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FINAL MULTI-YEAR WATER SAMPLING PLAN

for the

**Laboratory for Energy-related Health Research/
Old Campus Landfill Superfund Site
University of California, Davis**



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prepared for

**Environmental Health and Safety
University of California, Davis
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for the

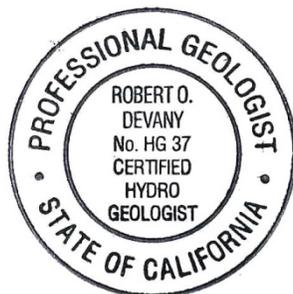
**Laboratory for Energy-related Health Research/
Old Campus Landfill Superfund Site
University of California, Davis**

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Weiss Associates' work for the Laboratory for the Energy-related Health Research/Old Campus Landfill site was conducted under my supervision. To the best of my knowledge, the data contained herein are true and accurate and satisfy the scope of work prescribed by the client for this project. The data, findings, recommendations, specifications, or professional opinions were prepared solely for the use of the University of California, Davis in accordance with generally accepted professional engineering and geologic practice. We make no other warranty, either expressed or implied, and are not responsible for the interpretation by others of the contents herein.



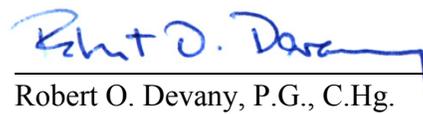

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ACRONYMS AND ABBREVIATIONS

AOC	Administrative Order on Consent
ARAR	applicable or relevant and appropriate requirement
BC	Brown and Caldwell
CAWMR	Comprehensive Annual Water Monitoring Report
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	constituent of concern
DOE	United States Department of Energy
DTSC	Department of Toxic Substances Control
HHRA Part B	<i>Site-Wide Risk Assessment, Volume I: Human Health Risk Assessment (Part B Risk Characterization for DOE Areas)</i>
HSU	hydrostratigraphic unit
LEHR	Laboratory for Energy-related Health Research
MCL	Maximum Contaminant Level
MOC	monitoring-only constituent
N	nitrogen
OCL	Old Campus Landfill
SOP	standard operating procedure
RD/RAWP	<i>Remedial Design/Remedial Action Work Plan for the Former Laboratory for Energy-Related Health Research Federal Facility, University of California, Davis</i>
ROD	<i>Record of Decision for DOE Areas at the Laboratory for Energy-Related Health Research, University of California, Davis</i>
RPM	Remedial Project Manager
RSL	Regional Screening Level
RWQCB	Regional Water Quality Control Board
Site	Laboratory for Energy-related Health Research/Old Campus Landfill Superfund Site
UC Davis	University of California, Davis
US EPA	United States Environmental Protection Agency
Weiss	Weiss Associates
µg/L	micrograms per liter

1. INTRODUCTION AND BACKGROUND

This document presents the proposed 2012 and 2013 Water Sampling Plan for groundwater and storm water monitoring at the Laboratory for Energy-related Health Research (LEHR)/Old Campus Landfill (OCL) Superfund site (Site) at the University of California, Davis (UC Davis) (Figure 1). Water monitoring at the Site is performed by UC Davis and the United States Department of Energy (DOE) and has occurred regularly since 1991. These are two separate water sampling programs that monitor adjacent and overlapping areas of the Site (Figure 2).

Water monitoring for the UC Davis areas will continue to be performed in accordance with the requirements of the Administrative Order on Consent (AOC) #99-16, issued by the United States Environmental Protection Agency (US EPA) (US EPA, 1999; US EPA, 2001). Subsequent approvals from the US EPA to modify the AOC monitoring and reporting requirements for the UC Davis areas have been documented in UC Davis's annual monitoring reports for each year beginning in 2005 and continuing through 2010 (BC, 2006; BC, 2007; BC, 2008; Weiss, 2009; Weiss, 2011; Weiss, 2012), as well as previous versions of this report. The *Remedial Design/Remedial Action Work Plan for the Former Laboratory for Energy-Related Health Research Federal Facility, University of California, Davis* (RD/RAWP) (DOE, 2010) provides further groundwater monitoring requirements for DOE areas of the Site. Because UC Davis manages both monitoring programs, field sampling efficiencies are realized by coordinating the two distinct but related efforts (e.g., collecting quarterly water level measurements immediately prior to field efforts to streamline mobilization and demobilization time).

The draft version of the 2010 Comprehensive Annual Water Monitoring Report (CAWMR) (Weiss, 2012) originally contained information on the proposed 2011 sampling strategy. However, at the August 12, 2011 Remedial Project Managers (RPM) meeting, regulatory agency representatives requested that the strategy be expanded to incorporate a longer timeframe (LEHR Team Meeting Minutes, 2011a). In addition, detailed comments on the proposed sampling regime were received from the US EPA on September 1, 2011 and the Regional Water Quality Control Board (RWQCB) on November 13, 2011. Based on these comments, a draft multi-year sampling strategy was presented to the regulatory agencies at the November 21, 2011 RPM meeting (LEHR Team Meeting Minutes, 2011b). Additional modifications were made during the meeting, and additional comments were received from the US EPA on November 30, 2011 and from the RWQCB on December 2, 2011. Changes requested in these comments were incorporated into the 2011 sampling regime, and sampling commenced on December 5, 2011. Subsequent to the commencement of sampling, comments were received from the Department of Toxic Substances Control (DTSC) on December 7, 2011 and December 30, 2011. Responses to these comments can be found in Appendix A.

Because the majority of the regulatory agency comments were focused on the proposed multi-year sampling plan presented in the 2010 CAWMR, the multi-year sampling plan was decoupled from the 2010 CAWMR to expedite its completion (LEHR Team Meeting Minutes, 2012). The Final 2010 CAWMR was issued on March 16, 2012 (Weiss, 2012).

For areas monitored by UC Davis, this plan uses available historical 2011 sampling data to develop the locations, sampling frequencies, and chemical suites for 2012 and 2013. For the DOE areas, the basis for the 2012 and 2013 sampling strategy is documented in Section 5.8 of the 2011 CAWMR (Weiss, 2013).

This report includes five sections. Section 2 presents the approach and multi-year sampling plan for the UC Davis areas; Section 3 presents the approach and 2012 sampling plan for the DOE areas; Section 4 presents the proposed sampling plan for storm water; and Section 5 provides references. The appendices provide supporting documentation for the proposed groundwater sampling strategy and include the responses to previously received comments (Appendix A); time-series plots for chloroform, chromium, and nitrate for each on-Site monitoring well (Appendix B); and tables showing quarters when the highest annual concentration of chloroform, chromium, and nitrate were observed in wells with sufficient data (Appendix C).

2. UC DAVIS SAMPLING

This section presents the sampling approach and resulting multi-year sampling plan for the UC Davis areas.

2.1 Sampling Approach

Within the UC Davis areas, annual sampling is recommended to monitor concentration trends and plume boundaries. This recommendation is based on three primary tenets: (1) chemical concentrations do not correlate well with groundwater elevation; (2) the highest chemical concentrations do not regularly occur in a particular quarter; and (3) horizontal and vertical movement of groundwater in hydrostratigraphic unit (HSU) 1 at the Site is extremely slow, contaminant mass transfer between HSU-1 and HSU-2 is low, and plume boundaries in both units are retracting or relatively stable. These tenets are discussed in detail below.

2.1.1 Chemical Concentration Correlation with Groundwater Elevation

The concentration versus water level time-series plots presented in Appendix B show that, for the majority of wells in HSU-1, HSU-2, or HSU-4, concentrations of chloroform, total chromium, and nitrate do not correlate well with water levels. 2011 water level contours and flow directions are shown on Figures 3 through 5.

2.1.2 Seasonal Influence on Maximum Chemical Concentrations

Tables summarizing concentrations for chloroform, chromium, and nitrate, provided in Appendix C, identify the quarters when the highest annual concentration of these constituents were observed to occur between the years 2006 and 2010. The only inference that can be made from these data is that the quarter when maximum concentrations occur varies. Furthermore, chloroform data for wells monitored quarterly in 2010 (UCD1-011, UCD1-012, UCD1-013, UCD1-025, UCD1-028, UCD1-062, UCD1-066, and UCD1-067) show stable concentrations from quarter to quarter. This supports the hypothesis that, due to remedial efforts at the chloroform source area, the chloroform plume has transitioned into a diffusion-limited system that is less sensitive to seasonal variations.

2.1.3 Horizontal and Vertical Migration of Contaminants

Horizontal movement of groundwater has been estimated to be very low (4 feet per year) in HSU-1 (Geomatrix, 2004), and vertical migration of contaminants in HSU-1 is expected to be even lower due to sedimentary structures. In addition, isoconcentration contour maps presented in annual water monitoring reports have shown that plume boundaries for key analytes are retracting in size or relatively stable. Therefore, only minor concentration changes are expected in HSU-1. These conditions also limit the mass transfer of contaminants from HSU-1 to HSU-2, particularly when source areas have been cleaned up. These Site conditions render more frequent analyses unnecessary.

2.2 Sampling Regime

To create the Multi-Year Water Sampling Plan, analytical results from samples collected during the 2011 sampling event were evaluated to assess whether concentration trends for target analytes were increasing or whether new contaminants had emerged. This Multi-Year Water Sampling Plan optimizes data collection to evaluate trends for target analytes in “key” UC Davis Site wells, including source wells, upgradient wells, and wells located near plume boundaries. Target analytes for the UC Davis areas include carbon-14, chloroform, total chromium, electrical conductivity (EC), nitrate (as nitrogen [N]), tritium, 1,2,3-trichloropropane, and 1,4-dioxane.

2.2.1 Sampling Plan for 2012 and 2013

The following types of wells are proposed to be sampled in 2012 and 2013 (Table 1):

- Wells with increasing concentrations;
- Wells with target analyte concentration trends that are above comparison criteria such as the California Department of Public Health (CDPH) Maximum Contaminant Level (MCL) or the US EPA Maximum Contaminant Level Goal (MCLG);
- Wells that are being used to document temporal trends in annual water monitoring reports; and
- Wells used to support the evaluation of monitored natural attenuation of chromium.

The following types of wells are proposed to be sampled less frequently or not at all:

- Wells with stable concentrations;
- Wells with long sampling histories showing low concentrations; and
- Wells located outside plume boundaries or at locations that are duplicative (wells close together).

2.2.2 Exceptions to Sampling Regime

There are two cases where the sampling regime differs from what is proposed in Section 2.2.1 above:

- Wells UCD1-049 and -050 are not slated to be sampled for nitrate (as N) even though they have historical concentrations of the compound that are in excess of the MCL; they are located less than 50 feet cross-gradient from wells UCD1-012 and -051. Both wells UCD1-012 and -051 are slated to be sampled annually for nitrate.
- There is one well, UCD1-069, where concentrations were increasing or above regulatory comparison criteria (Appendix B) but is not being recommended for sampling in 2012 or 2013: in 2011, one sample from this well contained total chromium at the regulatory criteria, but a second sample was below the criteria.

2.2.3 Additions to Sampling Regime

In addition, the Multi-Year Water Sampling Plan includes continued monitoring for two emerging constituents that were analyzed in a relatively small number of wells in 2011:

- Four locations contained positive detections of 1,2,3-trichloropropane (UCD1-051, -062, -066, and UCD2-048) at concentrations ranging from 0.013 to 1 J micrograms per liter ($\mu\text{g/L}$) in 2011. This constituent has also historically been detected in well UCD1-062 in 2008 and 2010. These concentrations are above the US EPA Regional Screening Level (RSL) for tap water (0.00065 $\mu\text{g/L}$ [US EPA, 2012]) and the CDPH notification level (0.005 $\mu\text{g/L}$ [CDPH, 2010]). In addition, both the RSL and notification level are below the reporting limit (generally 1 $\mu\text{g/L}$). The four locations containing detectable concentrations of 1,2,3-trichloropropane will continue to be sampled annually.
- 1,4-Dioxane was present above detection limits in two wells in 2011 (UCD1-066 and -067) at concentrations up to 18 $\mu\text{g/L}$. Historically, 1,4-dioxane has been detected in these same two wells. The detected concentrations are above the US EPA's 2011 RSL of 0.67 $\mu\text{g/L}$ for tap water. The reporting limit for 1,4-dioxane is generally 1 $\mu\text{g/L}$. Both of these locations will continue to be sampled annually for 1,4-dioxane. Additionally, wells UCD1-011, -013, and -065, which were not sampled in 2011, will be sampled biannually for 1,4-dioxane; these wells will be sampled in 2012. Another well, UCD1-025, was sampled for 1,4-dioxane in 2011 and will continue to be sampled annually.

Table 1 shows the multi-year sampling program for the UC Davis wells, constituents, and sampling frequencies. This table also shows the locations and constituents that have increasing concentration trends and/or have constituent concentrations that are at or above regulatory comparison criteria (in cells with grey shading or outlined with thicker/bolder borders, respectively). Target analyte suites and sampling frequencies are also shown on Figures 6 through 19, along with isoconcentration contours based on the highest concentrations detected in 2010 and 2011.

Analytical results from 2012 sampling will be evaluated to assess whether the Multi-Year Water Sampling Plan is sufficiently documenting plume stability, and whether there are any new or emerging contaminants. If modifications are needed to sampling frequencies or analytes, a future Multi-Year Water Sampling Plan Addendum will be produced to document the changes.

2.3 Sampling Methodology

Monitoring at the UC Davis Areas is conducted in accordance with the methods presented in the *Final Revised Field Sampling Plan, Laboratory for Energy-related Health Research/South Campus Disposal Site (LEHR/SCDS) Environmental Restoration (FSP)* (Dames & Moore, 1998) and the *Quality Assurance Project Plan Revisions for LEHR/SCDS, University of California, Davis (QAPP)* (Weiss, 2008). Procedures for collecting samples and water level measurements are also documented in standard operating procedures (SOPs) for the DOE areas (DOE SOP 5.1, *Water Level Measurements in Monitoring Wells* and DOE SOP 9.1, *Low-Flow Ground Water Sampling with Dedicated Pumps* [DOE, 2010]). Since consistent procedures between DOE and UC Davis areas are required, Weiss utilizes the SOPs approved by the US EPA in 2012 as part of the LEHR QAPP (DOE, 2012).

Although DOE has fully implemented dedicated low-flow pumps and sampling procedures in accordance with the applicable SOPs, UC Davis has not yet completed the transition to site-wide low-flow sampling as agreed to at the LEHR Team meeting on June 22, 2012. Currently, approximately 19 percent of the UC Davis well network has dedicated low-flow pumps; 49 percent has dedicated electric submersible pumps; and 32 percent does not have dedicated pumps. A comparison of the low-flow results to traditional 3-purge volume results, historically conducted at the Site, was performed for select DOE wells as described in the 2011 CAWMR (Weiss, 2013). This analysis showed no obvious differences between the two methods.

3. DOE SAMPLING PLAN

This section presents the sampling approach and resulting 2012 sampling plan for the DOE Areas (Figure 2). The on-Site wells selected to monitor DOE Areas are UCD1-013, -021, -023, -054, -068, -069, -070, -071, and -072. Off-Site reference wells selected to evaluate background are UCD1-018, -063, and -073. As discussed in Section 2.3 above, sampling procedures and protocols for the DOE Areas are specified in the RD/RAWP.

3.1 Sampling Approach

The RD/RAWP describes the process approved by the LEHR Project Team (DOE, US EPA, DTSC, RWQCB, and CDPH) for determining which constituents of concern (COCs)/wells will be included in the DOE Areas monitoring program (DOE, 2010). The approved monitoring program decision process for COCs is presented on Figure 20 (originally Figure 3-2 of the RD/RAWP). In accordance with this process, groundwater monitoring data will be evaluated annually and the program will be adjusted accordingly. The decision process was conducted for groundwater data collected during 2011, the first year of monitoring, and is presented in Section 5.0 of the 2011 CAWMR (Weiss, 2013). The monitoring program presented below is the outcome of the RD/RAWP decision process as well as modifications agreed upon by the LEHR Project Team during their January 24, 2012 team meeting (LEHR Team Meeting Minutes, 2012). Monitoring program changes between 2011 and 2012 are shown in Table 2.

3.1.1 Background Wells

The RD/RAWP specified one year of quarterly sample collection from wells UCD1-018, -063, and new well UCD1-073 to evaluate groundwater background. New well UCD1-073 was excluded from the background determination due to groundwater flow uncertainties indicated by 2011 water level data. Thus, data from wells UCD1-018 and -063 were used to represent background. Organic constituent background concentrations were assumed to be zero, with the exception of formaldehyde, which can occur naturally (Agency for Toxic Substances and Disease Registry, 2008). A pressure transducer array was installed in well UCD1-054, -071, and -073 to gather continuous groundwater elevation data. Data collection and evaluation is ongoing, and decisions will be made at future LEHR Project Team meetings regarding whether well UCD1-073 should be included in the determination of background reference concentrations.

3.1.2 Constituents of Concern

DOE COCs were originally identified in the *Site-Wide Risk Assessment, Volume I: Human Health Risk Assessment (Part B Risk Characterization for DOE Areas)* (HHRA Part B) (Weiss, 2005) based on their presence in soil at levels statistically above background and at concentrations contributing to human health cancer risks above one in one million, and/or their potential to impact groundwater above background. The RD/RAWP specified COC/well pairs to be sampled during the first year of the monitoring program (DOE, 2010). Baseline concentrations were established for each

COC/well pair using the first year of monitoring data from 2011. According to the RD/RAWP decision process, COCs with concentrations above background and exhibiting an increasing trend would undergo an evaluation of remedial cleanup technologies. Constituents in wells with concentrations below background levels or without an increasing trend would be sampled annually.

Baseline establishment was extended through 2012 and approved by the regulatory agencies during the January 24, 2012 LEHR Project Team meeting (LEHR Team Meeting Minutes, 2012). Sample frequencies in 2012 differ from the decision process diagram (Figure 20) due to extended baseline monitoring. The resulting sample frequencies and rationales were as follows:

- Hexavalent chromium in well UCD1-071 and selenium in well UCD1-068 were above background and tested positive for increasing trends. Instead of initiating an evaluation of remedial cleanup technologies for these two COCs per the RD/RAWP, the LEHR Project Team agreed to collect quarterly groundwater samples in 2012 and subsequently retest trends. It should be noted that these COCs may be below background if well UCD1-073 is found to be a viable background reference.
- Mercury in well UCD1-071 was above background in two of four samples but did not test positive for an increasing trend. Instead of reducing the sampling frequency to annual in 2012 per the RD/RAWP, the LEHR Project Team decided to sample mercury quarterly in well UCD1-071.
- Each remaining COC was below background or tested negative for increasing trends. Instead of reducing the sampling frequency to annual per the RD/RAWP, the LEHR Project Team decided to monitor the remaining COCs twice during 2012: once during the wet season and once during the dry season.

In the future, if concentrations of COCs remain below background levels for five years, a monitoring frequency reduction would be considered. If the baseline condition of a COC is below background and future samples exceed background, the sampling frequency would increase to quarterly. The quarterly results would be compared to background, and if concentrations continue to exceed background and have an increasing trend, remedial technologies would be evaluated for the impacted area.

3.1.3 Monitoring-Only Constituents

A second set of constituents were identified in the HHRA Part B as possibly having a very small impact on groundwater in the future (Weiss, 2005). For clarity, this set of chemicals is referred to as monitoring-only constituents (MOCs). The RD/RAWP established annual sampling for MOCs. Results from 2011 monitoring indicated that aluminum was above background in wells UCD1-069 and -072. The LEHR Project Team agreed to sample wells UCD1-069 and -072 for aluminum twice in 2012 to confirm the 2011 results. Each additional MOC was below background and will be sampled once in 2012.

If aluminum is confirmed to exceed background, response actions will be evaluated and implemented in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and applicable or relevant and appropriate requirements (ARAR) identified in the *Record of Decision for DOE Areas at the Laboratory for Energy-related Health Research, University of California, Davis* (ROD) (DOE, 2009). An amendment to the ROD would be necessary

to address these newly identified constituents. Constituents remaining below background will continue to be sampled annually until it can be concluded that they do not threaten groundwater.

3.1.4 New Well Constituents

The RD/RAWP specified full-suite sampling in five new on-Site wells (UCD1-068 through -072) during the first two quarters after installation (first and second quarters of 2011). Results from 2011 sampling indicated that 25 constituent/new well combinations were above background. The LEHR Project Team agreed to sample these above-background constituents twice in 2012. This group of compounds consists of constituent/well combinations that were not specified in the ROD or the RD/RAWP.

Gross beta was present above background in each of the five new on-Site wells in 2011. The elevated gross beta could originate from natural potassium-40 (beta emitter) that is known to be present at LEHR. In 2012, potassium-40 will be sampled once in the new wells and background wells to help assess the cause of elevated gross beta.

If constituents are confirmed above background in the new wells, their source will be evaluated to assess whether they originate from DOE Areas. If DOE Areas are the source, response actions will be evaluated and implemented in accordance with CERCLA and ARARs identified in the ROD (DOE, 2009). An amendment to the ROD would be necessary to address these newly identified constituents.

3.2 Sampling Regime

The DOE Areas sampling regime for 2012 is presented in Table 3 and summarized below. This sampling regime will be updated annually based on the RD/RAWP decision process. The sampling regime does not extend beyond 2012. In addition to the constituents described below, field parameter measurements will also be collected for pH, oxidation reduction potential, specific conductance, dissolved oxygen, and turbidity, as described in the RD/RAWP.

3.2.1 Constituents of Concern

For reasons stated in Section 3.1, quarterly samples will be collected for hexavalent chromium and mercury in well UCD1-071, and selenium in well UCD1-068. The remaining 28 COC/well combinations will be sampled twice in 2012: once during the wet season and once during the dry season.

3.2.2 Monitoring-Only Constituents

Aluminum will be sampled twice in 2012 at wells UCD1-069 and -072: once during the wet season and once during the dry season. The remaining 15 MOC/well combinations will be sampled once in 2012.

3.2.3 New Well Constituents

Twenty-five constituent/well combinations will be sampled twice at the new on-Site wells in 2012: once during the wet season and once during the dry season. Potassium-40 will be sampled once at each new on-Site well.

3.2.4 Background

Background samples will continue to be collected at wells UCD1-018, -063 and -073. Continuous groundwater level measurements will also continue to be collected from transducers at wells UCD1-054, -071 and -073 to resolve the groundwater gradient issue.

4. STORM WATER SAMPLING PLAN

Based on the 2011 sampling results, no changes are recommended to the analyte list. As in previous years, samples from storm water sampling locations LF-01, LF-03, and LS-01 (Figure 2) are recommended to be analyzed for:

Parameter	Method
EC ¹	FSP SOP using field meter
Hardness, as CaCO ₃	US EPA Method 130.2 or SM2340
Iron, total	US EPA Method 200.7
Mercury	US EPA Method SW1631
Nitrate and nitrite as nitrogen	US EPA Method 300.0
Oil and grease	US EPA Method E1664
Organic carbon, total	SM5310
pH	FSP SOP using field meter
Suspended solids, total	US EPA Method 160.2 or SM2540
Temperature	FSP SOP using field meter

Notes:

¹ Reported as specific conductance (EC at 25° Celcius).

Acronyms/Abbreviations:

CaCO ₃	calcium carbonate
EC	electrical conductivity
FSP	<i>Final Revised Field Sampling Plan</i> (Dames & Moore, 1998)
SOP	standard operating procedure
US EPA	United States Environmental Protection Agency

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- Weiss, 2011. *2009 Comprehensive Annual Water Monitoring Report for the Laboratory for Energy-related Health Research/Old Campus Landfill*, University of California, Davis, Rev 0, February 1.
- Weiss, 2012. *2010 Comprehensive Annual Water Monitoring Report for the Laboratory for Energy-related Health Research/South Campus Disposal Site*, University of California, Davis, Rev 0, March 16.
- Weiss, 2013. *Final 2011 Comprehensive Annual Water Monitoring Report for the Laboratory for Energy-related Health Research/South Campus Disposal Site*, University of California, Davis, Rev A., March 18.

FIGURES

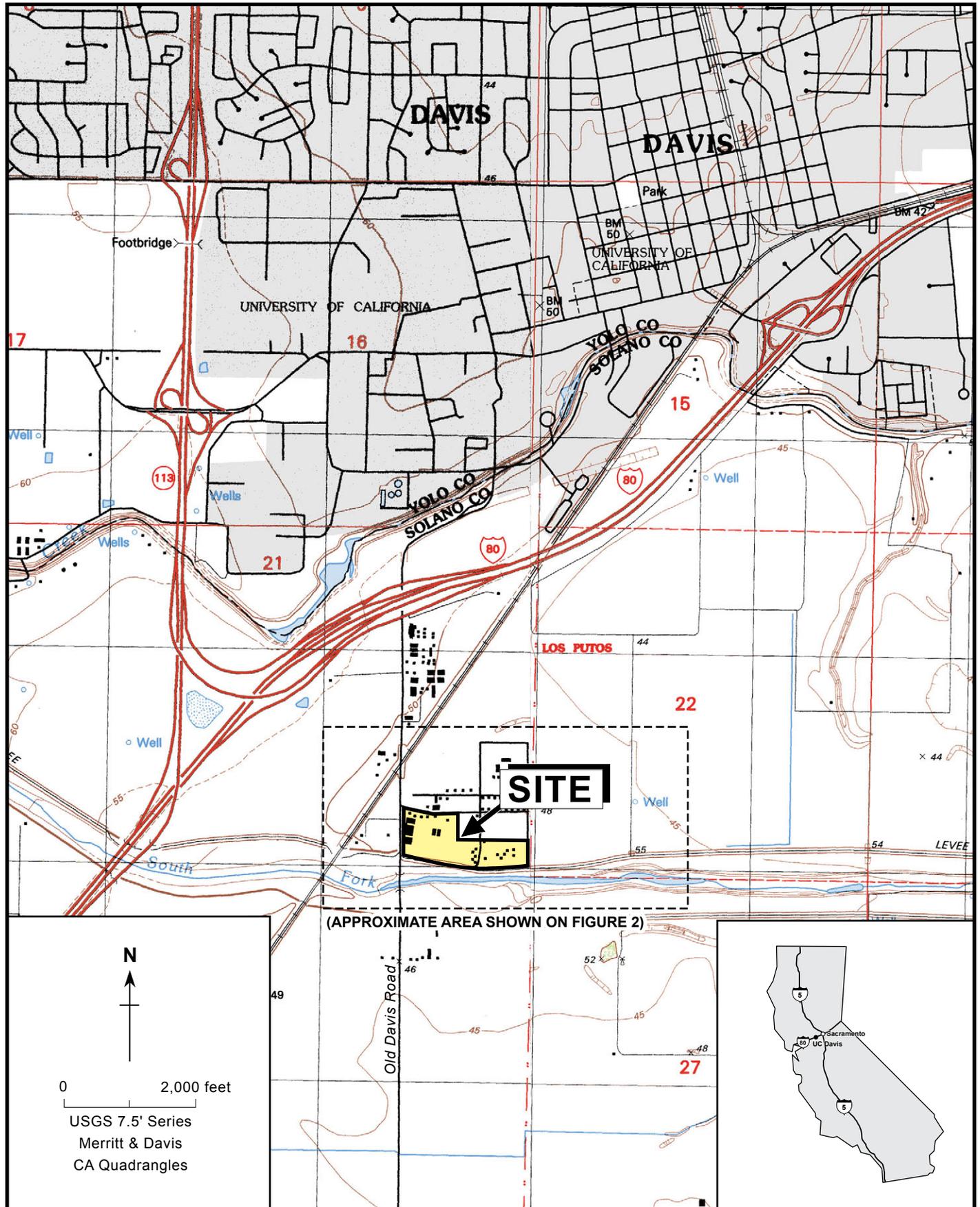


Figure 1. Site Vicinity Map - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

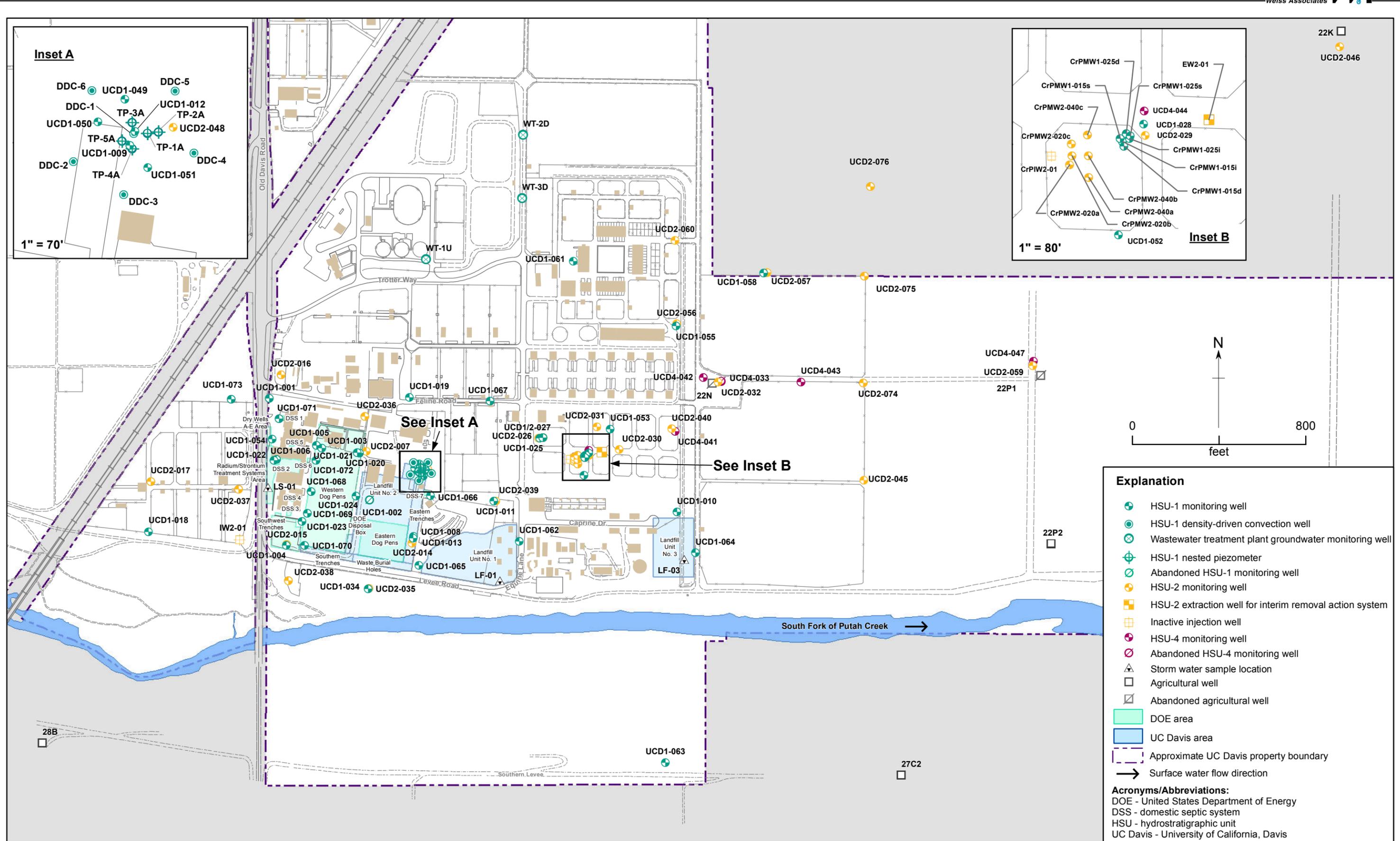
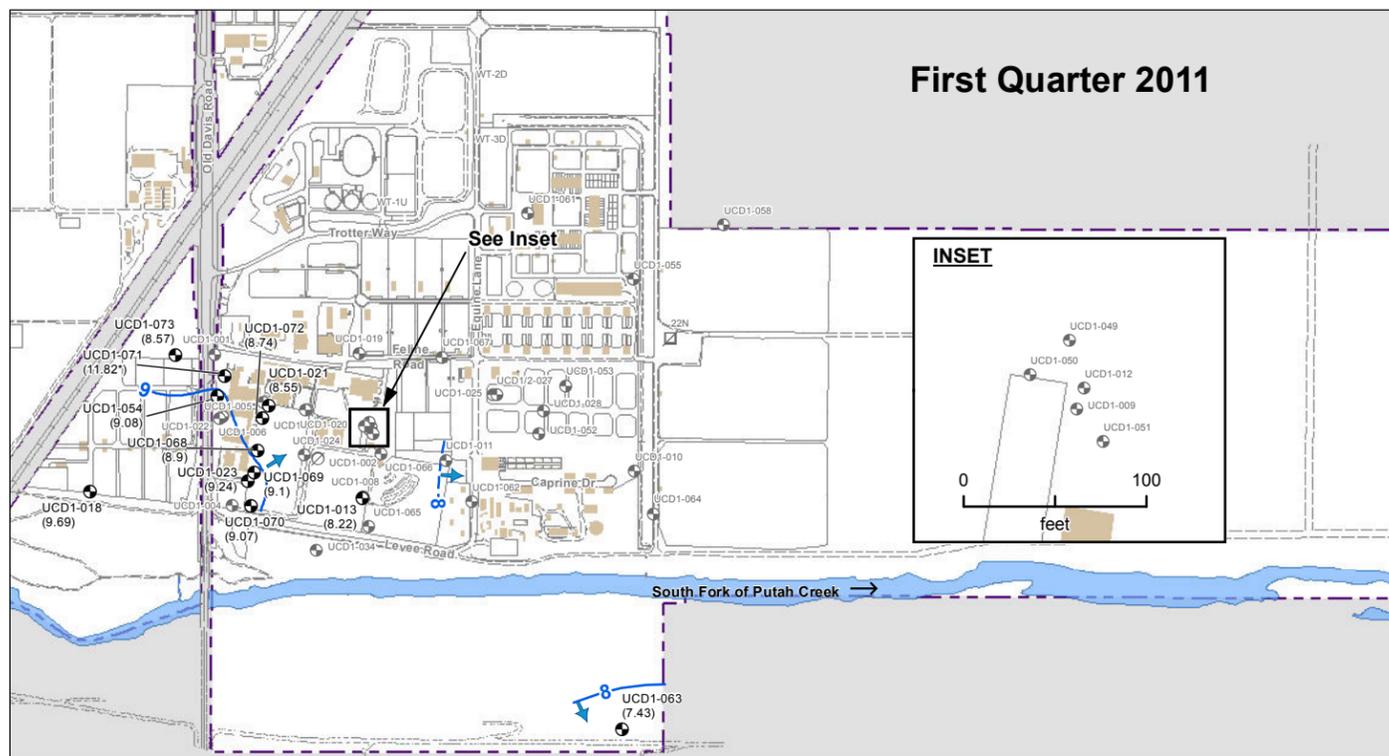
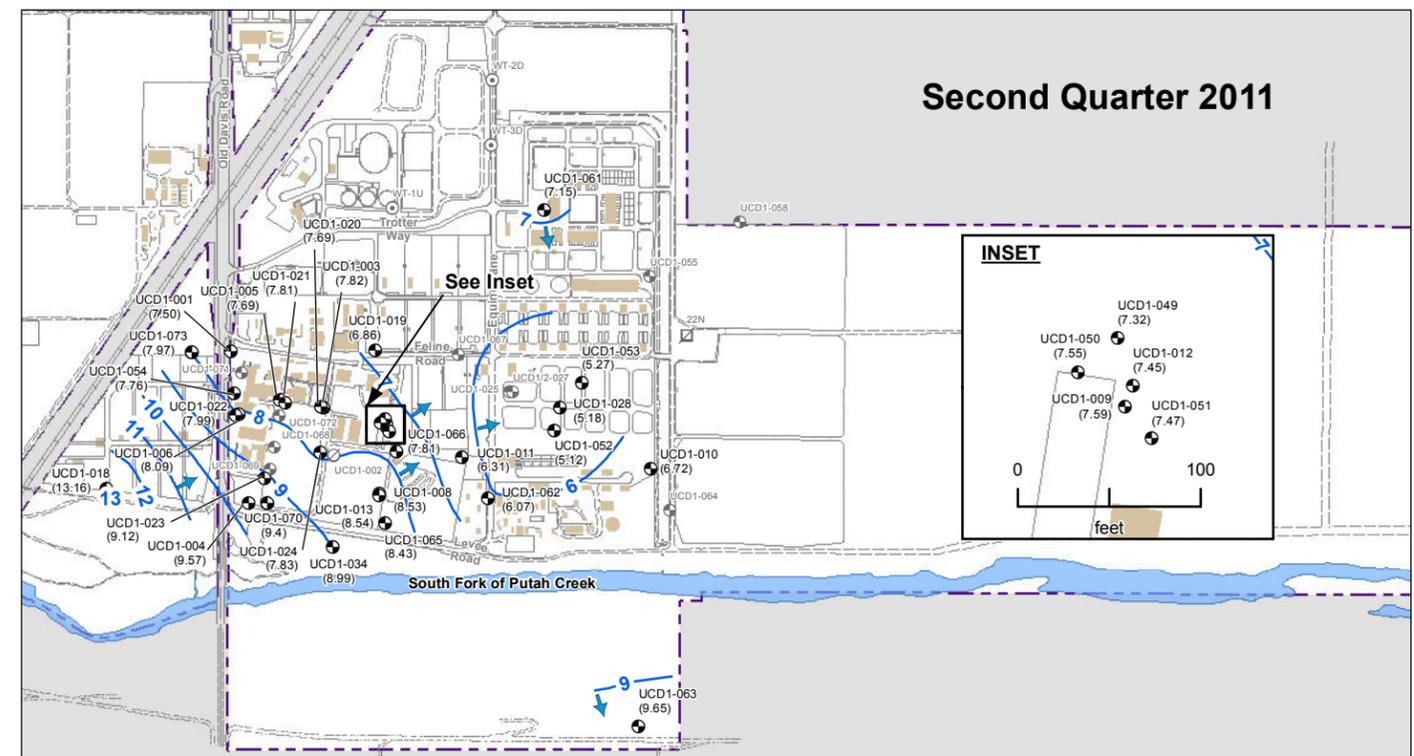


Figure 2. Water Sampling Locations - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

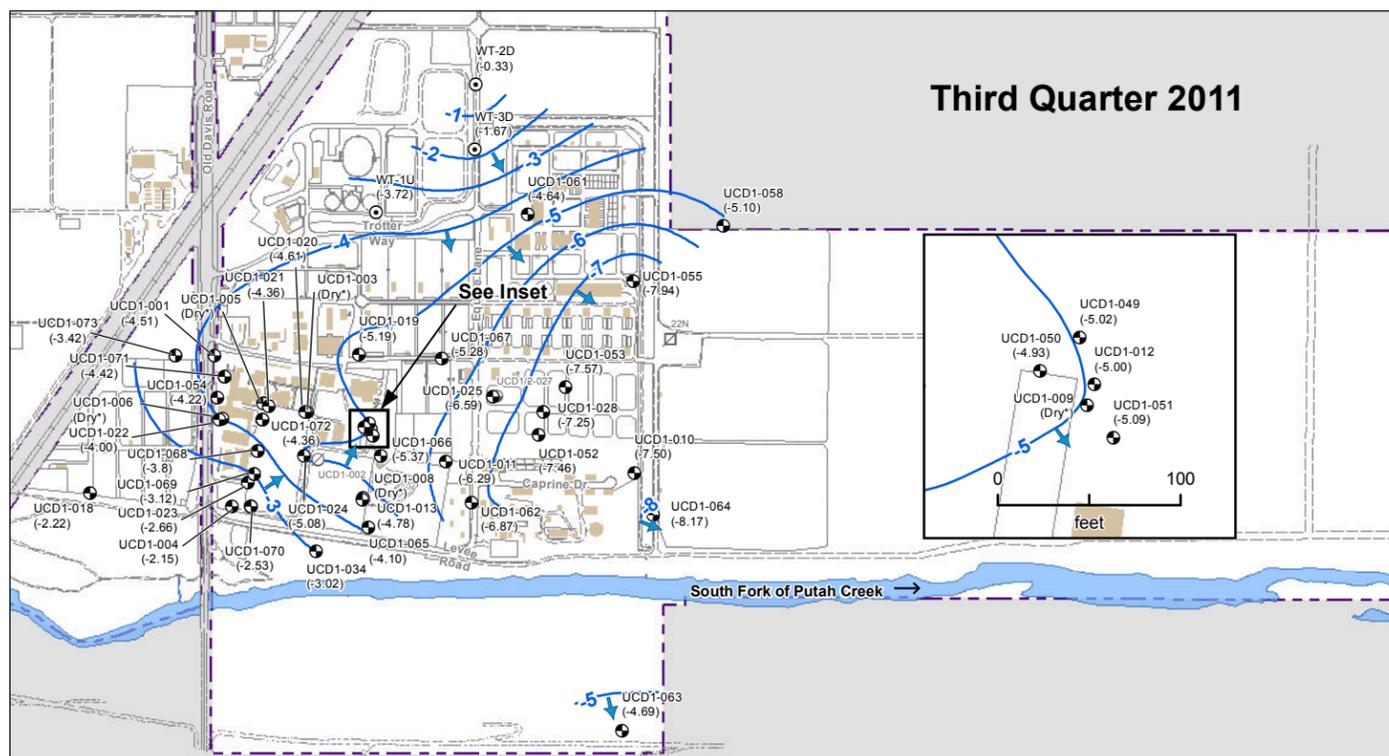
First Quarter 2011



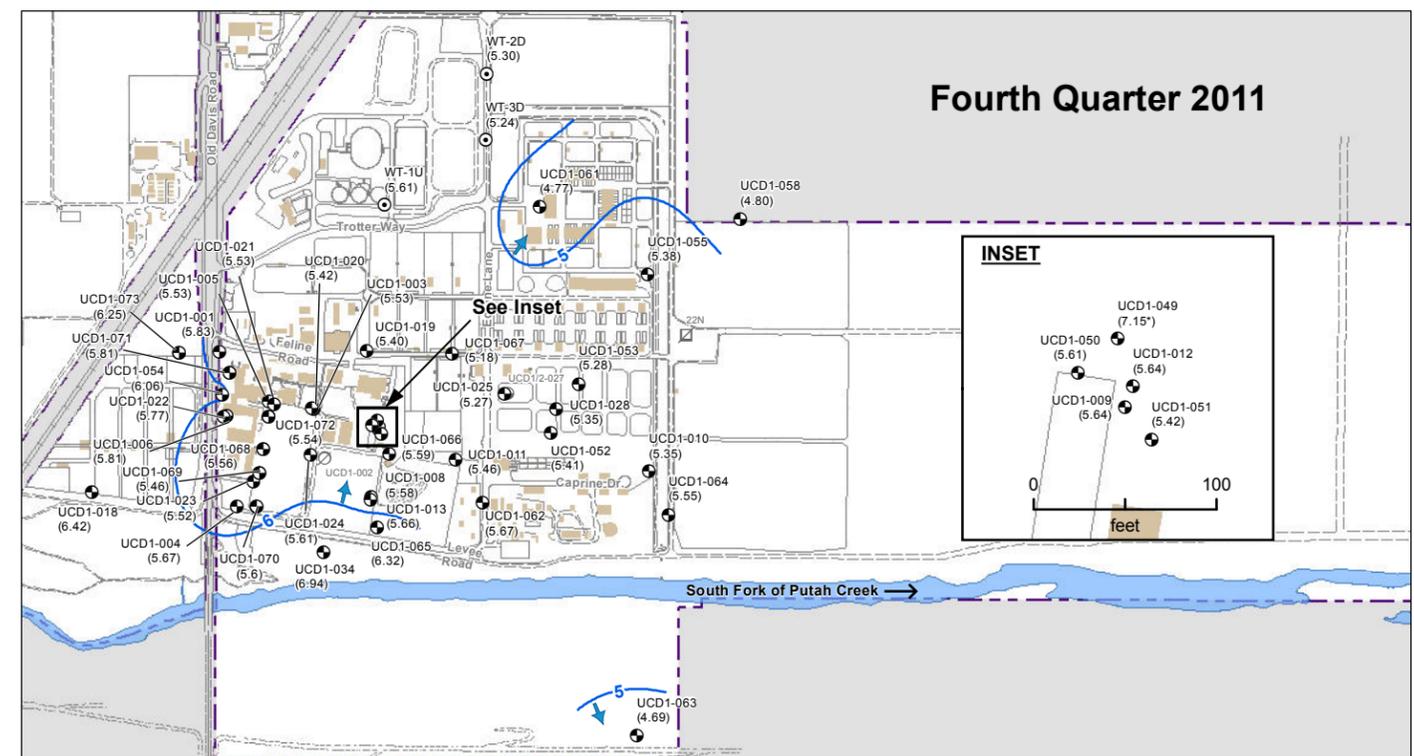
Second Quarter 2011



Third Quarter 2011



Fourth Quarter 2011



Explanation

-  Monitoring well
-  Wastewater treatment plant
-  groundwater monitoring well
-  Monitoring well, not measured
-  Abandoned monitoring well
-  Abandoned agricultural well
-  Building
-  South Fork Putah Creek
-  Road
-  Dirt road
-  Railroad
-  Fence

- (1.00) Groundwater elevation, feet relative to mean sea level
- * Groundwater elevation not used for contouring (dry or anomalous)

- 1.0 — Groundwater elevation contour, dashed where inferred, feet relative to mean sea level
-  Groundwater flow direction, inferred
-  Surface water flow direction
- UC Davis property boundary, approximately located

Acronyms/Abbreviations:
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis

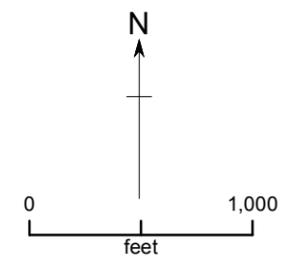
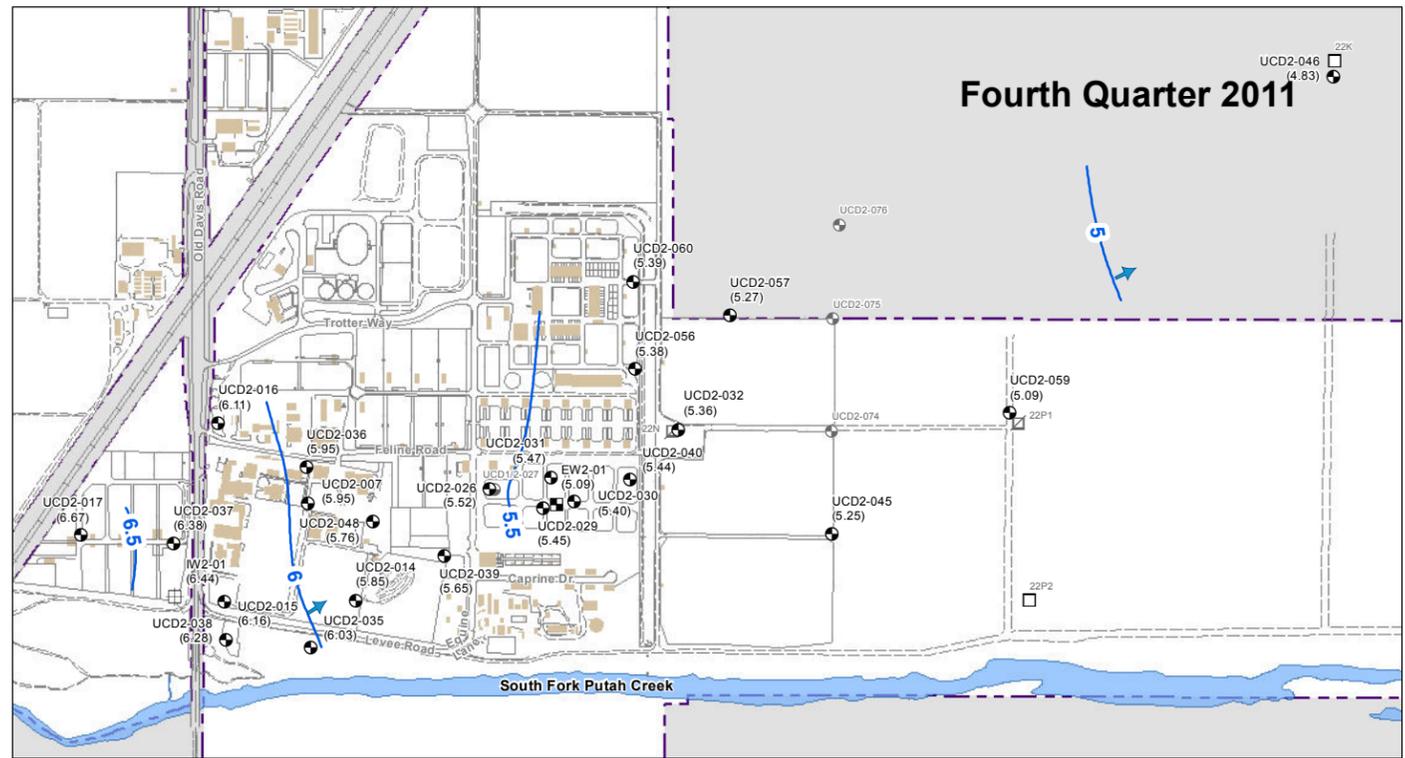
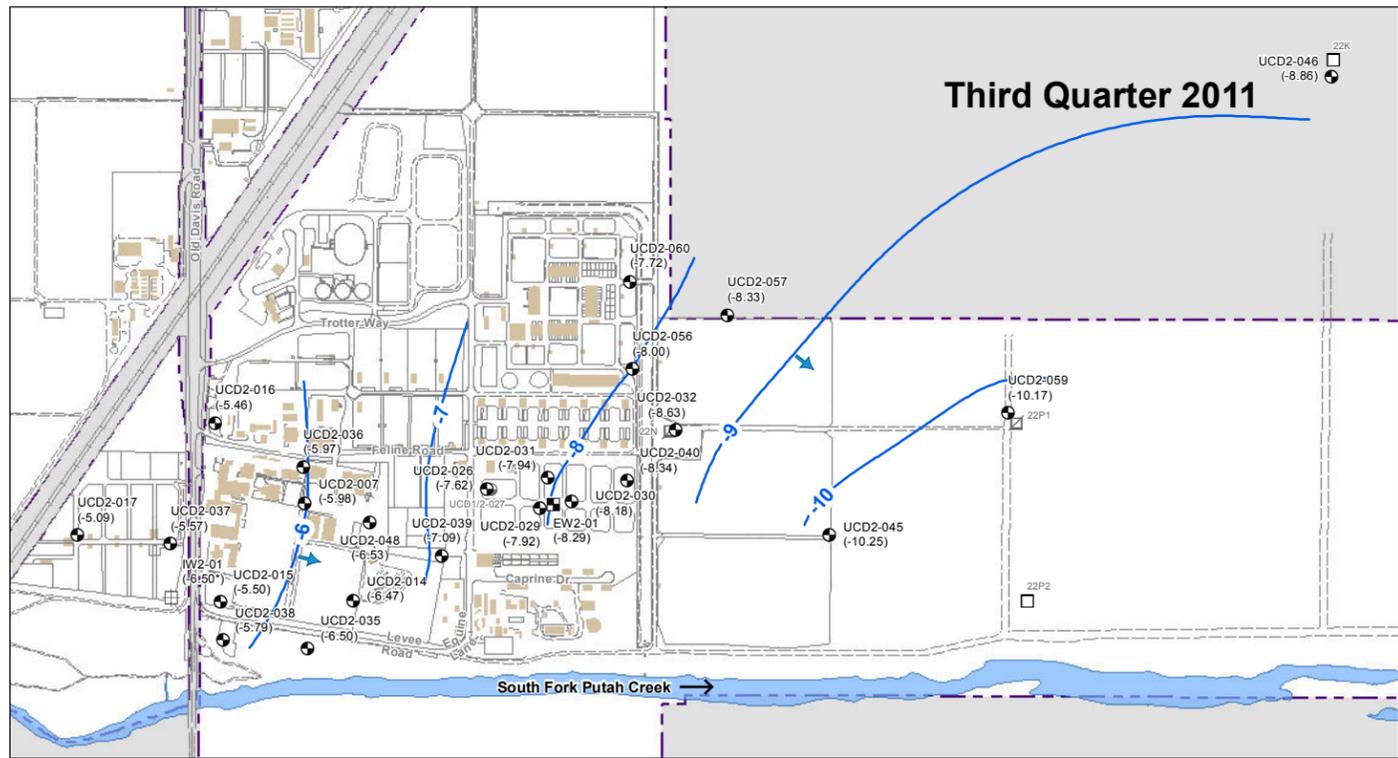
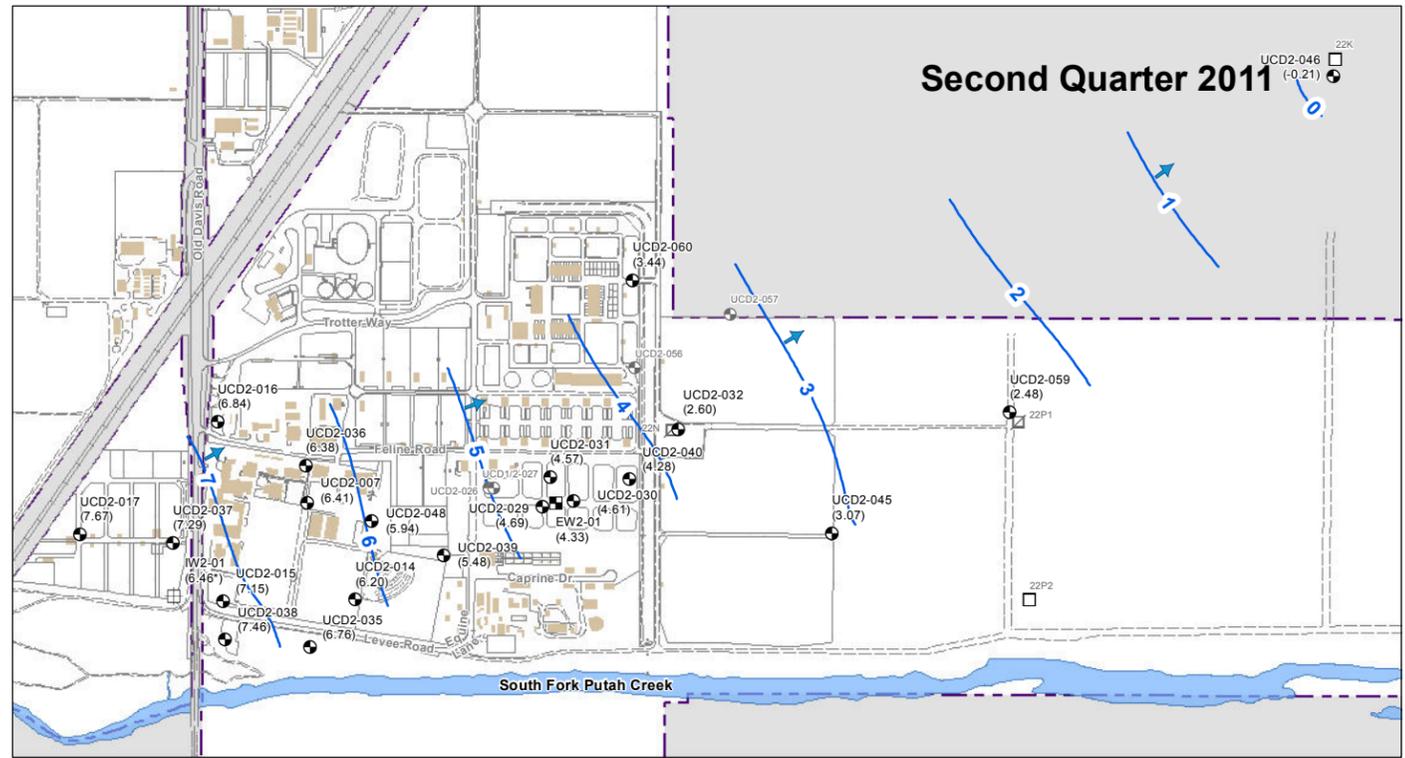
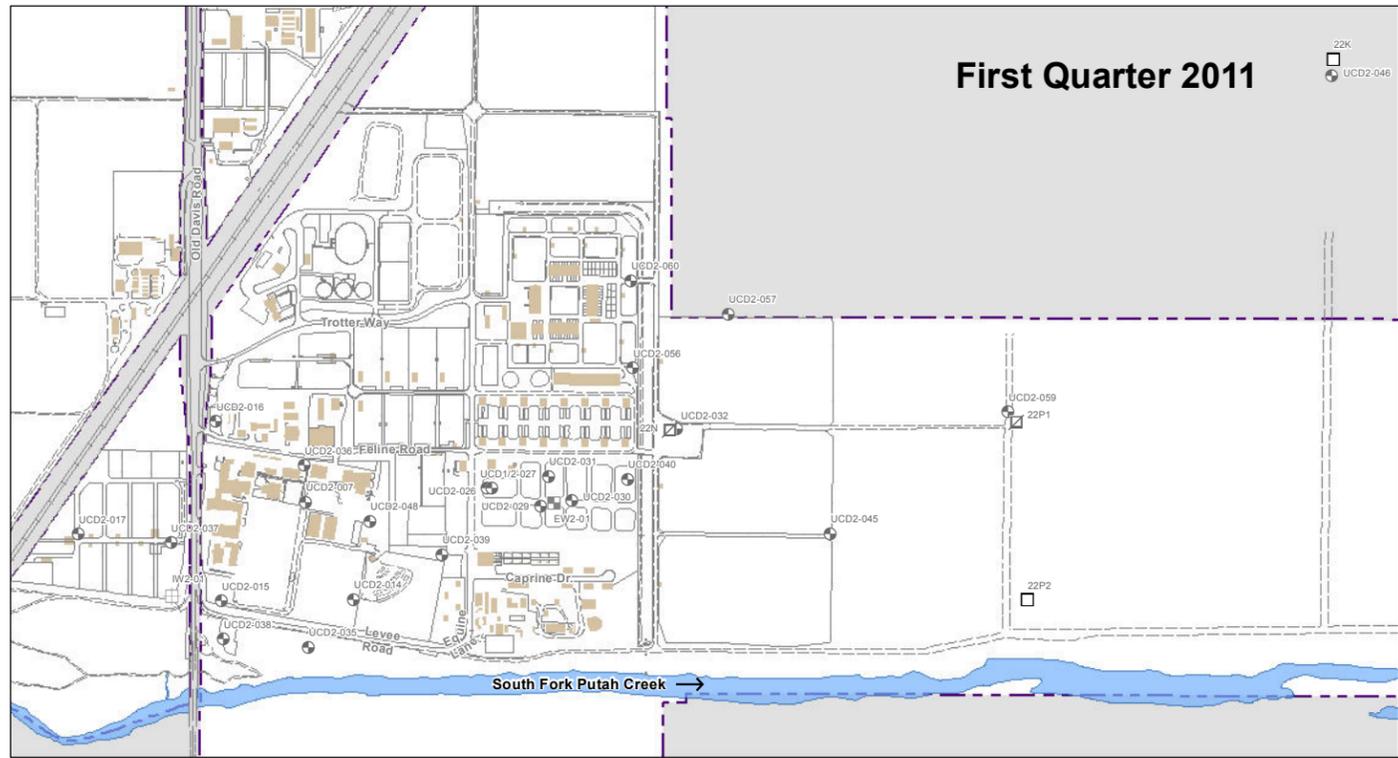


Figure 3. Groundwater Elevations in HSU-1 – Four Quarters 2011 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



- Explanation**
- Monitoring well
 - Extraction well for interim removal action system
 - ⊕ Inactive injection well
 - Monitoring well, not measured
 - Agricultural well
 - ▣ Abandoned agricultural well
 - Building
 - Road
 - Dirt road
 - Railroad
 - Fence
 - (1.00) Groundwater elevation, feet relative to mean sea level
 - * Groundwater elevation not used for contouring (dry or anomalous)
 - 1.0 — Groundwater elevation contour, dashed where inferred, feet relative to mean sea level
 - ➔ Groundwater flow direction, inferred
 - ➔ Surface water flow direction
 - UC Davis property boundary, approximately located

Acronyms/Abbreviations:
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis

Note:
 Wells UCD2-074, UCD2-075, and UCD2-076 were installed in November 2011 and are only shown in the fourth quarter. However, water level data from these three wells were not collected concurrently with other wells and are not shown.

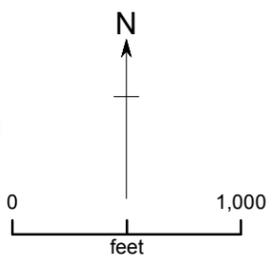
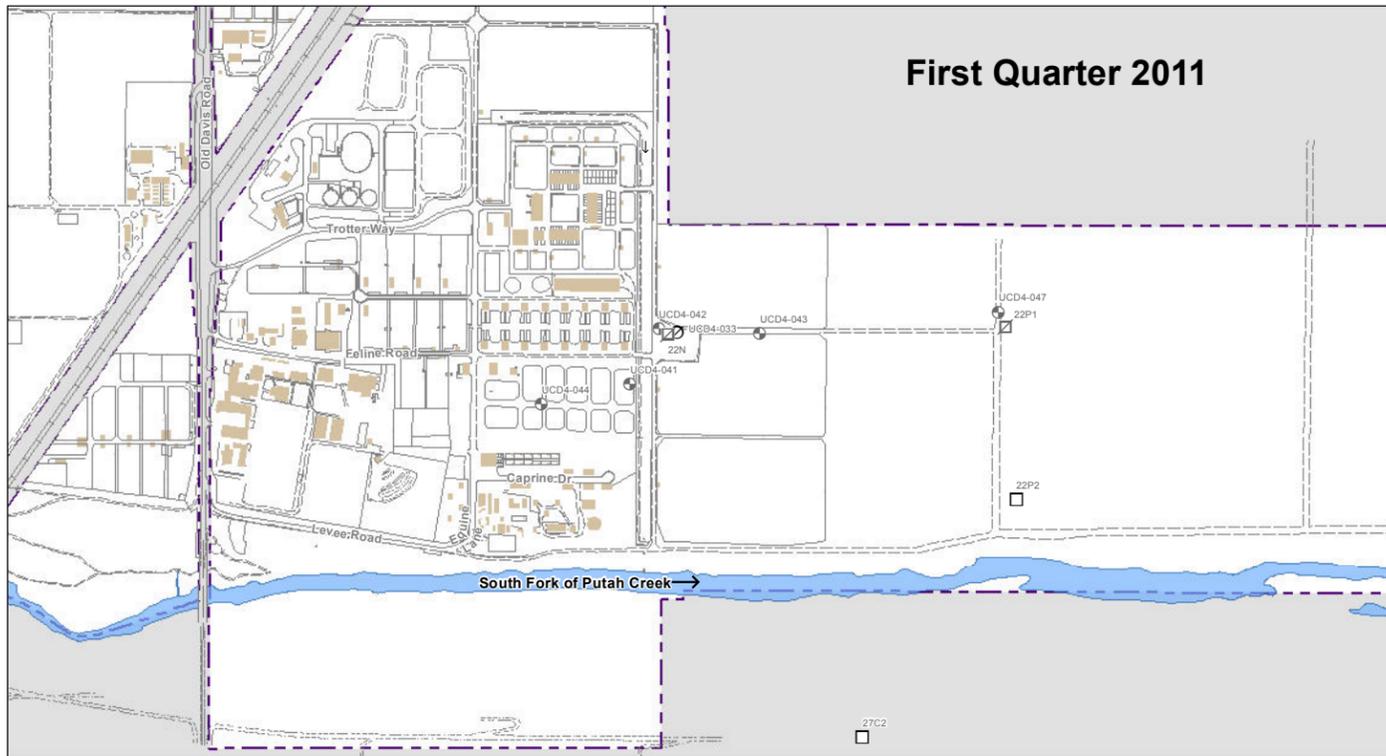
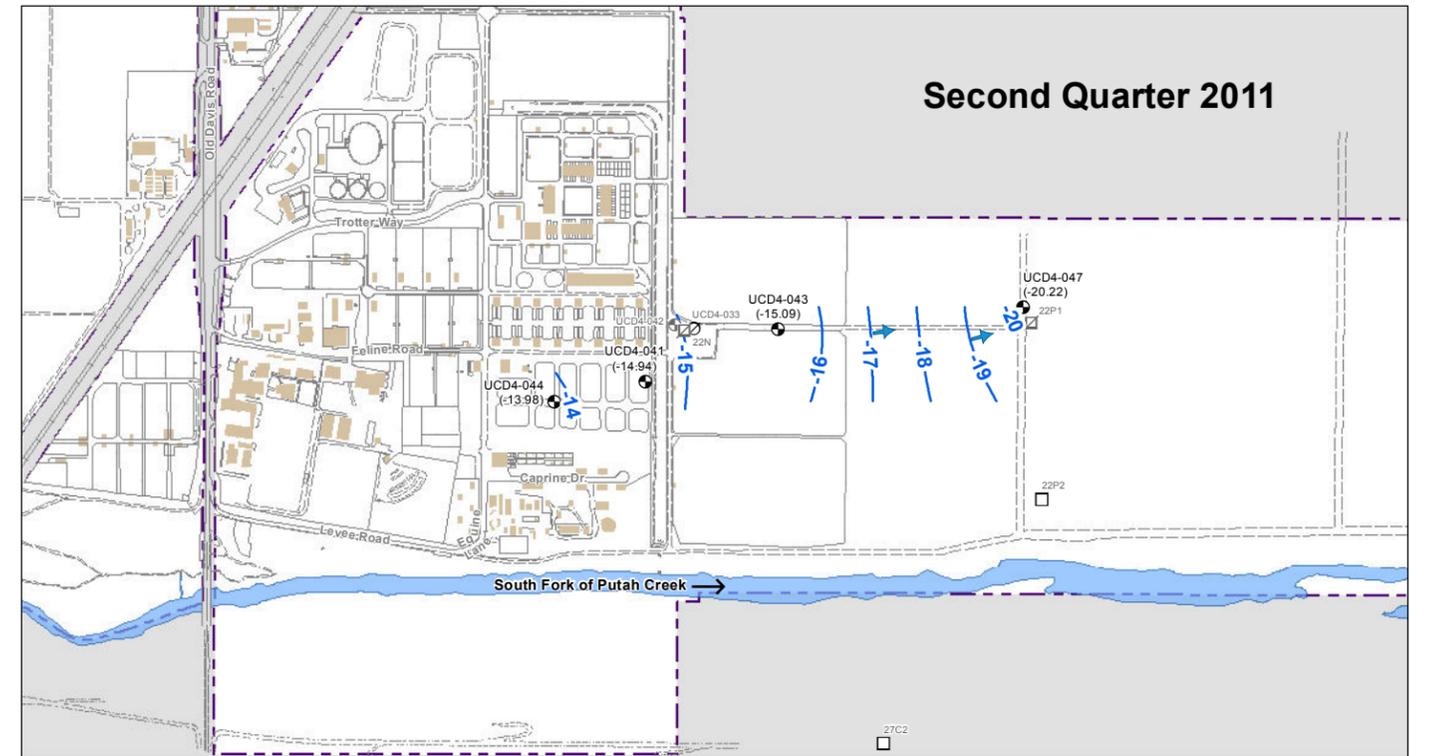


Figure 4. Groundwater Elevations in HSU-2 – Four Quarters 2011 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

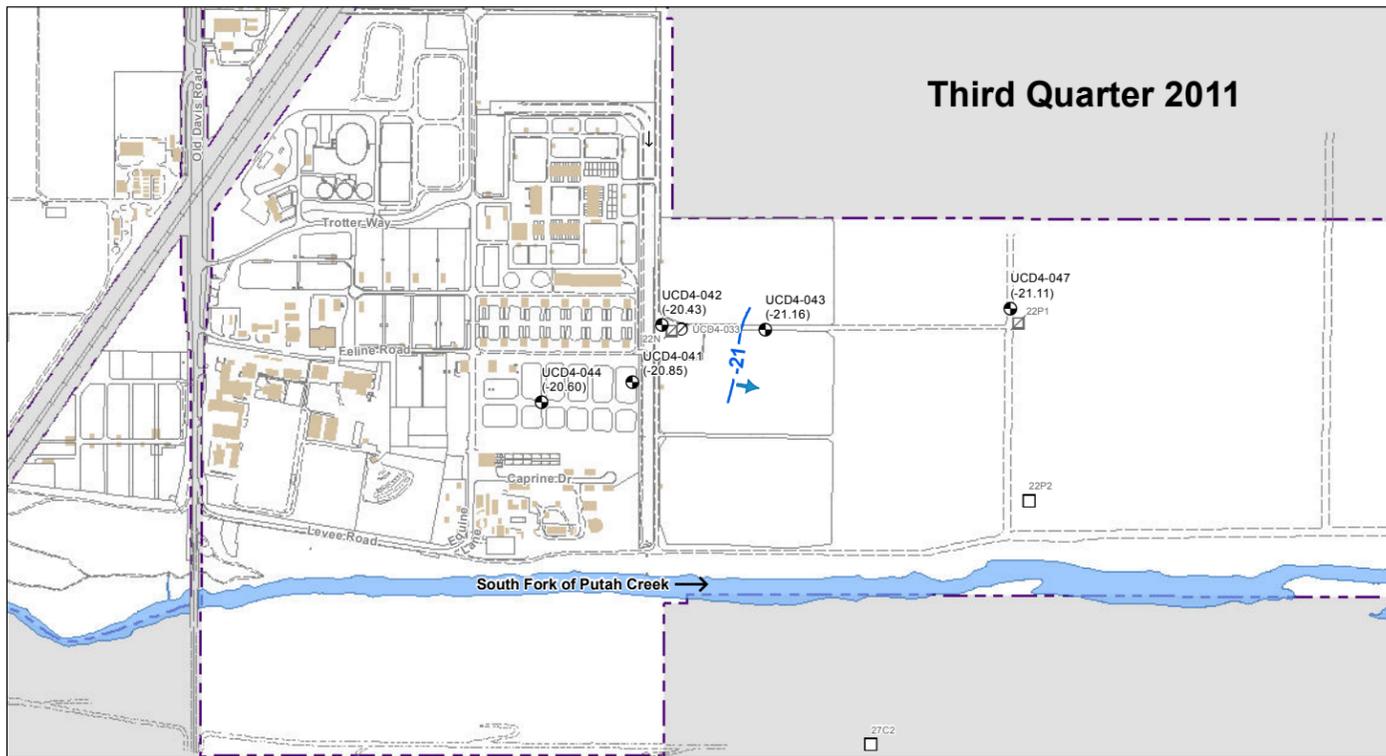
First Quarter 2011



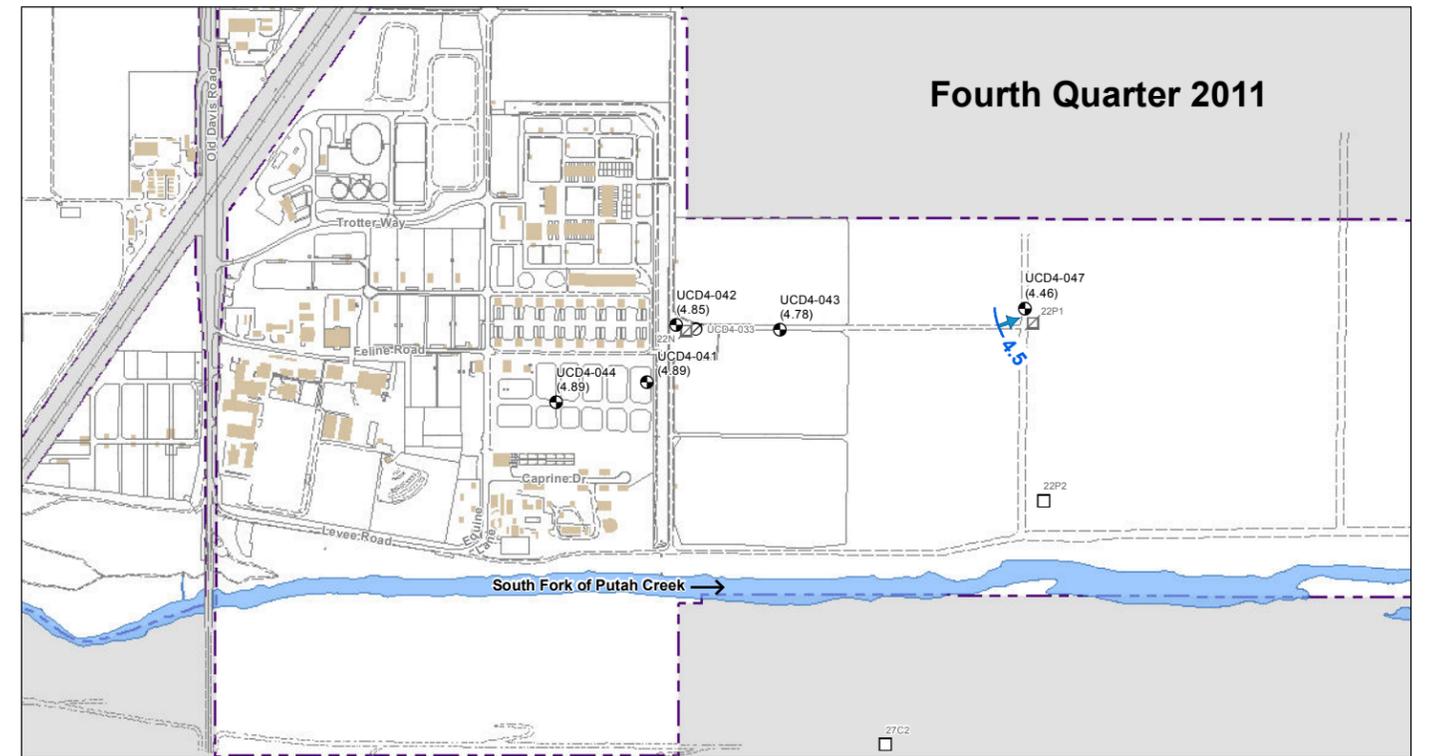
Second Quarter 2011



Third Quarter 2011



Fourth Quarter 2011



Explanation

- Monitoring well
- Monitoring well, not measured
- ⊗ Abandoned monitoring well
- Agricultural well
- ⊗ Abandoned agricultural well
- Building
- South Fork Putah Creek
- Road
- Dirt road
- Railroad
- * Fence

- (1.00) Groundwater elevation, feet relative to mean sea level
- 1.0 — Groundwater elevation contour, dashed where inferred, feet relative to mean sea level
- Groundwater flow direction, inferred
- Surface water flow direction
- - - UC Davis property boundary, approximately located

Acronyms/Abbreviations:

- HSU - hydrostratigraphic unit
- UC Davis - University of California, Davis

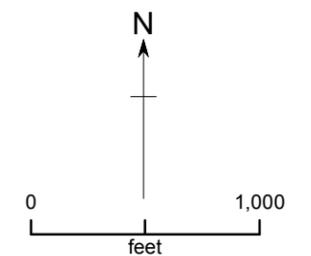
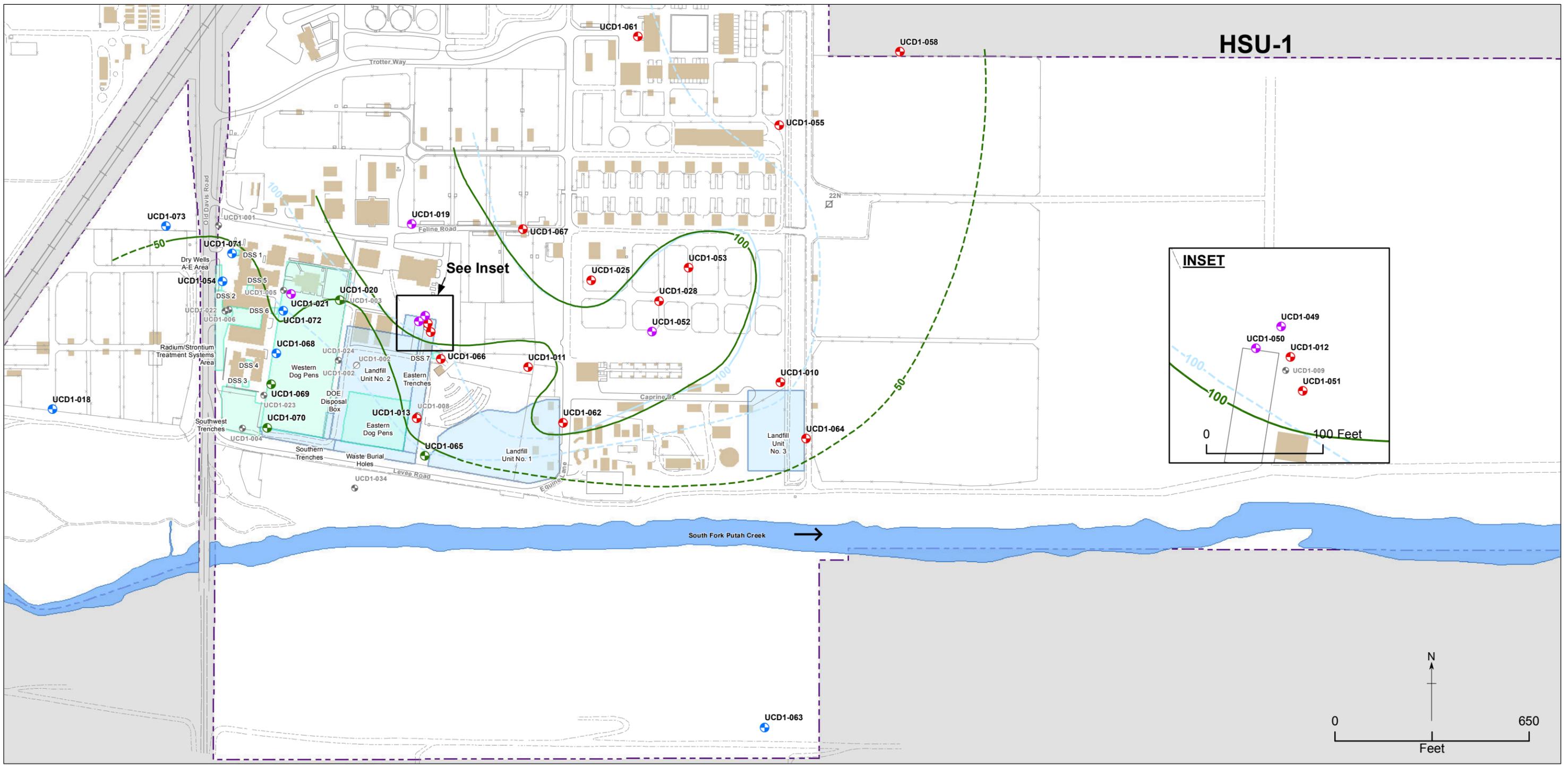


Figure 5. Groundwater Elevations in HSU-4 – Four Quarters 2011 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Explanation

-  Well was only sampled in 2011
-  Well was sampled in 2011 and will be sampled annually
-  Well was sampled in 2011 and will be sampled semi-annually as part of DOE monitoring program
-  Well was sampled in 2011 and will be sampled in 2013
-  Monitoring well, not sampled
-  Abandoned monitoring well
-  Abandoned agricultural well

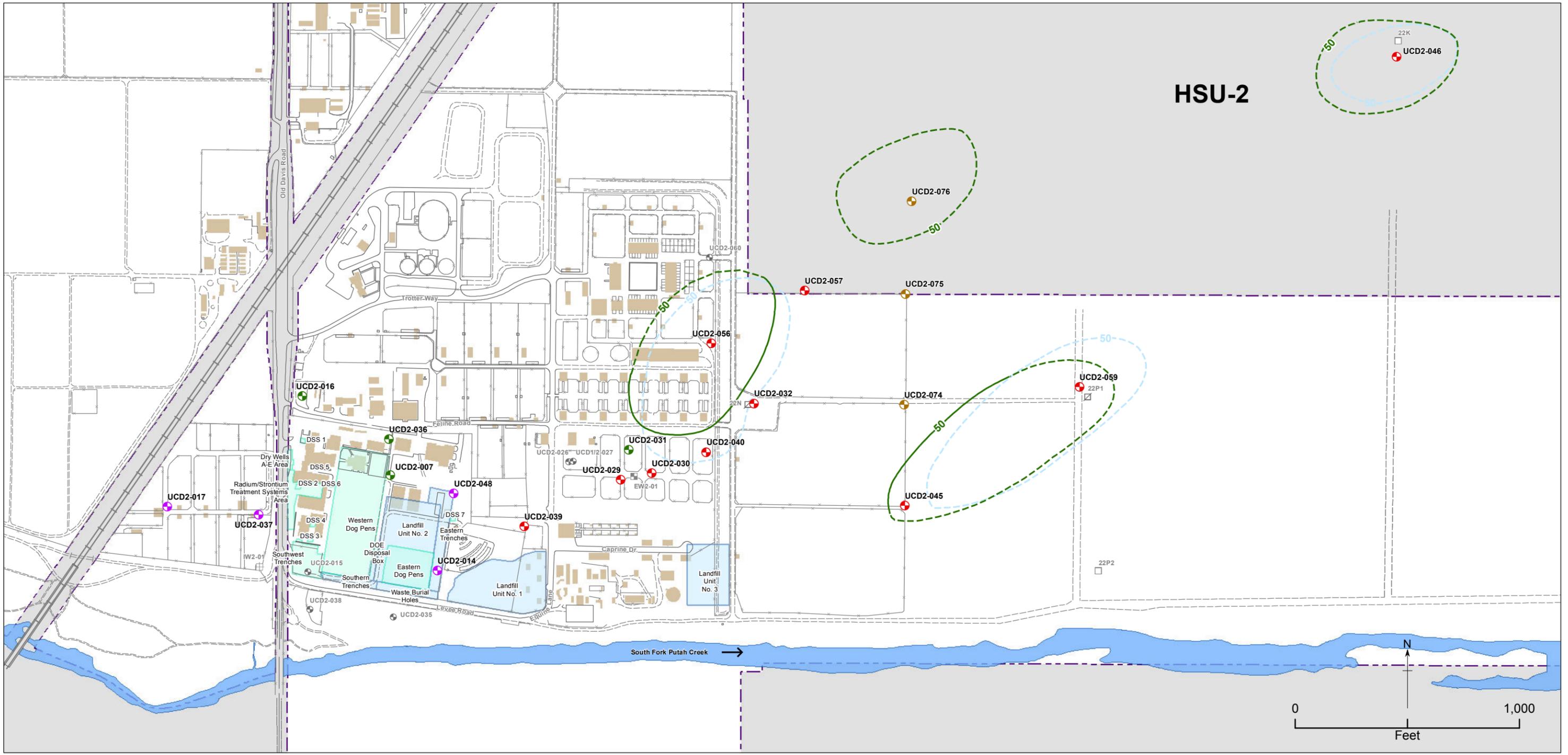
-  UC Davis area
-  DOE area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located

-  Road
-  Dirt road
-  Railroad
-  Fence

-  Total Chromium isoconcentration contour based on highest of four quarters of 2011 data (µg/L), approximately located, dashed where inferred
-  Total Chromium isoconcentration contour based on highest of four quarters of 2010 data (µg/L), approximately located, dashed where inferred
-  Surface water flow direction

Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis
 µg/L - micrograms per liter

Figure 6. Proposed Groundwater Sampling Locations for Total Chromium in Groundwater from HSU-1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Explanation

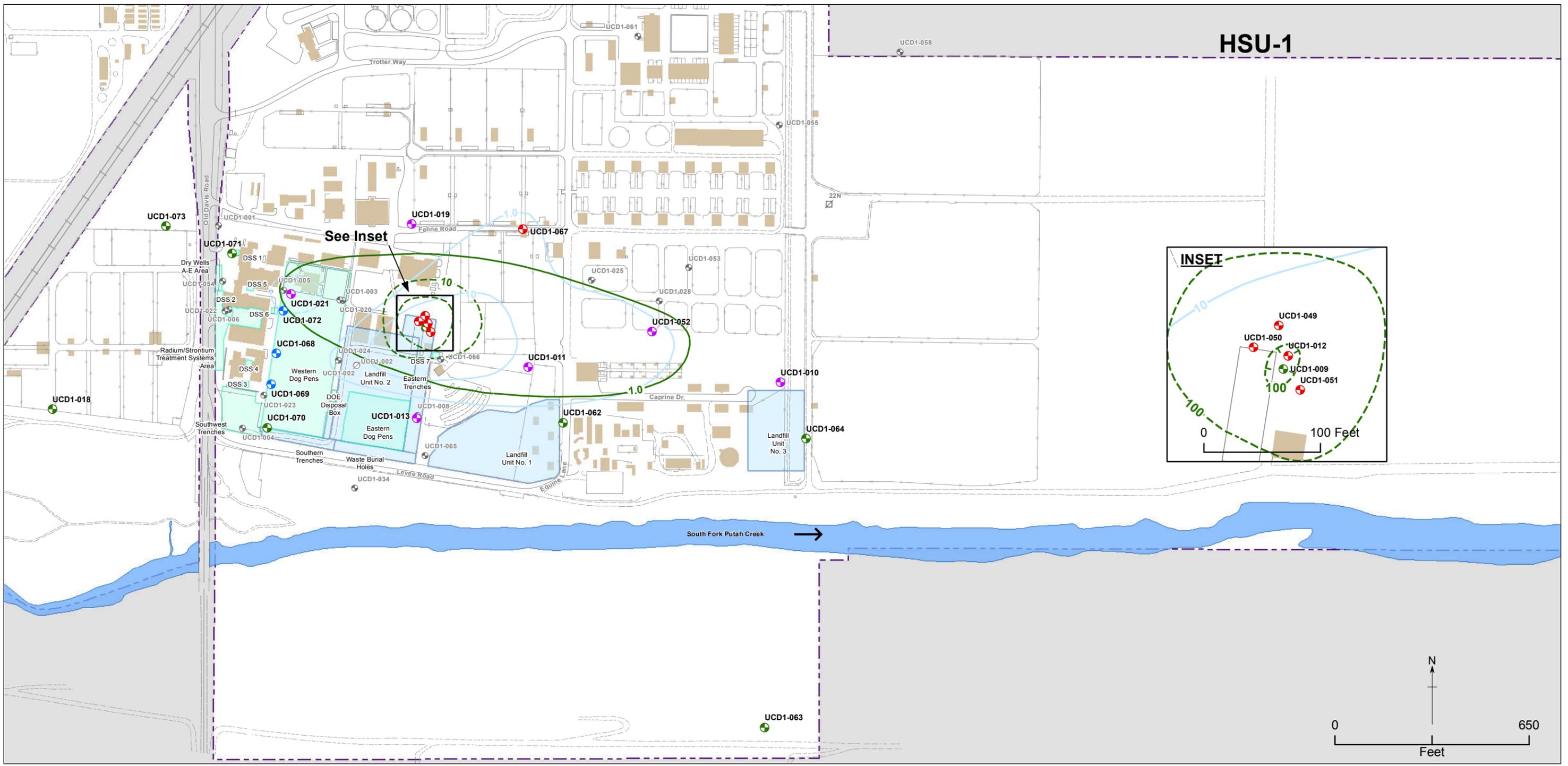
-  Well was only sampled in 2011
-  Well was sampled in 2011 and will be sampled annually
-  Well was sampled in 2011 and will be sampled in 2013
-  Monitoring well was sampled in 2011 and January 2012 and will be sampled during three additional quarters of 2012 and once in 2013
-  Monitoring well, not sampled
-  Extraction well for interim removal action system
-  Inactive injection well

-  Abandoned agricultural well
-  Agricultural well
-  DOE area
-  UC Davis area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located
-  Road
-  Dirt road
-  Railroad
-  Fence

-  Total Chromium isoconcentration contour based on highest of four quarters of 2011 data (µg/L), approximately located, dashed where inferred
-  Total Chromium isoconcentration contour based on highest of four quarters of 2010 data (µg/L), approximately located, dashed where inferred
-  Surface water flow direction

Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis
 µg/L - micrograms per liter

Figure 7. Proposed Groundwater Sampling Locations for Total Chromium in Groundwater from HSU-2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Explanation

-  Well was only sampled in 2011
-  Well was sampled in 2011 and will be sampled annually
-  Well was sampled in 2011 and will be sampled semi-annually as part of DOE monitoring program
-  Well was sampled in 2011 and will be sampled in 2013
-  Monitoring well, not sampled
-  Abandoned monitoring well
-  Abandoned agricultural well

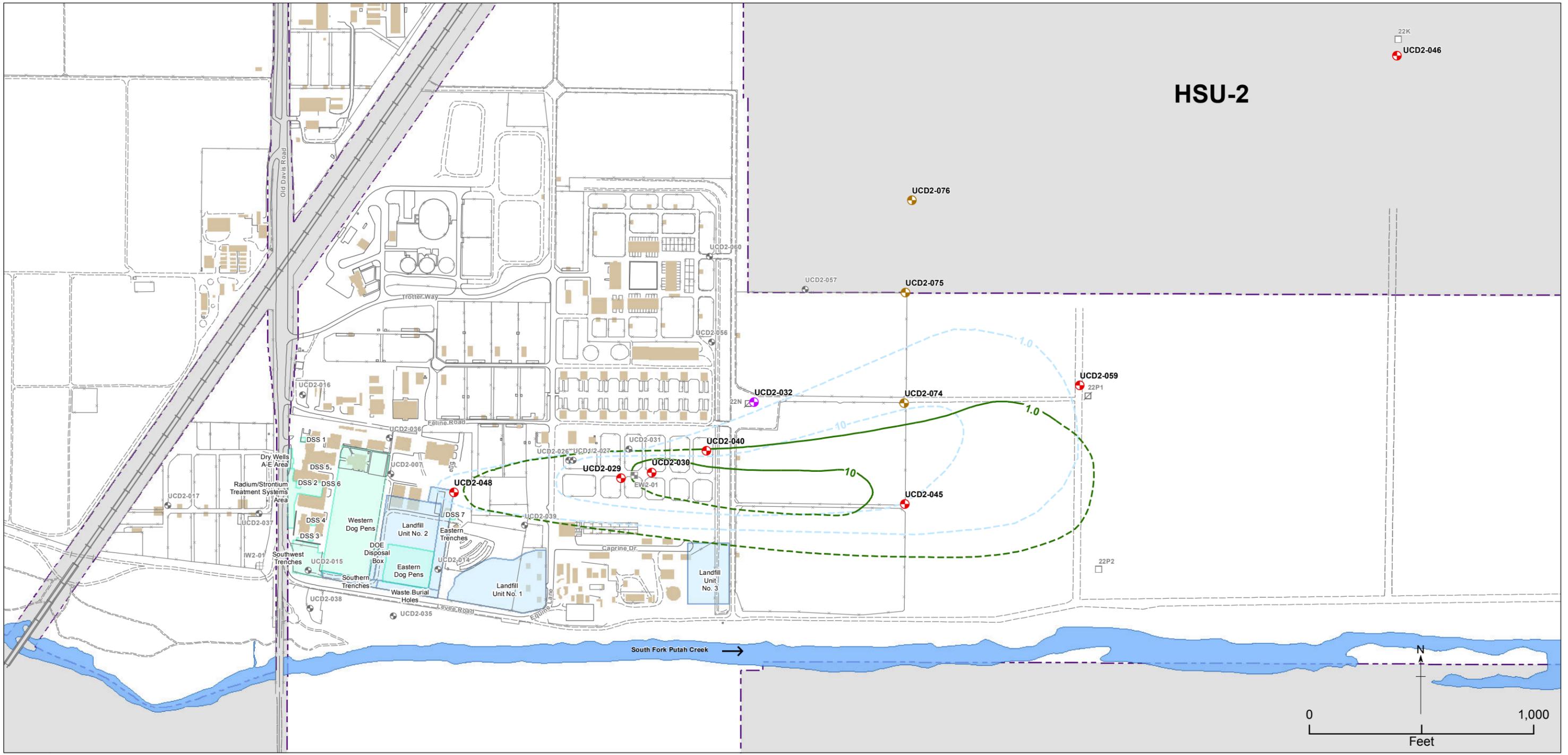
-  UC Davis area
-  DOE area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located

-  Road
-  Dirt road
-  Railroad
-  Fence

-  Chloroform isoconcentration contour based on highest of four quarters of 2011 data (µg/L), approximately located, dashed where inferred
-  Chloroform isoconcentration contour based on highest of four quarters of 2010 data (µg/L), approximately located, dashed where inferred
-  Surface water flow direction

Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis
 µg/L - micrograms per liter

Figure 8. Proposed Groundwater Sampling Locations for Chloroform in Groundwater from HSU-1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Explanation

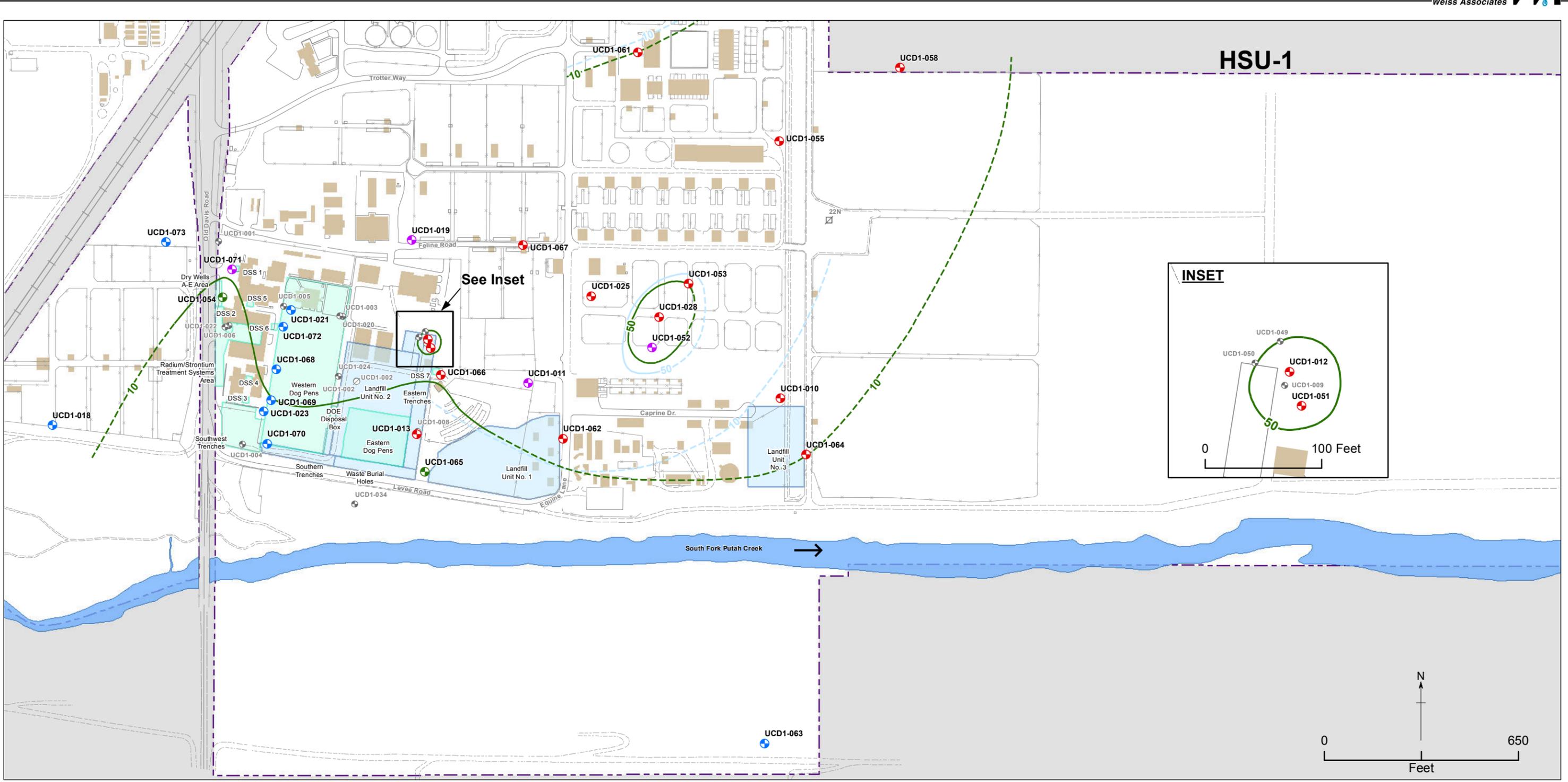
- 🔴 Well was sampled in 2011 and will be sampled annually
- 🟡 Well was sampled in 2011 and will be sampled in 2013
- 🟠 Monitoring well was sampled in 2011 and January 2012 and will be sampled during three additional quarters of 2012 and once in 2013
- ⬜ Monitoring well, not sampled
- 🏠 Extraction well for interim removal action system
- ⊞ Inactive injection well

- 🏠 Abandoned agricultural well
- ⬜ Agricultural well
- 🟢 DOE area
- 🟡 UC Davis area
- 🏠 Building
- 🟢 South Fork Putah Creek
- 🟡 UC Davis property boundary, approximately located
- Road
- - - Dirt road
- Railroad
- - - Fence

- 🟢 Chloroform isoconcentration contour based on highest of four quarters of 2011 data (µg/L), approximately located, dashed where inferred
- 🟡 Chloroform isoconcentration contour based on highest of four quarters of 2010 data (µg/L), approximately located, dashed where inferred
- ➔ Surface water flow direction

Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis
 µg/L - micrograms per liter

Figure 9. Proposed Groundwater Sampling Locations for Chloroform in Groundwater from HSU-2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Explanation

-  Well was only sampled in 2011
-  Well was sampled in 2011 and will be sampled annually
-  Well was sampled in 2011 and will be sampled semi-annually as part of DOE monitoring program
-  Well was sampled in 2011 and will be sampled in 2013
-  Monitoring well, not sampled
-  Abandoned monitoring well
-  Abandoned agricultural well

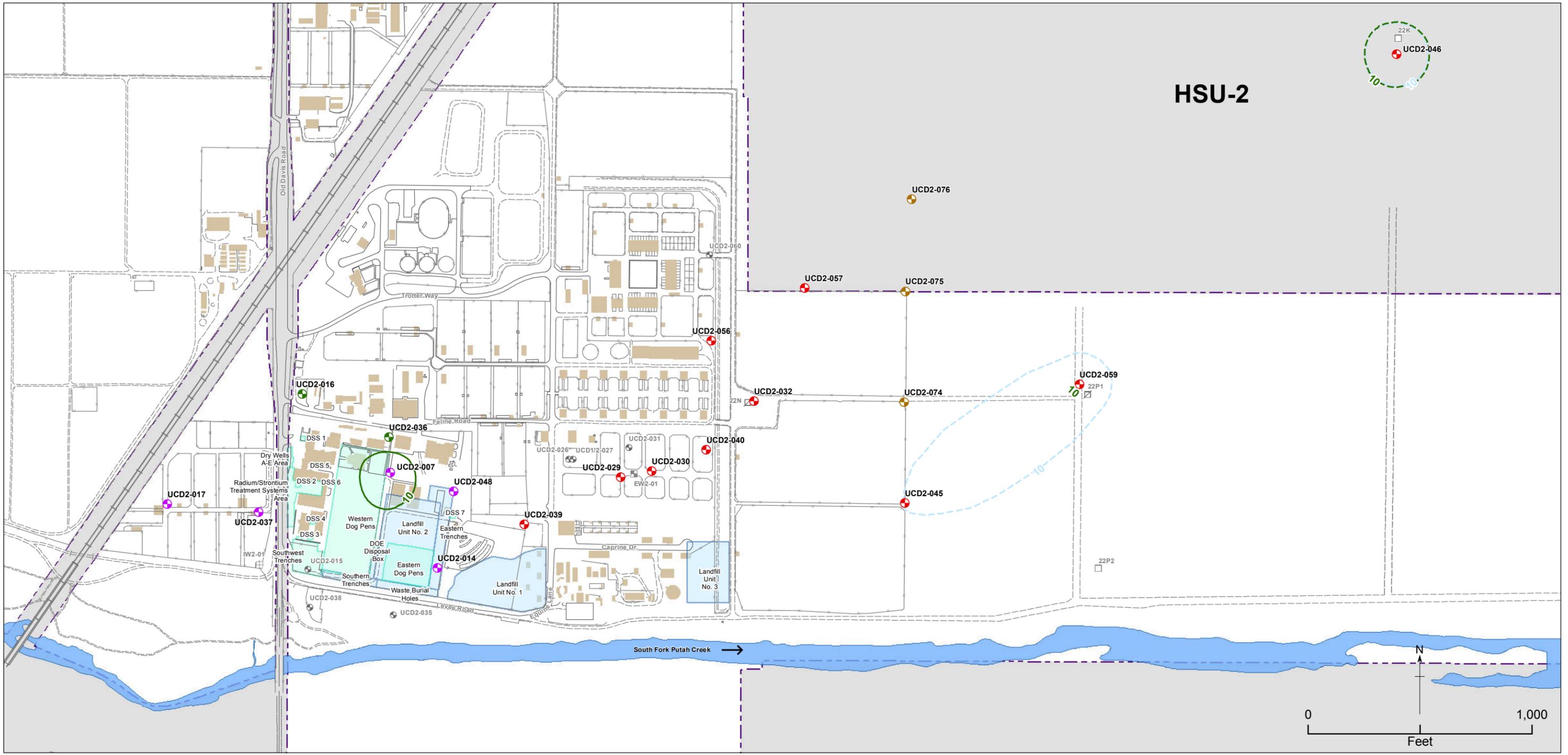
-  UC Davis area
-  DOE area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located

-  Road
-  Dirt road
-  Railroad
-  Fence

-  Nitrate (as N) isoconcentration contour based on highest of four quarters of 2011 data (mg/L), approximately located, dashed where inferred
-  Nitrate (as N) isoconcentration contour based on highest of four quarters of 2010 data (mg/L), approximately located, dashed where inferred
-  Surface water flow direction

- Acronyms/Abbreviations:**
- DOE - United States Department of Energy
 - DSS - domestic septic system
 - HSU - hydrostratigraphic unit
 - mg/L - milligrams per liter
 - N - nitrogen
 - UC Davis - University of California, Davis

Figure 10. Proposed Groundwater Sampling Locations for Nitrate (as Nitrogen) in Groundwater from HSU-1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Explanation

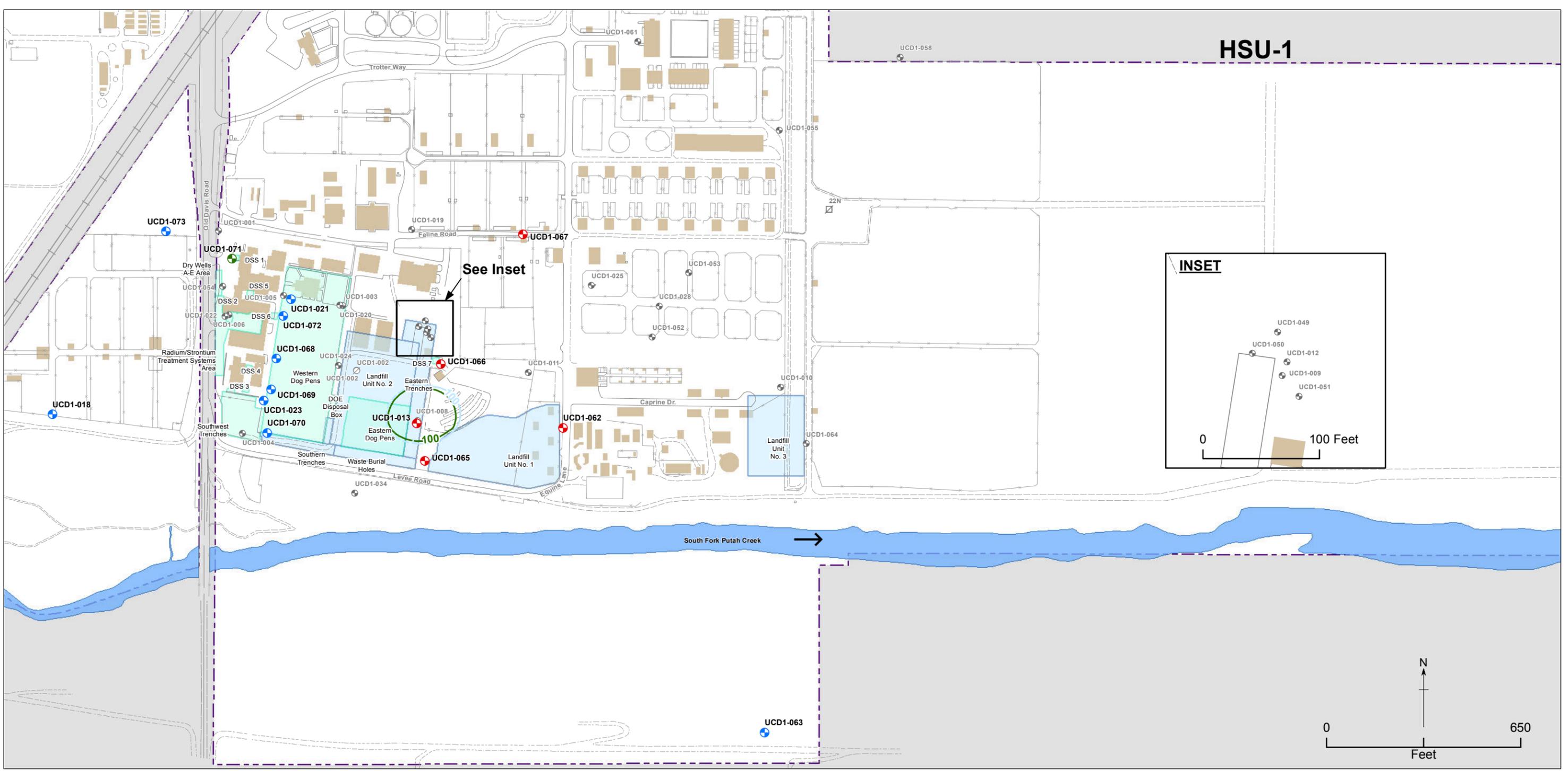
-  Well was only sampled in 2011
-  Well was sampled in 2011 and will be sampled annually
-  Well was sampled in 2011 and will be sampled in 2013
-  Monitoring well was sampled in 2011 and January 2012 and will be sampled during three additional quarters of 2012 and once in 2013
-  Monitoring well, not sampled
-  Extraction well for interim removal action system
-  Inactive injection well

-  Abandoned agricultural well
-  Agricultural well
-  DOE area
-  UC Davis area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located
-  Road
-  Dirt road
-  Railroad
-  Fence

-  Nitrate (as N) isoconcentration contour based on highest of four quarters of 2011 data (mg/L), approximately located, dashed where inferred
-  Nitrate (as N) isoconcentration contour based on highest of four quarters of 2010 data (mg/L), approximately located, dashed where inferred
-  Surface water flow direction

- Acronyms/Abbreviations:**
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 mg/L - milligrams per liter
 N - nitrogen
 UC Davis - University of California, Davis

Figure 11. Proposed Groundwater Sampling Locations for Nitrate (as Nitrogen) in Groundwater from HSU-2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Explanation

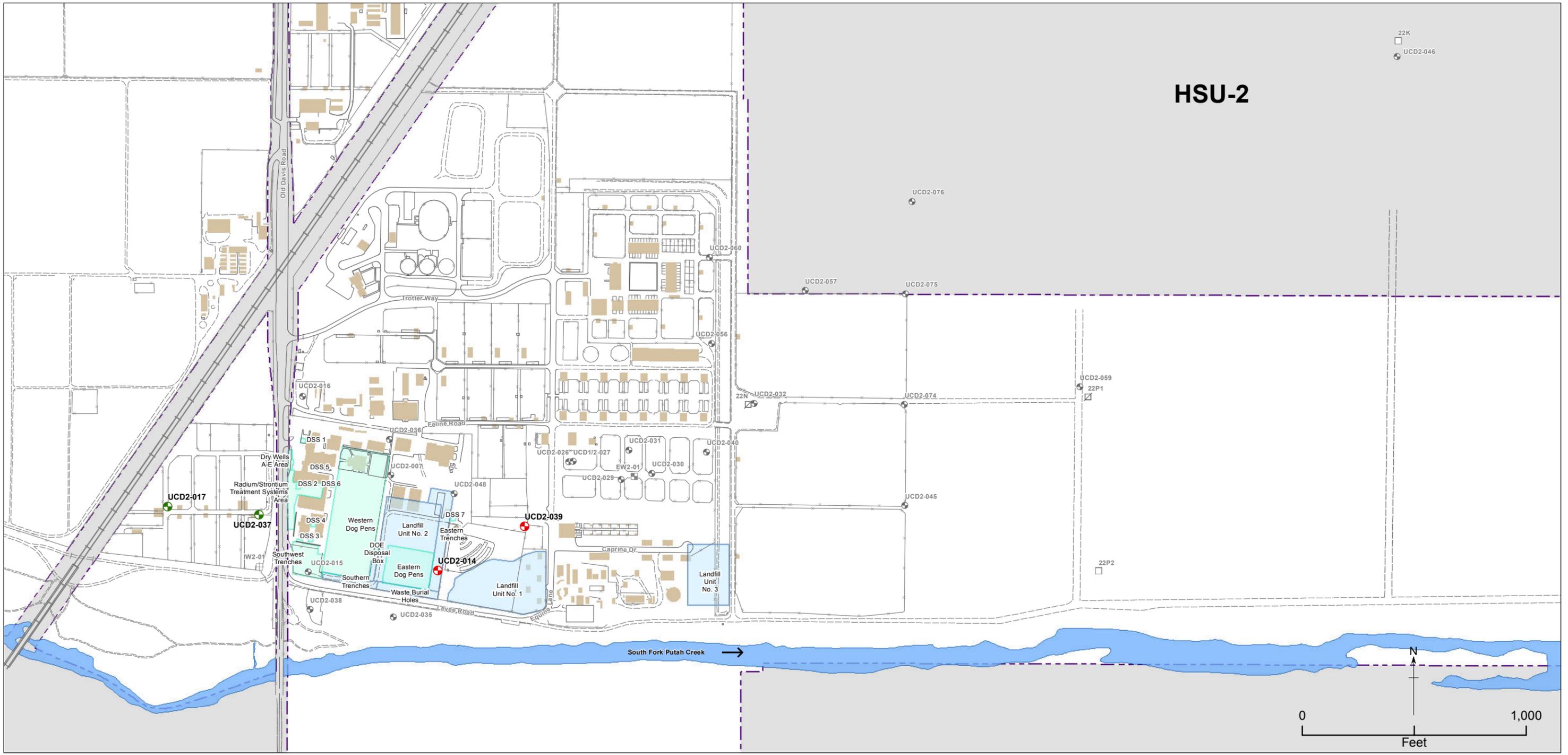
- Well was only sampled in 2011
- Well was sampled in 2011 and will be sampled annually
- Well was sampled in 2011 and will be sampled semi-annually as part of DOE monitoring program
- Monitoring well, not sampled
- Abandoned monitoring well
- ⊠ Abandoned agricultural well

- UC Davis area
- DOE area
- Building
- South Fork Putah Creek
- ⊠ UC Davis property boundary, approximately located
- Road
- - - Dirt road
- Railroad
- * - * - Fence

- ~ Carbon-14 isoconcentration contour based on highest of four quarters of 2011 data (µg/L), approximately located, dashed where inferred
- ~ Carbon-14 isoconcentration contour based on highest of four quarters of 2010 data (µg/L), approximately located, dashed where inferred
- Surface water flow direction

Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis

Figure 12. Proposed Groundwater Sampling Locations for Carbon-14 in Groundwater from HSU-1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Explanation

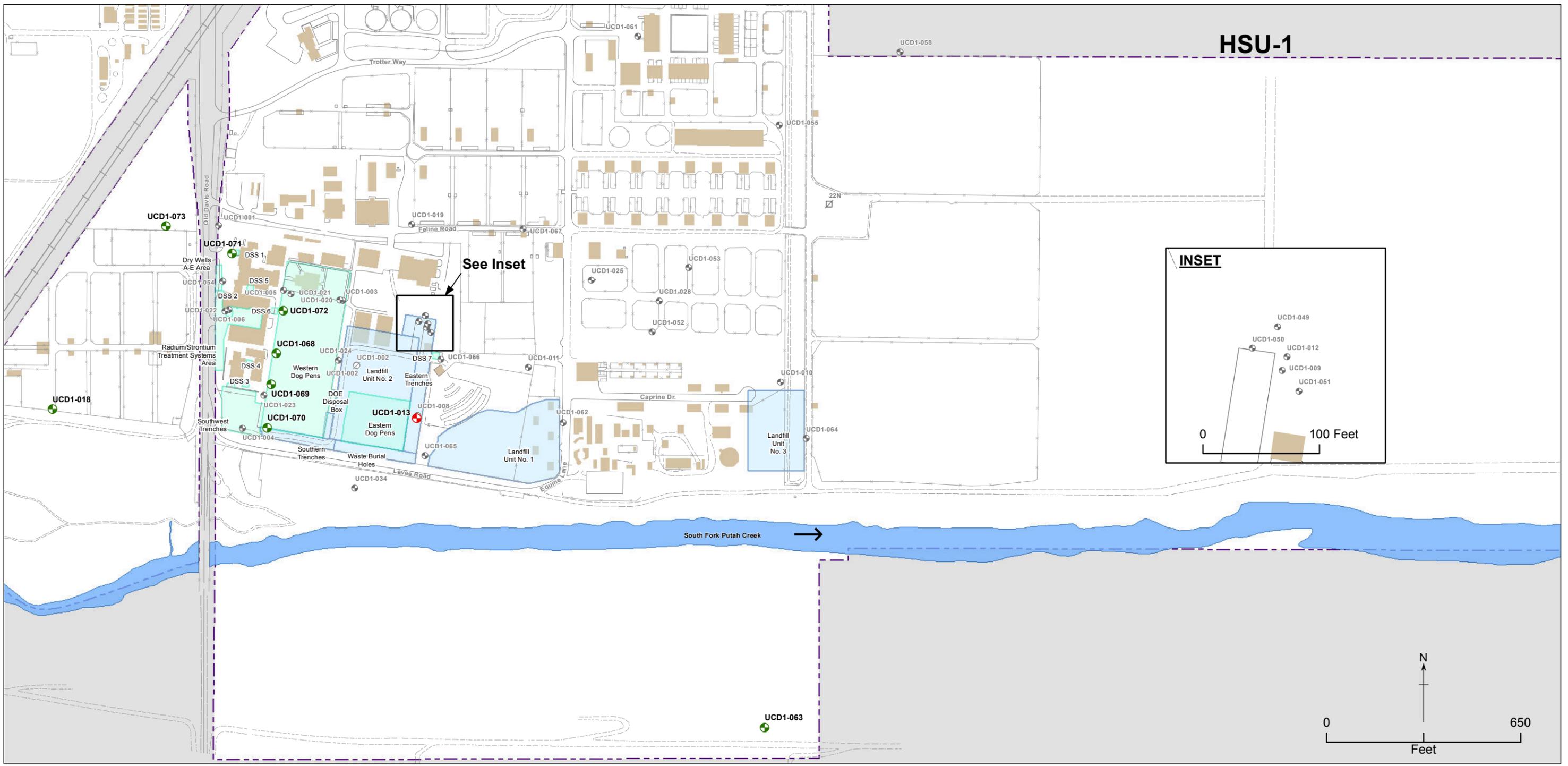
-  Well was only sampled in 2011
-  Well was sampled in 2011 and will be sampled annually
-  Monitoring well, not sampled
-  Extraction well for interim removal action system
-  Inactive injection well
-  Abandoned agricultural well
-  Agricultural well

-  DOE area
-  UC Davis area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located
-  Road
-  Dirt road
-  Railroad
-  Fence

→ Surface water flow direction

Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis

Figure 13. Proposed Groundwater Sampling Locations for Carbon-14 in Groundwater from HSU-2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

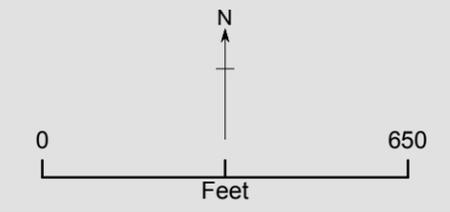


Explanation

- Well was only sampled in 2011
- Well was sampled in 2011 and will be sampled annually
- Monitoring well, not sampled
- Abandoned monitoring well
- Abandoned agricultural well

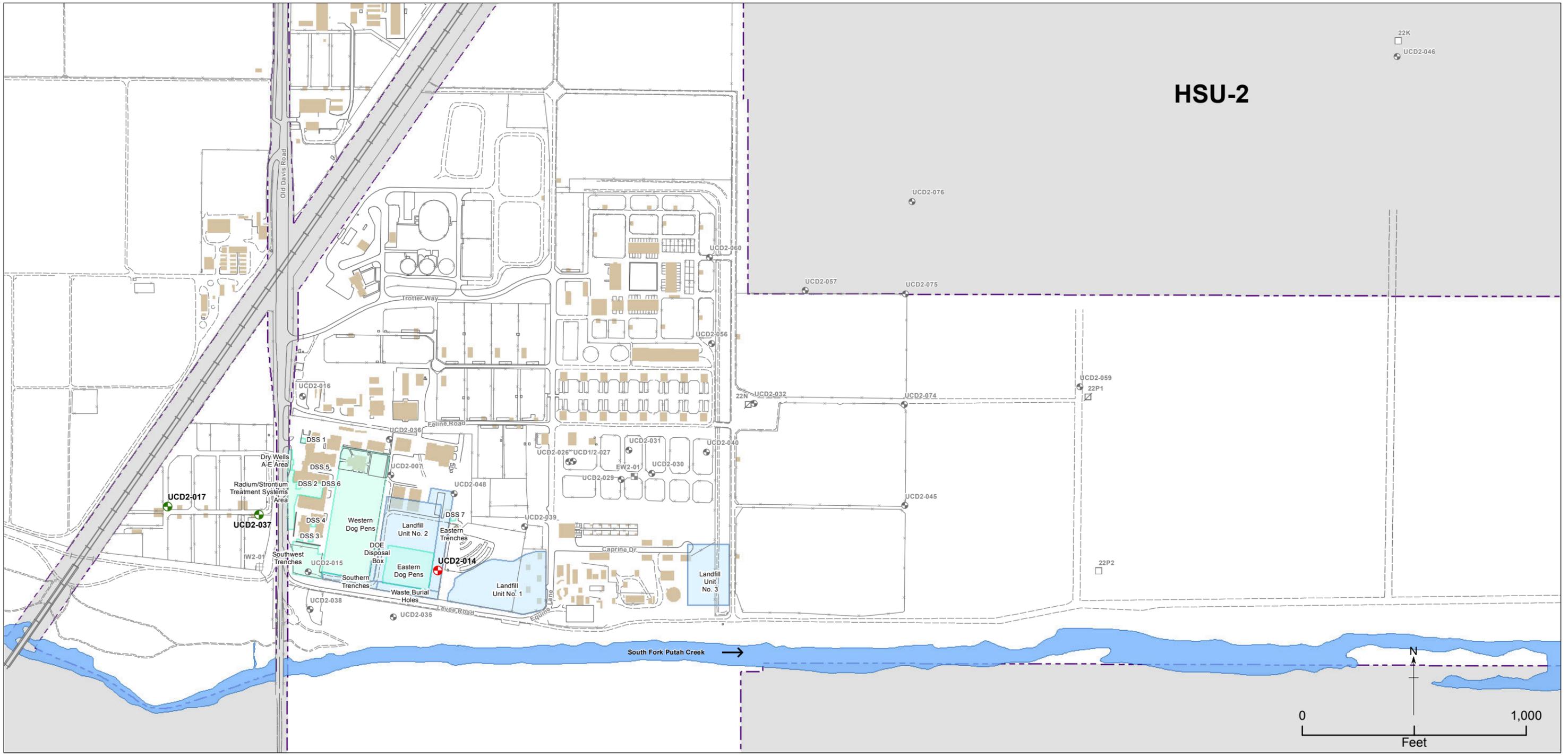
- UC Davis area
- DOE area
- Building
- South Fork Putah Creek
- UC Davis property boundary, approximately located
- Road
- - - Dirt road
- Railroad
- * * * Fence

→ Surface water flow direction



Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis

Figure 14. Proposed Groundwater Sampling Locations for Tritium in Groundwater from HSU-1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



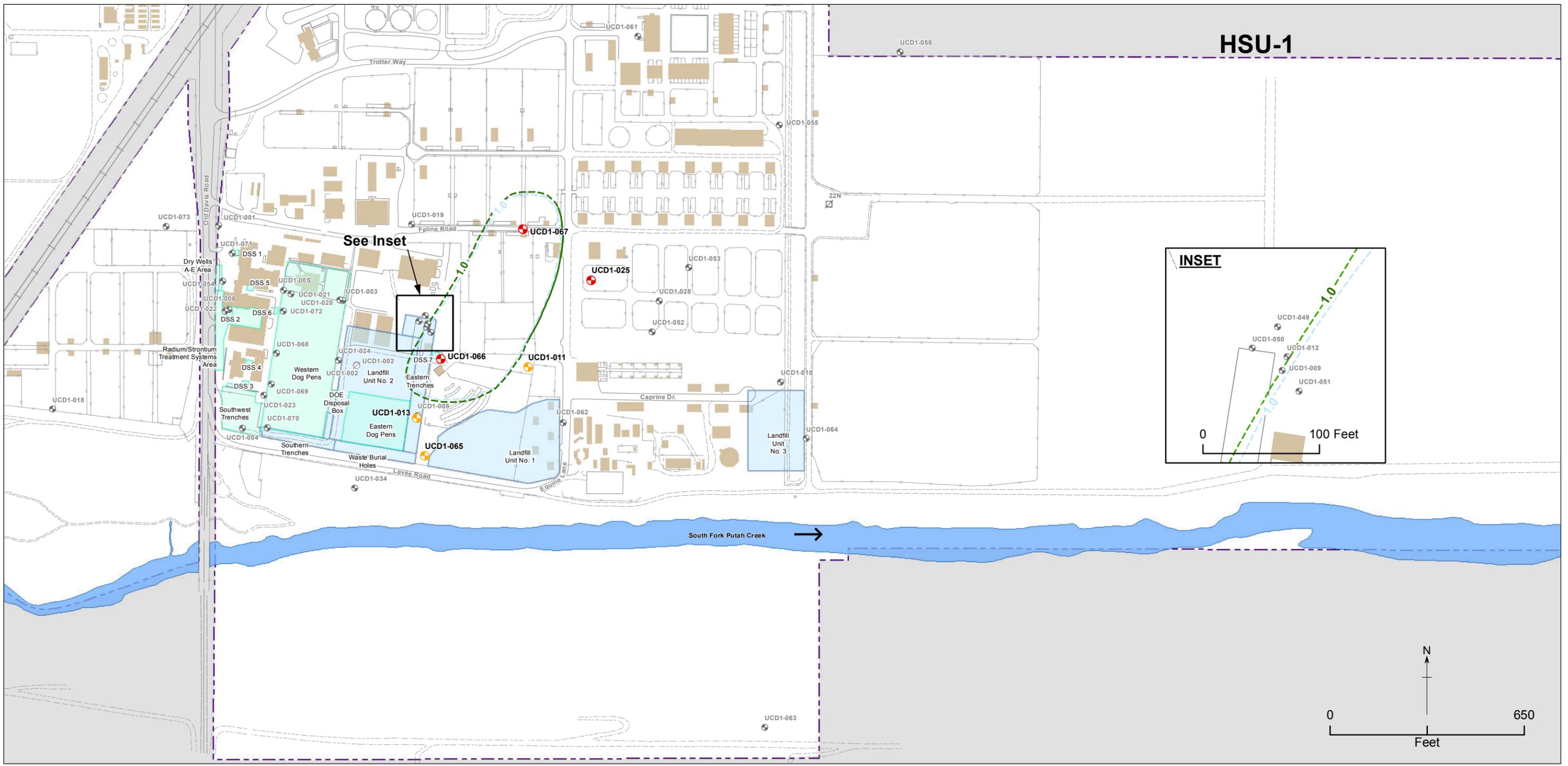
- Explanation**
-  Well was only sampled in 2011
 -  Well was sampled in 2011 and will be sampled annually
 -  Monitoring well, not sampled
 -  Extraction well for interim removal action system
 -  Inactive injection well
 -  Abandoned agricultural well
 -  Agricultural well

-  DOE area
-  UC Davis area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located
-  Road
-  Dirt road
-  Railroad
-  Fence

→ Surface water flow direction

Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis

Figure 15. Proposed Groundwater Sampling Locations for Tritium in Groundwater from HSU-2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Explanation

-  Well was sampled in 2011 and will be sampled annually
-  Well will be sampled in 2012
-  Monitoring well, not sampled
-  Abandoned monitoring well
-  Abandoned agricultural well

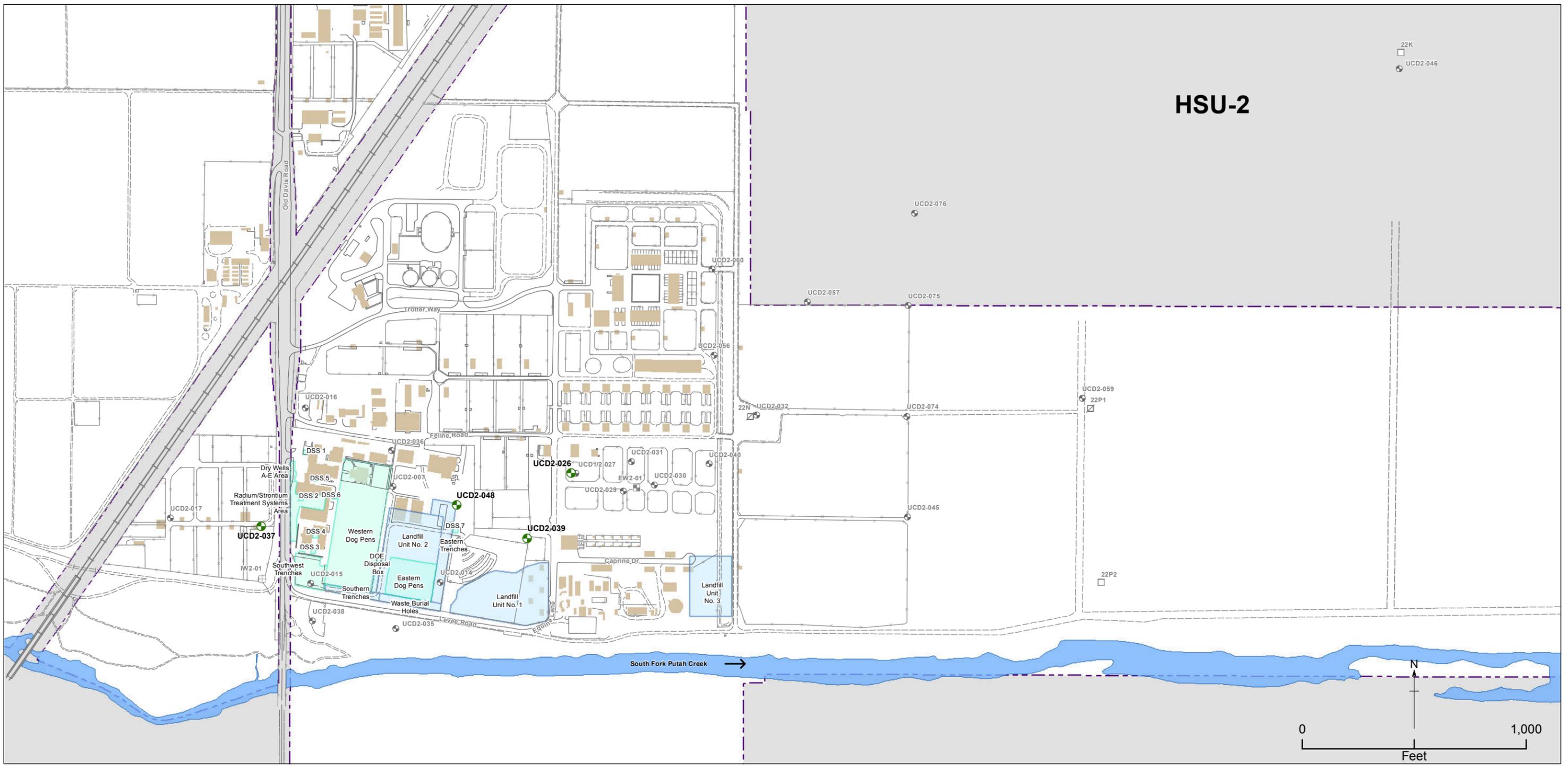
-  UC Davis area
-  DOE area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located

-  Road
-  Dirt road
-  Railroad
-  Fence

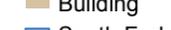
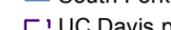
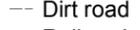
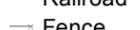
-  1,4-Dioxane isoconcentration contour based on highest of four quarters of 2011 data (µg/L), approximately located, dashed where inferred
-  1,4-Dioxane isoconcentration contour based on highest of four quarters of 2010 data (µg/L), approximately located, dashed where inferred
-  Surface water flow direction

- Acronyms/Abbreviations:**
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis
 µg/L - micrograms per liter

Figure 16. Proposed Groundwater Sampling Locations for 1,4-Dioxane in Groundwater from HSU-1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



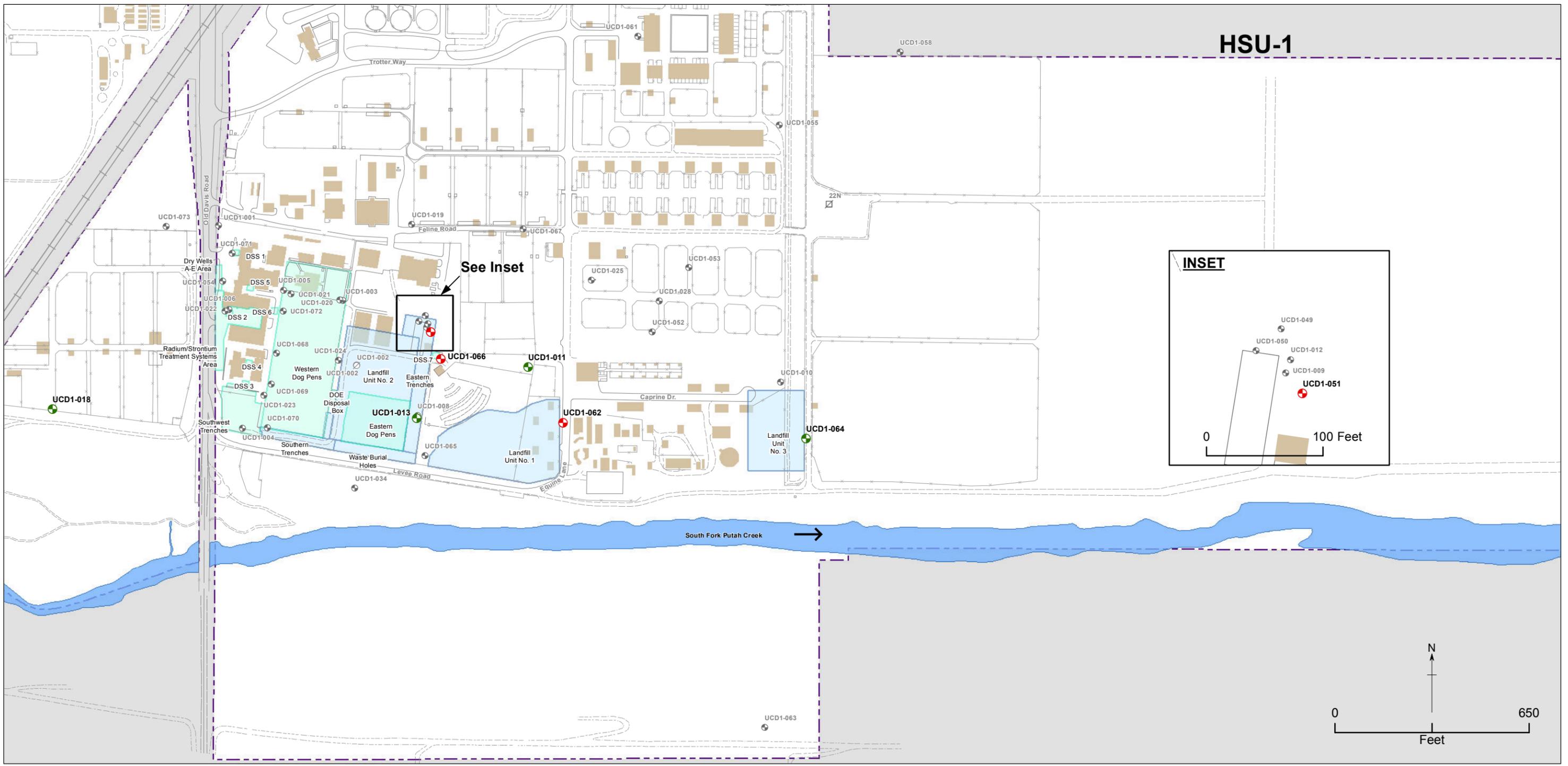
- Explanation**
-  Well was only sampled in 2011
 -  Monitoring well, not sampled
 -  Extraction well for interim removal action system
 -  Inactive injection well
 -  Abandoned agricultural well
 -  Agricultural well

-  DOE area
-  UC Davis area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located
-  Road
-  Dirt road
-  Railroad
-  Fence

→ Surface water flow direction

Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis

Figure 17. Proposed Groundwater Sampling Locations for 1,4-Dioxane in Groundwater from HSU-2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

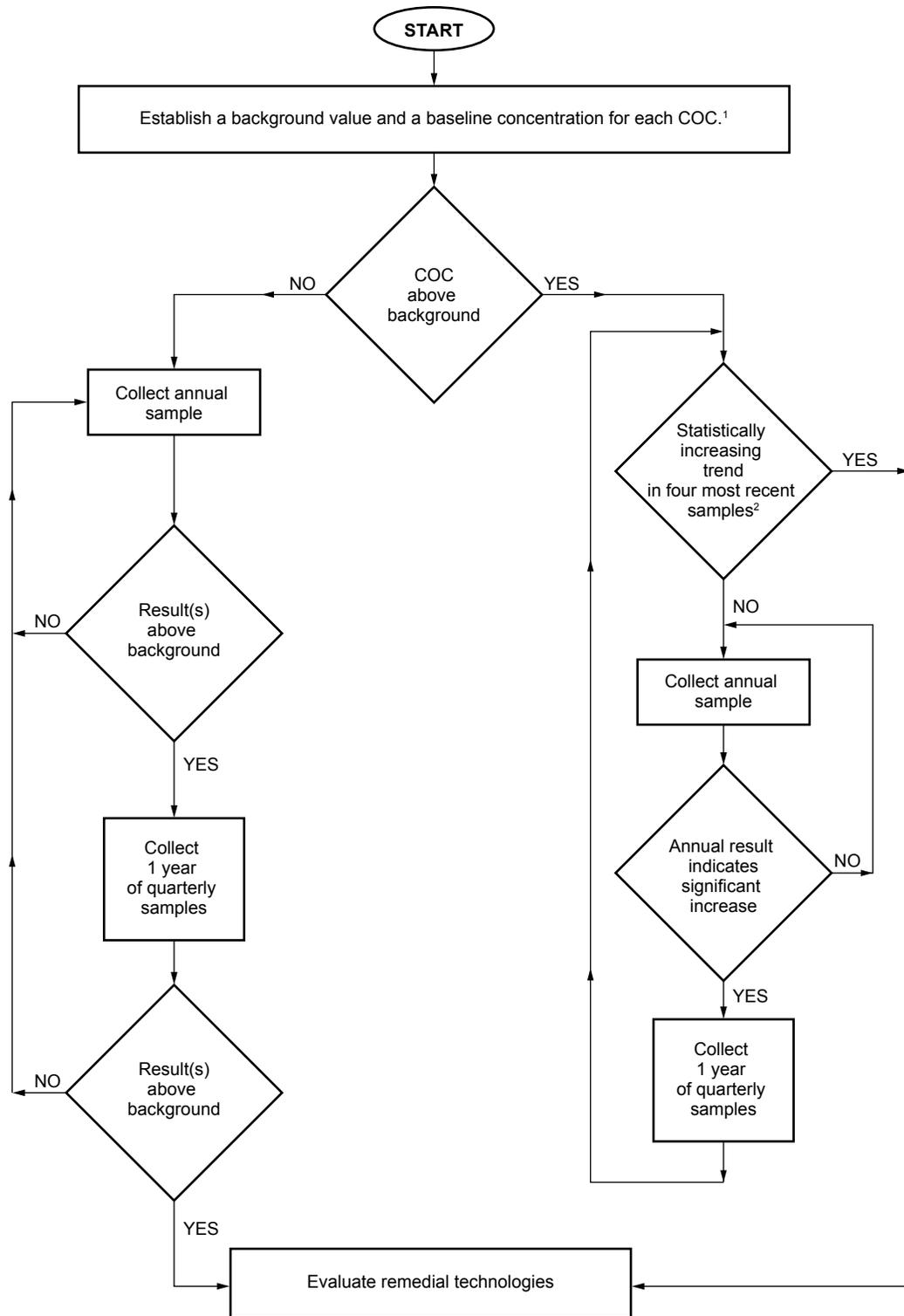


Explanation

-  Well was only sampled in 2011
-  Well was sampled in 2011 and will be sampled annually
-  Monitoring well, not sampled
-  Abandoned monitoring well
-  Abandoned agricultural well
-  UC Davis area
-  DOE area
-  Building
-  South Fork Putah Creek
-  UC Davis property boundary, approximately located
-  Road
-  Dirt road
-  Railroad
-  Fence
-  Surface water flow direction

Acronyms/Abbreviations:
 DOE - United States Department of Energy
 DSS - domestic septic system
 HSU - hydrostratigraphic unit
 UC Davis - University of California, Davis

Figure 18. Proposed Groundwater Sampling Locations for 1,2,3-Trichloropropane in Groundwater from HSU-1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis



Notes:

1. Background values and baseline concentrations will be established using data collected over the first four quarters of the groundwater monitoring program.
2. Increase must be above baseline to trigger contingency remediation evaluation; otherwise, proceed with annual monitoring.

Figure 20. Decision Process From Remedial Design/Remedial Action Work Plan

TABLES

Table 1. UC Davis Water Sampling Plan by Well and Analyte - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

HSU or Other Descriptor	Wells	Number of Wells	Groundwater Level	Radiological Analytes		Chemical Analytes						Other Analytes					
				Tritium	Carbon-14	Volatile Organic Compounds	Nitrate (as Nitrogen)	Total Chromium ^a	1,4-Dioxane	1,2,3-Trichloropropane	Electrical Conductivity	Title 22 Metals	Total Suspended Solids	Sulfate	Alkalinity	Anions	Cations
HSU-1	UCD1-001	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-003	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-004	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-005	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-006	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-008	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-009	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-010	1	Q	--	--	13	12/13	12/13	--	--	--	FM	--	--	--	--	--
	UCD1-011	1	Q	--	--	13	13	12/13	12	--	--	FM	--	--	--	--	--
	UCD1-012	1	Q	--	--	12/13	12/13	12/13	--	--	--	FM	--	--	--	--	--
	UCD1-013 ^b	1	Q	12/13	12/13	13	12/13	12/13	12	--	--	FM	--	--	--	--	--
	UCD1-018 ^b	1	Q	--	12 (S)	--	12 (S)/13	12 (S)/13	--	--	--	FM	--	--	--	--	--
	UCD1-019	1	Q	--	--	13	13	13	--	--	--	FM	--	--	--	--	--
	UCD1-020	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-021 ^b	1	Q	--	12 (S)	13	12 (S)	13	--	--	--	FM	--	--	--	--	--
	UCD1-022	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-023 ^b	1	Q	--	12 (S)	--	12 (S)	--	--	--	--	FM	--	--	--	--	--
	UCD1-024	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-025	1	Q	--	--	--	12/13	12/13	12/13	--	--	FM	--	--	--	--	--
	UCD1-027	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-028	1	Q	--	--	--	12/13	12/13	--	--	--	FM	--	--	--	--	--
	UCD1-034	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	UCD1-049	1	Q	--	--	12/13	--	13	--	--	--	FM	--	--	--	--	--
	UCD1-050	1	Q	--	--	12/13	--	13	--	--	--	FM	--	--	--	--	--
	UCD1-051	1	Q	--	--	12/13	12/13	12/13	--	12/13	--	FM	--	--	--	--	--
	UCD1-052	1	Q	--	--	13	13	13	--	--	--	FM	--	--	--	--	--
	UCD1-053	1	Q	--	--	--	12/13	12/13	--	--	--	FM	--	--	--	--	--
	UCD1-054 ^b	1	Q	--	--	--	--	12 (S)	--	--	--	FM	--	--	--	--	--
	UCD1-055	1	Q	--	--	--	12/13	12/13	--	--	--	FM	--	--	--	--	--
	UCD1-058	1	Q	--	--	--	12/13	12/13	--	--	--	FM	--	--	--	--	--
	UCD1-061	1	Q	--	--	--	12/13	12/13	--	--	--	FM	--	--	--	--	--
	UCD1-062	1	Q	--	12/13	--	12/13	12/13	--	12/13	--	FM	--	--	--	--	--
	UCD1-063 ^b	1	Q	--	12 (S)	--	12 (S)/13	12 (S)/13	--	--	--	FM	--	--	--	--	--
	UCD1-064	1	Q	--	--	--	12/13	12/13	--	--	--	FM	--	--	--	--	--
UCD1-065	1	Q	--	12/13	--	--	--	12	--	--	FM	--	--	--	--	--	
UCD1-066	1	Q	--	12/13	--	12/13	12/13	12/13	12/13	12/13	FM	--	--	--	--	--	
UCD1-067	1	Q	--	12/13	12/13	12/13	12/13	12/13	12/13	12/13	FM	--	--	--	--	--	
UCD1-068 ^b	1	Q	--	12 (S)	12 (S)	12 (S)	12 (S)	--	--	--	FM	--	--	--	--	--	
UCD1-069 ^b	1	Q	--	12 (S)	12 (S)	12 (S)	--	--	--	--	FM	--	--	--	--	--	
UCD1-070 ^b	1	Q	--	12 (S)	--	12 (S)	--	--	--	--	FM	--	--	--	--	--	
UCD1-071 ^b	1	Q	--	--	--	13	12 (S)	--	--	--	FM	--	--	--	--	--	
UCD1-072 ^b	1	Q	--	12 (S)	12 (S)	12 (S)	12 (S)	--	--	--	FM	--	--	--	--	--	
UCD1-073 ^b	1	Q	--	12 (S)	--	12 (S)/13	12 (S)/13	--	--	--	FM	--	--	--	--	--	
HSU-2	UCD2-007	1	Q	--	--	--	13	--	--	--	FM	--	--	--	--	--	
	UCD2-014	1	Q	12/13	12/13	--	13	13	--	--	FM	--	--	--	--	--	
	UCD2-015	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	UCD2-016	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	UCD2-017	1	Q	--	--	--	13	13	--	--	FM	--	--	--	--	--	
	UCD2-026	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	UCD2-027	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	UCD2-029	1	Q	--	--	12/13	12/13	12/13	--	--	FM	--	--	--	--	--	
	UCD2-030	1	Q	--	--	12/13	12/13	12/13	--	--	FM	--	--	--	--	--	
	UCD2-031	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	UCD2-032	1	Q	--	--	13	12/13	12/13	--	--	FM	--	--	--	--	--	
	UCD2-035	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	UCD2-036	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	UCD2-037	1	Q	--	--	--	13	13	--	--	FM	--	--	--	--	--	
	UCD2-038	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	UCD2-039	1	Q	--	12/13	--	12/13	12/13	--	--	FM	--	--	--	--	--	
	UCD2-040	1	Q	--	--	12/13	12/13	12/13	--	--	FM	--	--	--	--	--	
	UCD2-045	1	Q	--	--	12/13	12/13	12/13	--	--	FM	--	--	--	--	--	
	UCD2-046	1	Q	--	--	12/13	12/13	12/13	--	--	FM	--	--	--	--	--	
	UCD2-048	1	Q	--	--	12/13	13	13	--	12/13	FM	--	--	--	--	--	
	UCD2-056	1	Q	--	--	--	12/13	12/13	--	--	FM	--	--	--	--	--	
	UCD2-057	1	Q	--	--	--	12/13	12/13	--	--	FM	--	--	--	--	--	
	UCD2-059	1	Q	--	--	12/13	12/13	12/13	--	--	FM	--	--	--	--	--	
UCD2-060	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--		
UCD2-074 ^c	1	Q	--	--	Q/13	Q/13	Q/13	--	--	FM	Q	--	--	Q	Q	Q	
UCD2-075 ^d	1	Q	--	--	Q/13	Q/13	Q/13	--	--	FM	Q	--	--	Q	Q	Q	
UCD2-076 ^d	1	Q	--	--	Q/13	Q/13	Q/13	--	--	FM	Q	--	--	Q	Q	Q	
HSU-4	UCD4-041	1	Q	--	--	12	--	--	--	--	FM	--	--	--	--	--	
	UCD4-042	1	Q	--	--	12	--	--	--	--	FM	--	--	--	--	--	
	UCD4-043	1	Q	--	--	12	--	--	--	--	FM	--	--	--	--	--	
	UCD4-044	1	Q	--	--	12	--	--	--	--	FM	--	--	--	--	--	
	UCD4-047	1	Q	--	--	12	--	--	--	--	FM	--	--	--	--	--	
DDC Wells ^e and Piezometers	DDC-1-A, B, and C	3	Q	--	--	12/13	--	--	--	--	FM	--	--	--	--	--	
	DDC-2-A, B, and C	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	DDC-3-A, B, and C	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	DDC-4-A, B, and C	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	DDC-5-A, B, and C	3	Q	--	--	12/13	--	--	--	--	FM	--	--	--	--	--	
	DDC-6-A, B, and C	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	TP-1A, -1B, and -1C	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	TP-2A, -2B, and -2C	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	TP-3A, -3B, and -3C	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
TP-4A, -4B, and -4C	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--		
TP-5A, -5B, and -5C	3	Q	--	--	--	--	--	--	--	--	--	--	--	--	--		
Wastewater Treatment Plant Wells	WT-1U	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	WT-2D	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
	WT-3D	1	Q	--	--	--	--	--	--	--	--	--	--	--	--	--	
IRA	Effluent (EW2-01)	1	Q	--	--	Q	--	Q	--	--	FM	Q	Q	Q	--	--	

Notes:
^a Wells sampled for total chromium will also be sampled for iron.
^b Well sampled by DOE in 2011 for additional analytes per the Remedial Design/Remedial Action Workplan; DOE sampling plan for 2012 is shown in Table 3.
^c Well UCD2-074 was re-installed in January 2012; hence the well will be sampled during four quarters of 2012 and once in 2013.
^d Wells that were installed/sampled in November/December 2011; these wells will also be sampled during three quarters of 2012 and once in 2013.
^e Operational DDC wells will be sampled semi-annually.

█	Constituent (chloroform, nitrate, or chromium only) has an increasing concentration trend over time; see Appendix B for details
█	Sample (chloroform, nitrate, or chromium only) from well has historically contained constituent concentration that is at or above the regulatory comparison criteria.
Q	Well will be sampled quarterly.
(S)	Well will be sampled semi-annually as part of the DOE program.
--	Not analyzed or proposed for analysis.
12	Well will be sampled in November/December 2012. The total number of wells to be sampled is 52.
13	Well will be sampled in November/December 2013. The total number of wells to be sampled is 46.
FM	Field measurement of electrical conductivity will be conducted each time well is sampled.

Acronyms/Abbreviations:
DDC - density-driven convection system
DOE - United States Department of Energy
HSU - hydrostratigraphic unit
IRA - interim removal action

Reference:
DOE 2010. Remedial Design/Remedial Action Work Plan for the Former Laboratory for Energy-Related Health Research Federal Facility, University of California, Davis, November.

Table 2. Changes to the DOE Areas Water Monitoring Program, 2011 to 2012 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Well	Area Monitored	Program Year	Radiological Analysis							Chemical Analysis																			
			Americium-241	Beta, Gross	Carbon-14	Cesium-137	Potassium-40	Radium-226	Strontium-90	Uranium-238	Aluminum	Benzene	Chlordane	Chloroform	Chromium, Hexavalent	Chromium, Total	Copper	1,1-Dichloroethane	Dieldrin	Formaldehyde	Iron	Manganese	Mercury	Molybdenum	Nickel	Nitrate (as Nitrogen)	Selenium	Silver	Zinc
UCD1-013	Eastern Dog Pens	2011																A											
		2012																	A										
UCD1-018	Background	2011	Q		Q	Q		Q	Q		Q			Q	Q							Q	Q	Q	Q	Q	Q	Q	Q
		2012	A	S	S	S	A	S	S	S	S			Q	S	S			S	S	S	S	Q	S	A	S	Q	S	A
UCD1-021	Ra/Sr System and DSS 5	2011	A		Q			Q			A														Q				
		2012	A		S			S			A														S				
UCD1-023	Southwest Trenches	2011			Q																	A			Q			A	
		2012			S																		A		S			A	
UCD1-054	Dry Wells	2011				Q			Q					Q	Q							Q	Q				Q		
		2012				S			S					S	S								S	S			S		
UCD1-063	Background	2011	Q		Q	Q		Q	Q		Q			Q	Q							Q	Q	Q	Q	Q	Q	Q	
		2012	A	S	S	S	A	S	S	S	S			Q	S	S			S	S	S	Q	S	A	S	Q	S	A	
UCD1-068	Ra/Sr System and DSS 4	2011	A		Q			Q			A				A									A	Q	Q			
		2012	A	S	S		A	S		S	A			S	S	A			S					A	S	Q			
UCD1-069	DSS 3	2011									A								Q				Q		Q		A		
		2012			S	S		A		S	S			S					S	S	S		S		S		A		
UCD1-070	Southwest Trenches	2011			Q																	A			Q		A		
		2012			S	S		A		S													A		S		A		
UCD1-071	Dry Wells and DSS 1	2011				Q			Q		A			Q	Q							Q	Q				Q		
		2012			S		S	A		S	S	A	S		Q	S						S	Q	S			S		
UCD1-072	Ra/Sr System and DSS 6	2011	A		Q			Q			A														Q				
		2012	A	S	S		A	S		S	S			S	S	S			S						S				
UCD1-073	Background	2011	Q		Q	Q		Q	Q		Q			Q	Q							Q	Q	Q	Q	Q	Q	Q	
		2012	A	S	S	S	A	S	S	S	S			Q	S	S			S	S	S	Q	S	A	S	Q	S	A	

Notes:
 No change in sample frequency
 Decrease in sample frequency
 Increase in sample frequency
 New constituent

Acronyms/Abbreviations:
A - annual
DSS - domestic septic system
Q - quarterly
Ra/Sr - radium/strontium
S - semi-annual

Table 3. 2012 DOE Sampling Plan - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Well Name	1,1-Dichloroethane	Aluminum	Americium-241	Benzene	Beta, Gross	Carbon-14	Cesium-137	Chlordane	Chloroform ^b	Chromium, Hexavalent	Chromium, Total ^b	Copper	Dieldrin	Formaldehyde	Iron	Manganese	Mercury	Molybdenum	Nickel	Nitrate (as Nitrogen) ^b	Potassium-40 ^c	Radium-226	Selenium	Silver	Strontium-90	Uranium-238	Zinc	
UCD1-013								A					A															
UCD1-018 ^a		S	A		S	S	S			Q	S	S		S	S	S	Q	S	A	S	A	S	Q	S	S	S	S	A
UCD1-021		A	A			S														S		S						
UCD1-023						S											A			S								A
UCD1-054							S			S	S						S	S						S	S			
UCD1-063 ^a		S	A		S	S	S			Q	S	S		S	S	S	Q	S	A	S	A	S	Q	S	S	S	S	A
UCD1-068		A	A		S	S			S	S	A			S					A	S	A	S	Q			S		
UCD1-069	S	S			S	S			S			S		S	S	S		S		S	A			A		S		
UCD1-070					S	S											A			S	A					S	A	
UCD1-071		A		S	S		S			Q	S					S	Q	S			A			S	S	S		
UCD1-072		S	A		S	S			S	S	S			S						S	A	S				S		
UCD1-073 ^a		S	A		S	S	S			Q	S	S		S	S	S	Q	S	A	S	A	S	Q	S	S	S	S	A

Notes:

- monitoring-only constituent
- additional constituent
- constituent of concern

^a Well is considered "background"

^b Analytes/locations are shown graphically on Figures 3, 5, and 7

^c Potassium-40 is a naturally occurring constituent and is being investigated as a possible reason for elevated gross beta in on-Site wells

Acronyms/Abbreviations:

- A - annual
- Q - quarterly
- S - semi-annual