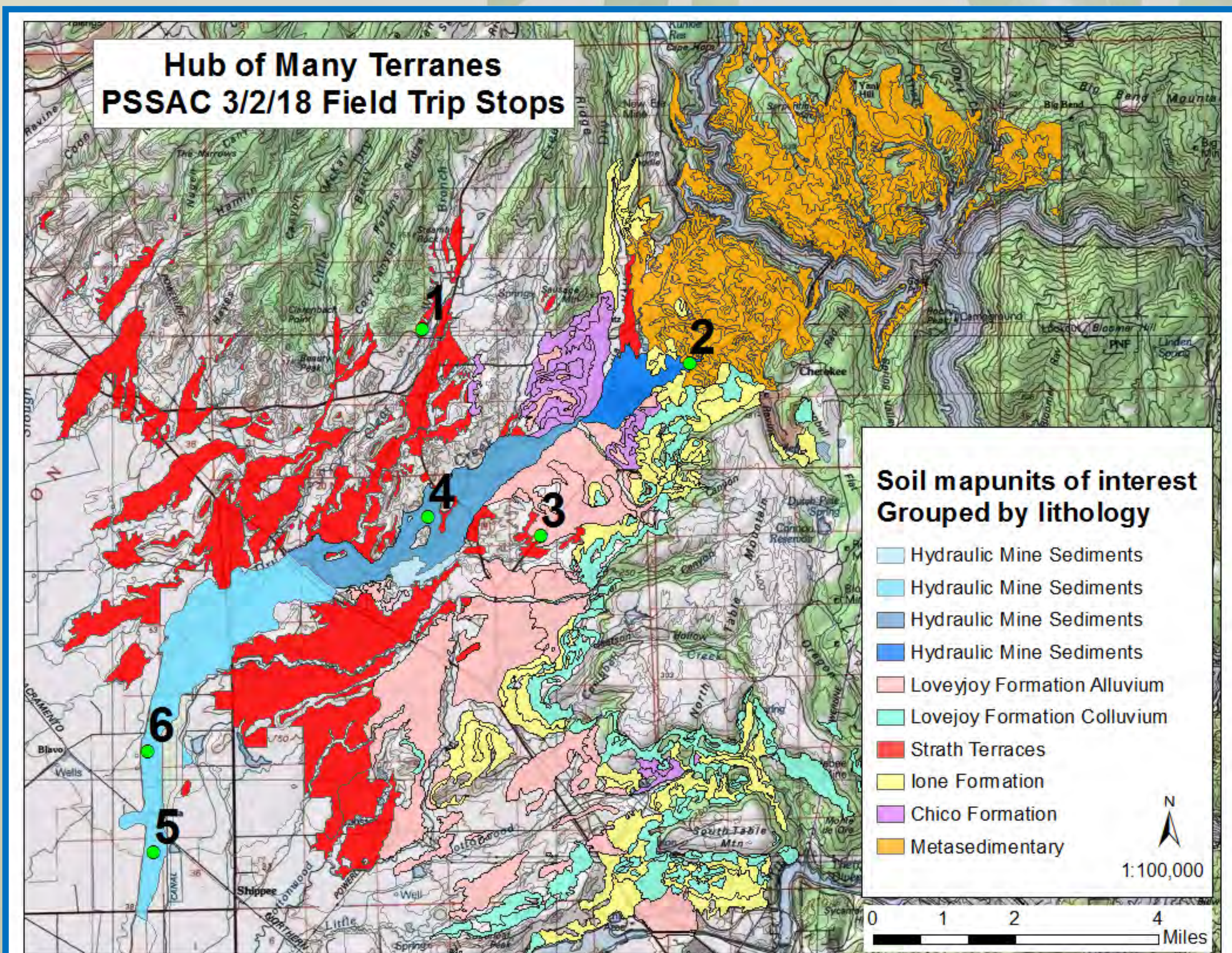
Soils and Landforms of the Butte Valley—Cherokee Strip-Butte Basin

Annual Meeting & Field Tour Guide Book

March 1-3, 2018



PSSAC

Professional Soil Scientists Association of California

In Collaboration with

CSU Chico and the

USDA—NRCS

David B. Kelley & Garrett C. Liles, Eds.

Welcome to the
Professional Soil Scientists Association of California
Annual Meeting & Field Tour

Guide Book

Soils and Landforms of the Butte Valley-Cherokee Strip-Butte Basin Region

March 1-3, 2018

David B. Kelley & Garrett C. Liles, Eds.
Kelley & Associates Environmental Sciences, Inc., and
California State University Chico,
College of Agriculture

Thank you to the individuals who helped make this program possible

Joel Butterworth, ICF International
Andrew Conlin, NRCS, Chico
Meagan Hynes, Talus Soil Consulting
Tony Rolfes, NRCS, Davis
Mary Reed, PSSAC
Jennifer Wood, NRCS, Davis

Cover: Soils and Lithology map compiled by Andrew Conlin and Jennifer Wood, NRCS

Guide Book: Soils and Landforms of the Butte Valley-Cherokee Strip-Butte Basin Region

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California Soil Cooperators Meeting & Field Days

Thursday March 1 -NCSS State Cooperators Meeting

- Current soil survey projects, products & cooperative research opportunities
- Colusa Hall 100A on the Chico State Campus 9am - 4pm

Friday March 2 - Field Tour

- Explore soil, geomorphology, & geology at the Cascade-Sierra interface
- Butte College area → Dry Creek Drainage → Cherokee Strip - 9am - 4pm

Saturday March 3 - Region 6 Collegiate Soil Judging Event

- Morning Competition and afternoon soil viewing and discussion
- Butte College Campus 9am -3pm

These events are open to the soil and management community. **NOTE the Friday-Saturday events are co-sponsored by PSSAC with an associated registration fee for meals and a field guide -** http://pssac.org/meetings/2018-annual-meeting -
Please register in advance!!

For more info -
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News Release

"Helping People Help the Land"

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Multiday Event in Chico will Focus on Soils, Students and Community

CHICO, Calif., Feb. 16, 2018 — USDA's Natural Resources Conservation Service (NRCS), CSU Chico and the Professional Soil Scientists Association of California (PSSAC) are hosting a special soil event from March 1 through March 3 for anyone interested in soils or learning how to use soil survey information.

The soil science community is invited to come together to talk about upcoming projects, shared goals and the future. This will include an all inclusive partners and cooperators meeting, a healthy dose of exploring soils and land use in the field, and interacting with university students. Attendees can come to any or all events. All are welcome.

To start things off, there will be a National Cooperative Soil Survey State Cooperators meeting on Thursday, March 1, at Chico State University in Colusa Hall, room 100A, from 9 a.m. to 4 p.m. Topics will include contemporary use of NRCS soil survey information, current and developing university soil science related projects, UC Davis student soil research projects and NRCS natural resource inventory product. No registration is needed for this meeting.

On Friday, March 2, PSSAC will host their annual meeting and a field tour, co-hosted with Chico State University and professional soil scientists, where attendees can explore the soils and geology at the Cascade – Sierra Interface and Cherokee Strip (placer mine deposits extending in the Northern Sacramento Valley) in Butte County. There will be a group dinner and speakers to follow that evening. Advance registration is required.

The event wraps up on Saturday, March 3, with the Region 6 Collegiate Soil and Land Judging Contest at Butte College from 9 a.m. to 3 p.m. Meeting participants will help facilitate the event and mentor the students with a morning competition and afternoon soil viewing and discussion.

For more information, please contact Tony Rolfes at tony.rolfes@ca.usda.gov or (530) 792-5656 or Garrett Liles at gcliles@csuchico.edu.

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DAY 1
Thursday, March 1, 2018

California NRCS NCSS Planning Meeting

CSU Campus Thursday March 1st, 9 am - 4 pm

Colusa Hall 100A – Chico CA

9:00 am to 9:30 am - Welcome and introductions – Garrett Liles Chico State
NCSS Overview in California –Toby O'Geen UCD and Tony Rolfes NRCS

9:30 am to 10:45 am - Using Soil Survey Information: **Moderator** – Tony Rolfes, NRCS
- Addressing Soil Resource Concerns through the Conservation Planning Process – Phil Hogan, NRCS
- Conservation Effects Assessment Project - Carrie-Ann Houdeshell, NRCS
- SSJV Management Practices Project – John Dickey, PlanTierra

10:45 am to 11:00 am – Break

11:00 am to 12:00 pm - University Projects: **Moderator**: Jennifer Wood, NRCS
- Regional Soil Health Assessment Project – Garrett Liles, CSU
- "Soil Life - Integrating Research and Outreach in the Digital Age." - Jessica Chiartas, UCD
- Updates to UCD Apps and developing Soil Health Project – Toby O'Geen, UCD

12:00 am to 1:00 pm - Lunch

1:00 pm to 1:30 pm - UCD Student Project Presentations: **Moderator**: Jessica Chiartas, UCD
- Integrating soil survey and climate data to highlight water conservation opportunities in California irrigated agriculture - Scott Devine
- Predictive Phosphorus Mapping in California Vineyards Soils – Stu Wilson

1:30 pm to 2:00 pm - Meet the Students and University Project Coordinators

2:00 pm to 3:00 pm- NRCS Soil Survey Products and Projects: **Moderator**: Ken Oster, NRCS
- Current Soil Survey Project Example - Phil Smith, NRCS
- ESD's and Ag Handbook 296 MLRA - Ed Tallyn and Jon Gustafson, NRCS
- Soil Interpretations and new soil survey technologies - Dylan Beaudette, NRCS

3:00pm to 3:15 pm - Break

3:15 pm to 4:00 pm - Open discussion on Soil Survey: **Moderator:** Cynthia Stiles, NRCS
- Discussion to help inform NRCS soil scientist and University Cooperators on soil survey data, interpretations and product needs and ideas - All

4:00 pm to 4:15 pm- Wrap up – Summarize partners and cooperator inputs and going forward.
Toby O'Geen and Tony Rolfes.

Phil Hogan, NRCS District Conservationist in Yolo County located in Woodland
Phil was born in Santa Monica and during his first 15 years grew up in LA. He then moved to Denver area, where he graduated from Cherry Creek High School.
Work: Phil has worked for Padre Island National Seashore; Indiana Dunes National Lakeshore and the Bureau of Land Management in Rawlins, WY. He started with the NRCS as a soil conservation technician in Woodland 1981, he worked his way up to a soil conservationist, then transferred to the NRCS state office in Davis as a public affairs specialist. Phil served as the District Conservationist in Dixon from 1990 to 1993, and have served as the District Conservationist in Woodland since April, 1993. Phil has a total of about 38.5 years of federal service, 37 with the SCS/NRCS
Education: Phil started out as a music education major at the University of Northern Colorado, then when it dawned on him he couldn't read music, he transferred to Colorado State University to the School of Forestry and Natural Resources. His goal was to become an Interpretive Naturalist with the National Park Service, so he earned a B.S. in Outdoor Recreation.
Other Accomplishments: Phil graduated from the California Agricultural Leadership Program in 2000.
Phil has a strong personal and professional interest in land use planning and farmland protection and he completed the first land Evaluation and Site Assessment Project (LESA) in California in Yolo County.
Phil is a CPESC (Certified Professional in Sediment and Erosion Control).
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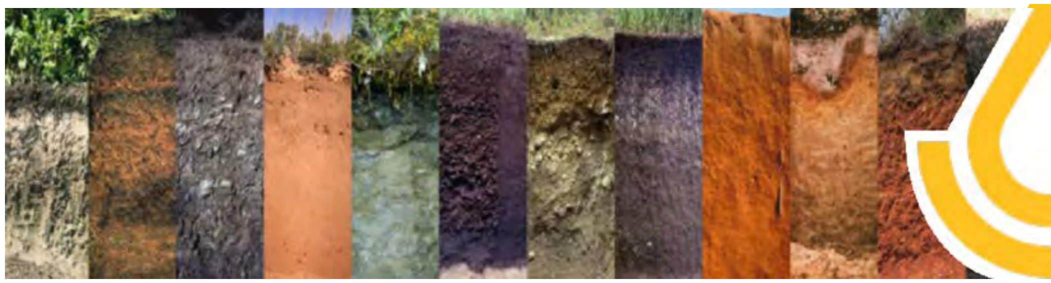
Carrie-Ann Houdeshell, NRCS Soil Scientist/Modeling Unit Coordinator in Davis CA.
Carrie-Ann grew up in Southern California. She had planned to be a lawyer (like her dad), but saw the Soil Science Department's office on a Senior Day visit to Cal Poly San Luis Obispo, that changed her life that instant. She knew from that day, she wanted to learn about soils and why they change across the landscape.
Work and Education: Carrie-Ann started as an AmeriCorps Volunteer working in the Fort Irwin Soil Survey Office in Barstow, CA in 1994. After receiving her Master Degree in Soil and Water Science from UC-Riverside in 2000 she was hired by NRCS as a Soil Scientist for the Joshua Tree National Park Soil Survey. She spent 14 years mapping soils in the desert, and is proud to say that she and the soils team finished the Joshua Tree National Park Soil Survey before she had left. She worked all over the desert including mapping soils in Death Valley, where she mapped over 600,000 acres. Carrie-Ann loves the desert landscapes and stayed in that position until she took the Modeling Unit Coordinator position in Davis, April 2014.
Other Interesting Notes: Carrie-Ann misses the large landforms of the Mojave Desert, but truly appreciates the uniqueness of the Sacramento Valley as well as the Delta. She loves it when she can get to the field and look at soils with one of the CA soil survey offices. However she hasn't quite gotten used to needing water boots in order to jump into a soil pit.

Dr. John Dickey, Owner and Principal Soil Scientist and Agronomist, PlanTierra LLC, located in Davis CA. John is the Technical Program Manager for the South San Joaquin Valley Management Practices Evaluation Program (MPEP), a component of the Irrigated Lands Program for growers south of Fresno.
John's family were Delta farmers, gold rush bankers, in hardware and rice millers.
John was born in San Francisco and raised in Orange County. Since high school he lived and worked in the Central Valley, Indiana, and West Africa.
Work: John worked as a Farm labor in Dixon CA. In Burkina Faso West Africa with Peace Corps in early 80s. He was on the Purdue faculty where he worked with Burkina Faso's ARS equivalent, doing on-farm research during the early 90's. John has been doing Environmental Consulting mostly from 1990 onward, beginning with CH2M HILL, and with his own firms since 2007.
Education: John has a BS in International Ag Development, an MS in Agronomy both at UCD and his Soil Science PhD from Purdue.
Current Project: The Management Practices Evaluation Program, a grower-led, grower-owned program, currently focused on maximizing retention and use of applied N by crops in the Central Valley. The program is about half way through a three year NRCS CIG. His team not only rely on NRCS' soil survey data for practice performance evaluation, but also collaborate on grower outreach and applied research. Other NRCS partners, like Toby O'Geen, UCD and Temple, Texas modelers, are key collaborators.



The Soil Science Division (SSD) supports the NRCS mission by delivering vital information and expertise to agency staff, partners, and the public in innovative ways. The division's priorities for FY 2018 will enable it to continue that service.

Soil and Ecological Site Inventory

Initial Soil Inventory

Accelerate the foundational (initial) soil inventory on all lands, including private, Tribal, and Federal lands

The initial soil inventory is the foundation upon which all subsequent soils products and information are developed, maintained, and interpreted. As of 2017, an initial survey had been completed on more than 80 percent of the United States, including 92 percent of non-Federal lands. Detailed soil survey maps and data are accessible through Web Soil Survey for these areas.

More than 450 million acres of soils have not yet been inventoried. Over 70 percent of this acreage, 330 million acres, is on Federal lands. The remaining 120 million acres include conservation-priority areas, such as Tribal lands in Alaska. The Soil Science Division, in collaboration with National Cooperative Soil Survey (NCSS) partners and State Conservationists, is implementing a plan to accelerate the inventory of the remaining private and Tribal lands. The plan proposes completion of the foundational soil inventory by 2026. Priority will be given to Tribal and private lands on which conservation technical assistance and farm bill program delivery are NRCS priorities.

The initial inventory is the basis for customers to ask questions, request existing data, and seek current soil interpretations. It is also the basis for development of new data and interpretations. It is needed in the development of conservation programs and provides the scientific basis to address soil health issues and other emerging land use concerns.

Ecological Sites

Provide ecological site products to broaden conservation applications and training in collaboration with national, center, and State technical staff and Federal partners

Ecological site inventory, state-and-transition models, and ecological site descriptions are critical for selecting, implementing, and assessing conservation practices; recognizing thresholds of irreversible change in managed ecosystems; and estimating potentials for soil carbon sequestration. The use of ecological site information for conservation planning is an application of existing NRCS guidelines. The first step of this use is selecting the ecological site and ecological state; the next step is defining conservation goals and objectives; the third step is selecting appropriate conservation practices; and the fourth step is monitoring the impact of the practices to adjust future management decisions. Long-range and project plans for soil survey will include protocols for the definition, inventory, and description of ecological sites. Provisional ecological sites are planned to be available for the continental United States by 2020 and for the entire country by 2025.

Dynamic Soil Properties

Accelerate the collection of dynamic soil property (DSP) data

Dynamic soil properties, which are those properties that change with land use and management, enhance soil survey products. Dynamic soil properties are used to frame, measure, and predict the response of soils to disturbances caused by human and nonhuman factors. Dynamic soil properties link soil inventories—as collected by traditional soil survey methods—to advancing areas of soil health, conservation, and management practices. Potential levels of DSPs are determined by inherent soil properties, but a range of actual observed values are possible. The range can depend on land use, land cover, management practices, and individual field conditions. Links can be made between ecological sites, interpretive soil groups (such as forage suitability groups), and DSP values in both absolute and relative terms. There is an increasing demand for dynamic soil property data to inform management activities, to better assess the impact of those activities (ecosystem services), and to provide more detailed and site-specific information for model development and for applications. Collection of DSP data will be integrated into all projects and will become a routine component of soil inventory.

Major Land Resource Area Updates

Accelerate field activities of major land resource area (MLRA) updates in order to develop a seamless coverage of soils information across the Nation

Updating soil survey information by MLRA ensures that current, accurate information is available to meet the needs of the majority of users and is delivered in a timely manner. Project plans are coordinated across the existing (i.e., "traditional" or "non-MLRA") soil survey area boundaries and follow natural landforms. The MLRA process facilitates mapping, interpreting, and delivering seamless soils information across broad geographical areas that have common resource values, land uses, and management concerns. The MLRA update process is driven by the outcome of previous and ongoing Soil Data Join Recorrelation (SDJR) activities as well as by collaboration with NCSS partners. NCSS partners will be involved in all aspects of the planning and field work processes through their involvement on technical teams, management teams, and boards of advisors.

Technical Soil Services

Assist States in providing science-based technical soil services to enhance and support soil health activities, conservation planning, and program delivery and to maintain and expand our partnerships with university cooperators and external customers

The Soil Science Division (SSD) is committed to assisting the State Conservationists through State soil scientists. The SSD provides assistance to improve the quality and quantity of technical soil services that support agency priorities. The SSD, the Ecological Sciences Division, and the Soil Health Division will continue to work in partnership with States to provide science-based soil property information and applications. The SSD will continue to collaborate with State soil scientists to promote the application of soils information in resource assessment for conservation planning, onsite investigations to support conservation practice design, assessments of soil health and dynamic soil properties, identification of hydric soils for wetland determinations, and other conservation technical assistance. The SSD is also committed to assisting States as they help customers understand and properly use the soil survey, provide customers with predictions and interpretations about the behavior of soil, and offer help to traditional, nontraditional, and underserved customers through soil workshops, training sessions, and volunteer opportunities. These services will be beneficial for assisting in critical conservation areas and for broadening the conservation partnership.

National Cooperative Soil Survey

Strengthen the National Cooperative Soil Survey (NCSS) through increased transparency and collaboration with internal and external partners

The strength of the NCSS derives from collaboration between NCSS partners—Federal, State, and local government agencies, universities, and the private sector—to achieve common goals in advancing soil science. The Soil Science Division will work through State Conservationists and State soil scientists to strengthen communication lines among NCSS partners. The SSD will promote agency priorities in soil health, conservation initiatives, and conservation planning to landowners. The SSD will encourage NCSS partners to actively participate in regional and national conferences and to serve in subject matter training cadres.

NCSS
National Cooperative Soil Survey

DAY 2

Friday, March 2, 2018

SOIL LANDSCAPES OF THE SACRAMENTO VALLEY
PSSAC 2018

David B. Kelley
K&AES, Inc./Tuscan. Inc.

The Sacramento Valley Landscape

There is no hiding the complexity of the landscapes one encounters in the mid- to lower-valley region of the Sacramento Valley, where The Sacramento River courses south through magnificent agricultural landscapes of trees, rice, and rangelands into the largest remnant tidal marsh on the West Coast, the northern edge of the Sacramento-San Joaquin Delta. The complexity of the landscapes to be observed from Red Bluff to Chico, from Chico to Cherokee, where our Professional Soil Scientists Association of California (PSSAC) will hold its 2018 field tour and workshop, may be underappreciated but it is robust. In part, this is because much of the complexity is expressed as surface features that don't tell enough about the not-so-obvious underground complexities of Butte County. The following discussion provides some hints at these complexities of this vital agricultural and history-rich region.

The City of Chico is situated along the northern edge of a basin with a landscape expression of hills, stream terraces, alluvial plains, and fans near the Sacramento River and Butte Creek, which for the most part are streams of the Sierra Nevada rising in the north and to the east of the Sacramento Valley. The Sacramento Valley to the north and, to the south, the San Joaquin Valley (whose streams also originate in the Sierra but south of the Sacramento's watershed), conjoin just south of the City of Sacramento, combining to form the Great Central Valley of California, a region of unparalleled agricultural productivity and many amiable Californians—cattle, sheep, citizens, horses, and politicians.

In the past few years leading up to 2017, California's normally dry climate held sway, *in extremis*. The effects of what many consider to be California's epic drought were somewhat attenuated by fall, winter, and spring rains of 2017, and some prospect of coming rains, perhaps the week of our meeting in 2018, but now marking a period of fading adequacy. (As an example of these extremes, some places recorded no rainfall in January 2015, traditionally the middle month of our Mediterranean climate's rainy season, but 2017 brought record rainfall totals in the same seasonal time frame. In 2018 we have gone back to very dry and warm conditions.) The region experienced several "pineapple express" events in 2016 - 2017, when moisture from the central and north Pacific was lifted over or through the Coast Range and dumped on our cities and rangelands and farms, but, most important, on the Sierra. So far, those moisture-laden winds of the Pacific have sort of ignored us. Good weather in the California prior to 2017 had come to be defined as rainy days with prospects of more to come; in 2018, that is still the case. Sometimes one can only take so many sunny, 60-degree days in the wintertime.

On our field excursion, we will have a chance to examine some of the complexities of the soil landscapes of the region. We will see upland soils of ancient and gravelly remnant alluvial fans that reflect other sets of climatic conditions, river hydraulics, sea level differences, mining prospects, and cultural influences not so obvious now. And we will observe soils that were, figuratively speaking, in terms of pedologic time, laid down yesterday. Similarly, we will see soils of great age (200K years? 500K years?) alongside soils of the Holocene (less than 20K years old).

Annual Grasslands or California Prairie?

Most of the so-called annual grasslands of California, crisscrossed by corridors of riparian vegetation associated with drainages, might be better characterized as prairies—they support many forbs and other dicots, remnant bunchgrasses, and many native species, as well as broadleaf weeds (most likely a big part of the forage and grazing base) and many other invasive species. They are dominated, for part of the year, by annual introduced grasses that are native to Mediterranean countries and that found a sound welcome here on the California prairies. In some areas, the natives have been all but eliminated, though they find refuge in some of the riparian systems we will visit, and in the vernal pools, small depressional wetlands associated with restricted internal drainage of the soil profiles. These vernal pools and swales are productive refugia for native species of plants and animals amid a sea of introduced annual grasses and forbs. They are endorheic wetlands (for the most part, waters entering them do not leave except by evaporation), and, in some areas that have not been cultivated, provide classic study sites for remarkably resilient native populations that are somewhat insular and somewhat at risk. The ecological communities of the vernal pool ecosystems, which may be characterized by their unique vegetation and faunal displays (and whose actor playlists may vary from year-to-year, depending on rainfall and disturbance factors) may persist as ecological features for thousands of generations.

Some vernal pools and swales in the Chico area, and other short-term wetlands of the prairie ecosystems, are associated with restricted drainage features of the clayey soil profiles—specifically, clay lenses that don't allow ponded surface waters to permeate the subsoil. In other instances and other places that we will see on our Butte County trip, the sub-surface restrictions may be in the form of lithic contacts at shallow depth, or in the form of indurated (cemented) layers, or duripans, that are pedogenic expressions of clay and mineral migrations and concentrations. These may result from the development of iron silicate precipitates and crystals that bridge soil particles and can form massive aquicludes (in some cases, cemented horizons two- to six-feet thick). The climate—winter rain and summer dry—allows the expression of vegetation types in landscape positions and conditions that reflect the truly harsh ecological cycles the pools undergo. The plants and the critters that have evolved in these unique systems are generally rare and passingly vulnerable to changing conditions. The pools and their biota are singularly adapted to the effects of grazing animals—sheep, cattle, and horses in contemporary California, and presumably elk and other grazers in pre-contact California—and other grassland processes such as wind and water erosion and deposition of aeolian sediments, fires, periods of water sufficiency and of drought, predation and herbivory, and other insults.

Many of these vernal pool complexes occupy fan terraces and some structural (underlain by bedrock) hills that have been shaped by streams and volcanic outwashes and influenced by watershed dynamics, climates, and sea level changes over the last few hundred thousand years. The system lies at the edge of of the Sierra foothills, a region marked by volcanic parent materials, both residual and aerially deposited, and formed under changing conditions of the Mediterranean climate. We will be able to discuss the ecosystem dynamics of this wonderful complex of earth, air, fire, and water cohorts when have some field time at the soil pits and observation stops.

Throughout the region, you will notice the green annual grasslands that color the hills and provide grazing for thousands of hoofed animals. In November, those hills were gray and brown and crackly dry, and, in some cases, on fire. On our trip in Butte County we will see the greened up hills where it is not unusual for summer and autumn fires to crisp and char all the forage. We shall see what a little rain can do.

We will have the opportunity in the field to discuss some of the past events that led to the formation of the Butte Basin landscape. We can't know it all: the geologic history, the fluvial/geomorphic history, the pedologic history, the cultural and agricultural histories—but we can examine, assess, and speculate about those histories, and we might even be able to weakly predict some of the futures the Basin will have. The only way to introduce this trip is to recognize the physical scale and dynamics of the natural (if ever-changing) features of the landscape. These include the Sacramento River canyon (well, the river may have occupied a canyon when sea level was 400 feet below its present stand), the eastern edges of the uplifted or remnant sediments and soils that rim the upslope edges of the Valley, the short and numerous secondary drainages that reflect and form parts of the alluvial dynamics of the Valley, and the mother stream of the Valley, the Sacramento River.

From a prehistoric perspective, there are other important things to recognize about this landscape. It is defined by its major stream, the Sacramento River; it has deep sediment accumulations (reflected by deep and delightful agricultural soils); it is a geological trough occupied by the river, not formed by it. On the sides of the valley, at least along the lower Sacramento, streams don't easily make their way into the Sacramento River channel—that mother stream has massive and robust levees that turn some of the eastern and western watershed streams aside and force them to yazoo their way into the basin-mingling waters of the sinks along the river. In some cases, the distal edges of the fans are not so much truncated by the Sacramento (at least in its current form), but drowned by its sediment deposits, just as Butte Creek's waters are drowned somewhere in the spreading fringes of the Sacramento. There are an older fans here, or at least memories of them, in the form of duripan soils and surface litters of stream-worked volcanic cobbles.

Imagine a landscape where the lower reach of the Sacramento River, its base level reflecting sea level, runs in a channel that is from 100 to 300 feet lower than it is now. We don't need to go too far back in time to find that possibility: that was the situation at the end of the Pleistocene and the beginning of the Holocene, before the catastrophic, cataclysmic global warming of the late Pleistocene returned glacial waters to the sea. Imagine San Francisco's gap in the Coast Range—we call it the Golden Gate today—as a river valley 200 to 400 feet lower than sea level today, with the comingled waters of the Sacramento and San Joaquin Rivers coursing through the valley and entering the sea a mile or more west, toward Japan, from the Golden Gate Bridge. If we encountered the river in those days, what would the landscape look like? We can suggest that both east- and west-side creeks may have had their own own canyons, cut through ancient, massive ancestral (pre-Holocene) alluvial fans, and completely different gradient dynamics—fast streams, carrying more water and more (and larger) sediment, doing more work on the landscape, breaching the broad Sacramento River levees, moving through alluvial plains that look much different from the ones we see now. Further, imagine that this was the landscape that the first people to invade this continent encountered. We can ask where they might have camped twelve to fifteen to twenty thousand years ago, what fish they might have eaten, what critters they may have encountered, what their trade routes and seasonal migration patterns might have been. Not only would the flora and fauna have been different (and maybe terrifying), but the ground that lay beneath their aboriginal hide-covered feet and their villages and campsites and hunting grounds has been covered up by successive sediment inundations as the Valley sides and riverscapes built, such that it is sometimes difficult or impossible to exhume and parse their story.

<u>Coda</u>

This is the framework for our field day. We will see and discuss some remnants of this new landscape (Holocene-new), as well as remnants of an older, maybe more unfathomable landscape. (If we can perceive the differences in the landscape that existed ten thousand years ago, can we do the same for a million-year-old landscape? A ten million-year-old landscape? Ask your friendly gold miner.) Be prepared to feel and discuss our way through our field tour. We have designed the field day to introduce the fans and terraces and creekways and basins as organic, dynamic, and intriguing landscapes, even to folks who know them already. We hope that participants will see this landscape differently after today from the way they might have seen it yesterday.

One sub-theme of the field tour will be land and resource utilization of the soil landscape—for cities, colleges, mines, farms, highways, and other cultural activities and institutions. Our emphasis will be on tying the soil geomorphic resources of the region to the resource utilization and history of the cultural occupation of it. Thank you for coming and welcome to our deep landscape.

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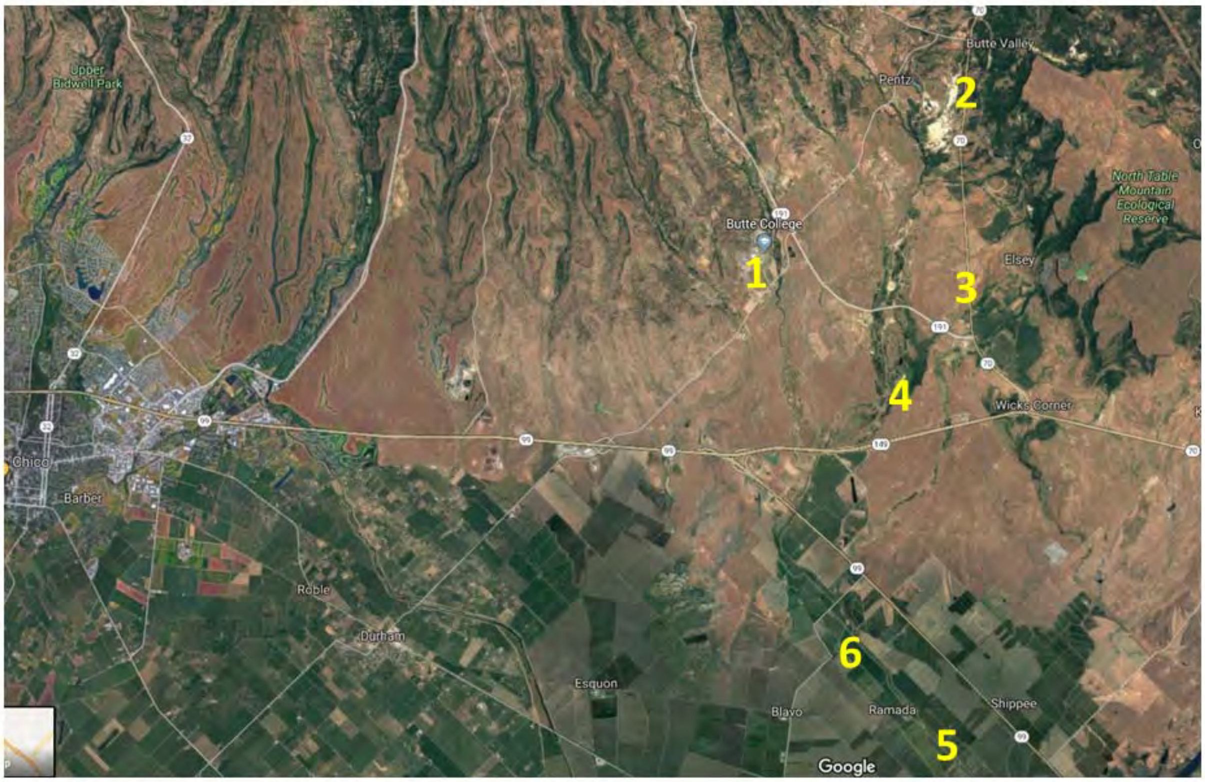
Friday, 2 March 2018 PSSAC Field Trip

Soils and Landforms of the Butte Valley-Cherokee Strip-Butte Basin:
A short trip back in time to understand landscape evolution

Garrett Liles, CSU Chico
Andrew Conlin, USDA-NRCS



Chico - Butte Valley – Cherokee Strip – Butte Basin

Stop 1. (~1 Hour) Butte College for a vista talk about the geologic and geomorphic history of the Butte Valley and western Feather River Drainage

- Ione and former route of the Feather River
- Vernal Pools
- Mineral deposits buried under Table Mountain Lovejoy
- Ages of local geologic formations and some of their signatures

Stop 2. (~30 minutes) Upper Reach of the Cherokee Strip.

- Look at bedding and discussion of the Cherokee Mine.
- View upper extent of the mudflow and discuss how it buried this small valley.
- Mining and resources extraction

Stop 3. (~20-30 minutes) Grassy knoll east of Hwy 191 (Pentz Road) (big pull out that will accomodate all vehicles off the road).

- Look at broader Northern Sac Valley setting - Sutter Buttes, Black Butte, Ione islands, and down into the next stop at the Franklin Mine site.
- Local land management

Stop 4. (~3 hours, including lunch break and discussion) Franklin Mine Site.

Stop 5. (~1 hour) Cherokee Strip and adjacent soils - Sohnrey farms

- Look at the contrast between Cherokee Strip materials and adjacent Butte Basin Vertisols.

Stop 6. (10-15 minutes) Nelson Shippee Road on Cherokee Strip

- Short stop to look at the clear contrast between light Cherokee materials and the dark basin clays. Discuss management of these materials
- Time Zero concept and how interesting this place is to study (given access)
- Redoximorphic Features—What are the rules?

Stop 7. Dinner, drinks, and discussion (5:30 – 8:30)
Roots Banquet Room, 3221 Esplanade, Chico

With Guest Speakers:

- **Dave Brown** – "Mine Reclamation and Water Quality"
  David L. Brown, Ph.D., Professor, joined the Geological and Environmental Sciences Department at CSU, Chico in August 1997.
  In recent years, his teaching has emphasized courses in hydrology and environmental science with an emphasis on interdisciplinary studies such as mined land remediation, ecohydrology, ecosystem science, energy and sustainability. He supervises undergraduate and graduate students with a broad range of research topics, including mined land reclamation, agricultural nonpoint source pollution, riparian restoration, groundwater-surface water interactions, and pesticide runoff prevention.
- **Dave Young** – "Recent Fire and Mudflow Event in Montecito!"
  David Young, Northern CA Zone Soil Scientist, BAER Team Leader/Soils Specialist. USDA Forest Service, Pacific Southwest Region (R5)
  Humboldt graduate (1993) with a B.S. in Natural Resources Management, Minors in Forestry and Soil Science. Worked as a private-sector Forester in the '90s with forestry consulting firms, working throughout the west coast and Alaska, mainly in THP prep. and silviculture. He has worked with the Forest Service since 2000 as a Soil Scientist, and worked with PSW Research Station under Bob Powers for 6 years, installing National Fire Plan research sites, and helping manage several other long-term studies including the Long Term Soil Productivity (LTSP) experiment. Dave is currently the Zone Soil Scientist for Northern California, in a shared-services position covering 8 National Forests, and works seasonally on Burned Area Emergency Response teams in post-fire watershed assessment throughout the Western US and abroad. He continues to work cooperatively with PSW on all things LTSP as a member of the Region 5 steering committee.

VERNAL POOLS OF THE TUSCAN PRESERVE
Notes on the Soil Landscape
PSSAC Field Tour 2018
Broyles Road and Highway 99
Butte County, California

David B. Kelley

The Tuscan Preserve was established on approximately 60 acres of vernal pool grasslands on the Wurlitzer Ranch in northern Butte County in 1991 as a research area, mitigation site, and nature preserve. The preserve is administered as a conservation easement by Tuscan, Inc., a non-profit foundation (David B. Kelley, President), and is managed and overseen by a team of restoration ecologists, botanists, and soil scientists who have conducted or supervised research activities at the preserve for over 20 years. When the preserve was established, Tuscan's endowment was set up to provide for the long-term management, maintenance, and monitoring of the site and for its upkeep and associated activities. The 60 acres support 3 to 4 acres of native vernal pools, vernal swales, and seasonal wetlands, and about 7.5 acres of created vernal pool and vernal swale wetlands. The created wetlands were built as mitigation for impacts to jurisdictional vernal pool and swale wetlands on project sites in the City of Chico. A population of Butte County Meadowfoam (*Limnanthes floccosa* subsp. *californica*), a protected annual species associated with vernal pools and vernal swales, was established on the site through seeded plantings in 1992, 1993, and 1994, as mitigation for impacts to a population of the species on the Chico project site. That population flourished across the site. The land of the preserve is owned by the Wurlitzer Family Trust and is under the permanent protection of the conservation easement held by Tuscan, Inc.

The preserve lies amid several hundred acres of similar ranchlands/grasslands that have been used almost exclusively for grazing for many years. The surrounding ranchland supports vernal pools and swales that, in turn, support protected special-status plant and animal species. The land is grazed annually from November through late April or May. The Tuscan Preserve and its resources are ideally situated to take advantage of the seasonal presence of grazing animals. A portion of the preserve was subjected to a prescribed burn in 2001 to attempt to provide some control of annual non-native grasses. Burning and grazing options remain legitimate and active vegetation control measures on the preserve; there is no question that the diverse native plant populations of the preserve benefit from regular grazing activities.

In the course of developing resource information on the Tuscan Preserve, a great deal of information on climate, soils, hydrology, and biological resources of the larger ranch has been acquired. Much of that information (for example, rainfall data, temperature ranges, and the structure of vegetation communities) is available from various detailed studies and publications that have been produced from work conducted on the preserve.

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Soils and Geomorphology The soils of the larger Wurlitzer Ranch surrounding and including the Tuscan Preserve are soils of old stabilized alluvial fans and associated drainageways and stream or fan deposits. The fan soils occupying the topographic high positions in the soil landscape are, for the most part, well developed, gravelly, and nutrient-poor (leached), with sub-surface root- and water-penetration constraints. Where hydraulic barriers (duripans and enriched clay layers) have developed in the near-surface horizons, the potential for vernal pool development is high.

In the younger soils associated with dissecting drainageways (which occupy the lowest topographic positions of the landscape), the nutrient status is higher, but some sub-surface hydraulic barrier problems exist. Many of the deposits are fine textured and have restricted drainage associated with enriched clay layers. Vernal pool floral expressions are associated with ponded depressions on these surfaces.

Mid-level topographic positions, between the older surfaces and duripan soils and the younger deposits with clay pan constraints, have mixed sub-surface hydraulic barrier and root penetration constraints and support vernal pools where the constraining horizons lie close to the surface.

Soils Soils of the preserve have been mapped in the modern Butte County soil survey (undertaken by the Natural Resources Conservation Service out of their survey party office in Chico). On the preliminary soils map, old series names (Tuscan, Igo, and Anita series) are no longer as widely represented in the new mapping effort. New series replacing these series include three mapped complexes: the Redtough-Fallager-Anita complex, the Wafap-Hamslough complex, 0-2% slopes, and the Oroville-Thermalito-Fernandez Thompson Flat complex, 0-9% slopes (NRCS, pers. comm.). These complexes include duripan soils with clayey soils in the surface depressions and swales; clayey or loamy alluvial soils with some gravels, associated with drainageways; and high terrace soils with drainage restrictions and clayey soils filling depressions and swales on that surface.

Soils of the 60 acres of the Tuscan Preserve have been intensively characterized, partly as a function of site resource assessment prior to constructing mitigation wetlands. A good bit of the remainder of the surrounding Wurlitzer Ranch has been characterized in a similar manner, but not as intensively. Soils across the ranch are relatively diverse (hence their mapping, at an Order 2 level, as “complexes”), but most are suitable for consideration as vernal pool, vernal swale, or seasonal wetland construction targets.

Hydrology The Wurlitzer Ranch is marked by numerous vernal pool wetlands (surface depressions which pond surface runoff waters for long periods following the cessation of rainfall, and which have developed unique associations of plant and animal species indigenous to the grasslands of the region). The opportunity for development of these wetlands on the ranch is directly related to the soils (described above) and rainfall regimes of the ranch. Many of the swales and pools in the surface depressions of the landforms of the site are wet enough, long enough, to allow the formation of hydric soils and hydrophytic plant communities.

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Water from surface ponding does not easily enter groundwater zones because of sub-surface hydraulic barriers (as described above). In vernal pools on flat surfaces, water leaves the pools and swales by evapotranspiration, with some lateral sub-soil flows to lower topographic positions. Lateral flows are probably minor components of the water balance of these pools. On some surfaces where the duripan dips toward swales and drainageways, lateral sub-surface flow may be a larger component of the hydrologic balance. In drainageways, some sub-surface perching of infiltrated surface or stream-borne waters (enough to daylight, or "perch", waters at the soil surface) can occur.

Surface flows are attenuated by surface depressions, as with many vernal pool systems. Watersheds of individual vernal pools may be very small (on the order of tens of square meters) to somewhat larger, depending on surface topography and disturbances (for example, roadways and other fills have created flow barriers which serve to allow water to pond long enough to create hydric soils and hydrophytic communities).

In general, groundwater is not near enough to the surfaces of the various landforms to affect surface hydrology. Recharge of groundwater, over most of the site, probably does not occur on a large scale. Some of the alluvial soils (associated with deposits from the Sacramento River, the dominant stream of the valley, and its tributaries) on the western edge of the ranch are possible recharge zones. In the areas where fan deposits intersect alluvial deposits, the opportunity for recharge may exist.

The Tuscan Preserve is fenced and entry is restricted. However, the site is visited regularly by many research and educational groups, tours for natural resource professionals, and other interested parties. Access to the site is readily available through discussion with Tuscan, Inc., administrators (contact David B. Kelley at the letterhead address).

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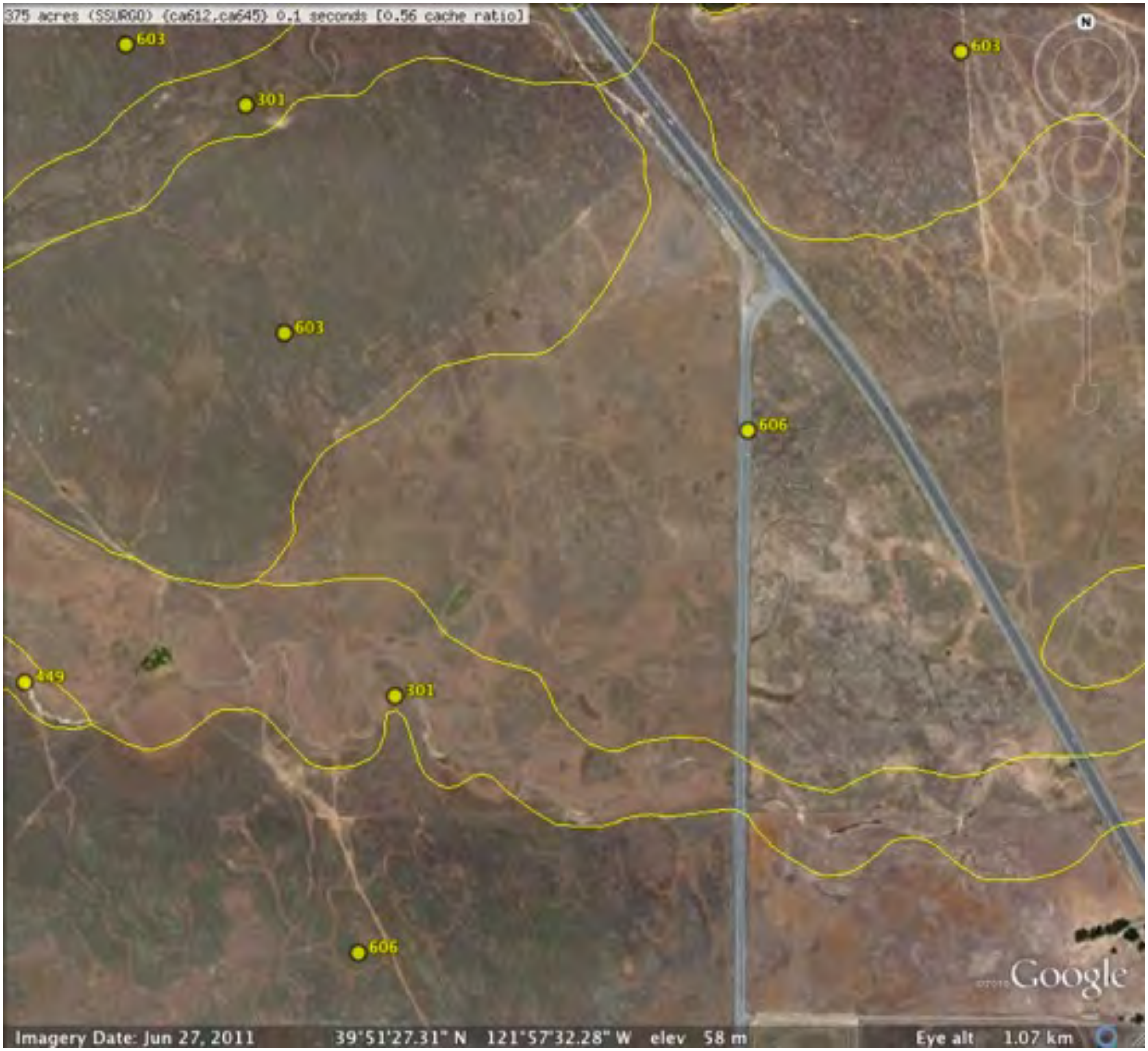

Aerial Photo of Tuscan Preserve

Aerial Photo of Tuscan Preserve, burned

VERNAL POOL SOIL MORPHOLOGY AND HYDROLOGY AT A SITE IN TEHAMA COUNTY, CALIFORNIA

Duripan exposed along streambank at site, in area mapped as Corning-Redding gravelly loams, 0 to 5 percent slopes

PREPARED FOR:

PSSAC 2018 Annual Conference Guidebook
Chico, CA

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Section 1
Introduction

This informal essay presents soils information that was compiled in support of an analysis conducted by ICF (an environmental consulting firm) in association with tillage of an approximate 500-acre site in Tehama County, south of Red Bluff. ICF was retained by its client to determine whether the tillage (by a chisel plow) of vernal pools and other seasonal wetlands (e.g., vernal swales) at the site affected soil restrictive layers to the extent that the soils would no longer support the wetlands or had otherwise substantially degraded the wetlands.

The information herein consists of excerpts from the two reports prepared by ICF that document its site analysis and is intended only to present an example of the morphological and hydrologic characteristics of soils that support certain vernal pools and other seasonal wetlands.

Figure 1. Onsite vernal pool not subjected to tillage. Pool is dominated by coyote thistle (*Eryngium castrense*).

Figure 2. Tilled vernal pool in right-foreground.

Section 2
Overview of Vernal Pools at the Site

A variety of vernal pool communities, which may be differentiated partly based on their soil characteristics, occur in California. Some vernal pools are underlain by soil that is clay to the surface, such as the pools that occur on basin and basin rim soils (e.g., Pescadero and Galt series) (Smith and Verrill 1996). In such soils, a restrictive layer exists to the surface, such that water entering a pool (e.g., via incident precipitation) ponds on the surface, at least after any seasonal desiccation cracks have swelled shut in the early part of the rainy season. In this type of vernal pool, after any desiccation cracks have closed, the pool becomes ponded primarily from rainfall as a result of a soil layer having a low saturated hydraulic conductivity (Ksat) that exists at the soil surface. These types of vernal pools appear not to occur on the site.

The vernal pools present at the site are different than those supported by a clay surface layer, as described above. Instead, the vernal pools and vernal swales on the site occur in areas mapped as Redding and Corning soils, which fit the core concept of Northern Hardpan Vernal Pools, as described by Solomeshch et al. (2007). It should be recognized that the vernal pools and vernal swales on the site probably are not underlain by the primary components of the map units (i.e., Redding and Corning series soils) and instead occur on unnamed, hydric inclusions that may occur in the soil map units. Northern Hardpan Vernal Pools are characterized as having a subsoil layer that acts as the primary driver in the development of soil saturation in the plant root zone as a result of a shallow perched water table, and eventually in ponded conditions in depressions. The fact that the controlling layer in the hydrology of Northern Hardpan and similar vernal pools is a subsoil layer, such as a claypan or duripan, and not a surface or subsurface soil layer, is widely recognized in the literature (Hanes et al. 1998; Hobson and Dahlgren 1998, 2000; Williamson 2005; Rains et al. 2006, 2008; and Bauder et al. 2011).

Section 3
NRCS Soil Survey Mapping

The following is a summary of the morphological and hydrologic characteristics of the soils mapped at the site, based on the Soil Survey of Tehama County, California (Gowans 1967) and digital Soil Survey Geographic (SSURGO) data from the Natural Resources Conservation Service (NRCS) that were viewed using SoilWeb Earth (California Soil Resource Laboratory 2015). These sources were reviewed to gain an understanding of the non-site-specific soil characteristics of the soils at the site and inform the onsite investigations discussed below in Section 4, Onsite Backhoe Pit Soil Observations.

The NRCS mapping shows that seven soil map units occur on the site, as listed in Table 1. The table also presents the type(s) of wetlands that occur in each map unit, as identified in a wetland delineation report prepared for the site.

Table 1. Soil Map Units and Subgroup Classification of Primary Component

Soil Map Unit and Map Symbol	Subgroup Classification of Primary Component(s)	Wetland/Waterway Type Occurring in Parts of Map Unit
Arbuckle gravelly loam, 0 to 2 percent slopes (AvA)	Typic Argixerolls	Seasonal Wetland
Arbuckle gravelly loam, clayey substratum, 0 to 3 percent slopes (Aw)	Typic Argixerolls	Seasonal Wetland
Corning-Redding gravelly loams, 0 to 5 percent slopes (CyB)	Corning: Typic Palexeralfs Redding: Abruptic Durixeralfs	Vernal Pool, Vernal Swale
Perkins gravelly loam, 0 to 8 percent slopes (PkA)	Mollic Haploxeralfs	Seasonal Wetland (very few)
Perkins gravelly loam, 3 to 8 percent slopes (PkB)	Mollic Haploxeralfs	(none)
Red Bluff gravelly loam, 0 to 3 percent slopes (Rg)	Mollic Haploxeralfs	Seasonal Wetland
Riverwash (Rr)	n/a	Stream Channel

Sources: Gowans 1967; California Soil Resource Laboratory 2015.

On the basis of the soil survey, wetland mapping from the delineation report, and professional judgment, it was determined that three types of subsoil or substrate restrictive layers occur on the site which could support vernal pools or other seasonal wetlands, provided that suitable topographic conditions are present, as follows:

- Claypan (Bt1 and Bt2 horizons [Corning] and 2Bt horizon [Redding]) – a clay-enriched, pedogenic layer, typically with a clay texture. (This layer sometimes occurs above the Redding soil duripan on the site, typically at its higher elevations.)
- Duripan (3Bqm horizon) – a pedogenic, silica-iron cemented layer.
- Clayey substratum (BC horizon) – an alluvial deposit having a clay texture, sometimes also with gravels present.

Table 2 shows the type, thickness, and depth of the restrictive layers based on soil survey map unit descriptions.

Table 2. Soil Map Units Occurring at the Site and Type and Depth to Restrictive Layer, based on Soil Survey Map Unit Descriptions

Soil Map Unit and Map Symbol	Type(s) and Typical Thickness of Restrictive Layer (inches)	Typical Depth to and Range in Depth from Soil Surface to Upper Restrictive Layer (inches)
Arbuckle gravelly loam, 0 to 2 percent slopes (AvA)	(no restrictive layer)	n/a
Arbuckle gravelly loam, clayey substratum, 0 to 3 percent slopes (Aw)	clayey substratum – unspecified thickness	Typical depth: not specified Range in depth: 36 to 72
Corning-Redding gravelly loams, 0 to 5 percent slopes (CyB)	Corning: Claypan – 8 Redding: Claypan – 10 Duripan – 12	Corning: Typical depth: 21 Range in depth: 10 to 27 Redding: Typical depth: 13 Range in depth: 9 to 25
Perkins gravelly loam, 0 to 8 percent slopes (PkA)	(no restrictive layer)	n/a
Perkins gravelly loam, 3 to 8 percent slopes (PkB)	(no restrictive layer)	n/a
Red Bluff gravelly loam, 0 to 3 percent slopes (Rg)	(no restrictive layer)	n/a
Riverwash (Rr)	(no restrictive layer)	n/a

Source: Gowans 1967.

Note: in vernal pool landscapes, based on ICF's experience, the upper boundary of the restrictive layer tends to be closer to the surface within vernal pools and vernal swales (i.e., in the "intermound" landscape positions) compared to the "mound" landscape positions. Therefore, the depths to the restrictive layer shown for the Corning and Redding series shown above may be shallower within vernal pools and swales.

Table 3 presents the NRCS saturated hydraulic conductivity (Ksat) classes. Based on ICF's field observations, soils with a subsoil that is in the "Moderately Low", "Low," or "Very Low" classes are capable of supporting Northern Hardpan Vernal Pools, provided that the subsoil layer is not too deep and that suitable microtopographic conditions (e.g., depressions) are present.

Table 3. NRCS Saturated Hydraulic Conductivity (Ksat) Classes

Ksat Class	Ksat (µm/s)
Very High	> 100
High	10–100
Moderately High	1–10
Moderately Low	0.1–1
Low	0.01–0.1
Very Low	< 0.01

Source: Soil Survey Division Staff 1993; California Soil Resource Laboratory 2015.
µm/s = micrometers per second

Table 4 shows the Ksat values of each of the horizons of each of the major components of the map units, based on SSURGO data (California Soil Resource Laboratory 2015).

Table 4. Estimated Saturated Hydraulic Conductivity (Ksat) of Soil Series Occurring on the Site, based on SSURGO Data

Soil Series (Map Symbol)	Soil Layer Depth Range (inches)	Soil Layer Type	Ksat (μm/s)	Falls within Ksat Class
Arbuckle (AvA)	0–2	surface	6.99	Moderately High
	2–14	surface	6.99	Moderately High
	14–25	subsoil	6.99	Moderately High
	25–59	subsoil	8.99	Moderately High
	59–72	substratum	5.99	Moderately High
Arbuckle, clayey substratum (Aw)	0–14	surface	8.99	Moderately High
	14–48	subsoil	2.69	Moderately High
	48–72	substratum—clayey	0.91	Moderately Low
Corning (CyB)	0–21	surface	8.99	Moderately High
	21–36	subsoil—claypan	0.21	Moderately Low
	36–54	substratum	0.91	Moderately Low
Perkins (PkA)	0–4	surface	11.99	High
	4–9	subsurface	9.99	Moderately High
	9–20	subsoil	8.99	Moderately High
	20–36	subsoil	3.99	Moderately High
	36–52	subsoil	3.99	Moderately High
	52–60	subsoil	4.23	Moderately High
Perkins (PkB)	0–9	surface	8.99	Moderately High
	9–20	subsoil	2.69	Moderately High
	20–52	subsoil	2.69	Moderately High
	52–60	subsoil	8.99	Moderately High
Red Bluff (Rg)	0–20	surface and subsurface	8.99	Moderately High
	20–60	subsoil	2.69	Moderately High
Redding (CyB)	0–13	surface	8.99	Moderately High
	13–23	subsoil—claypan	0.21	Moderately Low
	23–35)	subsoil—duripan	–	(not specified)
Riverwash	0–6	(alluvium)	91.99	High
	6–60	(alluvium)	91.99	High

Sources: California Soil Resource Laboratory 2015; Gowans 1967.

Notes:

1. Soil layer depth ranges and Ksat values shown are for the typical profile of the major component(s) in the map units and not of the inclusions (minor components) within the map units, the latter of which appear to be associated with many of wetlands on the site and may differ somewhat from the major component.
2. Soil depth ranges for some series correspond to more than one (similar) horizon as described by Gowans (1967).
3. Soil layer depth ranges have been converted from centimeters as presented in the SSURGO data (California Soil Resource Laboratory (2015) to inches and rounded to the nearest inch.
4. Because Ksat values are identical among some soil layer depth ranges and among some series, they appear to have been estimated from soil morphological properties rather than having been determined using laboratory or site-specific field methods.
5. Ksat values, which are expressed as micrometers per second (μm/s), have been converted from millimeters per hour (mm/hr) in the SSURGO data and have been rounded to two decimal places.
6. No Ksat value was provided for the Redding series duripan, which is generally regarded as being nearly impermeable, and is therefore assumed to be in the “Low” or “Very Low” Ksat class.

mm/hr = millimeters per hour
μm/s = micrometers per second

Section 4

Onsite Backhoe Pit Soil Observations

The onsite investigations included inspections of soil profiles from backhoe and hand-dug pits, as well as the collection and laboratory analysis of soil samples to estimate the Ksat class of various horizons at multiple locations. The following discussion presents only the work conducted at 14 of the backhoe pits, which was intended to identify the approximate depth range to restrictive layers from tilled and untilled areas (Table 5). The tillage depth was also determined at each of the 14 backhoe pits. With the exception of the Riverwash map unit, the pit locations were selected to encompass the extensive soil map units occurring onsite.

Table 5. Type of and Depth to Restrictive Layer as Observed at 14 Backhoe Pits

Pit #	Slope Position	Type of and Depth from Original Soil Surface to Restrictive Layer(s) (inches)
P-1	Mound (reference pit located in area not tilled)	Duripan – 27
P-2	Depression (non-wetland) (reference pit located in area not tilled)	Duripan – 11
P-3	Top of mound (mima) (reference pit located in area not tilled)	Claypan – 47 Duripan – 50
P-4	Mound sideslope	Duripan – 29
P-5	Gently sloping mound sideslope upslope of wetland	Claypan – 14 Duripan – 20
P-6	Vernal pool rim	Claypan – 3 Duripan – 15
P-7	Mound	Claypan – 28 Duripan – 39
P-8	Immediately upslope of wetland	Clayey substratum – 43
P-9	Nearly level non-wetland area	Duripan – 17
P-10	Immediately upslope of wetland	Clayey substratum – 26
P-11	Bottom of seasonal wetland swale	Clayey substratum – 11
P-12	Adjacent to other waters channel on floodplain	Clayey substratum – 39
P-13	Immediately upslope of wetland	Clayey substratum – 32
P-14	Immediately upslope of seasonal wetland swale	Clayey substratum – 27

Note: Claypans identified based on abrupt textural change from horizon above and clay texture. Duripans identified by at least moderately or strongly cemented or indurated soil material. Clayey substratum identified by a non-pedogenic layer having a clay texture (with or without gravels) and lacking an abrupt upper boundary.

In examining the soil profiles exposed in the backhoe pits, the presence of one or more of the following conditions was used to measure the approximate depth of tillage.

- Disrupted soil structure.
- Disrupted or discontinuous gravelly layers at depth.
- Buried organic detritus or plant material.
- Fragments of claypan, duripan, or clayey substratum soil lying on the ground.
- Fragments of claypan, duripan, or clayey substratum soil "suspended" in the profile above the naturally-occurring depth of that layer.

Figure 3 illustrates a vernal pool that appears to have been tilled to an approximate depth of 3 inches, well above the restrictive layers, such that the hydrologic functioning of the soil was not substantially altered. At this location and at all other pits evaluated, it was determined that the tillage did not affect the soils' ability to support wetlands nor otherwise substantially degrade the hydrology of the wetlands. This conclusion was supported by wetland delineation work conducted by others at the site and a review of a Google Earth image acquired before and another image acquired 3 years after the tillage occurred. The imagery shows that the pre-tillage image signatures of the vernal pools, vernal swales, etc., are nearly identical to the post-tillage signatures, suggesting that the extent of ponding had not changed as a result of the tillage.

Figure 3. Example of tilled vernal pool soil (similar to Redding series). Tillage at this location extended to approximately 3 inches, well above the claypan (begins at 17 inches) and indurated duripan (begins at 20 inches).

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CHAPTER 2. GEOLOGIC BACKGROUND OF BUTTE COUNTY REGION

Gonzalez, Marisol, 2014, Stratal Geometries of Tuscan Deposits in Big Chico Creek Canyon Outcrops and in the Subsurface underlying Chico, California: Master's Thesis, California State University, Chico, 145 p.

Geologic Setting

Northern California's complex geologic history contains remnants of ancient convergent boundaries that were later disrupted by a modern transform boundary. The northern Sacramento Valley is located between the Sierra Nevada to the east and the California Coast Ranges to the west. The deeper rocks in the valley are predominantly marine sedimentary rocks, ranging in age from Late Jurassic to Early Miocene which is unconformably capped by alluvial deposits and volcanic rocks from the Early Miocene to Holocene (Harwood and Helley, 1987). The Sacramento Valley first formed as a late Mesozoic forearc basin between the accretionary trench represented by the Franciscan Group of the Coast Ranges and the eastern magmatic arc complex whose roots have been exposed in the Sierra Nevada (Harwood and Helley, 1987).

By the end of the Nevadan Orogeny (Late Jurassic), the Sierra Nevada consisted of deformed Paleozoic and allochthonous Mesozoic terranes creating three major tectonic belts (Fig. 2; Schweickert et al., 1984): the Smartville Complex, the Central Belt, and the Eastern Belt. Each belt has a different stratigraphic and deformational history (Day et al., 1985). Within the belts of the northern Sierra are northwest trending folds and steeply dipping faults that developed during the Late Jurassic Nevadan Orogeny collectively called the Foothill Fault System (Day et al., 1985). In the Central Belt, plutons with compositions ranging from gabbro to granodiorite intruded and deformed the pre-existing igneous and sedimentary rocks (Schweickert et al., 1984). A large flux of granitic intrusions began in 120 Ma during the Cretaceous in the western portion of the Sierra Nevada. These plutons intruded on older Jurassic plutons and migrated steadily eastward for 40 million years (m.y.) (Cecil et al., 2012; Chen et al., 1982; Evernden and Kistler, 1970). The highest tectonic unit is the Smartville ophiolitic complex which overlies rocks of the Central Belt along a steeply west dipping fault contact (Moores and Day, 1984). There are currently two models for the Nevadan Orogeny: 1) a collision of an oceanic arc with an Andean-style subduction zone, 2) *in situ* development of a rifted arc along the North American margin followed by transpression (Moores and Day, 1984). Moores and Day (1984) argue for the collisional model due to the evidence of a major folded overthrust sheet of ophiolitic rocks which first thrust eastward and then are altered by vertical to west-directed folds and reverse faults.

During the Late Cretaceous, the basin uplifted and tilted to the southwest (Harwood and Helley, 1987). On the northeastern margin of the Sacramento Basin nonmarine and shallow marine deposition occurred (Nilsen and Imperato, 1990). Harwood and Helley (1987) believe periods of uplift and subsidence caused by Paleogene subduction and lateral faulting continued to affect the depositional basin throughout the early Cenozoic. During these cycles of uplift, four distinctive submarine canyons developed, filled with transgressive marine sequences.

According to Griscom and Jachens (1989), three lithospheric plates meet at the Mendocino Triple Junction (MTJ) along the northern tip of the San Andreas Fault: the Juan de Fuca Plate (sometimes called the Gorda plate), Pacific Plate, and North American Plate. Currently, the Juan de Fuca plate subducts eastward beneath the North American plate north of the MTJ. However, during the past 29 m.y., the MTJ first formed near Los Angeles and then continued to migrate northwest creating volcanism and effectively lengthening the San Andreas Fault.

As the MTJ migrated northward in the late Oligocene to early Miocene, marine sedimentation was replaced by fluvial deposition and volcanic activity to the east within the Sierra Nevada. Eruptions of volcanic rhyolitic tuffs began during the Oligocene continuing through the early-mid Miocene, followed by large andesitic eruptions along the crest of present day Sierra Nevada. After the rhyolitic and andesitic eruptions, andesitic mudflows followed ancient drainages down the western slopes of the Sierra during the middle Miocene through the early Pliocene (Wagner and Saucedo, 1990). Harwood and Helley (1987) hypothesis the Pliocene-aged Tuscan Formation contains many of these mudflow units.

Stratigraphic Units

The Sierran Basement. Sierran Basement within the Central Belt outcrop near Chico, CA (figure). The Central Belt is composed of ultramafic, plutonic, and sedimentary rocks variably metamorphosed from low to medium grade caused by one or more periods of faulting, isoclinal folding, and intruded granitic plutons of the Sierra batholith (Late Jurassic to Early Cretaceous age) (Day et al., 1985).

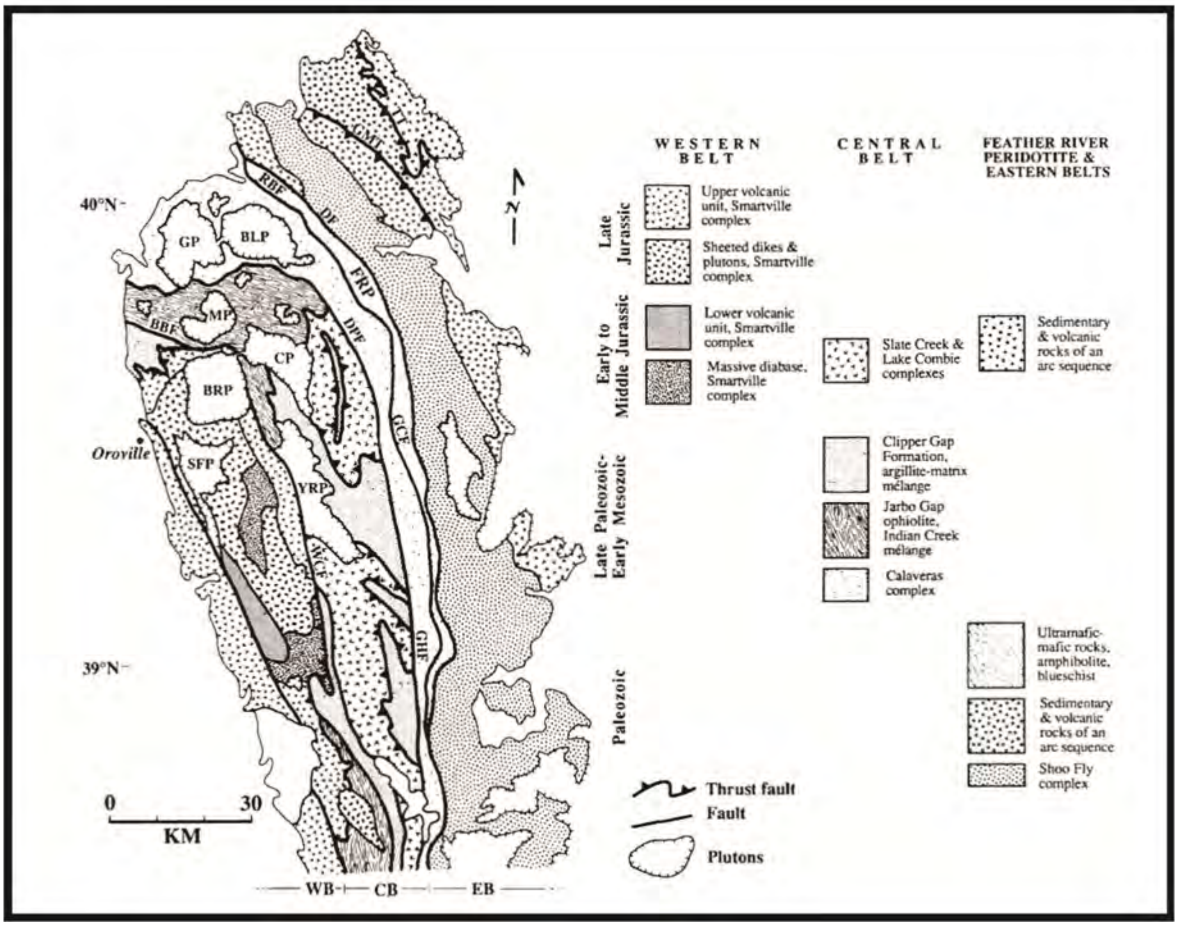

Figure 2: Tectonic map of the northern Sierra Nevada foothills region. Map depicts from east to west and in structurally descending order: Western Belt, Central Belt, and Eastern Belt. Modified from Dilek and Moores, 1989.

The Central Belt contains two different bedrock complexes: 1) in the north, the Devonian to Permian aged Shoo Fly Complex occupies most of the belt which is overlain by a pyroclastic sequence. Metamorphic grade does not rise above chlorite grade; b) The southern portion of the Central Belt, just south of Placerville, California, is dominated by the Calaveras Complex composed medium to high-grade metamorphic rocks flanked to the east by a narrow strip of the Shoo Fly Complex (Schweickert et al., 1984). Sedimentary sequences rich in chert and argillite underlies the Central Belt (Day et al., 1985). Weakly metamorphosed Central Belt rocks are composed of intercalated slate, argillaceous sandstone, bedded to massive chert, pebbly mudstone and conglomerate, and isolated blocks of fossiliferous limestone (Day, et al., 1985). Creely (1965) mapped the rock units near the northwest end of Lake Oroville as the Calaveras Formation and described the rocks as a shale matrix mélange.

Chico Formation. Upper Cretaceous (Coniacian-Lower Campanian) aged Chico Formation can be found on the westerns, northern and eastern margins of California's Great Valley (Haggart and Ward, 1984). The Chico Formation dips gently southwest, almost continuously along the Big Chico Creek, Little Chico Creek, and Little Butte Creek. The Chico Formation has an estimated thickness of 615 m to 915 m (Nilsen and Imperato, 1990) and can be split up into defining members: 1) cobble conglomerate of the basal Ponderosa Way Member, 2) coarse grained conglomerate sandstone of the overlying Musty Buck Way Member, 3) fine grained silty sandstone of the uppermost Ten Mile Member and 4) the mudstone Kingsley Cave Member (Haggart and Ward, 1984). Haggart and Ward (1984) state that the Chico Formation represents a transgressive sequence, from coarse-grained fluvial conglomerates at the base of the unit, to finer grained mudstone at the top of the unit.

Lovejoy Basalt. The Lovejoy Basalt erupted in the Middle Miocene during a period of widespread and voluminous mafic magmatism (Christiansen et al., 2002). Harwood and Helley (1987) theorized that the Lovejoy Basalt erupted from a fissure at Thompson Peak just south of Susanville, California, flowing a maximum of 240 kilometers across the northern end of the Sierra Nevada and funneling through one or more paleocanyons into the modern day Sacramento Valley.

Studies by Garrison et al. (2008) measure the Lovejoy Basalt maximum exposed thickness of ~ 245 meters. It is a dense, low-MgO aphyric-dominated flood basalt occurring in isolated exposures in a northeast-southwest trending band extending from the Honey Lake Fault scarp across the northern end of the Sierra Nevada to the Sacramento Valley The basalt has an "ink black" appearance due to the high glass content (30%-40%) and a fine-grained groundmass consisting of a microcrystalline plagioclase and olivine. It is highly jointed and fractured, and it can exhibit columnar jointing forming cliffs and talus slopes.

The age of the Lovejoy Basalt has been widely debated due to the loss of argon from weathering and alteration of clay minerals. Through the use of $^{40}Ar/^{39}Ar$ step-heating spectra, a 15.4 Ma age was obtained from five samples in a study by Garrison et al. (2008). Garrison et al. (2008) hypothesized that the Lovejoy Basalt is material from the migration of the Yellowstone mantle plume and the Columbia Flood basalts due to their similar geochemistry. It does not appear subduction related due to its geochemical differences from the Cascade arc lava. Currently, the mantle source of the Lovejoy Basalt is still unknown.

Tuscan Formation. Harwood et al.'s (1981) model divides the Pliocene-aged Tuscan Formation into three separate members from oldest to youngest: Unit A, Unit B Unit C and Unit D. The upper Tuscan Formation is defined by Units C and D and Units A and B define the lower Tuscan Formation (Harwood and Helley, 1985). Unit A is about 65 meters thick and consists of interbedded lahar deposits, volcanic conglomerate deposits, volcanic sandstone and siltstone. The volcanic sandstone contains fragments of metamorphic rock, white to dark gray in color with clasts reaching 20 cm in diameter. Some metamorphic fragments can contain white vein quartz, chert, greenstone and serpentinite. Similar to Unit A, Unit B and Unit C of the Tuscan Formation have interbedded lahar deposits, volcanic sandstone and siltstone, but coarse boulder breccia is more abundant in Unit B than in Unit A. Unit B is about 130 meters thick; conglomerate can reach 15 meters in thickness. Unit C is predominantly breccia deposits with fragments of angular to sub-rounded volcanic fragments in a matrix of gray-tan mudstone. Unit C contains breccia deposits with reverse grading. The thickness of Unit C breccia deposits can range from 0.5-10 meters thick. The total thickness of Unit C is approximately 50-80 meters. According to Harwood and Helley (1985), Unit B and C do not contain metamorphic clasts. Unit D is a fragmental deposit, characterized by large monolithologic masses of andesite, pumice, and a fragmented obsidian mudstone matrix. Unit D is approximately 10-50 meters.

Red Bluff Formation. The Pleistocene-aged Red Bluff Formation rocks contain coarse red gravel with some interstratified sand and silt reworked from the older deposits discussed above. The Red Bluff Formation represents alluvial fans sourced from foothill rocks with a maximum thickness of 4.5 meters (Buer, 2007; Harwood et al., 1981). Buer (2007) observed metamorphic rocks from the Coast Ranges and the Klamath Mountains in the Red Bluff Formation west of the Sacramento River. According to Buer (2007) the Red Bluff Pediment originally existing as a gently sloping uniform surface, then was subject to deformation. Quaternary structural deformation is primarily indicated by surface deformations such as the Corning Dome, Battle Creek Fault, and Inks Creek fold system.

Modesto Formation. Pleistocene aged Modesto Formation is divided into two members: the upper and lower member. The upper member of the Modesto Formation consists of gravel, sand, silt and clay from the Sierran/Cascadian foothills, the Klamath Mountains and the Coast Ranges. The lower member of the Modesto Formation is lithologically similar to the upper member with the exception that the lower member contains B-Horizon soils (Harwood et al., 1981). The Modesto Formation is lithologically similar to the Red Bluff Formation, but finer grained, less gravel, less indurated and less oxidized giving it a lighter color than the red-colored Red Bluff (Harwood et al., 1981).

Review of Tuscan-related Literature

The distribution of Tuscan rocks was regionally characterized by Lydon (1969) and Harwood and Helley (1987) of the U.S. Geological Survey and locally mapped in Big Chico Creek Canyon as a Master's thesis by Doukas (1983) providing the best-to-date map of the Tuscan units along Big Chico Creek. Although these studies provided detailed descriptions of the structural geology of the Tuscan and general unit descriptions, little work has focused on the detailed sedimentology of the Tuscan and its internal structure. Numerous CSU student projects provide an excellent basis to continue work on the Tuscan (Moody and Teasdale 2006; Smith et al., 2008, Skartvedt-Forte, 2006 and many others). This study will build upon their work by providing a higher resolution understanding of the depositional history, stratigraphy, and ultimately hydrogeology of the Tuscan Formation.

One of the most extensive studies on the Tuscan Formation is by Phillip A. Lydon (1969). Lydon determined that the Tuscan Formation exclusively is volcanic in origin and uses the term "lahar" to describe the Tuscan due to the volcanic breccia. Lydon observed olivine basalt and pyroxene andesite as the most common rock type clasts in the formation. The lahars formed "lobe like or sheet like shapes" and covered up to 2000 square miles with a maximum exposed thickness of 1700 feet. Lydon believed that the water needed to create the mobility of the flows came from magmatic or meteoric sources and not necessarily from melted snow or ice. Heavy rainfall could have also been a catalyst needed to create a flow from dry brecciated debris.

Harwood and Helley (1987) produced the first geologic map that included their nomenclature of the Tuscan Formation. They divided the Tuscan on a regional scale into four units: A, B, C, D (see Stratigraphic Units section for more details). Structurally, they observed that uplift from the northern Sierra Nevada created monoclinal flexure and a fault rupture beneath the surface forming the Chico Monocline. Due to tectonic uplift of the late Cenozoic, stream gradients steepened and erosion increased. The steepened stream gradients allowed the volcanic material from the Tuscan Formation along with coarse, bouldery alluvial material to be deposited as the Red Bluff Formation (Harwood & Helley, 1987; Larsen et al., 2002).

One of the most detailed geologic maps of the Tuscan Formation in the Big Chico Creek area was part of a Master's thesis from San Jose State University (Doukas, 1983). Doukas' map builds off of Harwood and Helley (1987) map, focusing on structure, and using the overly simplified ABCD model to map the Tuscan units.

Holly Brunkal's (2003) Master's thesis describes the Tuscan as having facies from three depositional systems: debris flow/ hyperconcentrated flood-flow facies, fluvial channel facies and flood plain/overbank facies. The Tuscan Formation is divided into proximal, medial and distal setting environments. Brunkal concluded that in the medial to distal setting, environments of the Tuscan Formation are fluvially dominated while the upper Tuscan is debris flow dominated. Brunkal's stratigraphic sections were measured at the Neal Road Landfill southeast of Chico, Tuscan Springs and at Upper Bidwell Park east of Chico. While Brunkal's study provided a detailed study of the Tuscan Formation, only three stratigraphic sections were measured and do not provide enough coverage to fully characterize the Tuscan Formation and its individual flow units.

Margaret Skartvedt-Forte's (2006) Master's thesis from Chico State University developed "three-dimensional stochastic realization derived from a geostatistical analysis" using Groundwater Modeling System (GMS) software. By adapting a volcanic fan apron model to the Tuscan Formation in her geostatistical analyses, Skartvedt-Forte was able to identify flow paths, connectivity of the water-bearing units, and confinement of the aquifer system. Skartvedt-Forte's study provided excellent numerical data and statistical probabilities; however, the study did not focus on incorporating geologic data into the model. Further detailed geologic information from mapping the Tuscan Formation would help make the model more applicable to groundwater modelers.

There have been many smaller yet disjointed projects and abstracts by Chico State students and faculty on the Tuscan Formation that serve as good site specific studies (e.g. measured stratigraphic columns, conglomerate clast counts, paleocurrent analysis, and geochemical provenance studies).

Jennifer Hall (2011) studied the Tuscan Formation-Red Bluff Formation boundary. Hall looked at 13 samples from three wells drilled by the company Mactec and funded by the company ABB located at Hegan Lane, Chico. Cuttings from wells were used to tabulate relative percentages of quartz grains, feldspar types, rock fragment types (metamorphic, volcanic, sedimentary) along with other diagnostic minerals. Hall was able to determine a boundary between the two formations; the Tuscan samples contained almost 100% volcaniclastic grains, and the Red Bluff samples consisting of a mixture of volcaniclastic, metamorphic, and sedimentary rock fragments. Hall concluded that the changes reflect a dominant volcanic source for the Tuscan grains that then switched to mixed sources for Red Bluff grains, which may have occurred during a 1 m.y. long uniformity between the two formations. My study will build on Hall's methodology by providing more data from additional wells.

Volcaniclastic debris flow processes from sedimentary textures in the southern Tuscan Formation were studied by Carlton et al. (2008). They studied two debris flow deposits (a top flow and bottom flow were identified; both flows are ~10 m thick) and measured clast size distribution as well as matrix grain size distribution from digital analysis of Back Scatter Electron (BSE) images. Carlton et al. (2008) also used XRD analyses to identify mineral phases in the matrix. They concluded that the top flow and bottom flow were both cohesive debris flows from a lahar deposit which were clay rich and resisted inverse grading. Both flows contained cristobalite, opal, and montmorillonite, indicating that there must have been hydrothermal alteration of the volcanic rock due to the high concentrations of these minerals. The bottom flow was interpreted as a transitional facies between a cohesive debris flow and a hyperconcentrated stream flow. However, Carlton et al. (2008) only described two flows of the Tuscan Formation making it difficult to apply their data to the entire unit.

Linberg et al. (2006) characterized the lithology of the Tuscan Formation debris flows in Big Chico Creek. Major element XRF analyses of clasts from the debris flow units are dominated by calc-alkaline, medium-K series basaltic andesites, but range from basalt to andesite. Mafic lithics and olivine crystals were found in the sand size grained matrix. Lindberg et al. (2006) believe that the source of the Tuscan Formation flows came from an ancient cinder cone or series of mafic cinder cones similar to the modern Cascades called the Yana Volcanic Center, which include the ancient volcanos Mt. Yana and Mt. Maidu. Based on radiometric K-Ar and Ar-Ar dating of samples from the Yana Volcanic Center, volcanic activity occurred between 2,695 +/- 79 and 3,030 +/- 38 Ka. These dates coincide with the age constraints of the Tuscan, the Nomlaki Tuff (3.27Ma) and Ishi Tuff (1.8 Ma) providing further evidence the Tuscan is a remnant from the Yana Volcanic Center.

Difficulties Defining Tuscan Stratigraphy

Age Dating. Age constraints on the Tuscan Formation are from the Ishi Tuff (1.8 Ma) and the Nomlaki Tuff (3.27 Ma) assuming that the Nomlaki Tuff is the basal unit of both the Tuscan Formation and the Tehama Formation (Lydon, 1969). The Late Pliocene age is based on Blancan fauna found in the Tehama Formation 10 feet above the Nomlaki Tuff, 6 miles northwest of Flournoy (Russell and VanderHoof, 1931). Potassium-argon dates by Evernden and others (1964) supports the age of 3.3 million years to 1.5 million years. Extrapolating downward from the top of Chron C2An.2r, Henry and Perkins (2001) estimate the age of the Nomlaki ash bed at 3.27 ± 0.04 Ma using the Cande and Kent (1995) magnetic polarity timescale.

Due to the re worked nature of the Nomlaki Tuff, identification in the field is difficult and it can often be mistaken for other units. Currently, there is no chemical identification of Nomlaki Tuff in Upper Bidwell Park. In addition to potential misidentification of the Nomlaki Tuff, age date samples are 25 miles from Upper Bidwell Park, providing further age uncertainty in the study area.

Terminology. The Tuscan Formation has been defined as a lahar by Lydon et al. (1968). However, the definition of "lahar" has been used in many different ways by different researchers. It is therefore difficult to simply lump the Tuscan in an arbitrary category such as a lahar because it is a much more complex formation containing deposits from debris flow facies, fluvial facies, and transitional flow units. Smith and Lowe (1991) explain that traditionally lahars have been described as volcanic debris flows and their deposits. Lahars have also been described as a more complex phenomenon consisting of a rapid flowing sediment mixture of rock, debris, and water from a volcanic event or events, as well as multiple flow types and transformations. The term "lahar" has also commonly been used to describe any poorly sorted volcaniclastic sedimentary deposits, even if the unit is lacking evidence for debris flow deposition. Due to the ambiguous definition of "lahar", it has been suggested by Smith (1986) that the term be abandoned. Other researchers have suggested that lahar be used to describe the volcanic event and not the individual rock unit deposited.

Another term often used when describing the Tuscan is diamictite: any poorly sorted sedimentary rock with great variation in clast sizes, potentially encompassing breccia and conglomerate (Schoenborn and Fedo, 2012). The term diamictite describes sedimentary features of the Tuscan Formation but it does not fully encompass the complex variety of depositional processes of the formation. More descriptive terms such as debris flows, hyperconcentrated flow, debris avalanche, and normal stream flow may be more appropriate when describing the Tuscan Formation.

Finally, the Tuscan has historically been referred to as a "tuff breccia." A tuff is defined as deposits that are composed of mostly reworked ash, directly ejected from a volcanic source. While the Tuscan contains tuff deposits (e.g., Ishi Tuff, Nomlaki Tuff, and others), it is not a tuff but rather a complex structure consisting of interbedded debris flow breccias, intermediate hyperconcentrated flow deposits, conglomerates from active creeks, and sandstones from active creeks.

Smith (1986), Smith and Lowe (1991), and Walton and Palmer (1988) give full descriptions of lahars, volcanic debris flows, and their lithofacies. Although these studies were conducted in the Marysvale Volcanic Field, Utah, and Mount St. Helens, their facies and depositional environments are similar to that of the Tuscan Formation. Smith and Lowe's (1991) study defines flow types within lahar deposits as normal stream flows, hyperconcentrated flows, debris flows and debris avalanches. Normal stream flows are turbulent leading to abundant traction-related structures. Deposits may contain well sorted cross-bedded sands with scour-and-fill structures though poorly sorted deposits with angular grains can occur. Hyperconcentrated flow is only partially turbulent, may be normal graded, coarse grained, and can often resemble high-density turbidites. Debris flows have poor sorting, reverse to normal grading and were deposited en masse. Debris flows are commonly laminar though exceptions occur on steep slopes where it is possible to have turbulent flow. During extreme conditions, large voluminous landslides can produce debris avalanches. Due to transportation of large block source material "hummocky upper surfaces" often called "lahar mounds" may be created in debris avalanches.

This thesis will utilize the terminology normal stream flow, hyperconcentrated flow, debris flow, and debris avalanche when describing the Tuscan deposits as an alternative to lahar and diamictite.

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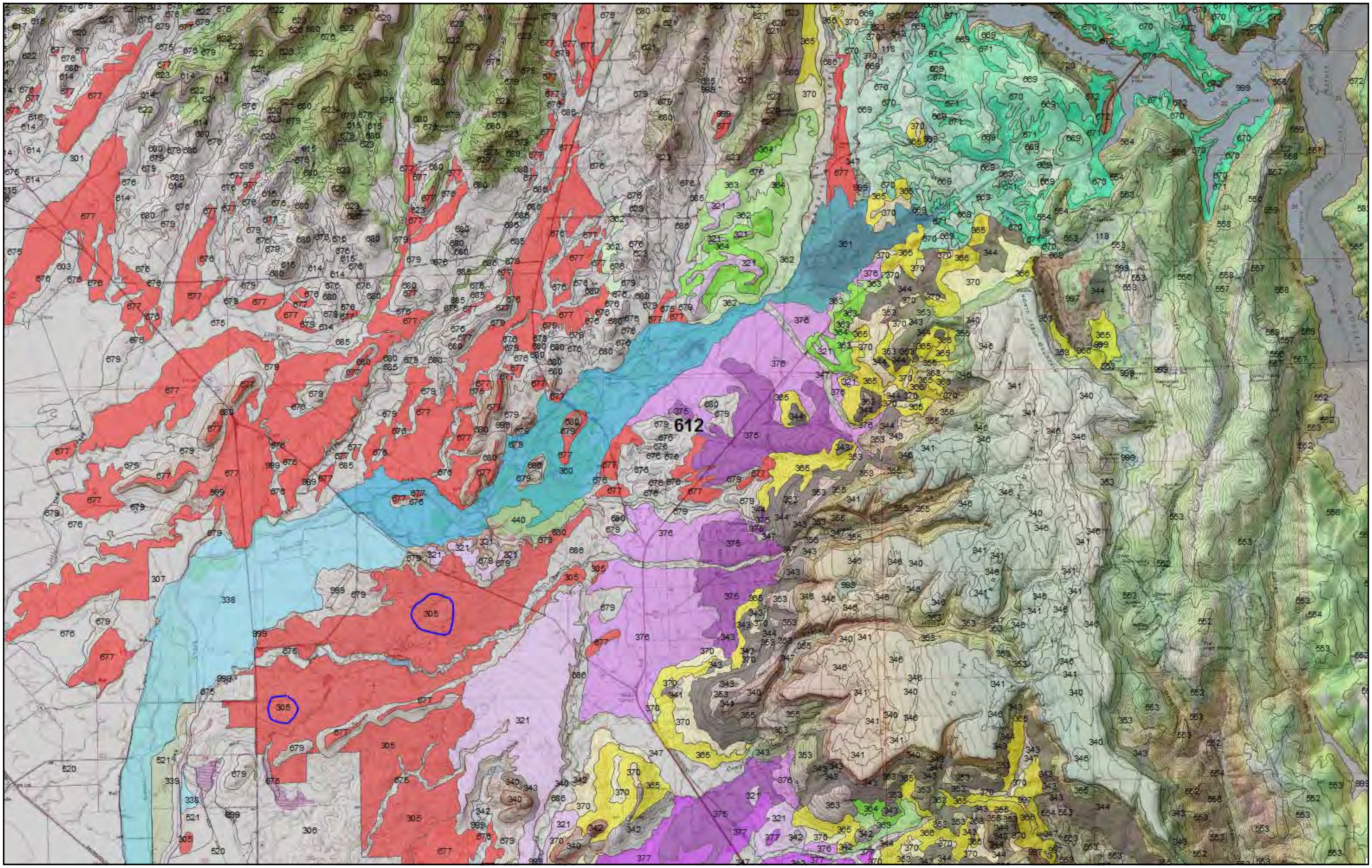
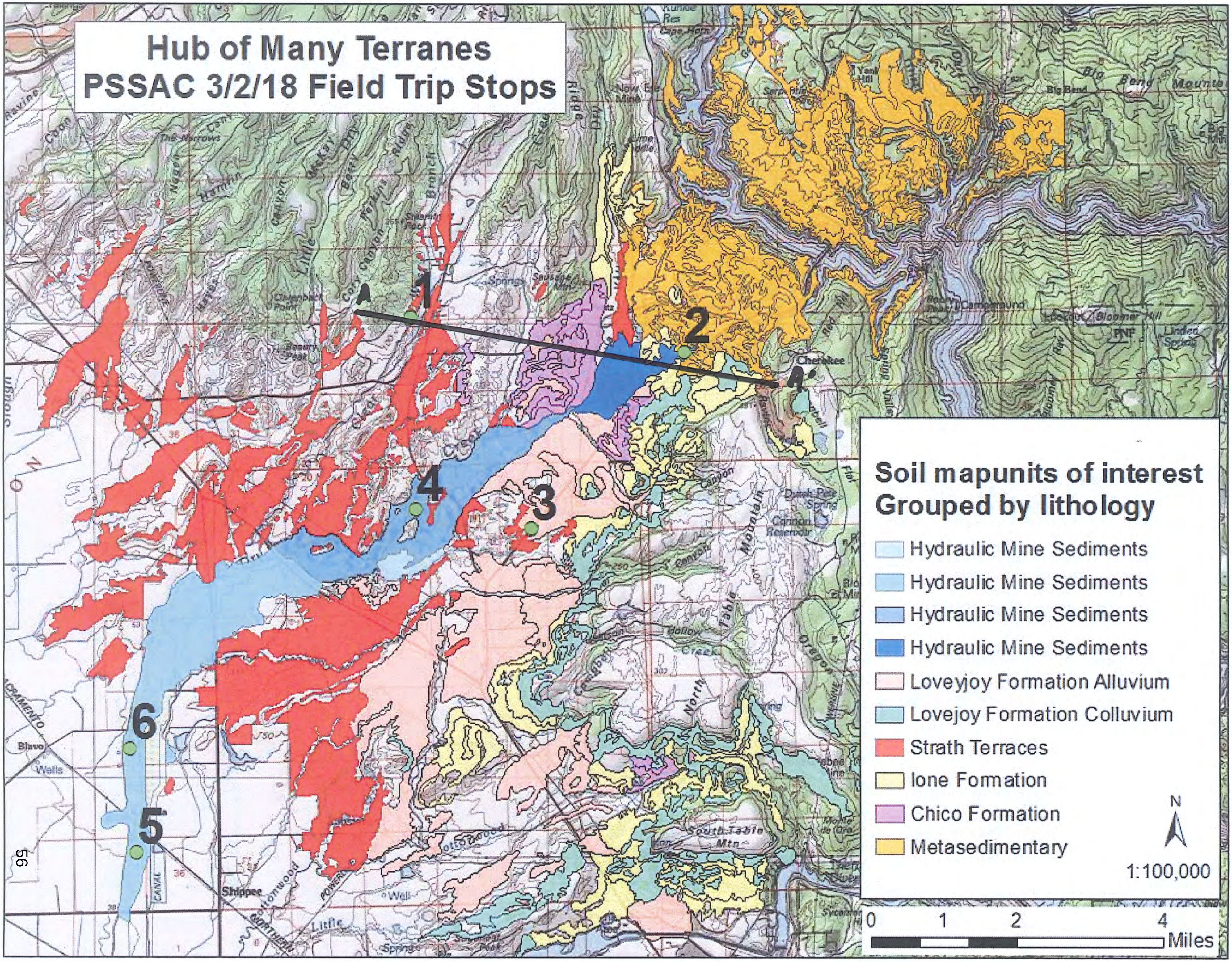
Butte-Cherokee Landforms




Hub of Many Terranes
PSSAC 3/2/18 Field Trip Stops
1
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Soil mapunits of interest
Grouped by lithology
Hydraulic Mine Sediments
Hydraulic Mine Sediments
Hydraulic Mine Sediments
Hydraulic Mine Sediments
Loveyjoy Formation Alluvium
Lovejoy Formation Colluvium
Strath Terraces
Ione Formation
Chico Formation
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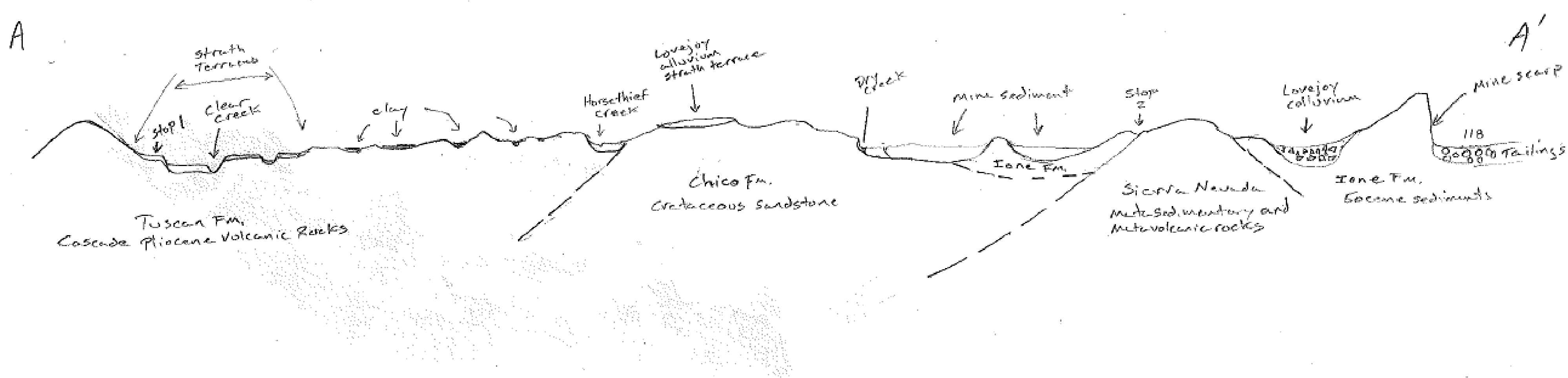
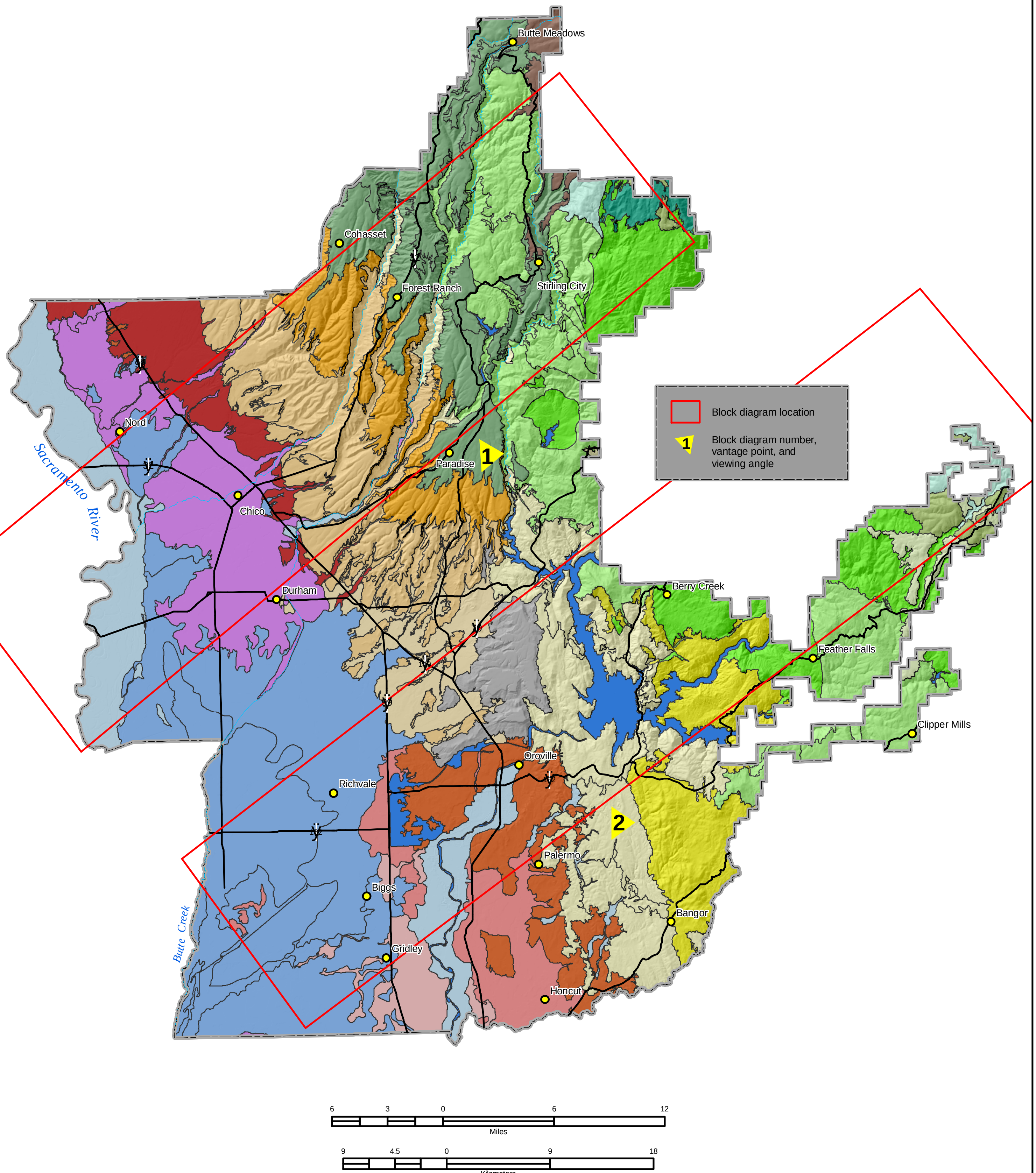
Butte Valley Cross Section

Original sketch: Andrew Conlin

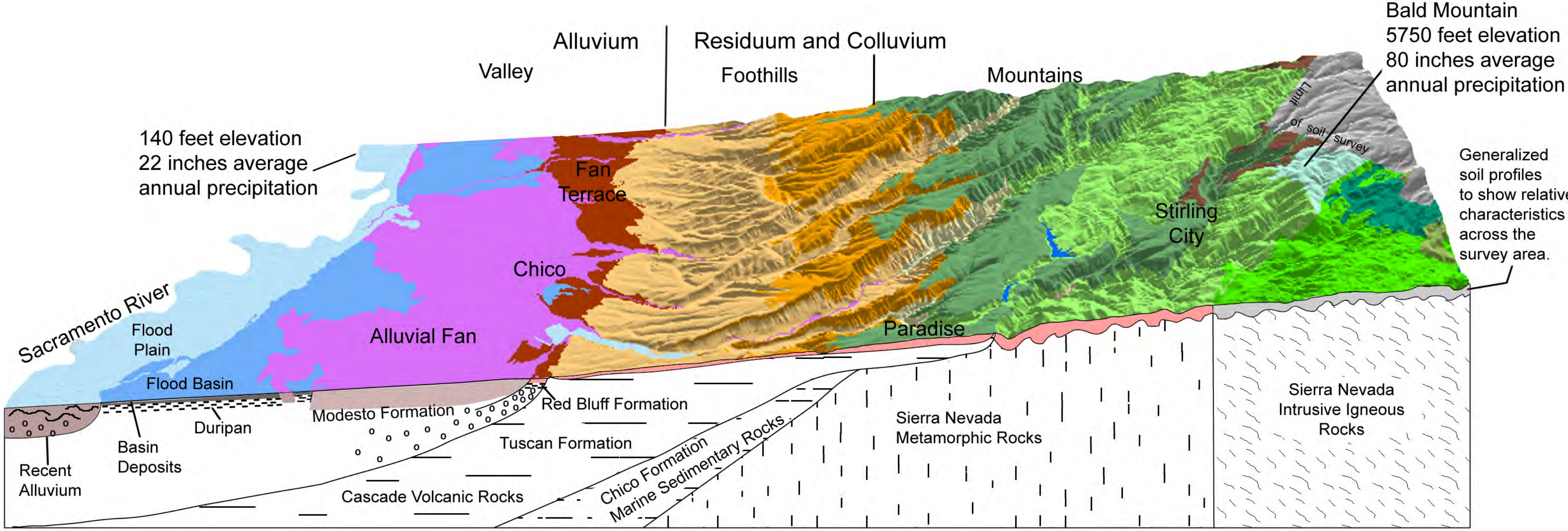


General Soil Map Unit Block Diagram Locations and Viewing Angles

Butte Area, California
Parts of Butte and Plumas Counties



General Soil Map Block Diagram 1

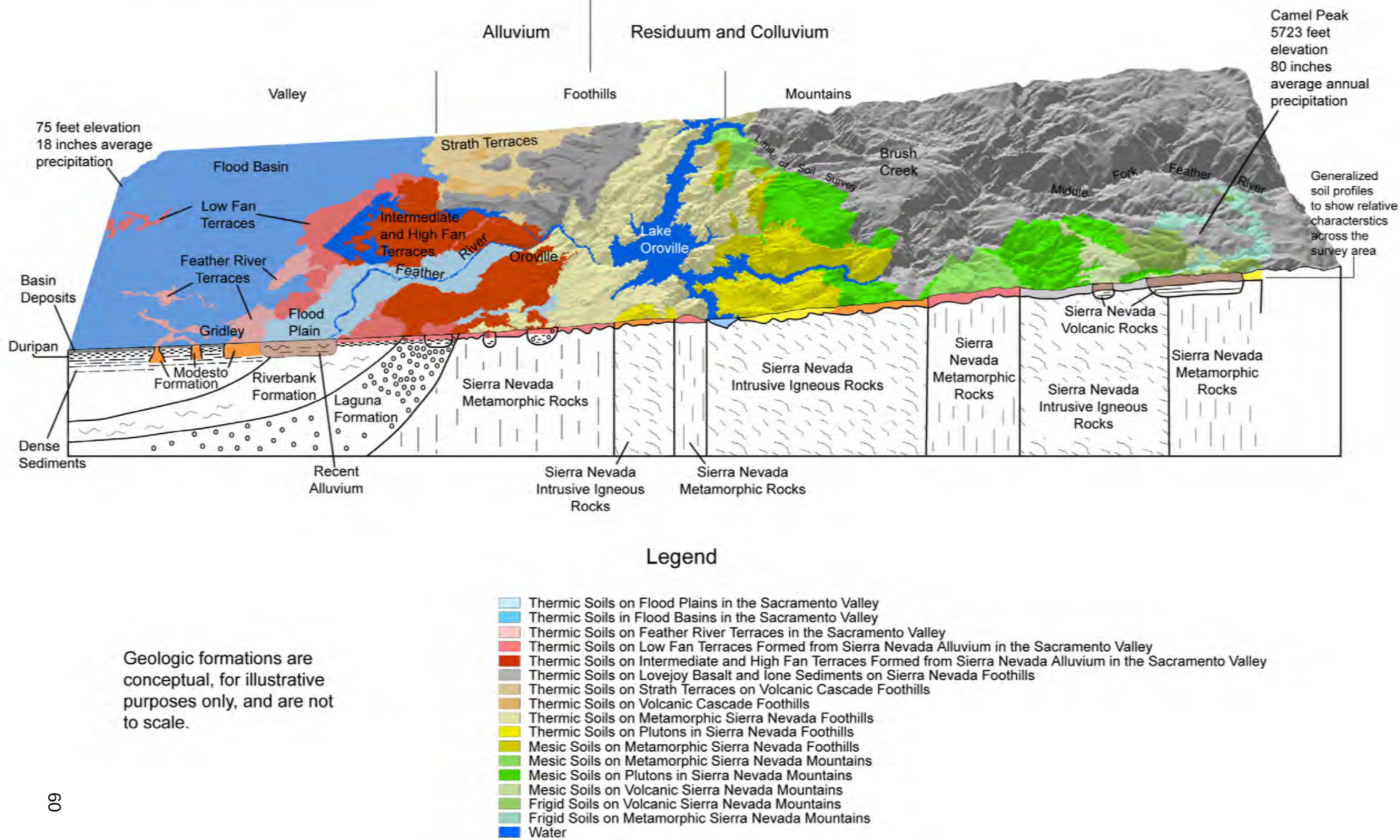


Legend

- Thermic Soils on Flood Plains in the Sacramento Valley
- Thermic Soils in Flood Basins in the Sacramento Valley
- Thermic Soils on Alluvial Fans in the Sacramento Valley
- Thermic Soils on Fan Terraces Formed from Cascade Alluvium in the Sacramento Valley
- Thermic Soils on Volcanic Cascade Foothills
- Thermic Soils on Metamorphic Sierra Nevada Foothills
- Mesic Soils on Volcanic Cascade Foothills
- Mesic Soils on Volcanic Cascade Mountains
- Mesic Soils on Metamorphic Sierra Nevada Mountains
- Mesic Soils on Plutons in Sierra Nevada Mountains
- Frigid Soils on Volcanic Cascade Mountains
- Frigid Soils on Volcanic Sierra Nevada Mountains
- Frigid Soils on Metamorphic Sierra Nevada Mountains
- Frigid Soils on Moraines in Sierra Nevada and Cascade Mountains
- Water

Geologic formations are conceptual, for illustrative purposes only, and are not to scale.

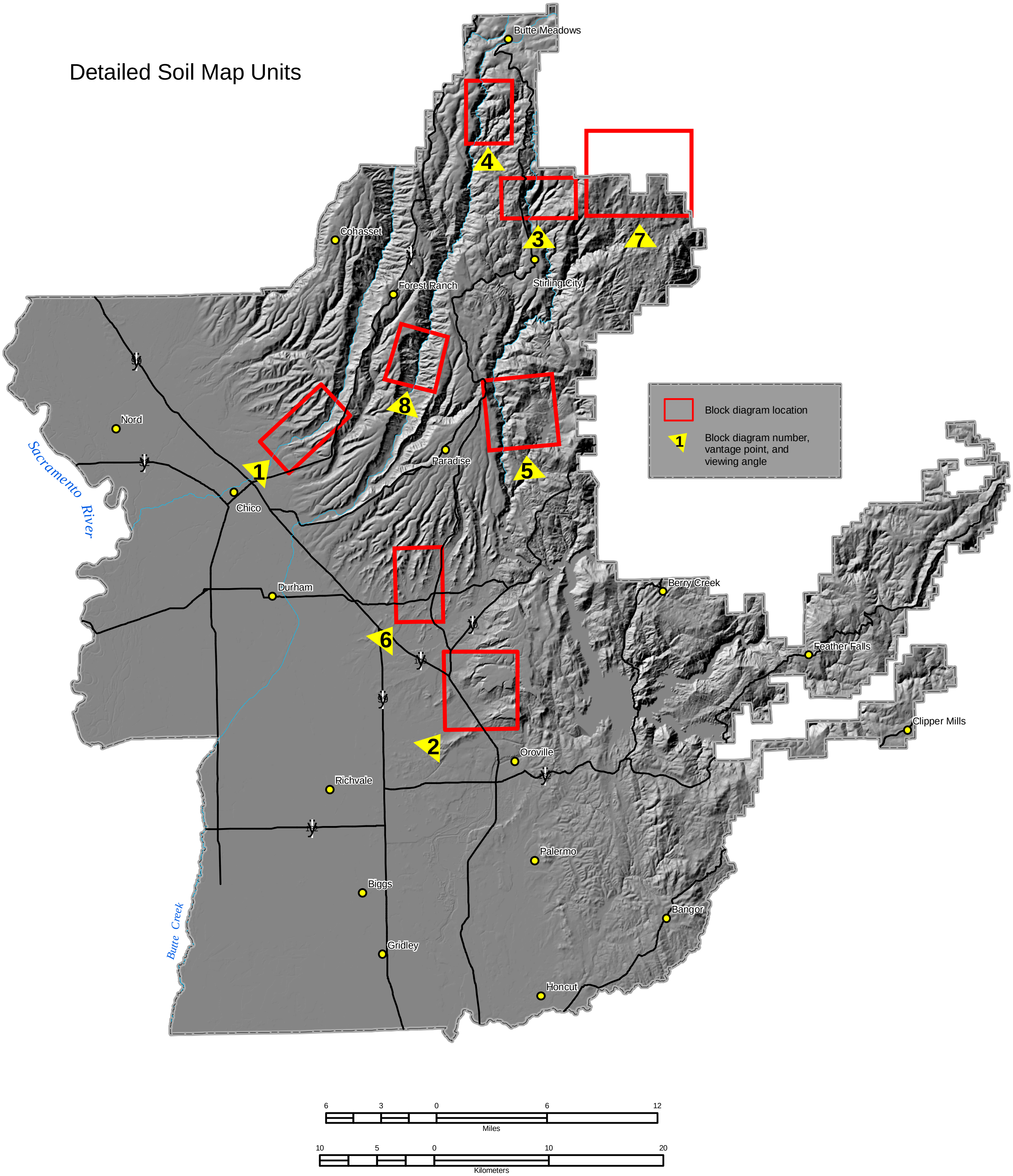
General Soil Map Block Diagram 2



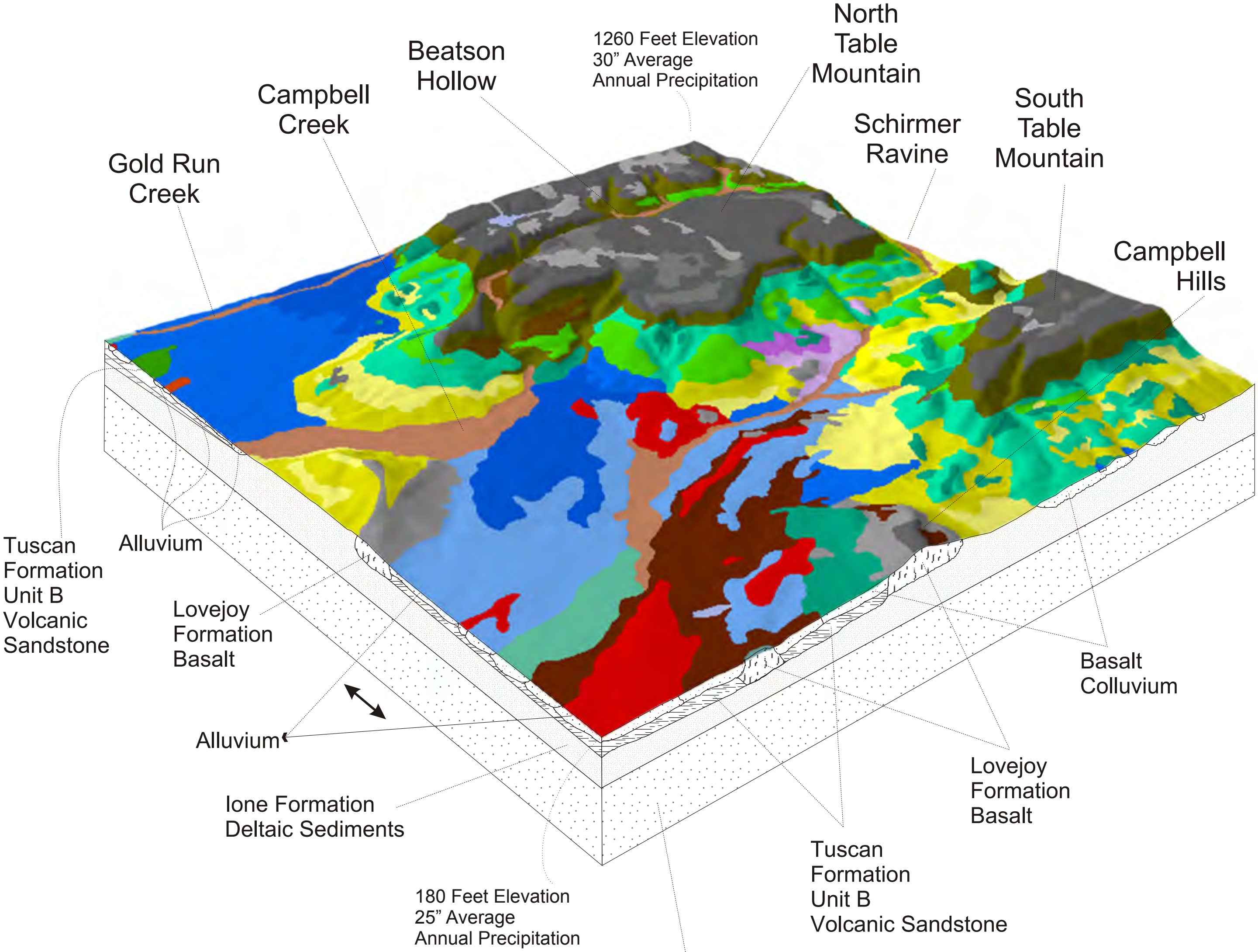
Geologic formations are conceptual, for illustrative purposes only, and are not to scale.

Block Diagram Locations and Viewing Angles

Butte Area, California
Parts of Butte and Plumas Counties



Block Diagram 2.



Legend

Stream Terraces
- 347 HAPLIC PALEXERALFS LOAM, 0 TO 5 PERCENT SLOPES
- 686 REDSLUFF TAXADJUNCT CLAY LOAM, 0 TO 2 PERCENT SLOPES

Alluvial Fans
- 375 WICKSCORNER LOAM, 2 TO 10 PERCENT SLOPES
- 376 FLAGCANYON-WICKSCORNER COMPLEX, 2 TO 5 PERCENT SLOPES

Alluvial Fan Terraces
- 377 FLAGCANYON TAXADJUNCT-DURIXERALFS-DURAQUERTS COMPLEX, 0 TO 5 PERCENT SLOPES

Strath Terraces
- 675 CLEARHAYES-HAMSLOUGH COMPLEX, 0 TO 2 PERCENT SLOPES
- 676 CARHART-ANITA TAXADJUNCT COMPLEX, 0 TO 12 PERCENT SLOPES
- 677 TUSCAN-FALLAGER-ANITA, GRAVELLY DURIPAN, COMPLEX, 0 TO 3 PERCENT SLOPES
- 305 REDTOUGH-REDSWALE-ANITA, GRAVELLY DURIPAN, COMPLEX, 0 TO 5 PERCENT SLOPES
- 321 DURIXERALFS-TYPIC PETRAQUEPTS COMPLEX, 0 TO 2 PERCENT SLOPES

Side Slopes on Basalt Plateaus
- 343 COALCANYON-COONHOLLOW COMPLEX, 5 TO 15 PERCENT SLOPES
- 344 COALCANYON-COONHOLLOW-ROCK OUTCROP COMPLEX, 15 to 30 PERCENT SLOPES
- 353 CHEROKEESPRING GRAVELLY SILT LOAM, 2 TO 15 PERCENT SLOPES
- 355 COALCANYON-TALUS COMPLEX, 15 TO 30 PERCENT SLOPES
- 356 COALCANYON-ROCK OUTCROP, CLIFFS-TALUS-COONHOLLOW COMPLEX, 30 TO 200 PERCENT SLOPES

Volcanic Sandstone Hills
- 679 LUCKSEV-BUTTESIDE-CARHART COMPLEX, 2 TO 15 PERCENT SLOPES

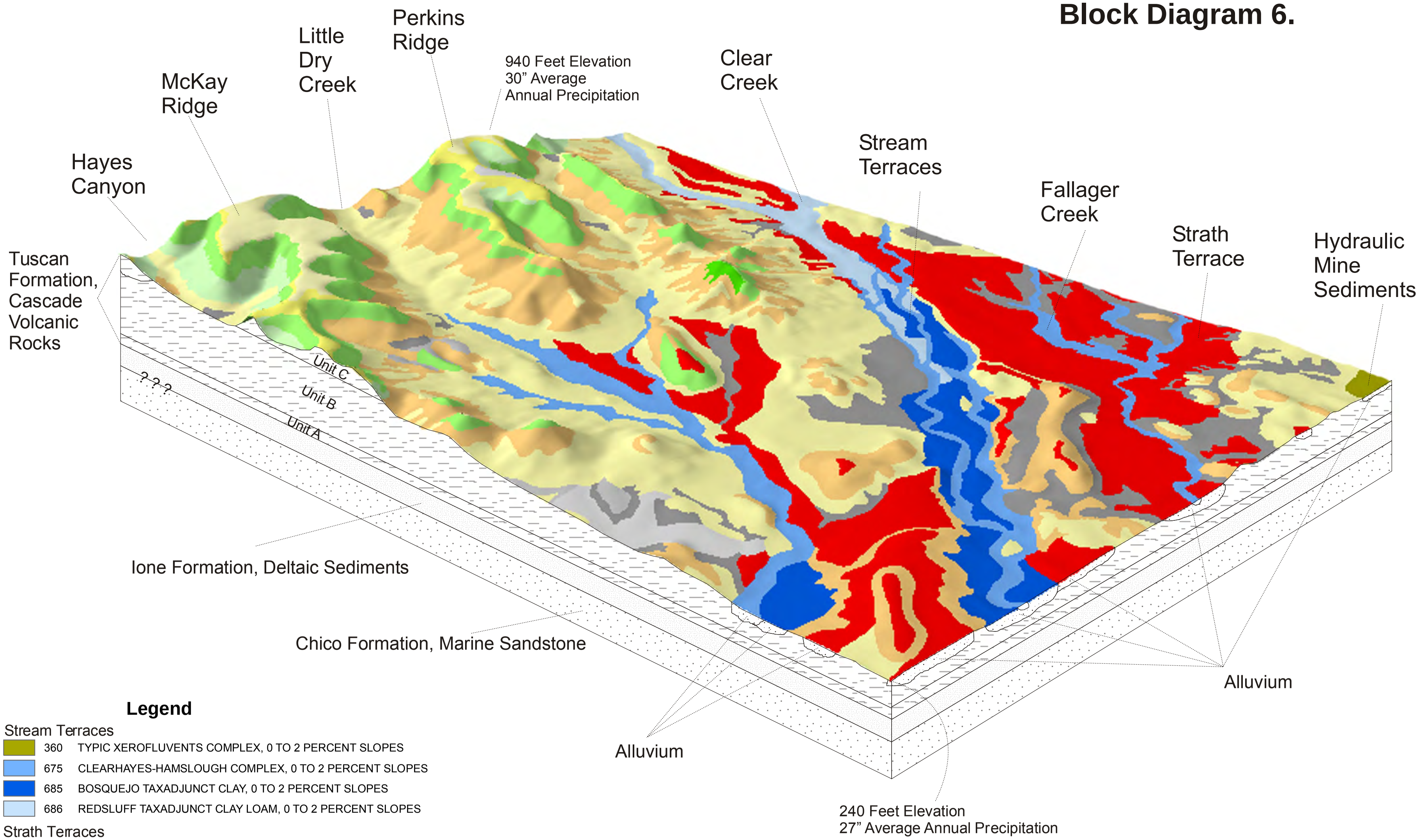
Tops of Basalt Plateaus
- 340 ROCK OUTCROP-THERMALROCKS-CAMPBELLHILLS COMPLEX, 2 TO 15 PERCENT SLOPES
- 341 ELSEY-BEATSONHOLLOW-CAMPBELLHILLS-ROCK OUTCROP COMPLEX, 2 TO 5 PERCENT SLOPES
- 342 THERMALROCKS-BEATSONHOLLOW TAXADJUNCT-ROCK OUTCROP COMPLEX, 2 TO 30 PERCENT SLOPES
- 346 CHEROTABLE-KRAMN COMPLEX, 2 TO 15 PERCENT SLOPES

Deltaic Sediment Hills
- 363 ULTIC HAPLOXERALFS, SANDSTONE, LOW ELEVATION, COMPLEX, 5 TO 15 PERCENT SLOPES
- 364 ULTIC HAPLOXERALFS, SANDSTONE, LOW ELEVATION COMPLEX 15 TO 30 PERCENT SLOPES
- 370 PALEXERULTS, 2 TO 15 PERCENT SLOPES
- 365 PALEXERULTS, 15 TO 30 PERCENT SLOPES
- 366 PALEXERULTS, 30 TO 50 PERCENT SLOPES

- 999 WATER

Geologic formations are conceptual, for illustrative purposes only, and are not to scale.

Block Diagram 6.



Legend

Stream Terraces
- 360 TYPIC XEROFLUVENTS COMPLEX, 0 TO 2 PERCENT SLOPES
- 675 CLEARHAYES-HAMSLOUGH COMPLEX, 0 TO 2 PERCENT SLOPES
- 685 BOSQUEJO TAXADJUNCT CLAY, 0 TO 2 PERCENT SLOPES
- 686 REDSLUFF TAXADJUNCT CLAY LOAM, 0 TO 2 PERCENT SLOPES

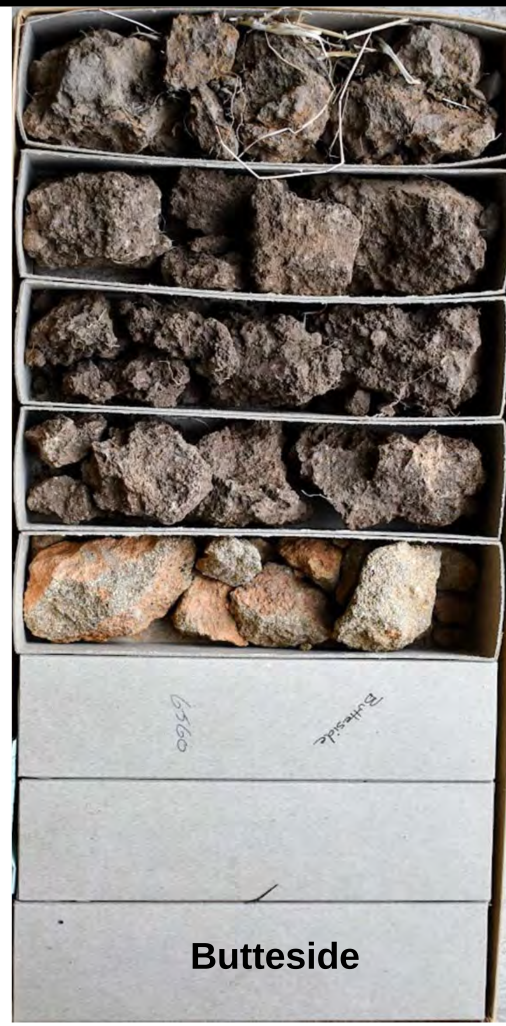
Strath Terraces
- 677 TUSCAN-FALLAGER-ANITA, GRAVELLY DURIPAN, COMPLEX, 0 TO 3 PERCENT SLOPES

Volcanic Ridges
- 620 DOEMILL-JOKERST-ULTIC HAPLOXERALFS, THERMIC COMPLEX, 3 TO 8 PERCENT SLOPES
- 621 DOEMILL-JOKERST-ULTIC HAPLOXERALFS, THERMIC COMPLEX, 8 TO 15 PERCENT SLOPES
- 622 XERORTHENTS, SHALLOW-TYPIC HAPLOXERALFS-ROCK OUTRCROP, CLIFFS COMPLEX, 15 TO 30 PERCENT SLOPES
- 623 XERORTHENTS, SHALLOW-TYPIC HAPLOXERALFS-ROCK OUTCROP, CLIFFS COMPLEX, 30 TO 50 PERCENT SLOPES
- 627 ULTIC HAPLOXERALFS-ROCKSTRIPE-ROCK OUTCROP, CLIFFS COMPLEX, 50 TO 70 PERCENT SLOPES

Volcanic Hills
- 614 DOEMILL-JOKERST COMPLEX, 0 TO 3 PERCENT SLOPES
- 615 DOEMILL-JOKERST COMPLEX, 3 TO 8 PERCENT SLOPES
- 676 CARHART-ANITA TAXADJUNCT COMPLEX, 0 TO 12 PERCENT SLOPES
- 679 LUCKSEV-BUTTESIDE-CARHART COMPLEX, 2 TO 15 PERCENT SLOPES
- 680 LUCKSEV-BUTTESIDE COMPLEX, 15 TO 35 PERCENT SLOPES

Geologic formations are conceptual, for illustrative purposes only, and are not to scale.

Map Unit 676/679/680 - Tuscan Formation Soils



LOCATION CARHART CA

Established Series
IRD: AEC/DWB
01/2006

CARHAR T SERIES

The Carhart series consists of moderately deep, poorly drained soils that formed in alluvium from volcanic rocks. Carhart soils are in basins and drainageways and on toeslopes, footslopes, and saddles on Cascade foothills. Slopes range from 0 to 12 percent. The mean annual precipitation is about 28 inches, (711 mm) and the mean annual temperature is about 61 degrees F, (16 degrees C).

TAXONOMIC CLASS: Fine, smectitic, thermic Xeric Endoaquerts

TYPICAL PEDON: Carhart clay, on a north facing 3 percent slope under a cover of ryegrass, medusahead, lupine and clover at an elevation of 282 feet, (86 m). When described on 4/24/01 the soil was slightly moist throughout. (Colors are for dry soil unless otherwise noted).

A--0 to 2.5 inches, (0 to 6 cm); gray (7.5YR 5/1) clay, dark gray (7.5YR 4/1) moist; 55 percent clay; strong medium and coarse subangular blocky structure; very rigid, friable, very sticky, very plastic; many very fine roots; many very fine, fine and medium irregular and common very fine and fine tubular pores; neutral, pH 6.8 by Hellige-Truog; gradual smooth boundary. (2 to 16 inches, (5 to 41 cm) thick)

Bssg1--2.5 to 12 inches, (6 to 30 cm); gray (7.5YR 5/1) clay, dark gray (7.5YR 4/1) moist; 55 percent clay; moderate coarse prismatic parting to strong medium and coarse angular blocky structure; very rigid, friable, very sticky, very plastic; common very fine and fine roots; common very fine and fine irregular and tubular and common medium irregular pores; 20 percent slickensides; neutral, pH 7.0 by Hellige-Truog; gradual smooth boundary.

Bssg2--12 to 24 inches, (30 to 61 cm); gray (7.5YR 5/1) clay, dark gray (7.5YR 4/1) moist; 55 percent clay; strong fine and medium angular blocky structure; very rigid, friable, very sticky, very plastic; common very fine roots; common very fine and fine irregular and tubular pores; 50 percent slickensides; slightly alkaline, pH 7.5 by Hellige-Truog; gradual smooth boundary.

Bssg3--24 to 30 inches, (61 to 76 cm); gray (7.5YR 5/1) clay, dark gray (7.5YR 4/1) moist; 55 percent clay; strong fine and medium subangular blocky structure; very rigid, friable, very sticky, very plastic; few very fine roots; few very fine and fine tubular pores; 15 percent slickensides; moderately alkaline, pH 8.0 by Hellige-Truog; clear wavy boundary. (Combined thickness of the Bssg horizon is 15 to 38 inches, (38 to 97 cm) thick)

2Crtk --30 inches, (76 cm); Moderately cemented volcanic sandstone bedrock; 15 percent clay films; 15 percent carbonate masses in cracks; slight effervescence, by HCl, 1 normal; moderately alkaline, pH 8.5 by Hellige-Truog.

TYPE LOCA TION: Butte County, California, about 1.1 miles south of the intersection of Durham-Pentz Road and Clark Road, approximately 2350 feet north and 800 feet east of the southwest corner of Section 34, Township 21N, Range 3E, 39 degrees, 37 minutes, 55 seconds North latitude and 121 degrees, 38 minutes, 1 seconds West longitude, NAD83 - U.S.G.S Quad: Hamlin Canyon, California.

RANGE IN CHARACTERISTICS: Depth to paralithic bedrock is 20 to 40 inches, (51 to 102 cm). The mean annual soil temperature is 60 to 68 degrees F, (16 to 20 degrees C). The particle-size control section averages 40 to 59 percent clay and 0 to 10 percent rock fragments, mostly gravel. Mineralogy is smectitic. Reversible surface-initiated cracks 1 to 2 inches, (3 to 5 cm) wide extend to a depth of 20 inches, (51 cm) for 200 to 250 days when the soil is not irrigated. A fluctuating water table can occur between the top of the bedrock and the surface of the soil from December through May. Rock fragments on the surface range from 0 to 5 percent gravel and 0 to 5 percent cobbles. Some pedons have Bss and Crq horizons or gravelly substratums.

The A horizon dry color is 7.5YR 5/1, 5/2, 6/2, 6/3, 10YR 4/1, 5/1 or 6/1. Moist color is 7.5YR 4/1, 4/2, 3/2, 10YR 3/2, 4/1 or 5YR 4/1. Texture is clay. Clay content ranges from 40 to 59 percent. Rock fragments range from 0 to 10 percent gravel. Redoximorphic features are oxidized iron masses and iron-manganese masses. Reaction ranges from neutral to slightly alkaline.

The Bssg horizon dry color is 7.5YR 4/1, 4/2, 5/1, 5/2, 5/3, 10YR 5/2 or 6/1. Moist color is 7.5YR 4/1, 4/2, 10YR 4/1 or 5/1. Texture is clay. Clay content ranges from 40 to 59 percent. Rock fragments range from 0 to 10 percent gravel. Redoximorphic features are iron-manganese nodules and gleyed matrix. Reaction ranges from neutral to strongly alkaline.

COMPETING SERIES: These are the Clear Lake, Copus, Dodgeland and Hildreth soils. Clear Lake, Corpus and Dodgeland soils are very deep. Hildreth soils are deep.

GEOGRAPHIC SETTING: Carhart soils are in basins and drainageways and on toeslopes, footslopes, and saddles on Cascade foothills. Slopes range from 0 to 12 percent. These soils formed in alluvium weathered from volcanic rocks with trace amounts of quartz and chert resistates overlaying volcanic sandstone or tuff. Elevation is 140 to 760 feet, (43 to 232 m). Mean annual precipitation is 24 to 35 inches, (610 to 889 mm). The mean annual temperature is 60 to 62 degrees F, (16 to 17 degrees C). Frost free season is 250 to 260 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Anita, Lucksev and Butteside soils. Anita soils are shallow to a duripan. Lucksev soils are shallow, have mixed mineralogy and an argillic horizon. Butteside soils have mixed mineralogy and an argillic horizon.

DRAINAGE AND PERMEABILITY: Poorly drained; very high runoff; slow saturated hydraulic conductivity. Water frequently ponds up to 2 inches, (5 cm) above the surface for long duration from December through March in concave areas with less than 2 percent slope. A fluctuating water table can occur between the top of the bedrock and the surface of the soil from December through May.

USE AND VEGETATION: This soil is used for livestock grazing, wildlife habitat, watershed, and some home site development. Vegetation is medusahead, ryegrass, clover, lupine, vinegarweed, tarweed, Mediterranean barley, brodiaea, coyote thistle, butter and eggs, and some filaree and popcorn flower.

DISTRIBUTION AND EXTENT: Butte County, California and occur in the M261Fa (Tuscan Flows) subsection of the M261F (Sierra Nevada Foothills) section. MLRA 18 - Sierra Nevada Foothills (Cascade part). The soils are not extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Butte County, California 2005. Source of name is from how tough this soil is to dig.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Particle-size control section - zone from 10 to 30 in, (25 to 76 cm)
Ochric epipedon - zone from 0 to 2.5 in, (0 to 6 cm) (A)
Cambic horizon - zone from 2.5 to 30 in, (6 to 76 cm) (Bssg1, Bssg2, Bssg3)
Paralithic contact - 30 in, (76 cm)
The soil moisture control section - zone from 7 to 20 inches, (18 to 51 cm) is dry in all parts from about June to November (about 150 days).

National Cooperative Soil Survey
U.S.A.

LOCATION BUTTESIDE CA

Established Series
IRD: AEC/DWB
01/2006

BUTTESIDE SERIES

The Butteside series consists of moderately deep, moderately well drained soils that formed in residuum and colluvium from volcanic rocks. Butteside soils are on ridge tops and side slopes on Cascade foothills. Slopes range from 2 to 35 percent. The mean annual precipitation is about 27 inches, (686 mm) and the mean annual temperature is about 60 degrees F, (16 degrees C).

TAXONOMIC CLASS: Fine, mixed, superactive, thermic Typic Haploxeralfs

TYPICAL PEDON: Butteside gravelly loam, on a west facing 25 percent slope under a cover of annual grasses and forbs at an elevation of 265 feet, (81 m). When described on 5/10/01 the soil was dry throughout. (Colors are for dry soil unless otherwise noted).

A--0 to 2 inches, (0 to 5 cm); pale brown (10YR 6/3) gravelly loam, dark grayish brown (10YR 4/2) moist; 23 percent clay; moderate coarse platy parting to moderate medium and coarse subangular blocky structure; extremely hard, firm, slightly sticky, slightly plastic; many very fine roots; few very fine and fine tubular and irregular pores; 20 percent distinct threadlike strong brown (7.5YR 5/6) oxidized iron masses in pores; 1 percent chert gravel and 14 percent volcanic gravel; slightly acid, pH 6.6 by Hellige-Truog; abrupt smooth boundary. (1 to 3 inches, (3 to 8 cm) thick).

Bt1--2 to 8 inches, (5 to 20 cm); brown (7.5YR 5/3) clay loam, brown (7.5YR 4/3) moist; 32 percent clay; moderate medium and coarse prismatic parting to moderate medium angular blocky structure; very hard, firm, moderately sticky, moderately plastic; common very fine roots; common fine and medium irregular and few very fine tubular pores; 80 percent continuous distinct clay films on ped faces; 1 percent chert gravel and 9 percent volcanic gravel; neutral, pH 6.9 by Hellige-Truog; clear smooth boundary.

Bt2--8 to 13 inches, (20 to 33 cm); brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; 38 percent clay; strong fine and medium subangular blocky structure; moderately hard, friable, moderately sticky, moderately plastic; common very fine roots; common very fine and fine irregular and tubular and few medium irregular and tubular pores; 85 percent continuous distinct clay films on ped faces; 1 percent chert gravel and 4 percent volcanic gravel; neutral, pH 6.9 by Hellige-Truog; abrupt smooth boundary.

Bt3--13 to 27 inches, (33 to 69 cm); pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; 50 percent clay; strong medium and coarse prismatic parting to strong fine, medium and coarse angular blocky structure; extremely hard, firm, very sticky, very plastic; common very fine roots; many very fine, fine and medium irregular and common very fine and fine tubular pores; 90 percent continuous distinct clay films on ped faces; 1 percent chert gravel, 1 percent volcanic gravel and 5 percent sandstone cobbles; neutral, pH 7.2 by Hellige-Truog; abrupt smooth boundary. (Combined thickness of the Bt horizons is 18 to 39 inches, (46 to 99 cm) thick).

2Crtq --27 inches, (69 cm); very pale brown (10YR 8/3), moderately cemented volcanic sandstone bedrock, light yellowish brown (10YR 6/4) moist; slightly alkaline, pH 7.5 by Hellige-Truog.

TYPE LOCA TION: Butte County, California, about 1.25 miles south of Durham-Pentz Road and about 0.5 miles west of Clark Road, approximately 100 feet south and 1800 feet east of the northwest corner of Section 4, Township 20 N., Range 3 E., 39 degrees, 37 minutes, 30 seconds North latitude and 121 degrees, 38 minutes, 44 seconds West longitude, NAD83 - U.S.G.S Quad: Shippee, California.

RANGE IN CHARACTERISTICS: Depth to paralithic bedrock is 20 to 40 inches, (51 to 102 cm). The mean annual soil temperature is 60 to 68 degrees F, (16 to 20 degrees C). The particle-size control section averages 35 to 50 percent clay and 5 to 35 percent rock fragments, mostly gravel. Mineralogy is mixed. Redoximorphic features such as masses of oxidized iron, with colors of 7.5YR 5/6 occur in the A horizon. Rock fragments on the surface range from 0 to 15 percent gravel, 0 to 25 percent cobbles, 0 to 10 percent stones and 0 to 1 percent boulders.

The A horizon dry color is 10YR 4/2, 6/2, 6/3, 7.5YR 5/2 or 6/3. Moist color is 10YR 4/2, 3/2, 7.5YR 4/2 or 3/2. Texture is gravelly loam, gravelly clay loam or sandy clay loam. Clay content ranges from 22 to 38 percent. Rock fragments range from 2 to 20 percent gravel and 0 to 5 percent cobbles.

The Bt horizon dry color is 10YR 5/2, 5/3, 6/3, 7/3, 7/4, 7.5YR 4/2, 5/2 or 5/3. Moist color is 10YR 4/2, 4/3, 7.5YR 4/2 or 4/3. Texture is gravelly clay loam, cobbly clay loam, clay loam, sandy clay loam, sandy clay, gravelly clay, very gravelly clay or clay. Clay content ranges from 30 to 50 percent. Rock fragments range from 2 to 25 percent gravel and 0 to 15 percent cobbles. Reaction ranges from slightly acid to strongly alkaline.

COMPETING SERIES: These are the Artois, Goldeagle and Yeguas soils. The Artois and Yeguas soils are very deep. The Goldeagle soils are deep.

GEOGRAPHIC SETTING: Butteside soils are on ridge tops and side slopes on Cascade foothills. Slopes range from 2 to 35 percent. These soils formed in residuum and colluvium weathered from volcanic rocks. Elevation is 140 to 760 feet, (43 to 232 m). Mean annual precipitation is 24 to 35 inches, (610 to 889 mm). The mean annual temperature is 60 to 62 degrees F, (16 to 17 degrees C). Frost free season is 250 to 260 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Lucksev and Carhart soils. The Lucksev soils are shallow. The Carhart soils are smectitic.

DRAINAGE AND PERMEABILITY: Moderately well drained; high to very high runoff; moderate to moderately slow saturated hydraulic conductivity in the A horizon and moderately slow to slow in the Bt horizon.

USE AND VEGETATION: This soil is used for livestock grazing, wildlife habitat, watershed and home site development. Vegetation is filaree, soft chess, ryegrass, medusahead, clover, red brome, ripgut brome, wild oat, goat grass and Mediterranean barley. Blue oaks and foothill pines occur at higher elevations.

DISTRIBUTION AND EXTENT: Butte County, California and occur in the M261Fa (Tuscan Flows) subsection of the M261F (Sierra Nevada Foothills) section. MLRA 18 - Sierra Nevada Foothills (Cascade part). The soils are not extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Butte County, California 2005. Source of name is coined.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Particle-size control section - zone from 2 to 22 in, (5 to 56 cm)
Ochric epipedon - zone from 0 to 2 in, (0 to 5 cm) (A)
Argillic horizon - zone from 2 to 27 in, (5 to 69 cm) (Bt1, Bt2, Bt3)
Paralithic contact - 27 in, (69 cm)
The soil moisture control section - zone from 6 to 19 in, (15 to 48 cm) is dry in all parts from about May to October (about 180 days).

National Cooperative Soil Survey
U.S.A.

LOCATION LUCKSEV CA

Established Series
IRD: AEC/DWB
03/2006

LUCKSEV SERIES

The Lucksev series consists of shallow and very shallow, moderately well drained soils that formed in residuum, colluvium and alluvium from volcanic rocks. Lucksev soils are on ridge tops, side slopes and strath terraces on Cascade foothills. Slopes range from 2 to 35 percent. The mean annual precipitation is about 27 inches, (686 mm) and the mean annual temperature is about 60 degrees F, (16 degrees C).

TAXONOMIC CLASS: Clayey, mixed, superactive, thermic, shallow Typic Haploxeralfs

TYPICAL PEDON: Lucksev loam, on a west facing 35 percent slope under a cover of annual grasses and forbs at an elevation of 300 feet, (91 m). When described on 5/10/2001 the soil was dry throughout. (Colors are for dry soil unless otherwise noted).

A--0 to 2 inches, (0 to 5 cm); light yellowish brown (10YR 6/4) loam, brown (10YR 4/3) moist; 25 percent clay; moderate fine and medium platy parting to moderate fine and medium subangular blocky structure; very hard, friable, slightly sticky, slightly plastic; common fine roots and many very fine roots; common very fine and fine tubular and irregular pores and few medium irregular and tubular pores; 5 percent andesite gravel; slightly acid, pH 6.5 by Hellige-Truog; abrupt smooth boundary. (1 to 2 inches, (3 to 5 cm) thick)

Bt1--2 to 7 inches, (5 to 18 cm); brown (7.5YR 5/3) clay loam, brown (7.5YR 4/3) moist; 34 percent clay; strong medium and coarse angular blocky structure; extremely hard, firm, moderately sticky, moderately plastic; common very fine roots; common very fine and fine irregular and tubular pores; 70 percent continuous faint clay films; 2 percent quartz gravel and 10 percent andesite gravel; neutral, pH 6.8 by Hellige-Truog; clear smooth boundary.

Bt2--7 to 15 inches, (18 to 38 cm); light brown (7.5YR 6/4) clay, brown (7.5YR 4/3) moist; 40 percent clay; strong fine and medium subangular blocky structure; extremely hard, firm, very sticky, very plastic; common very fine roots; many very fine and fine tubular and common medium tubular pores; 90 percent continuous distinct clay films; 5 percent andesite gravel; neutral, pH 7.0 by Hellige-Truog; abrupt smooth boundary. (Combined thickness of the Bt horizon is 3 to 18 inches, (8 to 48 cm) thick).

2Cr q--15 inches, (38 cm); Moderately cemented volcanic sandstone bedrock with a 1 mm thick silica cap on top.

TYPE LOCA TION: Butte County, California, about 1.25 miles south of Durham-Pentz Road, and about 0.5 miles west of Clark Road, approximately 100 feet south and 2000 feet east of the northwest corner of Section 4, Township 20 N., Range 3 E., 39 degrees, 37 minutes, 30 seconds North latitude and 121 degrees, 38 minutes, 42 seconds West longitude, NAD83 - U.S.G.S Quad: Shippee, California.

RANGE IN CHARACTERISTICS: Depth to paralithic bedrock is 4 to 20 inches, (10 to 51 cm). The mean annual soil temperature is 60 to 68 degrees F, (16 to 20 degrees C). The particle-size control section averages 35 to 45 percent clay, and 2 to 35 percent rock fragments, mostly gravel. Mineralogy is mixed. A fluctuating water table can occur between the top of the bedrock and 2 inches, (5 cm) below the surface of the soil on gentler slopes from December through March. Redoximorphic features such as oxidized iron masses and iron-manganese concretions occur in the A horizon, and manganese accumulations on top of the paralithic contact.

Rock fragments on the surface range from 0 to 15 percent gravel, 0 to 20 percent cobbles, 0 to 5 percent stones and 0 to 2 percent boulders.

The A horizon dry color is 10YR 6/2, 6/3, 6/4, 7.5YR 5/3, 6/3 or 7/3. Moist color is 10YR 4/2, 4/3, 7.5YR 4/2 or 4/3. Texture is loam, gravelly loam, sandy clay loam or gravelly sandy clay loam. Clay content ranges from 22 to 35 percent. Rock fragments range from 2 to 35 percent gravel and 0 to 15 percent cobbles. Reaction ranges from slightly acid to neutral.

The Bt horizon dry color is 7.5YR 5/3, 6/3, 6/4, 7/4, 10YR 6/3 or 7/3. Moist color is 7.5YR 4/2, 4/3, 4/4, 10YR 4/3 or 5/3. Texture is clay loam, sandy clay loam, sandy clay, clay, gravelly clay loam, gravelly clay, gravelly sandy clay or cobbly clay. Clay content ranges from 30 to 50 percent. Rock fragments range from 2 to 30 percent gravel and 0 to 15 percent cobbles. Reaction ranges from neutral to slightly alkaline.

COMPETING SERIES: There are no other series in this family.

GEOGRAPHIC SETTING: Lucksev soils are on ridge tops, side slopes and strath terraces on Cascade foothills. Slopes range from 2 to 35 percent. These soils formed in residuum, colluvium and alluvium weathered from volcanic rocks. Elevation is 140 to 760 feet, (43 to 232 m). The mean annual precipitation is 24 to 35 inches, (610 to 889 mm). The mean annual temperature is 60 to 62 degrees F, (16 to 17 degrees C). Frost free season is 250 to 260 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Butteside and Carhart soils. Butteside soils are moderately deep. Carhart soils are moderately deep and smectitic.

DRAINAGE AND PERMEABILITY: Moderately well drained; very high runoff; moderately slow to moderate saturated hydraulic conductivity in the A horizon and slow to moderately slow in the Bt horizon. A fluctuating water table can occur between the top of the bedrock and 2 inches, (5 cm) below the surface of the soil on gentler slopes from December through March.

USE AND VEGETATION: This soil is used for livestock grazing, wildlife habitat, watershed and home site development. Vegetation is filaree, soft chess, clover, ryegrass, Mediterranean barley, medusahead, ripgut brome, wild oat, brodiaea, goldfields, goat grass and navarretia.

DISTRIBUTION AND EXTENT: Butte County, California and occur in the M261Fa (Tuscan Flows) subsection of the M261F (Sierra Nevada Foothills) section. MLRA 18 - Sierra Nevada Foothills (Cascade part). The soils are not extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Butte County, California 2005. Source of name coined from Lucky Seven Ranch.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - zone from 0 to 2 in, (0 to 5 cm) (A)
Argillic horizon - zone from 2 to 15 in, (5 to 38 cm) (Bt1, Bt2)
Paralithic contact - 15 in, (38 cm)
Particle-size control section - zone from 2 to 15 in, (5 to 38 cm)
The soil moisture control section - zone from 6 to 15 inches, (15 to 38 cm) is dry in all parts from about May to October (about 180 days).

National Cooperative Soil Survey
U.S.A.

Map Unit 685/686

MU 685 -
Bosquejo Taxadjunct

MU 686 -
Redsluff Taxadjunct

LOCATION BOSQUEJO CA

Established Series
IRD: BG/DWB/JJJ/SBS
10/2006

BOSQUEJO SERIES

The Bosquejo series consists of very deep, somewhat poorly drained soils that formed in alluvium weathered from volcanic rocks. Bosquejo soils are in interfan basins. Slopes range from 0 to 1 percent. The mean annual precipitation is about 22 inches, (559 mm) and the mean annual temperature is about 62 degrees F, (17 degrees C).

TAXONOMIC CLASS: Fine, smectitic, thermic Typic Haploxererts

TYPICAL PEDON: Bosquejo clay on a less than one percent slope under a cover of barley at an elevation of 144 feet, (44 m). When described on 6/16/1993, the soil was slightly moist throughout. (Colors are for dry soil unless otherwise noted).

Ap--0 to 8 inches, (0 to 20 cm); brown (7.5YR 5/2) clay, dark brown (7.5YR 3/2) moist; 47 percent clay; moderate coarse prismatic structure; hard, firm, very sticky and very plastic; common very fine roots; common very fine tubular pores; few fine black (N 2/0) moist, rounded iron-manganese concretions throughout; neutral, pH 7.0 by Hellige-Truog; clear smooth boundary. (8 to 12 inches, (20 to 30 cm) thick)

Bss1--8 to 19 inches, (20 to 48 cm); brown (7.5YR 5/2) clay, dark brown (7.5YR 3/2) moist; 51 percent clay; moderate medium prismatic structure; hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; common intersecting slickensides; slightly alkaline, pH 7.5 by Hellige-Truog; clear smooth boundary.

Bss2--19 to 24 inches, (48 to 61 cm); brown (7.5YR 4/2) clay, dark brown (7.5YR 3/2) moist; 54 percent clay; strong medium prismatic structure; hard, firm, very sticky and very plastic; few very fine roots; common very fine tubular pores; common intersecting slickensides; very slightly effervescent throughout; moderately alkaline, pH 8.0 by Hellige-Truog; abrupt smooth boundary. (Combined thickness of the Bss horizon is 10 to 32 inches, (25 to 81 cm) thick).

2Bk--24 to 37 inches, (61 to 94 cm); brown (7.5YR 5/2) silty clay, dark brown (7.5YR 3/4) moist; 43 percent clay; moderate medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine roots; common very fine and few fine tubular pores; violently effervescent throughout, common fine cylindrical carbonate masses; moderately alkaline, pH 8.0 by Hellige-Truog; abrupt smooth boundary. (0 to 15 inches, (0 to 38 cm) thick)

2Bw1--37 to 44 inches, (94 to 112 cm); brown (10YR 5/3) clay loam, dark brown (7.5YR 3/4) moist; 30 percent clay; moderate medium subangular blocky structure; slightly hard, friable, moderately sticky and moderately plastic; few very fine roots; common very fine tubular pores; very slightly effervescent throughout; moderately alkaline, pH 8.0 by Hellige-Truog; clear smooth boundary.

2Bw2--44 to 46 inches, (112 to 117 cm); brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; 22 percent clay; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; very slightly effervescent throughout; moderately alkaline, pH 8.0 by Hellige-Truog; gradual smooth boundary. (Combined thickness of the 2Bw horizon is 2 to 20 inches, (5 to 50 cm) thick)

2Bq--46 to 60 inches, (117 to 152 cm); brown (7.5YR 4/4) loam, dark brown (7.5YR 3/4) moist; 24 percent clay; weak fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; few very fine tubular pores; 5 percent fine rounded slightly cemented durinodes; few fine black (N 2/0) moist, iron-manganese nodules throughout; very slightly effervescent throughout; moderately alkaline, pH 8.0 by Hellige-Truog.

TYPE LOCA TION: Butte County, California; about 1.25 miles southeast of Nord, California, approximately 1150 feet south and 150 feet east of the northwest corner of Section 13, T. 22 N., R. 1 W.; 39 degrees, 45 minutes, 54 seconds North latitude and 121 degrees, 56 minutes, and 11 seconds West longitude; NAD27. U.S.G.S. Quad: Nord, California.

RANGE IN CHARACTERISTICS: Depth is greater than 60 inches, (152cm). The mean annual soil temperature is 60 to 64 degrees F, (16 to 18 degrees C). The soil moisture control section is dry in all parts from about June 1 to October 15 (about 130 to 150 days). The particle-size control section averages 40 to 50 percent clay. Mineralogy is smectitic. Organic matter ranges from 1 to 5 percent to a depth of 24 inches, (61 cm). Surface-initiated reversible cracks .25 to 1 inch, (.6 to 2.5 cm) wide extend to a depth of about 25 inches from May 15 to October 15 (about 150 days) when the soil is not irrigated. Intersecting slickensides are present in the Bss1 and Bss2 horizons from about 6 to 30 inches, (15 to 76 cm). A fluctuating water table can occur at depths of 12 to 60 inches, (30 to 152 cm) below the surface of the soil from December through May. When present, redoximorphic features such as oxidized iron masses with colors of 7.5YR 3/4, 4/4, 4/6 or 5/6 moist, occur in the 2Bw and 2Bq horizons and iron-manganese nodules occur throughout. Some pedons have silt loam overwash that ranges from 6 to 20 inches, (15 to 51 cm) thick.

The Ap horizon dry color is 7.5YR 4/2, 5/2, 10YR 4/2 or 5/2. Moist color is 7.5YR 3/2, 4/2, 10YR 3/2 or 3/3. Texture is most commonly clay but the range includes silt loam and clay loam. Clay content ranges from 18 to 50 percent. Reaction ranges from slightly acid to neutral.

The Bss horizon dry color is 7.5YR 4/2, 5/2, 10YR 4/2or 5/2. Moist color is 7.5YR 4/2, 5/2, 10YR 4/2 or 5/2. Texture is clay or silty clay. Clay content ranges from 40 to 55 percent. Reaction ranges from neutral to slightly alkaline.

The 2Bk horizon dry color is 7.5YR 5/2, 5/3, 10YR 5/2 or 5/3. Moist color is 7.5YR 3/3, 3/4, 4/3, 4/4, 10YR 3/3, 3/4, 4/3 or 4/4. Texture is clay loam, silty clay loam or silty clay. Clay content ranges from 30 to 45 percent. Reaction ranges from slightly alkaline to moderately alkaline.

The 2Bw1 and 2Bw2 horizons dry color is 7.5YR 5/2, 5/3, 10YR 5/2or 5/3. Moist color is 7.5YR 3/4, 4/3, 4/4, 10YR 3/4, 4/3 or 4/4. Texture is clay loam or loam. Clay content ranges from 20 to 35 percent. Reaction ranges from neutral to moderately alkaline.

The 2Bq horizon dry color is 7.5YR 5/2, 5/3, 10YR 5/2 or 5/3. Moist color is 7.5YR or 10YR 3/4, 4/3 or 4/4. Texture is loam. Clay content ranges from 18 to 27 percent. Reaction ranges from neutral to moderately alkaline.

COMPETING SERIES: These are the Capay, Ayar and Maxwell series. Capay soils are moderately well drained, have carbonates throughout the B horizon and formed in alluvium from sandstone and shale. Ayers soils are well drained and are underlain by bedrock. Maxwell soils have a Ca:Mg ratio of less than 2:1 and have hues of 5Y and 2.5Y.

GEOGRAPHIC SETTING: Bosquejo soils are in interfan basins. Slopes range from 0 to 1 percent. These soils formed in alluvium weathered from volcanic rocks. Elevation is 115 to 195 feet, (35 to 59 m). The mean annual precipitation is 21 to 25 inches, (533 to 635 mm). The mean annual temperature is 61 to 62 degrees F, (16 to 17 degrees C). Frost free season is 240 to 250 days.

GEOGRAPHICALL Y ASSOCIA TED SOILS: These are the Busacca, Conejo, Galt, and Kusalslough soils. Busacca soils are on distal fans, and lack intersecting slickensides. Conejo soils are on fans and are fine-loamy. Galt soils are in basins on terraces and are moderately deep to a duripan. Kusalslough soils are on flood plains and lack intersecting slickensides, do not crack, and formed from flood deposits deposited over basin materials.

DRAINAGE AND PERMEABILITY : Somewhat poorly drained; negligible to high runoff; slow saturated hydraulic conductivity in the Ap and Bss horizons, slow to moderately slow in the 2Bw horizon, and moderate in the 2Bq horizon. The soils are occasionally flooded for brief duration from December through March. A fluctuating water table can occur at depths of 12 to 60 inches, (30 to 152 cm) below the surface of the soil from December through May. Water occasionally to frequently ponds up to 6 inches, (15 cm) above the surface for brief duration from December through March.

USE AND VEGET ATION: This soil is used for grain, alfalfa, sugarbeets, sunflowers, and safflower, and less often for prune and almond orchards. Natural vegetation was annual and perennial grasses and forbs.

DISTRIBUTION AND EXTENT : Butte County, California. MLRA 17 - Sacramento Valley. The soils are not extensive.

MLRA SOIL SUR VEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES EST ABLISHED: Butte County, California 2005. Source of name from the Bosquejo Land Grant.

REMARKS: These soils were previously mapped as Anita or Farwell in the Soil Survey of Chico Area, California 1926.

Diagnostic horizons and features recognized in this pedon are:
Mollic epipedon - 0 to 24 inches, (0 to 61 cm). (Ap, Bss)
Cambic horizon - 24 to 60 inches, (61 to 152 cm). (2Bk, 2Bw)
Slickensides 8 to 24 inches (20 to 61cm) (Bss)
Particle-size control section- 10 to 40 inches, (25 to 102 cm)
Soil moisture control section- 7 to 19 inches, (18 to 48 cm).
A lithologic discontinuity is thought to exist where fine-textured basin alluvium was deposited over older coarser textured fan alluvium.

Altered hydrology: Dams and levees along the Sacramento River and its tributaries, drainage ditches and leveling for agriculture have altered the natural hydrology. This alteration has modified the frequency and duration of saturation, ponding and flooding.

National Cooperative Soil Survey
U.S.A.

LOCATION REDSLUFF CA

Established Series
IRD: AEC/DWB/DWH/SBS
10/2006

REDSLUFF SERIES

The Redsluff series consists of very deep, moderately well drained soils that formed in overbank alluvium over channel alluvium from predominantly volcanic rocks. Redsluff soils are on low fan terraces. Slopes range from 0 to 2 percent. The mean annual precipitation is about 24 inches, (610 mm) and the mean annual temperature is about 61 degrees F, (16 degrees C).

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, thermic Mollic Haploxeralfs

TYPICAL PEDON: Redsluff gravelly loam, on a less than 1 percent slope under a cover of annual grasses at an elevation of 184 feet, (56 m). When described on 5/14/97 the soil was dry throughout. (Colors are for dry soil unless otherwise noted)

Ap--0 to 2 inches, (0 to 5 cm); light brown (7.5YR 6/3) gravelly loam, dark reddish brown (5YR 3/3) moist; 20 percent clay; weak medium subangular blocky structure parting to strong fine granular; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few fine roots; many fine to coarse vesicular and tubular pores; 25 percent gravel; noneffervescent; slightly acid, pH 6.5 by Hellige-Truog; clear smooth boundary. (0 to 12 inches, (0 to 31 cm) thick)

Bt1--2 to 5 inches, (5 to 13 cm); light brown (7.5YR 6/3) gravelly loam, dark reddish brown (5YR 3/3) moist; 24 percent clay; moderate fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few fine roots; common fine and medium tubular pores; common distinct continuous clay films on faces of peds; 25 percent gravel; noneffervescent; slightly acid, pH 6.5 by Hellige-Truog; clear wavy boundary.

Bt2--5 to 12 inches, (13 to 31 cm); brown (7.5YR 5/3) gravelly clay loam, dark reddish brown (5YR 3/3) moist; 28 percent clay; moderate medium subangular blocky structure; hard, very firm, moderately sticky and moderately plastic; common very fine and fine roots; many fine and medium tubular pores; many distinct continuous clay films on faces of peds; 15 percent gravel; noneffervescent; neutral, pH 6.7 by Hellige-Truog; gradual smooth boundary.

Bt3--12 to 21 inches, (31 to 53 cm); brown (7.5YR 5/3) gravelly loam, dark reddish brown (5YR 3/3) moist; 26 percent clay; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine to medium tubular pores; many distinct continuous clay films throughout; 30 percent gravel; noneffervescent; neutral, pH 6.7 by Hellige-Truog; gradual smooth boundary.

Bt4--21 to 29 inches, (53 to 74 cm); light brown (7.5YR 6/3) gravelly loam, dark reddish brown (5YR 3/3) moist; 21 percent clay; moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and fine tubular pores; many distinct continuous clay films on faces of peds; 25 percent gravel; noneffervescent; neutral, pH 6.8 by Hellige-Truog; clear wavy boundary.

Bt5--29 to 37 inches, (74 to 94 cm); light brown (7.5YR 6/3) gravelly loam, brown (7.5YR 4/3) moist; 19 percent clay; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many very fine and fine tubular pores; many distinct continuous clay films on faces of peds and in pores; 25 percent gravel; noneffervescent; neutral, pH 7.0 by Hellige-Truog; clear smooth boundary.

Bt6--37 to 42 inches, (94 to 107 cm); light brown (7.5YR 6/3) extremely gravelly sandy loam, brown (7.5YR 4/3) moist; 15 percent clay; weak fine and medium subangular blocky structure; loose, nonsticky and nonplastic; common very fine and fine roots; many very fine and fine tubular pores; common faint continuous clay films on faces of peds; 40 percent gravel and 25 percent cobbles; noneffervescent; neutral, pH 7.0 by Hellige-Truog; abrupt smooth boundary. (Combined thickness of the Bt horizon is 30 to 65 inches, (76 to 165 cm) thick).

Cq--42 to 80 inches, (107 to 203 cm); extremely gravelly loamy sand; 1 percent clay; single grain; loose, nonsticky and nonplastic; few very fine and fine roots; many very fine and fine interstitial pores; common fine and medium irregular rigid silica concretions under rock fragments; 45 percent gravel and 35 percent cobbles; noneffervescent; neutral, (pH 7.0 by Hellige-Truog. (0 to 45 inches, (0 to 114 cm) thick)

TYPE LOCA TION: Butte County, California; about 0.38 miles east of the intersection of Keefer Road and Highway 99, approximately 1160 feet north and 2450 feet east of the southwest corner of Section 30, Township 23 N., Range 1 E., 39 degrees, 48 minutes, 51.9 seconds North latitude and 121 degrees, 54 minutes, 34.7 seconds West longitude, NAD83. U.S.G.S. Quad: Nord, California.

RANGE IN CHARACTERISTICS: Depth to extremely gravelly or coarser substratum is 35 to 65 inches, (89 to 165 cm). The mean annual soil temperature is 63 to 64 degrees F, (17 to 18 degrees C). The soil moisture control section is dry in all parts from about May to about October (about 150-180 days). The particle-size control section averages 25 to 35 percent clay and 2 to 25 percent rock fragments, mostly gravel. Mineralogy is mixed. A fluctuating water table can occur at depths of 35 to 80 inches, (89 to 203 cm) below the surface of the soil from December through April. Rock fragments on the surface range from 0 to 15 percent gravel and 0 to 5 percent cobbles. Some pedons have weakly cemented Bq horizons below 60 inches, (152 cm).

The Ap horizon dry color is 10YR 5/3, 5/4, 6/3, 6/4, 7.5YR 4/3, 4/4, 5/3 or 6/3. Moist color is 7.5YR 3/2, 3/3, 5YR 3/3, 10YR 3/2 or 3/3. Texture is loam or gravelly loam. Clay content ranges from 16 to 24 percent. Rock fragments range from 0 to 30 percent gravel. Reaction ranges from slightly acid to slightly alkaline.

The upper part of the Bt horizon dry color is 7.5YR 5/3, 5/4, 6/3 or 5YR 5/4. Moist color is 10YR 3/3, 4/3, 7.5YR 3/2, 3/3, 4/2, 5YR 3/3 or 4/3. Texture is loam or clay loam and gravelly, cobbly, very gravelly, and very cobbly equivalents. Clay content ranges from 20 to 35 percent. Rock fragments range from 5 to 30 percent gravel and 0 to 30 percent cobbles. Reaction ranges from slightly acid to slightly alkaline.

The lower part of the Bt horizon dry color is 7.5YR 5/4, 6/3, 6/4 or 5YR 5/4. Moist color is 7.5YR 4/3, 4/4, 5YR 3/3, 4/3 or 10YR 4/3. Texture is gravelly loam, extremely gravelly sandy loam, extremely gravelly coarse sandy loam or extremely cobbly sandy loam. Clay content ranges from 10 to 20 percent. Rock fragments range from 25 to 70 percent gravel and 0 to 45 percent cobbles. Reaction ranges from neutral to slightly alkaline.

The Cq horizon dry color is 7.5YR 6/4 or 7/4. Moist color is 7.5YR 3/3, 4/3 or 5YR 3/3. Texture is extremely gravelly loamy sand, extremely gravelly coarse sandy loam or extremely cobbly coarse sandy loam. Clay content ranges from 1 to 8 percent. Rock fragments range from 10 to 50 percent gravel, 15 to 45 percent cobbles and 0 to 5 percent stones. Reaction ranges from neutral to moderately alkaline.

COMPETING SERIES: These are the Bellyspring, Coarsegold, Hicksville, Olashes, Perkins, Pleasanton and Rescue series. Bellyspring and Coarsegold soils are moderately deep and do not have a fluctuating water table. Hicksville soils are deep and very deep to consolidated sediments, have bleached sand grains in the Bt horizon, have 2Bt horizons and lack secondary silica below a depth of 35 inches, (89 cm). Olashes soils have less than 15 percent rock fragments in the Bt horizon. Perkins soils have greater than 10 percent clay and less than 65 percent coarse fragments in the C horizon. Pleasanton soils have 18 to 27 percent clay in the particle-size control section, are well drained and do not have a fluctuating water table. Rescue soils are deep and very deep to paralithic bedrock.

GEOGRAPHIC SETTING: Redsluff soils are on low fan terraces. Slopes range from 0 to 2 percent. These soils formed in overbank alluvium over channel alluvium weathered from predominantly volcanic rocks. Elevation is 175 to 350 feet, (54 to 122 m). Mean annual precipitation is 24 to 28 inches, (610 to 737 mm). The mean annual temperature is 61 to 62 degrees F, (16 to 17 degrees C). Frost free season is 250 to 255 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Redtough, Redswale and Charger soils. Redtough soils are on high terraces and are shallow. Redswale soils are on high terraces and are very shallow. Charger soils are on alluvial fans and are coarse-loamy.

DRAINAGE AND PERMEABILITY: Moderately well drained; negligible runoff; moderate saturated hydraulic conductivity in the A horizon, moderate to moderately slow in the upper Bt horizon, moderate to moderately rapid in the lower Bt horizon, moderately rapid to rapid in the Cq horizon. The soils are rarely flooded for very brief periods in December to March. A fluctuating water table can occur at depths of 35 to 80 inches, (89 to 203 cm) below the surface of the soil from December through April.

USE AND VEGETATION: This soil is used for home site development, livestock grazing and orchards. Vegetation is annual grasses, forbs and scattered valley oak, with blue oak and foothill pine in canyon settings.

DISTRIBUTION AND EXTENT: Butte County, California and occurs in the 262Aa (North Valley Alluvium) subsection of the 262A (Great Valley) section. MLRA 17 - Sacramento Valley. The soils are not extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

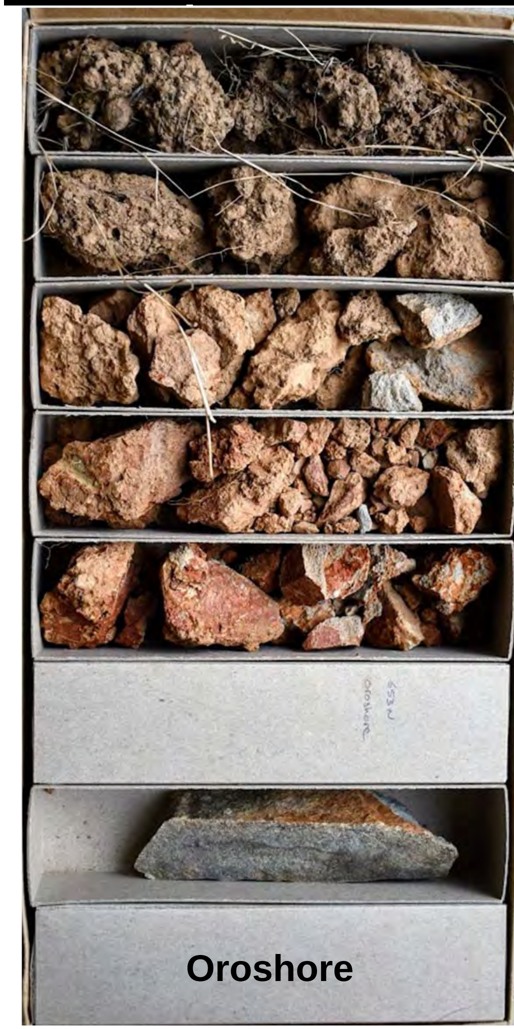
SERIES ESTABLISHED: Butte County, California 2005. Source of name is coined.

REMARKS:
Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - zone from 0 to 2 inches, (0 to 5 cm) (Ap)
Argillic horizon - zone from 2 to 21 inches, (5 to 53 cm) (Bt1, Bt2, Bt3)
Particle-size control section - zone from 2 to 21 inches, (5 to 53 cm) (Bt1, Bt2, Bt3)
The soil moisture control section - zone from 7 to 22 inches, (18 to 56 cm) (Bt2, Bt3, Bt4)

Remarks: Competing Hicksville soil needs to have the depth class refined. It is deep and very deep to consolidated sediments.

National Cooperative Soil Survey
U.S.A.

Map Unit 669/670/671 - Sierra Nevada Metamorphics



LOCATION OROSHORE CA

Established Series
IRD: AEC/DWB
10/2006

OROSHORE SERIES

The Oroshore series consists of moderately deep, well drained soils that formed in residuum and colluvium from metasedimentary and metavolcanic rocks. Oroshore soils are on ridge tops and side slopes on metamorphic Sierra Nevada foothills. Slopes range from 3 to 70 percent. The mean annual precipitation is about 38 inches, (965 mm) and the mean annual temperature is about 60 degrees F, (16 degrees C).

TAXONOMIC CLASS: Loamy-skeletal, mixed, active, thermic Ultic Haploxeralfs

TYPICAL PEDON: Oroshore gravelly loam, on a south southwest facing 17 percent slope under a cover of annual grasses and forbs and scattered blue oaks at an elevation of 750 feet, (229 m). When described on 6/6/2000 the soil was dry throughout. (Colors are for dry soil unless otherwise noted).

A--0 to 2 inches, (0 to 5 cm); pink (7.5YR 7/4) gravelly loam, brown (7.5YR 5/4) moist; 27 percent clay; moderate coarse subangular blocky parting to strong fine granular structure; slightly hard, very friable, slightly sticky, slightly plastic; common very fine roots; many very fine, fine and medium tubular and irregular, and common coarse tubular and irregular pores; 20 percent gravel; slightly acid, pH 6.5 by Hellige-Truog; clear smooth boundary. (1 to 4 inches, (3 to 10 cm) thick)

Bt1--2 to 15 inches, (5 to 38 cm); pink (7.5YR 8/4) gravelly clay loam, brown (7.5YR 5/4) moist; 30 percent clay; moderate medium and coarse subangular blocky structure; slightly hard, very friable, moderately sticky, moderately plastic; common very fine and fine roots and few medium roots; many very fine, fine, medium and coarse tubular pores; 70 percent continuous distinct clay films; 10 percent cobbles and 15 percent gravel; slightly acid, pH 6.5 by Hellige-Truog; clear smooth boundary.

Bt2--15 to 28 inches, (38 to 71 cm); pink (5YR 8/4) very cobbly clay loam, reddish yellow (5YR 6/6) moist; 33 percent clay; moderate fine and medium subangular blocky structure; slightly hard, very friable, moderately sticky, moderately plastic; common very fine roots; many very fine, fine and medium tubular pores; 80 percent continuous distinct clay films; 20 percent cobbles and 20 percent gravel; neutral, pH 6.7 by Hellige-Truog; gradual smooth boundary.

Bt3--28 to 34 inches, (71 to 86 cm); reddish yellow (5YR 7/6) extremely gravelly clay loam, yellowish red (5YR 5/6) moist; 37 percent clay; moderate fine and medium subangular blocky structure; hard, friable, moderately sticky, moderately plastic; common very fine roots; common very fine and fine tubular pores; 80 percent continuous prominent clay films; 20 percent cobbles and 50 percent gravel; neutral, pH 6.9 by Hellige-Truog; clear smooth boundary. (Combined thickness of the Bt horizon is 16 to 39 inches, (41 to 99 cm) thick).

Crt --34 inches, (86 cm); weakly cemented metavolcanic bedrock; few very fine roots; few very fine and fine tubular pores; 20 percent continuous prominent clay films; slightly alkaline, pH 7.8 by Hellige-Truog.

TYPE LOCA TION: Butte County, California, about 0.5 miles southwest of Lime Saddle Boat Ramp, approximately 1000 feet north and 1900 feet west of the southeast corner of Section 18, Township 21 N., Range 4 E., 39 degrees, 40 minutes, 17 seconds North latitude and 121 degrees, 34 minutes, 4 seconds West longitude, NAD83 - U.S.G.S Quad: Cherokee, California.

RANGE IN CHARACTERISTICS: Depth to paralithic bedrock is 20 to 40 inches, (51 to 102 cm). The mean annual soil temperature is 59 to 66 degrees F, (15 to 19 degrees C). The particle-size control section averages 27 to 35 percent clay and 35 to 80 percent rock fragments, mostly gravel. Mineralogy is mixed. Rock fragments on the surface range from 5 to 30 percent gravel, 0 to 25 percent cobbles, 0 to 10 percent stones and 0 to 10 percent boulders.

The A horizon dry color is 7.5YR 6/3, 6/4, 7/3, 7/4, 10YR 6/4, 7/3 or 7/4. Moist color is 7.5YR 4/2, 4/3, 4/4, 5/4 or 10YR 4/3. Texture is loam, gravelly loam or very gravelly loam. Clay content ranges from 20 to 27 percent. Rock fragments range from 10 to 45 percent gravel and 0 to 10 percent cobbles. Reaction ranges from neutral to moderately acid.

The Bt horizon dry color is 7.5YR 6/4, 7/4, 8/4, 5YR 6/4, 7/4, 7/6, 8/4, 10YR 6/4, 7/4 or 8/4. Moist color is 7.5YR 4/4, 5/4, 5/6, 6/6, 5YR 4/4, 4/6, 5/4, 5/6, 6/6, 5/8, 6/8, 10YR 4/4, 5/4, 5/6 or 5/8. Texture is gravelly clay loam, very gravelly clay loam, extremely gravelly clay loam, very cobbly clay loam or extremely cobbly clay loam. Clay content ranges from 27 to 39 percent. Rock fragments range from 15 to 65 percent gravel, 0 to 40 percent cobbles, and 0 to 20 percent stones. Reaction ranges from neutral to moderately acid.

COMPETING SERIES: This is the Hurleton series. Hurleton soils are moderately deep to a lithic contact of metadiorite and have 20 to 26 percent clay in the control section.

GEOGRAPHIC SETTING: Oroshore soils are on ridge tops and side slopes on metamorphic Sierra Nevada foothills. Slopes range from 3 to 70 percent. These soils formed in residuum and colluvium weathered from metasedimentary and metavolcanic rocks. Elevation is 440 to 2400feet, (134 to 732 m). Mean annual precipitation is 35 to 60 inches, (889 to 1524 mm). The mean annual temperature is 57 to 61 degrees F, (13 to 16 degrees C). Frost free season is 200 to 260 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Dunstone and Mounthope soils. Dunstone soils are shallow. Mounthope soils are deep.

DRAINAGE AND PERMEABILITY: Well drained; high runoff; moderate saturated hydraulic conductivity in the A horizon and moderately slow in the Bt horizon.

USE AND VEGETATION: This soil is used for home site development, livestock grazing, wildlife habitat and watershed. Vegetation is annual grasses and forbs, blue oak, whiteleaf manzanita, interior and canyon live oak, foothill pine, buckbrush and Pacific poison oak.

DISTRIBUTION AND EXTENT: Butte County, California and occur in the M261Fb (Lower Foothills Metamorphic Belt) subsection of the M261F (Sierra Nevada Foothills) section. MLRA 18 - Sierra Nevada Foothills. The soils are not extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Butte County, California 2005. Source of name is coined.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Particle-size control section - zone from 15 to 34 in, (38 to 86 cm)
Ochric epipedon - zone from 0 to 2 in, (0 to 5 cm) (A)
Argillic horizon - zone from 15 to 34 in, (38 to 86 cm) (Bt2, Bt3)
Paralithic contact - 34 in, (86 cm)
The soil moisture control section - zone from 7 to 22 inches, (18 to 56 cm) is dry in all parts from about May to October (about 170 days).

National Cooperative Soil Survey
U.S.A.

LOCATION DUNSTONE CA

Established Series
FJP/DWB
08/2009

DUNSTONE SERIES

The Dunstone series consists of shallow, well drained soils that formed in residuum and colluvium from metavolcanic rocks, mainly greenschist and metasedimentary rocks. Dunstone soils are on ridge tops and side slopes on metamorphic Sierra Nevada foothills. Slopes range from 1 to 90 percent. The mean annual precipitation is about 30 inches, (762 mm) and the mean annual temperature is about 61 degrees F, (16 degrees C).

TAXONOMIC CLASS: Loamy, mixed, superactive, thermic, shallow Ultic Haploxeralfs

TYPICAL PEDON: Dunstone loam, on a west facing 6 percent slope under a cover of annual grasses and forbs at an elevation of 725 feet, (223 m). When described on 7/12/1999 the soil was dry throughout. (Colors are for dry soil unless otherwise noted).

A--0 to 2 inches, (0 to 5 cm); brown (7.5YR 5/4) loam, dark brown (7.5YR 3/4) moist; 15 percent clay; moderate very fine and fine subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; many very fine roots; common very fine tubular pores; 20 percent fine irregular yellowish red (5YR 5/6) oxidized iron masses throughout; 2 percent subangular metavolcanic gravel; very strongly acid, pH 5.0 by Hellige-Truog; abrupt smooth boundary. (1 to 5 inches, (3 to 13 cm) thick)

BAt--2 to 7 inches, (5 to 18 cm); strong brown (7.5YR 5/6) loam, yellowish red (5YR 4/6) moist; 17 percent clay; moderate fine subangular blocky structure; moderately hard, very friable, slightly sticky, slightly plastic; many very fine roots; many very fine and fine tubular pores; 5 percent discontinuous faint clay films on faces of peds and pores; 3 percent subangular metavolcanic gravel; slightly acid, pH 6.6 by Hellige-Truog; clear wavy boundary. (3 to 9 inches, (8 to 23 cm) thick)

Bt1--7 to 10 inches, (18 to 25 cm); strong brown (7.5YR 5/6) loam, yellowish red (5YR 4/6) moist; 22 percent clay; moderate fine subangular blocky structure; moderately hard, very friable, slightly sticky, slightly plastic; many very fine roots; many very fine and fine tubular pores; 10 percent discontinuous faint clay films on faces of peds and pores; 3 percent subangular metavolcanic gravel; neutral, pH 6.7 by Hellige-Truog; clear wavy boundary. (3 to 9 inches, (8 to 23 cm) thick)

Bt2--10 to 16 inches, (25 to 41 cm); strong brown (7.5YR 5/6) loam, yellowish red (5YR 4/6) moist; 24 percent clay; moderate medium subangular blocky structure; moderately hard, very friable, slightly sticky, slightly plastic; common very fine roots; many very fine and fine tubular pores; 10 percent discontinuous faint clay films on faces of peds and pores; 5 percent subangular metavolcanic gravel; neutral, pH 6.8 by Hellige-Truog; clear wavy boundary. (5 to 11 inches, (13 to 28 cm) thick)

Cr--16 to 20 inches, (41 to 51 cm); moderately cemented weathered greenschist.

TYPE LOCA TION: Butte County, California; about 1.5 miles north of Wyandotte, California, approximately 2500 feet south and 1950 feet east of the northwest corner of Section 30, Township 19 N., Range 5 E., 39 degrees, 28 minutes, 33.42 seconds North latitude and 121 degrees, 27 minutes, 20.99 seconds West longitude: NAD83 - U.S.G.S. Quad: Bangor, California.

RANGE IN CHARACTERISTICS: Depth to paralithic bedrock is 10 to 20 inches, (25 to 51 cm). The mean annual soil temperature is 59 to 65 degrees F, (15 to 18 degrees C). The soil moisture control section is dry in all parts from about June 1 to October 15 (about 150 days). The particle-size control section averages 18 to 27 percent clay and 3 to 30 percent rock fragments, mostly gravel. Silt content can range up to 50 percent. Mineralogy is mixed. Rock fragments on the surface range from 0 to 5 percent cobbles, 0 to 2 percent stones and 0 to 1 percent boulders. Some pedons have a BCt horizon.

The A horizon dry color is 7.5YR 4/4, 4/6, 5/4, 5/6, 6/4, 6/6, 5YR 4/4 or 4/6. Moist color is 7.5YR 3/3, 3/4, 4/3, 4/4, 5YR 3/3, 3/4 or 4/4. Texture is loam, silt loam, gravelly silt loam or gravelly loam. Clay content ranges from 12 to 22 percent. Rock fragments range from 0 to 30 percent gravel and 0 to 5 percent cobbles. Base saturation by sum of cations ranges from 60 to 70 percent. Organic matter ranges from 1 to 8 percent. Reaction ranges from very strongly acid to slightly acid.

The BAt horizon dry color is 7.5YR 5/4, 5/6 or 5YR 4/6. Moist color is 7.5YR 4/3, 3/4, 5YR 3/3, 3/4, 3/6, 4/4 or 4/6. Texture is loam or gravelly loam. Clay content ranges from 16 to 22 percent. Rock fragments range from 3 to 30 percent gravel and 0 to 5 percent cobbles. Base saturation by sum of cations ranges from 65 to 74 percent. Organic matter ranges from 1 to 2 percent. Reaction ranges from moderately acid to neutral.

The upper Bt horizon dry color is 7.5YR 4/6, 5/4, 5/6, 6/4, 6/6; 5YR 4/6, or 5/6. Moist color is 7.5YR 3/4, 4/4; 5YR 3/4, 3/6, or 4/4. Texture is loam, gravelly loam, silt loam, gravelly silt loam, clay loam, or gravelly clay loam. Clay content ranges from 15 to 27 percent. Rock fragments range from 0 to 30 percent gravel and 0 to 5 percent cobbles. Base saturation by sum of cations ranges from 65 to 75 percent. Organic matter ranges from 0.5 to 2 percent. Reaction ranges from moderately acid to neutral.

The lower Bt horizon dry color is 7.5YR 4/6, 5/6, 6/6, 5YR 4/6, 5/6 or 2.5YR 5/6. Moist color is 7.5YR 4/6, 5YR 3/4, 4/4 or 2.5YR 3/6. Texture is loam, silt loam, gravelly loam, very gravelly loam, clay loam, gravelly clay loam or very gravelly clay loam. Clay content ranges from 18 to 35 percent. Rock fragments range from 0 to 45 percent gravel and 0 to 5 percent cobbles. Base saturation by sum of cations ranges from 74 to 85 percent. Organic matter ranges from and 0.5 to 2 percent. Reaction ranges from moderately acid to neutral.

COMPETING SERIES: This is the Orose series. Orose soils weathered from basic intrusive rocks, mainly gabbrodiorite, and clay content in the Bt ranges from 10 to 18 percent.

GEOGRAPHIC SETTING: Dunstone soils are on ridge tops and side slopes on metamorphic Sierra Nevada foothills. Slopes range from 1 to 90 percent. These soils formed residuum and colluvium from metavolcanic rocks, mainly greenschist and metasedimentary rocks. Elevation is 200 to 2400 feet, (76 to 732 m). Mean annual precipitation is 28 to 60 inches, (711 to 1524 mm). The mean annual temperature is 57 to 63 degrees F, (14 to 17 degrees C). Frost free season is 200 to 260 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Loafercreek, Sobrante and Argonaut soils. Loafercreek and Sobrante soils are moderately deep to a paralithic contact and have less than 35 percent clay in the particle-size control section. Argonaut soils are moderately deep to paralithic contact and have greater than 35 percent clay in the particle-size control section.

DRAINAGE AND PERMEABILITY: Well drained; very high runoff; moderate to moderately rapid saturated hydraulic conductivity in the A horizon, moderate in the upper Bt horizon and moderately slow to moderate in the lower Bt horizon.

USE AND VEGETATION: This soil is used for livestock, grazing, wildlife habitat, watershed and homesite development. Vegetation is wild oat, annual ryegrass, rattlesnake brome, hedgehog dogtail and scattered blue oak, foothill pine, interior live oak, toyon, whiteleaf manzanita, buckbrush, Pacific poison oak, and forbs.

DISTRIBUTION AND EXTENT: Butte County, California and occurs in (M261Fb) Lower Foothills Metamorphic Belt Subsection of the (M261F) Sierra Nevada Foothills section. MLRA 18 - Sierra Nevada Foothills. The soils are moderately extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES EST ABLISHED: Butte County, California 2005. Source of name is from Dunstone Road on the Bangor Quadrangle.

REMARKS: These soils were previously mapped as Aiken clay loam (Ac) in the Soil Survey of Oroville Area, California 1926.

Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - zone from 0 to 2 inches, (0 to 5 cm). (A)
Argillic horizon - zone from 7 to 16 inches, (18 to 41 cm). (Bt1, Bt2)
Particle-size control section - zone from 7 to 16 inches, (18 to 41 cm).
The soil moisture control section - zone from 6 to 12 inches, (15 to 30 cm).

ADDITIONAL DA TA: Reference samples from nearby SOOCA-007-008. NSSL, Lincoln, NE. Silt content is nearly 50 percent.

National Cooperative Soil Survey
U.S.A.

LOCATION MOUNTHOPE CA

Established Series
IRD: DWB
10/2006

MOUNTHOPE SERIES

The Mounthope series consists of deep, well drained soils that formed in colluvium and residuum from metasedimentary and metavolcanic rocks, mainly greenschist and intrusive igneous rock, mainly quartz diorite and gabbro. Mounthope soils are on metamorphic Sierra Nevada foothills. Slopes range from 2 to 100 percent. The mean annual precipitation is about 43 inches, (1092 mm) and the mean annual temperature is about 58 degrees F, (14 degrees C).

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, thermic Ultic Haploxeralfs

TYPICAL PEDON: Mounthope loam, on a southeast facing 27 percent slope under a cover of whiteleaf manzanita, toyon, buckbrush, interior live oak, blue oak, foothill pine, and Pacific poison oak at an elevation of 1640 feet, (500 m). When described on 11/20/2000 the soil was slightly moist throughout. (Colors are for dry soil unless otherwise noted)

Oi--0 to 1 inches, (0 to 3 cm); slightly decomposed plant material.

A--1 to 3 inches, (3 to 8 cm); brown (7.5YR 5/4) loam, reddish brown (5YR 4/4), moist; 20 percent clay; moderate medium subangular blocky parting to moderate fine granular structure; slightly hard, very friable, nonsticky, slightly plastic; few very fine roots; common fine and medium irregular pores; 5 percent subangular metavolcanic gravel; slightly acid, pH 6.5 by Hellige-Truog; abrupt smooth boundary. (2 to 4 inches, (5 to 10 cm) thick)

Bt1--3 to 7 inches, (8 to 18 cm); yellowish red (5YR 5/6) loam, reddish brown (5YR 4/4), moist; 24 percent clay; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common fine, few medium and many coarse roots; common fine tubular and few medium tubular pores; 5 percent discontinuous distinct clay films on surfaces along pores and 20 percent discontinuous distinct clay films on faces of peds; 10 percent subangular metavolcanic gravel; slightly acid, pH 6.2 by Hellige-Truog; abrupt smooth boundary.

Bt2--7 to 15 inches, (18 to 38 cm); yellowish red (5YR 5/6) loam, reddish brown (5YR 4/4), moist; 26 percent clay; moderate medium subangular blocky structure; hard, friable, slightly sticky, moderately plastic; common fine and medium and few coarse roots throughout; common fine tubular pores; 10 percent discontinuous distinct clay films on surfaces along pores and 20 percent discontinuous distinct clay films on all faces of peds; 5 percent subangular metavolcanic gravel; slightly acid, pH 6.2 by Hellige-Truog; clear wavy boundary. (Combined thickness of the Bt1 and Bt2 horizons is 8 to 12 inches, (20 to 30 cm) thick)

Bt3--15 to 22 inches, (38 to 56 cm); yellowish red (5YR 5/6) gravelly clay loam, yellowish red (5YR 4/6), moist; 28 percent clay; moderate medium subangular blocky structure; hard, friable, moderately sticky, moderately plastic; few fine and medium roots; common fine and medium tubular pores; 10 percent discontinuous distinct clay films on surfaces along pores and 25 percent discontinuous distinct clay films on faces of peds; 25 percent subangular metavolcanic gravel; slightly acid, pH 6.3 by Hellige-Truog; gradual wavy boundary.

Bt4--22 to 26 inches, (56 to 66 cm); yellowish red (5YR 5/6) gravelly clay loam, yellowish red (5YR 4/6), moist; 29 percent clay; moderate fine subangular blocky structure; hard, firm, moderately sticky, moderately plastic; few fine and medium roots; few fine tubular pores; 10 percent discontinuous distinct clay films on surfaces along pores and 35 percent discontinuous distinct clay films on faces of peds; 30 percent subangular metavolcanic gravel; slightly acid, pH 6.3 by Hellige-Truog; gradual wavy boundary.

Bt5--26 to 31 inches, (66 to 79 cm); yellowish red (5YR 5/6) very gravelly clay loam, yellowish red (5YR 4/6), moist; 31 percent clay; moderate medium subangular blocky structure; hard, firm, moderately sticky, moderately plastic; few fine and medium roots; common fine and medium tubular pores; 15 percent discontinuous distinct clay films on surfaces along pores and 35 percent discontinuous distinct clay films on faces of peds; 50 percent subangular metavolcanic gravel; slightly acid, pH 6.4 by Hellige-Truog; gradual wavy boundary.

Bt6--31 to 42 inches, (79 to 107 cm); yellowish red (5YR 5/6) very gravelly clay loam, yellowish red (5YR 4/6), moist; 28 percent clay; moderate fine subangular blocky structure; slightly hard, firm, moderately sticky, moderately plastic; few fine roots; few fine tubular pores; 10 percent discontinuous distinct clay films on surfaces along pores and 35 percent discontinuous distinct clay films on faces of peds; 50 percent subangular metavolcanic gravel; slightly acid, pH 6.3 by Hellige-Truog; clear smooth boundary.

Bt7--42 to 52 inches, (107 to 132 cm); reddish yellow (5YR 6/6) gravelly clay loam, yellowish red (5YR 4/6), moist; 30 percent clay; weak fine subangular blocky structure; slightly hard, firm, moderately sticky, moderately plastic; few fine roots; few fine tubular pores; 5 percent discontinuous distinct clay films on surfaces along pores and 15 percent discontinuous distinct clay films on faces of peds; 30 percent subangular metavolcanic gravel; slightly acid, pH 6.4 by Hellige-Truog; gradual smooth boundary. (Combined thickness of the Bt3 through Bt7 horizon is 20 to 46 inches, (51 to 117 cm) thick).

Cr --52 inches, (132 cm); moderately cemented greenschist bedrock.

TYPE LOCA TION: Butte County, California; about 5.1 miles northeast of Oroville Dam, approximately 1600 feet east and 1050 feet south of the northwest corner of Section 7, Township 20 N., Range 5 E., 39 degrees, 36 minutes, 34.15 seconds North latitude; 121 degrees, 27 minutes, 33.20 seconds West longitude. NAD83 - U.S.G.S. Quad: Oroville Dam, California.

RANGE IN CHARACTERISTICS: Depth to paralithic bedrock is 40 to 60 inches, (102 to 152 cm). The mean annual soil temperature is 59 to 63 degrees F, (15 to 17 degrees C). The soil moisture control section is dry in all parts from about May to about October (about 150 to 200 days). The particle-size control section averages 20 to 27 percent clay and 10 to 35 percent rock fragments, mostly gravel. Mineralogy is mixed. Organic matter ranges from 1 to 3.5 percent to a depth of 15 inches, (38 cm) and less than 1 percent to a depth of 52 inches, (132 cm). Rock fragments on the surface range from 0 to 15 percent gravel, 0 to 10 percent cobbles, 0 to 15 percent stones and 0 to 15 percent boulders.

The A horizon dry color is 7.5YR 5/4, 6/4, 7/4, 5/6 or 5YR 7/6. Moist color is 5YR 4/4, 5/4, 7.5YR 3/4 or 4/3. Texture is loam or gravelly loam with high silt content. Clay content ranges from 17 to 25 percent. Rock fragments range from 0 to 30 percent gravel. Reaction ranges from moderately acid to neutral.

The upper Bt horizon dry color is 5YR 5/6 or 7.5YR 5/6. Moist color is 5YR 4/4 or 7.5YR 3/4. Texture is gravelly loam or loam. Clay content ranges from 20 to 27 percent. Rock fragments range from 0 to 10 percent gravel. Reaction ranges from slightly acid to moderately acid.

The lower Bt horizon dry color is 5YR 7/4, 4/6, 5/6, 6/6, 7/6, 7.5YR 5/6, 6/6, 7/6, 7/4, 2.5YR 5/6, 6/6 or 7/6. Moist color is 5YR 3/4, 4/4, 4/6, 5/6, 5/8, 8/4, 7.5YR 3/4, 4/4, 4/6, 2.5YR 4/6, 4/8 or 5/8. Texture is clay loam, very gravelly loam, gravelly clay loam or very gravelly clay loam with high silt content. Clay content ranges from 20 to 35 percent. Rock fragments range from 5 to 50 percent gravel and 0 to 25 percent cobbles. Reaction ranges from moderately acid to slightly acid.

The BCt horizon when present dry color is 7.5YR 5/6. Moist color is 5YR 4/6. Texture is extremely gravelly loam, extremely gravelly clay loam, or extremely gravelly clay with high silt content. Clay content ranges from

25 to 27 percent and 25 to 40 percent in the lower part. Rock fragments range from 60 to 70 percent gravel and 0 to 20 percent cobbles. Reaction ranges from moderately acid to slightly acid.

COMPETING SERIES: These are the Bearwallow, Churn, Loafercreek, Sommeyflat, and Wisheylu series. Bearwallow, Loafercreek and Wisheylu soils are moderately deep. Churn and Sommeyflat soils are very deep.

GEOGRAPHIC SETTING: Mounthope soils are on metamorphic Sierra Nevada foothills. Slopes range from 2 to 100 percent. These soils formed in colluvium and residuum weathered from metasedimentary and metavolcanic rocks, mainly greenschist and intrusive igneous rock, mainly quartz diorite and gabbro. Elevation is 400 to 2400 feet, (122 to 732 m). Mean annual precipitation is 35 to 60 inches, (889 to 1524 mm). The mean annual temperature is 56 to 61 degrees F, (13 to 16 degrees C). Frost free season is 200 to 260 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Bigridge, Dunstone, Featherfalls, Hartsmill, Islandbar, Loafercreek, Minniecreek, Oroshore and Surnuf soils. Bigridge soils are deep to paralithic contact of greenschist and are mesic. Dunstone soils are shallow to a paralithic contact of greenschist and are loamy. Featherfalls soils are fine-loamy, deep to a paralithic contact of tronjhemite and are mesic. Hartsmill soils are loamy-skeletal and very deep to a paralithic contact of greenschist. Loafercreek soils are fine-loamy and moderately deep to a paralithic contact. Islandbar soils are loamy-skeletal, deep to a paralithic contact of tronjhemite and are mesic. Oroshore soils are moderately deep to a paralithic contact and are loamy-skeletal. Surnuf soils are fine, very deep and mesic.

DRAINAGE AND PERMEABILITY: Well drained; medium to high runoff; moderate saturated hydraulic conductivity in the A, Bt1, and Bt2 horizons, moderately slow in the Bt3, Bt4, Bt5, and Bt6 horizons, and moderately slow or moderate in the Bt7 horizon.

USE AND VEGETATION: This soil is used for wildlife habitat and home site development. Vegetation is whiteleaf manzanita, toyon, buckbrush, interior live oak, blue oak, foothill pine, Pacific poison oak, chaparral coffeeberry, squirreltail, hedgehog dogtail and very scattered ponderosa pine.

DISTRIBUTION AND EXTENT: Butte County, California and occurs in the (M261Fb) Lower Foothills Metamorphic Belt subsection of the (M261F) Sierra Nevada Foothills section. MLRA 18 - Sierra Nevada Foothills. The soils are not extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Butte County, California 2005. Source of name from Mt. Hope, Oroville Dam quad.

REMARKS:
Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - zone from 1 to 3 inches, (3 to 8 cm) (A).
Argillic horizon - zone from 3 to 52 inches, (8 to 132 cm) (Bt1, Bt2, Bt3, Bt4, Bt5, Bt6, Bt7).
Paralithic contact - the zone from 52 to 80 inches, (132 to 203 cm) (Cr).
Particle-size control section - zone from 3 to 23 inches, (8 to 58 cm) (Bt1, Bt2, Bt3, Bt4).
The soil moisture control section - zone from 8 to 21 inches, (20 to 53 cm).

ADDITIONAL DATA: Reference data from lab pedon number: 01N0267, NSSL, Lincoln, NE. Used field estimated clay because iron content is thought to interfere with complete dispersion.

National Cooperative Soil Survey
U.S.A.

Map Unit 343/344 - Lovejoy Formation Colluvium

Map Unit 375/376 - Lovejoy Formation Fan Remnants

LOCATION COALCANYON CA

Established Series
IRD: DWB
01/2006

COALCANYON SERIES

The Coalcanyon series consists of very deep, well drained soils that formed in colluvium from basalt. Coalcanyon soils are on side slopes on basalt plateaus in volcanic Sierra Nevada foothills. Slopes range from 5 to 50 percent. The mean annual precipitation is about 30 inches, (762 mm) and the mean annual temperature is about 60 degrees F, (16 degrees C).

TAXONOMIC CLASS: Loamy-skeletal, parasesquic, thermic Pachic Ultic Argixerolls

TYPICAL PEDON: Coalcanyon very cobbly loam, on a west facing 45 percent slope under a cover of hardwoods, shrubs and annual grasses at an elevation of 950 feet, (290 m). When described on 6/26/2001 the soil was dry to a depth of 27 inches, (69 cm) and moist below. (Colors are for dry soil unless otherwise noted).

A--0 to 2 inches, (0 to 5 cm); brown (7.5YR 4/3) very cobbly loam, dark brown (7.5YR 3/2) moist; 16 percent clay; moderate fine granular structure; slightly hard, friable, slightly sticky, nonplastic; many very fine and fine roots; many fine irregular pores; 10 percent basalt gravel and 30 percent basalt cobbles; slightly acid, pH 6.5 by Hellige-Truog; clear wavy boundary. (2 to 7 inches, (5 to 18 cm) thick)

BAt--2 to 11 inches, (5 to 28 cm); brown (7.5YR 4/3) very cobbly loam, dark brown (7.5YR 3/2) moist; 18 percent clay; moderate fine subangular blocky structure; slightly hard, friable, slightly sticky, nonplastic; many fine and medium roots throughout and common coarse roots between peds; many fine irregular pores; 5 percent discontinuous faint clay films on surfaces along pores; 15 percent basalt gravel and 40 percent basalt cobbles; slightly acid, pH 6.5 by Hellige-Truog; clear wavy boundary. (0 to 10 inches, (0 to 25 cm) thick)

Bt1--11 to 27 inches, (28 to 69 cm); brown (7.5YR 4/3) very cobbly loam, dark brown (7.5YR 3/2) moist; 22 percent clay; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common fine and medium roots throughout and common coarse roots between peds; common fine and medium tubular pores; 20 percent discontinuous faint clay films on surfaces along pores; 20 percent basalt gravel and 30 percent basalt cobbles; slightly acid, pH 6.5 by Hellige-Truog; clear wavy boundary.

Bt2--27 to 43 inches, (69 to 109 cm); brown (7.5YR 4/3) very cobbly loam, dark brown (7.5YR 3/3) moist; 26 percent clay; moderate medium subangular blocky structure; slightly hard, firm, moderately sticky, slightly plastic; common very fine, fine and coarse roots between peds; common fine and medium tubular pores; 35 percent discontinuous distinct clay films on surfaces along pores; 25 percent basalt gravel and 35 percent basalt cobbles; moderately acid, pH 6.0 by Hellige-Truog; clear wavy boundary.

Bt3--43 to 65 inches, (109 to 165 cm); reddish brown (5YR 4/3) extremely cobbly clay loam, dark reddish brown (5YR 3/3) moist; 29 percent clay; moderate medium subangular blocky structure; slightly hard, firm, moderately sticky, moderately plastic; common very fine and fine roots between peds; common fine tubular pores; 50 percent discontinuous distinct clay films on surfaces along pores; 20 percent basalt gravel and 50 percent basalt cobbles; moderately acid, pH 6.0 by Hellige-Truog; clear wavy boundary. (Combined thickness of the Bt horizon is 50 to 80 inches, (127 to 203 cm) or more thick).

TYPE LOCA TION: Butte County, California, about 5.7 miles northwest of Oroville, approximately 1500 feet east and 1300 feet south of the northwest corner of Section 13, Township 20 N., Range 3 E., 39 degrees, 35 minutes, 35 seconds North latitude and 121 degrees, 35 minutes, 23 seconds West longitude, NAD27 - U.S.G.S. Quad: Oroville, California.

RANGE IN CHARACTERISTICS: Depth of to bedrock is greater than 60 inches, (152 cm). The mean annual soil temperature is 61 to 64 degrees F, (16 to 18 degrees C). The particle-size control section averages 18 to 27 percent clay and 35 to 60 percent rock fragments, mostly gravel and cobbles. Mineralogy is mixed. Organic matter ranges from 1 to 13 percent to a depth of 43 inches, (3 to 109 cm) and is less than 1 percent below. Base saturation by ammonium acetate ranges from 78 to 91 percent throughout. Base saturation by sum of cations ranges from 55 to 58 percent throughout. Rock fragments on the surface range from 10 to 60 percent gravel, 5 to 65 percent cobbles, 0 to 25 percent stones and 0 to 20 percent boulders. Some pedons have silty textures throughout.

The A horizon dry color is 10YR 3/3, 3/4, 4/2, 4/3, 4/4 or 7.5YR 4/3. Moist color is 10YR 2/2, 3/2, 3/3 or 7.5YR 3/2. Texture is very cobbly loam, very gravelly loam or gravelly loam. Clay content ranges from 14 to 18 percent. Rock fragments range from 10 to 55 percent gravel, 5 to 35 percent cobbles, 0 to 45 percent stones and 0 to 15 percent boulders. Reaction ranges from slightly acid to neutral.

The BAt horizon dry color is 10YR 4/2, 4/3, 7.5YR 4/3 or 4/4. Moist color is 10YR 2/2, 3/2, 3/3, 7.5YR 3/2 or 3/3. Texture is very cobbly loam or very gravelly loam. Clay content ranges from 16 to 22 percent. Rock fragments range from 15 to 50 percent gravel, 5 to 40 percent cobbles, 0 to 55 percent stones and 0 to 15 percent boulders. Reaction ranges from slightly acid to neutral.

The Bt horizon dry color is 10YR 4/3, 4/4, 4/6, 5/3, 5/4, 7.5YR 4/3 or 5YR 4/3. Moist color is 10YR 3/2, 3/3, 3/4, 4/4, 7.5YR 3/2 or 3/3. Texture is very cobbly loam, extremely cobbly loam, very cobbly clay loam, extremely cobbly clay loam, extremely gravelly loam or extremely gravelly clay loam. Clay content ranges from 22 to 35 percent. Rock fragments range from 20 to 80 percent gravel, 5 to 50 percent cobbles, 0 to 60 percent stones and 0 to 15 percent boulders. Reaction ranges from moderately acid to neutral.

COMPETING SERIES: This is the Coonhollow soil. Coonhollow soils are deep to a paralithic contact.

GEOGRAPHIC SETTING: Coalcanyon soils are on side slopes on basalt plateaus in volcanic Sierra Nevada foothills. Slopes range from 5 to 50 percent. These soils formed in colluvium weathered from basalt. Elevation is 200 to 1500 feet, (61 to 457 m). The mean annual precipitation is 25 to 35 inches, (635 to 889 mm). The mean annual temperature is 59 to 62 degrees F, (15 to 17 degrees C). Frost free season is 250 to 260 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Beatsonhollow, Campbellhills, Cherotable, Coonhollow, and Thermalrocks soils. Beatsonhollow soils are in swales in a mound-swale microtopography on basalt plateaus, are loamy-skeletal and shallow to bedrock. Campbellhills soils are in fractures on basalt plateaus, are loamy-skeletal and deep to bedrock. Cherotable soils are on concave positions on basalt plateaus, are fine loamy and deep to bedrock. Coonhollow soils are deep to a paralithic contact. Thermalrocks soils are on convex positions on basalt plateaus, are loamy-skeletal and very shallow to bedrock.

DRAINAGE AND PERMEABILITY: Well drained; low to medium runoff; moderate saturated hydraulic conductivity in the A and BAt horizons and moderate to moderately slow in the Bt horizon.

USE AND VEGETATION: This soil is used for livestock grazing, wildlife habitat and watershed. Vegetation is live oak, blue oak, valley oak, foothill pine, whiteleaf manzanita, toyon, California laurel, Pacific poison oak, mustard, hedgehog dogstail, wild oat, soft chess, filaree, yellow starthistle and rose clover.

DISTRIBUTION AND EXTENT: Butte County, California and occurs in (M261Fb) Lower Foothills Metamorphic Belt subsection of the (M261 F) Sierra Nevada Foothills section. MLRA: 18 -- Sierra Nevada Foothills. The soils are not extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES EST ABLISHED: Butte County, California 2005. Source of name from Coal Canyon on the Oroville Quad.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Particle-size control section - zone from 11 to 33 in, (28 to 84 cm)
Mollic epipedon - zone from 0 to 43 in, (0 to 109 cm) (A, BAt, Bt1, Bt2)
Argillic horizon - zone from 11 to 65 in, (28 to 165 cm) (Bt1, Bt2, Bt3)
The soil moisture control section - zone from 13 to 38 inches, (33 to 96 cm) is dry in all parts from about May to October (about 150 to 200 days).

ADDITIONAL DA TA: Used data from Coonhollow SO1CA-007-007 NSSL, Lincoln, NE.

National Cooperative Soil Survey
U.S.A.

LOCATION COONHOLLOW CA

Established Series
IRD: DWB
10/2006

COONHOLLOW SERIES

The Coonhollow series consists of deep, well drained soils that formed in colluvium from basalt. Coonhollow soils are on convex sideslopes on basalt plateaus in volcanic Sierra Nevada foothills. Slopes range from 5 to 50 percent. The mean annual precipitation is about 30 inches, (762 mm) and the mean annual temperature is about 60 degrees F, (16 degrees C).

TAXONOMIC CLASS: Loamy-skeletal, parasesquic, thermic Pachic Ultic Argixerolls

TYPICAL PEDON: Coonhollow gravelly loam, on a northwest facing 45 percent slope under a cover of hardwoods, shrubs and annual grasses at an elevation of 1020 feet, (311 m). When described on 10/31/2000 the soil was moist throughout. (Colors are for dry soil unless otherwise noted).

A--0 to 3 inches, (0 to 8 cm); brown (7.5YR 4/3) gravelly loam, dark brown (7.5YR 3/2) moist; 16 percent clay; weak fine granular structure; soft, very friable, nonsticky, nonplastic; many fine roots throughout; many fine irregular pores; 10 percent basalt cobbles and 15 percent basalt gravel; neutral, pH 5.5 by pH meter 1:1 water; clear smooth boundary. (2 to 8 inches, (5 to 20 cm) thick)

ABt--3 to 11 inches, (8 to 28 cm); brown (7.5YR 4/3) very cobbly loam, dark reddish brown (5YR 3/3) moist; 19 percent clay; weak medium subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; common fine and medium roots throughout and few coarse roots between peds; few fine tubular and common fine irregular pores; 10 percent discontinuous distinct clay films on surfaces along pores; 15 percent basalt gravel and 30 percent basalt cobbles; neutral, pH 5.9 by pH meter 1:1 water; gradual wavy boundary. (0 to 10 inches, (0 to 25 cm) thick)

Bt1--11 to 22 inches, (28 to 56 cm); brown (7.5YR 4/3) very cobbly loam, dark reddish brown (5YR 3/3) moist; 23 percent clay; moderate medium subangular blocky structure; slightly hard, friable, moderately sticky, slightly plastic; common fine and very coarse roots throughout; common fine tubular and common medium irregular pores; 20 percent discontinuous distinct clay films on surfaces along pores; 15 percent basalt gravel and 40 percent basalt cobbles; neutral, pH 6.1 by pH meter 1:1 water; clear wavy boundary.

Bt2--22 to 32 inches, (56 to 81 cm); brown (7.5YR 4/3) extremely cobbly loam, dark reddish brown (5YR 3/3) moist; 26 percent clay; moderate medium subangular blocky structure; slightly hard, friable, moderately sticky, moderately plastic; common fine roots and few very fine roots between peds and few very coarse roots throughout; common medium tubular pores; 35 percent discontinuous distinct clay films on surfaces along pores; 15 percent basalt gravel and 50 percent basalt cobbles; slightly acid, pH 6.4 by pH meter 1:1 water; clear wavy boundary.

Bt3--32 to 45 inches, (81 to 114 cm); brown (7.5YR 5/3) extremely cobbly clay loam, brown (7.5YR 4/3) moist; 29 percent clay; moderate medium subangular blocky structure; hard, friable, moderately sticky, moderately plastic; few fine roots between peds and common medium roots between peds and common very coarse roots throughout; common medium tubular pores; 45 percent discontinuous distinct clay films on surfaces along pores; 20 percent basalt gravel and 55 percent basalt cobbles; slightly acid, pH 6.4 by pH meter 1:1 water; clear wavy boundary. (Combined thickness of the Bt horizon is 17 to 48 inches, (43 to 122 cm) thick).

Cr--45 to 50 inches, (114 to 127 cm); moderately cemented basalt bedrock; abrupt wavy boundary

R--50 inches, (127 cm); indurated basalt bedrock

TYPE LOCATION: Butte County, California, about 5.1 miles north of downtown Oroville, approximately 1750 feet east and 1800 feet north of the southwest corner of Section 18, Township 20N., Range 4E., 39 degrees, 35 minutes, 18 seconds North latitude and 121 degrees, 34 minutes, 15 seconds West longitude, NAD83 - U.S.G.S. Quad: Oroville, California.

RANGE IN CHARACTERISTICS: Depth to paralithic bedrock is 40 to 60 inches, (102 to 152 cm). The mean annual soil temperature is 61 to 64 degrees F, (16 to 18 degrees C). The particle-size control section averages 18 to 27 percent clay and 35 to 60 percent rock fragments, mostly gravel and cobbles. Mineralogy is mixed. Organic matter ranges from 1 to 13 percent to a depth of 32 inches, (81 cm) and is less than 1 percent to a depth of 50 inches, (127 cm). Base saturation by ammonium acetate ranges from 78 to 91 percent throughout. Base saturation by sum of cations ranges from 55 to 58 percent throughout. Rock fragments on the surface range from 10 to 60 percent gravel, 5 to 65 percent cobbles, 0 to 25 percent stones and 0 to 20 percent boulders. Some pedons have silty textures.

The A horizon dry color is 7.5YR 3/4, 4/3, 10YR 3/3, 4/3 or 5/3. Moist color is 7.5YR 3/2, 3/3, 10YR 2/2, 3/2 or 3/3. Texture is gravelly loam, loam, very gravelly loam or very cobbly loam. Clay content ranges from 16 to 22 percent. Rock fragments range from 10 to 55 percent gravel, 5 to 35 percent cobbles, 0 to 45 percent stones and 0 to 15 percent boulders. Reaction ranges from strongly acid to neutral.

The ABt horizon dry color is 7.5YR 4/3, 10YR 5/3 or 5/4. Moist color is 5YR 3/3; 7.5YR 4/3, 10YR 3/2 or 3/3. Texture is very cobbly loam, loam, gravelly loam or very gravelly loam. Clay content ranges from 18 to 22 percent. Rock fragments range from 10 to 50 percent gravel, 5 to 40 percent cobbles, 0 to 55 percent stones and 0 to 15 percent boulders. Reaction ranges from moderately acid to neutral.

The Bt horizon dry color is 7.5YR 4/3, 5/3, 5/4, 10YR 3/4, 4/3, 4/4, 5/2 or 5/3. Moist color is 5YR 3/3, 7.5YR 4/3, 3/2, 3/3 or 3/4. Texture is very cobbly loam, extremely cobbly loam, very cobbly clay loam, extremely cobbly clay loam, gravelly loam, very gravelly loam, gravelly clay loam, very gravelly clay loam or extremely gravelly clay loam. Clay content ranges from 18 to 38 percent. Rock fragments range from 15 to 80 percent gravel, 5 to 60 percent cobbles, 0 to 60 percent stones and 0 to 15 percent boulders. Reaction ranges from slightly acid to neutral.

COMPETING SERIES: This is the Coalcanyon series. Coalcanyon soils are very deep.

GEOGRAPHIC SETTING: Coonhollow soils are on convex sideslopes on basalt plateaus in volcanic Sierra Nevada foothills. Slopes are 5 to 50 percent. These soils formed in colluvium weathered from basalt. Elevation is 200 to 1500 feet, (61 to 457 m). Mean annual precipitation is 25 to 35 inches, (635 to 889 mm). The mean annual temperature is 59 to 62 degrees F, (15 to 17 degrees C). Frost free season is 240 to 260 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Beatsonhollow, Campbellhills, Cherotable, Coalcanyon and Thermalrocks soils. The Beatsonhollow soils are in swales in mound-swale microtopography on basalt plateaus, are loamy-skeletal, and shallow to bedrock. Campbellhills soils are in fractures on basalt plateaus, are loamy-skeletal and deep to bedrock. Cherotable soils are on concave positions on basalt plateaus, are fine-loamy and deep to bedrock. Coalcanyon soils are very deep and are on side slopes on basalt plateaus. Thermalrocks soils are on convex positions on basalt plateaus, are loamy-skeletal, and very shallow to bedrock.

DRAINAGE AND PERMEABILITY: Well drained; low to medium runoff; moderate saturated hydraulic conductivity in the A and Bt horizons and moderate to moderately slow in the Bt horizon.

USE AND VEGETATION: This soil is used for livestock grazing, wildlife habitat and watershed. Vegetation is interior live oak, blue oak, valley oak, foothill pine, whiteleaf manzanita, toyon, poison oak, mustard, rabbitfoot grass, wild oat, soft chess, filaree, starthistle and rose clover.

DISTRIBUTION AND EXTENT : Butte County, California and occurs in (M261Fb) Lower Foothills Metamorphic Belt subsection of the (M261F) Sierra Nevada Foothills section. MLRA 18 - Sierra Nevada Foothills. The soils are not extensive.

MLRA SOIL SUR VEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES EST ABLISHED: Butte County, California 2005. Source of name from canyon named Coon Hollow on the Oroville Quad.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Particle-size control section - zone from 11 to 31 in, (28 to 79 cm)
Mollic Epipedon - zone from 0 to 32 in, (0 to 81 cm) (A, ABt, Bt1, Bt2)
Argillic Horizon - zone from 11 to 45 in, (28 to 114 cm) (Bt1, Bt2, Bt3)
Paralithic Contact - zone from 45 to 50 in, (114 to 127 cm) (Cr)
Lithic Contact - 50 in, (127 cm)
The soil moisture control section - zone from 11 to 42 inches, (28 to 107 cm) is dry in all parts from about May to October (about 150 to 200 days).
Argillic horizon not supported by particle-size distribution, however believe this to be due to lack of dispersion due to iron content. Did not use lab textures.

ADDITIONAL DA TA: Reference data from lab pedon number: 01N0261, NSSL, Lincoln, NE.

National Cooperative Soil Survey
U.S.A.

LOCATION FLAGCANYON CA

Established Series
IRD: DWB
10/2006

FLAGCANYON SERIES

The Flagcanyon series consists of moderately deep, moderately well drained soils that formed in alluvium from basalt. Flagcanyon soils are on alluvial fans. Slopes range from 2 to 5 percent. The mean annual precipitation is about 28 inches, (711 mm) and the mean annual temperature is about 61 degrees F, (16 degrees C).

TAXONOMIC CLASS: Loamy-skeletal, mixed, superactive, thermic Haplic Durixeralfs

TYPICAL PEDON: Flagcanyon gravelly loam, on a west facing 4 percent slope under a cover of olives at an elevation of 380 feet, (116 m). When described on 7/16/2001 the soil was dry to a depth of 30 inches, (76 cm) and moist from 30 to 65 inches, (76 to 165 cm). (Colors are for dry soil unless otherwise noted).

A--0 to 3 inches, (0 to 8 cm); brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; 18 percent clay; moderate fine subangular blocky structure; hard, friable, slightly sticky, slightly plastic; many very fine roots; many fine irregular pores; 10 percent subrounded cobbles and 20 percent subrounded basalt gravel; very strongly acid, pH 5.1 by Hellige-Truog; clear smooth boundary. (2 to 8 inches, (5 to 20 cm) thick)

Bt1--3 to 9 inches, (8 to 23 cm); brown (10YR 4/3) very gravelly loam, dark yellowish brown (10YR 3/4) moist; 25 percent clay; moderate medium and coarse subangular blocky structure; hard, firm, slightly sticky, moderately plastic; common fine and medium roots between peds; common fine and medium irregular pores; 20 percent discontinuous faint clay films on surfaces along pores; 10 percent subrounded basalt cobbles and 30 percent subrounded basalt gravel; strongly acid, pH 5.5 by Hellige-Truog; clear wavy boundary.

Bt2--9 to 14 inches, (23 to 36 cm); dark yellowish brown (10YR 4/4) very gravelly loam, dark yellowish brown (10YR 3/4) moist; 27 percent clay; moderate medium and coarse subangular blocky structure; hard, firm, moderately sticky, moderately plastic; common very fine, fine, medium and coarse roots between peds; common very fine, fine and medium tubular and few coarse tubular pores; 30 percent discontinuous distinct clay films on surfaces along pores; 10 percent subrounded basalt cobbles and 40 percent subrounded basalt gravel; moderately acid, pH 6.0 by Hellige-Truog; clear wavy boundary.

2Bt3--14 to 30 inches, (36 to 76 cm); dark yellowish brown (10YR 4/4) very gravelly clay loam, dark yellowish brown (10YR 3/4) moist; 30 percent clay; moderate medium subangular blocky structure; hard, firm, moderately sticky, moderately plastic; common fine and medium roots around fragments; common fine and medium irregular pores; 40 percent discontinuous distinct clay films on surfaces along pores; 20 percent subrounded basalt cobbles and 40 percent subrounded basalt gravel; slightly acid, pH 6.5 by Hellige-Truog; abrupt wavy boundary. (Combined thickness of the Bt horizon is 19 to 41 inches, (48 to 104 cm) thick).

3Btq1--30 to 53 inches, (76 to 135 cm); duripan; yellowish brown (10YR 5/4) extremely gravelly sandy clay loam, dark yellowish brown (10YR 4/4) moist; 34 percent clay; moderate medium angular blocky structure; very hard, very firm, moderately cemented, cemented by silica, moderately sticky, moderately plastic; common very fine and fine roots around fragments; few fine irregular pores; 60 subrounded basalt cobbles and 50 percent subrounded basalt gravel; neutral, pH 6.8 by Hellige-Truog; abrupt wavy boundary.

3Btq2--53 to 65 inches, (135 to 165 cm); duripan; yellowish brown (10YR 5/4) extremely gravelly sandy clay, 40 percent dark yellowish brown (10YR 4/6) and 60 percent dark yellowish brown (10YR 4/4) moist; 36 percent clay; moderate medium angular blocky structure; very hard, very firm, moderately cemented, cemented by silica, moderately sticky, moderately plastic; few very fine roots around fragments; few very fine irregular pores; 45 percent continuous distinct clay films on rock fragments; 20 percent subrounded basalt cobbles and 60 percent subrounded basalt gravel; neutral, pH 7.0 by Hellige-Truog. (Combined thickness of the 3Btq horizon is 35 to 50 inches, (89 to 127 cm) or more thick).

TYPE LOCA TION: Butte County, California, about 6.1 miles northwest of Oroville, approximately 1,000 feet east and 1,400 feet south of the northwest corner of Section 14, Township 20 N., Range 3 E., 39 degrees, 35 minutes, 34 seconds North latitude and 121 degrees, 36 minutes, 31 seconds West longitude, NAD83 - U.S.G.S. Quad: Oroville, California.

RANGE IN CHARACTERISTICS: Depth to duripan is 20 to 40 inches, (51 to 102 cm). The mean annual soil temperature is 62 to 64 degrees F, (17 to 18 degrees C). The particle-size control section averages 27 to 35 percent clay and 35 to 60 percent rock fragments, mostly gravel. Mineralogy is mixed. A fluctuating water table can occur between the top of the duripan and 11 inches (28 cm) below the surface of the soil from December through April. Redoximorphic features such as soft manganese masses, with colors of N 2/0 occur in the Bt and 2Bt horizons. Rock fragments on the surface range from 0 to 10 percent gravel and 0 to 15 percent cobbles.

The A horizon dry color is 10YR 4/3, 7.5YR 4/3 or 5/3. Moist color is 10YR 3/2, 3/3, 7.5YR 3/2 or 3/3. Texture is gravelly loam, loam or fine sandy loam. Clay content ranges from 15 to 22 percent. Rock fragments range from 0 to 20 percent gravel and 0 to 10 percent cobbles. Organic matter ranges from 4 to 8 percent. Reaction ranges from strongly acid to slightly acid.

The Bt horizon dry color is 10YR 4/3, 4/4, 5/3, 7.5YR 4/3, 4/4, 5/3 or 5YR 4/4. Moist color is 10YR 3/4, 7.5YR 3/4, 4/2, 4/3, 4/4 or 5YR 3/4. Texture is very gravelly loam, very gravelly clay loam, extremely gravelly clay loam or gravelly loam. Clay content ranges from 22 to 60 percent. Rock fragments range from 15 to 60 percent gravel and 0 to 30 percent cobbles. Organic matter ranges from 1 to 4 percent. Reaction ranges from strongly acid to neutral.

The 2Bt horizon dry color is 10YR 4/3, 4/4, 5/3, 7.5YR 4/3, 4/4 or 5YR 4/4. Moist color is 10YR 3/4, 4/3, 7.5YR 3/4, 4/3 or 5YR 3/4. Texture is very gravelly clay loam, extremely gravelly clay loam or extremely gravelly clay. Clay content ranges from 35 to 50 percent. Rock fragments range from 40 to 60 percent gravel and 0 to 20 percent cobbles. Organic matter ranges from 1 to 2 percent. Reaction ranges from moderately acid to neutral.

The 3Btq horizon dry color is 10YR 5/4, 5/6, 8/4, 8/6 or 7.5YR 4/4. Moist color is 10YR 4/4, 4/6, 7/6 or 7.5YR 3/4. Texture is extremely gravelly sandy clay loam or extremely gravelly sandy clay. Clay content ranges from 22 to 50 percent. Rock fragments range from 45 to 60 percent gravel and 20 to 40 percent cobbles. Cementation class ranges from slightly cemented to moderately cemented. Organic matter ranges from 0.2 to 1 percent. Reaction matter ranges from neutral to moderately alkaline.

COMPETING SERIES: There are no other series in this family.

GEOGRAPHIC SETTING: Flagcanyon soils are on Table Mountain alluvial fans. Slopes range from 2 to 5 percent. These soils formed in alluvium weathered from basalt. Elevation is 280 to 500 feet, (85 to 152 m). Mean annual precipitation is 25 to 30 inches, (635 to 762 mm). The mean annual temperature is 60 to 62 degrees F, (16 to 17 degrees C). Frost free season is 250 to 260 days.

GEOGRAPHICALL Y ASSOCIA TED SOILS: These are the Cherokeespring, Coalcanyon, Coonhollow and Wickscorner soils. Cherokeespring soils are very deep, fine loamy and have greater than 50 percent silt. Coalcanyon soils are formed in colluvium from basalt, are on side slopes of basalt plateaus, are loamy-skeletal and have a mollic epipedon. Coonhollow soils are deep to a paralithic contact, are formed in colluvium from basalt, are on side slopes of basalt plateaus, are loamy-skeletal and have a mollic epipedon. Wickscorner soils are very deep, are fine-loamy and are on middle and upper fan terraces.

DRAINAGE AND PERMEABILITY : Moderately well drained; medium runoff; moderate saturated hydraulic conductivity in the A horizon, moderate to moderately slow in the Bt horizon, moderately slow in the 2Bt horizon and very slow in the 3Btq horizon. A fluctuating water table can occur between the top of the duripan and 11 inches (28 cm) below the surface of the soil from December through April.

USE AND VEGET ATION: This soil is used for livestock grazing, wildlife habitat, watershed and orchards, mainly olives. Vegetation is soft chess, wild oat, annual brome, filaree, brodiaea, hedgehog dogtail, ripgut brome, cowbag clover, ryegrass, fiddleneck, lupine, yellow starthistle and blackberry.

DISTRIBUTION AND EXTENT : Butte County, California and occur in (262Ag) Hardpan Terraces subsection of the (262A) Great Valley section. MLRA 17 - Sacramento Valley. The soils are inextensive.

MLRA SOIL SUR VEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES EST ABLISHED: Butte County, California 2005. Source of name from Flag Canyon on the Oroville Quad.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - zone from 0 to 3 inches, (0 to 8 cm) (A)
Argillic horizon - zone from 3 to 30 inches, (8 to 76 cm) (Bt1, Bt2, Bt3)
Duripan - zone from 30 to 65 inches, (76 to 165 cm).
Particle-size control section for this pedon: 3 to 23 inches, (8 to 58 cm).
The soil moisture control section - zone from 10 to 30 inches, (25 to 76 cm) is dry in all parts from about June through October 15 (about 135 days).
Assumed that base saturation by sum of cations ranges from 35 to 50 percent in the argillic horizon.

National Cooperative Soil Survey
U.S.A.

LOCATION WICKSCORNER CA

Established Series
IRD: DWB
10/2006

WICKSCORNER SERIES

The Wickscorner series consists of very deep, moderately well drained soils that formed in alluvium from basalt. Wickscorner soils are on alluvial fans. Slopes range from 2 to 10 percent. The mean annual precipitation is about 28 inches, (711 mm) and the mean annual temperature is about 61 degrees F, (16 degrees C).

TAXONOMIC CLASS: Fine-loamy, mixed, superactive, thermic Ultic Palexeralfs

TYPICAL PEDON: Wickscorner loam, on a west facing 5 percent slope under a cover of annual grasses at an elevation of 418 feet, (127 m). When described on 4/17/2001 the soil was dry from 0 to 8 inches, (0 to 20 cm) and slightly moist from 8 to 84 inches, (20 to 213 cm). (Colors are for dry soil unless otherwise noted).

A--0 to 2 inches, (0 to 5 cm); brown (7.5YR 4/3) loam, dark brown (7.5YR 3/3) moist; 20 percent clay; weak fine and medium subangular blocky parting to moderate fine granular structure; hard, firm, slightly sticky, slightly plastic; many very fine and fine roots and common medium roots; many very fine irregular pores; 10 percent rounded basalt gravel; moderately acid, pH 6.0 by Hellige-Truog; clear smooth boundary. (2 to 9 inches, (5 to 23 cm) thick)

Bt1--2 to 8 inches, (5 to 20 cm); brown (7.5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; 26 percent clay; moderate medium and coarse subangular blocky parting to moderate medium platy structure; very hard, very firm, slightly sticky, slightly plastic; many very fine and fine roots; few fine and medium tubular pores; 30 percent discontinuous distinct clay films on surfaces along pores; 2 percent rounded quartz gravel and 10 percent rounded basalt gravel; moderately acid, pH 5.8 by Hellige-Truog; gradual smooth boundary.

Bt2--8 to 22 inches, (20 to 56 cm); brown (7.5YR 4/3) gravelly clay loam, dark reddish brown (5YR 3/3) moist; 30 percent clay; moderate medium and coarse subangular blocky structure; hard, firm, moderately sticky, moderately plastic; common very fine and fine roots; common fine and medium tubular pores; 40 percent discontinuous distinct clay films on faces of peds; 32 percent rounded basalt gravel; moderately acid, pH 6.0 by Hellige-Truog; clear wavy boundary. (Combined thickness of the Bt horizon is 11 to 27 inches, (28 to 69 cm) thick).

2Bt3--22 to 38 inches, (56 to 97 cm); brown (7.5YR 4/3) very gravelly clay loam, dark reddish brown (5YR 3/3) moist; 36 percent clay; moderate fine and medium subangular blocky structure; hard, firm, very sticky, very plastic; common very fine and fine roots ; common very fine and fine and few medium tubular pores; 50 percent continuous distinct clay films on faces of peds; 3 percent rounded quartz gravel and 35 percent rounded basalt gravel; slightly acid, pH 6.5 by Hellige-Truog; abrupt wavy boundary.

2Bt4--38 to 59 inches, (97 to 150 cm); brown (7.5YR 5/4) very gravelly clay, dark reddish brown (5YR 3/3) moist; 42 percent clay; moderate coarse subangular blocky structure; hard, firm, very sticky, very plastic; few very fine and fine roots; few fine and medium tubular pores; 50 percent continuous distinct clay films on faces of peds; 5 percent rounded quartz gravel and 45 percent rounded basalt gravel; slightly acid, pH 6.3 by Hellige-Truog; abrupt wavy boundary. (Combined thickness of the 2Bt horizon is 0 to 37 inches, (0 to 94 cm) thick).

3Bt5--59 to 72 inches, (150 to 183 cm); brown (10YR 4/3) extremely gravelly sandy clay, dark brown (10YR 3/3) moist; 48 percent clay; moderate fine and medium subangular blocky structure; noncemented; very hard, firm, very sticky, very plastic; few very fine roots top of horizon; few fine tubular pores; 30 percent discontinuous distinct clay films on faces of peds; 30 percent fine and medium iron depletions, 20 percent very fine manganese masses; 3 percent rounded quartz gravel and 60 percent rounded basalt gravel with soft weathered rinds; slightly acid, pH 6.3 by Hellige-Truog; clear wavy boundary.

3Bt6--72 to 84 inches, (183 to 213 cm); yellowish brown (10YR 5/4) extremely gravelly sandy clay, brown (10YR 4/3) moist; 40 percent clay; moderate fine and medium subangular blocky structure; noncemented; very hard, firm, very sticky, very plastic; few fine tubular pores 35 percent discontinuous clay films on faces of peds, 10 percent very fine manganese masses; 30 percent fine and medium iron depletions;, 3 percent rounded quartz gravel and 60 percent rounded basalt gravel with soft weathered rinds; slightly acid, pH 6.3 by Hellige-Truog. (Combined thickness of the 3Bt horizon is 25 to 40 inches, (63 to 102 cm) or more thick).

TYPE LOCA TION: Butte County, California, about 7.4 miles northwest of Oroville, approximately 2800 feet west and 1100 feet north of the southeast corner of Section 2, Township 20 N., Range 3 E., 39 degrees, 36 minutes, 54 seconds North latitude and 121 degrees, 36 minutes, 25 seconds West longitude, NAD83 - U.S.G.S. Quad: Oroville, California.

RANGE IN CHARACTERISTICS: Depth is 60 to 80 inches, (152 to 203 cm) or more to duripan. The mean annual soil temperature is 62 to 64 degrees F, (17 to 18 degrees C). The soil moisture control section is dry in all parts from June through October 15 (about 135 days). The particle-size control section averages 27 to 35 percent clay and 20 to 35 percent rock fragments, mostly gravel. Below the control section it has 35 to 55 percent clay and 35 to 80 percent rock fragments. Mineralogy is mixed. Base saturation by sum of cations ranges from 50 to 75 percent to a depth of 72 inches, (183 cm). A fluctuating water table can occur at depths of 20 to 80 inches, (51 to 203cm) or more below the surface of the soil from December through April. Redoximorphic features such as manganese masses, with colors of N 2/0 occur in the 2Bt and 3Bt horizons. Rock fragments on the surface range from 0 to 5 percent gravel and 0 to 5 percent cobbles.

The A horizon dry color is 7.5YR 4/3, 5/3 or 10YR 4/3. Moist color is 7.5YR 2/2, 3/2, 3/3, 4/3 or 10YR 3/3. Texture is loam or fine sandy loam. Clay content ranges from 15 to 20 percent. Organic matter ranges from 2 to 6 percent. Rock fragments range from 0 to 10 percent gravel, mostly basalt and chert in small amounts. Reaction ranges from moderately acid to slightly acid.

The Bt horizon dry color is 7.5YR 4/3, 5/3, 5/4 or 10YR 5/3. Moist color is 5YR 3/3, 3/4, 4/3, 7.5YR 3/3, 3/4, 4/3 or 10YR 3/4. Texture is loam, clay loam, gravelly loam, gravelly clay loam, gravelly sandy clay loam or very gravelly loam. Clay content ranges from 20 to 33 percent. Organic matter ranges from 0.5 to 2 percent. Rock fragments range from 5 to 35 percent gravel and 0 to 5 percent cobbles. Reaction ranges from very strongly acid to moderately acid.

The 2Bt horizon dry color is 7.5YR 5/3, 5/4, 5YR 4/4, 5/4 or 10YR 5/3. Moist color is 5YR 3/3, 3/4, 4/3, 4/4, 7.5YR 3/3, 3/4 or 4/3. Texture is very gravelly clay loam, very gravelly clay, very gravelly sandy clay, gravelly clay, extremely gravelly clay loam or very gravelly sandy clay loam. Clay content ranges from 28 to 45 percent. Organic matter ranges from 0.5 to 1 percent. Rock fragments range from 2 to 60 percent gravel and 0 to 10 percent cobbles. Reaction ranges from strongly acid to neutral.

The 3Bt horizon dry color is 10YR 4/3, 5/4, 7.5YR 5/3, 5/4, 5YR 4/3, 4/4, 5/4 or 5/6. Moist color is 10YR 3/3, 3/4, 4/3, 7.5YR 3/4, 4/4, 4/3, 5YR 3/3, 3/4, 4/3 or 4/4. Texture is extremely gravelly sandy clay, extremely gravelly clay, extremely gravelly clay loam, very gravelly sandy clay or very gravelly clay. Clay content ranges from 35 to 55 percent. Organic matter ranges from 0.2 to 0.8 percent. Rock fragments range from 35 to 65 percent gravel, 0 to 45 percent cobbles and 0 to 2 percent stones. Reaction ranges from strongly acid to neutral. Cementation class ranges from noncemented to extremely weakly cemented.

COMPETING SERIES: These are the Cherokeespring, Windynip and Dryfield series. Cherokeespring soils have greater than 50 percent silt throughout.

GEOGRAPHIC SETTING: Wickscorner soils are on Table Mountain alluvial fans. Slopes range from 2 to 10 percent. These soils formed in alluvium weathered from basalt. Elevation is 220 to 660 feet, (67 to 201 m).

Mean annual precipitation is 24 to 30 inches, (610 to 762 mm). The mean annual temperature is 61 to 62 degrees F, (16 to 17 degrees C). Frost free season is 250 to 255 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Cherokeespring, Coalcanyon, Coonhollow and Flagcanyon soils. Cherokeespring soils have greater than 50 percent silt throughout. Coalcanyon soils are formed in colluvium from basalt, are on side slopes on basalt plateaus, are loamy-skeletal and have a mollic epipedon. Coonhollow soils are deep to a paralithic contact, are formed in colluvium from basalt, are on side slopes on basalt plateaus, are loamy-skeletal and have a mollic epipedon. Flagcanyon soils are moderately deep to duripan and are loamy-skeletal.

DRAINAGE AND PERMEABILITY: Moderately well drained; low to medium runoff; moderate saturated hydraulic conductivity in the A horizon, moderate to moderately slow in the Bt horizon and moderately slow to slow in the 2Bt and 3Bt horizons. A fluctuating water table can occur at depths of 20 to 80 inches (51 to 203cm) or more below the surface of the soil from December through April.

USE AND VEGETATION: This soil is used for livestock grazing, wildlife habitat and orchards, mainly olives. Vegetation is wild oat, soft chess, ryegrass, ripgut brome, foxtail, rose clover, fiddleneck, filaree, cowbag clover, lupine, yellow starthistle and bluedicks.

DISTRIBUTION AND EXTENT: Butte County, California and occur as inclusions in the (262Ag) Hardpan Terraces subsection of the (262A) Great Valley section. MLRA 17 - Sacramento Valley. The soils are inextensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California.

SERIES ESTABLISHED: Butte County, California 2005. Source of name from Wicks Corner.

REMARKS:
Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - zone from 0 to 2 inches, (0 to 5 cm) (A)
Argillic horizon - zone from 2 to 59 inches, (5 to 150 cm) (Bt1, Bt2, 2Bt3, 2Bt4)
Particle-size control section for this pedon: 2 to 22 inches, (5 to 56 cm)
The soil moisture control section - zone from 7 to 22 inches, (18 to 56 cm).
Concept of this soil is fine-loamy (over clayey-skeletal)

The Keefers series type location is located approximately 0.87 miles southwest. Wickscorner will replace Keefers and the Keefers type location will need to be moved to Shasta County to preserve the concept.

Dryfield and Windynip series are listed in the SC file as competing series. However, the descriptions are not available on the Official Series Descriptions site.

National Cooperative Soil Survey
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Map Unit 365/370 - Ione Formation

Ione Sediments - Palexerults

Map Unit 362/363/364 - Chico Sandstone

Chico Sandstone
Ultic Haploxeralfs

Map Unit 360/361 - Cherokee Strip

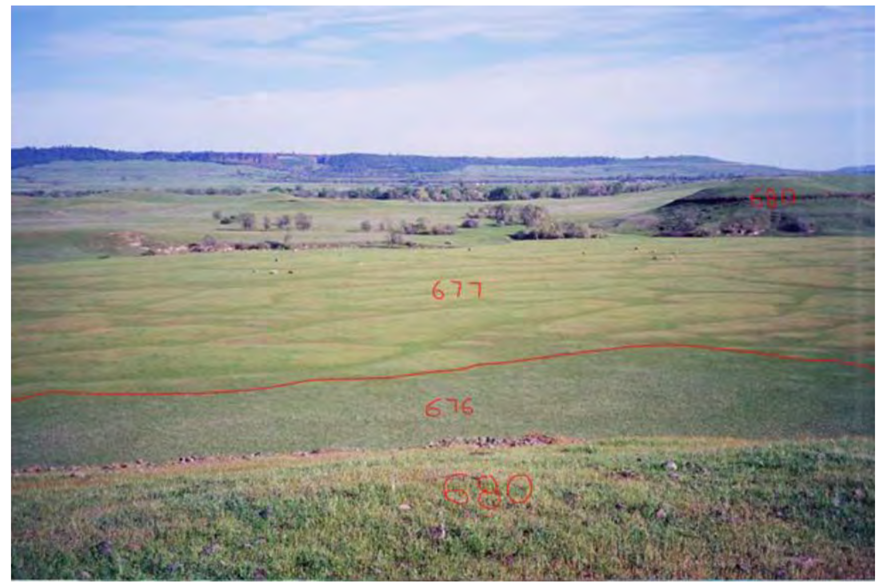
Typic Xerofluvents

MU 360
Lower energy -
downstream reach

MU 361
Higher energy -
upstream reach

Map Unit 677 – Tuscan – Fallager - Anita

Strath Terrace – alluvium over volcanic sandstone



Common 'look' on the landscape

Map Unit 677 – Tuscan – Fallager - Anita

Tuscan

Fallager

Anita, gravelly duripan

Map Unit 677 – Tuscan – Fallager - Anita

LOCATION TUSCAN CA

Established Series
Rev. SBJ/RCH/SBS
04/98

TUSCAN SERIES

The Tuscan series is a member of a fine, smectitic, thermic family Typic Durixeralfs. The soils have dark brown, slightly acid cobbly loam A1 horizons; reddish brown, slightly acid cobbly light clay loam B1 horizons; reddish brown, medium acid cobbly clay B2t horizons and reddish brown indurated cobbly C horizons developed in alluvium from basic rock.

TAXONOMIC CLASS: Clayey, smectitic, thermic, shallow Typic Durixeralfs

TYPICAL PEDON: Tuscan cobbly loam (range-pasture) (Colors for dry conditions unless otherwise noted).

A11--0 to 3 inches; Dark brown (7.5YR 4/3) cobbly loam dark reddish brown (5YR 3/3) moist; nearly massive when dry breaking readily to weak fine granular structure; slightly hard, friable, slightly sticky, slightly plastic; abundant very fine roots; many very fine pores; slightly acid; abrupt wavy boundary. 1 to 3 inches thick.

A12--3 to 7 inches; Reddish brown (5YR 4/3) cobbly loam, dark reddish brown (5YR 3/3) moist; strong very fine subangular blocky structure; slightly hard, friable, slightly sticky, slightly plastic; abundant very fine roots; many very fine pores; slightly acid; clear irregular boundary. 3 to 6 inches thick.

B1t--7 to 10 inches; Reddish brown (5YR 4/4) cobbly light clay loam, dark reddish brown (5YR 3/4) moist; moderate medium to very fine subangular blocky structure; hard, firm, sticky and slightly plastic; thin continuous clay films in pores, colloid mainly in bridges; few very fine roots; many very fine pores; slightly acid; abrupt wavy boundary. 2 to 4 inches thick.

B2t--10 to 17 inches; Reddish brown (5YR 4/4) cobbly clay, dark reddish brown (5YR 3/4) moist; massive; hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; moderately thick continuous clay films on some ped faces, in all pores, and in bridges; medium acid less acid with increasing depth; abrupt wavy boundary. 2 to 8 inches thick.

C1m--17 to 18 inches; Reddish brown (5YR 5/4) indurated cobbly hardpan, dark reddish brown (5YR 3/4) moist with some thin silica coatings on pebbles and cobbles and black manganese stains in seams; massive; extremely hard; (clay films are visible and apparently this horizon had considerable clay accumulation before becoming cemented); abrupt wavy boundary. 1 to 2 inches thick.

C2m--18 inches+; Cemented stratified cobbles and gravels of basic igneous origin.

TYPE LOCA TION: Tehama County, California, in the SW1/4 of the NW1/4 of Sec. 29, T.27N, R.2W, 3 miles east of Dairyville on Foothill Road.

RANGE IN CHARACTERISTICS: Thickness of solum usually is less than 20 inches but ranges from 8 to 24 inches. The A horizons contain < 1 percent organic matter. The A1 horizons range in color from grayish brown (10YR) brown and dark brown (7.5YR) to reddish brown and yellowish red (5YR) in lower part; in texture from gravelly or cobbly loam to cobbly light clay loam; in structure from massive to granular; in reaction from slightly acid to strongly acid. The B2t horizon ranges in color from brown and dark brown (7.5YR) to reddish brown (5YR) and dark reddish brown to dark red (2.5YR); in texture from gravelly or cobbly heavy clay loam to gravelly clay, occasionally very gravelly clay; in structure from massive to strong prismatic or angular blocky; in reaction from medium acid to neutral (pH 6.0-7.0). Most profiles have a B1 horizon; these range from 2 to 7 inches thick.

COMPETING SERIES: These include the Clough, Gloria, Igo, Moda, Palo Cedro, Redding, San Joaquin and Yokohl series. The Clough soils have abrupt AB boundaries and very gravelly, very strongly acid Bt horizons. The Gloria soils are moderately deep or deep to the duripan. The Igo soils lack argillic horizons. The Moda soils have abrupt AB boundaries and are brown or light brown. The Palo Cedro soils are brown, have abrupt AB boundaries and strongly acid Bt horizons. The Redding soils are kaolinitic, have abrupt AB boundaries and medium to strongly acid Bt horizons. The San Joaquin soils have A1 horizons with pale colors (values 4 or more moist) and abrupt AB boundaries. Yokohl soils have abrupt AB boundaries.

GEOGRAPHIC SETTING: The Tuscan soils occur on broad gently sloping old alluvial terraces that are hummocky or gently undulating. The alluvium was derived mostly from basalt, andesite and tuff. The soils occur at elevations of 200 to 1,000 feet in a subhumid climate with mean annual rainfall of 20 to 35 inches, with hot dry summers and cool moist winters. Mean annual temperature is about 60 degrees F., average January temperature about 45 degrees F., and average July temperature about 75 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: The Tuscan soils occur in the same general area as the Anita, Igo, Inks, Keefers, Redding and Supan soils.

DRAINAGE AND PERMEABILITY: Well drained, permeability moderate over slow and very slow, slow to medium runoff.

USE AND VEGETATION: Winter and spring range. Natural vegetation is annual grasses and forbs with a thin layer of moss in open areas.

DISTRIBUTION AND EXTENT: Eastern margin of Sacramento Valley and small scattered areas in central coastal counties, California.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Soil survey of Red Bluff Area, Tehama County, California, 1910.

REMARKS: The Tuscan series was formerly classified in the (maximal) Noncalcic Brown group. The soils have an argillic horizon and a duripan.

OSED scanned by SSQA. Last revised by state on 12/16/65.

National Cooperative Soil Survey
U.S.A.

LOCATION FALLAGER CA

Established Series
IRD: AEC/DWB
01/2006

FALLAGER SERIES

The Fallager series consists of very shallow, poorly drained soils that formed in alluvium from volcanic rocks. Fallager soils are in swales on strath terraces in Cascade foothills and fan terraces in the Sacramento valley. Slopes range from 0 to 3 percent. The mean annual precipitation is about 26 inches, (660 mm) and the mean annual temperature is about 62 degrees F, (17 degrees C).

TAXONOMIC CLASS: Clayey, mixed, superactive, thermic, shallow Typic Durixeralfs

TYPICAL PEDON: Fallager loam, on a south facing 1 percent slope under a cover of goldfields, navarretia, ryegrass, brodiaea, Mediterranean barley, cowbag clover, popcorn flowers and tarweed at an elevation of 237 feet, (72 m). When described on 3/27/01 the soil was dry throughout. (Colors are for dry soil unless otherwise noted).

A--0 to 1 inches, (0 to 3 cm); light reddish brown (5YR 6/3) loam, reddish brown (5YR 4/3) moist; 25 percent clay; moderate fine and medium subangular blocky structure; hard, friable, slightly sticky, slightly plastic; many very fine roots; many very fine and fine tubular pores; 40 percent medium irregular oxidized iron masses along ped faces; 5 percent cobbles and 5 percent gravel; slightly acid, pH 6.5 by Hellige-Truog; abrupt smooth boundary. (0.5 to 2 inches, (1 to 5 cm) thick)

Bt1--1 to 3 inches, (3 to 8 cm); reddish yellow (5YR 6/6) gravelly clay loam, reddish brown (5YR 4/3) moist; 35 percent clay; moderate fine and medium subangular blocky structure; very hard, friable, moderately sticky, moderately plastic; common very fine roots; common very fine tubular pores; 60 percent continuous distinct clay films; 15 percent fine spherical manganese masses throughout; 10 percent cobbles and 15 percent gravel; slightly acid, pH 6.5 by Hellige-Truog; gradual smooth boundary. (0 to 4 inches, (0 to 10 cm) thick)

2Bt2--3 to 7 inches, (8 to 18 cm); reddish brown (5YR 5/3) gravelly clay, reddish brown (5YR 4/3) moist; 43 percent clay; moderate fine and medium subangular blocky structure; very hard, friable, very sticky, very plastic; common very fine roots; common very fine and fine tubular pores; 80 percent continuous distinct clay films; 15 percent fine irregular manganese masses throughout; 10 percent cobbles and 15 percent gravel; neutral, pH 6.7 by Hellige-Truog; abrupt smooth boundary. (2 to 4 inches, (5 to 10 cm) thick)

3Bqm--7 inches, (18 cm); very strongly cemented duripan, cemented by silica; 10 percent medium platy manganese masses at top of horizon; 20 percent cobbles and 60 percent gravel; slightly alkaline, pH 7.5 by Hellige-Truog.

TYPE LOCA TION: Butte County, California, about 1.1 miles east of the intersection of Highway 99 and Highway 149, approximately 1350 feet south and 600 feet west of the northeast corner of Section 6, Township 20 N., Range 3 E., 39 degrees, 37 minutes, 18 seconds North latitude and 121 degrees, 40 minutes, 18 seconds West longitude, NAD83 - U.S.G.S Quad: Shippee, California.

RANGE IN CHARACTERISTICS: Depth to duripan is 4 to 10 inches, (10 to 25 cm) and is underlain by volcanic sediments or volcanic sandstone and tuff. The mean annual soil temperature is 62 to 65 degrees F, (17 to 18 degrees C). The particle-size control section averages 35 to 40 percent clay and 10 to 35 percent rock fragments, mostly gravel. Mineralogy is mixed. A fluctuating water table can occur between the top of the duripan and the surface of the soil from November through March. Redoximorphic features such as oxidized iron and iron-manganese masses occur in the A, Bt and 2Bt horizons and iron-manganese capping 1 to 3 mm thick on top of the 3Bqm. Rock fragments on the surface range from 0 to 10 percent gravel and 0 to 25 percent cobbles.

The A horizon dry color is 7.5YR 5/3, 6/4, 6/6 or 5YR 6/3. Moist color is 7.5YR 4/3, 5/4 or 5YR 4/3. Texture is loam, gravelly loam, cobbly loam, cobbly clay loam or gravelly silty clay loam. Clay content ranges from 20 to 30 percent. Rock fragments range from 5 to 15 percent gravel and 0 to 10 percent cobbles. Reaction is slightly acid.

The Bt horizon dry color is 7.5YR 5/3, 5/4, 6/4, 5YR 4/3, 5/4 or 6/6. Moist color is 5YR 3/3, 4/3, 4/4 or 7.5YR 4/3. Texture is gravelly clay loam, clay loam, cobbly clay loam or silty clay loam. Clay content ranges from 35 to 40 percent. Rock fragments range from 5 to 15 percent gravel and 0 to 10 percent cobbles. Reaction ranges from slightly acid to neutral.

The 2Bt horizon dry color is 7.5YR 5/3, 5/4, 5YR 5/3 or 10YR 5/3. Moist color is 5YR 4/3, 7.5YR 4/3 or 10YR 5/2. Texture is clay, gravelly clay or very gravelly clay. Clay content ranges from 40 to 60 percent. Rock fragments range from 10 to 30 percent gravel and 0 to 15 percent cobbles. Reaction ranges from neutral to moderately alkaline.

COMPETING SERIES: There are no other series in this family.

GEOGRAPHIC SETTING: Fallager soils are in swales on strath terraces in Cascade foothills and fan terraces in the Sacramento Valley. Slopes range from 0 to 3 percent. These soils formed in alluvium from volcanic rocks. Elevation is 100 to 540 feet, (30 to 165 m). Mean annual precipitation is 23 to 35 inches, (584 to 889 mm). The mean annual temperature is 60 to 62 degrees F, (16 to 17 degrees C). Frost free season is 250 to 255 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Tuscan, Redtough and Anita soils. Tuscan and Redtough soils are on mounds and are shallow to a duripan. Anita soils are in clay swales and basins and are shallow and smectitic.

DRAINAGE AND PERMEABILITY: Poorly drained; very high runoff; moderate to moderately slow saturated hydraulic conductivity in the A horizon, moderately slow in the Bt horizon, slow in the 2Bt horizon and impermeable in the 3Bqm horizon. Water frequently ponds up to 1 inch, (2.5 cm) above the surface for brief duration from December through March. A fluctuating water table can occur between the top of the duripan and the surface of the soil from November through April. Surface water flows through inter-connected swales during periods of intense rainfall events.

USE AND VEGETATION: This soil is used for livestock grazing, wildlife habitat and home site development. Vegetation is annual ryegrass, navarretia, soft chess, goldfields and brodiaea.

DISTRIBUTION AND EXTENT: Butte County, California and occur in 262Ab (Northern Eastside Terraces) subsection of the 262A (Great Valley) section. MLRA 17 - Sacramento Valley. The soils are not extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Butte County, California 2005. Source of name from Fallager Creek.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Particle-size control section - zone from 0 to 7 in, (0 to 18 cm)
Ochric epipedon - zone from 0 to 1 in, (0 to 3 cm) (A)
Argillic horizon - zone from 1 to 7 in, (3 to 18 cm) (Bt, 2Bt2)
Duripan - 7 in, (18 cm)
The soil moisture control section - zone at 7 inches, (18 cm) is dry in all parts from about April to October (about 180 days).

LOCATION ANITA CA

Established Series
Rev. SBJ/LCL/DWB
10/2007

ANITA SERIES

The Anita series consists of shallow, poorly drained soils that formed in alluvium. Anita soils are in shallow depressions, basins, and along drainageways on terraces. Slopes range from 0 to 3 percent. The mean annual precipitation is about 23 inches (584 mm) and the mean annual temperature is about 61 degrees F (16 degrees C).

TAXONOMIC CLASS: Clayey, smectitic, thermic, shallow Xeric Duraquerts

TYPICAL PEDON: Anita clay on a percent slope under a cover of annual grasses and forbs at an elevation of 250 feet (76 m) (Colors are for dry soil unless otherwise noted.)

A1--0 to 1 inches (0 to 3 cm); dark gray (5YR 4/1) clay, very dark gray (5YR 3/1) moist; strong medium granular structure; extremely hard, very firm, very sticky, very plastic; many very fine roots; many fine pores; slightly acid (pH 6.5) abrupt wavy boundary. (0 to 2 inches (0 to 5 cm) thick)

A2--1 to 3 inches 3 to 8 cm); dark gray (5YR 4/1) clay, very dark gray (5YR 3/1) moist; strong medium angular blocky structure; extremely hard, very firm, very sticky, very plastic; many fine roots; many fine pores; slightly acid (pH 6.5); abrupt wavy boundary. (2 to 4 inches (5 to 10 cm) thick)

Bss1--3 to 10 inches (8 to 25 cm); dark gray (5YR 4/1) clay, very dark gray (5YR 3/1) moist; weak medium prismatic structure; extremely hard, very firm, very sticky, very plastic; many very fine roots; many fine pores; common slickensides; slightly acid; clear wavy boundary. (6 to 12 inches (15 to 30 cm) thick)

Bss2--10 to 15 inches 25 to 38 cm); dark gray (5YR 4/1) clay, very dark gray (5YR 3/1) moist; massive when moist and strong coarse prismatic structure when dry; extremely hard, very firm, very sticky, very plastic, few very fine roots; few fine pores; common slickensides; neutral. (5 to 12 inches (13 to 30 cm) thick)

Bqkm --15 to 20 inches (38 to 51 cm); stratified brown (10YR 5/3) and very pale brown (10YR 7/4) indurated duripan, weak platy, and interbedded with clay in upper part; weakly calcareous; slightly alkaline (pH 7.8) (1 to 5 inches (3 to 13 cm) thick)

TYPE LOCA TION: Tehama County, California; about 1.5 miles north of the Butte County line, 3.1 miles southeast of Vina; approximately 2640 feet west and 1320 feet north of SE corner Section 29, T. 24 N, R. 1 E, 39 degrees, 54 minutes, 7 seconds north latitude, 122 degrees, 0 minutes, 7 seconds, west longitude, NAD27- USGS quad: Vina, California.

RANGE IN CHARACTERISTICS: Depth to the duripan is 12 to 20 inches (30 to 51 cm). Mean annual soil temperature ranges from 63 to 66 degrees F (17 to 19 degrees C) The soils usually are dry about June 15 and remain dry until September 15. Rock fragments on the surface range from 0 to 25 percent rounded cobbles, 0 to 10 percent rounded gravel, and 0 to 2 percent stones. Cracks 1/4 to 2 inches wide extend from the surface to the duripan from July through October. The surface commonly has hoof prints up to 6 inches (15 cm) or more deep. A fluctuating, perched water table occurs at depths of 0 to 20 inches (0 to 51 cm) or the duripan, from November through mid April and is dependent on storm frequency and duration.

Some pedons are underlain by sandstone or volcanic sediments with a discontinous silica cemented capping.

The A horizon dry color is 10YR 2/1, 2/2, 3/1, 3/2, 4/1, 4/2, 5/2; 7.5YR 2/1, 2/2, 3/1, 3/2, 4/1, 4/2, 5/2, 6/2; 5YR 2/1, 2/2, 3/1, 3/2, 4/1, or 4/2. Moist color is 10YR 2/1, 2/2, 3/1, 3/2, 4/1, 4/2; 7.5YR 2/1, 2/2, 3/1, 3/2, 4/1, 4/2; 5YR 2/1, 2/2, 3/1, 3/2, 4/1, or 4/2. Texture is gravelly silty clay, cobbly silty clay, stony silty clay , silty clay, gravelly clay, cobbly clay, stony clay or clay Clay content ranges from 40 to 60 percent. Redoximorphic features range from 0 to 20 percent manganese concentrations and 0 to 5 percent oxidized iron concentrations. Rock fragments range from 0 to 20 percent gravel and 0 to 20 percent cobbles. Reaction ranges from slightly acid to moderately alkaline.

The Bss horizon dry color is 10YR 2/1, 2/2, 3/1, 3/2, 4/1, 4/2, 5/2; 7.5YR 2/1, 2/2, 3/1, 3/2, 4/1, 4/2, 4/3; 5YR 2/1, 2/2, 3/1, 3/2, 4/1, 4/2 or 5/1. Moist color is 10YR 2/1, 2/2, 3/1, 3/2, 4/1, 4/2; 7.5YR 2/1, 2/2, 3/1, 3/2, 4/1, 4/2; 5YR 2/1, 2/2, 3/1, 3/2, 4/1, or 4/2. Texture is gravelly silty clay, cobbly silty clay, stony silty clay , silty clay, gravelly clay, cobbly clay, very cobbly clay, stony clay or clay. Clay content ranges from 40 to 60 percent. Rock fragments range from 0 to 35 percent gravel and 0 to 25 percent cobbles. Few to common slickensides and/or wedge shaped aggregates. Redoximorphic features range from 0 to 20 percent manganese concentrations and 0 to 5 percent oxidized iron concentrations. Reaction ranges from slightly acid to slightly alkaline.

The 2Bkqm horizon is commonly capped by 1/4 to 3/8 inch thick manganese capping. Rock fragments range from 0 to 80 percent gravel and 0 to 80 percent cobbles.

COMPETING SERIES: There are no competing soils in this series.

GEOGRAPHIC SETTING: The Anita soils occur in shallow depressions, basins, and along narrow stringers along drainageways on older terraces. Slopes range from 0 to 3 percent. They are underlain by indurated duripan which generally rest on sediments derived from tuffaceous rocks. Elevations are about 145 to 1,500 feet (44 to 457 m) and the climate is subhumid mesothermal with mean annual rainfall of 20 to 40 inches (508 to 1016 mm), and with hot dry summers and cool moist winters. Mean annual air temperature is about 60 to 64 degrees F (16 to 18 degrees C), average January temperature is about 40 degrees F (4 degrees C), and average July temperature about 81 degrees F (27 degrees C). The growing season is 200 to 280 days.

GEOGRAPHICALLY ASSOCIATED SOILS: The Anita soils are in the same general areas as the Guenoc soils on basalt bedrock, the Inks soils on tuff, the deep gravelly Keefers soils and the Tuscan soils with argillic horizons and duripans.

DRAINAGE AND PERMEABILITY: Poorly drained, high to very high runoff and slow to very slow permeability. A fluctuating, perched water table occurs at depths of 0 to 20 inches (0 to 51 cm) or the duripan, from November through mid April and is dependent on storm frequency and duration. Water ponds up to 2 inches (5 cm) above the surface for long duration from December through April.

USE AND VEGETATION: Used mostly for dryland range and pasture with a few areas in irrigated pasture. Natural vegetation is annual grasses and forbs mainly, annual ryegrass, softchess, filaree, medusahead, cowbag clover, navaretia, blowives, popcorn flower, jonny-tuck, foxtail brome, brodiea, coyote thistle, spike rush, tidy tips, meadowfoam, goldfields, death camas.

DISTRIBUTION AND EXTENT: Northeastern Sacramento Valley, east of the Sacramento River where it is moderately extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California.

SERIES ESTABLISHED: Chico Area, California, near the town of Anita, 1925. Type location moved to Tehama County in 1959.

REMARKS: The Anita series was formerly classified as a Grumusol. Data added in 1969: moderately well drained, elevation increased to 1500 feet, and hardpan generally rest on sediments derived from tuffaceous rocks. Reclassified from Durochrepts to Typic Durixerepts in 1998.

7/2004- Propose to reclassified to Xeric Duraquerts, change drainage to poorly; change depth from 12 to 30 to 12 to 20 inches; added watertable and ponding data, in the ROC added A horizon dry color 10YR 5/2, 7.5YR 5/2, 6/2, clay content, rock fragments, redox features, Changed A3 and A4 to Bss horizons, to dry colors added 5YR 5/1, 10YR 5/2 and moist color 7.5YR 4/3. added CBV-C, rock fragments and redox features, added surface rock fragments and surface features, added reference to lab data, slickensides and cracks, and added vegetation data.

Soils with a Duripan at a depths greater than 20 inches (51 cm) will now be outside of the range for the series. Used in the following counties; Shasta, Tehama, Butte, Lake, Santa Barbara, and Siskiyou counties. Usage in these counties will require further review.

ADDITIONAL DA TA:
Lab data from 58-52-42, Department of Soils, University of California Berkley 5/18/1960

National Cooperative Soil Survey
U.S.A.

Map Unit 520 - Basin Clay over Duripan

Neerdobe

LOCATION NEERDOBE CA

Established Series
IRD: DWB/DWH/JJJ
10/2006

NEERDOBE SERIES

The Neerdobe series consists of moderately deep, poorly drained soils that formed in alluvium from mixed rocks. Neerdobe soils are in flood basins. Slopes range from 0 to 1 percent. The mean annual precipitation is about 20 inches, (508 mm) and the mean annual temperature is about 62 degrees F, (17 degrees C).

TAXONOMIC CLASS: Fine, smectitic, thermic Xeric Duraquerts

TYPICAL PEDON: Neerdobe clay on a less than 1 percent slope under a cover of rice at an elevation of 98 feet, (30 m). When described on 5/3/1995, the soil was moist throughout. A water table was at a depth of 38 inches, (97 cm). (Colors are for dry soil unless otherwise stated.

Ap--0 to 5 inches, (0 to 13 cm); dark gray (10YR 4/1) clay, dark gray (10YR 4/1) moist; 57 percent clay; moderate medium subangular blocky structure parting to strong fine granular; extremely hard, very firm, moderately sticky and very plastic; few very fine roots and common fine roots; few fine irregular pores; noneffervescent; moderately acid, pH 5.8 by pH meter 1:1 water; abrupt smooth boundary. (3 to 13 inches, (8 to 33 cm) thick)

Bssg1--5 to 15 inches, (13 to 38 cm); dark gray (10YR 4/1) clay, dark gray (10YR 4/1) moist; 55 percent clay; moderate medium prismatic structure parting to moderate fine angular blocky; extremely hard, very firm, moderately sticky and very plastic; few very fine roots; few very fine tubular pores; continuous slickensides; common fine irregular strong brown (7.5YR 4/6), oxidized iron masses and common fine and coarse threadlike gray (10YR 6/1) iron depletions; noneffervescent; slightly alkaline, pH 7.4 by pH meter 1:1 water; clear smooth boundary.

Bssg2--15 to 23 inches, (38 to 58 cm); dark gray (10YR 4/1) clay, dark gray (10YR 4/1) moist; 56 percent clay; moderate medium prismatic structure parting to moderate fine angular blocky; extremely hard, very firm, moderately sticky and very plastic; few very fine roots; few very fine tubular pores; many slickensides; common fine irregular strong brown (7.5YR 4/6) oxidized iron masses and common fine threadlike gray (10YR 6/1) iron depletions; noneffervescent; moderately alkaline, pH 7.9 by pH meter 1:1 water; clear smooth boundary.

Bssg3--23 to 28 inches, (58 to 71 cm); dark grayish brown (10YR 4/2) clay, dark gray (10YR 4/1) moist; 56 percent clay; moderate medium angular blocky structure; extremely hard, very firm, moderately sticky and very plastic; few very fine roots; few very fine tubular pores; common slickensides; common fine and medium spherical carbonate concretions; common fine irregular gray (10YR 6/1) iron depletions, and few fine spherical gray (N 5/0)dry, iron depletions; noneffervescent; moderately alkaline, pH 8.2 by pH meter 1:1 water; abrupt smooth boundary. (Combined thickness of the Bssg horizon is 12 to 25 inches, (30 to 63 cm) thick).

Bk--28 to 33 inches, (71 to 84 cm); light brownish gray (10YR 6/2) clay grayish brown (10YR 5/2) moist; 55 percent clay; moderate fine angular blocky structure parting to strong fine angular blocky; slightly hard, friable, moderately sticky and very plastic; common very fine tubular pores and few fine tubular pores; common fine irregular carbonate concretions and common fine irregular carbonate masses; common fine threadlike gray (10YR 6/1) iron depletions; strongly effervescent; strongly alkaline, pH 8.5 by pH meter 1:1 water; abrupt smooth boundary. (4 to 8 inches, (10 to 20 cm) thick)

2Bkq--33 to 38 inches, (84 to 97 cm); very pale brown (10YR 7/3) loam, brown (10YR 5/3) moist; 22 percent clay; strong fine platy structure; slightly hard, friable, weakly cemented, slightly sticky and slightly plastic; common fine tubular pores and few very fine tubular pores; common fine threadlike gray (10YR 6/1), dry, iron depletions between peds; strongly effervescent; strongly alkaline, pH 8.6 by pH meter 1:1 water; abrupt smooth boundary. (0 to 7 inches, (0 to 18 cm) thick).

2Bkqm--38 to 56 inches, (97 to 142 cm); indurated duripan; very pale brown (10YR 7/3) loam, brown (10YR 4/3) moist; 18 percent clay; strong fine platy structure; indurated, masses of silica; slightly effervescent; strongly alkaline, pH 8.6 by pH meter 1:1 water. Alternating layers of indurated and moderately cemented from 38 to 56 inches (97 to 142 cm.). Silica and lime threads throughout the duripan.

TYPE LOCA TION: Butte County, California; about 3 miles southwest of Nelson, approximately 2200 feet east and 1900 feet north of the southwest corner of Section 7, Township 19 N., Range 2 E., 39 degrees, 30 minutes, 48 seconds North latitude and 121 degrees, 47 minutes, 30 seconds West longitude, NAD27. - U.S.G.S. Quad: Nelson, California.

RANGE IN CHARACTERISTICS: Depth to duripan is 20 to 40 inches, (51 to 102 cm). The mean annual soil temperature is 62 to 66 degrees F, (17 to 19 degrees C). The soil moisture control section is dry from June to October (120 to 125 days). The particle-size control section averages 40 to 60 percent clay. Base saturation by ammonium acetate ranges from 90 to 100 percent throughout. Depth to carbonates ranges from 15 to 38 inches, (38 to 97 cm). SAR ranges from 0 to 2 throughout. Exchangeable sodium ranges from 1 to 4 percent throughout. Electrical conductivity ranges from 0 to 1 mmho/cm throughout. Reversible surface initiated cracks, 1 to 3 inches, (2.54 to 8 cm) wide, extend to a depth of 20 to 36 inches, (51 to 91 cm) from May 15 to October 15 (150 days) when not irrigated. Common to many slickensides are in the Bssg horizon. A fluctuating water table can occur from the top of the duripan to the surface of the soil from December through May. Redoximorphic features such as manganese masses with colors of N 2/0 and oxidized iron masses with colors of 7.5YR 4/4 and matrix chromas of 2 or less occur in horizons above the duripan. Some pedons have few to common manganese nodules. Some pedons have silt loam overwash from 6 to 20 inches, (15 to 51 cm) thick and may have stratified layers of silt loam, very fine sandy loam, loamy very fine sand, sandy loam, fine sandy loam, or loam with 2 to 25 percent clay. Some pedons lack calcium carbonate.

The Ap horizon dry color is 10YR 3/1, 4/1, 4/2 or 5/2. Moist color is 10YR 3/1 4/1 or 3/2. Texture is clay or clay loam. Clay content ranges from 35 to 60 percent. Organic matter ranges from 1 to 2.5 percent. Rock fragments, range from 0 to 2 percent gravel. Reaction ranges from moderately acid to neutral.

The Bssg horizon dry color is 10YR 3/1, 4/1, 4/2 or 5/2. Moist color is 10YR 3/1, 3/2, 4/1 or 4/2. Texture is silty clay or clay. Clay content ranges from 40 to 60 percent. Organic matter ranges from 0.5 to 1 percent. Reaction ranges from slightly alkaline to moderately alkaline.

The Bk horizon dry color is 10YR 4/1, 4/2, 5/1, 5/2 or 5/3. Moist color is 10YR 3/1, 3/2, 3/3, 4/2 or 4/3. Texture is clay or clay loam. Clay content ranges from 35 to 60 percent. Organic matter ranges from 0.1 to 0.5 percent. Effervescence ranges from slight to strong. Reaction ranges from moderately alkaline to strongly alkaline.

The 2Bkq horizon dry color is 10YR 7/3 or 8/3. Moist color is 10YR 4/3 or 5/3. Texture is loam. Clay content ranges from 18 to 27 percent. It is moderately to strongly cemented with silica and lime. Effervescence ranges from moderate to strong.

The 2Bkqm horizon dry color is 10YR 4/3, 5/3, 6/3, 7/3, or 8/3. Moist color is 10YR 3/3, 4/3, 5/3 or 7.5YR 4/4. It is weakly cemented to indurated with silica. Effervescence ranges from slight to violent.

COMPETING SERIES: These are the Jacktone and Ordferry series. Jacktone soils are somewhat poorly drained and have a water table below 5 feet, (152 cm). Ordferry soils have chromic colors.

GEOGRAPHIC SETTING: Neerdobe soils are in flood basins. Slopes range from 0 to 1 percent. These soils formed in alluvium from mixed rocks. Elevation is 55 to 170 feet, (17 to 52 m). The mean annual precipitation is

18 to 25 inches, (457 to 635 mm). The mean annual temperature is 59 to 62 degrees F, (15 to 17 degrees C). Frost free season is 240 to 250 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Blavo, Esquon, Eastbiggs and Lofgren. Blavo soils are moderately deep to a duripan and are very-fine. Esquon soils are deep to a duripan. Eastbiggs soils are moderately deep to a duripan, have an argillic horizon with an abrupt clay increase and are on low terraces. Lofgren soils are deep to a duripan and are very-fine.

DRAINAGE AND PERMEABILITY : Poorly drained; high to very high runoff; slow saturated hydraulic conductivity in the Ap and the Bssg horizons, moderately slow to slow in the Bk horizon, moderate in the 2Bkq horizon and impermeable in the 2Bkqm horizon. A fluctuating water table can occur between the top of the duripan and the surface of the soil from December through May. Water frequently ponds up to 6 inches, (15 cm) above the surface for long duration from December through March.

USE AND VEGETATION: This soil is used for production of rice and wildlife habitat. The natural vegetation is grasses and hydrophytic plants.

DISTRIBUTION AND EXTENT : Butte County, California. MLRA 17 Sacramento Valley. The soils are moderately extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Butte County, California, 2005. Source of name is coined.

REMARKS: Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon 0 to 15 inches, (0 to 38 cm) (Ap, Bssg1).
Cambic horizon 15 to 33 inches, (38 to 84 cm) (Bssg2, Bssg3, Bk).
Duripan 38 to 60 inches, (97 to 152 cm) (2Bkqm).
Lithologic discontinuity 44 to 82 inches, (112 to 208 cm) (2Bkq, 2Bkqm1, 2Bkqm2).
Redoximorphic features 0 to 60 inches, (0 to 152 cm) (Ap, Bssg1, Bssg2, Bssg3, Bk, 2Bkq, 2Bkqm).
Particle-size control section 10 to 38 inches, (25 to 97 cm).
Soil moisture control section 7 to 21 inches, (18 to 53 cm).

This soil was previously mapped as Stockton brown phase in the Soil Survey of the Oroville Area, California 1926 and the Soil Survey of the Chico Area, California 1925.

ADDITIONAL DATA: Characterization data from lab pedon number: 95P0512, NSSL, Lincoln, NE.

National Cooperative Soil Survey
U.S.A.

Hydraulic Mine sediments over basin Clay

Govstanford

LOCATION GOVSTANFORD CA

Established Series
IRD: AEC/DWB/JJJ/SBS
10/2006

GOVSTANFORD SERIES

The Govstanford series consists of very deep, somewhat poorly drained soils that formed in hydraulic mine sediment over basin clays. Govstanford soils are on flood plains and alluvial fans over flood basins. Slopes range from 0 to 1 percent. The mean annual precipitation is about 22 inches, (559 mm) and the mean annual temperature is about 61 degrees F, (16 degrees C).

TAXONOMIC CLASS: Coarse-loamy over clayey, mixed over smectitic, superactive, nonacid, thermic Oxyaquic Xerofluvents

TYPICAL PEDON: Govstanford loam on less than 1 percent slope under a cover of almonds at an elevation of 139 feet, (42 m). When described on 11/22/1993, the soil was moist throughout. (Colors are for dry soil unless otherwise noted)

Ap1--0 to 3 inches, (0 to 8 cm); pale brown (10YR 6/3) loam, dark brown (10YR 3/3) moist; 17 percent clay; moderate medium platy structure parting to moderate medium subangular and moderate fine granular; moderately hard, firm, nonsticky and slightly plastic; many very fine roots; few fine tubular pores; slightly acid, pH 6.5 pH by Hellige-Truog; clear smooth boundary.

Ap2--3 to 11 inches, (8 to 28 cm); pale brown (10YR 6/3) loam, brown (10YR 4/3) moist; 21 percent clay weak fine subangular blocky structure; hard, very firm, slightly sticky and slightly plastic; common very fine, fine and medium and few coarse roots; few fine tubular pores; neutral, pH 6.8 by pH Hellige-Truog; clear wavy boundary. (Combined thickness of the Ap horizon is 3 to 12 inches, (8 to 30 cm) thick).

C1--11 to 18 inches, (28 to 46 cm); light yellowish brown (10YR 6/4) sandy loam, brown (10YR 4/3) moist; 5 percent clay weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; many fine, common very fine and medium and few coarse roots; few fine tubular and common fine interstitial pores; neutral, pH 7.0 pH by Hellige-Truog; clear smooth boundary.

C2--18 to 25 inches, (46 to 64 cm); yellowish brown (10YR 5/4) silt loam, brown (10YR 4/3) moist; 13 percent clay; weak medium subangular blocky structure; hard, very firm, nonsticky and nonplastic; few very fine and fine roots; common irregular tubular and irregular pores; slightly alkaline, pH 7.5 pH by Hellige-Truog; clear smooth boundary.

C3--25 to 34 inches, (64 to 86 cm); yellowish brown (10YR 5/4) silt loam, brown (10YR 4/3) moist; 9 percent clay; weak medium subangular blocky structure; hard, very firm, nonsticky and nonplastic; few very fine, fine and coarse roots; common very fine and fine tubular pores; common fine distinct brown (7.5YR 4/4) moist, thread shaped soft oxidized iron masses and common fine faint dark grayish brown (10YR 4/2) moist, irregularly shaped soft iron depletions; slightly alkaline, pH 7.5 pH by Hellige-Truog; abrupt smooth boundary. (Combined thickness of the C horizon is 10 to 28 inches, (25 to 71 cm) thick)

2Assg--34 to 42 inches, (86 to 107 cm); black (10YR 2/1) clay, black (10YR 2/1) moist; 56 percent clay; moderate fine subangular blocky structure; extremely hard, slightly rigid, very sticky and very plastic; few very fine and medium roots; few fine tubular pores; common intersecting slickensides; slightly alkaline, pH 7.5 pH by Hellige-Truog; clear smooth boundary. (8 to 26 inches, (20 to 66 cm) thick)

2Bssg1--42 to 61 inches, (107 to 155 cm); very dark gray (10YR 3/1) silty clay, very dark brown (10YR 2/2) moist; 56 percent clay; moderate medium subangular blocky structure; extremely hard, slightly rigid, very sticky and very plastic; few very fine and fine roots; few fine tubular pores; many intersecting slickensides; moderately alkaline, pH 8.0 pH by Hellige-Truog; clear smooth boundary.

2Bssg2--61 to 72 inches, (155 to 183 cm); very dark grayish brown (10YR 3/2) silty clay, very dark grayish brown (10YR 3/2) moist; 52 percent clay moderate medium subangular blocky structure; extremely hard, slightly rigid; very sticky and very plastic; few fine tubular pores; common intersecting slickensides; moderately alkaline, pH 8.0 pH by Hellige-Truog. (Combined thickness of the 2Bssg horizon is 7 to 31 inches, (18 to 79 cm) thick).

TYPE LOCA TION: Butte County, California; about 2.3 miles south of Durham, approximately 200 feet north of where the Old Sacramento Northern Railroad crossed Butte Creek and 100 feet west of the old tracks; in an unsectionized area in the Esquon Land Grant; 39 degrees, 37 minutes, 0 seconds North latitude and 121 degrees, 46 minutes, 38 seconds West longitude, NAD27. U.S.G.S. Quad: Nelson, California.

RANGE IN CHARACTERISTICS: Depth to the lithologic discontinuity is 20 to 36 inches, (51 to 91 cm). The mean annual soil temperature is 62 to 66 degrees F, (17 to 19 degrees C). The soil moisture control section is dry from June to October (120 to 150 days). The particle-size control section averages 4 to 17 percent clay in the coarse-loamy material and 40 to 60 percent in the clayey material. Mineralogy is mixed in the coarse-loamy material and smectitic in the clayey material. Organic matter ranges from 1 to 2 percent to a depth of 11 inches, (28 cm). Intersecting slickensides range from common to many in the 2Assg and 2Bssg horizons from 34 to 72 inches, (86 to 183 cm). A fluctuating water table can occur at depths of 20 to 72 inches, (51 to 183 cm) below the surface of the soil from December through April. In some pedons oxidized iron masses, iron-manganese concretions and manganese masses occur in the underlying basin material.

The Ap horizon dry color is 10YR 5/3, 6/2 or 6/3. Moist color is 10YR 3/3, 4/2 or 4/3. Texture is loam, fine sandy loam or sandy loam. Clay content ranges from 15 to 27 percent. Reaction ranges from slightly acid to slightly alkaline.

The upper C horizon dry color is 10YR 6/2, 6/3, 6/4, 7/2 or 7/3. Moist color is 10YR 4/2, 4/3, 4/4, 5/2, 5/3 or 5/4. Texture is sand, loamy sand, sandy loam, fine sandy loam, loam or silt loam. Clay content ranges from 3 to 18 percent. Reaction ranges from neutral to moderately alkaline.

The lower C horizon dry color is 10YR 6/2, 6/3, 6/4, 7/2 or 7/3. Moist color is 10YR 4/2, 4/3, 4/4, 5/2, 5/3 or 5/4. Texture is sand, loamy sand, sandy loam, fine sandy loam, loam, silt loam or silt. Clay content ranges from 5 to 18 percent. Redoximorphic features such as oxidized iron masses (7.5YR 3/4, 4/4 and 4/6) moist, and iron depletions (10YR 4/2) moist, occur in pores and on ped faces in this part of the horizon. Reaction ranges from neutral to moderately alkaline.

The 2Assg horizon dry color is 10YR 2/1, 3/1, 4/1, 5/1 or 4/2. Moist color is 10YR 2/1, 3/1, 4/1 or 3/2. Texture is silty clay or clay. Clay content ranges from 40 to 60 percent. Reaction ranges from neutral to moderately alkaline.

The 2Bssg horizon dry color is 10YR 2/2, 3/2, 4/1, 5/1, 5/2 or 6/2. Moist color is 10YR 3/1, 3/2, 4/1 or 4/2. Texture is silty clay, clay or silty clay loam. Clay content ranges from 35 to 55 percent. Reaction ranges from neutral to moderately alkaline.

COMPETING SERIES: There are no other series in this family.

GEOGRAPHIC SETTING: Govstanford soils are on flood plains and alluvial fans over flood basins. Slopes range from 0 to 1 percent. These soils formed in hydraulic mine sediment (slickens) over basin alluvium. Elevation is 110 to 160 feet, (34 to 49 m). The mean annual precipitation is 20 to 23 inches, (508 to 584 mm). The mean annual temperature is 61 to 62 degrees F, (16 to 17 degrees C). Frost free season is 245 to 250 days.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Esquon, Neerdobe, Edjobe, Busacca and Conejo soils. Esquon soils are deep to a duripan, are fine and are in basins. Neerdobe soils are moderately deep to a duripan, are fine and are in basins. Edjobe soils are fine and are on basin rims. Busacca soils are fine and on distal fans. Conejo soils are fine-loamy and are on distal fans.

DRAINAGE AND PERMEABILITY: Somewhat poorly drained; medium runoff; moderate to moderately rapid saturated hydraulic conductivity in the Ap horizon, moderate to rapid in the C horizon, slow in the 2Assg and 2Bssg1 horizons and moderately slow to slow in the 2Bssg2 horizon. The soils are occasionally flooded for brief periods in December through March inside the levees. A fluctuating water table can occur at depths of 20 to 72 inches, (51 to 183 cm) below the surface of the soil from December through April.

USE AND VEGETATION: This soil is used for orchards, pasture, home site development, row crops and wildlife habitat.

DISTRIBUTION AND EXTENT: Butte County, California. MLRA 17 - Sacramento Valley. The soils are not extensive.

MLRA SOIL SURVEY REGIONAL OFFICE (MO) RESPONSIBLE: Davis, California

SERIES ESTABLISHED: Butte County, California 2005. Source of name is coined.

REMARKS: These soils were previously mapped as Stockton overwash in the Soil Survey of Chico Area, California 1926.

Diagnostic horizons and features recognized in this pedon are:
Ochric epipedon - zone from 0 to 11 inches, (0 to 28 cm) (Ap1, Ap2)
Lithologic discontinuity at 34 inches, (86 cm).

National Cooperative Soil Survey
U.S.A.

Notes:

Notes:

Notes:

Notes:

DAY 3

Saturday, March 3, 2018

SCORECARD
Region 6 SOILS CONTEST
CSU Chico
Chico, CA
March 3, 2018

1. ______	______	
2. ______	______	
3. ______	______	
4. ______	______	
5. ______	______	
Total ______	______	

Contestant I.D. ____________________
Site No. ____________________
Horizons____________________
Describe to a depth of ____________cm
Nail in third horizon at ____________ cm

I. Soil Morphology

Score:

Horizonation				Boundary		Structure		Cons.	Color			Texture					Soil Features			Score
Master																	Redox			
Prefix (2)	LTR (2)	Sub (2)	No (2)	Lower Depth (cm) (2)	Dist (2)	Grade (2)	Shape (2)	Moist Strength (2)	Hue (2)	Value (2)	Chroma (2)	Sand% (± 5) (2)	Clay% (± 5) (2)	%CF (± 5) (2)	CF Mod. (2)	Class (2)	Depl. (2)	Conc. (2)	Efferv (2)	Possible (40)

II. Soil Profile Characteristics

Score:

Hydraulic Conductivity (10)		Loading Rate at 75 cm (5)	Effective Soil Depth (5)	Water Retention Difference (5)	Soil Wetness Class (5)
Surface (5) ______High ______Mod. ______Low	Limiting Layer (5) ______High ______Mod. ______Low	______ gpd/ft^2 (3) Ref. (2) ______	____ V. shallow (< 25 cm) ____ Shallow (25 to 49 cm) ____Mod. Deep (50 to 99 cm) ____ Deep (100 to 150 cm) ____ Very deep (> 150 cm)	____Very low (< 7.5 cm) ____Low (7.5 to < 15 cm) ____Mod. (15 to < 22.5 cm) ____High (≥ 22.5 cm)	____ (< 25 cm) ____ (25 to 49 cm) ____ (50 to 99 cm) ____ (100 to 150 cm) ____ (> 150 cm)

v 1.0

III. Site Characteristics

Score:

Parent Material *(5 each)*	**Landform** *(5)* Constructional	Erosional	Slope *(5)*	Slope Profile *(5)*	Surface Runoff *(5)*	Erosion Pot. *(5)*
____Alluvium	*Choose only one landform*		____ 0 to < 2%	____ Summit	____Ponded	____ Low
____Colluvium	____Floodplain	____Upland headslope	____ 2 to < 6%	____ Shoulder	____Very slow	____ Medium
____Glacial outwash	____Stream terrace	____Upland sideslope	____ 6 to < 12%	____ Backslope	____Slow	____ High
____Human trans. materials	____Kame/esker	____Upland noseslope	____ 12 to < 20%	____ Footslope	____Medium	
____Lacustrine deposit	____Alluvial fan	____Interfluve	____ ≥ 20%	____ Toeslope	____Rapid	
____Pedisediment	____/hillslope		________ % slope	____ None	____Very rapid	
____Residuum	____					

IV. Soil Classification

Score:

Epipedon *(5)*	Subsurface Horizon/ Feature (5 each)	Order *(5)*	Suborder *(5)*	Great Group *(5)*	Family Particle Size Control Section*(5)*	Family Particle Size Class *(5 each)*	
____ Mollic	____ Albic	____ Alfisol	____ Alb	_____ Argi	____ Mineral soil surface to root-limiting layer	____ Sandy-skeletal	____ Coarse-loamy
____ Ochric	____ Argillic	____ Entisol	____ Aqu	_____ Dystr	____ 25 cm to root limiting layer	____ Loamy-skeletal	____ Fine-loamy
____ Umbric	____ Calcic	____ Inceptisol	____ Fluv	_____ Endo	____ 25 to 100 cm	____ Clayey-skeletal	____ Coarse-silty
____ None	____ Cambic	____ Mollisol	____ Orth	_____ Epi	____ Lower boundary of Ap to root limiting layer	____ Sandy	____ Fine-silty
	____ Densic		____ Psamm	_____ Eutr	____ Lower boundary of Ap to 100 cm	____ Loamy	____ Fine
	____ Glossic		____ Other	_____ Fluv	____ All of the argillic	____ Clayey	____ Very-fine
	____ Lithic			_____ Hapl	____ Upper 50 cm of argillic		
	____ Paralithic			_____ Pale	____ Upper boundary of argillic to root limiting layer		
	____ None			_____ Psamm	____ Upper boundary of argillic to 100 cm		
				_____Quartzi	____ Other		
				_____Other			

Note: For strongly contrasting classes, indicate the upper class with a "1" and the lower class with a "2". For example: coarse loamy over clayey-skeletal should have a "1" marked next to coarse-loamy, and a 2 marked next to clayey-skeletal.

V. Interpretations

Score:

Houses With Basements *(3)*	Septic Tank Absorption Fields *(3)*	Local Roads and Streets *(3)*	Hydric *(3)*
_______ Slight	_______ Slight	_______ Good	________ Yes
_______ Moderate	_______ Moderate	_______ Fair	________ No
_______ Severe	_______ Severe	_______ Poor	
Reason # (3): ______________	Reason # (3): ________________	Reason # (3): __________________	Indicator (3) __________________

v 1.0

PSSAC

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CSU CHICO SOIL

USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service