

## Chapter 12 Expansive Soils

### 12.1 Risk Assessment

#### 12.1.1 Description of Hazards

**Requirement §201.6(c)(2)(i):** The risk assessment shall include a description of the type location and extent of all natural hazards that can affect the jurisdiction.

Expansive soils are generally clays or sedimentary rocks derived from clays, which experience volume changes as a result of moisture variation.

The hazard that expansive soils create can be significant. Many of the expansive soils do not create large areas of destruction; however, they can disrupt supply lines (i.e. roads, power lines, railways, and bridges) and damage structures. The effects on structures can be dramatic if expansive soils supporting structures are allowed to become too wet or too dry. Lightly loaded one-story or two-story buildings, warehouses, residences, and pavements are especially vulnerable to damage because these structures are less able to suppress the differential heave of the swelling foundation soil than heavy, multistory structures. Patios, driveways, and walkways may also crack and heave as the underlying expansive soils become wet and swell.

Expansive soils do not change size quickly; observing damage in real-time can sometimes be difficult. Although the damage might not occur in a matter of minutes, it still has the potential to severely damage structures and roads over a matter of time if not sufficiently mitigated.

Many areas of Santa Cruz County are underlain by expansive soils. However, expansive soil does not cause problems unless poorly designed structures are built on it. A house built on expansive soil will probably move if the foundation was not designed to take this soil type into account. Movement occurs because the soils expand so forcefully, the foundation actually moves. Different parts of the house can move at different rates and distances, thus cracking the foundation. Significant cracks often appear at the corners of windows and doors, in walls, garage slabs, walkways, and driveways. Doors and windows may become jammed. The integrity, design, value and use of a home could be affected. During extreme drought conditions, even homes that are not normally affected by expansive soil problems may experience slight cracking.

The general areas of expansive soils within Santa Cruz County are known (Figure 24). The National Resource Conservation Service's (NRCS) Soil Survey of Santa Cruz County mapped various soils types throughout the County. In addition, soils reports performed over the years throughout the County for building permits have corroborated the locations of expansive soils. The primary soil types mapped by NRCS as expansive are Watsonville Loam, Clear Lake Clay, Diablo Clay, Fagan Loam, Los Osos Loam, Mocho Silt Loam, Pinto Loam, Felton Sandy Loam, Cropley Silty Clay, Danville Loam and Lompico Varient Loam. The general locations of expansive soils are in the coastal terraces in Live Oak, Seacliff, and Rio Del Mar and in South County near Watsonville. However, smaller pockets of expansive soils may exist throughout the County.

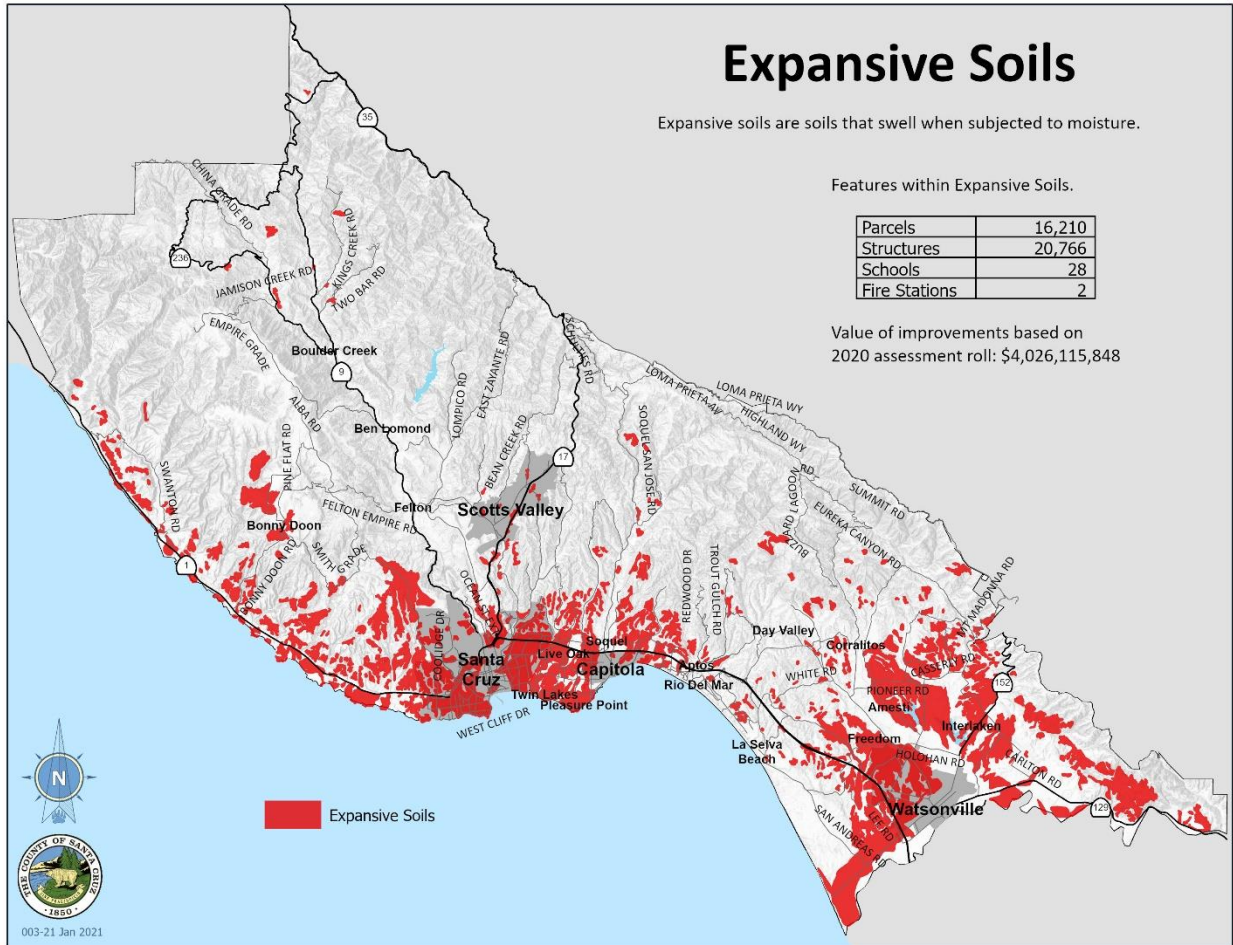


Figure 24 Map of expansive soils

Each year in the United States, expansive soils cause billions of dollars in damage to buildings, roads, pipelines, and other structures. This is more damage than that caused by floods, hurricanes, tornadoes, and earthquakes combined (FEMA 1997).

It is estimated that Santa Cruz County has thousands of homes built on expansive soils. Typically, the structures that experience problems with expansive soils are older homes, but newer homes (built within the last 15 years) may also experience problems due to expansive soils. The types of problems associated with expansive soils are generally not catastrophic, but the effects result in cracked foundations, cracked walls, cracked concrete slabs, cracks around windows and doors, as well as jammed windows and doors. Cracks to foundations may lead to additional problems if other catastrophic events were to occur (such as earthquakes).

### 12.1.2 Previous Occurrences

**Requirement §201.6(c)(2)(i):** The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Each year the Building Department reviews many permit applications to fix problems associated with expansive soils. The number of occurrences is difficult to measure, since property owners may consider the effects of expansive soils to be minor and therefore choose not to do anything about it.

Structures in Santa Cruz County will continue to experience problems with expansive soils on a yearly basis as moisture conditions in soils fluctuate.

Building Codes (2019 California Building Code (CBC) Section 1802 provide local jurisdictions with tools to request soils reports for building permits in areas where expansive soils are suspected and have detailed procedures to determine when soils are considered expansive. In addition, Section 1805.8 of the 2019 CBC provides requirements for design for expansive soils. Therefore, over time we expect to see fewer problems with structures due to expansive soils.

### *12.1.3 Assessing Vulnerability: Overview*

**Requirement §201.6(c)(2)(ii):** The risk assessment shall include a description of the jurisdiction’s vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description shall include an overall summary of each hazard and its impact on the community.

It is estimated that Santa Cruz County has over 20,000 homes built on expansive soils. Typically, the structures that experience problems with expansive soils are older homes, but newer homes (built within the last 15 years) may also experience problems due to expansive soils. The types of problems associated with expansive soils are generally not catastrophic, but the effects result in cracked foundations, cracked walls, cracked concrete slabs, cracks around windows and doors, as well as jammed windows and doors. Cracks to foundations may lead to additional problems if other catastrophic events were to occur (such as earthquakes).

### *12.1.4 Assessing Vulnerability: Identifying Structures*

**Requirement §201.6(c)(2)(ii)(A):** The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard areas.

Due to its unique geologic makeup, expansive soils are located mainly in the coastal areas and in agricultural areas in the southern portion of the County. Over 16,000 parcels are estimated to be located on expansive soils with nearly 21,000 structures built on these parcels. These areas represent some of the most expensive real estate in the county and the estimated potential total loss in value comes to over \$4 billion (Table 24). Depending on the extent of damage and cost of repairs, however, the actual potential losses is probably significantly lower.

12.1.5 Assessing Vulnerability: Estimating Potential Losses

**Requirement §201.6(c)(2)(ii)(B):** The plan should describe vulnerability in terms of an estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

Over 14,000 residential parcels have been identified as threatened by expansive soils, and those parcels contain over 18,500 structures with a potential total loss value of over \$3.3 billion.

Land Use	Parcels	Structures	Total Assessed Value 2020
Agricultural	391	457	\$70,418,713
Commercial	521	633	\$294,988,893
Government	271	162	\$0
Industrial	109	124	\$84,523,561
Institutional	135	488	\$184,528,509
Miscellaneous	387	285	\$30,126,533
Residential	14,326	18,591	\$3,361,132,321
Utilities	70	26	\$397,318
<b>Total</b>	<b>16,210</b>	<b>20,766</b>	<b>\$4,026,115,848</b>
Population	35,234		
Population is based on the 2010 Census. Unincorporated Block centroids were selected by the hazard area.			

Table 25 Expansive soil potential loss inventory

12.1.6 Assessing Vulnerability: Analyzing Development Trends

**Requirement §201.6(c)(2)(ii)(C):** The plan should describe vulnerability in terms of providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Santa Cruz County has a number of compact urban communities as well as extensive areas of agricultural land and forested hillsides. A number of rural villages and towns are located throughout the County. As dictated by the 1978 Growth Management Ordinance, most new development has occurred within or adjacent to the urban services line (i.e., the boundary point for such infrastructure as water and sewage service). As with most communities, increased housing costs have resulted in the need to provide higher density housing. In Santa Cruz County, all development of this type occurs where urban services are available. Other development is mostly infill or reuse development, and development of existing rural residential properties.

Since expansive soils exist both within and outside of the urban services line, mitigation of expansive soils must be looked at on a countywide basis with a focus on the areas of known expansive soils.

No changes in these development regulation or patterns occurred that would affect the County's overall vulnerability since the previous plan was adopted in 2016. While the County does not track the number of residential and commercial structures that have been built in areas of expansive soil since the last LHMP was adopted in 2010, it is a subset of the overall number of new structures built in the unincorporated portion of the County. According to annual Growth Management Reports, there have been 909 new residential structures built in the County since 2010 (Table 12).

As stated above, growth management policies prevent new development from occurring where hazards are present. Development on existing lots of record is required to avoid hazards and incorporate appropriate foundation designs and other requirements to mitigate potential impacts from expansive soils. The Environmental Planning Section of the Planning Department, staffed by Resource Planners, specialize in reviewing each application for new residential and commercial structures to ensure that new development does not occur in hazard zones and that development on existing lots of record avoid, minimize, and mitigate potential impacts from identified expansive soil hazards.

## 12.2 Mitigation Strategy

**Requirement §201.6(c)(3):** The plan shall include a mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.

The mitigation strategy includes:

- Continuation of review of building permit applications to require identification;
- Mitigation of expansive soils as required per the 2007 California Building Code; and
- Pursue an effective public information program and continuing collaborative efforts with the cities, agencies, and community organizations to facilitate collaborative efforts in providing expansive soil mapping, information, and education.

An assessment of this mitigation strategy as part of this 5-year plan update indicates the strategy is effective and remains relevant for reducing potential losses identified in the risk assessment. The expansive soil risk has not changed since the previous plan was adopted. No adjustments are needed to address a change in circumstances. There have been no expansive soil related disasters during the five-year update period.

### 12.2.1 Mitigation Goals

**Requirement §201.6(c)(3)(i):** The hazard mitigation strategy shall include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Santa Cruz County has developed several expansive soils mitigation goals to decrease the problems associated with expansive soils.

Expansive Soils 1 - Education and Awareness: Train building plan check staff on expansive soils. Provide public information and education/awareness to all residents of the County concerning expansive soil areas and mitigation efforts.

Expansive Soils 2 - Preventative and Implementation: Develop and implement activities to protect properties and infrastructure.

Expansive Soils 3 - Funding and Partnerships: Seek partnerships in funding and resources for future mitigation efforts.

### *12.2.2 Identification and Analysis of Mitigation Actions*

**Requirement §201.6(c)(3)(ii):** The mitigation strategy shall include a section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

The County participates in ongoing mitigation actions to avoid or reduce the effects of expansive soils. Flood hazard mitigation strategies include the following actions. The alpha-numeric identifiers after each action are further described in Chapter 15 Mitigation Strategy.

- Continue to require soils reports as part of the building permit process. (C-6)
- Develop design criteria for expansive soils properties. (C-11)

### **2021 Progress Report**

The integration of the plan into existing planning mechanisms and the implementation of mitigation actions demonstrate progress in risk reduction. An explanation of how the mitigation plan for expansive soil hazards has been implemented over the last five years is included in Appendix L and described below for each Mitigation Action related to expansive soil hazard reduction.

- Planning staff continues to require soils reports as part of the building permit process. (C-6)
- The permit review process uses design criteria based on the State building code and local amendments. (C-11)

By using these planning mechanisms to avoid, minimize, and mitigate the hazards from expansive soils, the County has demonstrated progress in reducing the risk from landslide hazards. Further explanation of how the previous mitigation plan has been implemented over the last five years is included in Appendix L. The worksheets in Appendix L also describe how the current mitigation strategy, including the goals and hazard mitigation actions, will be implemented over the next five years. The projects described in Mitigation Actions C-6 and C-11 are still relevant and will continue to be implemented over the next five years.