TETRA TECH

Technical Memorandum

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Subject:	Residential Response Action Supplement to Feasibility Study at the Iron King-Humboldt Smelter Superfund Site, Dewey-Humboldt, Arizona

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EXECUTIVE SUMMARY

Between 2006 and 2019, the United States Environmental Protection Agency (USEPA) performed three soil removal actions in 47 residential yards at the Iron King Mine / Humboldt Smelter Superfund Site. USEPA sampled 396 yards, collecting 10 to 15 samples per yard. Sampling results were used to calculate an exposure point concentration (EPC) of each analyte of concern at each yard. EPCs were compared to removal cleanup levels of the respective analytes. Cleanup levels varied among the removal actions, but the net effect of the removal actions was removal of soils and replacement of these with clean soil fill where calculated EPCs of lead exceeded the removal cleanup level for lead of 400 milligrams per kilogram (mg/kg) or calculated EPCs of arsenic exceeded the removal cleanup level for arsenic of 144 mg/kg.

To be additionally protective during the remedy selection phase of the project, USEPA is considering lowering the cleanup levels during the remedial action phase of the project from those applied in previous removal actions. This would imply expanding the response action in existing residential yards to remove soils in yards with lead EPCs over 197 mg/kg, and soils in yards with arsenic EPCs over 92 mg/kg. Assumption of this document is that no further action will occur at residential properties cleaned up during previous removal actions from lead concentrations exceeding 400 mg/kg and arsenic concentrations exceeding 144 mg/kg.

Under the new EPC criteria, the present analysis identified an additional 62 yards beyond the 47 that previously underwent cleanup. Total volume of soil estimated for removal is approximately 38,100 cubic yards based on delineation of excavation areas within each yard. The methodology applied to estimate soil volume is discussed in Section 4.2 below.

Approximately $3 million is the estimated construction capital cost to remove contaminated soil, backfill excavation areas with clean soil, place contaminated soil at the Iron King Mine, and restore yards to pre-removal conditions. This does not include project management, design, construction management, or contingencies. If these components are added per USEPA Feasibility Study (FS) Guidance percentages based on project cost, estimated total project cost increases to $5 million (USEPA 2000). The cost estimate has an accuracy in the range of plus 50 percent to minus 30 percent. Upper end costs of the response action could therefore be as high as $7.5 million. The estimates assume performance of cleanup by a contractor under USEPA's remedial program. USEPA Region 9's Emergency Response (ER) Contractor may conduct this response action, which may involve less or more expense for the design and construction management components than USEPA FS Guidance.

1.0 PURPOSE AND OBJECTIVES

Under Contract W912P718D0001, the U.S. Environmental Protection Agency (USEPA) tasked Tetra Tech, Inc. (Tetra Tech) with creating a supplement to the Feasibility Study with information supporting potential cleanup of additional existing residential yards for the Iron King Humboldt Smelter (IKM/HS) Superfund site (the Site) in Dewey-Humboldt, Arizona.

Objectives of this technical memorandum are the following:

- Describe previous removal actions at existing residential properties at the Site.
- Identify potential changes to residential soil cleanup values for arsenic and lead under evaluation.
- Identify yards that would be subject to additional cleanup if changes to cleanup levels occur.
- Estimate the volume of soil that would be excavated.
- Identify a general scope for the response process at additional residential properties.
- Estimate cost of conducting the response action.

2.0 SITE LOCATION AND DESCRIPTION

The Site is in the town of Dewey-Humboldt (population 4000) in central Arizona, on State Highway 69 about 80 miles north of Phoenix and 80 miles south of Flagstaff. A legacy endures of mining and smelting in this area (formerly called the "Big Bug Mining District"). The town lies in a broad segment of the Agua Fria River valley southeast of the City of Prescott Valley and east of Prescott. The Chaparral Gulch, a major drainage connecting the Bradshaw mountains to the Agua Fria River, passes into the town from the west. Contamination at the Site is the result of two historical industrial operations: the former Iron King Mine and the former Humboldt Smelter. Portions of the Site are on both sides of Arizona State Highway 69. The former mine is immediately west of Highway 69, and the former smelter lies about a half-mile east of Highway 69. Drainages and features appear on Figure 1.

USEPA's remedial investigation (RI) report (CH2M Hill, Inc. 2016) identified contamination—including mine tailings, dross, slag, and waste rock—in primarily non-residential areas at the former mine, former smelter, and the Chaparral Gulch connecting them. USEPA's RI also investigated currently residential parcels that may have become contaminated via blowing tailings, historical smelter stack emissions, and private use of tailings as fill. This information became the basis for cleanup actions in residential yards. Before deciding on cleanup scope, USEPA evaluated extensive and spatially varied background samples (Appendix E to RI report). Based on several lines of evidence, the evaluation delineated the physical area within which impacts from the Site potentially occur—termed the Area of Potential Site Impact (APSI). The scope of response actions has been limited to yards within the APSI where exposure point concentrations (EPCs) exceed cleanup levels.

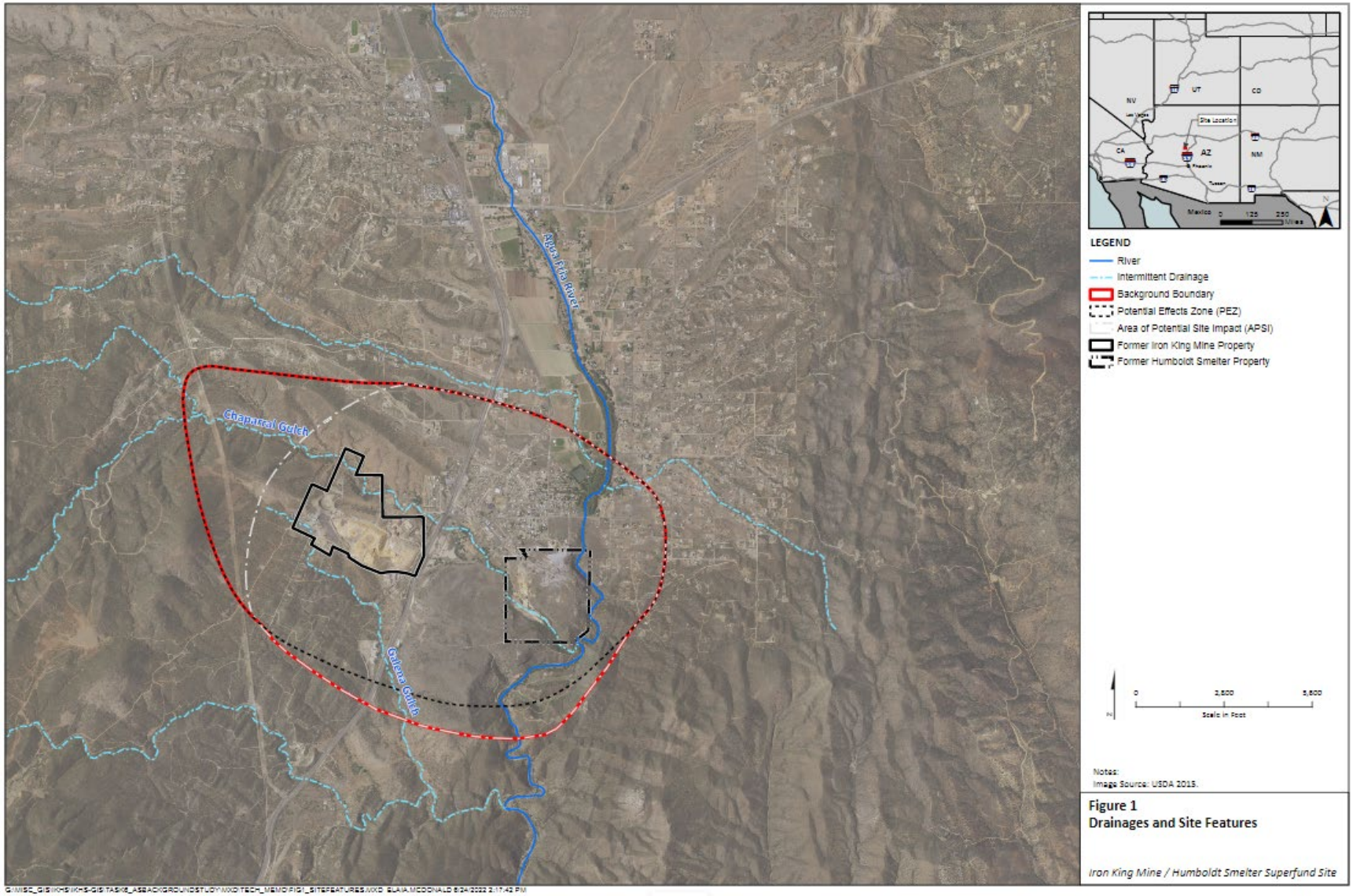

Figure 1. Drainages and Site Feature

3.0 PREVIOUS REMOVAL ACTIONS AND CLEANUP VALUES

The following section describes (1) the history of removal actions near the former Iron King Mine Property, (2) cleanup values for the previous removal actions, and (3) how cleanup values may change to facilitate a new response action for residential cleanup.

3.1 REMOVAL ACTIONS AND PREVIOUS CLEANUP VALUES

During previous cleanups, 10 to 15 samples of soil were collected at each of 396 residential properties. (Farther from the mine and smelter, samples were not collected at every yard, but seven areas were screened for contamination. The screened areas encompassed an additional 184 properties for a total of 580 properties.) Where 10 to 15 samples were collected in each yard, results were used to calculate an EPC at each yard for each analyte of concern. The EPCs were compared to removal cleanup levels, and soil removal actions occurred in yards where calculated EPCs of lead and arsenic exceeded their respective removal cleanup levels.

In 2006-2007, a property owner/operator known as Ironite Products Company performed a removal action at four residential and municipal properties near the former Iron King Mine property. This removal action was in response to detections of concentrations of arsenic and lead in surface soil exceeding the site-specific EPC (at that time) of 23 mg/kg for arsenic in soil set by USEPA (Brown and Caldwell 2007). This effort was early in USEPA's work at the Site, before any risk assessment at a very limited number of properties. USEPA action levels have evolved as understanding of the contamination at the Site has expanded.

USEPA has performed three additional removal actions at the Site, as summarized below. Two of these actions involved soil removal in additional yards. In 2011, USEPA conducted another removal action to excavate residential soils exceeding site-specific EPCs of 165.2 mg/kg for arsenic and 512.7 mg/kg for lead at 12 residential properties. Ten of these properties were situated along the former rail line leading into the former Humboldt Smelter property. During this removal, surface soils were excavated and replaced with clean soil from ground surface to 2 feet below ground surface (bgs). Initial removal of soil was to 1 foot bgs; then, if arsenic or lead or both exceeded action levels in confirmation samples, another 1-foot lift was removed to 2 feet bgs (Ecology and Environment, Inc. [E&E] 2012). During that removal action, USEPA also removed a small mine tailings pile in a non-residential area near the former mine and applied a chemical tackifier called "gorilla snot" to the dross waste at the smelter to temporarily prevent dispersion of aerial dust from the dross.

In 2017, USEPA performed a similar removal action from ground surface to 18 inches bgs at an additional 31 residential properties where calculated EPCs in soils exceeded site-specific removal cleanup levels of 400 mg/kg for lead and 144 mg/kg for arsenic. Contaminated soils were excavated to 12 inches bgs. In specific areas within select yards, an additional 6 inches of soil was excavated to total depth of 18 inches bgs to eliminate need for snow fencing (Weston Solutions, Inc. 2018).

While cleanup levels varied among the removal actions, the net effect of those actions (except at one property) was removal of soils where calculated EPCs of lead equaled or exceeded a cleanup

level for lead of 400 mg/kg or calculated EPCs of arsenic equaled or exceeded a cleanup level for arsenic of 144 mg/kg.

Finally, in a removal action in 2019, EPA applied a cover material called "Posi-Shell" on top of the dross at the smelter plateau to prevent waste dross from blowing into the air. EPA also added fencing and warning signage to the smelter property at that time. This removal action did not involve cleanup at additional residential properties.

Figure 2 shows the yards cleaned up during previous removal actions.

3.2 POTENTIAL CHANGES TO CLEANUP VALUES

To be additionally protective, USEPA is considering lowering cleanup levels during the remedial action phase of the project from those applied in previous removal actions. As an supplement to the feasibility study, USEPA is evaluating expansion of residential cleanup of surface soils to include yards with lower calculated EPCs of lead and arsenic in soil. Cleanup is to ensure remaining soils do not exceed the remedial cleanup levels of 197 mg/kg for lead and 92 mg/kg for arsenic. The assumption for the purposes of this document is that yards already cleaned up in previous removal actions would not be subject to additional cleanup activity.

Arsenic. A highly sophisticated statistical analysis of hundreds of spatially distributed soil samples as far as 3 miles from the mine and smelter determined that the background threshold value (BTV) for arsenic in surface soils is 92 mg/kg (Tetra Tech 2022). Coincidentally, this concentration also corresponds to a residential noncancer hazard index of 1 for arsenic under a child-only scenario, and a lifetime cancer risk level of $3.5x10^{-5}$. The new cleanup level 92 mg/kg would result in both: (1) cleanup to background and 2) cleanup to an appropriate long-term residential risk benchmark. This arsenic concentration is assumed to be the new cleanup level for the purposes of this document.

Lead. By application of the Integrated Exposure Uptake and Biokinetic (IEUBK) model for child lead exposure, a target reference blood level of 10 micrograms per deciliter (µg/dL) originally was used in the calculation to derive the 400 mg/kg removal cleanup level for lead. Previously, the Centers for Disease Control and Prevention (CDC) had recommended 10 µg/dL as a "blood level of concern" (Agency for Toxic Substances and Disease Registry [ATSDR] CDC 2012), which EPA currently uses to calculate an acceptable exposure concentration for lead. USEPA may change this number in the future. Regardless, to be more protective, USEPA is considering use of a more conservative target reference blood level of 5 µg/dL, which would lower the cleanup level to 197 mg/kg. This lead concentration is assumed to be the new cleanup level for the purposes of this document.

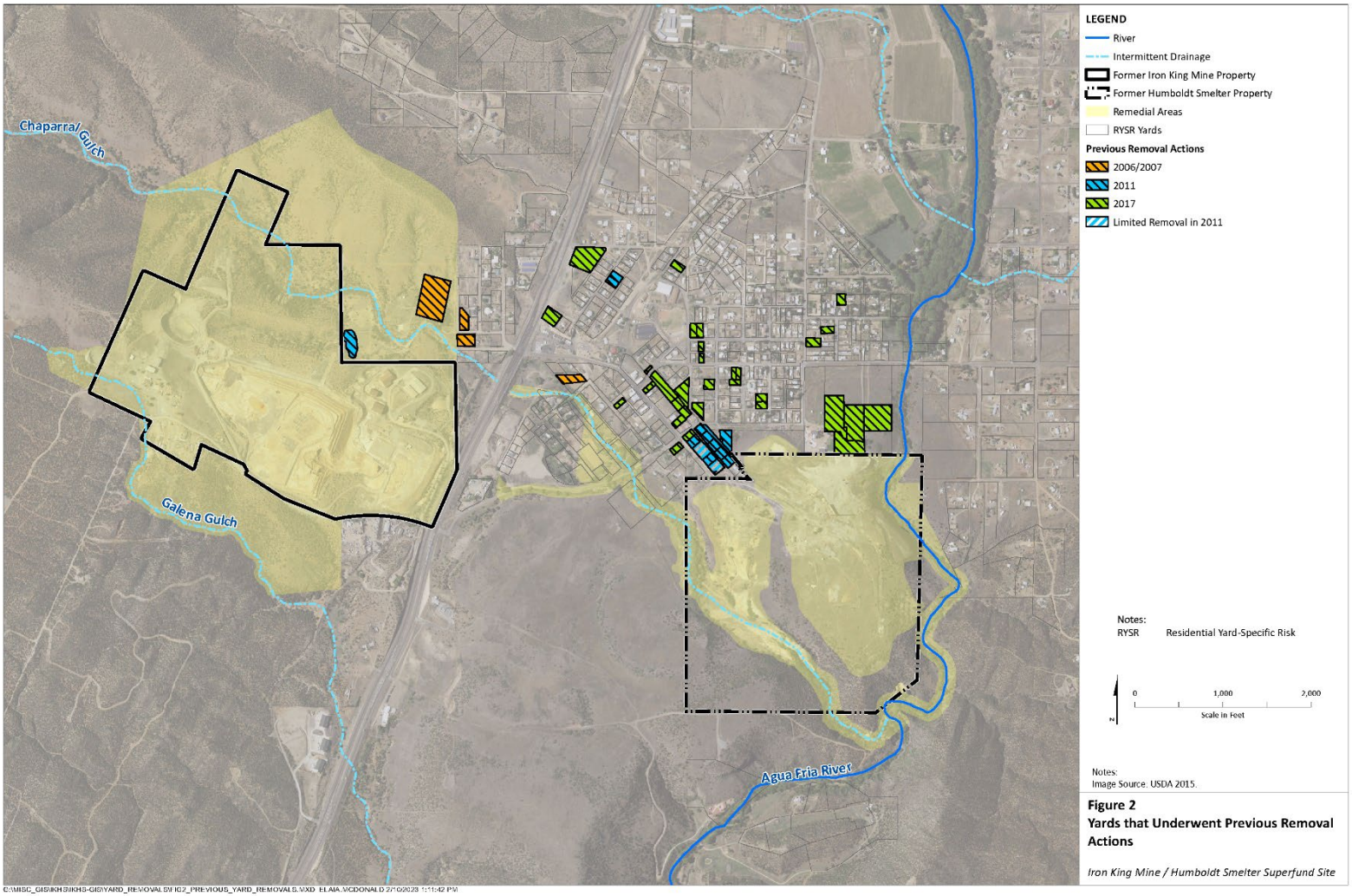

Figure 2 Yards that Underwent Previous Removal Actions

4.0 SCOPE OF THE RESPONSE ACTION AND POST-REMOVAL SITE CONTROLS

The following subsections present the scope of response action for properties identified under the new cleanup criteria under consideration, specify the method of determining volume of soil required for cleanup, describe activities required for the response action, and identify the estimated cost for cleanup.

4.1 ADDITIONAL YARDS THAT WOULD UNDERGO CLEANUP

USEPA has concluded that the change in cleanup criteria would imply need for response actions at approximately 62 additional residential properties based on the adjusted cleanup level/benchmarks for lead (to 197 from 400 mg/kg) and arsenic (to 92 from 144 mg/kg). An assumption of this document is that no further action will occur at residential properties cleaned up during previous removal actions from lead concentrations exceeding 400 mg/kg and arsenic concentrations exceeding 144 mg/kg. Levels of lead and arsenic in soils used for backfilling at those properties were far below the new cleanup level/benchmarks.

Yards of the 13 properties zoned residential in Chaparral Gulch that meet the requirements for cleanup are not included among the additional yards specified in this document to undergo cleanup because of the assumption that they will be cleaned up as part of the larger cleanup of the gulch per the feasibility study (Tetra Tech 2022).

Figure 3 is a map of properties that would be subject to the response action, and Table 1 lists those properties.

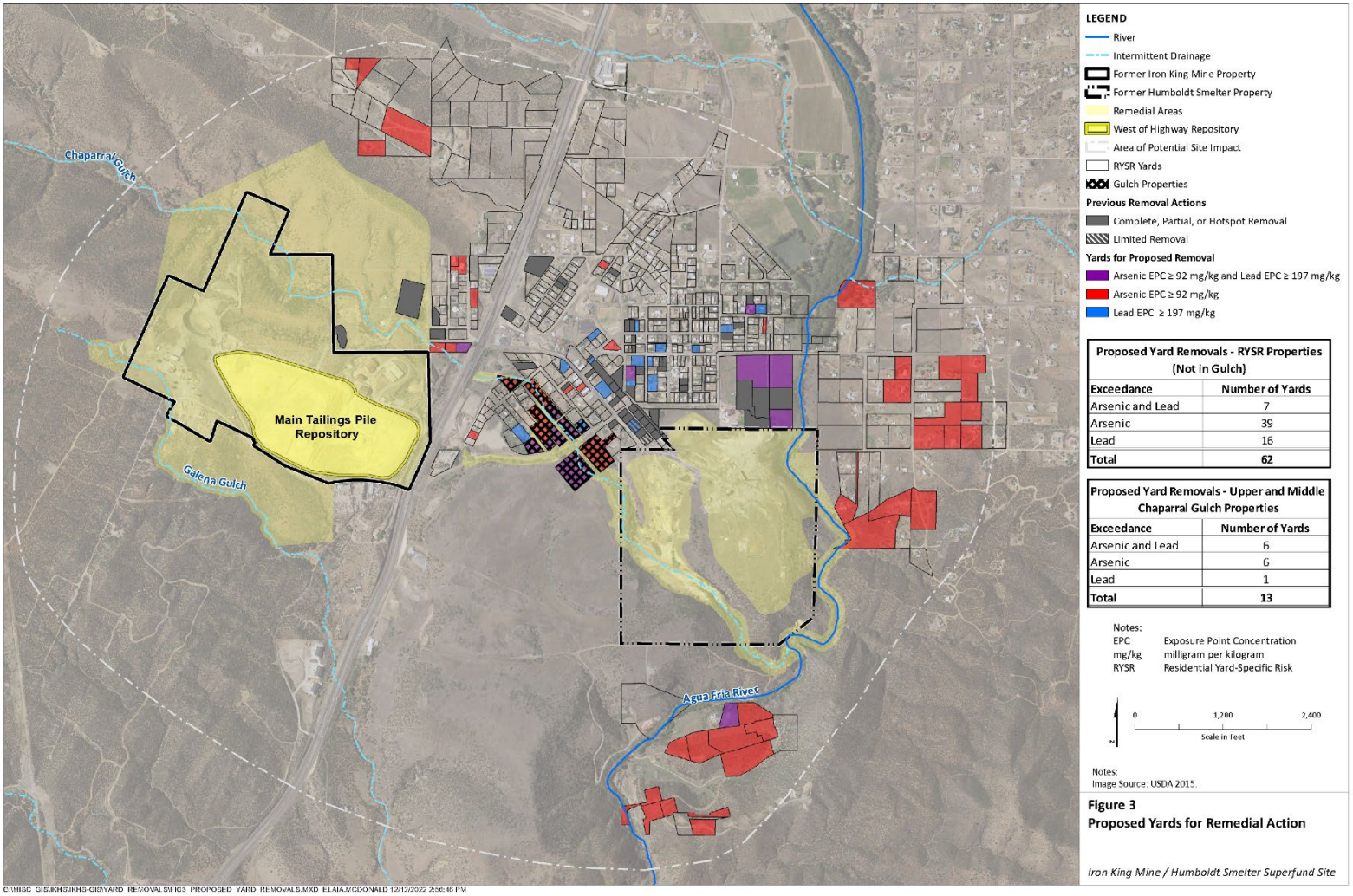

Figure 3. Proposed Yards for Response Action

4.2 METHOD FOR ESTIMATING VOLUMES OF SOIL TO BE REMOVED FROM YARDS

To facilitate a preliminary cost estimate, a method was developed to estimate the total volume of soil that may need to be excavated from the additional yards

This volume-estimate model used chemical analytical results from existing residential sampling that occurred during the remedial investigation to calculate EPCs. The calculated EPCs for the yards shown in Table 1 exceeded the proposed new cleanup levels of 92 mg/kg for arsenic, or 197 mg/kg for lead, or both.

For each yard shown in Attachment A, a visual inspection was made to identify the samples with highest concentrations that were located in a roughly contiguous area. To simulate removal, sample results were removed one at a time and replaced with the average clean backfill concentrations (detailed in Table 2) of arsenic and lead detected in samples of backfill during the 2017 removal action. The borrow material was imported from building materials company CEMEX (Weston Solutions, Inc. 2018). After each sample point replacement, a new EPC was calculated, and this process continued until the calculated UCL for arsenic and lead were both below the new proposed cleanup values. EPCs were estimated as the 95 percent upper confidence limit (UCL) as calculated by use of USEPA's (2015) ProUCL 5.1 statistical tool. A removal area (or polygon) was then derived by enclosing those points that were removed with boundaries set half-way between each removed sample point and the nearest sample point spatially that had not been removed. The area of the removal area polygon was then determined using Google Earth. The removal area polygons are shown for each property in Attachment A.

To estimate soil volumes, the removal area was then multiplied by a soil depth. It was assumed that the removal areas delineated above would be excavated to 12 inches bgs, with an additional depth of 12 inches (total depth 24 inches bgs) in 20 percent of removal areas to account for areas where arsenic or lead or both would exceed cleanup levels in confirmation samples. This led to an anticipated removal volume approximating 38,124 cubic yards. During the response action, additional data could be used to refine areas requiring more excavation. Table 3 lists total yard area, yard removal area, and yard removal volume for each yard. After application of this method, all EPCs in each yard were below the cleanup goals of 92 mg/kg for arsenic and 197 mg/kg for lead.

4.3 RESPONSE ACTION ACTIVITIES

The following sections describe overall procedures and activities anticipated at each property identified in Section 4.1.

4.3.1 Access Agreements and Pre-Remediation Work Plans

An access agreement and Pre-Remediation Work Plan (work plan) would be prepared for each identified property. During preparation of each property's work plan, USEPA, USEPA's selected technical contractor, and USEPA's selected construction contractor would conduct a walkthrough of each property with the property owner to review and define the schedule of activities, methods and locations of excavation, restoration plans, materials and sources, decontamination procedures, property owner questions and concerns, existing property

conditions, and physical site information. Following preparation of a property-specific work plan and before a response action, the content would be reviewed and signed for approval by the property owner and the USEPA representative.

4.3.2 Supplemental Sampling

During preparation of a property work plan, USEPA and the technical contractor would evaluate existing remedial investigation data to determine whether or not supplemental soil sampling would be necessary to further delineate areas of concern and identify specific removal areas.

4.3.3 Photographic Documentation

With the property owner's permission, pre- and post-response action conditions of the property, streets, and sidewalks would be documented in photographs and a video. The technical contractor would take photographs and record videos as soon as practical following completion of backfill and restoration of excavated areas at any given property. Assumedly, storage and management of these private landowner data would accord with USEPA privacy policies.

4.3.4 Air Monitoring and Sampling

Before initiation of any dust-generating activities at a property, four property or work zone perimeter air monitoring/sampling stations (one upwind and three downwind) would be established to determine whether airborne particulates would be produced or would migrate from work zones or off the property at concentrations above site-specific action levels (to be determined during the response action). Each air monitoring/sampling station would include a particulate monitor collocated with an air sampler equipped with a filter cassette for lead and arsenic analyses.

Daily air monitoring and sampling procedures would occur throughout response action dust-generating activities. Each day, before initiation of any dust-generating field activities, sample pumps equipped with sample media would be calibrated and deployed in conjunction with particulate monitors to the property/work zone perimeter locations. The monitors and sample pumps would be observed periodically during work hours to confirm they are operating properly, and then would be collected following completion of work each day.

Any anomalies in conditions, such as strong winds or significant vehicular traffic, would be noted in the site logbook for later correlation with any spikes in monitoring data.

4.3.5 Backfill Source Selection and X-Ray Fluorescence Analysis

Before site mobilization, USEPA and the construction contractor would identify sources of backfill materials to use for restoration of residential properties following the removal of contaminated soils. Before using the selected materials, the technical contractor would collect or receive composite samples of the fill materials. Aliquots (4 ounces apiece) of each five-point composite sample would be collected by use of a disposable plastic scoop at five random locations from every 500 cubic yards of backfill material. The aliquots would be combined and homogenized into one composite sample. All composite samples would undergo x-ray fluorescence (XRF) analysis in the field by use of an XRF spectrometer. Ten percent of those

samples would be sent for confirmation laboratory analysis for Resource Conservation and Recovery Act (RCRA) eight metals (lead, arsenic, barium, cadmium, chromium, mercury, selenium, and silver). Especially regarding arsenic and lead, results of these analyses would be compared to either Arizona Residential Soil Remedial levels or specified cleanup levels for arsenic and lead (the lowers between these sets of benchmarks) to determine if borrow is suitable for backfill. That suitability also would require concentrations of the other six RCRA metals be at or below their Arizona Residential Soil Remedial levels.

4.3.6 Excavation and Restoration Activities

Following work plan approval and supplemental sampling and analysis, construction contractor personnel would be mobilized to identify properties for removal of contaminated soils. Construction contractor personnel would excavate contaminated soils to 1 foot bgs by applying various heavy equipment and techniques, including equipment excavation and hand-digging. After the initial excavation, the technical contractor would conduct confirmation sampling and analysis (as described in Section 4.3.7) to document concentrations of remaining lead and arsenic in the soil.

If composite samples from any area exceeded the site-specific action levels for arsenic (92 mg/kg) and/or lead (197 mg/kg), another one-foot lift will be removed in that area and another composite sample will then be collected at the two-foot depth. In cases where contaminated soil was still found at the two-foot depth, plastic snow fence material will be placed at that depth before placing backfill material in the excavation. The intention for the placement of the snow fence is to provide a visual barrier between clean backfill material and the still-contaminated soil beneath it.

Construction contractor personnel would backfill excavation areas with appropriate clean fill materials, and compact, grade, and restore those areas to final landscaping grade in accordance with the property's approved work plan. The technical contractor would sample and analyze all applicable backfill materials before use (as described in Section 4.3.5) to document concentrations of RCRA eight metals are below any human-health-risk-based benchmarks and acceptable for use.

During soil excavation and remediation actions, the technical contractor would document activities in written logbooks and in an electronic field data collection device using a mobile map via the Environmental Systems Research Institute, Inc. (ESRI) iOS Geographic Information System (ArcGIS®) application for real-time project tracking.

4.3.7 Post-Excavation Confirmation Sampling

The technical contractor would sample soil of the excavation floor at each excavation area to document concentrations of lead and arsenic at the limit of excavation in those areas and in accordance with the procedures specified in the sampling and analysis plan. A visual barrier/marker (orange snow fencing) would be placed over the excavation floor before backfilling at any excavated area where lead or arsenic soil concentrations remain above the site-specific action levels for lead and/or arsenic. A Completion of Work package for each property owner, as described in 5.3.8, would convey lead and arsenic concentrations left in place.

4.3.8 Resident Completion Packages

Following response actions at each property, USEPA, the technical contractor, and the construction contractor would develop a Completion of Work package for the property owner and site records that would confirm USEPA's completion of all work specified in the approved work plan. Each Completion of Work package would include a completion letter, the property access agreement, proposed excavation map, a signed work plan, pre-remediation photographs, post-remediation photographs, and a post-excavation sampling map.

4.4 TRANSPORTATION AND PLACEMENT OF CONTAMINATED SOIL

Assumedly, excavated materials would be transported to the Main Tailings Pile on the Iron King Mine property for disposal. Loading and transport activities at residential yards presumably would proceed at the same rate as excavation to avoid need for stockpiling large quantities of material in the residential neighborhood. Figure 3 shows the proposed respository at the Main Tailings Pile where contaminated soils from this response action would be placed following removal.

4.5 DATA VALIDATION

Laboratory data acquired during the response action would undergo a Tier 2 (Stage 2A) review by a chemist. The data validation package includes documentation and quality control data provided by the laboratory, including custody records, shipping information, sample preparation/extraction records, and instrument calibration and method blank data.

The data validation would accord with the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA 2017a) and Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review (USEPA 2017b), with implementation of quality control limits appropriate for the methods applied for analyses of the samples.

4.6 ESTIMATED COSTS

A cost estimate was developed to assess the value of the response action (USEPA 2000). The cost estimate was prepared for this response action by following analogous, parametric, bottom-up approaches, and using direct vendor quotes:

- **Analogous** or "top down" approaches are based on expert judgement whereby similar project experience is referenced to provide a rough order-of-magnitude estimate.
- **Parametric** approaches couple a structured estimating process with statistically based parametric/predictive modeling methods based on historical unit prices.
- **Bottom-up** approaches often rely on compiled sources of unit cost data taken either from a built-in database (if part of a software package, for example) or from other sources (for example, cost estimating references like RS Means). Unit costs for year 2019 published by RS Means of Norwell, Massachusetts, were used for many of the cost elements.

- **Professional Judgement and Vendor Quotes:** Published cost data were not always available for each cost element because of unique characteristics of some elements of the response action. These cost elements were developed either by use of vendor quotes or professional judgement and evaluated and adjusted as necessary to account for inflation.

A detailed explanation of the cost estimating approach is in Attachment B. Assumptions that underly determination of the number of cubic yards of removal are documented in Section 3.2. In total, the estimated cost of the response action is approximately $3 million. This does not include costs of project management, design, construction management, or contingencies. If these components are added per USEPA FS Guidance percentages based on project cost, the estimated project cost increases to $5 million (USEPA 2000). USEPA Region 9's Emergency Response (ER) Contractor may conduct this response action, which may involve less or more expense for the design and construction management components than USEPA FS Guidance. The cost estimate has an accuracy in the range of plus 50 percent to minus 30 percent. Upper end costs of the response action could therefore be as high as $7.5 million. A detailed listing of costs is in Table 4.

5.0 CONCLUSIONS

The objective of the response action would be to further reduce the potential threat to human health from exposure to elevated lead and arsenic concentrations in surface and subsurface soils at the Site. As many as 62 properties would be addressed during this response action based on the refined EPCs for lead and arsenic in residential surface soils. The response action would include excavation and capping of metals-impacted soils. A total of 38,100 cubic yards of contaminated soils may be excavated from yards and transported to the Iron King Mine at a cost of approximately $3 million. This does not include costs of project management, design, construction management, or contingencies. If these components are added per USEPA FS Guidance percentages based on project cost, the estimated cost would increase to $5 million. The cost estimate has an accuracy in the range of plus 50 percent to minus 30 percent. Upper end costs of the response action could therefore be as high as $7.5 million.

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TABLES

Table 1 - List of Yards to Undergo Soil Removal

Screening Area	Lead UCL EPC	Arsenic UCL EPC	Removal
3005	187.2	**154.9**	Arsenic
167C	52.19	**103.3**	Arsenic
2105	53.97	**101.1**	Arsenic
3008	113	**149**	Arsenic
2743D	40.08	**156.1**	Arsenic
2903	21.15	**112.3**	Arsenic
107A	**239.5**	**103.8**	Arsenic and Lead
203A	**249**	**119.1**	Arsenic and Lead
2901	42.94	**125.2**	Arsenic
3009	121.3	**138.9**	Arsenic
1913	24.34	**103.7**	Arsenic
1914	26.56	**96.73**	Arsenic
2808	36.7	**125.3**	Arsenic
1902	25.1	**92.45**	Arsenic
167A	168.1	**159.7**	Arsenic
1911	39.9	**108.2**	Arsenic
1906	39.1	**125.7**	Arsenic
3006A	104.8	**127.5**	Arsenic
3013A	83.73	**154**	Arsenic
109	**392.5**	**174.3**	Arsenic and Lead
1903	34.3	**210.1**	Arsenic
2109	79.28	**110.4**	Arsenic
3004	**618.8**	**178.7**	Arsenic and Lead
1912	33.5	**127.9**	Arsenic
1908	35.1	**103.3**	Arsenic
3011	65.51	**114**	Arsenic
3010	106.4	**155.2**	Arsenic
3015	97.79	**178.7**	Arsenic
3012	90.49	**143.7**	Arsenic
2806	36.7	**99.87**	Arsenic
1104B	53.69	**103.7**	Arsenic
O16	**394.6**	48.3	Lead
2415	**208.9**	58.13	Lead
157	137.9	**538**	Arsenic
1101B	44.86	**125.6**	Arsenic
2214	139.1	**156.2**	Arsenic
114	72.49	**104.3**	Arsenic
180	**232.2**	**147**	Arsenic and Lead
188	265.8	**46.15**	Lead
2216	**240.7**	**99.71**	Arsenic and Lead
251	15.3	**100.1**	Arsenic
2215	55.65	**429**	Arsenic
308	**198.2**	55.55	Lead
2709	**223.2**	41.54	Lead

Table 1 - List of Yards to Undergo Soil Removal

Screening Area	Lead UCL EPC	Arsenic UCL EPC	Removal
2430	**223.1**	34.91	Lead
246 and 30W	**425.9**	**228.8**	Arsenic and Lead
156	32	**108**	Arsenic
2550	**287.5**	44.06	Lead
2718	**292.7**	65.83	Lead
2401	**333.1**	67.98	Lead
309	19.3	**134.5**	Arsenic
2324	107	**140.2**	Arsenic
2755	65.31	**107.3**	Arsenic
213	**199.1**	48.7	Lead
2691	**284.4**	78.08	Lead
142	**203.5**	69.3	Lead
149	**314.5**	23.12	Lead
182	**660.1**	47.01	Lead
2426	122.7	**312.2**	Arsenic
262	**204.4**	33.29	Lead
2435	95.45	**95.33**	Arsenic
2407	**228.6**	74.19	Lead

Notes:

Concentrations in **bold** are above EPC threshold for analyte

EPC	Exposure Point Concentration
UCL	Upper Confidence Limit

Table 2 - Average Backfill Analytical Results from 2017 Removal Action

Analyte Concentrations	
Arsenic	Lead
13 milligrams per kilogram (mg/kg)	11 mg/kg

Table 3 - Yard-Specific Removal Area and Volume

Yard Number	Yard Area (SF)	Yard Removal Area (SF)	Yard Removal Volume (CY)
109	81,796	42,470	1,888
114	26,297	1,575	70
142	24,436	2,977	132
149	9,838	1,933	86
156	16,500	2,396	106
157	32,999	1,690	75
180	26,258	1,501	67
182	9,539	1,368	61
188	25,173	2,069	92
213	10,419	1,734	77
251	20,912	1,025	46
262	8,523	229	10
308	19,366	1,907	85
309	13,654	763	34
1902	97,456	13,425	597
1903	77,942	30,552	1,358
1906	88,338	13,676	608
1908	71,697	5,861	260
1911	90,520	2,731	121
1912	71,955	14,414	641
1913	128,862	7,295	324
1914	118,021	11,013	489
2105	248,347	18,185	808
2109	77,001	10,071	448
2214	27,572	5,093	226
2215	20,123	1,656	74
2216	24,700	3,165	141
2324	12,505	736	33
2401	15,419	1,342	60
2407	4,919	216	10
2415	33,219	3,432	153
2426	8,970	2,118	94
2430	18,119	1,350	60
2435	8,255	2,368	105
2550	16,364	2,028	90
2691	10,252	1,758	78
2709	18,610	1,798	80
2718	16,348	2,381	106
2755	11,268	1,750	78
2806	68,999	9,720	432
2808	117,204	4,229	188
2901	138,948	18,485	822
2903	182,004	34,256	1,522
3004	73,520	39,129	1,739

Table 3 - Yard-Specific Removal Area and Volume

Yard Number	Yard Area (SF)	Yard Removal Area (SF)	Yard Removal Volume (CY)
3005	291,355	75,652	3,362
3008	208,544	154,050	6,847
3009	133,283	25,639	1,140
3010	70,198	40,512	1,801
3011	71,364	9,234	410
3012	69,689	45,522	2,023
3015	69,871	45,861	2,038
107A	174,017	17,421	774
1101B	29,988	7,574	337
1104B	60,057	11,297	502
167A	93,858	23,676	1,052
167C	289,599	22,754	1,011
203A	142,058	16,942	753
246 and 30W	17,221	1,525	68
2743D	184,715	10,200	453
3006A	87,322	11,234	499
3013A	83,521	9,658	429
O16	35,219	1,166	52
Total:	**4,335,046**	**857,787**	**38,124**

Notes:

CY	Cubic yards
SF	Square feet

Table 4 -Response Action - Yard-Specific Removal
Iron King Mine - Humboldt Smelter

Site Quantities				
Waste Volume	38,124	BCY		
Waste Area	19.7	Acres		
Revegetation	95,310	SY		
Backfill Volume	38,124	BCY		
Cost Item	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Capital Costs				
Clearing and Grubbing (30% of area)	**5.9**	**Acre**	**11,175.00**	**$66,017.70**
Waste Excavation, Hauling, Grading, and Compaction (Disposal at MTP)				**$1,058,509.16**
Excavation	38,124	BCY	$9.60	$366,084.43
On Highway Haul Trucks	47,655	LCY	$6.55	$312,139.16
Grading	47,655	LCY	$7.98	$380,285.57
Waste Placement				**$220,641.88**
Load and Place	38,124	BCY	$0.75	$28,592.90
Grading and Compaction	47,655	LCY	$4.03	$192,048.98
Revegetation - Seeding	**95,310**	**SY**	**4.70**	**$447,955.43**
Dust Control	**180**	**Day**	**$1,975.00**	**$355,500.00**
Clean Fill Backfill				**$905,441.83**
Clean Fill Purchase (Includes Hauling)	47,654.8	LCY	$19.00	$905,441.83
Subtotal Construction Costs				**$3,054,066.00**
Mobilization, Insurance, Bonding		10% Subtotal Capital Costs		**$305,406.60**
Institutional Controls		Lump Sum		**$25,000.00**
Subtotal Costs				**$3,384,472.60**
Project Management		5% Construction Cost		$169,223.63
Remedial Design		6% Construction Cost		$203,068.36
Construction Management		6% Construction Cost		$203,068.36
Construction Contingencies		30 % of Construction Cost		$1,015,341.78
Total Capital Costs				**$4,975,174.72**
Total Present Worth				**$5,000,000**
			Range -30%	**$3,500,000**
			Range +50%	**$7,500,000**

Notes:

x1.25 Expansion Factor Used for all LCY quantities

x0.9 Compaction Factor Used for all CCY quantities

BCY Bank Cubic Yards

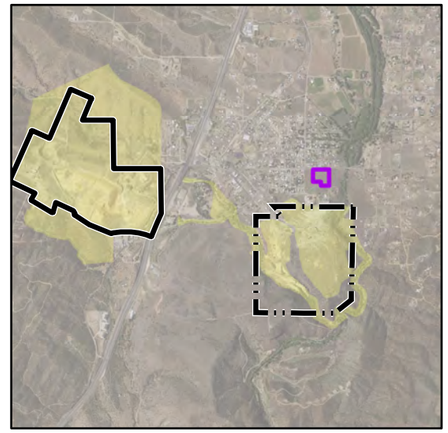
CCY Compacted Cubic Yards

LCY Loose Cubic Yards

SY Square Yards

ATTACHMENT A

SAMPLE CONCENTRATIONS BY YARD



LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg and Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 50 100
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 1
Soil Sample Results at Yards for Proposed Removal - 107A

Iron King Mine / Humboldt Smelter Superfund Site

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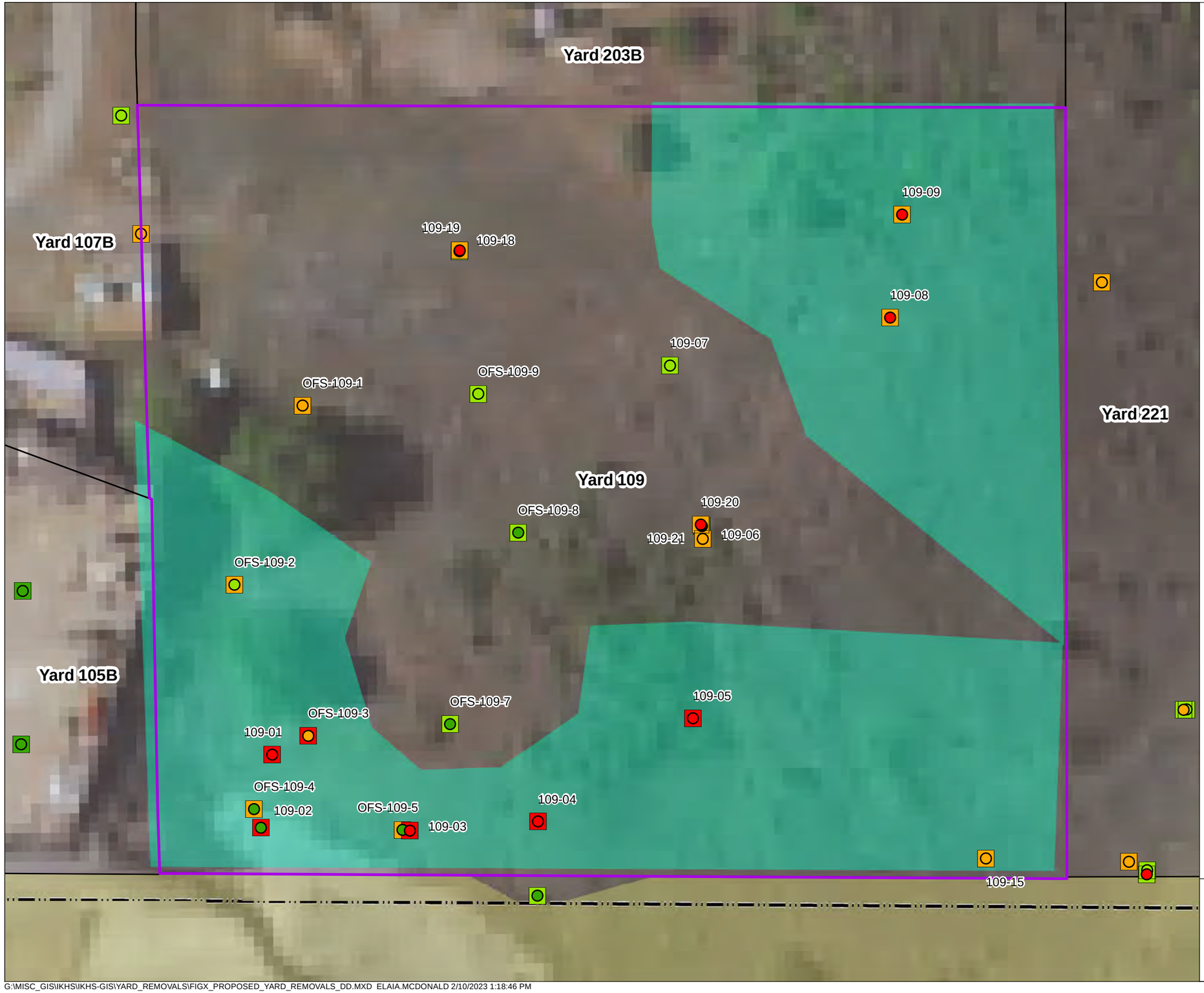

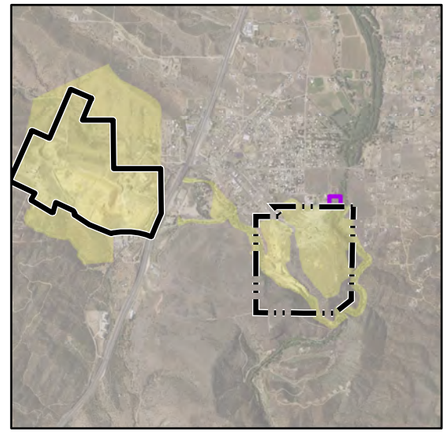

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg and Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR - Residential Yard-Specific Risk

N

0 30 60
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 2
Soil Sample Results at Yards for Proposed Removal - 109

Iron King Mine / Humboldt Smelter Superfund Site

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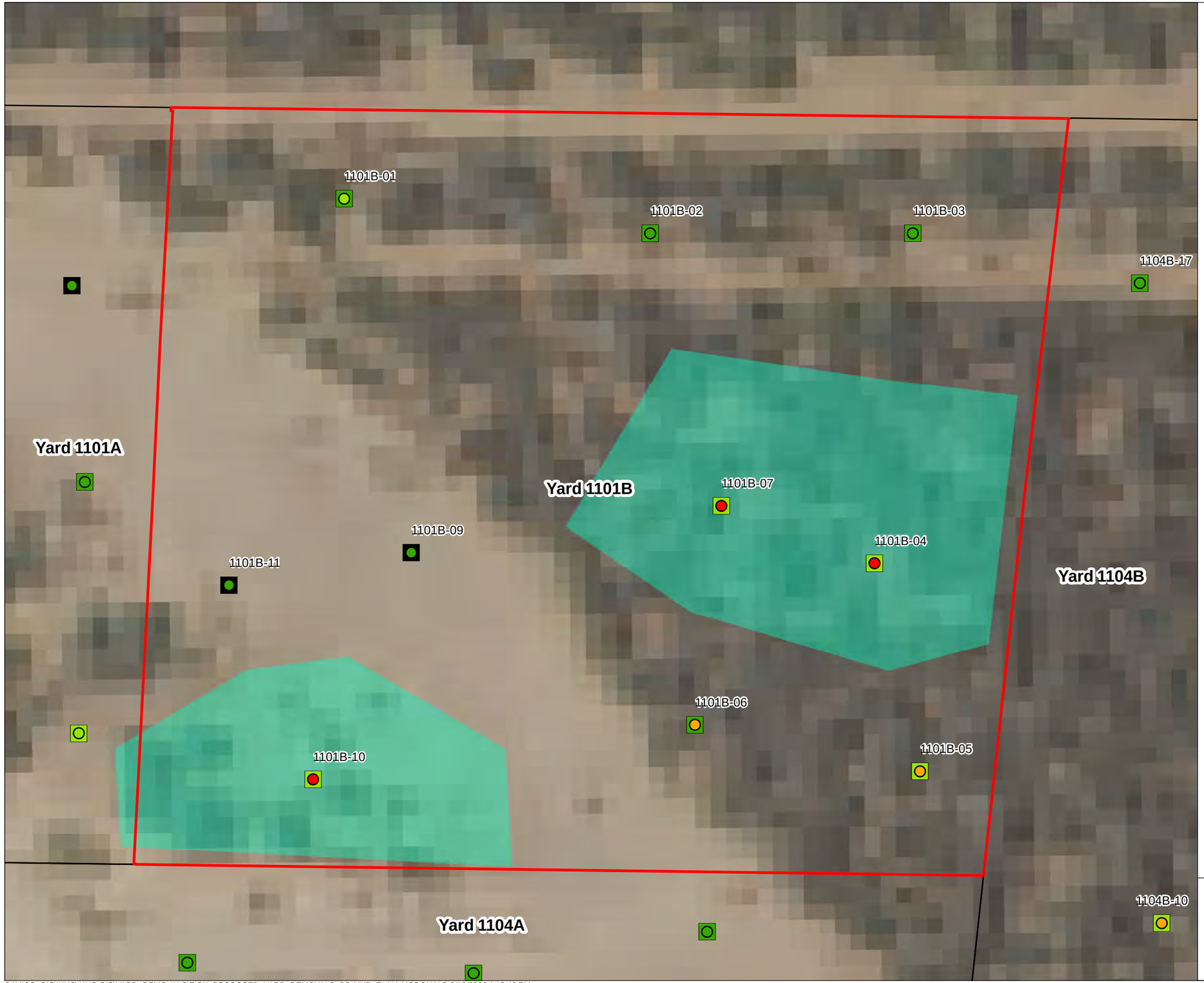

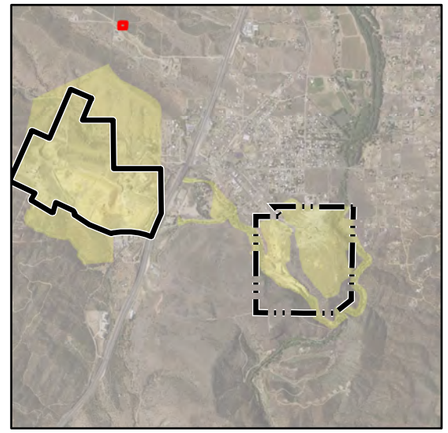

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 20 40
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 3
Soil Sample Results at Yards for Proposed Removal - 1101B

Iron King Mine / Humboldt Smelter Superfund Site

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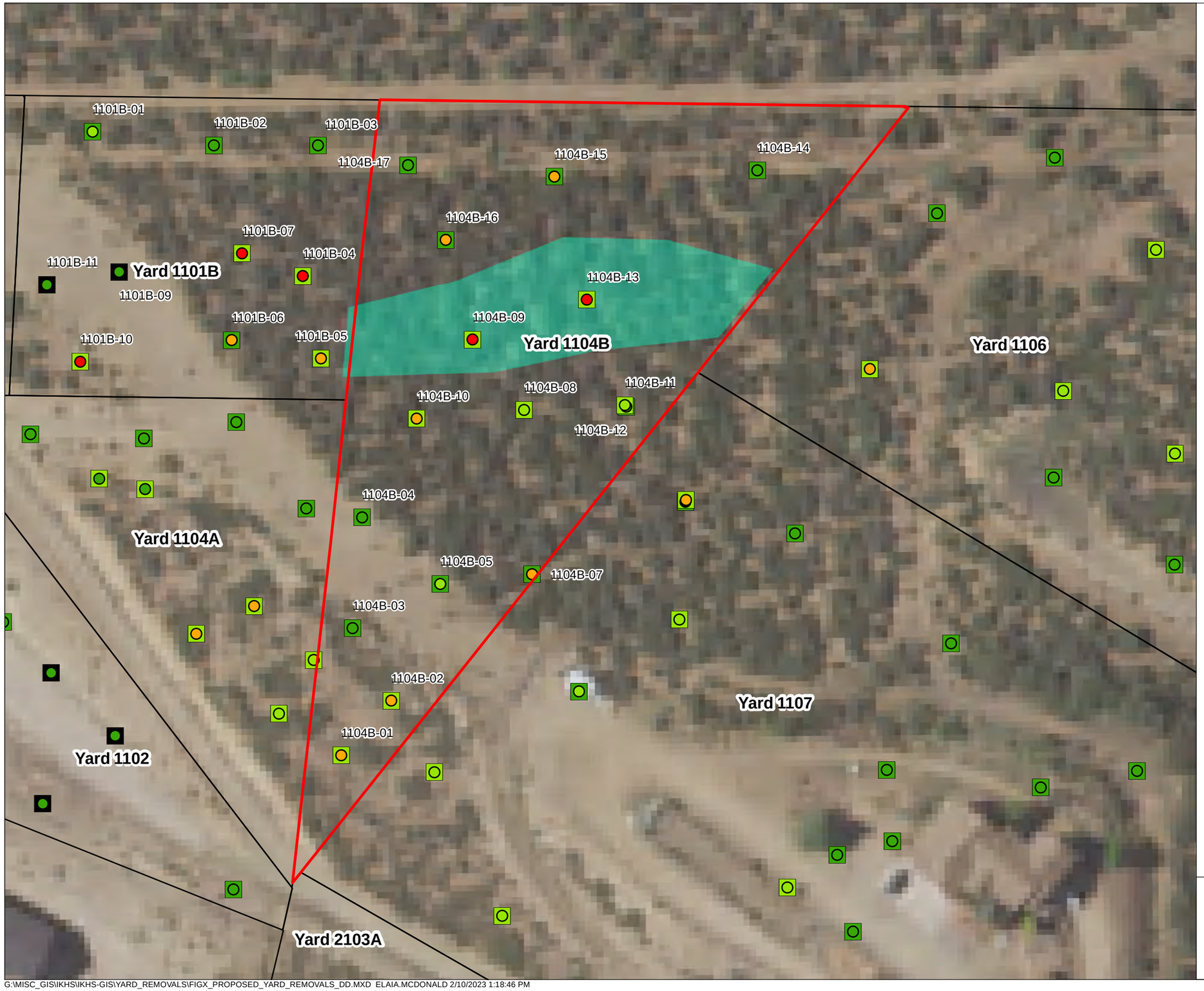

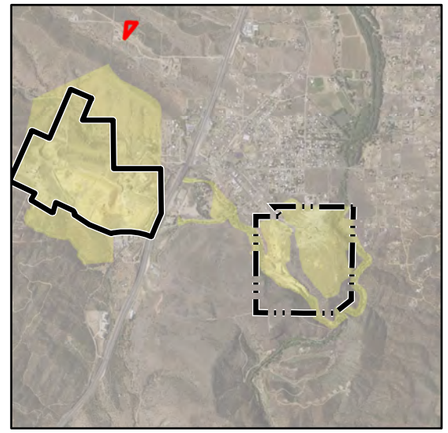

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 50 100
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 4
Soil Sample Results at Yards for Proposed Removal - 1104B

Iron King Mine / Humboldt Smelter Superfund Site

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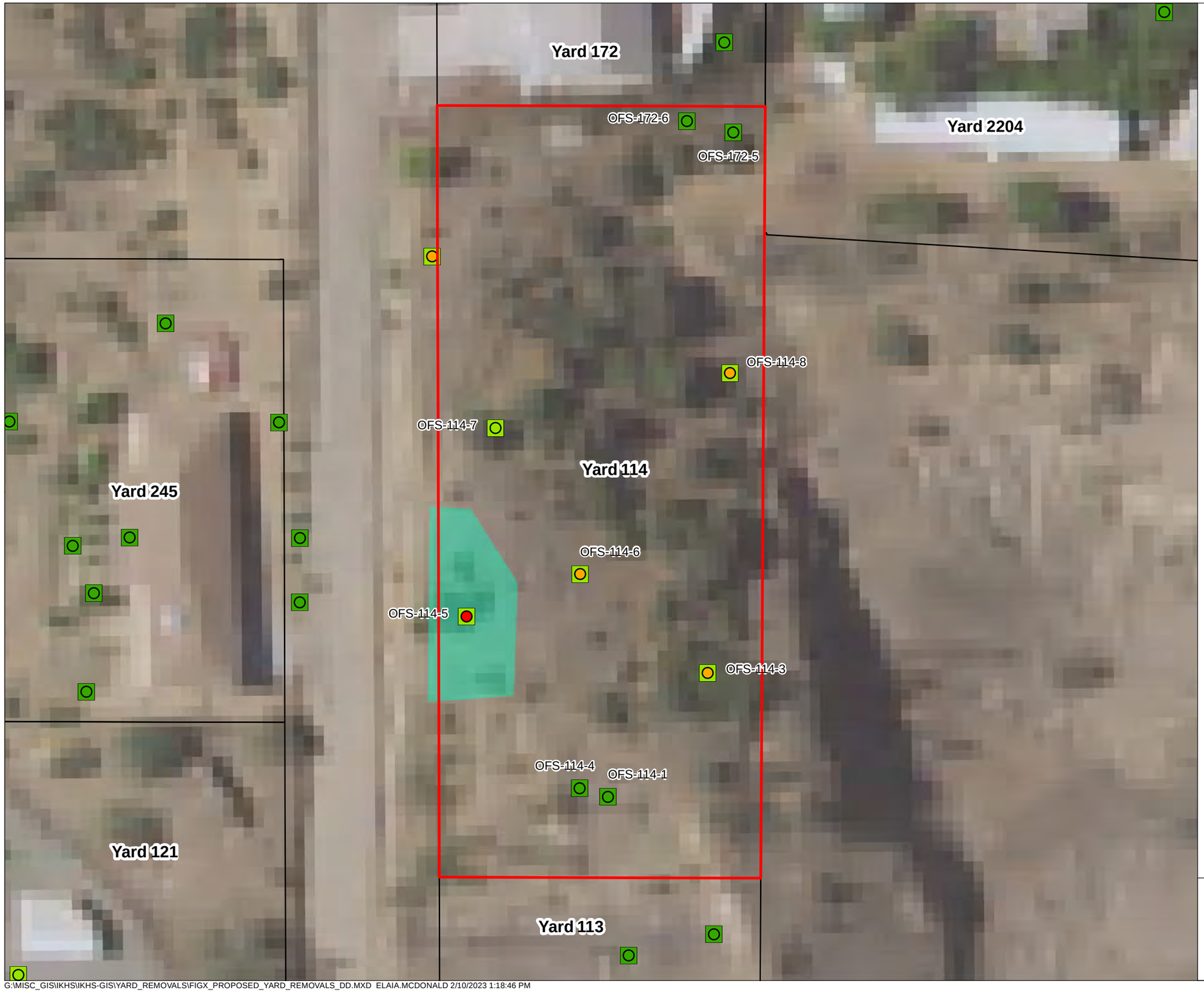

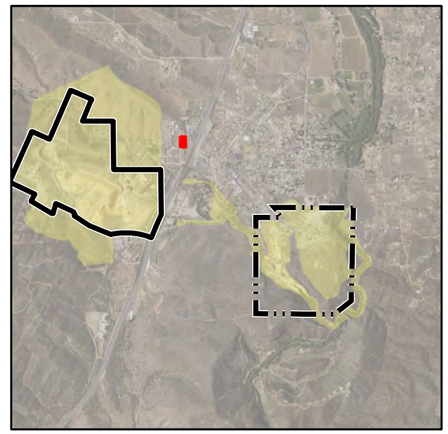

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 30 60
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 5
Soil Sample Results at Yards for Proposed Removal - 114

Iron King Mine / Humboldt Smelter Superfund Site

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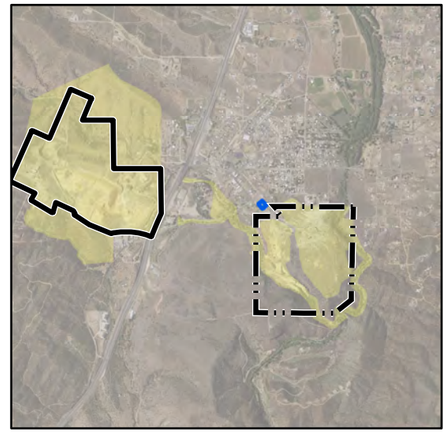

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 25 50
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 6
Soil Sample Results at Yards for Proposed Removal - 142

Iron King Mine / Humboldt Smelter Superfund Site

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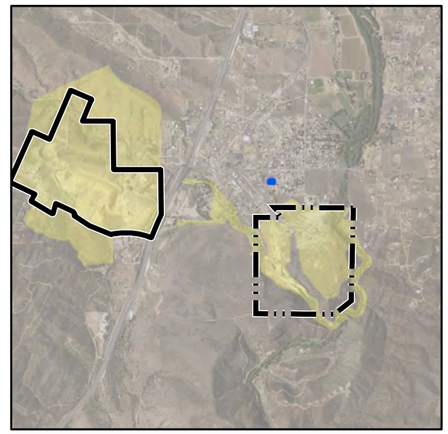

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 7
Soil Sample Results at Yards for Proposed Removal - 149

Iron King Mine / Humboldt Smelter Superfund Site

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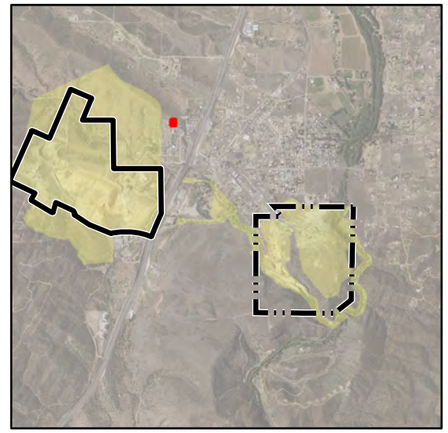

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 8
Soil Sample Results at Yards for Proposed Removal - 156

Iron King Mine / Humboldt Smelter Superfund Site

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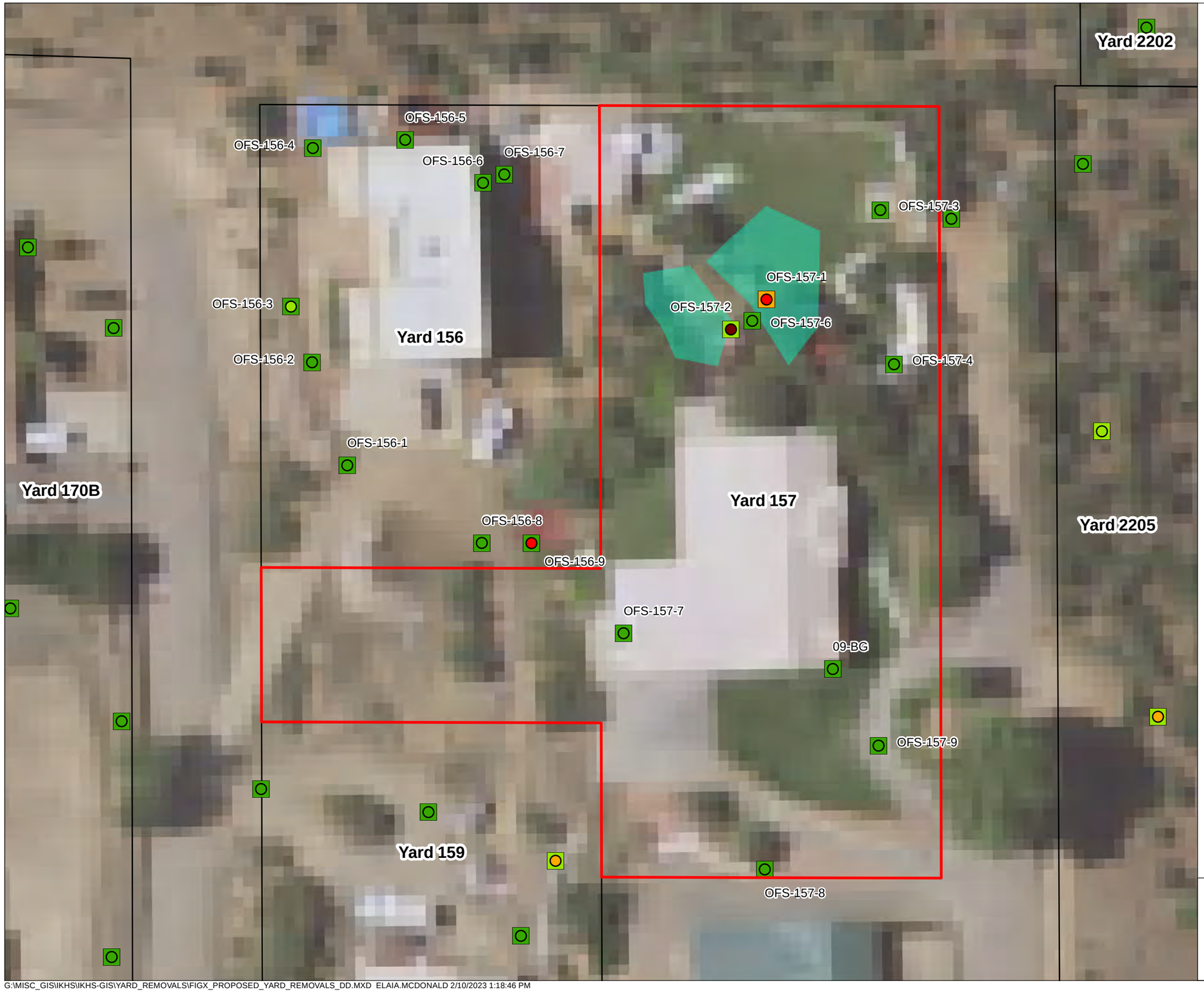

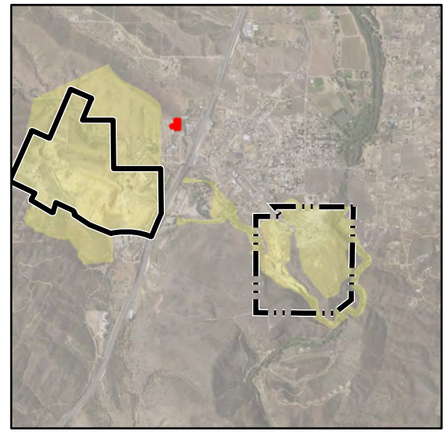

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 30 60
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 9
Soil Sample Results at Yards for Proposed Removal - 157

Iron King Mine / Humboldt Smelter Superfund Site

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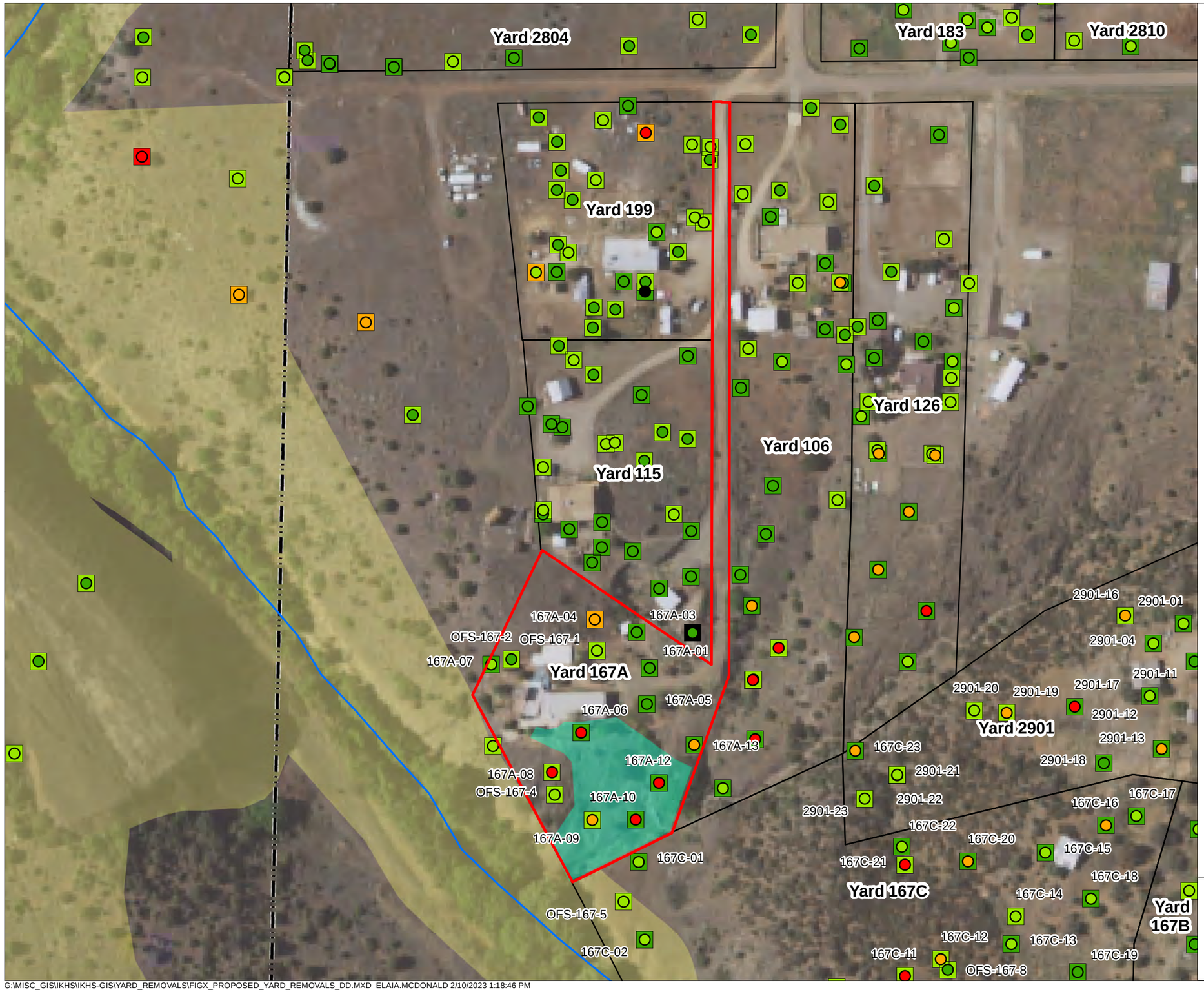

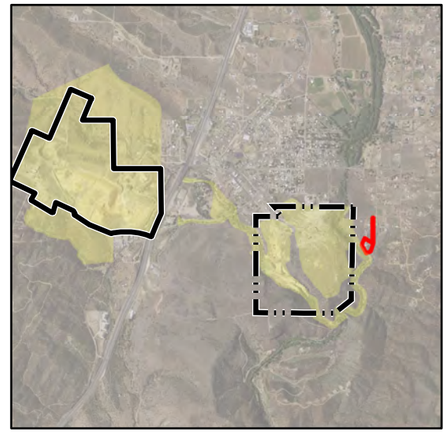

LEGEND

- River
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

0 125 250
Scale in Feet
N

Notes:
Image Source: USDA 2015.

Figure 10
Soil Sample Results at Yards for Proposed Removal - 167A

Iron King Mine / Humboldt Smelter Superfund Site

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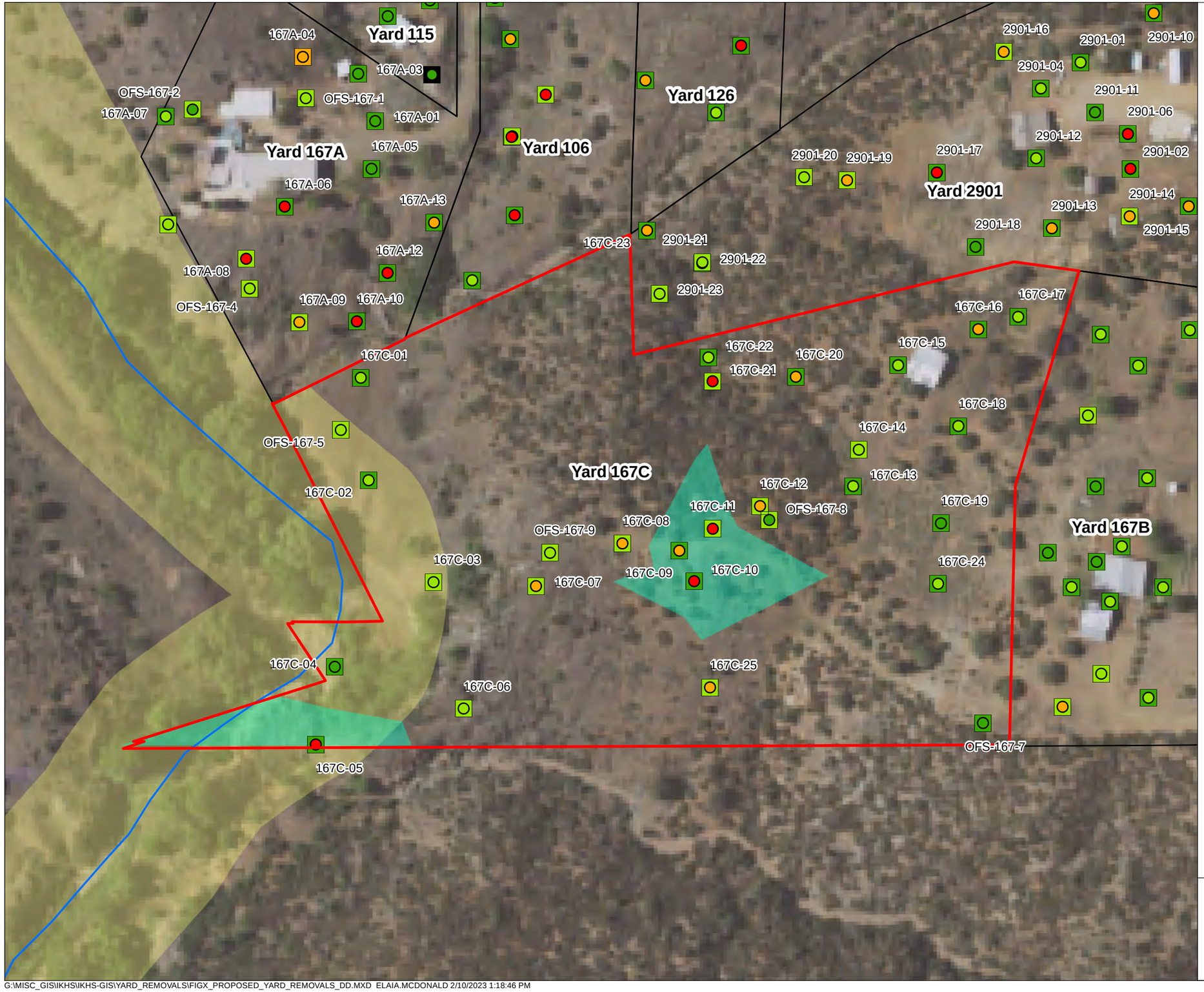

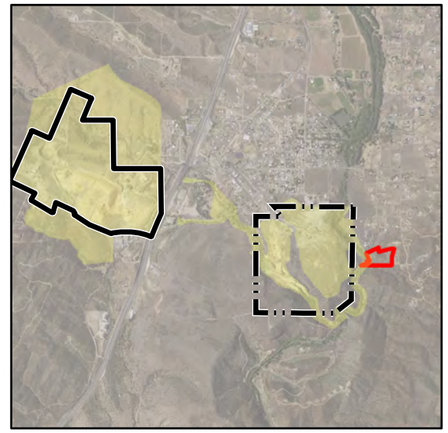

LEGEND

- River
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

0 90 180
Scale in Feet

N

Notes:
Image Source: USDA 2015.

Figure 11
Soil Sample Results at Yards for Proposed Removal - 167C

Iron King Mine / Humboldt Smelter Superfund Site

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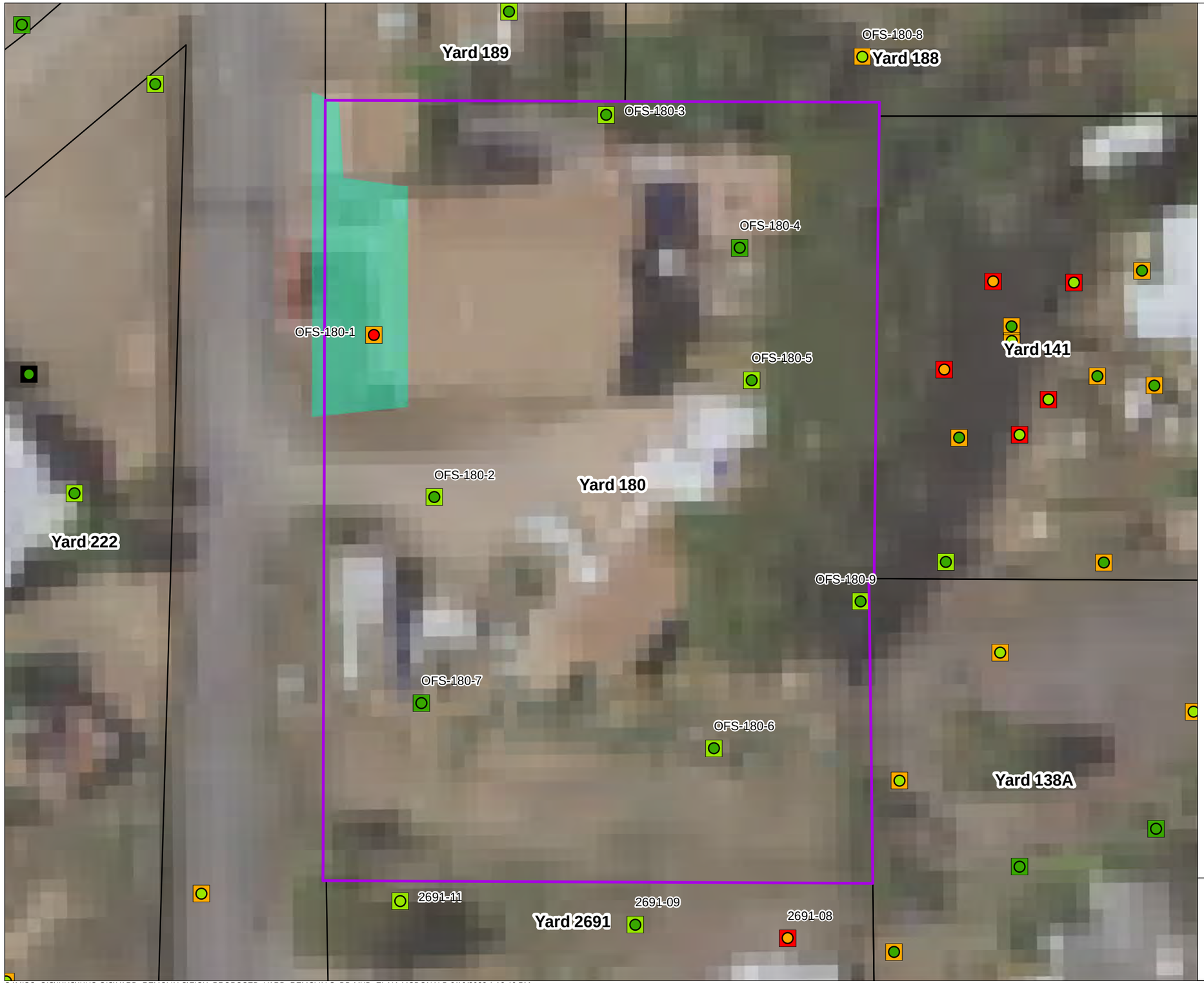

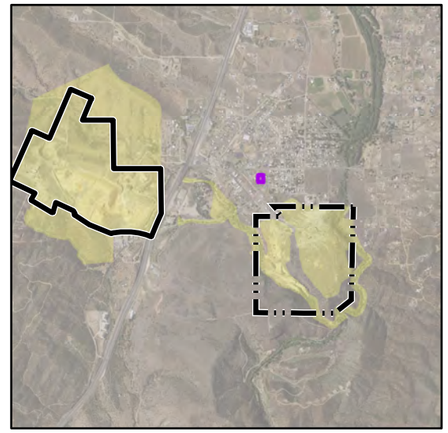

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg and Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

0 20 40
Scale in Feet
N

Notes:
Image Source: USDA 2015.

Figure 12
Soil Sample Results at Yards for Proposed Removal - 180

Iron King Mine / Humboldt Smelter Superfund Site

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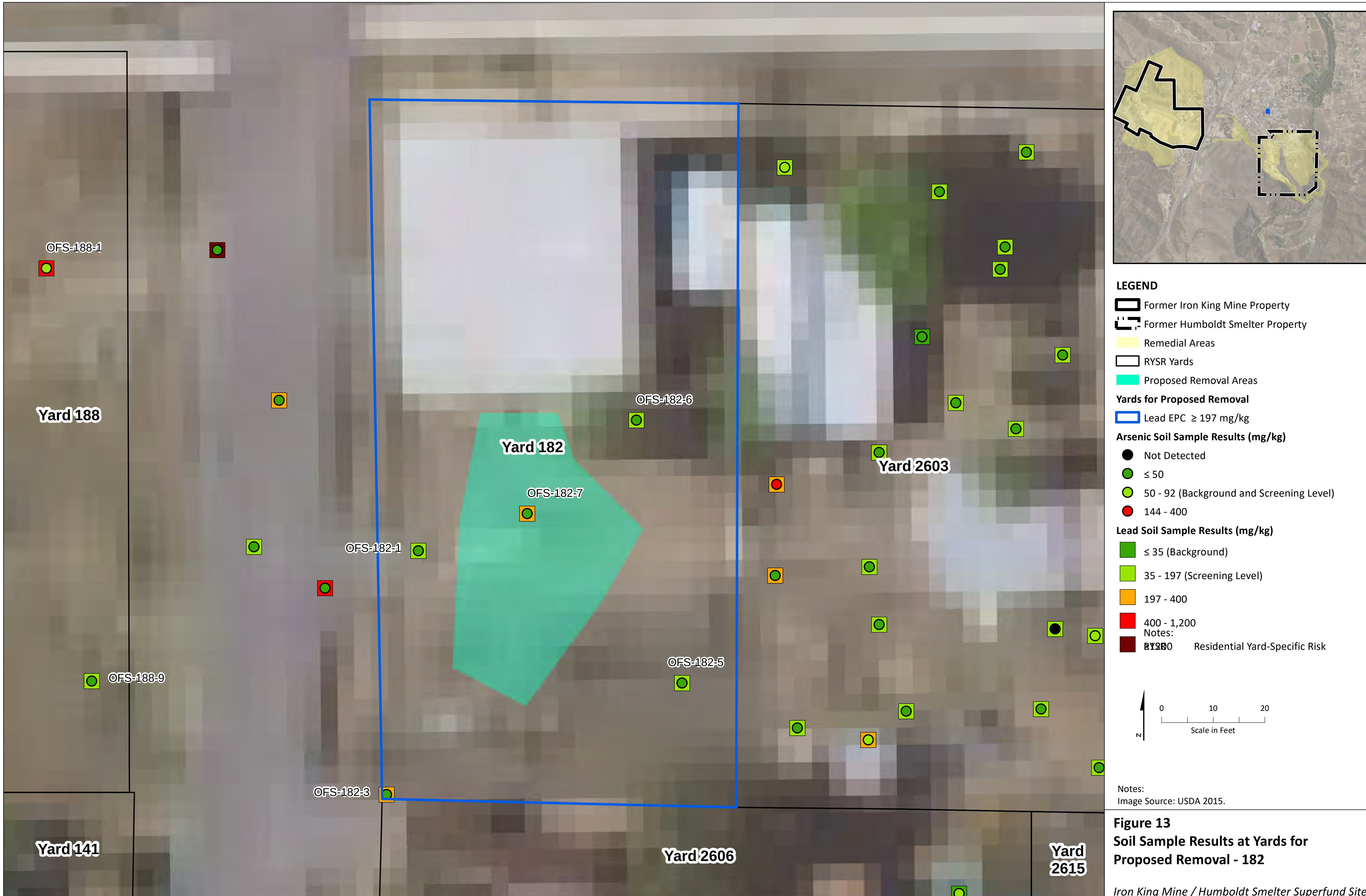
OFS-188-1
Yard 188
OFS-188-9
Yard 141
Yard 182
OFS-182-6
OFS-182-7
OFS-182-1
OFS-182-5
OFS-182-3
Yard 2603
Yard 2606
Yard 2615
LEGEND
Former Iron King Mine Property
Former Humboldt Smelter Property
Remedial Areas
RYSR Yards
Proposed Removal Areas
Yards for Proposed Removal
Lead EPC ≥ 197 mg/kg
Arsenic Soil Sample Results (mg/kg)
Not Detected
≤ 50
50 - 92 (Background and Screening Level)
144 - 400
Lead Soil Sample Results (mg/kg)
≤ 35 (Background)
35 - 197 (Screening Level)
197 - 400
400 - 1,200
Notes:
Residential Yard-Specific Risk
0
10
20
Scale in Feet
N

Notes:
Image Source: USDA 2015.

Figure 13
Soil Sample Results at Yards for Proposed Removal - 182

Iron King Mine / Humboldt Smelter Superfund Site

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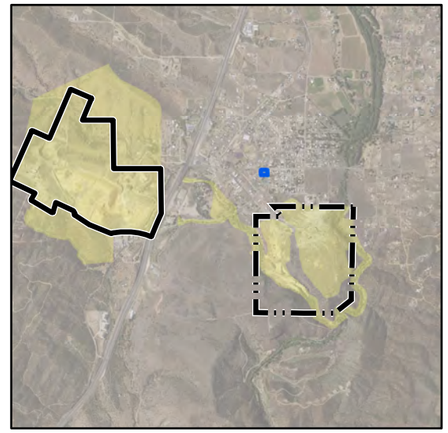

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200
- ≥1200

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 14
Soil Sample Results at Yards for Proposed Removal - 188

Iron King Mine / Humboldt Smelter Superfund Site

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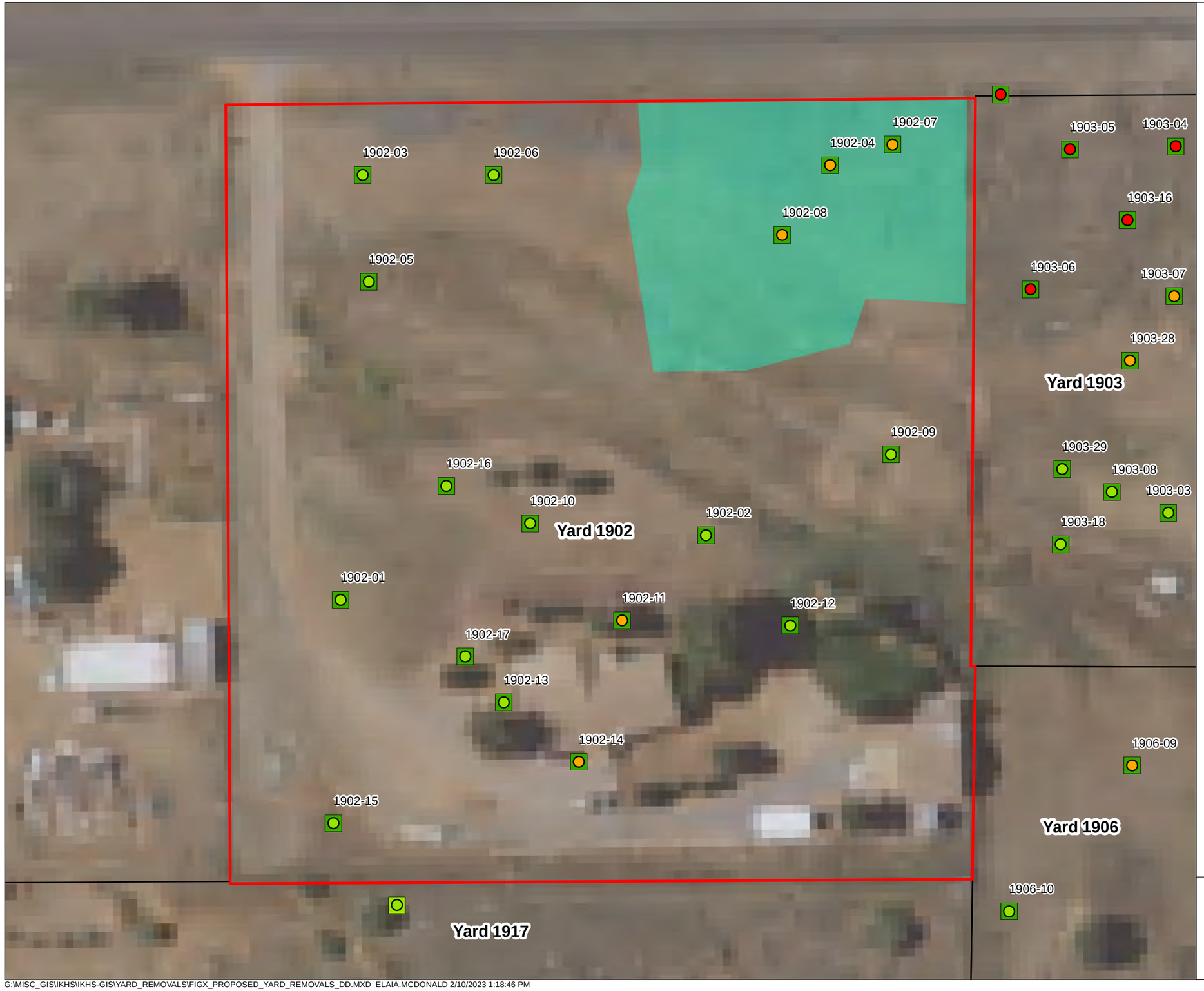

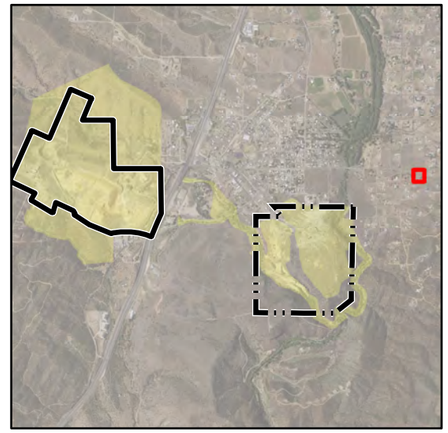

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 40 80
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 15
Soil Sample Results at Yards for Proposed Removal - 1902

Iron King Mine / Humboldt Smelter Superfund Site

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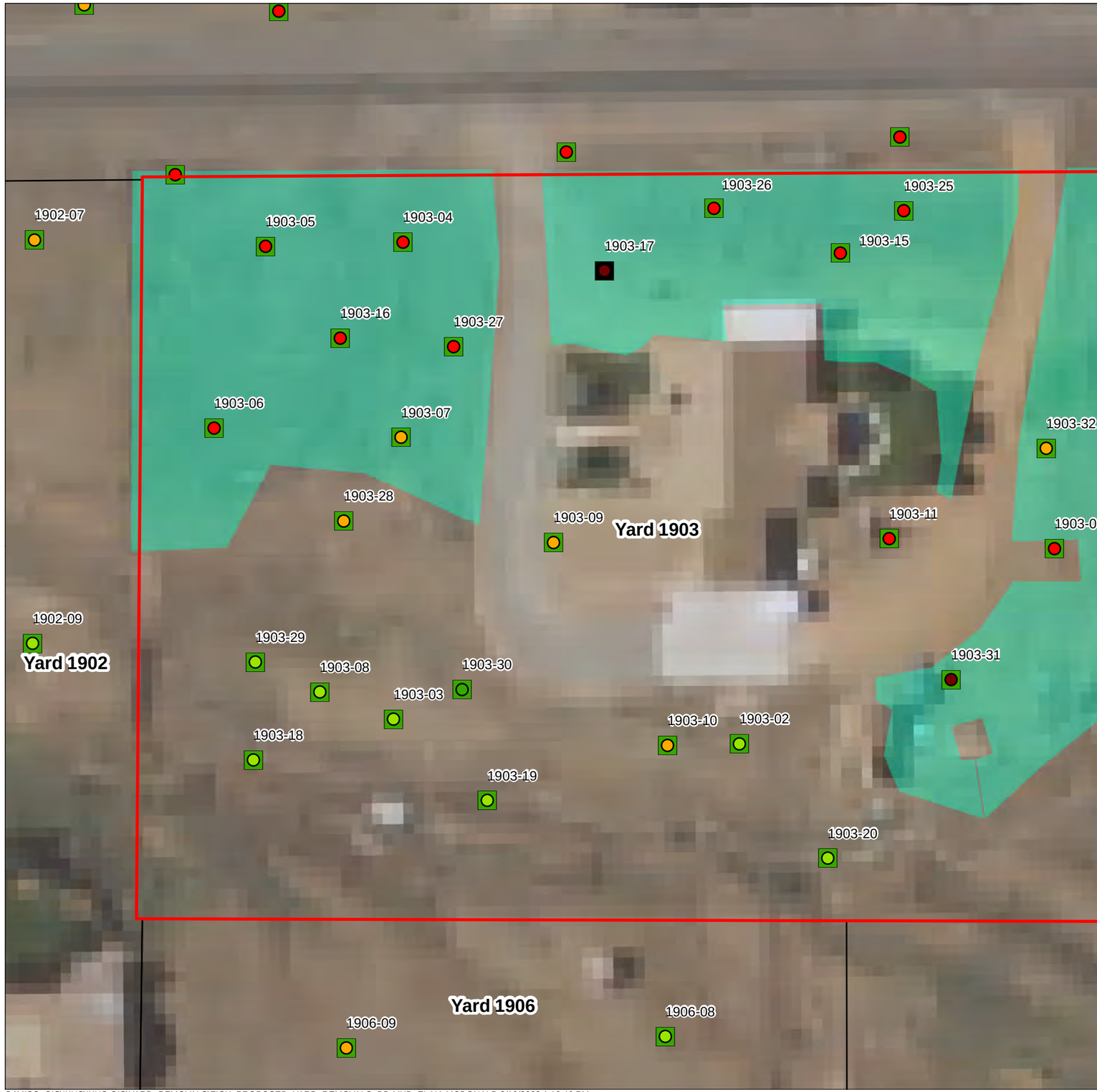

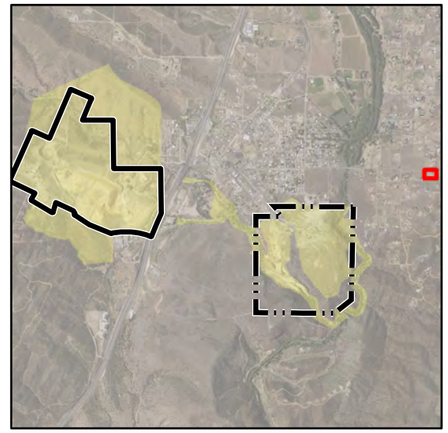

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)

Notes:
RYSR Residential Yard-Specific Risk

N

0 30 60
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 16
Soil Sample Results at Yards for Proposed Removal - 1903

Iron King Mine / Humboldt Smelter Superfund Site

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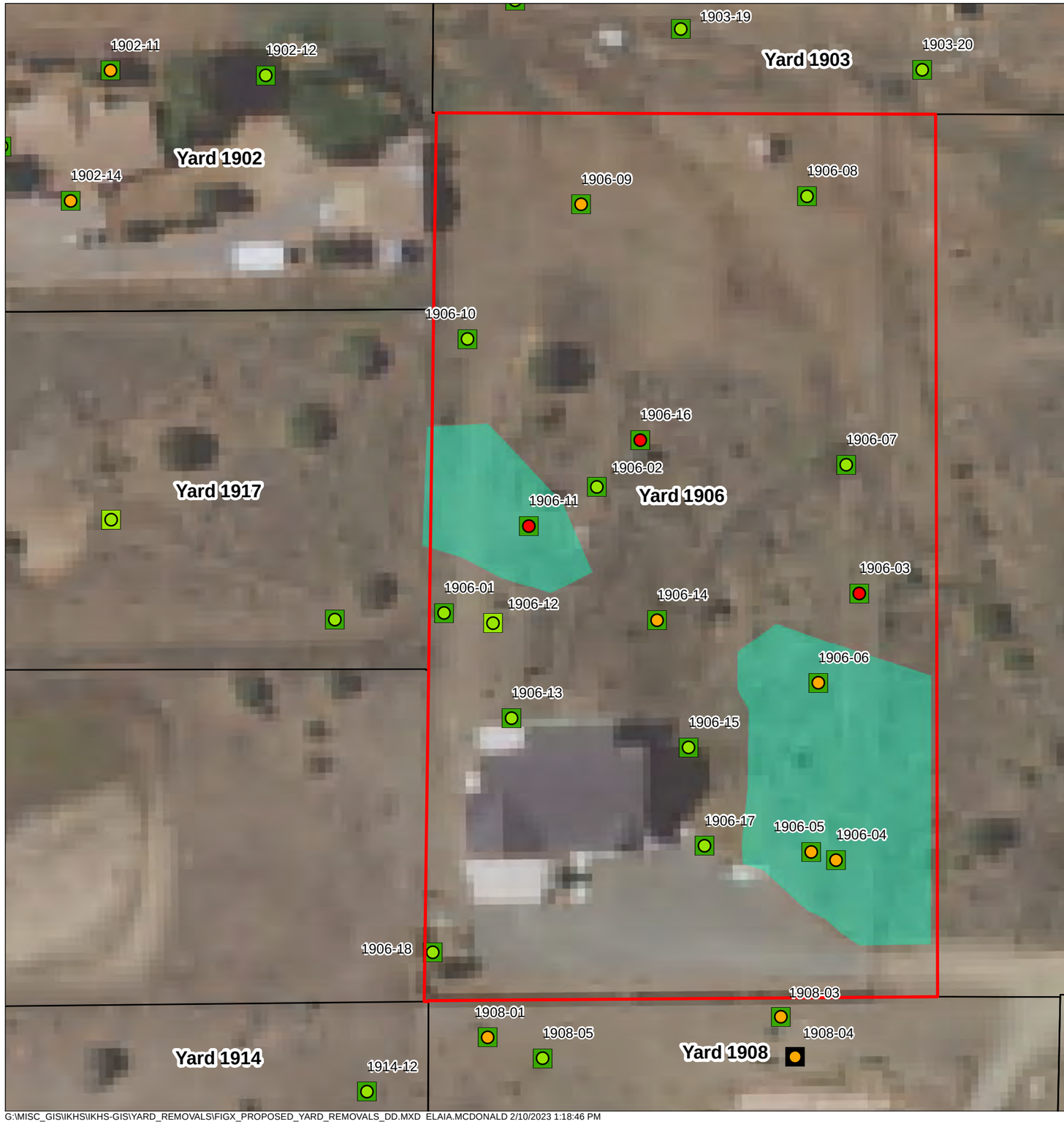

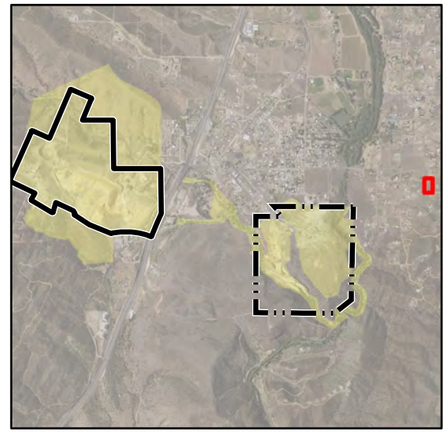

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 40 80
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 17
Soil Sample Results at Yards for Proposed Removal - 1906

Iron King Mine / Humboldt Smelter Superfund Site

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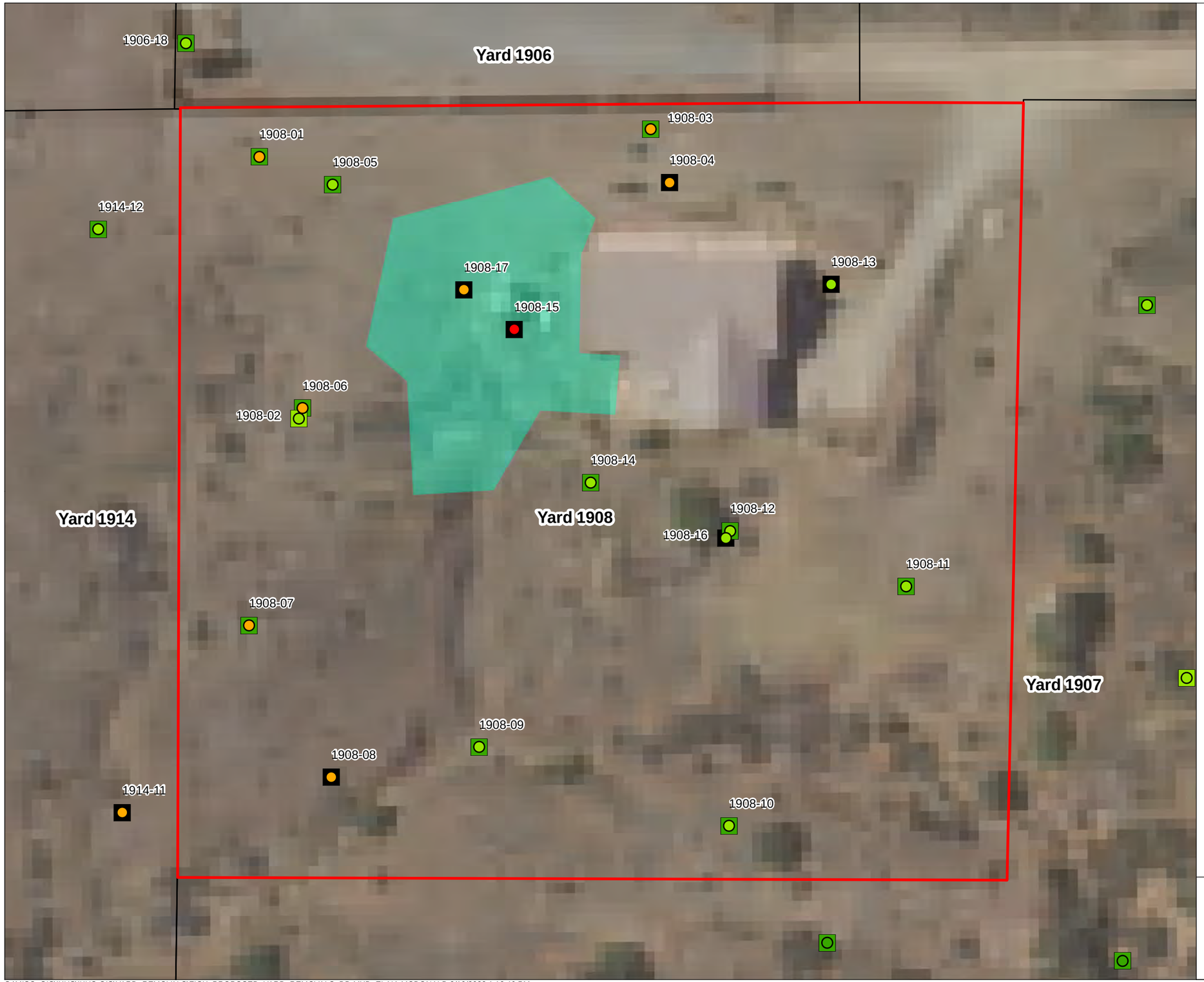

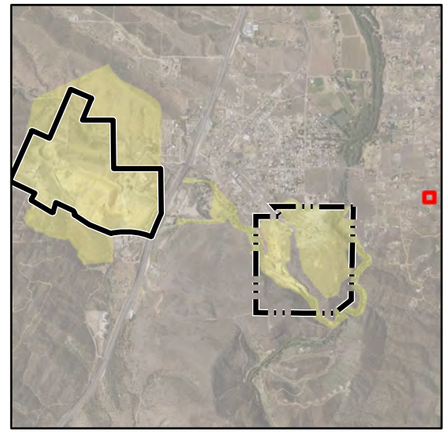

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 30 60
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 18
Soil Sample Results at Yards for Proposed Removal - 1908

Iron King Mine / Humboldt Smelter Superfund Site

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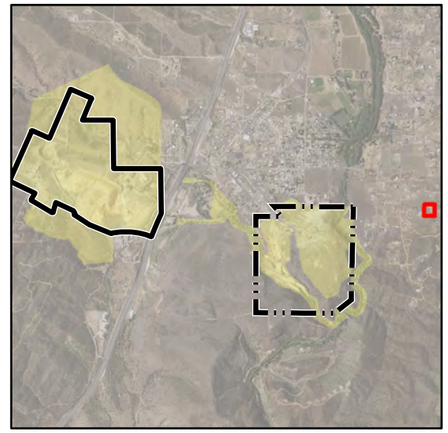

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 40 80
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 19
Soil Sample Results at Yards for Proposed Removal - 1911

Iron King Mine / Humboldt Smelter Superfund Site

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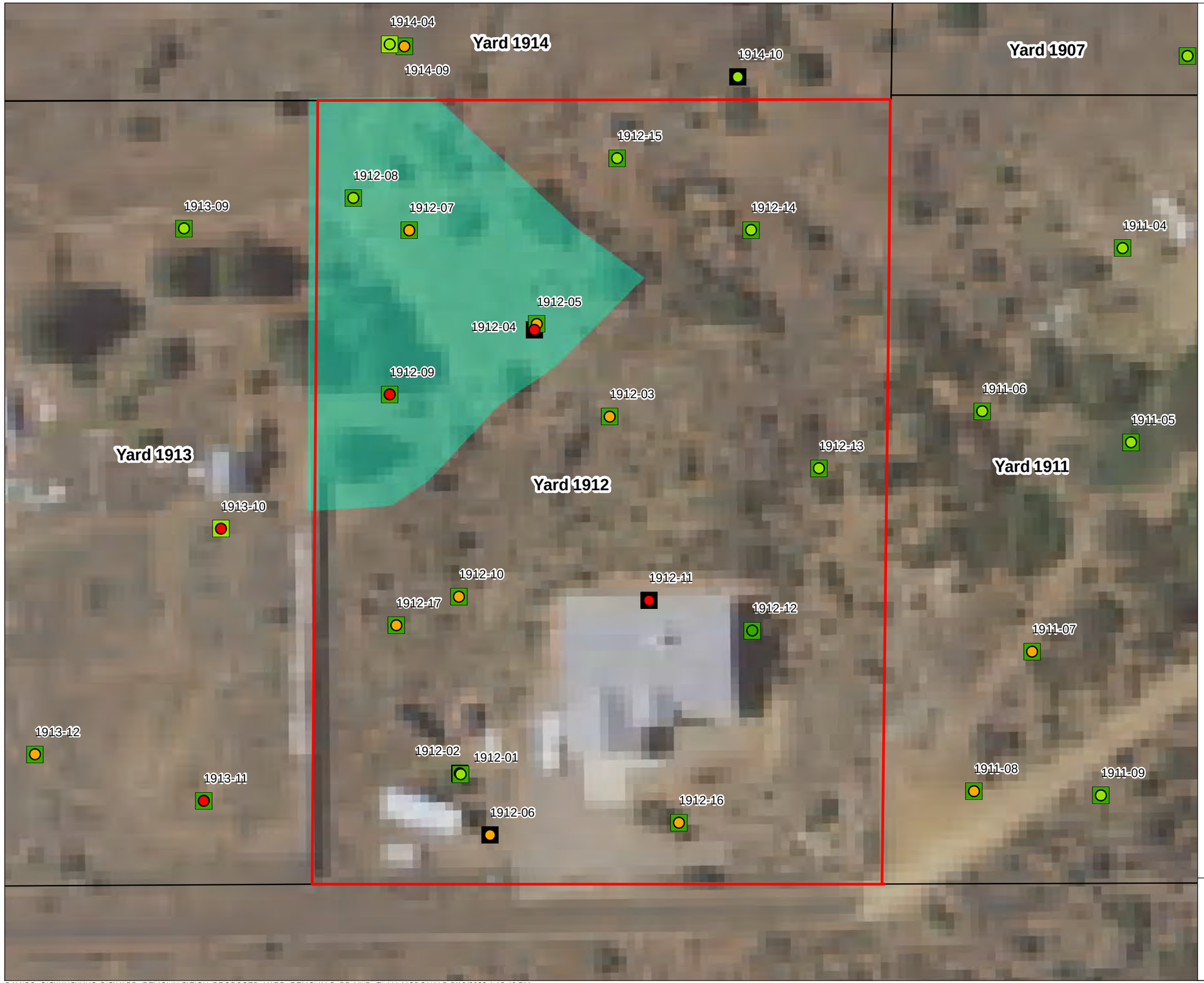

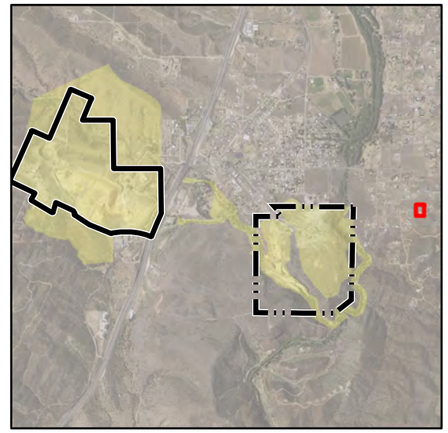

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 40 80
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 20
Soil Sample Results at Yards for Proposed Removal - 1912

Iron King Mine / Humboldt Smelter Superfund Site

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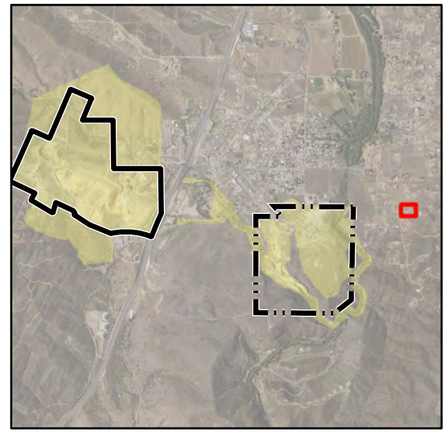

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 40 80
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 21
Soil Sample Results at Yards for Proposed Removal - 1913

Iron King Mine / Humboldt Smelter Superfund Site

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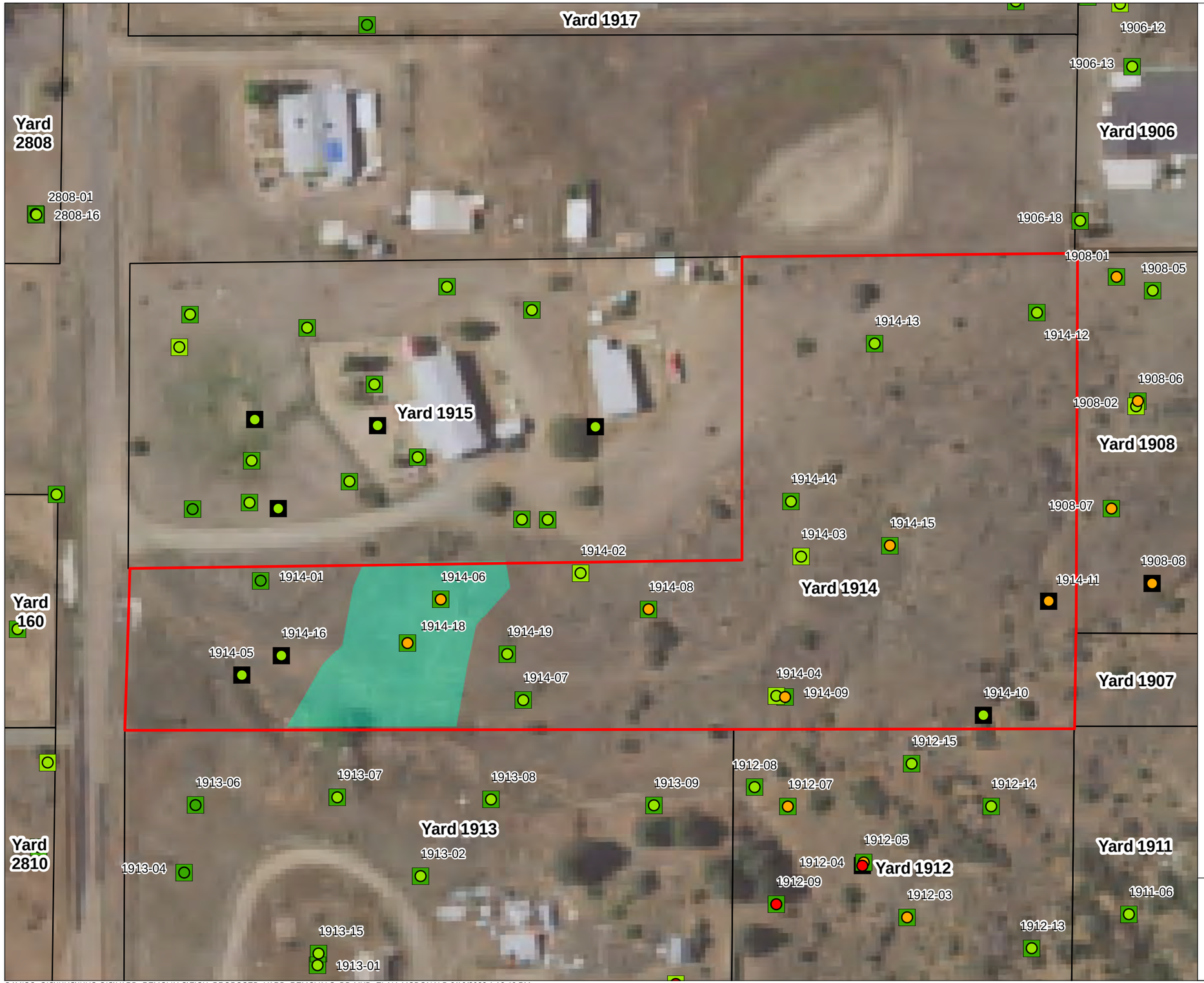

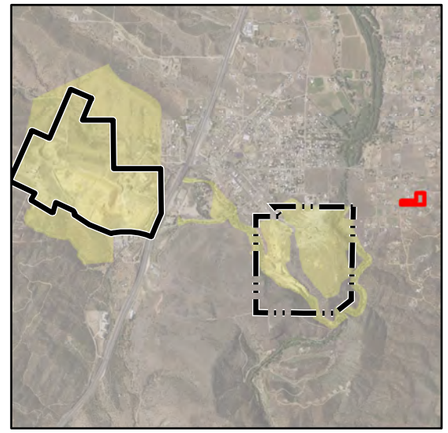

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 60 120
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 22
Soil Sample Results at Yards for Proposed Removal - 1914

Iron King Mine / Humboldt Smelter Superfund Site

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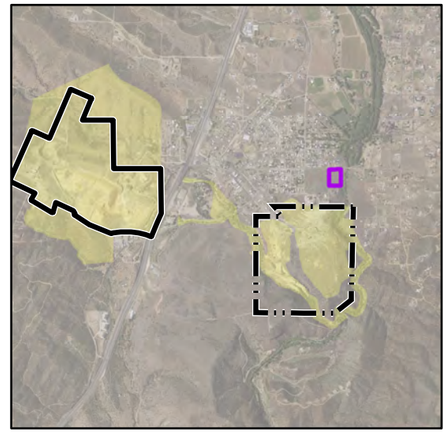

LEGEND

- River
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg and Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 50 100
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 23
Soil Sample Results at Yards for Proposed Removal - 203A

Iron King Mine / Humboldt Smelter Superfund Site

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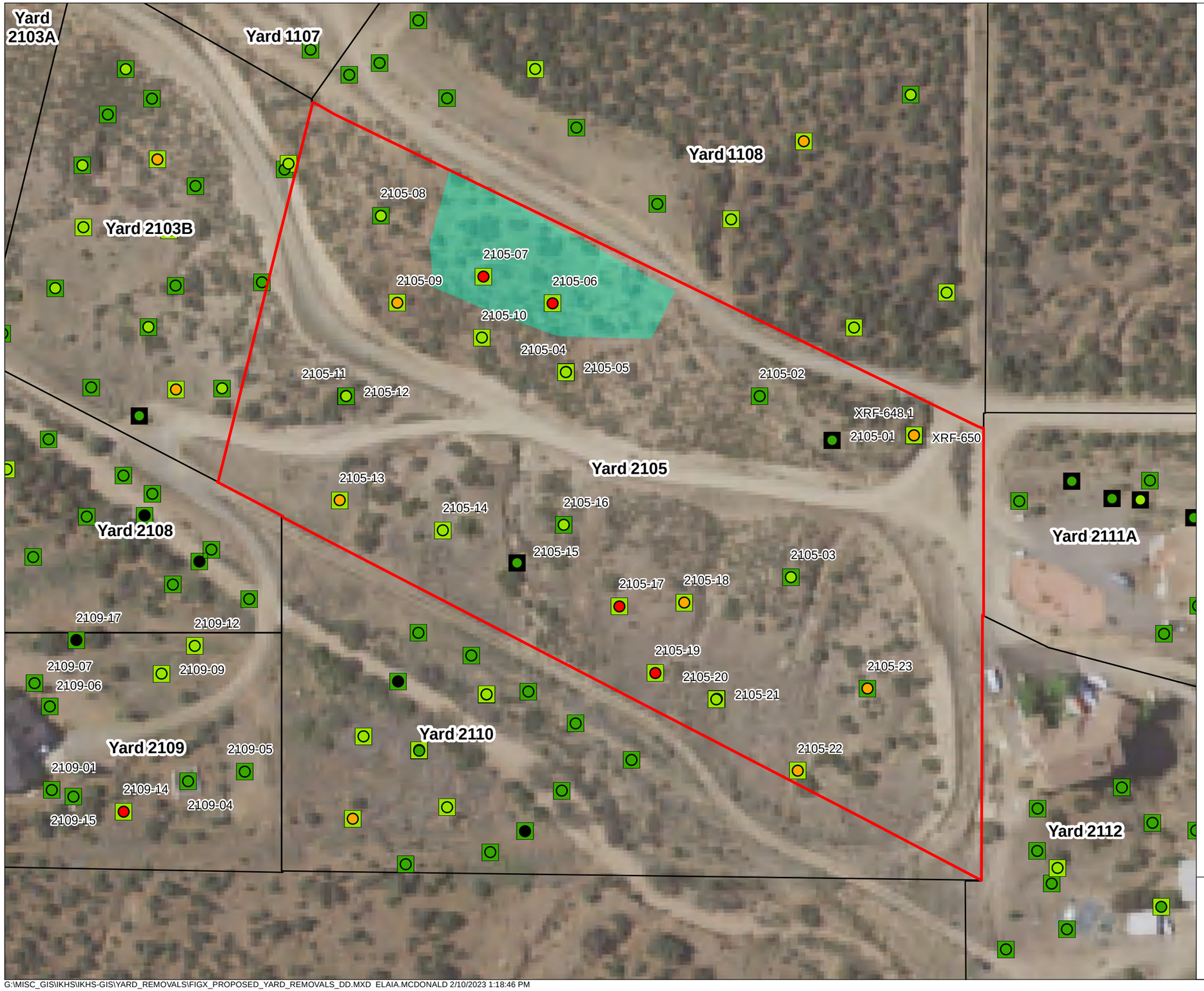

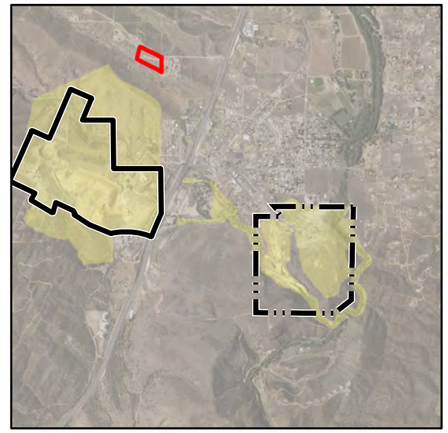

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 80 160
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 24
Soil Sample Results at Yards for Proposed Removal - 2105

Iron King Mine / Humboldt Smelter Superfund Site

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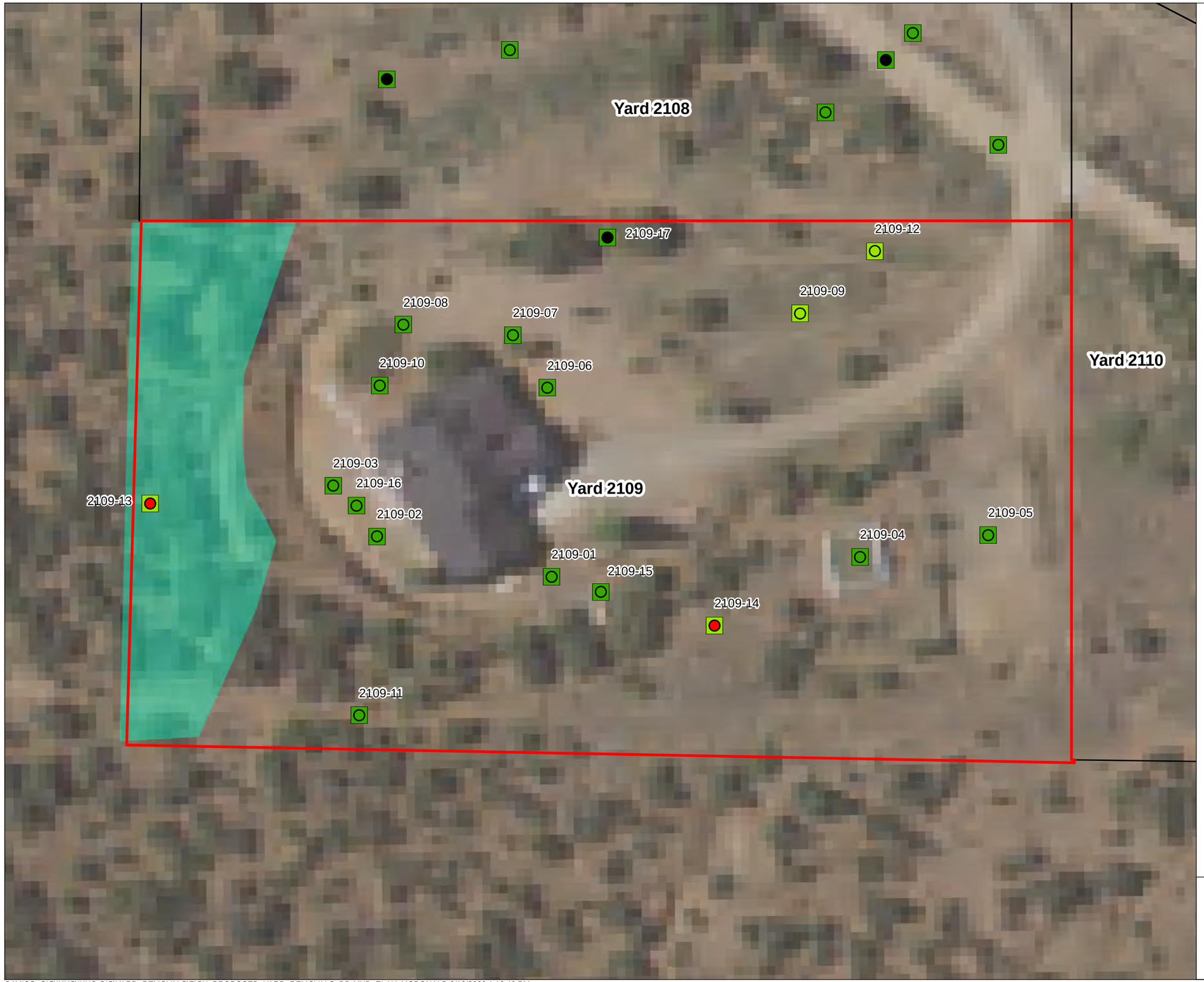

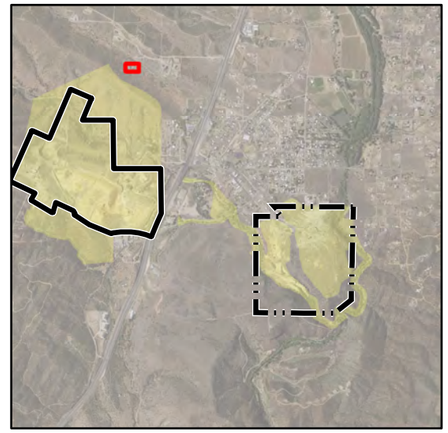

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 30 60
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 25
Soil Sample Results at Yards for Proposed Removal - 2109

Iron King Mine / Humboldt Smelter Superfund Site

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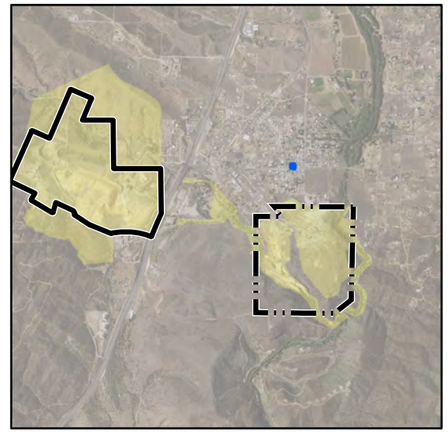

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)

Lead Soil Sample Results (mg/kg)

- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 26
Soil Sample Results at Yards for Proposed Removal - 213

Iron King Mine / Humboldt Smelter Superfund Site

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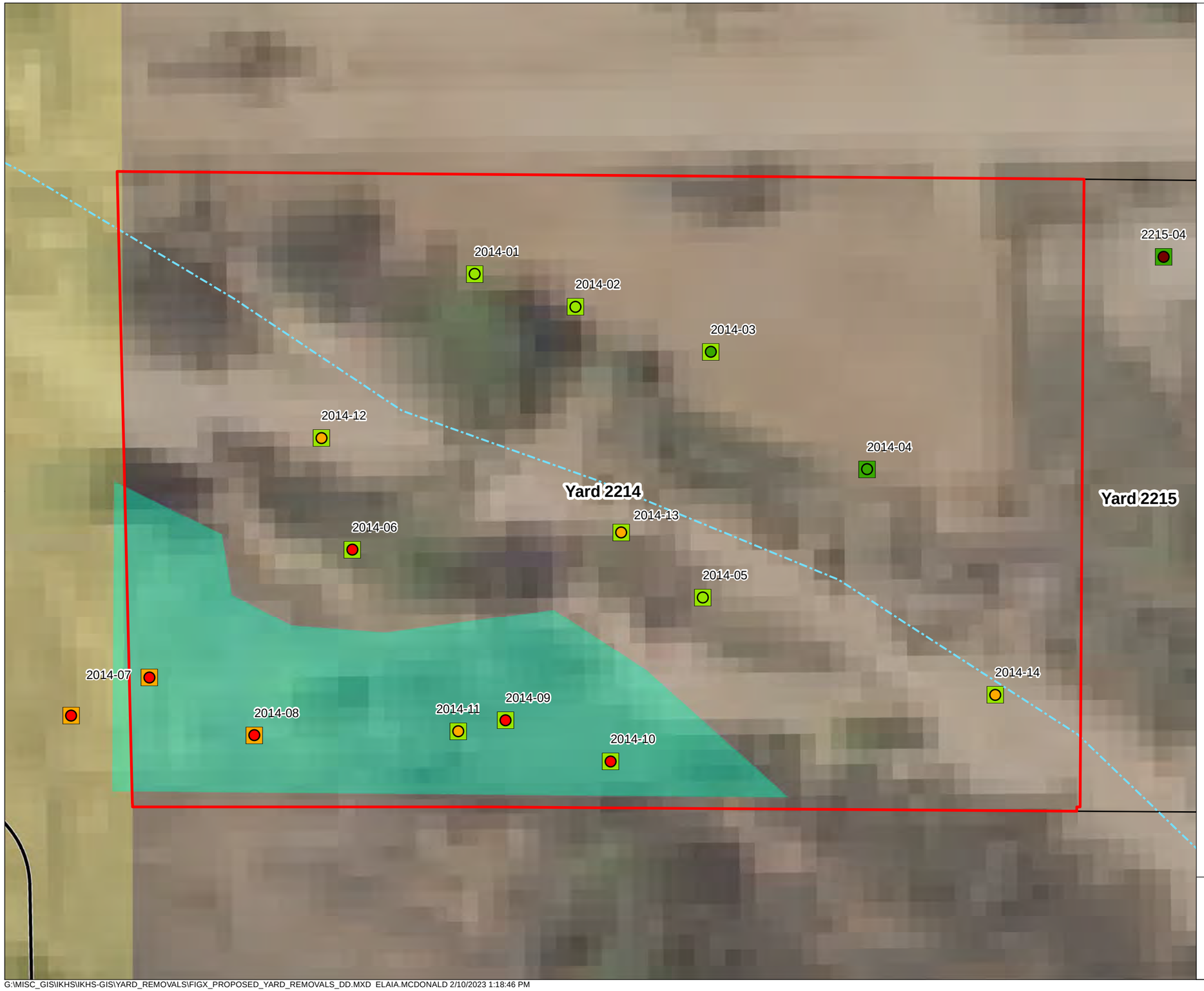

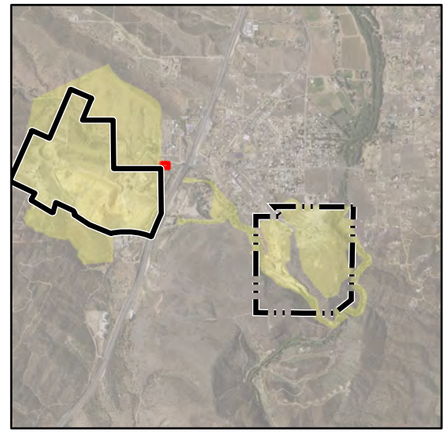

LEGEND

- Intermittent Drainage
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

0 20 40
Scale in Feet
N

Notes:
Image Source: USDA 2015.

Figure 27
Soil Sample Results at Yards for Proposed Removal - 2214

Iron King Mine / Humboldt Smelter Superfund Site

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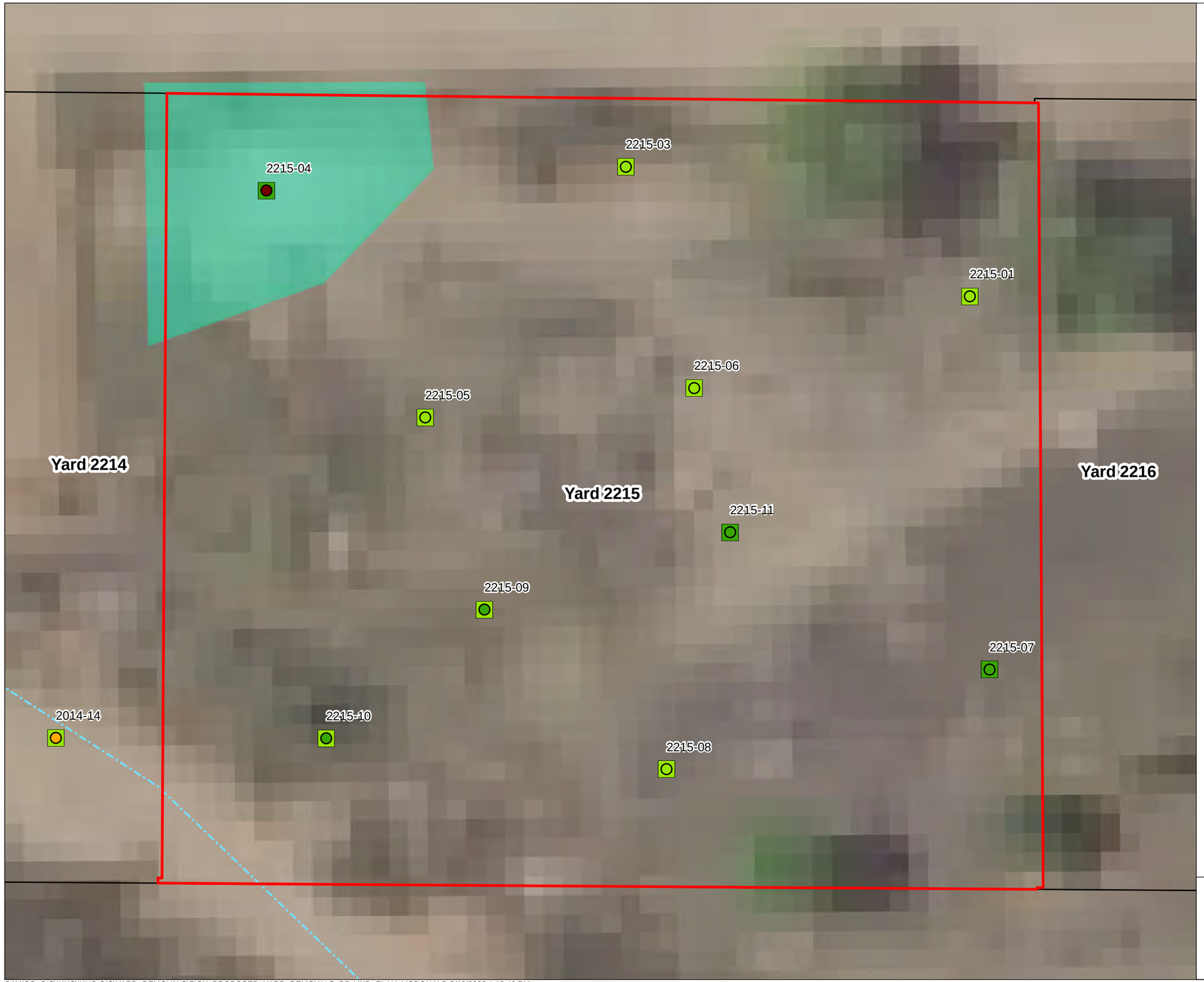

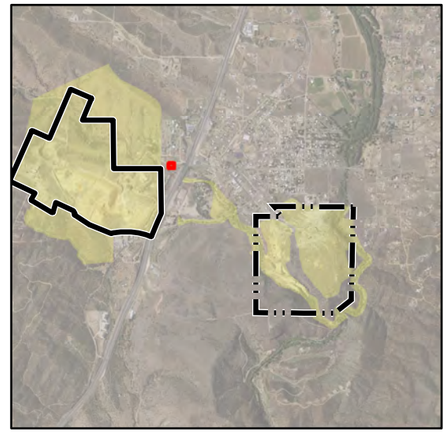

LEGEND

- Intermittent Drainage
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- ≥ 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 28
Soil Sample Results at Yards for Proposed Removal - 2215

Iron King Mine / Humboldt Smelter Superfund Site

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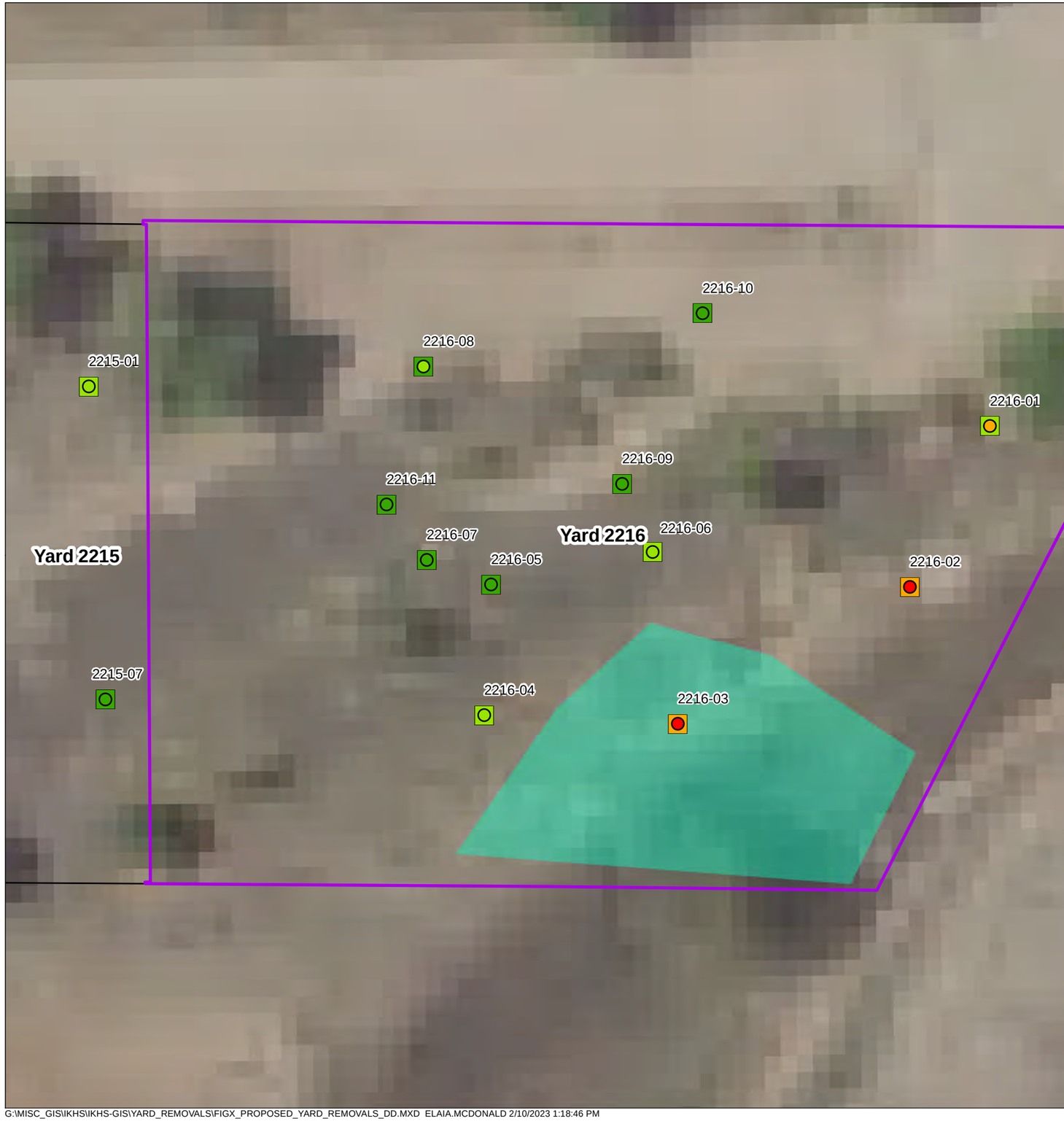

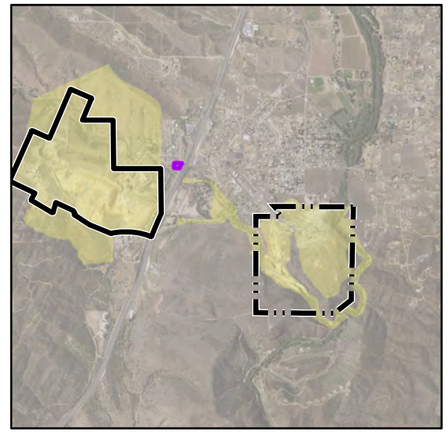

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg and Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 20 40
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 29
Soil Sample Results at Yards for Proposed Removal - 2216

Iron King Mine / Humboldt Smelter Superfund Site

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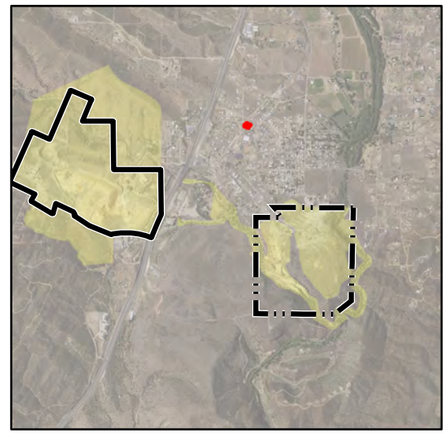

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 30
Soil Sample Results at Yards for Proposed Removal - 2324

Iron King Mine / Humboldt Smelter Superfund Site

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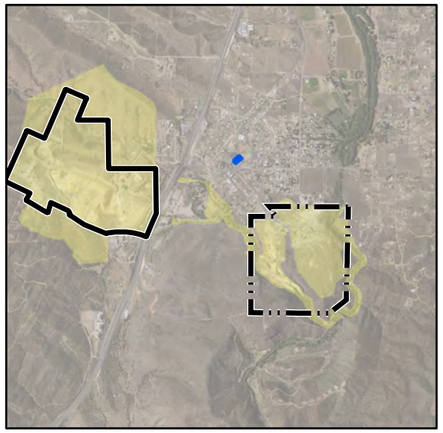

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 20 40
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 31
Soil Sample Results at Yards for Proposed Removal - 2401

Iron King Mine / Humboldt Smelter Superfund Site

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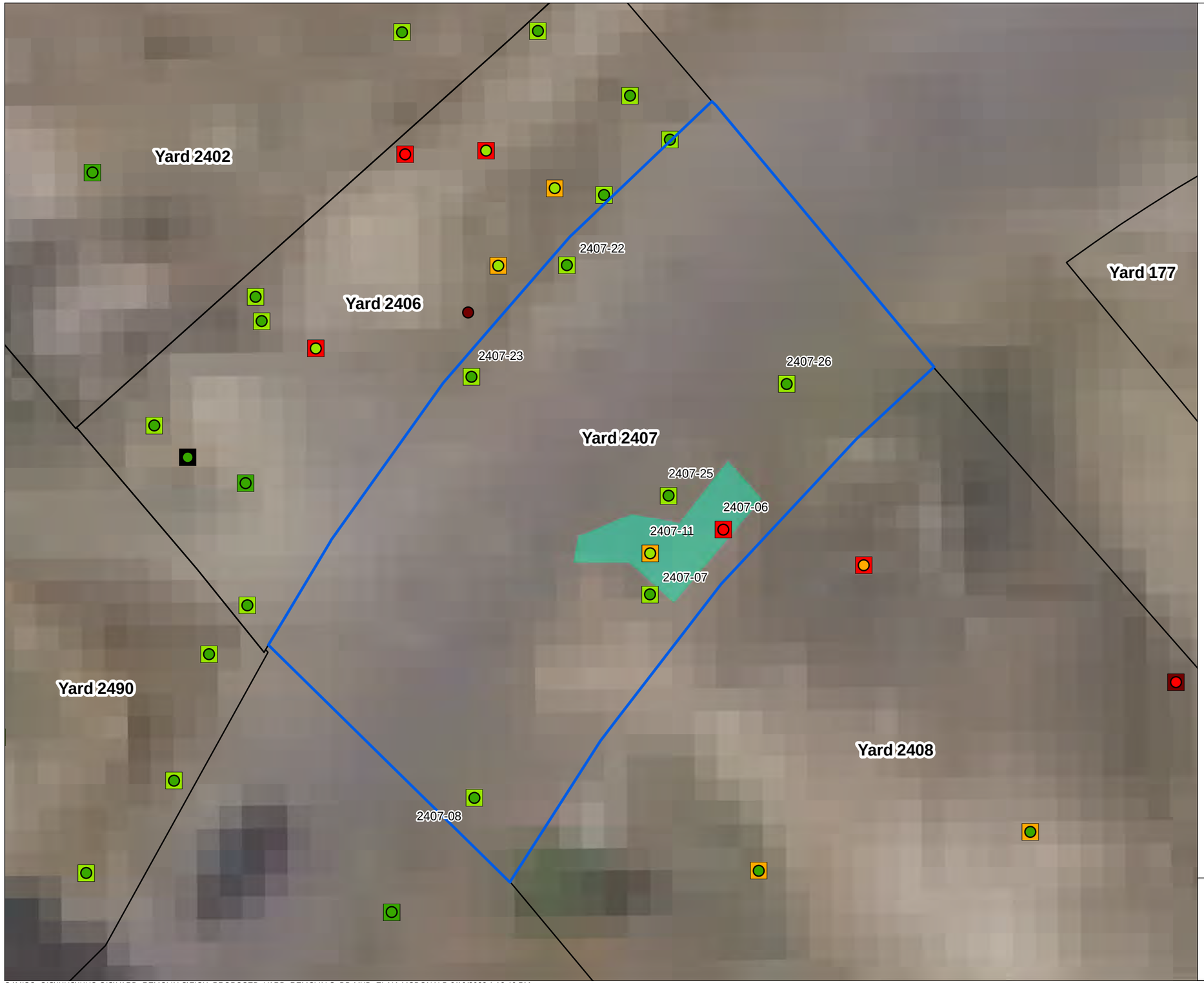

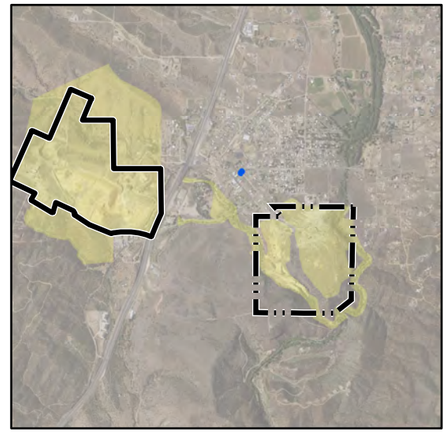

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200
- ≥1200

Notes:
RYSR Residential Yard-Specific Risk

0 10 20
Scale in Feet
N

Notes:
Image Source: USDA 2015.

Figure 32
Soil Sample Results at Yards for Proposed Removal - 2407

Iron King Mine / Humboldt Smelter Superfund Site

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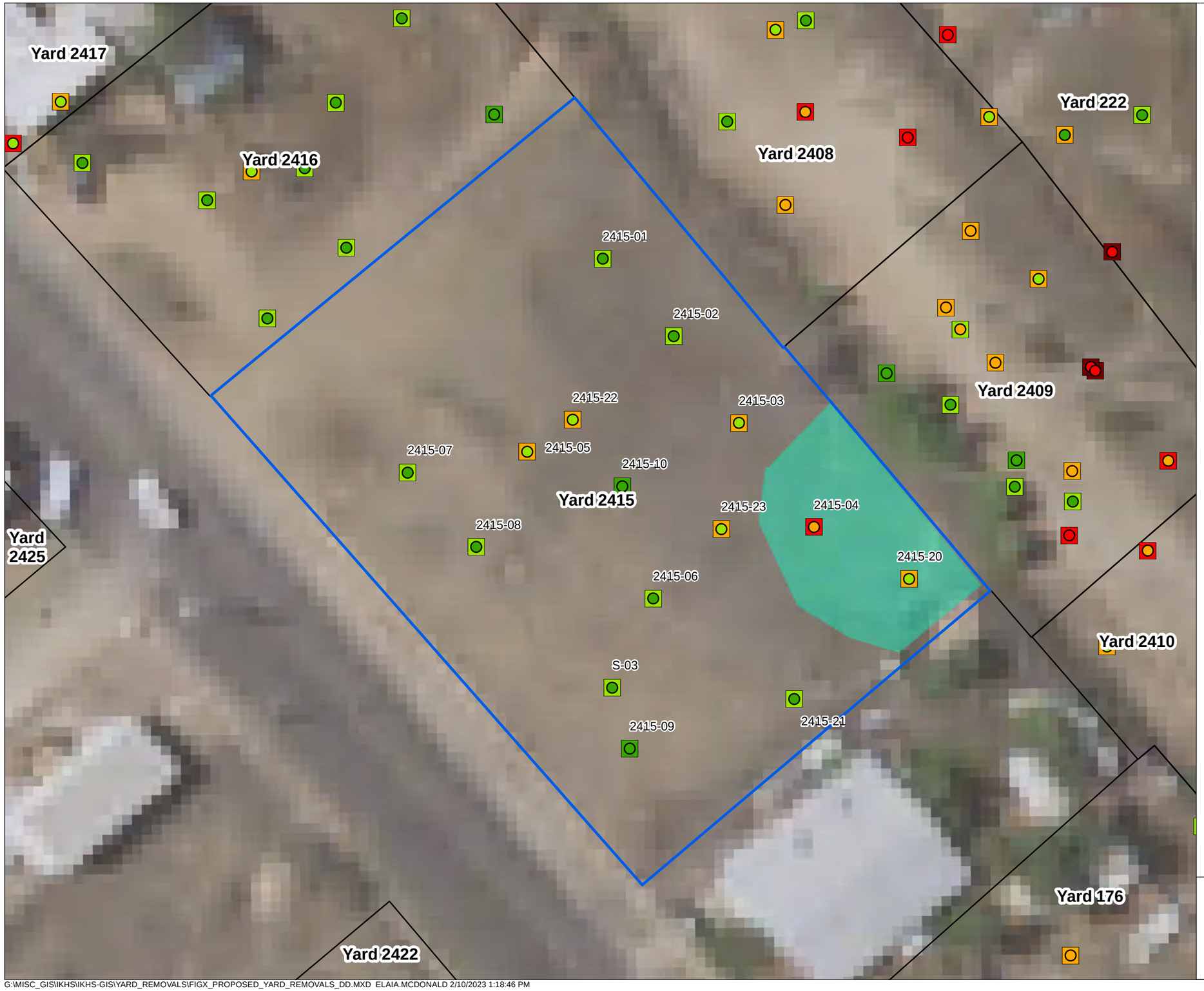

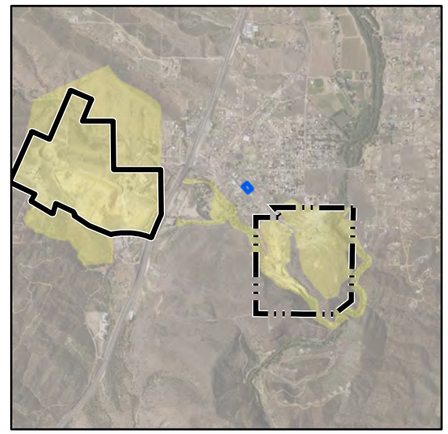

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200
- 1,200 - 2,120

Notes:
RYSR Residential Yard-Specific Risk

N

0 30 60

Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 33
Soil Sample Results at Yards for Proposed Removal - 2415

Iron King Mine / Humboldt Smelter Superfund Site

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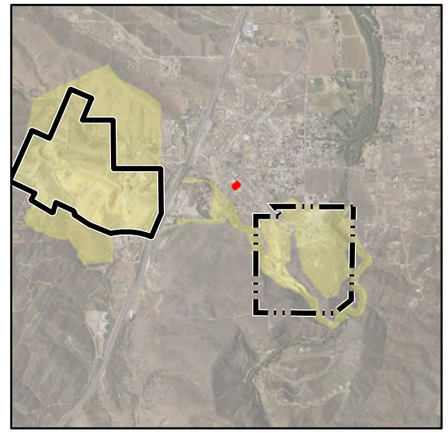

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 34
Soil Sample Results at Yards for Proposed Removal - 2426

Iron King Mine / Humboldt Smelter Superfund Site

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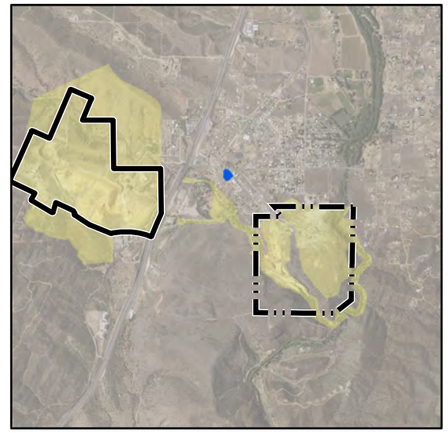

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 25 50
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 35
Soil Sample Results at Yards for Proposed Removal - 2430

Iron King Mine / Humboldt Smelter Superfund Site

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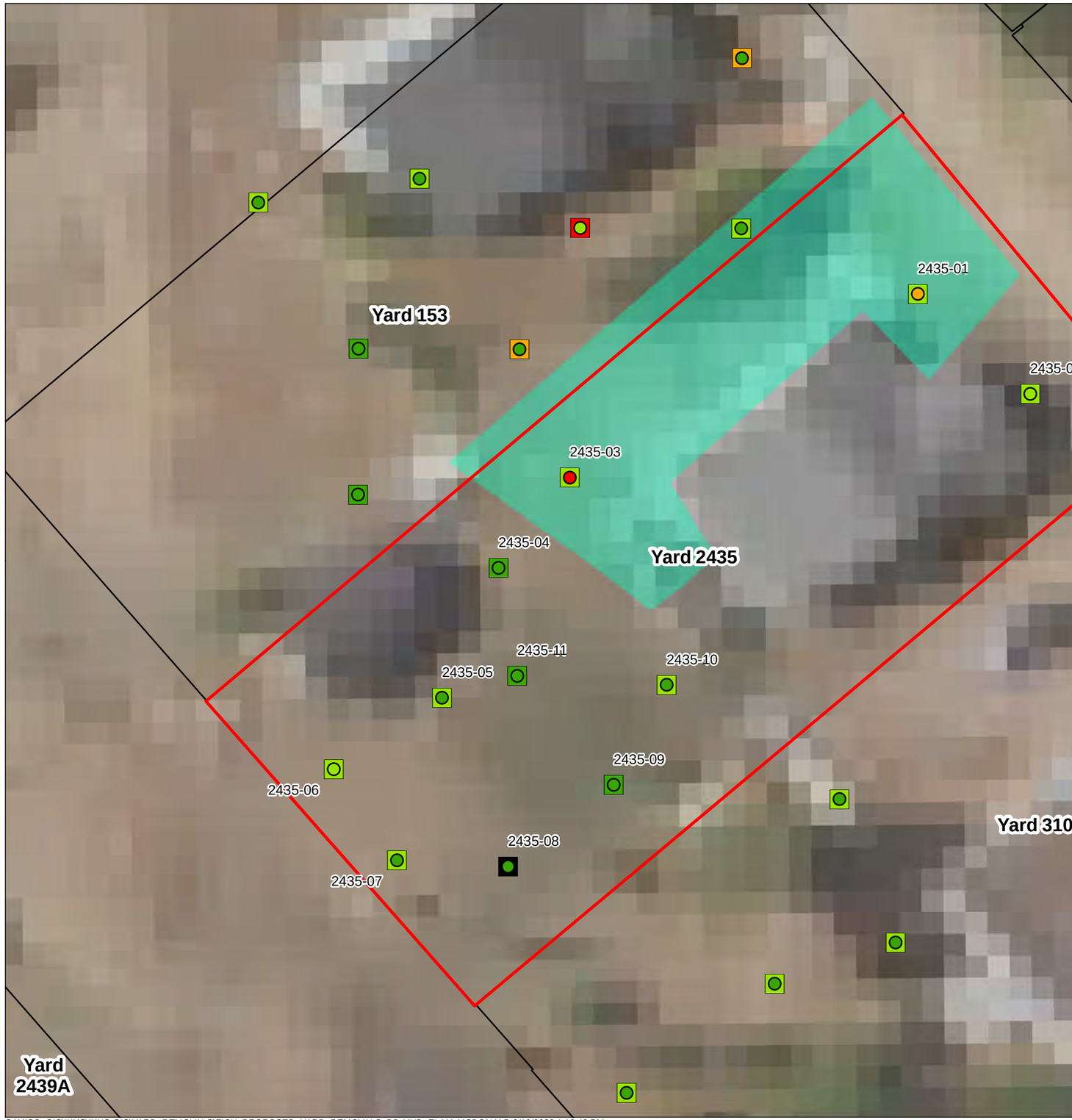

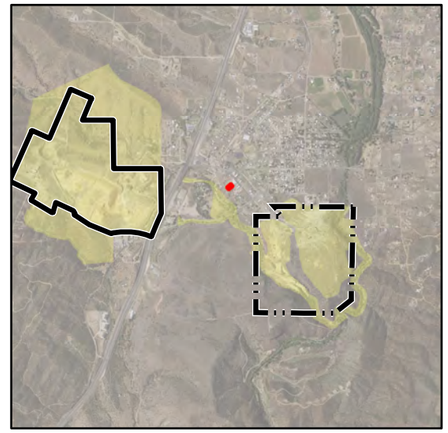

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400 RYSR Residential Yard-Specific Risk
- 400 - 1,200

Notes:

0 10 20

Scale in Feet

N

Notes:
Image Source: USDA 2015.

Figure 36
Soil Sample Results at Yards for Proposed Removal - 2435

Iron King Mine / Humboldt Smelter Superfund Site

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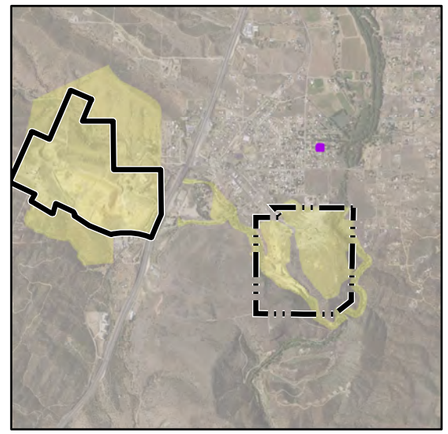

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg and Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200
- ≥1200

Notes:
RYSR Residential Yard-Specific Risk

0 10 20
Scale in Feet
N

Notes:
Image Source: USDA 2015.

Figure 37
Soil Sample Results at Yards for Proposed Removal - 246 and 30W

Iron King Mine / Humboldt Smelter Superfund Site

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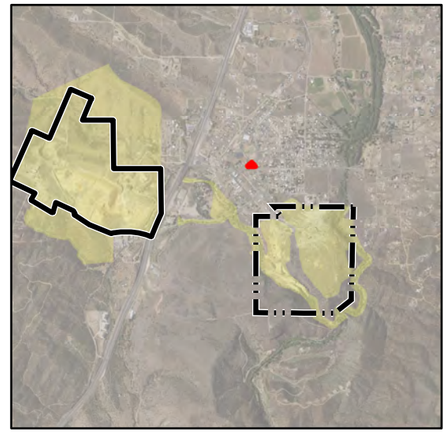

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 25 50
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 38
Soil Sample Results at Yards for Proposed Removal - 251

Iron King Mine / Humboldt Smelter Superfund Site

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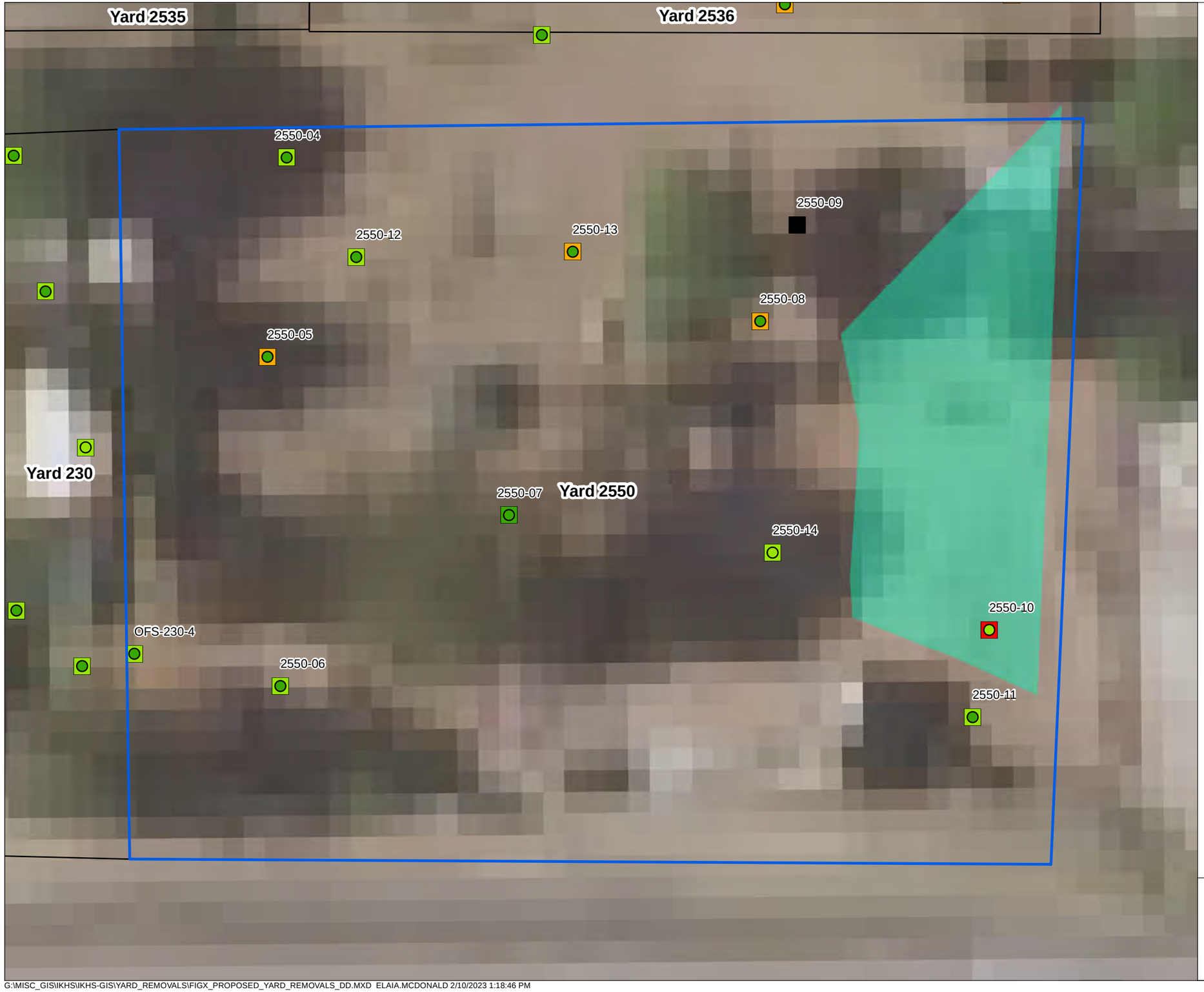

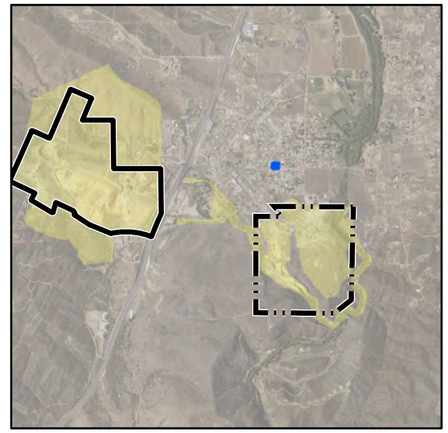

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 39
Soil Sample Results at Yards for Proposed Removal - 2550

Iron King Mine / Humboldt Smelter Superfund Site

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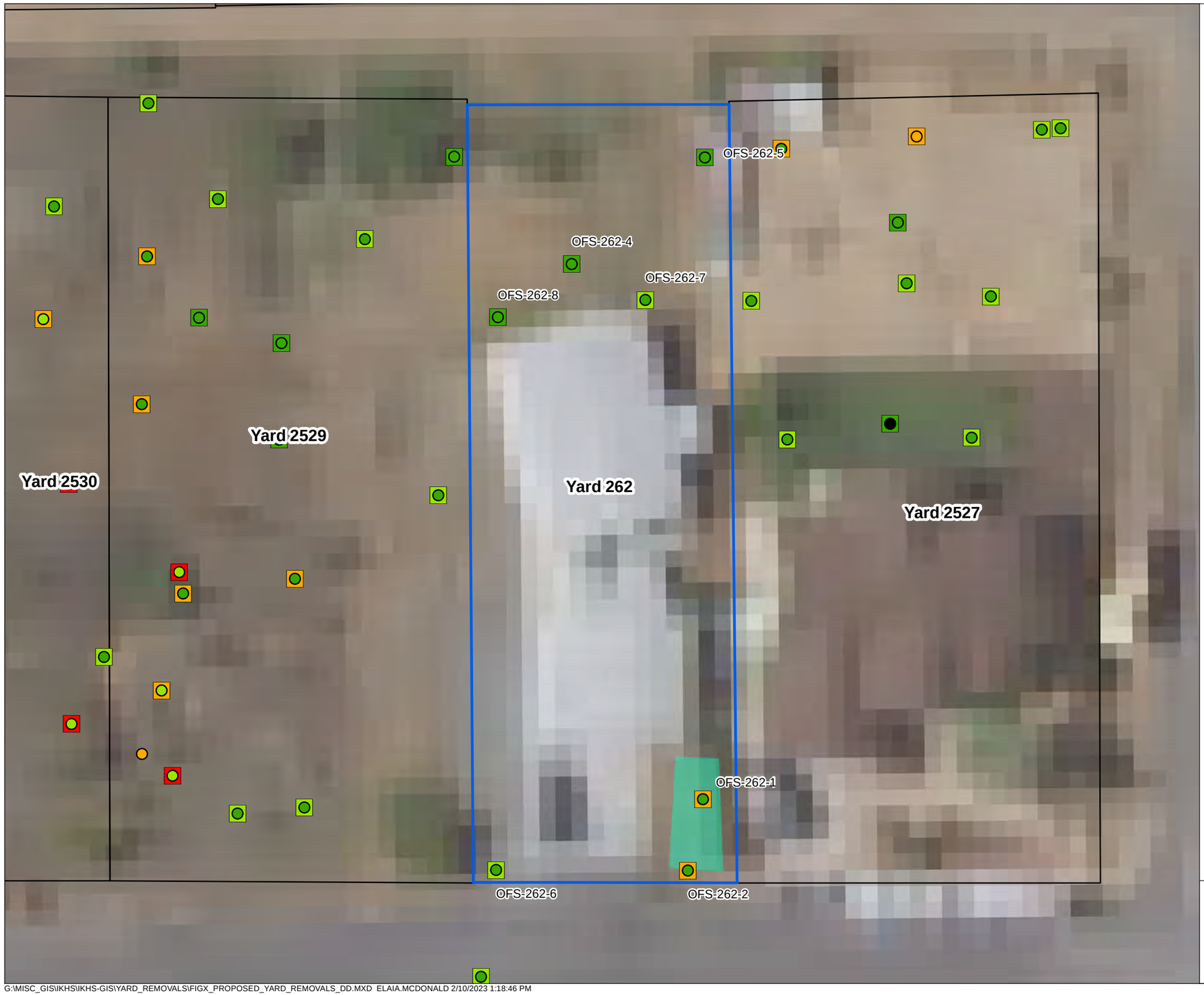

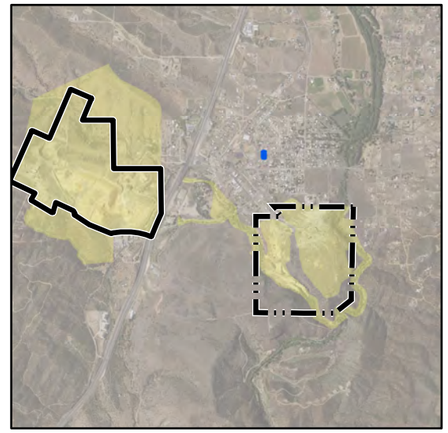

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 20 40
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 40
Soil Sample Results at Yards for Proposed Removal - 262

Iron King Mine / Humboldt Smelter Superfund Site

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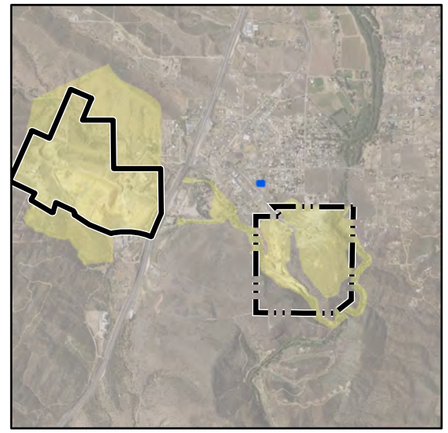

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144

Lead Soil Sample Results (mg/kg)

- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 41
Soil Sample Results at Yards for Proposed Removal - 2691

Iron King Mine / Humboldt Smelter Superfund Site

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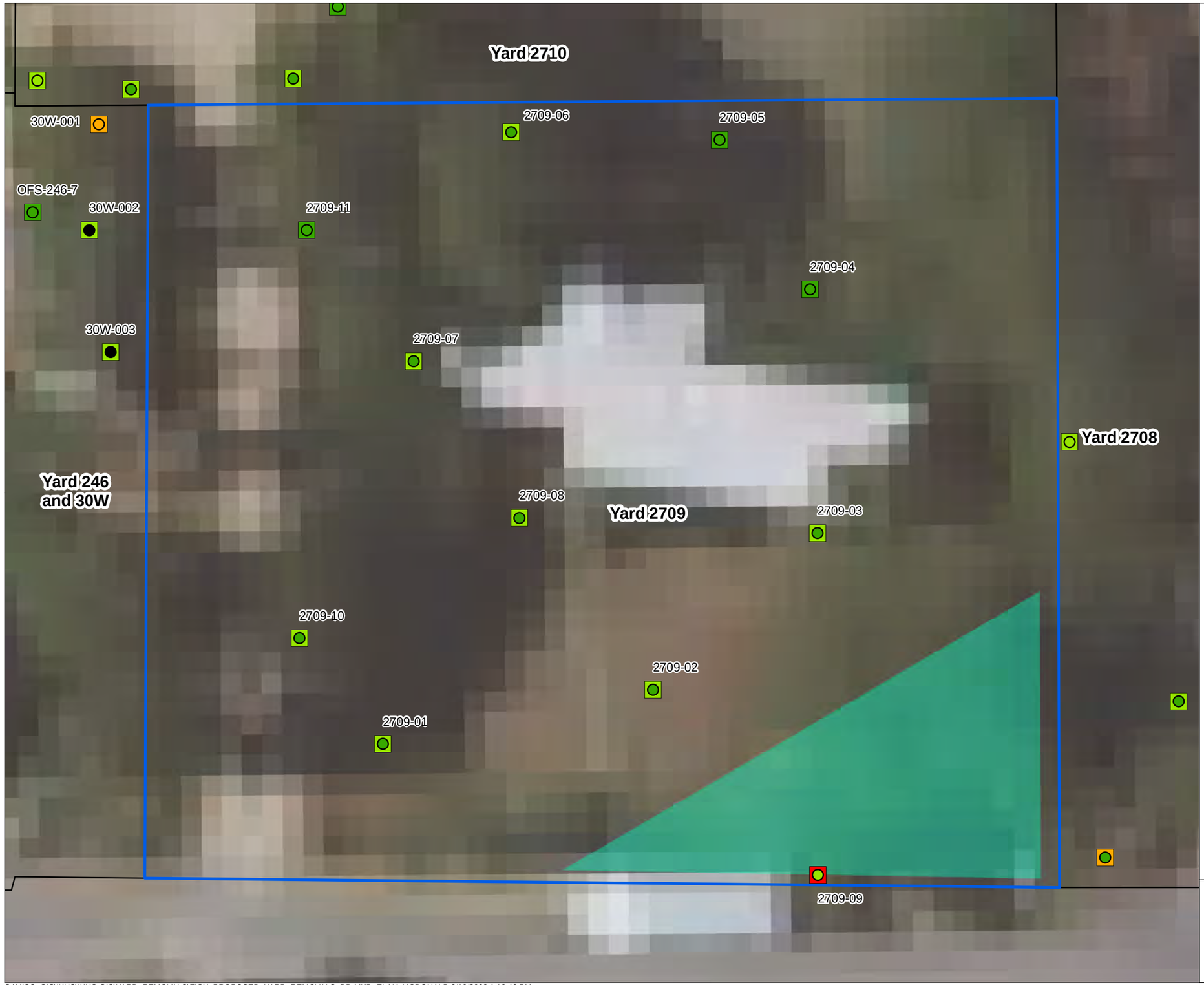

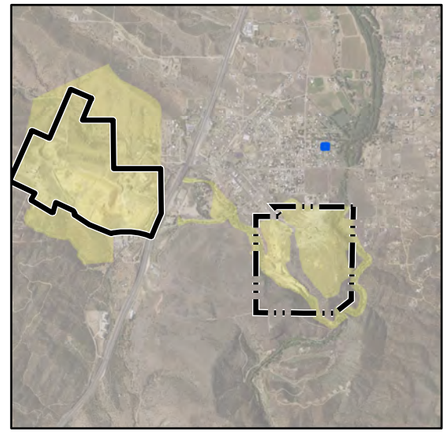

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 42
Soil Sample Results at Yards for Proposed Removal - 2709

Iron King Mine / Humboldt Smelter Superfund Site

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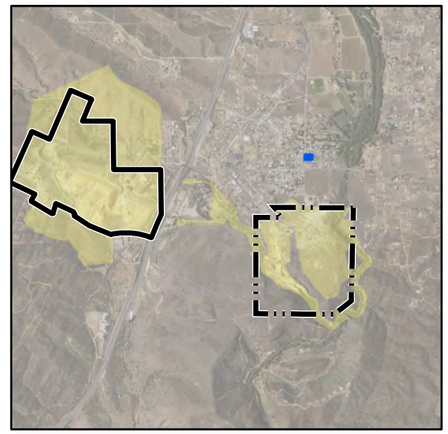

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- ≥ 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400 RYSR Residential Yard-Specific Risk
- 400 - 1,200

Notes:

0 10 20

Scale in Feet

N

Notes:
Image Source: USDA 2015.

Figure 43
Soil Sample Results at Yards for Proposed Removal - 2718

Iron King Mine / Humboldt Smelter Superfund Site

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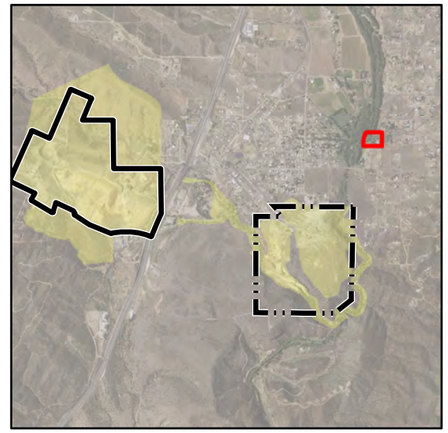

LEGEND

- River
- Intermittent Drainage
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 50 100
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 44
Soil Sample Results at Yards for Proposed Removal - 2743D

Iron King Mine / Humboldt Smelter Superfund Site

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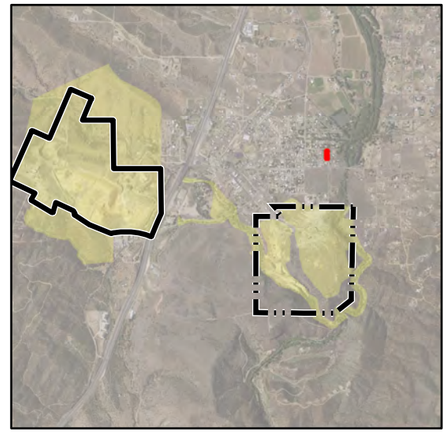

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 25 50
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 45
Soil Sample Results at Yards for Proposed Removal - 2755

Iron King Mine / Humboldt Smelter Superfund Site

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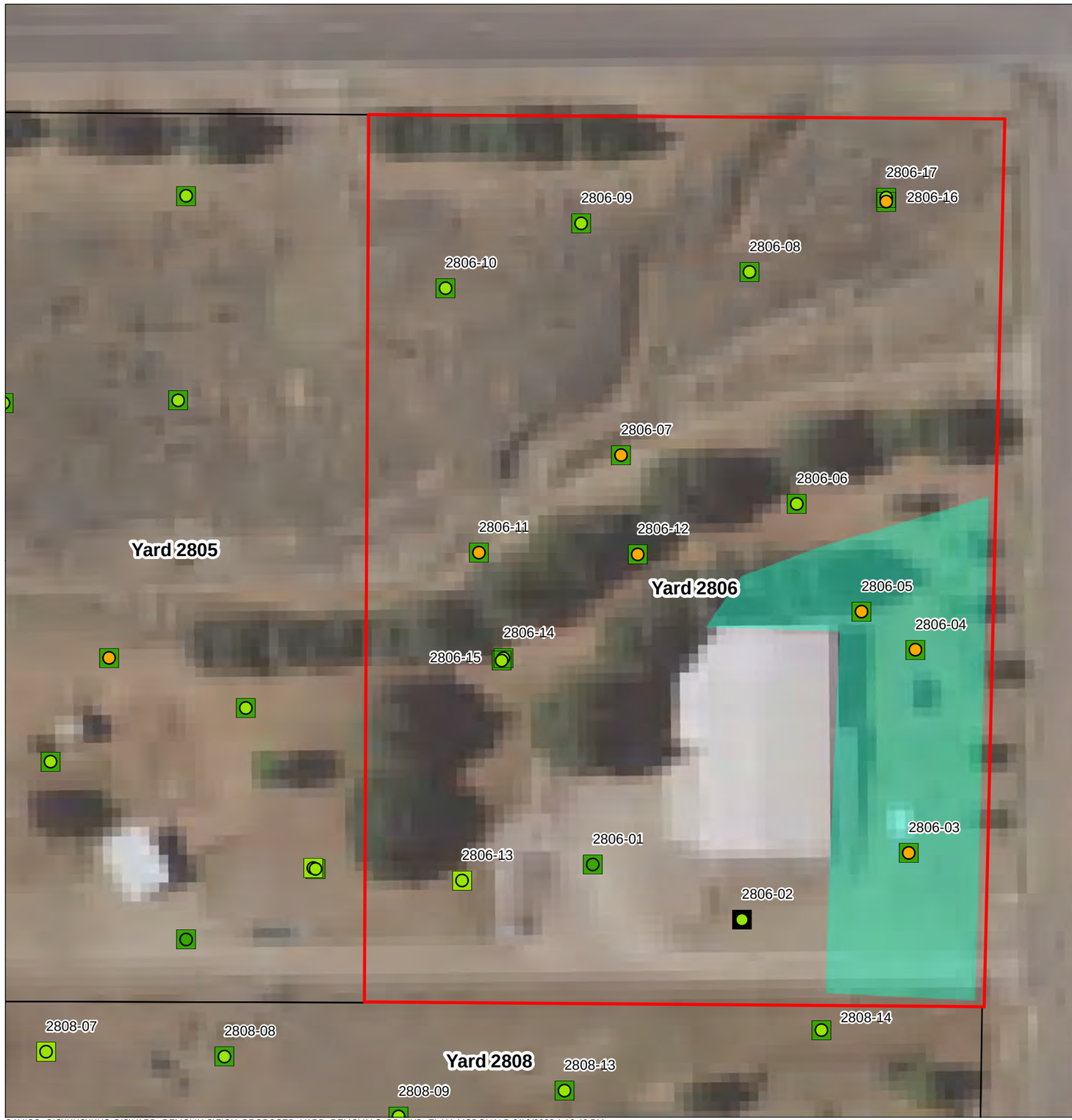

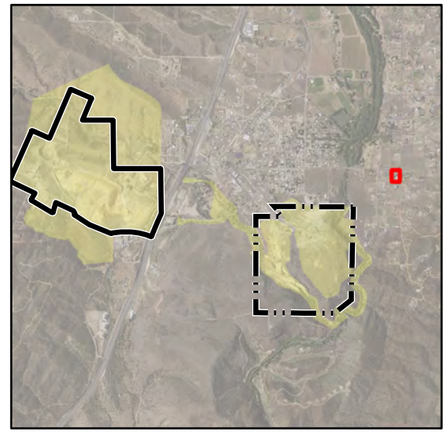

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 40 80
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 46
Soil Sample Results at Yards for Proposed Removal - 2806

Iron King Mine / Humboldt Smelter Superfund Site

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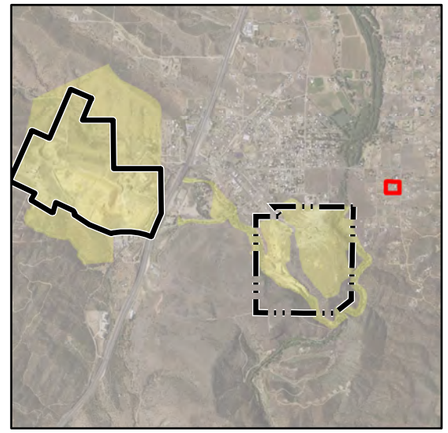

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- ≥ 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 40 80
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 47
Soil Sample Results at Yards for Proposed Removal - 2808

Iron King Mine / Humboldt Smelter Superfund Site

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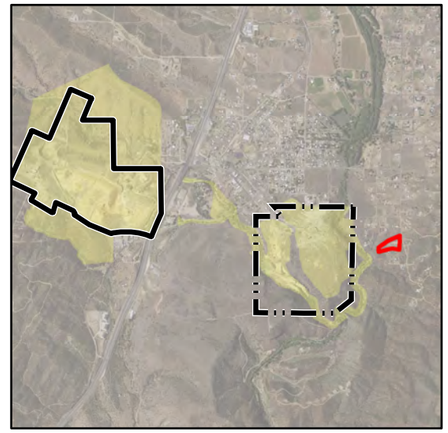

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 60 120
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 48
Soil Sample Results at Yards for Proposed Removal - 2901

Iron King Mine / Humboldt Smelter Superfund Site

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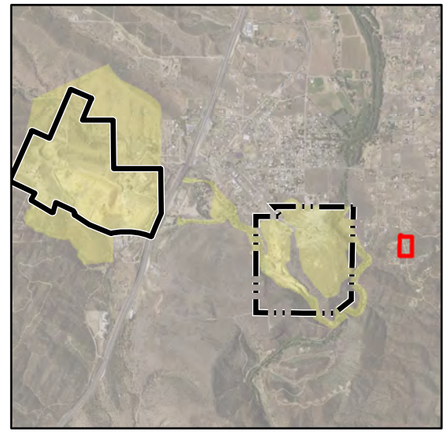

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 70 140
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 49
Soil Sample Results at Yards for Proposed Removal - 2903

Iron King Mine / Humboldt Smelter Superfund Site

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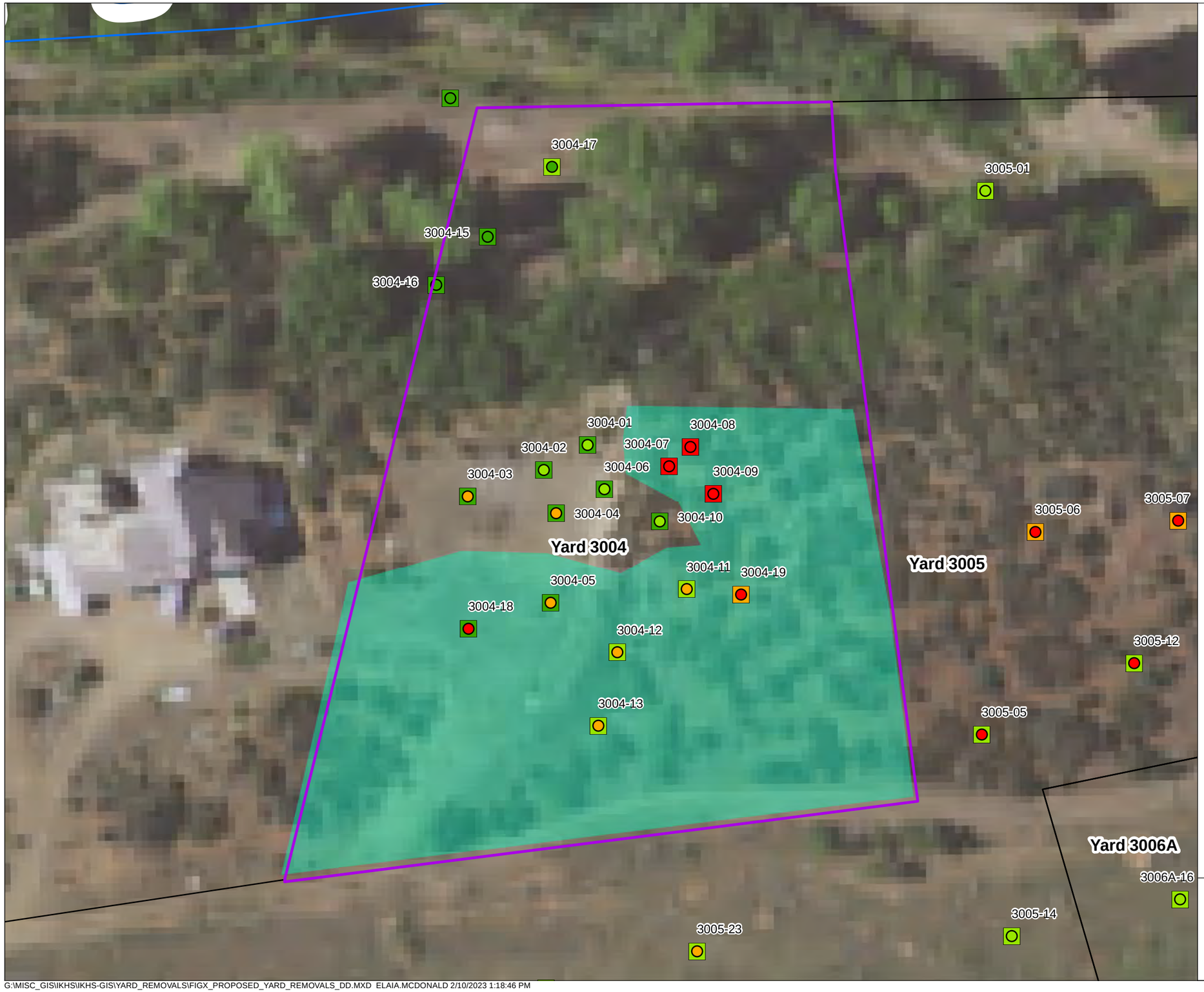

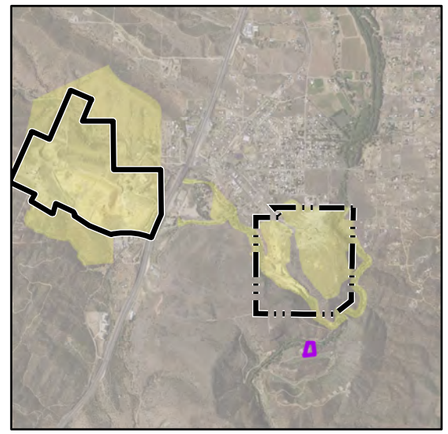

LEGEND

- River
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg and Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR = Residential Yard-Specific Risk

N

0 40 80

Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 50
Soil Sample Results at Yards for Proposed Removal - 3004

Iron King Mine / Humboldt Smelter Superfund Site

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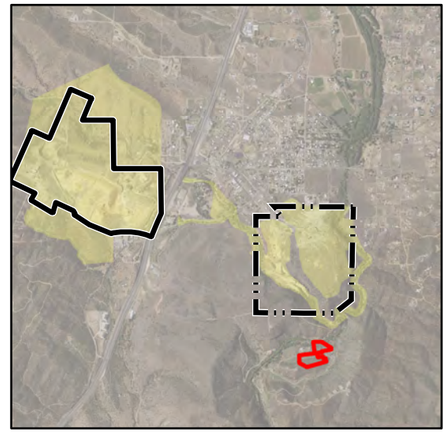

LEGEND

- River
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

0 90 180
Scale in Feet
N

Notes:
Image Source: USDA 2015.

Figure 51
Soil Sample Results at Yards for Proposed Removal - 3005

Iron King Mine / Humboldt Smelter Superfund Site

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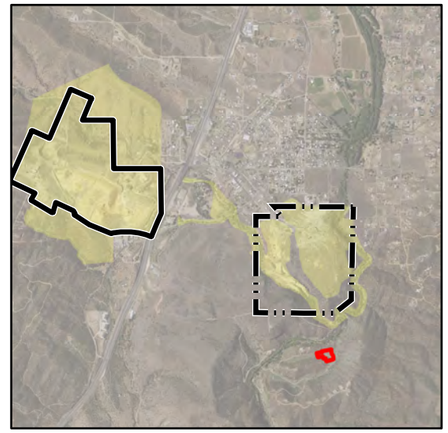

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 40 80
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 52
Soil Sample Results at Yards for Proposed Removal - 3006A

Iron King Mine / Humboldt Smelter Superfund Site

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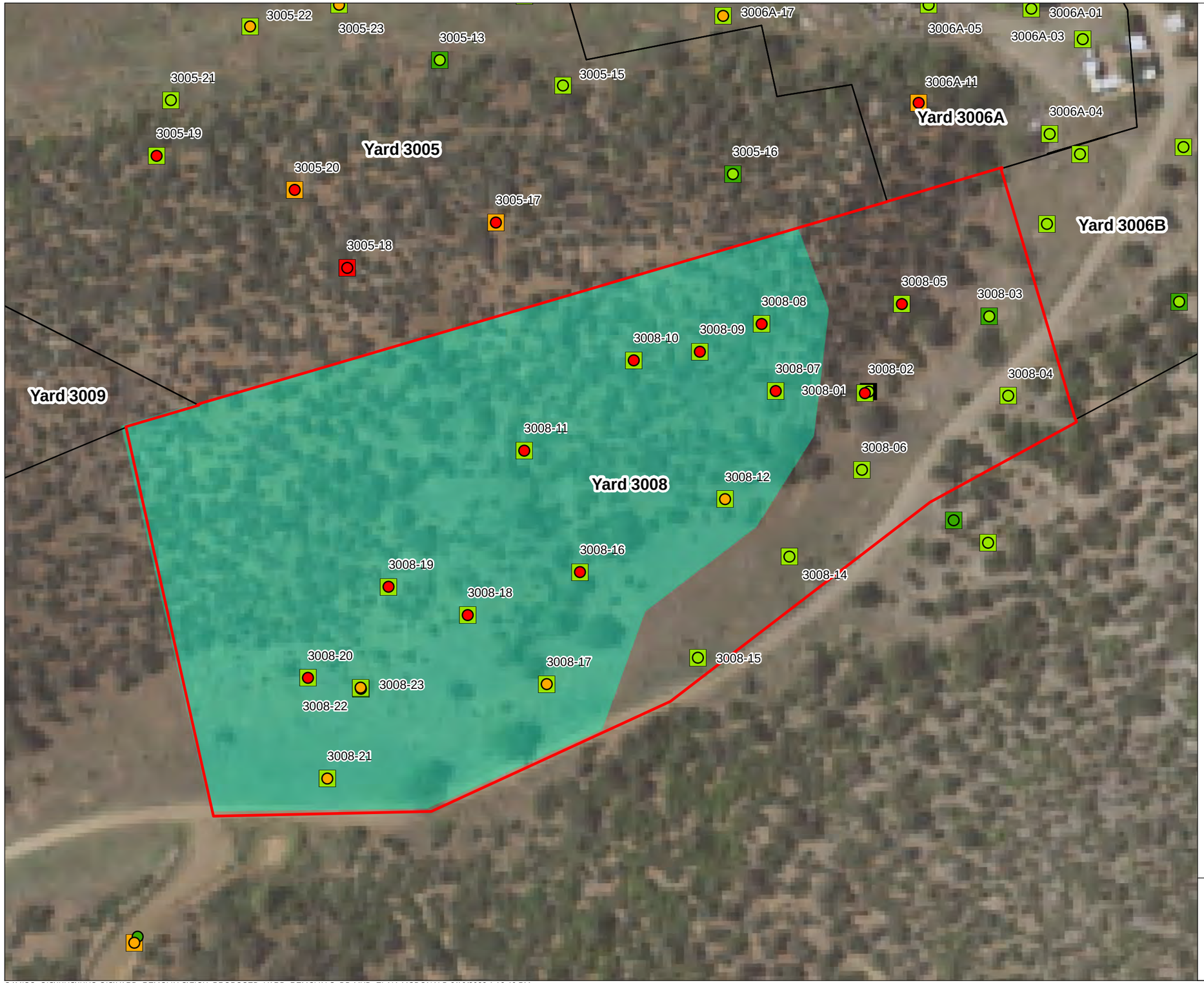

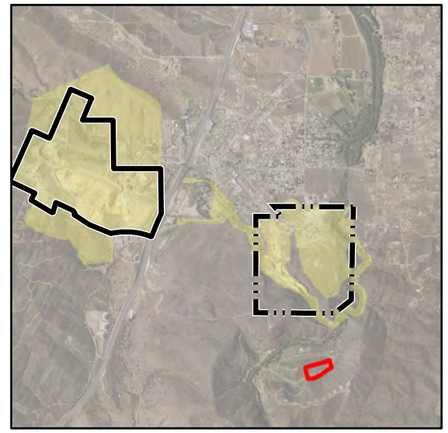

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR = Residential Yard-Specific Risk

N

0 75 150

Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 53
Soil Sample Results at Yards for Proposed Removal - 3008

Iron King Mine / Humboldt Smelter Superfund Site

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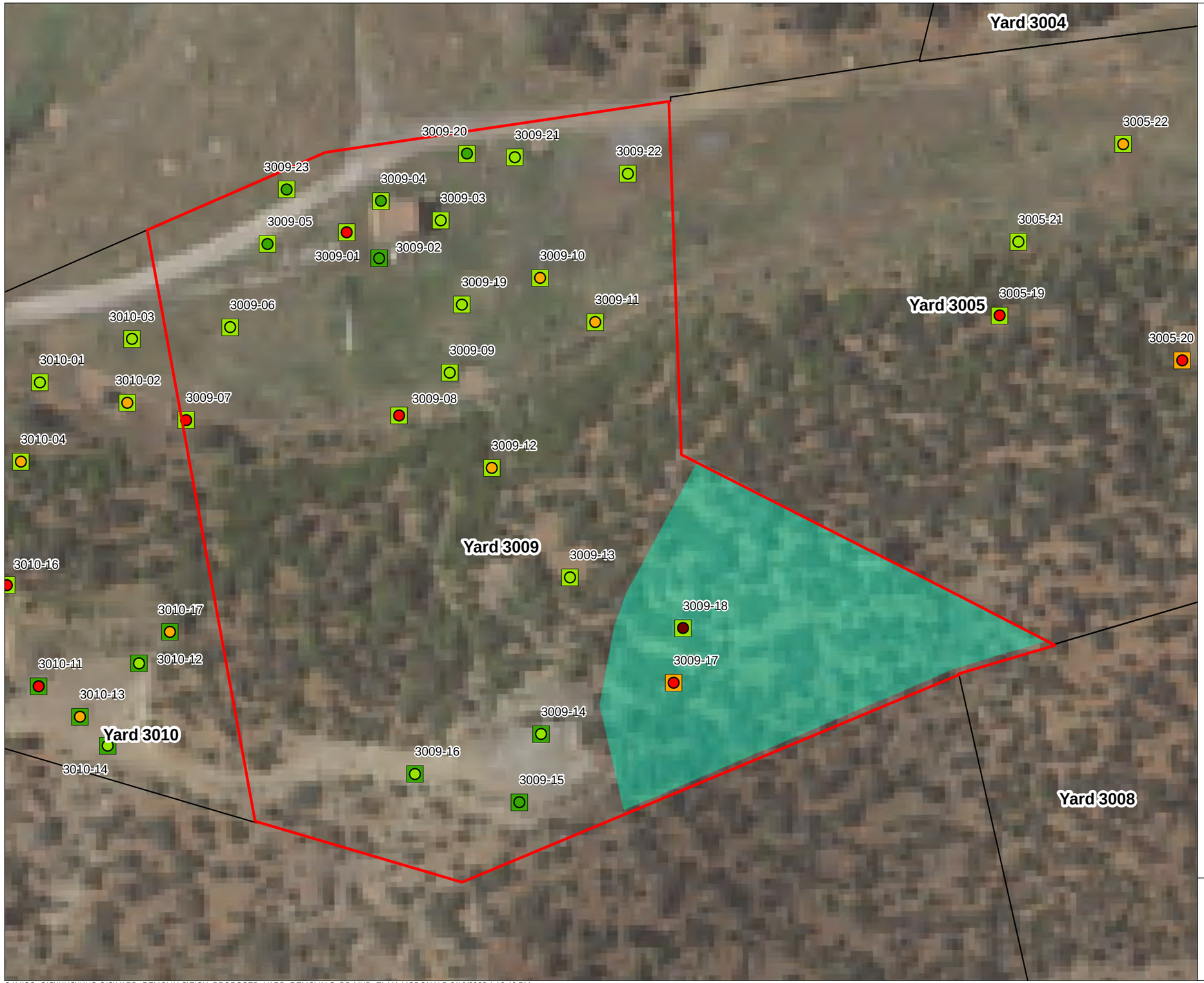

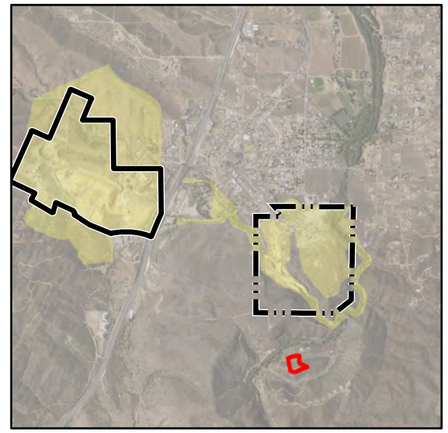

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400
- ≥ 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 50 100
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 54
Soil Sample Results at Yards for Proposed Removal - 3009

Iron King Mine / Humboldt Smelter Superfund Site

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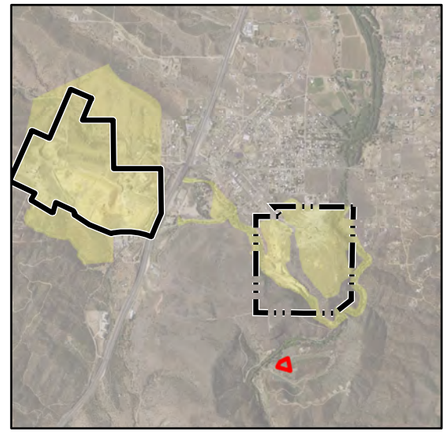

LEGEND

- River
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 40 80
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 55
Soil Sample Results at Yards for Proposed Removal - 3010

Iron King Mine / Humboldt Smelter Superfund Site

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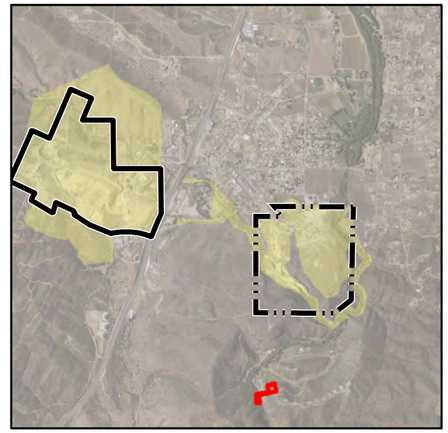

LEGEND

- River
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 60 120
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 56
Soil Sample Results at Yards for Proposed Removal - 3011

Iron King Mine / Humboldt Smelter Superfund Site

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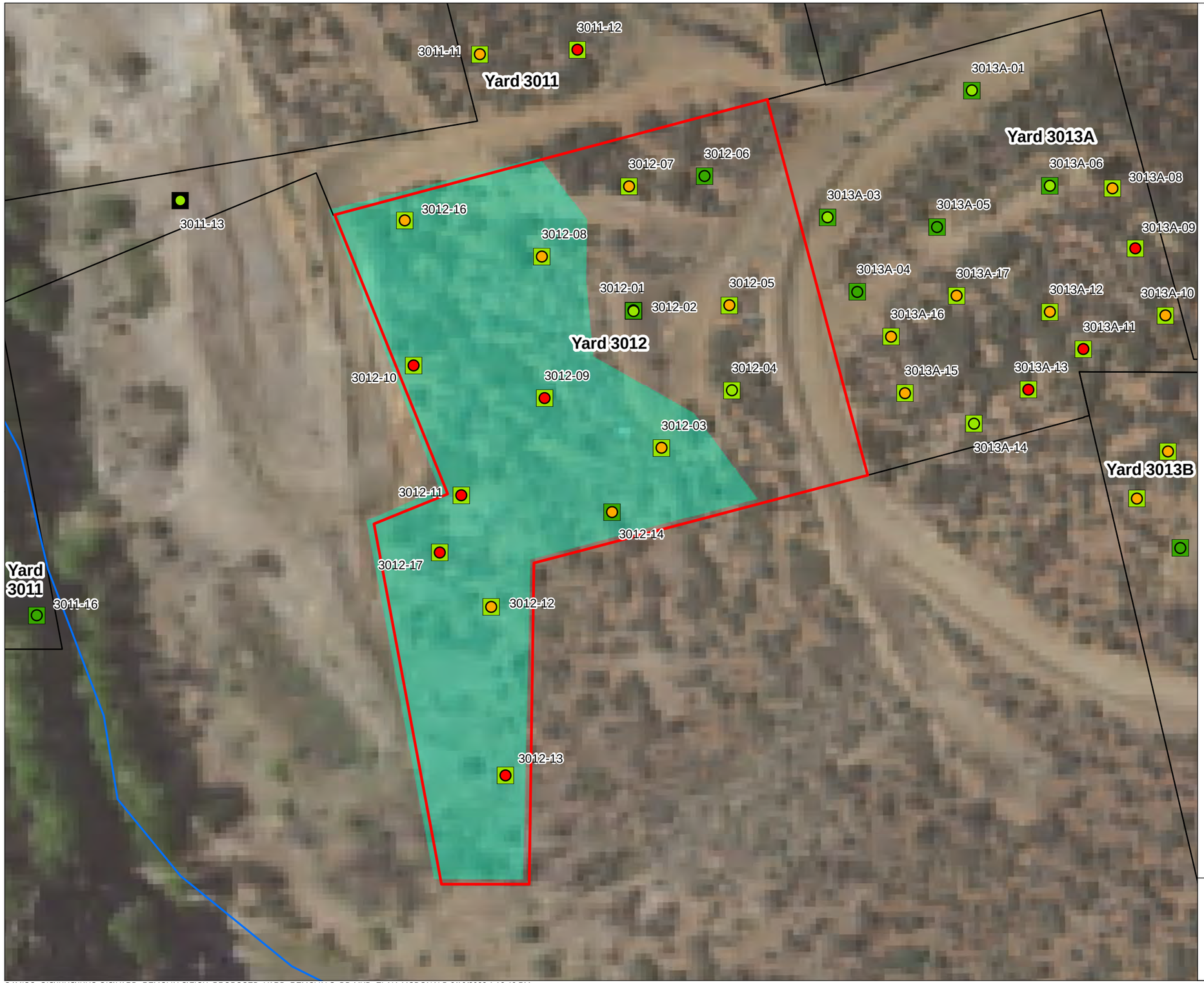

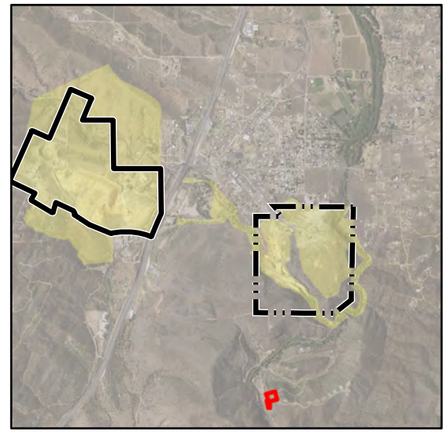

LEGEND

- River
- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)

Notes:
RYSR Residential Yard-Specific Risk

N

0 50 100
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 57
Soil Sample Results at Yards for Proposed Removal - 3012

Iron King Mine / Humboldt Smelter Superfund Site

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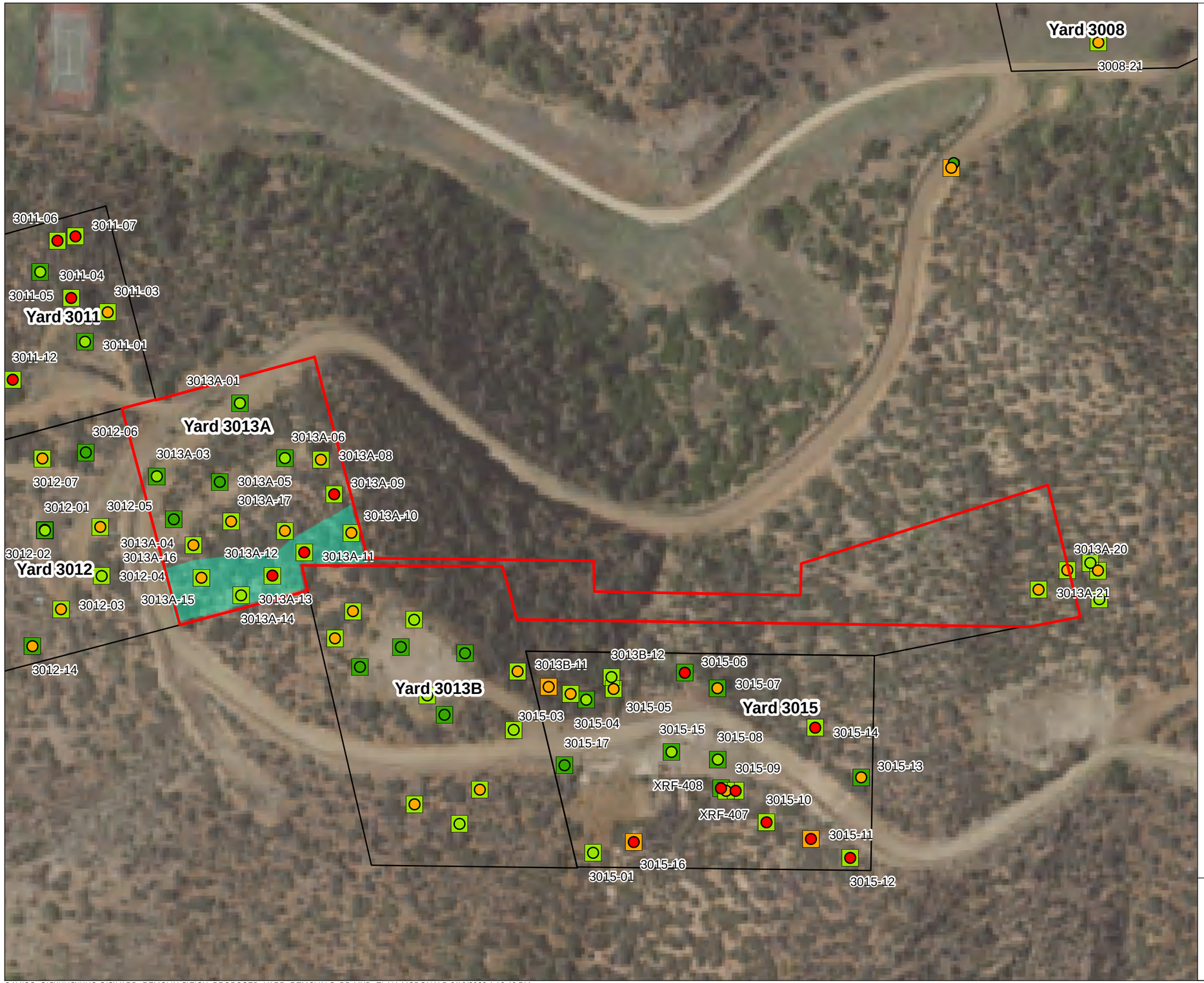

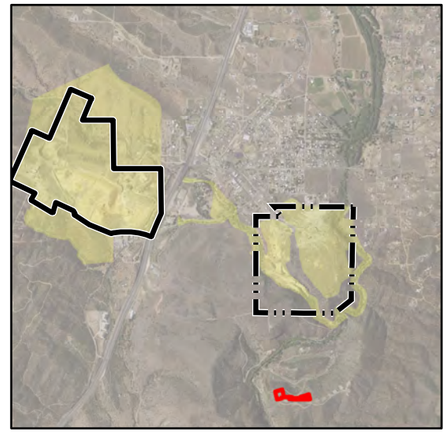

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 100 200
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 58
Soil Sample Results at Yards for Proposed Removal - 3013A

Iron King Mine / Humboldt Smelter Superfund Site

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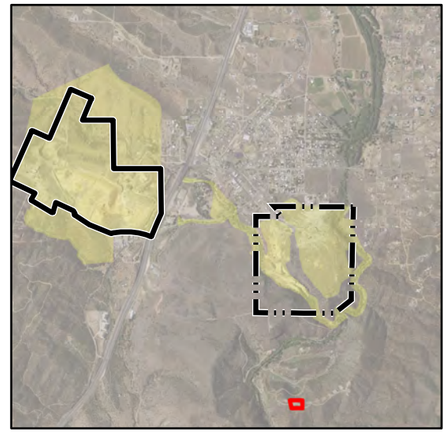

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 92 - 144
- 144 - 400

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 30 60
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 59
Soil Sample Results at Yards for Proposed Removal - 3015

Iron King Mine / Humboldt Smelter Superfund Site

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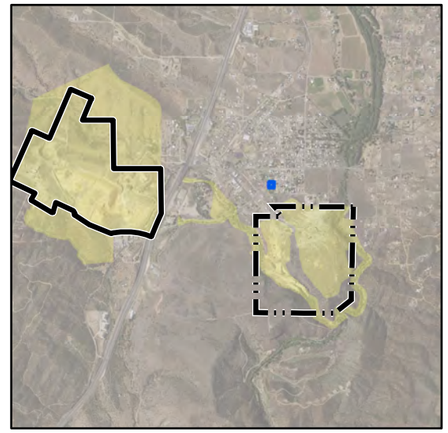

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- Not Detected
- ≤ 50
- 50 - 92 (Background and Screening Level)

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 60
Soil Sample Results at Yards for Proposed Removal - 308

Iron King Mine / Humboldt Smelter Superfund Site

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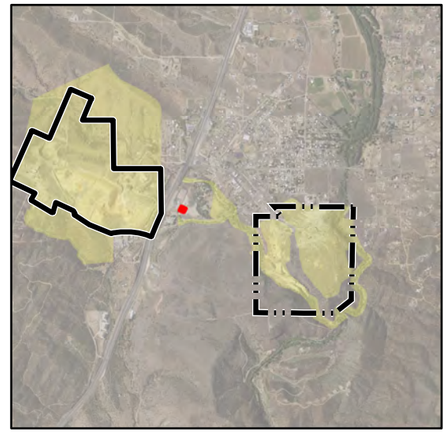

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Arsenic EPC ≥ 92 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)
- 144 - 400

Lead Soil Sample Results (mg/kg)

- Not Detected
- ≤ 35 (Background)

Notes:
RYSR Residential Yard-Specific Risk

N

0 10 20
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 61
Soil Sample Results at Yards for Proposed Removal - 309

Iron King Mine / Humboldt Smelter Superfund Site

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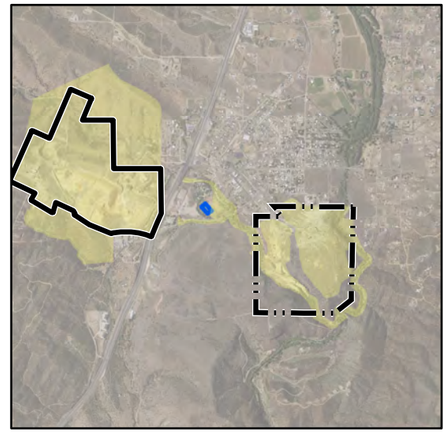

LEGEND

- Former Iron King Mine Property
- Former Humboldt Smelter Property
- Gulch Properties
- Remedial Areas
- RYSR Yards
- Proposed Removal Areas

Yards for Proposed Removal

- Lead EPC ≥ 197 mg/kg

Arsenic Soil Sample Results (mg/kg)

- ≤ 50
- 50 - 92 (Background and Screening Level)

Lead Soil Sample Results (mg/kg)

- ≤ 35 (Background)
- 35 - 197 (Screening Level)
- 197 - 400
- 400 - 1,200

Notes:
RYSR Residential Yard-Specific Risk

N

0 30 60
Scale in Feet

Notes:
Image Source: USDA 2015.

Figure 62
Soil Sample Results at Yards for Proposed Removal - O16

Iron King Mine / Humboldt Smelter Superfund Site

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ATTACHMENT B

COST ESTIMATE

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ATTACHMENTS

Attachment A-1: Detailed Cost Estimates

ACRONYMS AND ABBREVIATIONS

AZ	Arizona
BCY	Bank cubic yards
CCY	Compacted cubic yards
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DBB	Design-bid-build
EC	Engineering control
EPA	U.S. Environmental Protection Agency
FS	Feasibility study
HS	Humboldt Smelter
IC	Institutional control
IKHS	Iron King/Humboldt Smelter
IKM	Iron King Mine
LCY	Loose cubic yards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NORM	Naturally occurring radioactive material
NPL	National Priorities List
O&M	Operation and maintenance
OMB	Office of Management and Budget
OSWER	Office of Solid Waste and Emergency Response
PV	Present value
RA	Remedial action
RACER	Remedial Action Cost Engineering and Requirements System
RCRA	Resource Conservation and Recovery Act
RD	Remedial design
RI	Remedial investigation
TAC	*Texas Administrative Code*
TENORM	Technologically enhanced naturally occurring radioactive material
Tetra Tech	Tetra Tech, Inc.

1.0 INTRODUCTION

This appendix to the response action memorandum provides an estimate of costs associated with the response action at the Iron King/Humboldt Smelter (IKHS) Superfund site (the Site).

The Site is in Dewey-Humboldt, Yavapai County, Arizona, and is listed on the National Priorities List (NPL). The site encompasses the former Iron King Mine (IKM) and the Humboldt Smelter (HS), as well as adjacent areas impacted by mine wastes from these sites and other associated minor historical operations. The IKHS site was added to the U.S. Environmental Protection Agency's (EPA) NPL in 2008, and EPA completed the remedial investigation (RI) of the Site in 2016. The conceptual site model from the RI shows that major transport mechanisms for arsenic, lead, and other contaminants from the Site are erosion, historical-operational discharges or other releases of water, and windblown particulates and aerial dispersion (CH2M 2016).

Preparation of cost estimates for this response action followed EPA's Guide for Developing and Documenting Cost Estimates during the Feasibility Study (EPA 2000). EPA uses this guidance to develop cost estimates during screening and detailed analysis phases of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) feasibility studies (FSs). Cost estimates are used to compare alternatives and support remedy selection.

This appendix provides the cost estimate for the response action (Attachment A-1).

2.0 COST TERMINOLOGY

EPA's guidance defines direct and indirect costs (EPA 2000, pp. 2-5). EPA defines *direct costs* as equipment, labor, material, subcontractor's markup, overhead, and profit. EPA defines *indirect costs* as project management (including the prime contractor's overhead and profit), remedial design, construction management (including health and safety items), site supervision, legal, and other professional and technical services not applied directly to the specific cost item.

EPA's guidance subdivides the work into the following cost categories; note the work does not include any operations and maintenance (O&M) work or any periodic costs:

- **Capital, and annual O&M:** Capital, and annual O&M as *direct costs* that include *contractor* markup, overhead, and profit.
    - **Capital:** Costs required to construct the remedial action alternative that may extend multiple years.
    - **Annual O&M:** Assumed no annual O&M was needed for the response action due to completion of the action in 1 year.
    - **Periodic Costs:** Assumed no periodic costs needed for the response action due to completion of the action in 1 year.
- **Professional and Technical Services:** *Indirect* costs that include remedial design, legal construction management, and technical and professional services.
- **Net present Value:** Net present value (PV) of periodic capital costs.

3.0 COST ESTIMATION METHOD

Preparation of cost estimates followed the Guide for Developing and Documenting Cost Estimates during the Feasibility Study (EPA 2000). The cost estimate preparation included a combination of analogous, parametric, bottom-up, and direct vendor quote approaches.

- **Analogous** or "top down" cost estimates are based on expert judgement whereby similar project experience is referenced to provide a rough order-of-magnitude estimate.
- **Parametric** cost estimates couple a structured estimating process with statistically based parametric/predictive modeling methods based on historical unit prices. Parametric modeling takes its name from the parameters (or variables) modified during the project simulation process. Parametric models are built from a set of mathematical equations. These may be standard equations found in reference books, proprietary equations developed by consultants or vendors, or some combination of the two. Parametric cost estimating is a method for estimating future proceedings based on analysis of past events and trends. "Parameters" (conditions) that appear to have driven what happened in the past are identified and connected to experience through mathematical relationships. For parametric models to have any validity, they must be based on or proven by actual project data.
- **Bottom-up Method – RS Means.** Cost estimates often rely on compiled sources of unit-cost data taken either from a built-in database (if part of a software package, for example) or from other sources (for example, cost estimating references like RS Means). In applying this method, also known as "bottom up" estimating, Tetra Tech, Inc. (Tetra Tech) used unit-costs for year 2019 published by RS Means of Norwell, Massachusetts, for many of the cost elements. Published costs used throughout the estimate are noted for each element within the estimate. With RS Means, the specific unit-costs reflect the installing contractor's labor, equipment, material, and markup (overhead and profit) for the locality. These costs do not include sales tax for materials (state sales tax of 5.6% in Arizona), general contractor's fees, or any other contingencies. RS Means sources used for this estimate were:
    - R.S. Means (2019) and a location adjustment factor for Prescott, Arizona (AZ)
- **Professional Judgement and Vendor Quotes:** Published cost data were not always available for each cost element because of unique characteristics of some elements of the remediation alternatives. These cost elements were developed either by use of vendor quotes or professional judgement, and evaluated and adjusted as necessary to account for inflation. This estimate includes vendor quotes and professional judgement decisions regarding individual cost elements. Overhead and profit were added into each unit price.

4.0 COMMON ASSUMPTIONS FROM EPA GUIDANCE

For the cost estimate, the following were common assumptions regarding both screening and detailed alternatives cost estimating. These cost assumptions are based on recommendations in EPA guidance (EPA 2000).

4.1 ACCURACY

Cost estimates for the both screening and detailed analysis resulted from application of analogous, parametric, and detailed methods to achieve the desired detailed analysis cost accuracy (+50% to -$30%) specified in EPA Guidance (EPA 2000, pp. 2-4)

4.2 TECHNICAL AND PROFESSIONAL SERVICES

Technical and professional costs include remedial design, legal construction management, technical and professional services, and prime contractor's overhead and profit. For this FS, professional labor management and design costs are based on the percentages recommended in EPA guidance (EPA 2000, pp. 5-13) (listed below in Table A-1).

Table A-1. Recommended Professional Labor and Design Costs

Percentages for Professional and Technical Services					
Cost Component	**Percentage of Cost Elements (%)**				
	<$100K	**$100K-$500K**	**$500K-$2M**	**$2M-$10M**	**>$10M**
Capital Cost Elements					
Project Management	10	8	6	5	5
Removal Design	20	15	12	8	6
Removal Action	15	10	8	6	6
Operations and Maintenance					
Project Management (range)	5-10	5-10	5-10	5-10	5-10

Source: EPA 2000

EPA's project management costs are included in these costs along with those related to remedial design. For IKHS, EPA follows a traditional design-bid-build (DBB) contracting approach to manage the removal design (RD), remedial action (RA), and O&M phases. Following this approach, EPA prepares the RD and then procures an RA prime contractor. EPA administers the DBB project in accordance with U.S. Government Federal Acquisition Regulation requirements. As such, EPA procures third-party consultants and contractors using competitive bidding with equivalent bid packages for consultants and contractor services. Once the scope is awarded to a prime contractor, EPA assumes the role of Project Manager and uses either in-house expertise or separately contracts a third party to oversee the prime contractor performing and executing the RA.

4.3 CONTRACTOR'S OVERHEAD AND PROFIT

These are the general contractor's costs outside the installing contractor's markup of periodic capital and O&M costs (EPA 2000, p 2-5). Profit and overhead of 10 percent were assumed for all alternatives, as this is a typical profit margin agreed to on federal contract projects. In the estimate, overhead and profit are included in the unit prices

4.4 CONTINGENCY

Contingency is factored into a cost estimate to cover unknowns, unforeseen circumstances, or unanticipated conditions that cannot be evaluated by use of the data on hand during preparation of the estimate.

Scope and bid contingency were applied as a percentage of the total removal (construction) and post-removal (O&M) costs rather than individual elements as recommended by EPA (EPA 2000).

- **Scope Contingency:** Scope contingency covers unknown costs resulting from changes in scope that may occur during the design. Given that the IKHS is using proven technologies, such as excavation, rather than emerging technologies with larger unknowns, the average contingencies based on the average range for detailed analysis as provided by EPA were assumed for the cost components as follows and as listed in Table A-2 below (for **detailed** alternative cost estimates: excavation (35%), synthetic cap (15%), clay cap (8%), and revegetation (8%) for an average of about 15 percent).

Table A-2. Scope Contingency Assumed for Detailed Alternatives Analysis

Scope Contingency Percentages		
Cost Component (EPA 2000)	**Percentage (%)**	**Average (%)**
EPA contingency Percentages in EPA Cost Guidance (EPA 2000)		
Soil excavation	*15-55*	*35*
Synthetic Cap	*10-20*	*15*
Revegetation	5-10	8
Average		***19***

Note:
EPA U.S. Environmental Protection Agency
Source: EPA 2000

- **Bid Contingency:** Bid (construction) contingency covers unknown costs associated with constructing or implementing a project scope, and typically considers adverse weather, material or supply shortages, or new regulations. Given that Humboldt has mild weather and hot summers, and is near a major city (Prescott), and that the project will be subject to well-understood regulatory requirements under CERCLA, bid contingency was an average of the percentage recommended by EPA or 15 percent.
- **Total Construction Contingency:** Total scope and bid contingency applied to capital and O&M costs was 30 percent for the Detailed Cost Estimate.

4.4 ARIZONA SALES TAX

The State of Arizona sales tax is 5.6 percent. Cities and/or municipalities of Arizona are also allowed to collect up to 4.5 percent in city sales tax.

State sales tax was not applied to manufactured goods for RS Means cost data because an adjustment to the overall construction cost was estimated to be less than 2 percent of the construction costs.

4.5 PROJECT DURATION

Project duration was assumed as 1 year for removal and disposal of contaminated soils.

5.0 COMMON COST ELEMENTS

Many RA cost elements are common for all risk management sites at IKHS. These common cost elements and the corresponding common unit costs are applied consistently throughout the risk management areas.

Table A-3 lists cost elements used in the cost estimate. Unit costs for these elements were extracted from the RS Means 2019 cost database, derived using professional judgement or by obtaining vendor quotes. A description of how cost elements were developed for each cost element follows.

Table A-3. Common Cost Elements for Cost Analysis of Alternatives

Cost Elements	Method
Excavation	RS Means
Soil and Waste transporations	RS Means + Professional Judgement
Revegetation	RS Means
Institutional Controls (IC) and Engineering Controls (EC)	Professional Judgement and Percentage of Capital Costs

6.0 DETAILED COST ESTIMATES FOR EACH ALTERNATIVE

A detailed cost estimate is provided in Attachment A-1. The master list of unit costs used in the estimate is in Table E-6 of the FS (Tetra Tech 2022). For each unit cost, the source is identified, whether RS Means, professional judgement, or a vendor quote.

For the detailed cost estimates, development of the following costs was based on professional judgement and past project experience. Other costs were derived from RS Means.

- **Mobilization, Demobilization, Insurance, and Bonding:** These items were assumed at 10 percent of the total, as insurance and bonding can be around 2 to 5 percent, and mobilization includes setup of all facilites and mobilization of all equipment and labor to and from the Site.
- **ICs:** ICs at each site were assumed as a lump sum of $25,000 based on professional judgement regarding costs of a site inspection, deed restrictions, and documentation of site inspections.
- **Site Maintenance:** No Site maintenance was estimated, as the removal action was assumed completed in 1 year.
- **Soil Borrow Costs:** Table A-4 lists swell and shrinkage factors used to calculate differences between bank cubic yards (BCY) for excavation and, respectively, loose cubic yards (LCY) for hauling and compacted cubic yards (CCY) for placement and compaction (Nunnally 1980).

Table A-4. Swell and Shrinkage Factors

Material Type	Swell Factor (BCY to LCY)	Shrinkage Factor (BCY to CCY)
Common Earth (Used for all Non-slag Wastes)	1.25	0.9

- **Dust suppression:** All construction will require dust suppression on roads, screening plants, and work areas. A water truck will wet areas during construction.
- **Traffic control:** All excavation and capping alternatives will require traffic management at the Site and along area roads. Traffic control will include a temporay light at Highway 69 and 3rd Street, and traffic control flagmen at four locations: exit points from excavation areas on east and west sides of Highway 69, and entrance points to repositories.

- **Restoration of disturbed areas:** All disturbed areas at removal sites and repositories will require restoration, which may include grading, amendment, seeding, transplanting, and surface water erosion controls.

7.0 REFERENCES

CH2M. 2016. Remedial Investigation Report, Iron King Mine – Humboldt Smelter Superfund Site, Dewey-Humboldt, Yavapai County, Arizona. Prepared for U.S. Environmental Protection Agency (EPA) Region 9. September.

Nunnally, S.W. 1980. *Construction Methods and Management*. Englewood Cliffs, New Jersey 07632: Prentice-Hall, Inc.

RS Means. 2019. Remedial Action Cost Engineering and Requirements System (RACER) cost database software, Version 10.4. AECOM Technology Corporation.

Tetra Tech, Inc. (Tetra Tech). 2022. Feasibility Study Iron King Mine / Humboldt Smelter Superfund Site. September

EPA. 2000. A Guide to Developing and Documenting Cost Estimates during the Feasibility Study. EPA 540-R-00-002, OSWER 9355.0-75. July.

ATTACHMENT A-1: DETAILED COST ESTIMATE

TABLE A-1
RESPONSE ACTION - YARD-SPECIFIC REMOVAL
IRON KING MINE - HUMBOLDT SMELTER

Site Quantities				
Waste Volume	38,124	BCY		
Waste Area	19.7	Acres		
Revegetation	95,310	SY		
Backfill Volume	38,124	BCY		
Cost Item	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Capital Costs				
Clearing and Grubbing (30% of area)	**5.9**	**Acre**	**11,175.00**	**$66,017.70**
Waste Excavation, Hauling, Grading, and Compaction (Disposal at MTP)				**$1,058,509.16**
Excavation	38,124	BCY	$9.60	$366,084.43
On Highway Haul Trucks	47,655	LCY	$6.55	$312,139.16
Grading	47,655	LCY	$7.98	$380,285.57
Waste Placement				**$220,641.88**
Load and Place	38,124	BCY	$0.75	$28,592.90
Grading and Compaction	47,655	LCY	$4.03	$192,048.98
Revegetation - Seeding	**95,310**	**SY**	**4.70**	**$447,955.43**
Dust Control	**180**	**Day**	**$1,975.00**	**$355,500.00**
Cost Item	**Quantity**	**Unit**	**Unit Cost**	**Cost**
Clean Fill Backfill				**$905,441.83**
Clean Fill Purchase (Includes Hauling)	47,654.8	LCY	$19.00	$905,441.83
Subtotal Construction Costs				**$3,054,066.00**
Mobilization, Insurance, Bonding		10% Subtotal Capital Costs		**$305,406.60**
Institutional Controls		Lump Sum		**$25,000.00**
Subtotal Costs				**$3,384,472.60**
Project Management		5% Construction Cost		$169,223.63
Remedial Design		8% Construction Cost		$203,068.36
Construction Management		6% Construction Cost		$203,068.36
Construction Contingencies		30 % of Construction Cost		$1,015,341.78
Total Capital Costs				**$4,975,174.72**
Total Present Worth				**$5,000,000.00**
			Range -30%	**$3,500,000.00**
			Range +50%	**$7,500,000.00**

Notes:
x1.25 Expansion Factor Used for all LCY quantities
x0.9 Compaction Factor Used for all CCY quantities

BCY	Bank Cubic Yards
CCY	Compacted Cubic Yards
LCY	Loose Cubic Yards
MTP	Main Tailings Pile
SY	Square Yards