throughout southern California.[38] For the Project area, historic (and future) drought conditions contribute to an increase in dead fuels, which in turn leads to dryer and more explosive fuels. However, this information is not integrated into the DEIR or the supporting technical documents.

4.1.4 Succession and Invasive Species

Modeling fuel treatment effectiveness is one of the most difficult aspects of fire planning. It requires the modeler to make assumptions about the future conditions of fuels and vegetation structure, which is difficult at best. This analysis however is critical to the plan itself. It is therefore extremely problematic that the analysis here relies on existing vegetation conditions and fails to address that as succession occurs, how future habitat conditions may pose significantly higher risks for the community than what was is currently modeled.[39] Therefore, it is not clear what future states of the vegetation community will look like or how that influences community risk.

It is also not clear how problem invasive species (with a high fire risk) will impact the area in the future. In particular, nonnative grasses, herbs, and forbs pose a significant threat. While the Fire Protection Plan recognizes the impacts of invasive species, it does not provide suitable analysis or mitigation for this problem. For example, some insect species instigate high fire risk conditions. Vegetation mortality from insects and pathogens can become a significant contributor to wildfire risk.[40] Insect infestations and pathogens are predicted to increase as a direct result of changing climate.[41] This occurs because future climate scenarios may actually enhance the survival and spread of invasive species and reduce vegetation health, thereby making the vegetation community more susceptible to damage or disease.[42]

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[35] Cayan.
[36] Westerling.
[37] Dennison, P.E., D.A. Roberts, S.R. Thorgusen, J.C. Regelbrugge, D. Weise, and C. Lee. 2003. Modeling seasonal changes in live fuel moisture and equivalent water thickness using a cumulative water balance index. Remote Sensing of Environment 88(4):441-442.
[38] Franklin, S.E. 1995. Fuel management, fire behavior and prescribed burning. In: Brushfires in California Wildlands: Ecology and Resources Management. Edited by J.E. Keeley and T. Scott. International Association of Wildland Fairfield, WA.
[39] Dudek 2017. Pg. 28.
[40] Logan, J.A., Régnière, J., Powell, J.A. 2003. Assessing the impacts of global warming on forest pest dynamics. Front Ecol Environ 1(3): 130–137.
[41] Joyce, L.A., et al., 2008. National Forests. In: Preliminary review of adaptation options for climate-sensitive ecosystems and resources. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, U.S. Environmental Protection Agency, Washington, DC, USA: 3-1 to 3-127.
[42] USDA Forest Service, 2007. California Forest Pest Conditions – 2007, California Forest Pest Council.

Climate change is also likely to augment the spread of invasive species, which is already occurring in the planning area and surrounding habitat. This can occur when the normal disturbance regimes under which the native community evolved are altered. Throughout the western United States, we have witnessed the spread of invasive species, particularly grasses, which change the fire frequency and intensity and shorten the return interval of fires. This results in a feedback loop where wildfires advance the spread of invasive species, ultimately leading to a type-conversion of the habitat to a nonnative dominated ecosystem.[43,44] Therefore, what was modeled in the DEIR and supporting documents was not the worst-case scenario, but one based largely on existing conditions.

In sum, the DEIR relies on a faulty model which yields a faulty analysis and inadequate mitigation.

4.2 Changes in the Causes of Wildfires

While historic fires were generally recorded under wind events, future fires will likely not be exclusively wind driven. Given recent trends and possible changes due to a myriad of interrelated factors such as climate change, succession, and invasive species, there may be a concomitant increase in both human-caused fire events and lightning-caused wildfires. These scenarios are not addressed in the DEIR or the Plan. For example, human-caused ignition events are predicted to increase with population.[45] This is exacerbated by the prediction that there will also be an increase in the frequency of lightning as a result of climate change.[46] This, of course, has direct implications for the risk of wildfires that we are already experiencing.

In 2008, over 2,000 wildfires were started by over 6,000 dry-lightning strikes in Northern California. The record number of lightning strikes and extreme drought conditions created catastrophic conditions that burned nearly 1.2 million acres, destroyed over 500 structures, and killed 15 people.[47] It is assumed that climate change is stimulating this change, and may bring lightning-caused fires to areas in quantities never seen in recorded history.[48] Adding additional homes to an already burdened fire district adds the potential for an increase in human-caused fire events. It should be noted that this is not just in reference to arson. Most wildfires today are the cause of human negligence or accidents from vehicles, heavy equipment, lawn care equipment, etc.

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[43] Klinger, R. C., M. L. Brooks, and J. M. Randall, Fire and Invasive Plant Species, in Sugihara, N. G., J. W. van Wagtendonk, K. E. Shaffer, J. Fites-Kaufman, and A. E. Thode (eds). 2006. Fire in California's Ecosystems. University of California Press.

[44] Harrison, S., B.D. Inouye, and H.D. Safford. 2003. Ecological heterogeneity in the effects of grazing and fire on grassland diversity. Conservation Biology 17:837-845.

[45] Syphard, A., V. Radeloff, J. Keeley, T. Hawbaker, M. Clayton, S. Stewart, and R. Hammer. 2007. "Human influence on California fire regimes." Ecological Applications 17:1388– 1402.

[46] Price, C., 2008. Thunderstorms, Lightning and Climate Change. in Lightning - Principles, Instruments and Applications, ed. H.D. Betz, Springer Publications.

[47] http://www.fire.ca.gov/index_incidents_overview.php

[48] http://www.usnews.com/science/articles/2010/04/21/an-arctic-with-fire.html

5.0 Conclusion

Wildfires are a predictable occurrence, and will happen again. Even with best practices and mitigation measures, wildfire hazard risk to the proposed HGVS development and to existing and future residents in the area would be significant. In fact, there is a high likelihood that the community could suffer catastrophic losses to structures, infrastructure, and poses a considerable risk to public safety, community resilience, and the safety of first responders. Like most of southern California, wildfire events that threaten HGVS can occur under the most adverse environmental conditions, and (if recent fire history is a guide) can likely occur during times of a regional fire siege of multiple large fires. Under an extreme (yet all too common) fire siege, the number of first responders and resources required to be assigned for adequate structure defense at HGVS may be deficient. While mitigating the need for resource deployment is a laudable goal, the extreme risk to this proposed community and the surrounding area is undeniable, and places a significant burden on area residents, forcing them to make critical decisions (without adequate training) that can be consequential to their safety and survival during a wildfire.

The analysis of fire risks and mitigation measures for the Project is based on faulty modeling, which led to a faulty analysis and unsubstantiated conclusions and recommendations. No clear evidence is provided that a secondary access is infeasible or that the proposed measures are a superior option. This is not how communities should be planned today – it was how we did it things in the past, and we saw the catastrophic results of those bad decisions. Rolling back our planning process and standards for this Project is not justified.

It is alarming to see that the solution to a regional fire siege threat is to rely on untested strategies designed to reduce the need for resource deployment for structural defense, while also ignoring many of the time tested measures that are known to provide adequate protection (e.g. multiple access roads and dead-end road standards). Despite the assertion throughout the DEIR and supporting documents that the Project design and proposed mitigation measures will provide adequate community protection, the DEIR provides no evidence to support this conclusion. With no significant empirical evidence to support the effectiveness of the proposed measures, the Project will regrettably become an experimental community, designed to test whether certain features can improve community resilience and public safety. The consequences of this approach could be tragic.

The County has a responsibility to be prospective and protective in its planning decisions, particularly when they involve high fire risk areas like the Project site. The Project should include an adaptive management framework that provides for the flexibility to anticipate issues such as changes in extreme climate conditions and heightened wildfire risk (at a level informed by the best available science). While, advancements in our understanding of fire risks lag behind community planning and risk assessment needs, this is no excuse for placing a community in a high risk area with inadequate and untested protection measures. A lack of critical information and understanding in this area creates a situation in which pivotal land use decisions are made based on such malleable factors as public perception or budgetary constraints.

Regardless of analysis used or the models evaluated, it must be remembered that these are simply tools that are meant to provide information to assist in making an informed decision. We must remember that these tools are fraught with considerable uncertainty. Ultimately, the decision to approve a development is based on the level of risk that we are willing to accept for a community. Ideally, decision-makers should operate under the precautionary principle that states: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically."[49] Failure to adhere to a "caution is best" approach can have serious repercussions on the long-term sustainability and resilience of our neighborhoods and the success or failure of community planning.

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[49] The most widely cited definition of the precautionary principle comes from the Wingspread Statement on the Precautionary Principle, 1998.