

## LRDP WORKING GROUP SUMMARY REPORT

### AGRICULTURAL OPERATIONS

#### **Working Group Charter:**

*The Agricultural Operations working group is tasked with developing a greater understanding of the nature of land-based research in the coming years, and how that research will influence land planning use and future physical planning at UC Riverside. The group will be encouraged to imagine how developing technologies and changes in research methodologies may influence how the campus conducts land-based research, and what implications that will have with respect to acreage, energy/water consumption, sustainability etc. It is important that the LRDP is able to characterize land-based research that is supportive of the campus' academic and research mission. This group will also need to carefully review the current assumptions about future development of the West Campus vs Agricultural Operations specific needs for the existing (and possible expanded) land.*

#### **VISION & IMPLEMENTATION**

*In 2035, what does UCR look like from the perspective of Agricultural Operations?*

##### **I. Vision Statement 1**

- **Mission:** The land and the resources that are part of the Citrus Research Center – Agricultural Experiment Station (CRC-AES), also referred to as Agricultural Operations, have been and continue to be vital to meeting the mission of the University of California Agricultural Experiment Station (AES) and as a land grant university at UC Riverside since 1907. As one of three AES campuses in the UC Division of Agriculture and Natural Resources (UC ANR) the mission of the AES at UCR is to “discover and disseminate research-based knowledge to ensure an abundant and nutritious food supply, protection of natural resources, healthy people and communities, and economic and ecological sustainability for the future of California, the nation, and the world”. The UC ANR vision is “to address the challenges to the state to ensure a high quality of life, a healthy environment, and economic success for future generations.”.
- To accomplish this mission, access to the highest quality resources is crucial. Over the last century, those resources have included wet and dry laboratories, containment/quarantine facilities, instrumentation facilities, and vivaria. These facilities are present at all R1 research universities. What sets UC Riverside apart and is a major factor in the national and international impact of UCR AES research throughout its history is the availability of the living laboratory that is the land of CRC-AES. That space is as vital to the research, teaching, and outreach missions of the College as bench space in the most modern laboratories on the campus. Consequently, the limited resources available at CRC-AES must be conserved wisely and with a careful consideration of future needs.

##### **II. Vision Statement 2**

The land currently associated with the West Campus and CRC-AES will increase in value as a resource to meet the educational mission of the campus. Classroom, laboratory, and hands on experience with agricultural production and living laboratories have grown substantially in the last decade. As the campus continues to increase in size, there will be expanded opportunities to use the field resources for teaching by faculty to undergraduate students in all of the campus Colleges and Schools. In addition, expanded enrollment of graduate students will expand the need for field research sites as part of their graduate training.

### **III. Vision Statement 3**

The West Campus is a major gateway for the public to the campus community. In the last decade, the Agricultural Operation resources have become a vital part of campus outreach activities. Field days and workshops are regularly held on-site. The Citrus Variety Collection attracts guests from around the globe. New campus centers (e.g., CIBER) have established new facilities that will be integral to the outreach activities of their organizations within the planning horizon projected by the Long-Range Development Plan and the emerging Campus Strategic Plan.

In 2035 the UCR CRC-AES “Living Laboratory”, will be a state-of-the-art field research facility, supporting basic, translational and applied research aimed at increased crop production efficiency, enhanced food security, and a sustainable healthy environment.

There is a critical and growing need for research land to support existing and future faculty programs:

Current faculty research programs, especially those for which basic discoveries require translational research to adopt and validate new technologies. Field tests will be needed for genetically engineered and gene edited crops for disease resistance and crops adapted for climate change. Future faculty programs are being initiated with current faculty hires, and new ones will be developed to address critical issues in food production, crop protection and environmental quality. Recent examples of new program developments include the Centre for Integrative Bee Research (CIBER), a new 2.8 acre screened structure to further protect one of the world’s largest and most diverse living citrus germplasm collections against the current threat of Huanglongbing (HLB), also known as Citrus Greening Disease, and microbiomes research, all of which utilize CRC-AES facilities, attract millions of dollars of research funding from industry, state and federal sources, and which are projected to expand.

CRC-AES’s living laboratory is now fully mapped with geographic information system (GIS) which is a framework for gathering, managing and analyzing spatial location data. This system allows researchers to incorporate their data to reveal deeper geospatial insights into their field data and extend this knowledge to the industry through field days.

The CRC-AES living laboratory research facilities are a major incentive in attracting the best faculty to join UCR, especially with proximity to the campus core. They provide a unique research resource, extensive Avocado, Citrus, Asparagus, Cowpea and Turfgrass germplasm collections. Results from 2019 polling of faculty on their research needs supported the idea that CRC-AES field research facilities adjacent to the campus core featured strongly in new faculty decisions to join UCR.

The living laboratory also provides unique instruction and learning resources for undergraduate and graduate student to conduct and experience new exploration through class participation, and for K-12

engagement (show and tell) for future students. The R'Garden (student and community garden) provides further extension of the UCR student experience and is a resource for the campus R'Pantry (provides for UCR's 66% students who food insecure). CRC-AES land and facilities also provide an excellent outreach and extension resource through annual field days (e.g., UCR Citrus Day for Industry, Turf day, avocado field days) and special group visits, engaging stakeholders, cooperating companies, the local community and the community at large. In addition, CRC-AES' prominent location on the West Campus provides a 'shop window' opportunity to highlight the campus as a community and environment friendly enterprise within the City of Riverside. Currently this is a missed opportunity. The "Aspirational Examples" section below provides examples of ways campuses connect to the public and underscores the need for new gateway to this living laboratory with an updated headquarters for CRC-AES and Research Extension Facility for campus and community.

### KEY PLANNING ASSUMPTIONS

*What are the Working Group's thoughts regarding the key planning assumptions related to its area of focus?*

KPA	WORKING GROUP'S RESPONSE
<b><i>West Campus North of MLK</i></b>	
Academic and Campus Support Land Uses	<p>The working group believes....</p> <p><b>Current land use and projected CRC-AES land use in the future:</b></p> <p>Current CRC-AES land facilities at Riverside are ~450 acres. The bulk of this research land is located in two adjacent major blocks on West campus, South of Martin Luther King Blvd. (MLK) (293 acres) and North of MLK, East of Iowa (62 acres), North of MLK West of Iowa (88 acres). Other CRC-AES research land areas are located on East Campus, and include the Biological Control fields (11 acres) located between Lot 13, Botanical Gardens and Chancellor's Residence and the olive, almond, macadamia, avocado and guava collections (4 acres). (Appendix, Map A)</p> <p>The best practice (and SOP) for managing CRC-AES field research land to be 'research-ready' for experimentation use requires that at any one time, about 15% of CRC-AES research land is in a 'down-time' mode during which alternative rotation cropping, tillage practices, weed management and eradication treatments, irrigation supply and drainage adjustments are made, typically taking from 1 to 3 years depending on details of previous research use and planned research use. Due to heavy demand and recent land loss to non-agricultural uses, CRC-AES currently has only 8% of land in the pre-research preparation mode. (Appendix, Map B)</p> <p>UCR CRC-AES also has a field research facility in the Coachella Valley, in Thermal ~90 miles east of campus (the Coachella Valley Agricultural Research Station or CVARS). CVARS provides a unique desert research environment, different from the UCR research land. CVARS features one of the world's largest date palm collections as well as citrus, vegetable crops and grapes.</p>

<p>Polling in early 2019 for future land use projections of CNAS departments, which have a strong current user base of CRC-AES research land, indicated an anticipated growth trajectory of both current and future faculty programs. (A total of 48 faculty programs across 5 CNAS departments responded with planned use; this did not include future faculty hires, nor faculty from BCOE or other non-CNAS programs, nor the R'Garden program).</p> <p>A reasonable projection for field research growth and was determined to be about a 44% increase in CRC-AES land use by 2035. This does not match the projected 52% growth of the student body and faculty programs needed to accommodate that growth under the “35-by-35” UCR Vision (from 23,000 in 2019 to 35,000 in 2035). For CRC-AES, and with the premise that all available CRC-AES land on the West and East campus remains field research-dedicated, this would translate approximately to requiring an additional minimum of 200 acres of research-use land (44% of 450 acres). This in part would help offset the 70 acres of field research land already lost to Parking Lot 30, International Student Village, Solar farm, Hammer Throw for athletics, and CARB. The Agricultural Operations (CRC-AES) LRD Working Group noted that in the two previous campus LRDPs (1990-2015), there was no follow-through on the stated intent that any loss to field research use of CRC-AES land would be replaced with acquisition of new (replacement) research land. With the exception of the Hammer Throw arena, all recent losses of field research land to non-ag research uses are located on the north side of MLK.</p>	<p><b>Considerations for new research land acquisition.</b></p> <p><b>Ideal Option (1):</b> acquisition of research land adjacent to current CRC-AES land. Primary questions include: What adjacent land is potentially available? Can former lost land (e.g., Lot 30) be reclaimed for field research? Although minimally useful, can City land on CRC-AES south of MLK be acquired for field research? Are funds available to further enhance the living laboratory to mitigate recent loss of existing lands?</p> <p><b>Secondary option (2):</b> acquisition of research land not adjacent to CRC-AES facilities. Beyond the actual purchase of a consolidated block of land of adequate size, reasonable proximity, and quality, a primary challenge for new UCR research land acquisition without contiguity with existing CRC-AES land and facilities is a very costly and inefficient requirement to duplicate core field research infrastructure. Primary among an extensive list of such needs would be irrigation infrastructure, land preparation equipment/rolling stock (tractors, service vehicles, land and crop management implements), security needs including gated fencing, pesticide storage and waste removal facilities, and support buildings. New land would require compatibility with the surrounding environment relative to pesticide use regulations (distance from K-12 schools, preschools, nursing homes), such as adequate buffer zoning between research land and schools, hospitals and other mandated facilities.</p> <p><b>Role of the R'Garden in undergraduate education and outreach:</b></p> <p>The R'Garden serves as living laboratory for student learning and growth while simultaneously connecting the University of California, Riverside with community</p>
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	<p>members to engage in environmental education, sustainable practices, and community-based participatory research around food systems through student-led projects and collaborations. Members of the university and the city of Riverside have the opportunity to participate in community-based and ecologically sound programs, research solutions, and develop interdisciplinary courses that will enhance the students' experience at the University of California, Riverside.</p> <p>The R'Garden was established on December 1, 2012 at its new location adjacent to Parking Lot 30. However, it was not the first established garden at UC Riverside. The first garden was situated near Parking Lot 32 sometime before the 1970s through 2004. It was an 8-acre garden exclusively for UC Riverside faculty and staff. The second garden was a two-year pilot program from 2009-2011 and got its start with the formation and advocacy of student groups Sustainable UCR and Cultivate R'Space. It was located between the Transportation and Parking Services Office on Linden Street and intramural soccer fields east of Pentland Way.</p> <p>UCR CRC-AES and the R'Garden offer invaluable opportunities for the undergraduates and graduate students to engage in translational research, apply what they learn in their classrooms and labs into land-based research. The R'Garden, aware of its situational implications has continued the land-grant mission to grow food for the community, free of charge, for five years and has recently secured the opportunity to grow high-quality food for UCR Dining and Hospitality Services. Additionally, R'Garden is the sustainability hub. The UCOP funded demonstration Solar Greenhouse, completely off-grid, is located in the R'Garden. Engineering students CAPSTONE projects: solar water heater, solar food dehydrator are co-located in R'Garden.</p>
Land Use overlay for solar farm	
<b><i>West Campus South of MLK</i></b>	
Land South of MLK dedicated to land based research	<p><b>Current land use and projected land for the future, including protected citrus culture, citrus variety collection, turf research, and citrus germplasm facility</b></p> <p><b>Teaching, Outreach and Building Community Relations</b></p> <p><b>Projection for the Future</b></p> <p>In 2035, the UCR CRC-AES (Ag Ops) "Living Laboratory" will continue its long history of field-based integration of teaching through experiential based learning, community outreach to the agricultural community through field days and opportunities for growers to tour research field sites. R'Garden will continue to engage students and the community in sustainable food production practices, and community-based participatory research around food systems.</p> <p>List of Selected Teaching Activities on Land South of MLK</p>

<ul style="list-style-type: none"> <li>• Annually, Ag Ops hosts up to 10 undergraduate interns, generally 30% are research focused interns.</li> <li>• Science Ambassadors orientation</li> <li>• Student tour guide orientation</li> <li>• Faculty-lead educational outreach opportunities for UCR Plant Biology undergraduate classes (BPSC 011, BPSC 021 and BPSC 050).</li> <li>• Faculty-lead educational outreach for graduate student recruitment days.</li> <li>• Educational outreach tours for UCR Microbiology and Plant Pathology as well as Botany and Plant Sciences seminars.</li> <li>• Annually, sections of PLPA 240, field plant pathology are taught in the field at UCR and CVARS.</li> <li>• Annually, teach Riverside City College students about agricultural research.</li> <li>• Host international interns from France and Tunisia in 2018.</li> <li>• Teaching and outreach to high school groups (90 people every 2 years), International students from Mexico (45 students) annually, multinational research groups.</li> </ul>	<p><b>List of Selected Outreach Activities on Land South of MLK</b></p> <p>Annual events and ongoing collaborations:</p> <ul style="list-style-type: none"> <li>• Collaborative Agreement between UCR and Givaudan Flavours since 2006 dedicates 8 days each year of the Curator and Givaudan Citrus Variety Collection Endowed Chair to outreach associated with citrus treks in the UCR Citrus Variety Collection field collection.</li> <li>• USDA National Clonal Germplasm Repository for Citrus and Dates conducts collaborative research and extension activities with multiple UCR faculty and is situated within CRC-AES.</li> <li>• UC Cooperative Extension Master Gardeners from Riverside and San Diego Counties tour the CVC annually to learn about citrus diversity two to three times per year.</li> <li>• Turf research annual field day since 2010.</li> <li>• Annual UCR Citrus Day for the Citrus Industry since 2012.</li> <li>• Periodic UCR Citrus Days for the public since 2013.</li> <li>• Tours for State and Federal Legislators and their Staff of CRC-AES.</li> <li>• Provide fresh vegetables on contract to UCR Dining Services.</li> <li>• Citrus from the CVC are provided for a lab project for CHEM 125 that was originally designed by Cynthia Larive and Tracy Kahn many years ago.</li> <li>• Citrus provided for chemistry classes at Riverside City College.</li> </ul> <p>Recent one-time tours/events</p> <ul style="list-style-type: none"> <li>• One of the Givaudan “treks” this year was associated with making a virtual reality trek movie over two full days and two partial days. This film may in the future include scents inspired from the fruits included in the virtual trek.</li> <li>• Tours of the Citrus Variety Collection and presentations for various other groups such as the Core Planning Workshop from the American Public Garden</li> </ul>
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	<p>Association, UCR Chancellor's Associates Citrus Mixology Event, and CNAS Emeriti Faculty were provided.</p> <ul style="list-style-type: none"> <li>• CNAS, the Citrus Variety Collection and Governmental and Community Relations hosted a visit and lunch with CNAS faculty for the California Agricultural Leadership Program DC Exchange program on Nov. 6, 2018. The CALP DC exchange program brings together government representatives from U.S. congressional staff to federal agency employees for an in-depth learning experience about California agriculture.</li> <li>• At the request of the Chancellor, in 2016, the Citrus Variety Collection and UCR Dining Services collaborated developing UCR Citrus Products. The products that include citrus are available the Market at Glen Mor and Scotty's Convenience Store at the Hub. Additionally, CVC citrus is featured in a UCR beer for Wicks Brewing Company.</li> <li>• CRC-AES, Citrus Variety Collection and USDA National Clonal Germplasm Repository for Citrus and Dates provided a mid IOCVC and IRCHLB-conference tour of the Citrus Variety Collection and CRC-AES.</li> <li>• Annually, CRC-AES hosts international delegations as outreach as well as opportunity for future collaborations: Vietnam (alternate years), Fujairah, Argentina, Mexico and professional societies.</li> <li>• Hosting groups with the specific objective to form collaborations on date research: Egypt, Iran, Iraq, Saudi Arabia, Israel, Ministry of Ag - United Arab Emirates, Eurosemillas - Cordova, Spain, Ministry of Ag – China,</li> <li>• A C-SPAN story was published in Oct. 2018 about the Citrus Variety Collection as part of their Cities Tour: <a href="https://www.c-span.org/video/?454819-1/citrus-variety-collection">https://www.c-span.org/video/?454819-1/citrus-variety-collection</a>.</li> </ul>
Future of the pesticide pits	<p>University of California Riverside's Pesticide Pits encompassed 3.25 acres on the West side of campus. For decades, research was conducted, hazardous waste was discarded into this area (including pesticides, chemical containers, and equipment). In the year 1988, investigation and remediation activities began. By 2017 the site was cleaned up so that remaining soil, including the backfilled soil, was deemed health protective for current and future users and would not adversely affect groundwater quality. No groundwater impacts were discovered. <b>After over 18 years of monitoring, it was discovered that no impact to groundwater is indicated.</b></p> <p><b>Deed Restriction</b></p> <p>The Department of Toxic Substances Control (DTSC) required a deed restriction "covenant" be placed on the site to restrict its use for certain types of land uses.</p> <p><b>Unacceptable use</b></p> <p>The covenant prohibits the site from being used for the following purposes:</p> <ol style="list-style-type: none"> <li>1. Residential</li> <li>2. Hospitals (for humans)</li> <li>3. Classrooms (for persons under 18 years of age)</li> <li>4. Daycare centers for children</li> </ol> <p><b>Acceptable use</b></p>

	<p>The following are examples of land-use that are appropriate:</p> <ul style="list-style-type: none"> <li>▪ Crop production ONLY IF destroyed (not consumed)</li> <li>▪ Turf grass research</li> <li>▪ Buildings</li> <li>▪ Storage for equipment</li> <li>▪ Greenhouse</li> </ul> <p>The deed restriction can be revised but is unlikely to be rescinded. It is not certain that pursuit of a variance is required or necessary at this time.</p> <p><b>No further action letter</b></p> <p>The University is seeking the “No further action” letter from DTSC. This comes with actions that the University must take in the form of certifications and filing of notices. Additionally, the letter will come with conditions (e.g., abandonment of monitoring wells and piezometers, and adherence to the Soil Erosion Control Plan).</p> <p>The cost of DTSC oversight is \$7,000 - \$8,000 annually to review reports and conduct their site visit. In addition, there are tangible costs of personnel to support DTSC activities (e.g., EH&amp;S, CRC-AES, Legal).</p> <p><b>The Citrus Research Center-Agricultural Experiment Station</b></p> <p>CRC-AES has been working to prevent erosion and maintain the site, according to the Soil Erosion Control Plan. Because of their actions, the University was able to approach DTSC and propose elimination of their oversight. They are critical to future land-use in their inquiries to the regulatory agency. Activities undertaken in the Pits site had a special fund set aside to perform work. At this point, CRC-AES had not yet sent in their requests for reimbursement of costs owed them.</p> <p><b>Soil quality</b></p> <p>Currently, CRC-AES has heightened concern over importing soil whose source is unknown. When soil is brought in from external locations there is little control over its condition. One solution is to bring in soil (moved) from another part of CRC-AES. This results in resources to collect, transport, and maintain.</p> <p><b>Risk reduction</b></p> <p>The deed restriction “covenant” can be revised, but is unlikely to be rescinded. The site’s, residual risks would have to be reduced to change the prohibitions upon the land. The following steps can be taken to reduce risks:</p> <ol style="list-style-type: none"> <li>1. <b>Soil removal / replacement</b> The removal and replacement of soil to some degree, at whatever depth, is needed to result in no residual risk.</li> <li>2. <b>Groundwater wells and piezometer removal</b> There are currently eight wells. Three of these wells are located on the field. It is estimated that a cost of \$45,000 is needed to destroy the wells. It is a secured facility, yet there remains the risk of people contaminating the wells (e.g., trucks can drive into the well and spill chemicals into them). The “No further action” letter is likely to require that all eight wells be removed.</li> </ol>
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	<p>3. <b>Soil sampling</b>        Collect and analyze quality of the soil</p> <p>4. <b>Risk Assessment</b>        Conduct a risk assessment on the soil</p> <p>5. <b>Proposal of no residual risk</b>        We must demonstrate that the University conducted risk assessment, and further remediation on site</p> <p>There is no guarantee that DTSC would release the covenant based on this risk reduction plan. The purpose of the covenant being recorded in perpetuity is that owners would have to notify DTSC in the event that land-use has changed.</p>
<b><i>Carbon Neutrality</i></b>	
Climate neutral by 2025	<p>There are three critical ways that the land-based research at CRC-AES impacts the carbon neutrality of the UC Riverside campus. First, a very large proportion of the past and, projected, future research is on trees used in sub-tropical agricultural systems. These trees capture a significant amount of atmospheric carbon during photosynthesis (published estimates range from 48 to 78 lb CO<sub>2</sub> per tree per year) and the carbon is sequestered in tree biomass and in fruit production. This carbon sequestration offsets CO<sub>2</sub> emissions produced elsewhere on campus. Second, by having the land resource on campus, the amount of energy used and CO<sub>2</sub> emissions are both greatly reduced compared to what would be used/produced if the land resource were remote from campus. That is, the emissions and energy used by researchers to travel to their field sites is minimal compared to what would be used/ produced if they were required to drive to an off-site location to conduct their research. Third, the recent increase in the amount of food produced on CRC-AES land for consumption on campus through Dining Services eliminates the CO<sub>2</sub> and associated energy costs that are associated with long-distance transport of food produced in more remote locations and subsequently brought to campus. CRC-AES also has been the repository for green waste from the rest of the campus for many years. This important role also contributes to carbon neutrality and reduces costs by not requiring the campus to ship this green waste off campus.</p>
<b><i>Utilities and Infrastructure</i></b>	
Legacy Ag Ops irrigation infrastructure	<p>UC Citrus Experiment Station was put into operation in 1917 at the current location. Irrigation water was supplied to the site via the Gage Canal from wells in Highgrove, near San Bernardino. The water source and quality (very high quality) has been consistent for the past 100 years. The infrastructure for irrigation was built based on gravity flow system with full capture of tailwater. Water is supplied to each of the parcels using headstands and tailwater is collected in a salvage reservoir and then pumped up to the dirt reservoir and then blended into the main reservoir. It is estimated that around 1930, an upper reservoir where water from the Gage canal is pumped to, thus enabling pressurized water to be delivered. Currently about 50% of</p>

	the fields have pressurized water. Expanding pressurized water is dependent upon the capacity of the upper reservoir and demand for irrigation.
<b><i>Any Additional KPA Categories Not Identified in Work Plan, But of Interest to Working Group</i></b>	
Any additional KPA the WG would like to respond to	<p>Since the last LRD process was completed, approximately 67 acres of land north of MLK has been taken out of land-based research and irreversibly converted to alternate uses (e.g., parking lots, solar farm, International Village, and California Air Resource Board). This has severely impacted the availability of land for research and teaching projects. In addition to the direct conversion of land to uses other than land-based research, those alternate uses have secondary impacts on the use of adjacent lands maintained in the land-based research inventory. Legal restrictions that restrict pesticide use in proximity of certain activities, dust created by cultivation, and other normal agricultural practices may result in inability to use adjacent lands for research. As noted elsewhere in this report, the amount of land held in reserve for assignment has dropped well below the buffering threshold. Additionally, with UCR Administration's mandate for the past 20 years to reduce field research activities north of MLK, land south of MLK is completely occupied by active research. Land on the north side of MLK is being used at an increasing rate to accommodate research needs. Large sections are reserved for future citrus research for newly hired breeders, as well as other sections reserved for turf grass breeding program, urban-ag water use studies, plant-insect ecological interaction studies. In addition, with projected faculty growth, there will be a demand for an additional 200 A of land with class 1 soil to accommodate the needs of those faculty. Consequently, combining what has been taken out of the research land base and what will be needed in the future based on faculty growth, it is reasonable to project that there will be a need for between 250 acres and 350 acres of new land. If further land is removed from the land-base, then that need increases at least proportionately.</p> <p>In order to take advantage of proximity, equipment, experimental design, storage, administration, security, and travel, it is critical that expansion/replacement acreage be in a contiguous block. An examination of comparable prices of bare land sold in the area (n = 35) suggests that a reasonable average price is <b>\$9180/ acre</b>. Using that average price, the land cost for a suitable block of land ranging from 250-359 acres would range from <b>\$2,295,000 – \$3,213,000</b>. Costs for construction of buildings (mechanics shop, equipment storage, pesticide storage, office, housing for a staff member) as well as electrical and potable water are undetermined costs. Other infrastructure (including well, reservoir, irrigation infrastructure, fencing, electronically controlled gates, security, utilities, equipment, etc.) can be estimated at an additional <b>\$2,700,000</b>. Additional personnel would be needed to staff the remote site and that would entail on-going annual costs of <b>\$640,000</b>. Finally, the cost to investigators would also increase because of the increased travel time and vehicle expense required to access the more remote location. It is difficult to estimate the increased costs because the distance is unknown, but between personnel time, number of individuals</p>

<p>involved, and the vehicle expense, it is reasonable to imagine that the costs could exceed \$100/ trip.</p> <p>Additional Opportunities for adding to land base for Land-based research:</p>	<ol style="list-style-type: none"> <li>1. Campus should work on recovering the donut-hole on land south of MLK. This parcel of land is owned by the City of Riverside and is embedded within the CRC-AES foot-print. Title of the parcel should be obtained by the campus and the land incorporated into research and teaching functions.</li> <li>2. There may be better options for siting the worker housing that is currently located adjacent to the CRC-AES headquarters on MLK. The houses appear to be in need of significant renovation and the site may have higher use than as residences. The land may be repurposed for research and teaching (e.g., greenhouses).</li> <li>3. The USDA Forest Service Fire Laboratory is located adjacent to the southern boundary of CRC-AES along Canyon Crest Blvd. There may be opportunities to consider for utilizing/leveraging this land for land research or for building/greenhouse space.</li> <li>4. USDA Salinity Laboratory is located on land leased from UC Riverside. Are there opportunities to partner with USDA for greenhouses, land, and buildings that could enhance the land-based research functions and extend beyond the current lease?</li> <li>5. The Chancellor's house abuts land currently utilized as part of CRC-AES along Watkins Ave. Is it useful to consider the possibility of relocating R'Gardens from the current high-value research site contiguous to the main CRC-AES West Campus to a location near the house or on to adjacent land?</li> <li>6. Similarly, there are there are abandoned properties near campus on Frost Court. Is it possible to relocate R'Gardens to that site or on/near the Botanic Gardens?</li> </ol>
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## OTHER CONSIDERATIONS

I. **Any items/issues/assumptions that – from your working group's perspective – fundamentally affect land use, space, and/or development not identified in the KPA handout that should be considered in this LRDP**

### **Impact of Land-Based Research Conducted at Agricultural Operations: White Paper Prepared 1/2018.**

**History:** The UC Citrus Experiment Station was located in Riverside in 1907. However, the scope of the newly-founded Experiment Station quickly outgrew the original site near Mt. Rubidoux and the facility was moved to a site of nearly 1000 acres at the base of the Box Springs Mountains in 1917. Those research faculty associated with Experiment Station were members of the founding Departments of what became the College of Natural and Agricultural Sciences. The land resource of the Citrus Experiment Station, including what is now referred to as Agricultural Operations (aka Ag Ops), was incorporated into a new UC institution that started to accept undergraduate students in 1954. UC

Riverside was recognized as a general campus in 1959. The Agricultural Experiment Station Departments trace their Riverside academic roots back more than a century and continue to function as cornerstones of the research and teaching mission of the campus

**Mission:** The land and the resources that are part of Agricultural Operations have been and continue to be vital to meeting the mission of the Agricultural Experiment Station at UC Riverside. That mission is listed on the College of Natural and Agricultural Sciences web site as:

“The mission of the Agricultural Experiment Station (AES) at the University of California, Riverside is to discover and disseminate research-based knowledge to ensure an abundant and nutritious food supply, protection of natural resources, healthy people and communities, and economic and ecological sustainability for the future of California, the nation, and the world. The AES at UCR is part of the broader University of California Division of Agriculture and Natural Resources (UC ANR), whose vision is to address the challenges to the state to ensure a high quality of life, a healthy environment, and economic success for future generations.”

To accomplish the mission, it is necessary to have access to the highest quality resources. Over the last century, those resources have included wet and dry laboratories, containment/quarantine facilities, instrumentation facilities, and vivaria. These facilities are commonly found in any R1 research university. What sets UC Riverside apart and has been a major factor in the impact that the research has had nationally and internationally, is the availability of the living laboratory that is the land of Agricultural Operations. That space is as vital to the research, teaching, and outreach missions of the College as bench space in the most modern laboratories on the campus. Consequently, the limited resources available at Agricultural Operations must be conserved wisely and with a careful consideration of future needs.

**Societal impact:** The land at Agricultural Operations is used across a range of time scales based on the nature of the research. Some of the land is devoted to maintaining the genetic and genomic resources of long-lived trees. This is particularly obvious in the UCR Citrus Variety Collection and in the citrus scion and rootstock breeding programs. Similarly, UCR has hosted the most recognized avocado scion and rootstock breeding programs worldwide and harbor the largest germplasm collection available in the USA. California is the nation’s leading producer of avocados, accounting for 95% of total production generating farm revenue in excess of \$412 million, followed by Florida and Hawaii which produce more tropical varieties of avocado, not Hass-like. California avocado growers, through the California Avocado Commission, have invested approximately \$20 million in avocado scion and rootstock breeding efforts. There are current efforts by UCR scientist and UCR office of Research and Economic Development to elevate the scion avocado breeding program globally by luring private investment from throughout the world. Industry partners will commit money (~ \$10 million) for 10 years to develop new avocado varieties for the fresh fruit market, commercially oil production, sugar production, and pharmaceuticals. The land at Agricultural Operations is critical to conduct key activities for both breeding programs. In addition, land is devoted to the maintenance of avocado mapping populations (which are limited worldwide), avocado breeding blocks, and avocado research plots.

Pest management studies conducted by plant pathologists, nematologists, and entomologists on tree hosts require that tree resources be available. It is not possible to write a competitive grant, have it funded, and then wait five years or more for the host tree resources to grow to an appropriate and useable size. Along the same line, research on soilborne diseases often depends on high population

density and uniform distribution of the causal agents such as microorganisms or plant-parasitic nematodes. It may take several years for researchers to establish such conditions. Those locations are also needed to evaluate new plant protection compounds, biological control agents or biostimulants. For safety and security reasons this research cannot be accomplished in grower's fields. Additionally, we are a center for IR4 program, federally funded program for registration of pesticides for specialty crops. This program requires a diversity of plants for conducting pesticide tests. These are tests conducted on products that are not yet registered and therefore conducted in a secure facility. Also, disease-suppressive soils are locations where initially high population densities of pathogens occur and result in considerable crop damage but then decline typically after 3-5 years. The study of such soils is important for the discovery of new biological control agents and their mode-of-action. Studies conducted by soil and water scientists face similar constraints of orchard, plantation, or grove availability. At the other end of the spectrum, land must be available for planting annual crops for scientists who need them for their research.

We are at a critical juncture in agricultural research. The production of food and fiber is fundamental to social systems and the health of ever-expanding human populations. However, we are also facing the impacts of global climate change with limited understanding of the dynamics of those changes on agricultural systems. In many ways, the future of agricultural research must be framed in the context of climate change. UC Riverside needs to position itself to use its history, location (semi-arid), and ongoing research strengths to place itself at the forefront of research to solve problems in this rapidly changing environment. The existence of Agricultural Operations and its proximity to the researchers is a very significant asset that would be beyond the reach of the UC coastal campuses given the cost of land there.

In addition to the agricultural research, the land at Agricultural Operations has been critical for studies of fundamental biology, pollination ecology, impact of fire on plant ecology, atmospheric sciences, and vector biology. Research in agriculture and other life sciences has incorporated new approaches since the founding of the Experiment Station and, in particular, the use of molecular, genomic, and proteomic approaches have opened new insights into the genetic bases for system function. The research is now entering the stage of translational science and the need to integrate field studies and molecular sciences is expanding. Consequently, the need for field plots will only increase. Translational science on transgenic plants must be conducted in a secure location. UCR is able to host this type of translational research. It is not a stretch of logic to suggest that much of the research reputation for the campus a function of having a field resource, and that land availability has been, and will continue to be, an underpinning resource for successful competitive grant applications by the faculty.

The research conducted at the Agricultural Operations facilities and the land resources have had significant scientific and societal impacts. The College of Natural and Agricultural Sciences web site contains a selected list from a much longer list of accomplishments titled "*CNAS Changed Everyday Life Around the World*" copied below:

- All navel oranges in California are descended from two trees that were planted in Riverside in 1875. The burgeoning Inland Empire citrus crop resulted in the establishment of the UC Citrus Experiment Station (1907). Later renamed the Citrus Research Center and Agricultural Experiment Station (CRC-AES), for more than a century it has provided basic and applied research to improve the quality and abundance of agricultural products for California and the nation.

- In 1888, California citrus growers imported the Vedalia lady beetle from Australia to control the cottony cushion scale, in the first case of biological control on record. The Citrus Experiment Station created the Division of Beneficial Insects, and its research established biocontrol as the pest-management approach of choice, leading to reductions in use of pesticides (1923).
- The landscaping that beautifies California's freeways would not exist had not AES researchers discovered the mechanisms by which smog kills plants, and bred varieties that could withstand the damage (1944).
- UCR/AES researchers have saved California's citrus crops from annihilation several times (1946—solution to citrus tristeza virus; 1950—discovery that soil fumigation solves replant problem; 1991—release of stingless wasp controls ash whitefly; 2008—identification of closely related bacterium to solve citrus greening disease).
- Based on research at UCR, the Coachella Valley became more livable after a UCR researcher figured out how to control the eye gnats and mosquitoes that infested the desert communities (1956 and later).
- California's Citrus Clonal Protection Program, which provides the industry with true-to-type, disease-free citrus propagating material, was established by UCR scientists; it has been a model for similar programs worldwide (1957).
- Our ability to eat citrus fruit virtually all year long, instead of only during their natural winter season, is due to the discovery by UCR researchers of chemicals that slow the aging and abscission of the fruit (1963).
- No longer do we need to fear rickets and various autoimmune diseases from a lack of Vitamin D. How the vitamin D is used in the body was first described by UCR researchers (1967).
- Cowpeas are a major source of protein in Africa and an increasingly important crop in California. UCR researchers developed drought- disease-, and insect-resistant strains to increase yield (1970 and later).
- Low-water-use, high-traffic-tolerant turfgrass varieties were developed by UCR scientists for use in parks, schools, sports fields, golf courses, and homes (1970 and later).
- Our ability to control agrichemical runoff depends on UCR research that established how chemical compounds move through soil (1982).
- California wine continues to delight palates since UCR researchers controlled the glassy-winged sharpshooter, the insect that vectors Pierce's Disease, which was devastating the grape crop (1990 and later).
- California's signature eucalyptus trees, introduced from Australia in the 1860s, had no insect pests for a century, but now are faced with 18 species of lethal pests. In classic demonstrations of biological control methods, UCR entomologists travel back to Australia to find natural enemies of these pests (1994 and later).
- Ranunculus flowers continue to beautify our lives after UCR research developed a method to eradicate a bacterium that threatened to destroy the California crop (1995).
- UCR entomologists have developed ant bait stations that greatly reduce the need for sprayed chemicals, by inducing ants to ingest relatively low-toxic pesticides and return to their nests to die (2006).
- A variety of rice that can survive being submerged under water has been developed by UCR researchers. It could save thousands of people from starvation in flood-prone areas of Asia (2008).
- Drought-resistant strains of rice and other crops will result from UCR research that identifies the hormone that helps plants survive drought by inhibiting their growth in times of stress (2009).

- A natural enemy of the Asian citrus psyllid, discovered in Pakistan by UCR entomologists, has been released in Southern California in an effort to control the insect from infesting California's citrus crop, as it has done in Florida, Louisiana, and Texas (2011).
- Seedless grapefruit and mandarins have been developed at UCR since the 1980s. A recent variety is Tango, a seedless mandarin whose sweetness and easiness to peel make it a favorite, especially for children. Tango is now beginning to appear in supermarkets (2012).

With only a few exceptions, all of these highlighted contributions would have been practically impossible without the availability of the land resource available on campus. The list represents a century of sustained research efforts that must continue in the future.

**Economic impact:** All of these research contributions have an economic value in addition to the social value. For example, the value of the ash whitefly biological control success has been estimated at between \$322 - \$411 million. Similarly, the value of biological control of Cuban laurel thrips damaging landscape *Ficus* is \$73.4 million. Biological control of *Eucalyptus* insect pests on California street trees protected a resource valued at between \$1.12 - \$2.85 billion. The total benefit for urban forest biological control, all developed using trees and facilities at Agricultural Operations, ranged from \$1.9 - \$3.8 billion at a cost of just over \$5 million for a return of \$360 - \$ 730 for every dollar invested in the research.

Work performed at Agricultural Operations was central to developing effective and stable quarantine protocols for preventing the movement of glassy-winged sharpshooter (a serious vector of Pierce's disease of grapes) on commercial nursery materials. In addition, effective treatment practices for direct winter control of the vector in citrus prior to movement into grapes were developed using land resources at Agricultural Operations. Prior to this work, both the nursery and grape commodities of California were threatened with financial ruin due to draconian shipping restrictions or disease incidence (respectively). At risk was an estimated \$6 billion worth of agricultural commodities and the annual cost of Pierce's Disease was estimated to be \$104 million. With the development of these protocols, commercial production and shipment of both commodities has been possible.

With the introduction of the bacterial pathogen causing citrus greening disease, huanglongbing (HLB), and its insect vector, the Asian Citrus Psyllid, the California citrus industry is at dire risk. The disease has become widespread in Florida and it is estimated that citrus production has declined by 75% and production costs have increased by at least 1/3. These impacts translate into an estimated revenue loss of approximately \$1 billion per year. For California, initial estimates peg grower production loss, alone, at \$4.7 billion over a 20 year period if effective management programs are not developed. Consequently, the land, trees, and genomic resources at Agricultural Operations are critical for the development of resistant cultivars, treatment protocols to manage the vector, and implementation of classical biological control.

The citrus varieties, particularly seedless grapefruit and Mandarins/tangerines, developed at UC Riverside using land and resources at Agricultural operations have dramatically changed the citrus industry in the state. Tangerine production is a particularly noteworthy example. In 2007, the value of tangerine production was \$54.7 million to California Agriculture. That same year, the Tango mandarin was patented by UCR scientists. In the most recent year for which data is available (2016/17), Mandarin production in California had a wholesale value of \$775 million. The value of tangerines had increased by more than an order of magnitude in less than a decade. Mandarins have become the more profitable citrus crop to grow in California, in part, because of the success of the Tango seedless variety, sold in the

marketplace as “Cutie” or “Halo”. Being seedless allows growers to plant the variety without taking on the additional costs of keeping pollinators off the trees. This benefit to growers has facilitated the rapid expansion of mandarin plantings in California.

Research at UC Riverside Agricultural Operations has also had a substantial effect on international trade. In the 1990s, production of fresh market tomatoes in Sinaloa, Mexico was becoming impractical, with only the fall crops producing a positive return on investment. Winter crops broke even and the growers lost considerable funds in the spring crop. Because these growers are the primary employer, the government of Mexico was subsidizing the growers to maintain employment. By adopting integrated pest management programs developed by UCR Entomologists, growers reduced pesticide applications from 35-40 applications of two to six different pesticides per crop down to 5-12 applications per crop, a reduction of 86%-70%. Growers could now generate significant profits in all crops. Large growers (500+ ha) typically increased net profits from 1.5 million US dollars per year to over 5 million dollars per year. Perhaps more importantly, because the new program replaced highly toxic pesticides for controlling these pests with pheromones (mating disruption) and essentially non-toxic materials such as *Bacillus thuringiensis* (a bacterium that infects insects), the death of farmworkers from exposure to pesticides was essentially eliminated.

**Summary:** Overall, research associated with Agricultural Operations has a multi-billion-dollar impact for a global population. The land and facilities associated with Agricultural Operations have been vital to the success and reputation of the campus for more than a century. However, UC Riverside is no longer a fledgling institution; it has grown dramatically in size and complexity over the last few decades and is poised for continued expansion as the research and teaching missions expand. Currently, research land south of Martin Luther King Blvd is at capacity; what may first appear as open land is used seasonally for research on rotational crops. With proposed project requests for up to 50 acres of research land in the queue and the increased hiring in areas of applied or field research, development on the north side of Martin Luther King must be reconsidered. Consequently, it is critical to plan carefully for the future so as to take advantage of new opportunities while, at the same time, preserving the resources that remain vital to the mission and reputation of the research community.

***To maintain our global presence and impact, UCR needs to review and revise campus plans that directly impact Agricultural Operations.*** There have been two Long Range Development Planning exercises conducted in the last 27 years (1990 and 2005). Although conducted with the best information available at the time and in light of the projections for long term growth of the University of California, they are not immutable. It is possible to take only a cursory examination of the two plans to see that there are dramatic differences between them. Even the most recent plan is out of date and out of context. Campus growth projections and state budgets have changed. The location of campus units (e.g., student housing, school of medicine, parking) have changed such that the planning exercise is no longer relevant. Previous decisions about land use must be revisited since it is not appropriate to stick to an outdated plan. A new plan must reevaluate the underlying assumptions and potentially affected clientele. Decisions made decades ago do not necessarily reflect current priorities or realities. The cornerstone of any good development process begins with a confirmation of the planning needs and this has not been done with regards to the CRC-AES land base, facilities, and research needs for the future.

## ASPIRATIONAL EXAMPLES

**I. Examples of other institutions that can serve as aspirational targets with respect to your working group's particular area of focus. Please list associated reference documents, as applicable.**

Other campuses and extension centers in California which focus on agricultural research and teaching currently have facilities that spotlight their expertise and provide office space, teaching and conference facilities. The “Aspirational Examples” section below provides examples of ways campuses connect to the public and underscores the need for new gateway to this living laboratory with an updated headquarters for Agricultural Operation and Research Extension Facility for campus and community.

The UC Davis Robert Mondavi Institute for Wine and Food Science

<https://robertmondaviinstitute.ucdavis.edu/> is a large academic complex and includes a LEED Platinum certified winery, brewery and food and milk processing laboratory based on Robert Mondavi's \$25 million gift in 2001 and focused on his vision to provide a prestigious forum for collaboration, public engagement, and education toward “Enhancing public understanding of wine, brewing and food sciences.”

Cal Poly Pomona's AGRIscares <https://www.cpp.edu/~agriscapes/>, also established in 2001 occupies 20 acres of farmland and facilities and includes a visitor center with space available for meetings, workshops and small conferences, The Farm Store sells produce grown on campus along with other food items and a large greenhouse complex used for production and research. Each year AGRIscares hosts thousands of school children on field trips to our Children's Garden along with tours of the Center.

The conference center at UC ANR Lindcove Research and Extension Center in Exeter CA, consists of a 90-seat conference room with a kitchen and a demonstration orchard located some distance from the conference center. Current campaign goals are to develop the roadways and parking areas to make the Conference Center more accessible for events, create an outdoor eating area, build an outdoor amphitheater to conduct educational programs for children, and develop two citrus demonstration orchards for teaching the citrus industry, master gardeners, and general public.



**Robert Mondavi Institute for Wine and Food Science at UC Davis**



**Cal Poly Pomona AGRIscares**



**Plans for the enhancement of the Conference Center of the UC Lindcove Research and Extension Center in Exeter, CA.**

### Our Vision

These three examples of facilities at other institutions in California differ in size, complexity and intent but all serve the purpose of providing a gateway and connection between the campus, industry and the community. CRC-AES' prominent location on the West Campus should provide an opportunity to provide an attractive gateway to campus located in the heart of UCR's CRC-AES complex. This gateway center will provide administrative offices for CRC-AES and facilities for outreach and engagement activities for agricultural constituents, professional colleagues, students and the community. The center will provide a focal point for programs that educate, integrate and communicate the value of agricultural research to people in the region and throughout the world, including researchers, students, government and business leaders, the general public, and industry professionals from fields such as agriculture, food, nutrition and medicine. The center will include:

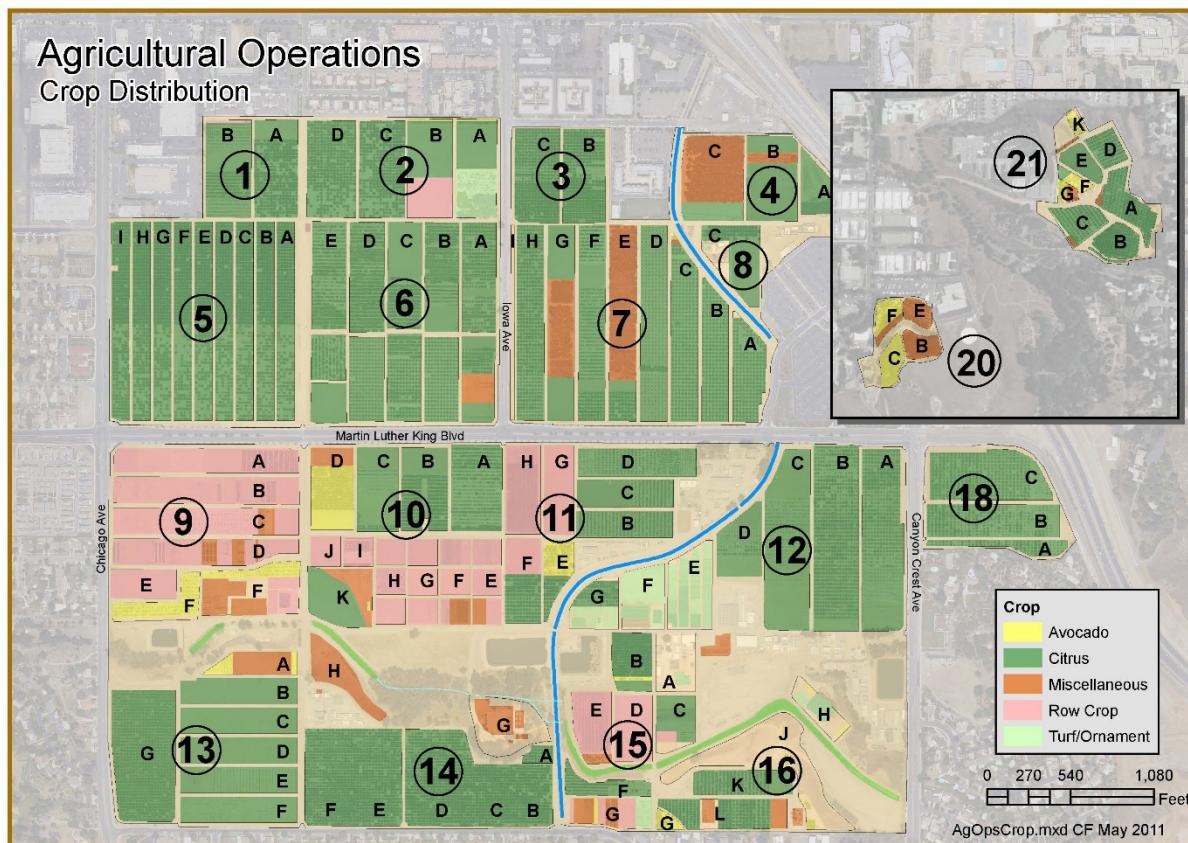
- Large auditorium and smaller conference rooms
- Demonstration laboratory for K-12 and undergraduate student learning opportunities
- Smart classroom with modern interactive technologies
- Administrative offices for Agricultural Operations
- A commercial kitchen with demonstration area to provide meals for events and opportunities to teach how to cook produce produced on the station.
- Top-level outdoor patio with views of Agricultural Operations, campus and the environs.
- Access to the R'Garden, the university's community garden that emphasizes sustainability and community outreach and education

As we look ahead to 2035, this CRC-AES gateway facility to the "Living Laboratory" will continue the AES mission and UCR's history dedicated to engaging the community in its work. For the past seven years, the UCR Citrus Day for Industry and annual Turf days have draped the shop and used tents to share the benefits of the university's basic and translational research. This Living Laboratory Gateway will provide a functional and centralized location for those activities with architecture that reflects the historic past

while highlighting the modern state-of-the art aspects of this living laboratory. It will be the focus of tours for local and international groups, UCR Extension activities, field days for the citrus and other agricultural industry professionals, seminars, and community events focused on a variety of agricultural themes.

## APPENDIX:

Map A: Fields 20 and 21 are east of Perimeter Rd on East Campus.



Map B: Current land allocation on west campus Ag Ops.

