Information Sheet
Comparison Between COPC Concentrations Found in Samples Taken From Sections 3, 4, and 5 of the NSDD and Selected Screening Levels

Introduction

In support of the continued investigation of contaminant levels in Sections 3, 4, and 5 of the North-South Diversion Ditch (NSDD) [i.e., Solid Waste Management Unit (SWMU) 58], concentrations of contaminants of potential concern (COPCs) were selected. Subsequently, concentrations were plotted on bar graphs to show the distribution of COPC concentrations in relation to selected screening values. Additionally, maps showing the locations of the concentration of each COPC were created to illustrate the extent of contamination with the COPCs.

Methods and Materials

Data were taken from the Paducah Gaseous Diffusion Plant – Oak Ridge Environmental Information System (PGDP OREIS) in December 2002. Data selected were from samples collected within one of the remediation units (RUs) that define the extent of the potential response action for SWMU 58. These RUs and the samples collected within each are shown in Figs. 1 through 3. The samples within the RUs also are listed by Section in Table 1. All samples were collected from 0-2 ft below ground surface (bgs), except sample H219 from Section 4 that had an end depth of 5 ft bgs.

After data were compiled, COPCs were selected following procedures contained in *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky. Volume 1. Human Health* (DOE/OR/07-1506&D2) (i.e., Risk Methods Document). These procedures used the following data screens.

(1) Examine data qualifiers and retain only those analytes that were detected at least one time.

(2) Compare the maximum detected concentration of retained analytes against child resident no action screening values taken from Table A.17 in the Risk Methods Document. Retain those analytes that have a maximum detected concentration that exceeds this no action screening value.

(3) Compare the maximum detected concentration of retained analytes against the provisional surface soil background concentrations taken from Table A.12 in the Risk Methods Document. Retain those analytes that have a maximum detected concentration that exceeds this background concentration.

The analytes retained after applying these screens (i.e., preliminary COPCs) along with their maximum detected concentration and screening values are highlighted in Table 2. As shown there, 17 of 39 detected inorganic chemicals, 2 of 10 organic compounds [when polynuclear aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) are considered as groups], and 12 of 17 radionuclide analytes are retained after applying the three screens.

To further reduce the data set to that representative of current conditions in SWMU 58, results from samples collected prior to January 1, 1995, were removed from the data set. These data were removed consistent with data screening guidance in the Risk Methods Document. This guidance notes that if data are from transient media (i.e., surface water and sediment), then only recently collected data are representative of site conditions. The analytes retained after removing data from samples collected prior to January 1, 1995, are presented in Table 3. As shown there, 14 of 26 detected inorganic chemicals, 1 of

2 detected organic compounds (when PCBs are considered as a group), and 11 of 15 detected radionuclide analytes are retained after applying this additional screen. Inorganic chemicals that were retained earlier but are removed from the data set on the basis of date of sampling are aluminum, antimony, and barium; the organic compound removed from the data set in the basis of date of sampling is Total PAHs; and radionuclides removed from the data set on the basis of date of sampling are cobalt-60 (^{60}Co) and plutonium-238 (^{238}Pu).

Finally, one inorganic chemical and one radionuclide that exceeded their screening values were removed as part of developing the final list of COPCs. These were sodium and thorium-228 (^{228}Th). Sodium was removed because it is an essential nutrient that does not have a no action screening value. Its removal is consistent with guidance in the Risk Methods Document. The radionuclide ^{228}Th was removed to remain consistent with comments on other documents concerning retaining this radionuclide as a COPC. As discussed in those comments, it is not appropriate to retain ^{228}Th as a COPC because it has a very short half-life (i.e., 1.91 years).

The final COPC list, consisting of 12 inorganic chemicals, 1 organic compound, and 10 radionuclides, is shown in Table 4. Also listed in Table 4 are the frequencies of detection and minimum, maximum, average, and median detected concentrations of COPCs.

Tables 5 and 6 list the no action and action screening values, respectively, against which COPC concentrations are compared. (Background concentrations are shown in Tables 2 and 3). As described in the footnotes to Tables 5 and 6, the no action and action screening values are those for the industrial worker and child recreational user taken from Tables A.17 and A.14 of the Risk Methods Document, respectively.

Results and Conclusions

Figures 4 through 26 depict the concentrations of each of the COPCs relative to the COPC's no action screening value (i.e., the lesser of the industrial use and child recreational use no action screening value from Table 5 shown as a dark blue line) and background concentration (also from Table 3 and shown as a dark green line). Note that results are shown within ditch section and that the related PGDP action screening levels are provided for reference in text boxes. (PGDP action screening levels are risk-based values calculated using a target hazard of 3 or a cancer risk level of 1×10^{-4}. As discussed in the Risk Methods Document, if an analyte has a concentration that exceeds an action level, then a response action should be considered.)

In Figs. 4 through 26, nondetect results are reported at one-half their detection limit and are shown as a light blue bar, and detected results are reported at there full value and are shown using a light green bar. As shown there, the reported concentrations of all COPCs are less than their action screening levels. Additionally, the detected concentrations of chromium, copper, nickel, Americium-241 (^{241}Am), technetium-99 (^{99}Tc), and thorium-232 (^{232}Th) are less than their no action screening levels, although some results for each of these (except ^{241}Am which doesn't have a background concentration) exceed their background concentration. Results for COPCs with detected concentrations greater than their no action screening levels are as follows.

- Arsenic – Results from 26 samples: No detected concentrations are greater than the action screening levels; 16 of 16 detected concentrations are greater than the no action screening level; only 3 of 16 detected concentrations are greater than the surface soil background concentration.

- Beryllium – Results from 26 samples: No detected concentrations are greater than the action screening levels; 12 of 13 detected concentrations are greater than the no action screening level; 8 of 13 detected concentrations are greater than the surface soil background concentration.

- Iron – Results from 26 samples: No detected concentrations are greater than the action screening levels; 26 of 26 detected concentrations are greater than the no action screening level; only 1 of 26 detected concentrations is greater than the surface soil background concentration.

- Manganese – Results from 26 samples: No detected concentrations are greater than the action screening levels; 26 of 26 detected concentrations are greater than the no action screening level; only 1 of 26 detected concentrations is greater than the surface soil background concentration.

- Mercury – Results from 26 samples: No detected concentrations are greater than the action screening levels; 8 of 14 detected concentrations are greater than the no action screening level; 9 of 14 detected concentrations are greater than the surface soil background concentration.

- Silver – Results from 26 samples: No detected concentrations are greater than the action screening levels; 1 of 6 detected concentrations is greater than the no action screening level; 6 of 6 detected concentrations are greater than the surface soil background concentration.

- Thallium – Results from 26 samples: No detected concentrations are greater than the action screening levels; 8 of 8 detected concentrations are greater than the no action screening level; 8 of 8 detected concentrations are greater than the surface soil background concentration. Also, in some samples from Section 3, the detection limit for thallium is high relative to its screening levels.

- Uranium (as a metal) – Results from 15 samples: No detected concentrations are greater than the action screening levels; all samples from Section 3. 2 of 2 detected concentrations are greater than the no action screening level; 2 of 2 detected concentrations are greater than the surface soil background concentration. In some samples, the detection limit for uranium is high relative to its screening levels.

- Vanadium – Results from 26 samples: No detected concentrations are greater than the action screening levels; 26 of 26 detected concentrations are greater than the no action screening level; 5 of 26 detected concentrations are greater than the surface soil background concentration.

- Total PCBs – Results from 12 samples (all samples from Section 3): No detected concentrations are greater than the action screening levels; 11 of 12 detected concentrations are greater than the no action screening level. A comparison against background was not performed because the background concentration of Total PCBs is assumed to be 0 mg/kg.

- Cesium-137 (^{137}Cs) – Results from 15 samples: No detected concentrations are greater than the action screening levels; all samples from Section 3. 11 of 13 detected concentrations are greater than the no action screening level; 9 of 13 detected concentrations are greater than the surface soil background concentration.

- Neptunium-237 (^{237}Np) – Results from 25 samples: No detected concentrations are greater than the action screening levels; 16 of 18 detected concentrations are greater than the no action screening level; 17 of 18 detected concentrations are greater than the surface soil background concentration.

- Plutonium-239 (^{239}Pu) – Results from 26 samples: No detected concentrations are greater than the action screening levels; 3 of 23 detected concentrations are greater than the no action screening level; 23 of 23 detected concentrations greater than the surface soil background concentration.

- Thorium-230 (^{230}Th) – Results from 15 samples: No detected concentrations are greater than the action screening levels; all samples from Section 3. 10 of 15 detected concentrations are greater than the no action screening level; 13 of 15 detected concentrations are greater than the surface soil background concentration.

- Uranium-234 (^{234}U) – Results from 26 samples: No detected concentrations are greater than the action screening levels; 1 of 22 detected concentrations is greater than the no action screening level; 13 of 22 detected concentrations are greater than the surface soil background concentration.

- Uranium-235 (^{235}U) – Results from 26 samples: No detected concentrations are greater than the action screening levels; 7 of 26 detected concentrations are greater than the no action screening level; 15 of 26 detected concentrations are greater than the surface soil background concentration.

- Uranium-238 (^{238}U) – Results from 26 samples: No detected concentrations are greater than the action screening levels; 18 of 25 detected concentrations are greater than the no action screening level; 20 of 25 detected concentrations are greater than the surface soil background concentration.

The spatial distribution of sampling and the locations where both screening levels are exceeded are shown in the maps in Figs. 27 to 49. As shown in these maps, most of the sampling results are from Section 3 of the NSDD, with few samples available for Section 5. Within the limitations of the number of samples, these maps also show that metals contamination in excess of screening levels is most prevalent in Sections 3 and 5 and that radionuclide contamination in excess of screening levels is most prevalent in Section 3. (Note that a conclusion regarding Total PCBs contamination cannot be made because only Section 3 samples are available.)

When taken in total, the results from the maps and contaminant distribution graphs indicate that the contamination within Section 3 tends to be greater relative to that found in Sections 4 and 5. Additionally, these results indicate that Section 4 is clean relative to the other sections of the NSDD with only beryllium, thallium, vanadium, ^{237}Np, ^{230}Th, and ^{238}U detected at concentrations exceeding both screening levels. For Section 3, COPCs with a detected concentration exceeding the screening levels are mercury, nickel, silver, uranium, Total PCBs, ^{137}Cs, ^{237}Np, ^{239}Pu, ^{230}Th, ^{234}U, ^{235}U, and ^{238}U. For Section 5, COPCs with a detected concentration exceeding the screening levels are arsenic, beryllium, iron, manganese, nickel, thallium, vanadium, ^{237}Np, and ^{238}U.

Table 1. Stations within Sections 3, 4, and 5 of the NSDD providing data

Station Name	Project Sample Identifier	Sample End Depth	Number of Results
	Section 3		
K003	*3PADOF003*	*NV*	*1*
LB024	*CH202096-00000*	*NV*	*70*
NS005	*CH212038-00000*	*0*	*160*
NSD024	WC01-293	1	132
	WC01-294	2	132
NSD025	WC01-297	1	132
	WC01-298	2	132
NSD026	WC01-301	1	132
	WC01-301D	1	132
	WC01-302	2	132
NSD027	WC01-305	1	132
	WC01-306	2	132
NSD028	WC01-309	1	132
	WC01-310	2	132
NSD029	WC01-313	1	132
	WC01-314	2	132
NSD030	WC01-317	1	132
	WC01-318	2	132
RC-3814	*RC-3814*	*NV*	*2*
RC-3815	*RC-3815*	*NV*	*2*
RC-3816	*RC-3816*	*NV*	*2*
RC-3817	*RC-3817*	*NV*	*2*
RC-3818	*RC-3818*	*NV*	*2*
RC-3819	*RC-3819*	*NV*	*2*
RC-3820	*RC-3820*	*NV*	*2*
RC-3821	*RC-3821*	*NV*	*2*
RC-3822	*RC-3822*	*NV*	*2*
RC-3823	*RC-3823*	*NV*	*1*
RC-3824	*RC-3824*	*NV*	*2*
RC-3825	*RC-3825*	*NV*	*2*
SB009	*CH202109-00000*	*NV*	*70*
	CH202109-DUP	*NV*	*18*
	CH202110-00000	*NV*	*70*
SS9	*2126-91*	*NV*	*42*
	2379-89	*NV*	*46*
	2464-90	*NV*	*43*
	2984-91	*NV*	*1*
Number of Results for Section 3			2,524 (1,980)[a]
	Section 4		
H219	*CH213067-00000*	*5*	*160*
NS003	*CH212036-00000*	*0*	*160*
NS004	*CH212037-00000*	*0*	*161*
NSD2000-01 bank	120012	NV	35
	2000-5798	NV	13
NSD2000-06 sedi	2000-5819	NV	8

Table 1. (continued)

Station Name	Project Sample Identifier	Sample End Depth	Number of Results
NSD2000-06 SPT	2000-5820	NV	8
NSD2000-07 SPT	2000-5805	NV	8
NS-SD-01	050027SD	NV	35
	ERI00SD-01	NV	2
NS-SD-02	050026SD	NV	35
	ERI00SD-02	NV	2
NS-SD-04	050024SD	NV	35
	ERI00SD-04	NV	2
NS-SD-05	050023SD	NV	35
	ERI00SD-05	NV	2
NS-SD-06	050022SD	NV	34
	ERI00SD-06	NV	2
NS-SD-07	050021SD	NV	34
	ERI00SD-07	NV	11
	ERI00SD-07DUP	NV	9
SB010	*CH202112-00000*	*NV*	*9*
Number of Results for Section 4			800 (310)[a]
	Section 5		
K018	*3PADOF018*	*NV*	*2*
NSD2000-09 sedi	2000-5821	NV	8
NSD2000-11 sedi	2000-5823	NV	8
NSD2000-12 sedi	2000-5824	NV	8
NSD2000-16 sedi	2000-5827	NV	8
NSD2000-16 SPT	2000-5815	NV	8
	2000-5828	NV	8
NS-SD-09	050019SD	NV	35
	ERI00SD-09	NV	2
NS-SD-11	050017SD	NV	35
	ERI00SD-11	NV	2
NS-SD-12	050016SD	NV	35
	ERI00SD-12	NV	2
NS-SD-16	050012SD	NV	35
	ERI00SD-16	NV	11
SS25	*2142-91*	*NV*	*42*
	2395-89	*NV*	*46*
	2480-90	*NV*	*43*
	2992-91	*NV*	*1*
Number of Results for Section 5			339 (205)[a]
Number of Results for SWMU 58			3,663 (2,495)[a]

Notes:
NSDD = North-South Diversion Ditch
NV = a value is not available in the data set

[a]The first value includes all sample results. The value in parenthesis is the number of results remaining after removing results from samples collected prior to January 1, 1995. The samples collected prior to January 1, 1995, are in italicized font.

Table 2. Maximum detected concentrations of analytes – all samples

Analyte[a]	NSDD Section 3	4	5	Overall[b]	Surface Soil Background[c]	Residential No Action[d]
			Inorganic Chemicals (mg/kg)			
Aluminum	22,227	11,100	12,060	22,227	13,000	732
Antimony	1	1.4	ND	1.4	0.21	0.0635
Arsenic	7.7	9.6	32.7	32.7	12	0.132
Barium	111	105	270	270	200	37
Beryllium	6.5	5.3	1.9	6.5	0.67	0.16
Cadmium	1.9	1.8	ND	1.9	0.21	2.64
Calcium	16,900	83,000	26,900	83,000	200,000	NV
Chromium	120	22.3	57.3	120	16	60.5
Cobalt	12	10.7	23.4	23.4	14	209
Copper	135	16.9	40.4	135	19	68.1
Iodide	20.8	ND	ND	20.8	NV	NV
Iron	21,741	24,800	50,900	50,900	28,000	314
Lead	34.8	16.9	38.1	38.1	36	50
Lithium	14	ND	12	14	NV	69.8
Magnesium	2,494	2,350	2,480	2,494	7,700	NV
Manganese	1,450	651	1,780	1,780	1,500	7.46
Mercury	1.49	0.07	ND	1.49	0.2	0.158
Molybdenum	ND	1.2	7.8	7.8	NV	10.9
Nickel	101	17	26.4	101	21	34
Niobium	6	ND	ND	6	NV	NV
Potassium	1,611	807	928	1,611	1,300	NV
Ruthenium	22	ND	17.85	22	NV	NV
Selenium	0.25	0.23	ND	0.25	0.8	12.1
Silicon	608	819	881	881	NV	NV
Silver	19.6	ND	ND	19.6	2.3	6.12
Sodium	173	116	447	447	320	NV
Strontium	76.4	ND	65.8	76.4	NV	801
Tantalum	2	ND	2.97	2.97	NV	NV
Thallium	ND	1.2	8.4	8.4	0.21	0.107
Thorium	16	ND	12	16	NV	NV
Tin	217	ND	14	217	NV	439
Titanium	388	ND	258	388	NV	NV
Total Organic Carbon (TOC)	11,000	1,000	ND	11,000	NV	NV
Total Phosphate as Phosphorus	506	ND	588	588	NV	NV
Tungsten	16	ND	78.8	78.8	NV	NV
Uranium	234	ND	16	234	4.9	2.16
Vanadium	40.6	40.7	74.7	74.7	38	0.562
Zinc	374	72.4	50.9	374	65	401
Zirconium	18	ND	15.2	18	NV	NV
			Organic Compounds (mg/kg)			
4-Methyl-2-pentanone	0.009	0.015	ND	0.015	NV	NV
4-Methyl-3-penten-2-one	ND	0.41	ND	0.41	NV	NV
Acetone	0.25	0.34	ND	0.34	NV	53.4
Benz(a)anthracene[e]	0.25	0.2	ND	0.25	NV	0.067

Table 2. (continued)

Analyte[a]	NSDD Section 3	4	5	Overall[b]	Surface Soil Background[c]	Residential No Action[d]
Benzo(a)pyrene[e]	0.19	ND	ND	0.19	NV	0.0067
Benzo(b)fluoranthene[e]	0.21	0.15	ND	0.21	NV	0.067
Benzo(k)fluoranthene[e]	0.2	ND	ND	0.2	NV	0.67
Carbon disulfide	0.008	ND	ND	0.008	NV	15.7
Chrysene[e]	0.27	0.2	ND	0.27	NV	6.7
Fluoranthene	0.61	0.56	ND	0.61	NV	34.3
Methylene chloride	0.017	0.1	ND	0.1	NV	3.92
PCB-1248[f]	29	ND	ND	29	NV	0.0574
PCB-1254[f]	5.9	ND	0.2	5.9	NV	0.0388
PCB-1260[f]	6.1	ND	ND	6.1	NV	0.0574
Phenanthrene	0.5	0.44	ND	0.5	NV	NV
Pyrene	0.56	0.45	ND	0.56	NV	25.7
Total PAHs	0.2407	0.37	ND	0.37	NV	0.0067
Total PCBs	20	ND	0.4	20	NV	0.0574
Radionuclides (pCi/g)						
Alpha activity	360	29.08	51.47	360	NV	NV
Americium-241	4.26	0.25	0.71	4.26	NV	0.836
Beta activity	710	40	38.63	710	NV	NV
Cesium-137	4.16	ND	0.5	4.16	0.49	0.0128
Cobalt-60	-0.0027	ND	0.0081	0.0081		0.00263
Neptunium-237	30	0.54	0.48	30	0.1	0.0405
Plutonium-238	0.31	ND	ND	0.31	0.073	2.27
Plutonium-239	53	0.85	1.25	53	0.025	2.22
Potassium-40	15.5	ND	9.85	15.5	16	0.0407
Technetium-99	1,500	36	30.95	1,500	2.5	67.4
Thorium-228	4.38	ND	ND	4.38	1.6	0.00418
Thorium-230	497	31	15.66	497	1.5	2.85
Thorium-232	5.07	ND	ND	5.07	1.5	2.61
Total Uranium[g]	73.2	ND	ND	73.2	NV	NV
Uranium-234	120	5.6	4.99	120	2.5	3.81
Uranium-235	12	0.22	0.3	12	0.14	0.0591
Uranium-238	74	6.5	7.32	74	1.2	0.261

Notes:
Highlighted cells contain a value greater than the larger of the provisional background concentration and residential no action screening value.
ND = Analyte not detected in a sample from the indicated section of the NSDD.
NV = A value is not available in the Risk Methods Document.

[a]Only analytes detected in one or more samples are listed. Analytes not listed were never detected.
[b]The largest detected value within a sample taken in SWMU 58.
[c]Values taken from Table A.17 of the Risk Methods Document.
[d]Values taken from Table A.12 of the Risk Methods Document.
[e]Analyte is a polynuclear aromatic hydrocarbon (PAH) included in "Total PAHs" result.
[f]Analyte is a polychlorinated biphenyl included in "Total PCBs" result.
[g]Total Uranium is not retained as an analyte because the uranium isotopes are evaluated separately.

Table 3. Maximum detected concentrations of analytes – samples collected after January 1, 1995

Analyte[a]	NSDD Section 3	4	5	Overall[b]	Surface Soil Background[c]	Residential No Action[d]
			Inorganic Chemicals (mg/kg)			
Aluminum	12,500	11,100	8,730	12,500	13,000	732
Arsenic	7.31	9.6	32.7	32.7	12	0.132
Barium	82.3	94.9	146	146	200	37
Beryllium	0.59	1.1	1.9	1.9	0.67	0.16
Cadmium	ND	0.41	ND	0.41	0.21	2.64
Calcium	6,870	83,000	26,900	83,000	200,000	NV
Chromium	120	22.3	57.3	120	16	60.5
Cobalt	5.72	10.7	23.4	23.4	14	209
Copper	135	16.9	38.5	135	19	68.1
Iron	15,100	24,800	50,900	50,900	28,000	314
Lead	34.8	16.9	38.1	38.1	36	50
Lithium	8.75	ND	ND	8.75	NV	69.8
Magnesium	1,460	2,350	2,480	2,480	7,700	NV
Manganese	365	651	1,780	1,780	1,500	7.46
Mercury	1.49	0.07	ND	1.49	0.2	0.158
Molybdenum	ND	1.2	1.8	1.8	NV	10.9
Nickel	101	16.6	26.4	101	21	34
Potassium	ND	807	ND	807	1,300	NV
Silicon	ND	819	881	881	NV	NV
Silver	19.6	ND	ND	19.6	2.3	6.12
Sodium	ND	116	447	447	320	NV
Thallium	ND	1.2	2.8	2.8	0.21	0.107
Tin	217	ND	ND	217	NV	439
Uranium	234	ND	ND	234	4.9	2.16
Vanadium	35.8	40.7	74.7	74.7	38	0.562
Zinc	138	72.4	50.9	138	65	401
			Organic Compounds (mg/kg)			
Methylene chloride	0.017	ND	ND	0.017	NV	3.92
PCB-1248[e]	11.3	ND	ND	11.3	NV	0.0574
PCB-1254[e]	5.9	ND	ND	5.9	NV	0.0388
PCB-1260[e]	3.8	ND	ND	3.8	NV	0.0574
Total PCBs	20	ND	ND	20	NV	0.0574
			Radionuclides (pCi/g)			
Alpha activity	ND	29.08	51.47	51.47	NV	NV
Americium-241	4.26	0.25	0.71	4.26	NV	0.836
Beta activity	ND	22.22	38.63	38.63	NV	NV
Cesium-137	4.16	ND	ND	4.16	0.49	0.0128
Neptunium-237	3	0.36	0.48	3	0.1	0.0405
Plutonium-238	0.31	ND	ND	0.31	0.073	2.27
Plutonium-239	20.6	0.74	1.25	20.6	0.025	2.22
Technetium-99	153	20.36	30.95	153	2.5	67.4
Thorium-228	4.38	ND	ND	4.38	1.6	0.00418
Thorium-230	497	ND	ND	497	1.5	2.85
Thorium-232	5.07	ND	ND	5.07	1.5	2.61
Total Uranium[f]	73.2	ND	ND	73.2	NV	NV

Table 3. (continued)

Analyte[a]	NSDD Section 3	NSDD Section 4	NSDD Section 5	Overall[b]	Surface Soil Background[c]	Residential No Action[d]
Uranium-234	31.2	3.33	4.99	31.2	2.5	3.81
Uranium-235	1.94	0.22	0.3	1.94	0.14	0.0591
Uranium-238	40	4.34	7.32	40	1.2	0.261

Notes:
Highlighted cells contain a value greater than the larger of the provisional background concentration and residential no action screening value.
ND = Analyte not detected in a sample from the indicated section of the NSDD.
NV = A value is not available in the Risk Methods Document.

[a]Only analytes detected in one or more samples collected after January 1, 1995, are listed. Analytes not listed were never detected in a sample collected after that date.
[b]The largest detected value within a sample taken in SWMU 58 after January 1, 1995.
[c]Values taken from Table A.17 of the Risk Methods Document.
[d]Values taken from Table A.12 of the Risk Methods Document.
[e]Analyte is a polychlorinated biphenyl included in "Total PCBs" result.
[f]Total Uranium is not retained as an analyte because the uranium isotopes are evaluated separately.

Table 4. Summary statistics for the final list of COPCs for Sections 3, 4, and 5 of the NSDD

COPC[a]	Frequency of Detection[b]	Minimum Detected Concentration	Maximum Detected Concentration	Average of Detected Concentrations[c]	Median of Detected Concentrations
		Inorganic Chemicals (mg/kg)			
Arsenic	16/26	2.4	32.7	8.6	6.5
Beryllium	13/26	0.31	1.9	0.84	0.81
Chromium	26/26	8.09	120	45	41
Copper	26/26	2.7	135	34	17
Iron	26/26	5,260	50,900	14,500	11,400
Manganese	26/26	72.7	1,780	348	197
Mercury	14/26	0.03	1.49	0.44	0.49
Nickel	24/26	2.3	101	38	16
Silver	6/26	3.08	19.6	9.2	7.8
Thallium	8/26	0.56	2.8	1.2	1.0
Uranium	2/15	164	234	199	199
Vanadium	26/26	13.6	74.7	29	25
		Organic Compounds (mg/kg)			
Total PCBs	12/12	0.1	20	3.8	1
		Radionuclides (pCi/g)			
Americium-241	20/25	0.06	4.26	1.0	0.41
Cesium-137	13/15	0.03	4.16	1.8	1.9
Neptunium-237	18/25	0.08	3	1.2	0.87
Plutonium-239	23/26	0.16	20.6	4.3	0.93
Technetium-99	23/25	2.91	153	43	20
Thorium-230	15/15	0.35	497	139	101
Thorium-232	15/15	0.29	5.07	1.6	1.2
Uranium-234	22/26	0.69	31.2	6.4	3.3
Uranium-235	26/26	0.03	1.94	0.34	0.04
Uranium-238	25/26	0.79	40	7.2	3.2

Notes:

[a]Only analytes on the final COPC list are included.
[b]The number of samples in which the COPC was detected over the total number of samples in which the COPC was analyzed.
[c]The mean of all detected results assuming a normal distribution.

Table 5. No Action Levels for COPCs found in soil and sediment in the NSDD

COPC	No Action Levels		Value Used in Plots[c]
	Industrial[a]	Recreational (Child)[b]	
	Inorganic Chemicals (mg/kg)		
Arsenic	0.523	0.346	0.346
Beryllium	0.948	0.404	0.404
Chromium[d]	356	152	152
Copper	493	211	211
Iron	2,070	883	883
Manganese	45.2	19.3	19.3
Mercury	0.982	0.419	0.419
Nickel	242	103	103
Silver	41.1	17.5	17.5
Thallium[e]	0.727	0.310	0.310
Uranium	20.2	8.69	8.69
Vanadium	3.32	1.42	1.42
	Organic Compounds (mg/kg)		
Polychlorinated biphenyls (Total)	0.199	0.127	0.127
	Radionuclides (pCi/g)		
Americium-241	5.16	11.6	5.16
Cesium-137[f]	0.0858	0.178	0.0858
Neptunium-237[f]	0.271	0.565	0.271
Plutonium-239	11.5	30.3	11.5
Technetium-99	362	926	362
Thorium-230	14.9	39.0	14.9
Thorium-232	13.5	35.7	13.5
Uranium-234	19.8	52.2	19.8
Uranium-235[f]	0.395	0.826	0.395
Uranium-238[f]	1.71	3.64	1.71

Notes:
COPC = contaminant of potential concern

[a]Industrial worker no action levels are taken from Table A.17 of the Risk Methods Document. Values are the lesser of that derived using a hazard index of 0.1 and a cancer risk of 1×10^{-6}. Exposure routes included in the derivation for inorganic chemicals and organic compounds are incidental ingestion of soil or sediment, inhalation of particles and vapors emitted from soil or sediment, and dermal contact with soil or sediment. The exposure frequency and duration used in the derivation were 250 days per year and 25 years.

[b]Child recreational user no action levels are taken from Table A.17 of the Risk Methods Document. Values are the lesser of that derived using a hazard index of 0.1 and a cancer risk of 1×10^{-6}. Exposure routes included in the derivation for inorganic chemicals and organic compounds are incidental ingestion of soil or sediment, inhalation of particles and vapors emitted from soil or sediment, and dermal contact with soil or sediment. For radionuclides, the dermal contact exposure route was replaced by the external exposure to ionizing radiation. The exposure frequency and duration used in the derivation of screening levels for hazard causing COPCs were 140 days per year and 6 years. The exposure frequencies used in the derivation of screening levels for cancer causing COPCs were 140, 140, and 104 days per year for the child, teen, and adult, respectively. The exposure durations used in the derivation of screening levels for cancer causing COPCs were 6, 12, and 22 years for the child, teen, and adult, respectively.

[c]Although both values are reported on the plot, the value listed here is that used graphically. Values are the lesser of the industrial worker and child recreational user no action levels.

[d]No action levels are those for total chromium.

[e]No action levels are those for thallium chloride.

[f]Action levels are those for the radionuclide and its short-lived decay products.

Table 6. Action Levels for COPCs found in soil and sediment in the NSDD

COPC	Action Levels	
	Industrial[a]	Recreational (Child)[b]
Inorganic Chemicals (mg/kg)		
Arsenic	315	314
Beryllium	1,280	547
Chromium[c]	100,000	100,000
Copper	100,000	77,600
Iron	100,000	100,000
Manganese	46,400	20,100
Mercury	825	358
Nickel	93,000	40,900
Silver	20,700	9,090
Thallium[d]	343	150
Uranium	3,340	1,480
Vanadium	4,470	1,910
Organic Compounds (mg/kg)		
Polychlorinated biphenyls (Total)	42.5	28.3
Radionuclides (pCi/g)		
Americium-241	516	1,160
Cesium-137[e]	8.58	17.8
Neptunium-237[e]	27.1	56.5
Plutonium-239	1,150	3,030
Technetium-99	36,200	92,600
Thorium-230	1,490	3,900
Thorium-232	1,350	3,570
Uranium-234	1,980	5,220
Uranium-235[e]	39.5	82.6
Uranium-238[e]	171	364

Notes:
COPC = contaminant of potential concern

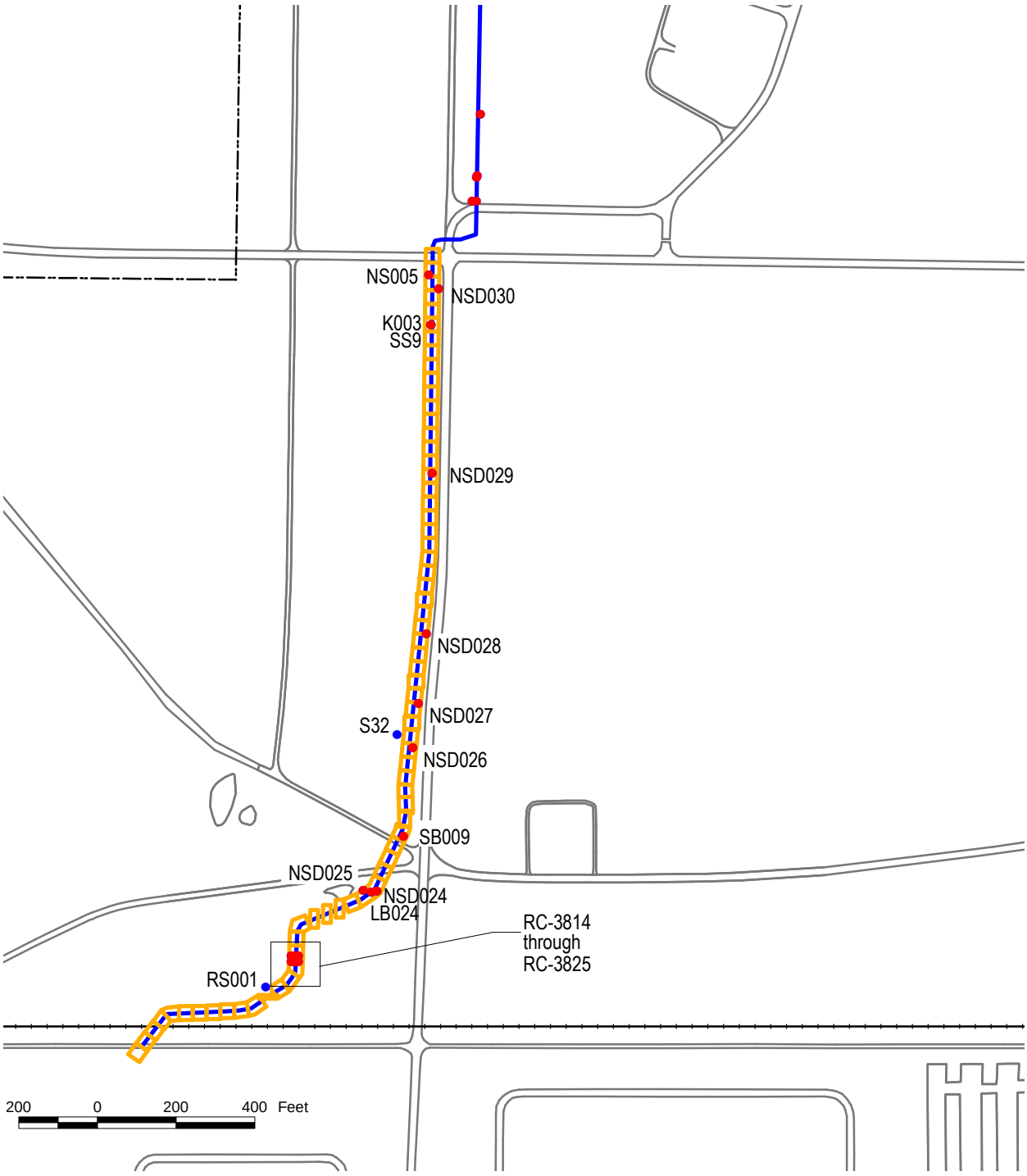
[a]Industrial worker action levels are taken from Table A.14 of the Risk Methods Document. Values are the lesser of that derived using a hazard index of 3 and a cancer risk of 1×10^{-4}. Exposure routes included in the derivation for inorganic chemicals and organic compounds are incidental ingestion of soil or sediment, inhalation of particles and vapors emitted from soil or sediment, and dermal contact with soil or sediment. The exposure frequency and duration used in the derivation were 250 days per year and 25 years.

[b]Child recreational user no action levels are taken from Table A.14 of the Risk Methods Document. Values are the lesser of that derived using a hazard index of 3 and a cancer risk of 1×10^{-4}. The exposure routes included in the derivation for inorganic chemicals and organic compounds are incidental ingestion of soil or sediment, inhalation of particles and vapors emitted from soil or sediment, and dermal contact with soil or sediment. For radionuclides, the dermal contact exposure route was replaced by the external exposure to ionizing radiation. The exposure frequency and duration used in the derivation of screening levels for hazard causing COPCs were 140 days per year and 6 years. The exposure frequencies used in the derivation of screening levels for cancer causing COPCs were 140, 140, and 104 days per year for the child, teen, and adult, respectively. The exposure durations used in the derivation of screening levels for cancer causing COPCs were 6, 12, and 22 years for the child, teen, and adult, respectively.

[c]Action levels are those for total chromium.

[d]Action levels are those for thallium chloride.

[e]Action levels are those for the radionuclide and its short-lived decay products.



LEGEND:

- Stations within RUs
- Stations within 50' of NSDD

RU_SECT3

TRUE NORTH 20° PLANT NORTH

Fig. 1. Location of sample stations in Section 3 of the North-South Division Ditch (SWMU 58).

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PADUCAH GASEOUS DIFFUSION PLANT

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Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

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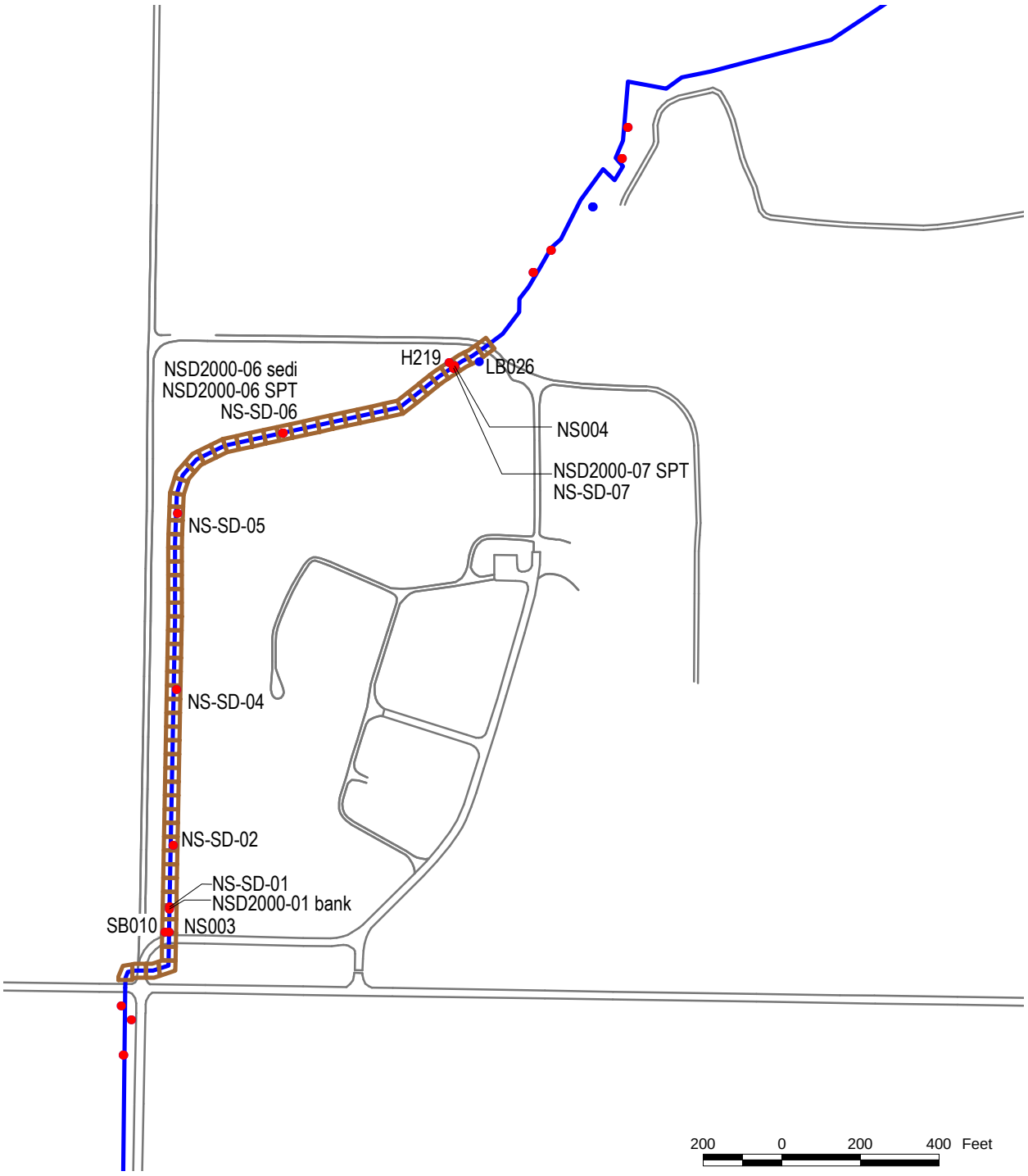
Oak Ridge, Tennessee 37831

FIGURE No. c5ac90001sk600.apr
DATE 01-23-03



LEGEND:

- Stations within RUs
- Stations within 50' of NSDD

RU_SECT4

TRUE NORTH 20° PLANT NORTH

Fig. 2. Location of sample stations in Section 4 of the North-South Division Ditch (SWMU 58).

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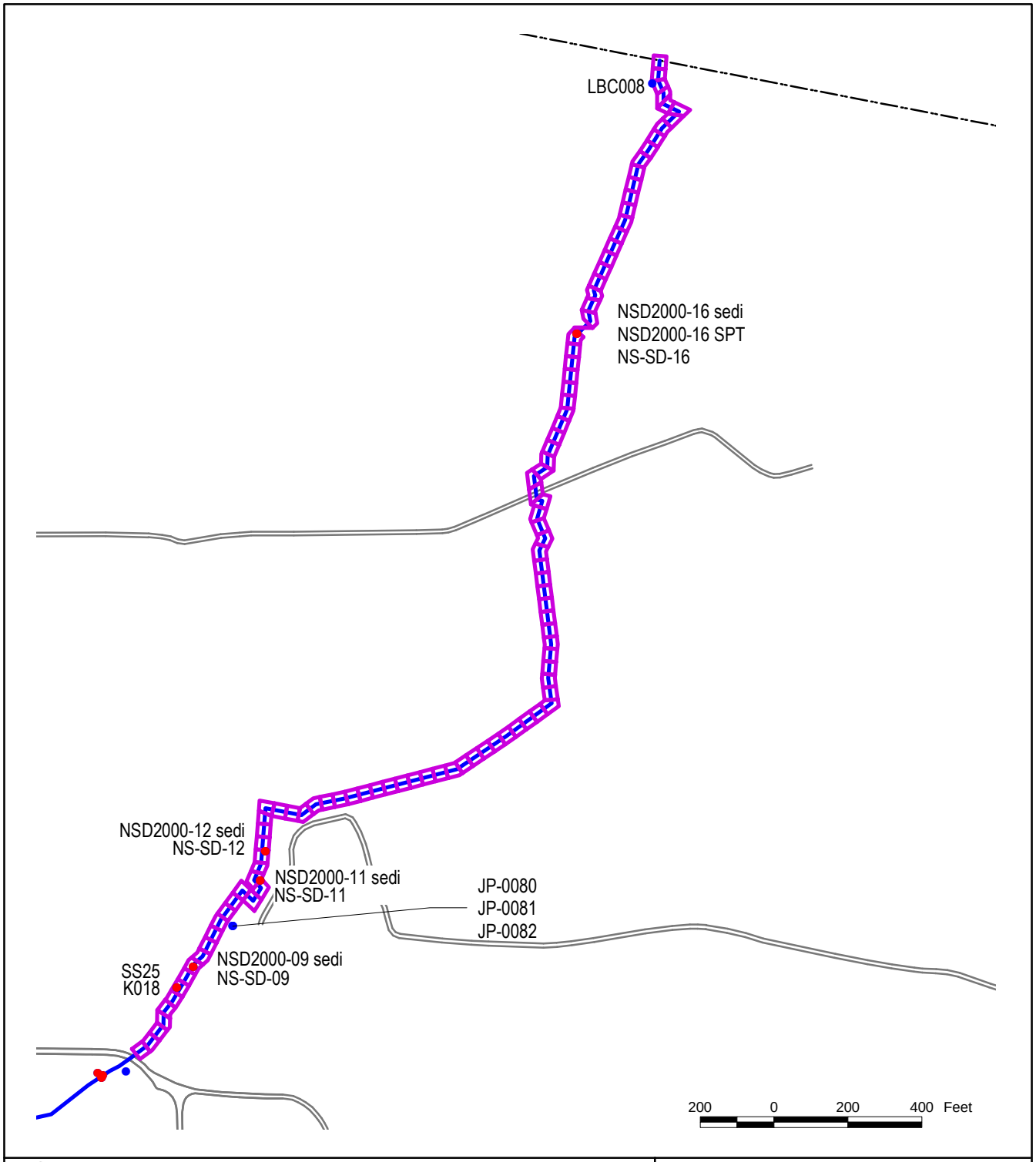
FIGURE No. c5ac90001sk600.apr
DATE 01-23-03



LEGEND:

- Stations within RUs
- Stations within 50' of NSDD

RU_SECT5

TRUE NORTH 20° PLANT NORTH

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Fig. 3. Location of sample stations in Section 5 of the North-South Division Ditch (SWMU 58).

FIGURE No. c5ac90001sk600.apr
DATE 01-23-03

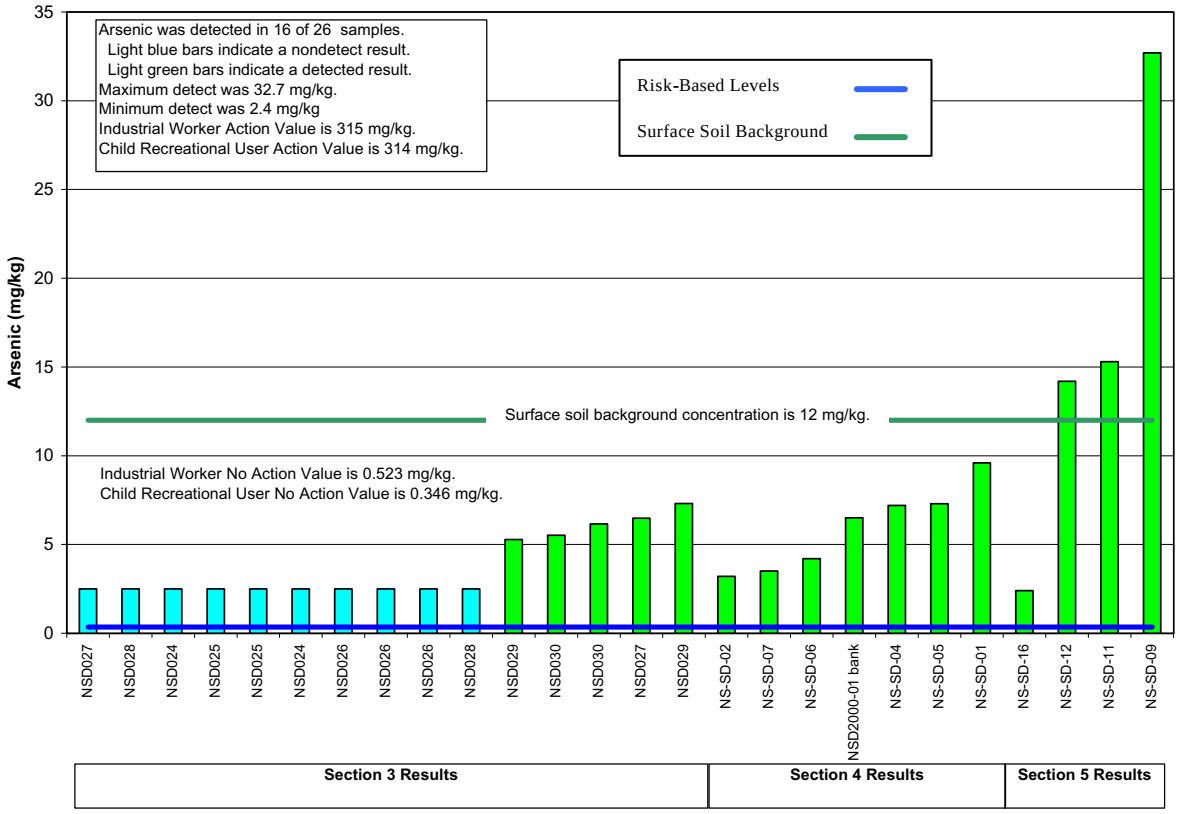


Fig. 4. Comparison between arsenic concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

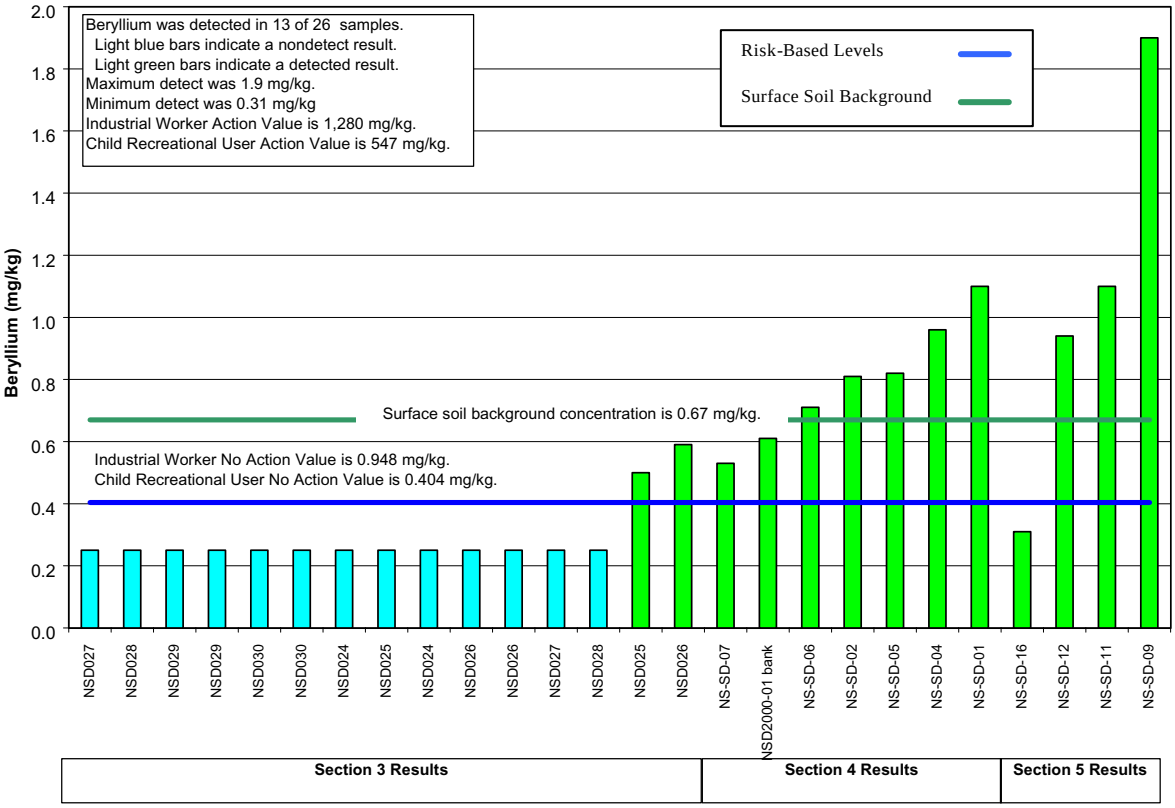


Fig. 5. Comparison between beryllium concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

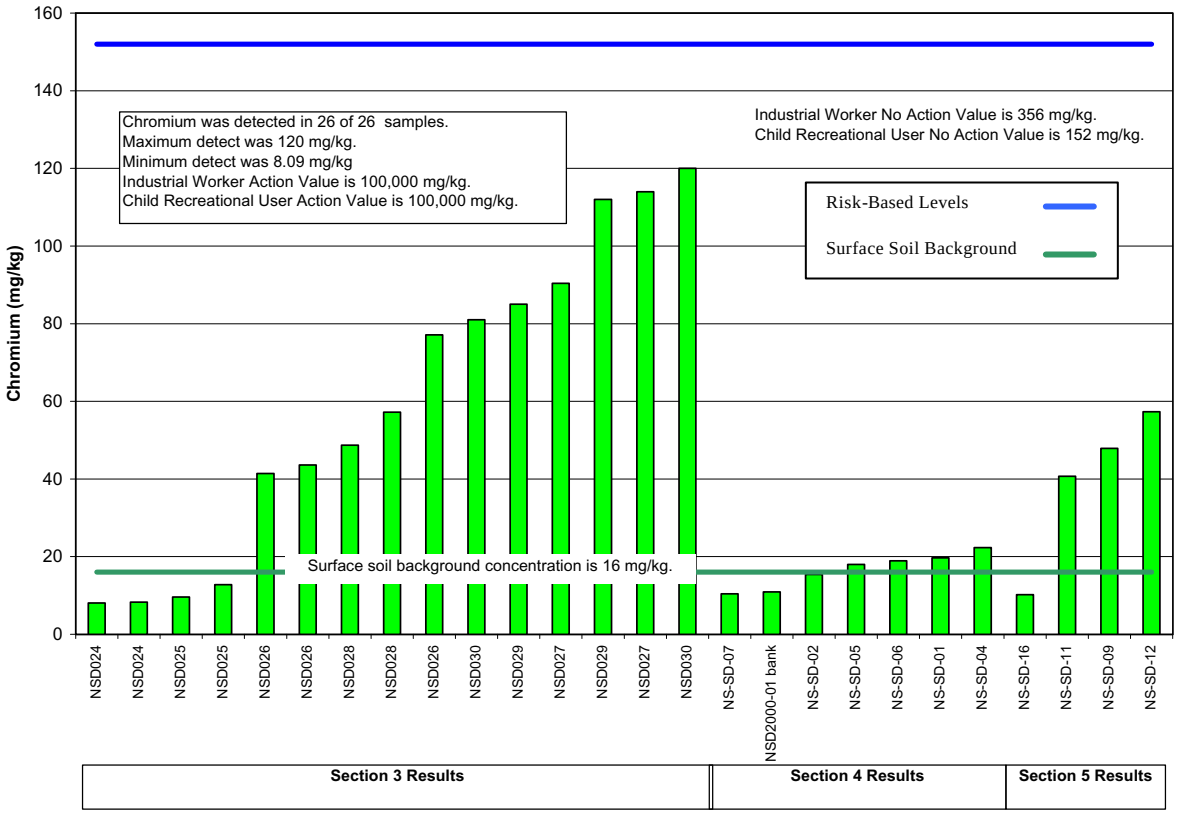


Fig. 6. Comparison between chromium concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

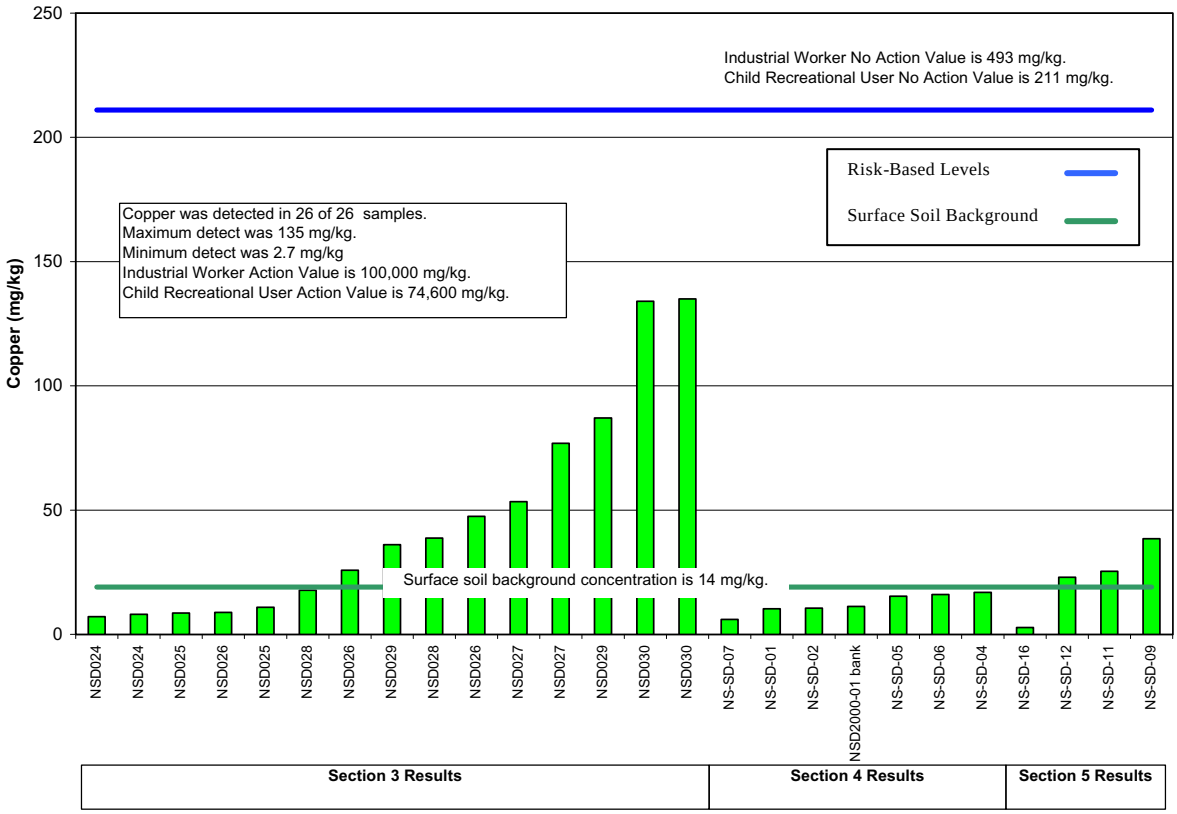


Fig. 7. Comparison between copper concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

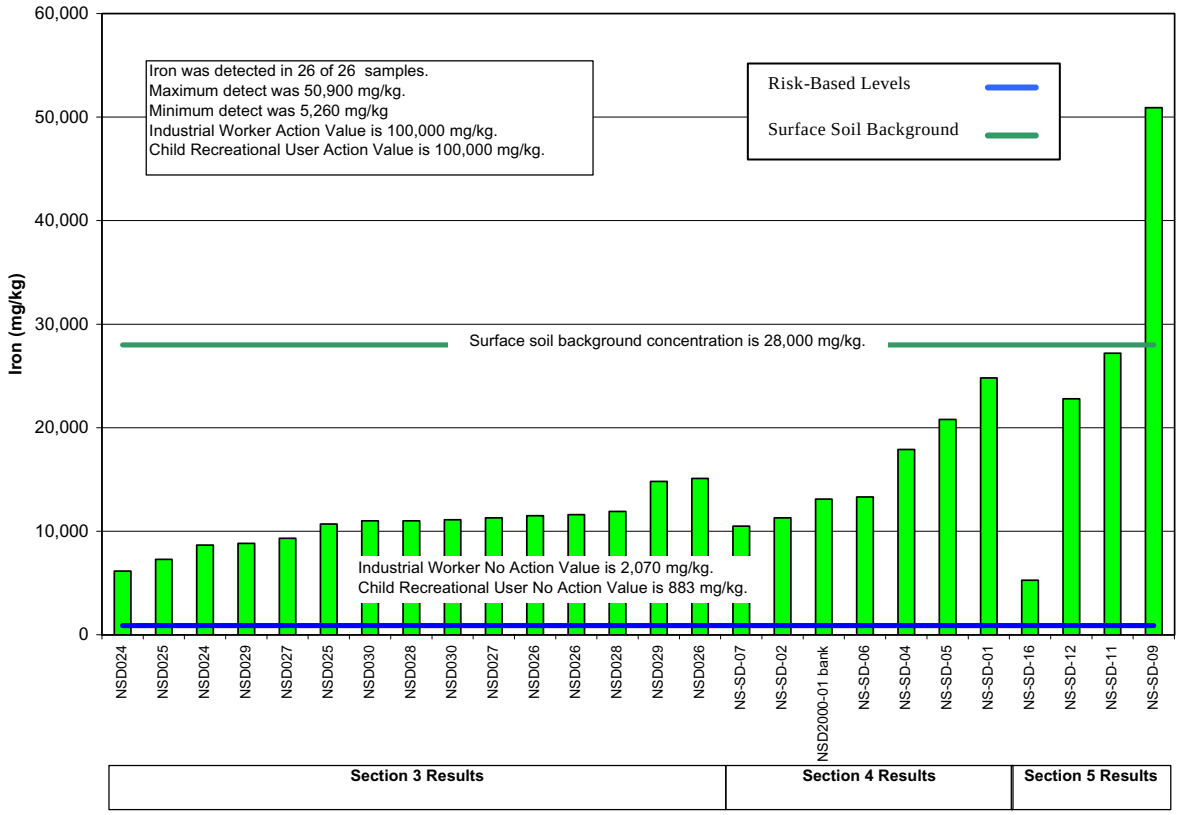


Fig. 8. Comparison between iron concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

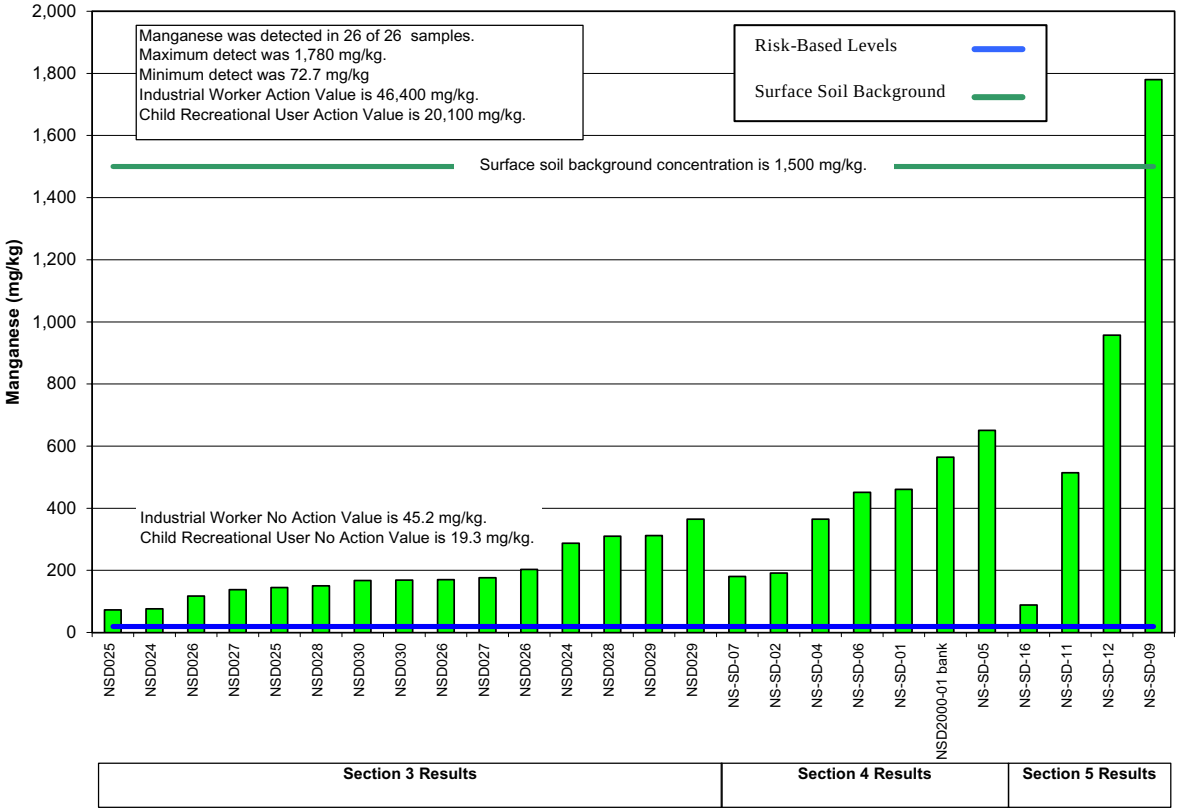


Fig. 9. Comparison between manganese concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

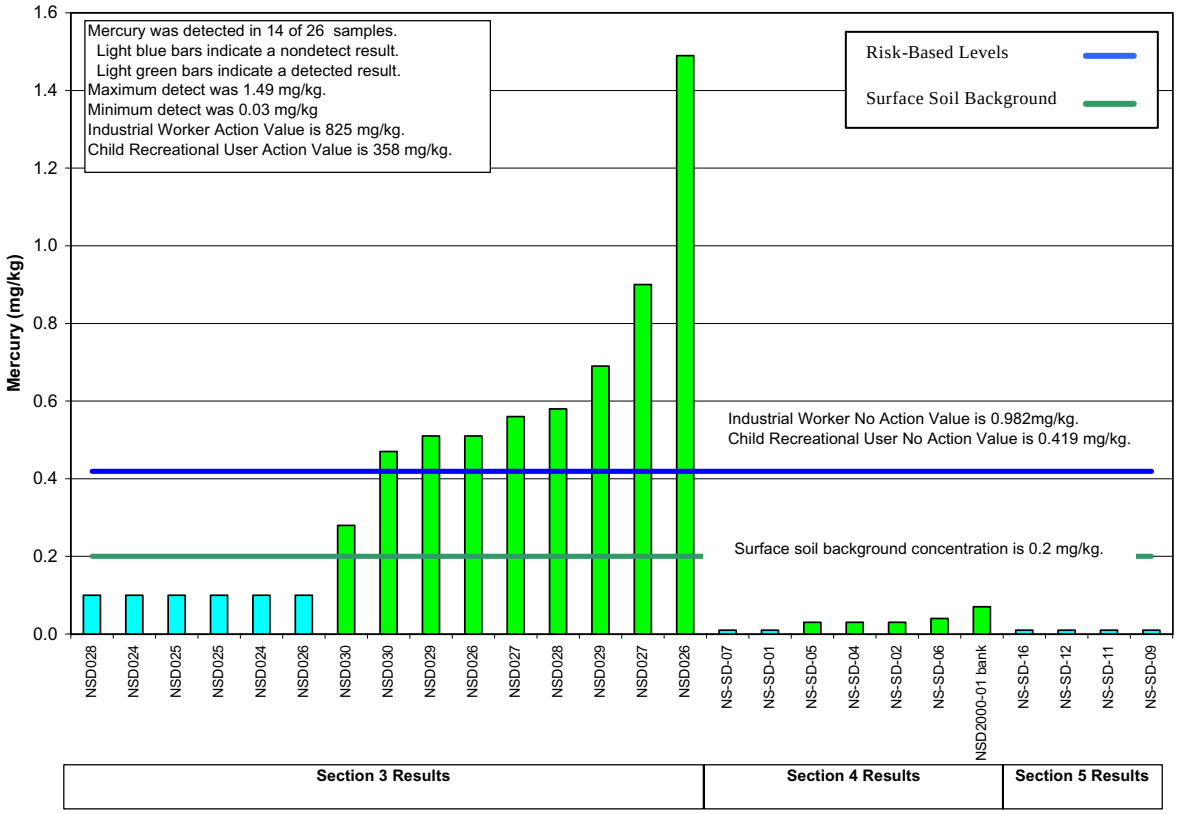


Fig. 10. Comparison between mercury concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

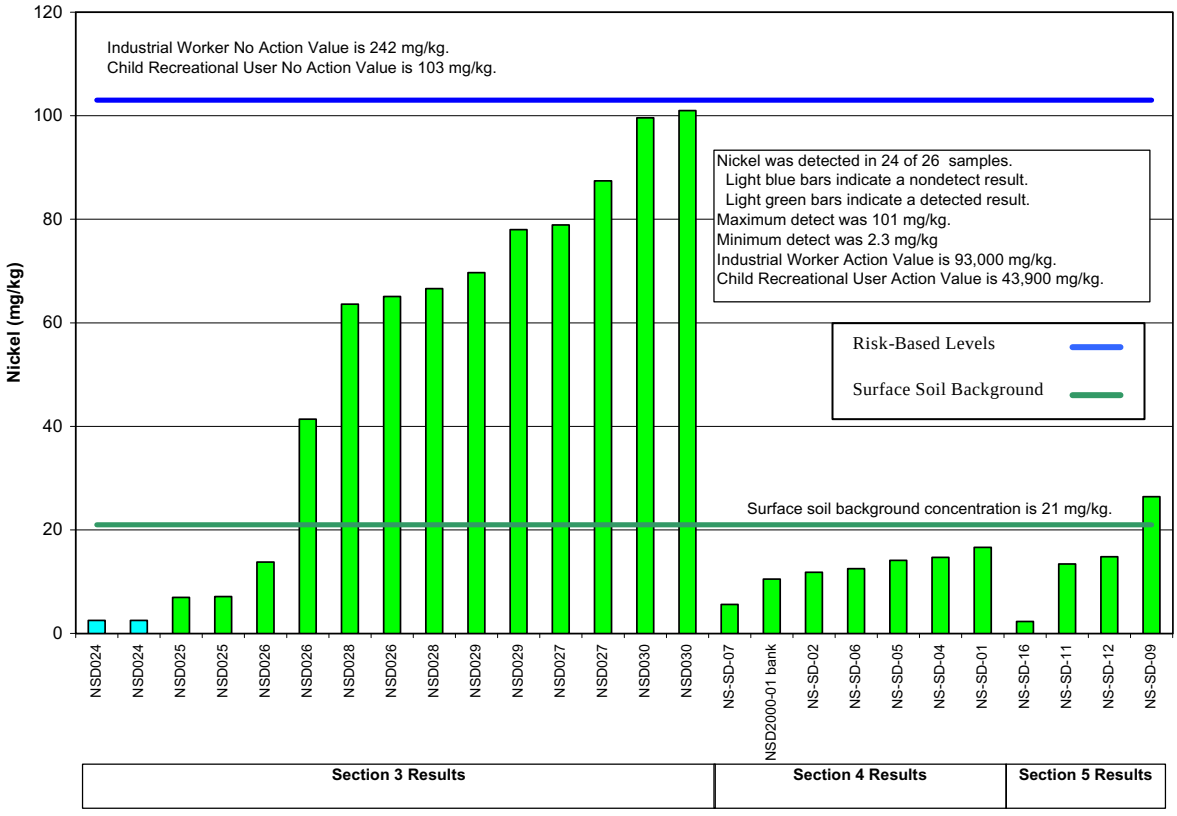


Fig. 11. Comparison between nickel concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

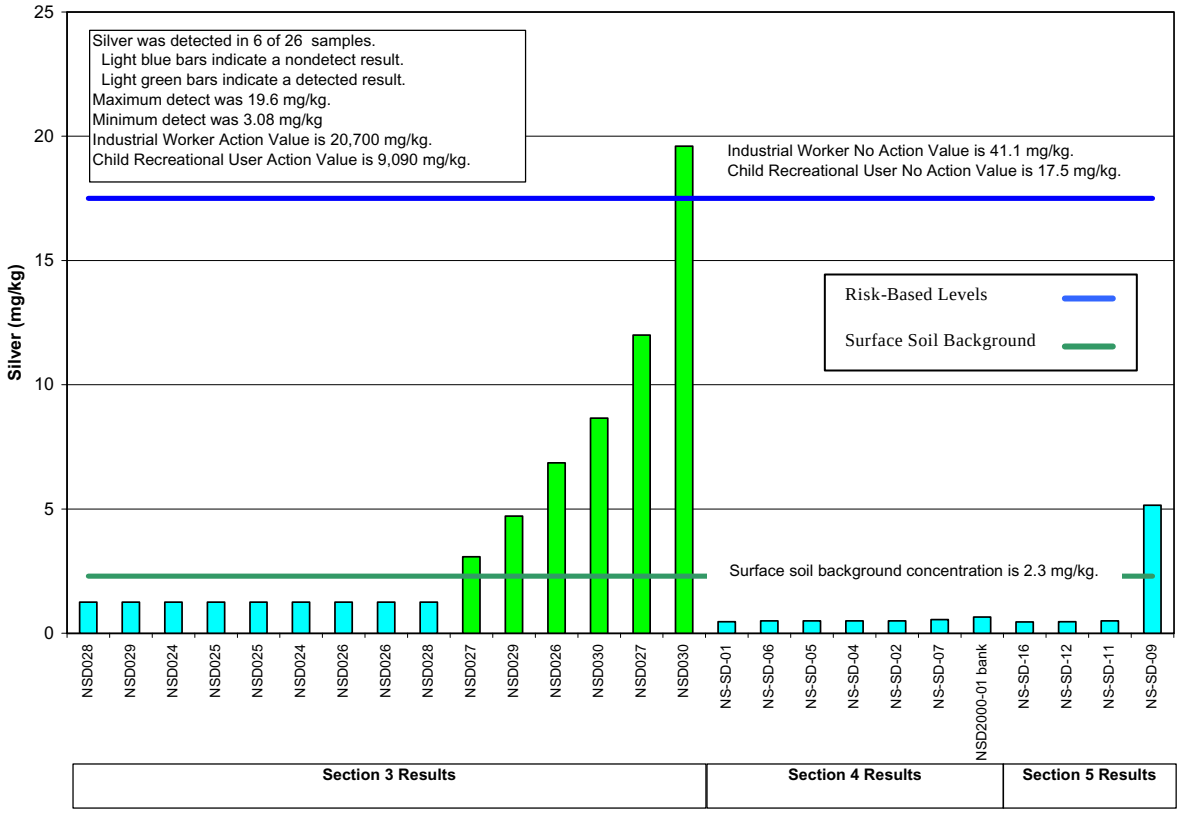


Fig. 12. Comparison between silver concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

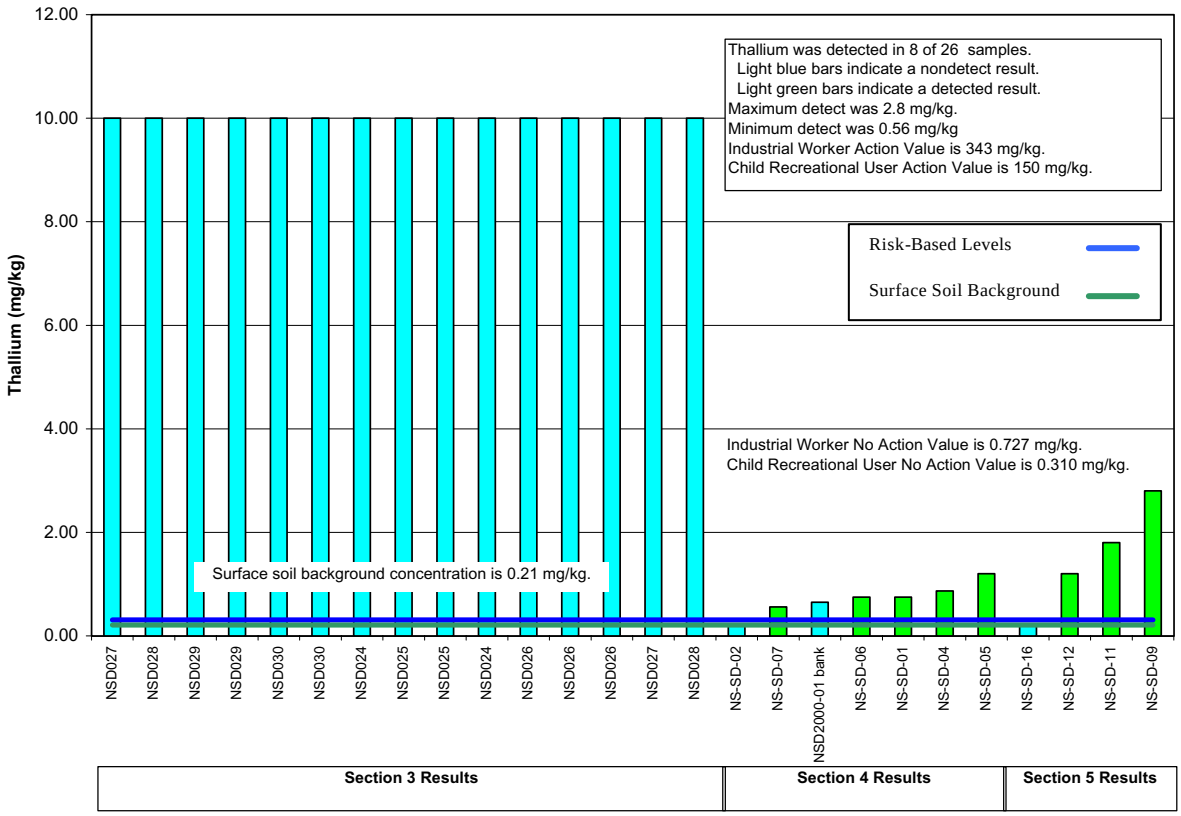


Fig. 13. Comparison between thallium concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

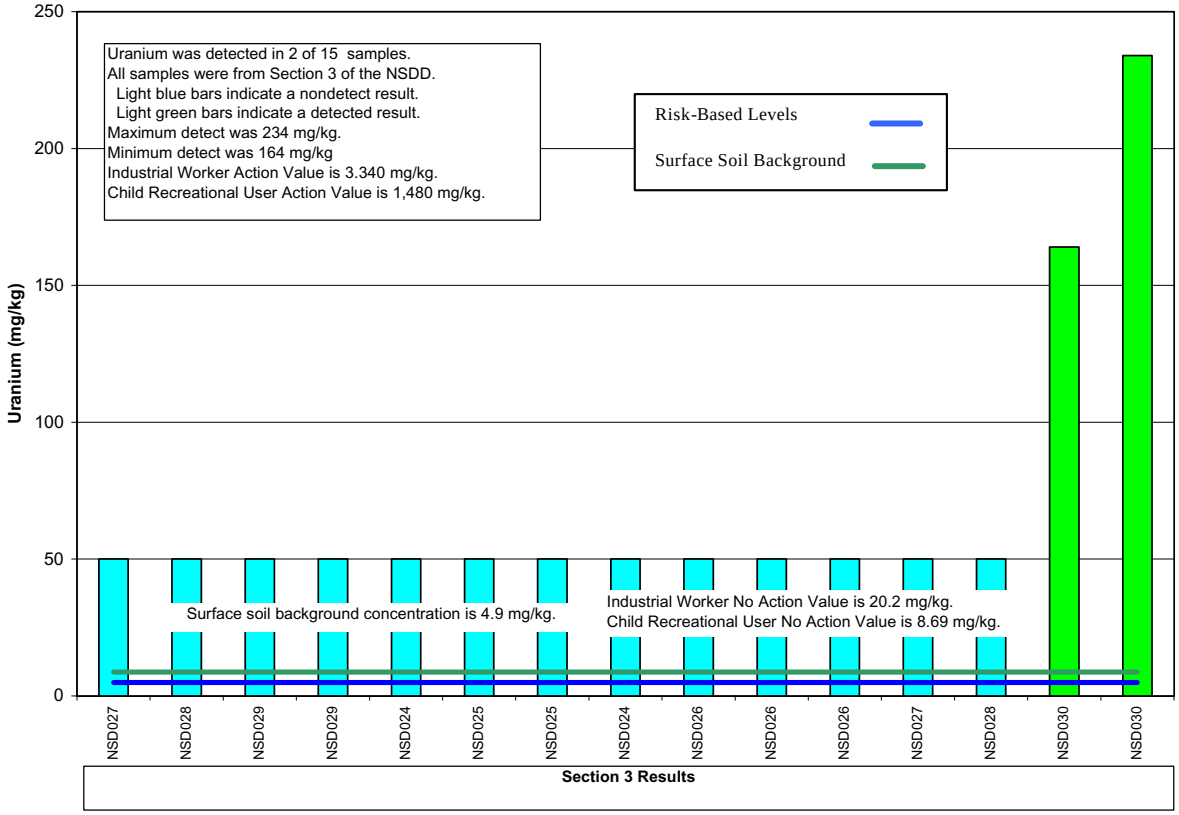


Fig. 14. Comparison between uranium concentrations reported in retained samples from Section 3 of the NSDD and risk-based levels and surface soil background concentrations.

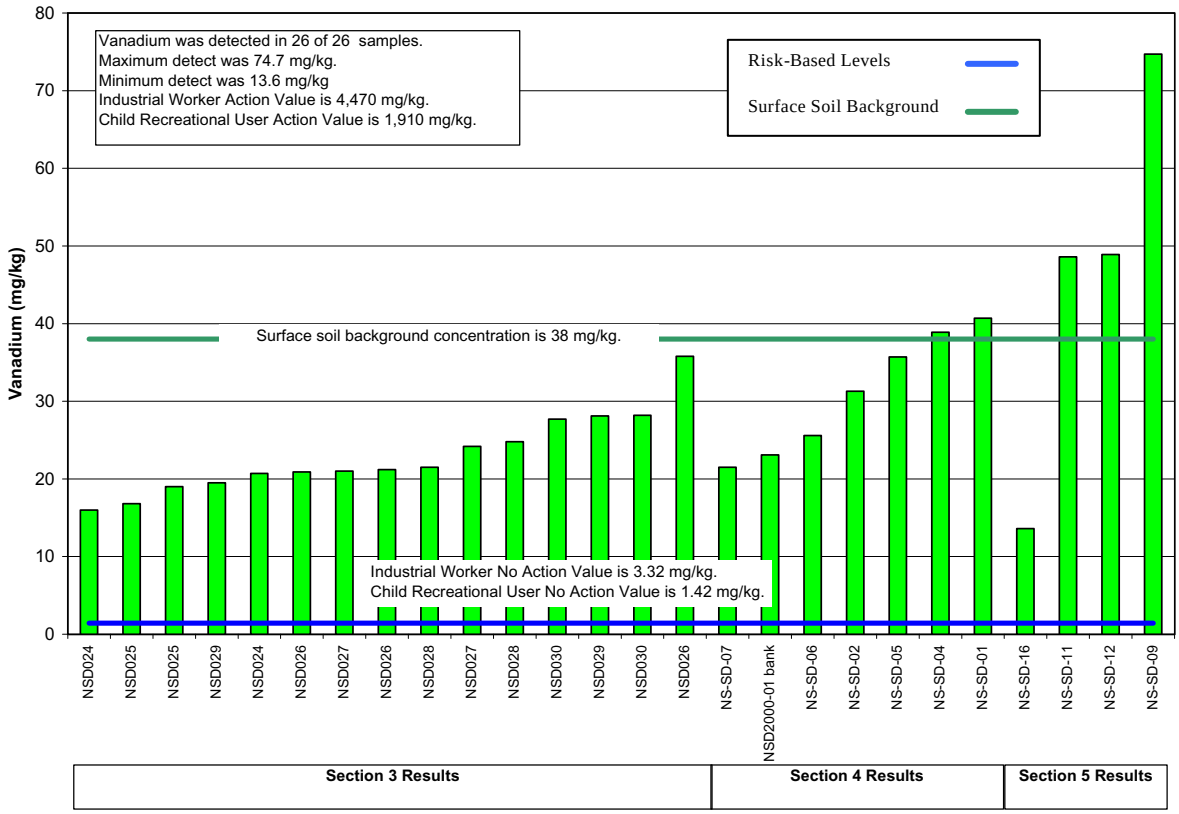


Fig. 15. Comparison between vanadium concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

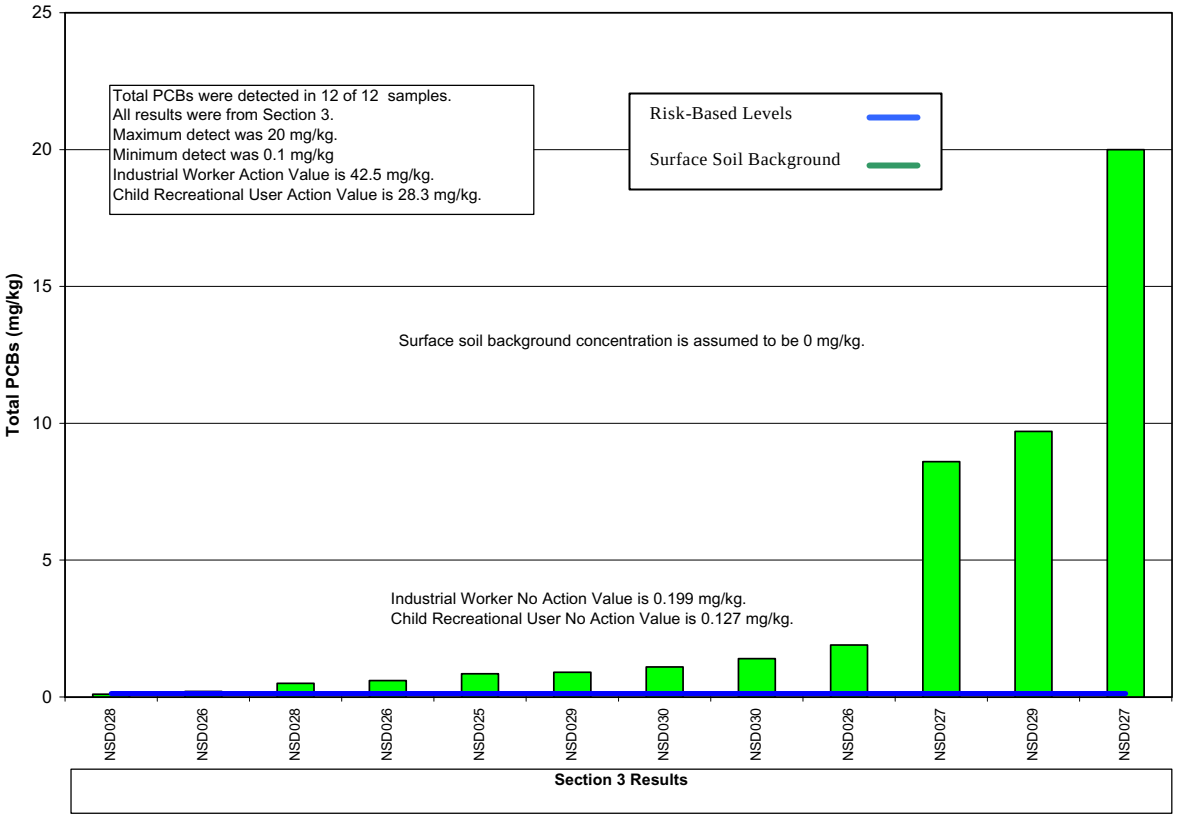


Fig. 16. Comparison between total PCB concentrations reported in retained samples from Section 3 of the NSDD and risk-based levels and surface soil background concentrations.

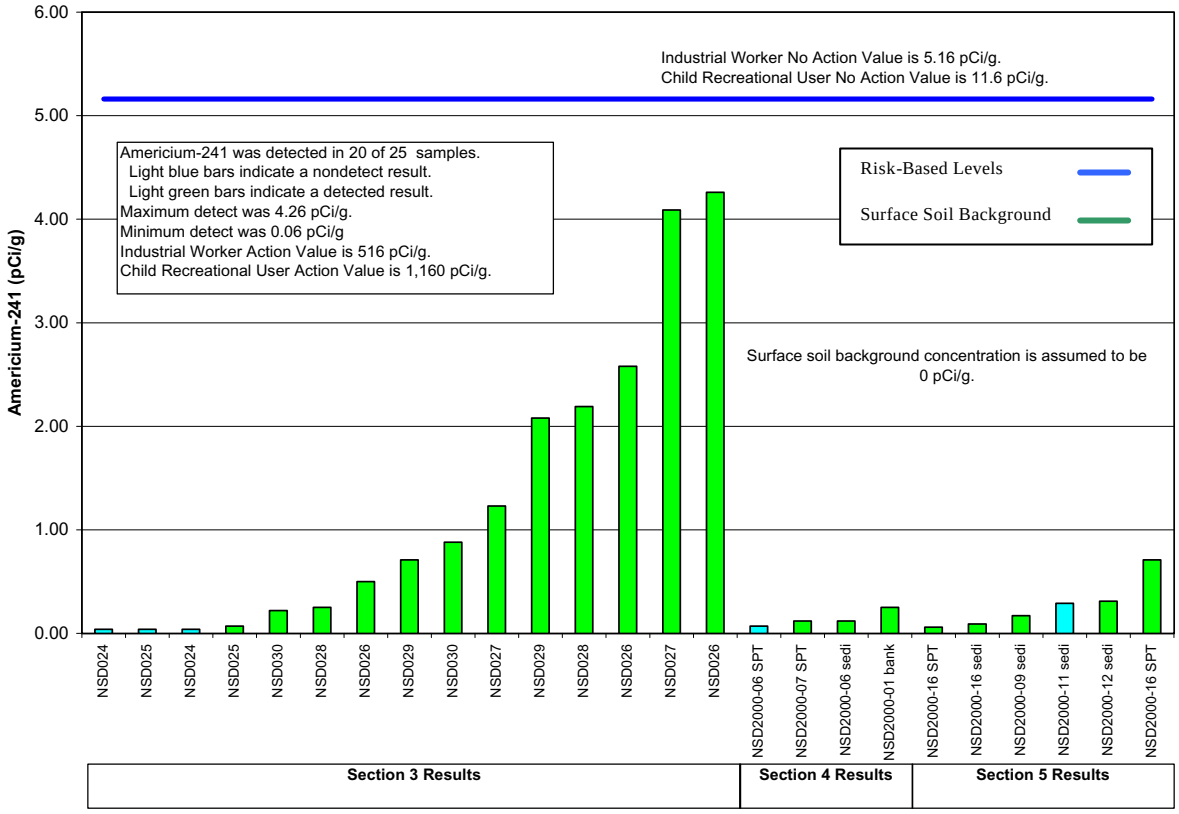


Fig. 17. Comparison between americium-241 concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

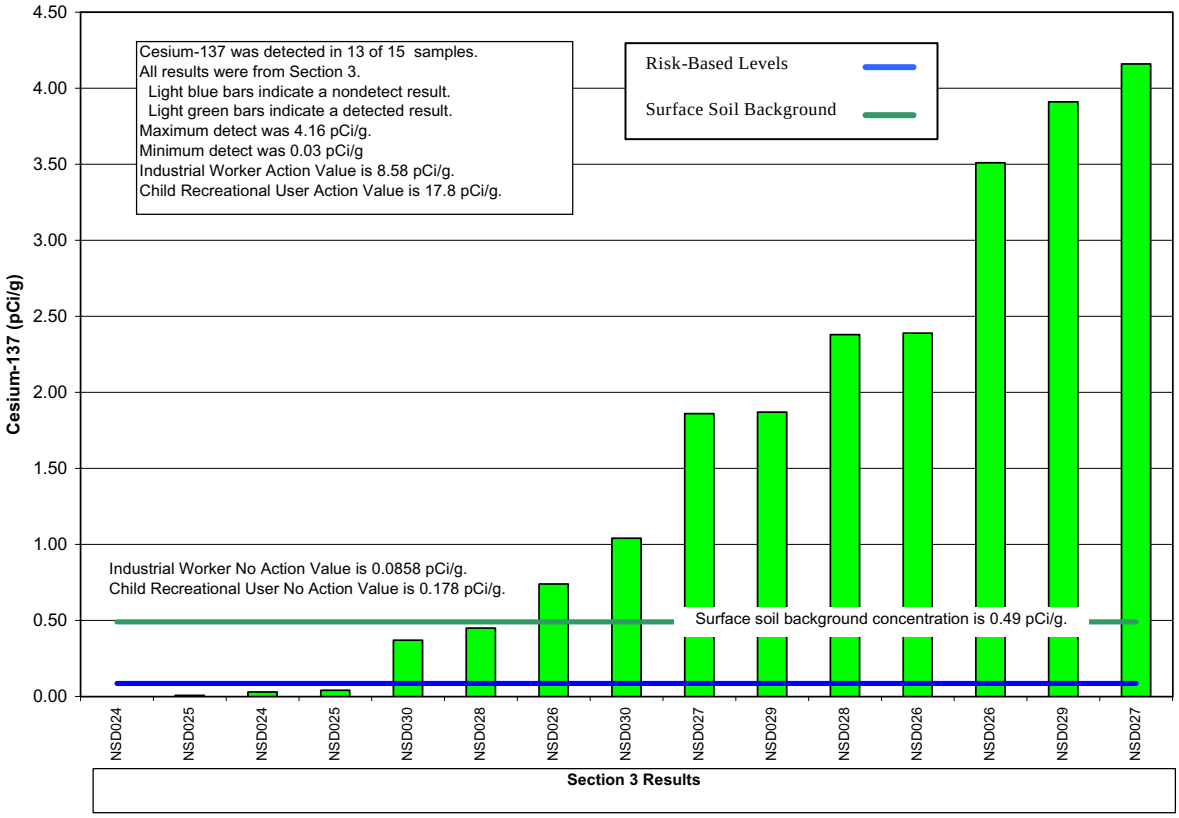


Fig. 18. Comparison between cesium-137 concentrations reported in retained samples from Section 3 of the NSDD and risk-based levels and surface soil background concentrations.

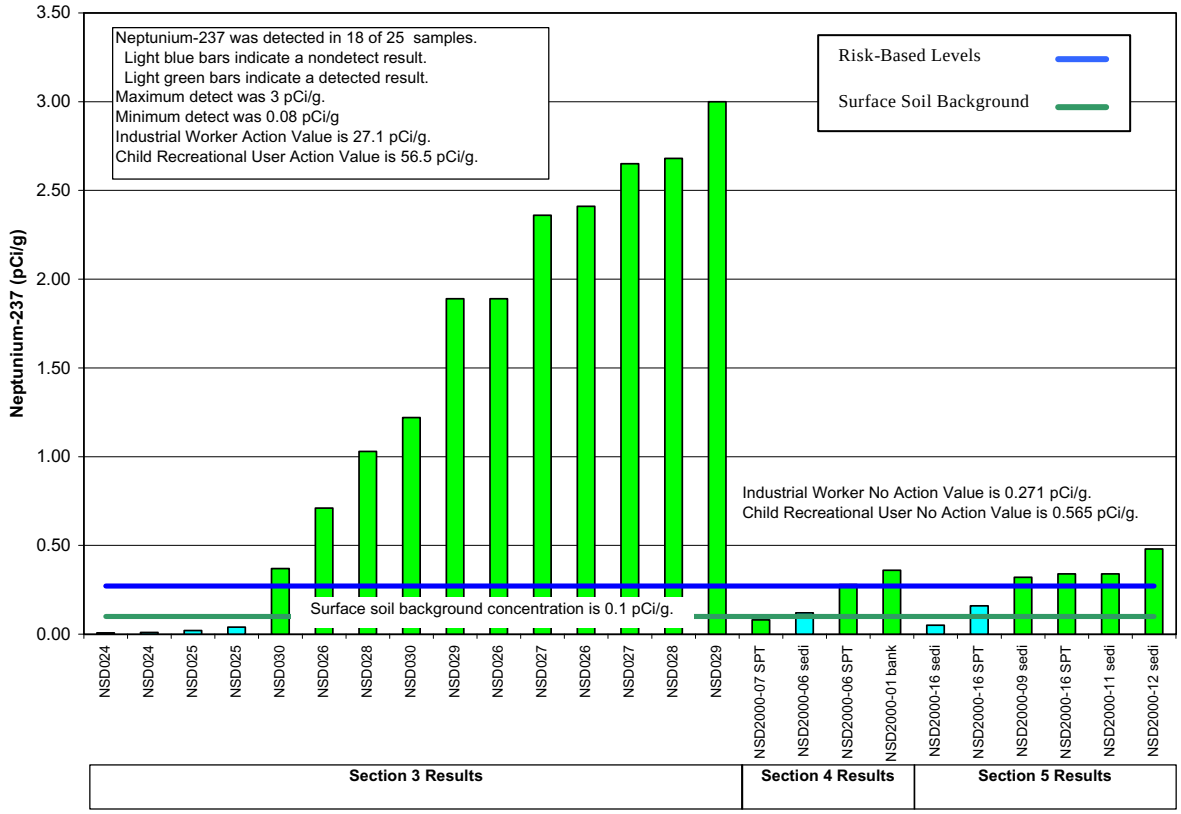


Fig. 19. Comparison between neptunium-237 concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

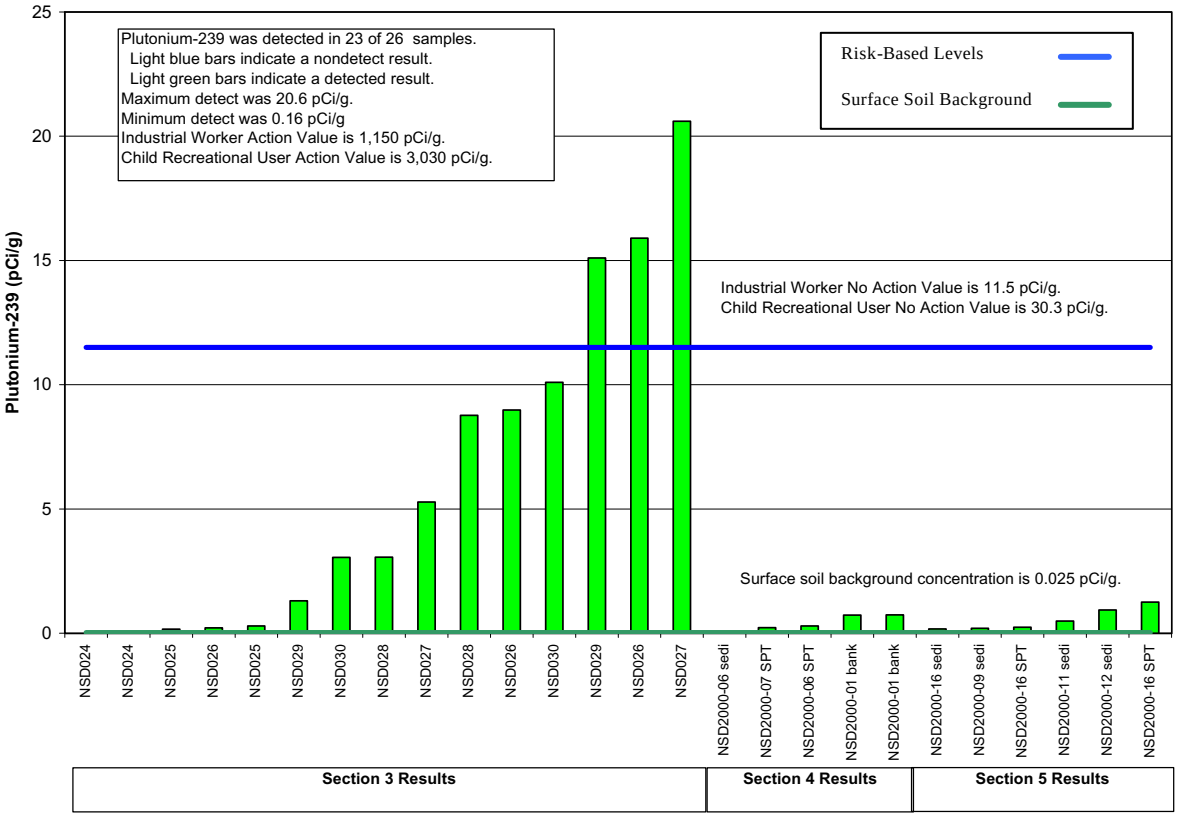


Fig. 20. Comparison between plutonium-239 concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

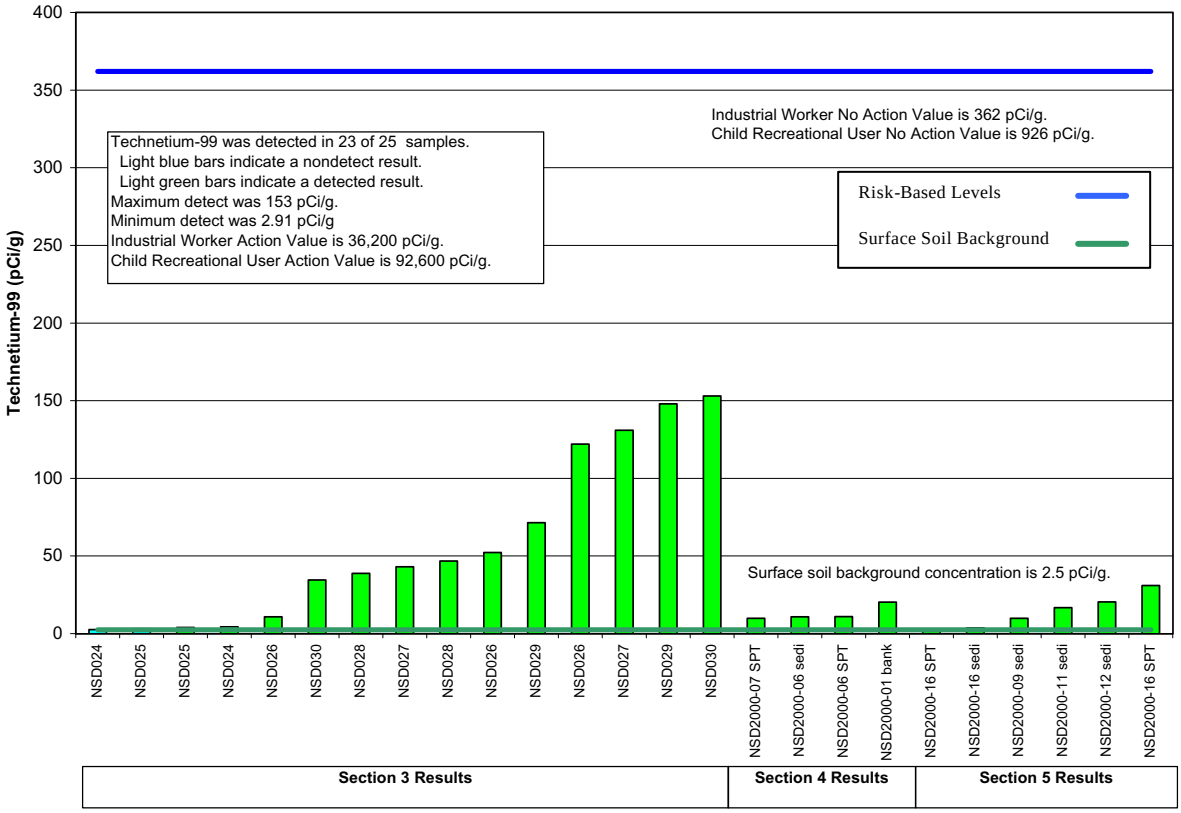


Fig. 21. Comparison between technetium-99 concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

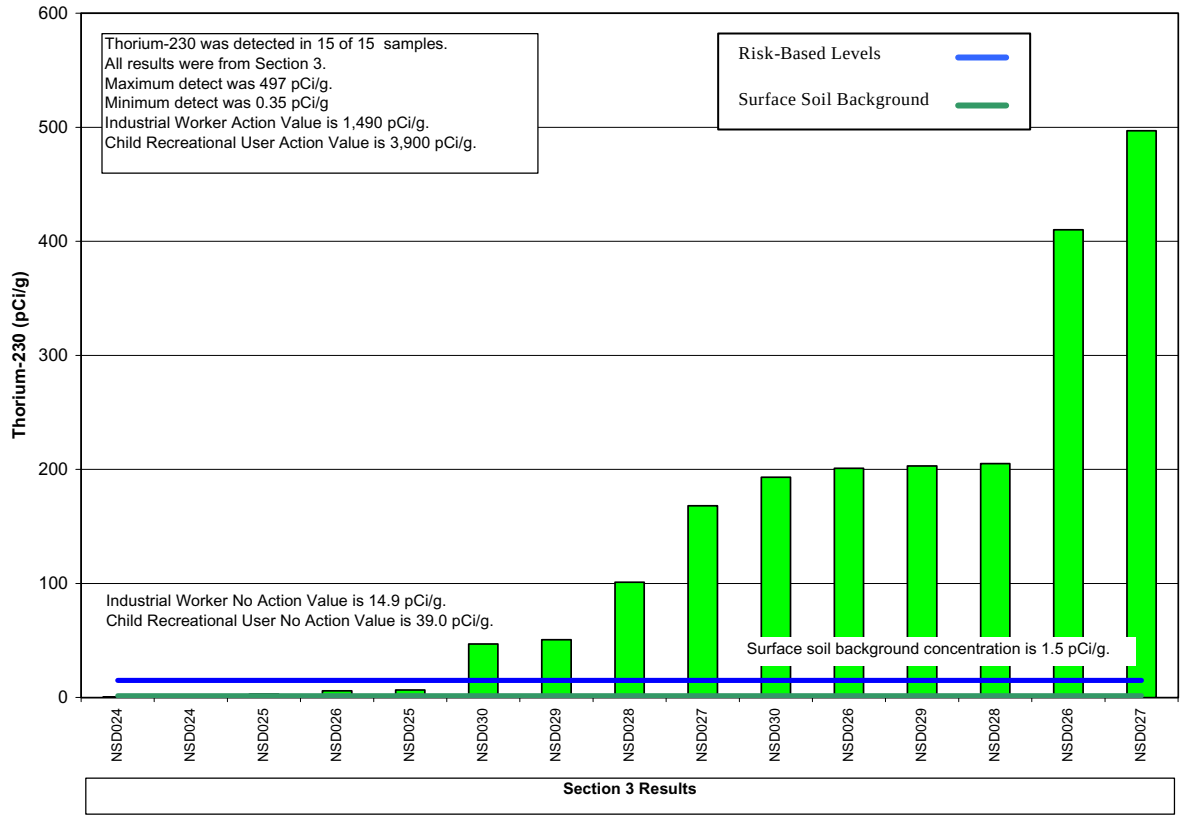


Fig. 22. Comparison between thorium-230 concentrations reported in retained samples from Section 3 of the NSDD and risk-based levels and surface soil background concentrations.

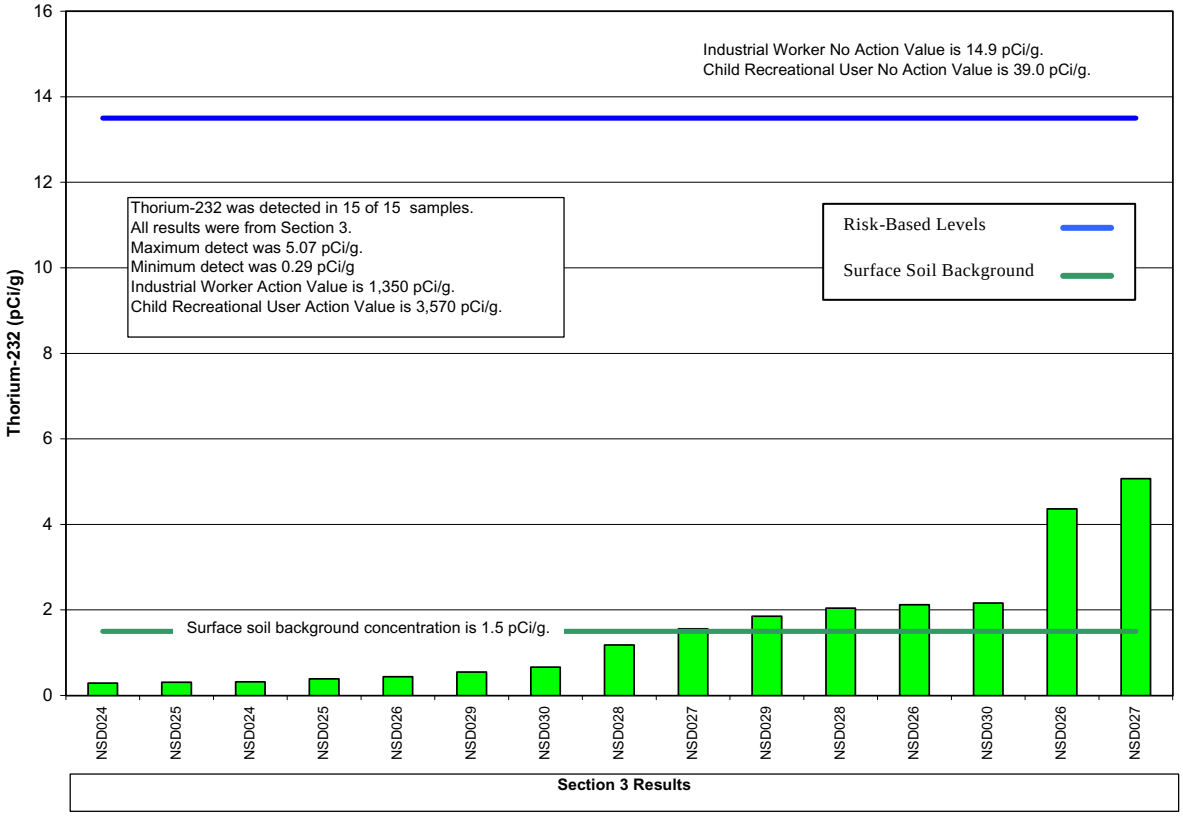


Fig. 23. Comparison between thorium-232 concentrations reported in retained samples from Section 3 of the NSDD and risk-based levels and surface soil background concentrations.

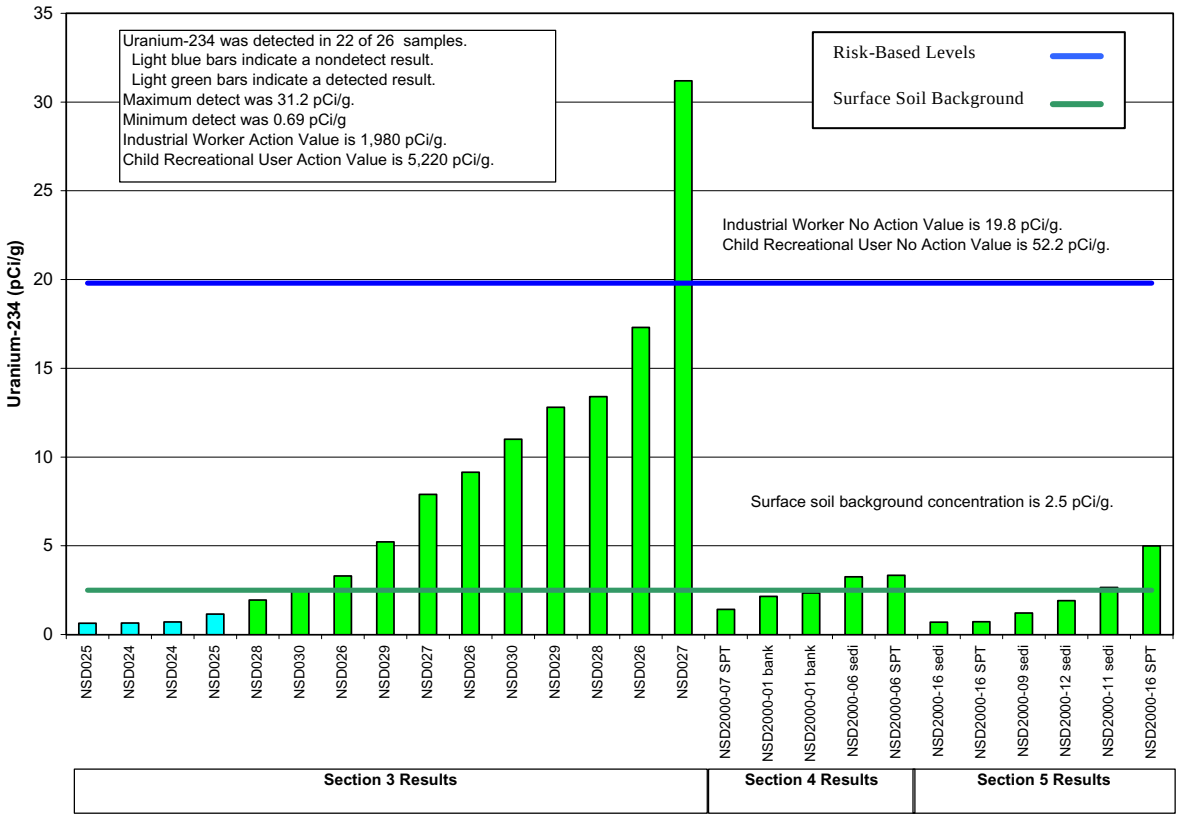


Fig. 24. Comparison between uranium-234 concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

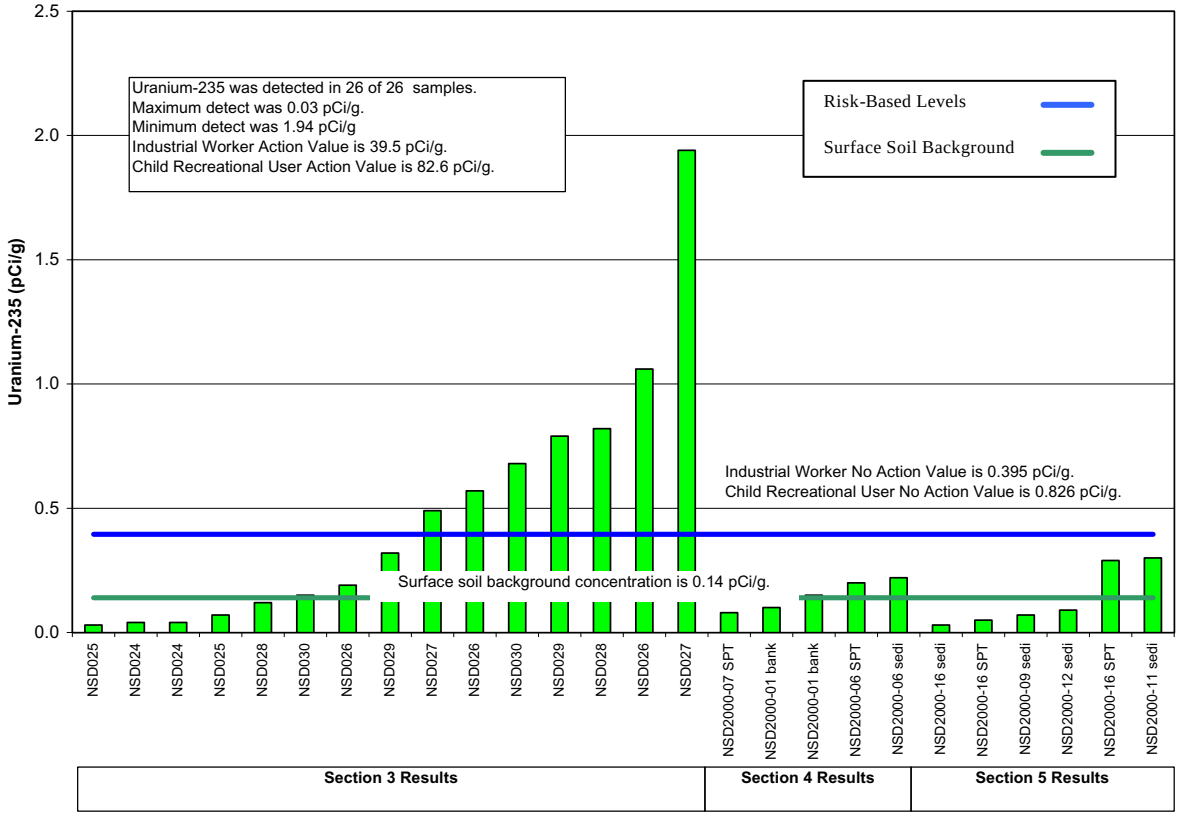


Fig. 25. Comparison between uranium-235 concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.

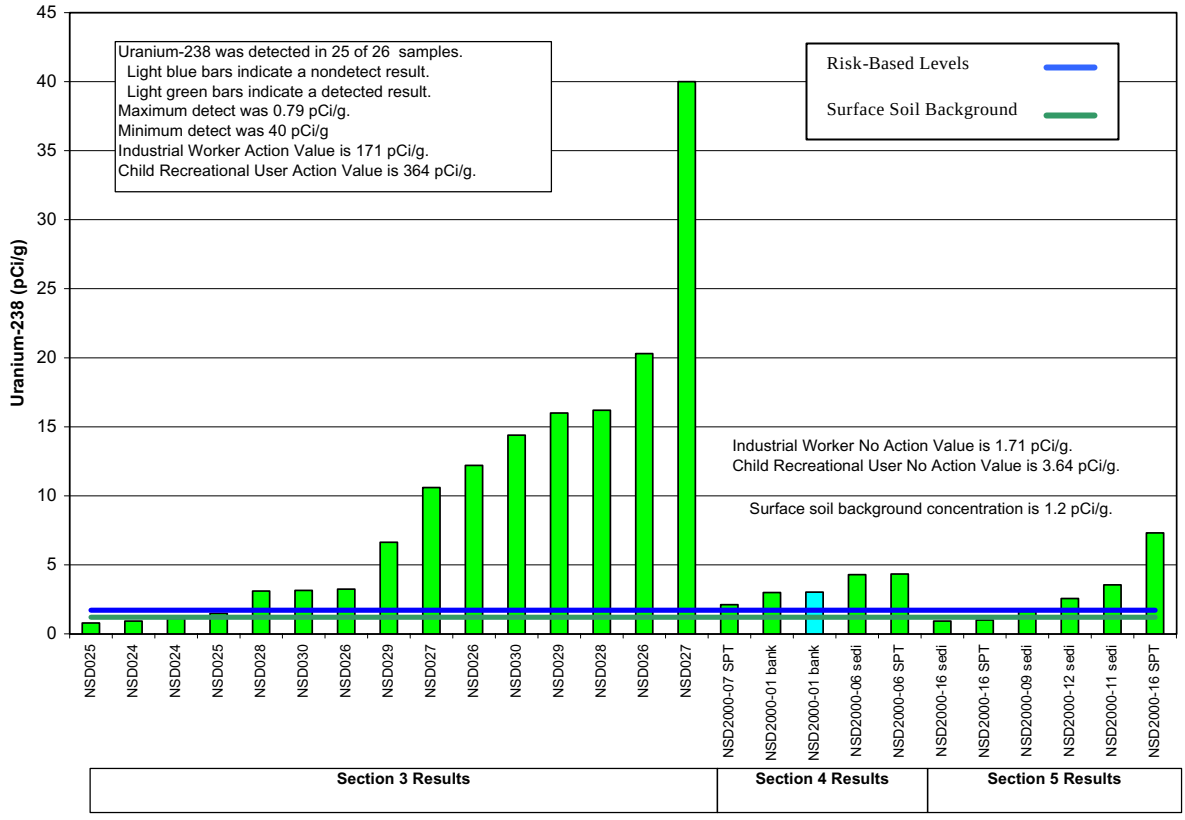
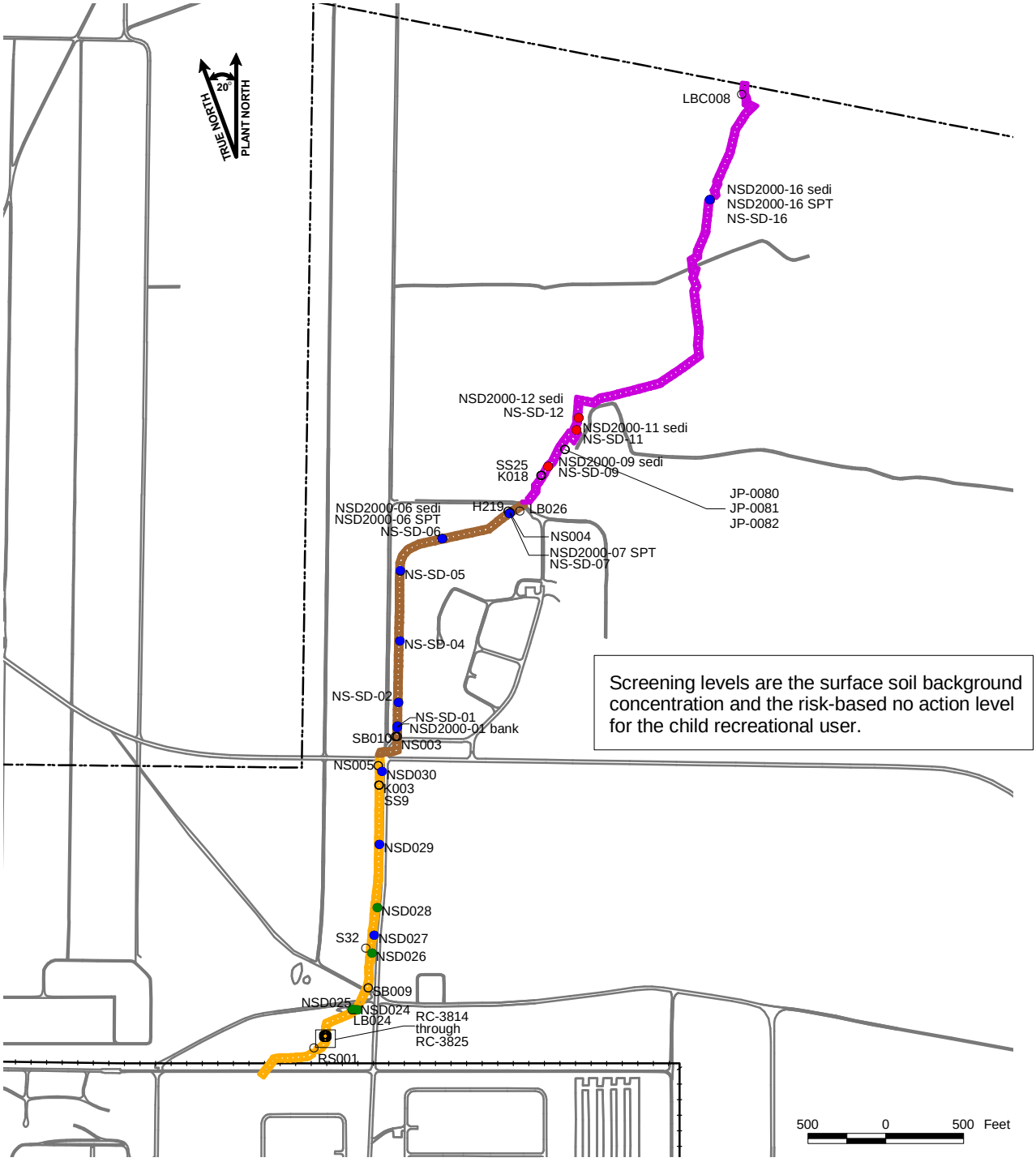


Fig. 26. Comparison between uranium-238 concentrations reported in retained samples from Sections 3, 4, and 5 of the NSDD and risk-based levels and surface soil background concentrations.



LEGEND:

- ○ SAMPLE STATION (NOT ANALYZED FOR COPC)
- RU - SECTION 3
- RU - SECTION 4
- RU - SECTION 5
- *RU = REMEDIATION UNIT
- NON-DETECT
- DETECT < SCREENING LEVELS
- DETECT > SCREENING LEVELS

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Fig. 27. Locations in Sections 3-5 of the NSDD where one or more sampling results have an arsenic concentration greater than screening levels.

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FIGURE No. c5ac90001sk607.apr
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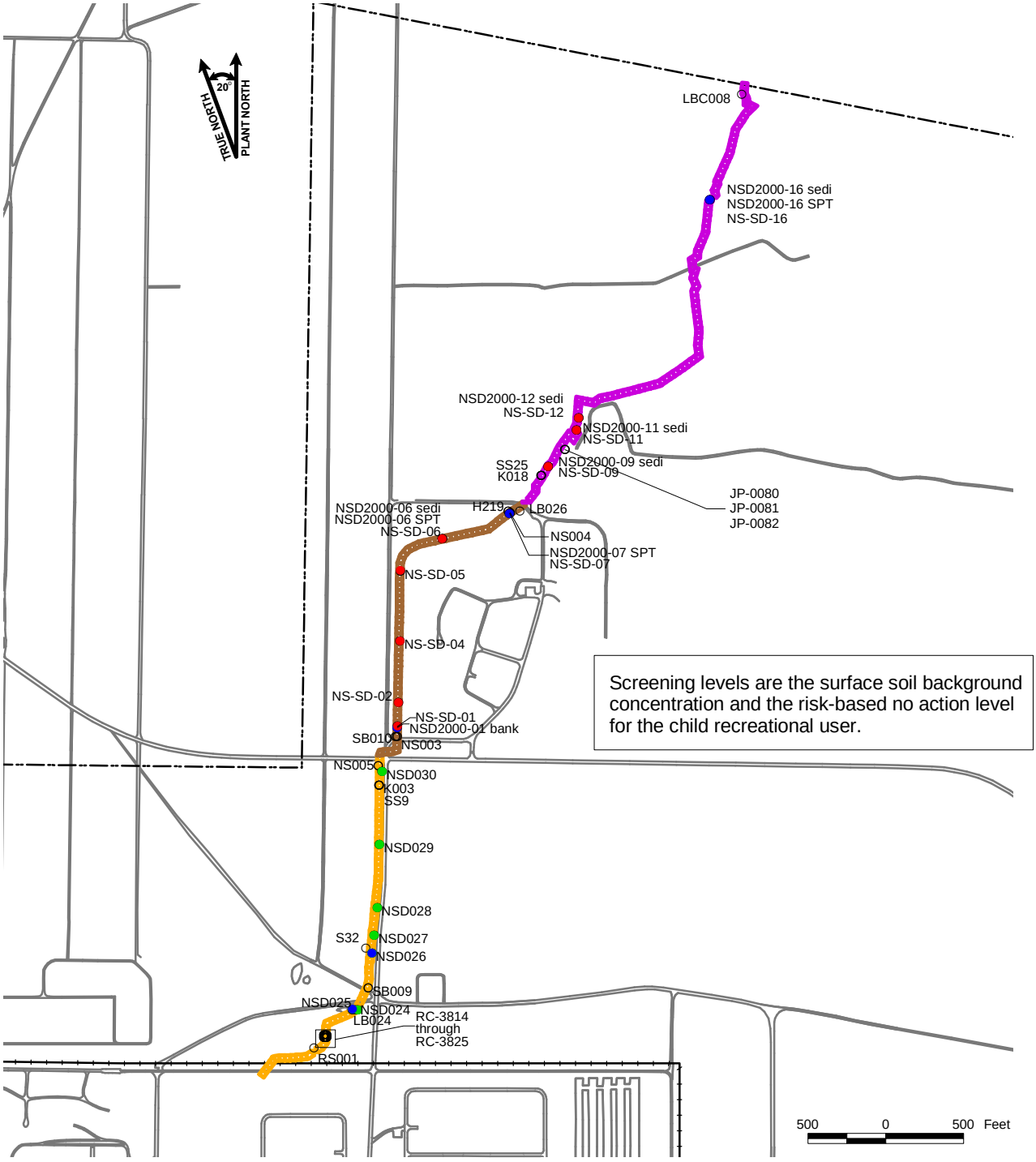

LEGEND:

- ○ SAMPLE STATION (NOT ANALYZED FOR COPC)
- RU - SECTION 3
- RU - SECTION 4
- RU - SECTION 5
- *RU = REMEDIATION UNIT
- NON-DETECT
- DETECT < SCREENING LEVELS
- DETECT > SCREENING LEVELS

Fig. 28. Locations in Sections 3-5 of the NSDD where one or more sampling results have a beryllium concentration greater than screening levels.

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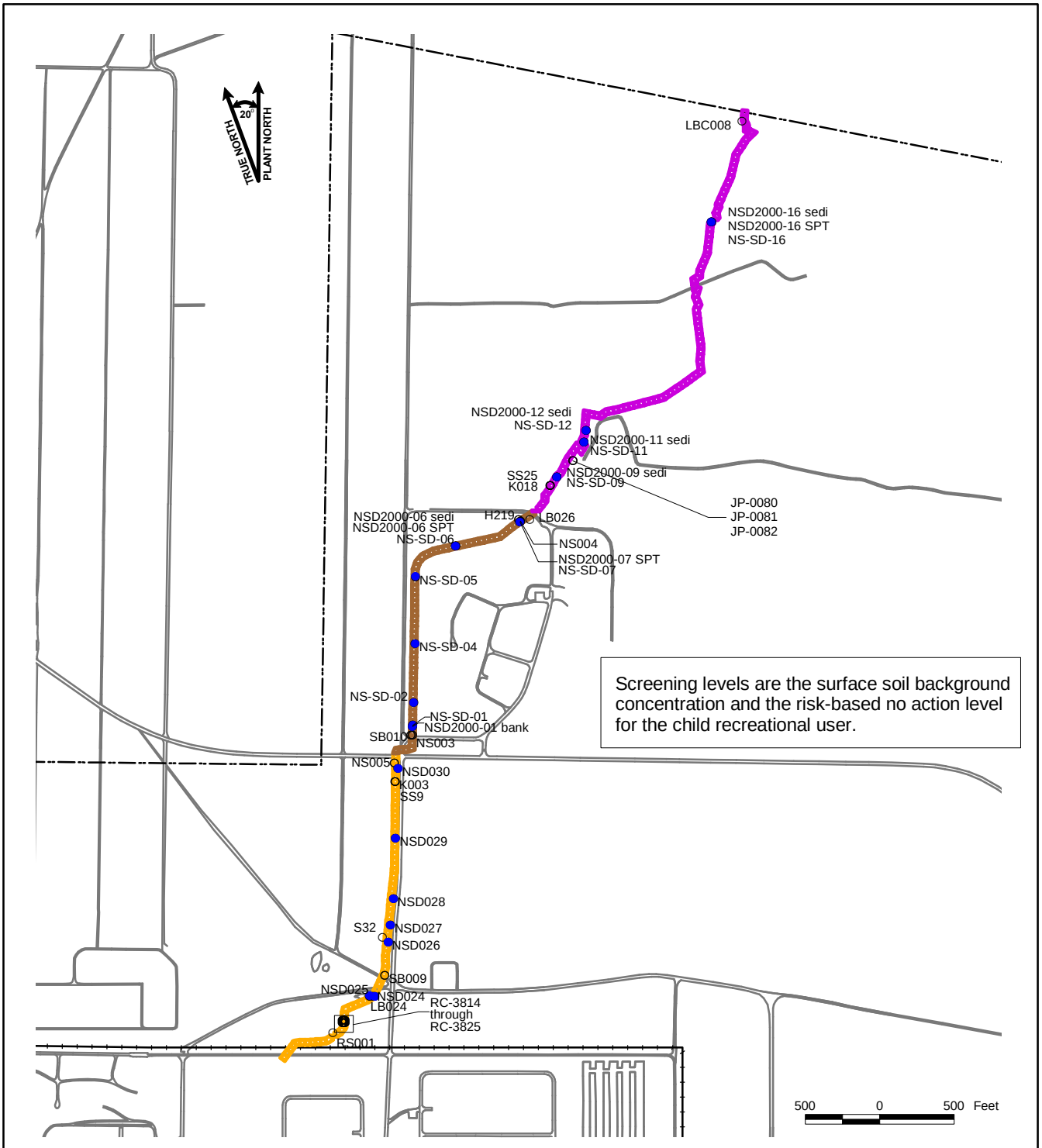
FIGURE No. c5ac90001sk607.apr
DATE 02-06-03



LEGEND:

- ○ SAMPLE STATION (NOT ANALYZED FOR COPC)
- RU - SECTION 3
- RU - SECTION 4
- RU - SECTION 5
- *RU = REMEDIATION UNIT
- NON-DETECT
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Fig. 29. Locations in Sections 3-5 of the NSDD where one or more sampling results have a chromium concentration greater than screening levels.

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FIGURE No. c5ac90001sk607.apr
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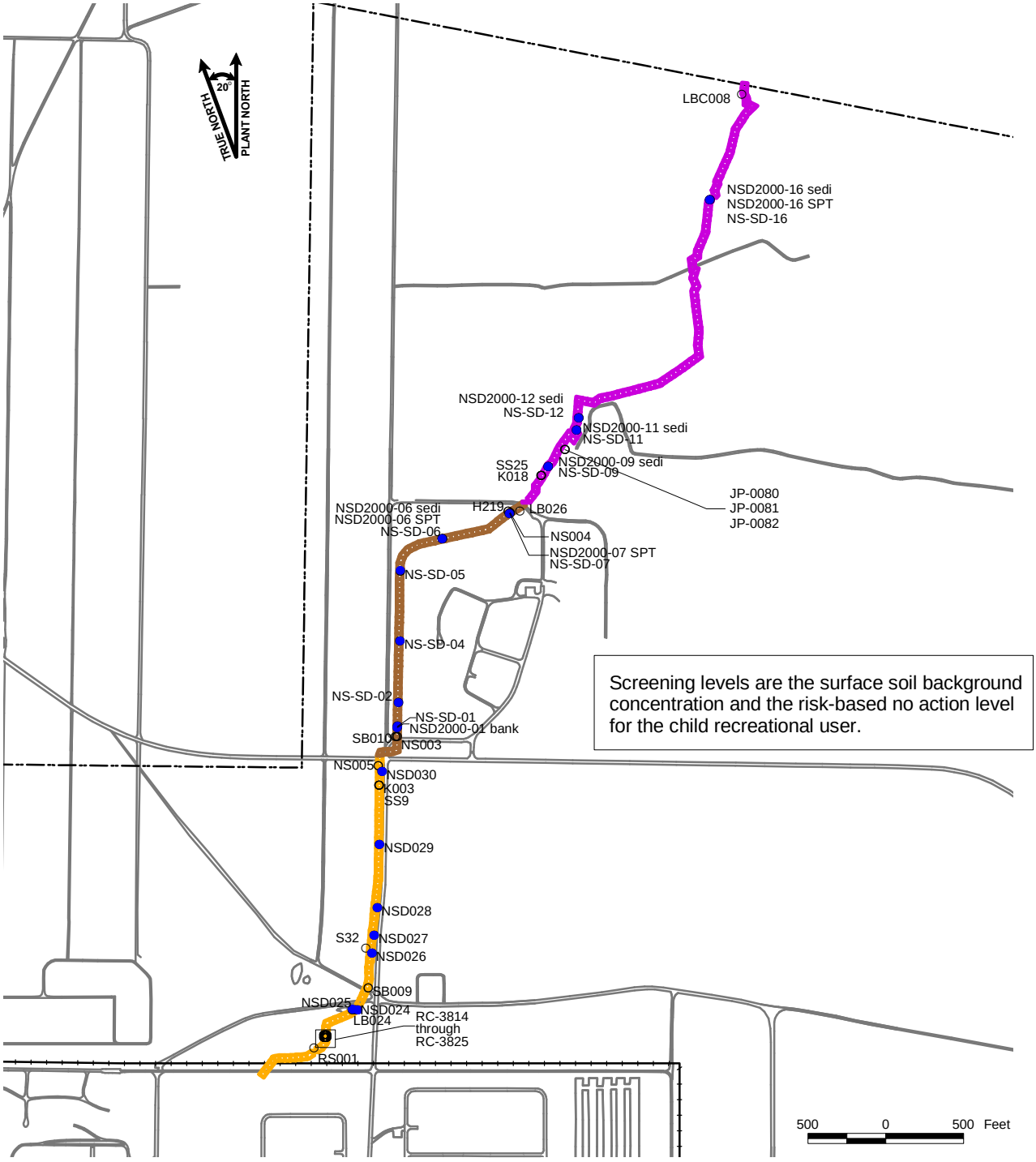

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Fig. 30. Locations in Sections 3-5 of the NSDD where one or more sampling results have a copper concentration greater than screening levels.

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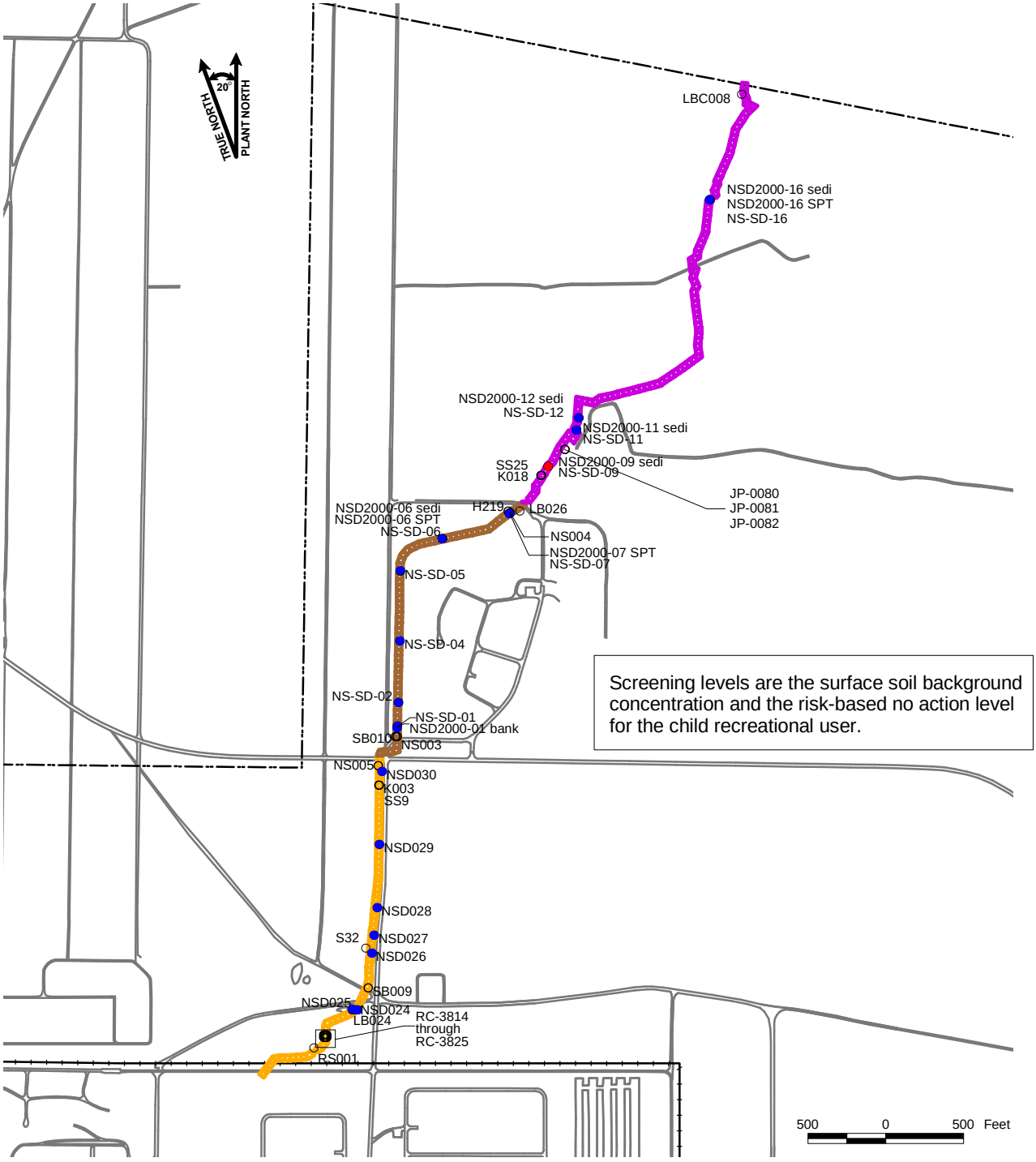

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- RU - SECTION 5
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Fig. 31. Locations in Sections 3-5 of the NSDD where one or more sampling results have an iron concentration greater than screening levels.

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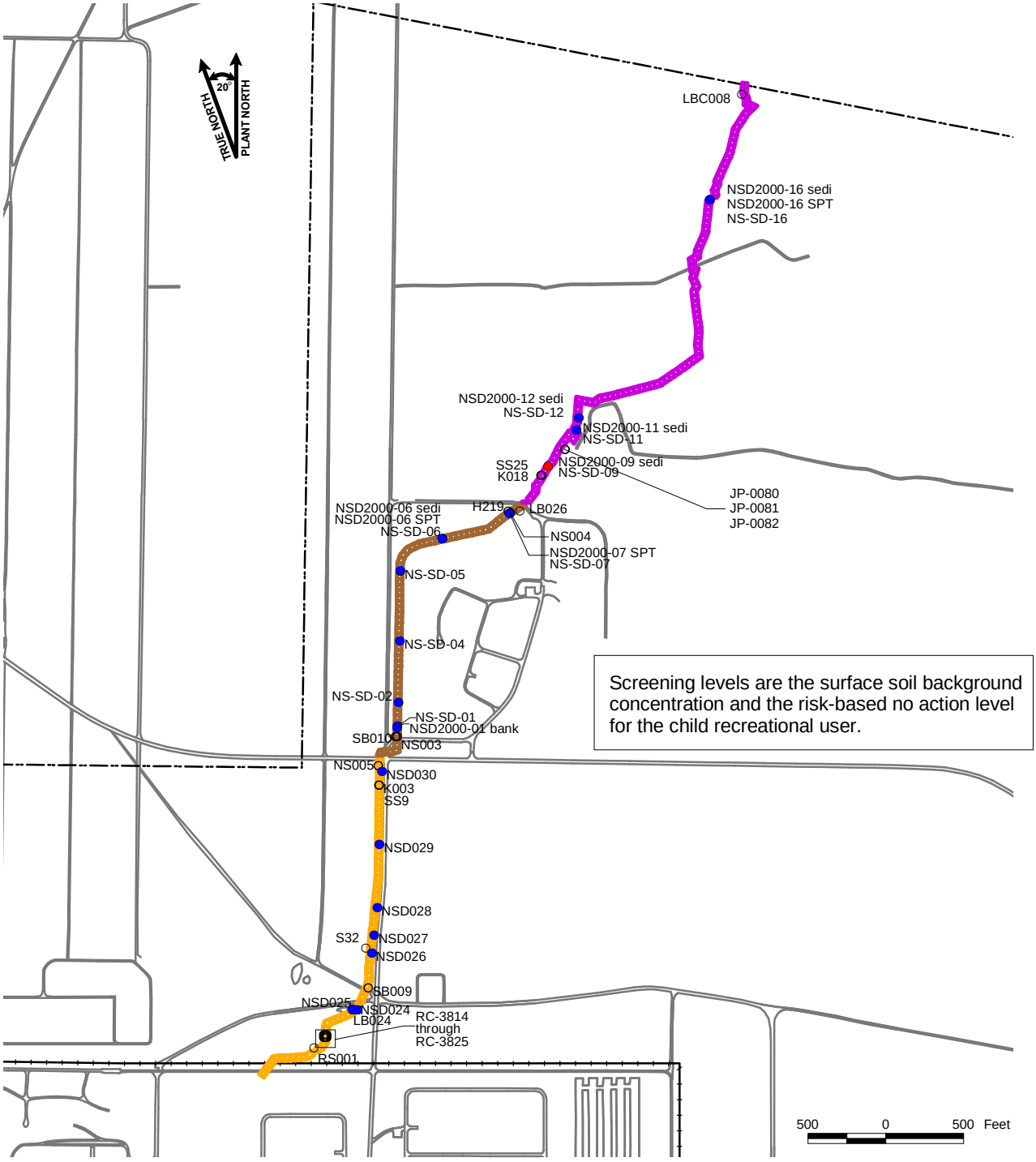

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- RU - SECTION 5
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Fig. 32. Locations in Sections 3-5 of the NSDD where one or more sampling results have a manganese concentration greater than screening levels.

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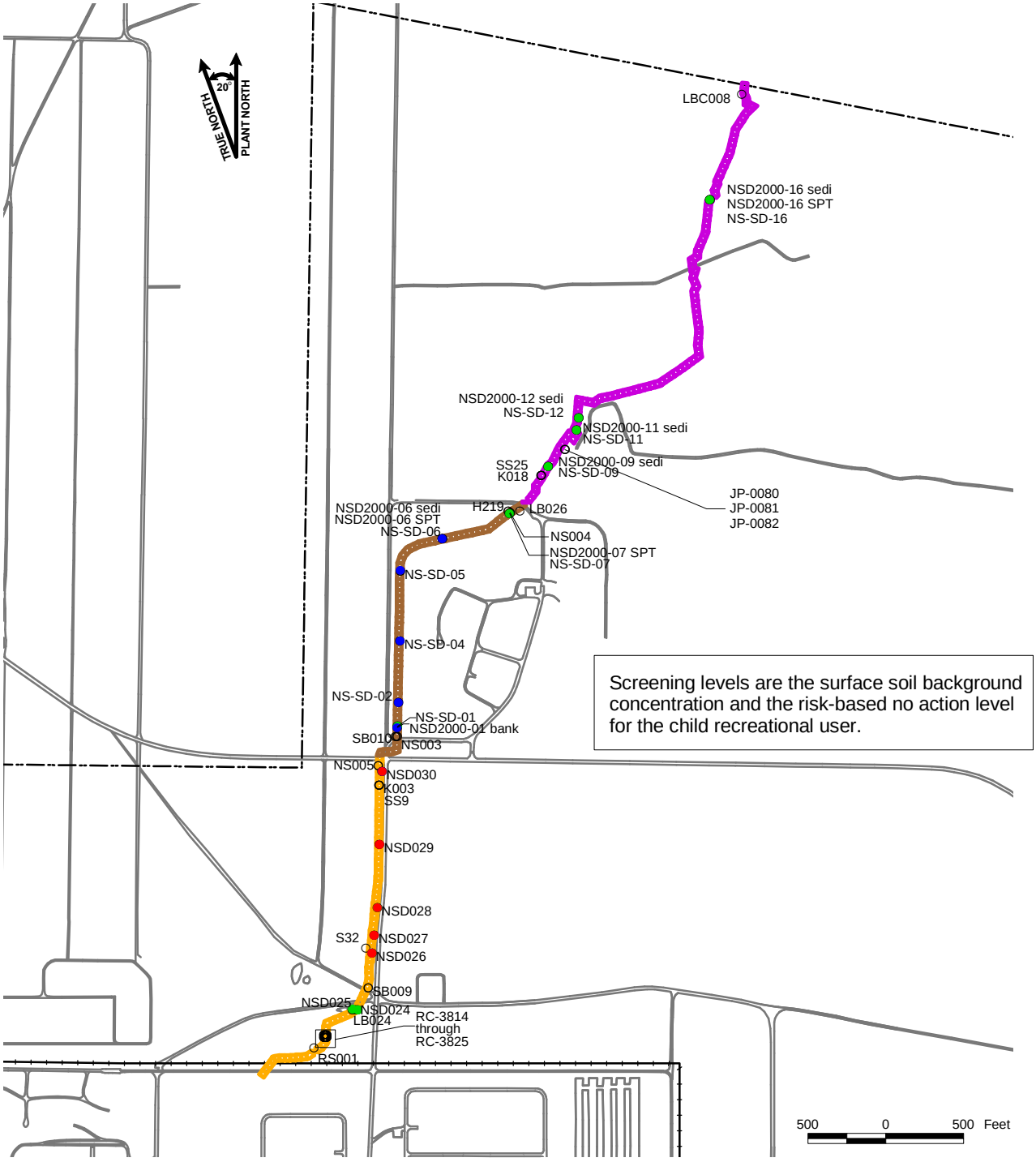

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Fig. 33. Locations in Sections 3-5 of the NSDD where one or more sampling results have a mercury concentration greater than screening levels.

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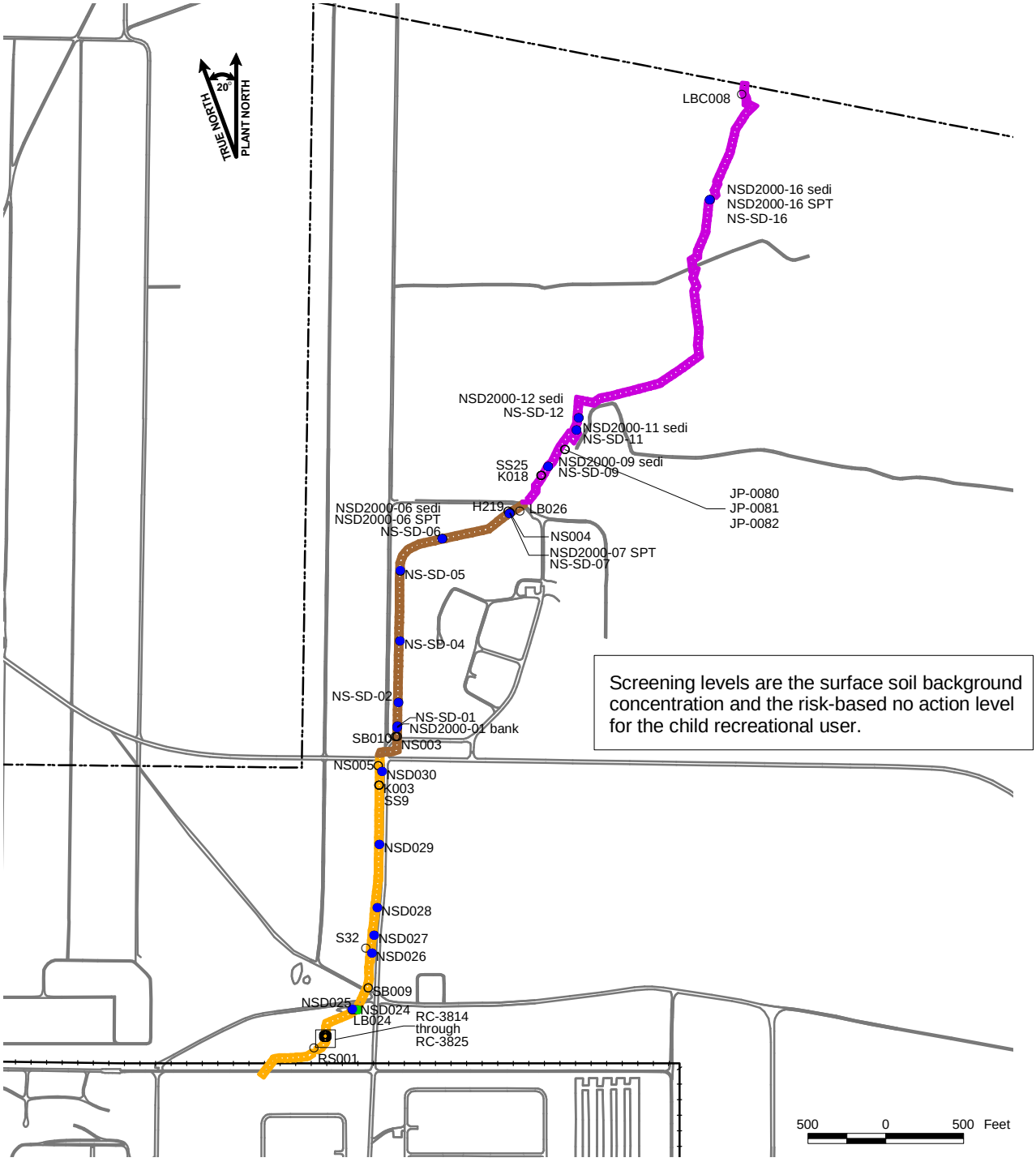

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Fig. 34. Locations in Sections 3-5 of the NSDD where one or more sampling results have a nickel concentration greater than screening levels.

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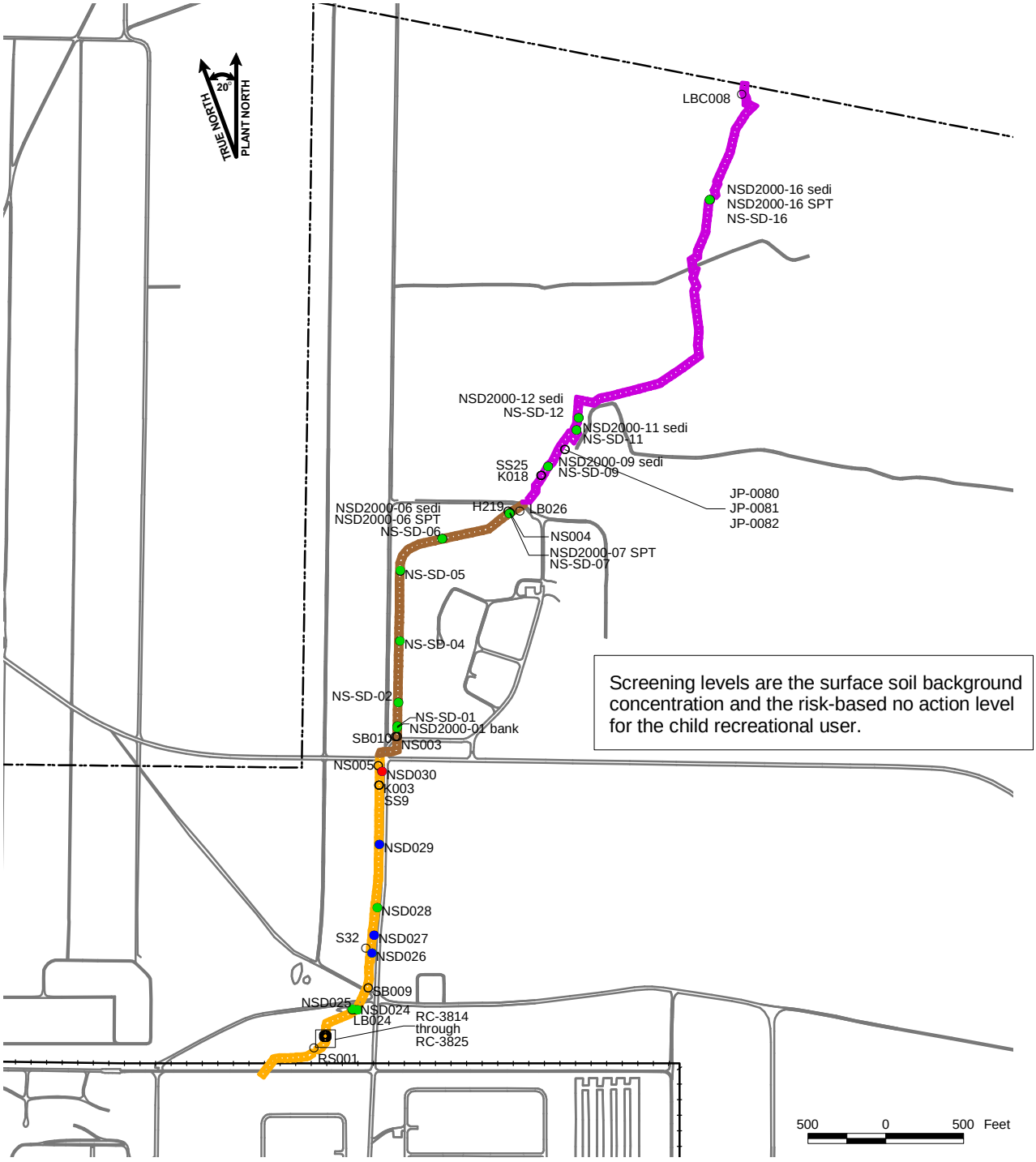

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Fig. 35. Locations in Sections 3-5 of the NSDD where one or more sampling results have a silver concentration greater than screening levels.

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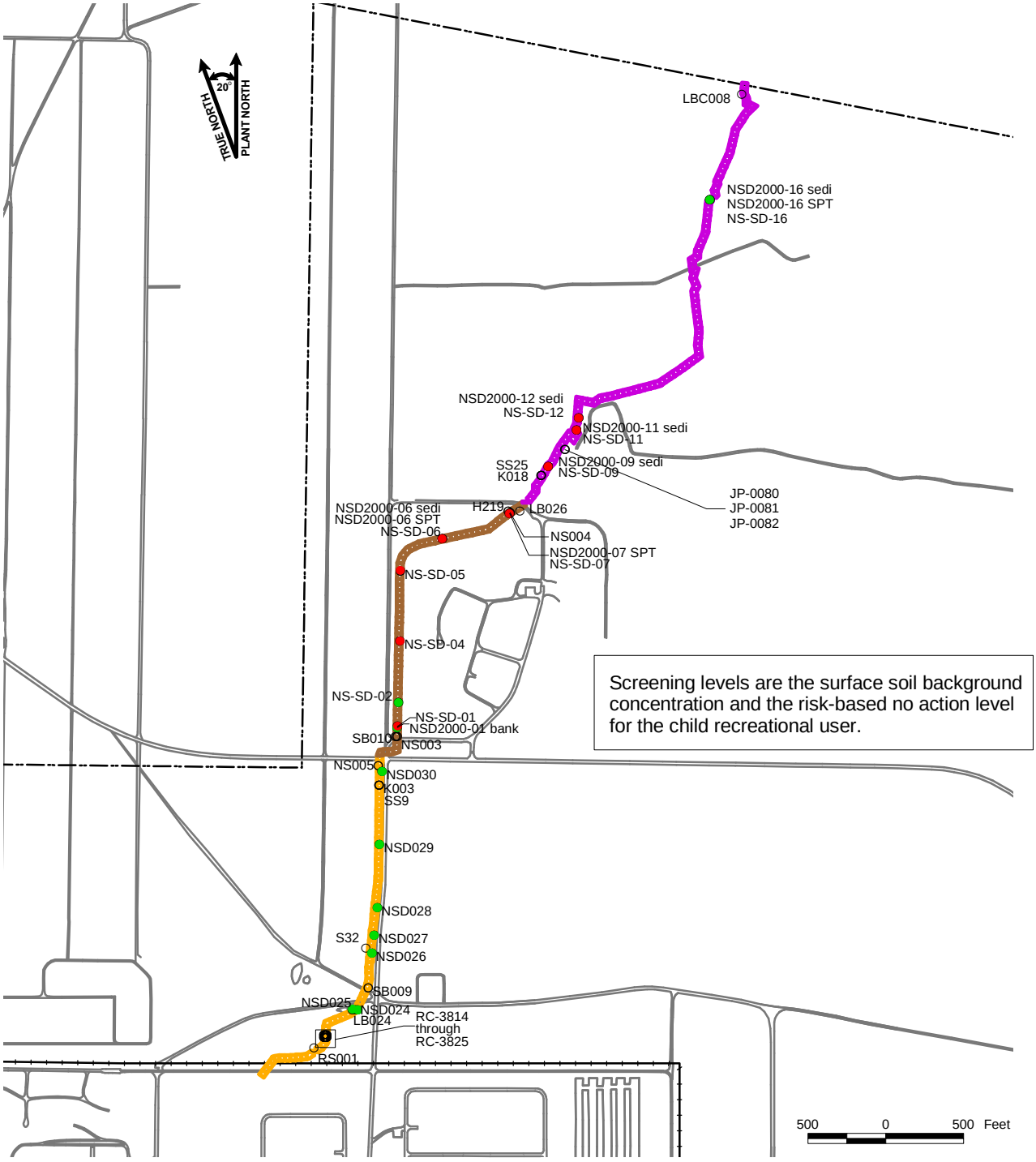

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Fig. 36. Locations in Sections 3-5 of the NSDD where one or more sampling results have a thallium concentration greater than screening levels.

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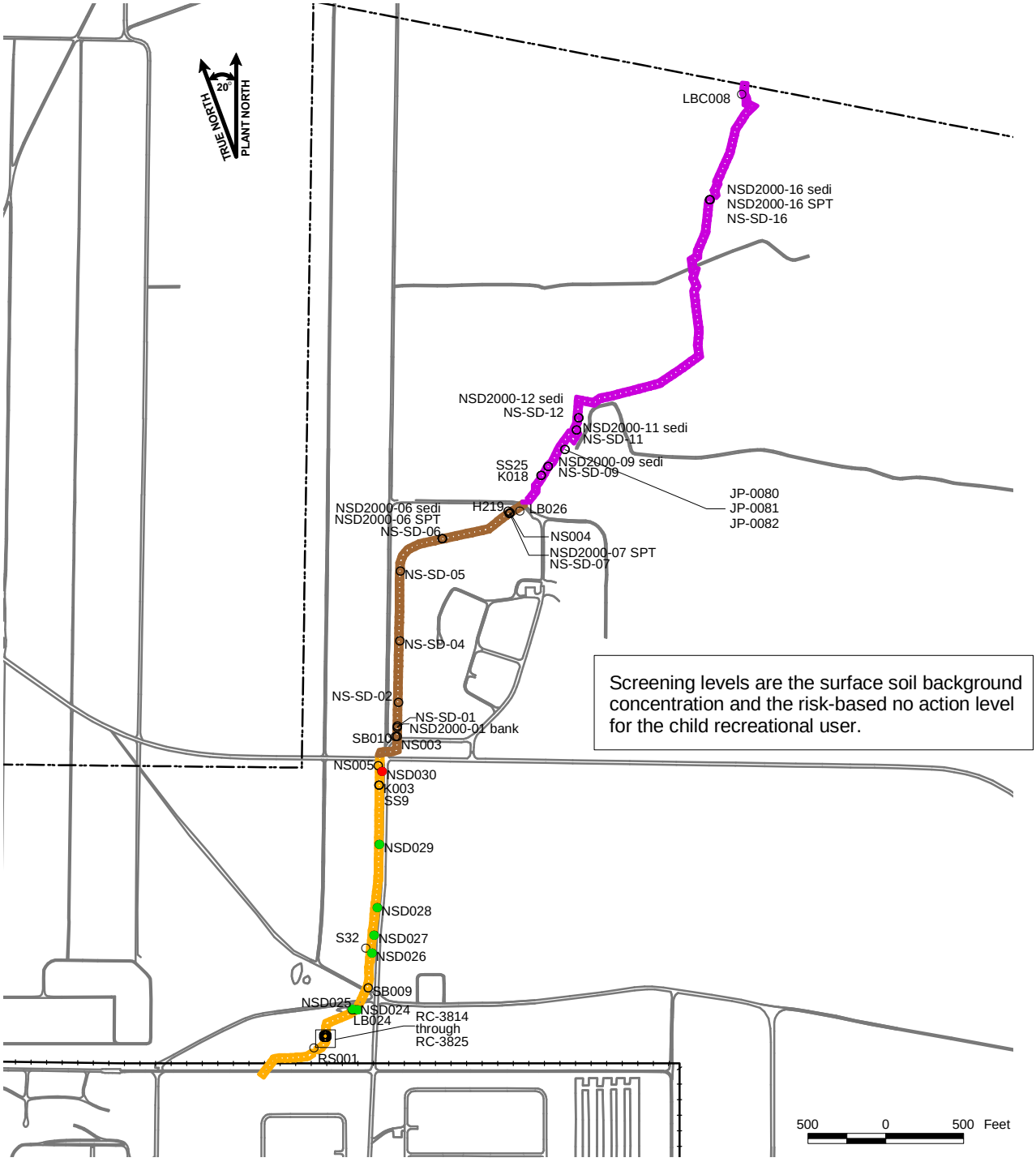

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- RU - SECTION 5
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Fig. 37. Locations in Sections 3-5 of the NSDD where one or more sampling results have a uranium concentration greater than screening levels.

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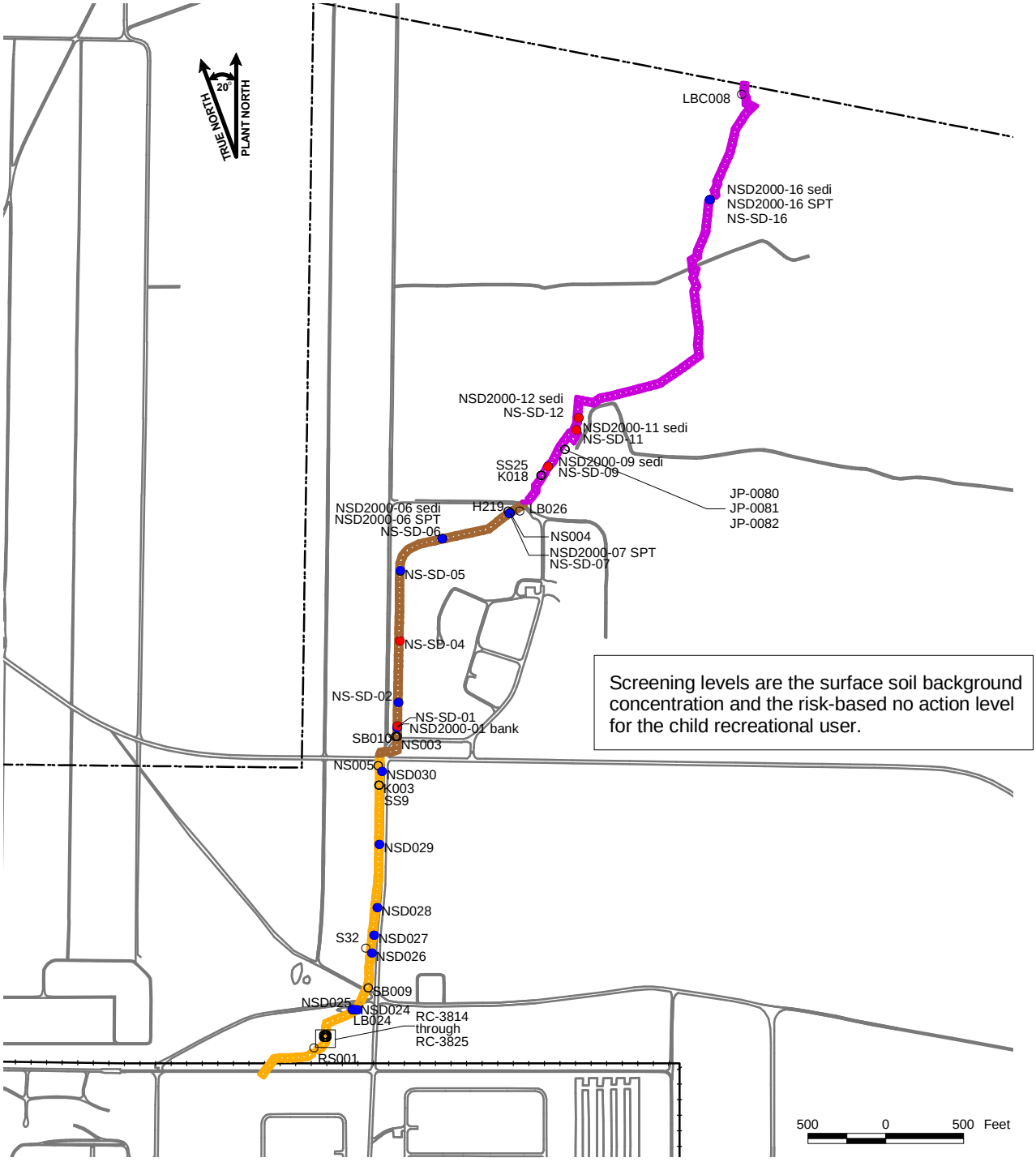

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Fig. 38. Locations in Sections 3-5 of the NSDD where one or more sampling results have a vanadium concentration greater than screening levels.

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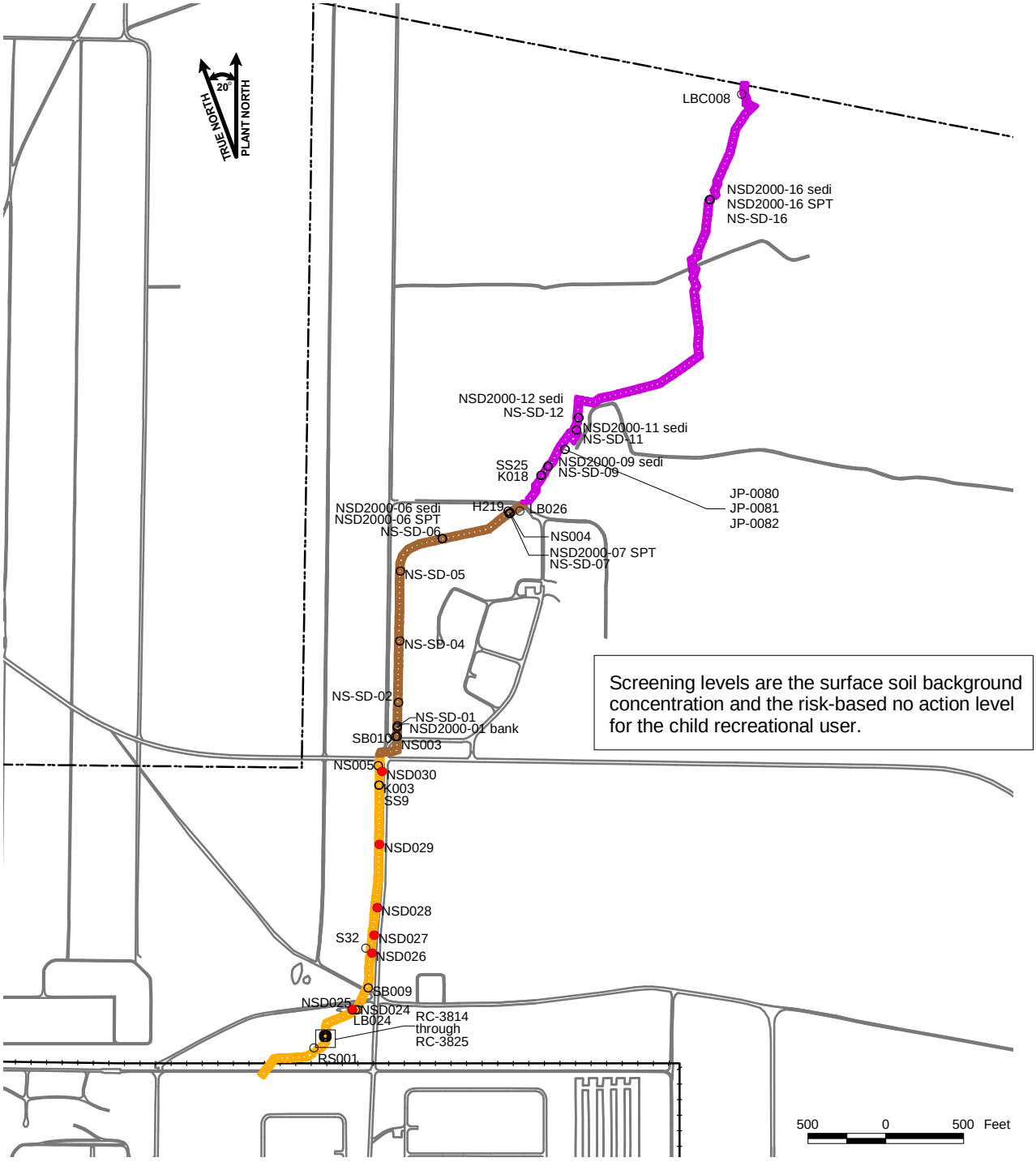

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Fig. 39. Locations in Sections 3-5 of the NSDD where one or more sampling results have a total PCBs concentration greater than screening levels.

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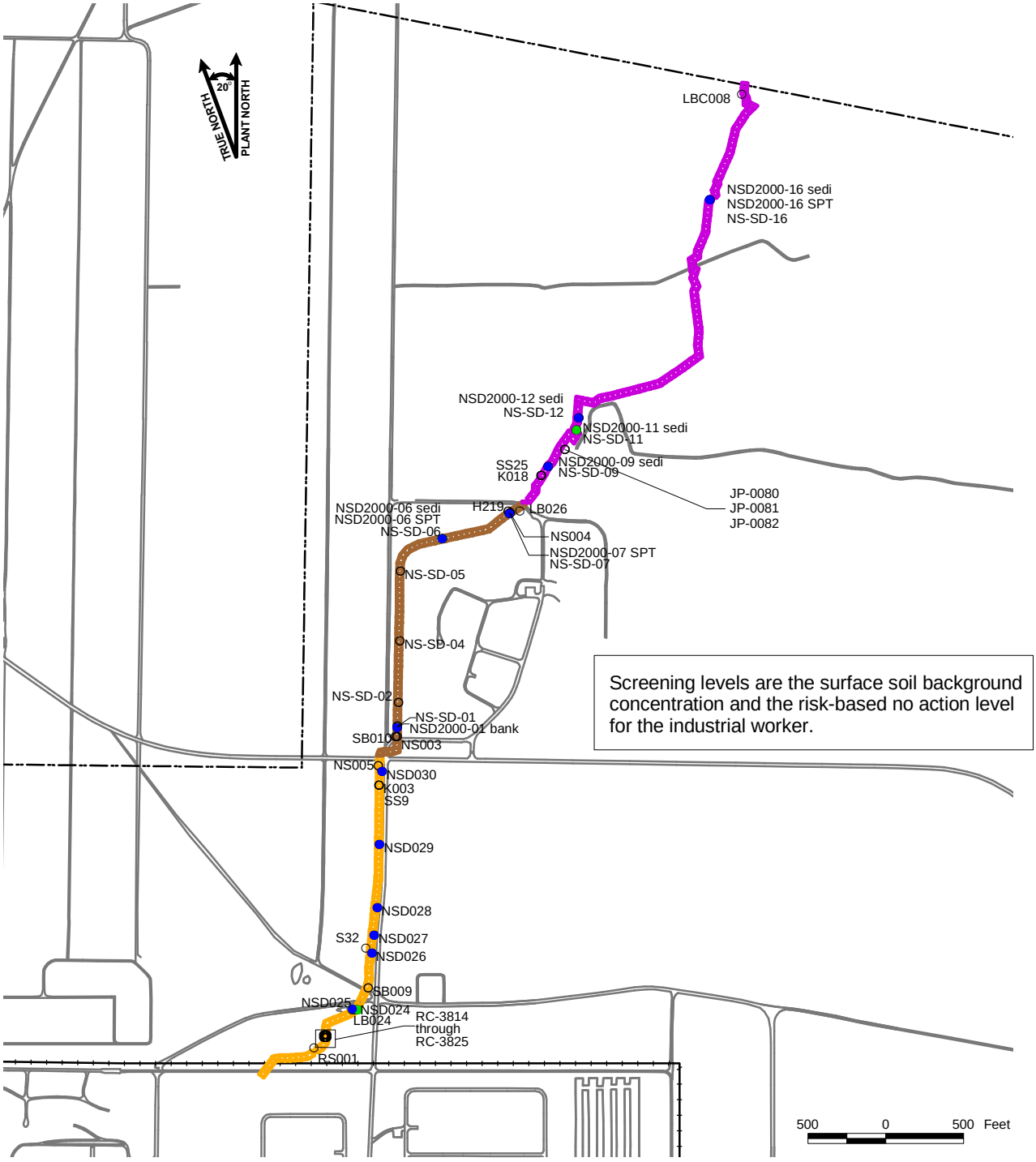

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Fig. 40. Locations in Sections 3-5 of the NSDD where one or more sampling results have an americium-241 activity greater than screening levels.

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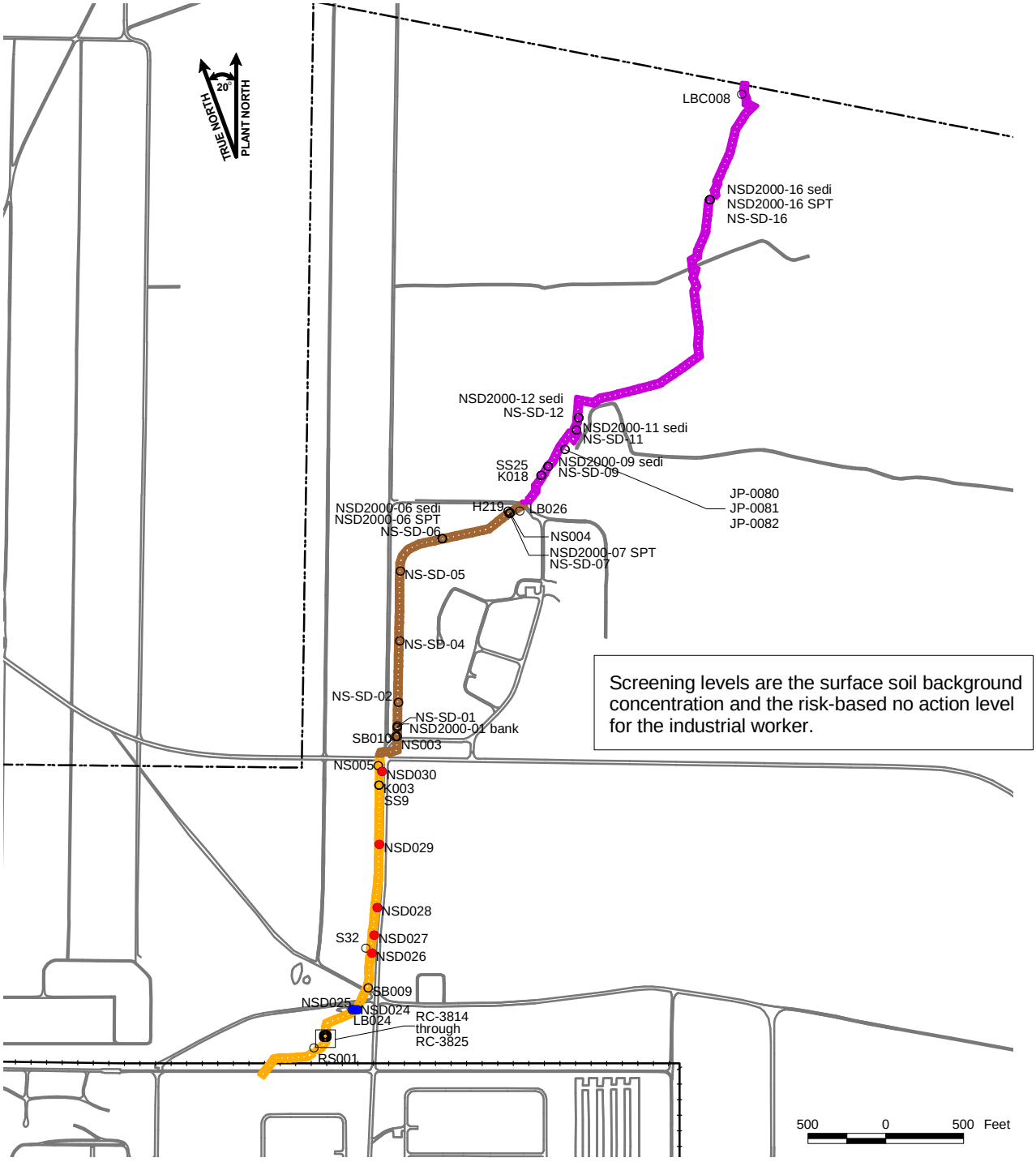

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- RU - SECTION 5
- *RU = REMEDIATION UNIT
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Fig. 41. Locations in Sections 3-5 of the NSDD where one or more sampling results have a cesium-137 activity greater than screening levels.

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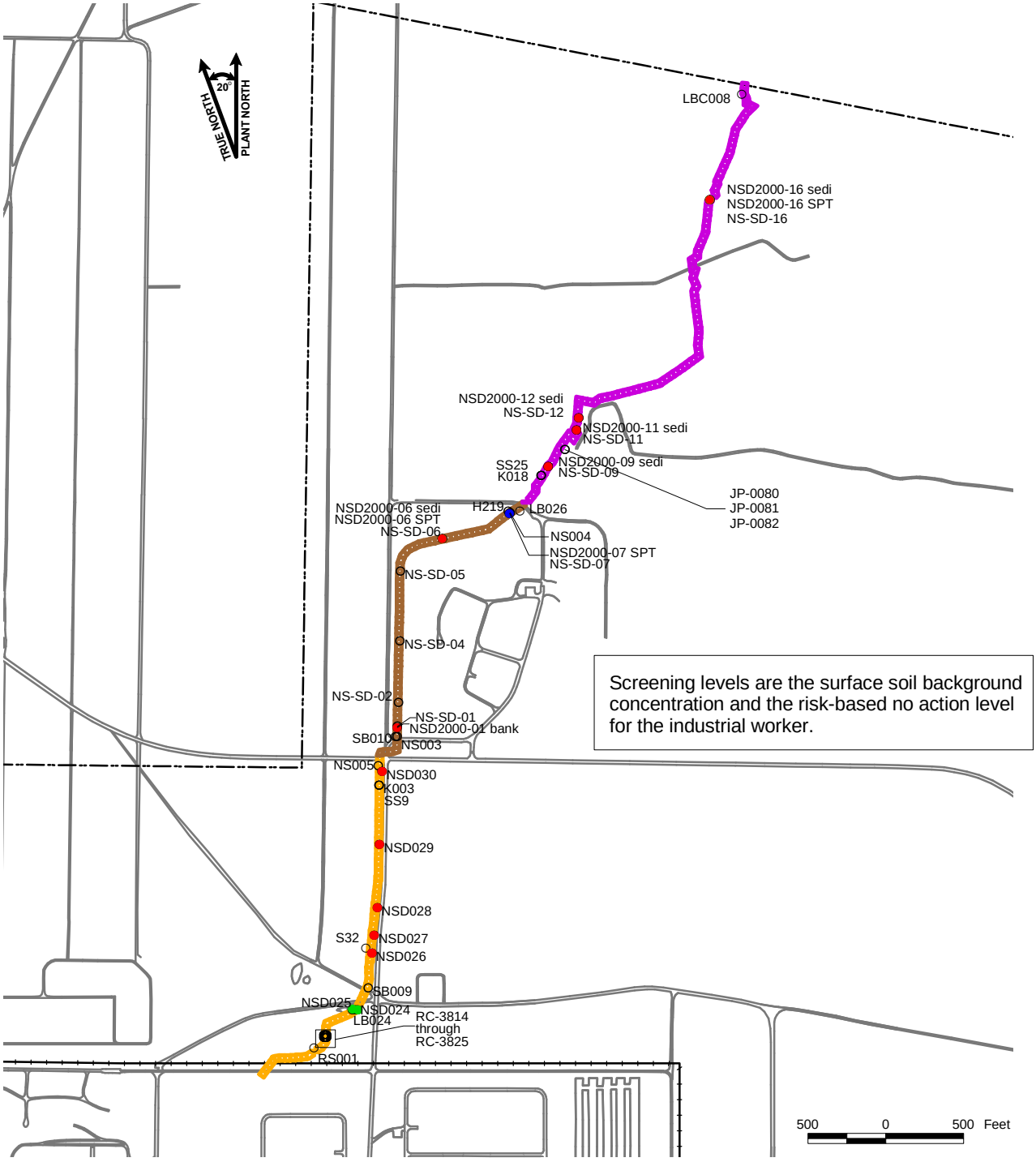

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Fig. 42. Locations in Sections 3-5 of the NSDD where one or more sampling results have a neptunium-237 activity greater than screening levels.

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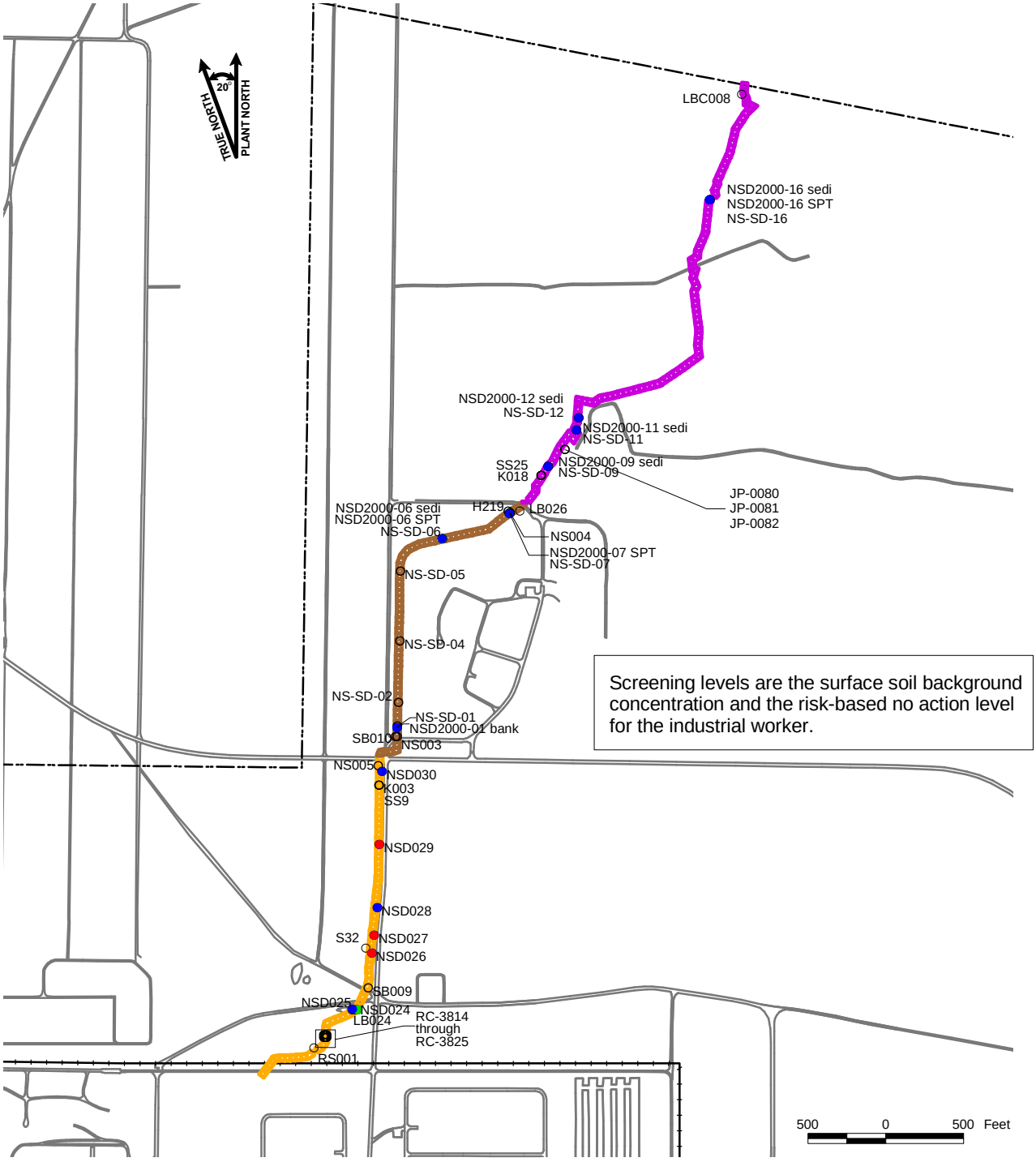

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Fig. 43. Locations in Sections 3-5 of the NSDD where one or more sampling results have an plutonium-239 activity greater than screening levels.

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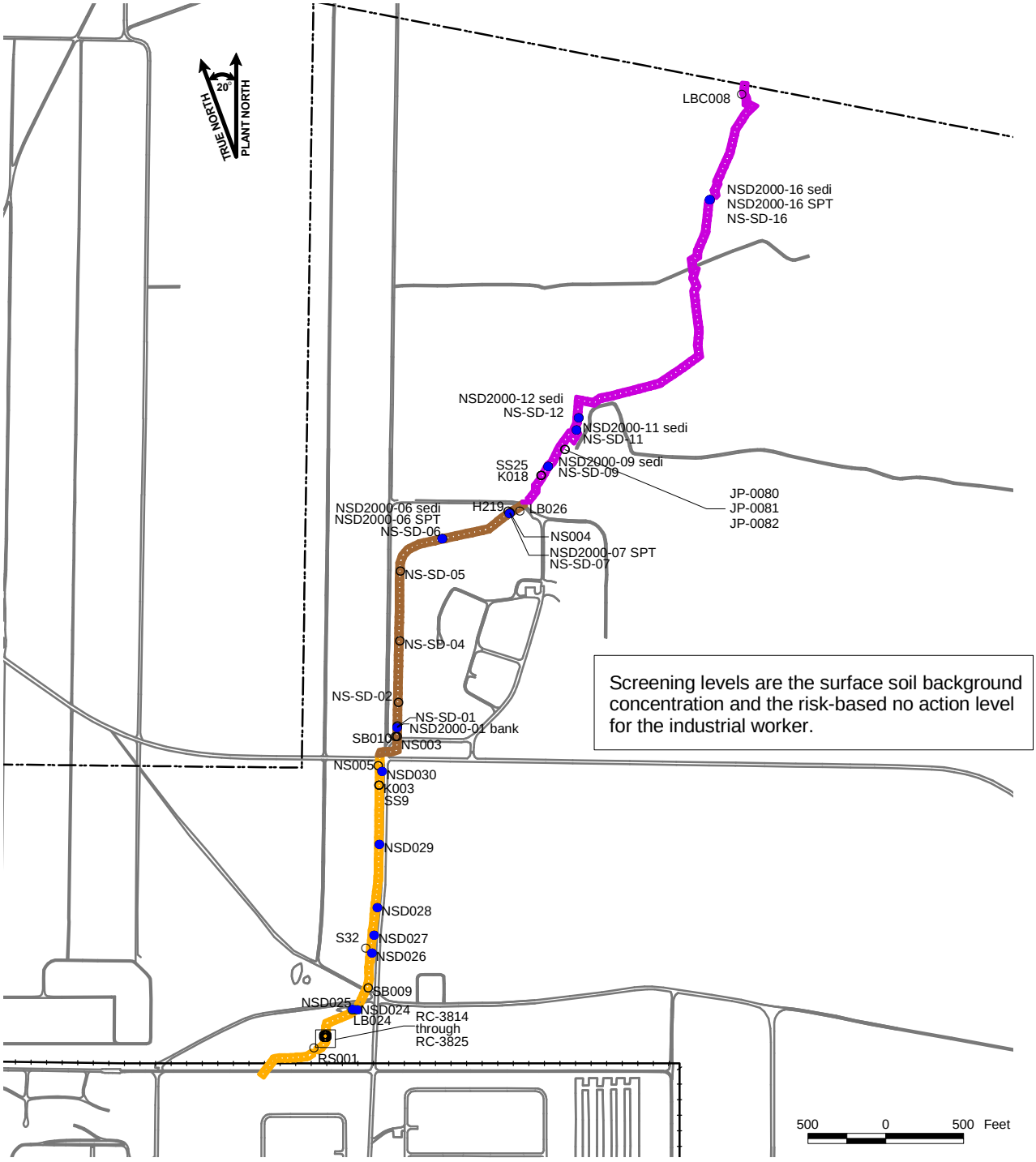

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Fig. 44. Locations in Sections 3-5 of the NSDD where one or more sampling results have a technetium-99 activity greater than screening levels.

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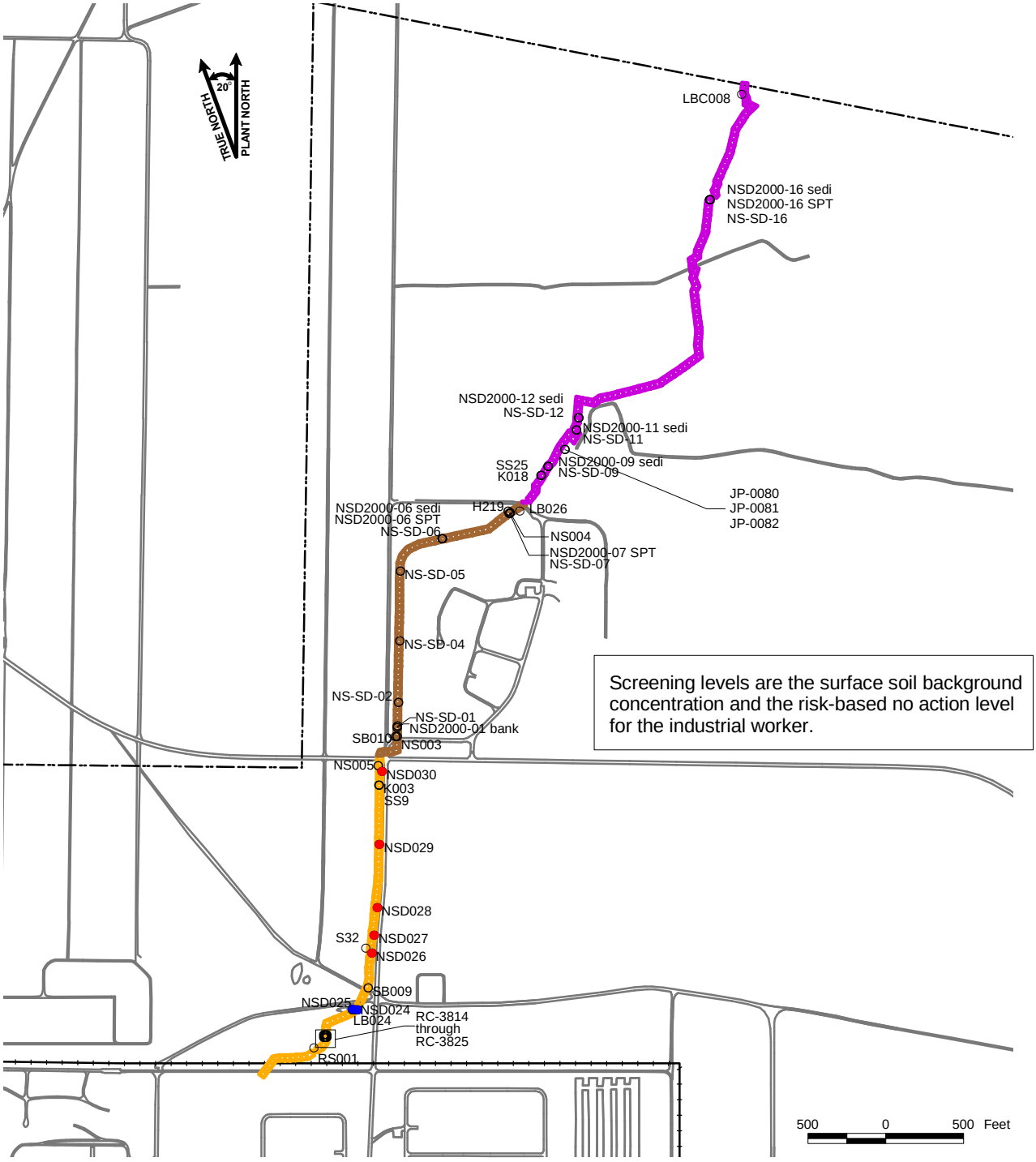

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Fig. 45. Locations in Sections 3-5 of the NSDD where one or more sampling results have a thorium-230 activity greater than screening levels.

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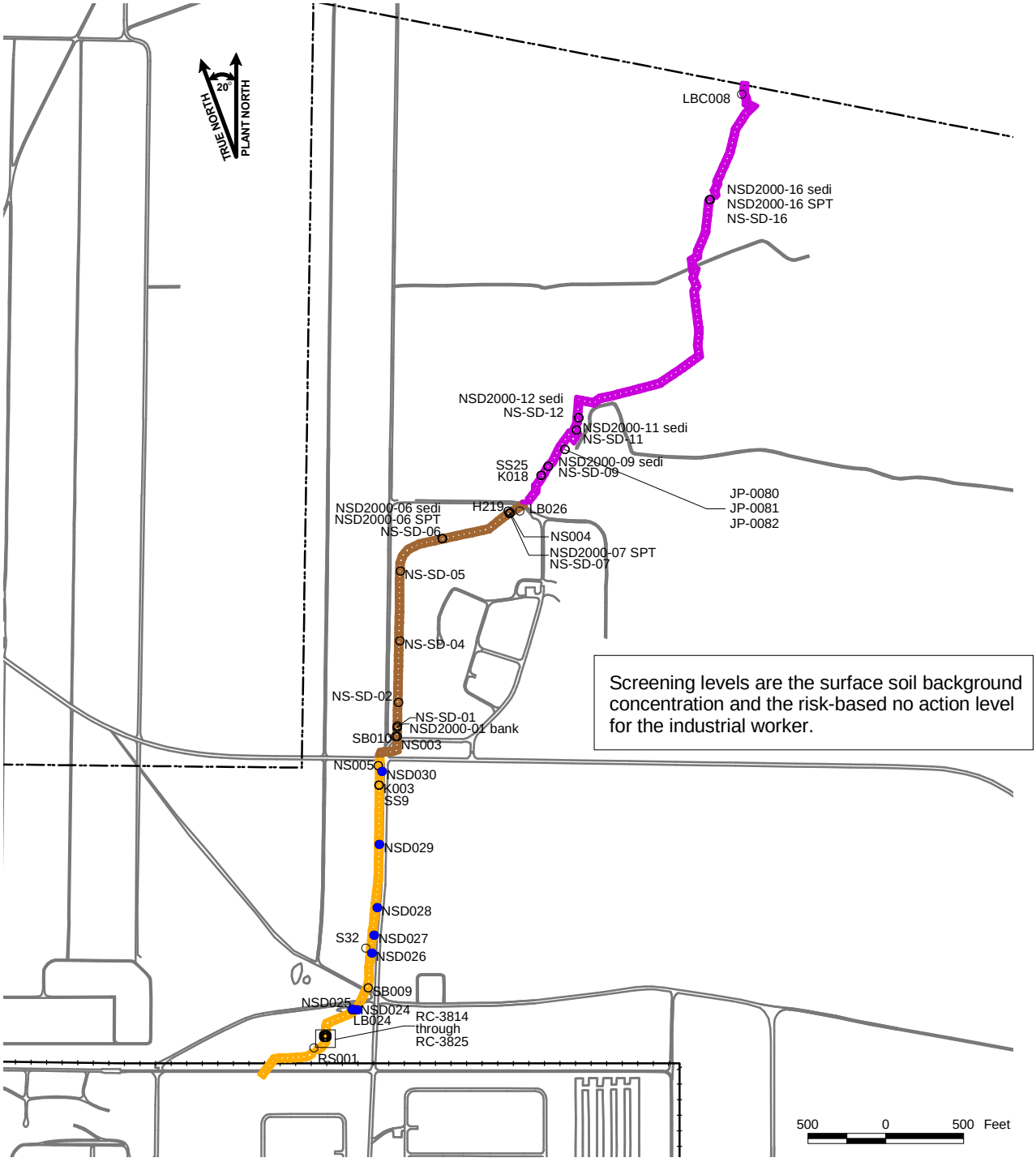

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Fig. 46. Locations in Sections 3-5 of the NSDD where one or more sampling results have a thorium-232 activity greater than screening levels.

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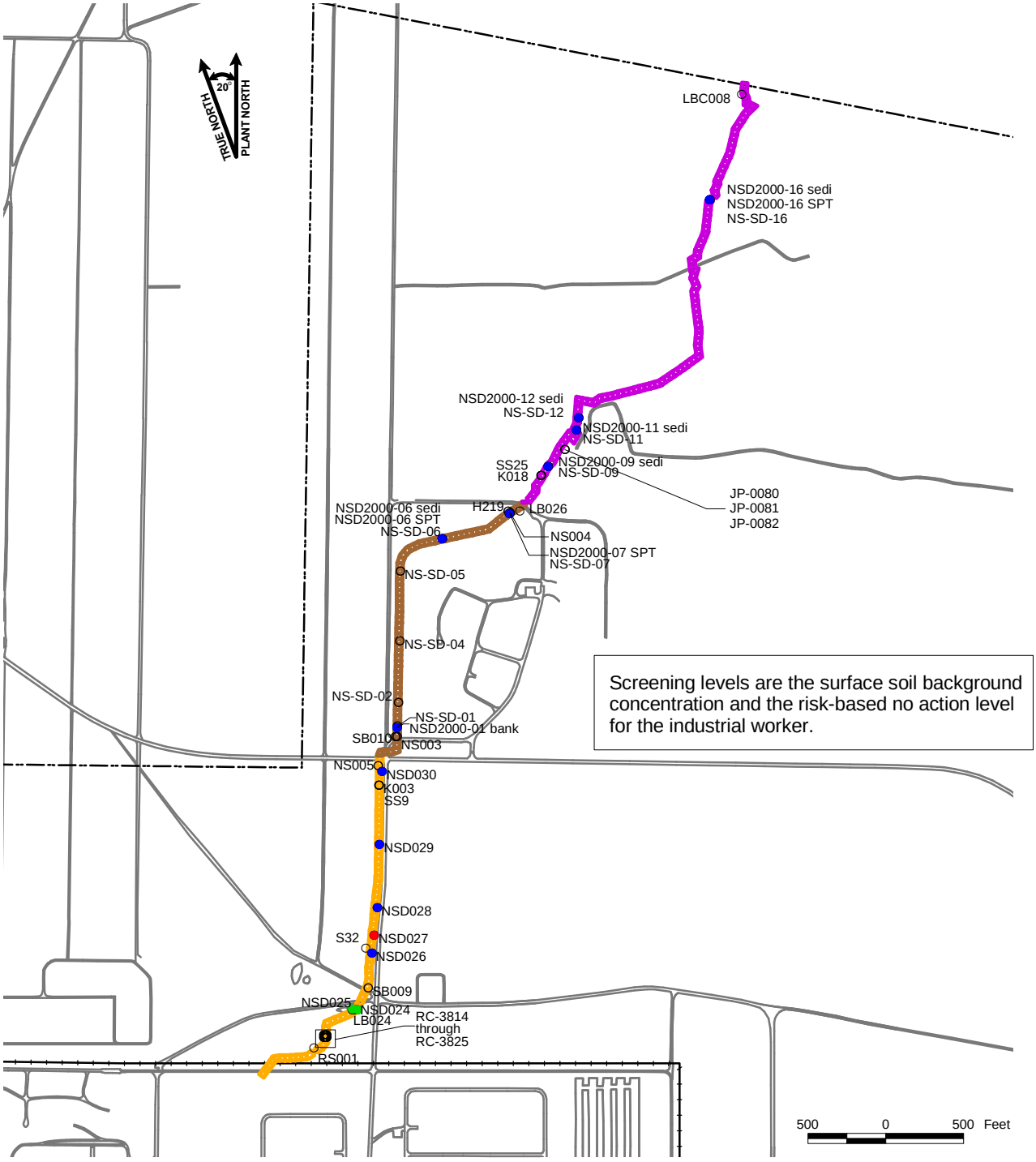

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Fig. 47. Locations in Sections 3-5 of the NSDD where one or more sampling results have a uranium-234 activity greater than screening levels.

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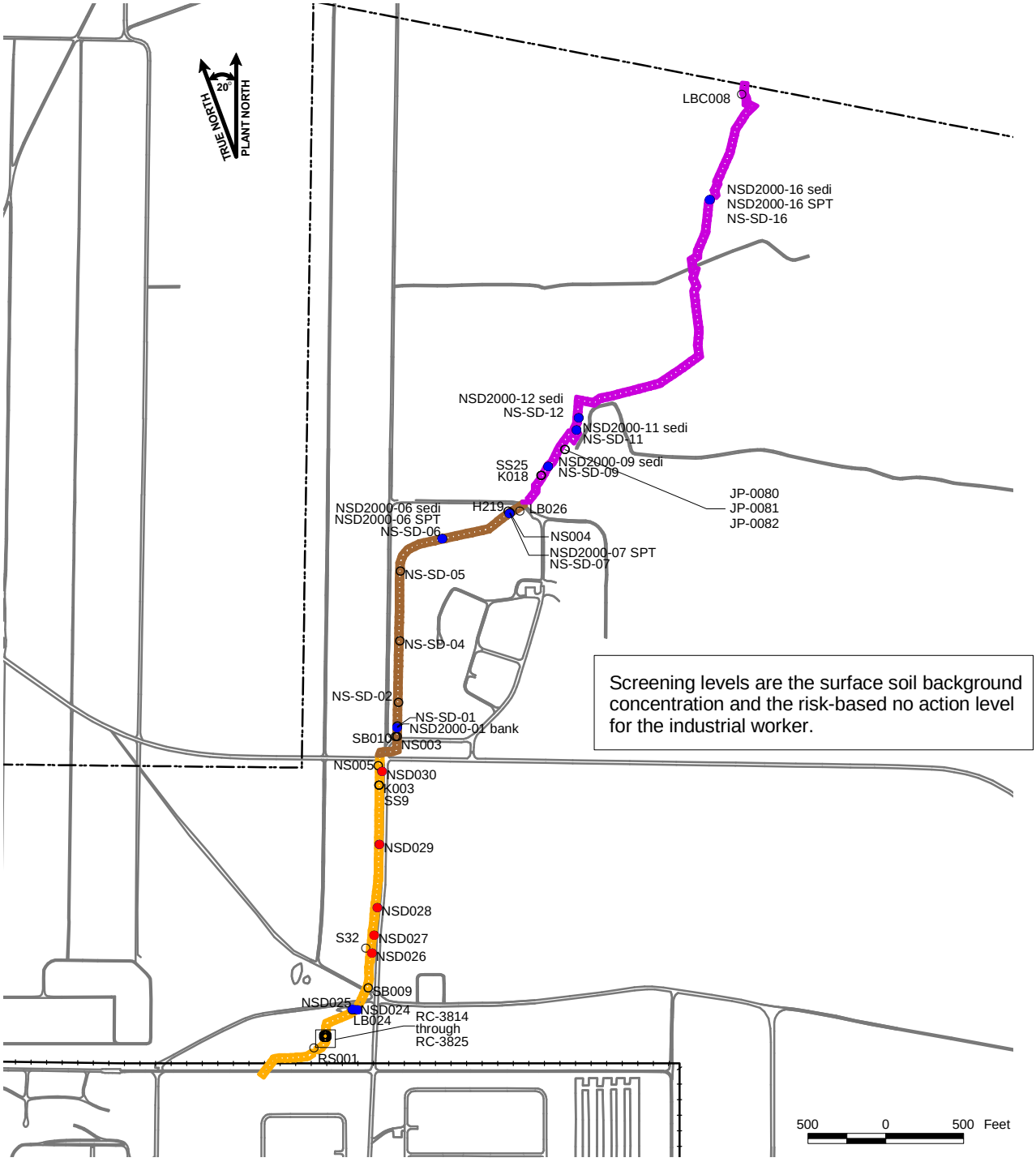

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Fig. 48. Locations in Sections 3-5 of the NSDD where one or more sampling results have a uranium-235 activity greater than screening levels.

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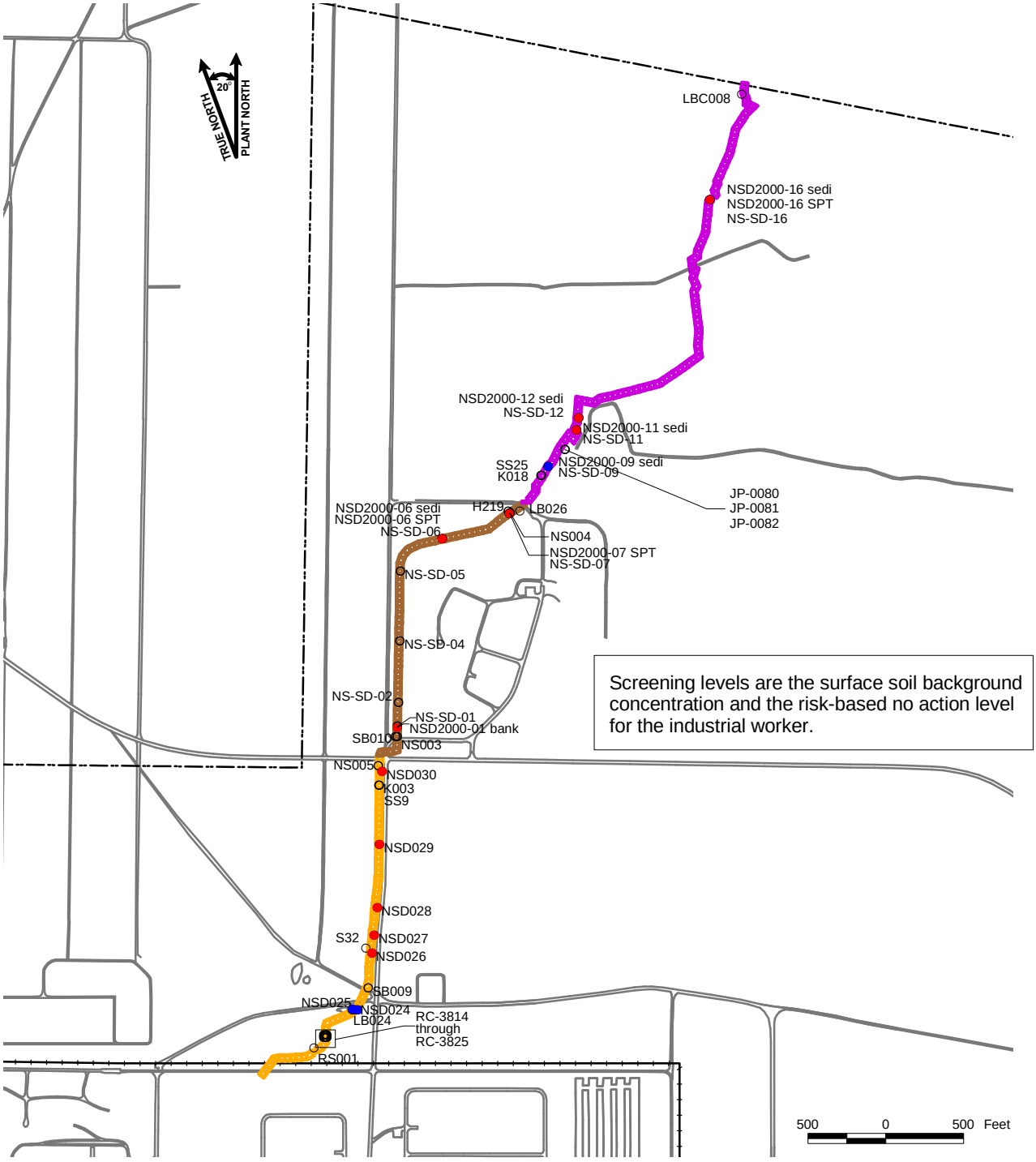
FIGURE No. c5ac90001sk607.apr
DATE 02-06-03

DOCUMENT No.



LEGEND:

- ○ SAMPLE STATION (NOT ANALYZED FOR COPC)
- RU - SECTION 3
- RU - SECTION 4
- RU - SECTION 5
- *RU = REMEDIATION UNIT
- ● NON-DETECT
- ● DETECT < SCREENING LEVELS
- ● DETECT > SCREENING LEVELS

Fig. 49. Locations in Sections 3-5 of the NSDD where one or more sampling results have a uranium-238 activity greater than screening levels.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

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