Appendix D. Site C PAG Contact RSEM Surface Water Quality Monitoring Time Series Plots – L5 Monthly and 5 in 30-day Data.

Figure 176. 2019 Peace River (*in situ*) and RSEM L5 pond (lab) specific conductivity.

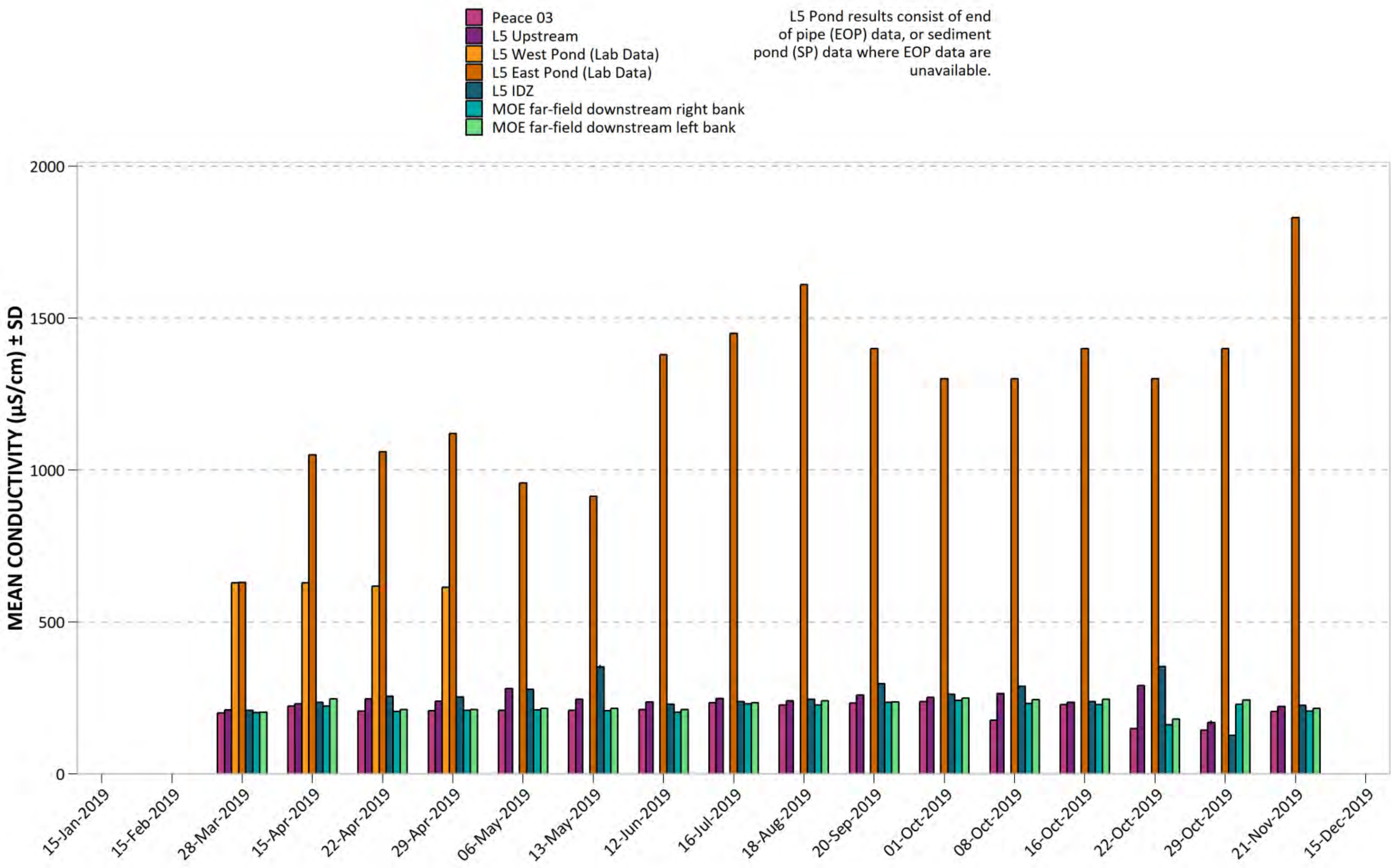

Figure 177. 2019 Peace River and RSEM L5 pond lab specific conductivity.

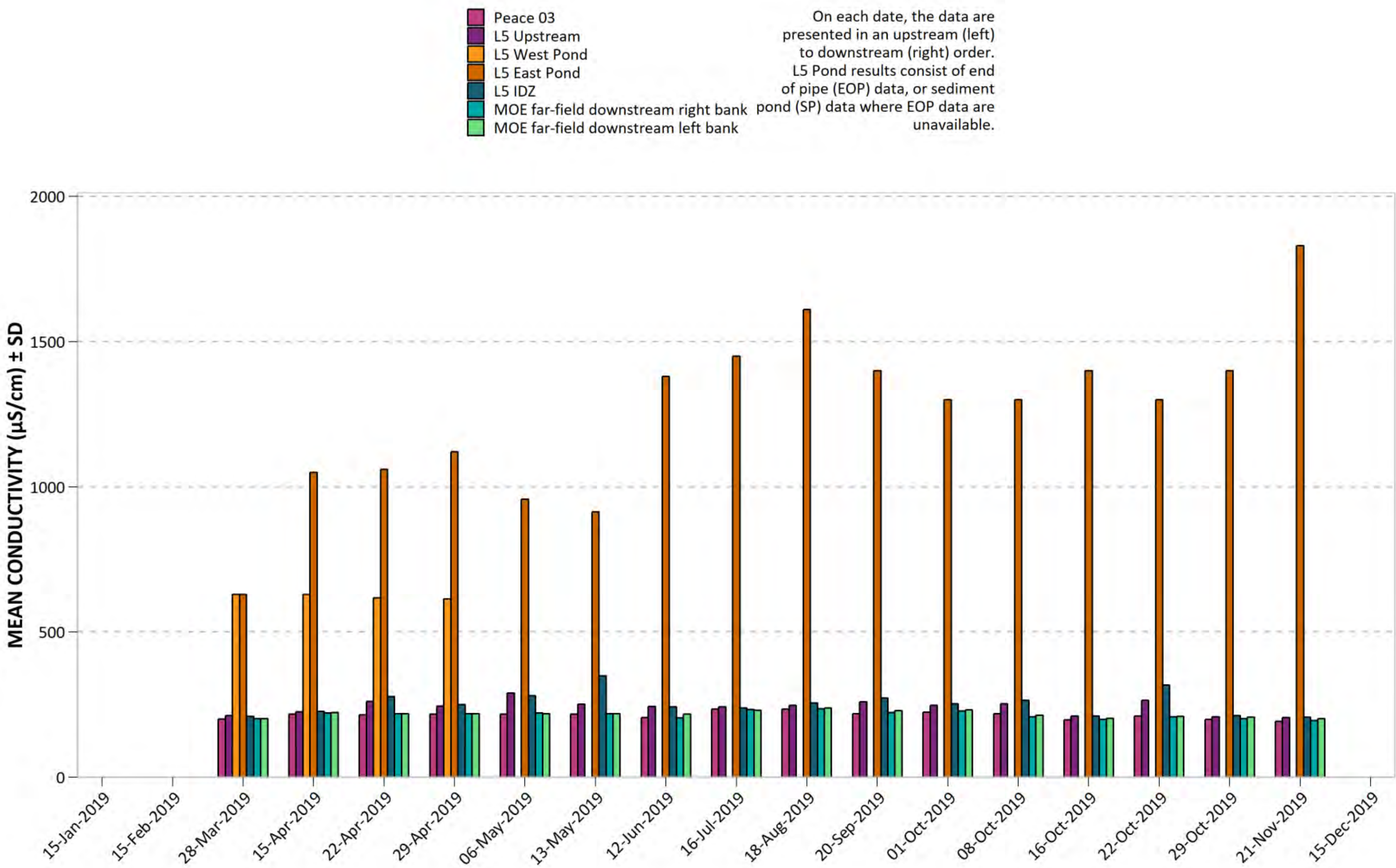

Figure 178. 2019 Peace River and RSEM L5 pond hardness (as $CaCO_3$).

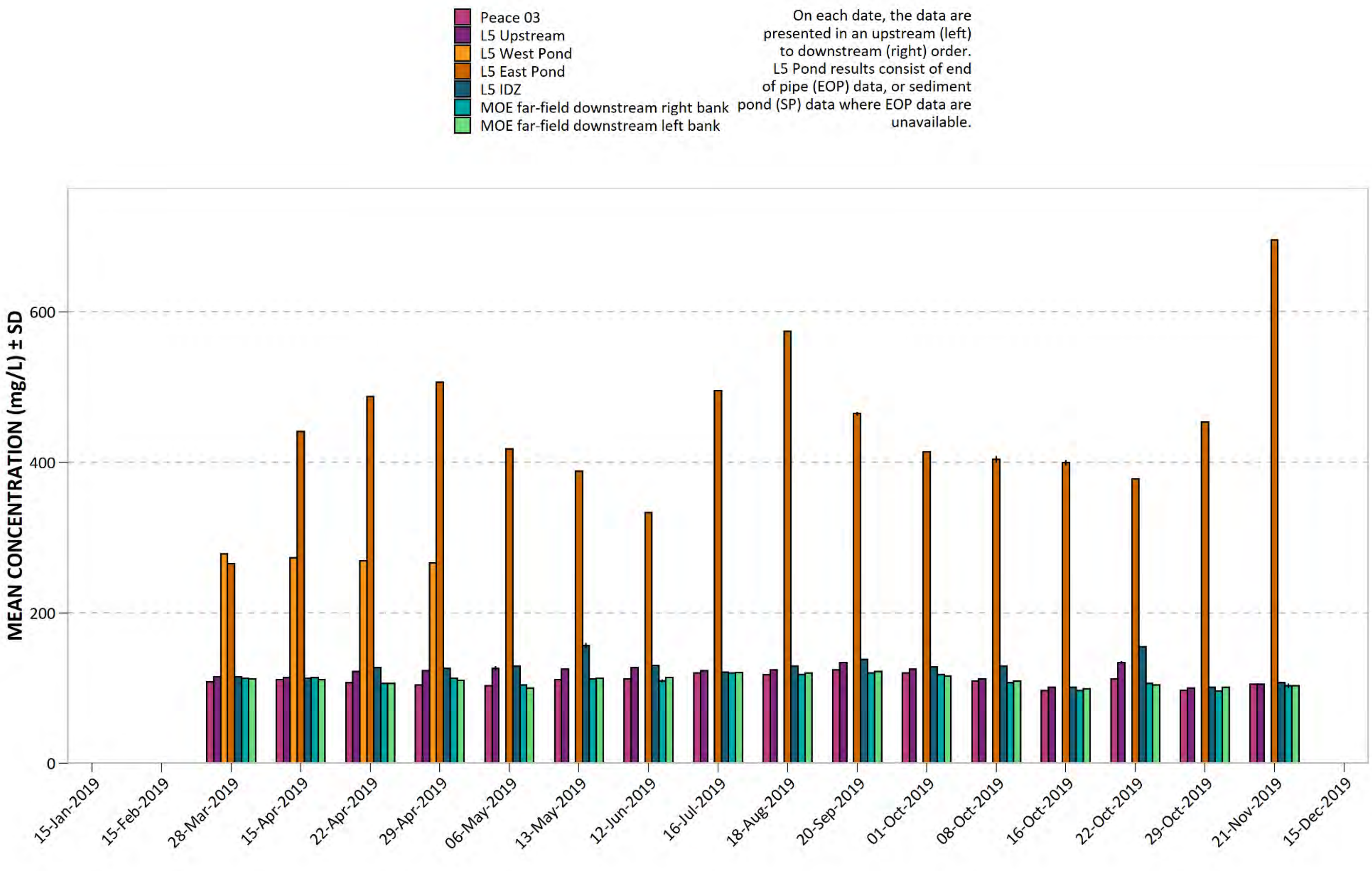

Figure 179. 2019 Peace River and RSEM L5 pond total dissolved solids (TDS).

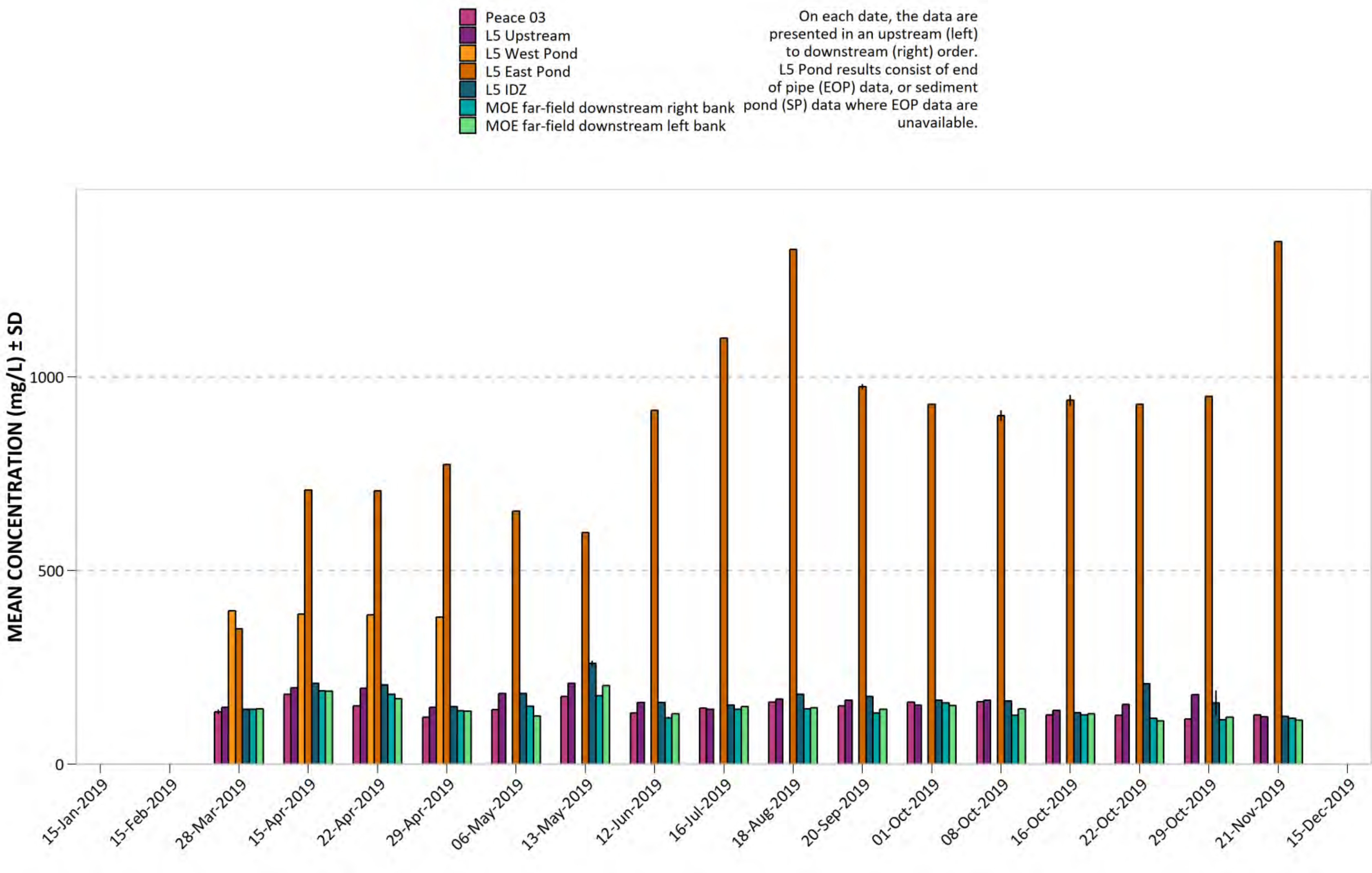

Figure 180. 2019 Peace River and RSEM L5 pond total suspended solids (TSS).

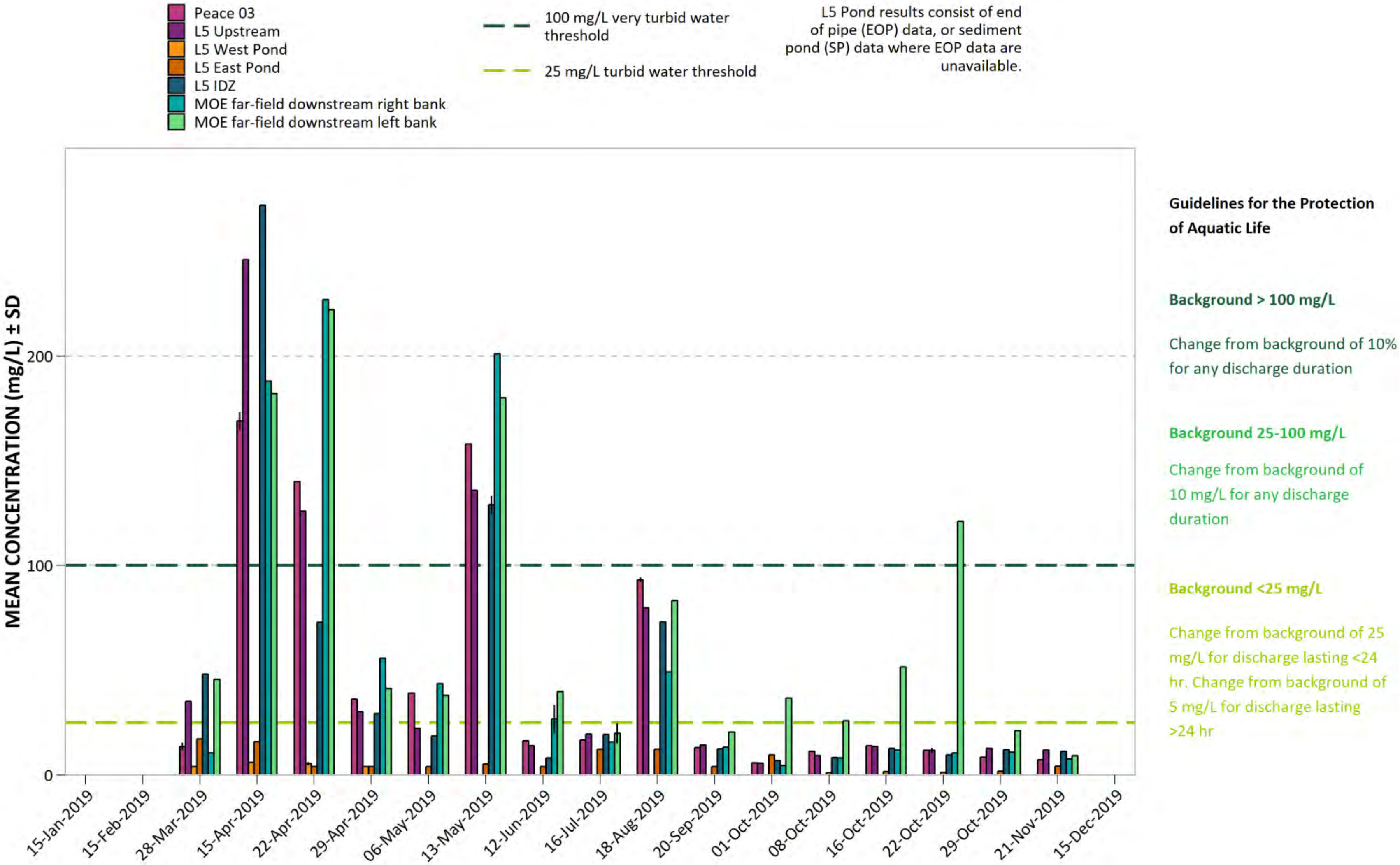

Figure 181. 2019 Peace River (*in-situ*) RSEM L5 pond (lab) turbidity.

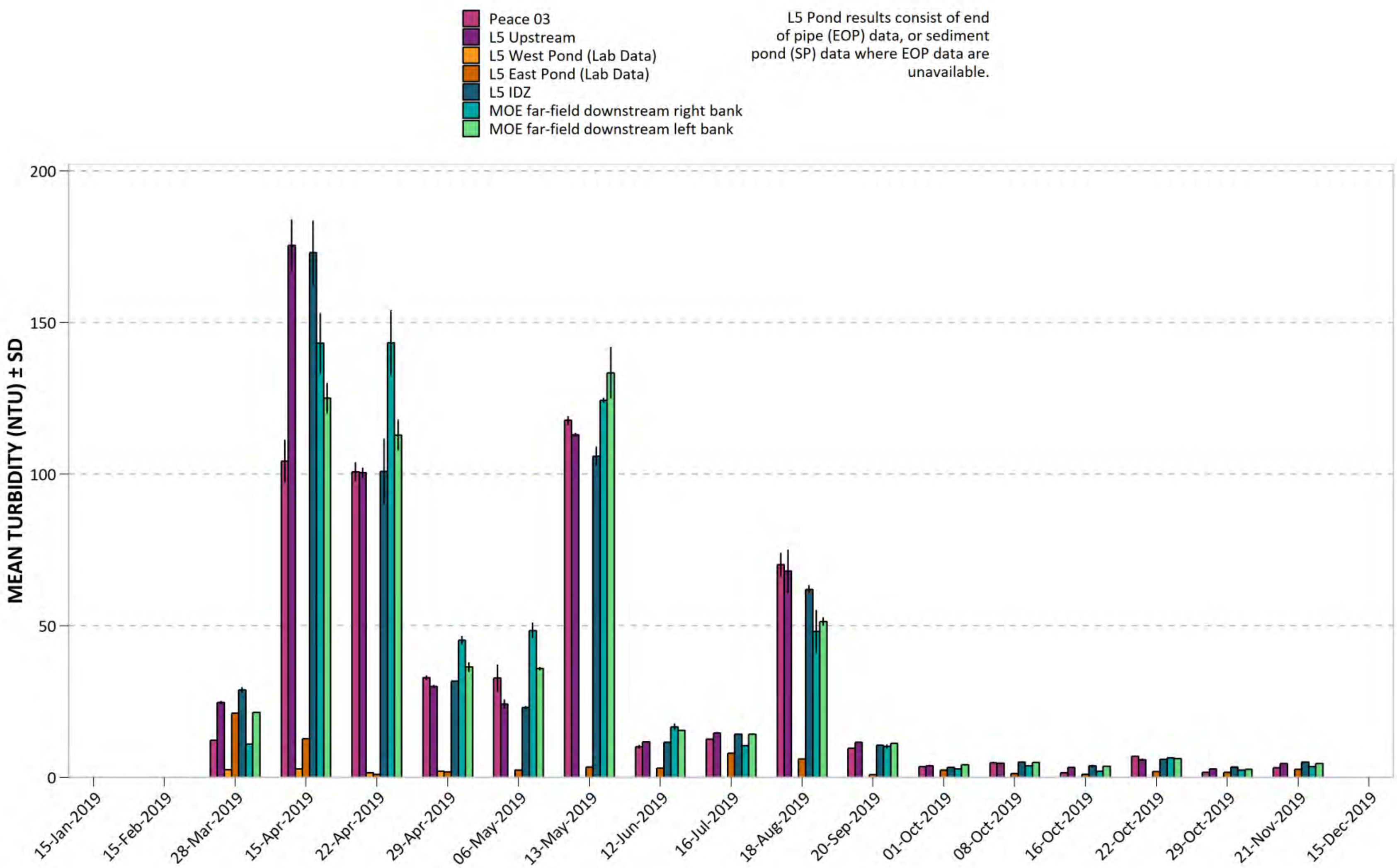

Figure 182. 2019 Peace River (*in*-situ) and RSEM L5 pond (lab) pH.

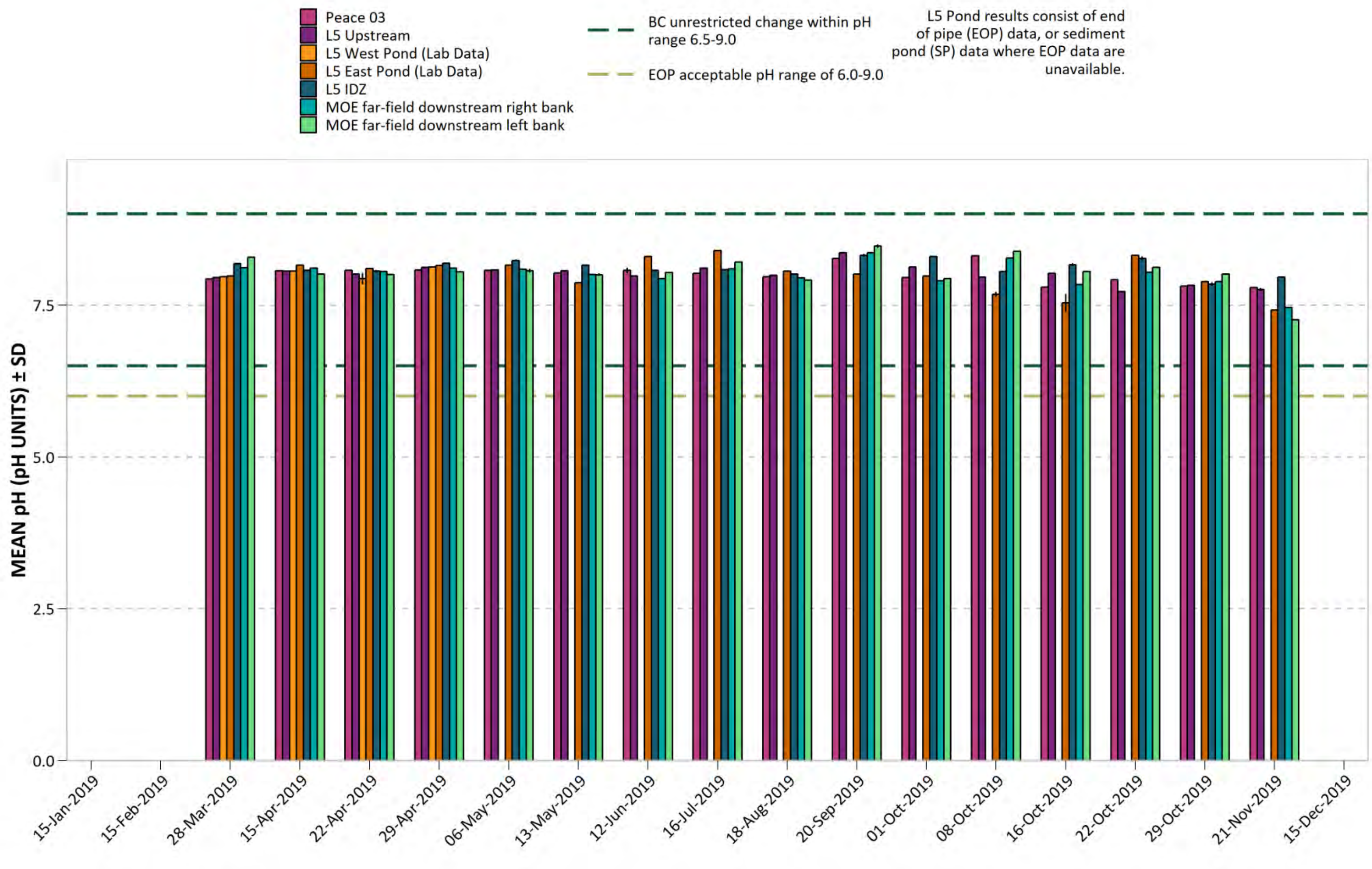

Figure 183. 2019 Peace River and RSEM L5 pond lab pH.

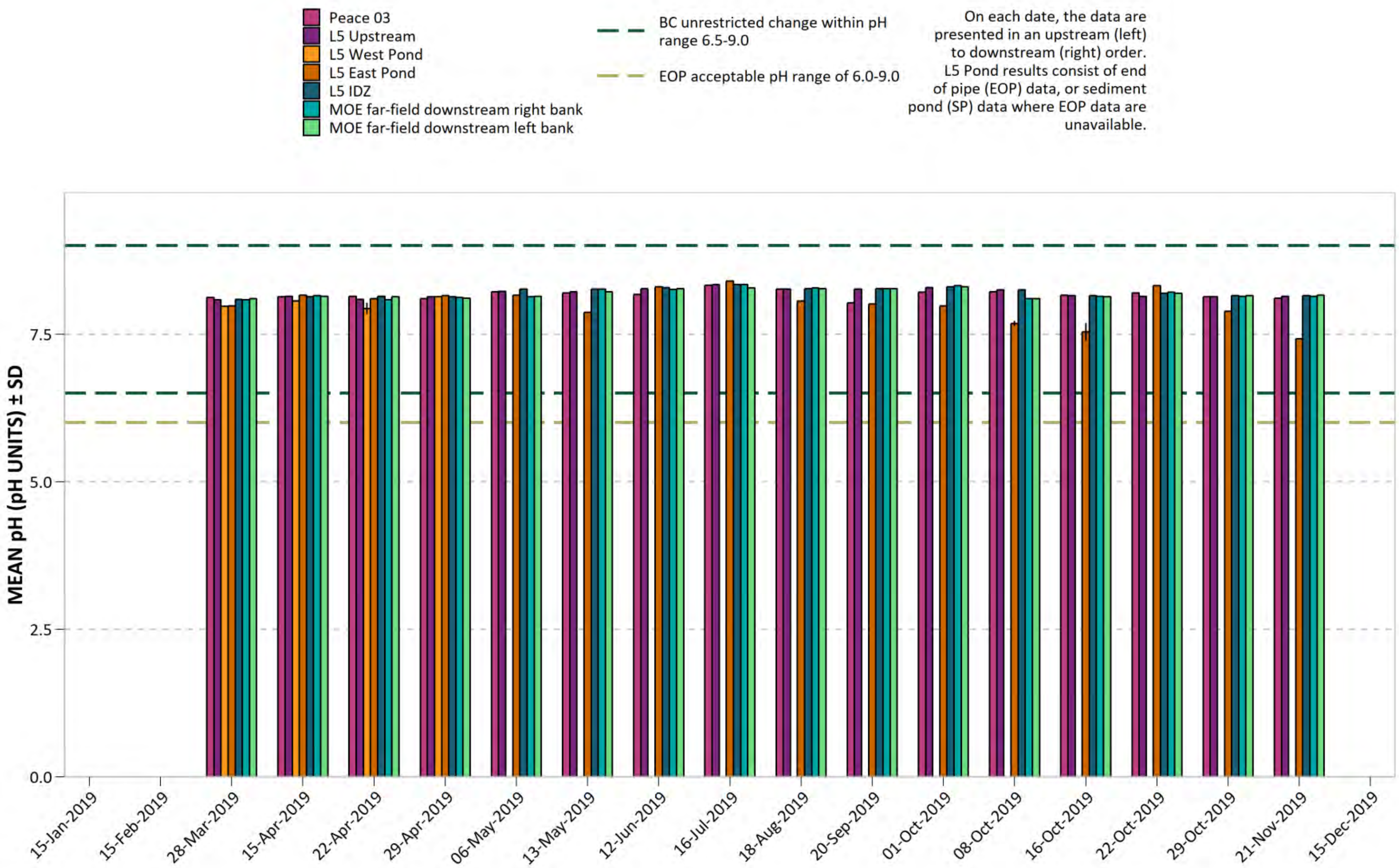

Figure 184. 2019 Peace River and RSEM L5 pond total alkalinity (as $CaCO_3$).

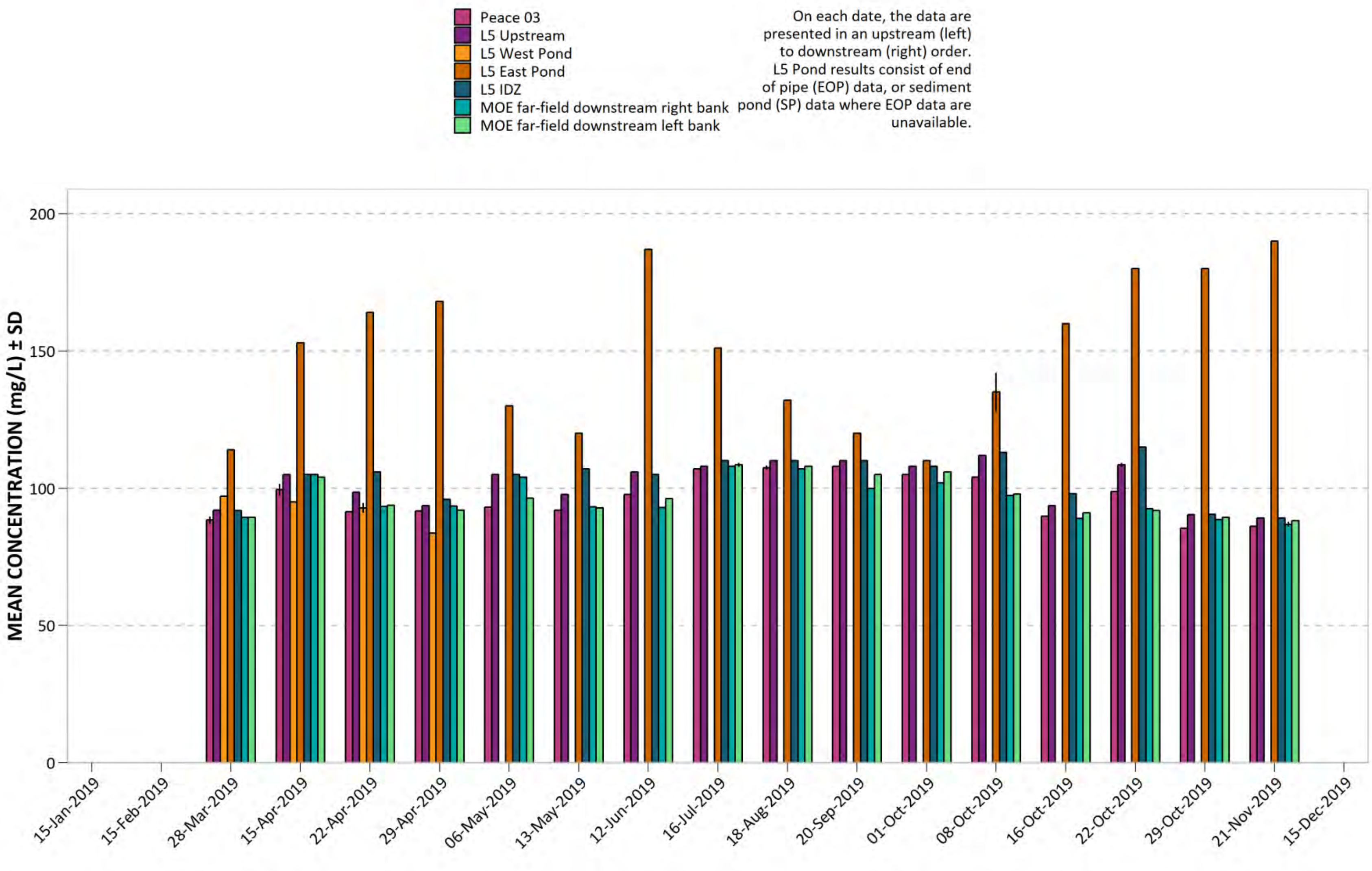

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Figure 185. 2019 Peace River and RSEM L5 pond total ammonia (as N).

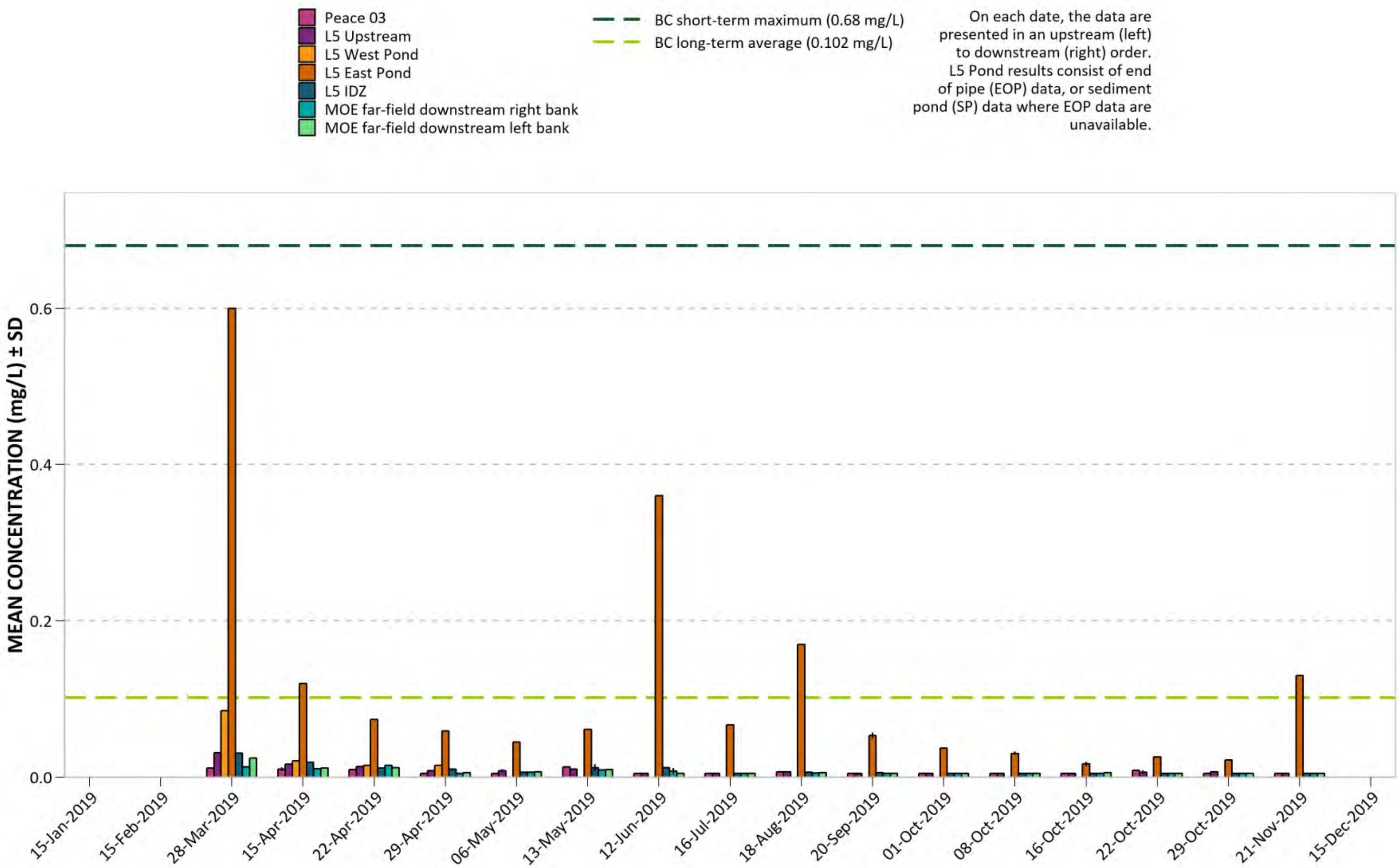
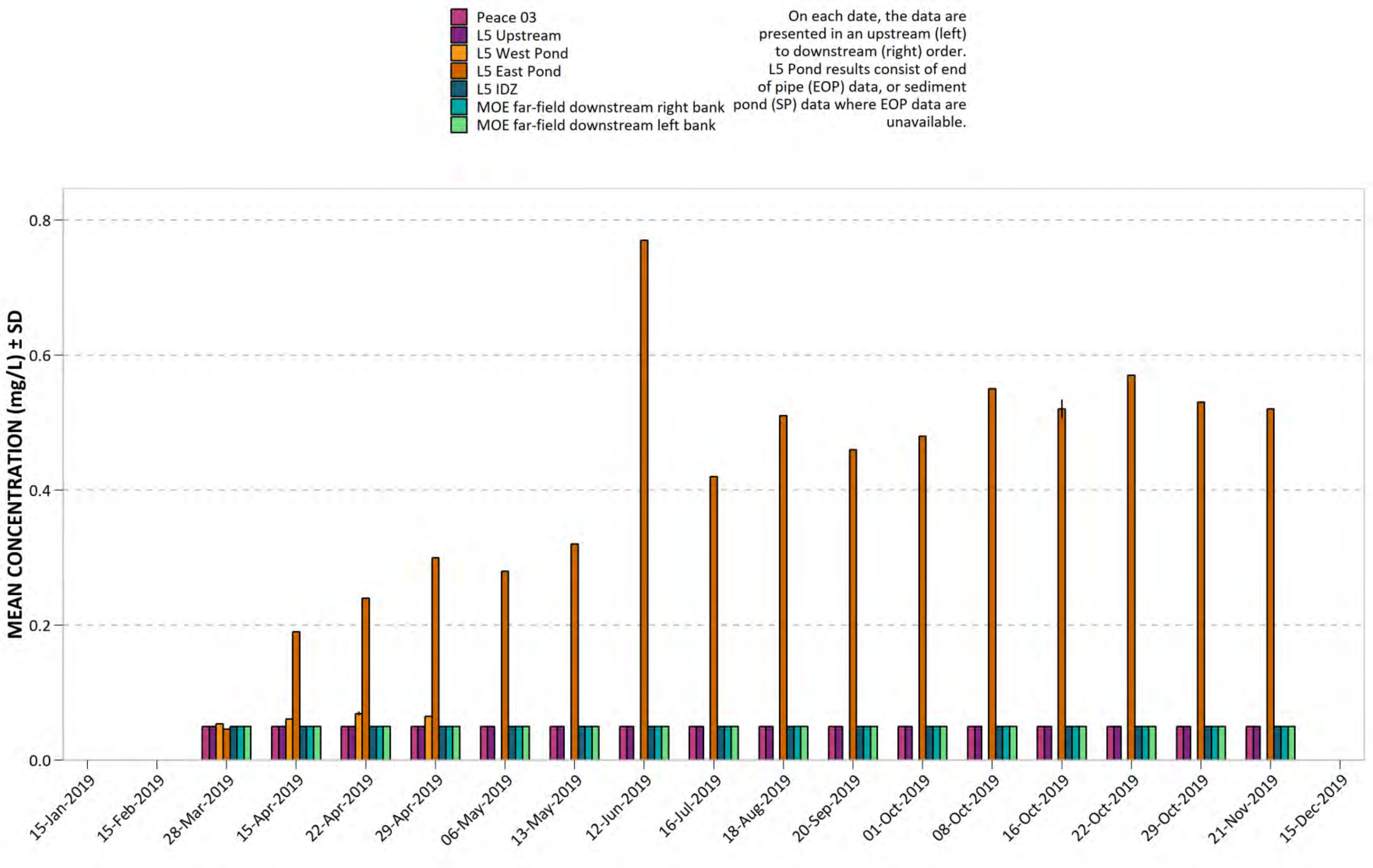
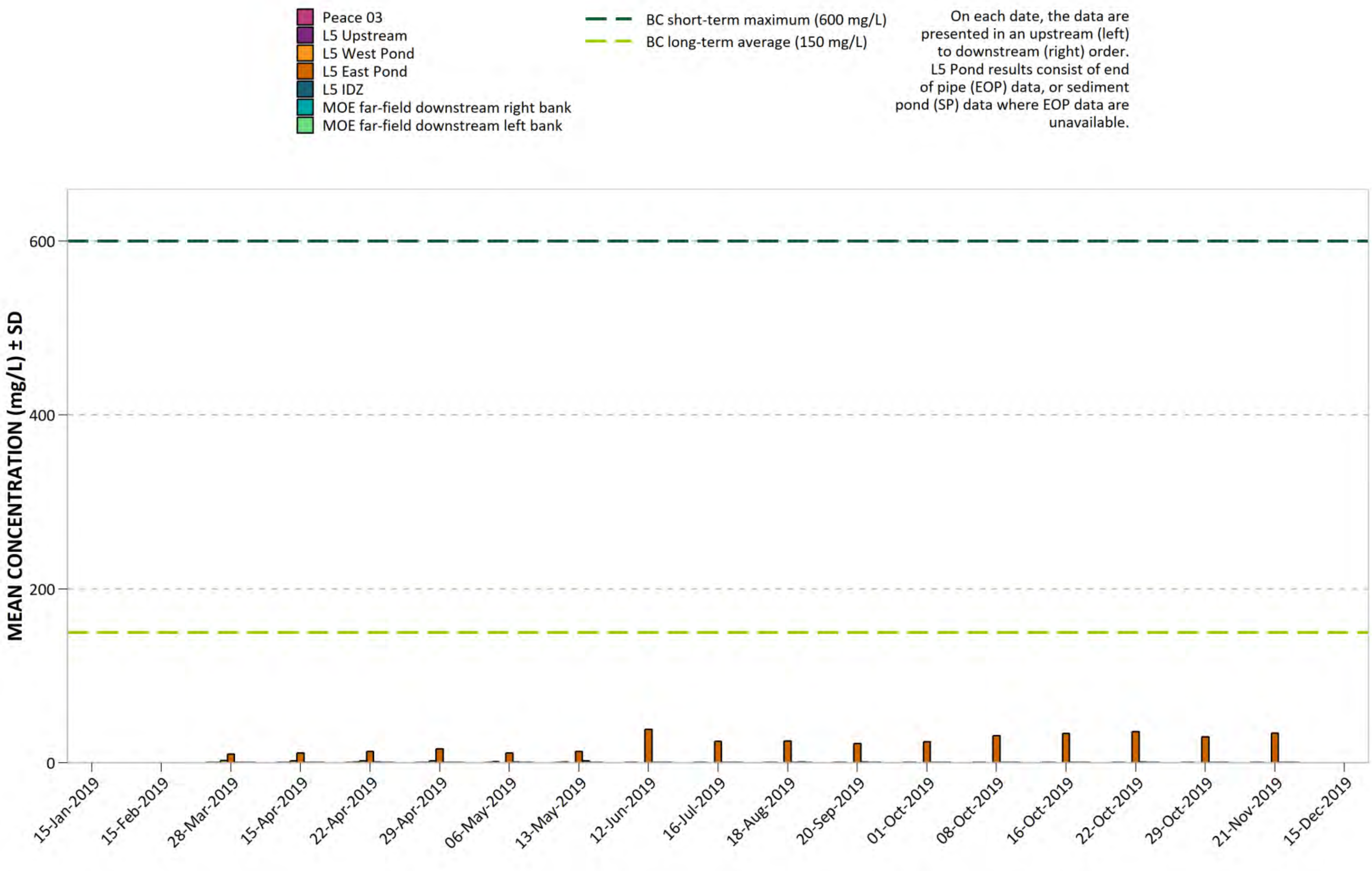


Figure 186. 2019 Peace River and RSEM L5 pond bromide (Br).



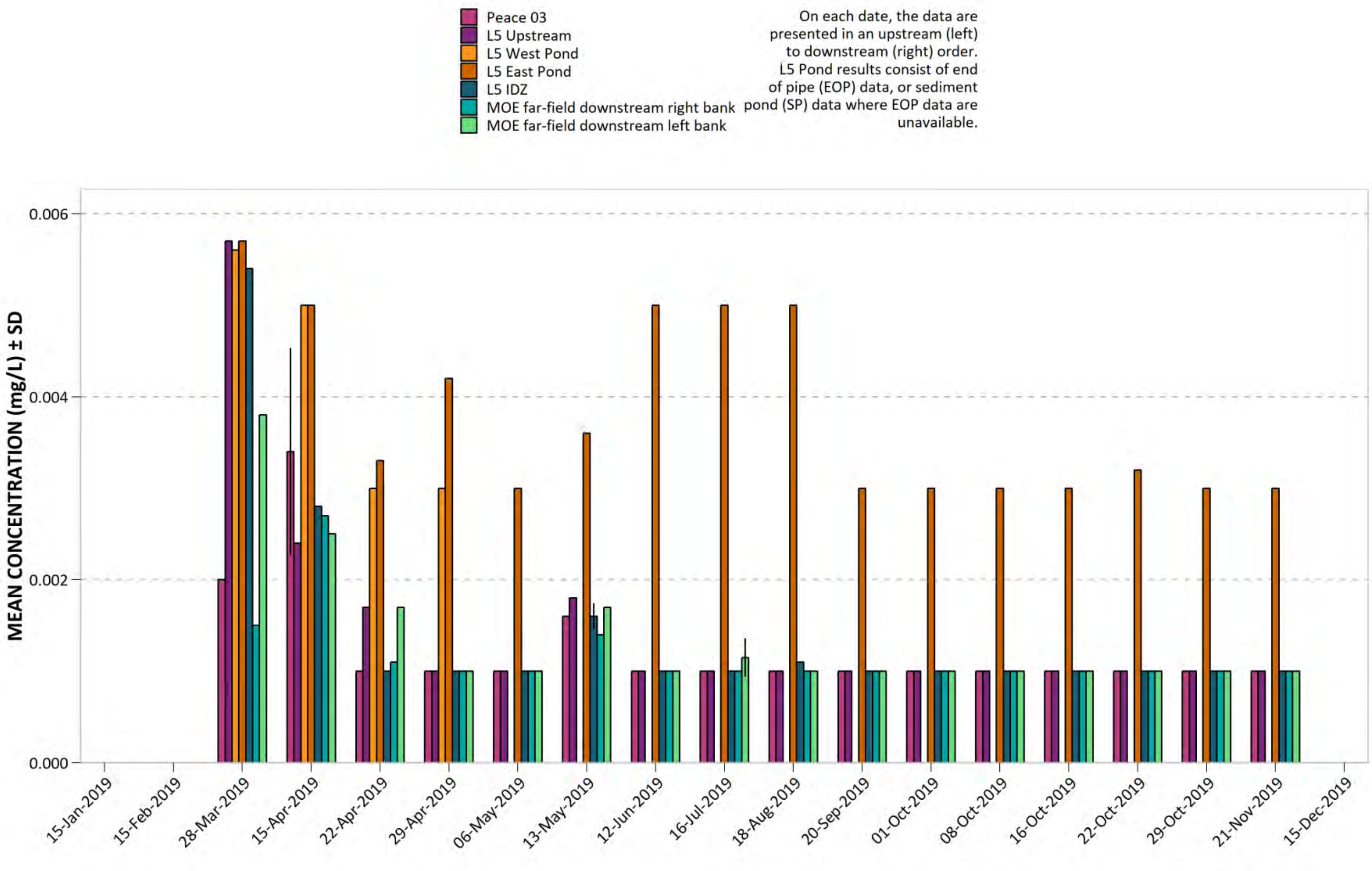
All Peace River results were less than the MDL and thus were assigned the MDL value of 0.05 mg/L.

Figure 187. 2019 Peace River and RSEM L5 pond chloride (Cl).



All Peace River results were less than the MDL and thus were assigned the MDL value of 0.5 mg/L.

Figure 188. 2019 Peace River and RSEM L5 pond dissolved orthophosphate.



Peace River results less than the MDL were assigned the MDL value 0.001 mg/L. Pond data less than the MDL were assigned the corresponding MDL.

Figure 189. 2019 Peace River and RSEM L5 pond fluoride (F).

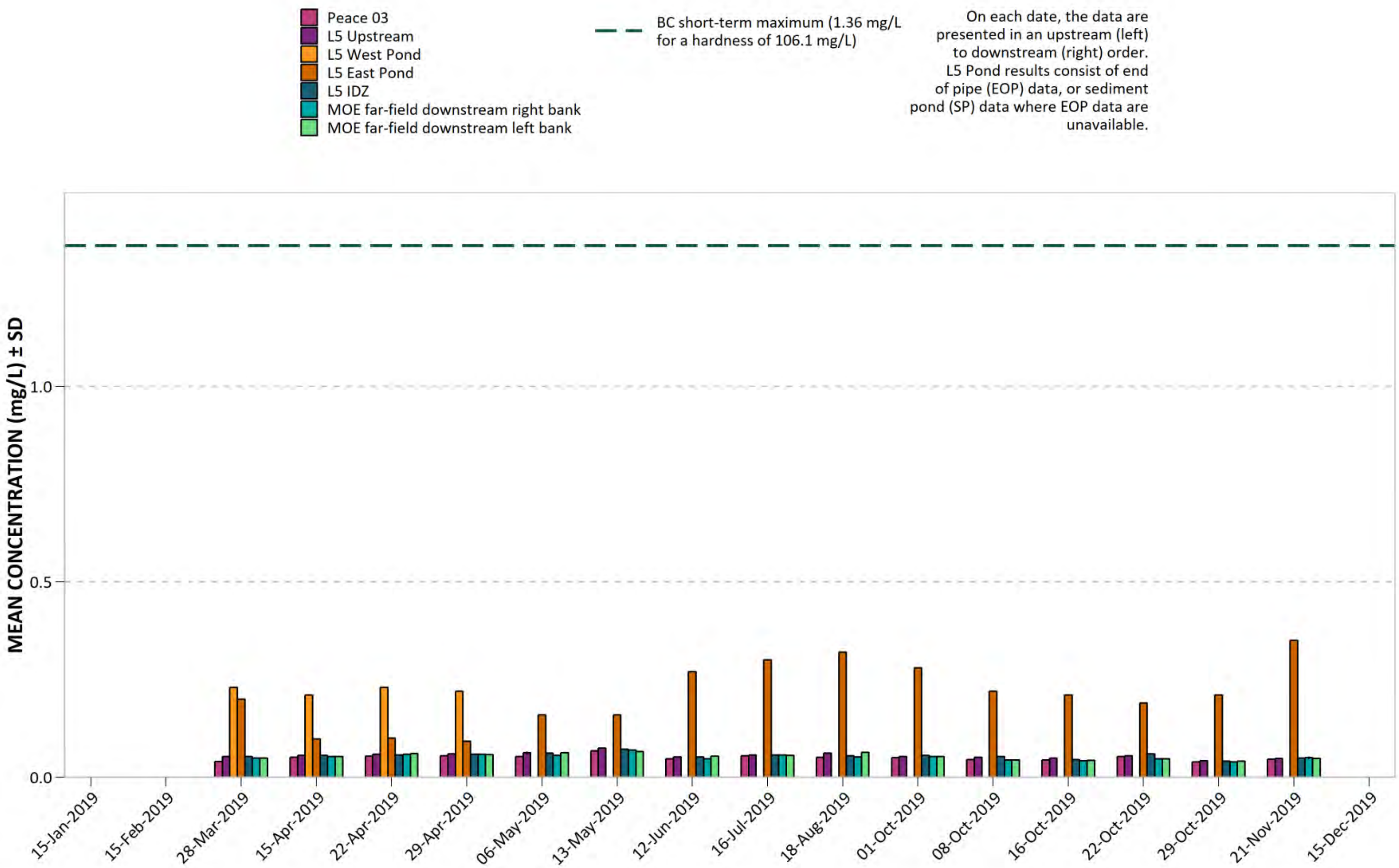


Figure 190. 2019 Peace River and RSEM L5 pond nitrate (as N).

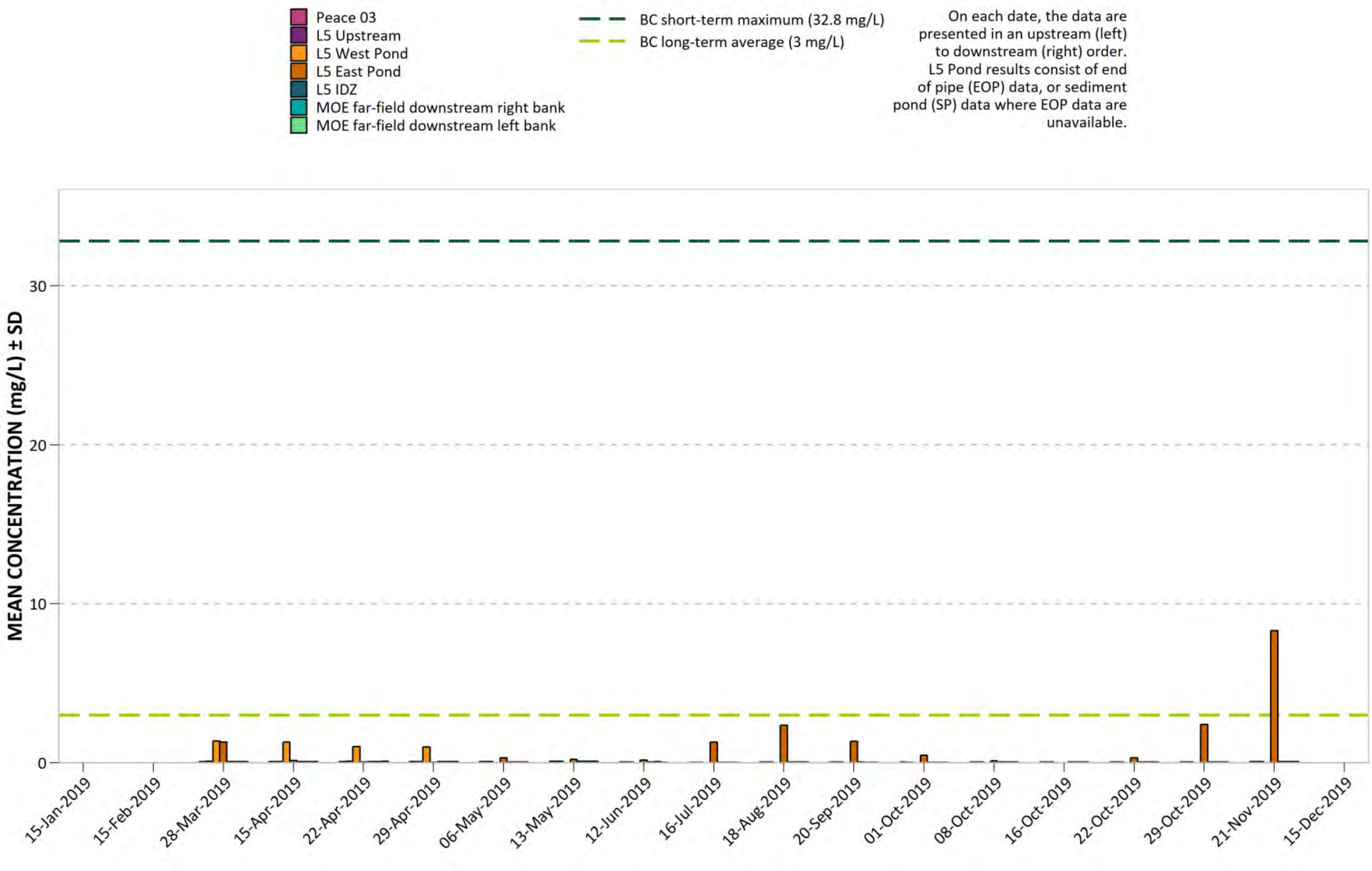
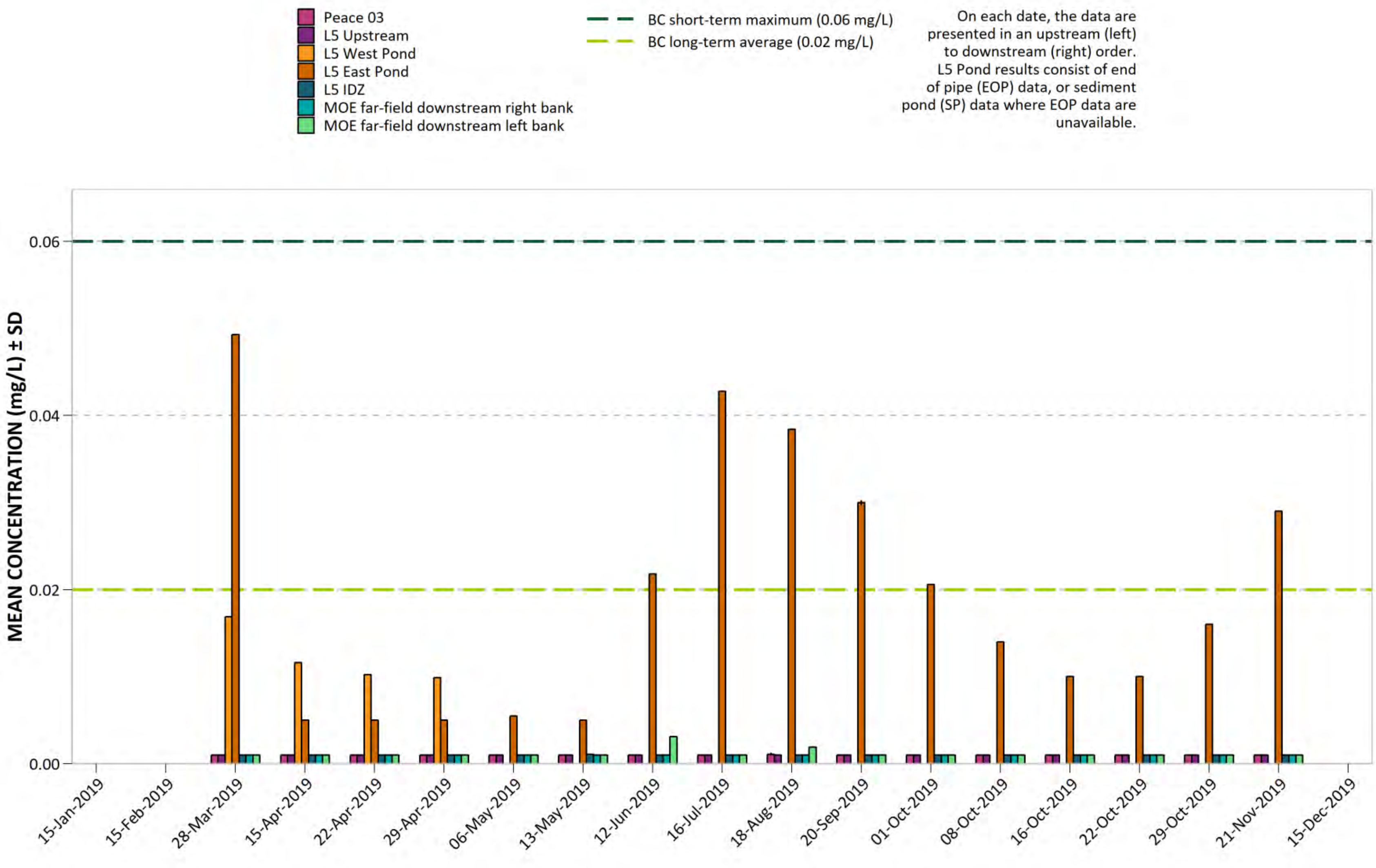


Figure 191. 2019 Peace River and RSEM L5 pond nitrite (as N).



Note: BC WQG for nitrite are chloride dependent, and therefore guidelines depicted in the plot are applicable for Peace River sites only. Based on the range of chloride values observed in the Peace River, the applicable BC Maximum and 30-day guidelines are 0.06 mg/L and 0.02 mg/L, respectively.

Figure 192. 2019 Peace River and RSEM L5 pond sulfate (SO_4).

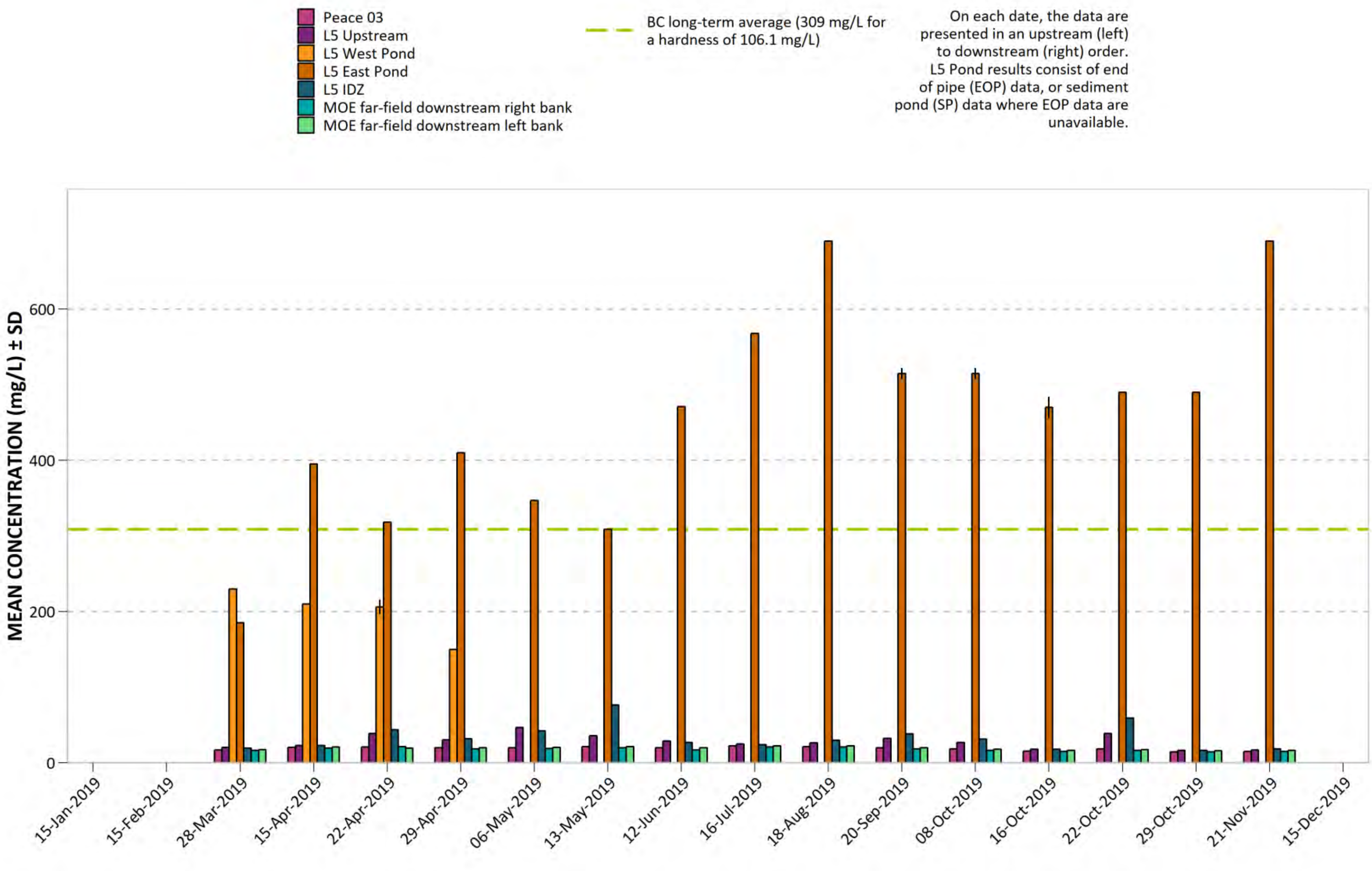


Figure 193. 2019 Peace River and RSEM L5 pond dissolved organic carbon (DOC).

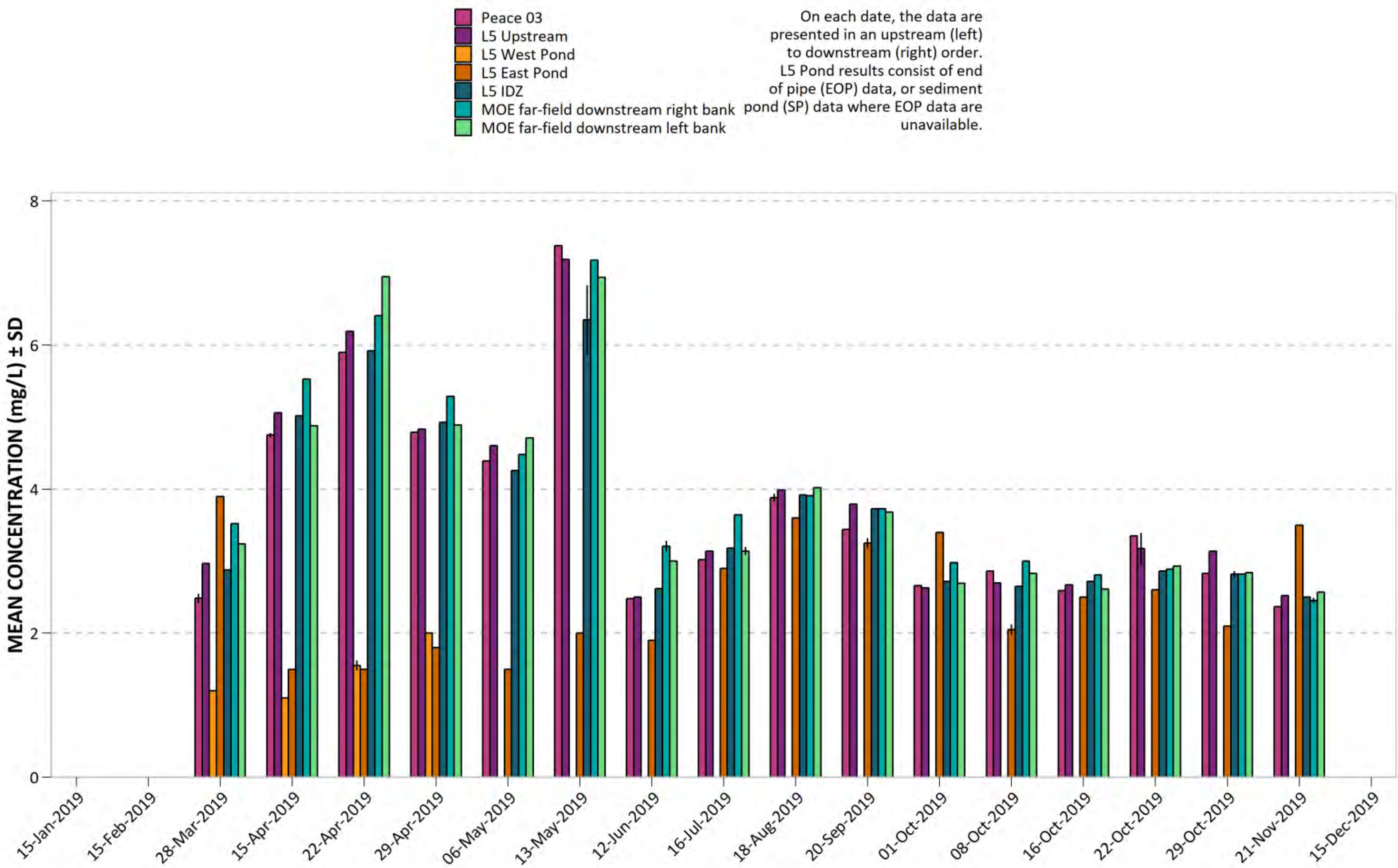


Figure 194. 2019 Peace River and RSEM L5 pond total organic carbon (TOC).

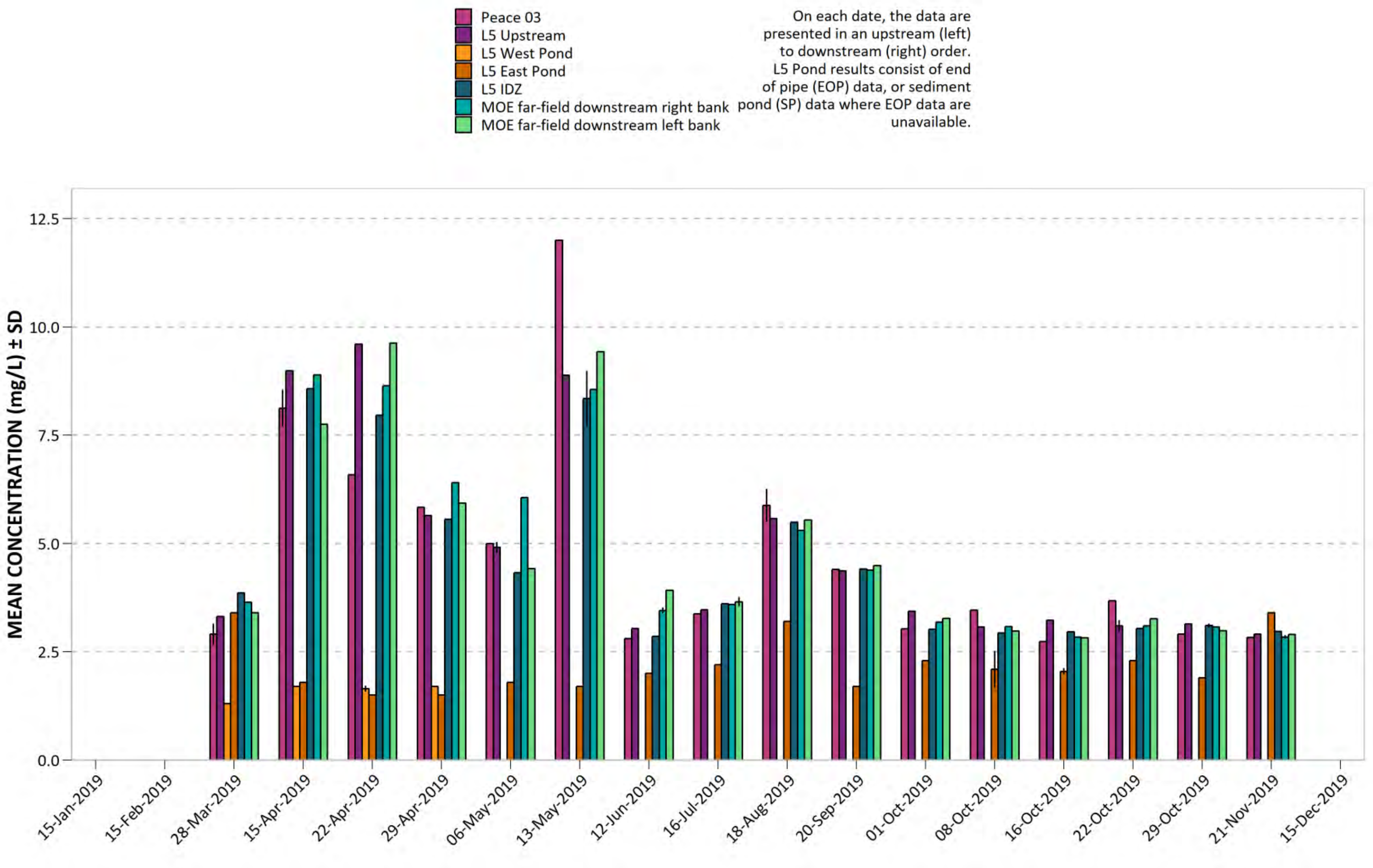


Figure 195. 2019 Peace River and RSEM L5 pond total aluminum (Al).

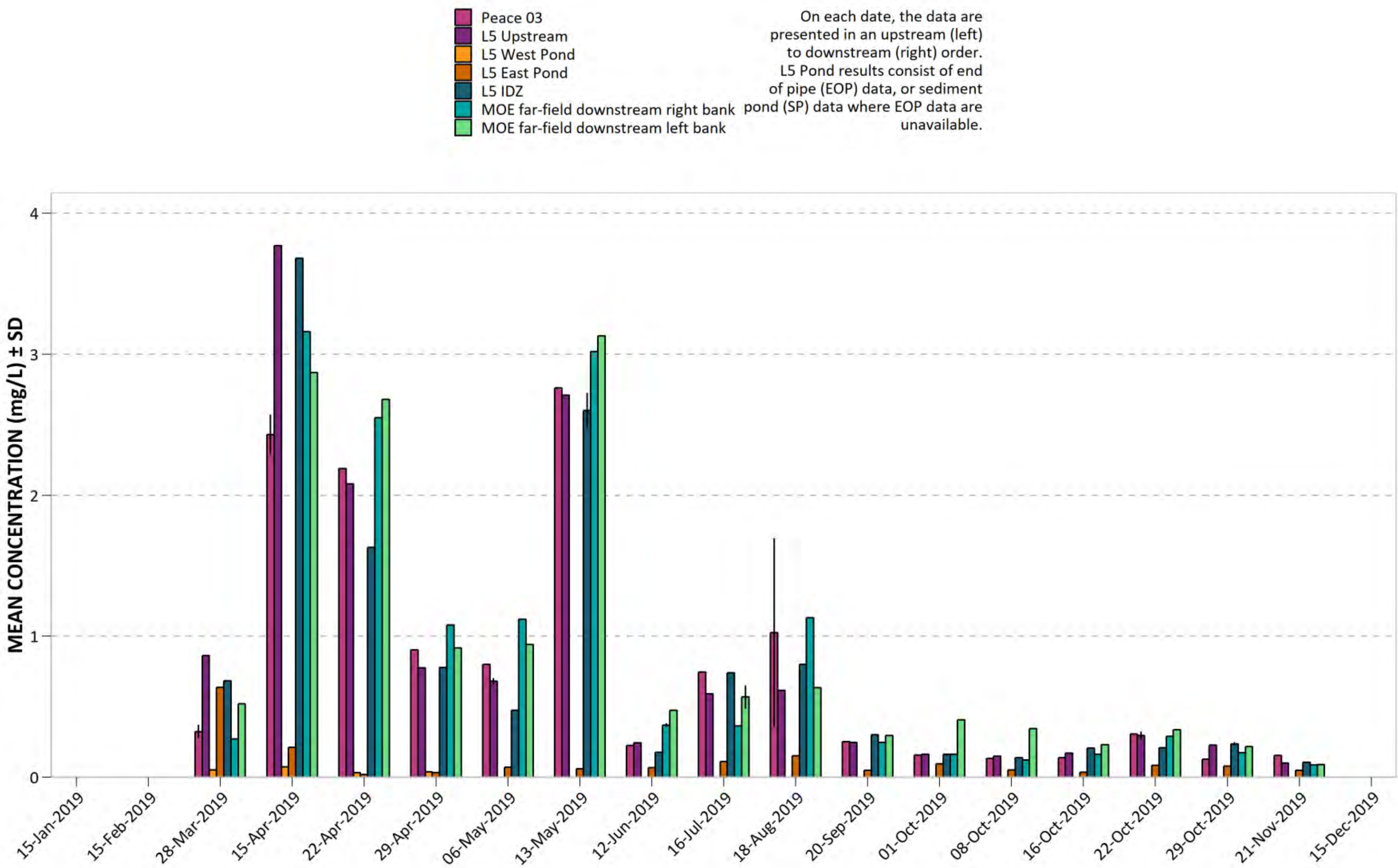
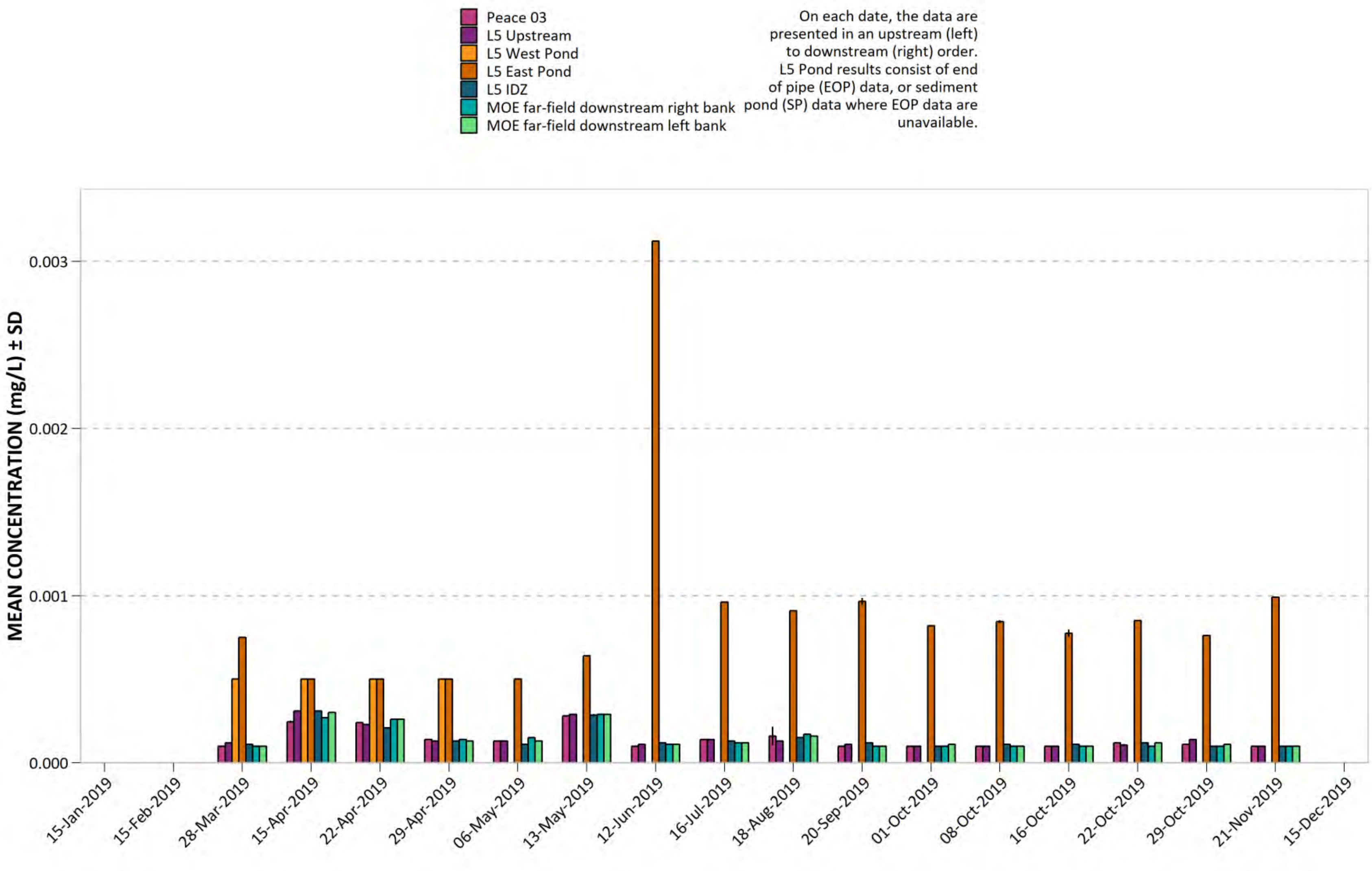


Figure 196. 2019 Peace River and RSEM L5 pond total antimony (Sb).



Results less than the MDL were assigned the MDL value of 0.0005 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 197. 2019 Peace River and RSEM L5 pond total arsenic (As).

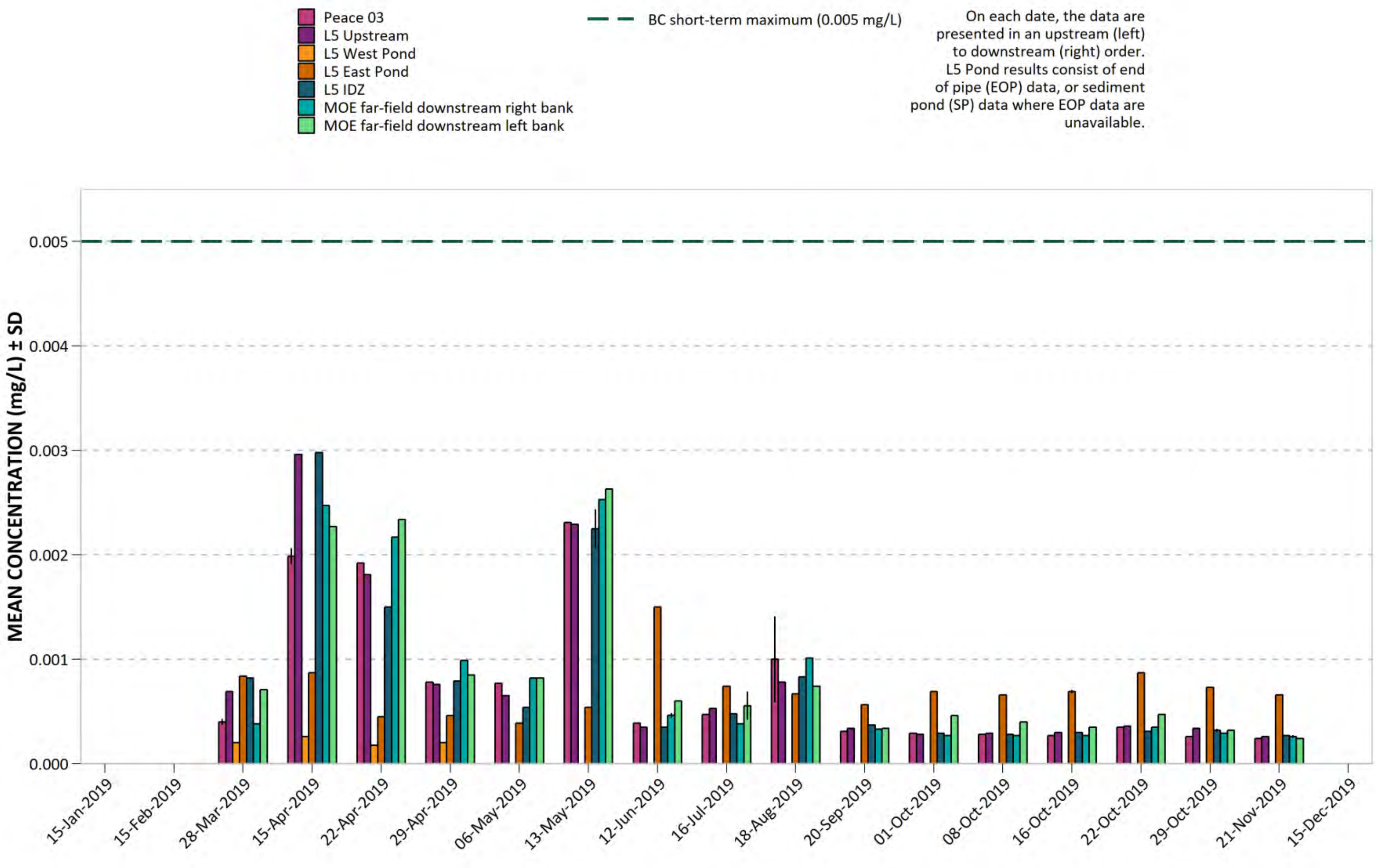


Figure 198. 2019 Peace River and RSEM L5 pond total barium (Ba).

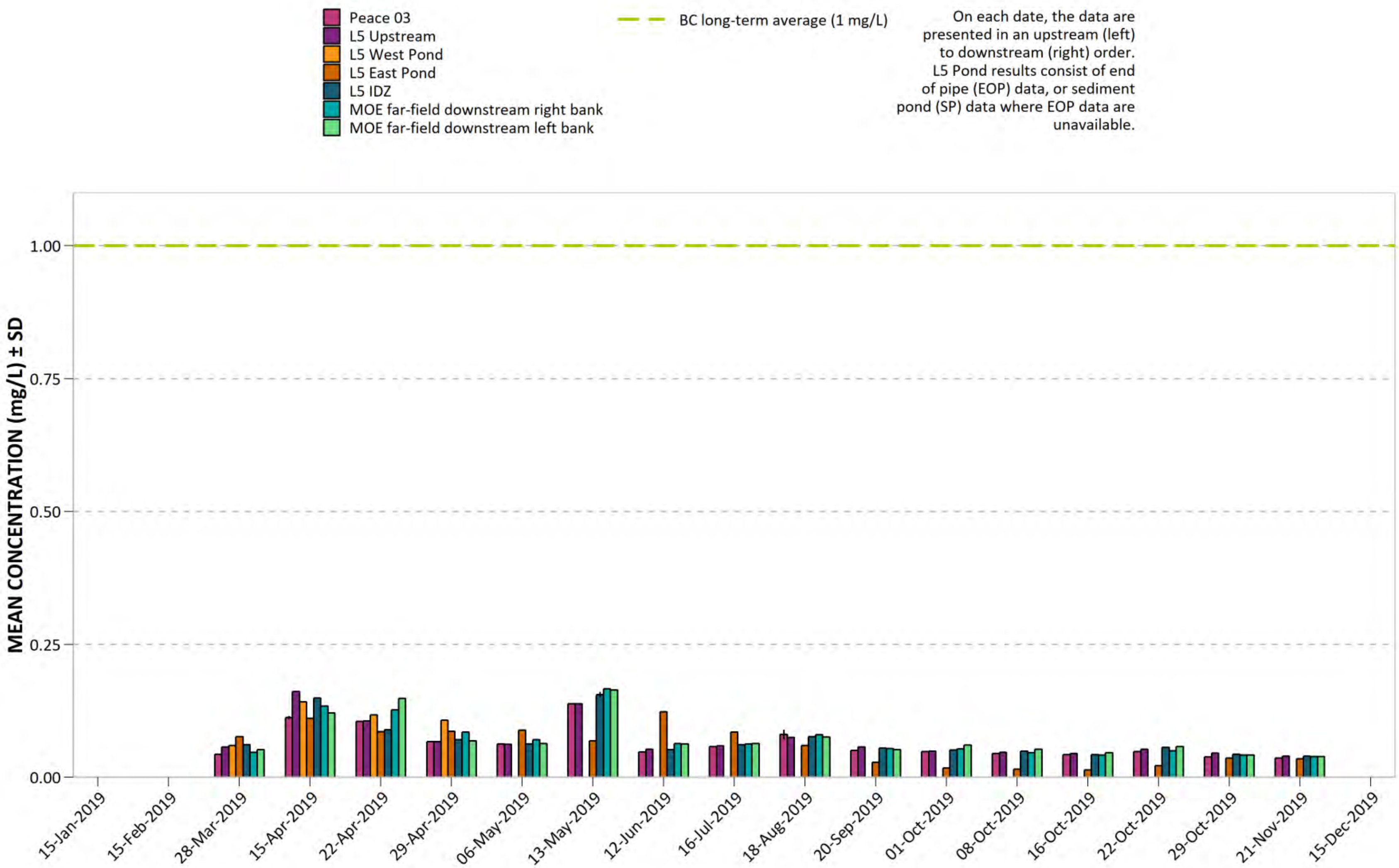
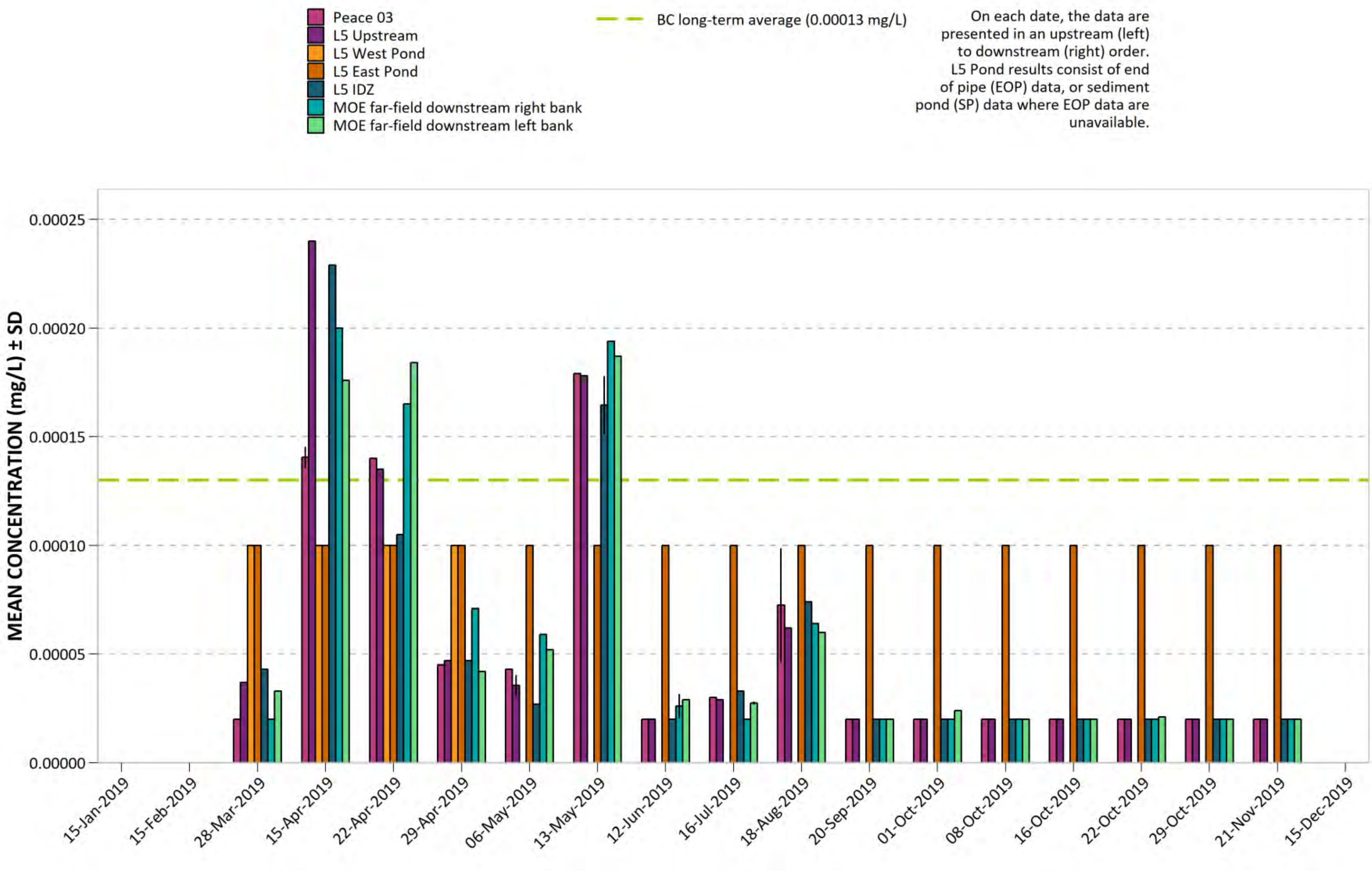
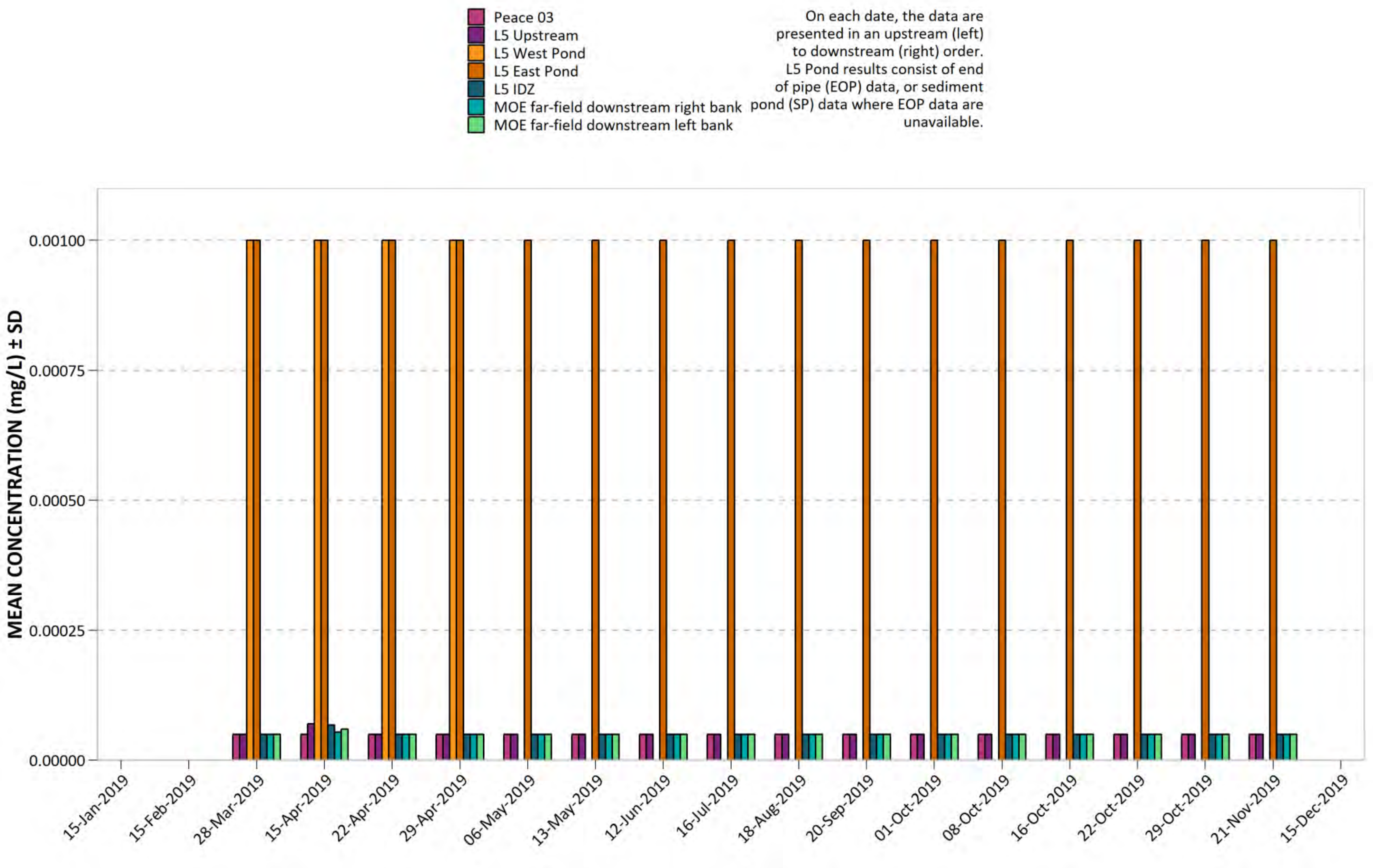


Figure 199. 2019 Peace River and RSEM L5 pond total beryllium (Be).



Results less than the MDL were assigned the MDL value of 0.0001 mg/L (Pond) or 0.00002 mg/L (Peace River).

Figure 200. 2019 Peace River and RSEM L5 pond total bismuth (Bi).



Results less than the MDL were assigned the MDL value of 0.001 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 201. 2019 Peace River and RSEM L5 pond total boron (B).

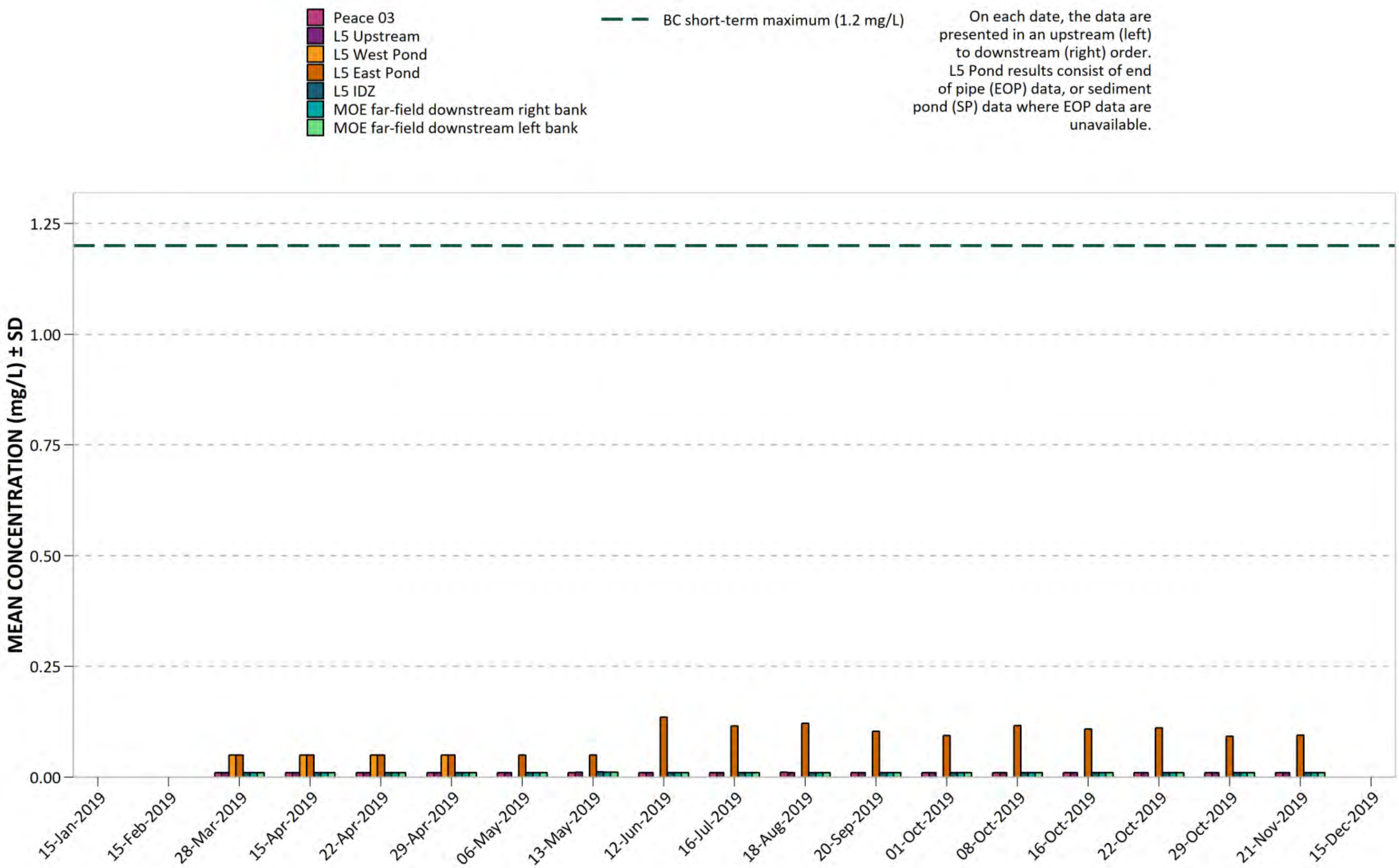


Figure 202. 2019 Peace River and RSEM L5 pond total cadmium (Cd).

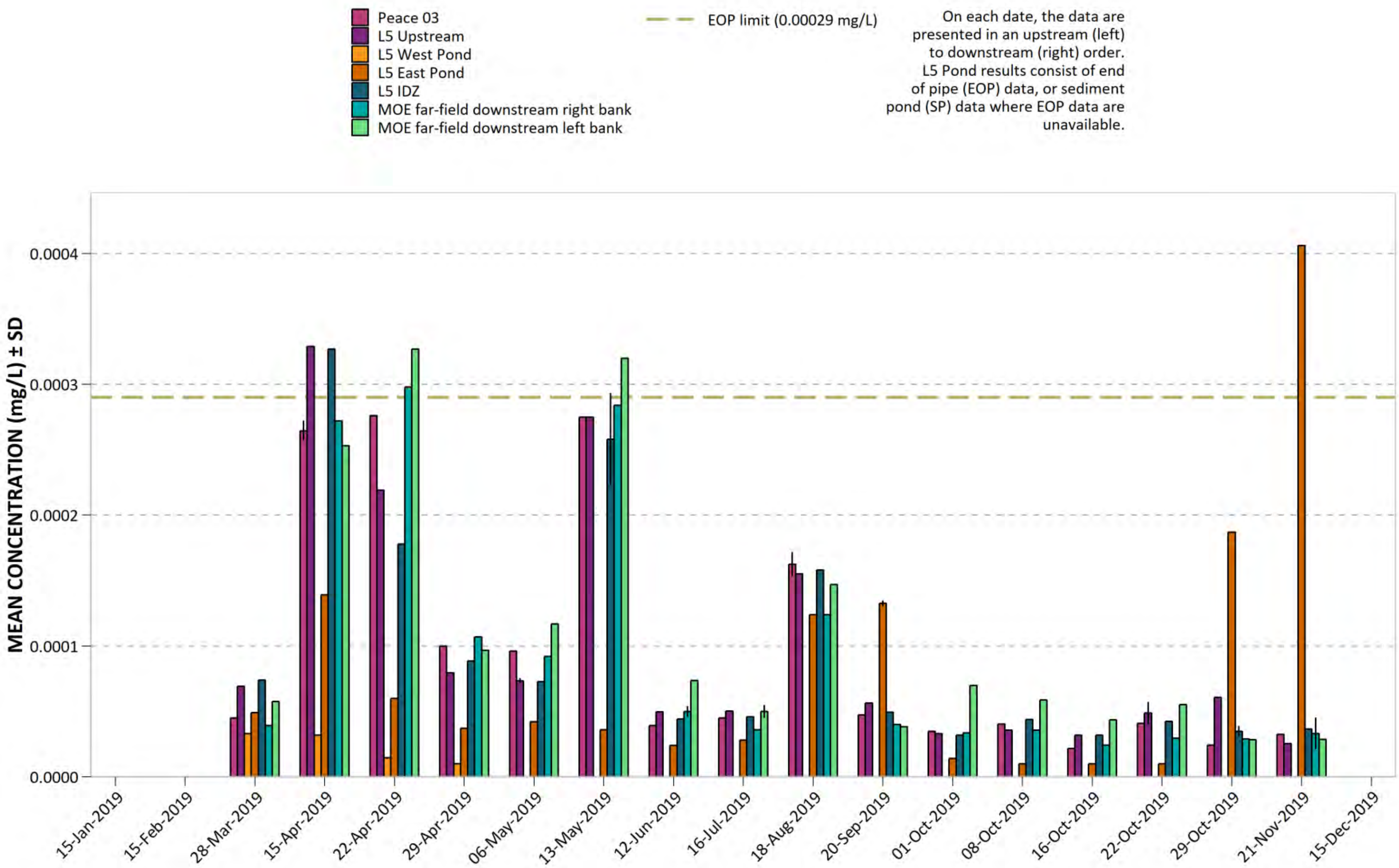


Figure 203. 2019 Peace River and RSEM L5 pond total calcium (Ca).

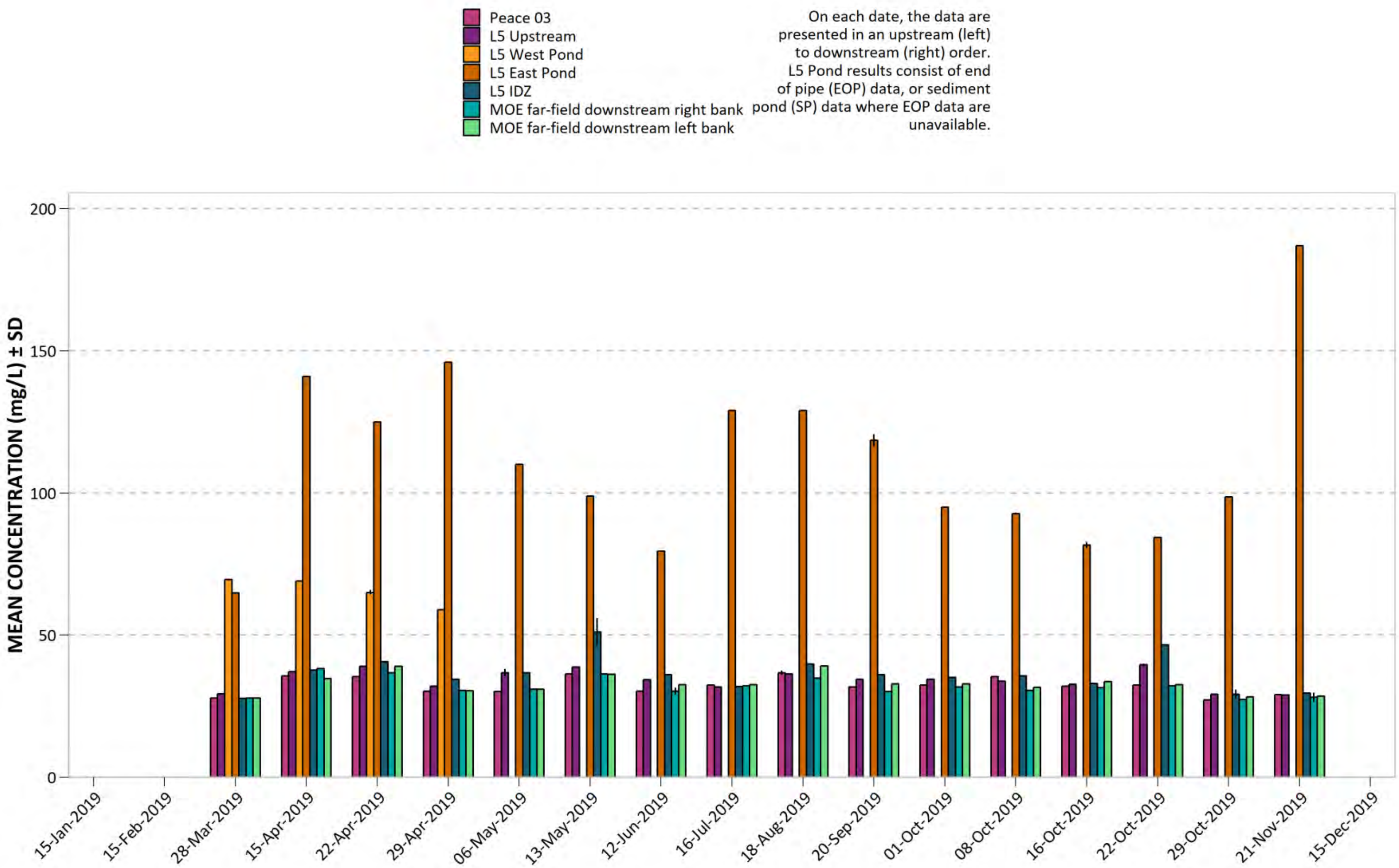


Figure 204. 2019 Peace River and RSEM L5 pond total chromium (Cr).

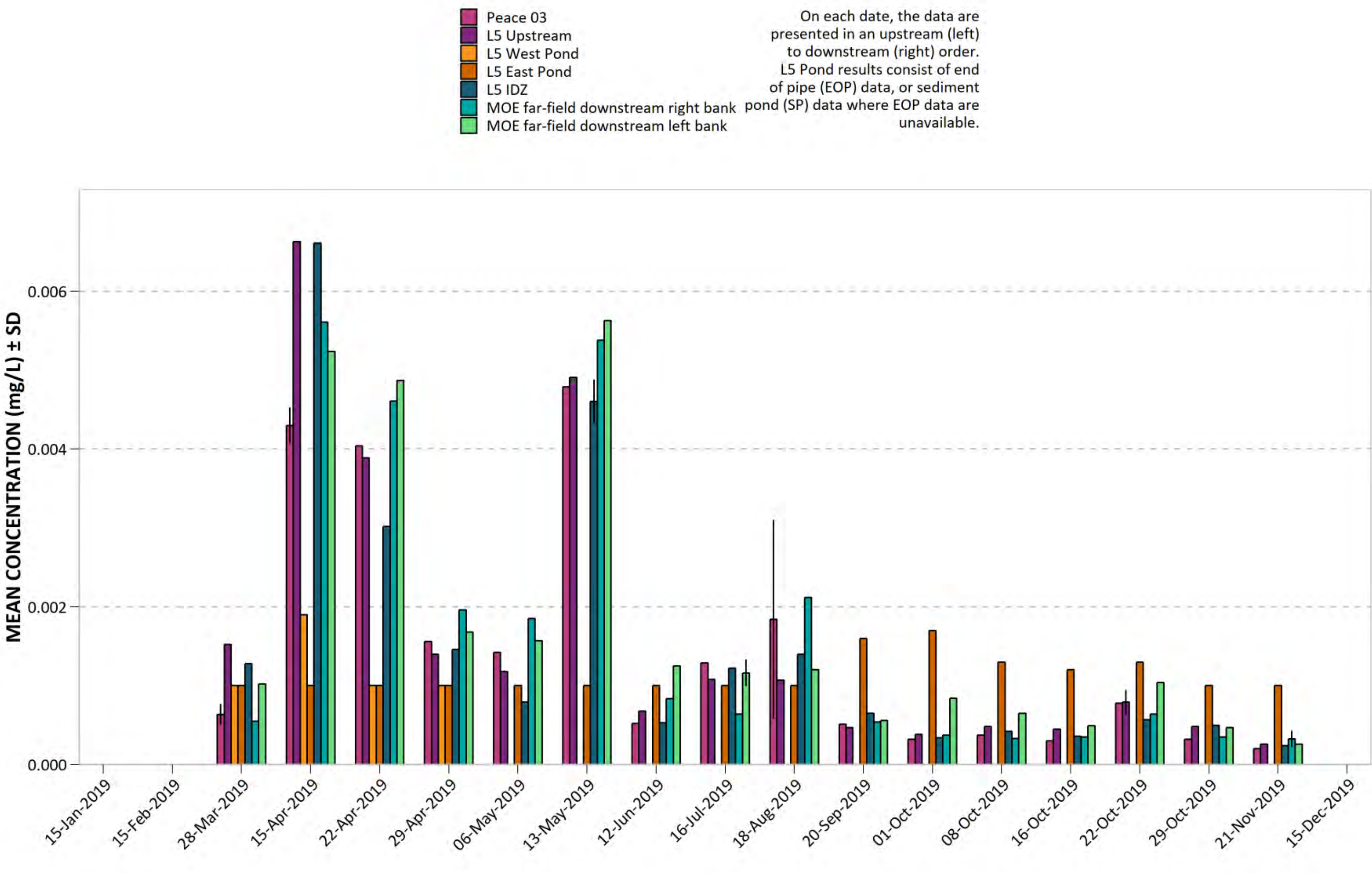


Figure 205. 2019 Peace River and RSEM L5 pond total cobalt (Co).

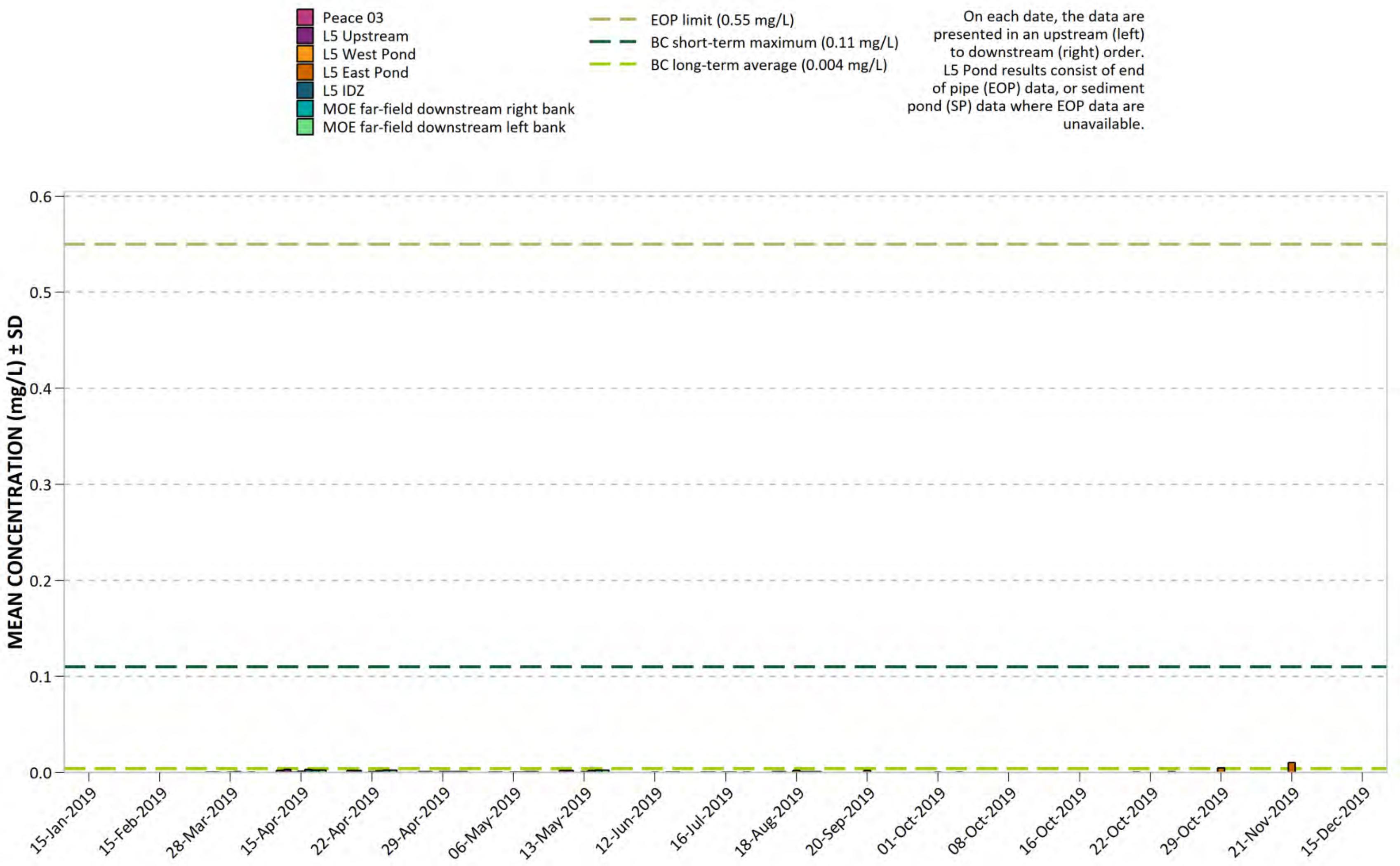


Figure 206. 2019 Peace River and RSEM L5 pond total copper (Cu); new dissolved copper BC WQG replaced the total copper BC WQG in August 2019 (MOE 2019).

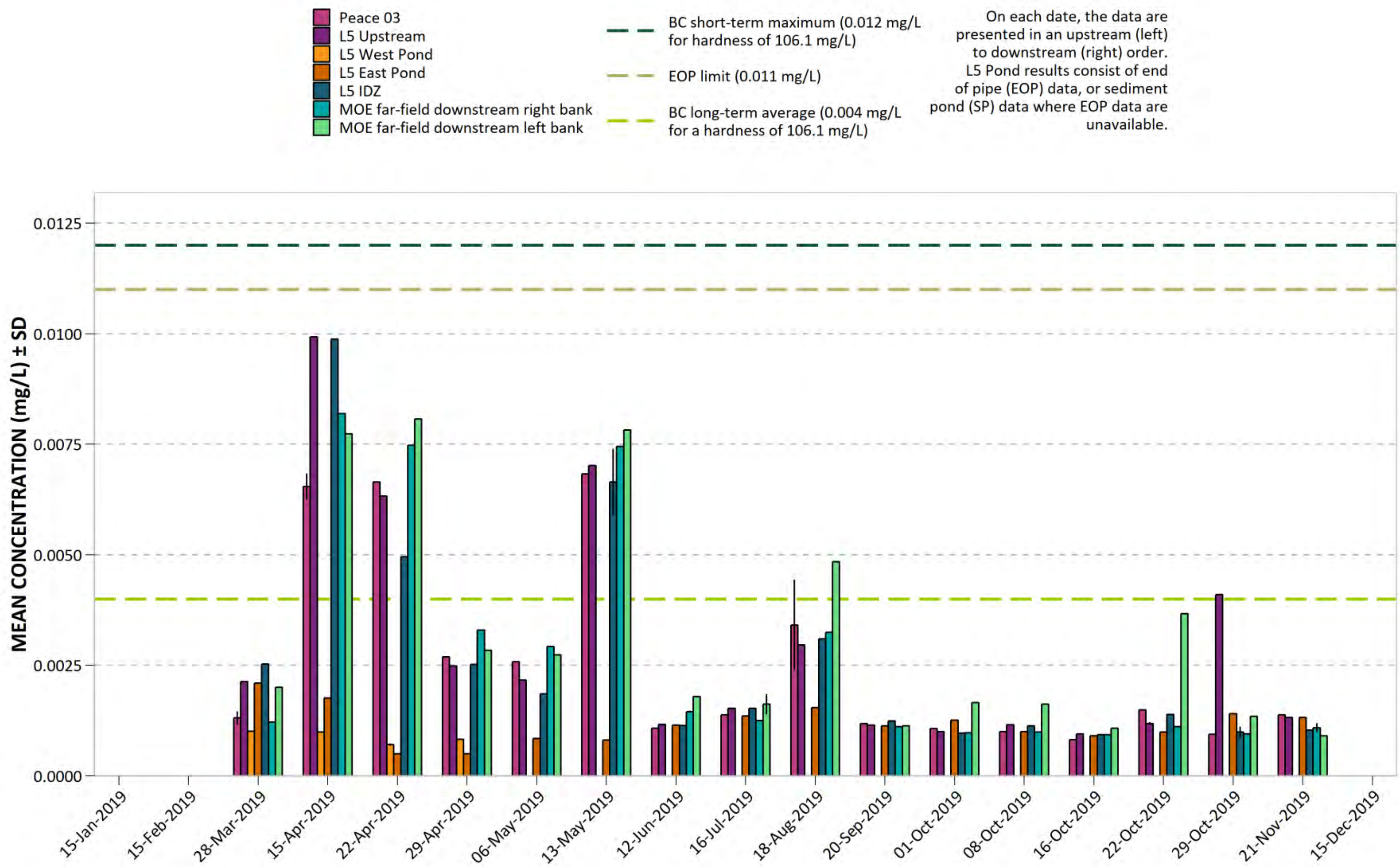


Figure 207. 2019 Peace River and RSEM L5 pond total iron (Fe).

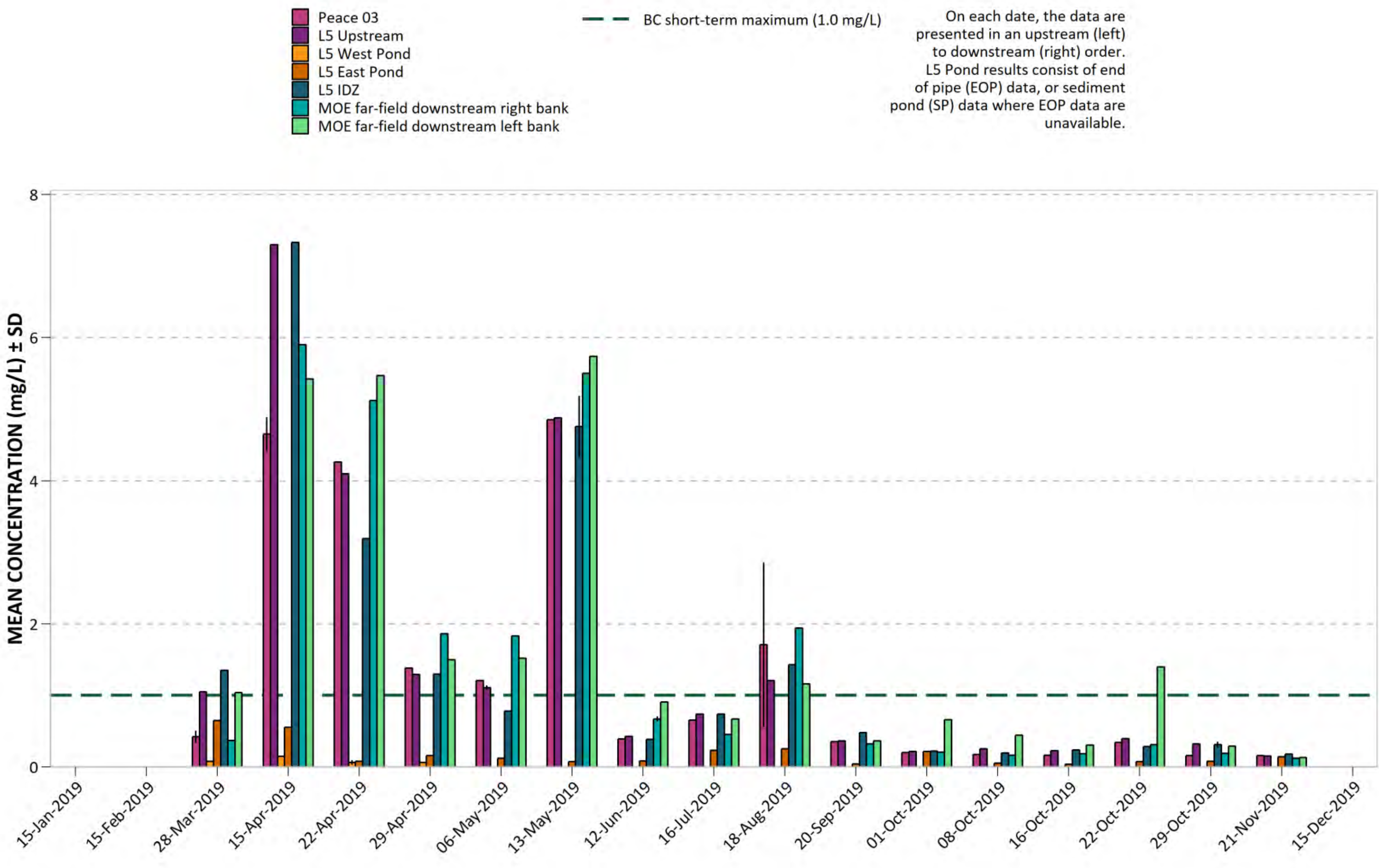


Figure 208. 2019 Peace River and RSEM L5 pond total lead (Pb).

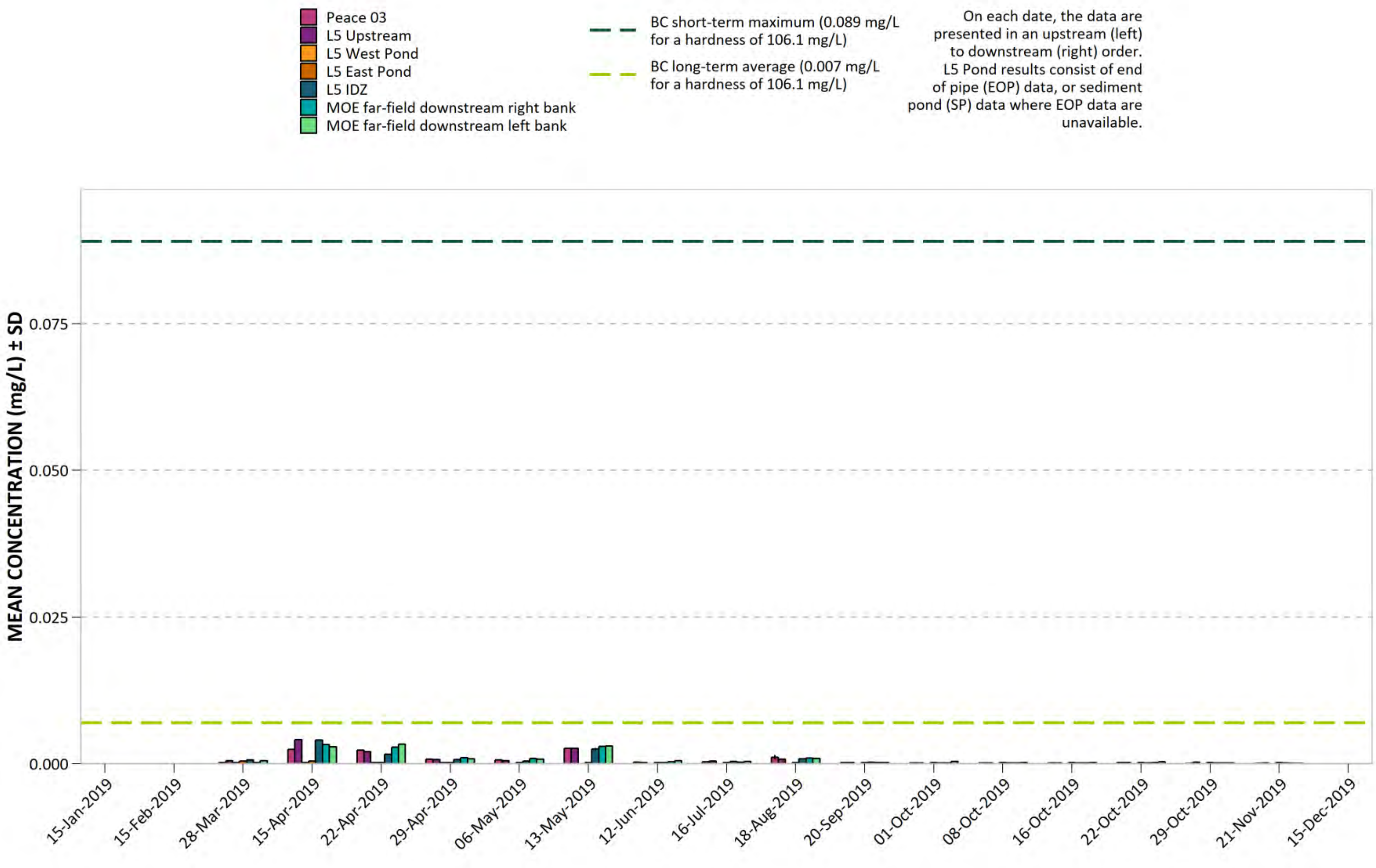


Figure 209. 2019 Peace River and RSEM L5 pond total lithium (Li).

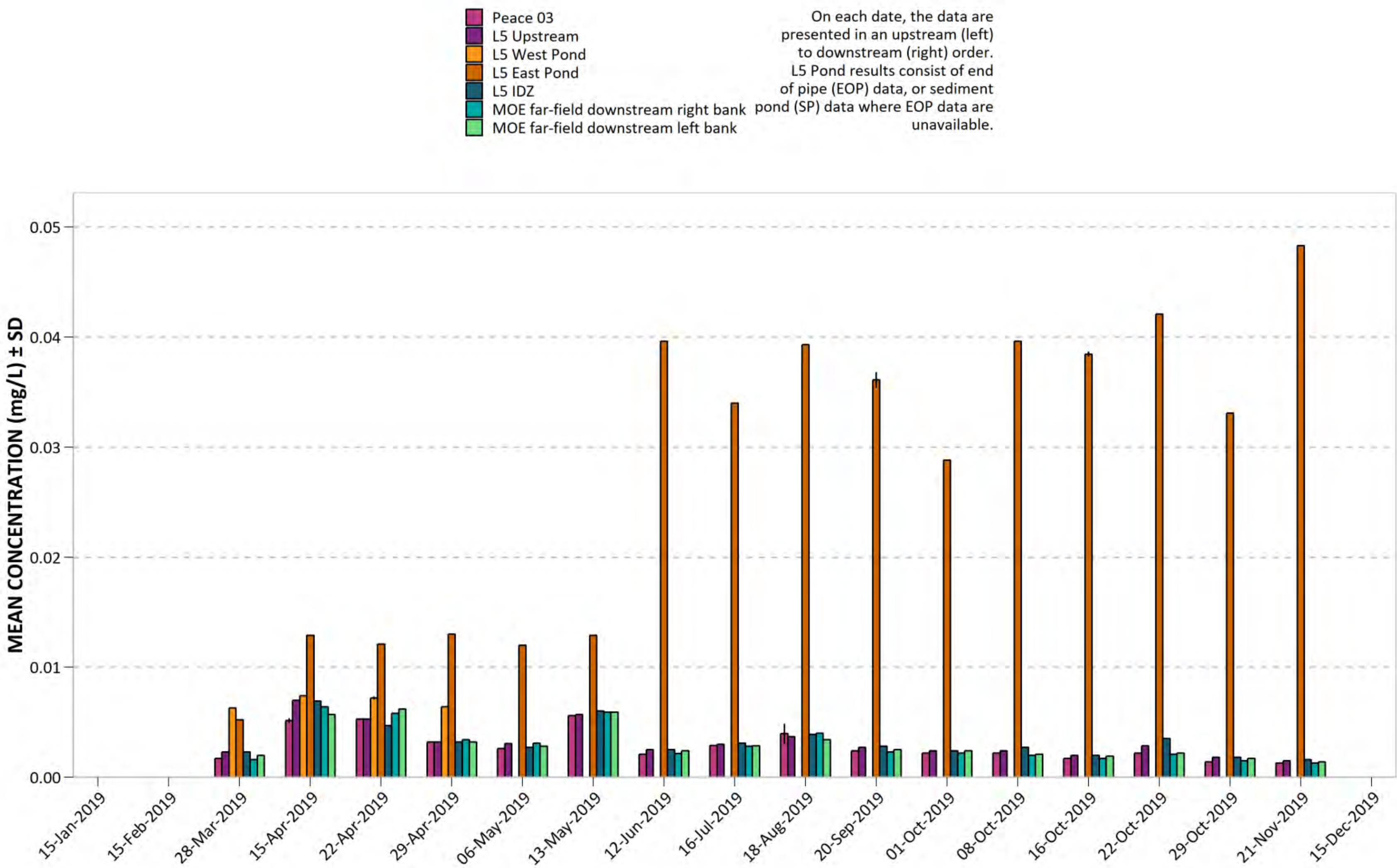


Figure 210. 2019 Peace River and RSEM L5 pond total magnesium (Mg).

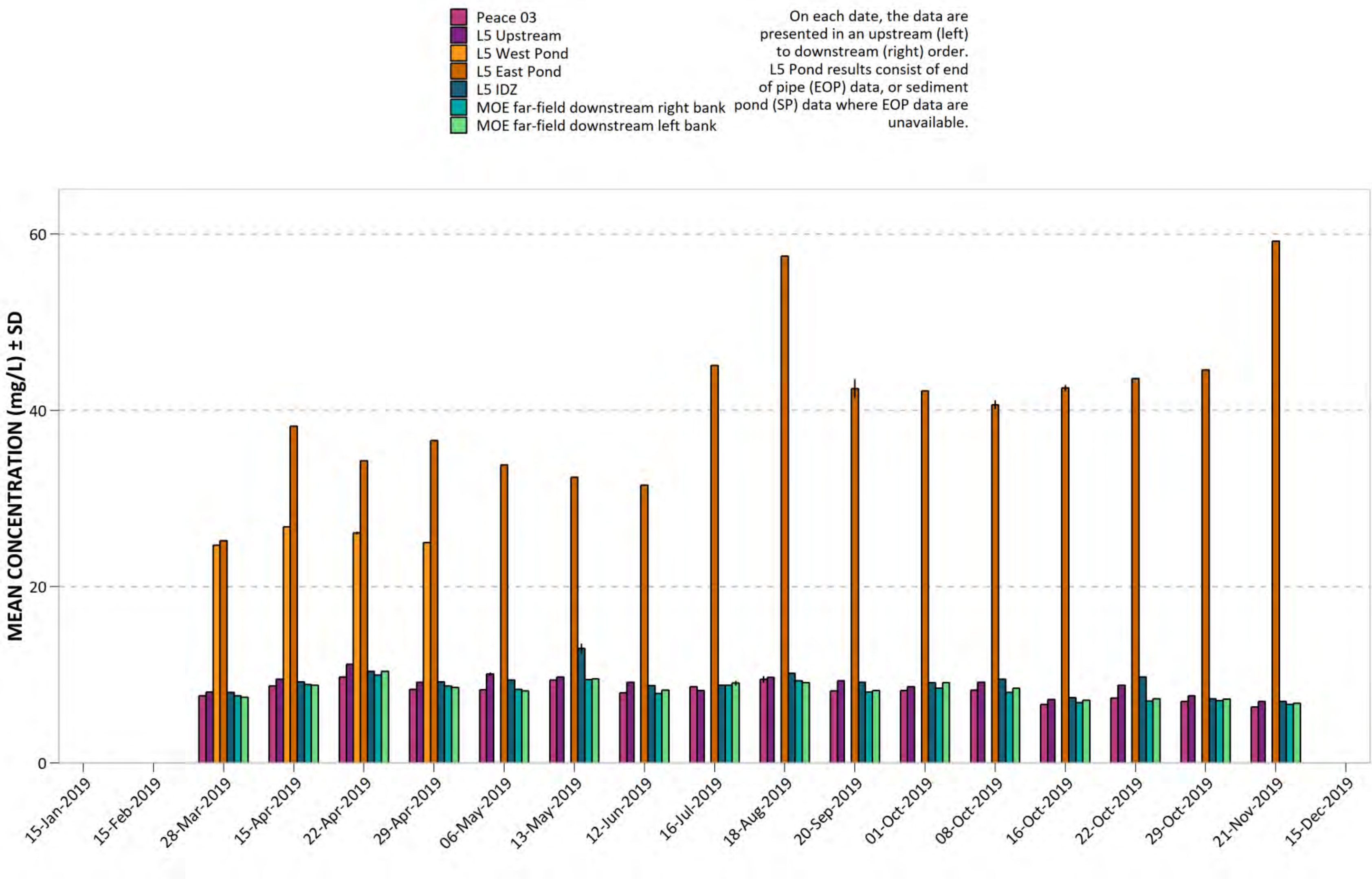


Figure 211. 2019 Peace River and RSEM L5 pond total manganese (Mn).

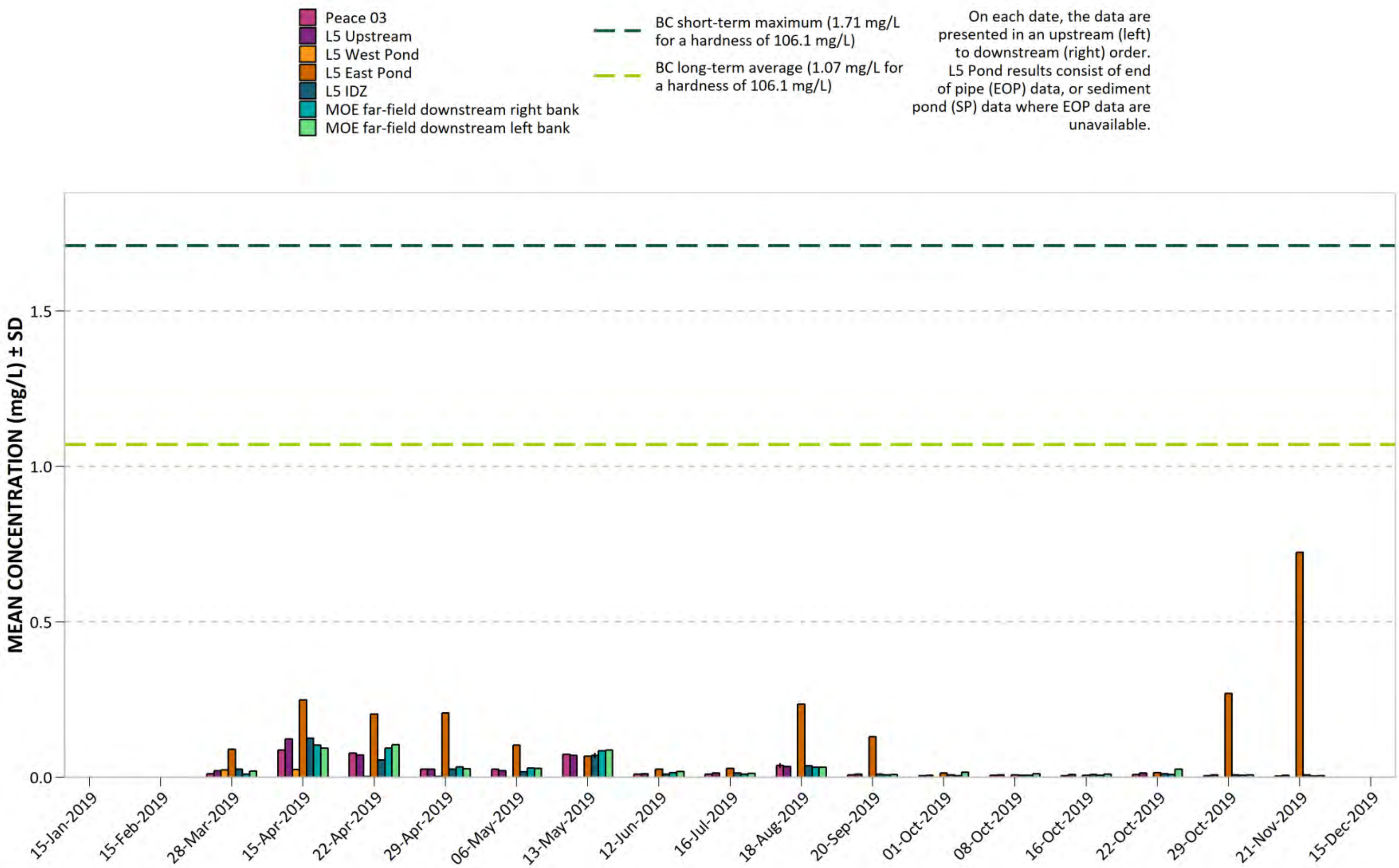
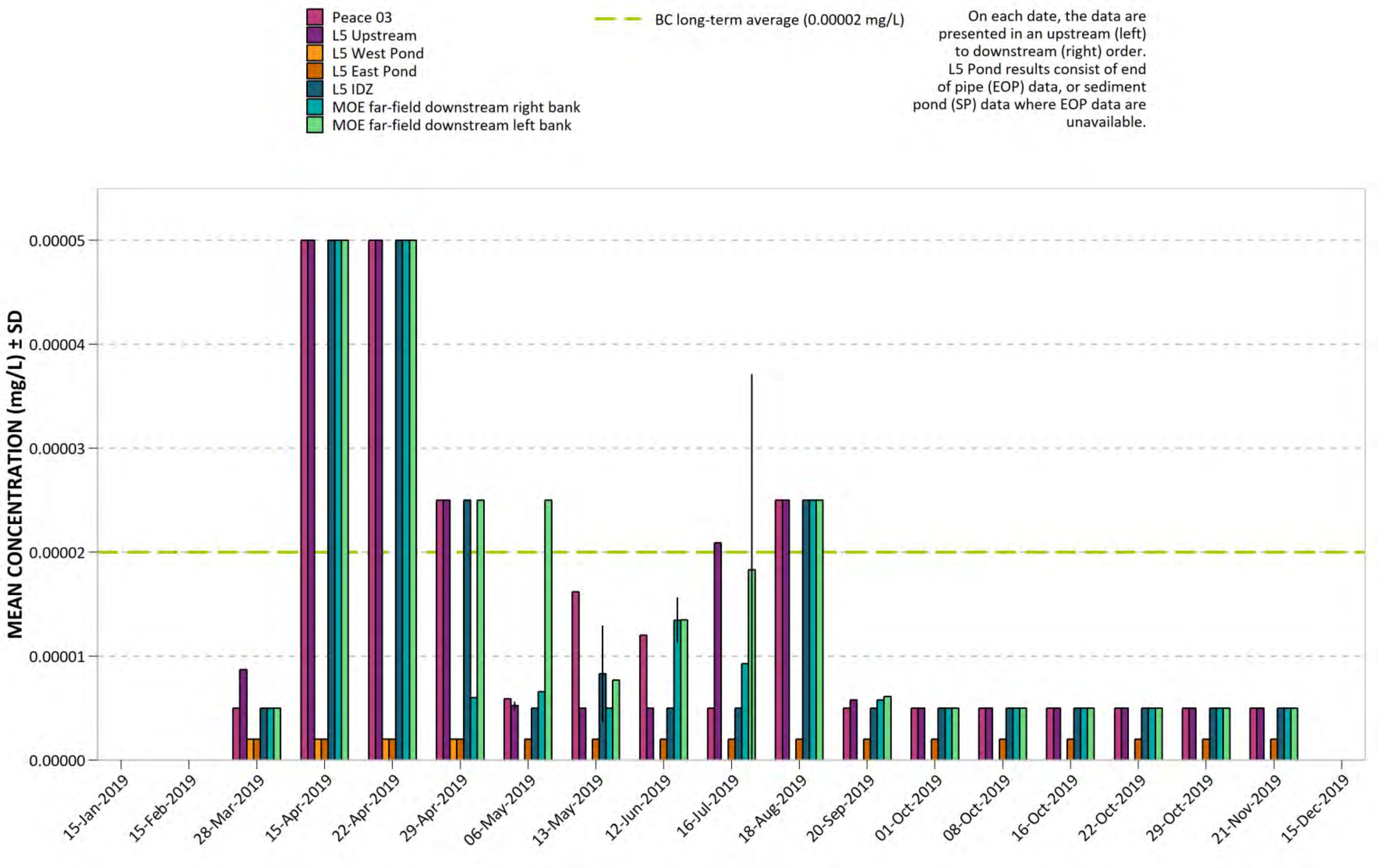


Figure 212. 2019 Peace River and RSEM L5 pond total mercury (Hg).



Results lower than the MDL are assigned the MDL value, which varies for total mercury depending on matrix effects. Most results in 2019 were assigned the MDL value.

Figure 213. 2019 Peace River and RSEM L5 pond total molybdenum (Mo).

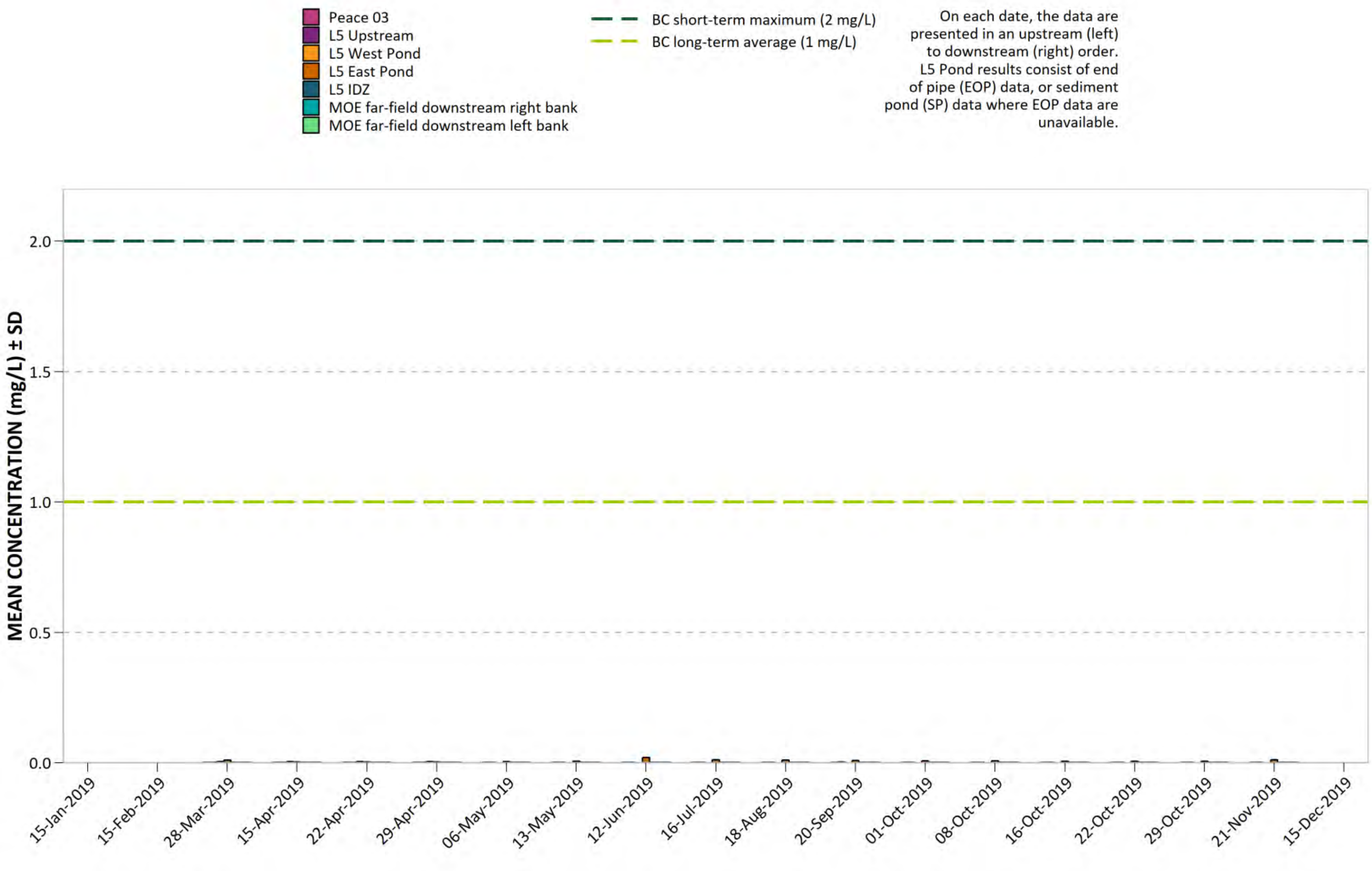


Figure 214. 2019 Peace River and RSEM L5 pond total nickel (Ni).

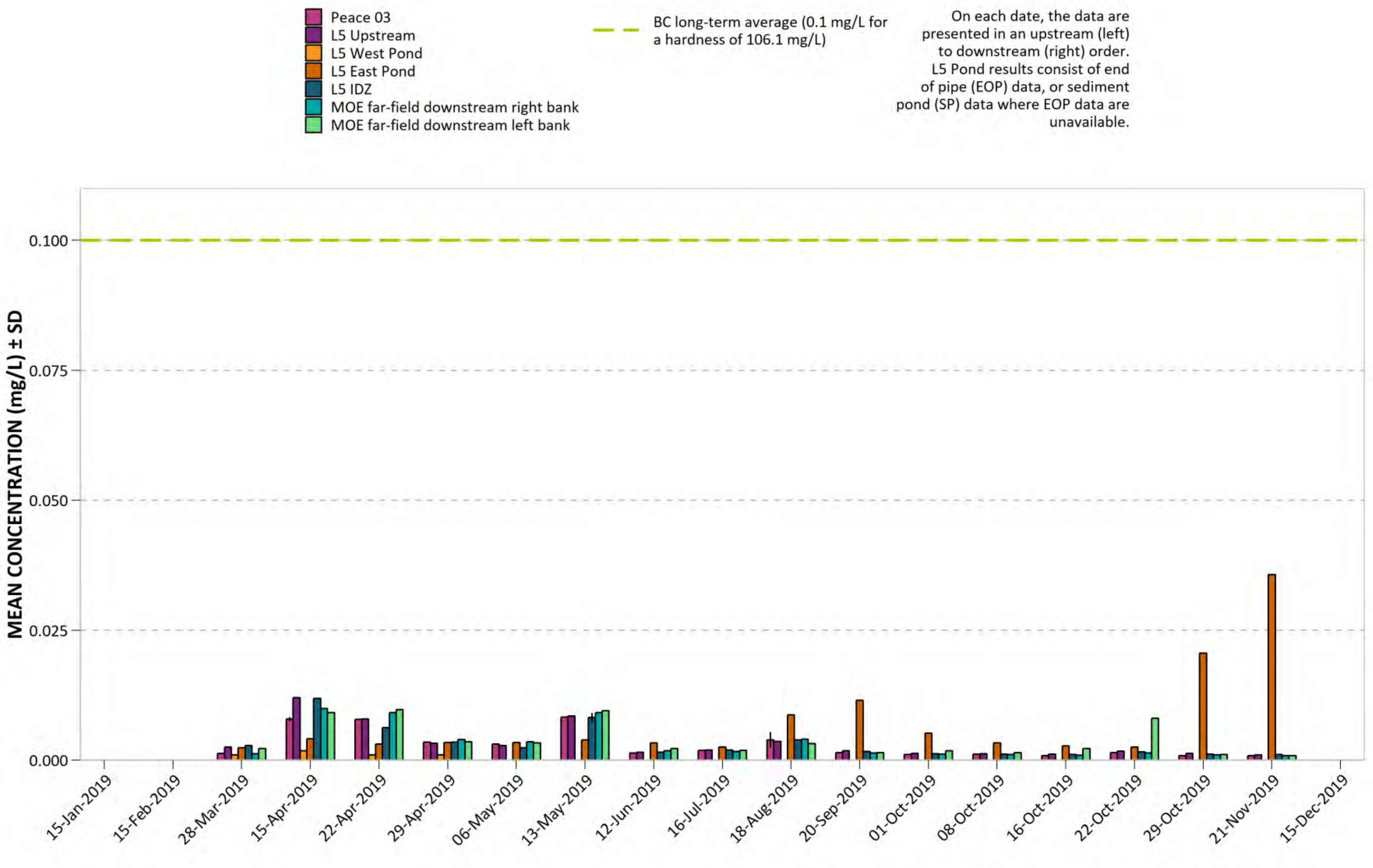


Figure 215. 2019 Peace River and RSEM L5 pond total potassium (K).

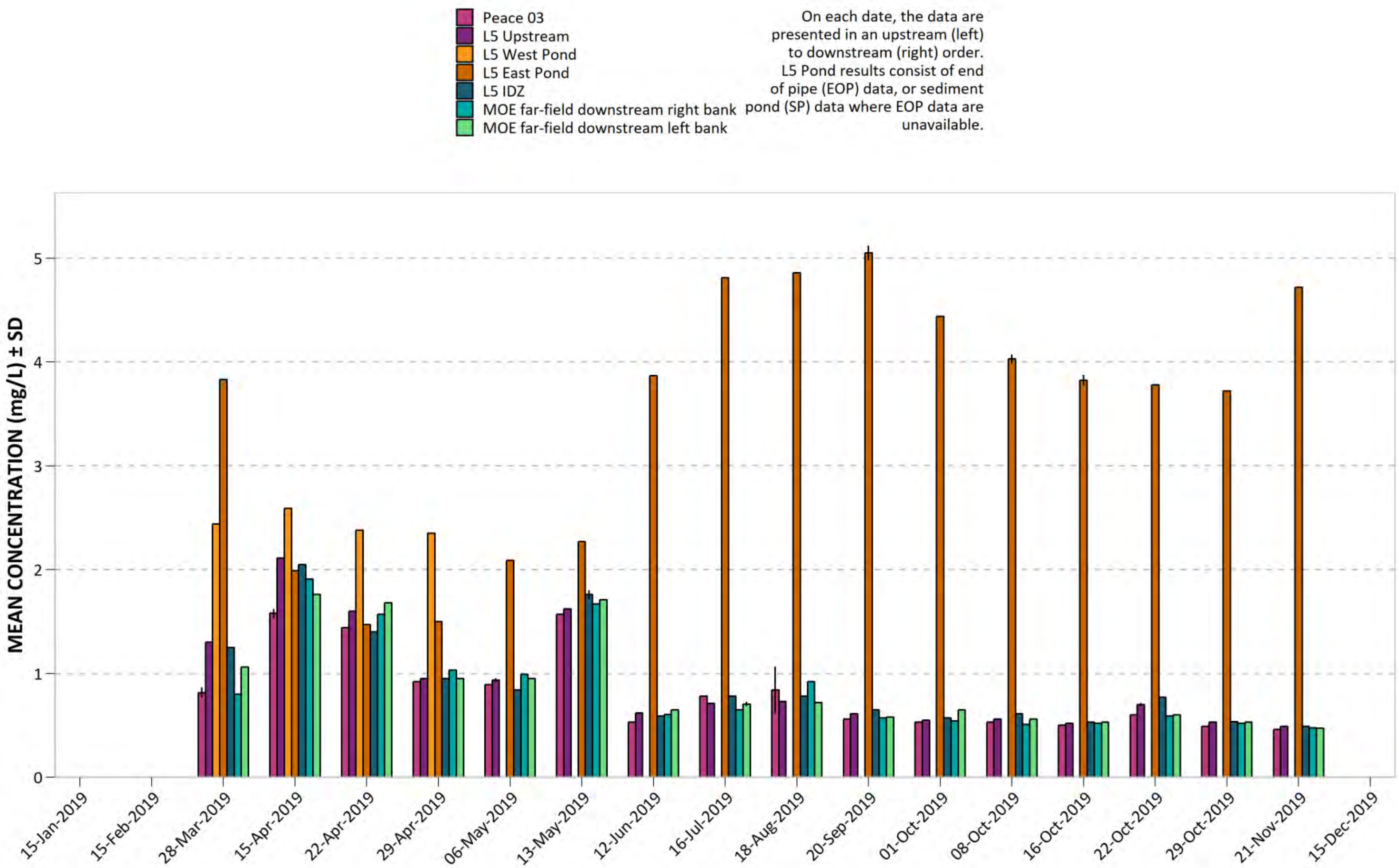


Figure 216. 2019 Peace River and RSEM L5 pond total selenium (Se).

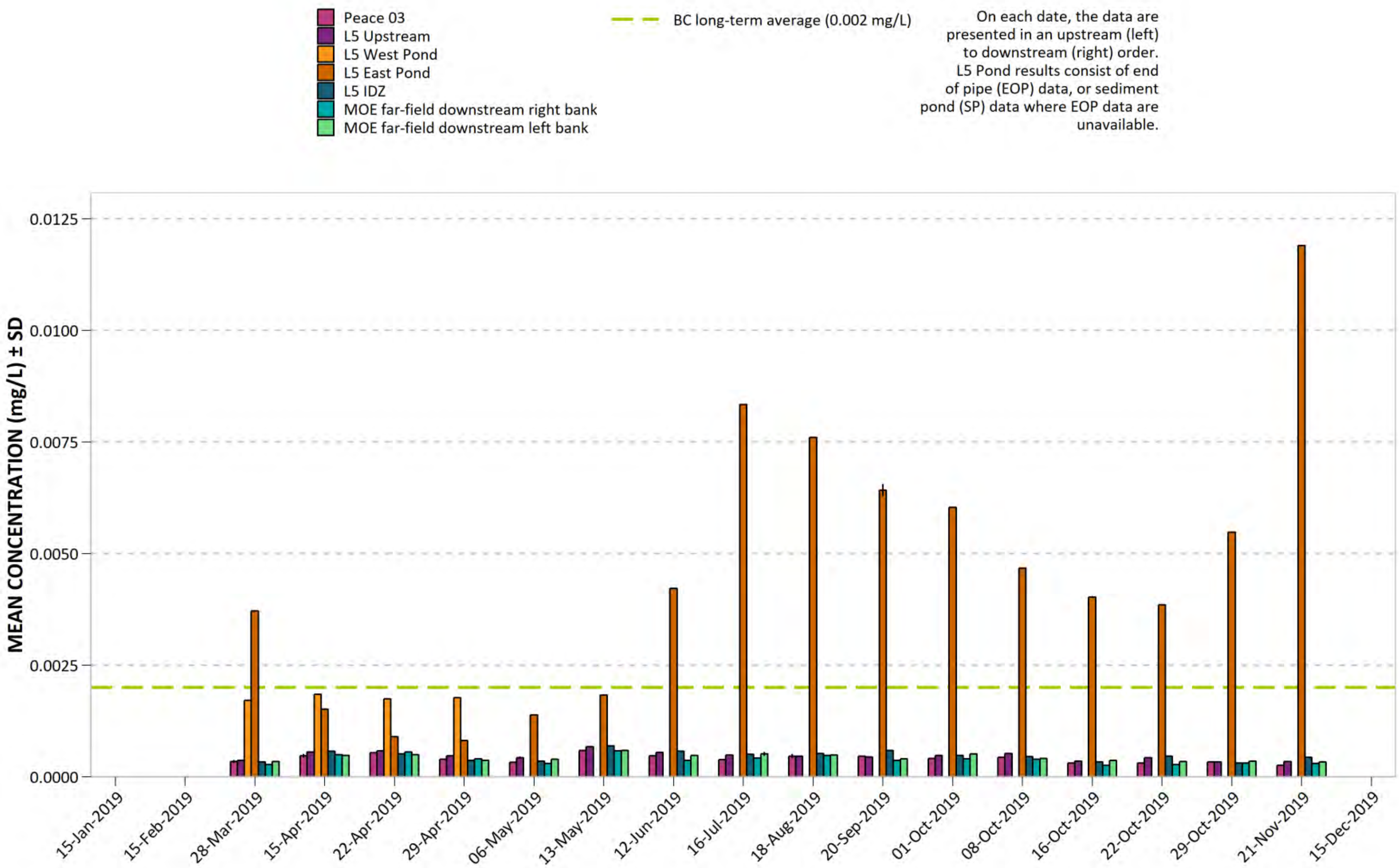


Figure 217. 2019 Peace River and RSEM L5 pond total silicon (Si).

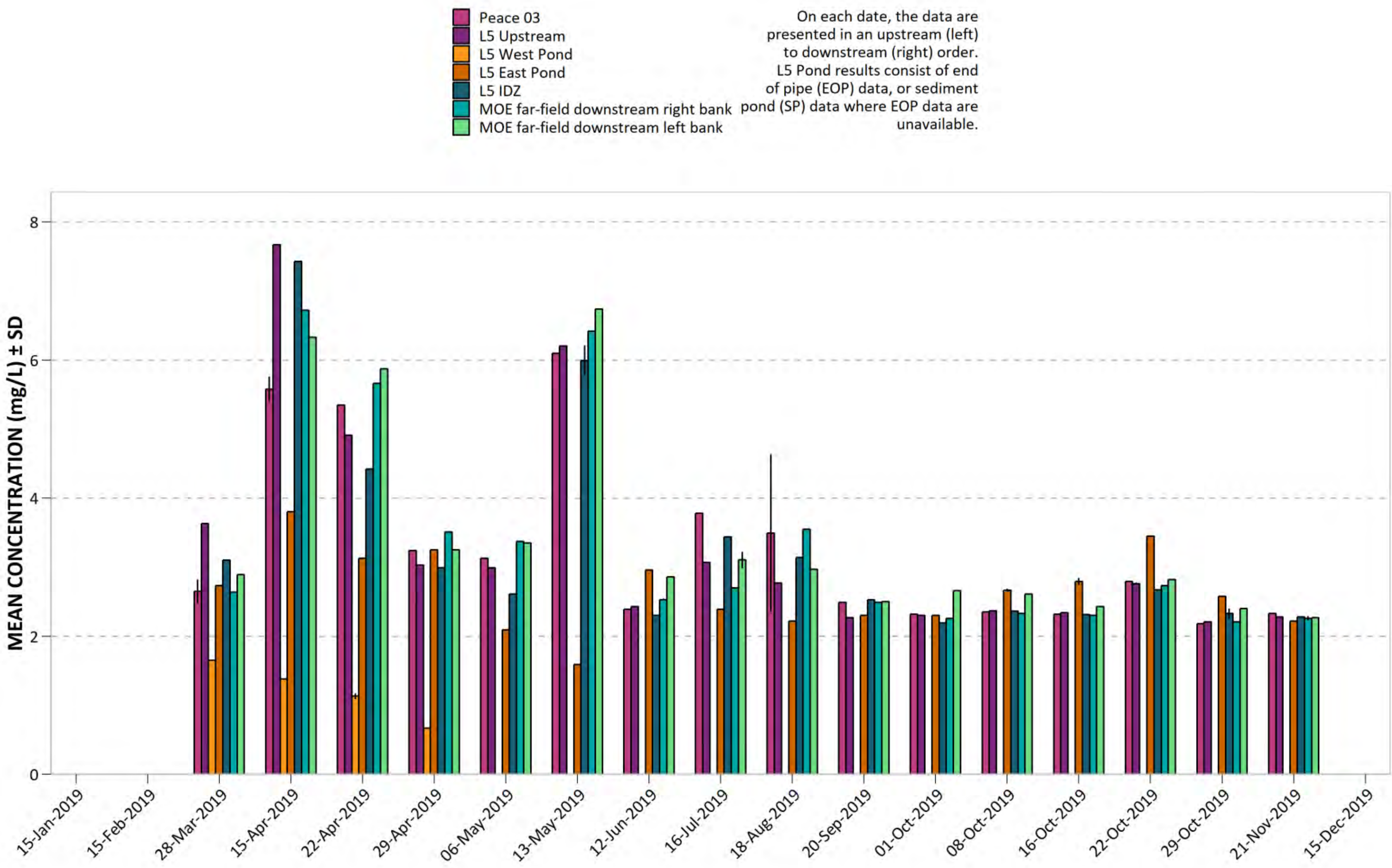


Figure 218. 2019 Peace River and RSEM L5 pond total silver (Ag).

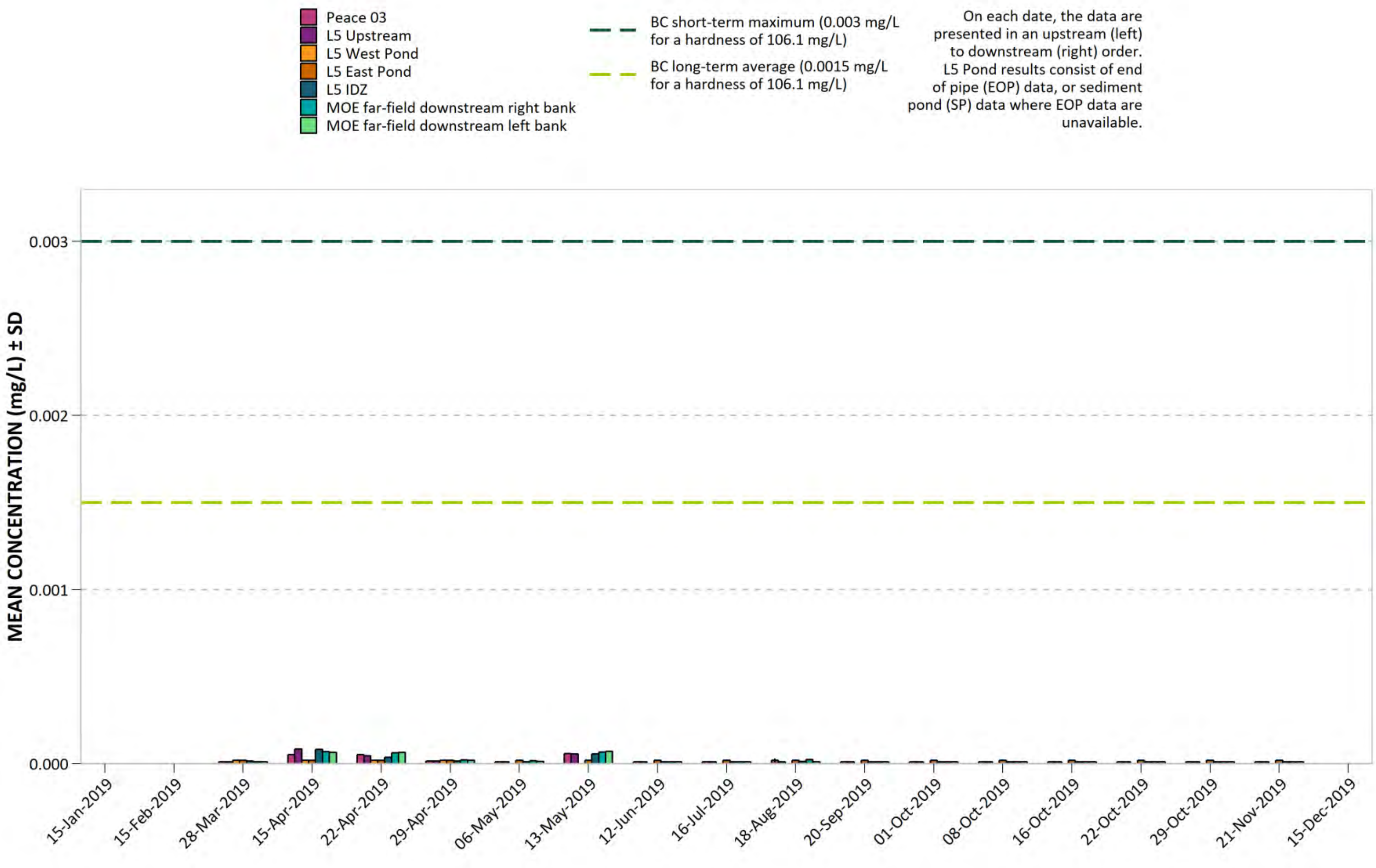


Figure 219. 2019 Peace River and RSEM L5 pond total sodium (Na).

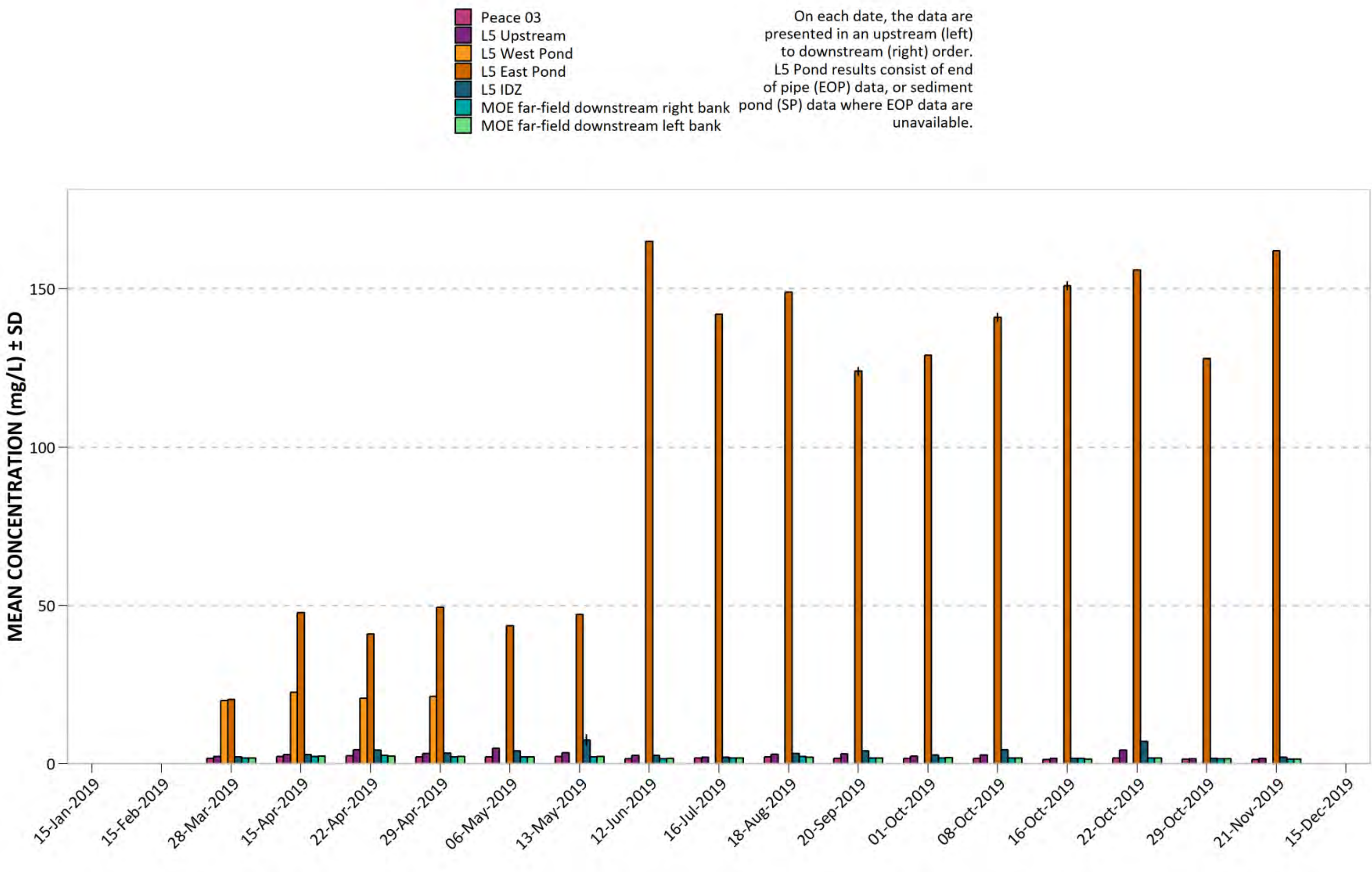


Figure 220. 2019 Peace River and RSEM L5 pond total strontium (Sr).

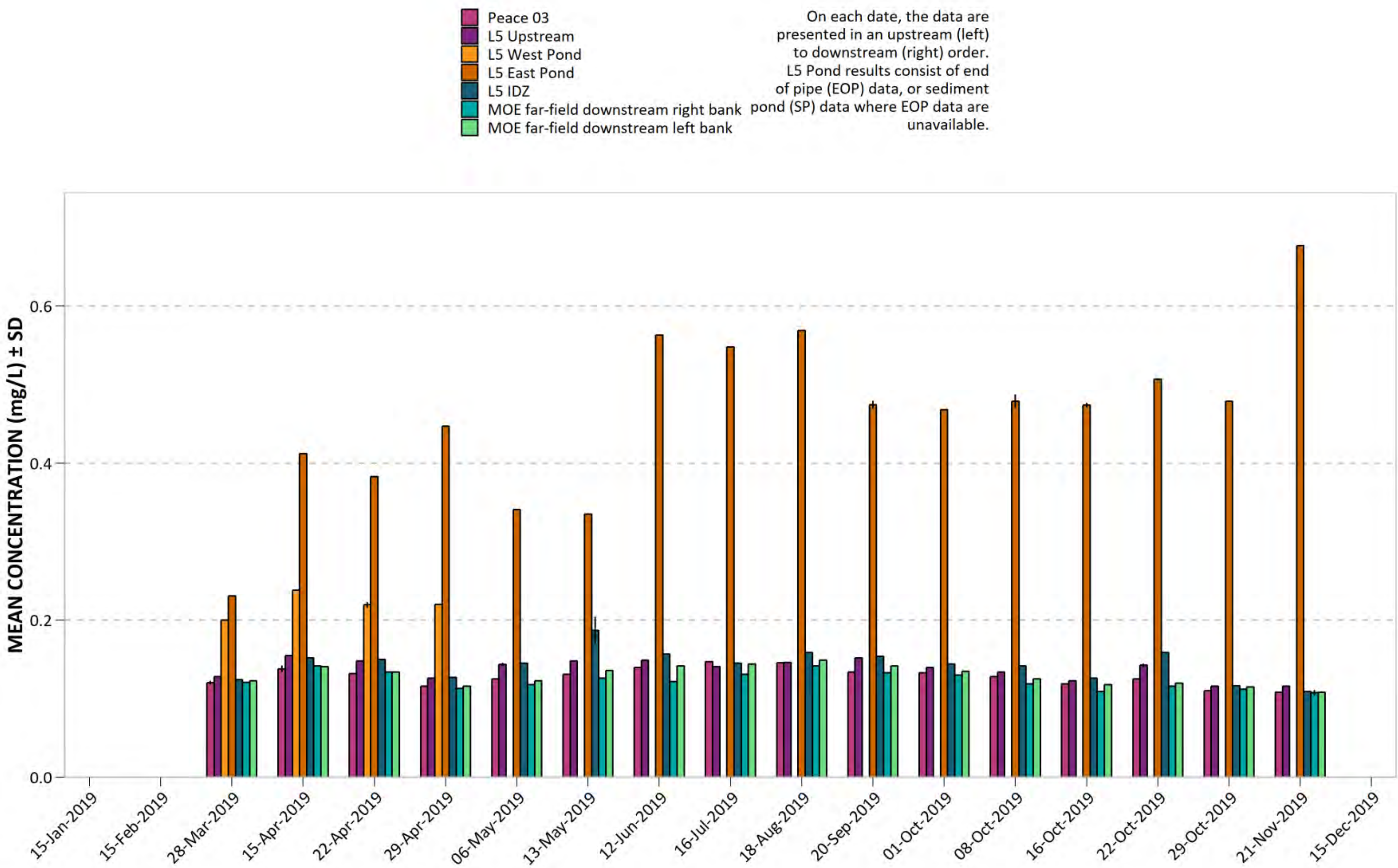


Figure 221. 2019 Peace River and RSEM L5 pond total sulfur (S).

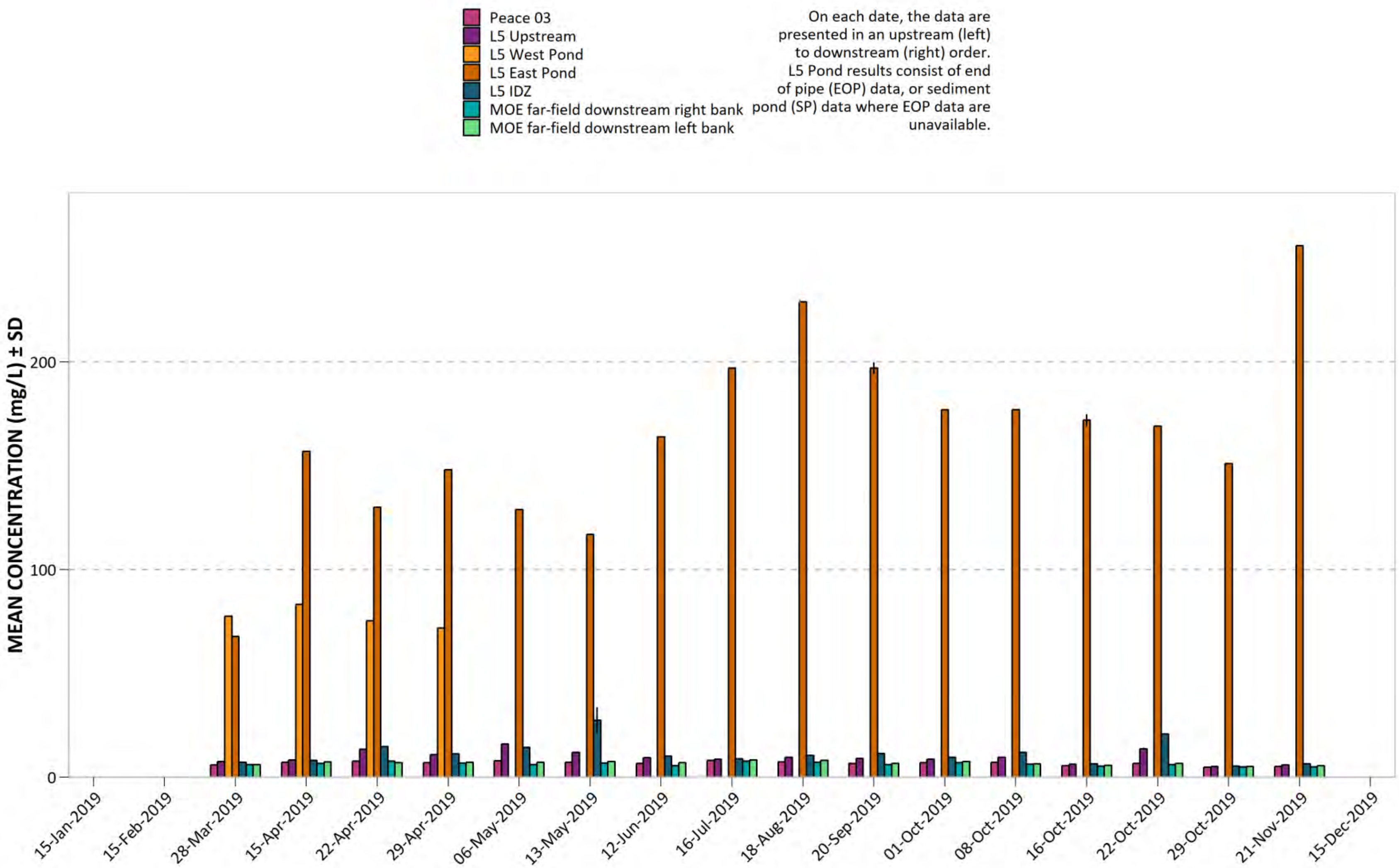
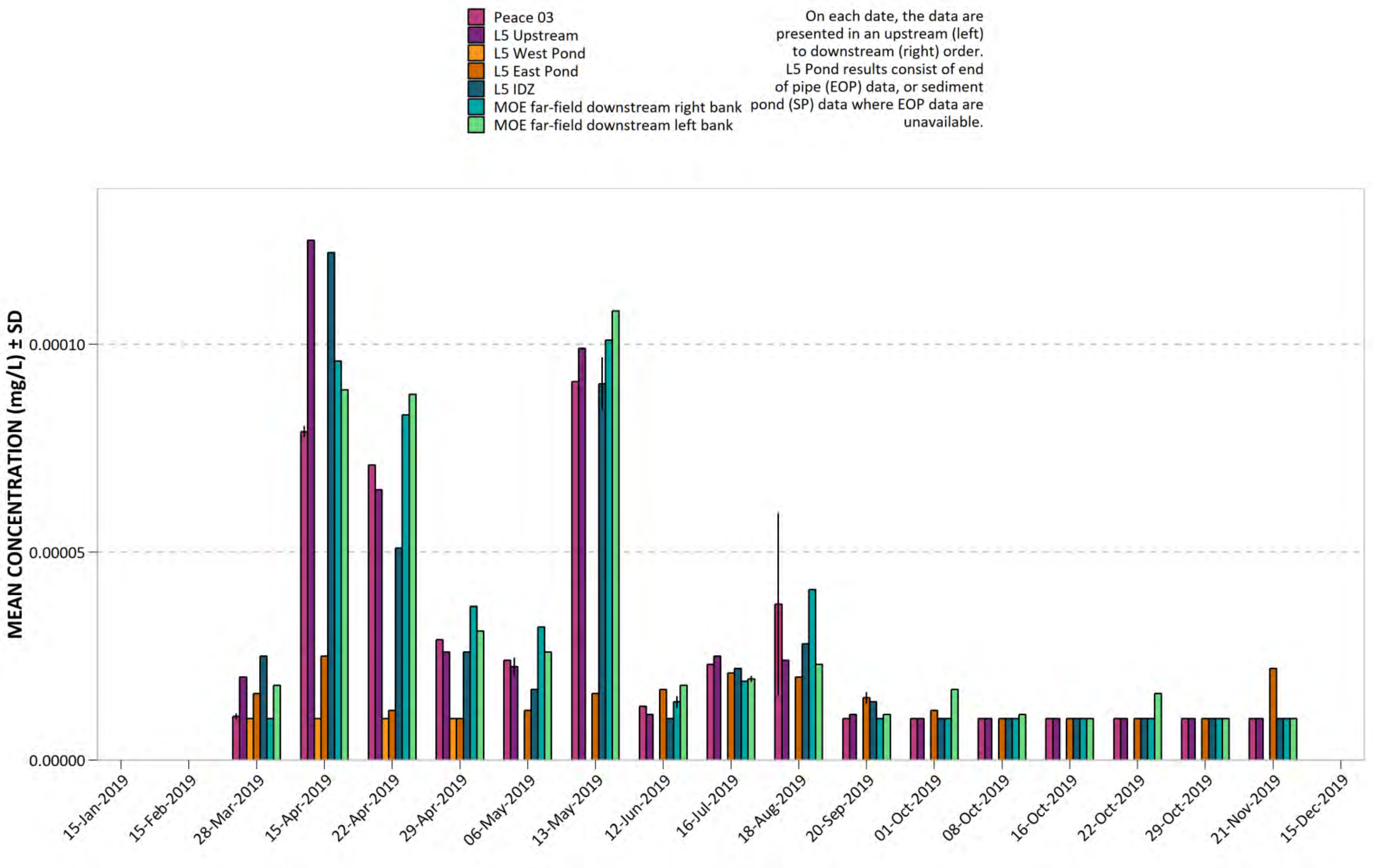
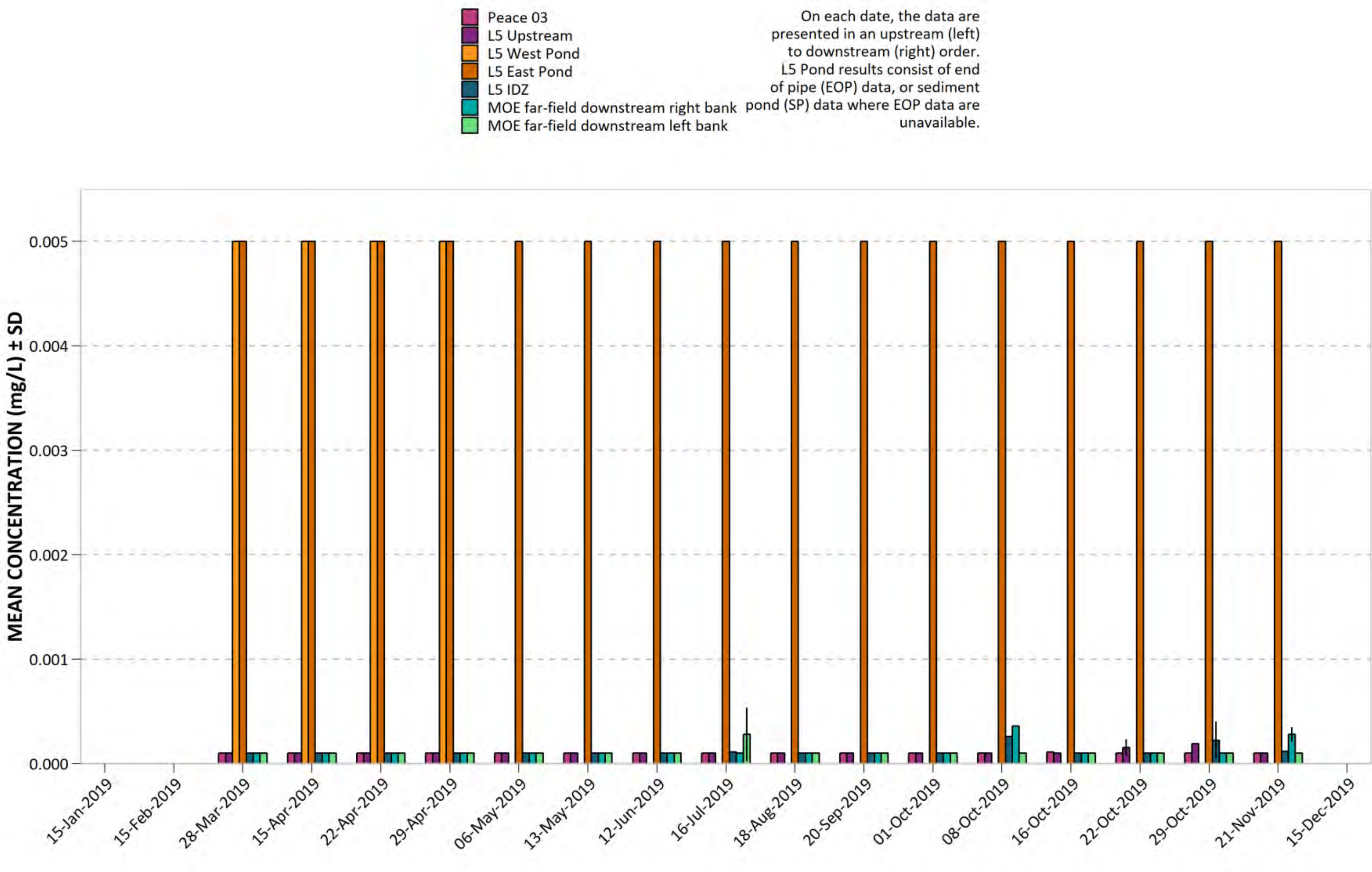


Figure 222. 2019 Peace River and RSEM L5 pond total thallium (Tl).



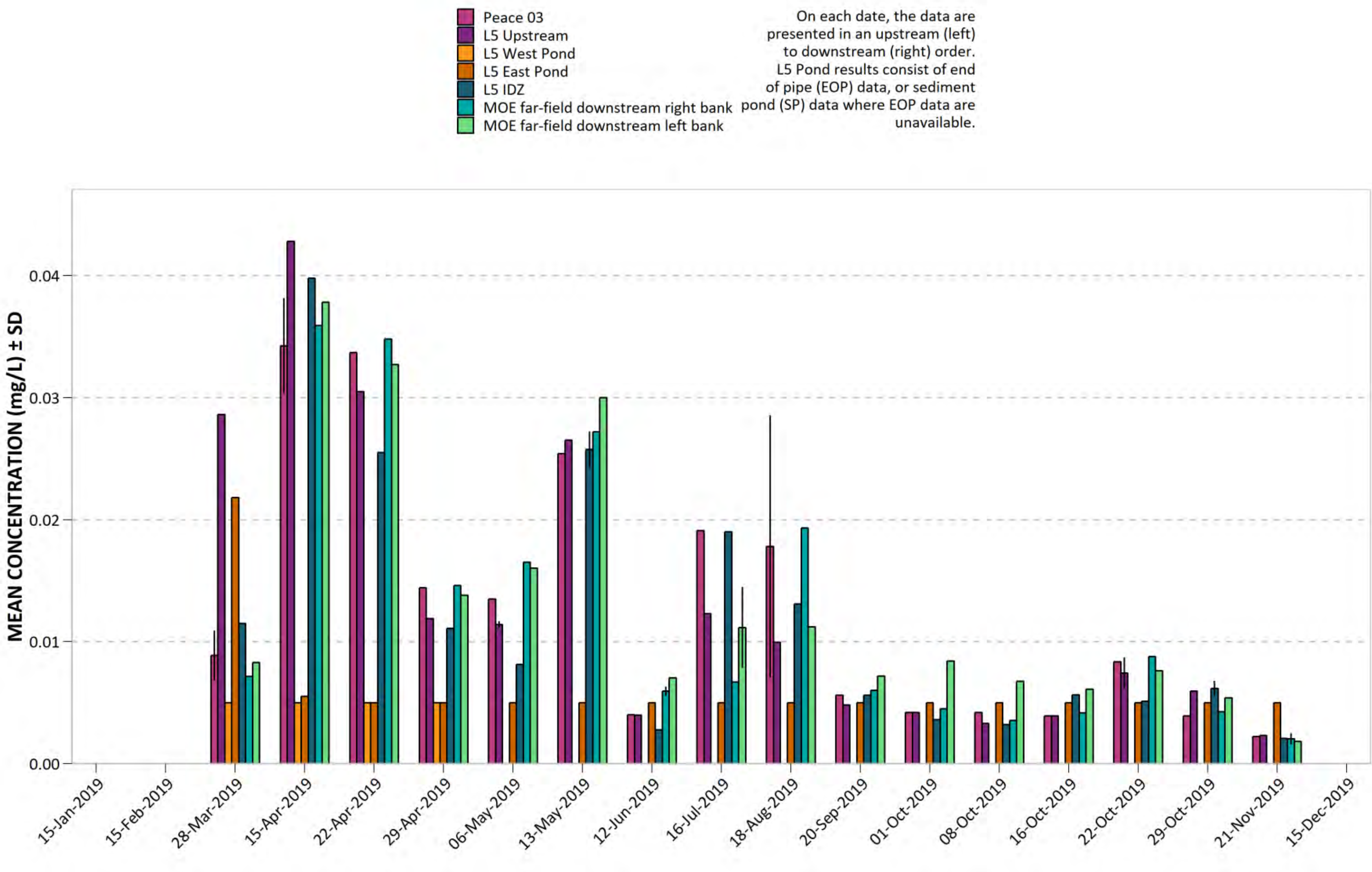
Results less than the MDL were assigned the MDL value of 0.00001 mg/L (Pond and Peace River).

Figure 223. 2019 Peace River and RSEM L5 pond total tin (Sn).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 224. 2019 Peace River and RSEM L5 pond total titanium (Ti).



Pond results less than the MDL were assigned the MDL value of 0.005 mg/L.

Figure 225. 2019 Peace River and RSEM L5 pond total uranium (U).

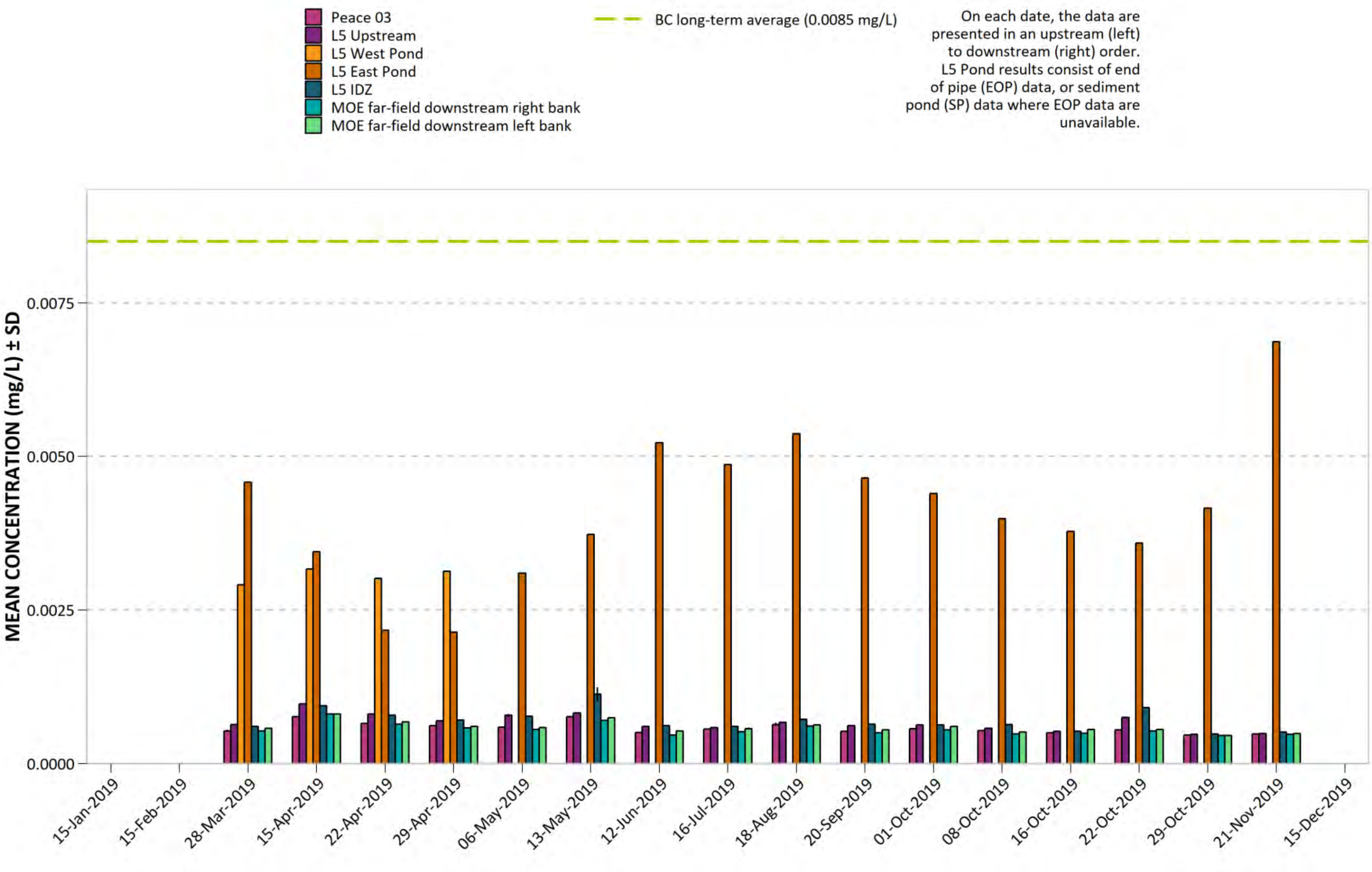
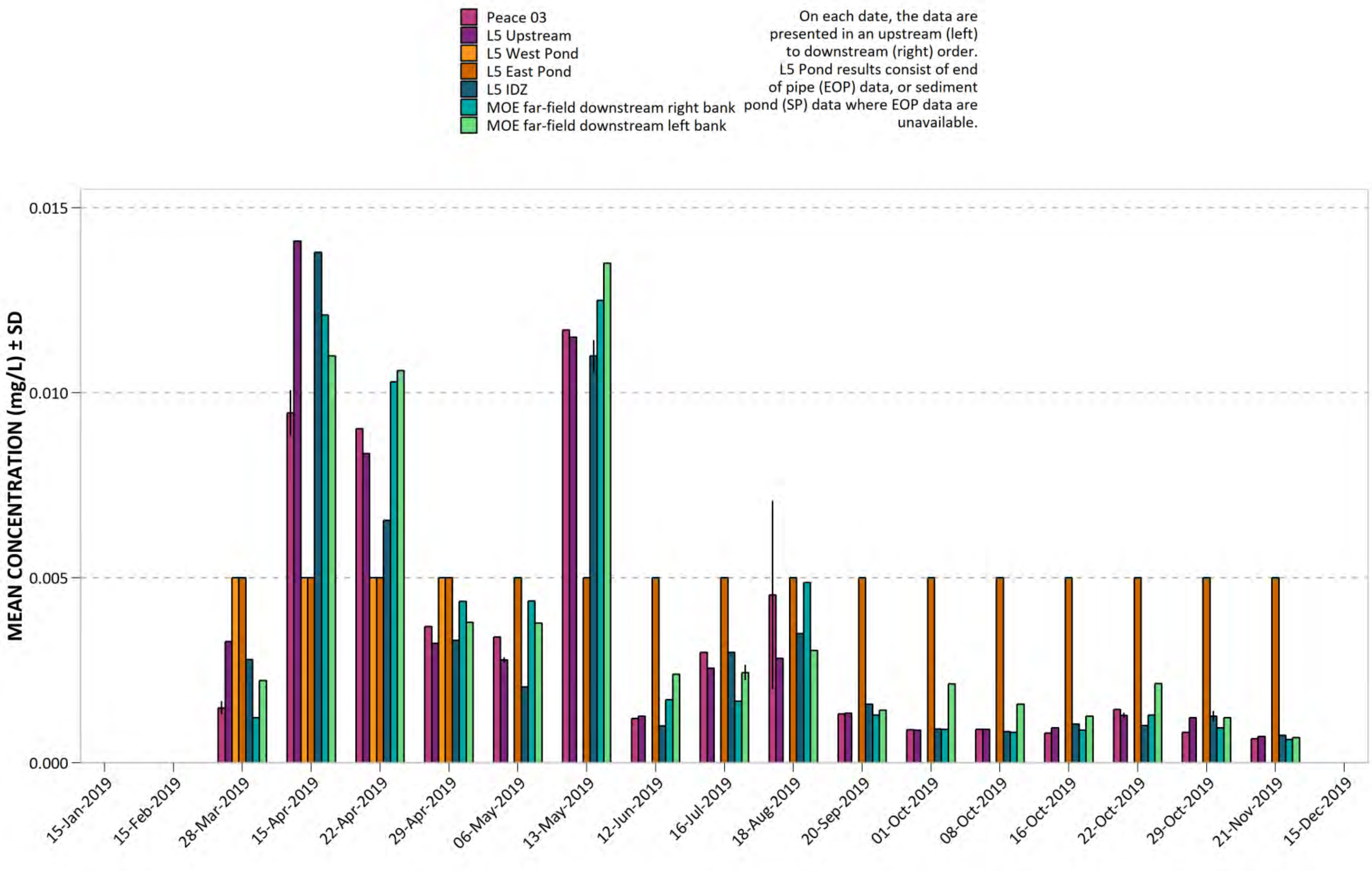
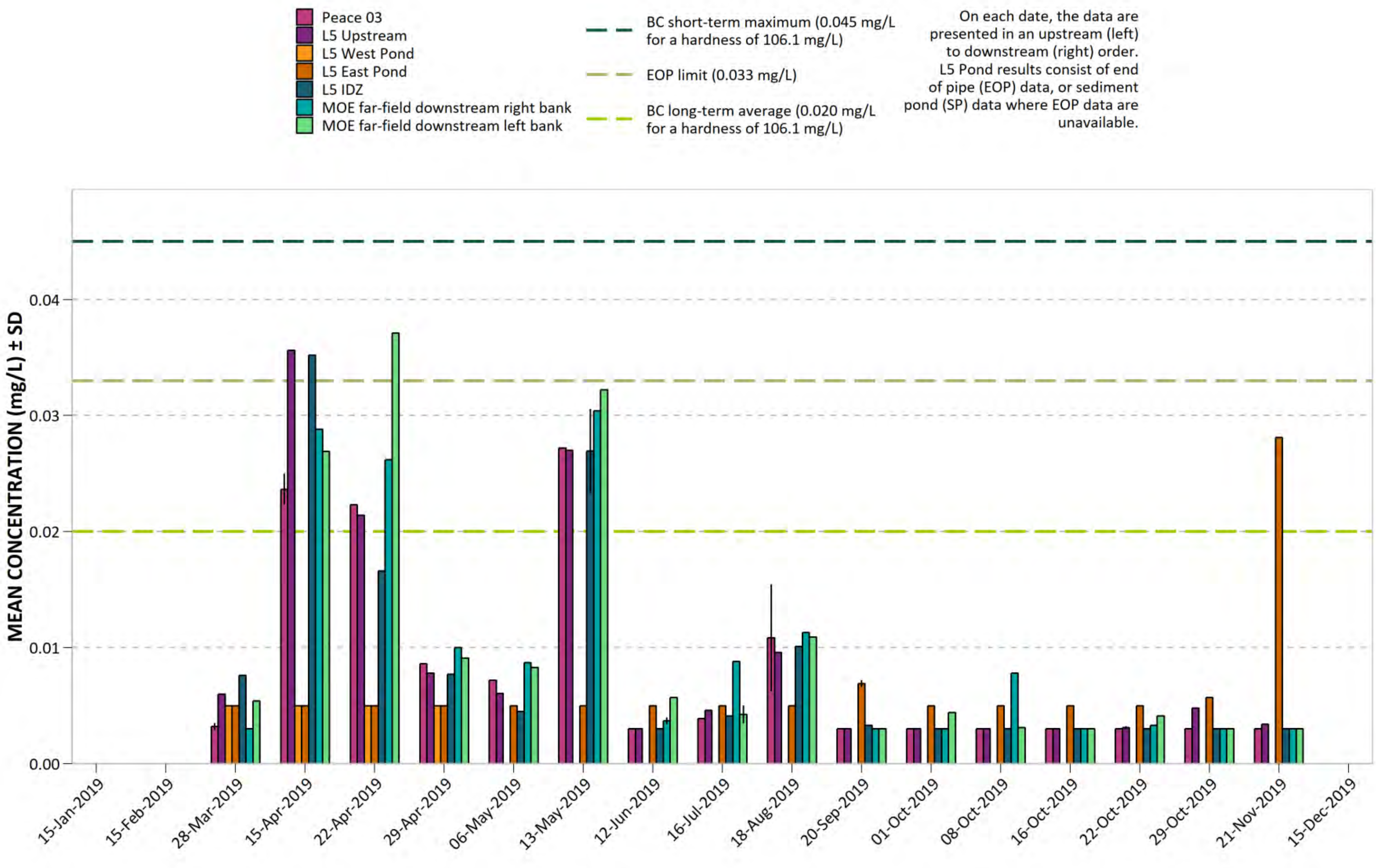


Figure 226. 2019 Peace River and RSEM L5 pond total vanadium (V).



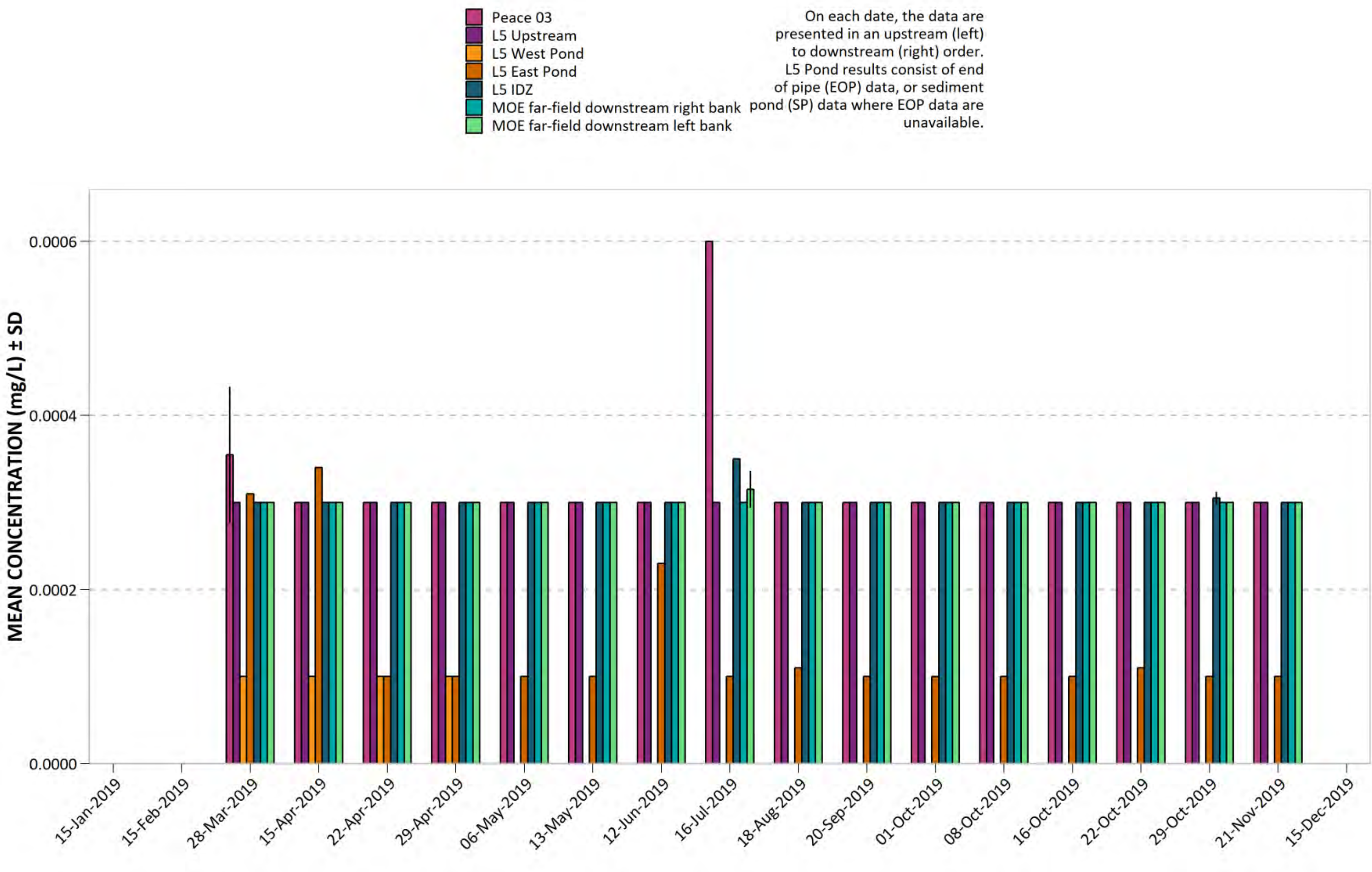
Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0005 mg/L (Peace River).

Figure 227. 2019 Peace River and RSEM L5 pond total zinc (Zn).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.003 mg/L (Peace River).

Figure 228. 2019 Peace River and RSEM L5 pond total zirconium (Zr).



Results less than the MDL were assigned the MDL value of 0.0001 mg/L (Pond) or 0.0003/0.0006 mg/L (Peace River).

Figure 229. 2019 Peace River and RSEM L5 pond dissolved aluminum (Al).

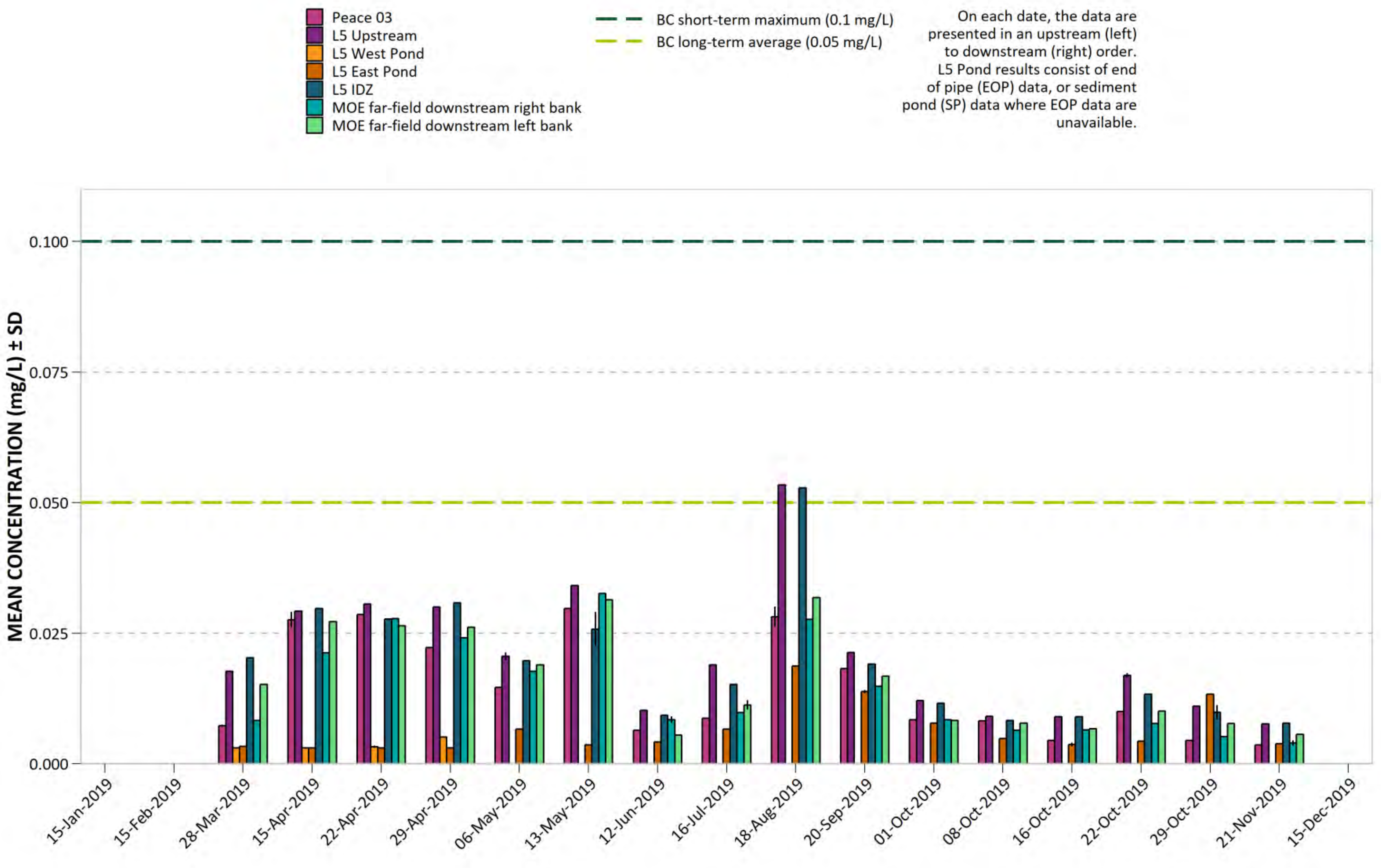
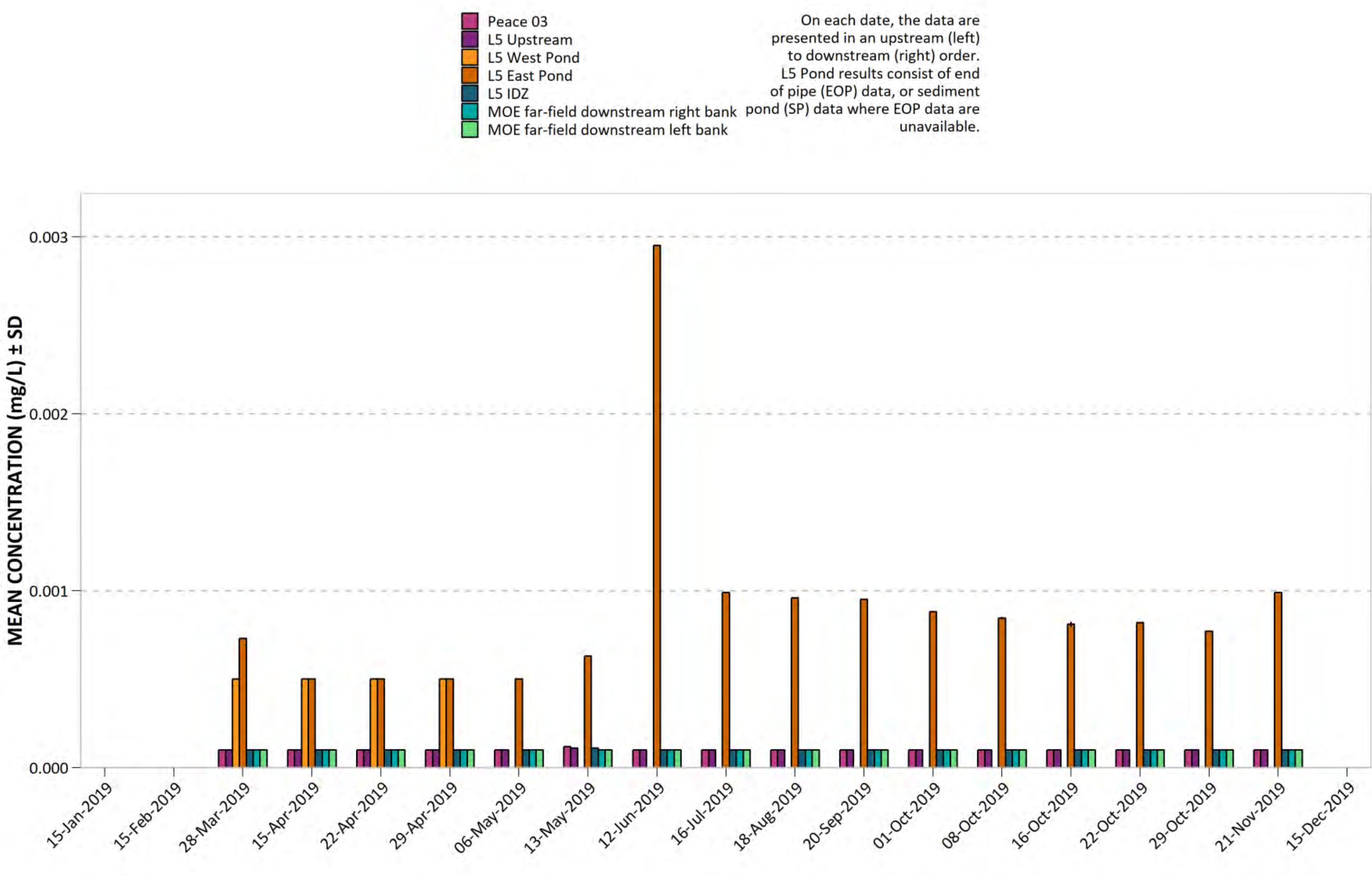


Figure 230. 2019 Peace River and RSEM L5 pond dissolved antimony (Sb).



Results less than the MDL were assigned the MDL value of 0.0005 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 231. 2019 Peace River and RSEM L5 pond dissolved arsenic (As).

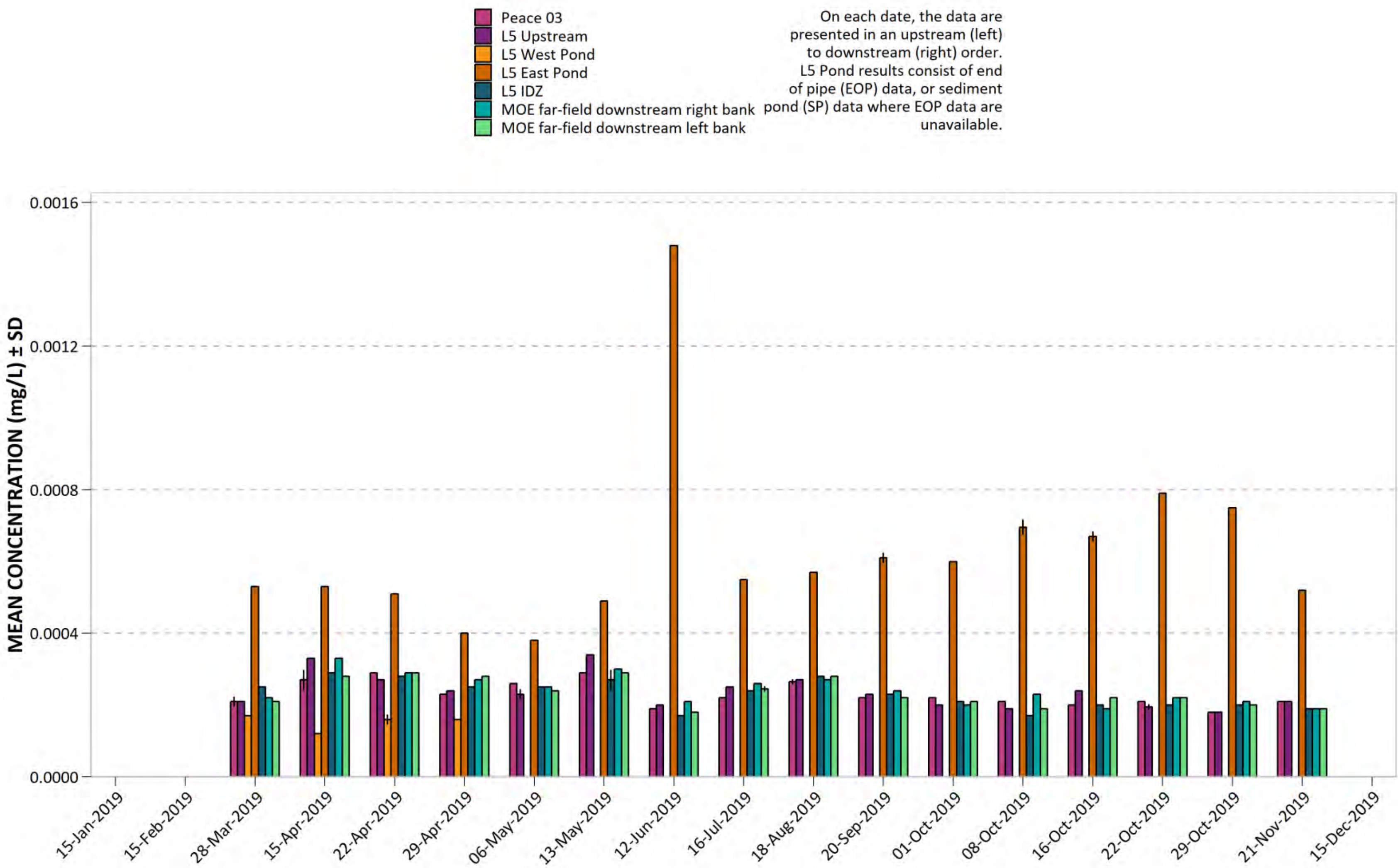


Figure 232. 2019 Peace River and RSEM L5 pond dissolved barium (Ba).

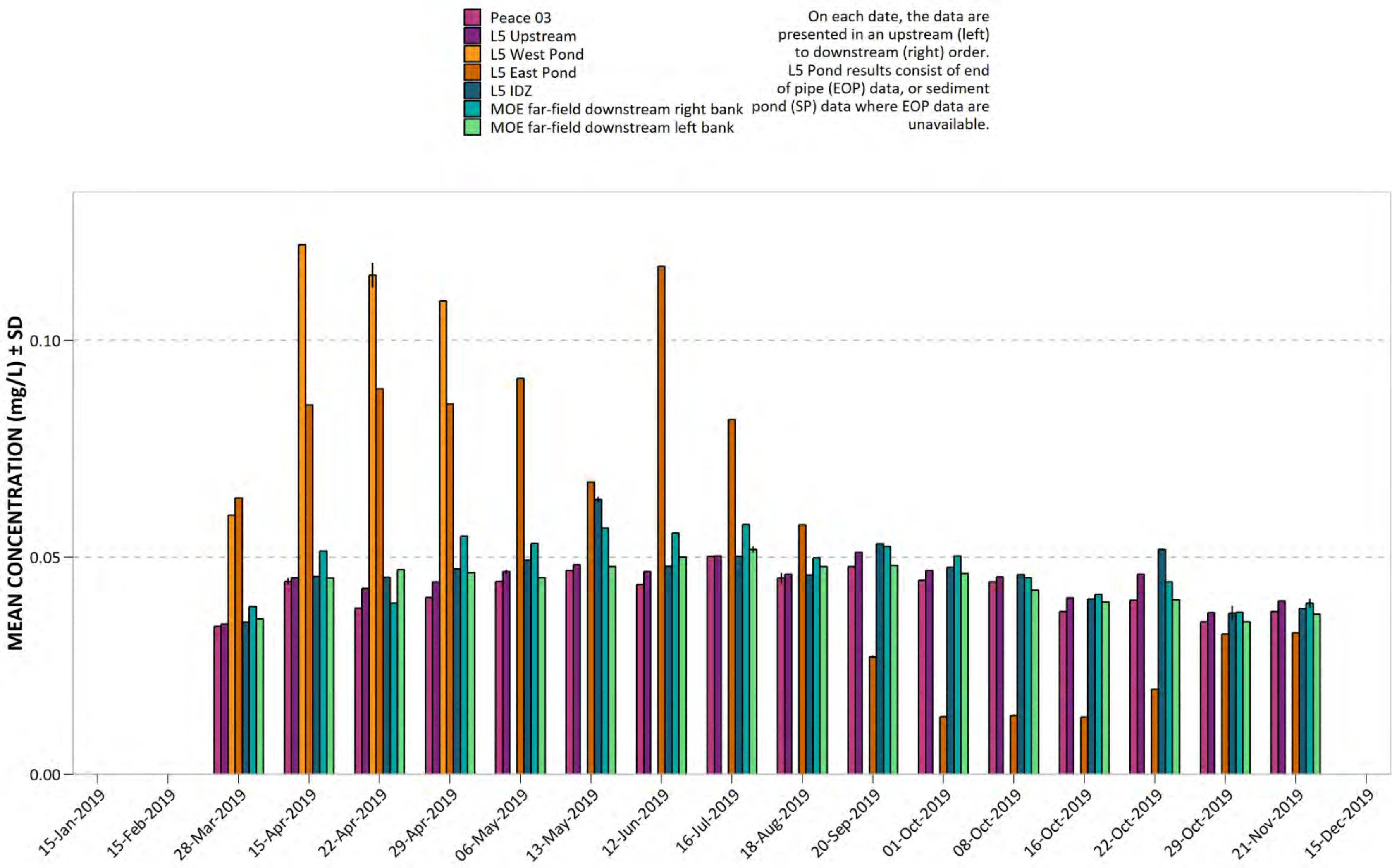
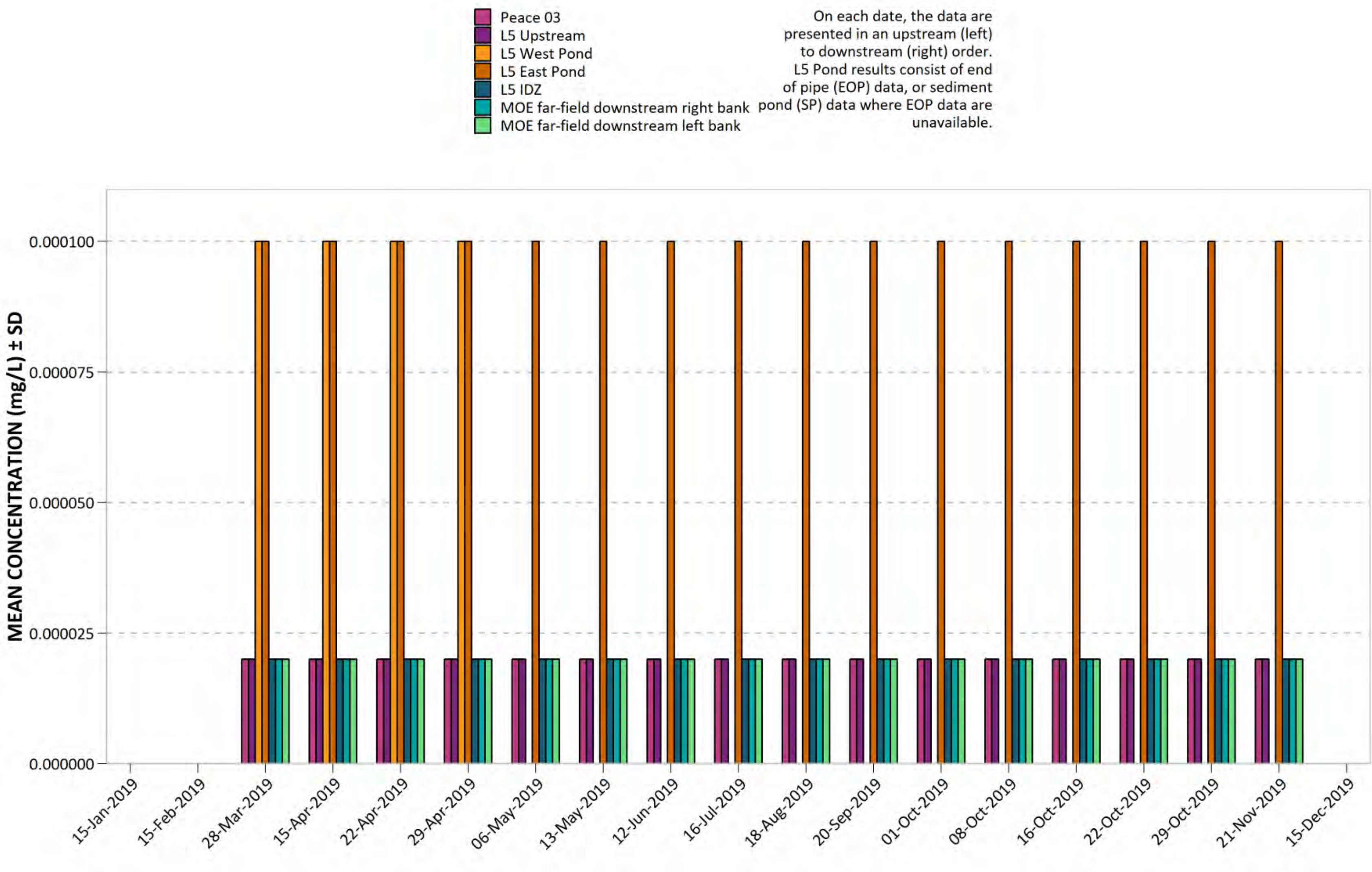
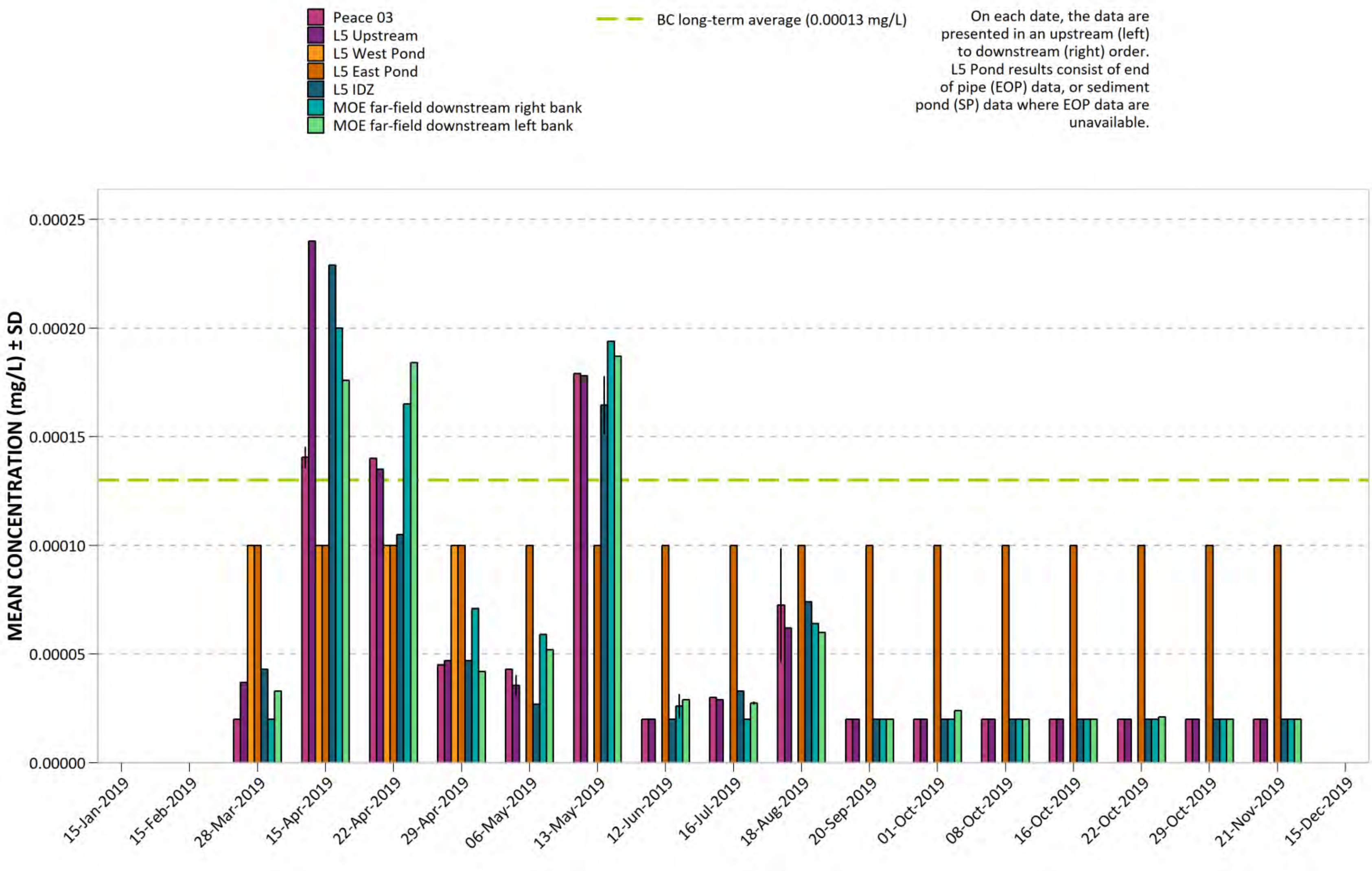


Figure 233. 2019 Peace River and RSEM L5 pond dissolved beryllium (Be).



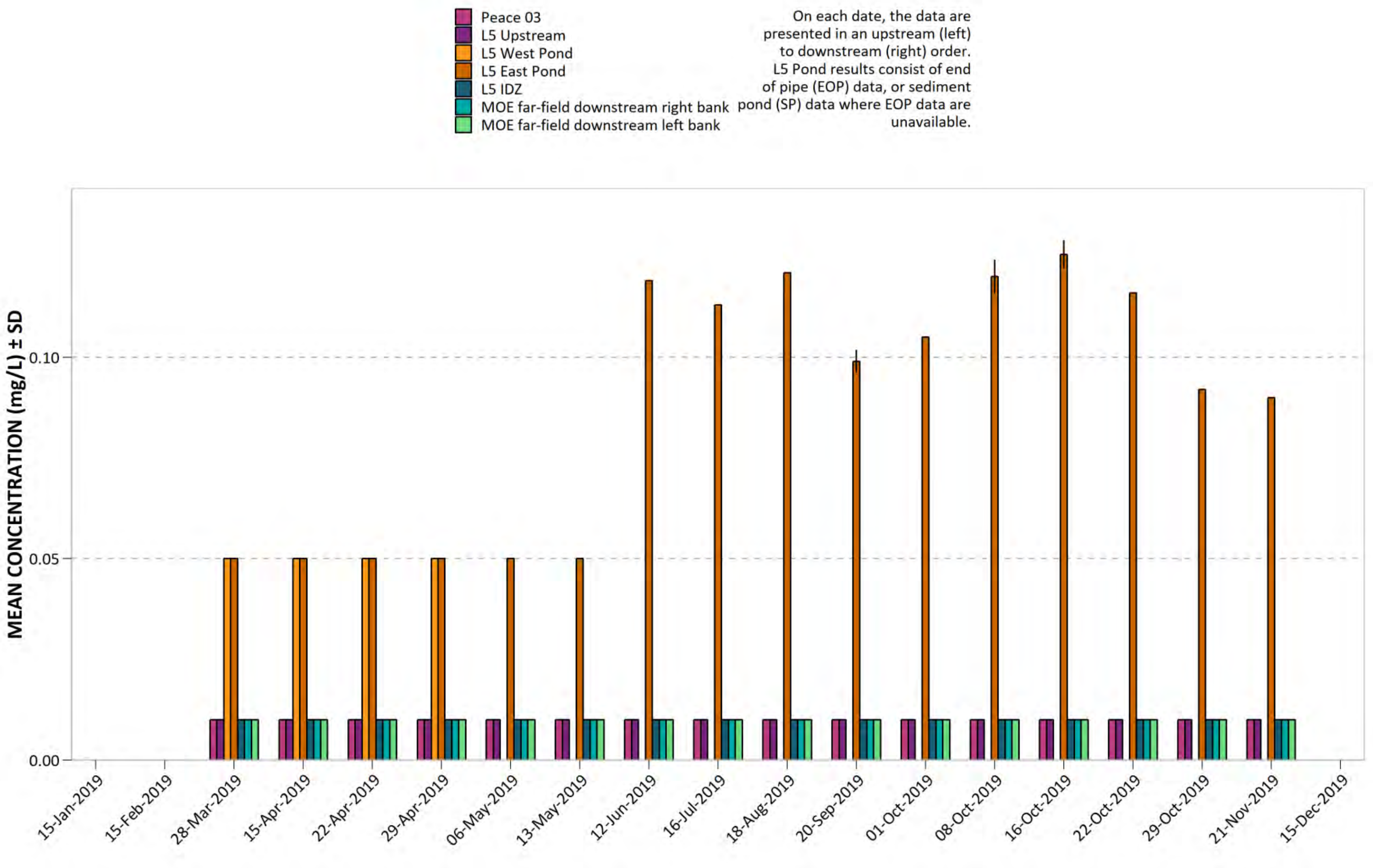
All results were less than the MDL and thus were assigned the MDL value of 0.0001 mg/L (Pond) or 0.00002 mg/L (Peace River).

Figure 234. 2019 Peace River and RSEM L5 pond dissolved bismuth (Bi).



All results were less than the MDL and thus were assigned the MDL value of 0.001 mg/L (Pond) or 0.00005 mg/L (Peace River).

Figure 235. 2019 Peace River and RSEM L5 pond dissolved boron (B).



Results less than the MDL were assigned the MDL value of 0.05 mg/L (Pond) or 0.01 mg/L (Peace River).

Figure 236. 2019 Peace River and RSEM L5 pond dissolved cadmium (Cd).

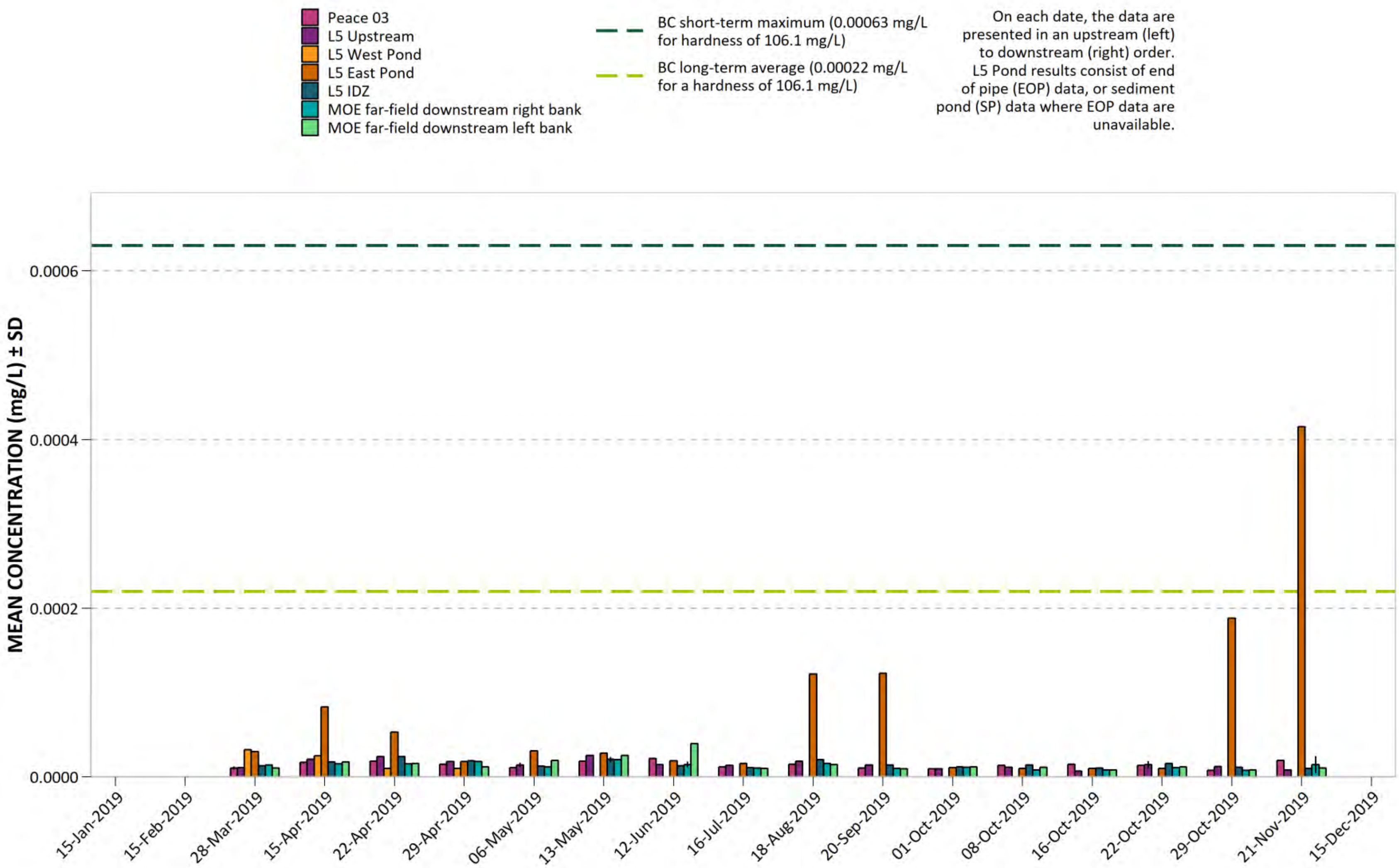


Figure 237. 2019 Peace River and RSEM L5 pond dissolved calcium (Ca).

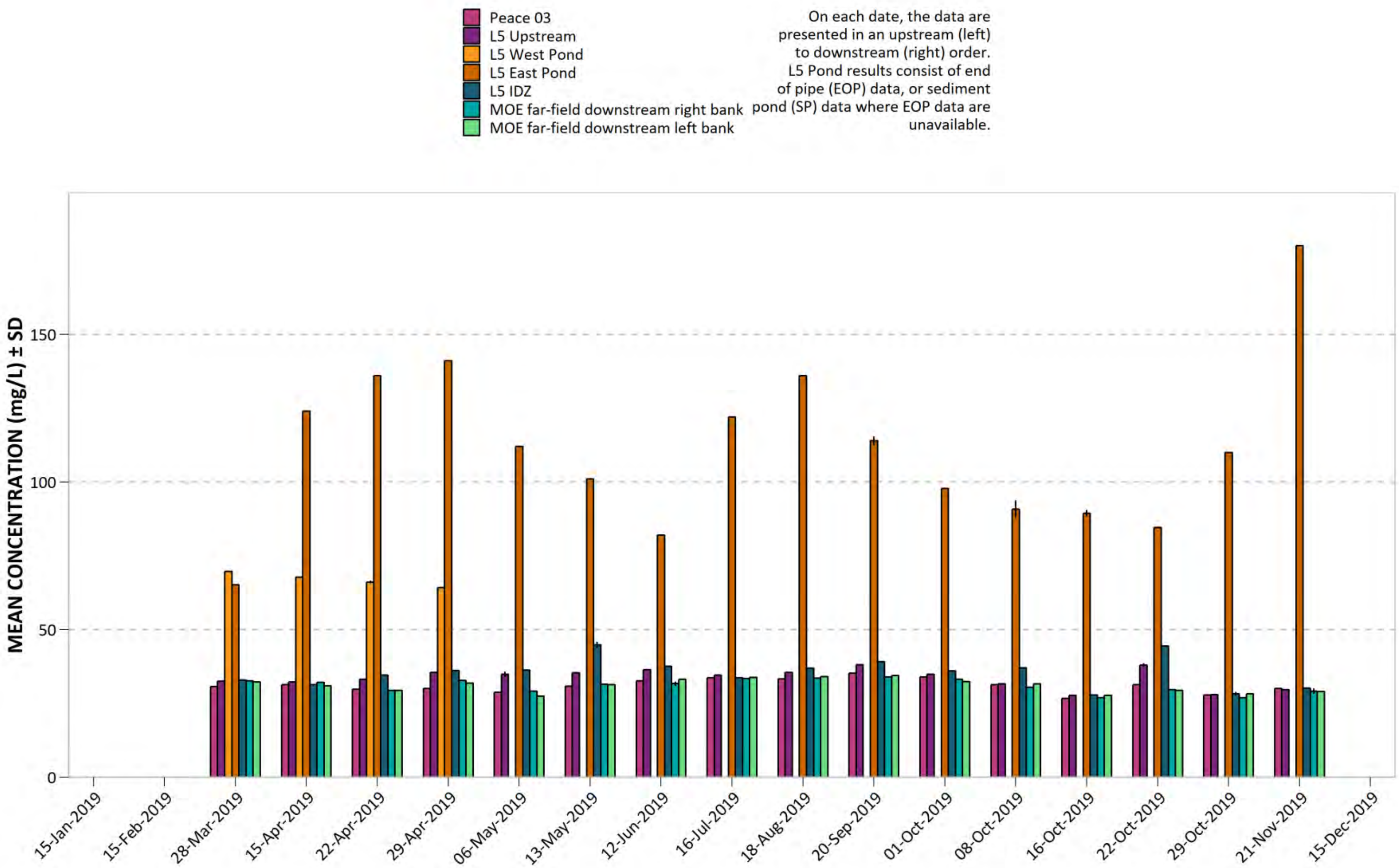
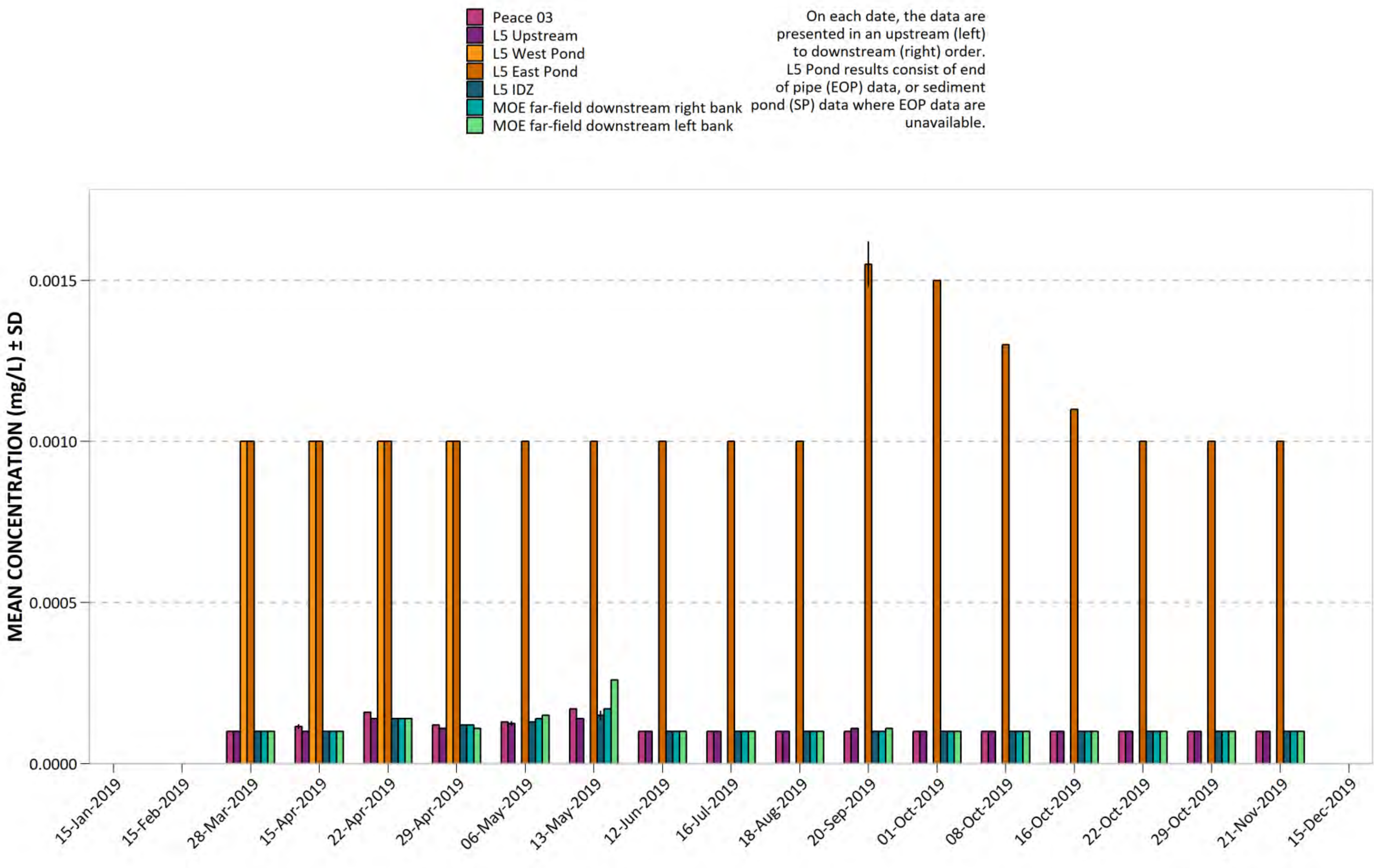
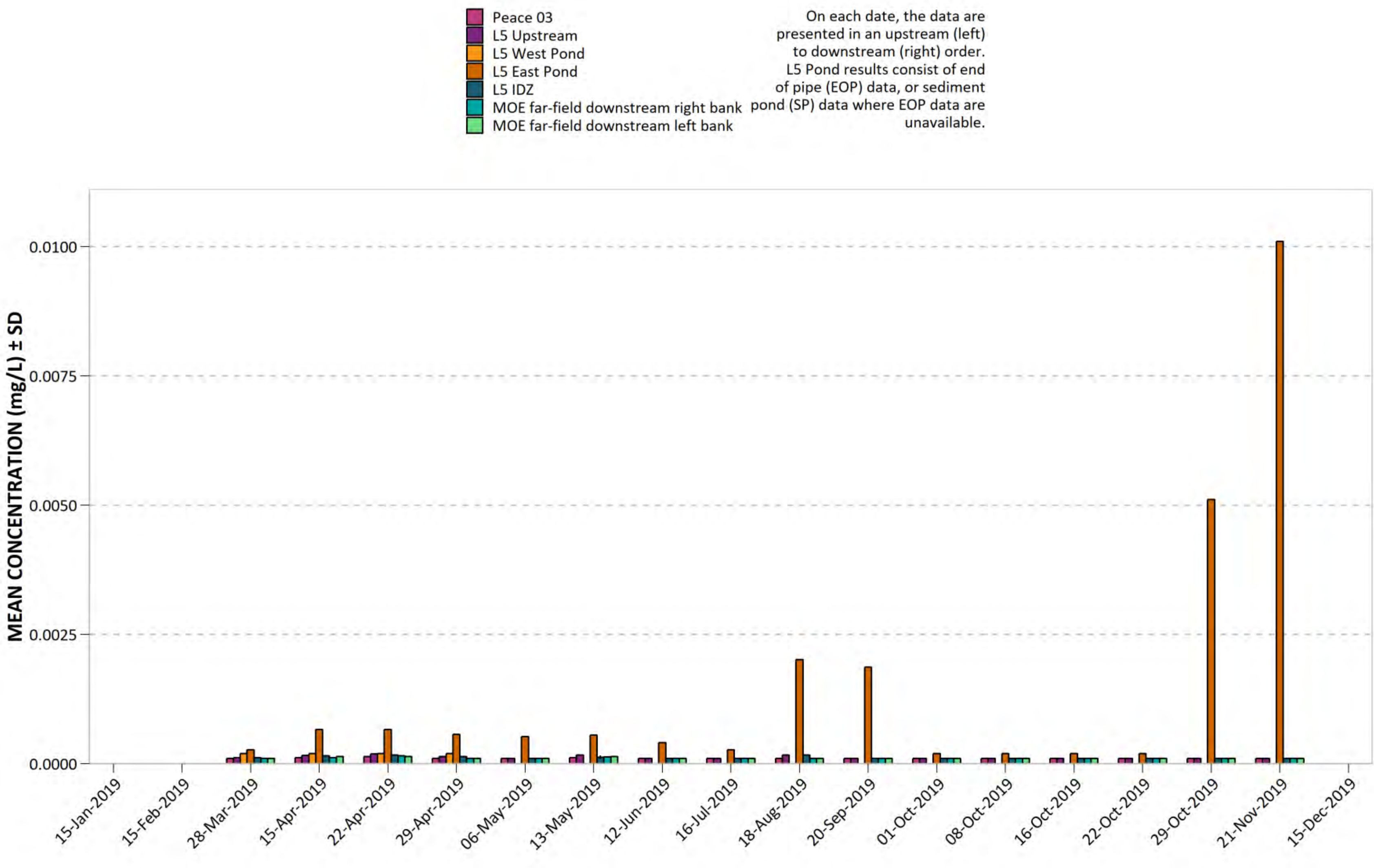


Figure 238. 2019 Peace River and RSEM L5 pond dissolved chromium (Cr).



Results less than the MDL were assigned the MDL value of 0.001 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 239. 2019 Peace River and RSEM L5 pond dissolved cobalt (Co).



Results less than the MDL were assigned the MDL value of 0.0002 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 240. 2019 Peace River and RSEM L5 pond dissolved copper (Cu). New dissolved copper BC WQG replaced the total copper BC WQG in August 2019 (MOE 2019).

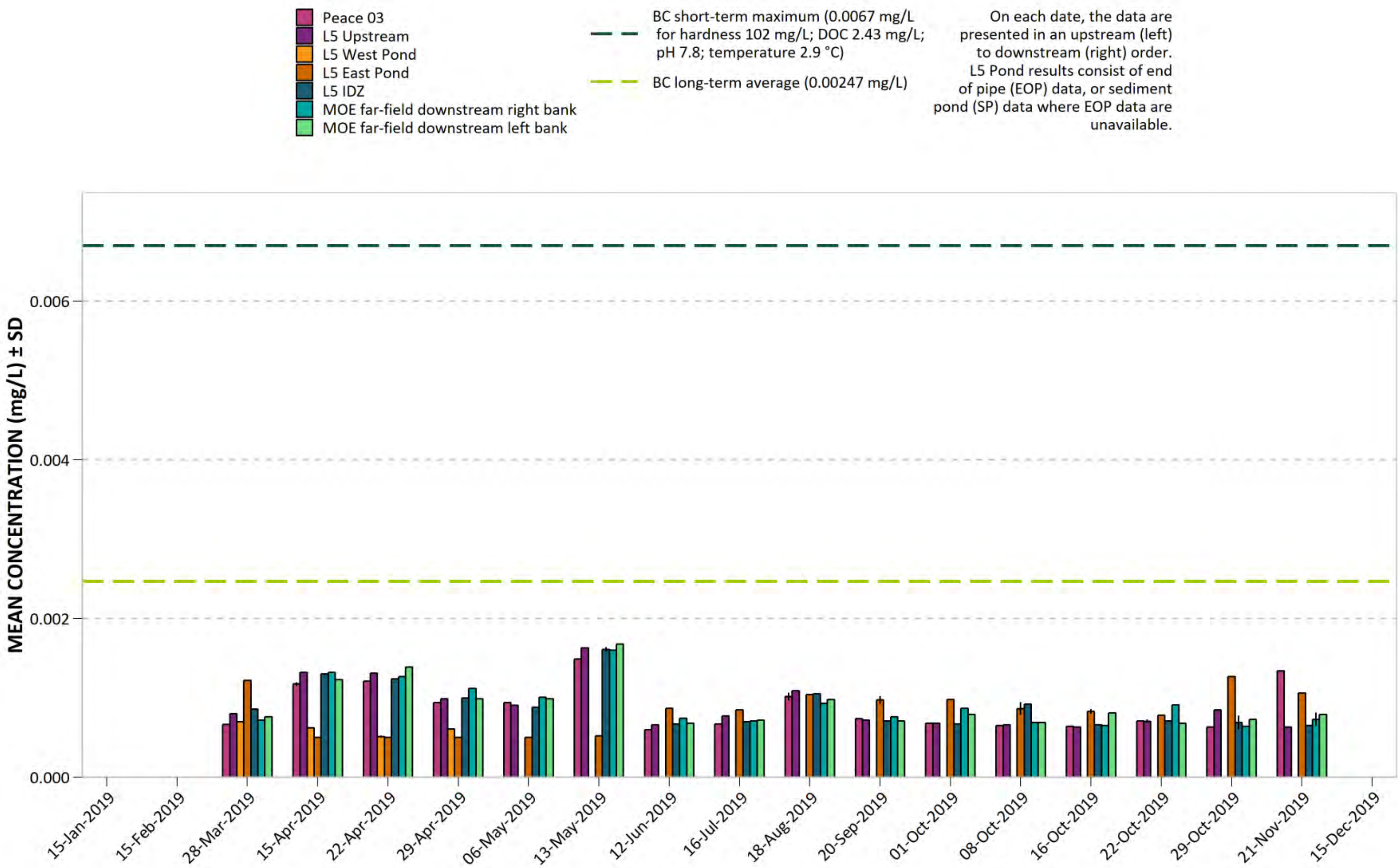
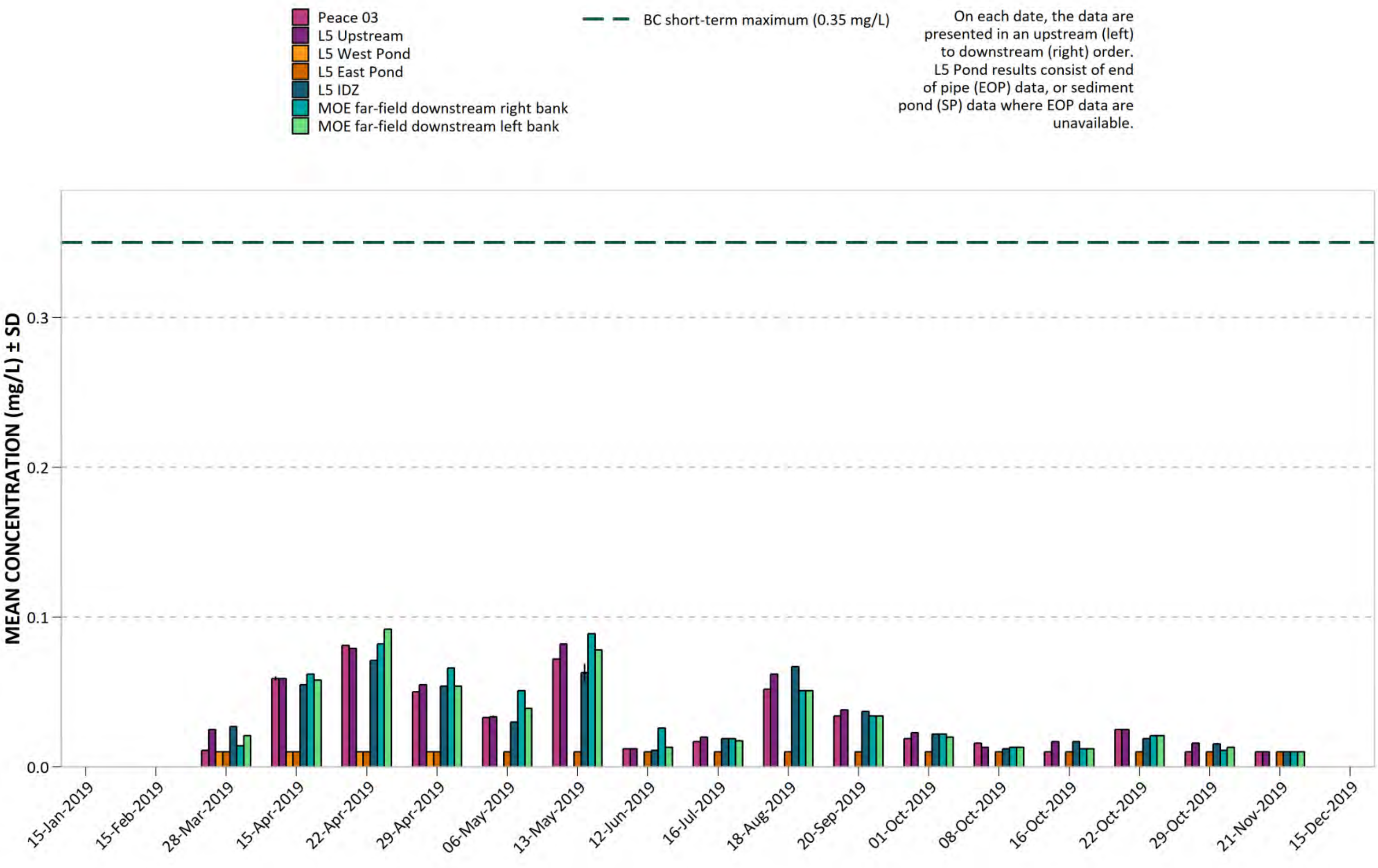
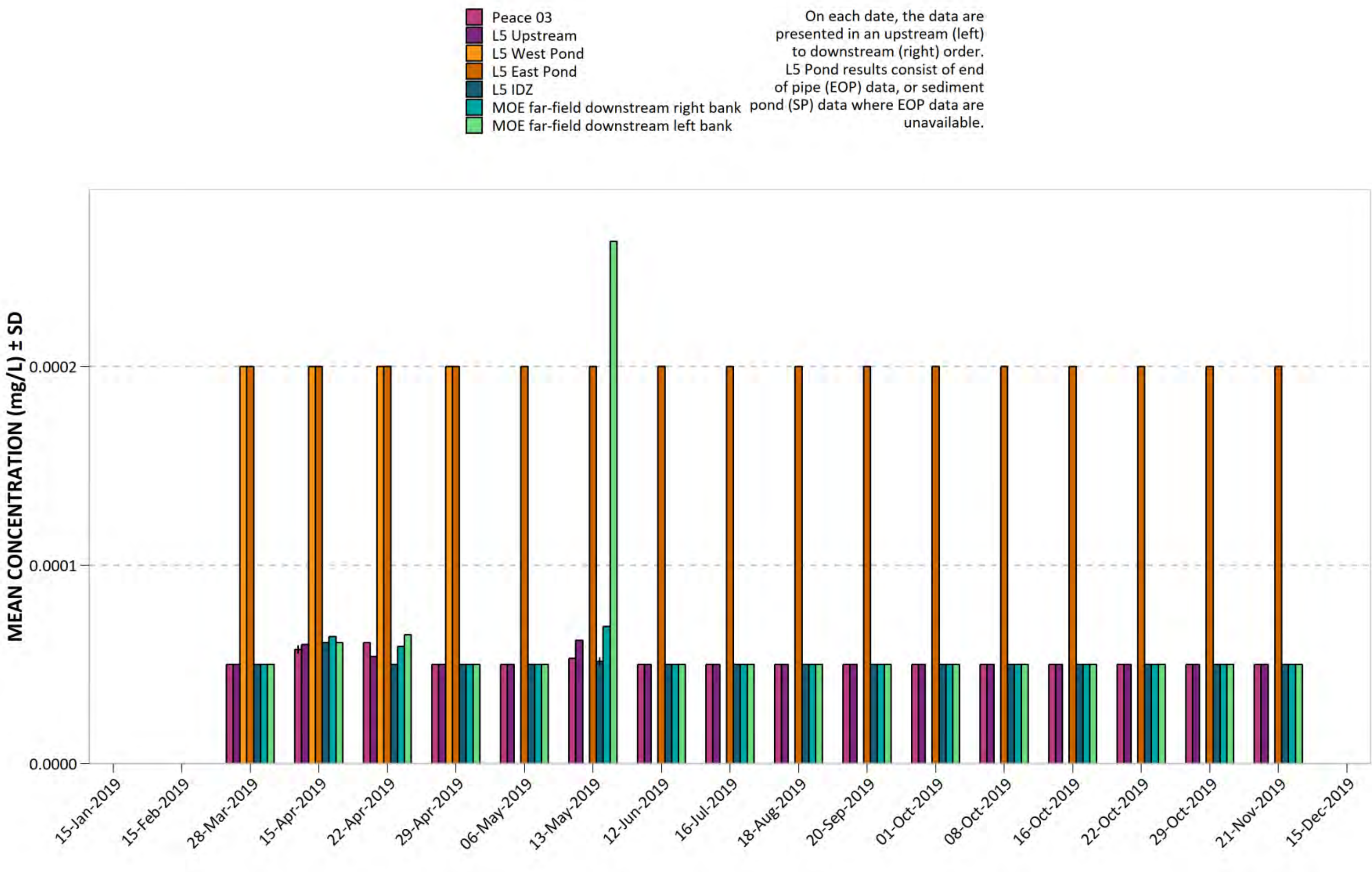


Figure 241. 2019 Peace River and RSEM L5 pond dissolved iron (Fe).



Results less than the MDL were assigned the MDL value of 0.01 mg/L (Pond and Peace River).

Figure 242. 2019 Peace River and RSEM L5 pond dissolved lead (Pb).



Results less than the MDL were assigned the MDL value of 0.0002 mg/L (Pond) or 0.00005 mg/L (Peace River).

Figure 243. 2019 Peace River and RSEM L5 pond dissolved lithium (Li).

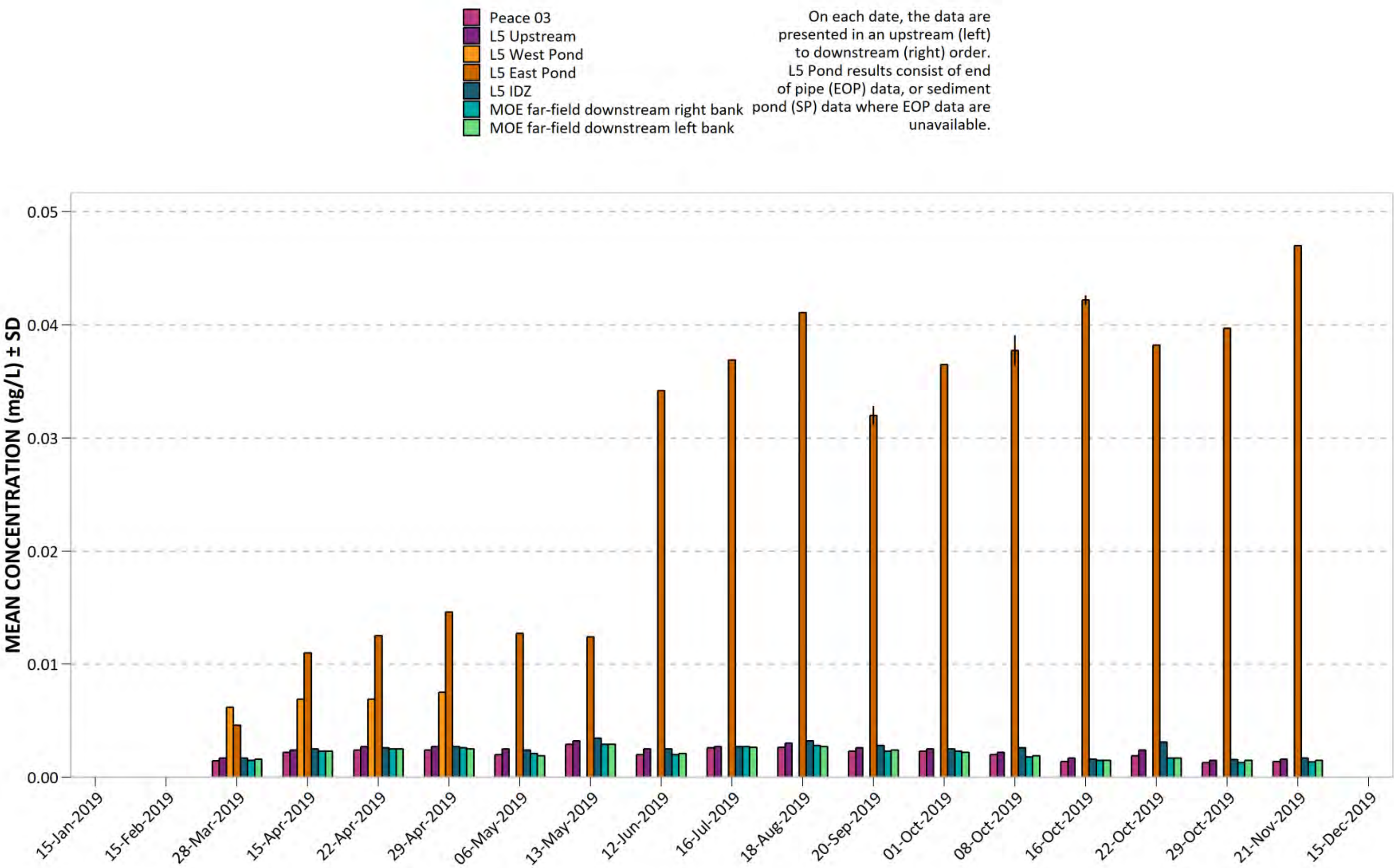


Figure 244. 2019 Peace River and RSEM L5 pond dissolved magnesium (Mg).

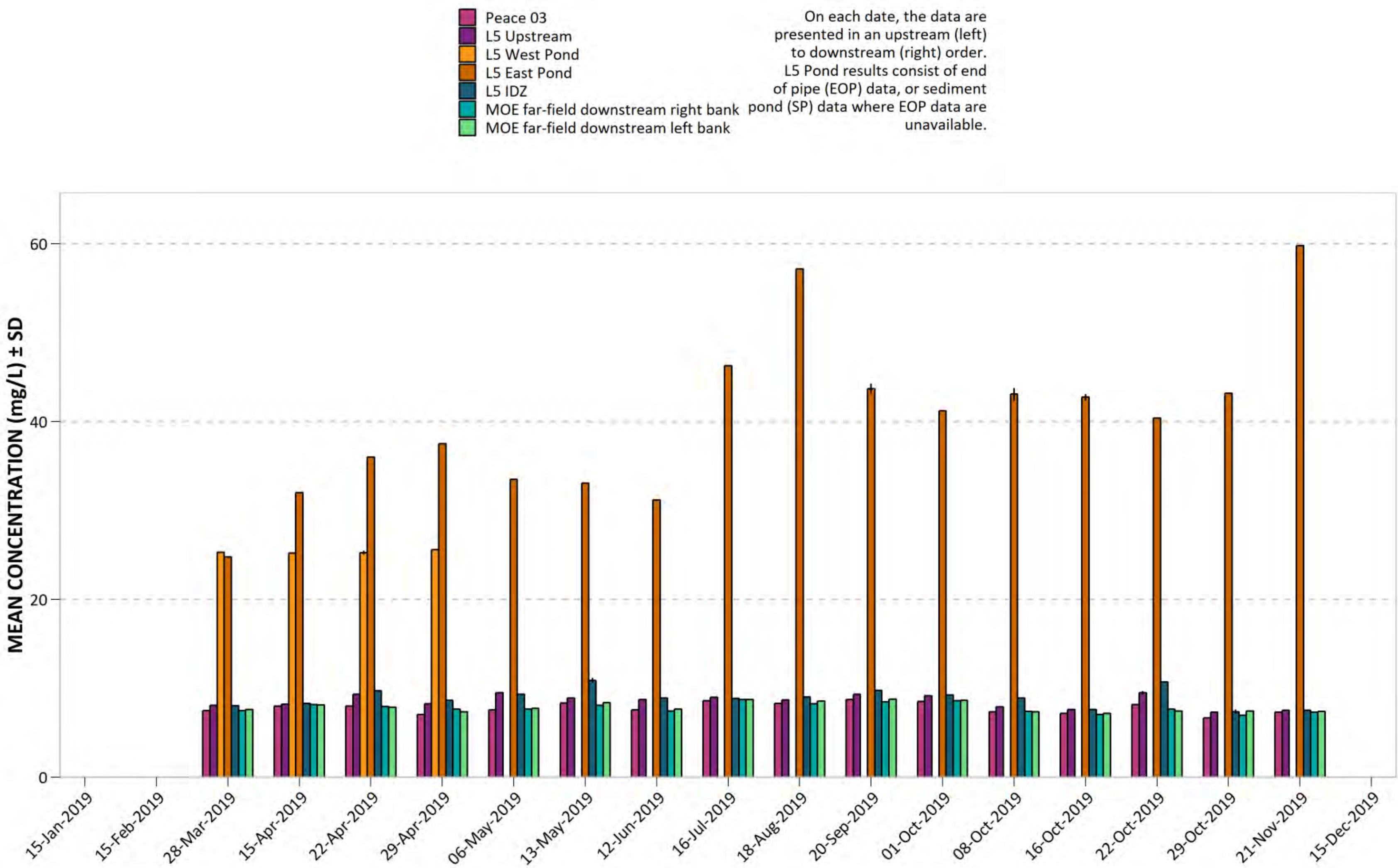


Figure 245. 2019 Peace River and RSEM L5 pond dissolved manganese (Mn).

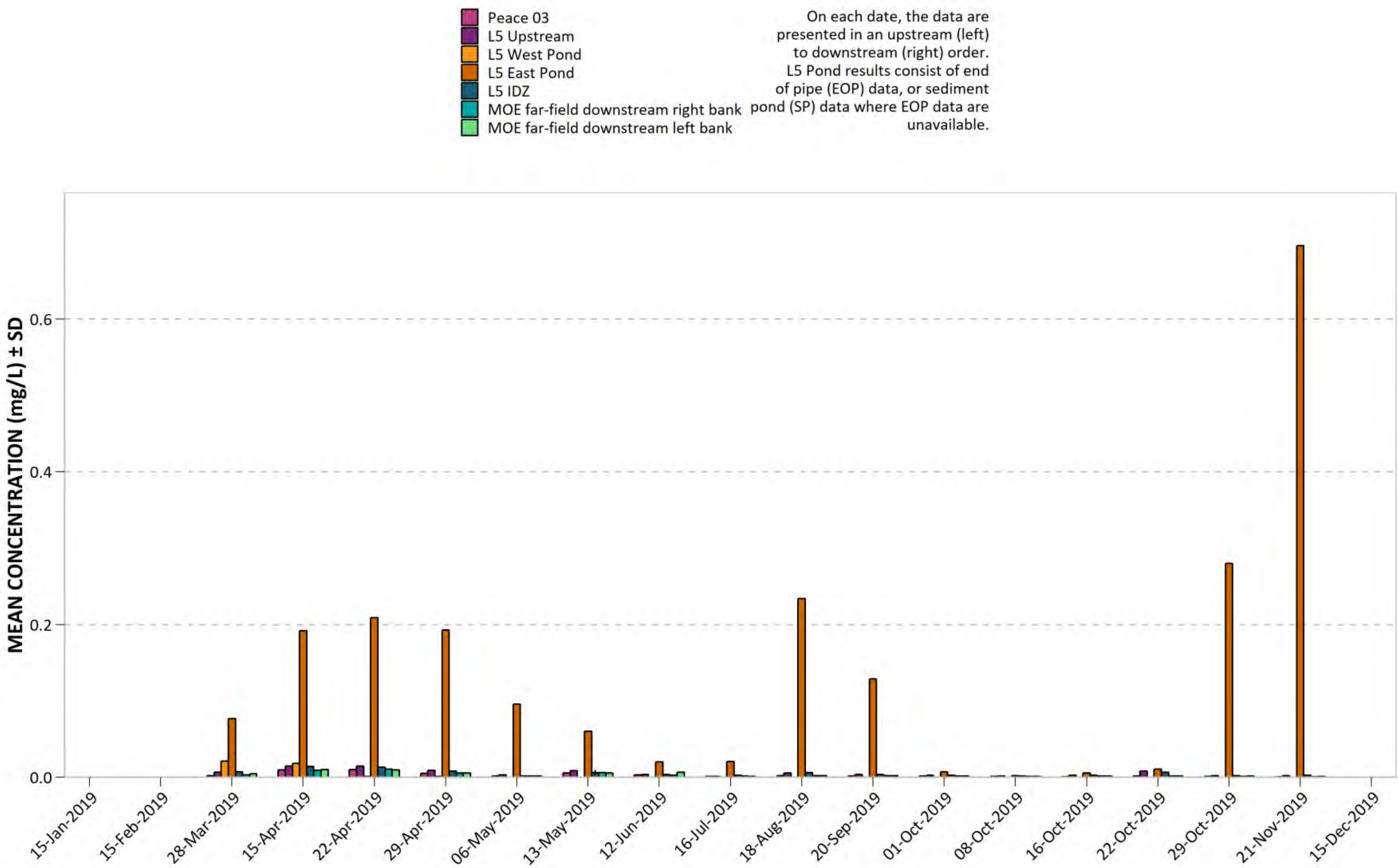
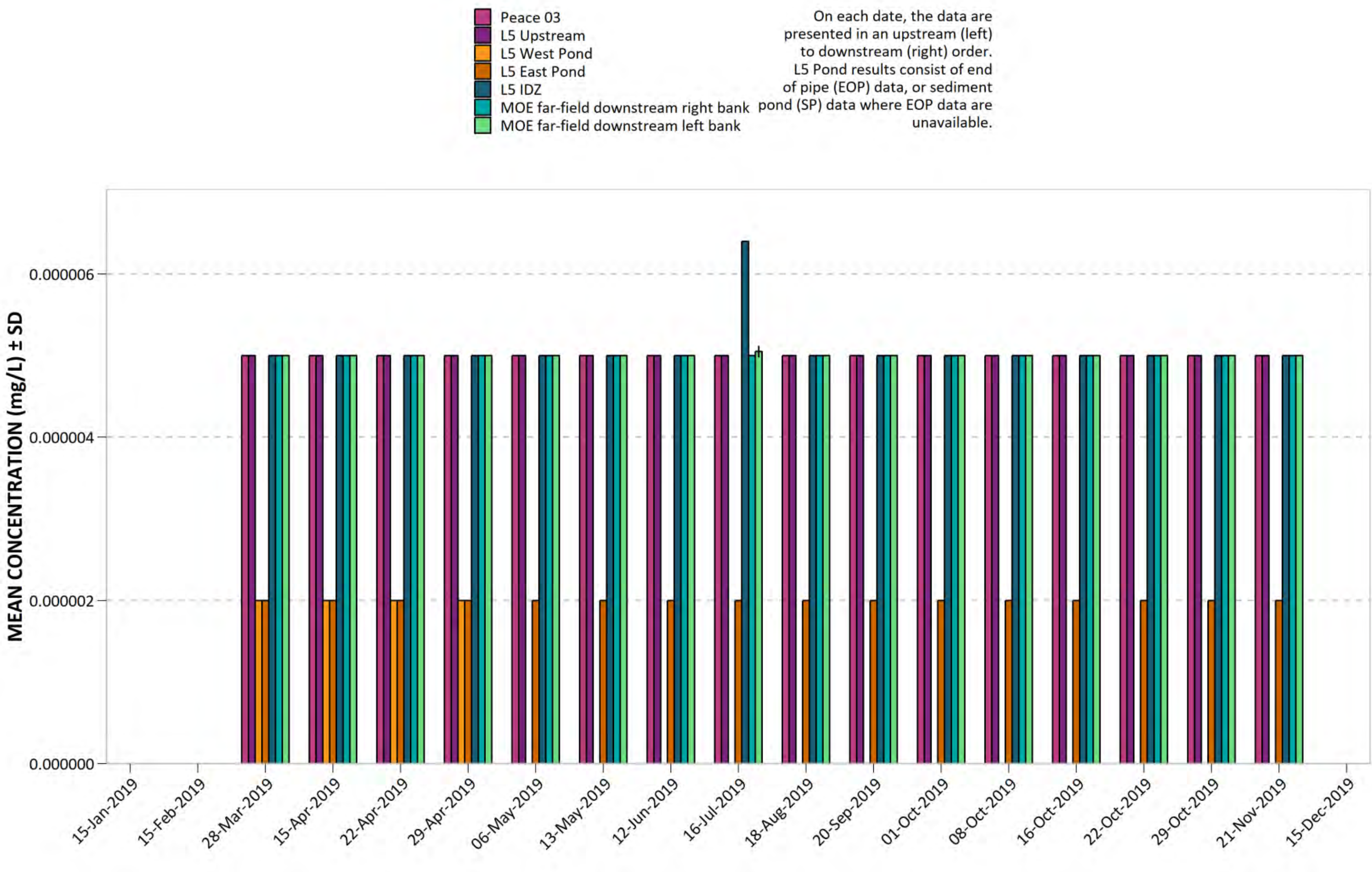


Figure 246. 2019 Peace River and RSEM L5 pond dissolved mercury (Hg).



Results less than the MDL were assigned the MDL value of 0.000005 mg/L (Peace River), 0.000002 mg/L (Pond)

Figure 247. 2019 Peace River and RSEM L5 pond dissolved molybdenum (Mo).

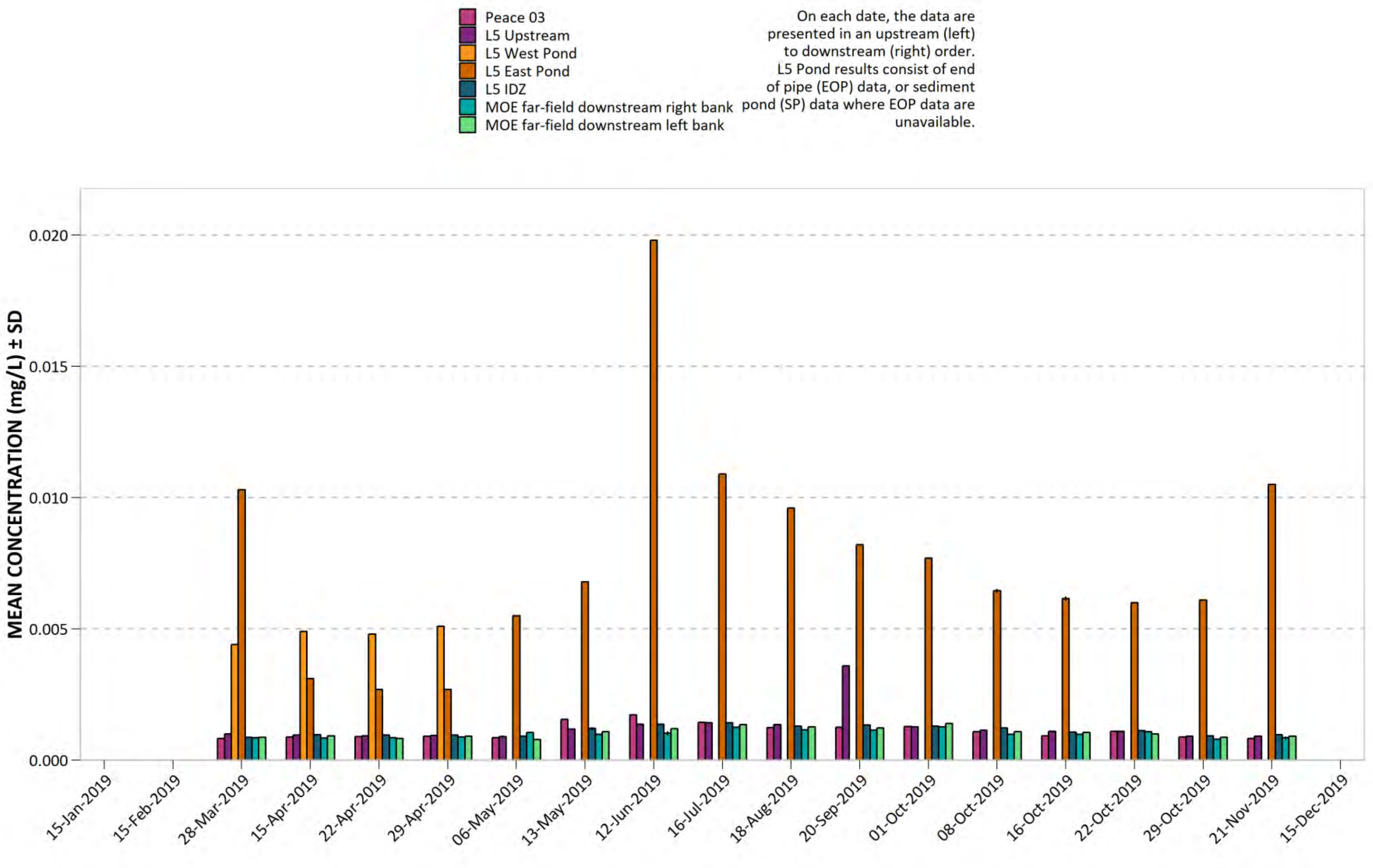


Figure 248. 2019 Peace River and RSEM L5 pond dissolved nickel (Ni).

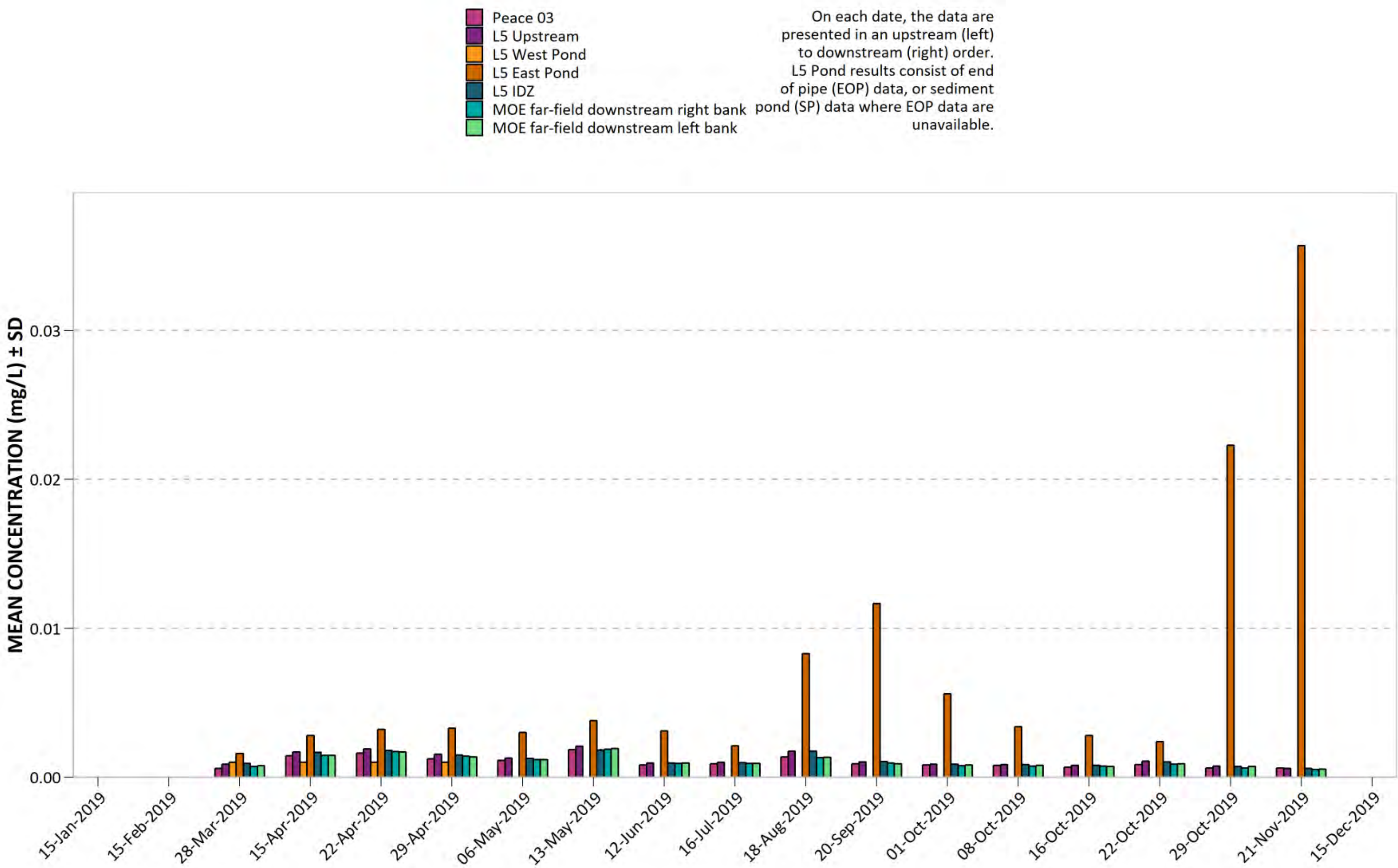


Figure 249. 2019 Peace River and RSEM L5 pond dissolved potassium (K).

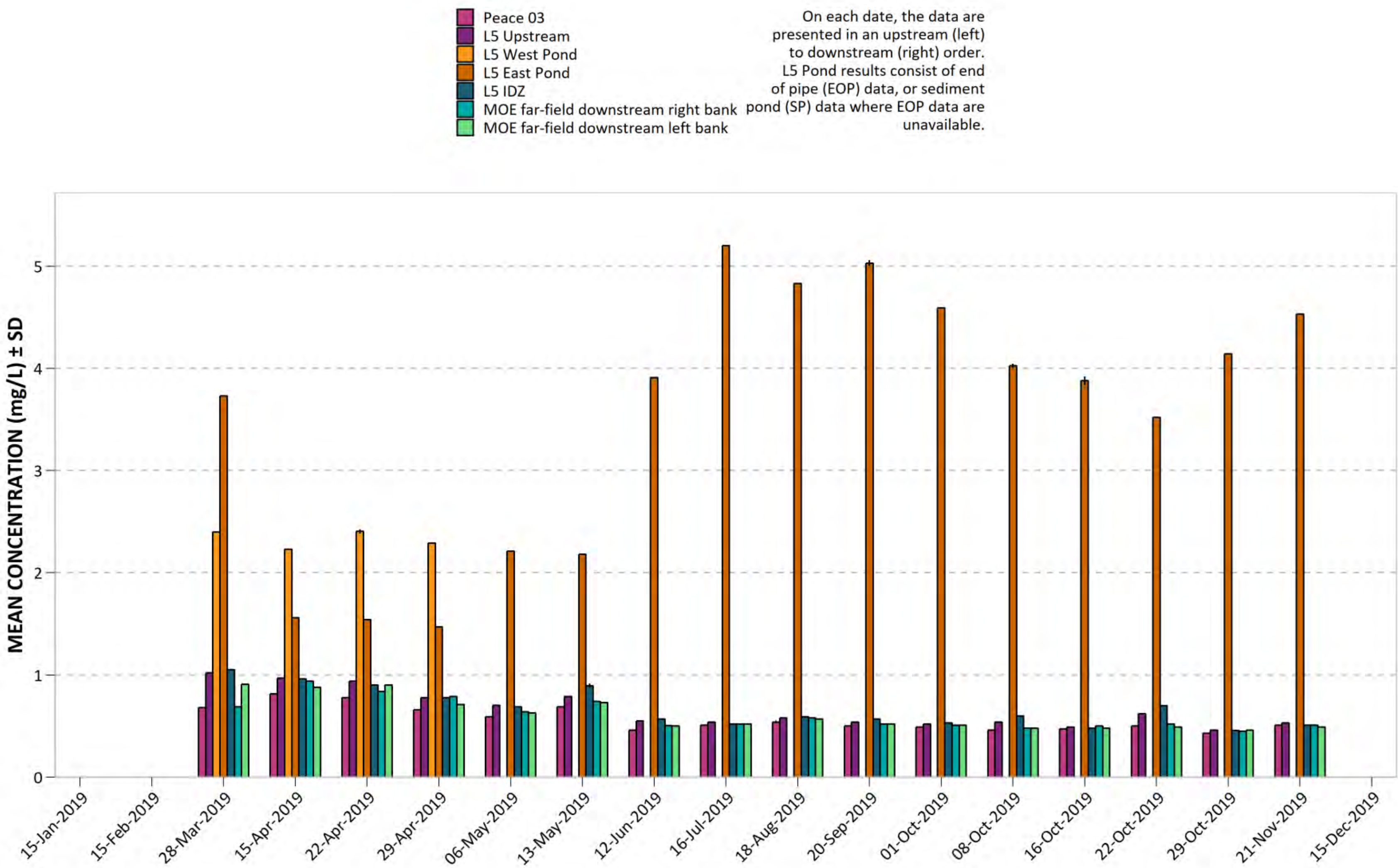


Figure 250. 2019 Peace River and RSEM L5 pond dissolved selenium (Se).

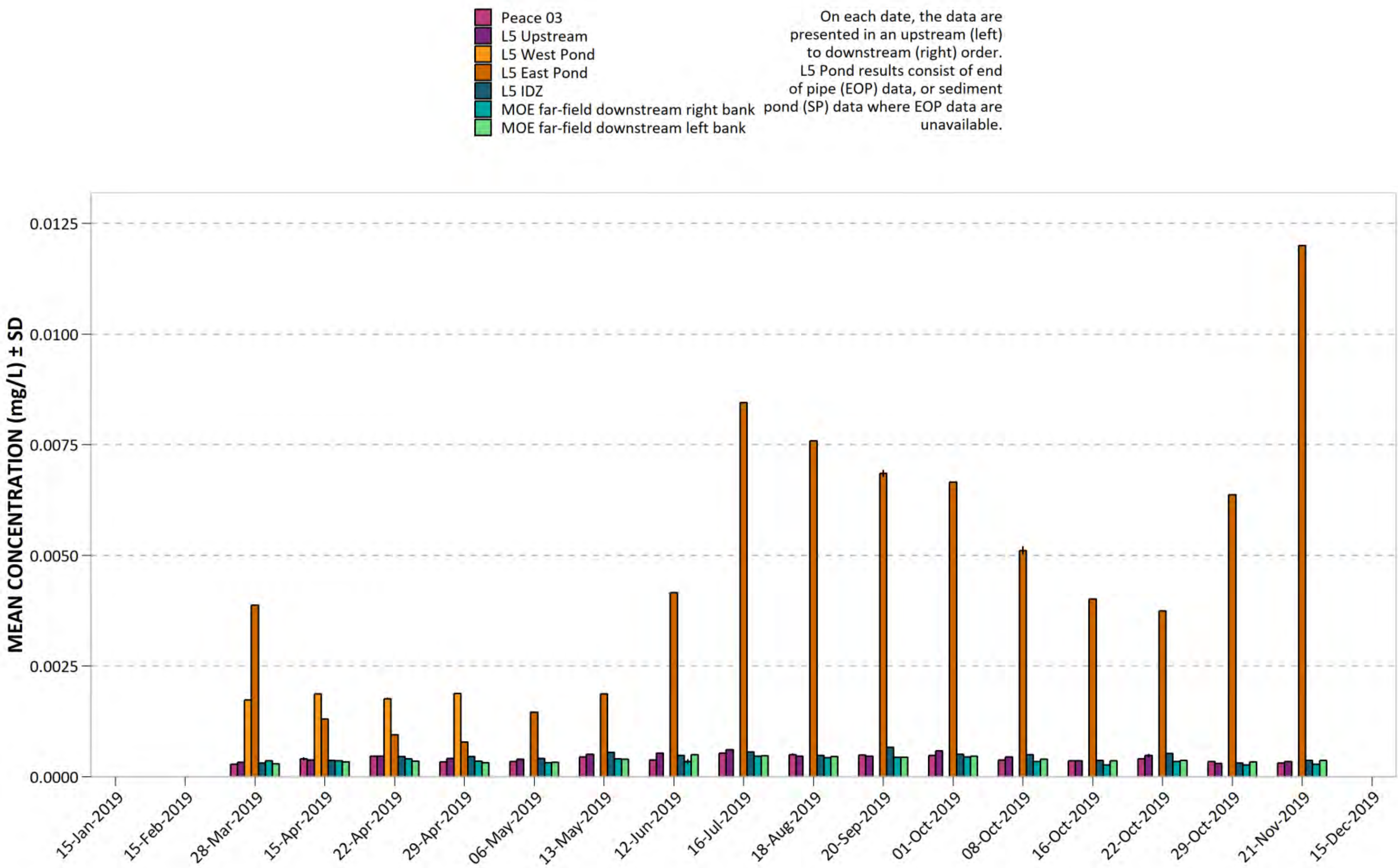


Figure 251. 2019 Peace River and RSEM L5 pond dissolved silicon (Si).

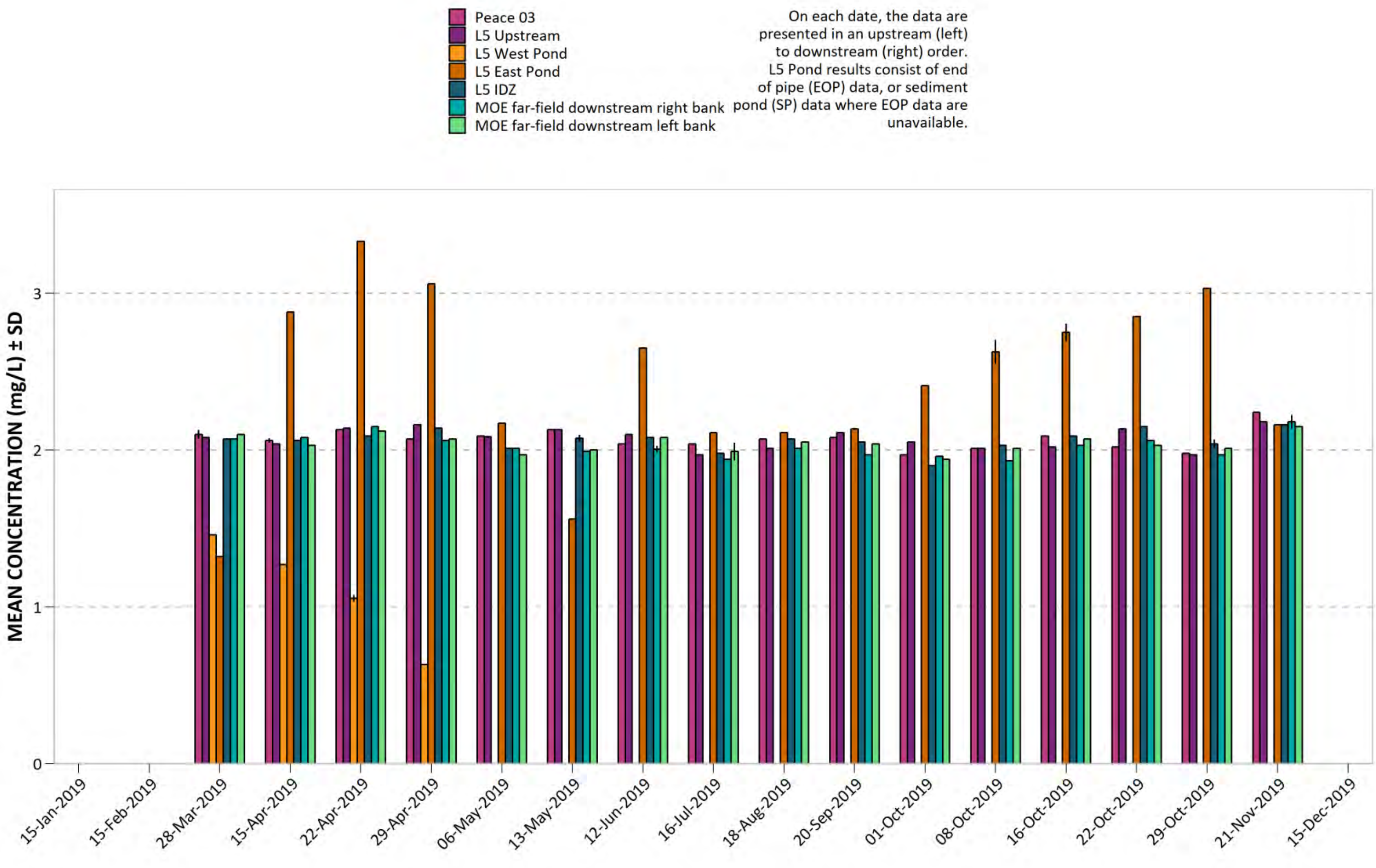
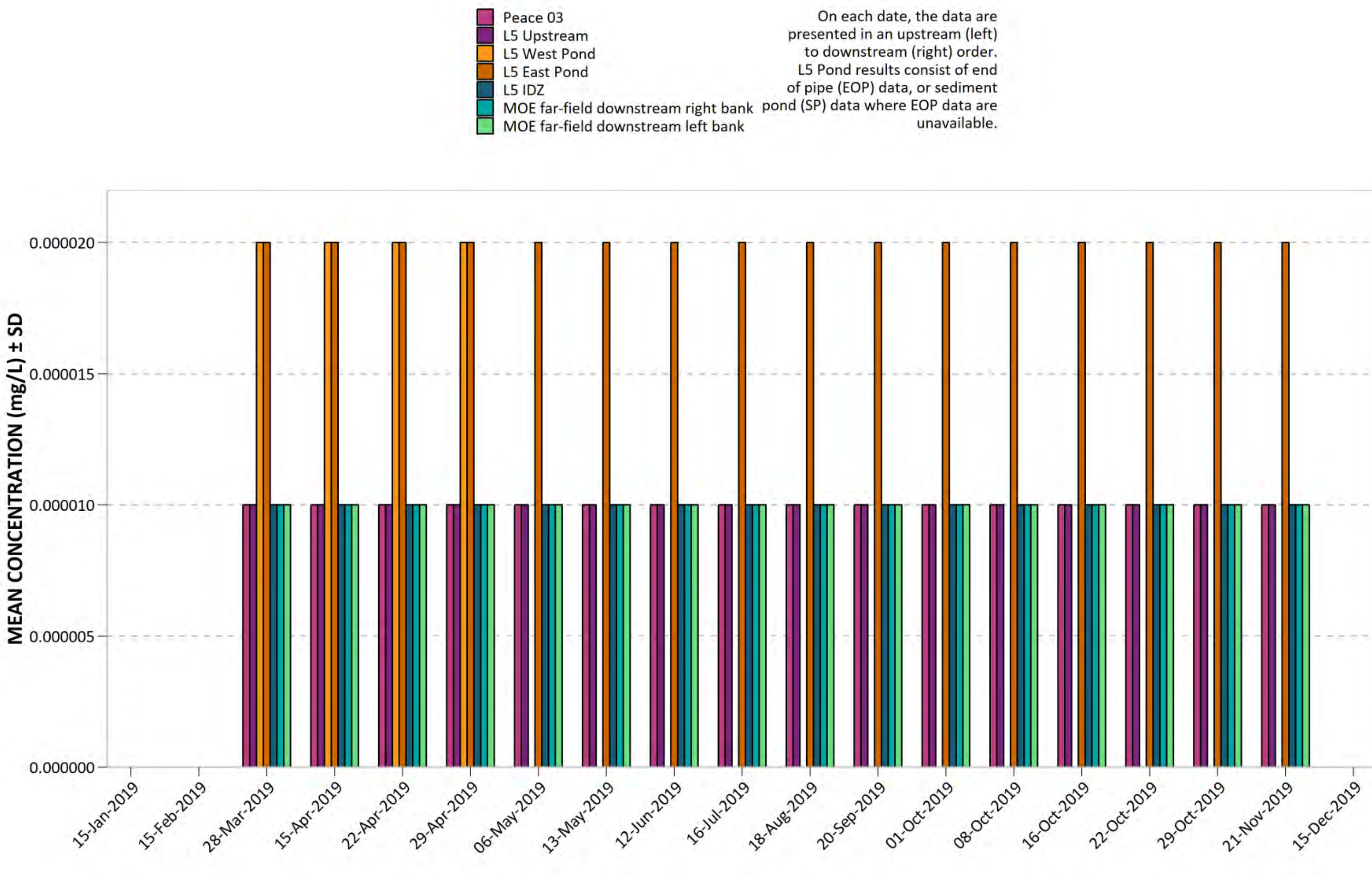


Figure 252. 2019 Peace River and RSEM L5 pond dissolved silver (Ag).



Results less than the MDL were assigned the MDL value of 0.00002 mg/L (Pond) or 0.00001 mg/L (Peace River).

Figure 253. 2019 Peace River and RSEM L5 pond dissolved sodium (Na).

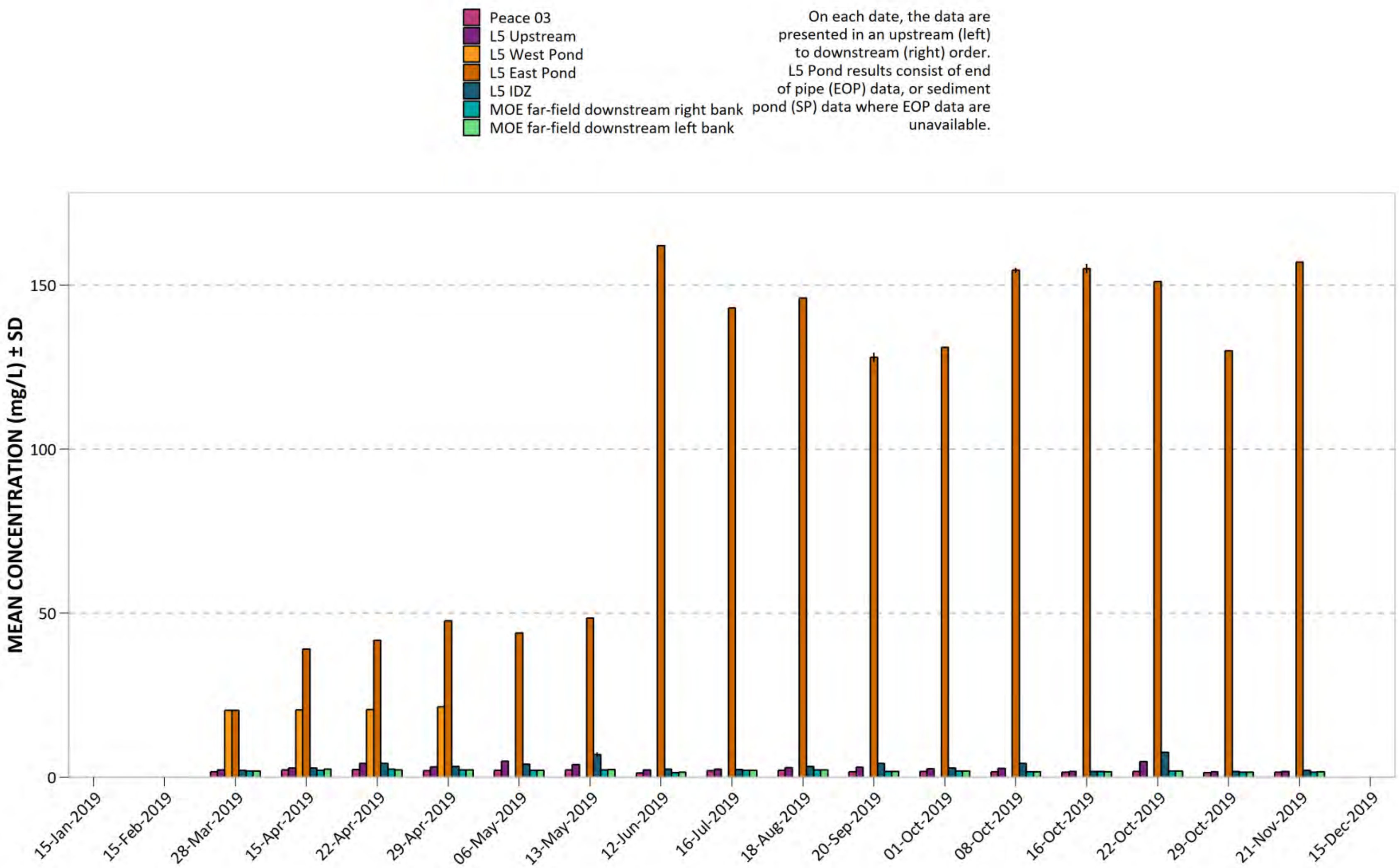


Figure 254. 2019 Peace River and RSEM L5 pond dissolved strontium (Sr).

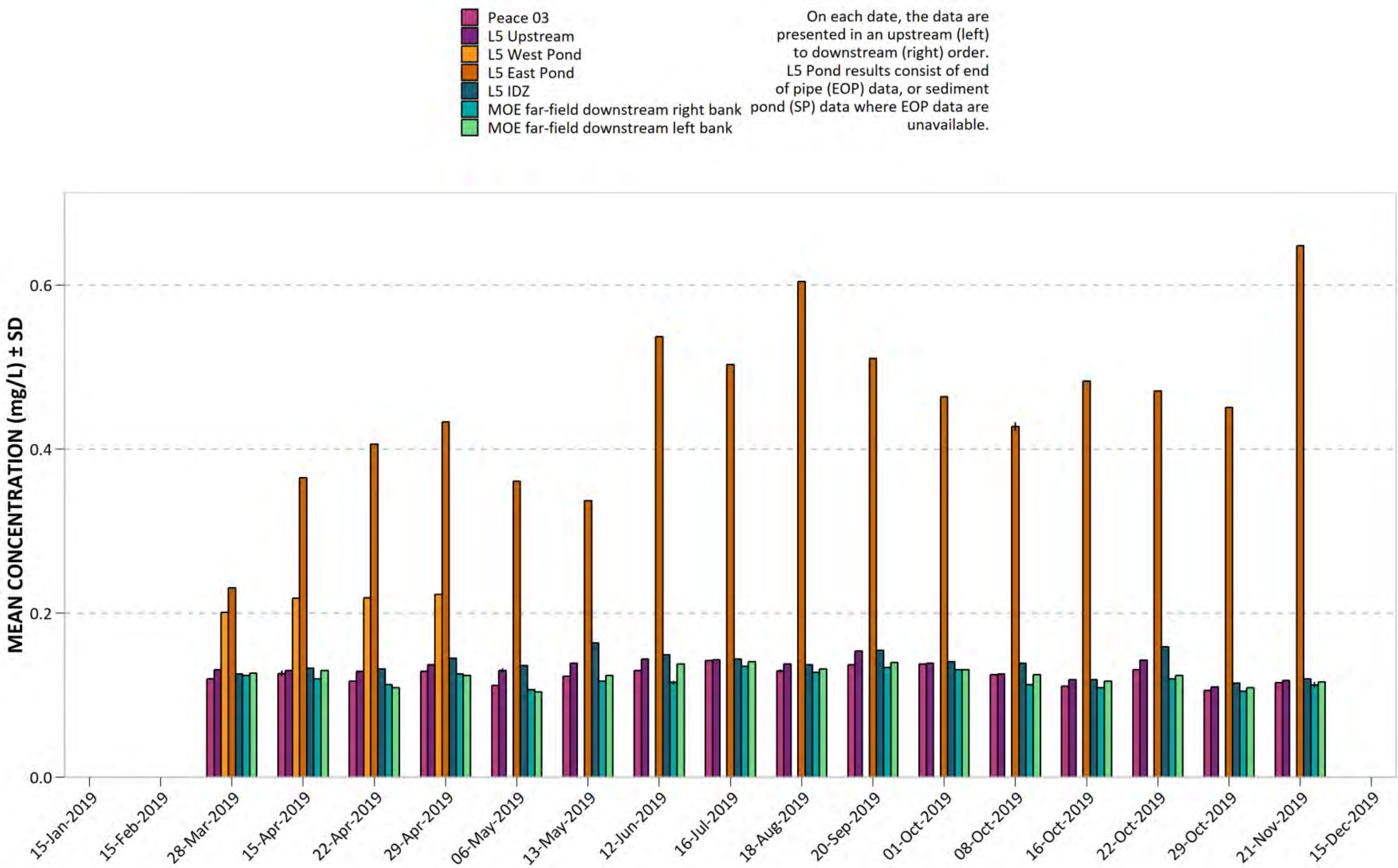


Figure 255. 2019 Peace River and RSEM L5 pond dissolved sulfur (S).

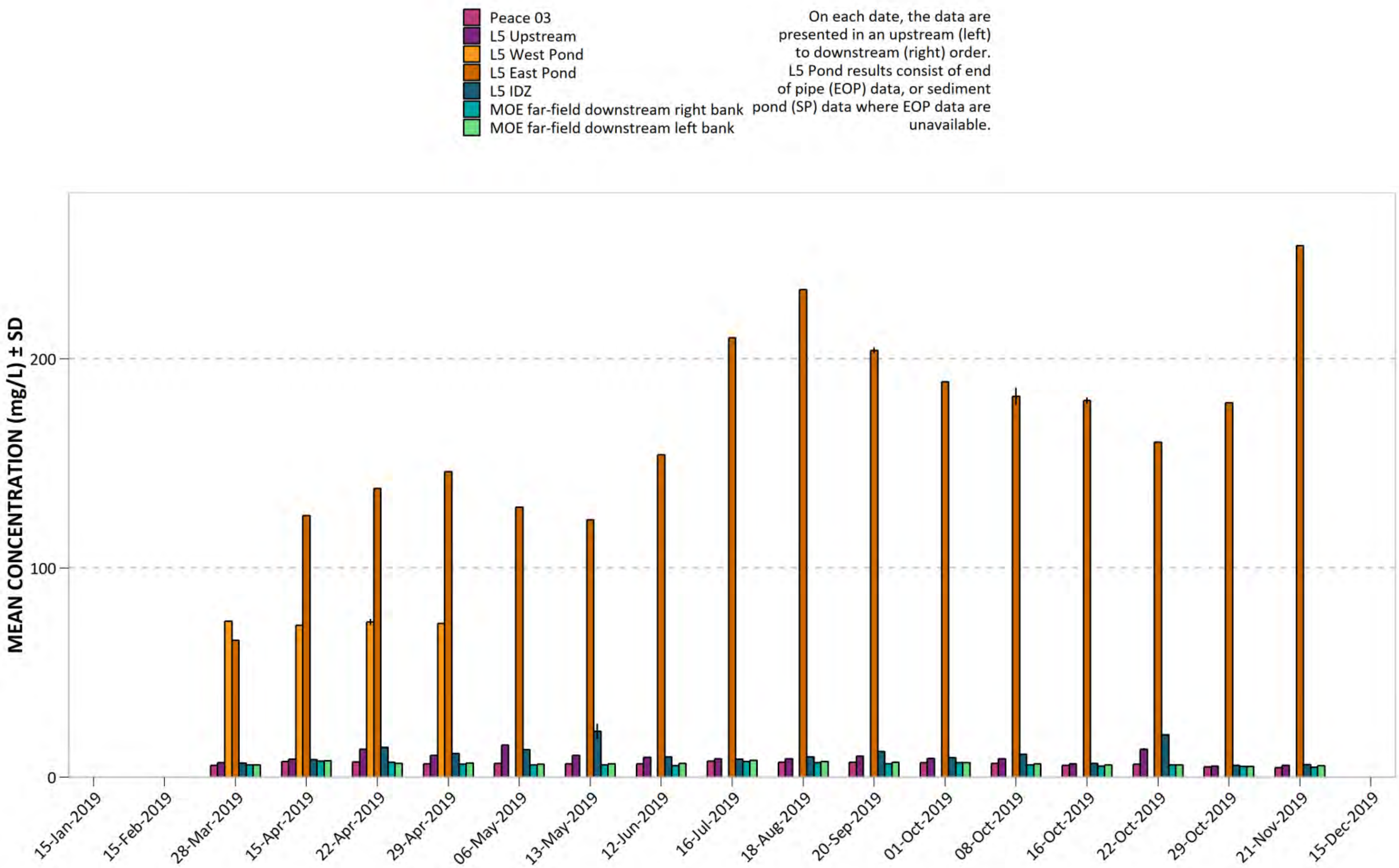
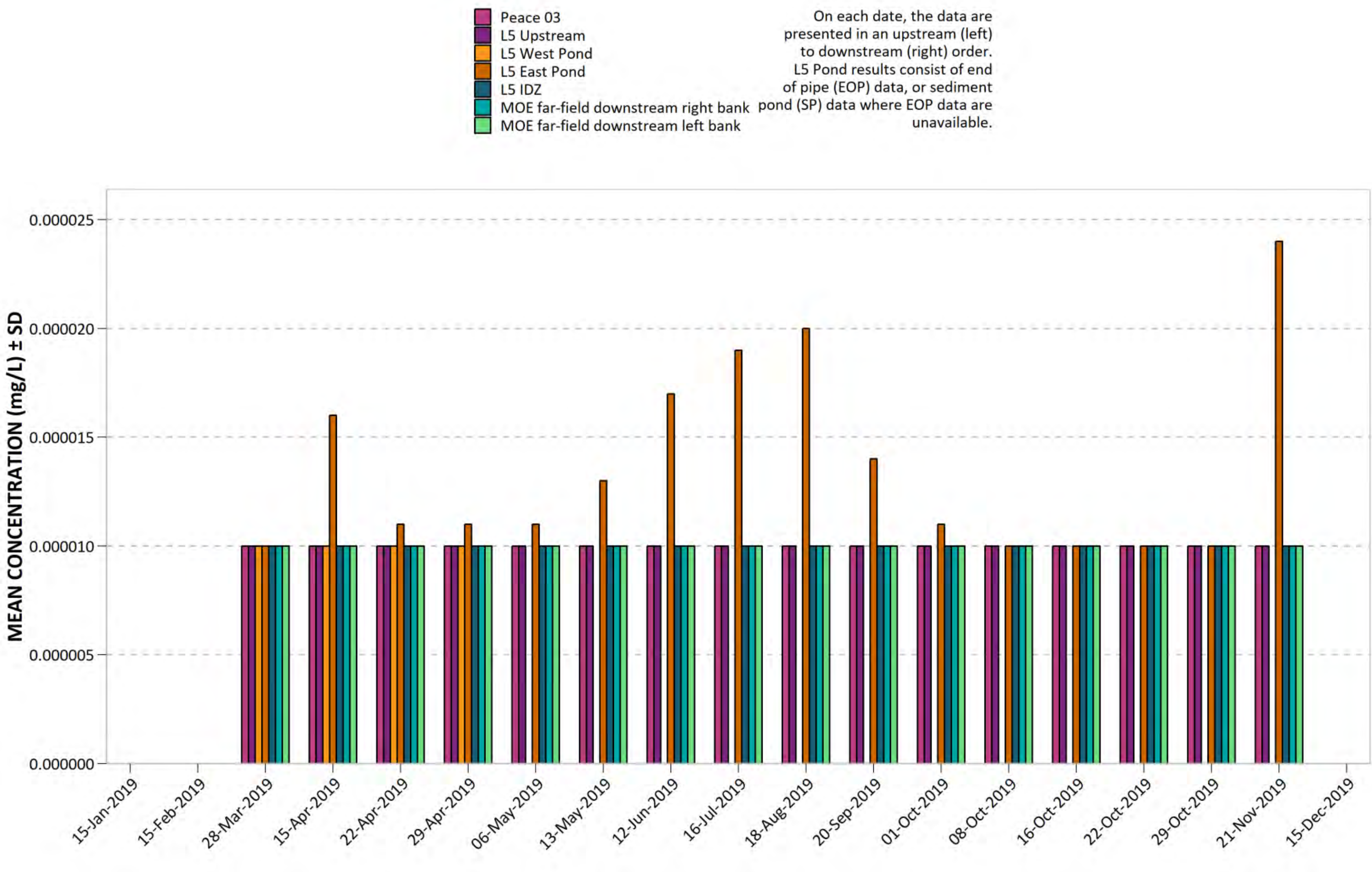
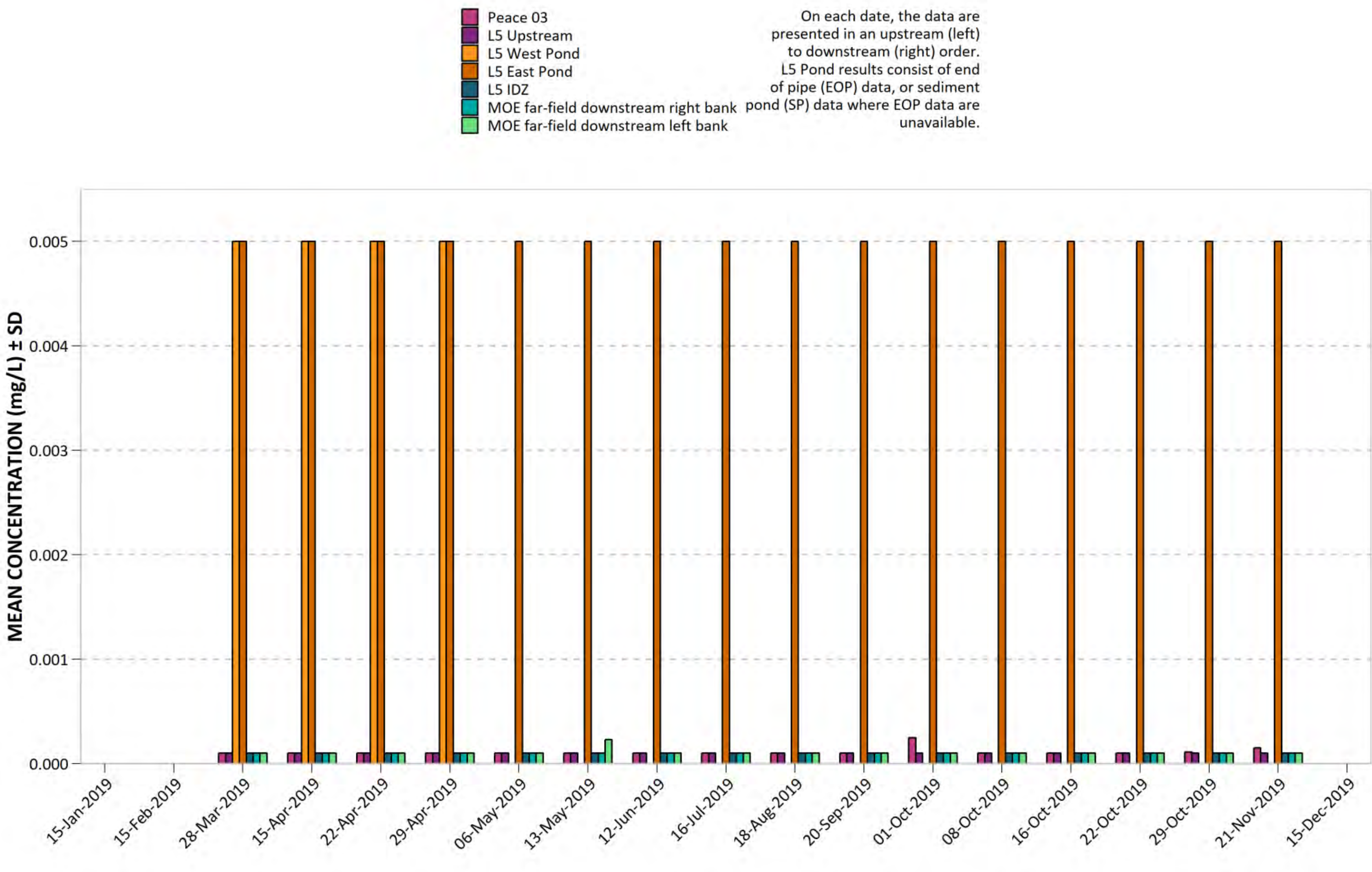


Figure 256. 2019 Peace River and RSEM L5 pond dissolved thallium (Tl).



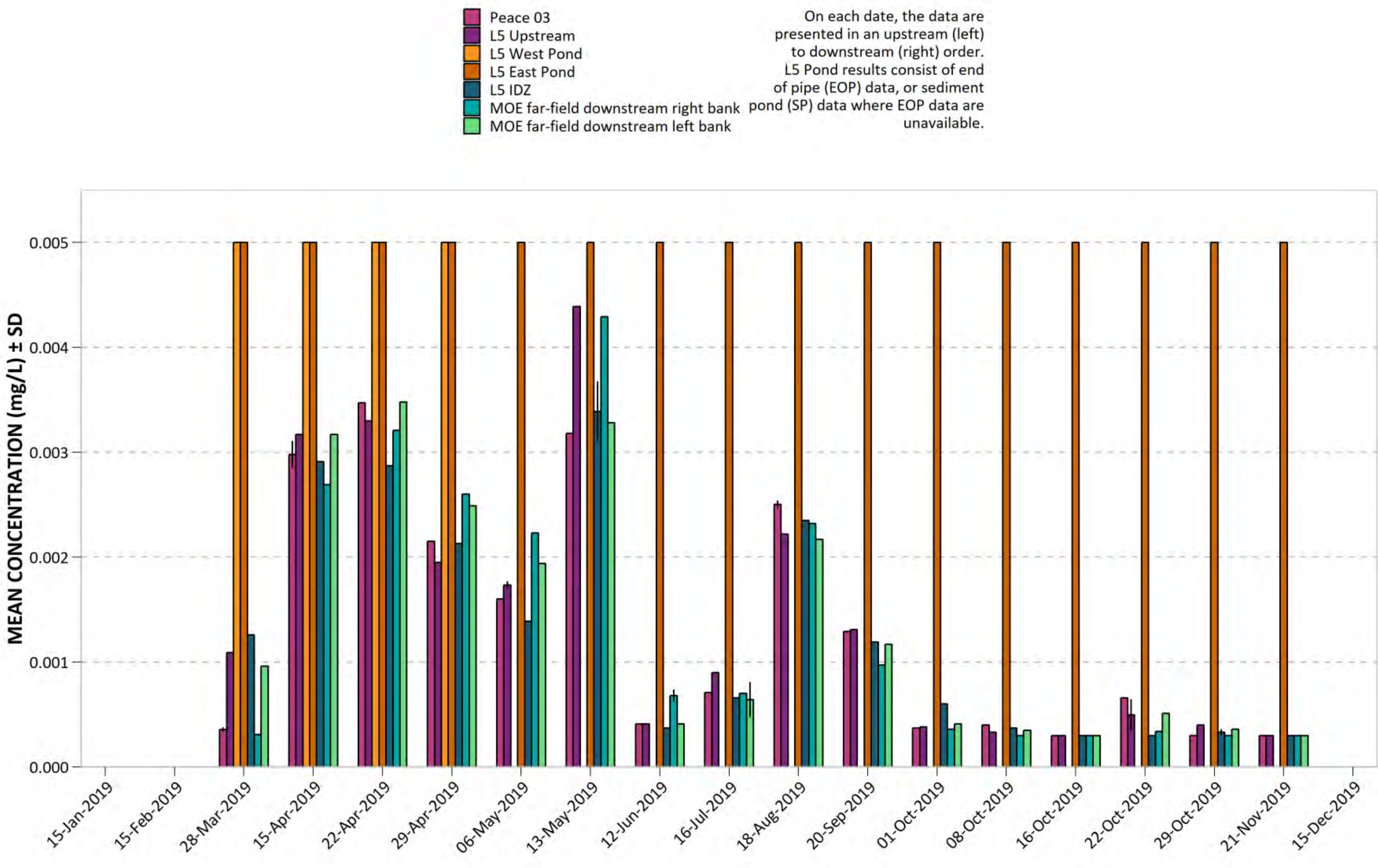
Results less than the MDL were assigned the MDL value of 0.00001 mg/L (Peace River and Pond).

Figure 257. 2019 Peace River and RSEM L5 pond dissolved tin (Sn).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 258. 2019 Peace River and RSEM L5 pond dissolved titanium (Ti).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0003 mg/L (Peace River).

Figure 259. 2019 Peace River and RSEM L5 pond dissolved uranium (U).

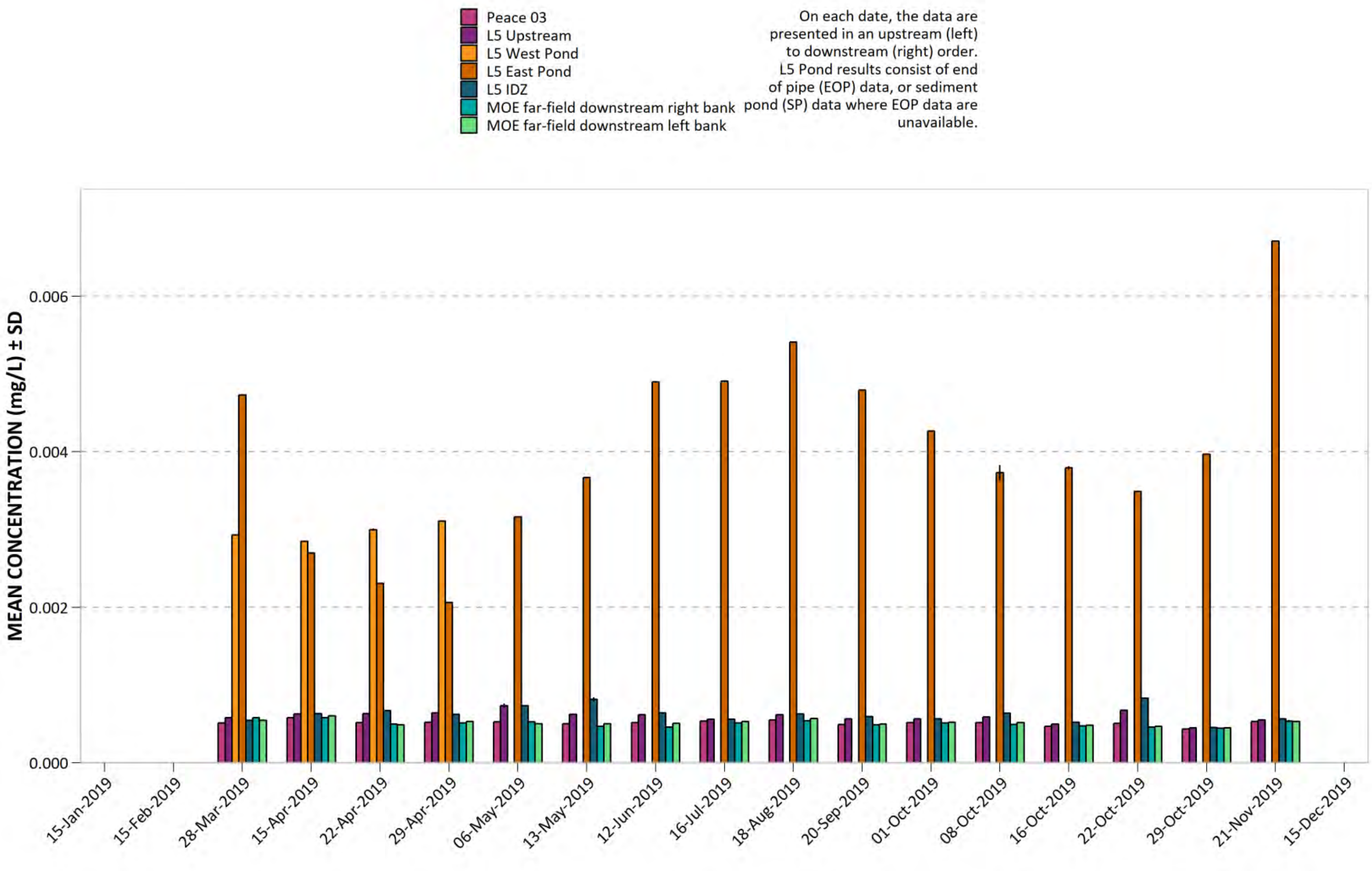
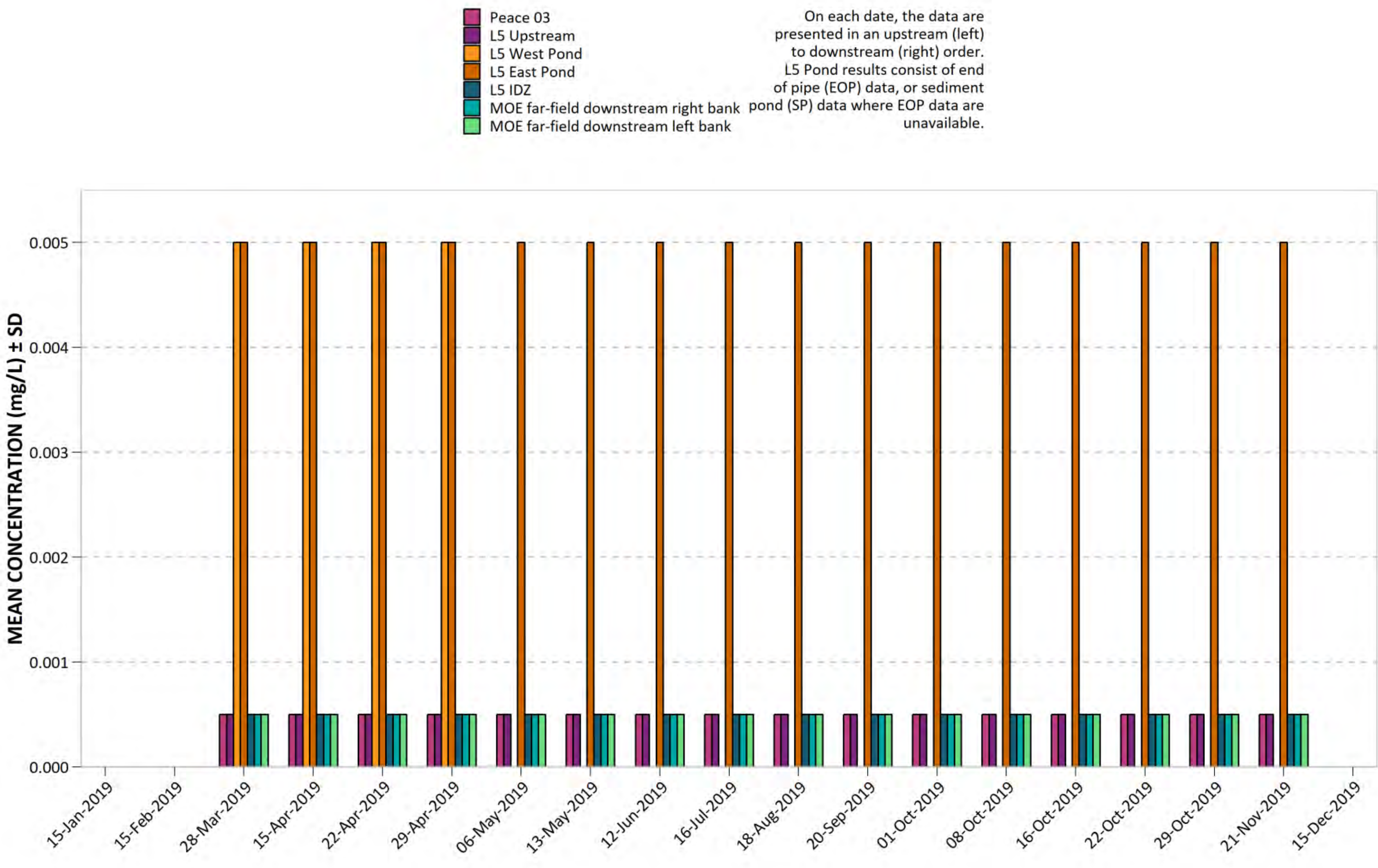
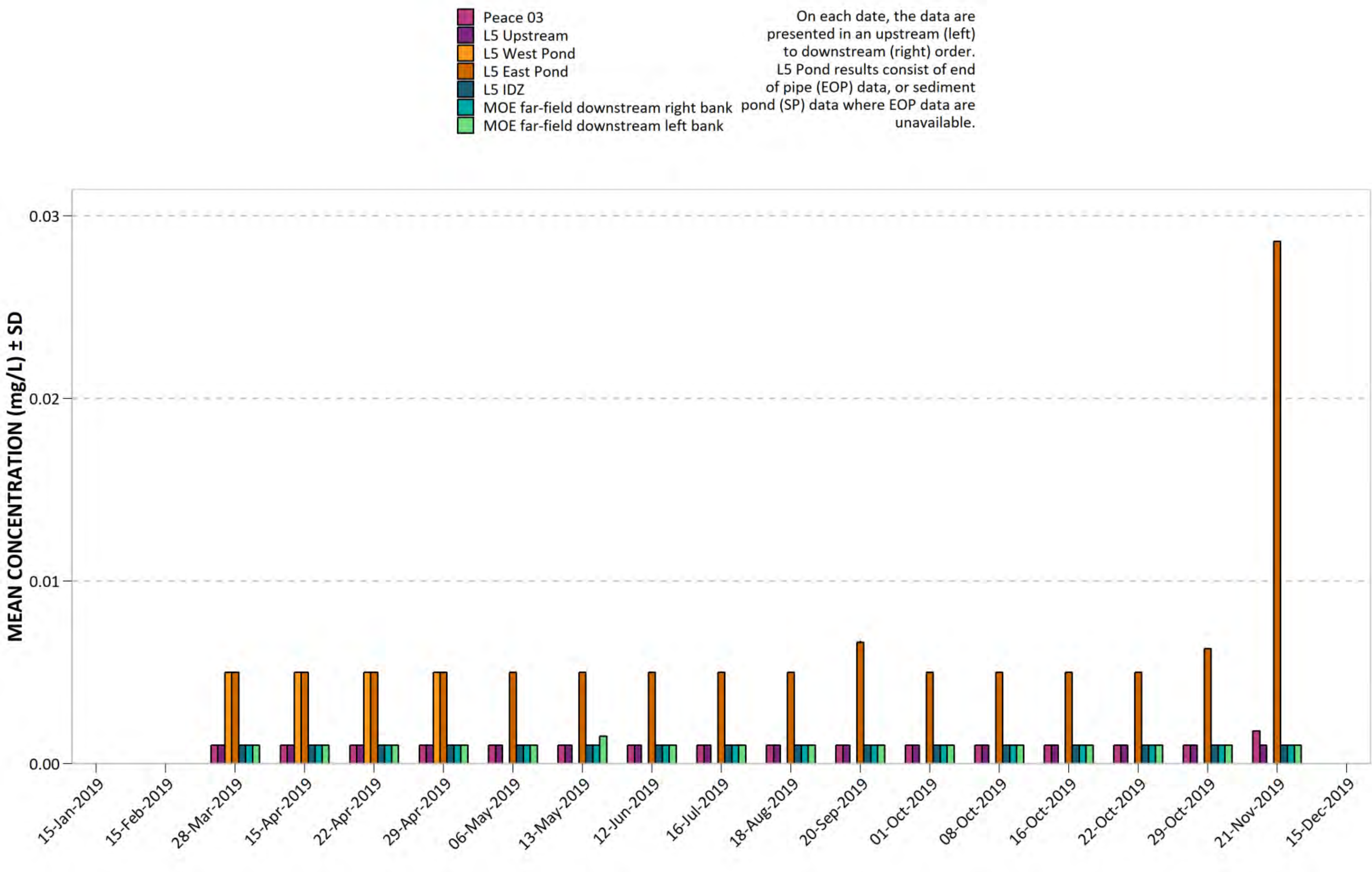


Figure 260. 2019 Peace River and RSEM L5 pond dissolved vanadium (V).



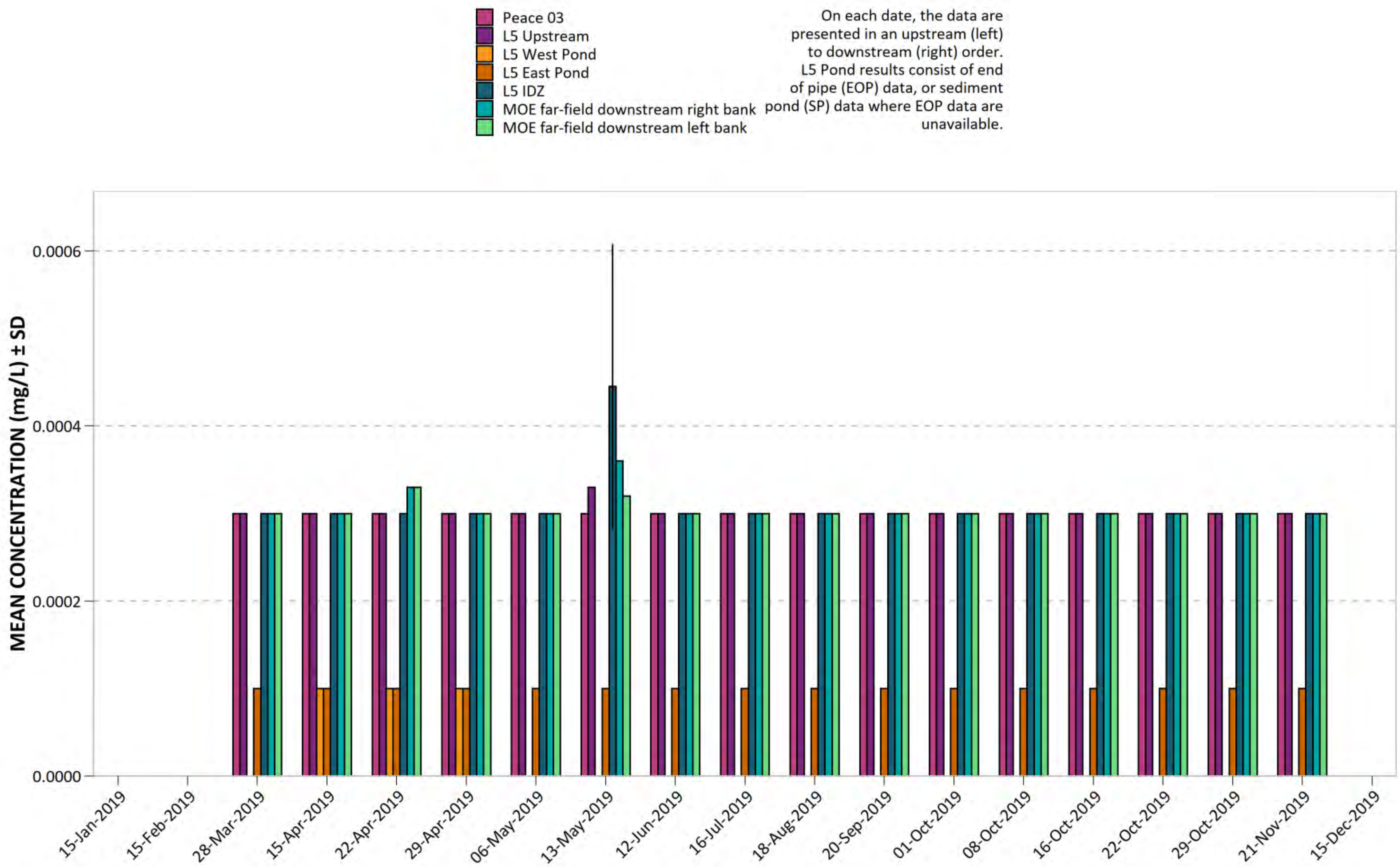
Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0005 mg/L (Peace River).

Figure 261. 2019 Peace River and RSEM L5 pond dissolved zinc (Zn).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.001 mg/L (Peace River).

Figure 262. 2019 Peace River and RSEM L5 pond dissolved zirconium (Zr).



Results less than the MDL were assigned the MDL value of 0.0001 mg/L (Pond) or 0.0003 mg/L (Peace River).

Appendix E. Site C PAG Contact RSEM Surface Water Quality Monitoring Time Series Plots – L6 Monitoring Data.

Figure 263. 2019 Peace River (*in situ*) and RSEM L6 pond (lab) specific conductivity.

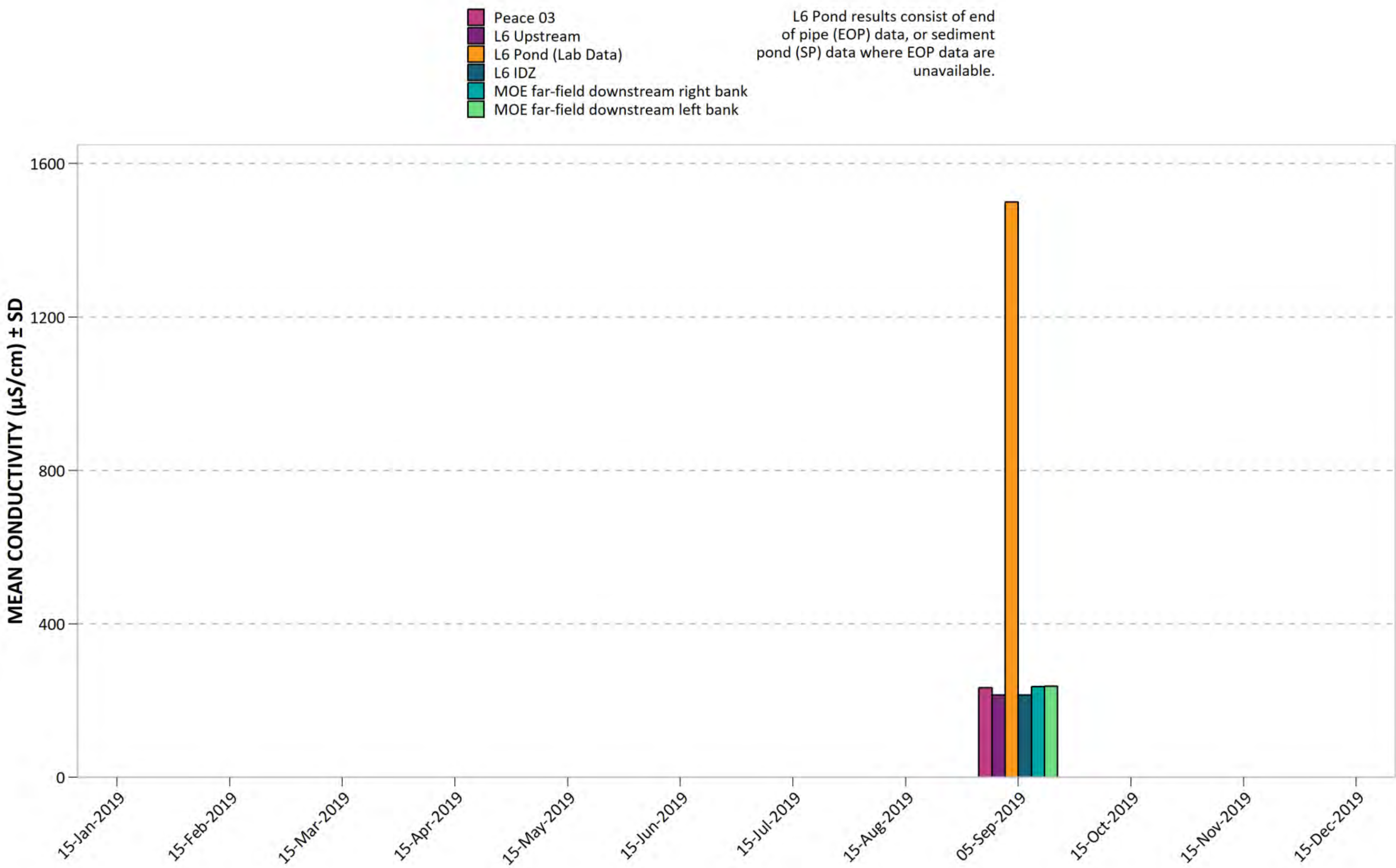


Figure 264. 2019 Peace River and RSEM L6 pond lab specific conductivity.

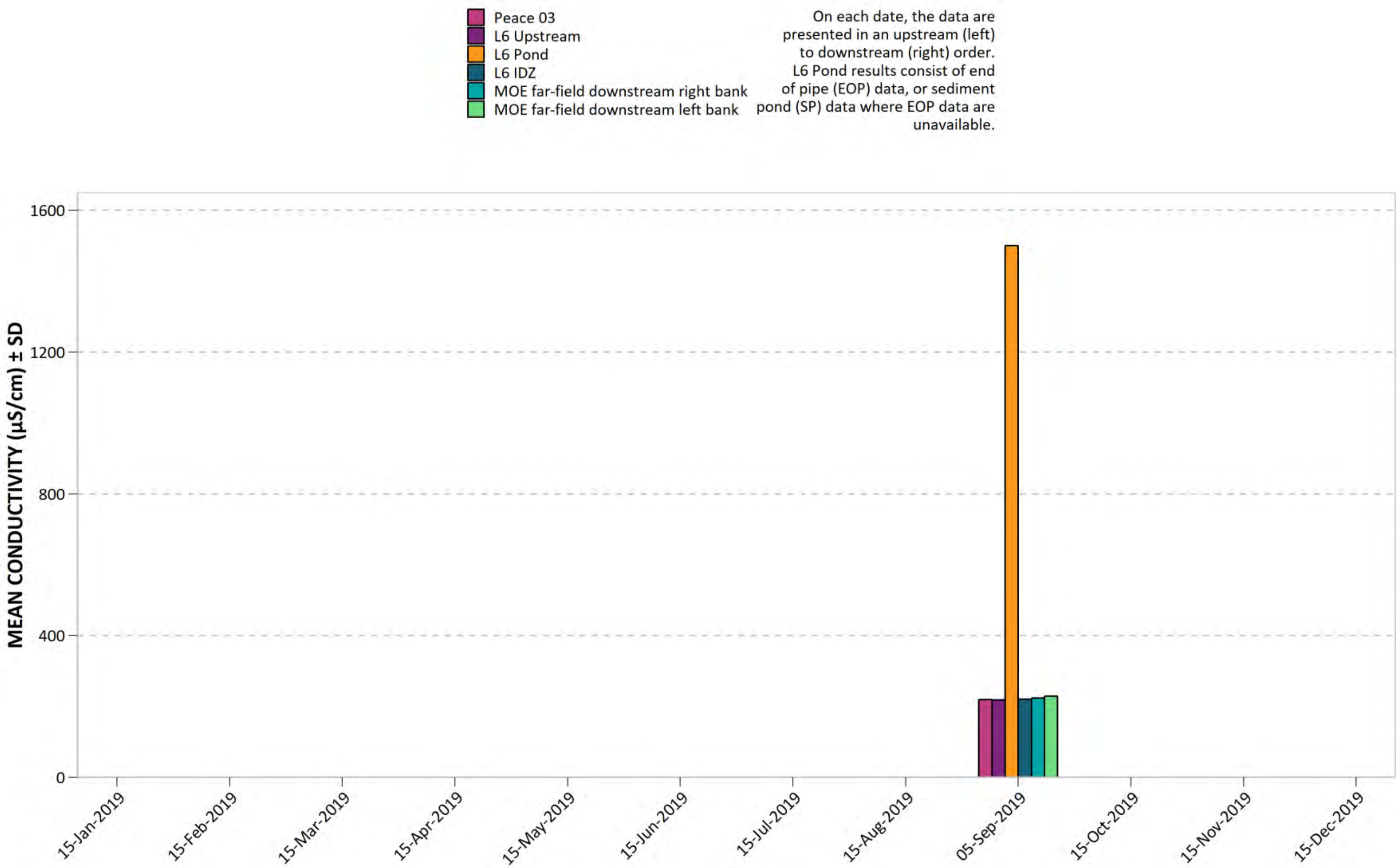


Figure 265. 2019 Peace River and RSEM L6 pond hardness (as $CaCO_3$).

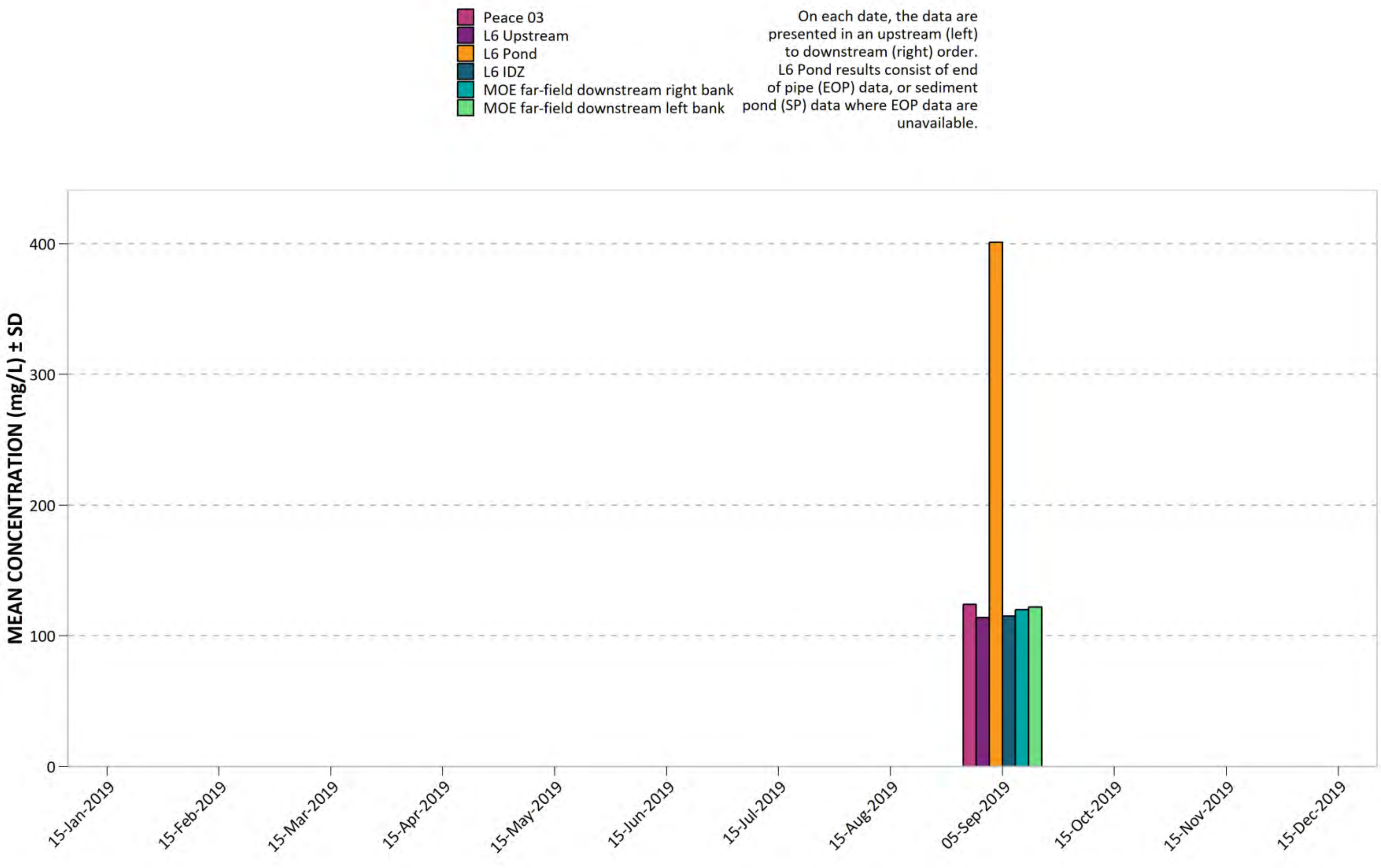


Figure 266. 2019 Peace River and RSEM L6 pond total dissolved solids (TDS).

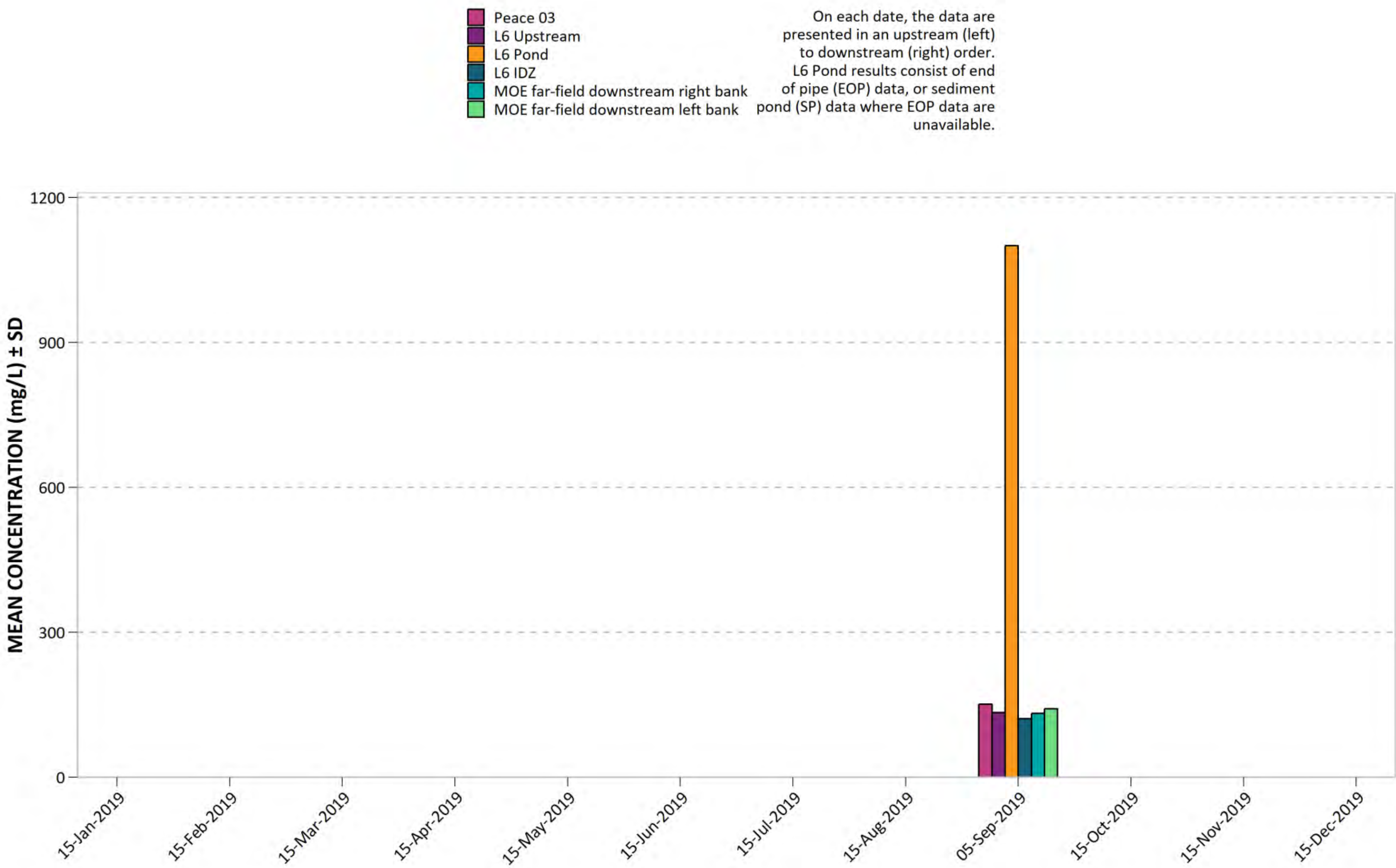


Figure 267. 2019 Peace River and RSEM L6 pond total suspended solids (TSS).

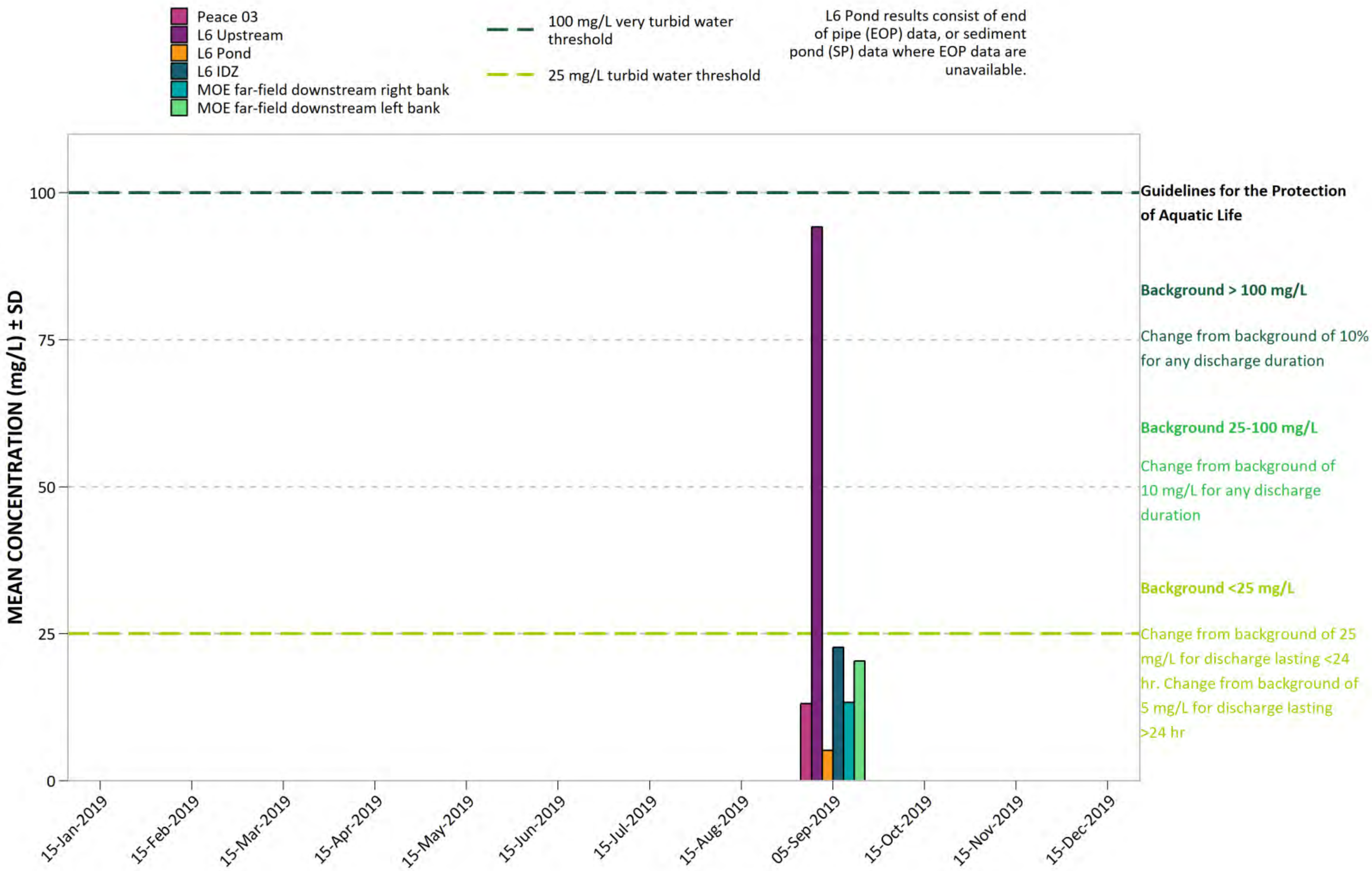


Figure 268. 2019 Peace River (*in-situ*) RSEM L6 pond (lab) turbidity.

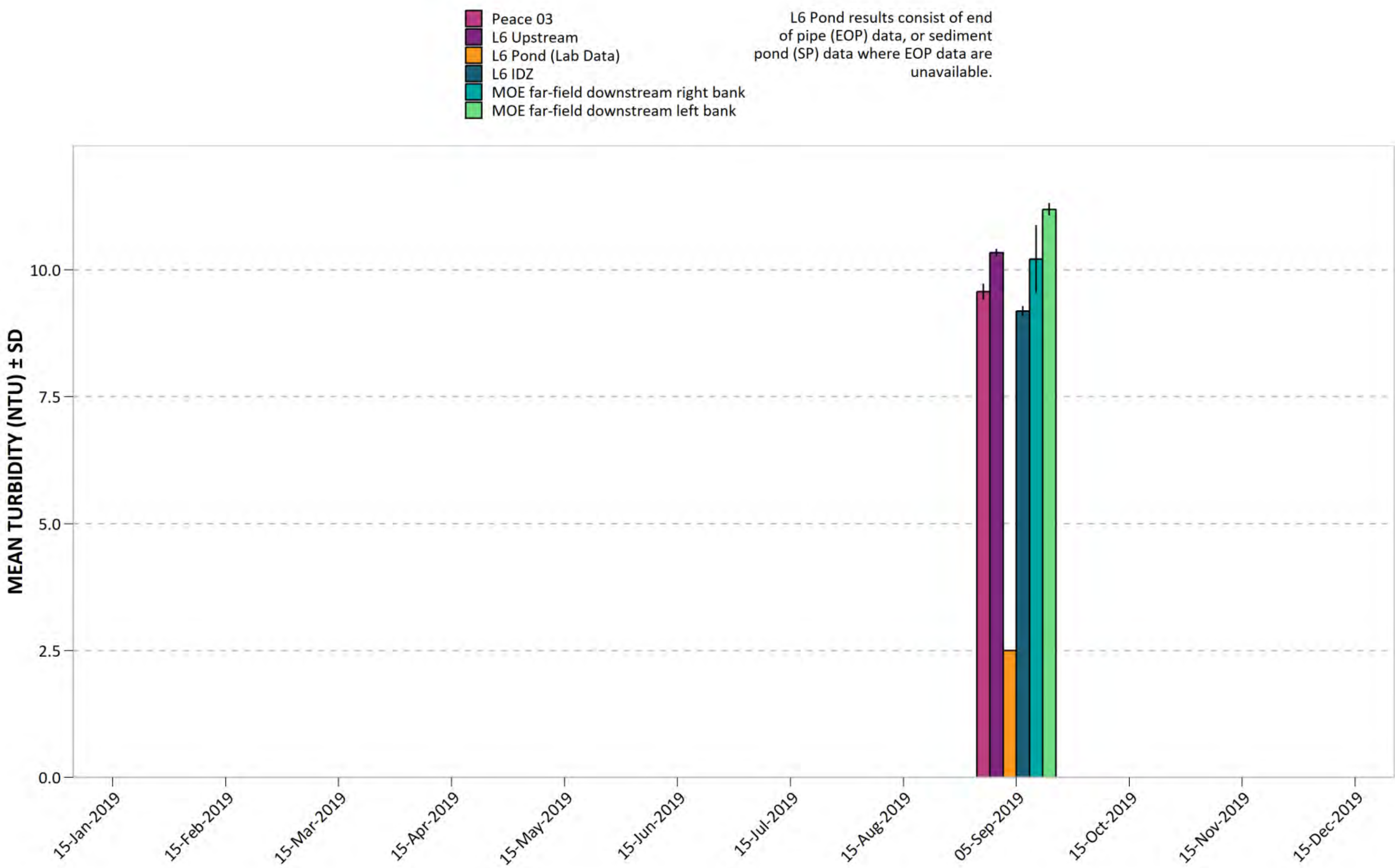


Figure 269. 2019 Peace River (*in*-situ) and RSEM L6 pond (lab) pH.

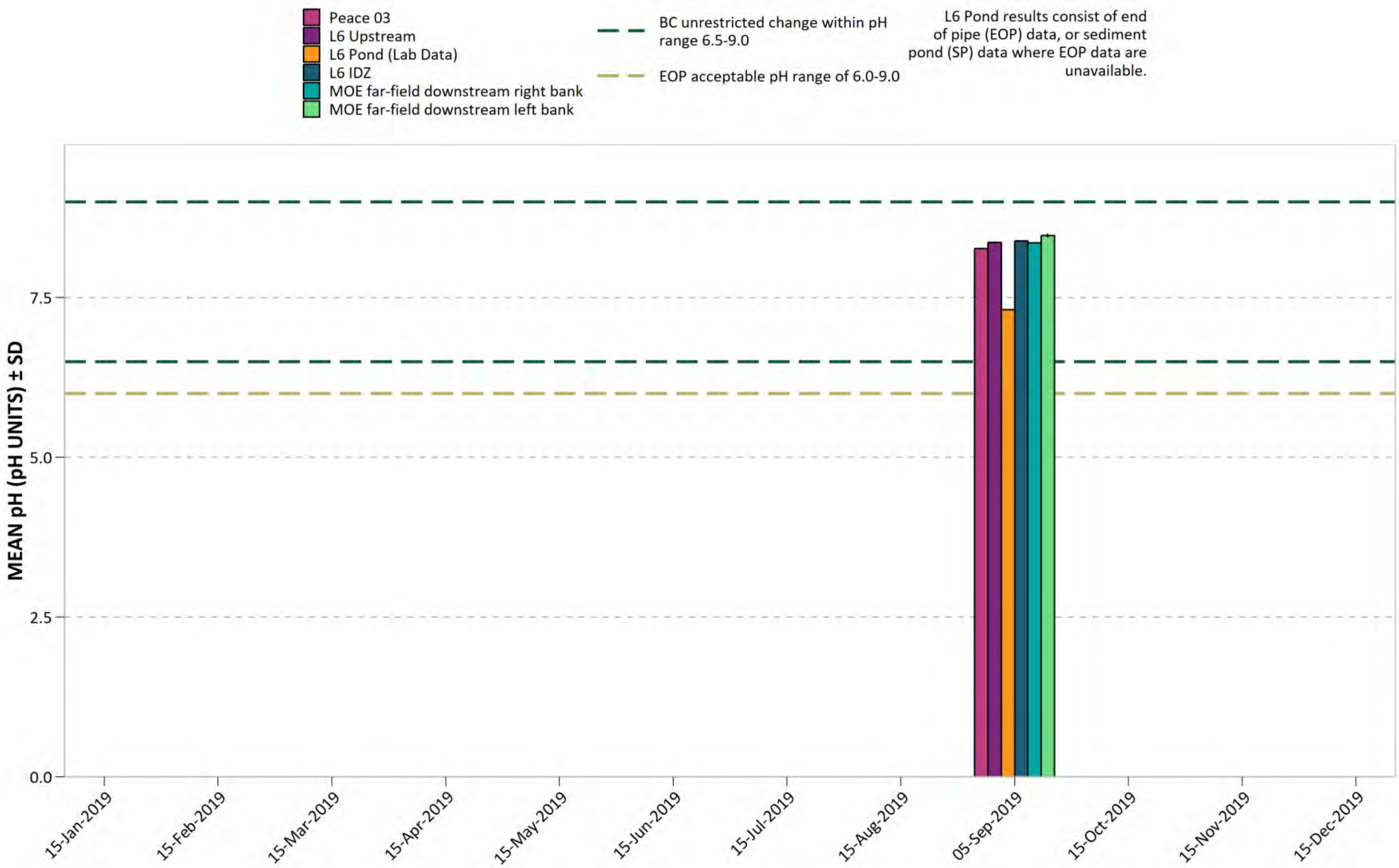


Figure 270. 2019 Peace River and RSEM L6 pond lab pH.

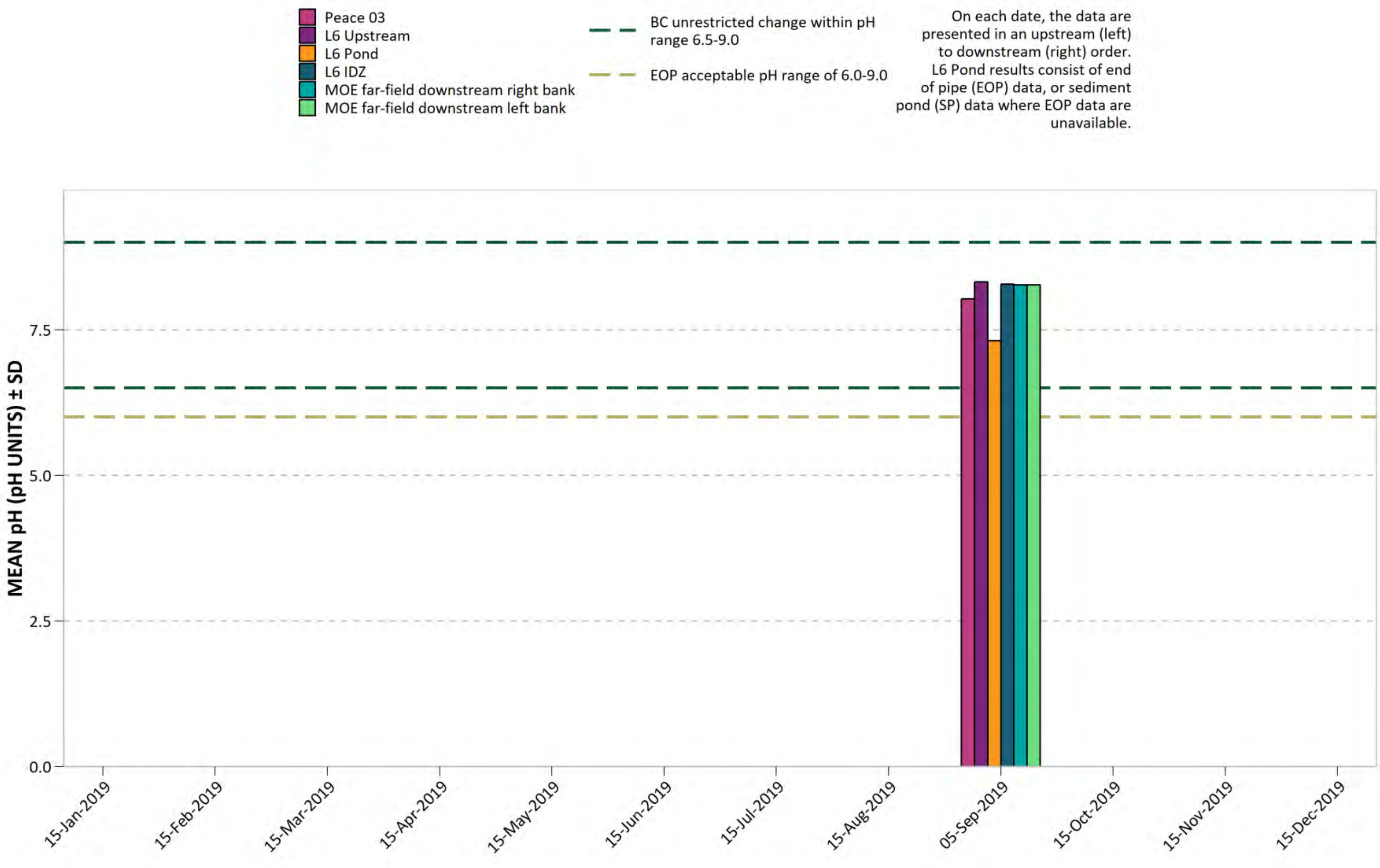


Figure 271. 2019 Peace River and RSEM L6 pond total alkalinity (as $CaCO_3$).

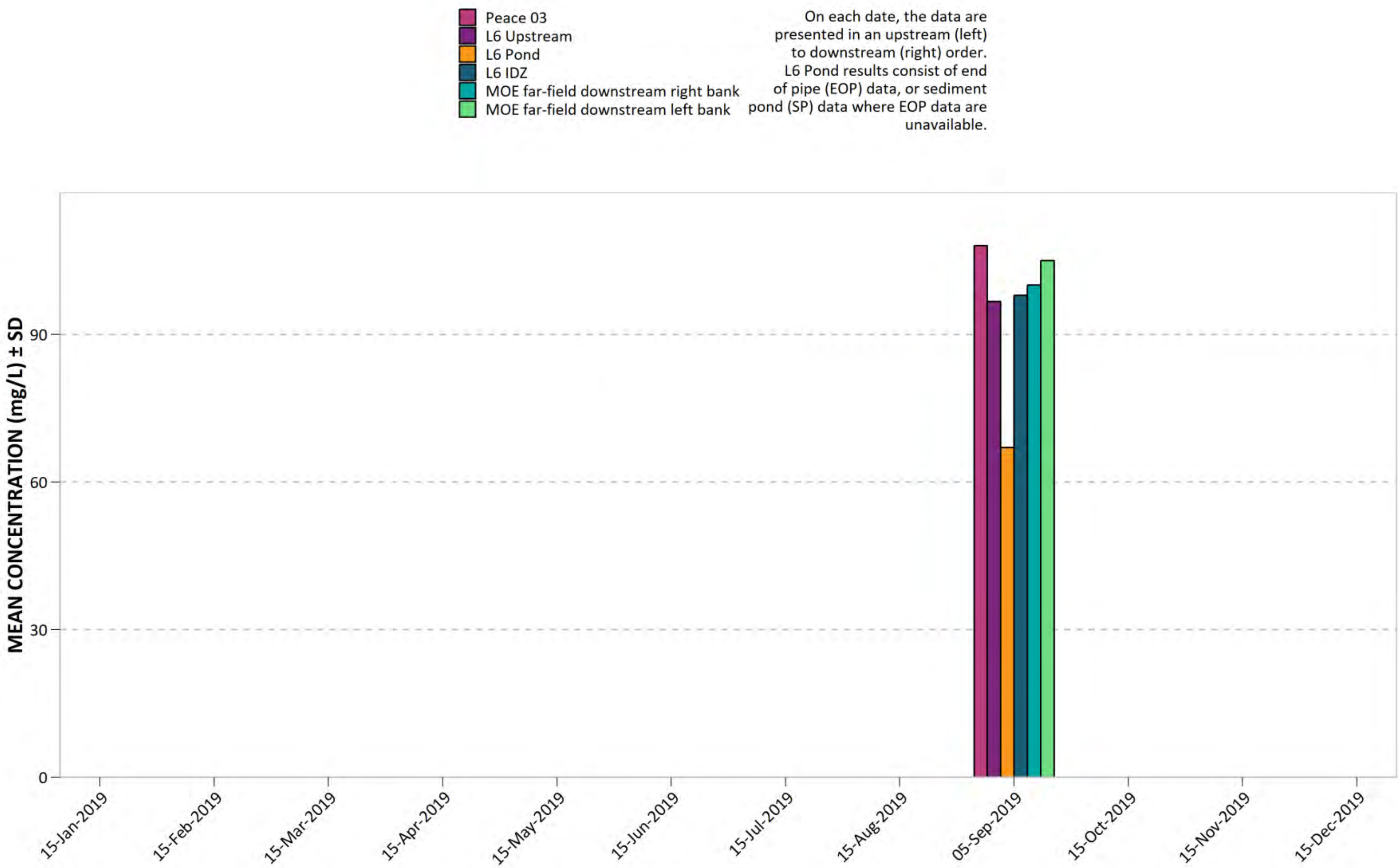


Figure 272. 2019 Peace River and RSEM L6 pond total ammonia (as N).

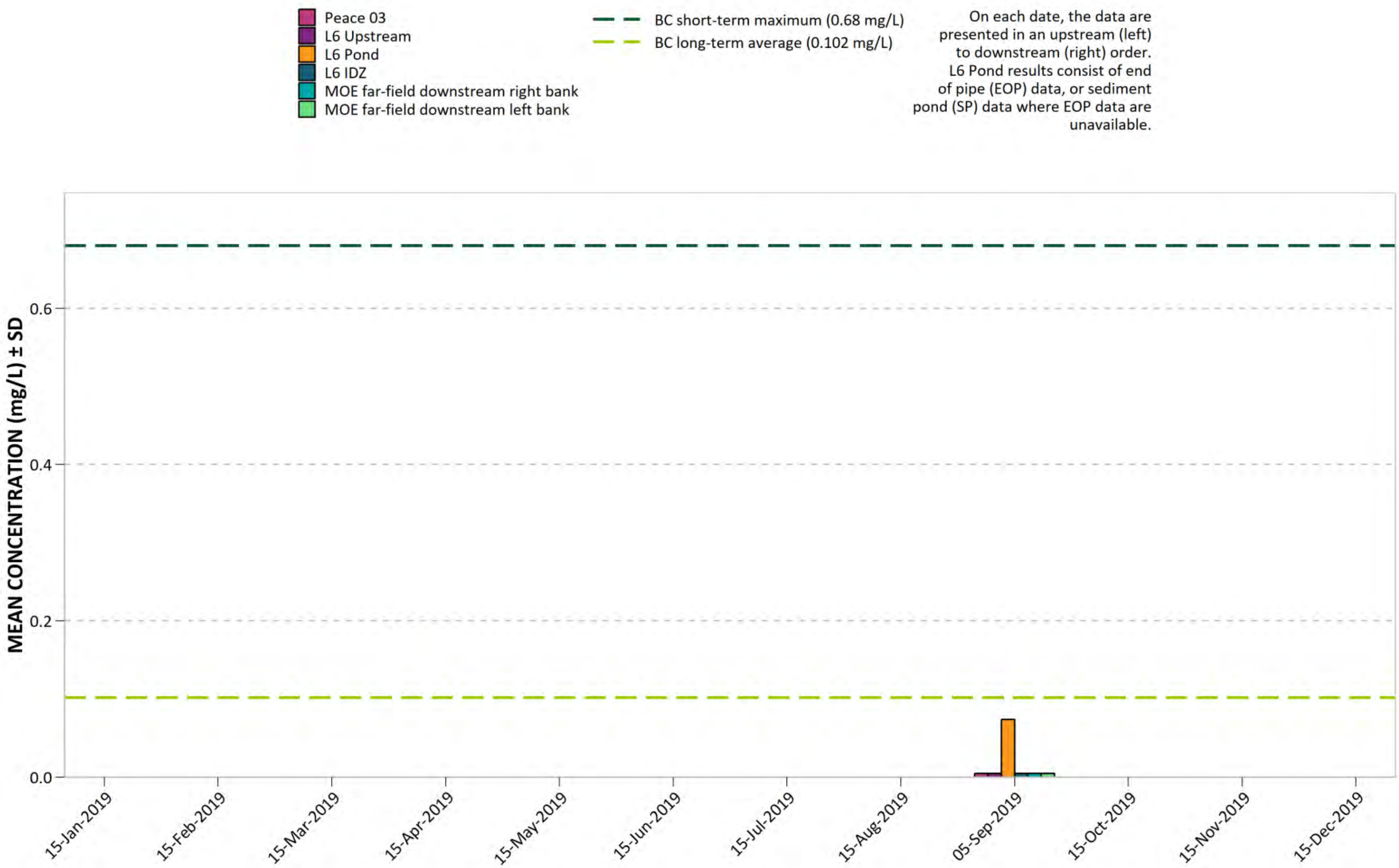
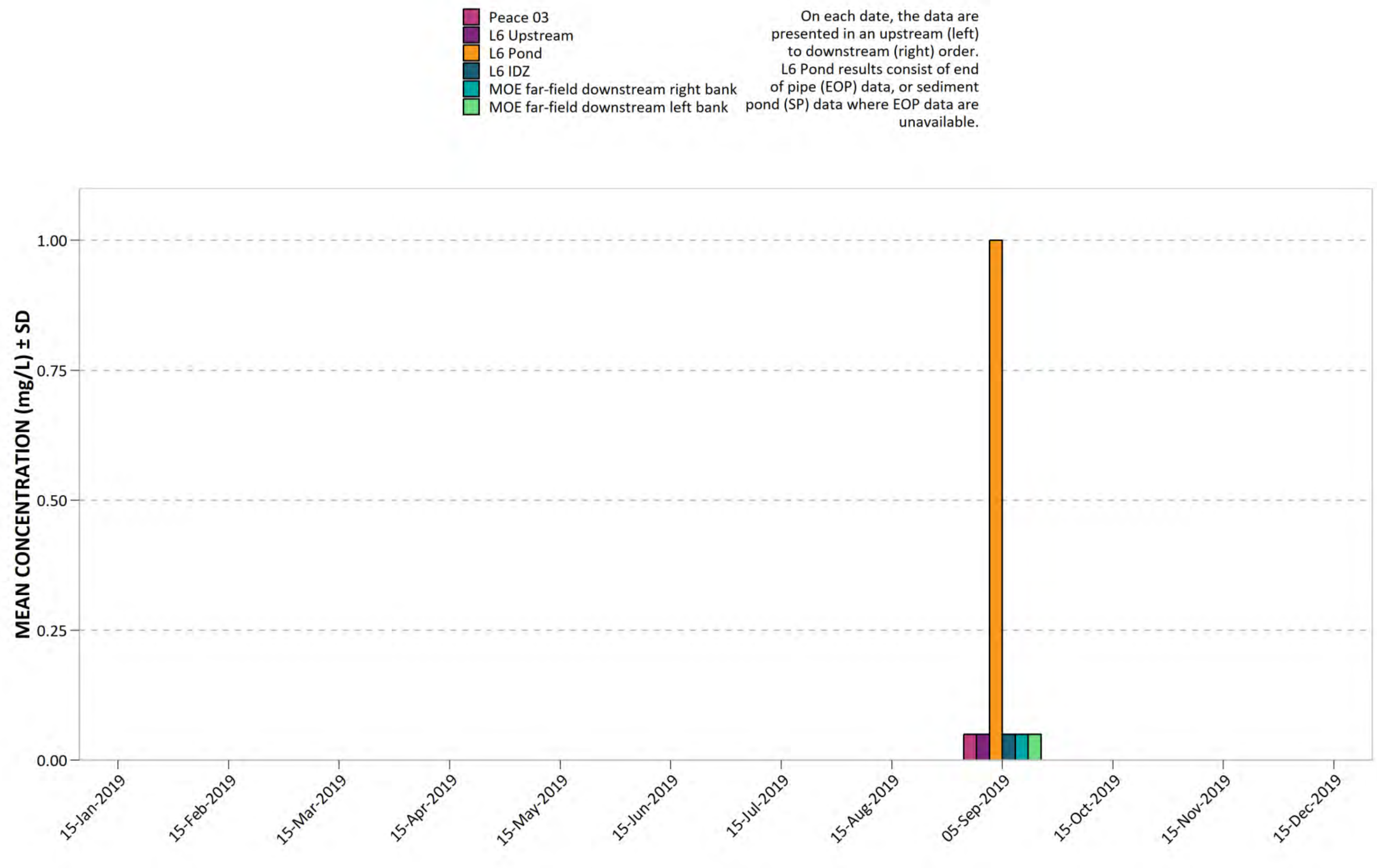
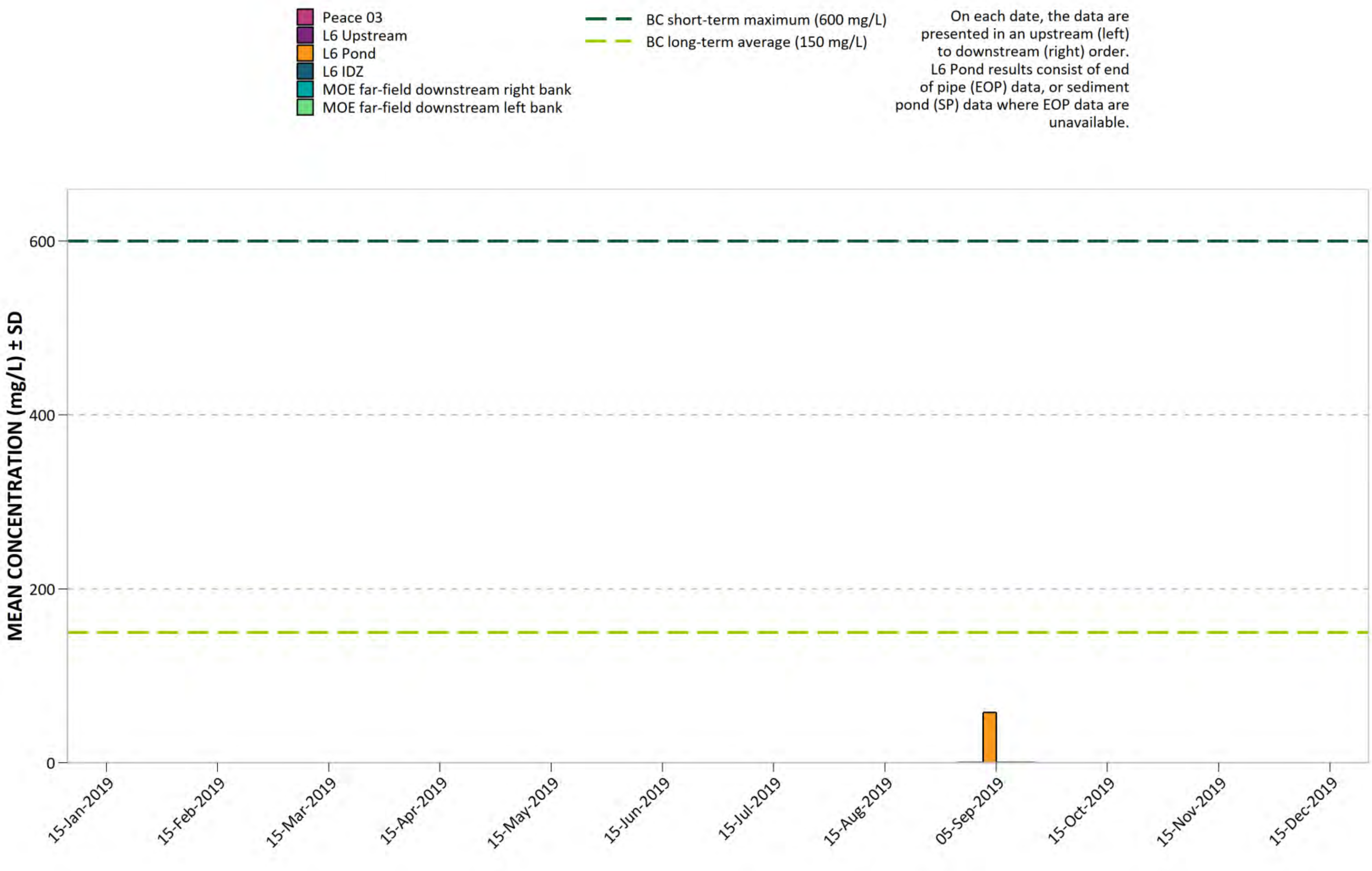


Figure 273. 2019 Peace River and RSEM L6 pond bromide (Br).



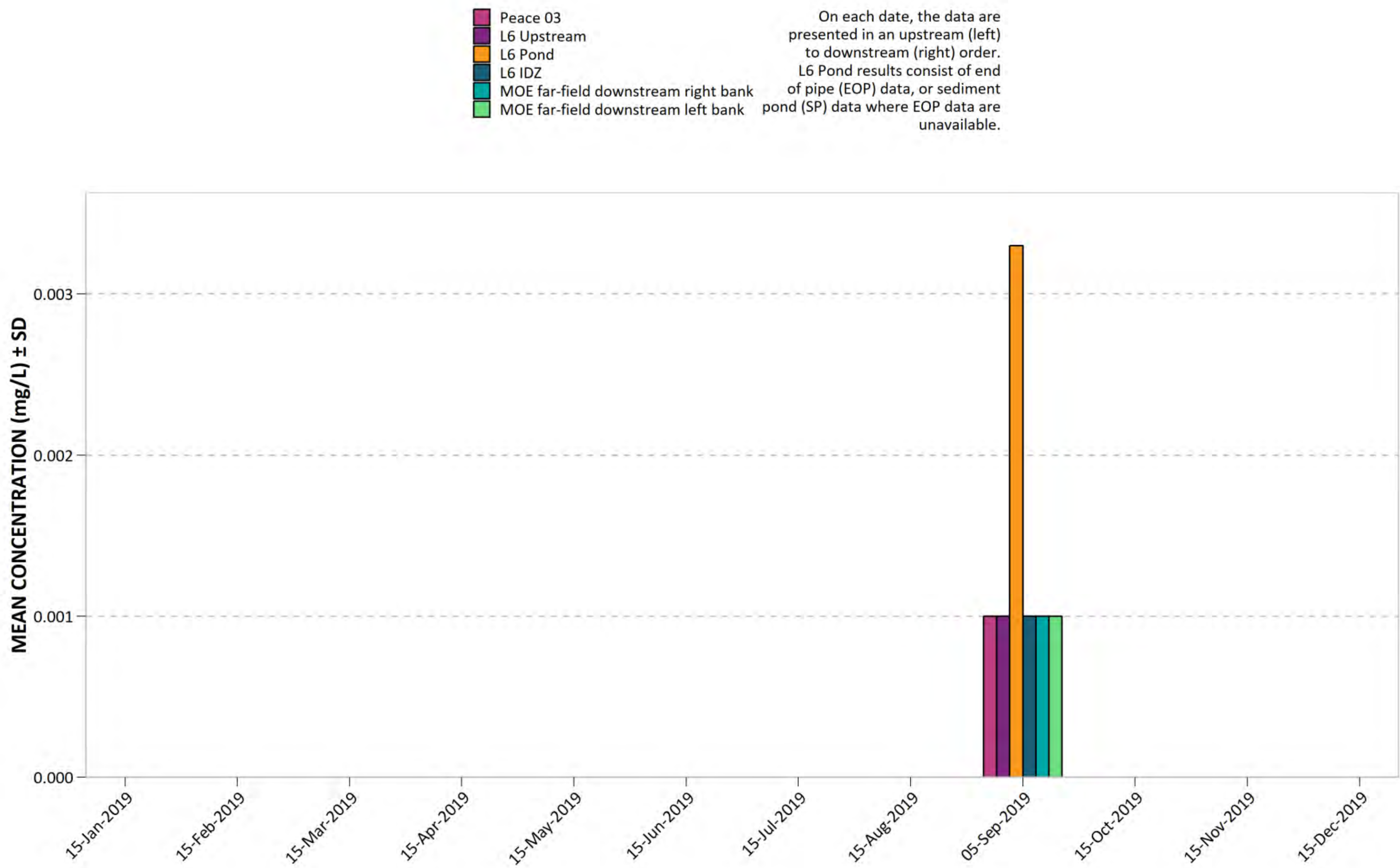
All Peace River results were less than the MDL and thus were assigned the MDL value of 0.05 mg/L.

Figure 274. 2019 Peace River and RSEM L6 pond chloride (Cl).



All Peace River results were less than the MDL and thus were assigned the MDL value of 0.5 mg/L.

Figure 275. 2019 Peace River and RSEM L6 pond dissolved orthophosphate.



Peace River results less than the MDL were assigned the MDL value 0.001 mg/L. Pond data less than the MDL were assigned the corresponding MDL.

Figure 276. 2019 Peace River and RSEM L6 pond fluoride (F).

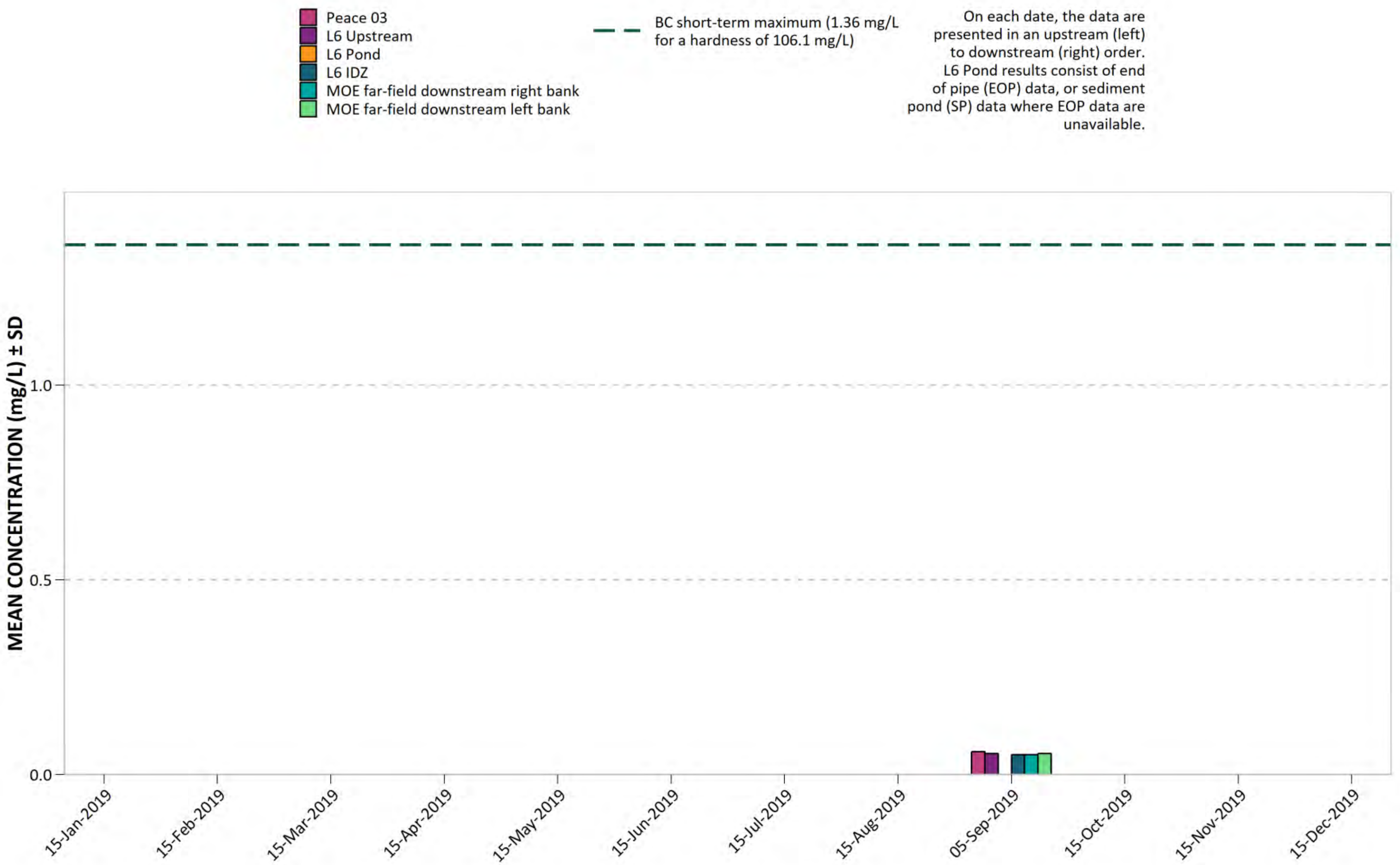


Figure 277. 2019 Peace River and RSEM L6 pond nitrate (as N).

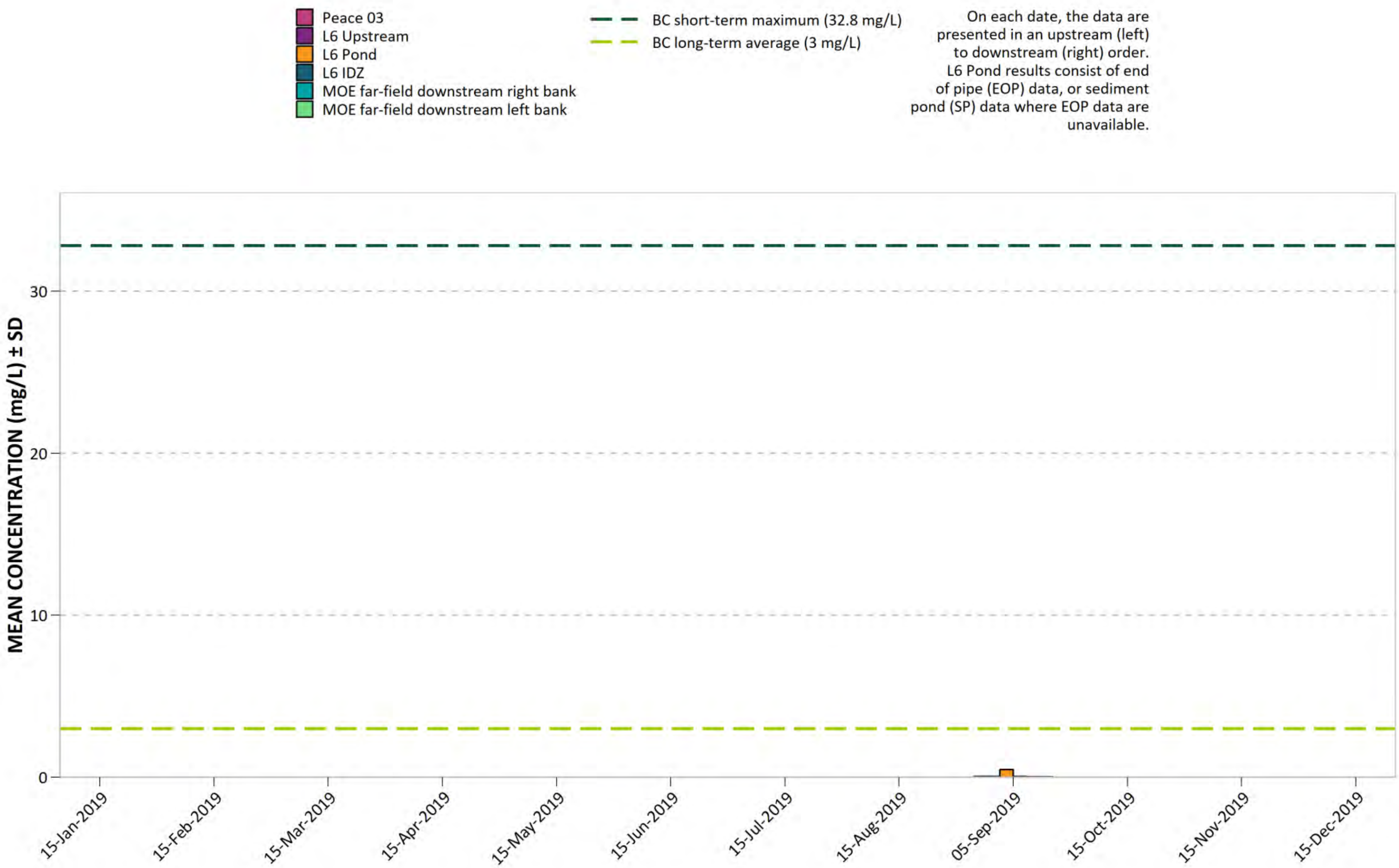
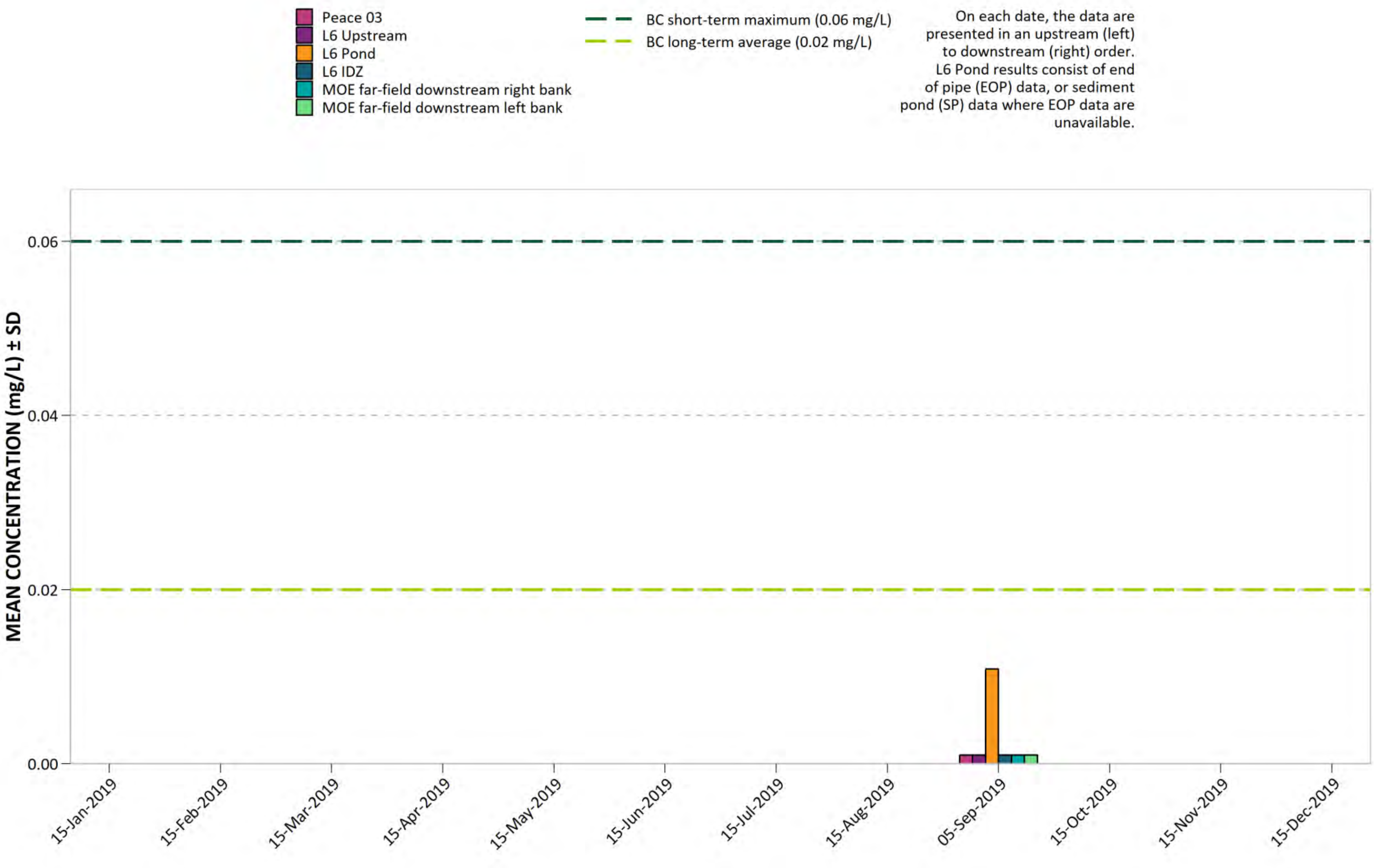


Figure 278. 2019 Peace River and RSEM L6 pond nitrite (as N).



Note: BC WQG for nitrite are chloride dependent, and therefore guidelines depicted in the plot are applicable for Peace River sites only. Based on the range of chloride values observed in the R6 pond, the applicable BC Maximum and 30-day guidelines are 0.6 mg/L and 0.2 mg/L, respectively.

Figure 279. 2019 Peace River and RSEM L6 pond sulfate (SO_4).

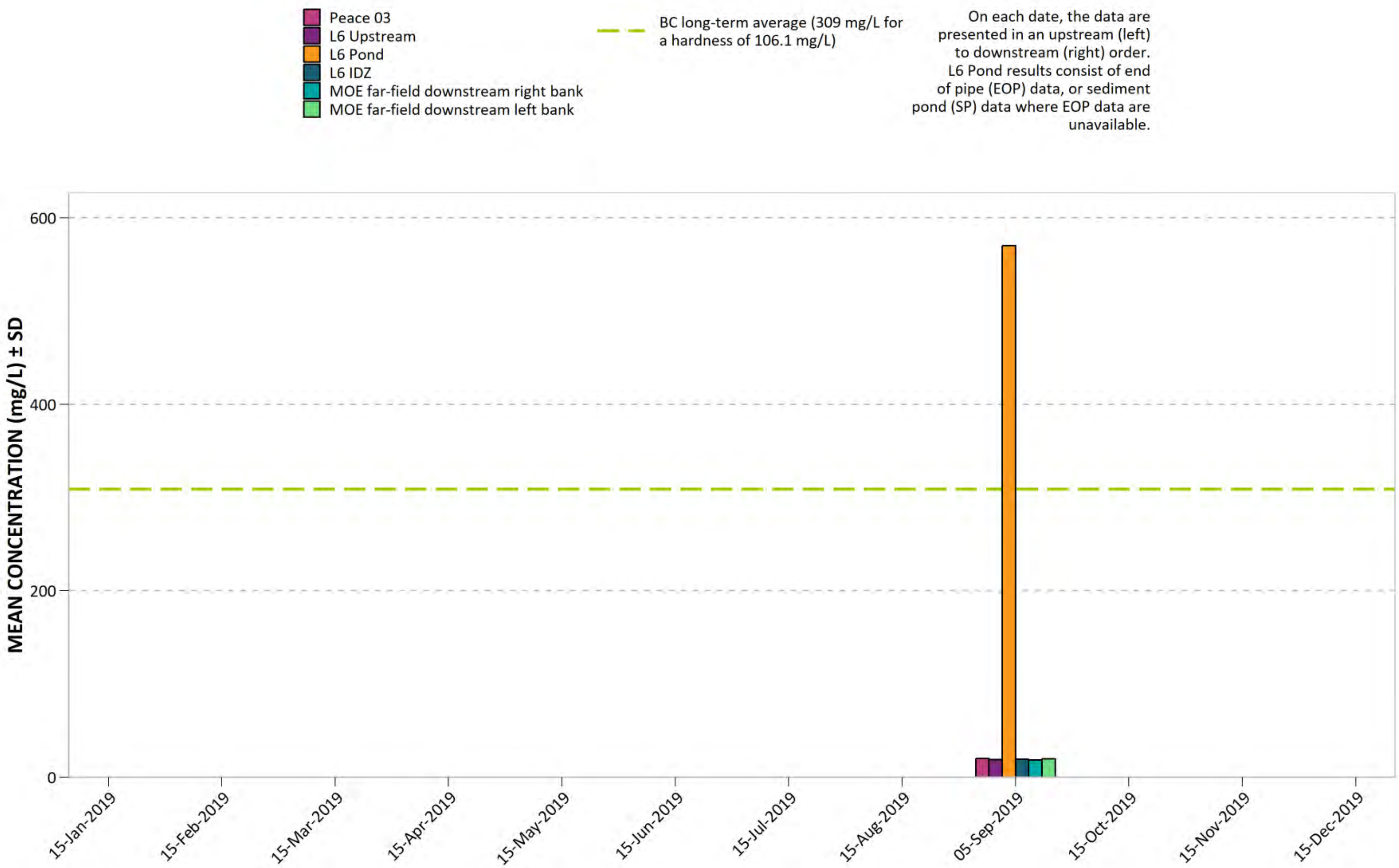


Figure 280. 2019 Peace River and RSEM L6 pond dissolved organic carbon (DOC).

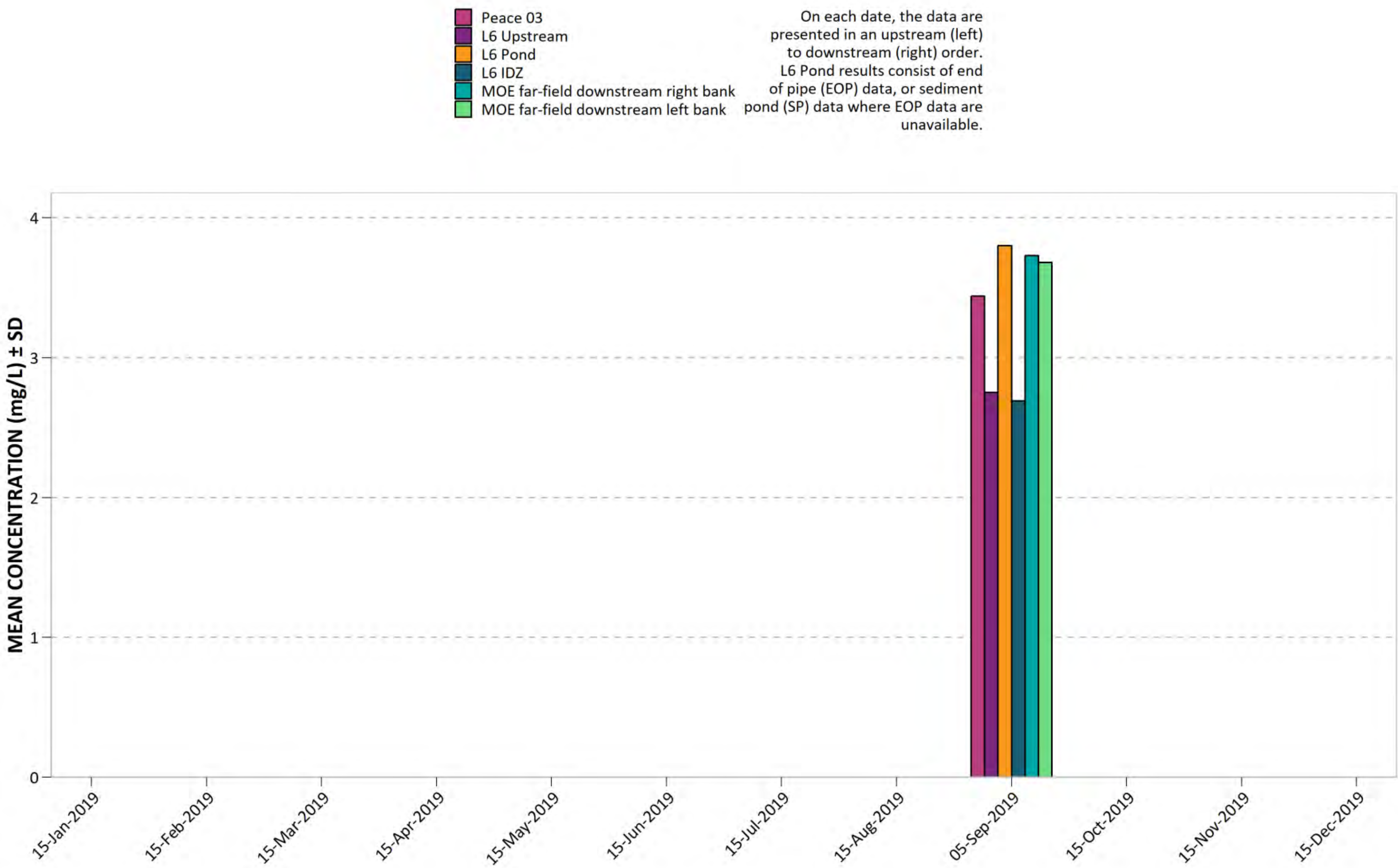


Figure 281. 2019 Peace River and RSEM L6 pond total organic carbon (TOC).

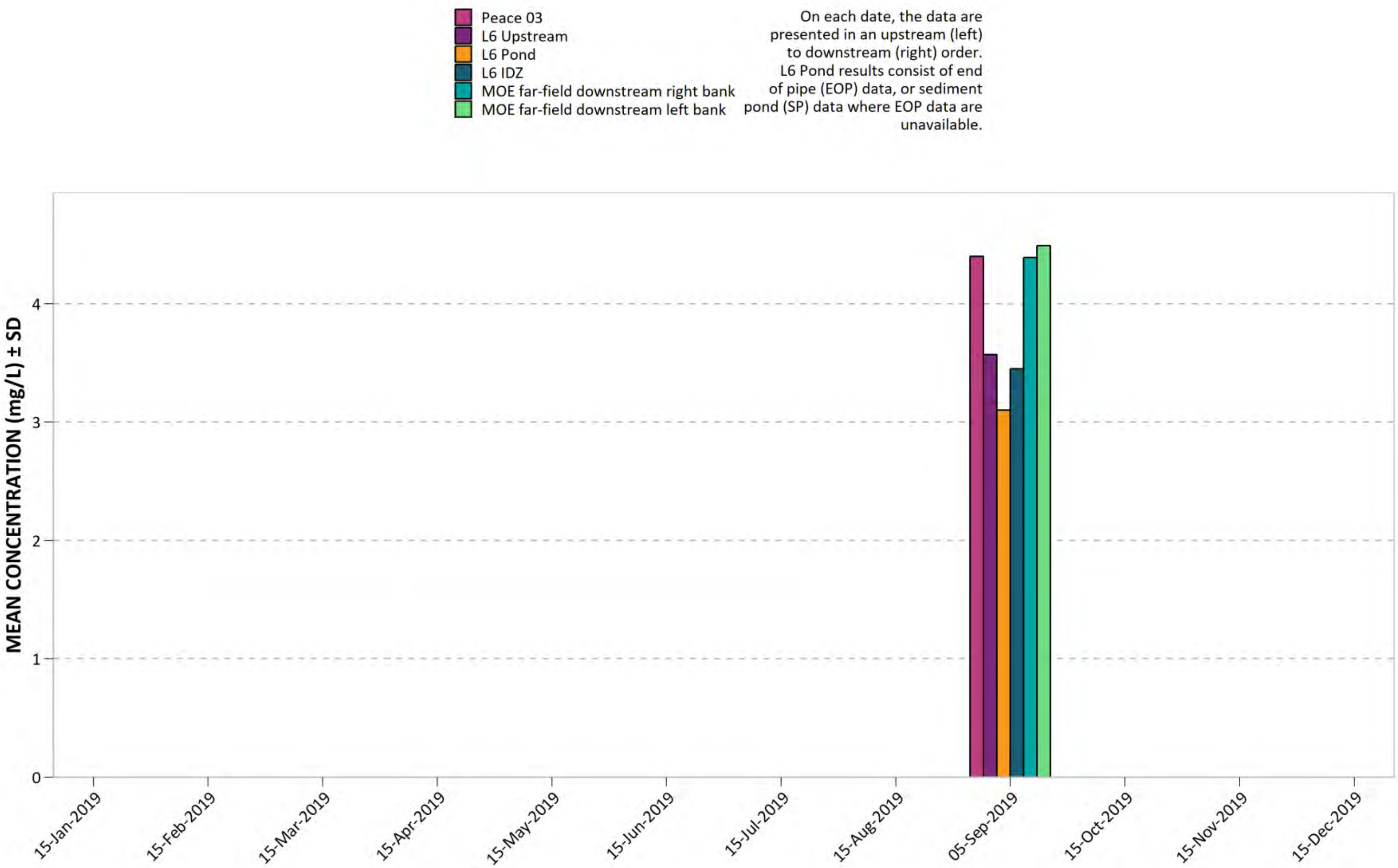


Figure 282. 2019 Peace River and RSEM L6 pond total aluminum (Al).

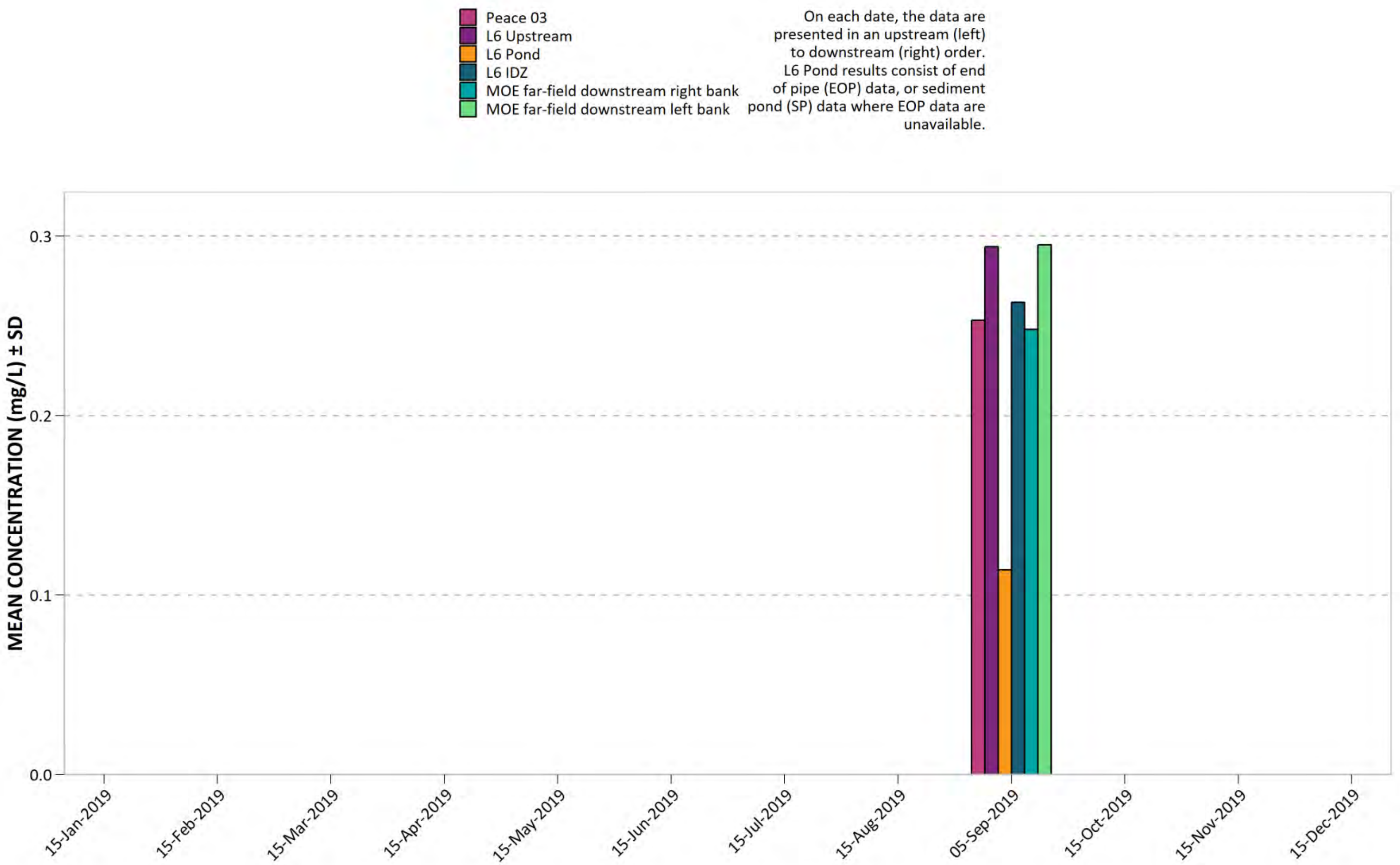
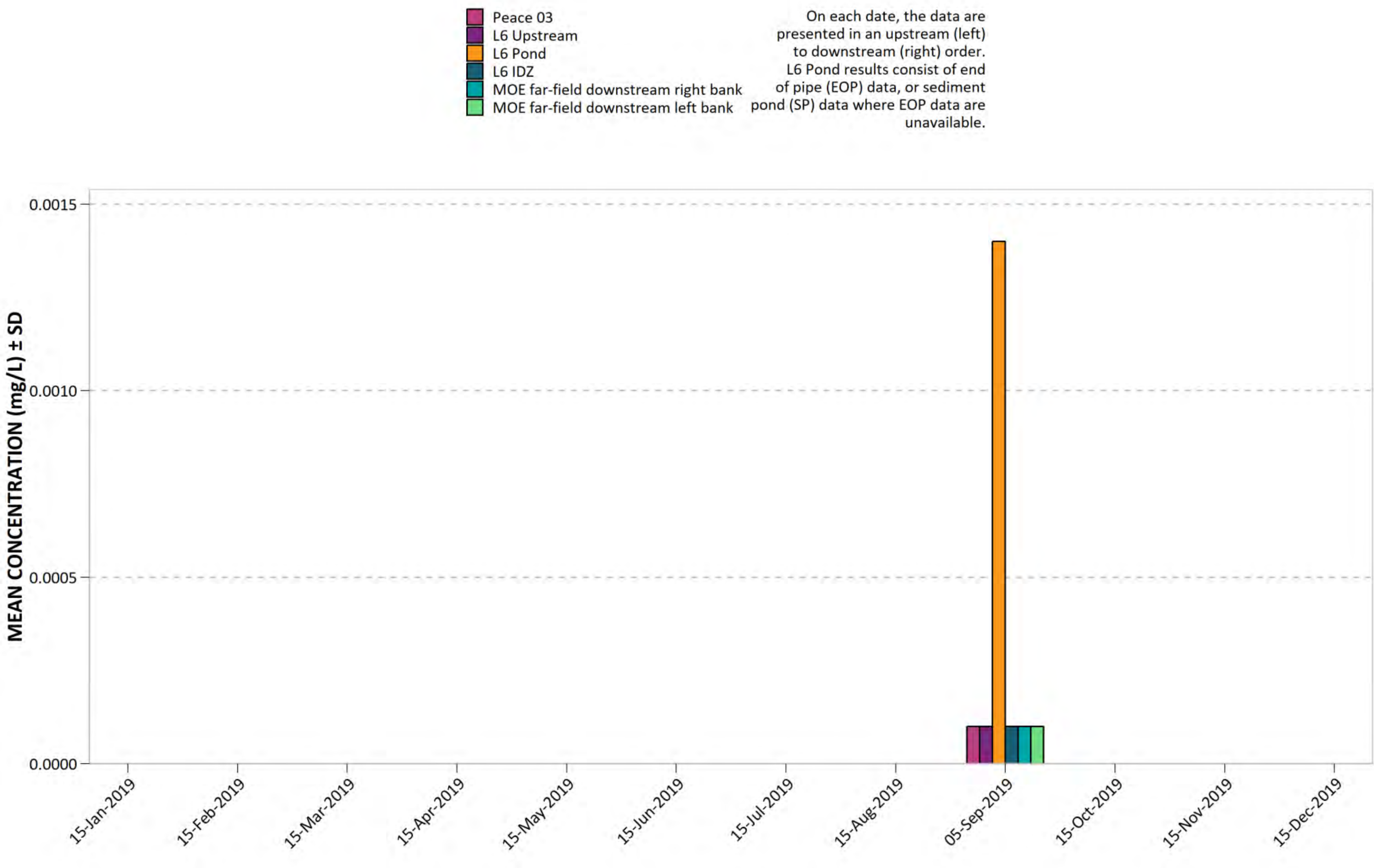


Figure 283. 2019 Peace River and RSEM L6 pond total antimony (Sb).



Results less than the MDL were assigned the MDL value of 0.0005 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 284. 2019 Peace River and RSEM L6 pond total arsenic (As).

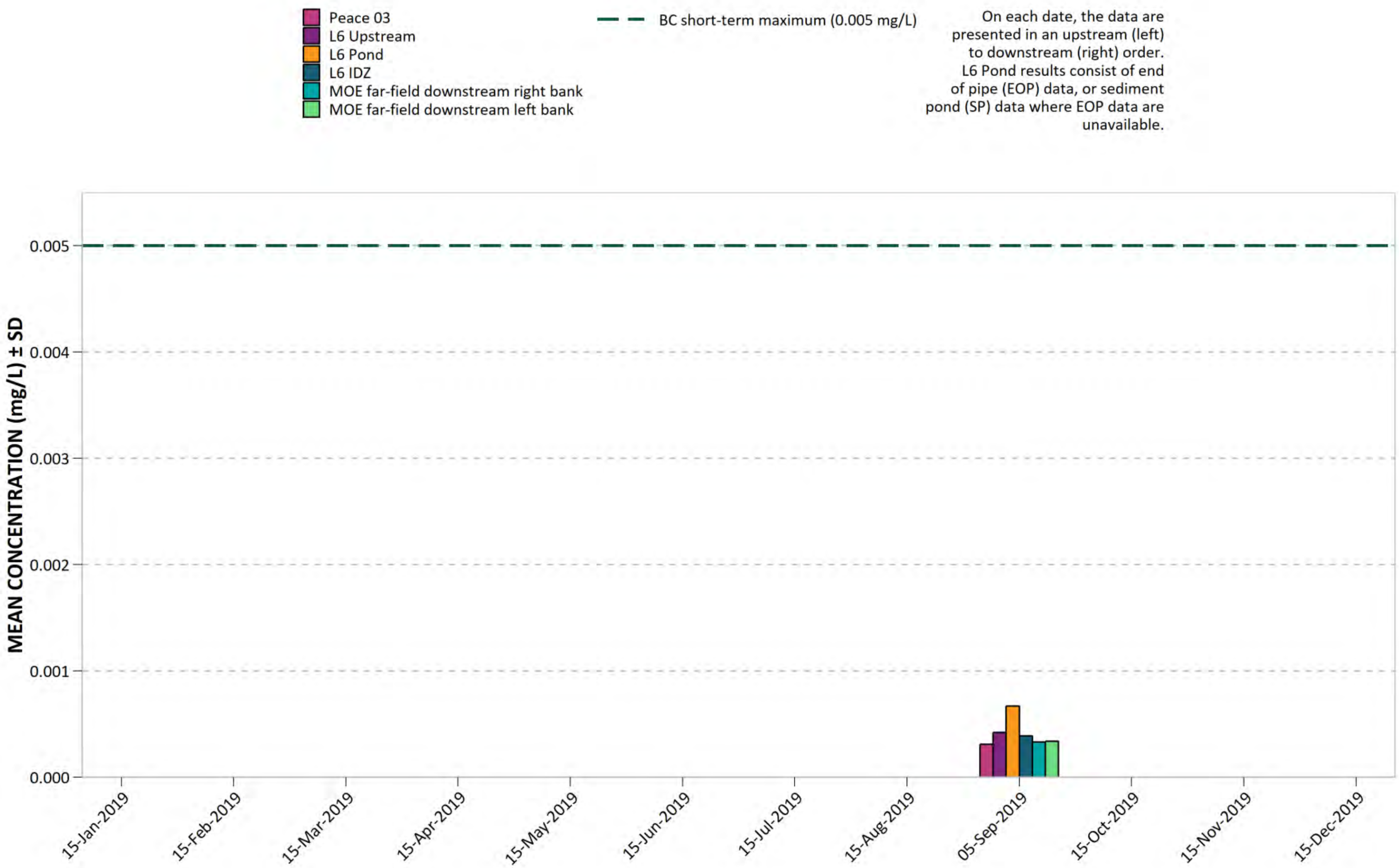


Figure 285. 2019 Peace River and RSEM L6 pond total barium (Ba).

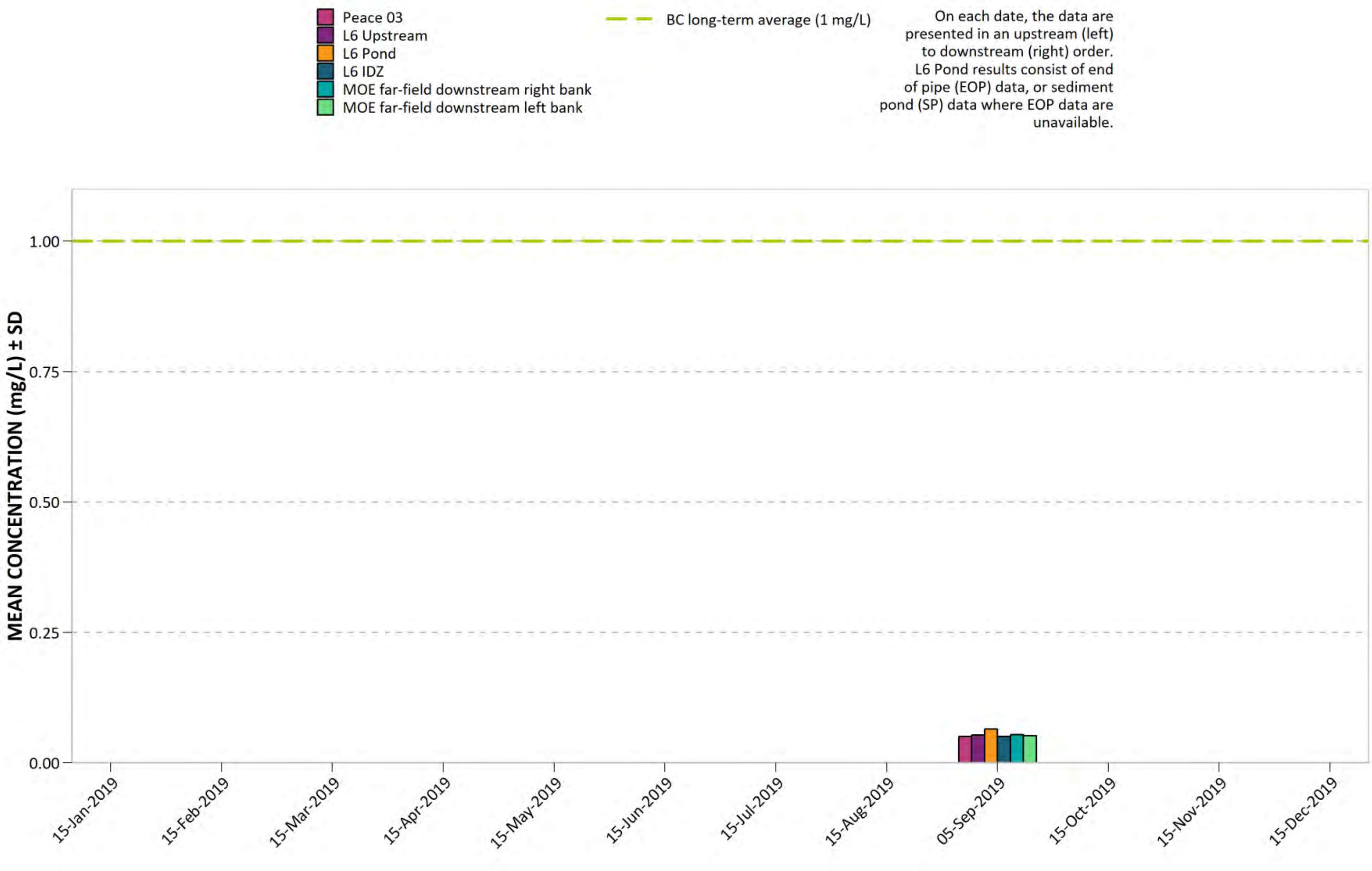
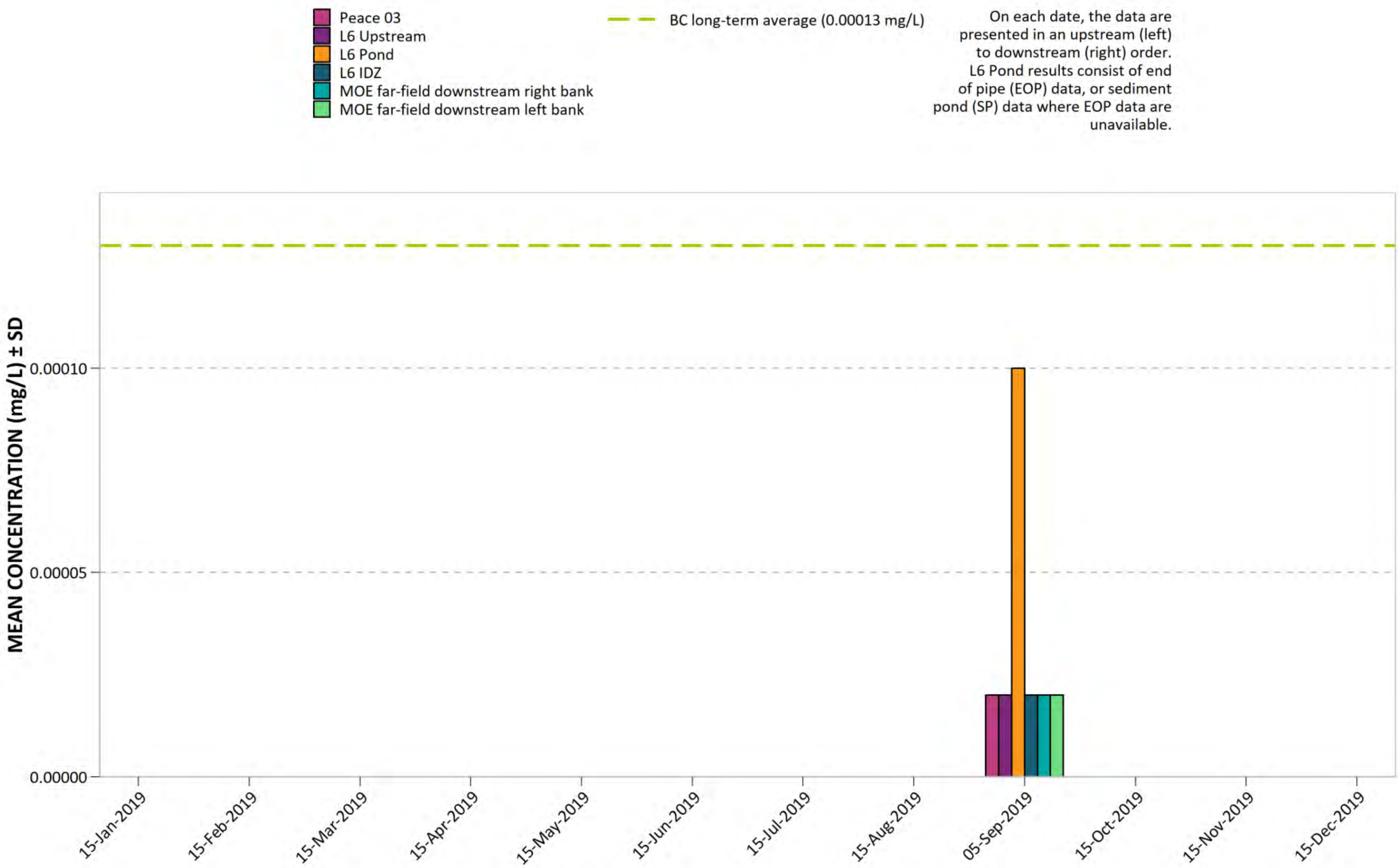
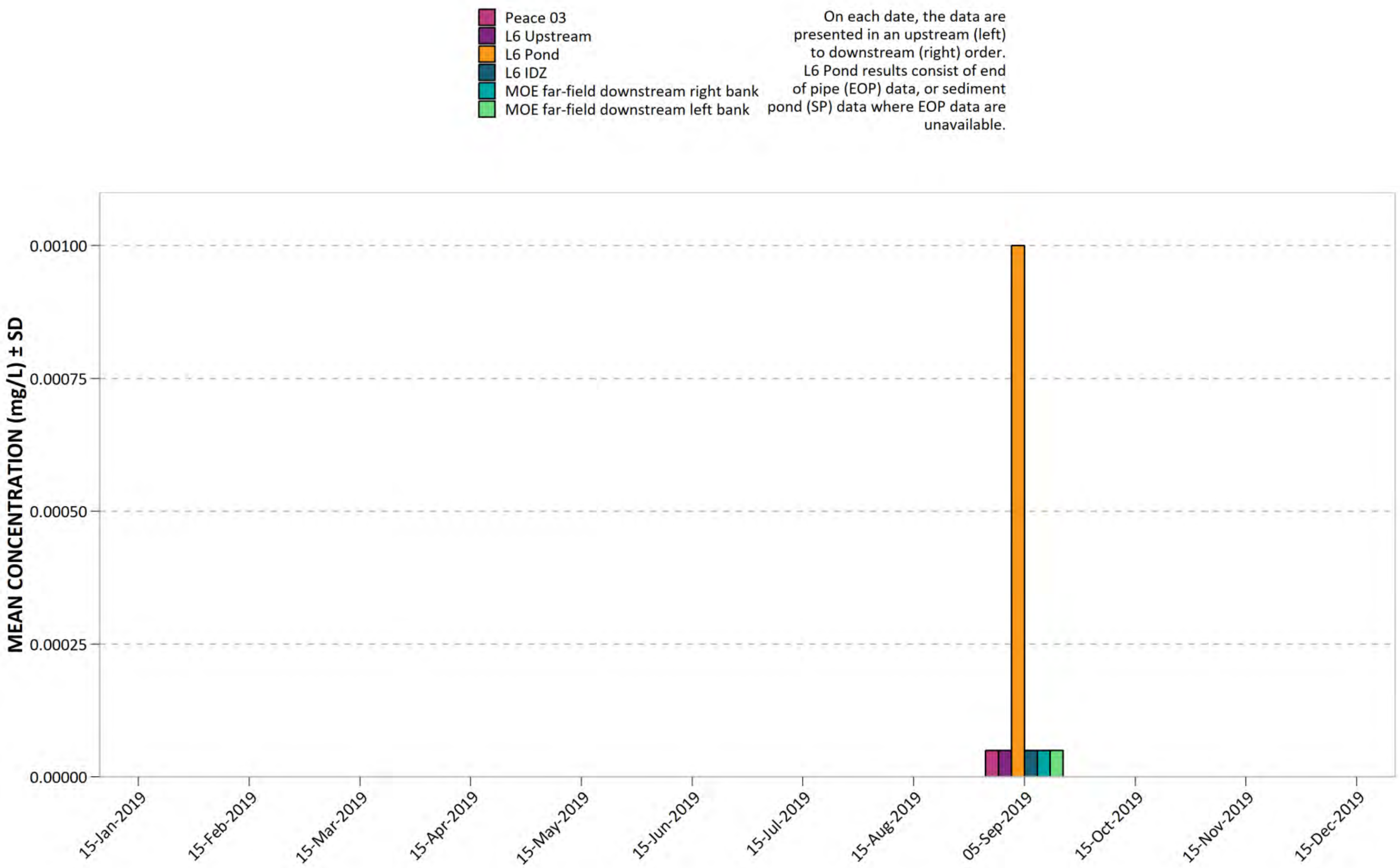


Figure 286. 2019 Peace River and RSEM L6 pond total beryllium (Be).



All results were less than the MDL and thus were assigned the MDL value of 0.0001 mg/L (Pond) or 0.00002 mg/L (Peace River).

Figure 287. 2019 Peace River and RSEM L6 pond total bismuth (Bi).



Results less than the MDL were assigned the MDL value of 0.001 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 288. 2019 Peace River and RSEM L6 pond total boron (B).

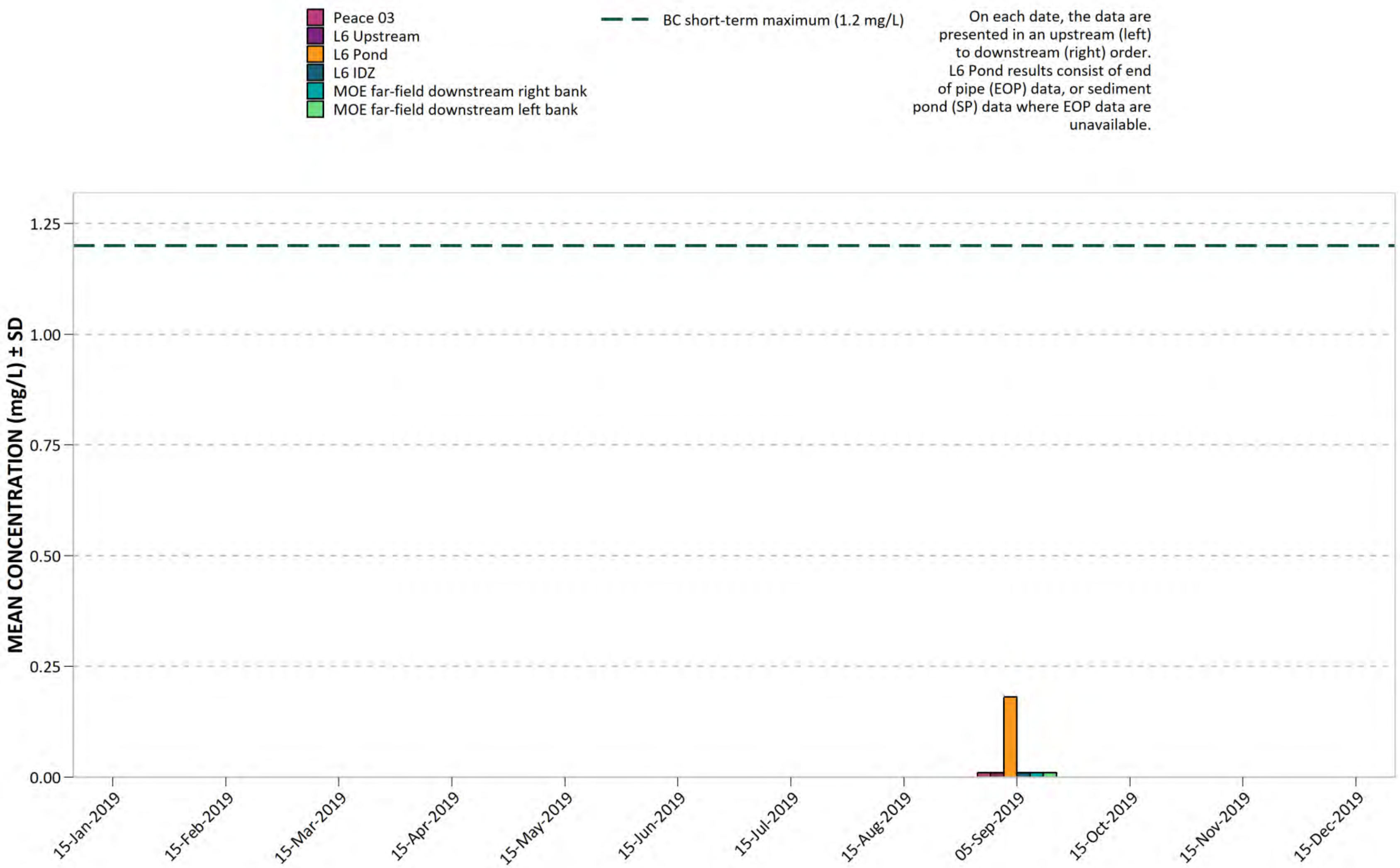


Figure 289. 2019 Peace River and RSEM L6 pond total cadmium (Cd).

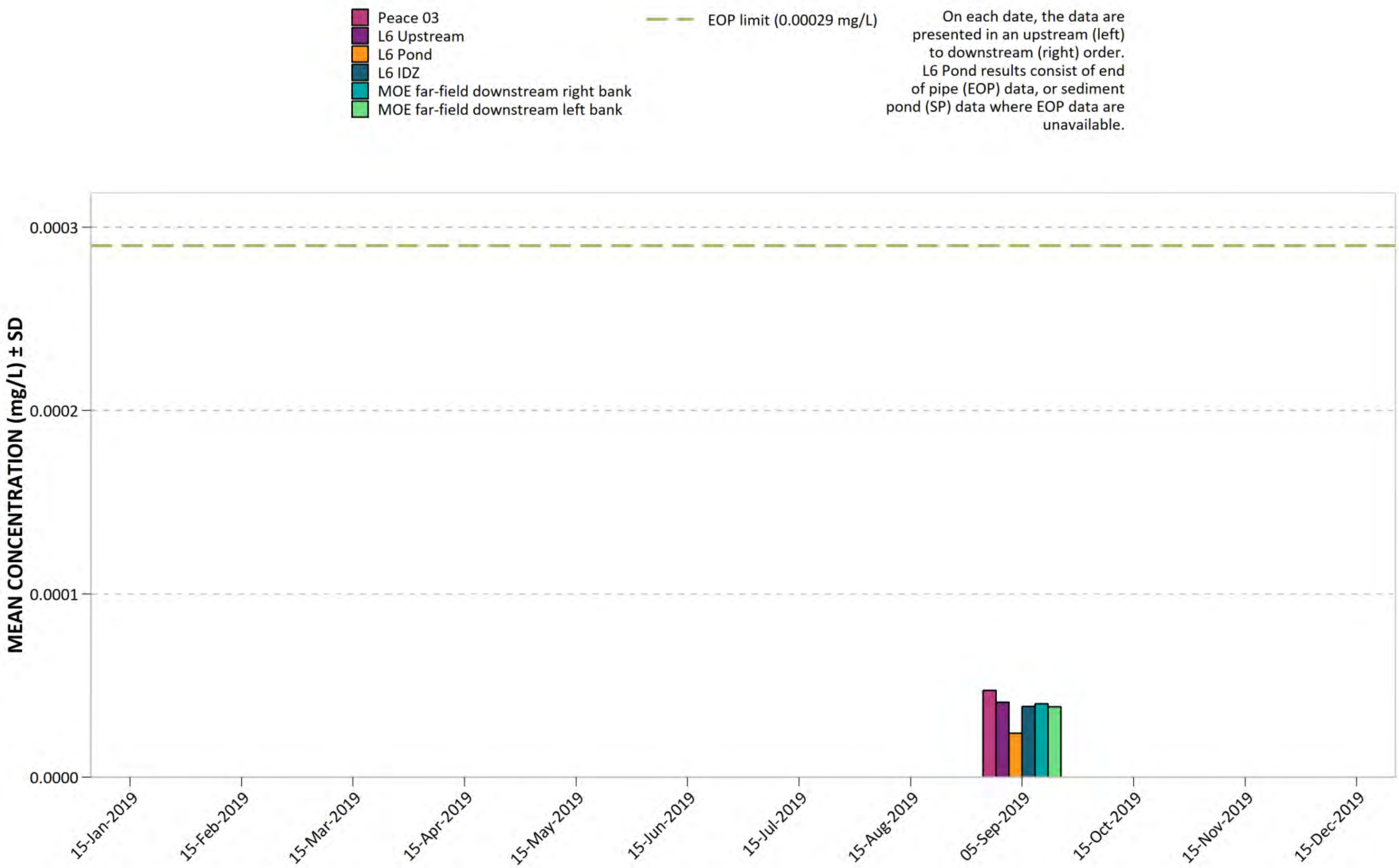


Figure 290. 2019 Peace River and RSEM L6 pond total calcium (Ca).

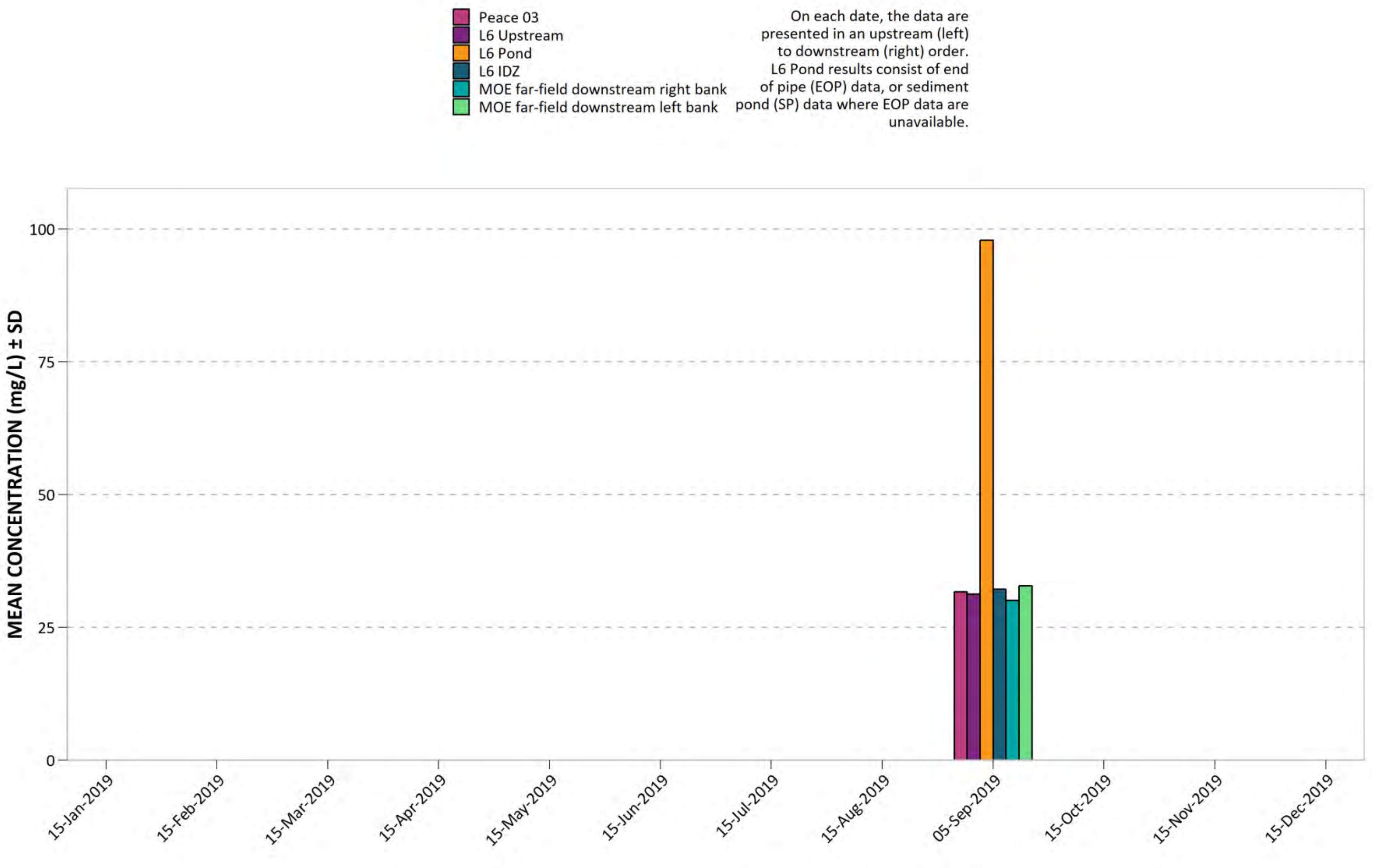


Figure 291. 2019 Peace River and RSEM L6 pond total chromium (Cr).

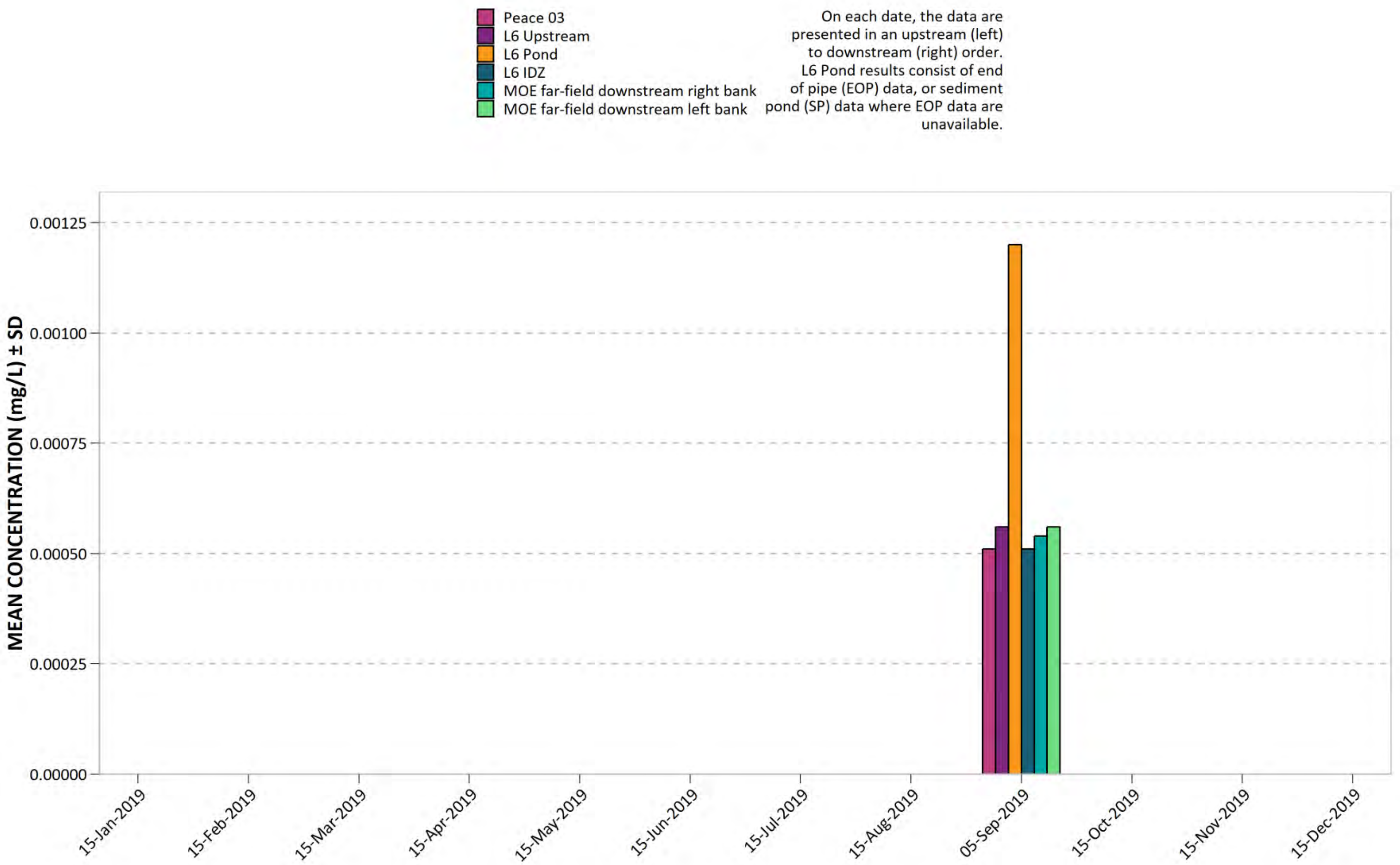


Figure 292. 2019 Peace River and RSEM L6 pond total cobalt (Co).

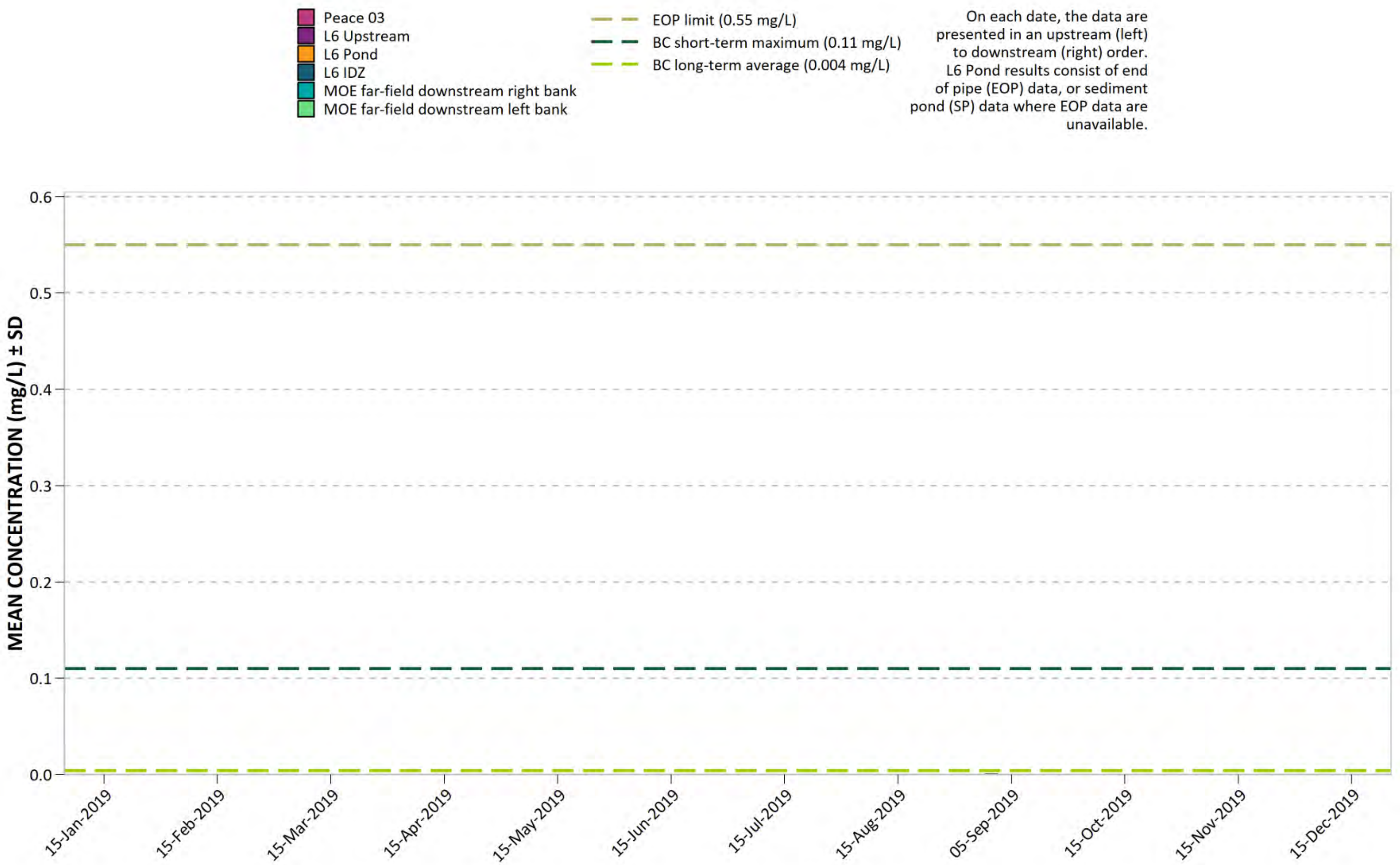


Figure 293. 2019 Peace River and RSEM L6 pond total copper (Cu). New dissolved copper BC WQG replaced the total copper BC WQG in August 2019 (MOE 2019).

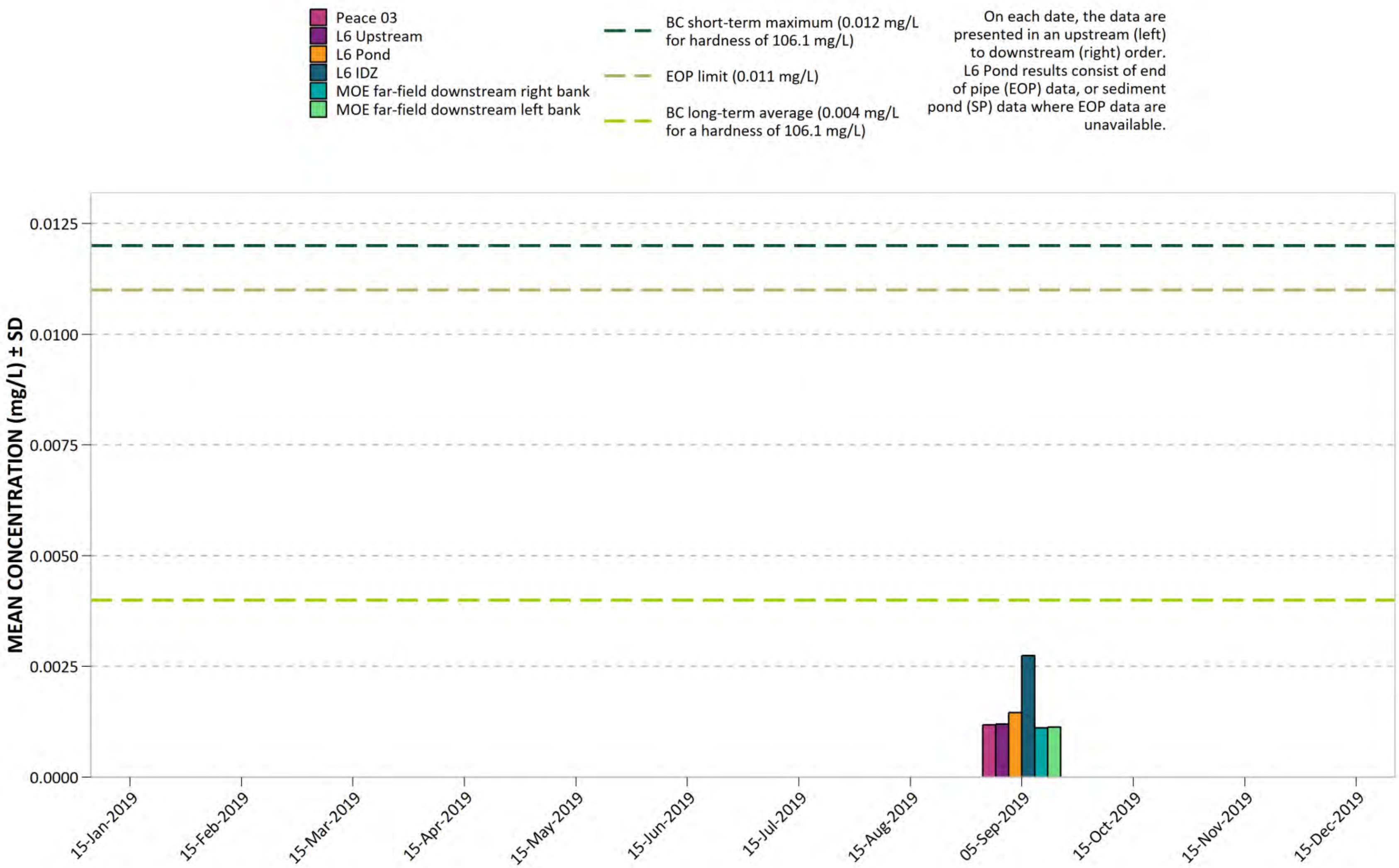


Figure 294. 2019 Peace River and RSEM L6 pond total iron (Fe).

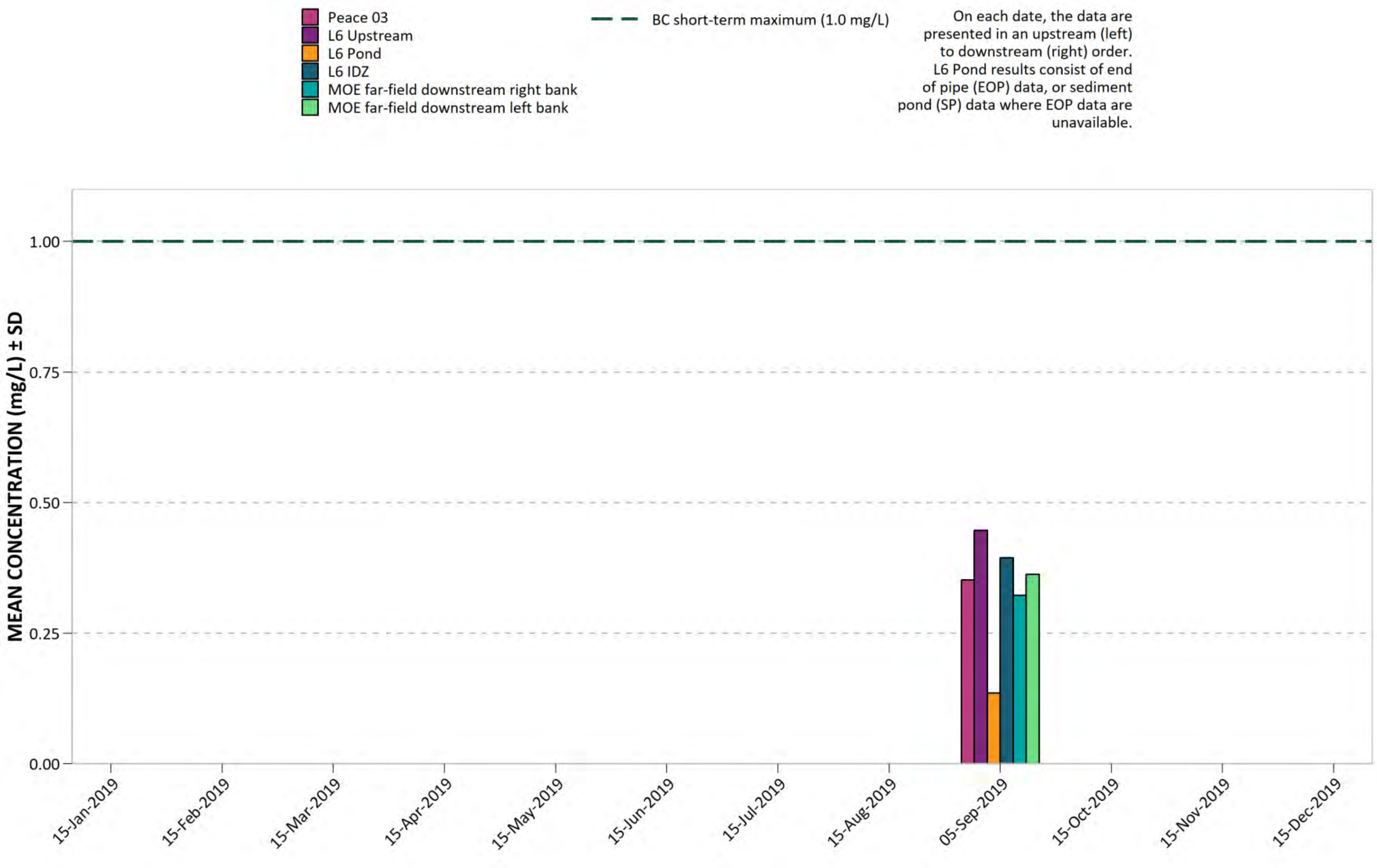


Figure 295. 2019 Peace River and RSEM L6 pond total lead (Pb).

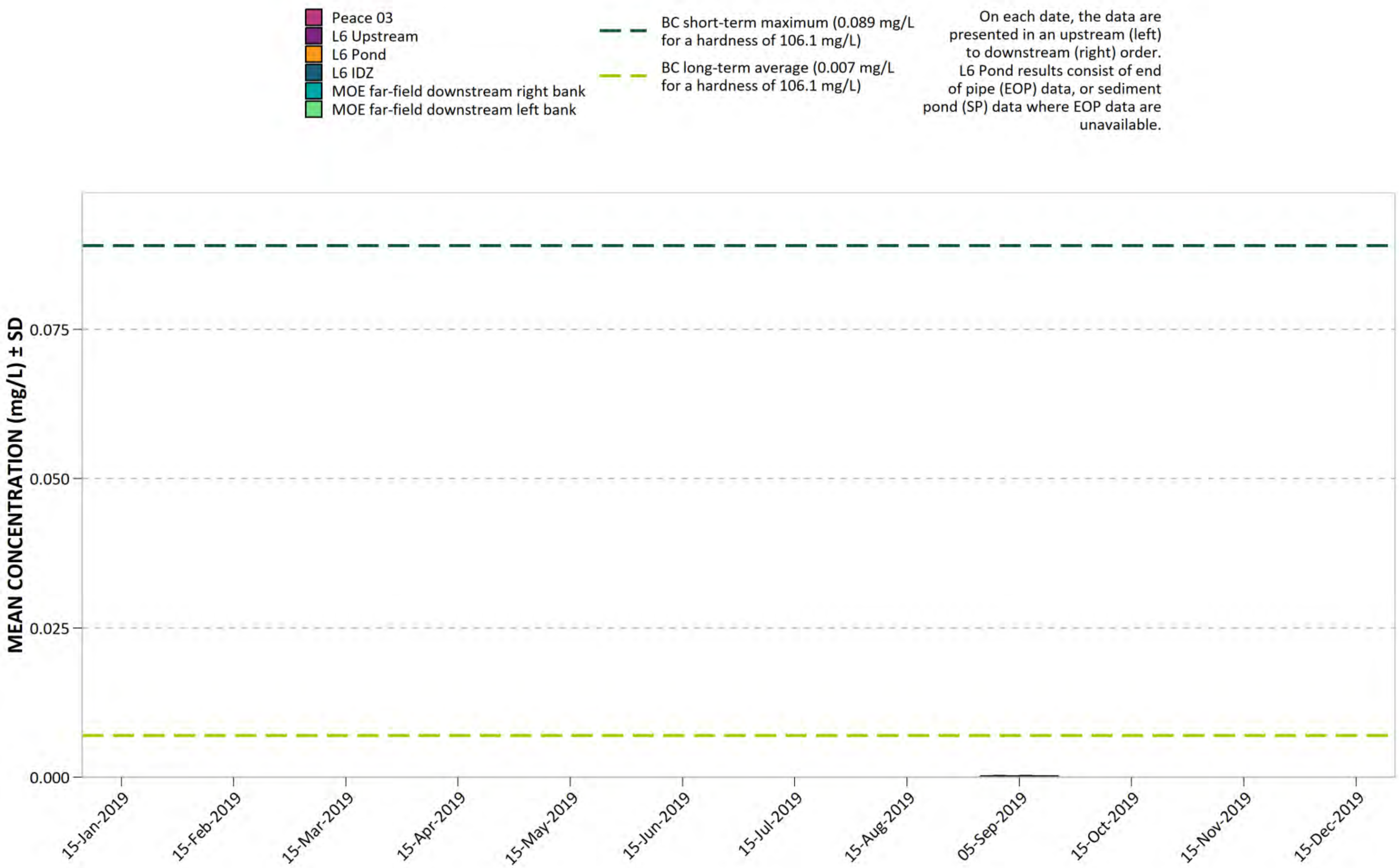


Figure 296. 2019 Peace River and RSEM L6 pond total lithium (Li).

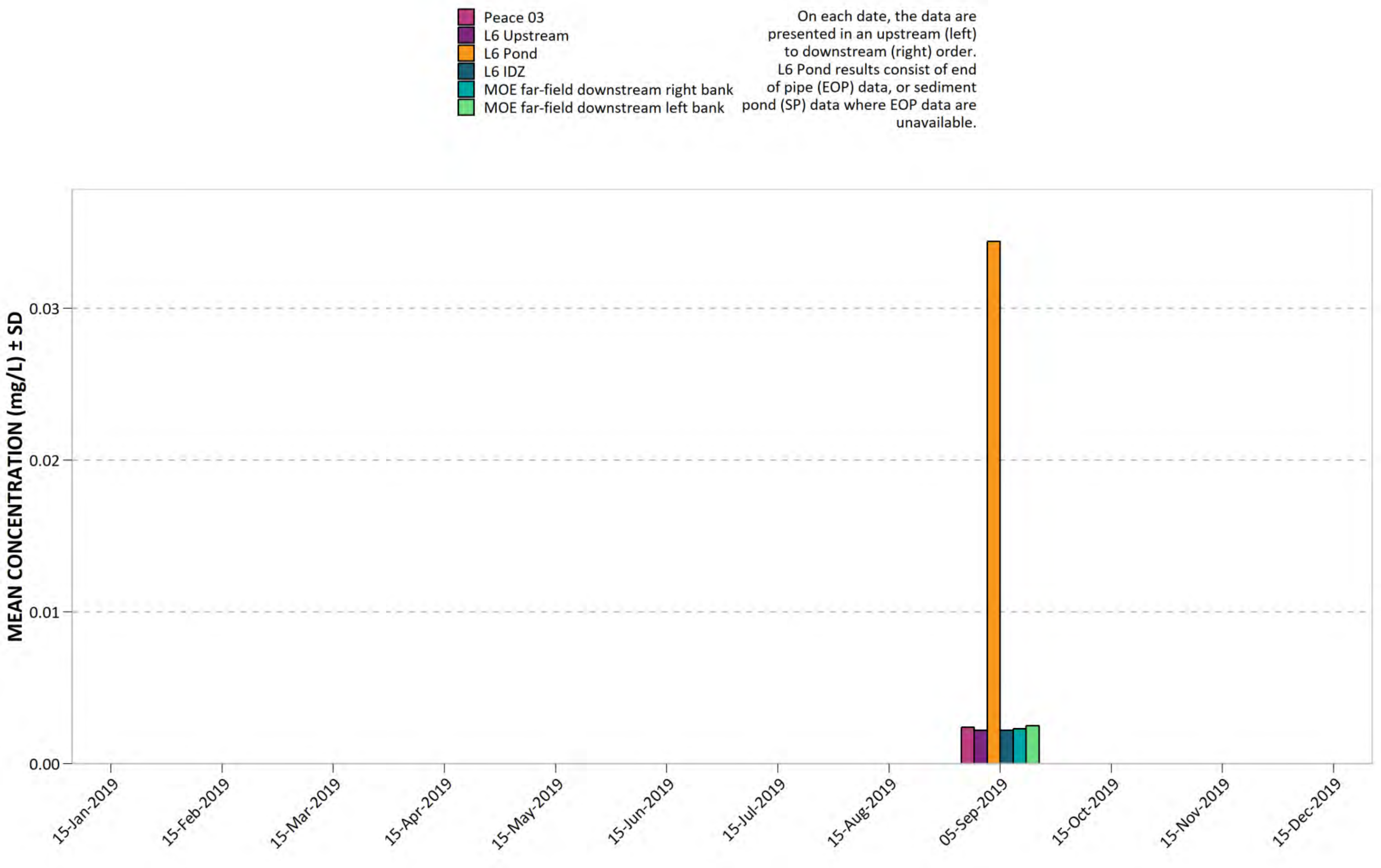


Figure 297. 2019 Peace River and RSEM L6 pond total magnesium (Mg).

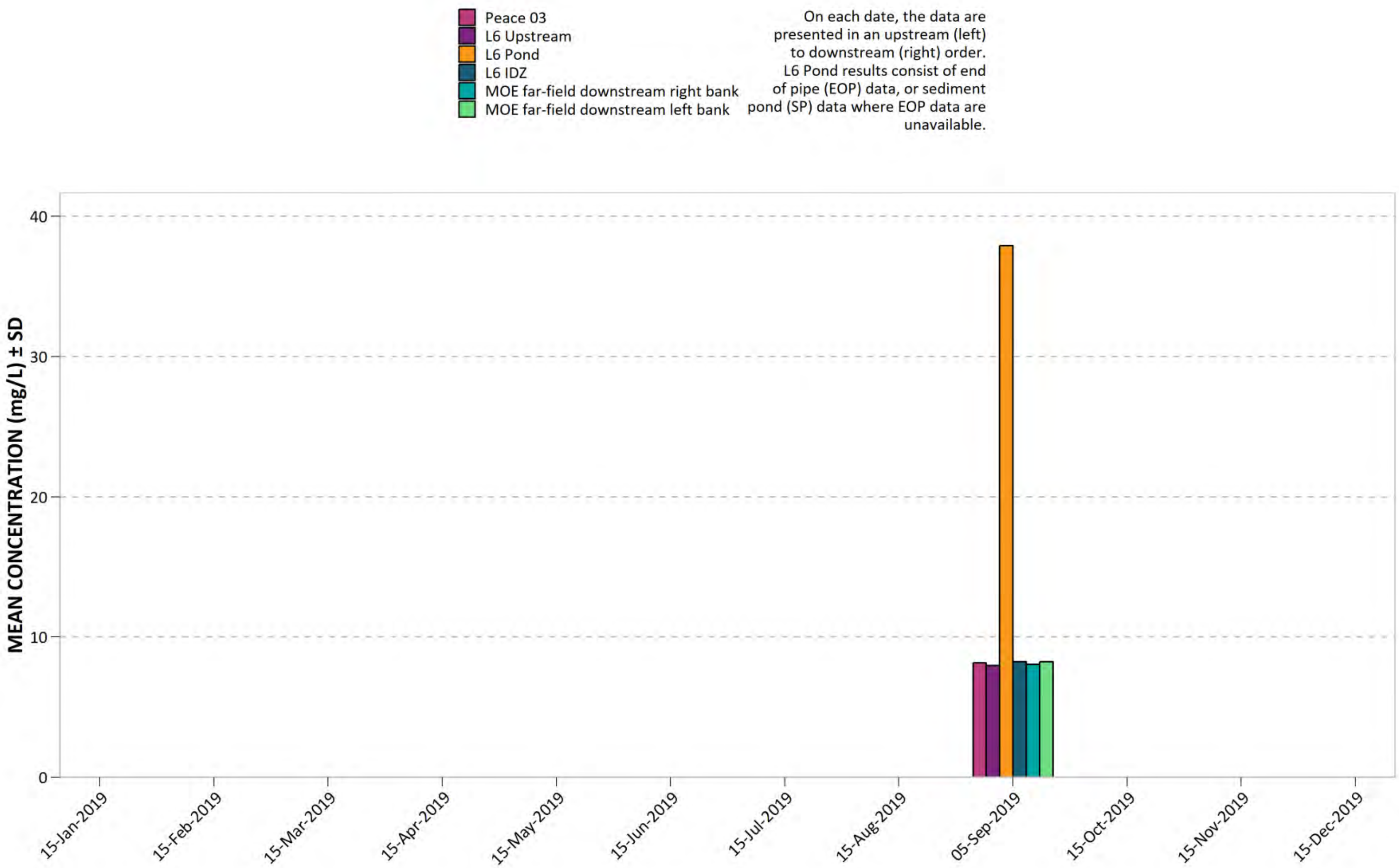


Figure 298. 2019 Peace River and RSEM L6 pond total manganese (Mn).

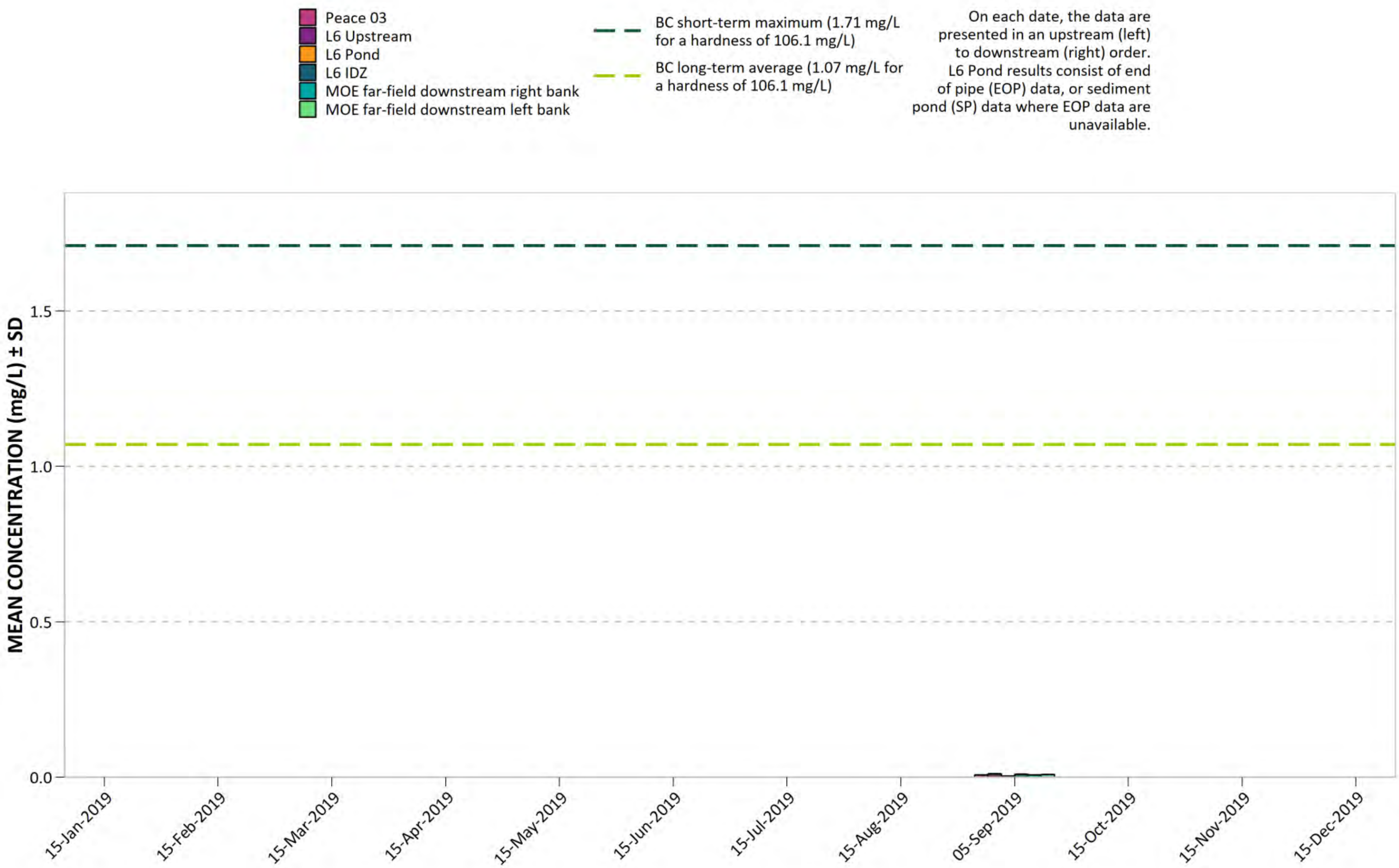
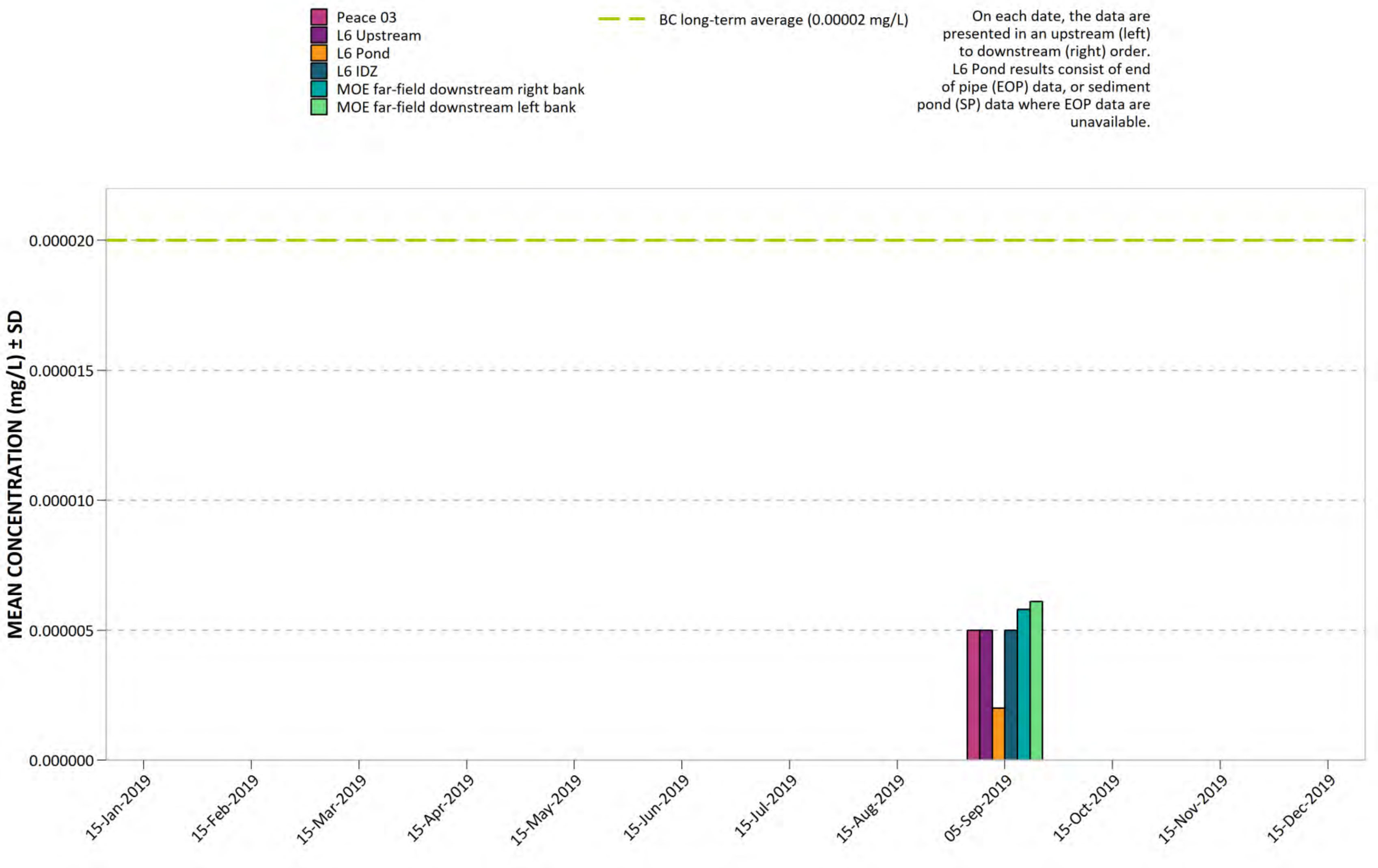


Figure 299. 2019 Peace River and RSEM L6 pond total mercury (Hg).



Results lower than the MDL are assigned the MDL value, which varies for total mercury depending on matrix effects. Most results in 2019 were assigned the MDL value.

Figure 300. 2019 Peace River and RSEM L6 pond total molybdenum (Mo).

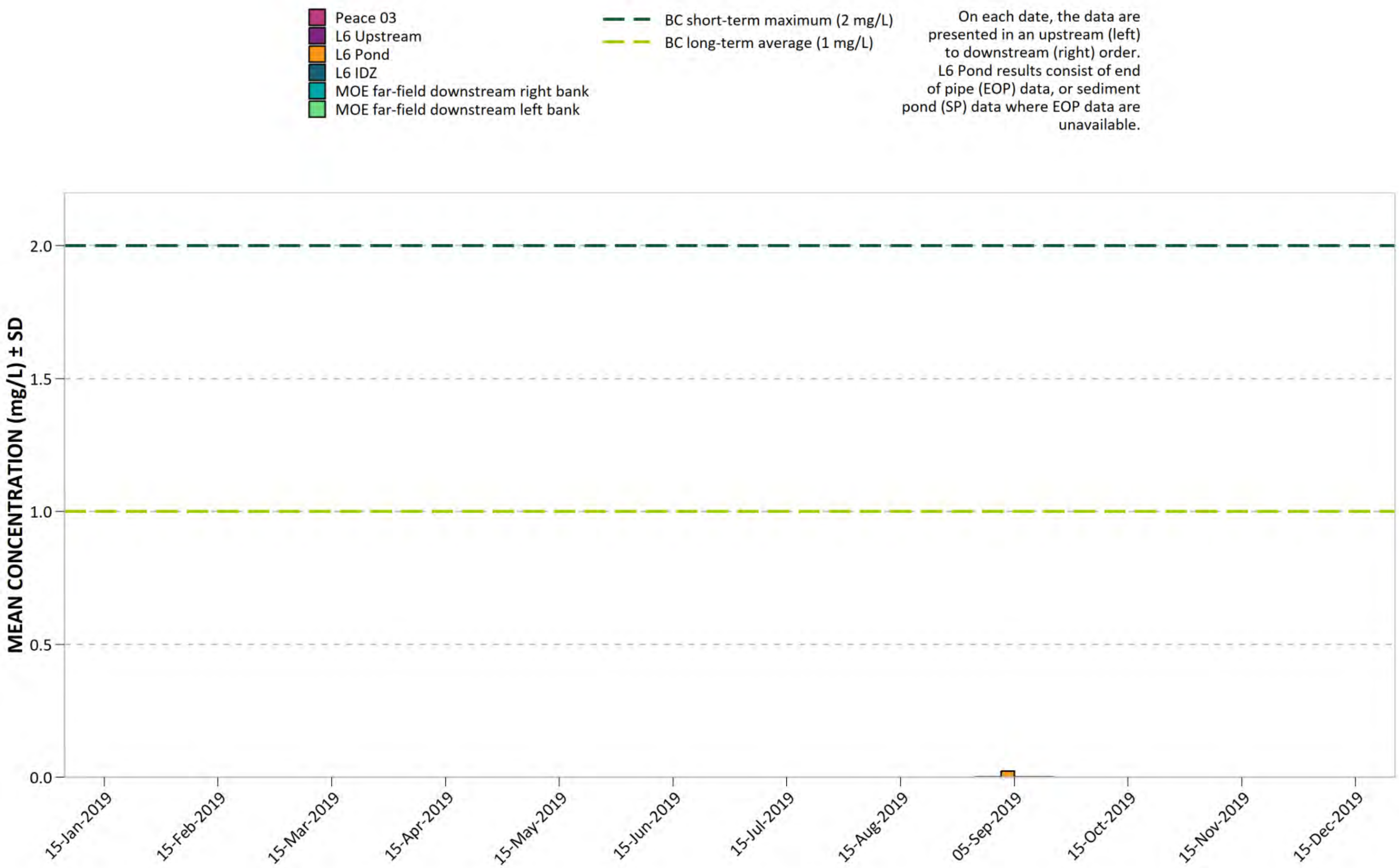


Figure 301. 2019 Peace River and RSEM L6 pond total nickel (Ni).

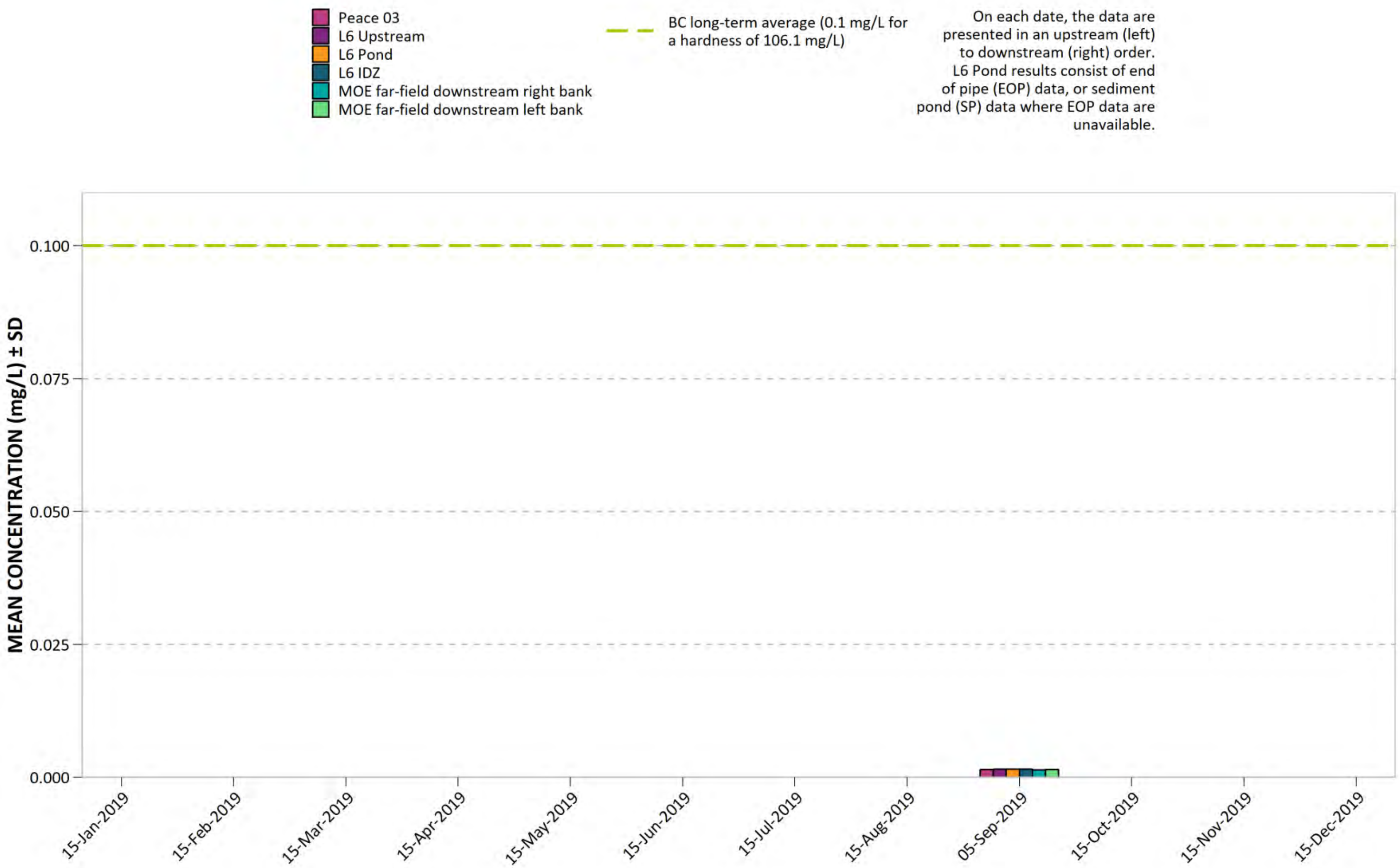


Figure 302. 2019 Peace River and RSEM L6 pond total potassium (K).

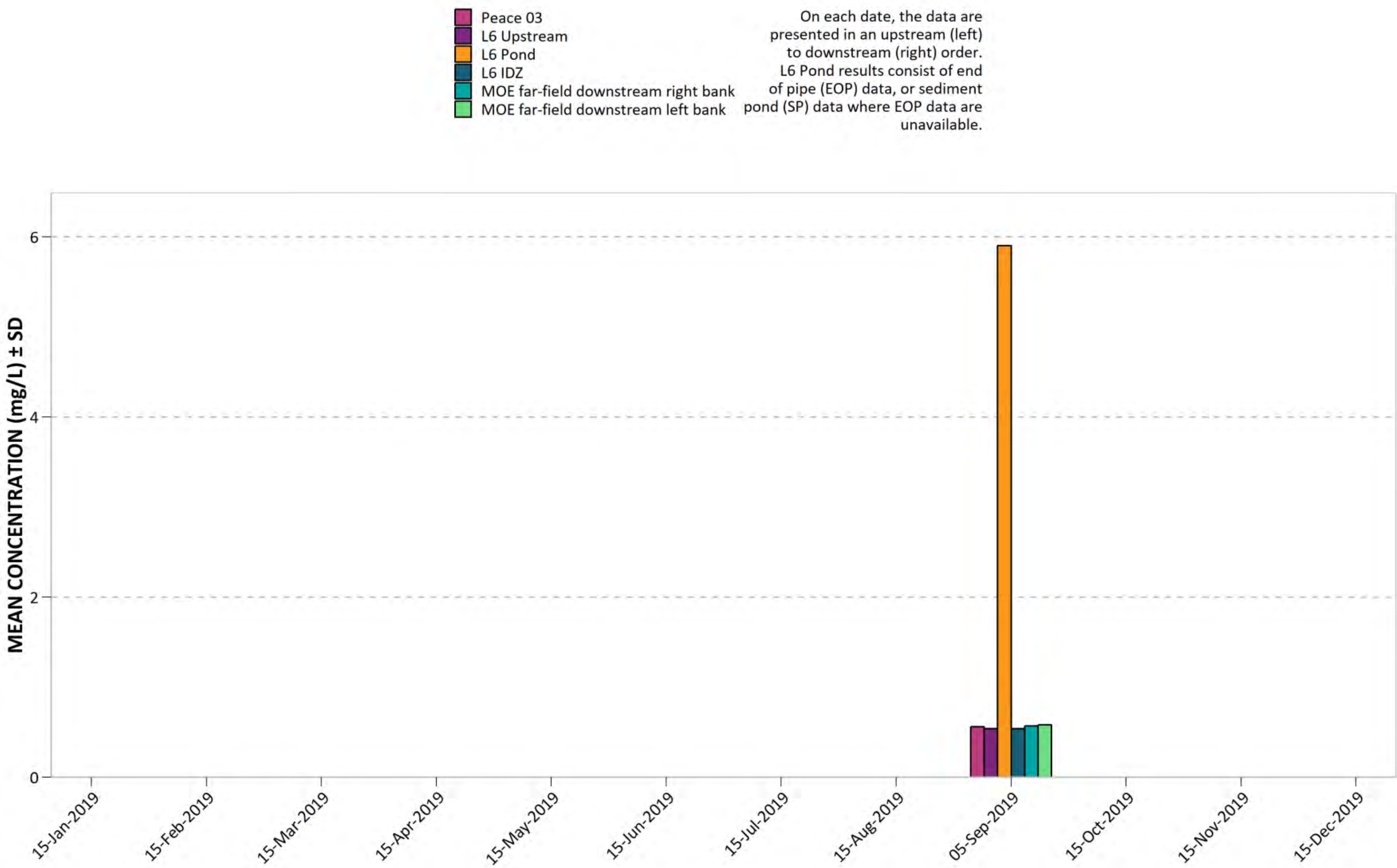


Figure 303. 2019 Peace River and RSEM L6 pond total selenium (Se).

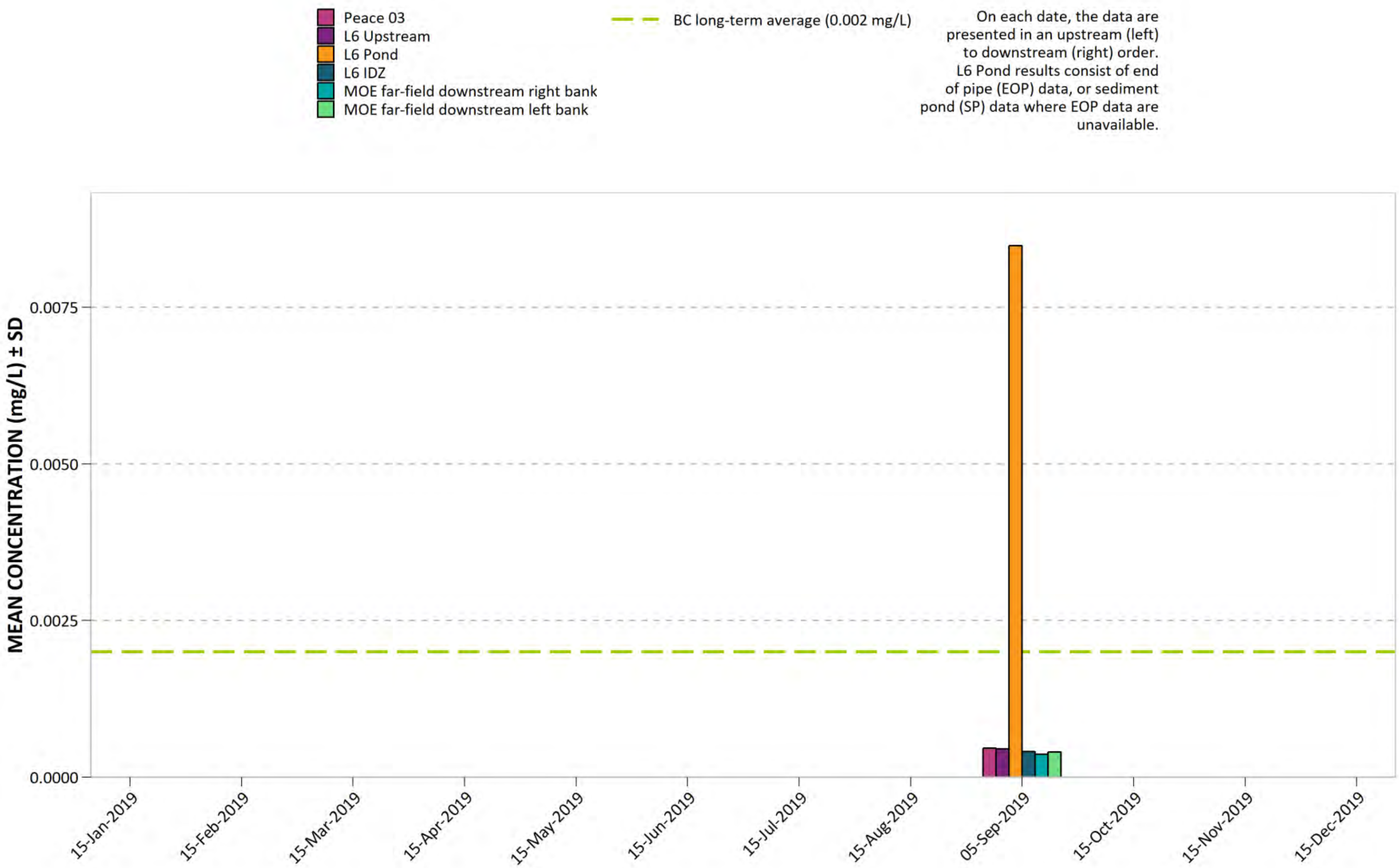


Figure 304. 2019 Peace River and RSEM L6 pond total silicon (Si).

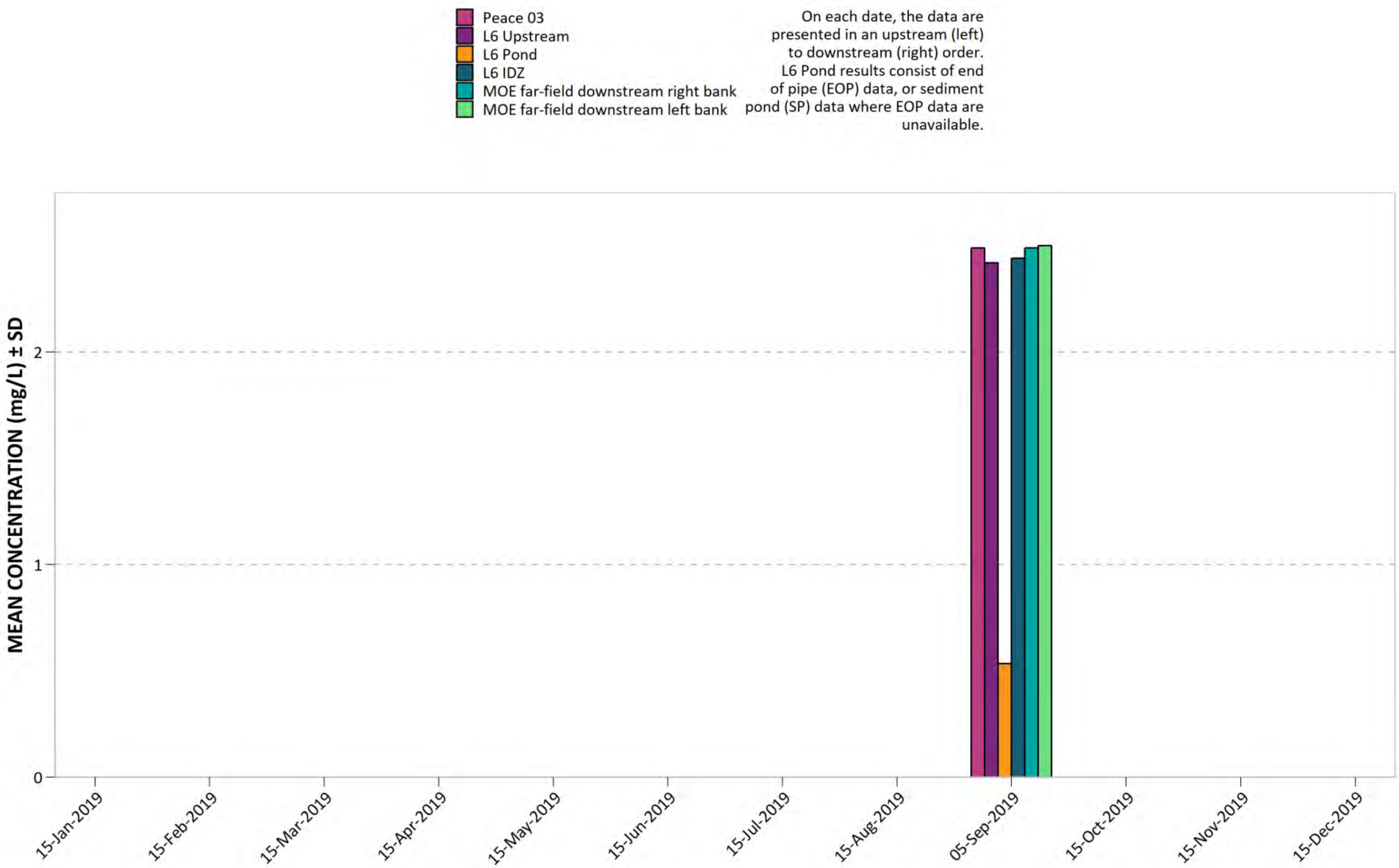


Figure 305. 2019 Peace River and RSEM L6 pond total silver (Ag).

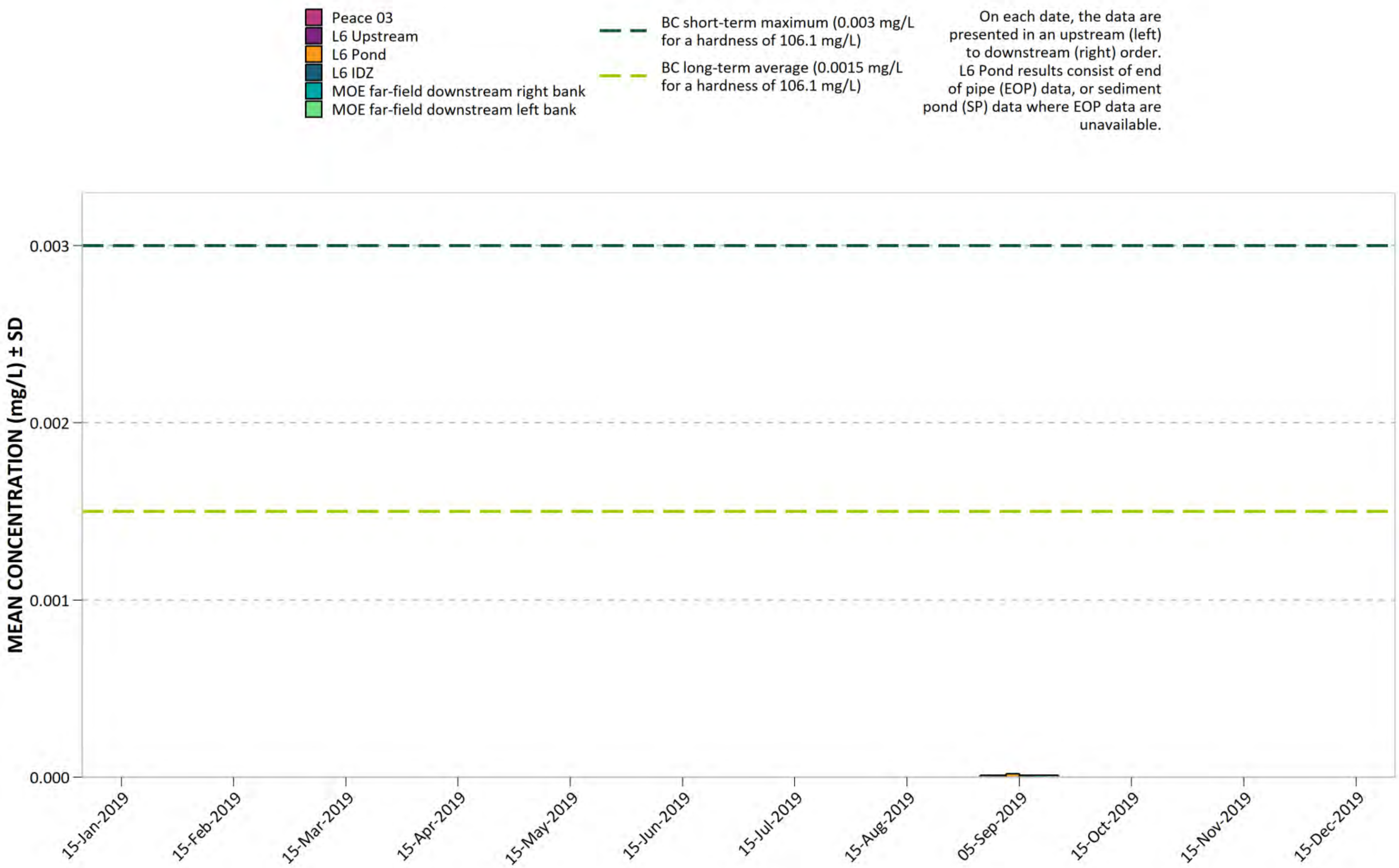


Figure 306. 2019 Peace River and RSEM L6 pond total sodium (Na).

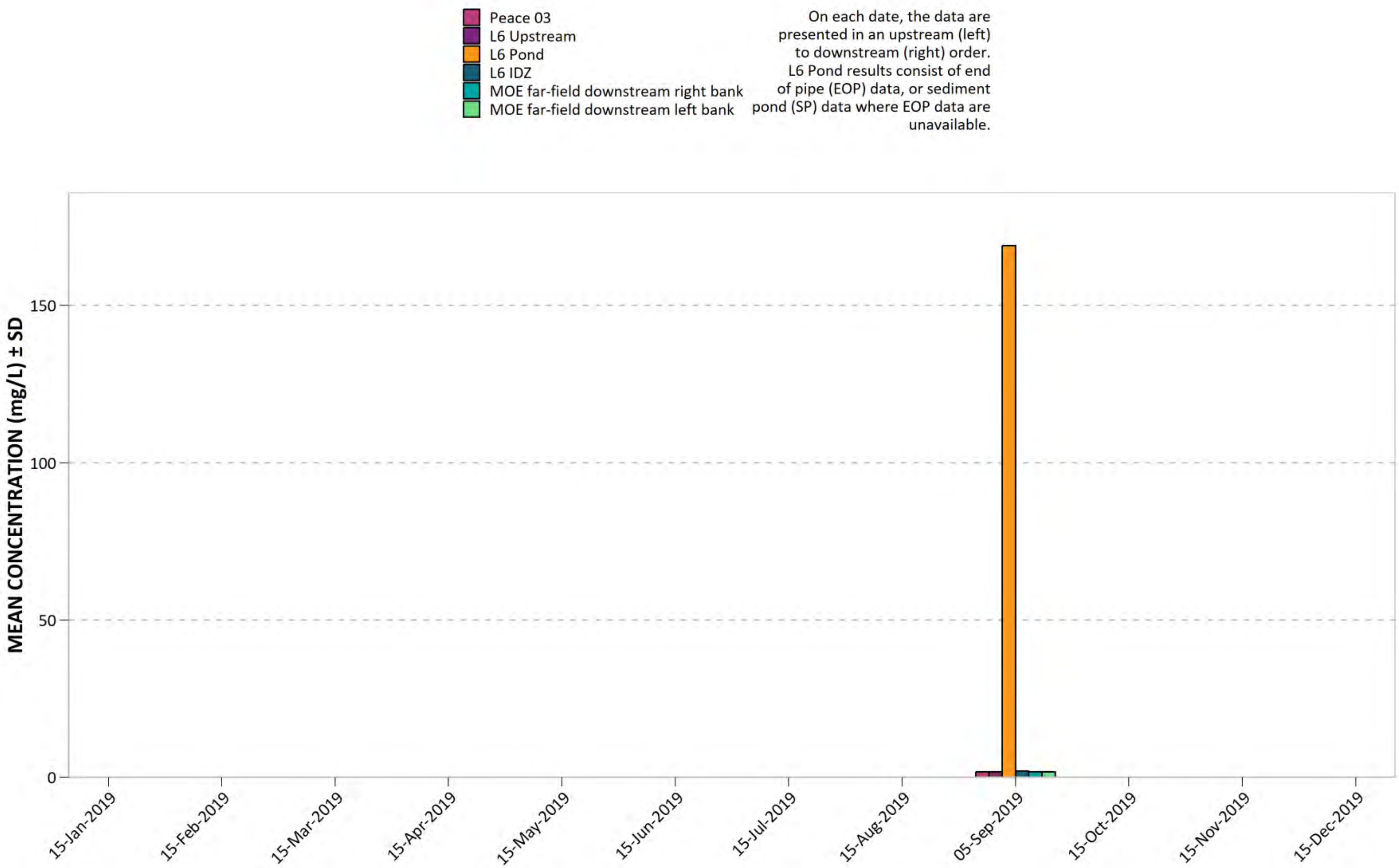


Figure 307. 2019 Peace River and RSEM L6 pond total strontium (Sr).

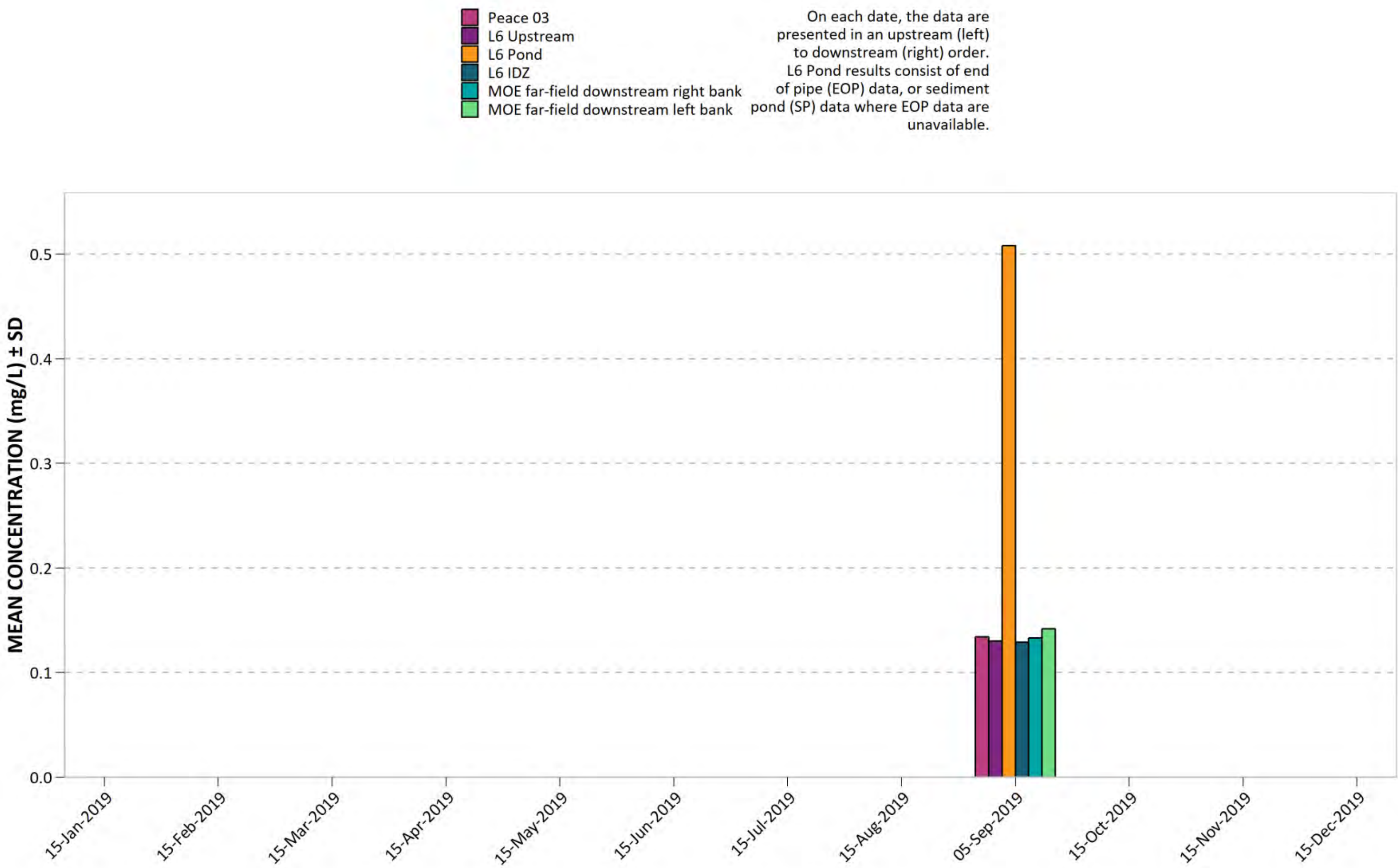


Figure 308. 2019 Peace River and RSEM L6 pond total sulfur (S).

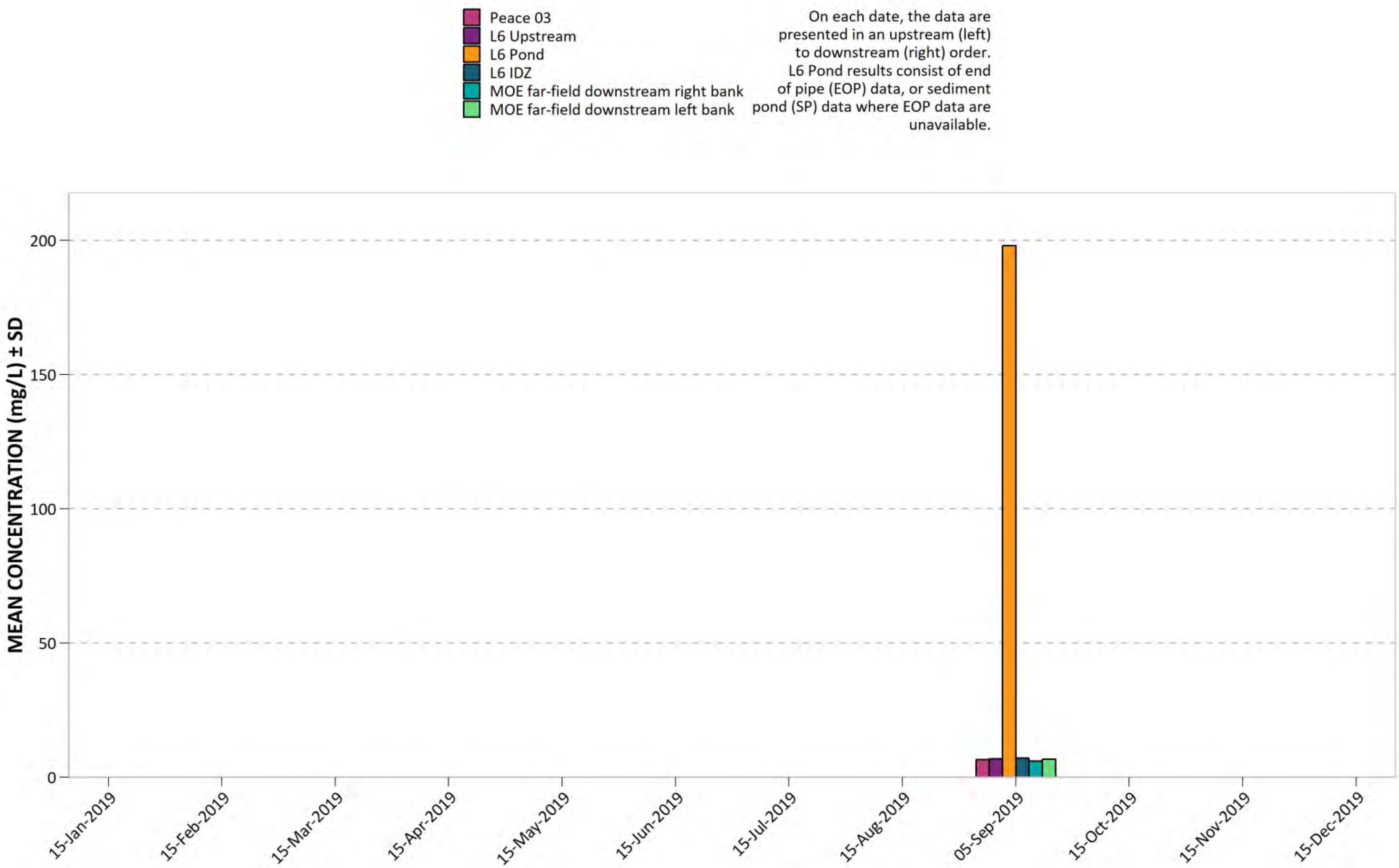
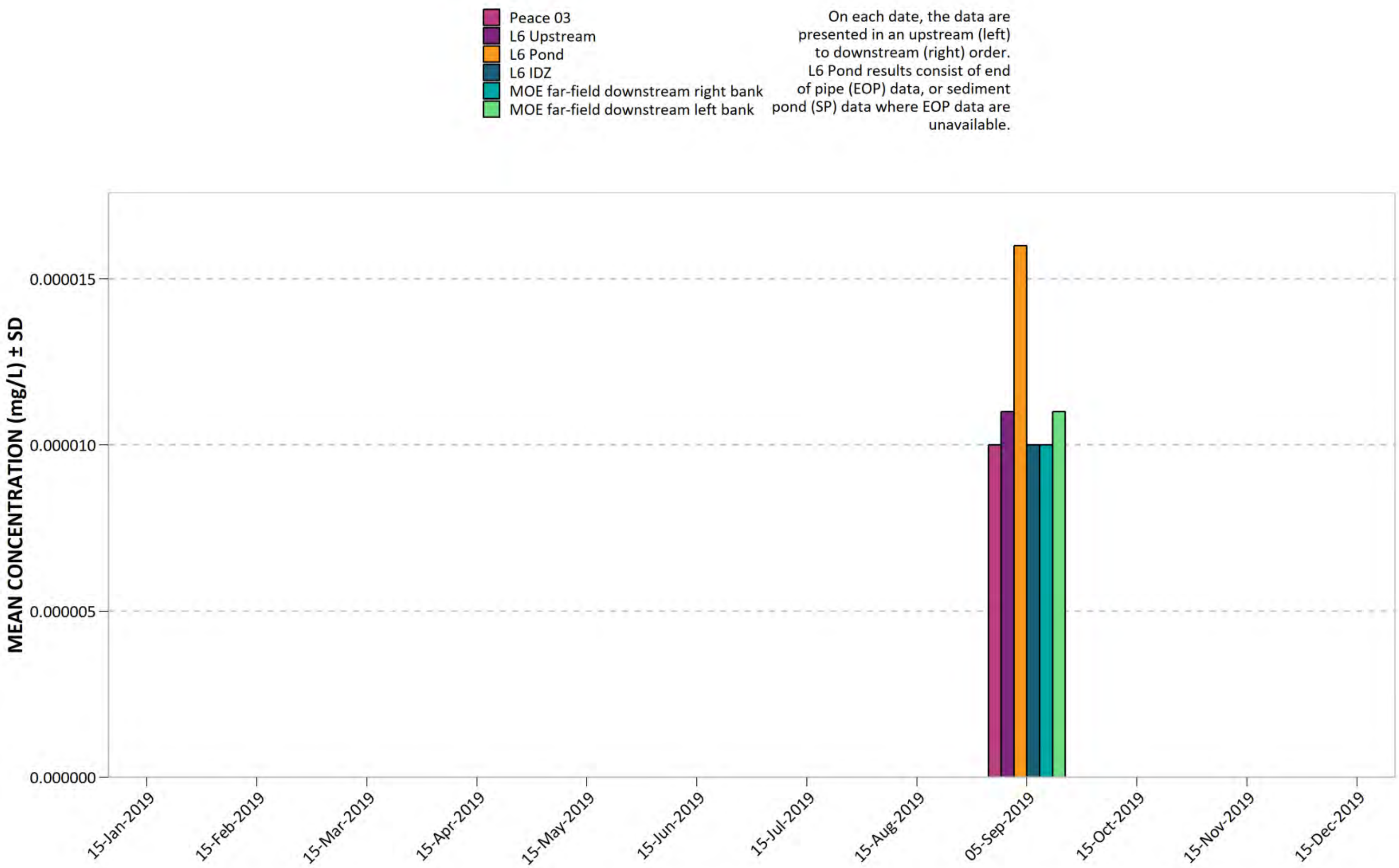
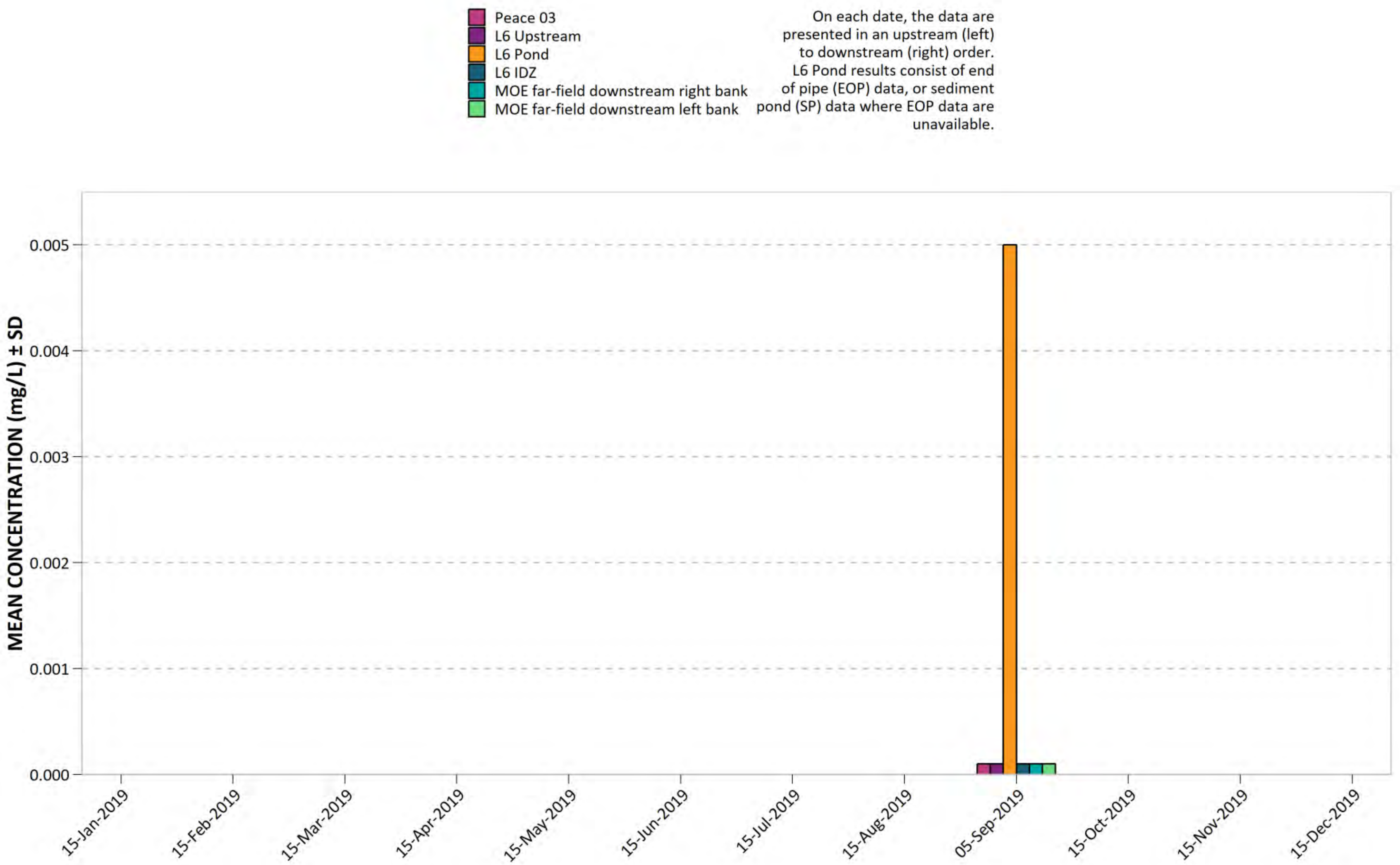


Figure 309. 2019 Peace River and RSEM L6 pond total thallium (Tl).



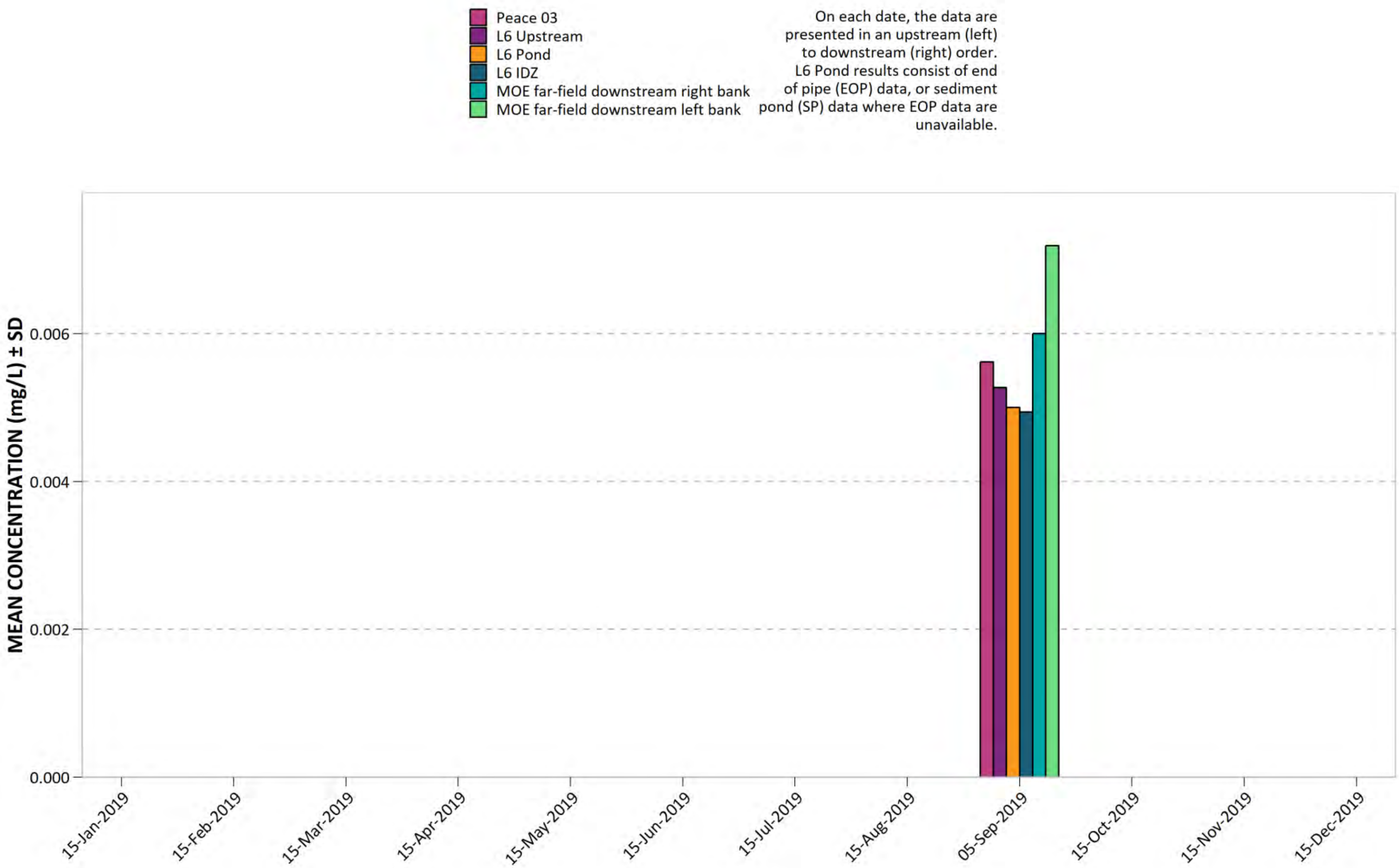
Results less than the MDL were assigned the MDL value of 0.00001 mg/L (Pond and Peace River).

Figure 310. 2019 Peace River and RSEM L6 pond total tin (Sn).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 311. 2019 Peace River and RSEM L6 pond total titanium (Ti).



Pond results less than the MDL were assigned the MDL value of 0.005 mg/L.

Figure 312. 2019 Peace River and RSEM L6 pond total uranium (U).

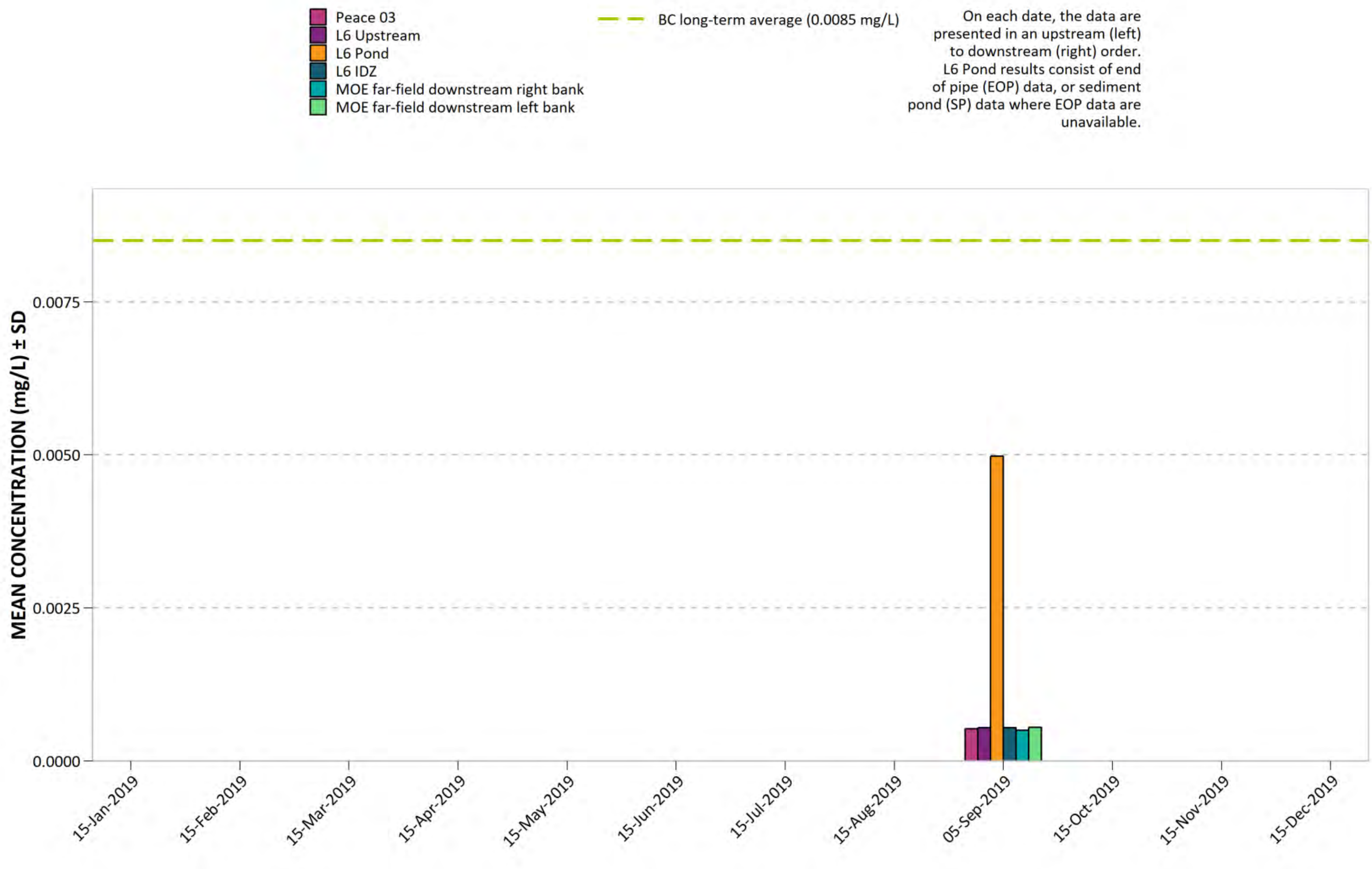
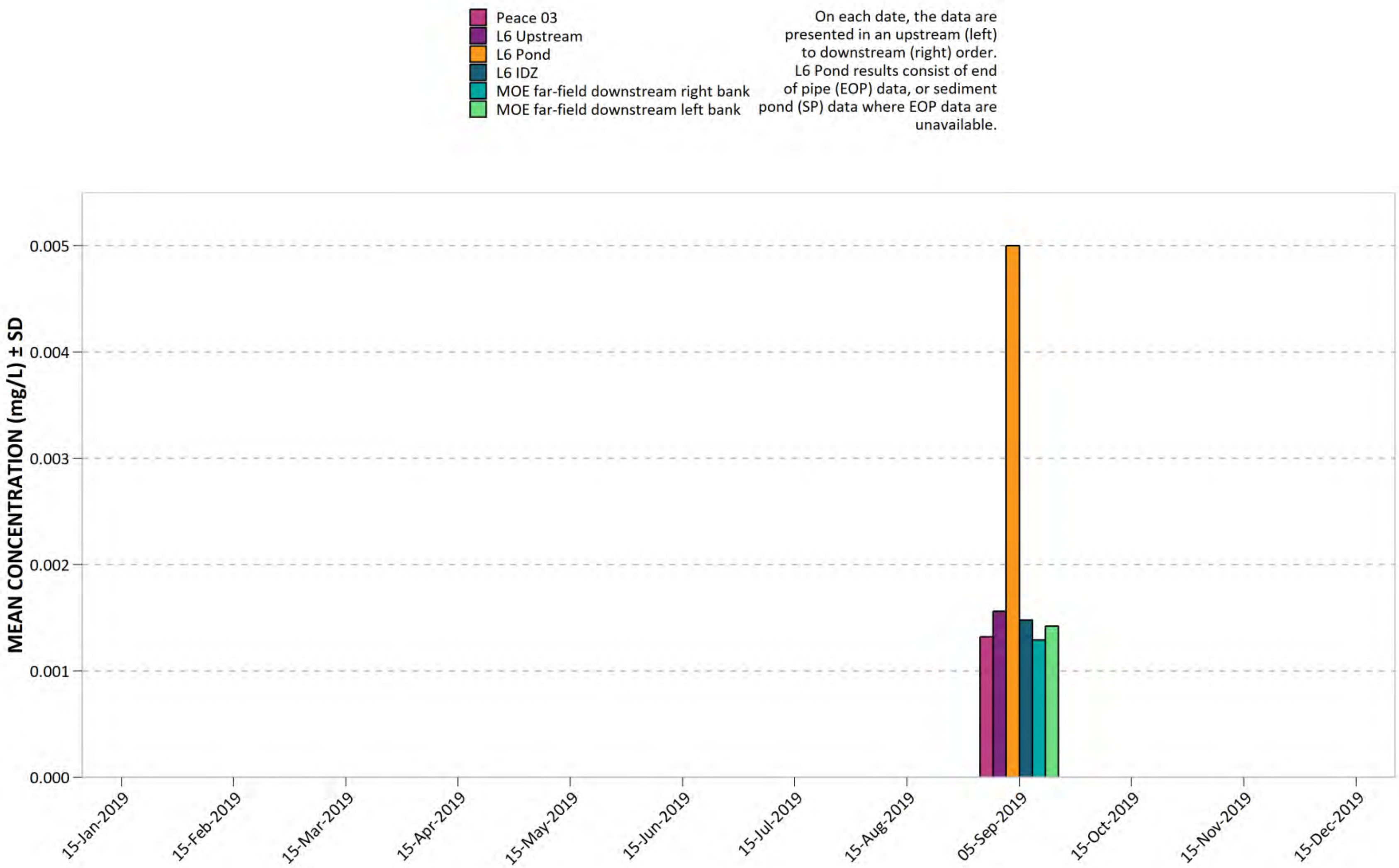
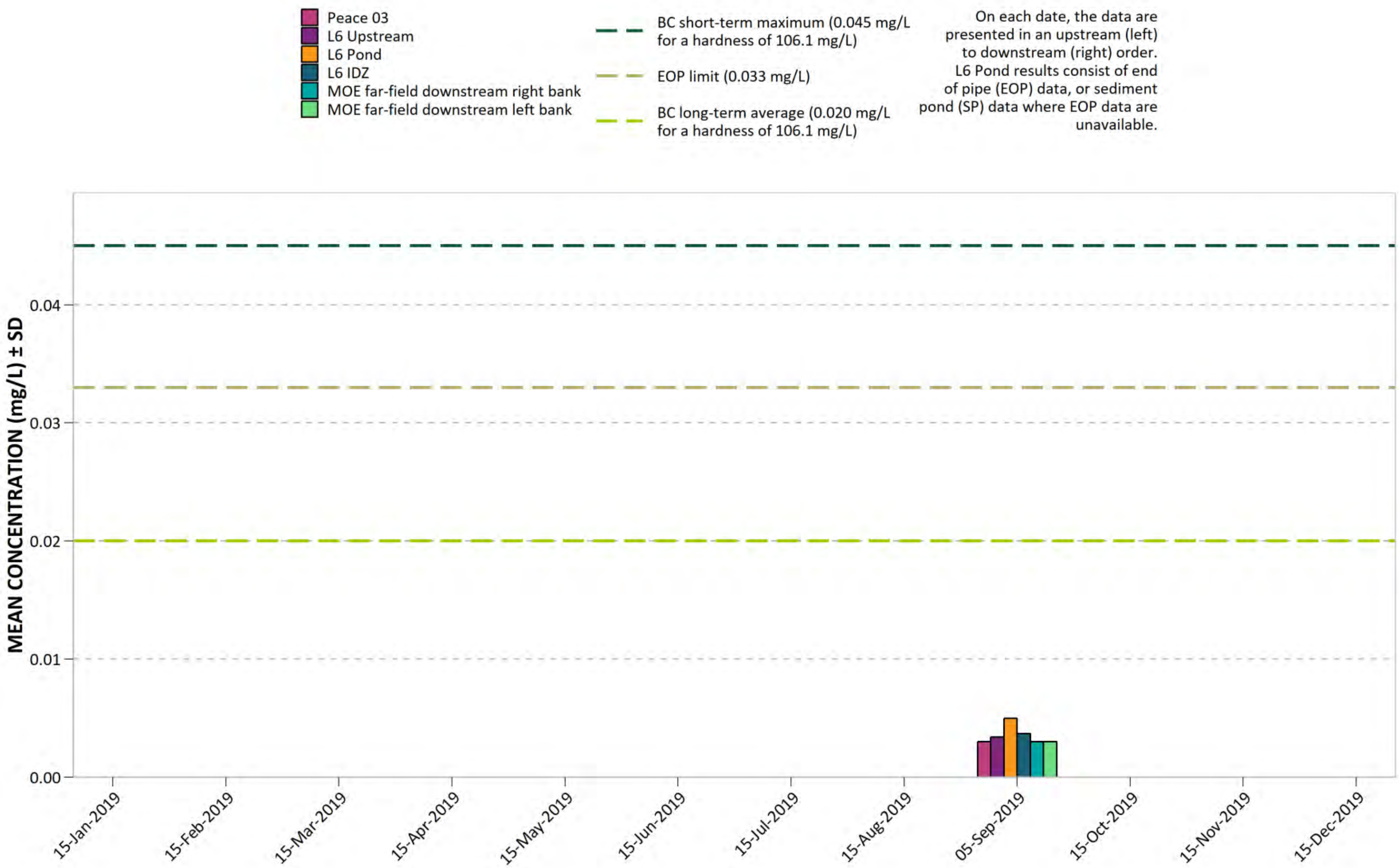


Figure 313. 2019 Peace River and RSEM L6 pond total vanadium (V).



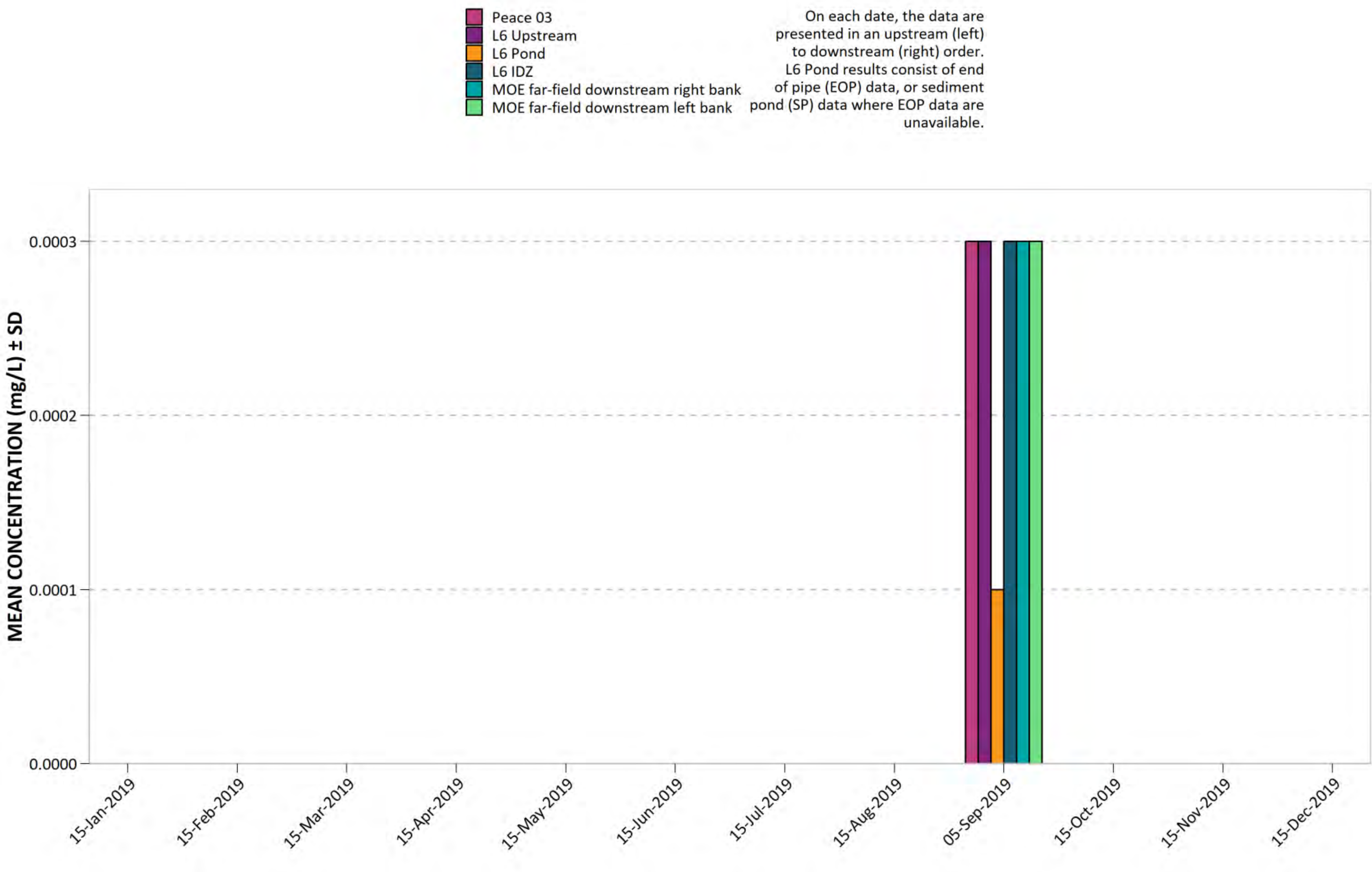
Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0005 mg/L (Peace River).

Figure 314. 2019 Peace River and RSEM L6 pond total zinc (Zn).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.003 mg/L (Peace River).

Figure 315. 2019 Peace River and RSEM L6 pond total zirconium (Zr).



Results less than the MDL were assigned the MDL value of 0.0001 mg/L (Pond) or 0.0003 mg/L (Peace River).

Figure 316. 2019 Peace River and RSEM L6 pond dissolved aluminum (Al).

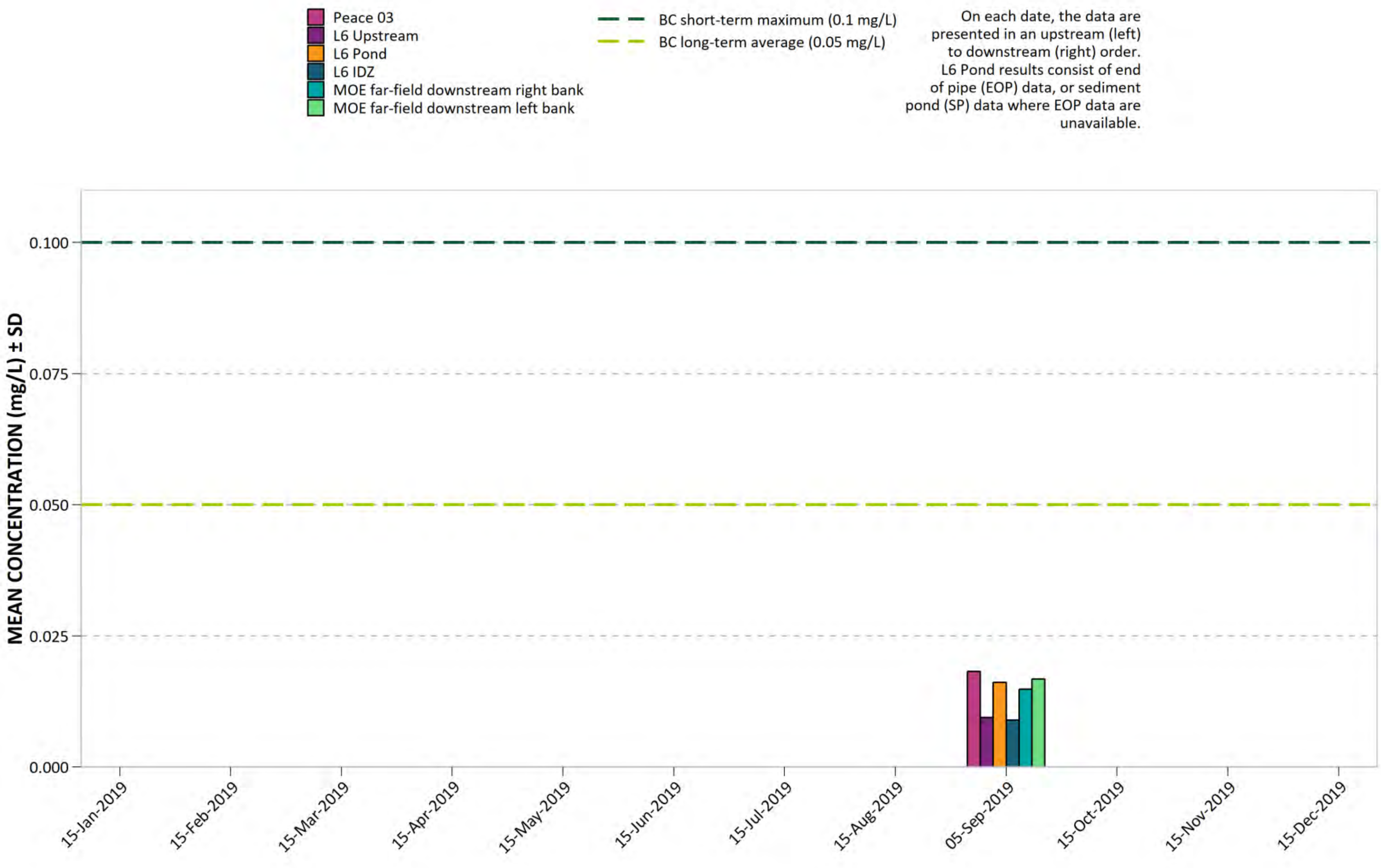
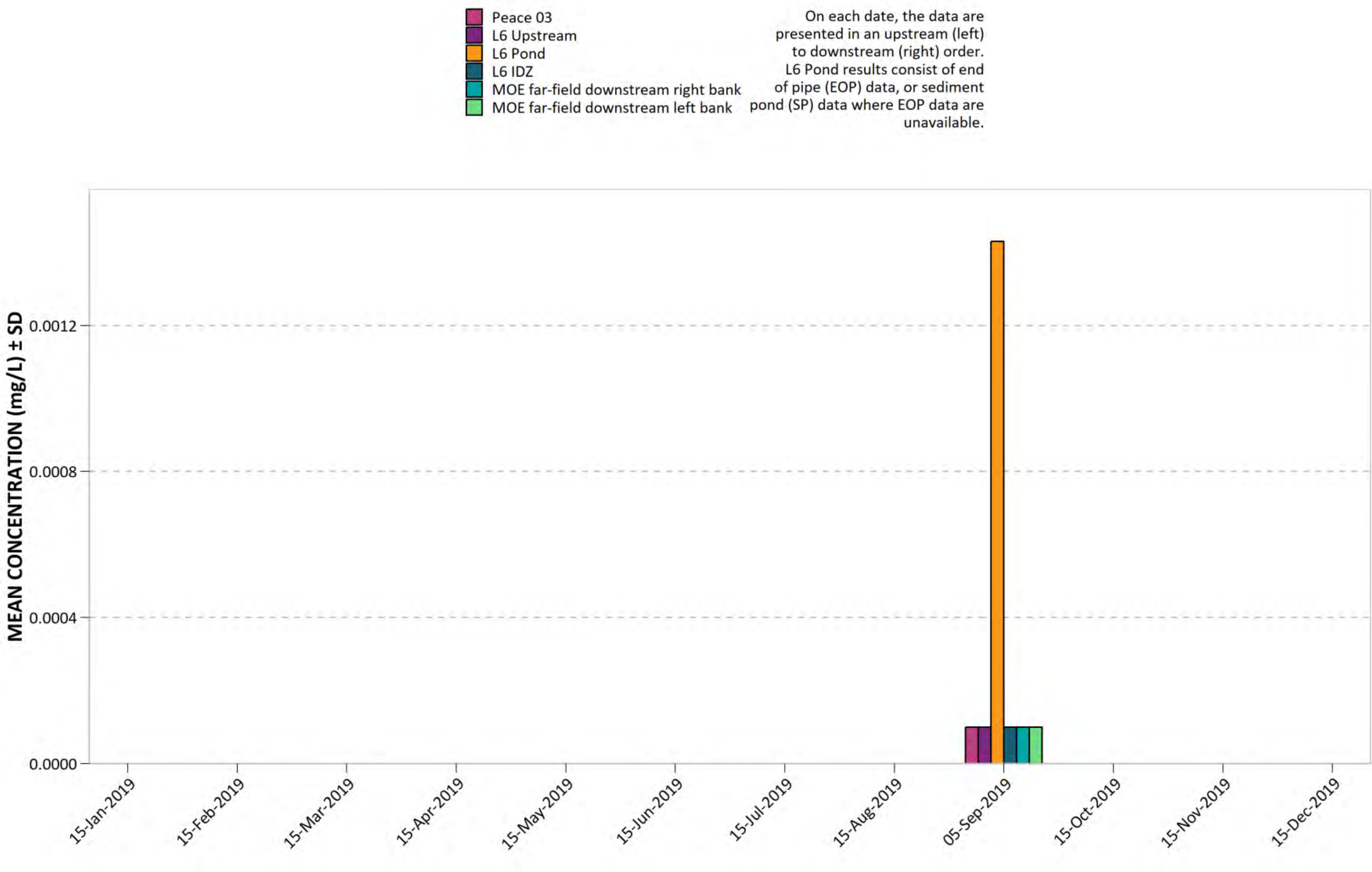


Figure 317. 2019 Peace River and RSEM L6 pond dissolved antimony (Sb).



Results less than the MDL were assigned the MDL value of 0.0005 mg/L (R5b pond) or 0.0001 mg/L (Peace River).

Figure 318. 2019 Peace River and RSEM L6 pond dissolved arsenic (As).

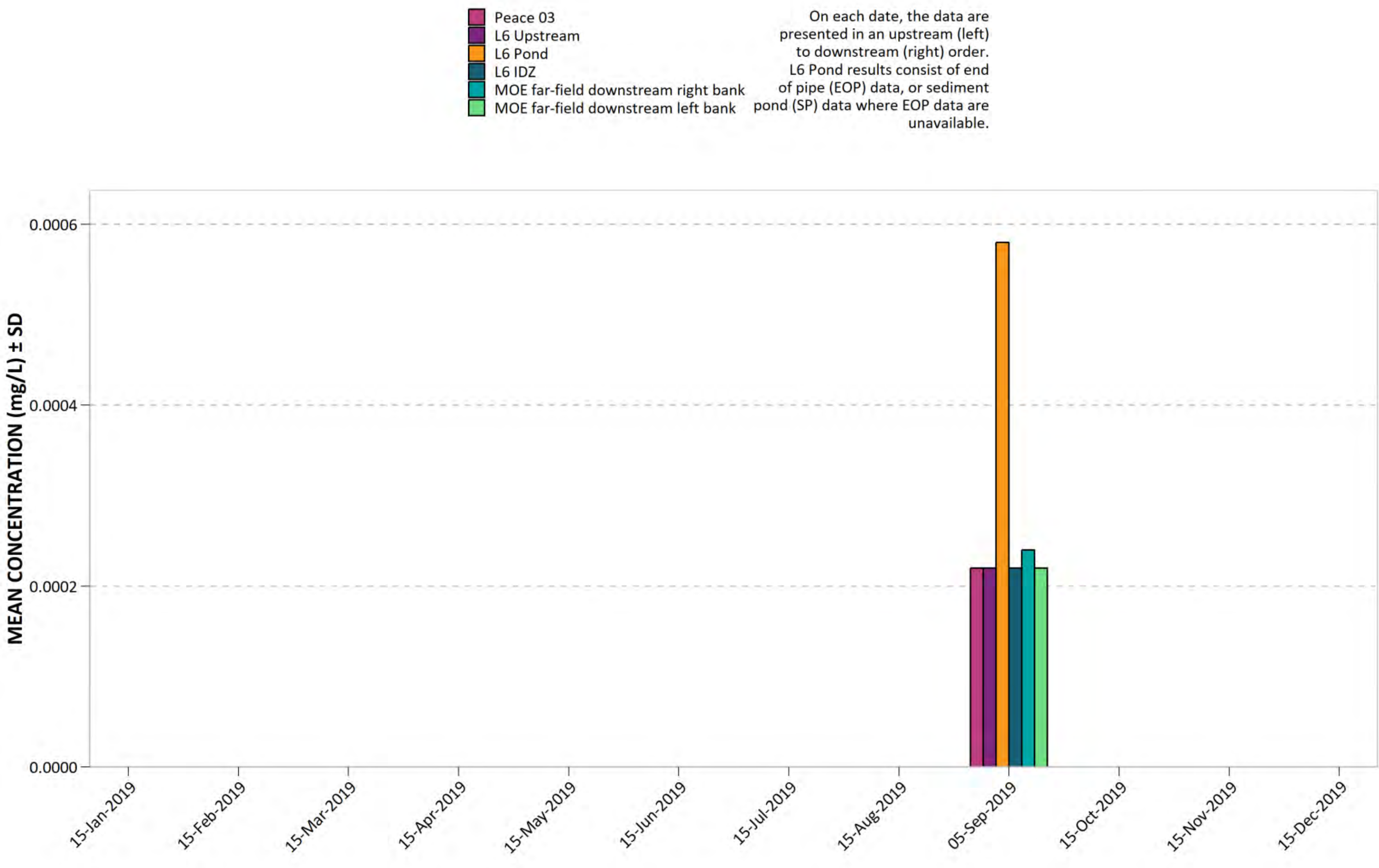


Figure 319. 2019 Peace River and RSEM L6 pond dissolved barium (Ba).

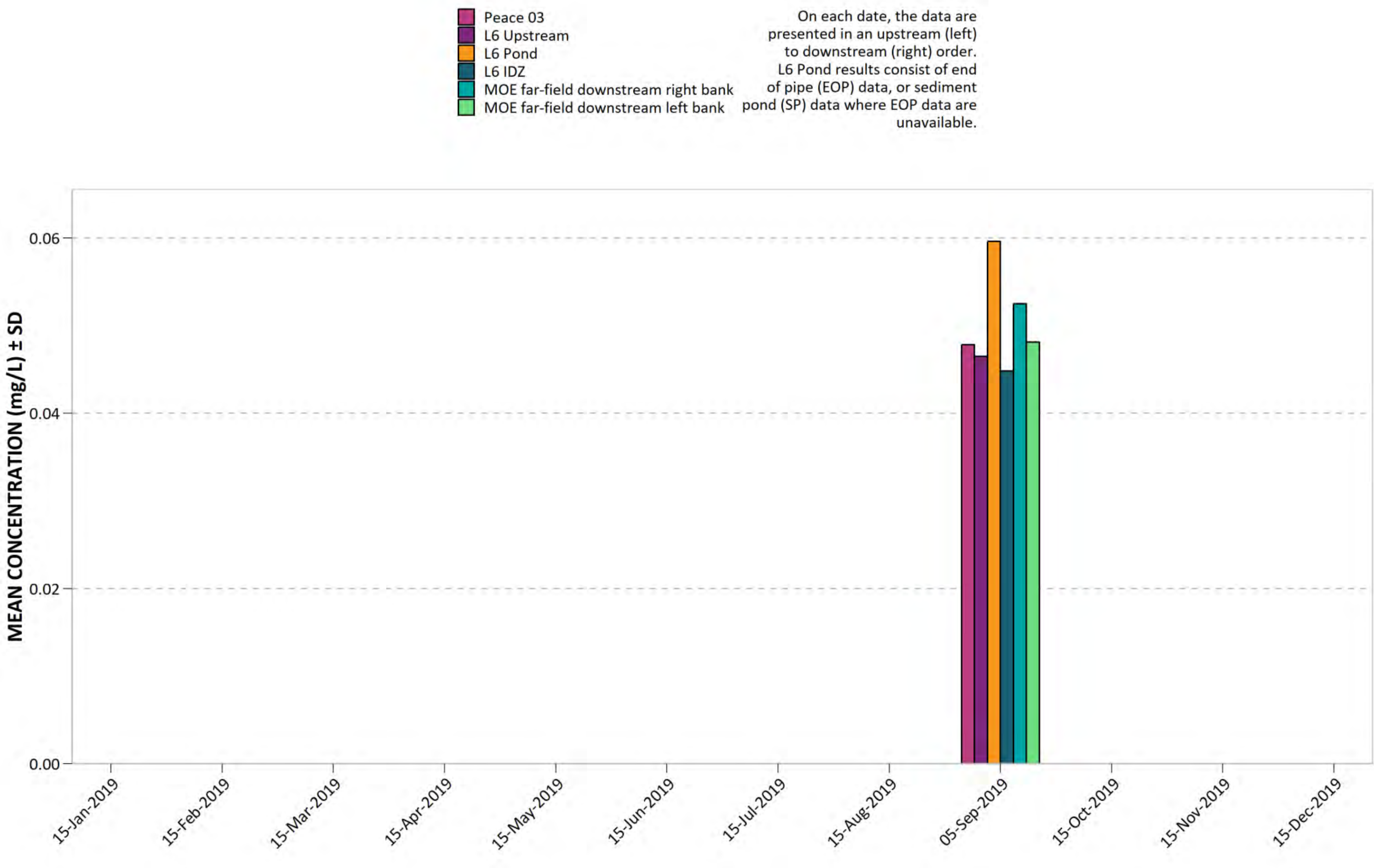
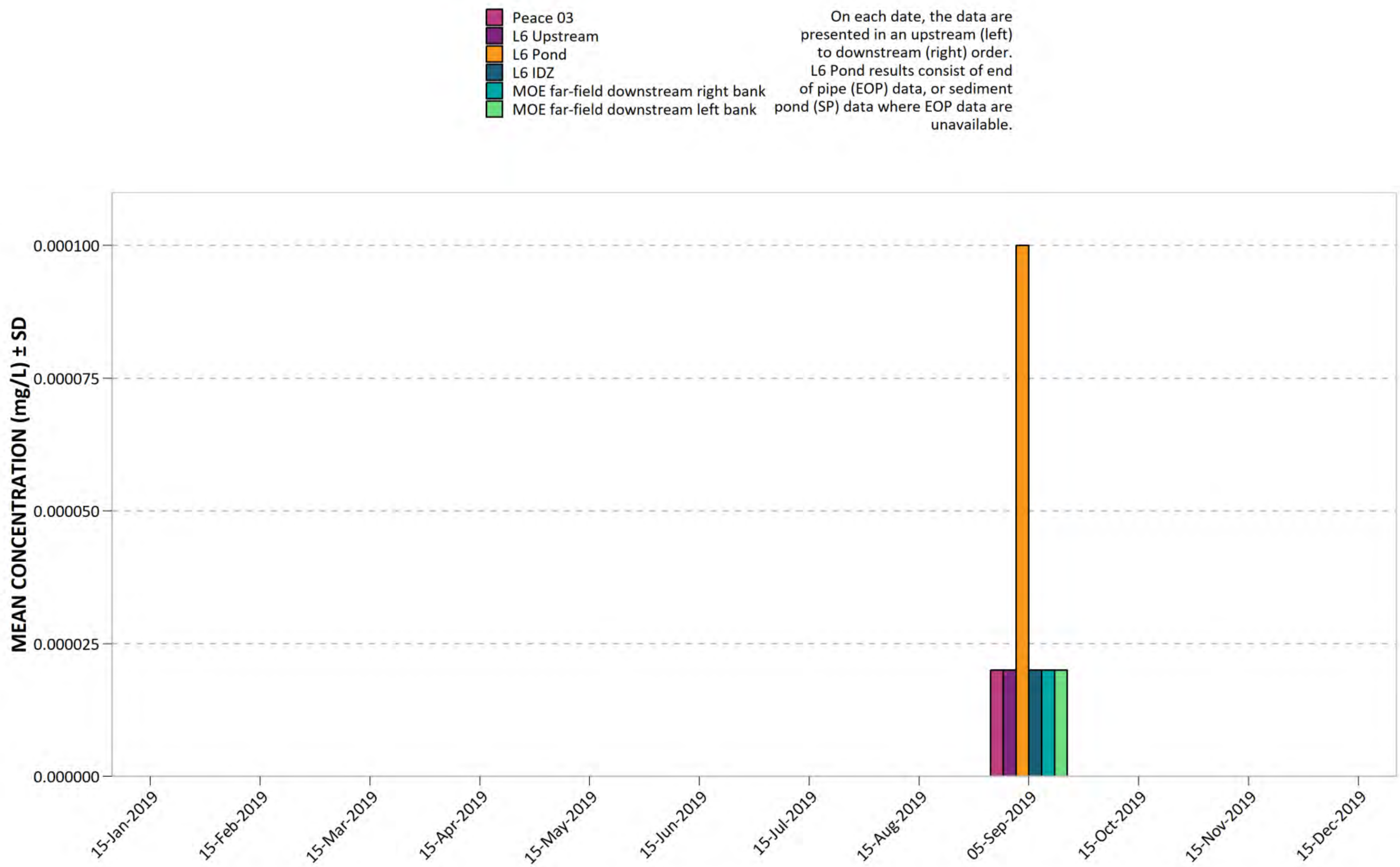
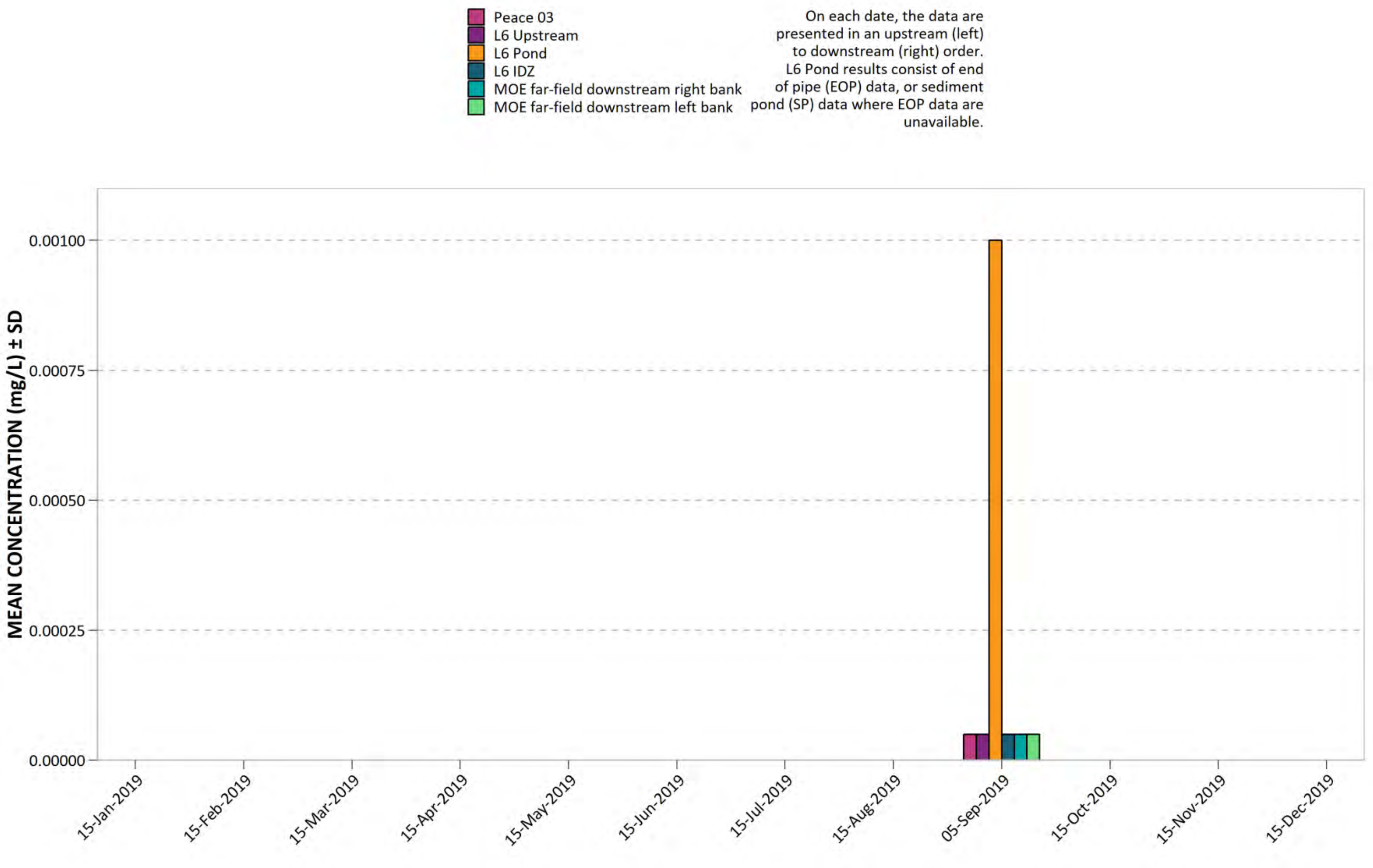


Figure 320. 2019 Peace River and RSEM L6 pond dissolved beryllium (Be).



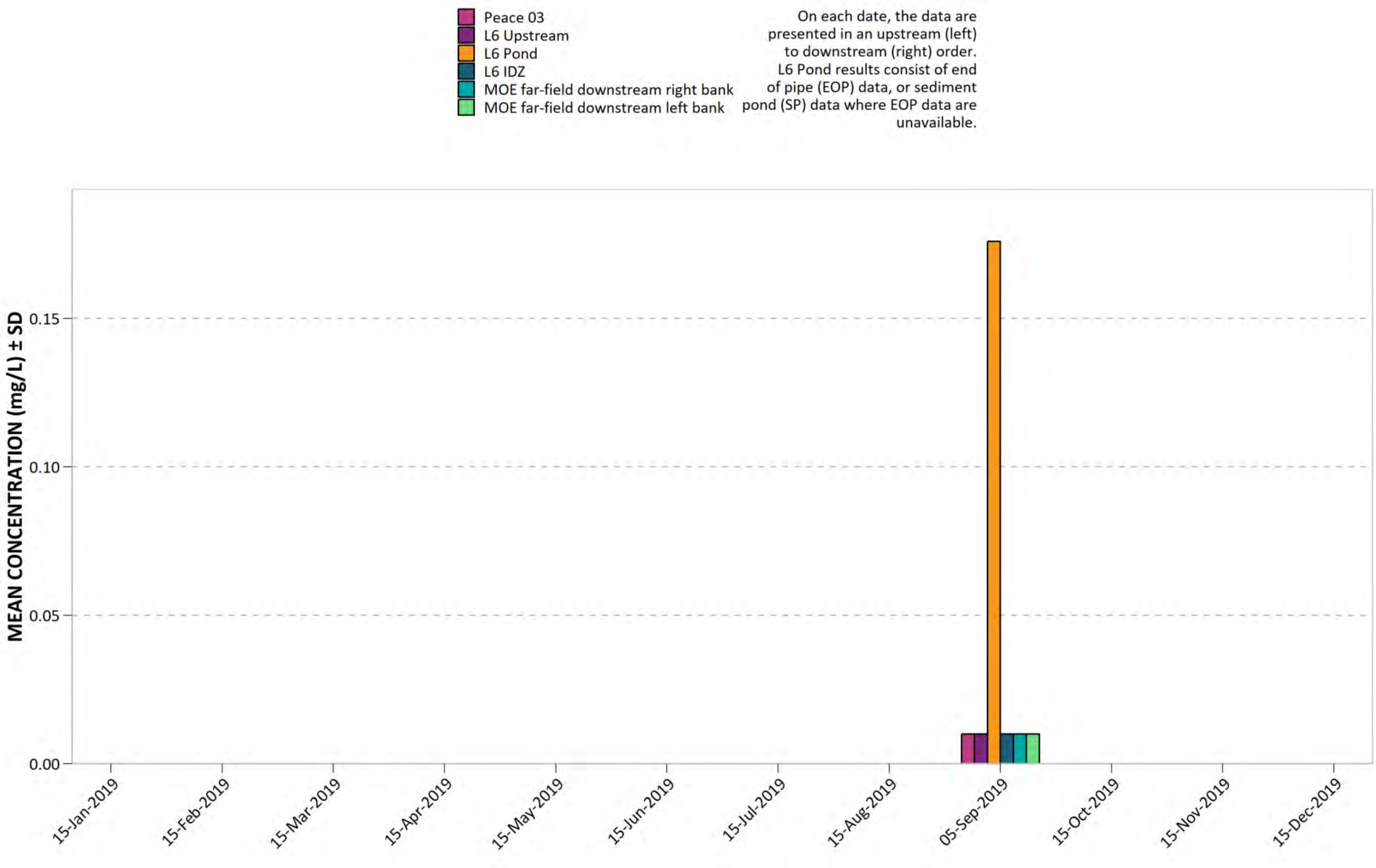
All results were less than the MDL and thus were assigned the MDL value of 0.0001 mg/L (Pond) or 0.00002 mg/L (Peace River).

Figure 321. 2019 Peace River and RSEM L6 pond dissolved bismuth (Bi).



All results were less than the MDL and thus were assigned the MDL value of 0.001 mg/L (Pond) or 0.00005 mg/L (Peace River).

Figure 322. 2019 Peace River and RSEM L6 pond dissolved boron (B).



Results less than the MDL were assigned the MDL value of 0.05 mg/L (Pond) or 0.01 mg/L (Peace River).

Figure 323. 2019 Peace River and RSEM L6 pond dissolved cadmium (Cd).

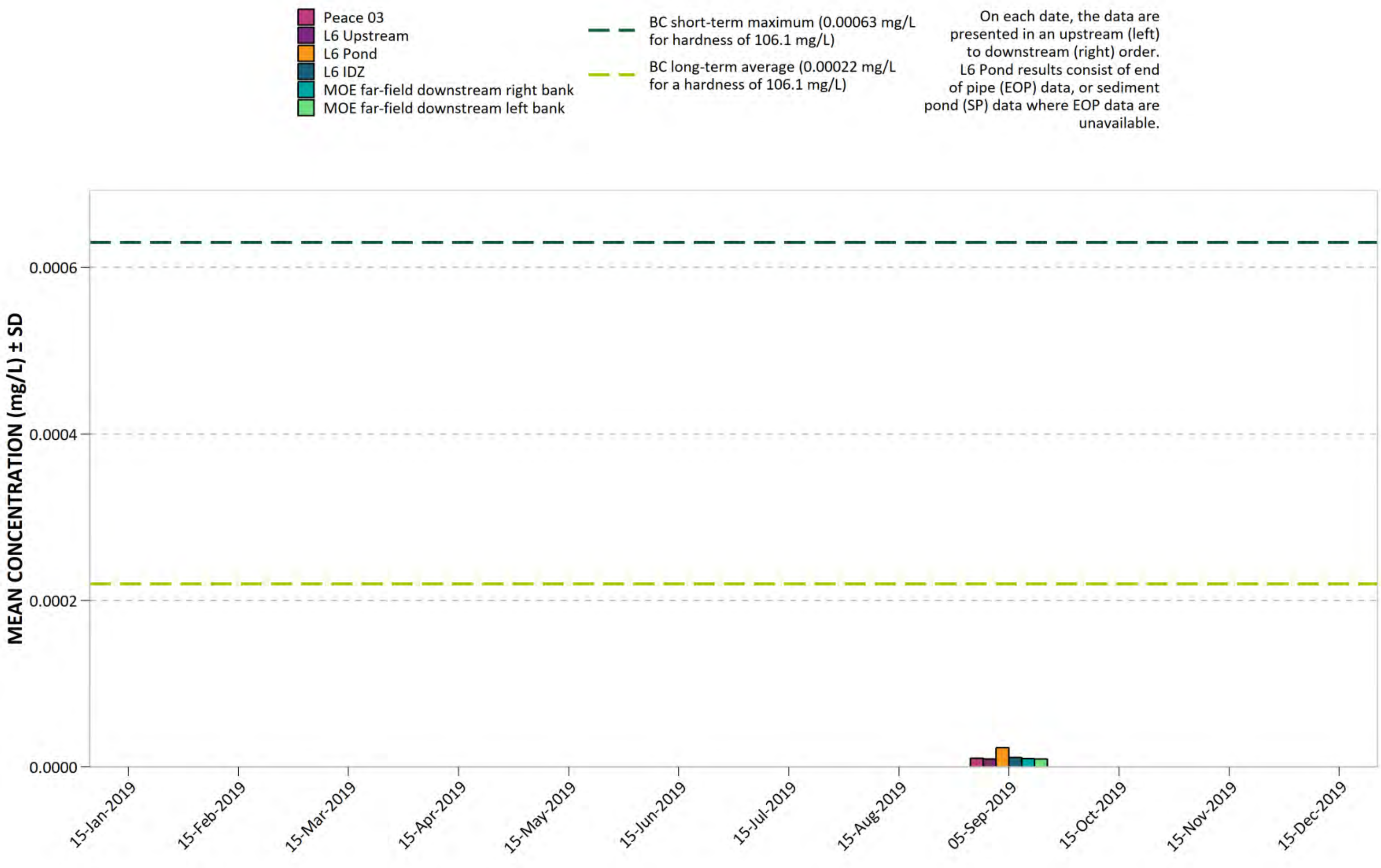


Figure 324. 2019 Peace River and RSEM L6 pond dissolved calcium (Ca).

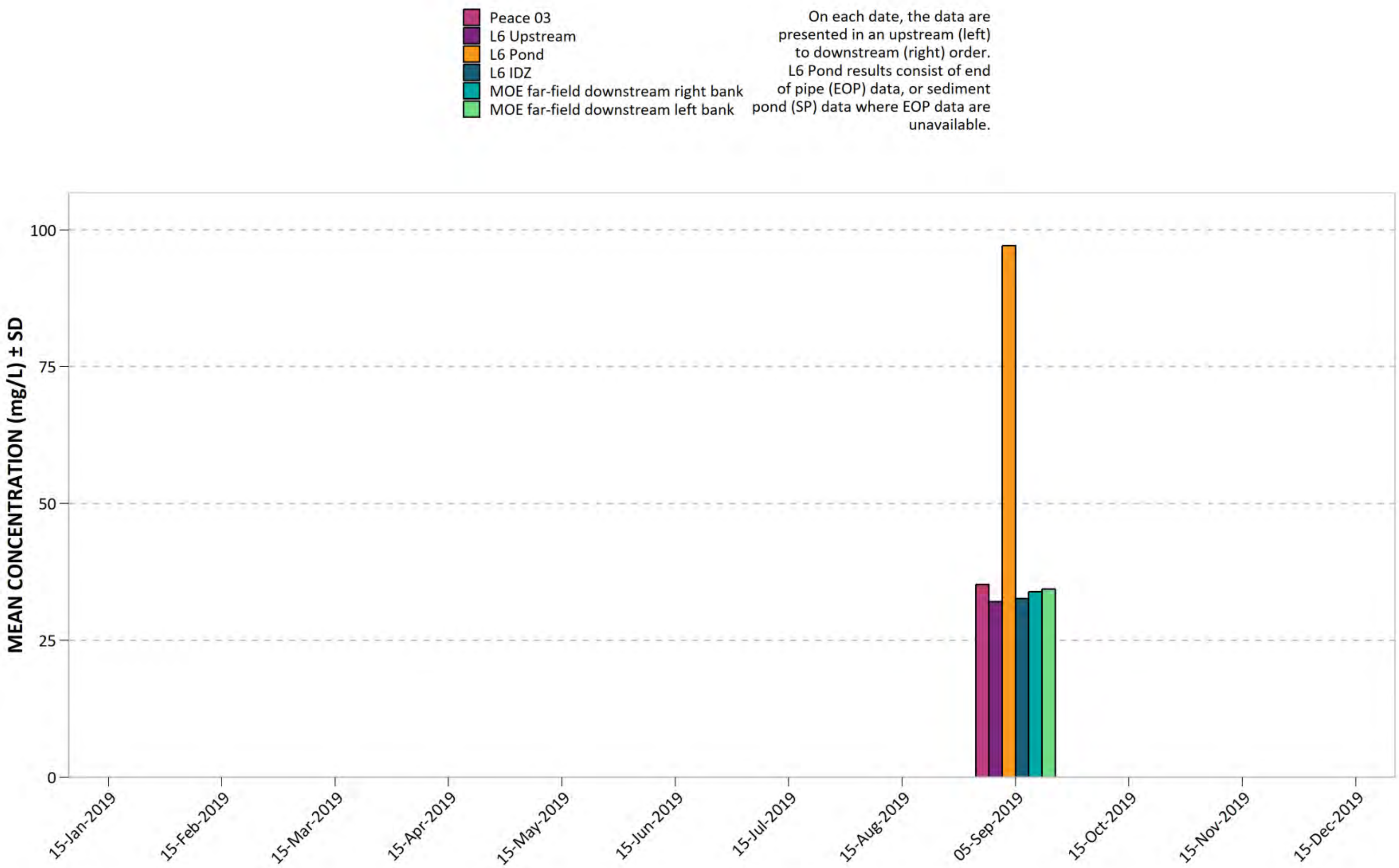
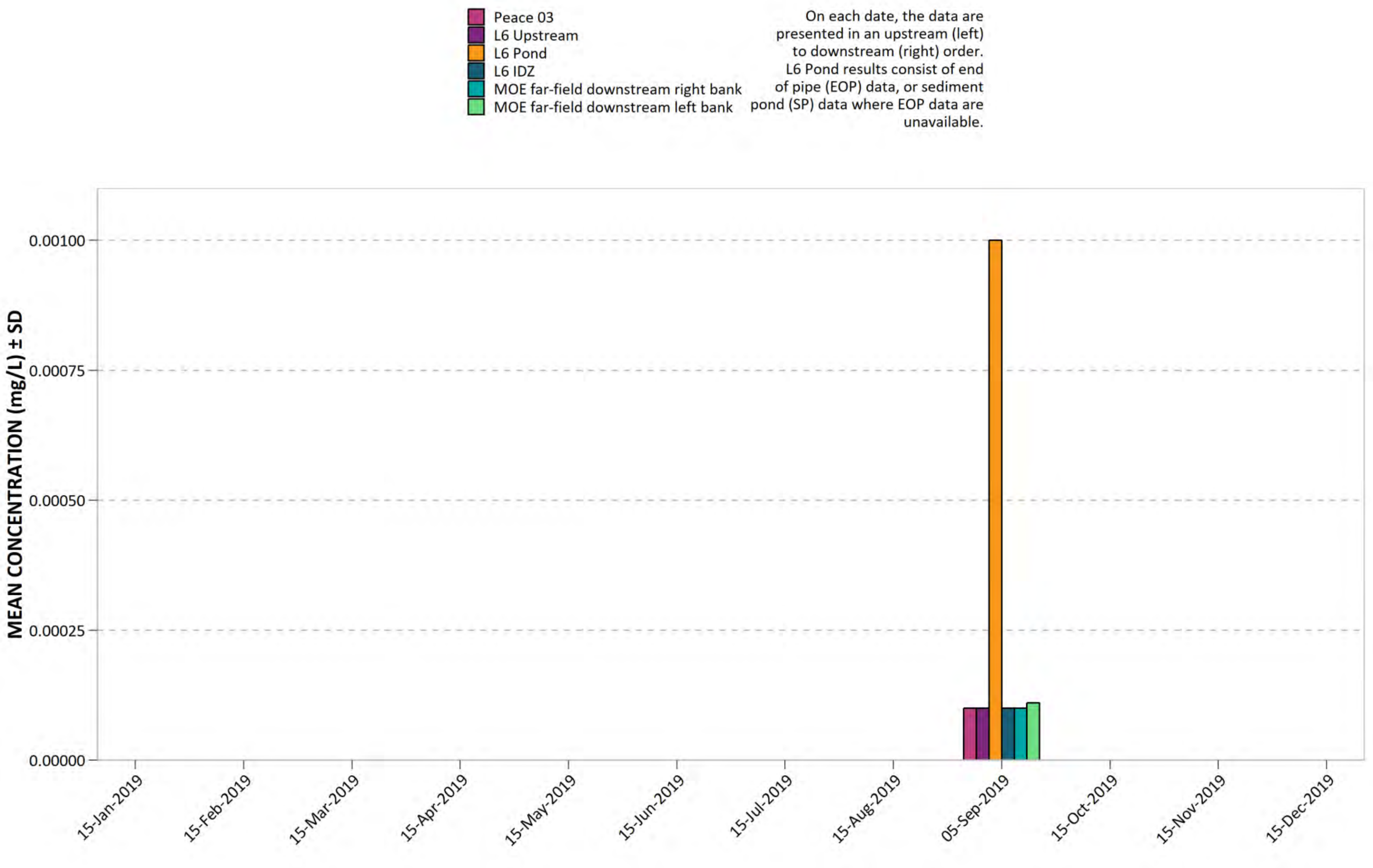
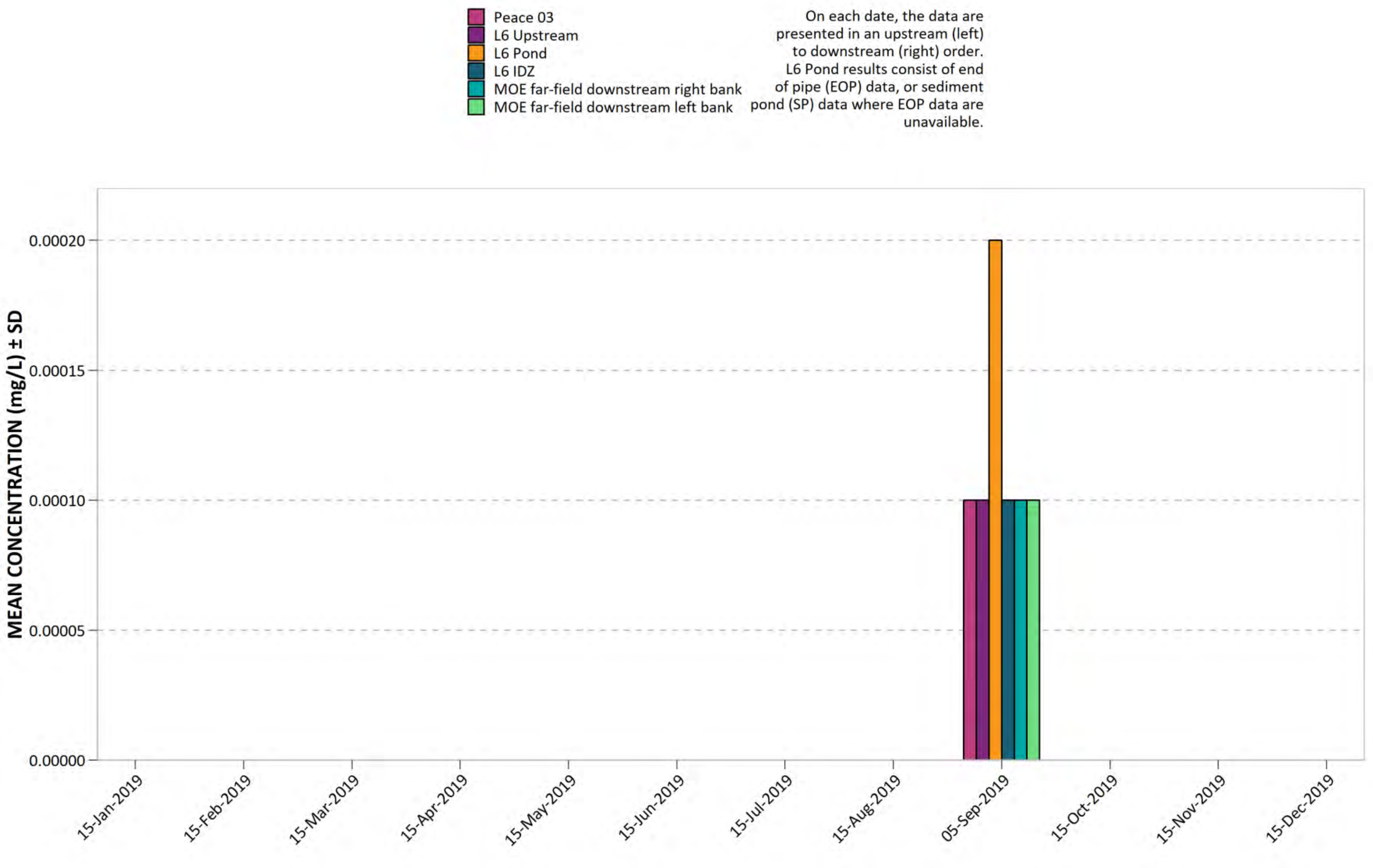


Figure 325. 2019 Peace River and RSEM L6 pond dissolved chromium (Cr).



Results less than the MDL were assigned the MDL value of 0.001 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 326. 2019 Peace River and RSEM L6 pond dissolved cobalt (Co).



Results less than the MDL were assigned the MDL value of 0.0002 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 327. 2019 Peace River and RSEM L6 pond dissolved copper (Cu). New dissolved copper BC WQG replaced the total copper BC WQG in August 2019 (MOE 2019).

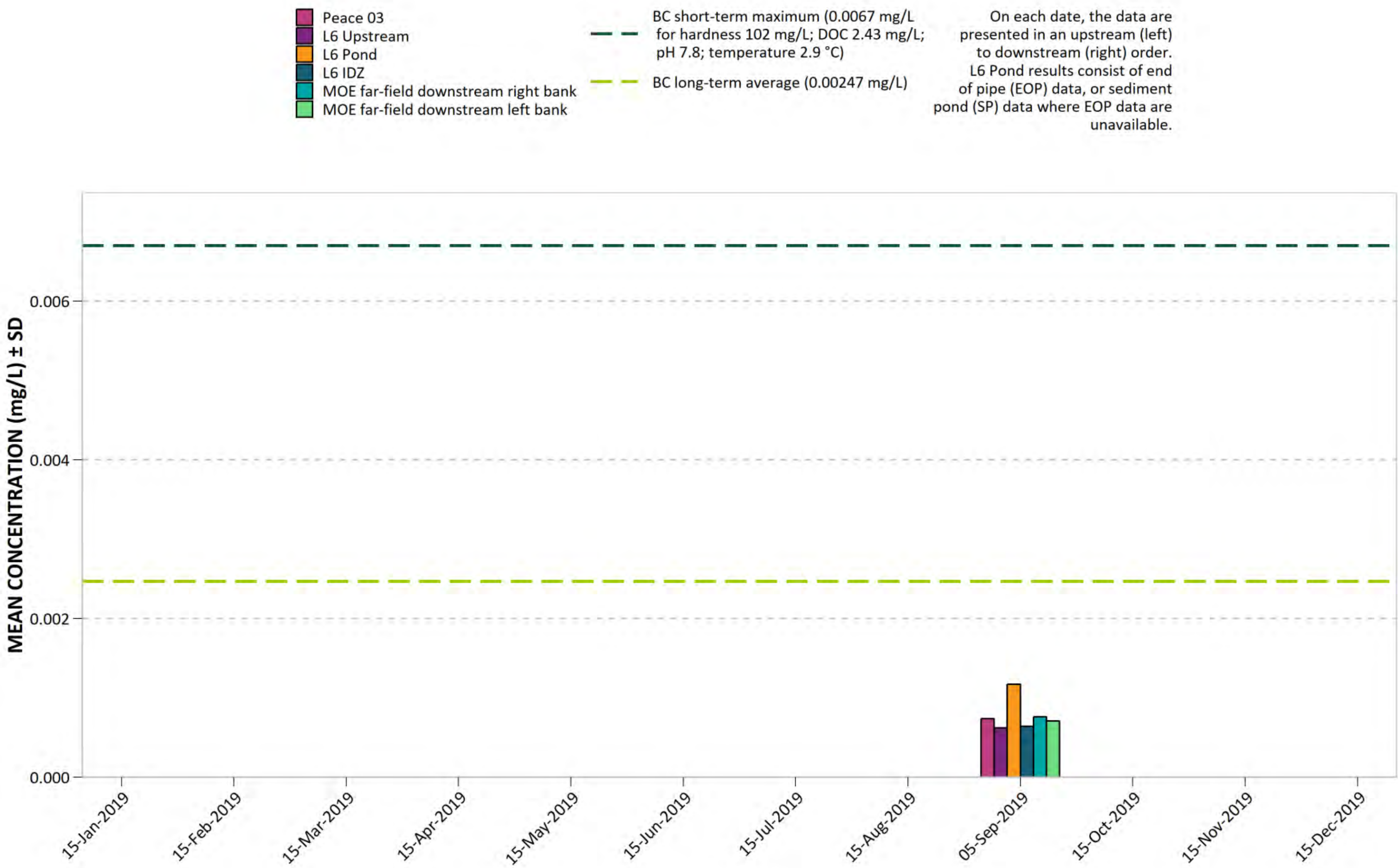
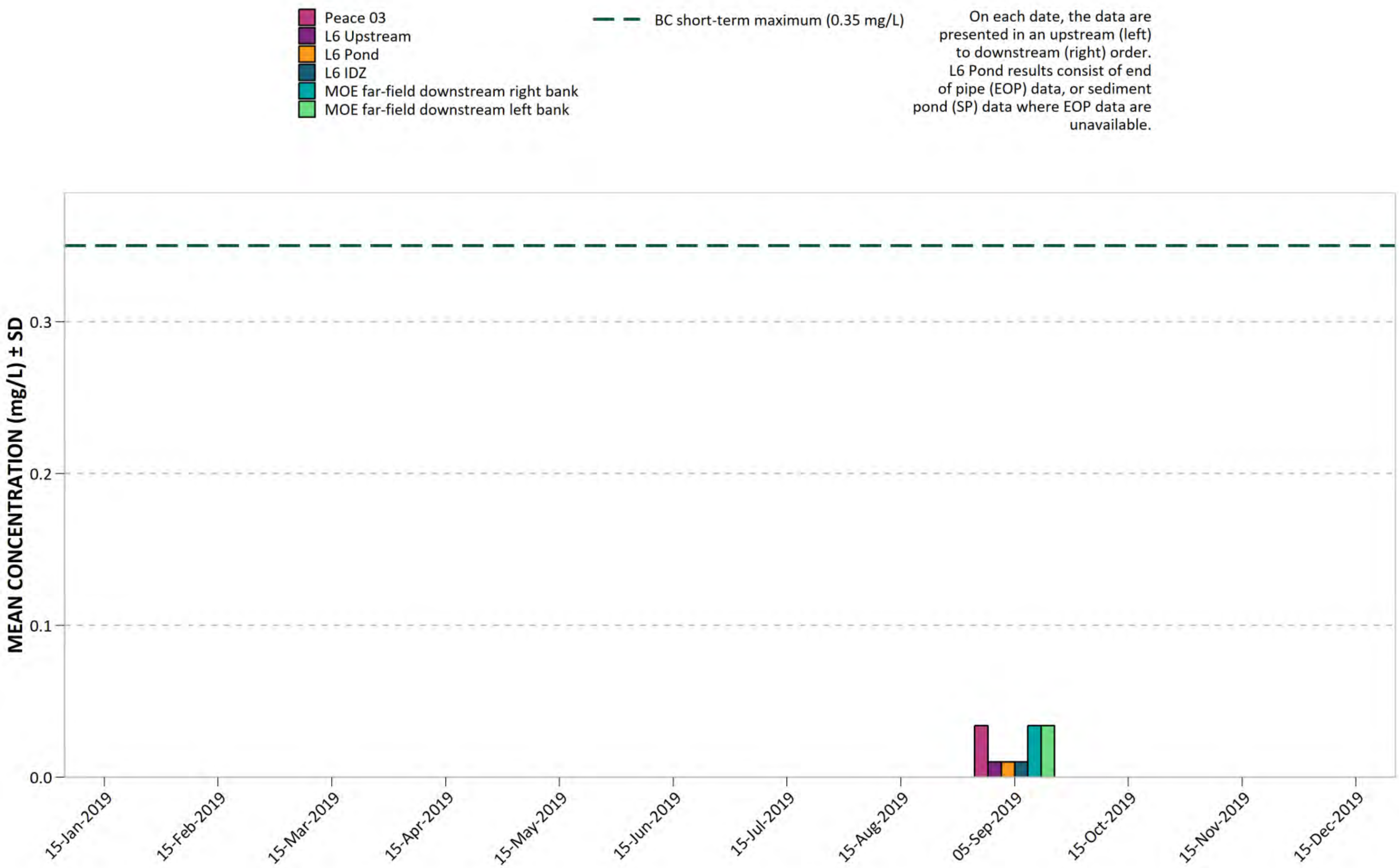
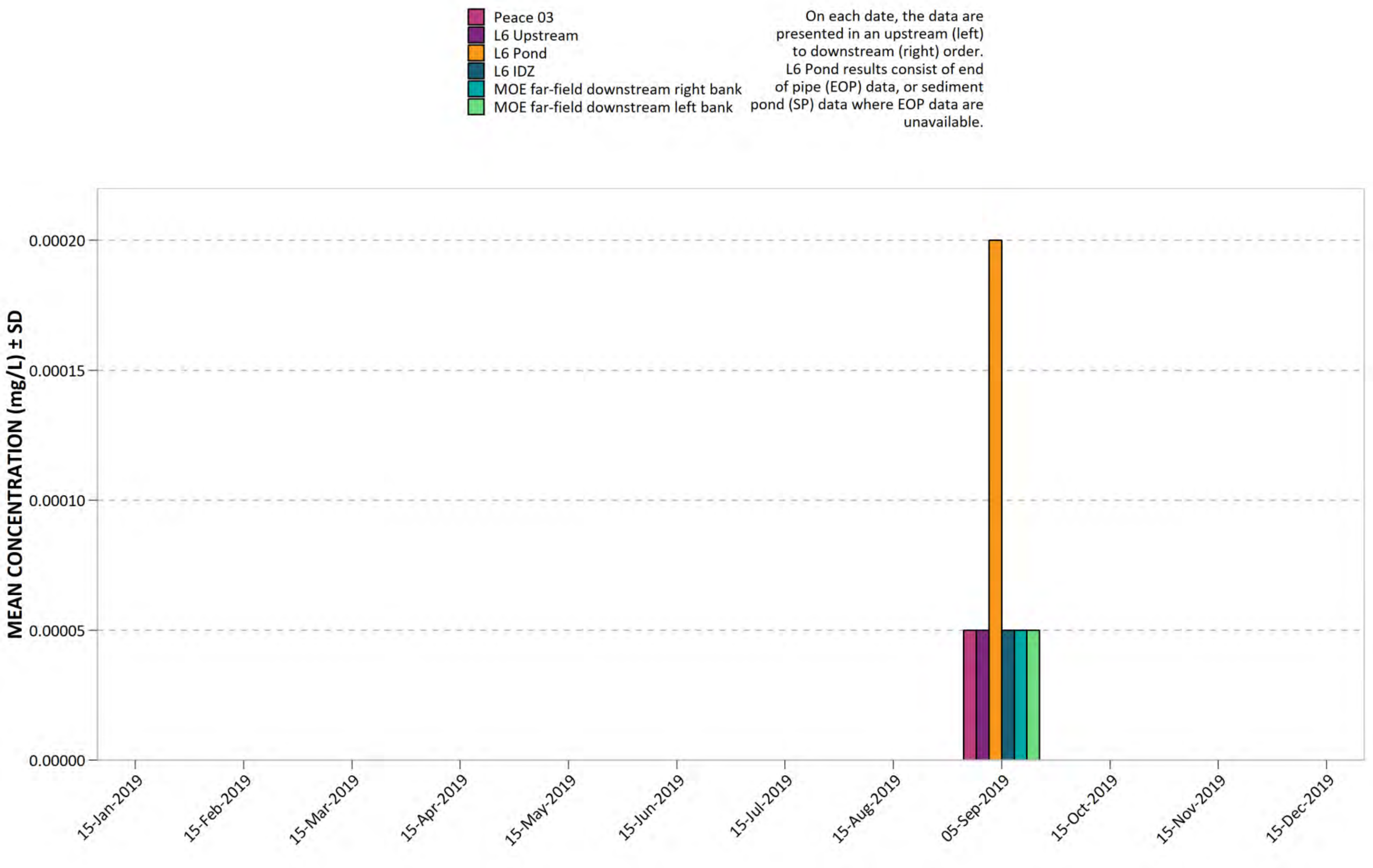


Figure 328. 2019 Peace River and RSEM L6 pond dissolved iron (Fe).



Results less than the MDL were assigned the MDL value of 0.01 mg/L (Pond and Peace River).

Figure 329. 2019 Peace River and RSEM L6 pond dissolved lead (Pb).



Results less than the MDL were assigned the MDL value of 0.0002 mg/L (Pond) or 0.00005 mg/L (Peace River).

Figure 330. 2019 Peace River and RSEM L6 pond dissolved lithium (Li).

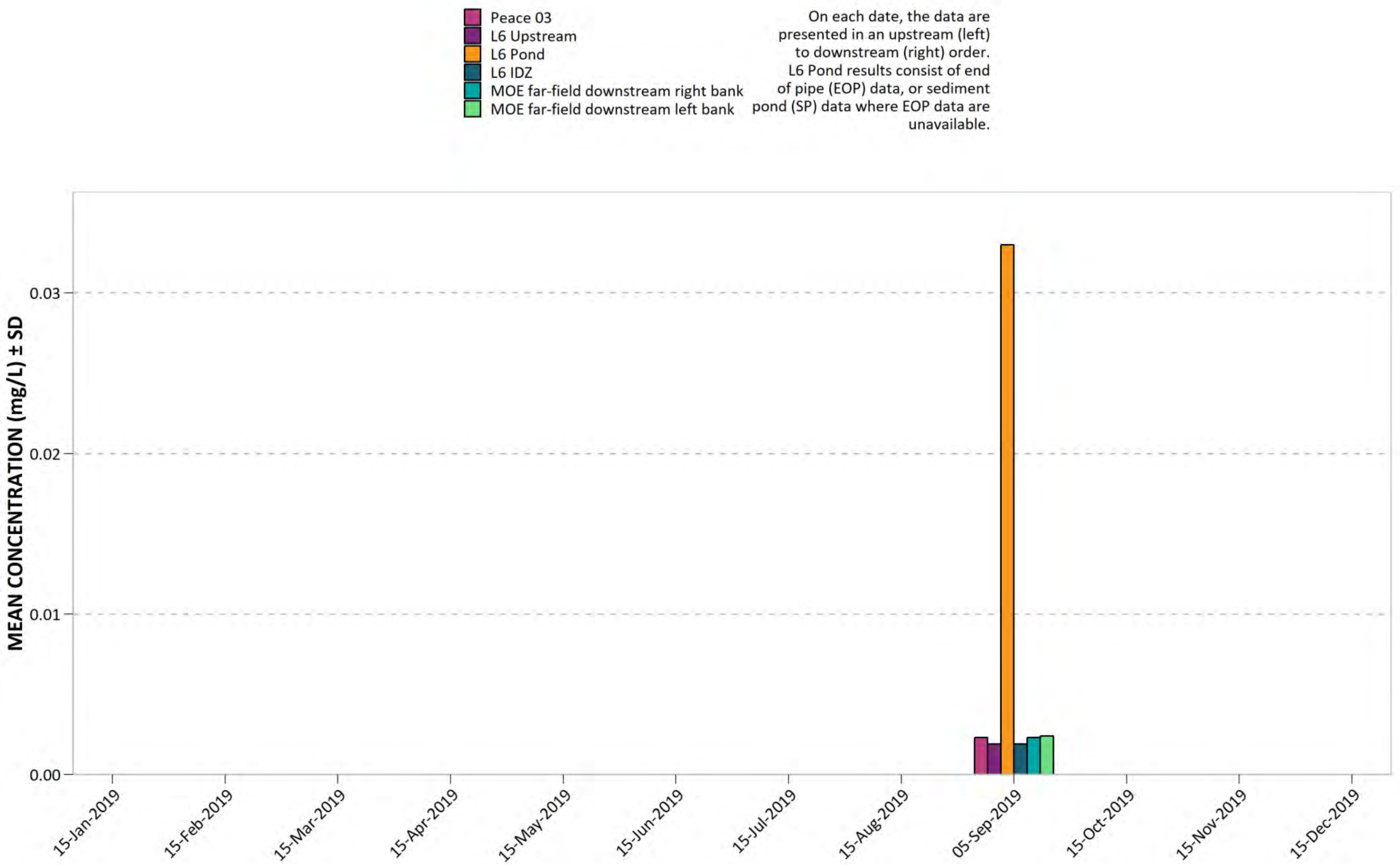


Figure 331. 2019 Peace River and RSEM L6 pond dissolved magnesium (Mg).

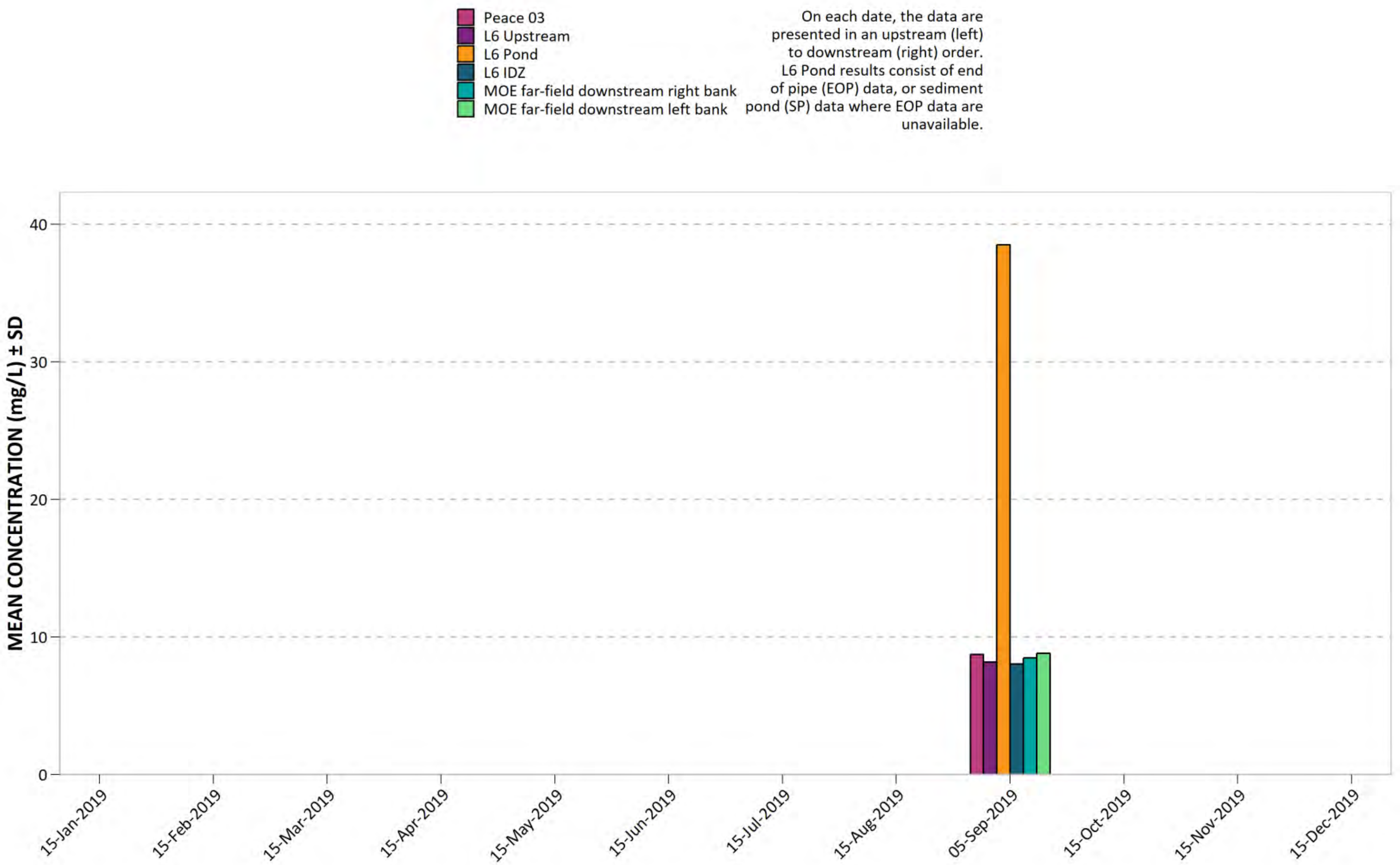


Figure 332. 2019 Peace River and RSEM L6 pond dissolved manganese (Mn).

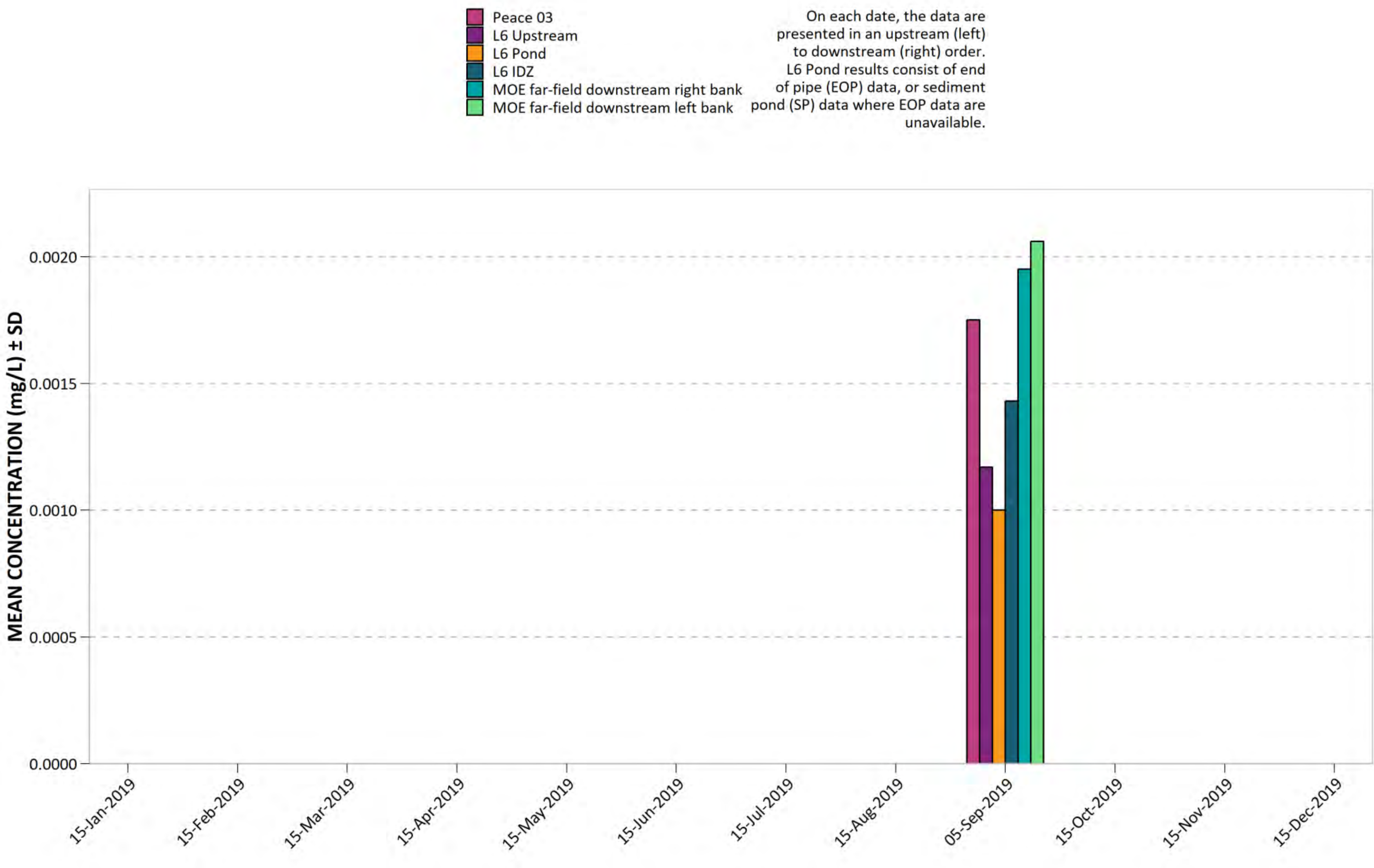


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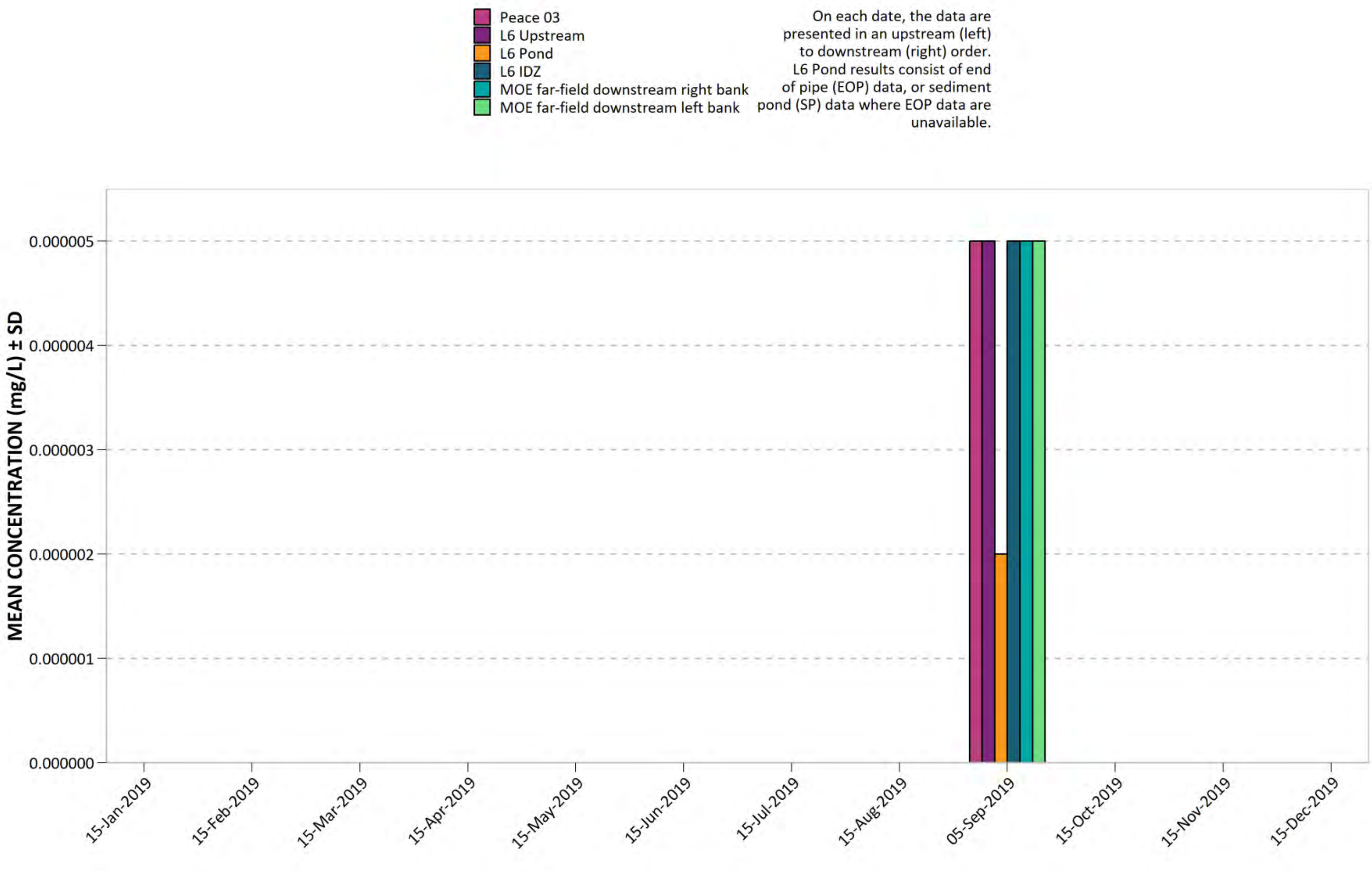
Figure 333. 2019 Peace River and RSEM L6 pond dissolved mercury (Hg).



Results less than the MDL were assigned the MDL value of 0.000005 mg/L (Peace River), 0.000002 mg/L (Pond)

Figure 334. 2019 Peace River and RSEM L6 pond dissolved molybdenum (Mo).

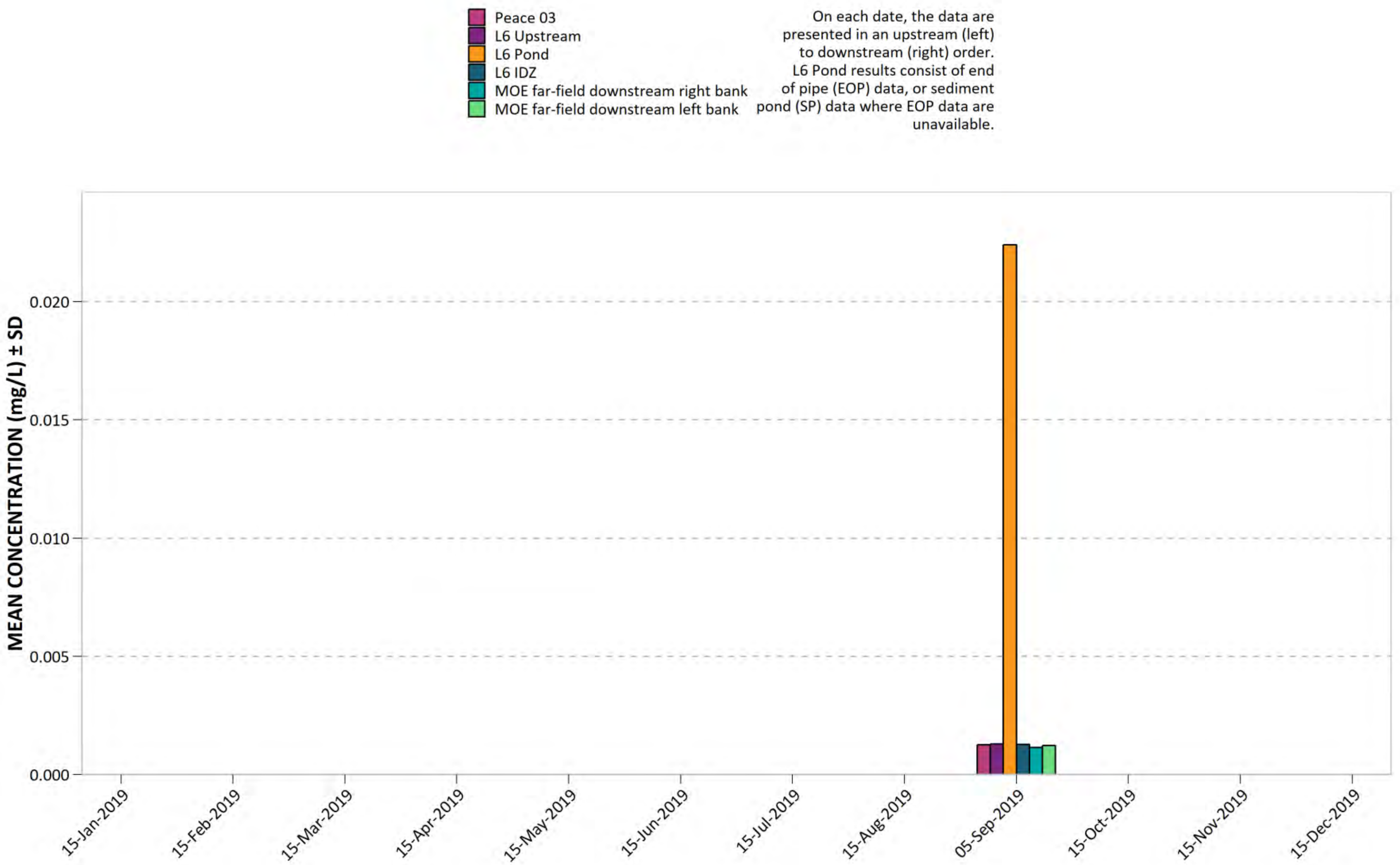


Figure 335. 2019 Peace River and RSEM L6 pond dissolved nickel (Ni).

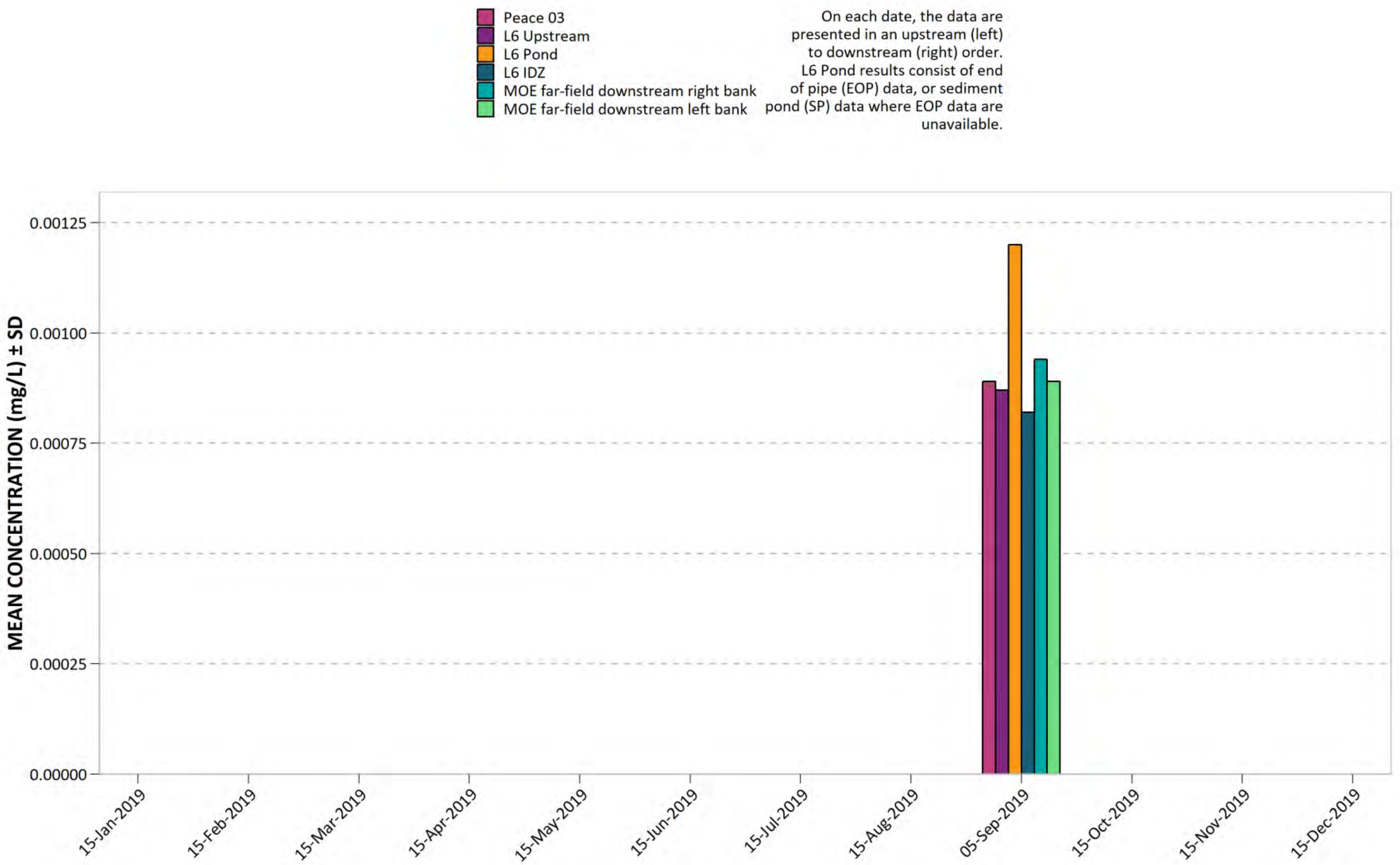


Figure 336. 2019 Peace River and RSEM L6 pond dissolved potassium (K).

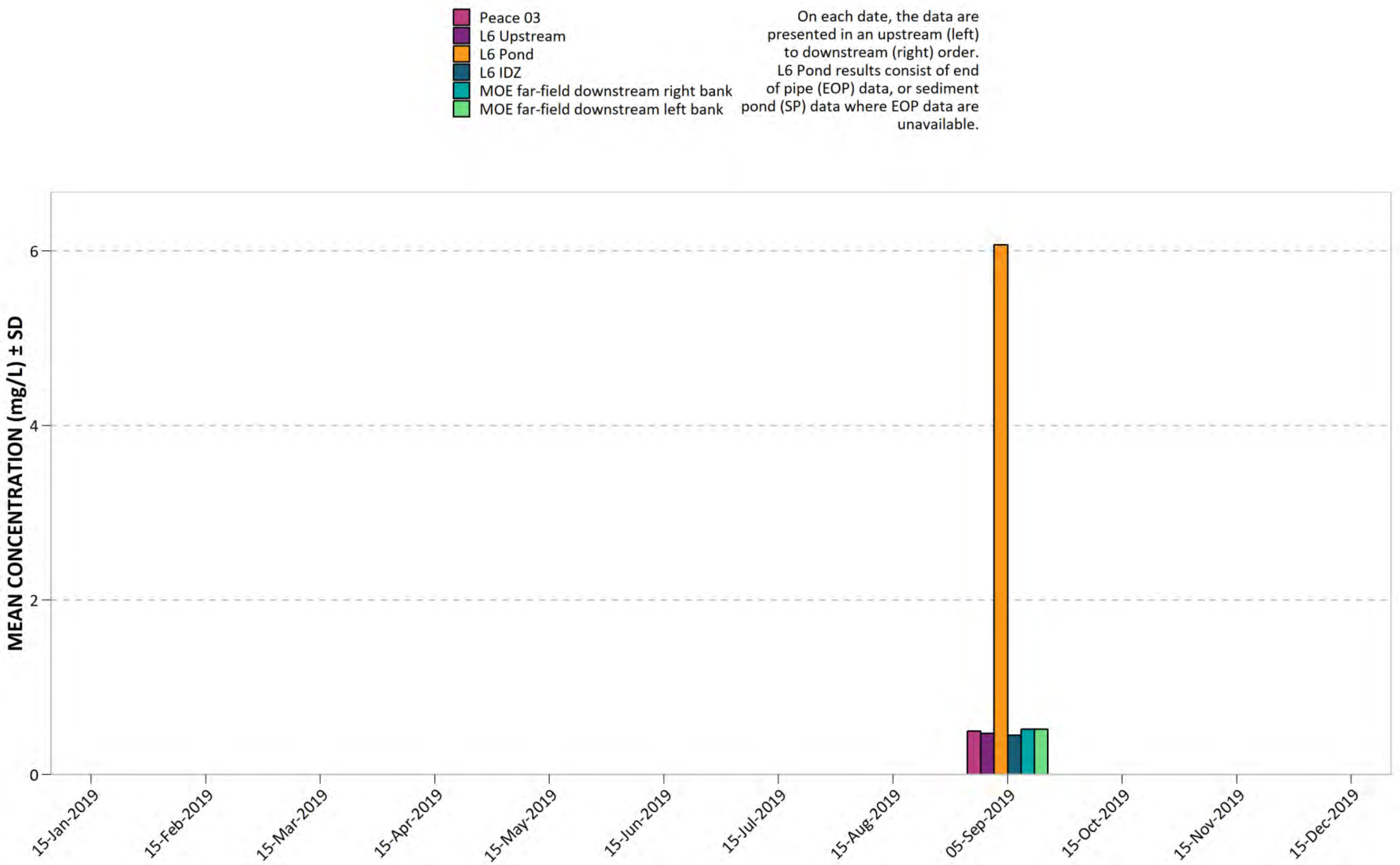


Figure 337. 2019 Peace River and RSEM L6 pond dissolved selenium (Se).

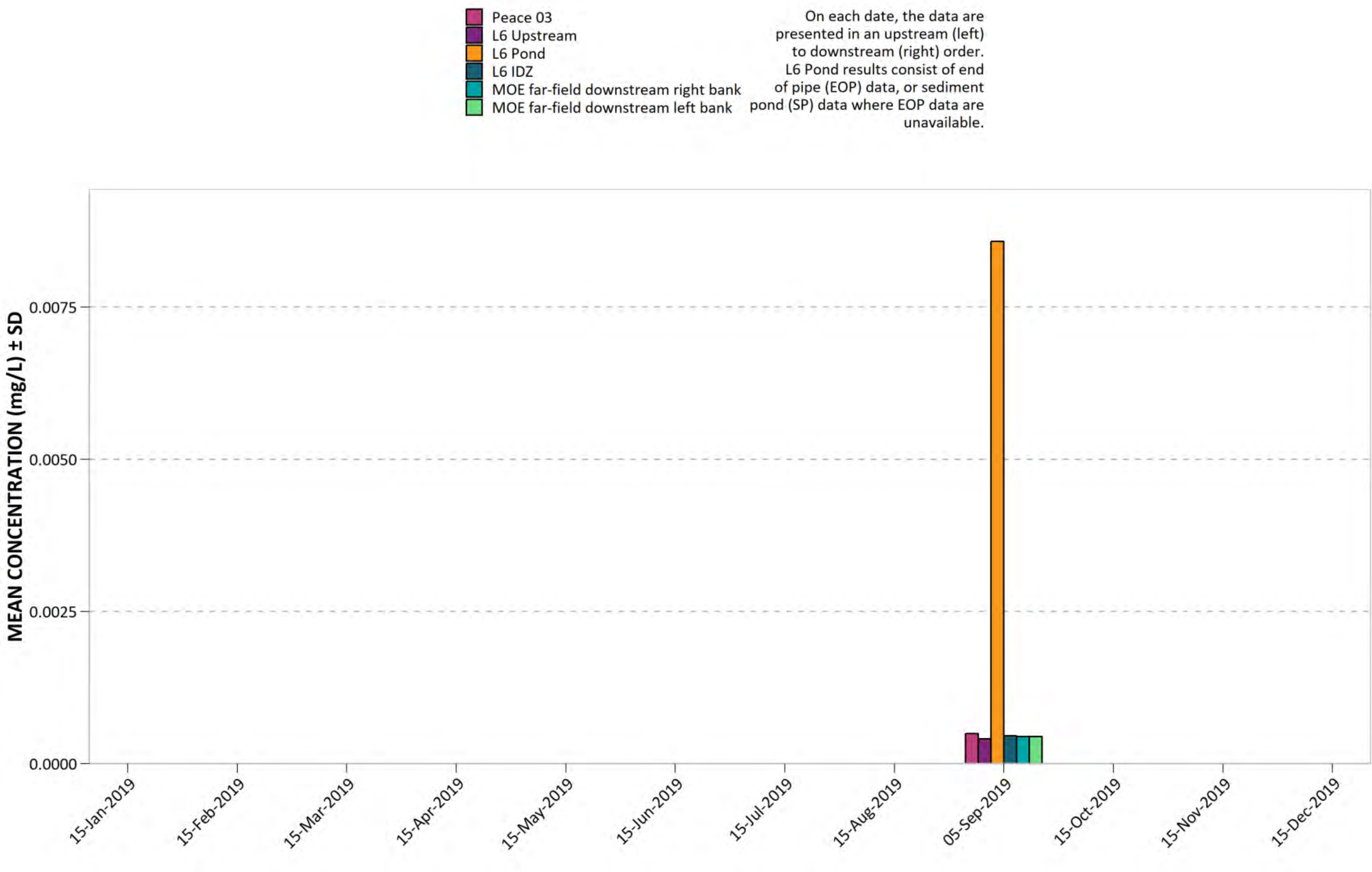


Figure 338. 2019 Peace River and RSEM L6 pond dissolved silicon (Si).

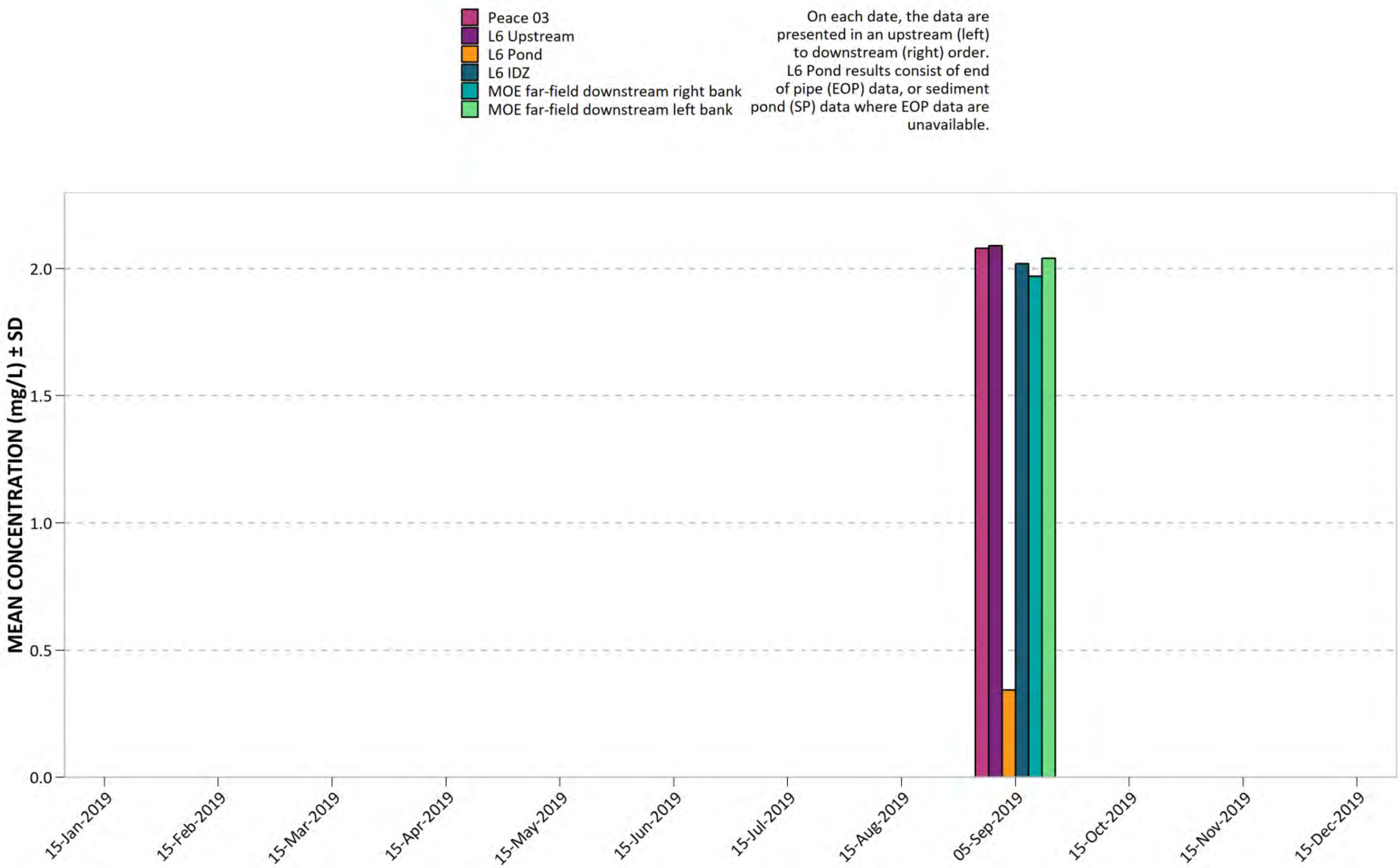
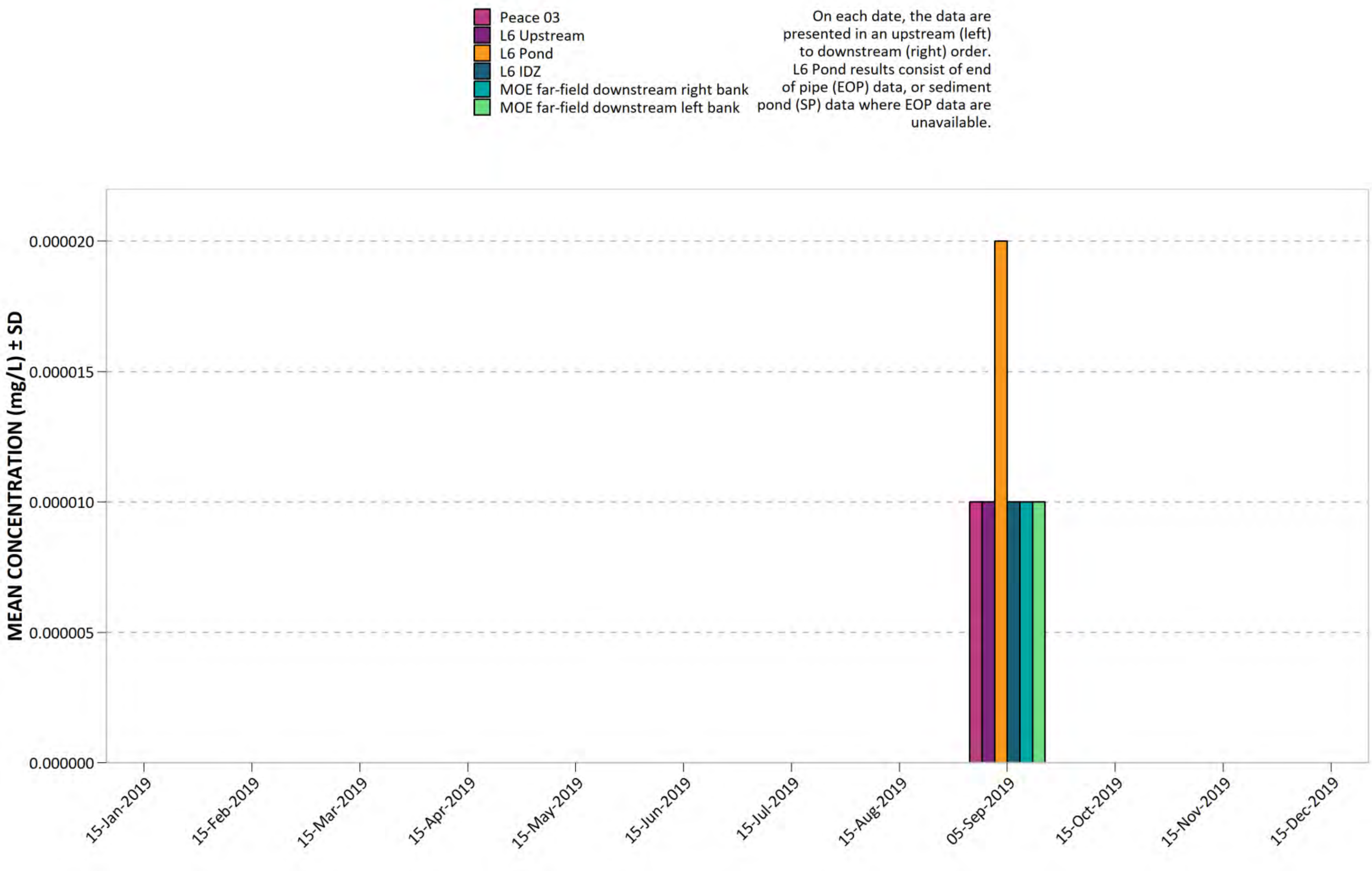


Figure 339. 2019 Peace River and RSEM L6 pond dissolved silver (Ag).



Results less than the MDL were assigned the MDL value of 0.00002 mg/L (Pond) or 0.00001 mg/L (Peace River).

Figure 340. 2019 Peace River and RSEM L6 pond dissolved sodium (Na).

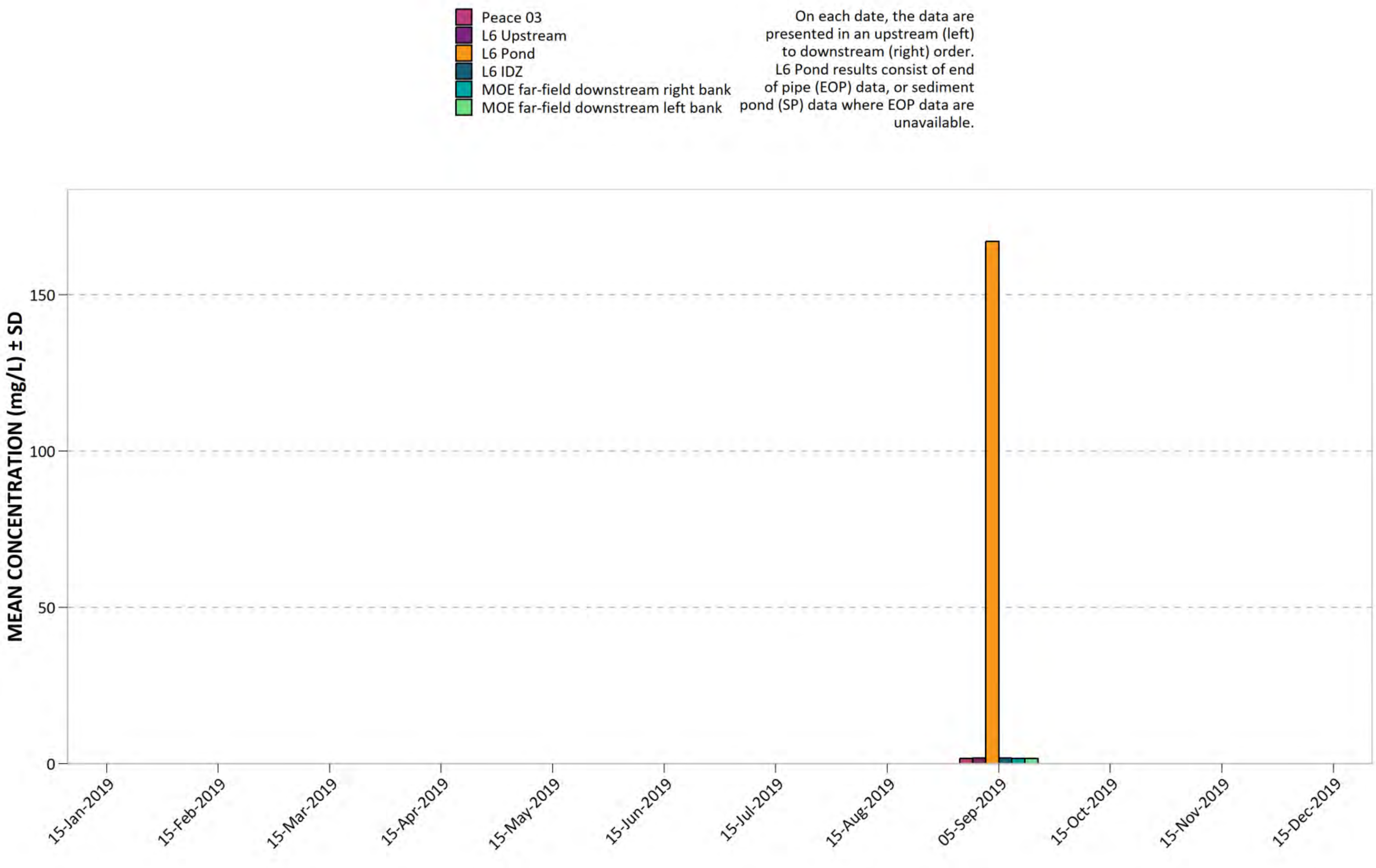


Figure 341. 2019 Peace River and RSEM L6 pond dissolved strontium (Sr).

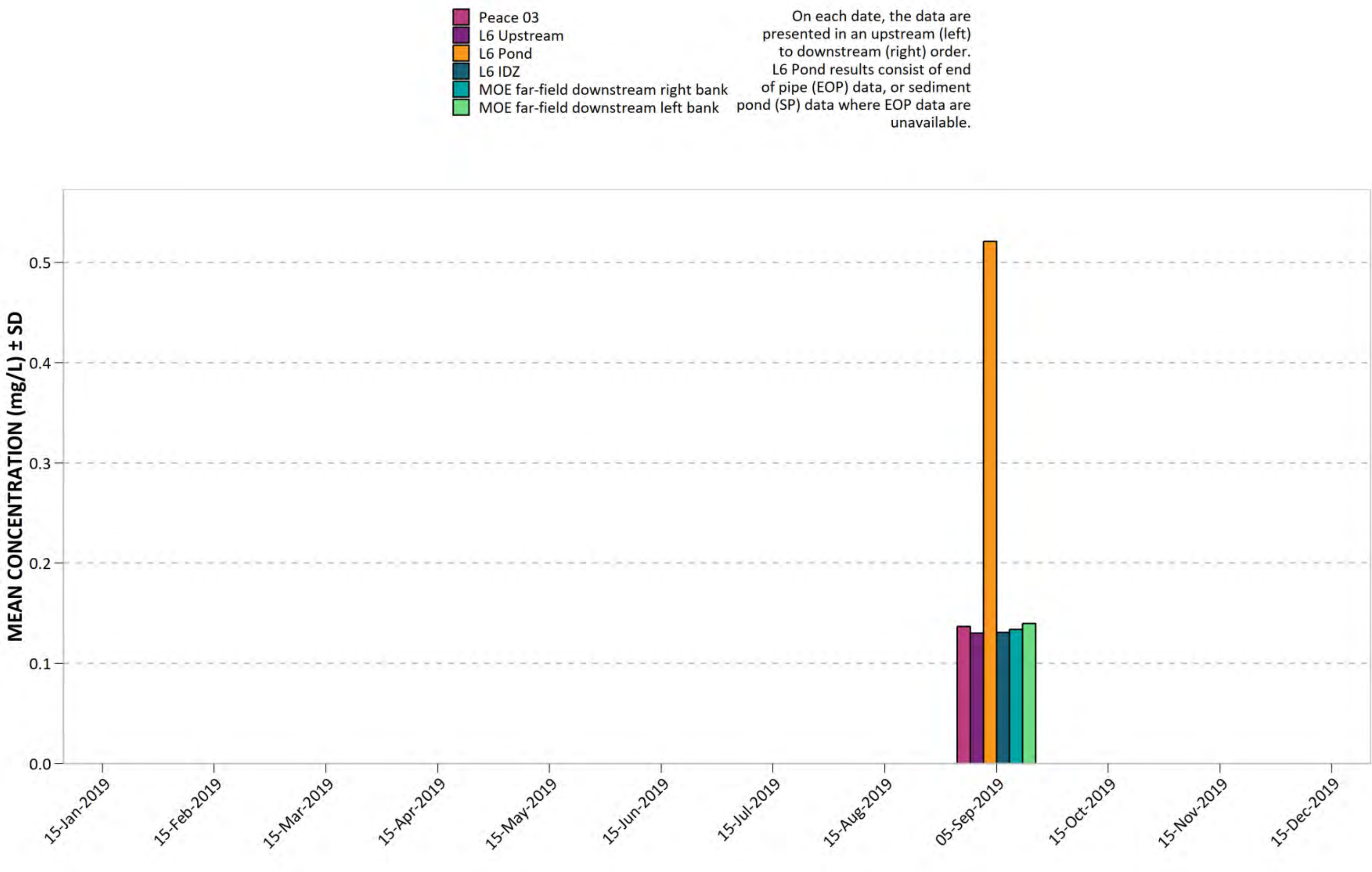


Figure 342. 2019 Peace River and RSEM L6 pond dissolved sulfur (S).

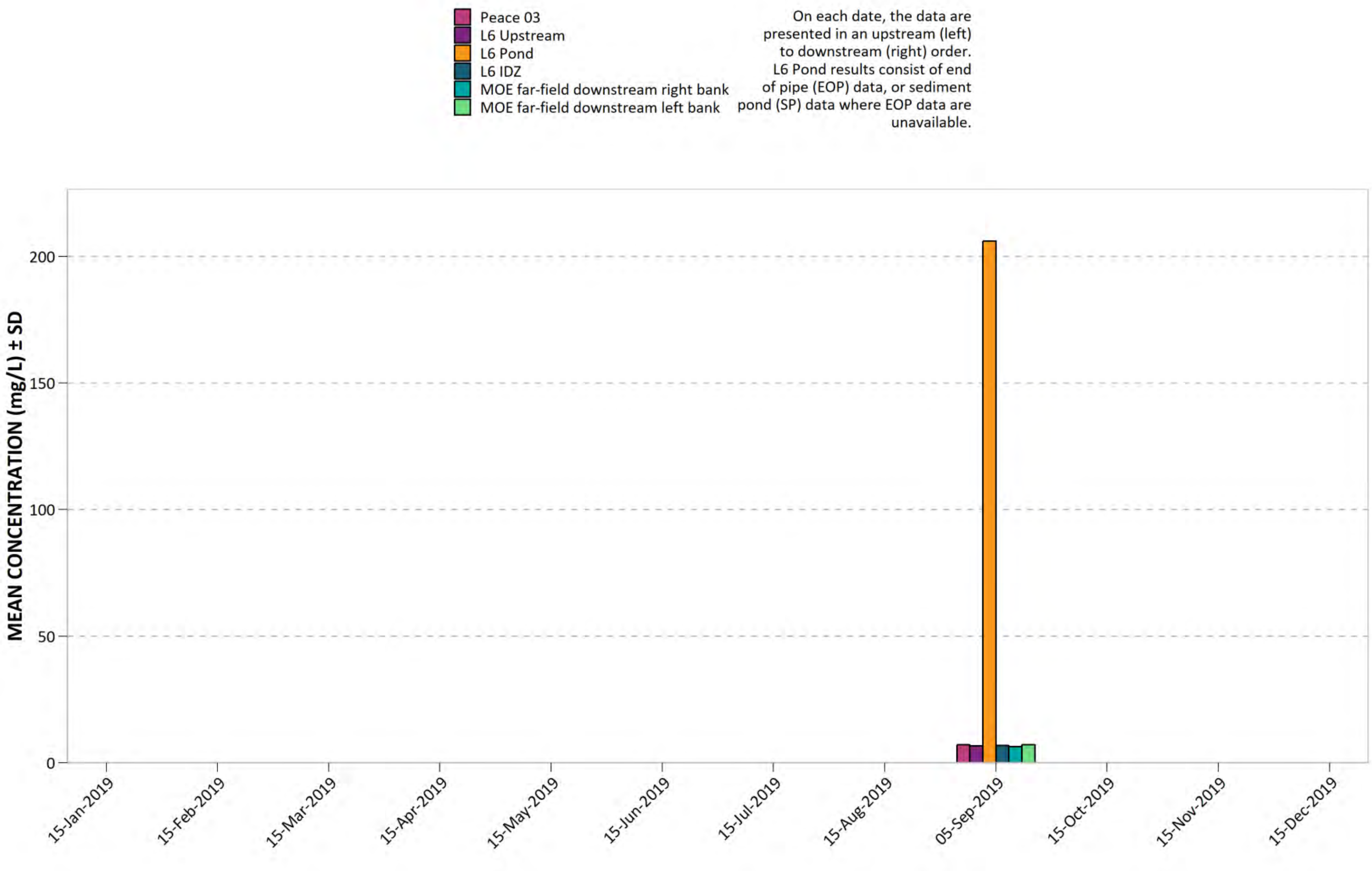
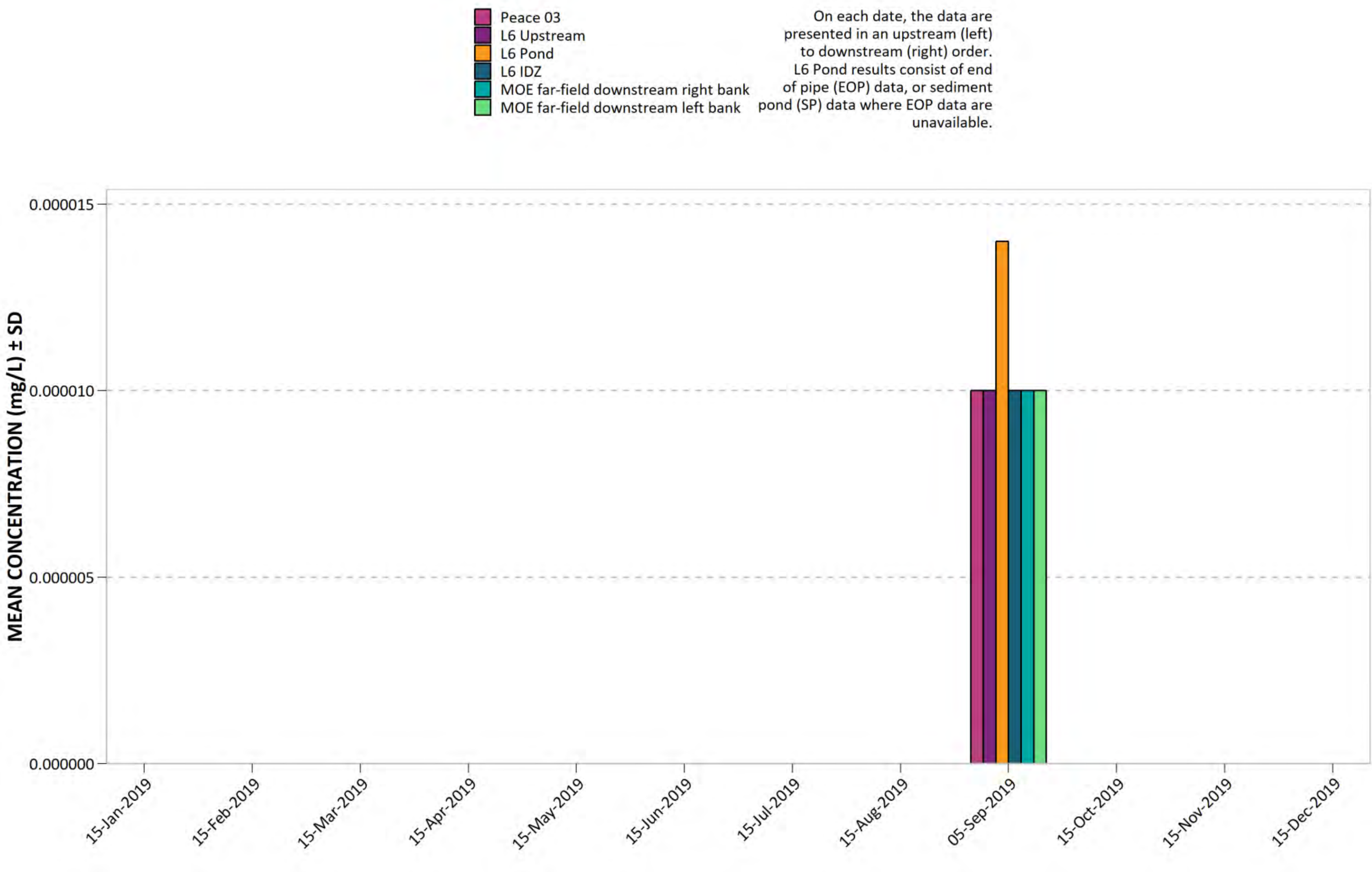
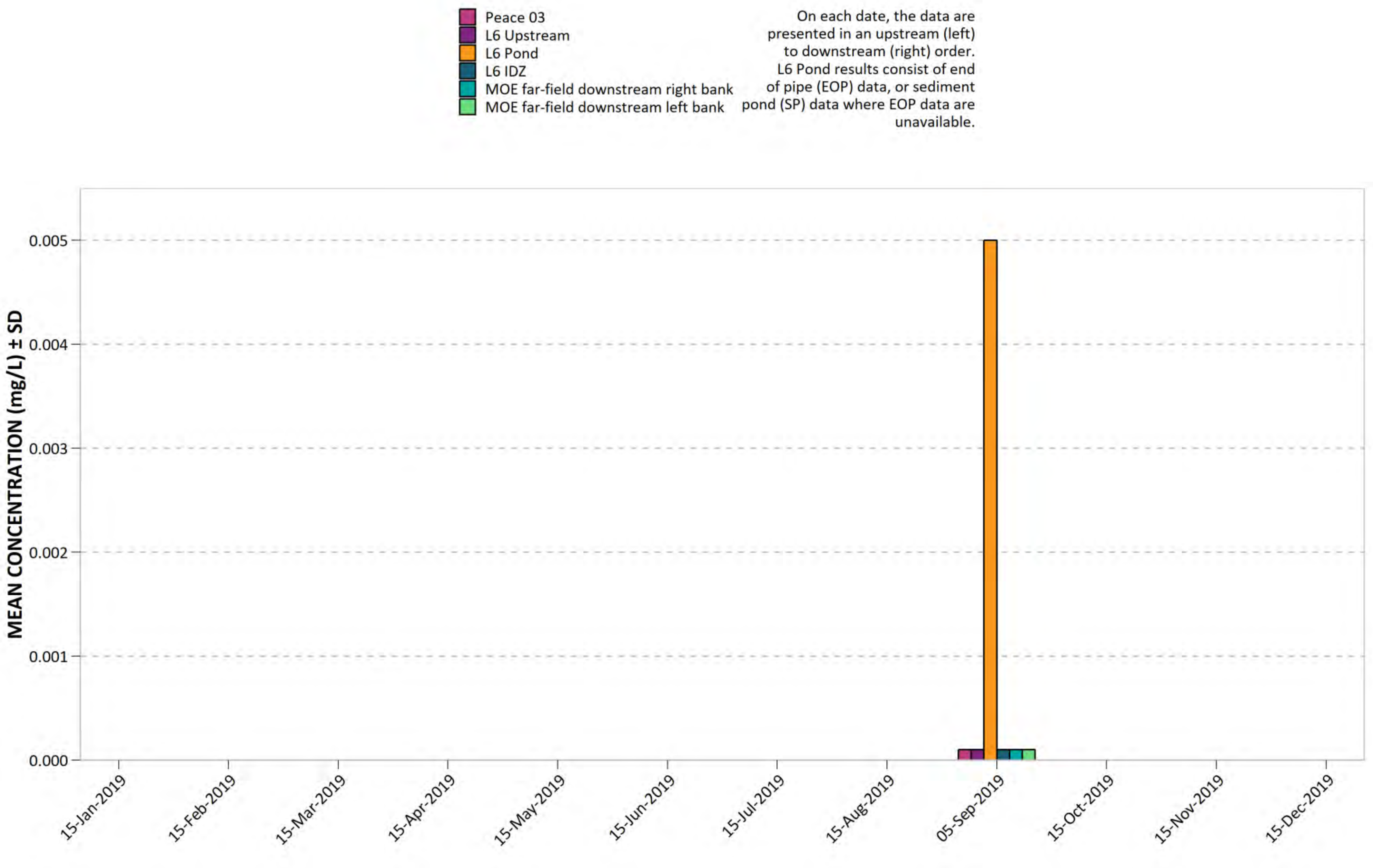


Figure 343. 2019 Peace River and RSEM L6 pond dissolved thallium (Tl).



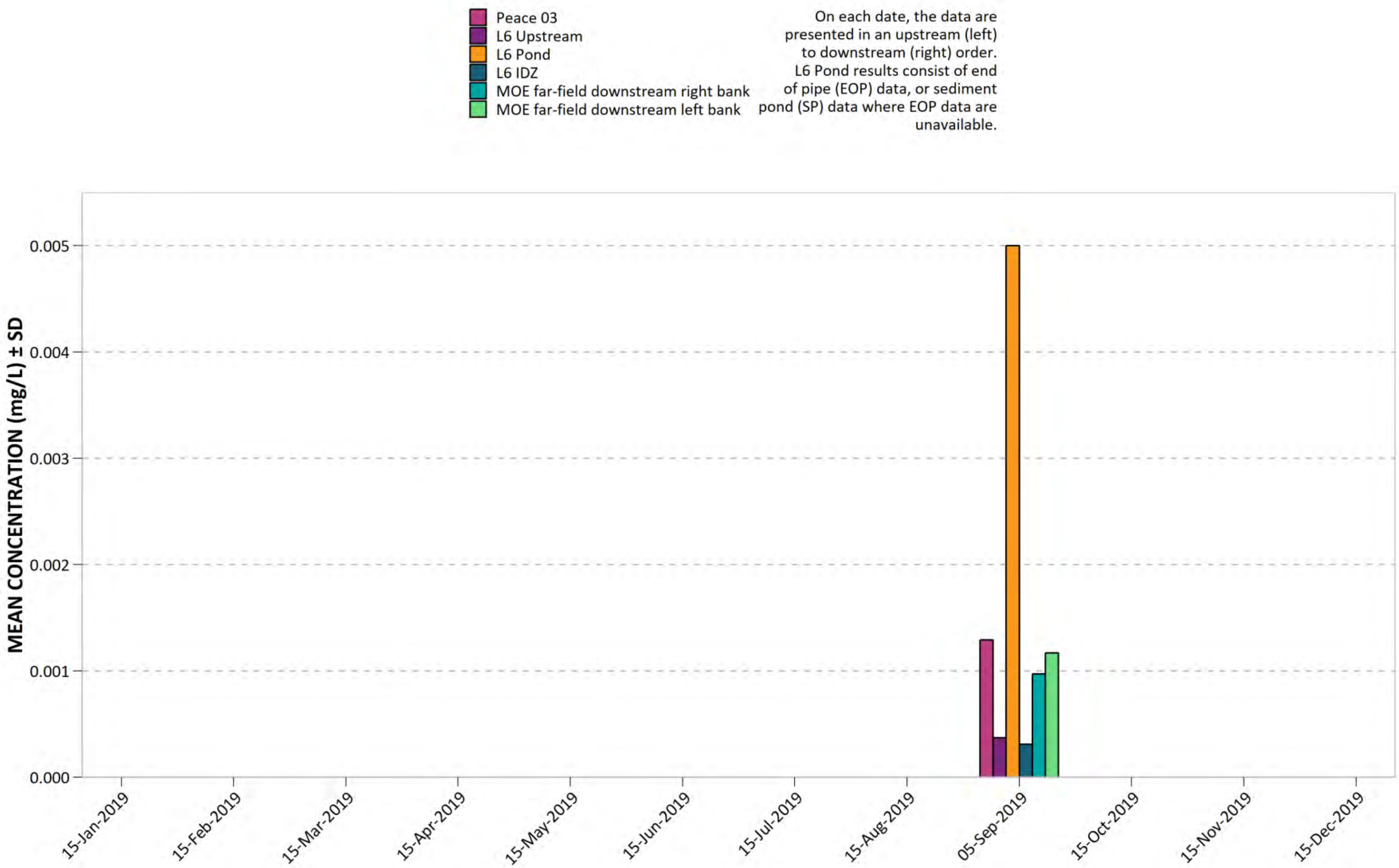
Results less than the MDL were assigned the MDL value of 0.00001 mg/L (Peace River and Pond).

Figure 344. 2019 Peace River and RSEM L6 pond dissolved tin (Sn).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0001 mg/L (Peace River).

Figure 345. 2019 Peace River and RSEM L6 pond dissolved titanium (Ti).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0003 mg/L (Peace River).

Figure 346. 2019 Peace River and RSEM L6 pond dissolved uranium (U).

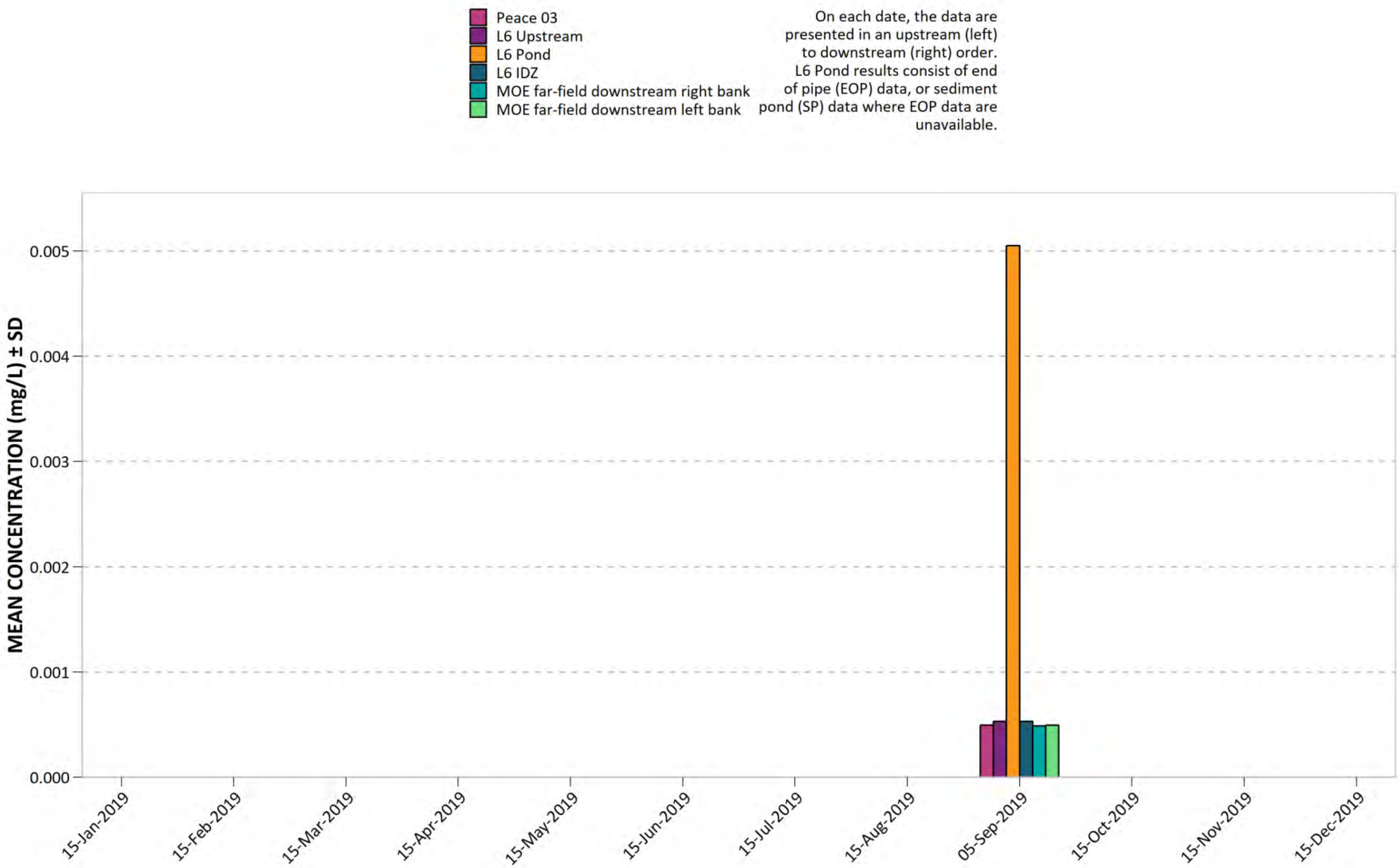
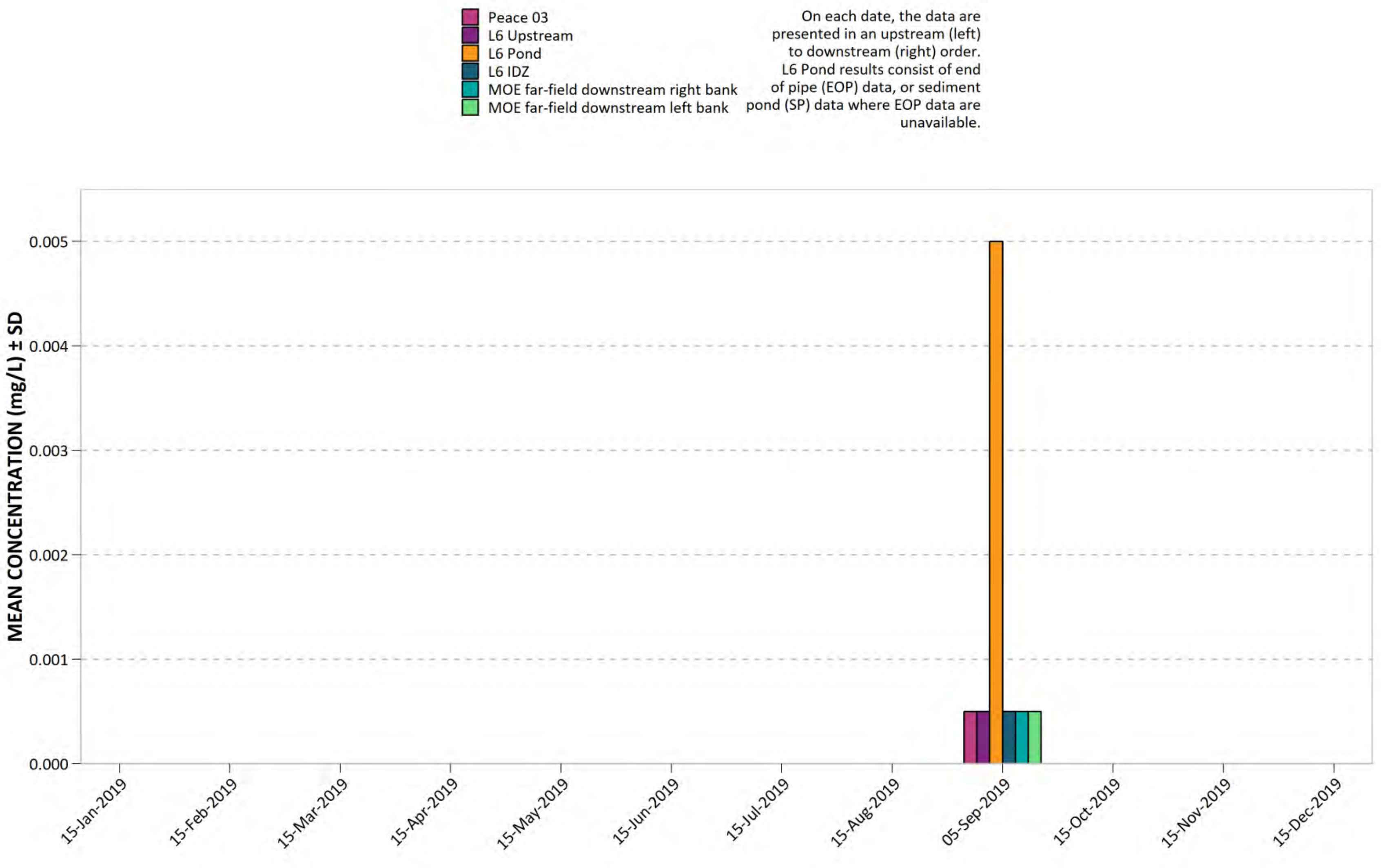
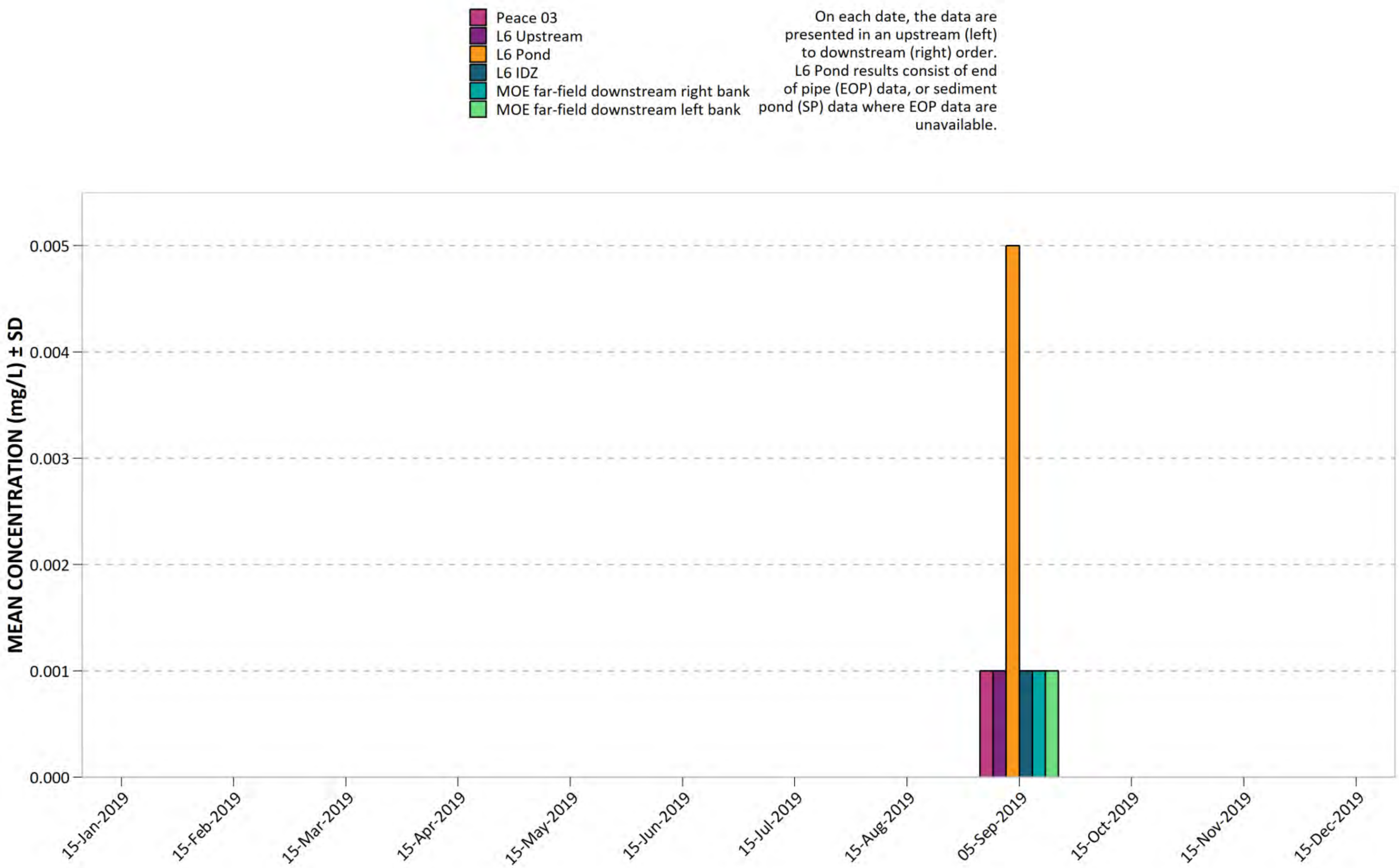


Figure 347. 2019 Peace River and RSEM L6 pond dissolved vanadium (V).



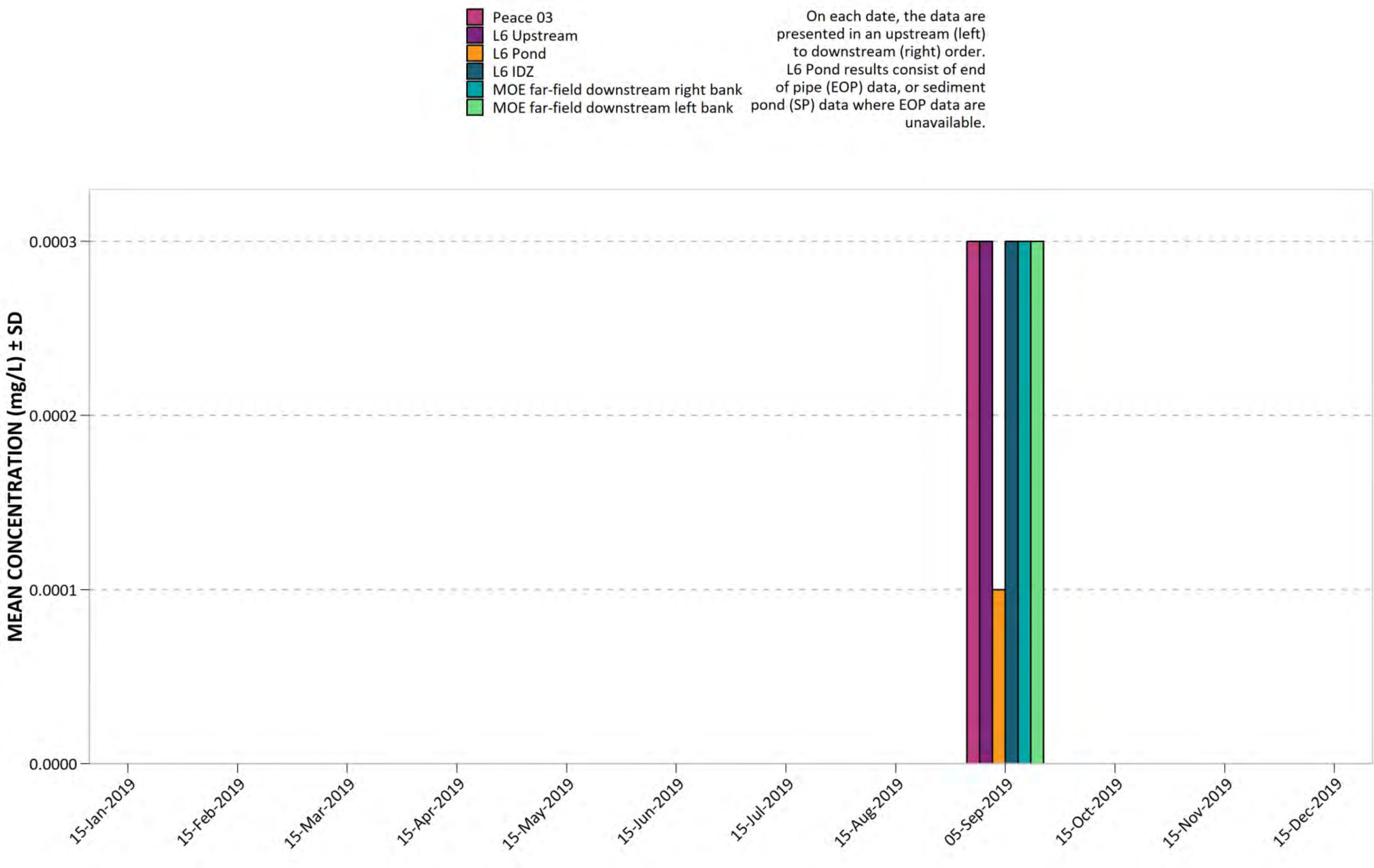
Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.0005 mg/L (Peace River).

Figure 348. 2019 Peace River and RSEM L6 pond dissolved zinc (Zn).



Results less than the MDL were assigned the MDL value of 0.005 mg/L (Pond) or 0.001 mg/L (Peace River).

Figure 349. 2019 Peace River and RSEM L6 pond dissolved zirconium (Zr).



Results less than the MDL were assigned the MDL value of 0.0003 mg/L (Peace River except June 8) or 0.0001 mg/L (R5b pond).

Appendix F. 2019 Quality Assurance and Quality Control Summary.

Table 41. ALS Environmental hold time exceedance summary for 2019.

Parameter	Date (2019)	Hold Time		Number of Samples/Sites Exceeded[1]	Qualifier
		Recommended	Actual		
Diss. Orthophosphate in Water by Colour	16-Jul	3	4	10	EHT
	5-Sep	3	5	3	EHT
	20-Sep	3	4	3	EHT
	12-Dec	3	4	7	EHT
Nitrate in Water by IC (Low Level)	16-Jul	3	4	10	EHT
	5-Sep	3	4	3	EHT
	12-Dec	3	4	8	EHT
Nitrite in Water by IC (Low Level)	16-Jul	3	4	10	EHT
	5-Sep	3	4	3	EHT
	12-Dec	3	4	8	EHT
Turbidity by Meter	12-Dec	3	5	8	EHT
Total Suspended Solids by Grav. (1 mg/L)	15-Apr	7	8	2	EHT
	6-May	7	8	4	EHT
Total Dissolved Solids by Gravimetric	15-Apr	7	8	10	EHT
Filtr./Pres. for carbons and nutrients	12-Dec	3	4	7	EHT

[1]Specific sample sites where hold time exceedances occurred are provided in ALS laboratory reports.

Hold time exceedances for monthly, 5 in 30 day, and IDZ mapping water quality samples collected in 2019.

ALS Legend & Qualifier Definitions

EHT: Exceeded ALS recommended hold time prior to analysis.

EHTR: Exceeded ALS recommended hold time prior to sample receipt.

EHTL: Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.

Table 42. Field blank and travel blank detections in 2019.

Sample Type	No. of Sampling Dates (2019)	Field Blank QA/QC Objective (≤5.0% Detectable)			
		No. of Parameter Results (n) [1]	No. of Detectable Results (>MDL)	% Detectable Results	QA/QC Objective Met
Field Blanks	20	1932	12	0.62%	Yes
Travel Blanks	21	1106	6	0.54%	Yes

[1] n refers to the total number of parameters analyzed in the field and travel blanks (non-detectable and detectable).

pH is not included in the calculation of detectable results.

The field blank QA/QC objective of ≤5% detectable is applied to the entire data set for the monitoring period (CCME 2011).

Table 43. Summary of cases with relative percent difference >20% for duplicate samples in 2019.

Date (2019)	Clear/ Turbid Flow [1]	Site	Parameter	Relative Percent Difference (%) [2]
29-Jan	Clear	RBPR-7.15	Manganese (Mn)-Dissolved	28.2
			Manganese (Mn)-Total	20.3
			Sodium (Na)-Dissolved	39.4
			Sodium (Na)-Total	39.4
28-Feb	Clear	RBPR-5.81	Total Organic Carbon	20.0
28-Mar	Clear	PR-3.88	Aluminum (Al)-Total	20.4
			Chromium (Cr)-Total	29.9
			Iron (Fe)-Total	28.2
			Lead (Pb)-Total	26.2
			Titanium (Ti)-Total	32.6
			Total Phosphorus (P)	23.1
22-Apr	Very Turbid	RBPR-5.81	Total Dissolved Solids	24.4
13-May	Very Turbid	LBPR-4.60	Manganese (Mn)-Dissolved	90.7
		LBPR-4.60	Sodium (Na)-Total	33.4
			Sulfur (S)-Dissolved	22.7
			Sulfur (S)-Total	32.0
12-Jun	Turbid	RBPR-9.34	Manganese (Mn)-Dissolved	22.0
			Nitrate (as N)	72.8
			Selenium (Se)-Dissolved	20.9
			Total Suspended Solids	35.1
16-Jul	Clear	LBPR-9.34	Aluminum (Al)-Total	20.6
			Arsenic (As)-Total	34.2
			Chromium (Cr)-Total	20.7
			Mercury (Hg)-Total	145.0
			Titanium (Ti)-Total	42.0
		LBPR-9.34	Total Suspended Solids	34.2
18-Aug	Turbid	PR-3.88	Aluminum (Al)-Total	44.6
			Arsenic (As)-Total	26.8
			Beryllium (Be)-Total	29.1
			Chromium (Cr)-Total	40.8
			Cobalt (Co)-Total	29.0
			Copper (Cu)-Total	23.6
			Iron (Fe)-Total	39.7

[1] Clear flow: Peace River sampling site TSS ≤ 25 mg/L; Turbid flow: Peace River TSS > 25 mg/L and ≤ 100 mg/L; Very Turbid: Peace River TSS > 100 mg/L.

[2] RPD was calculated if at least one replicate was > 5 times the MDL.

Table 43. Continued.

Date (2019)	Clear/ Turbid Flow [1]	Site	Parameter	Relative Percent Difference (%) [2]
18-Aug	Turbid	PR-3.88	Lead (Pb)-Total	29.1
			Nickel (Ni)-Total	27.7
			Selenium (Se)-Total	21.6
			Silicon (Si)-Total	24.7
			Thallium (Tl)-Total	35.7
			Titanium (Ti)-Total	39.2
			Vanadium (V)-Total	36.9
			Zinc (Zn)-Total	27.5
20-Sep	Clear	RBPR-5.69	Iron (Fe)-Total	20.9
			Selenium (Se)-Dissolved	28.0
			Titanium (Ti)-Total	38.8
			Turbidity (lab, NTU)	55.4
1-Oct	Clear	RBPR-5.81	Titanium (Ti)-Total	27.5
8-Oct	Clear	RBPR-7.05	Aluminum (Al)-Dissolved	24.5
			Cadmium (Cd)-Total	100.0
			Molybdenum (Mo)-Total	69.2
			Selenium (Se)-Dissolved	39.1
			Titanium (Ti)-Total	32.5
16-Oct	Clear	RBPR-7.15	Chromium (Cr)-Total	29.8
		RBPR-7.15	Turbidity (lab, NTU)	32.4
22-Oct	Clear	LBPR-4.50	Cadmium (Cd)-Total	24.6
			Chromium (Cr)-Total	27.8
			Titanium (Ti)-Total	24.2
			Total Dissolved Solids	29.1
21-Nov	Clear	RBPR-9.34	Cadmium (Cd)-Total	51.6
			Titanium (Ti)-Total	32.9
12-Dec	Turbid	LBPR-9.34	Aluminum (Al)-Dissolved	27.3
			Aluminum (Al)-Total	77.6
			Cadmium (Cd)-Total	87.5
			Chromium (Cr)-Total	61.9
			Iron (Fe)-Total	82.4
			Lead (Pb)-Total	69.5
			Manganese (Mn)-Dissolved	36.1
			Manganese (Mn)-Total	48.8
			Titanium (Ti)-Total	65.4
			Total Phosphorus (P)	57.1
			Total Suspended Solids	75.2

[1] Clear flow: Peace River sampling site TSS ≤ 25 mg/L; Turbid flow: Peace River TSS > 25 mg/L and ≤ 100 mg/L; Very Turbid: Peace River TSS > 100 mg/L.

[2] RPD was calculated if at least one replicate was > 5 times the MDL.

Table 44. Summary of cases with a relative standard deviation >18% for triplicate samples in 2019.

Date (2019)	Site	Parameter (units)	Average	SD	Relative Standard Deviation (%)[1]
20-Jan	PR-3.88	Turbidity (In Situ, NTU)	6.07	1.59	26.3
28-Feb	PR-3.88	Turbidity (In Situ, NTU)	6.93	1.45	20.9
28-Mar	RBPR-5.70	Turbidity (In Situ, NTU)	21.7	6.03	27.8

[1] (standard deviation/average)*100

Table 45. Summary of cases where the dissolved metals to total metals ratio was >1.2 in 2019.

Parameter	Date (2019)	Site	Concentration (mg/L)		D-Metal/ T-Metal Ratio
			Total Metal	Dissolved Metal	
Molybdemun (Mo)	20-Sep	LBPR-4.50	0.00265	0.00359	1.4
Selenium (Se)	20-Jan	RBPR-9.34	0.000199	0.000296	1.5
	28-Feb	RBPR-5.70	0.000218	0.000305	1.4
	28-Mar	RBPR-9.34	0.000276	0.000365	1.3
	29-Apr	LBPR-4.60	0.000366	0.000462	1.3
	16-Jul	PR-3.88	0.000386	0.000539	1.4
		RBPR-7.15	0.00042	0.000507	1.2
		RBPR-5.69	0.000341	0.000413	1.2
	20-Sep	LBPR-4.50	0.000487	0.000616	1.3
		RBPR-5.81	0.000252	0.000307	1.2
		RBPR-9.34	0.000368	0.000443	1.2
		RBPR-5.69	0.000221	0.000322	1.5
	1-Oct	LBPR-4.50	0.000479	0.000584	1.2
	16-Oct	RBPR-7.15	0.000275	0.000336	1.2
	22-Oct	PR-3.88	0.000305	0.000404	1.3
		RBPR-7.05	0.000338	0.000413	1.2
		RBPR-9.34	0.000273	0.00035	1.3
	29-Oct	RBPR-7.15	0.000229	0.000296	1.3
	21-Nov	PR-3.88	0.000257	0.000311	1.2
	12-Dec	PR-3.88	0.000344	0.000422	1.2
		RBPR-5.70	0.000226	0.000294	1.3
Sodium (Na)	16-Jul	RBPR-7.05	1.72	2.07	1.2
		LBPR-4.50	2.04	2.5	1.2

Appendix C

TECHNICAL MEMO

ISSUED FOR USE

To:	Greg Scarborough, BC Hydro Bryan Koehler, P.Eng., BC Hydro	**Date:**	March 31, 2020
c:		**Memo No.:**	
From:	Lara Reggin, P.Geo. Tetra Tech James Barr, P.Geo. Tetra Tech	**File:**	704-ENG.VMIN03021-02
Subject:	Site C Clean Energy Project 2019 Annual Report, ARD-ML Mitigation Site Audits		

1.0 INTRODUCTION

This report presents a summary of field reviews completed during 2019 for the Site C Clean Energy Project related to auditing the acid rock drainage and metal leaching (ARD-ML) materials management on-site in reference to:

- BC Hydro Construction Environmental Management Plan (CEMP, Revisions 5.0 to 6.1, February 19, 2019 to December 12, 2019, respectively);
- Site C Clean Energy Project, Peace River Hydro Partners Main Civil Works Contract, Appendix 6-2 Technical Specifications, Relocated Surplus Excavation Materials and Water Management, Section 13 40 00, Revision 4, December 4, 2015.
- Peace River Hydro Partners (PRHP) Environmental Management Plan (EMP), Appendix A: Acid Rock Drainage and Metal Leachate Management Plan (Rev 10rev_1, 2016-10-27); and
- PRHP Environmental Protection Plans (EPP), specific to facility or construction area.

Four site audits were completed in 2019 conducted by James Barr, P.Geo., and/or Lara Reggin, P.Geo., both of Tetra Tech, on the following dates: February 20, May 29, August 27-29, and October 29, 2019. Mr. Barr and Ms. Reggin fulfill the role as BCH QP(ARD) as per the CEMP Appendix E, S. 6.1.2.

- Wednesday February 20, 2019: The site audit was conducted by James Barr, P.Geo., of Tetra Tech. Mr. Barr was accompanied by Molly Brewis and Brian Hawes. The morning was dedicated to an ARD-ML workshop for on-site BC Hydro personnel. Time on-site was spent reviewing ARD-ML materials management at various construction areas and Relocated Surplus Excavation Material (RSEM) facilities and designated water discharge points. While on-site, contact and discussions were had with Bryan Woodward, Molly Brewis, and Brian Hawes of BC Hydro.
- Wednesday, May 29, 2019: The site audit was conducted by James Barr, P.Geo. and Scott Kingston, P. Geo., of Tetra Tech, and accompanied by BC Hydro personnel Brian Hawes and Brittany Myhal throughout the day, and briefly by Alysha Parker during viewing of the eastern Spillway Approach Channel area. Time on-site was spent reviewing ARD-ML materials management at various construction areas, RSEM facilities and designated water discharge points. While on-site, contact and discussions were had with Bryan Woodward, Molly Brewis, and Bryan Koehler of BC Hydro.
- Wednesday, August 28 and Thursday, August 29, 2019: The site audit was conducted by Lara Reggin, P.Geo., of Tetra Tech, and accompanied by BC Hydro personnel Bryan Koehler on both dates and accompanied by Brittany Myhal and Alysha Parker during portions of August 29, 2019. Time on-site was spent reviewing ARD-ML materials management at various construction areas and RSEM facilities, and designated water discharge points. Ms. Reggin participated in the Independent Engineer (IE) and Independent Environmental

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Monitor (IEM) tour from 10:00 am to 2:00 pm, August 28, 2019. Verbal contact and discussions were completed with Bryan Woodward of BC Hydro, and Kael Hanak and Katie Hill of PHRP.

- Tuesday, October 29, 2019: The site audit was conducted by James Barr, P. Geo. of Tetra Tech, and accompanied by Bryan Koehler during the audit. Time on-site was spent reviewing ARD-ML materials management at various construction areas and RSEM facilities and designated water discharge points. While on-site, Mr. Barr participated in the IE and IEM tour that took place from 10:00 am to 2:00 pm, October 30, 2019 during which verbal contact and discussions were had with representatives of BC Hydro, PRHP and Aecon, Flatiron, Dragados, and EBC (AFDE).

2.0 2019 SITE AUDITS OVERVIEW AND SITE CONDITIONS

Each site visit and ARD-ML audit was comprised of visiting areas on-site with stored or exposed shale rock (PAG), or areas in construction intended for future storage of PAG. In addition, several water conveyances and ponds contact both PAG and non-PAG potentially influenced by PAG materials, were observed and field data collected, as required.

2.1 Weather Conditions

The weather conditions during the four site visits for 2019 varied from snow covered, frozen conditions to dry conditions, with temperatures as low as -10°C in February and October, to highs of 29°C in May.

Some flowing water or seepages were noted at various locations on-site. Due to either frozen (February; October) or dry (May) conditions, flow was characterized as low within the ditches and on slopes.

Table 2-1: Weather Conditions and Observations During Site Audits

Site Audit Date	Weather	Observations
February 20, 2019	Sunny, -10°C, windy, dry; 7-day average temperature is -15°C, no precipitation within last 24 hours; 7-day trailing precipitation: 0.02 mm (snow water equivalent). Data: North Camp_B_Met60.	The weather conditions experienced during the site visit were cold, windy and sunny. The site was snow covered with no flowing or ponding water, except where heat tracing or heaters were used. There was minimal prior 7-day total precipitation measuring 0.02 mm.
May 29, 2019	Sunny, 25-29°C, low windy, dry; 7-day average temperature is -17°C, no precipitation within last 24 hours; 7-day total precipitation is 2.93 mm.	Dry seasonal conditions were prevalent on-site. No precipitation was measured in the previous 24 hours, and 2.93 mm was measured for the previous 7 days (Fort St John North Camp_C_MET_60) which precluded flowing water in many of the ditches and water conveyance structures.
August 28 – 29, 2019	Sunny with overcast periods, 5-19 °C, fog in morning, dry conditions; 7-day average temperature is 14 °C, no precipitation within last 24 hours; 7-day total precipitation 9.35 mm. Data: North Camp_B_Met60.	Dry seasonal conditions were prevalent on-site. No precipitation was measured in the previous 24 hours, and 9.35 mm was measured for the previous 7 days (Fort St John North Camp_C_MET_60) that precluded flowing water in many of the ditches and water conveyance structures.
October 29, 2019	Sunny, -10 to 2°C, light wind, dry; 7-day average temperature is 1 °C, no precipitation within last 24 hours; 7-day precipitation is 12.96 mm. Data: North Camp_B_Met60.	Dry, sunny to light overcast and cool seasonal conditions were prevalent on-site with temperatures ranging from -10 to 2°C. No precipitation was measured in the previous 24 hours, and 12.96 mm was measured for the previous 7 days (Fort St John North Camp_C_MET_60) that produced flowing water in many of the ditches and water conveyance structures.

2.2 Locations Visited

For the site audits, known PAG exposures are listed according to their RSEM or catchment area (Table 2-2), and are shown in Figure 1.

Table 2-2: List of Locations Visited During 2019 Site Audits

Locations Visited			Site Audit Date in 2019			
			20-Feb	29-May	August 28-29	29-Oct
Left Bank Construction Areas	RSEM L6	Diversion Tunnel Outlet Portal			✓	
		PAG in RSEM		✓		✓
		Bluff slope (natural)			✓	✓
	RSEM L5	Garbage Creek (water conveyance to L5)	✓	✓	✓	
		L5 Sediment Pond		✓		✓
		PAG in RSEM	✓	✓	✓	✓
		LBEx		✓		✓
		Diversion Tunnel Inlet Portal			✓	
		LB Diversion Tunnel			✓	
		West Hill Slope (west of L5)		✓		✓
	Howe Pit				✓	✓
	River Road	Blind Corner	✓	✓	✓	✓
		Upper cut-off Ditch				✓
		Discharge culvert, end of diversion pipe			✓	✓
	L3 Creek (Natural)		✓		✓	✓
	L4 Creek (Natural)		✓			
Right Bank Construction Areas	Water Treatment Plant	Containment Pond			✓	
	RSEM R5a	PAG in RSEM	✓	✓	✓	✓
		Up-gradient Cut-off Ditch	✓		✓	
		R5a Sediment Ponds (four cells)		✓	✓	✓
	RSEM R5b	Spillway Approach Channel		✓	✓	✓
		Road cuts along access roads			✓	
		Sediment Ponds	✓		✓	✓
	R6	RCC Cofferdam			✓	✓
		SBIAR (east and west cut-slope: ECS, WCS)	✓	✓	✓	✓
		RB Abutment Foundation			✓	✓
		R6 Sediment Pond East Cell		✓	✓	
		R6 Sediment Pond West Cell		✓	✓	
	Area A					✓
	Golden Horseshoe			✓		

RSEM: Relocated Surplus Excavation Material
RBDT: Right Bank Drainage Tunnel

3.0 FIELD DATA

3.1 Material Testing: Rinse pH

Seventeen samples were collected and tested for rinse pH including pH and conductivity. Measured rinse pH ranged between pH 2.59 from the SBIAR west-cut-slopes to pH > 8.00 in RSEM L5, RSEM R5a and RSEM L6 fill material. Table 3-1 summarizes the results from rinse pH tests completed during the 2019 monitoring period.

Table 3-1: Rinse pH Results from 2019

Date	Location	Sample	Coordinates	Description	Rinse pH*	EC (µS/cm)
20-Feb-19	RSEM L5 Fill Material	SC-RL5	629,090 mE 6,230,455 mN	RSEM L5, composite sample, dark grey shale, no iron oxide, from non-compacted dump along northeastern perimeter of upper bench.	>8	-
	RSEM R5a Fill Material	SC-R5A	628,095 mE 6,230,790 mN	RSEM R5a, composite sample, dark grey shale, from non-compacted dump along northern perimeter of lower bench.	>8	-
		SC-R5A-2	627,310 mE 6,231,665 mN	RSEM R5a, composite sample, dark grey shale, from non-compacted dump along western perimeter of middle bench.	>8	-
29-May-19	RSEM L6 PAG Storage	L6-001	630,389 mE 6,229,767 mN	RSEM L6, composite sample, dark grey shale, collected from top layer encrusted with white precipitate (sulphate), no iron oxide.	>8	754
	Golden Horseshoe	GH-001	629,655 mE 6,228,811 mN	Golden Horseshoe, eastern end of Spillway Approach, chip sample collected from shale exposed in ditch, moist from seepage, dark grey with white and orange hydroxide precipitation.	7.29	2,470
	RSEM R5a	R5A-001	627,405 mE 6,231,817 mN	Dark grey rock chips from near surface material, includes small amount of white precipitate crust.	>8	755
		R5A-002	627,386 mE 6,231,826 mN	Dark grey rock chips from near surface material, includes small amount of white precipitate crust.	>8	693
	SBIAR West Cut-slope	SB-001	630,294 mE 6,228,584 mN	Strongly weathered zone, grey clay with white precip.	5.43	>20,000
		SB-002		Strongly weathered zone, grey clay with yellow precip.	2.59	>20,000
		SB-003		@ 20cm depth, less weathered, grey shale + clay.	2.70	2,800
28-Aug-19	RSEM R5a	R5A-001	RSEM, West end	Recently placed PAG material at western extent of RSEM.	6.72	n/a
		R5A-002	R5A Upper Diversion Ditch	Newly exposed PAG slope adjacent to upper diversion ditch outlet.	3.44	n/a

<table>
<tr><th>Date</th><th>Location</th><th>Sample</th><th>Coordinates</th><th>Description</th><th>Rinse pH*</th><th>EC (µS/cm)</th></tr>
<tr><td rowspan="5">29-Oct-19</td><td>RSEM L5 Expansion</td><td>L5-W (094)</td><td>628,426 E
6,231,379 N</td><td>Western end of RSEM L5 Expansion, tracked PAG Fill Material, dark grey, fine grained to flakey, moist to dry at the time of visit.</td><td>2.59</td><td>4,580</td></tr>
<tr><td>L3 Creek</td><td>L3-Slope (095)</td><td>632,750 E
6,229,847 N</td><td>Natural shale slope west of L3 Creek outlet, dark grey and flakey, dry at the time of visit.</td><td>3.54</td><td>1,360</td></tr>
<tr><td rowspan="3">RSEM R5a</td><td>R5a-2</td><td>627,547 E
6,231,204 N</td><td>RSEM R5a upper bench, PAG fill material; dark grey, fine grained to flakey, moist to dry at the time of visit.</td><td>8.74</td><td>331</td></tr>
<tr><td>R5a-3</td><td>627,409 E
6,231,823 N</td><td>RSEM R5a above Cell D, PAG fill material; dark grey, fine grained to flakey, moist to dry at the time of visit.</td><td>9.24</td><td>488</td></tr>
<tr><td>R5a-Sludge</td><td>627,590 E
6,231,126 N</td><td>RSEM R5a, silica dust from supersacks; light brown to tan, silty, evenly textured.</td><td>9.24</td><td>107</td></tr>
</table>

* rinse pH values >8 indicate that shale is producing neutral to alkaline rinse conditions

3.2 In Situ Water Testing

Ten samples were collected and tested for in situ water data including estimated flow, pH, alkalinity, hardness, conductivity, temperature, clarity and precipitant/algae observations completed during the May and August 2019 site audits. Measured in situ pH ranged between pH 6.90 at the 0+50m spillway approach channel to pH 8.50 at the SBIAR west ditch near the north end of the shale slope. Table 3-2 summarizes the results from in situ water testing during the 2019 monitoring period.

Table 3-2: In Situ Water Quality Measurements taken during the May and August 2019 Site Audits

<table>
<tr><th></th><th></th><th>Location</th><th>Estimated Flow (L/s)</th><th>pH</th><th>Total Alkalinity (ppm)</th><th>Hardness (ppm)</th><th>EC (µS/cm)</th><th>T (ºC)</th><th>Clarity</th><th>Precipitant/ Algae</th></tr>
<tr><td rowspan="5">29-May-19</td><td>Left Bank Excavation Seepage</td><td>LBEx</td><td><0.10</td><td>7.00</td><td>100</td><td>Not collected</td><td>Not collected</td><td>Not collected</td><td>Clear</td><td>Iron oxide precipitation, white mineral on dry material</td></tr>
<tr><td rowspan="3">Spillway Approach Channel</td><td>0+00m</td><td>0.40</td><td>7.15</td><td>240</td><td>250</td><td>1,125</td><td>20.2</td><td>Cloudy</td><td>Strong iron oxide precipitation</td></tr>
<tr><td>0+50m</td><td>0.40</td><td>6.90</td><td>-</td><td>-</td><td>1,389</td><td>-</td><td>Cloudy</td><td>Strong iron oxide precipitation</td></tr>
<tr><td>0+75m</td><td>0.40</td><td>7.65</td><td>120</td><td>450</td><td>1,485</td><td>23.0</td><td>Cloudy</td><td>Strong iron oxide precipitation</td></tr>
<tr><td>Golden Horseshoe Ditch</td><td>Collection Ditch</td><td>0.10</td><td>7.43</td><td>240</td><td>Not collected</td><td>864</td><td>19.0</td><td>Clear</td><td>Orange coloured, abundant iron precipitation and some green and orange algal growth</td></tr>
</table>

		Location	Estimated Flow (L/s)	pH	Total Alkalinity (ppm)	Hardness (ppm)	EC (µS/cm)	T (ºC)	Clarity	Precipitant/ Algae
		Drainage inlet to sump	0.20	7.70	240	Not collected	1,155	18.0	Clear	Orange coloured, abundant iron precipitation
		Sump water	-	7.63	200	Not collected	1,230	18.5	Turbid	Green to orange coloured, moderate iron precipitation settled at base
August 28-29, 2019	SBIAR	West Ditch, near north end of Shale Slope (SB-001)	-	8.50	240	Not collected	Not collected	19.0	Not collected	Not collected
		East Ditch, near north end of Shale Slope (SB-002)	-	8.38	180	Not collected	Not collected	18.0	Not collected	Not collected
	Howe Pit drainage to pond on bench		0.50	7.80	120	Not collected	Not collected	Not collected	Not collected	Discharge water with bright orange sediment

3.3 Water Quality Laboratory Testing

A water quality sample LBEx (sample name "Spare") was collected for laboratory testing during the May 29, 2019 site audit from the Left Bank Excavation Seepage. A neutral pH of 7.87 was measured and one exceedance for total arsenic (5.19 µg/L) measured slightly above the BCAWQG-FST guideline (5.0 µg/L), shown in Table 3-3.

Table 3-3: Water Quality Result from Left Bank Excavation Seepage, Showing Base Parameters and Exceedance to BCAWQG-FST (May 29, 2019)

Parameter	Unit	LBEx (SPARE)
Conductivity	uS/cm	1,800
Hardness (as CaCO3)	mg/L	788
pH	pH	7.87
Sulphate	mg/L	201
Ammonia (total)	mg/L	0.42
Nitrite	mg/L	<0.01
Nitrate	mg/L	<0.05
Total Dissolved Solids	mg/L	1,230
Total Suspended Solids	mg/L	8.90
Arsenic (As) - Dissolved	µg/L	5.19
Arsenic (As) - Dissolved (Guideline)	µg/L	5.00

4.0 SUMMARY OF AUDIT, ACTIONS AND RESPONSES

Observations made by Tetra Tech during site visits were documented in Technical Memos provided to BC Hydro. Where applicable, BC Hydro communicated non-compliance to relevant contractors which were tracked by BC Hydro site personnel using the Active Compliance Management (ACM) tool. The following sections describe observations by Mr. Barr, Ms. Reggin and Mr. Kingston during site audits in 2019, recommended action items provided in the site audit reports and the corresponding resolutions to these actions.

4.1 Left Bank

4.1.1 RSEM L5

4.1.1.1 PAG in RSEM

The RSEM L5 PAG storage facility was visited during the February, May, and October 2019 audits.

During the February audit a total of 765,029 m^3 had been placed into the facility (PRHP Weekly Environmental Report, February 16, 2019) and the maximum surveyed elevation for PAG fill was 457.6 m. Shale was being dumped on the upper bench in the eastern portion of RSEM and the outer perimeter bench slope is contoured and compacted.

During the May 2019 audit, it was observed that exposed PAG was being stored at the toe of the southeast corner of the RSEM immediately adjacent to the perimeter water collection ditch that drains to the east pond; material appeared loose and was not constructed in compacted lifts.

During the October audit it was observed that the eastern PAG storage area which contained material placed between July and September 2018 remained uncovered and exposed to the atmosphere. The final PAG fill surface is to have a minimum of 0.60 m of non-PAG (NPAG) compacted granular material cover. Extended exposure time of the PAG fill appears to have led to the formation of white mineral precipitate on this material which was a visual indicator for early onset of ARD-ML conditions (e.g., sulphate and/or aluminum hydroxide). Verbal communication with PRHP suggested that the material was to be removed and used by PRHP as core material for embankment of the lower LBEx haul road and as core for the RSEM L5 Ext Phase 2 dyke, then capped with suitable NPAG material.

4.1.1.2 RSEM L5 Ponds

RSEM L5 pond was visited during the May site audit, and an attempt to visit in August was not successful due to the presence of a bear in the area. In May, it was noted that construction of a pond and drainage structure for the RSEM L5 ponds was complete, however, not yet commissioned for use. Hardware installation for telemetry (remote data transmission) of sondes and flow meter data was in progress during the May site visit. Flow from the east pond was 2 L/s. The west pond was not holding water due to construction related to the RSEM L5 extension.

In August, verbal communication with BC Hydro staff reported that construction was complete, and the Phase 1 ponds were in use. The Phase 2 ponds were constructed but not yet in use.

4.1.1.3 RSEM L5 Expansion and Temporary PAG Containment Pond

The RSEM L5 expansion was visited during the May, August and October 2019 audits, whereas the Temporary PAG Containment Pond which had been used in 2018 was no longer in operation at the February 2019 audit and had been filled with non-PAG fill.

During the May audit, RSEM L5 expansion construction was underway. An up-gradient non-contact cut-off ditch had not been constructed which required a cut into shale to complete the work. Some PAG was being placed into the RSEM expansion prior to completion of the starter dyke and PAG was being placed in compacted lifts. At the western end of the extension, evidence of active ARD-ML processes and drainage was observed and interpreted to be natural and not related to the current Site C Construction activities. Pooled water was observed to be highly stained with iron oxide and hydroxide precipitate.

In August, material was actively being placed in RSEM L5 on both audit days. Dozer and roller compactors were actively compacting material in RSEM in lifts. Material in RSEM includes a mix of shale and other fill materials. A sample collected for rinse pH from loosely stockpiled shale materials measured a rinse pH of 6.72.

The RSEM L5 Dyke expansion was completed by the time of the August audit. With the increased capacity RSEM L5 was receiving both PAG and NPAG fill.

In October, the western extent of the RSEM L5 Expansion was visited. PAG fill was track compacted and graded and cover material (Zone 1e) had not yet been placed; this is the Phase 1 fill that will be covered with Zone 1e material prior to placement of material during Phase 2, which was sampled for Rinse pH testing (Table 3-1). The upper non-contact cut-off ditch had not yet been constructed however, the upslope catchment appears small and an abundance of natural shale exposure along this slope would predetermine the need for use of lined ditches. Ponding of orange-discolored waters beyond the western extent of the L5 extension perimeter dyke was related to natural ARD-ML processes prior to construction activities (noted during the May 2019 site audit).

4.1.1.4 Garbage Creek

The Garbage Creek Temporary PAG Storage Area (TPSA) and Diversion Channel were visited during the February, May and August audits.

During the February audit, construction was in progress for the outlet channel pipe transition and there was no access to the head pond. Fill contained in the TPSA was NPAG and construction works in the channel had been excavated into shale bedrock.

In May, the site had undergone significant upgrades to the head pond and debris collection system including removal of sediment, installation of trash fence and trach rack at the inlet to the Diversion Channel. Exposed shale near the southern end of the Diversion Channel exhibited colouration indicative of active ARD-ML processes.

In August, the audit noted construction of lined channels and ditches that carry water to the lower Garbage Creek drainage channel, and that shale slopes along the upper portion and adjacent to the Diversion Channel were dressed with gravel and showed signs of vegetation growth.

4.1.2 LBEx Shale Exposure

The LBEx shale exposure was visited during the May and October 2019 audits.

In May, shale remained exposed at the lower western portion of the Left Bank Excavation. An unusual feature was noted near the upper bench of the excavation that appeared to be water saturated and showing evidence of secondary mineral precipitate. A large erosional gully had formed on a bench above the Diversion Inlet Portal due to water seepage and the water was strongly discolored with evidence of iron oxide and hydroxide accumulation. An in situ water test was conducted (Table 3-3) and a water quality sample (Table 3-4) collected for analysis at ALS Laboratories. The lab results indicated that the water had trace PAG contact water due to high EC and TDS and an arsenic concentration above the BCAWQG-FSTM, however, concentrations of other PAG related metals were nearly absent including copper, cadmium and cobalt. The gully was eroded through the overburden material and shale exposure was not evident. It was noted that geotechnical installations including slope inclinometer and vibrating wire piezometers were observed directly upslope of the seepage point which may be helpful in monitoring the observed seepage.

An attempt was made to access the LBEx during the August Audit, however the road was barricaded off due to equipment working in the area. In October, a follow-up visit was conducted at the erosional gully to view the iron oxide (FeOx) stained seepage observed previously in May. It was observed that repairs had been undertaken on the lower benches of LBEx, including filling of the erosional gully with cobble size riprap, and the placement of 25-50 lb. class riprap of approximately 30% limestone at the base of the gully. No visible signs of water flow were observed.

4.1.3 RSEM L6

The RSEM L6 location was visited during the February, May and October 2019 audits.

4.1.3.1 PAG in RSEM L6

The RSEM disposal area was visited during the February and May 2019 audits.

As of February 16, 2019 (PRHP Weekly Environmental Report) a total of 41,414 m^3 had been placed into the facility, following the first placement reported on December 8, 2018 (6,585 m^3). During the February audit, it was observed that PAG material placed within the RSEM covered the full surface area of the foundation, consequently this prevented direct observation of the foundation conditions to verify that the foundation material was placed and compacted in accordance with the RSEM L6 EPP. Weekly PRHP Environmental Monitoring reporting for the period ending October 27, 2018 through to November 3, 2018, reported construction of the foundation which included dry placement of Zone 1e material (NPAG) during night shift inside the starter dyke followed by building of a Zone 3 base to 1.0 m above the high-water mark.

In May, PAG was observed in RSEM L6 and a sample was collected from the near surface material for Rinse pH testing (Table 3-1). The shale material was encrusted with white precipitate interpreted to be a Ca+/-Mg sulphate precipitate, which is an early indicator for active ARD-ML process although the sample was not producing net acid run-off. In October, the designated PAG fill area had been partially filled with PAG and covered with NPAG material. PAG material remained exposed on the eastern extent and some white secondary mineral precipitation was visible on the shale surface that was possibly sulphate and/or aluminum hydroxide suggesting onset of ARD-ML conditions.

4.1.3.2 RSEM L6 Pond

The RSEM L6 Pond was visited during the May audit. The pond was in construction in February, and inactive during the August and October audits.

In May, the RSEM L6 Pond was observed to not be discharging nor reported to have discharged to date and water levels were being managed by a hydrovac truck to prevent discharge until appropriate IDZ sampling locations were established and authorizations in place to do so. The water in the pond was clear.

4.1.4 River Road

The River Road area was visited during the May, February, August and October site audits.

4.1.4.1 River Road Ditches and Blind Corner

The River Road ditches were visited during the February, May and August audits.

During the February audit, water in ditches was frozen and the shale slope covered with snow. A program was proposed by Pineview Environmental for a covering and revegetation trial at Blind Corner, including application of lime solution, resurfacing with topsoil, installation of soil anchor (Futerra R45 HP-TRM), and hydroseeding with fertilizer discussed and supported in context of a remedial program as an alternative to machined resloping and recovering of area.

In May, the shale slope at Blind Corner was observed to be strongly rilled with hydroseed eroded since its application in 2018. A few isolated small plants had sprouted on the shale, and the riprap remained in place and exposed along the toe of the slope. Monthly water quality monitoring had recently recorded no visible flows along the ditch lines of this facility, and no discharge to the Peace River had been recorded from LBRR-DD or LBRR-RR9 at River Road. The majority of water collected from run-off at Blind Corner was conveyed via the diversion pipe into the lower ditch line where settlement and infiltration is promoted. Sediment was observed to have accumulated in the lower ditch line of River Road immediately down-gradient of the diversion pipe.

In August, the River Road ditch was observed from Blind Corner to the L3 Creek. The ditch was encroached upon and limestone riprap within the ditch partially buried by road sediment. The diversion pipe at the bottom of River Road had no drainage flowing in the culvert, although along the culvert there were damp areas observed at the base of the pipe potentially coming from upslope drainage. The inlet of the pipe was observed, and no water was flowing in the ditch at the pipe inlet, however, there were some shallow (1 to 3 inches) pools of water along the ditch up-gradient of the culvert. The ditch up-gradient of the culvert is inundated with vegetation and sediment. The outflow culvert (RR-11) from River Road to the side arm of the Peace River was examined, and no water was flowing out of the culvert. The inlet of the culvert (which goes beneath River Road) could not be found since it was buried in road sediment.

In October, the ditch riprap remained partially filled and encased in road sediment resulting in inefficient or inaccessible buffering from limestone riprap and masking baseline waterflow from being sampled that was likely undercutting the riprap and ditch sediment. Small puddles of water observed along the small flow path along the inner side of the ditch were not in contact with limestone. At location LBRR-12+500 along River Road, visible FeOx sediment was observed and water did not appear to be flowing.

4.1.4.2 Howe Pit

Howe Pit was visited during the August and October 2019 audits.

During the August audit, Howe Pit remained accessible and construction of the warehouse and laydown area adjacent to the pit on the east side was completed. In August, the upper reaches of the lower chimney showed minor iron staining on the limestone riprap and significant vegetation growing in the ditch. The upper reaches of the upper chimney ditch were not lined with riprap, however, there was iron oxide staining at the base of the ditch. No standing or flowing water was in the vegetation-overgrown ditch.

A pond filled depression is located on the bench below Howe Pit, and is fed by drainage coming out of Howe Pit. At the time of the August audit, a flow of approximately 0.5 L/s was discharging from Howe Pit into the pond. The discharge water channel was lined with bright orange sediment from iron hydroxide precipitation and/or algal growth.

In situ water quality testing measured a pH 7.8 and Alkalinity of 120 ppm $CaCO_3$ indicating that the water quality was circumneutral at the time of sampling.

During the October 2019 audit, vegetation growth was observed in Howe Pit and water held in the Howe Pit Pond had various colours due to settled secondary mineral precipitation.

4.1.5 Left Bank Diversion Tunnel

The Left Bank Diversion Tunnel (LBDT) area was visited during the February, May, August and October audits. The areas were not entered during the audits due to traffic restrictions and heavy equipment operation.

4.1.5.1 Diversion Tunnels

The inlet and outlet portals for the Diversion Tunnels were observed from a distance during the February 2019 audit due to high equipment activity. Boring of one of the tunnels was estimated to be ~75% complete.

The tunnels were noted to not be producing large volumes of water. Discussion with on-site BC Hydro personnel indicated that water runs along shale overburden contact above the tunnels and has a low seepage rate through the bedrock into the tunnels. Any seepage water that is recovered from the tunnels was being conveyed to sumps near the portal prior to being stored in tanks and transported to either the water treatment plant or L5 RSEM sediment pond. When tunneling is completed, water is to be managed in accordance with the EPP and care of water (CoW) plans. Cuttings from the tunnel boring work were transported to RSEM L5; there were no temporary PAG piles observed within the tunnel portal working areas.

4.1.5.2 Left Bank Diversion Inlet Channel and Portal

During the May audit, infrastructure was being built for installation of tunnel liners within the excavation for the tunnel inlet channel. Bedrock that had been exposed in this channel excavation had been covered with shotcrete. Additionally, shotcrete applied to cover the shale surrounding the Inlet Portal was observed to be discolored by iron staining, however, the rate and progression of the discoloration had slowed from previous observations in February. This area will be submerged following completion of the dam.

During the August site audit, shale with visible surface weathering was observed around the perimeter and adjacent to the shotcrete covering the Inlet Portal. The area appeared to be dry and no active seepage from the slopes was observed. It was reported that run-off water was being collected in various sumps at the base of the channel excavation. The water was reported to be transported by hydrovac truck to the mobile water treatment plant (MWTP) on the Right Bank or to RSEM L5 Pond.

During the October audit, the Left Bank Diversion Inlet Portal area was not investigated in detail, although bedrock excavation and benching activities continued to be in progress on upper slopes towards the LBEx. Discoloration of the shotcrete was observed. Much of the iron oxide staining seen in the upper portion of the Portal face was interpreted to be from run-off which had contact shale prior to flowing over the shotcrete, whereas only some of the discoloration was from drainage pipes effluent from within the slope. Evidence of fracturing of the shotcrete containing white mineral formation (mainly calcium hydroxide) along the cracks was observed. The development of white mineral formation typically precedes orange coloured iron staining in reactions involving local groundwater from seepage. PAG contact water was reported to be transported by hydrovac to the MWTP.

4.1.5.3 Left Bank Diversion Outlet Channel and Portal

Tunneling work was underway from the Left Bank Diversion Outlet Portal in the early portion of the year. Observations from the February audit noted that shale exposed from excavation of the portal had been partially covered with shotcrete.

In proximity to the portal, as noted during the May and August audits, the shotcrete was covered with a geotextile at the crest, and portions to the west of the portal remain uncovered. The slope was being stabilized with an array of rock bolts which were in the process of being installed. Shale exposed from excavation into bedrock within the tunnel outlet channel had been covered with shotcrete. At the time of the May audit, much of the shotcrete had already been discolored.

4.1.6 Left Bank Core Trench

The Left Bank Core Trench (LBCT) was observed during the May, August and October 2019 audits.

During the May audit, excavation into shale was underway within the core trench area. Exposed shale was partially covered with shotcrete, however, the majority of shale remained exposed with a white precipitate observed on the shale interpreted to be a calcium and/or magnesium sulphate, an indicator of active ARD-ML processes that are not yet net acid generating.

During the August audit, it was noted that the excavation base of the core trench would go down to a siltstone stratigraphic layer (Unit 6), which may have longer lag time prior to onset of ARD-ML and may be less geochemically reactive compared to the overlying shale rock stratigraphy. The core trench is upstream of the filter core zone. Excavation goes down to the bedding plane, where there is not much in the way of seepage or groundwater, however dewatering pumps were in place. The excavation was planned to be completed at the end of summer 2019, (as indicated by discussion between Eduardo Hevia, PRHP and Tim Little, IEM during the IEM tour on August 28).

During the October audit, active excavation was underway within the core trench area. Upper shale slopes were covered with shotcrete and lower slopes had exposed shale. Work was planned to stop at the LBCT within days of the October audit with no additional work planned over the winter months. PAG contact water was reported to be transported by hydrovac to the water treatment plant.

4.1.6.1 LBEx Sediment Pond

The Left Bank Excavation (LBEx) Sediment pond was decommissioned and infilled by mid-July of 2019 to allow equipment access for the construction of the core trench. Water stored in the LBEx Sediment pond was collected and trucked to the MWTP. PAG contact run-off water from the LBEx is collected in ditches and sumps and is the diverted to the RSEM L5 ponds. The LBEx Sediment Pond was not visited in 2019 prior to being decommissioned.

4.1.7 L3 Creek

L3 Creek was visited during the February and October 2019 audits.

In February, there was ongoing construction of the Stilling Basin occurring up-gradient of LBL3C-1.65 where there was no flowing water and frozen conditions. Completion of the L3 Creek channel was lined with riprap as part of the channel reconstruction; flowing water within the main channel was only visible at the confluence with L4 Creek. However, concern that this water may be related to a groundwater seep rather than the L3 Creek channel flow were noted, as the source of the water could not be traced back to the L3 Creek.

During the October audit, the outlet of L3 Creek was observed to have an estimated flow of 5.0 L/s. The slope immediately west of L3 Creek was comprised of naturally exposed shale and a sample of this material was collected for Rinse pH testing (Table 3-1).

4.2 Right Bank

4.2.1 RSEM R5a

The RSEM R5a was visited during the February, May, August and October 2019 audits.

As of February 16, 2019 (PRHP Weekly Environmental Report) a total of 4,327,336 m^3 had been placed into the facility. Shale was being dumped on two upper benches, road and bench tops were well compacted, based on visual observations, and no visible iron oxide or discoloration were observed on shale surfaces. Two dark grey shale samples were collected by Tetra Tech: SC-R5A (lower bench, road surface) and SC-R5A2 (middle bench, dump pile) for rinse pH tests (Table 3-1). On the lower bench, dark grey shale was contoured/compacted with an unknown origin. The middle bench was compacted with loose dumps and borings visible in rocks therefore likely from RCC excavation. The toe of RSEM PAG fill was migrating towards the ponds which suggested that it was slowly being progressively covered. A Rinse pH heat map provided by Lorax indicated that material along the toe had measured a pH below 5.5 or between 5.5-7.0. Capacity exists for additional lifts and recontouring with a maximum PAG elevation of 457.6 m (KCB memo, Sept 24, 2018, ref. Drawing 1020-C11-00514). The RSEM R5a ponds were not visited in February due to being snow filled and not discharging.

During the May, August and October audits, the RSEM R5a storage area continued to remain active.

The volume of PAG fill within RSEM R5a was confirmed to be approximately 4.6 Mm^3 as of June 15, 2019, from the PRHP Weekly Environmental Monitoring Reporting (June 9-15, 2019). The capacity of the facility is approximately 9M m^3. During the May audit, an estimate of approximately 2M m^3 of material was expected to remain as future excavation from the Spillway Approach Channel. At the end of 2019, the volume of PAG material placed within RSEM R5a was estimated to be approximately 5.3 Mm^3 (PRHP Weekly Environmental Monitoring Reporting, December 8-14, 2019). Further excavation from the Spillway Approach Channel is planned for 2020. These volumes are believed to be PAG material only and may not account for NPAG material, sludge (negligible volume), sludge dewatering water, and other material sources that had been placed in the facility.

In May, active contouring of the second bench was observed, where shale material was being pushed out beyond the toe of previously exposed shale, however, some material was being pushed beyond and over the gravel covered perimeter berm. A large lobe of shale was observed to have been pushed down and beyond the perimeter berm and was near to entering Pond D. Two samples of shale were collected for Rinse pH tests (Table 3-1). The results indicated that the near surface shale was not currently generating net acid conditions, and EC indicated that easily soluble components at circumneutral pH are low. As of the August audit, PRHP had reported that some settlement of the RSEM appeared to have occurred, increasing available space for PAG. As such, PAG was being placed up to the allowed elevation upon previously covered RSEM areas, most notably immediately to the south of the settlement Ponds. Once final elevations were achieved this PAG would be covered by granular NPAG materials. In August, PAG was placed in piles up to 8 m high within the RSEM. In discussion with Kael Hanak (PRHP) it was confirmed that the piles of PAG were being leveled and compacted by running over with heavy equipment. One sample of shale was collected from recently (deposited fill in the western end of the RSEM for rinse pH test (sample R5a-001, Table 3-1. The results indicated that the near surface shale at this location within the RSEM is circumneutral.

Low water levels at less than approximately 10% of capacity were observed within Ponds A, B, C and D. Evidence of seeps in the form of erosional features were observed to the east of Pond A on the side slope, which had introduced PAG sediment into Pond A. Verbal communication with PRHP while on-site in August indicated that sediment would be cleaned out of all settlement ponds before winter. Ponds C and D both showed evidence of erosion along the slope above the ponds specifically as rills ranging from 1 to 10 cm deep within shale materials. Sediment from erosion was noted to be flowing into RSEM sediment ponds.

During the October audit, there was active placement of PAG material into RSEM and material was being excavated from the right bank core trench with an estimated haulage of 1 truck/5 mins (CAT 777, 100t). There was some evidence of a cover material being placed on exposed PAG above cell D pond, however, gravel cover appeared to be shallow, based on visual observation, as shale remained exposed from underneath the cover. A minimum of 0.60 m of Zone 1e NPAG material was to be used. A sample of the exposed shale (samples R5a-2) was collected for rinse pH testing (Table 3-1).

4.2.1.1 RSEM R5a Upper Cut-off Ditch

The non-contact cut-off ditch eastern spillway was visited during the February, May, August and October 2019 audits.

During the February audit, construction of the spillway channel was nearing completion and the area was snow covered. The PAG ridge previously observed in 2018 had been partially excavated and remains covered with polyethylene cover. The lower spillway ditch was filled with compacted gravel and geotextile. Some weathered PAG was observed in the eastern portion of RSEM R5a near to the Moberly Bridge abutment.

During the August 2019 audit, the upper cut-off ditch construction was complete with a lined ditch along the southern edge of RSEM R5a. The ditch outlet was constructed at the base of the ditch with a screened area leading to a concrete shaft, draining to an enclosed culvert which daylights near the lower slope above the Moberly River. It was noted that the culvert outlet will be below the water level once the reservoir is flooded, which may affect discharge. A PAG slope immediately to the south of the ditch outlet was cleared during construction of the ditch. This slope is shale, of similar composition to those exposed along the eastern bank of the Moberly River. A sample was collected from this newly exposed PAG for rinse pH, and results show that it was currently acid generating (Table 3-1).

4.2.1.2 Mobile Water Treatment Plant Sludge Disposal in RSEM R5a

The Mobile Water Treatment Plant Sludge Disposal in RSEM R5a was investigated during the August and October 2019 audits.

During the August audit, sludge accumulating in the MWTP clarifying ponds had been collected in dewatering bags (made of geotextile) and placed near the western end of the RSEM R5a, approximately 50 m west of the hydrovac truck disposal pond. Excess moisture was noted to seep out of the bags and thickening the sludge inside of it. Following completion of the RSEM and prior to flooding, the bags will be buried within the RSEM. At the time of the site audit, five bags were placed in the RSEM with varying degrees of firmness depending on dewatering progress. It was noted in August that if the bags were placed partially on top of one another the pressure from the bag on top would likely accelerate dewatering of the sludge.

During the October audit, slurry deposition was investigated within the RSEM area. No actively draining geotubes were visible on-site, however, evidence of previously used geotextile fragments were observed in the embankments. Water ponding and beaching was noted where sludge containing geotubes were previously dewatered. A second pond was observed to the west that was much larger with beaching of till like material (silt with rounded gravel fragments).

Approximately 75-100 super sacks containing dry silt-clay material, and dried sludge recovered from clarifying ponds was confirmed by PRHP to be silica residue from crushing activities (per communication with BC Hydro, November 4), that was sampled for Rinse pH testing (Table 3-1).

4.2.2 RSEM R5b

The RSEM R5b location was observed from the roadway in the August audit and visited during the October 2019 audit.

In October, there was on-site discussion regarding the need to develop a Phase 2 Diversion Plan for the facility to accommodate the increase in river elevation during the diversion of the river. It is understood that design flood water elevations are approximately 433 m elevation. The plan would need to identify that the compacted granular cover on RSEM R5b is protected from erosion and wave action. The current top of the RSEM R5b starter dyke was 424 m elevation, and the current top of the RSEM fill was 434 masl. The plan would need to accommodate rerouting of run-off water to alternative discharging RSEM ponds as the existing RSEM R5b would likely be submerged.

4.2.2.1 RSEM R5b Pond

The RSEM R5b pond was visited during the February and August 2019 audits.

In February, the pond surface was frozen, and outflow was 5 L/s. A propane heater was directed towards the drainage shack to keep the outflow from freezing, and the pipe had been modified as a box/weir due to previous ice damage. Inflow is from MWTP polishing ponds and water flow was currently measured using an echo area-velocity meter (Greyline PZ15-LP) which is suspended over an open outflow pipe in the shack.

In May, the RSEM R5b pond was not visited although site personnel indicated that hardware installation for telemetry (remote data transmission) of sondes and flow meter data had been completed at the RSEM R5b pond and testing of the system was in progress.

In August, PRHP was in the process of clearing sediment out of RSEM R5b Pond at the time of the site audit , and as such, the pond was drained. Water from the MWTP sludge pond discharge was being directed directly to the RSEM R5b discharge via flexible hose.

During the October audit, the pond was operational and discharging, although the rate of discharge was not observed. The ponds had been recently dredged with a hydrovac truck to provide full pond capacity in preparation of winter.

It was noted that there was a significant amount of accumulated water around GW-6 (northern side of RSEM R5b). It was confirmed following the October audit that water at this location had not been sampled recently by PRHP/Lorax and was sampled previously as part of the RSEM R5b potential seepage assessment (PRHP, RSEM R5b Groundwater Model, document #1016.Z.05.003.PRH01.CMO.02603.QLTY, May 2018). One water sample was collected by Lorax as part of the assessment in May 2018 wherein the data indicated high EC, TDS, and SO_4, however, concentrations of ARD-ML related elements did not appear to be present at elevated concentrations at the time of sampling.

4.2.3 RSEM R6

RSEM R6 was visited during the August 2019 audit, and verbal updates from NRS' were provided to the auditors during the October audit.

During the August audit, outflow from the RSEM R6 pond was visited and low to moderate flow was visibly being discharged into the spillway. The flowmeter located inside the hut was not functional, indicating no flow.

In October, the area was not visited and there were plans to relocate the MWTP from its current location in R5b to the R6 area to accommodate planned Approach Channel Excavation Activities.

4.2.4 Spillway Approach Channel

The Spillway Approach Channel was visited during the February, May and October 2019 audits. During the August audit, major excavation works were not active at the time of the site visit and the spillway approach was not visited, although observed from afar at the water treatment facility.

During the February audit, excavation of weathered material was partially complete to expose fresh unweathered shale. Upper benches were not yet excavated, and the area was snow covered with no water accumulating in ditches. Excavated material had been transported to RSEM R5a for disposal.

During the May audit, major excavation works were not active. Several construction upgrades had been completed or were in construction at the Spillway Approach Channel that were initiated following the Water Sustainability Act Order (Section 93) issued by the Comptroller of Water Rights on November 2, 2018. Specifically, this included 1) re-excavation of benches in the Spillway Approach Channel, 2) installation of a lined collection ditch to collect non-contact seepage waters at the top of the Spillway Approach Channel, and 3) installation of additional pre-treatment water storage capacity at base of the Spillway Approach Channel. It was understood via site personnel during the May audit that approximately 2M m^3 of shale remained to be excavated from this area for the final grading.

During the October audit, the ditch system along the benched shale was functioning, however, little to no flow was observed in the ditches due to predominantly frozen conditions. A moderate amount of seepage was observed from the shale as ice lenses. Several small pools of ponded water were observed by site NRS personnel with measured pH values of 2.0-3.0 (this was not verified during the Tetra Tech site visit). The lowermost ditch on the working Spillway Approach level bench (with penstock installation) was lined and contains pooled water. Water capture and conveyance ditches appear to be graded, and sumps or ponds which occur in shale appear to be lined with impermeable synthetic materials. Pumps were not operating at the time of the October site visit. Water contained in the Lower Collection Pond was pumped up to the MWTP containment pond prior to being treated.

In October, on-site discussions related to future plans for PRHP excavation of the Spillway Approach Channel to final grade, which may occur during the 2019-2020 winter: completion of this work will expose fresh unweathered PAG material. Sufficient capacity is reported to be available in RSEM R5a, however, it is recommended this capacity is confirmed (see note in RSEM R5a section). Although it is understood that the fresh rock will have RCC placed on the shale shortly after the excavation is completed, consideration is required for the logistics and necessity for new installation of up-gradient non-contact cut-off ditching, and down-gradient collection, overflow and conveyance structures. Design considerations for management of PAG contact water from extreme rainfall event flowing from the spillway approach channel requiring treatment prior to discharge.

4.2.4.1 Upper Intercept Ditch and PAG Contact Water Conveyance

The Upper Intercept Ditch and PAG Contact Water Conveyance was visited during the May and October audits.

During the May audit, installation of an intercept ditch was underway along the upper bench of the Spillway Approach Channel. The ditch was lined with a geomembrane. The intention for the ditch was to collect and divert seepage from overburden, which typically daylights at the bedrock-overburden contact, to minimize the abundance of PAG contact water. It was observed during the May site visit that the ditch sits above the bedrock-overburden contact which may reduce the effectiveness to collect seepage water, as intended. During the August audit, the groundwater interception ditch above the Spillway Approach Channel was complete, however, it did not intercept the shale/overburden contact where most of the groundwater flows from. It is limited to catching rainfall and surface run-off from the slope immediately above the ditch. The design intention of this ditch is to convey water pumped from the Golden Horseshoe ditch into the collection system. The upper portion of the non-contact ditch was not visited during the August site visit.

During the October audit, the lower portion of the ditch below the MWTP had been installed and was collecting water seeping from granular overburden materials successfully and draining to RSEM R5b.

4.2.4.2 Lower Collection Pond (720 Pond)

The lower collection pond was visited during the May, August and October 2019 audits.

In May, installation of the Lower Collection Pond was complete, and was lined and containing water. A perimeter berm surrounded the pond to prevent unintended overland flow from entering the pond and water was pumped from the pond up-gradient to the MWTP for treatment. Water collected in the pond was collected predominantly from seepage emanating from shale in the Spillway approach Channel. Water capture and conveyance ditches appear to be graded, and sumps or ponds which occur in shale appear to be lined with impermeable synthetic materials. A series of in situ water tests were conducted along the lower ditch line prior to draining into the Lower Collection Pond and results are, shown in Table 3-2. In May, the water was measured with circumneutral pH, however, EC values were elevated, and strong deposition of iron hydroxides were indicative of active ARD-ML processes.

During the August audit, down-gradient from the Spillway Approach Channel the Lower Collection Pond was observed. The pond was functioning as an emergency or interim lined storage pond that captures water from the PAG slope above the pond. Some minor iron oxide staining was observed on the slope.

In October, the Lower Collection Pond contained some water, however, it appeared that recent pumping had created freeboard of greater than 1 m.

4.2.4.3 Golden Horseshoe

The Golden Horseshoe area was visited during the May 2019 audit.

Shale remained exposed from previous clearing and excavation activities at the easternmost extent of the Spillway Approach channel. A large catchment ditch measuring approximately 3 m deep and 2 m wide, had been constructed which drains into a large sump. The sump was located at the head of the Upper Non-contact Intercept Ditch, but at lower elevation therefore preventing water from draining into the intercept ditch. Water is pumped from the sump to the MWTP and it is anticipated that a portion of the water infiltrates. Shale has had prolonged exposure to atmosphere and moderate to heavy formation of secondary minerals and iron staining are evidence for active ARD-ML processes in the area. Significant PAG contact water is accumulating in this facility. Three in situ water quality tests were conducted from within the ditch and the pond (Table 3-2). Circumneutral pH was measured in all three locations and measured EC values were increasing from the up-gradient test location in the collection ditch towards the pond suggesting increased dissolved components and greater inherent potential for low water quality. One sample was collected from the shale exposed in the collection ditch and was tested for Rinse pH (Table 3-1). Seepage from the overburden-bedrock contact and from the shale bedrock was estimated to total approximately 100 ml/s and water was also observed to be ponding on the shale.

4.2.5 Mobile Water Treatment Plant

The Mobile Water Treatment Plant (MWTP) was visited during the February, May, August and October 2019 audits; an operator was not present on-site at the time of these visits.

In February, the containment pond was frozen and two hydrovac trucks were actively dumping water. Capacity was not known, however, was visually estimated to be half full. The clarifying pond was frozen and the outlet from MWTP was flowing water due to winterization of the pipes. Cell 1 of the clarifying pond was apparently full of sludge and ice was an impediment to cleaning. The CO_2 bubbler was operating in shallow water in Cell 3. Propane heaters were warming the culvert from the non-contact diversion ditch and the outlet culvert from the polishing pond.

During the May audit, the containment pond was approximately half full and a depth gauge was observed in the center of the pond. Site personnel indicated that sludge accumulation in the clarifying pond would soon require clean out, and that a collection and disposal plan was in development by PRHP.

During the August audit, the containment pond had a low water level and significant freeboard. Site personnel indicated that sludge accumulation in the clarifying pond had recently been cleaned out.

During the October audit, the up-gradient containment pond had 2 m freeboard, lots of capacity visually, and was estimated to have 0.50 m of sludge in the bottom of the pond. The plant was processing 10.4 L/s throughput. The clarifying pond had an installed insulation layer on the first pond with CO_2 tanks available for bubblers, and the second and third ponds were not currently insulated. At the time of the October audit, any PAG contact water from the Spillway Approach Channel was mobilized to the MWTP and clean water from the Spillway was free drained to the RSEM R5b pond, however, for up to 72 hours following a rain event all water from the Spillway Approach Channel area was sent to the MWTP (PRHP, verbal communication).

On-site discussions in October indicated that the plant was to be moved as soon as possible to permit the final Spillway Approach Channel excavation activities, and the new plant would be located near the AFDE laydown area. The current containment pond was to be decommissioned by March 2020 once the move was complete and the plant functioning in the new location. Considerations for the move should include installation of excess water storage capacity up-gradient of MWTP for high rainfall events, and gravity conveyance from spillway approach channel.

4.2.6 RCC Cofferdam Excavation, GSS Powerhouse and Spillway Approach

The RCC Cofferdam area was observed during the February, August and October 2019 audits.

The RCC excavation and buttress was visited during the February 2019 audit. Water was being pumped by AFDE to ponds in the AFDE laydown area for evaporation/infiltration. AFDE was not currently pumping to the RSEM R6 pond managed by PRHP. PRHP continued to excavate the base of the buttress. AFDE reported that during the same week as the February audit, unplanned excavation of PAG material (unconfirmed ~20 m^3) in Area 32A was occurring for crane foundation and the temporary PAG pile would be moved to RSEM R5a. Ice lens formation was occurring on the eastern buttress wall, indicating seepage from bedrock into the working area.

During the August and October audits, the RCC Cofferdam Excavation was observed from the roadway since active excavation was in progress, although the AFDE Site and Powerhouse were visited. The north side of the AFDE site contains several small exposed shale slopes, which had been partially dressed with overburden or gravel material. Some of these slopes have been covered with a temporary coconut matting, however, erosion and degradation of the slope was still evident. Slopes show some evidence of seepage, and water was collecting at the base of the slope in a ditch. At the base of the slope near to the future powerhouse building foundation there was an existing ditch to capture run-off from these various slopes within the AFDE working area. This area will eventually be covered with concrete as part of the dam construction.

BC Hydro conducted rinse pH tests of this slope in July which returned rinse pH values ranging from 5.67 to 7.71. The run-off and seepage from this slope mixes with concrete contact water from the power plant construction site. BC Hydro collected two water quality samples from this ditch in July and August of 2019. The results indicated that the seepage was elevated in characteristic PAG related elements such as arsenic, copper, cadmium and zinc but was not yet exceeding the BCAWQG-FST.

Excavation in shale within the Right Bank core trench area was ongoing during the October audit.

4.2.7 South Bank Initial Access Road

The South Bank Initial Access Road (SBIAR) was visited during all four audits in February, May, August and October 2019.

During the February audit, cut banks were snow covered and ice lenses (i.e., from seepage) were observed on both cut-slopes. More ice had accumulated overall on the western cut compared to the eastern cut, however, ice lenses on the eastern cut were locally extensive. Down-gradient water quality sampling locations were both frozen, however it is likely that some flow exists under ice. The spillway and conveyance ditch to RSEM R6 were frozen. The old settlement pond at the base of the spillway was no longer present; and assimilated into the AFDE laydown area. Potential for PAG related influence on water quality at SBIAR is related to flushing/washing of mineral precipitate from shale slopes. Prolonged seepage on slopes maintains a moist reactive environment for ARD-ML reactions and up-gradient flow through water helps to dilute run-off from slopes.

During the May audit, minor to moderate seepage continued to be visible from both the east and western cut- slopes, with an overall greater amount visible from the western slope below Area 21. Rills were forming on the slope ranging in depth between 1 to 15 cm. Some vegetation was observed to be developing on the slopes with the greatest concentration observed along the overburden-bedrock contact and several isolated patches of sedge grass developing within the acid generating shale. A shallow weathering profile was conducted on the SBIAR west cut-slope to identify depth of clay weathering. The weathering profile was segmented into an upper strongly weathered zone (clay + secondary minerals), moderate weathered zone (clay + shale), and weakly weathered zone (shale + clay). Three samples were collected from the SBIAR west cut-slope for Rinse pH testing (Table 3-1).

During the August audit, minor seepage continued to be visible from both the east and western cut-slopes with overall greater amounts visible from the eastern slope as discreet wet patches and rills forming on the slope ranged in depth from 1 to 15 cm. Water was flowing in both the west and east ditches at a rate of approximately 2 L/second, and the majority of water was seemingly coming from the up-gradient ditch, not from the PAG slopes adjacent to the ditch. The secondary minerals formed on the slope have a high solubility that may increase total metal concentrations in solution. In situ water measurements were completed during the audit (Table 3-2).

During the October audit, ice lenses were forming on cut-slopes, particularly at the west cut-slope.

4.2.8 Area A

Area A was visited during the October 2019 audit to verify if granular excavation could be influencing bedrock weathering by inducing change to groundwater conditions from removal of overburden materials. It was concluded that granular excavations were not to depth sufficient to disturb weathered or fresh bedrock material and were at a sufficient distance from the side channel that activities would unlikely influence the water chemistry of the Right Bank side channel.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of BC Hydro and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than BC Hydro, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Limitations on the Use of this Document (Appendix C) are attached to this memo.

6.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully Submitted,
Tetra Tech Canada Inc.

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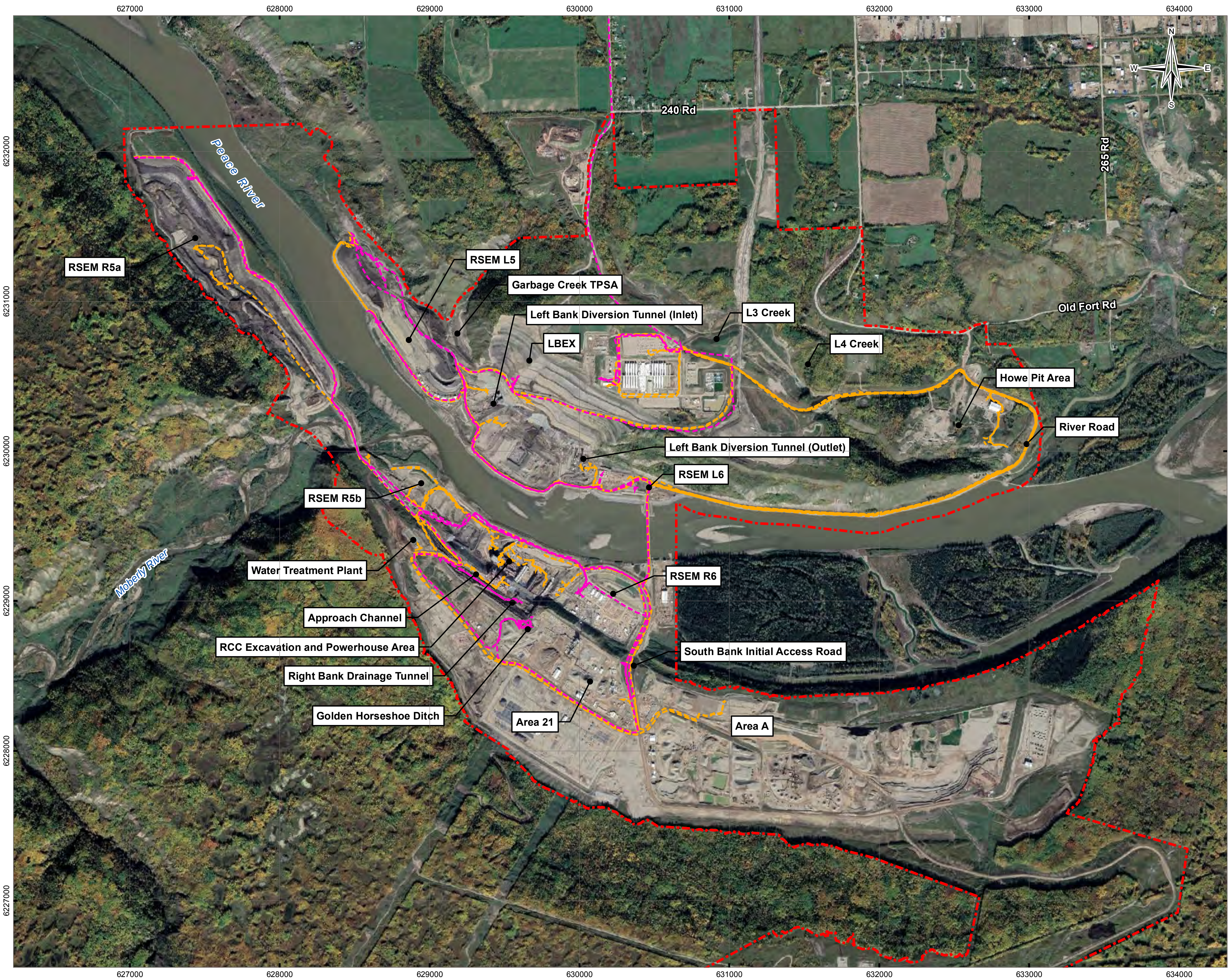
/bi

Attachments:	Figure 1	2019 ARD-ML Site Audit Locations
	Appendix A	Laboratory Analytical Certificate L2281768-1, SPARE Location
	Appendix B	Tetra Tech's Limitations on The Use of This Document

FIGURES



Q:\Vancouver\GIS\ENGINEERING\VMIN\VMIN03021-02\Maps\ARDML_SiteAudit\VMIN03021-02_Figure01_SiteAudit.mxd modified 3/11/2020 by stephanie.leusink

LEGEND

Site C Project Boundary

Site Audit GPS Tracks

May 29, 2019

October 29, 2019

NOTES

Base data source:
Imagery from Google Earth; DigitalGlobe (2019).

STATUS
ISSUED FOR USE

SITE C CLEAN ENERGY PROJECT

2019 ARD-ML Site Audit Locations

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:25,000

500 250 0 500

Metres

TETRA TECH

FILE NO.				
VMIN03021-02_Figure01_SiteAudit.mxd				
OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	YL	JB	0
DATE	PROJECT NO.			
March 11, 2020	ENG.VMIN03021-02			

Figure 1

APPENDIX A

LABORATORY ANALYTICAL CERTIFICATE L2281768-1 (SPARE LOCATION), WATER QUALITY SAMPLE

Tetra Tech Canada Inc.
ATTN: James Barr
150 - 1715 Dickson Avenue
KELOWNA BC V1Y 9G6

Date Received: 29-MAY-19
Report Date: 10-JUN-19 17:21 (MT)
Version: FINAL

Client Phone: 250-862-4832

Certificate of Analysis

Lab Work Order #: L2281768

Project P.O. #: NOT SUBMITTED
Job Reference: 704-ENG.VMIN03021-02, TASK B
C of C Numbers: 17-671524
Legal Site Desc:

Brent Mack, B.Sc.
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2281768-1				
	Description	Water				
	Sampled Date	29-MAY-19				
	Sampled Time	14:45				
	Client ID	SPARE				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (uS/cm)	1800				
	Hardness (as CaCO3) (mg/L)	788				
	pH (pH)	7.87				
	Total Suspended Solids (mg/L)	8.9				
	Total Dissolved Solids (mg/L)	1230				
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	17.2				
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	686				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	686				
	Ammonia, Total (as N) (mg/L)	0.415				
	Chloride (Cl) (mg/L)	<5.0 DLDS				
	Nitrate (as N) (mg/L)	<0.050 DLDS				
	Nitrite (as N) (mg/L)	<0.010 DLDS				
	Sulfate (SO4) (mg/L)	201				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0277				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00493				
	Barium (Ba)-Total (mg/L)	0.0149				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Bismuth (Bi)-Total (mg/L)	<0.000050				
	Boron (B)-Total (mg/L)	0.218				
	Cadmium (Cd)-Total (mg/L)	0.0000161				
	Calcium (Ca)-Total (mg/L)	149				
	Cesium (Cs)-Total (mg/L)	0.000010				
	Chromium (Cr)-Total (mg/L)	0.00015				
	Cobalt (Co)-Total (mg/L)	0.00034				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	0.758				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0649				
	Magnesium (Mg)-Total (mg/L)	90.5				
	Manganese (Mn)-Total (mg/L)	0.109				
	Mercury (Hg)-Total (mg/L)	<0.0000050				
	Molybdenum (Mo)-Total (mg/L)	0.00932				
	Nickel (Ni)-Total (mg/L)	0.00183				
	Phosphorus (P)-Total (mg/L)	0.054				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2281768-1				
	Description	Water				
	Sampled Date	29-MAY-19				
	Sampled Time	14:45				
	Client ID	SPARE				
Grouping	**Analyte**					
WATER						
Total Metals	Potassium (K)-Total (mg/L)	6.93				
	Rubidium (Rb)-Total (mg/L)	0.00169				
	Selenium (Se)-Total (mg/L)	0.000386				
	Silicon (Si)-Total (mg/L)	8.76				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	169				
	Strontium (Sr)-Total (mg/L)	0.660				
	Sulfur (S)-Total (mg/L)	161				
	Tellurium (Te)-Total (mg/L)	<0.00020				
	Thallium (Tl)-Total (mg/L)	0.000020				
	Thorium (Th)-Total (mg/L)	<0.00010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	DLM <0.00090				
	Tungsten (W)-Total (mg/L)	<0.00010				
	Uranium (U)-Total (mg/L)	0.0122				
	Vanadium (V)-Total (mg/L)	<0.00050				
	Zinc (Zn)-Total (mg/L)	<0.0030				
	Zirconium (Zr)-Total (mg/L)	0.000069				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	<0.0010				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00519				
	Barium (Ba)-Dissolved (mg/L)	0.0127				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010				
	Bismuth (Bi)-Dissolved (mg/L)	<0.000050				
	Boron (B)-Dissolved (mg/L)	0.205				
	Cadmium (Cd)-Dissolved (mg/L)	0.0000100				
	Calcium (Ca)-Dissolved (mg/L)	153				
	Cesium (Cs)-Dissolved (mg/L)	<0.000010				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	0.00030				
	Copper (Cu)-Dissolved (mg/L)	0.00021				
	Iron (Fe)-Dissolved (mg/L)	0.093				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				
	Lithium (Li)-Dissolved (mg/L)	0.0649				
	Magnesium (Mg)-Dissolved (mg/L)	98.6				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2281768-1				
	Description	Water				
	Sampled Date	29-MAY-19				
	Sampled Time	14:45				
	Client ID	SPARE				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Manganese (Mn)-Dissolved (mg/L)	0.106				
	Mercury (Hg)-Dissolved (mg/L)	<0.0000050				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00862				
	Nickel (Ni)-Dissolved (mg/L)	0.00169				
	Phosphorus (P)-Dissolved (mg/L)	<0.050				
	Potassium (K)-Dissolved (mg/L)	6.70				
	Rubidium (Rb)-Dissolved (mg/L)	0.00171				
	Selenium (Se)-Dissolved (mg/L)	0.000444				
	Silicon (Si)-Dissolved (mg/L)	7.77				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	175				
	Strontium (Sr)-Dissolved (mg/L)	0.659				
	Sulfur (S)-Dissolved (mg/L)	147				
	Tellurium (Te)-Dissolved (mg/L)	<0.00020				
	Thallium (Tl)-Dissolved (mg/L)	0.000018				
	Thorium (Th)-Dissolved (mg/L)	<0.00010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.00030				
	Tungsten (W)-Dissolved (mg/L)	<0.00010				
	Uranium (U)-Dissolved (mg/L)	0.0112				
	Vanadium (V)-Dissolved (mg/L)	<0.00050				
	Zinc (Zn)-Dissolved (mg/L)	<0.0010				
	Zirconium (Zr)-Dissolved (mg/L)	<0.000060				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Sulfate (SO4)	MS-B	L2281768-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

Samples of industrial wastes, acid mine drainage, or other solutions that contain appreciable amounts of hydrolyzable metal ions such as aluminum, iron, and manganese may require hot peroxide treatment to ensure oxidation and hydrolysis of reduced forms of polyvalent cations. Acidity results may be highly variable if this procedure is not followed. Results in this report for 'Acidity (as CaCO3)' have not been peroxide treated.

ALK-TITR-VA	Water	Alkalinity Species by Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CL-IC-N-VA	Water	Chloride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-SCREEN-VA	Water	Conductivity Screen (Internal Use Only)	APHA 2510

Qualitative analysis of conductivity where required during preparation of other tests - e.g. TDS, metals, etc.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-D-CVAA-VA	Water	Diss. Mercury in Water by CVAAS or CVAFS	APHA 3030B/EPA 1631E (mod)

Water samples are filtered (0.45 um), preserved with hydrochloric acid, then undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

HG-T-CVAA-VA	Water	Total Mercury in Water by CVAAS or CVAFS	EPA 1631E (mod)

Water samples undergo a cold-oxidation using bromine monochloride prior to reduction with stannous chloride, and analyzed by CVAAS or CVAFS.

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

NO2-L-IC-N-VA	Water	Nitrite in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-L-IC-N-VA	Water	Nitrate in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Reference Information

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

SO4-IC-N-VA	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.
Samples containing very high dissolved solid content (i.e. seawaters, brackish waters) may produce a positive bias by this method. Alternate analysis methods are available for these types of samples.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

17-671524

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2281768-COFC

COC Number: 17 - 671524

Page ___ of ___

Report To	Contact and company name below will appear on the final report
Company:	TETRA TECH
Contact:	JAMES BARR
Phone:	250-681-4427
	Company address below will appear on the final report
Street:	150-1715 DICKSON AVE
City/Province:	KELOWNA, BC
Postal Code:	V1Y 9G6

Invoice To		
	Same as Report To	[X] YES [ ] NO
	Copy of Invoice with Report	[ ] YES [ ] NO
Company:		
Contact:		

Report Format / Distribution

Select Report Format: [X] PDF [X] EXCEL [X] EDD (DIGITAL)

Quality Control (QC) Report with Report [X] YES [ ] NO

[ ] Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: [ ] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax

Email 2

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] [ ] · 3 day [P3-25%] [ ] · 2 day [P2-50%] [ ]

EMERGENCY: 1 Business day [E-100%] [ ] · Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] [ ]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #:	Q61495 Updated.
Job #:	704-ENG.VMIN03021-02, TASK 3
PO / AFE:	
LSD:	
AFE/Cost Center:	PO#
Major/Minor Code:	Routing Code:
Requisitioner:	
Location:	
ALS Contact:	Sampler:

ALS Lab Work Order # (lab use only): L2281768

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	TOTAL METALS + HG	DISS. METALS + HG	ALKALINITY SPEC.	ANIONS (CL-, SO4)	CONDUCTIVITY	HARDNESS	PH + ACIDITY	NITROGEN + NH3	TSS	TDS	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
	SPARE	29-05-19	2:45p	WATER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [X] NO

Are samples for human consumption/ use? [ ] YES [X] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

BC Approved Water Quality Freshwater Guidelines.

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] · SIF Observations Yes [ ] No [ ]

Ice Packs [ ] Ice Cubes [ ] · Custody seal intact Yes [ ] No [ ]

Cooling Initiated [X]

INITIAL COOLER TEMPERATURES °C: 21

FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: May 29/19	Time: 3:35p	Received by: Geoff	Date: May 29/19	Time: 15:35	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION · WHITE - LABORATORY COPY · YELLOW - CLIENT COPY

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

APPENDIX B

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

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In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

Appendix D

Site C Clean Energy Project
Water Quality Monitoring for
River Road, South Bank Initial Access Road and L3 Creek
2019 Annual Report

PRESENTED TO

BC Hydro

MARCH 31, 2020
ISSUED FOR USE
FILE: ENG.VMIN03021-02

Tetra Tech Canada Inc.
150, 1715 Dickson Avenue
Kelowna, BC V1Y 9G6 CANADA
Tel 250.862.4832 Fax 250.862.2941

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EXECUTIVE SUMMARY

Tetra Tech Canada Inc. (Tetra Tech) was retained by BC Hydro (the client) to develop and implement a surface water quality monitoring program for discharge locations along River Road ditch near Blind Corner and below Howe Pit, in proximity to the South Bank Initial Access Road (SBIAR), and along the L3 Creek catchment. Monitoring locations were also established upstream from the discharge to characterize variation to water chemistry within the catchment due to mixing and inflow of water from multiple sources.

In accordance with the CEMP App E Section 5.2.1.7, results for the River Road and SBIAR locations were evaluated against the current British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture (BCAWQG) freshwater short term (FST) acute values. Water quality measurements recorded at the discharge, or downstream, locations which were in exceedance to the BCAWQG-FST were reported to BC Hydro. Results were also evaluated against the British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture (BCAWQG) freshwater long-term (FLT) chronic values, due to acquiring three years of monthly data.

River Road

A total of twelve (12) monitoring locations have been established in the River Road catchment near Blind Corner to monitor the effectiveness of the limestone riprap, and to observe longer term influences from the PAG outcrop at Blind Corner and run-off/seepage from Howe Pit on the water collected in the River Road ditch. Sampling was attempted on a routine monthly basis from four of the River Road catchment locations, 1) in the lower chimney drain (LBRR-LC), 2) upstream of the lower chimney drain within the River Road ditch (LBRR-12+500), 3) at the end of the diversion pipe (LBRR-EDP), and 4) at the discharge of culvert RR-11 (LBRR-DD). Due to seasonally dry or frozen conditions water sampling was only conducted during the March 22, 2019 sampling event at the LBRR-RR8 and LBRR-RR9 locations and no lab samples were collected from LBRR-DD, LBRR-LC, LBRR-12+500 or LBRR-EDP in 2019. In situ testing was conducted in nine of the twelve locations during 2019.

The two samples collected during 2019 from RR8 and RR9 on March 22, 2019, measured exceedances to the BCAWQG-FST in total iron, dissolved iron, dissolved aluminum, total arsenic, and total copper.

Water quality measurements along River Road have indicated that run-off water quality is influenced by active ARD-ML processes within the ditch catchment. Although flows are generally low and ephemeral, or inaccessible underneath the limestone riprap, there is some potential for run-off to impact downstream water quality. As per CEMP Appendix E Section 5.2.1.7, it is recommended that water quality monitoring is continued on a monthly basis at the established locations within the River Road catchment. Continuous monitoring will enable the effectiveness of mitigation strategies that are implemented on the shale at Blind Corner.

SBIAR

A total of five (5) monitoring locations are established at the SBIAR location, including the western upstream and downstream SBIAR ditch (RBSBIAR-DS and -US), eastern upstream and downstream SBIAR ditch (RBSBIAR-EDS and -EUS), and within a preserved portion of the Peace River side channel down-gradient of the SBIAR facility (RBSC-DS), to monitor for potential long-term influence of the side channel water quality from construction of the SBIAR facility. The side channel remains hydraulically connected to the Peace River. Effluent water from SBIAR is conveyed to RSEM R6 for management prior to being discharged to the Peace River. Sampling at the RBSBIAR monitoring locations was conducted quarterly in 2018, and monthly in 2017 and 2019.

During 2019, sufficient water was available for lab testing in nine (9) months at RBSBIAR-US, -EUS-, -EDS, and RBSC, and ten (10) months at RBSBIAR-DS. In situ testing was completed on a monthly basis with sufficient water available in, at the most, eleven (11) months with exception to February during 2019.

The downstream west RBSBIAR-DS ditch measured exceedances to the BCAWQG-FST guidelines in total iron (March, July, August, December), dissolved iron (August), dissolved aluminum (March, July, August, November) and total zinc (March) concentrations during the ten months of sampling at RBSBIAR-DS between March and December 2019. The downstream east RBSBIAR-EDS ditch measured exceedances to the BCAWQG-FST guidelines in total iron (six occurrences), dissolved aluminum (six occurrences), total arsenic (four occurrences), total copper (three occurrences), total zinc (four occurrences), and chloride (July) concentrations during the nine months of sampling at RBSBIAR-EDS between March and November 2019.

L3 Creek

The catchment for L3 Creek includes RSEM L3 which is currently not considered, nor permitted, for placement of construction related PAG material. Due to the potential influence on L3 Creek discharge water quality from impacted water originating in the Howe Pit area and inflow from L4 Creek, the water quality within the L3 Creek catchment is being monitored in context of ARD-ML management. A total of five (5) monitoring locations have been established in the L3 Creek catchment, including a baseline location up-gradient of RSEM L3 (LBL3C-3.32), a midstream location below the confluence of L4 Creek and below the Gulley Road box culvert (LBL3C-1.43), slightly upstream from the L4 Creek confluence, LBL3C-1.65, and along L4 Creek, LBL4C-0.18.

During 2019, in the L3 Creek catchment lab samples were collected during eleven (11) months with exception to February. Insufficient water for enabling sampling in some months was due to low to no flow during dry or frozen conditions or inaccessibility during construction related activities. In situ testing was attempted on a monthly basis with sufficient water available for, at the most, ten (10) months during 2019.

The discharge LBL3C-0.02 location in L3 Creek measured exceedances to the BCAWQG-FST guidelines in total iron (March, April, July, August, October, November), dissolved aluminum (April through to November), total zinc (March), total arsenic (March and July), and total copper (March) concentrations during the water quality sampling in 2019.

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ACRONYMS & ABBREVIATIONS

Acronyms/Abbreviations	Definition
ARD	Acid Rock Drainage
ARD-ML	Acid Rock Drainage and Metal Leaching
BCAWQG	British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture
°C	Degrees Celsius
CEMP	Construction Environmental Management Plan
DL	Detection limit
EC	Electrical Conductivity
FST	Freshwater Short Term Maximum
FLT	Long-term Maximum
L/sec (or L/s)	Litres per second
mg/L	milligrams per litre
ML	Metal Leaching
n/a	Not applicable
NAG	Not Potentially Acid Generating
PAG	Potentially Acid Generating
ppm	parts per million
RPD	Relative Percent Difference
RSEM	Relocated Surplus Excavation Material
SBIAR	South Bank Initial Access Road
µg/L	micrograms per litre
UR	Not Read
WQG	Water Quality Guideline

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of BC Hydro and their agents. Tetra Tech Canada Inc. (Tetra Tech) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than BC Hydro, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this document is subject to the Limitations on the Use of this Document attached in the Appendix or Contractual Terms and Conditions executed by both parties.

1.0 INTRODUCTION

Tetra Tech Canada Inc. (Tetra Tech) was retained by BC Hydro (the client) to develop and implement a surface water quality monitoring program at midstream and discharge locations along River Road ditch near Blind Corner and below Howe Pit, in proximity to the South Bank Initial Access Road (SBIAR), and along the L3 Creek catchment. Water sampling locations are shown in the attached maps in Figures 1 through 3 and summarized with UTM coordinates in Table 1.

Monitoring locations were established by Tetra Tech in conjunction with BC Hydro personnel. Where possible, they are coincident with the locations and station names used in 2016 by Lorax Environmental Services Ltd. (Lorax) on behalf of Peace River Hydro Partners (PRHP). Photos of the water sampling locations during 2019 are included in the Photographs (1 through 33) section of the Appendix.

This report documents the establishment of the water sampling locations and summarizes the sampling events conducted monthly between January and December of 2019. Results of the monitoring program are discussed in the context of acid rock drainage and metal leaching (ARD-ML) management and mitigation.

Requirements for the development and implementation of the water quality monitoring programs are mandated under the Environmental Assessment Certificate – Condition 3, and the Federal Decision Statement – Condition 7. Reporting of the program results are required on an annual basis. The requirements described in the BC Hydro Site C Clean Energy Project Construction Environmental Management Plan (CEMP), (Revisions 5.0 to 6.1, February 19, 2019 to December 12, 2019, respectively), Appendix E Acid Rock Drainage and Metal Leachate Management Plan, Revision 5.2 (App E) is consistent with the requirements listed.

In accordance with the CEMP Appendix E Section 5.2.1.7, analytical results for the River Road and SBIAR locations were evaluated against the British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture (BCAWQG) freshwater short term maximum (FST) values[1]. Water quality measurements recorded at the discharge, or downstream, locations which were in exceedance to the BCAWQG-FST were reported to BC Hydro.

The water conveyance facilities at River Road ditch near Blind Corner and SBIAR are identified as having potential for direct ARD-ML impacts due to exposure of shale bedrock during construction related activities. The catchment for L3 Creek includes RSEM L3 which is currently not considered, nor permitted, for placement of construction related PAG material. Due to potential influence on discharge water quality from the Howe Pit area and inflow from L4 Creek, the water quality within the L3 Creek catchment is being monitored in context of ARD-ML management.

The L3 Creek catchment is not identified as a waterway with potential for ARD-ML impacts arising from construction related activities. Water quality monitoring has been conducted within this catchment to monitor discharge water quality and to maintain a record for potential future use. The BCAWQG-FST values were also used as a benchmark for monitoring the water quality at the discharge location (LBL3C-0.02) from L3 Creek.

The BCAWQG-FST and -FLT guidelines released in August 2019 revised the criteria for the evaluation of copper (Cu) guidelines which now require measurement of dissolved organic carbon (DOC), in addition to changes in

[1] The British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife and Agriculture document has been updated frequently during the course of the monitoring program, and has undergone revisions in March 2016, January 2017, March 2018, and August 2019. Screening of the monthly water quality results are performed against the contemporary guideline values. During the 2019 monitoring program, water quality results were screened using the March 2018 guidelines through to August 2019 and were then screened against the August 2019 guidelines from September 2019 through to the end of the year.

terminology including reference to “short term acute” from “short term maximum” and “long-term chronic” from “long-term average” concentrations. The September, October, November, and December 2019 sampling events are the initial collection of samples with DOC analysis that is required for the calculation of the new dissolved copper guidelines according to the BCAWQG-FST. The BC Biotic Ligand Model (BLM) software was utilized to acquire the dissolved copper guideline for each sample, that included an input of eleven essential water chemistry parameters such as DOC, water hardness, pH, alkalinity and other components. A lab temperature of 21 °C and humic acid as 10% of DOC was assumed.

Sample Event Records and Analysis

Field notes documented at each monitoring location include date and time of field observations with estimated flow rate and water clarity, and recorded situ measurements for water temperature, hardness, alkalinity, pH, and electrical conductivity that are collected using a hand-held meter.

An off-site laboratory analytical program was designed to measure a suite of parameters suitable for screening the water quality against the BCAWQG-FST for surface water. The sampling and analytical procedures implemented during 2019 were commensurate with Tetra Tech’s 2017 and 2018 monitoring periods and the program previously implemented in 2016 by Lorax for parameters, analytical methods and detection limits. Lab analysis was conducted for total and dissolved elements (metals), hardness, pH, alkalinity, acidity, total suspended and total dissolved solids, and anions including sulphate, nitrogen species and chloride. Dissolved Organic Carbon (DOC) was added commencing on September 24, 2019. Samples were collected in a set of clean bottles provided by the lab and were submitted for analysis.

Quality Assurance and Quality Control

The Quality Control (QC) program included sample collection by experienced field staff who were familiar with the water quality monitoring program. Samples were collected using a method consistent with the British Columbia Field Sampling Manual, Part E: Water and Wastewater Sampling (Clark, 2003).

The Quality Assurance (QA) program incorporated the use of a Travel Blank, Field Blank, and a replicate sample to test for potential contamination during sample collection, handling or laboratory preparation, and to evaluate the precision of laboratory analysis. Tetra Tech also reviewed the data for more general anomalies and inconsistencies, assessed on a case by case basis. Travel Blanks were prepared by the laboratory and field blanks were prepared in the field at sample collection sites by field staff using the same source water as was used for the travel blank.

The analytical results of these samples were reviewed by Tetra Tech, and if potential contamination or concerns with analytical results were identified, they were discussed with the laboratory and/or the field sampler representatives, with reanalysis of samples completed for verification if necessary. Blank samples were considered to ‘fail’ when a measured value had concentrations above the reported detection limits for that parameter.

ALS Laboratories was used as the principle laboratory for sample analysis. The lab implements a detailed QC program into the sample analysis which includes a series of checks and evaluations for consistency in the sample analysis. The QC program includes method blanks, certified reference materials, laboratory control samples and duplicates. Tetra Tech reviewed the results of each QC Lot reported on Assay Certificates to verify that the program consistently met internal ALS Data Quality Objectives.

Any concerns identified were communicated to ALS Laboratories. The data used for reporting is believed to be representative and reliable.

Monitoring Program

River Road

Monitoring locations along the River Road ditch are between road stations LBRR-12+400 and LBRR-12+920, within the lower chimney ditch draining surface water from a cut-off ditch on the Howe Pit bench, and LBRR-EDP, LBRR-RR8, and LBRR-RR9 located at the end of a diversion pipe that connects up-gradient within the River Road ditch at station LBRR-12+430 to divert water down-gradient into the River Road ditch below L3 Creek and up-gradient from culverts RR9 and RR8. The pipe bypasses the lower chimney drain (LBRR-LC), which continues to discharge from culvert RR-11, and bypasses L3 Creek, which continues to discharge from culvert RR-10. The purpose of the diversion pipe is to address erosion and sediment control by transport of run-off water into an elongated ditchline for reducing flow velocities and to promote settlement of suspended sediment. Inlets to culverts RR9 and RR8 are slightly elevated from the ditch base which will allow water to pond within the ditch and infiltrate and will permit discharge via the culverts only if water levels reach sufficient height. Both culverts are made of HDPE materials. The monitoring program includes collection of discharge at these culverts from the LBRR-RR8 and LBRR-RR9 locations, however, no discharge was observed to be coincident with the scheduled 2019 sampling events.

Sufficient flowing water permitted samples to be collected on March 22, 2019 at the RR8 and RR9 locations. Sampling was limited in the River Road catchment thus no water samples were collected during 2019 from the LBRR-DD, LBRR-LC, and LBRR-12+500, or LBRR-EDP locations due to dry, frozen and/or very low to no flow conditions that prevailed at these locations between January and December 2019, although field observations were documented each month.

Limestone riprap lines the River Road ditch between monitoring locations LBRR-12+920 and LBRR-DD and is effective at mitigating the pH of the baseline drainage water. The limestone material used as riprap along this road section has become progressively coated with a mineral precipitate (visually estimated as hydroxides containing iron, calcium and aluminum) due to chemical neutralization reactions and has become encased by sludge due to settlement of suspended solids within the water and encroachment of sand and gravel sediment from grading activities on River Road. The effectiveness of the limestone to provide the neutralizing potential is negatively compromised by these coatings.

SBIAR

Sufficient flowing water permitted monthly samples to be collected between March to December 2019 (ten months) from three monitoring locations RBSBIAR-US, RBSBIAR-DS, and RBSBIAR-EUS, between March to November 2019 (nine months) at RBSBIAR-EDS, and between April to December 2019 (nine months) at RBSC-DS. Due to no flow and frozen conditions, no water samples were collected in January and February of 2019 in the RBSBIAR catchment. Field observations were documented each month.

A summary of water quality exceedances at SBIAR relative to BCAWQG-FST listed by monitoring location and month are listed in Table 9, and the screening results based on the laboratory data are tabulated in Appendix B2. Results for each monthly sampling event were plotted on time series charts tor trend and qualitative correlation analysis. A quantitative correlation analysis was completed for the downstream RBSBIAR-DS and RBSBIAR-EDS ditch locations for parameters of specific interest to ARD/ML and screening procedures (Appendix C).

L3 Creek

Sufficient flowing water permitted water quality sample collection between March to November 2019 of nine samples from LBL3C-0.02 and LBL3C-3.32. Ten samples were collected between March to December 2019 at LBL3C-1.43. Eight samples were collected from LBL3C-1.65 (March to December 2019) and LBL4C-0.18 (March to November 2019). Field observations were documented each month. Results for each monthly sampling event were plotted on time series charts for trend and qualitative correlation analysis.

Investigations aim to explain the occurrence of dissolved aluminum and total iron measured above detectible concentrations in the downstream location LBL3C-0.02 but not at comparable concentrations in the upstream L3 Creek locations, LBL3C-1.43 or -3.32. Evidence of PAG outcrop in L4 Creek, reduced pH levels, and the occurrence of anomalous metal concentrations at the LBL4C-0.018 location indicate background water quality of local naturally occurring PAG contact waterways. L4 Creek waters are eventually diluted, or attenuated, by L3 Creek waters and PAG related metal concentrations are significantly reduced towards and at the LBL3C-0.02 discharge location.

2.0 BACKGROUND

Sampling locations were first established in April 2017 by Tetra Tech in conjunction with BC Hydro personnel. Where possible, they are coincident with the locations and nomenclature used in 2016 by Lorax Environmental Services Ltd. (Lorax) on behalf of Peace River Hydro Partners (PRHP). Nomenclature for sampling locations begins with the applicable bank of the Peace River, e.g. Right Bank (RB) and Left Bank (LB).

Water quality sampling has scheduled during the third week of each month during 2017, 2018 and 2019 to support a continuous monitoring record for reportable water quality compliance. Completion of the sampling event has been conducted monthly except under frozen or dry conditions. The 2019 program commenced on January 23, 2019, by Tetra Tech and BC Hydro personnel following seasonal frozen conditions and was completed on December 19, 2019. Each sampling event was documented by field notes and photographs, including during dry and frozen conditions.

Field notes documented at each monitoring location included date and time of field observations including estimate flow rate and water clarity, and a list of in situ tests completed with record of measurements for water temperature, hardness, alkalinity, pH, and electrical conductivity collected using a hand-held meter. (Tables 6, 8, 11 and 13).

The off-site laboratory analytical program was designed to screen water quality against the BCAWQG-FST for surface water and commensurate with the Lorax 2016 and Tetra Tech 2017 and 2018 program with regards to the analytical methods and detection limits. Analysis was conducted for the following parameters:

- Total Metals, Low Level (including Hg);
- Dissolved Metals, Low Level (including Hg);
- Hardness;
- pH;
- Alkalinity: Total/Species (CO_3^{2-} , HCO_3^-, OH^-);
- Acidity;
- Solids: Total Suspended (TSS) and Total Dissolved (TDS);

- Anions: Nitrogen species (nitrite, nitrate, ammonia), Sulphate, Chloride; and
- Dissolved Organic Carbon (DOC) – not collected prior to the September 24, 2019 event.

2.1 Summary of Parameters of Interest

Some of the key indicators that were monitored during this program are described below. Although some of these parameters do not have BCAWQG-FST guidelines, they can be useful indicators to potential changes in water chemistry related to ARD-ML processes.

Alkalinity and pH are important water quality parameters to indicate the ratio between residual alkalinity and acidity in solution and are key indicators for onset of acidic conditions within neutral to alkaline waters when monitored over time. Neutralization of acidity by carbonate minerals can temporarily increase alkalinity through release of the bicarbonate ion into solution, thereby buffering pH at a near constant value. Bicarbonate will continue to react, and deplete, with any residual acidity. Once all carbonate and bicarbonate sources are depleted, alkalinity no longer is available to neutralize acidity and pH will drop. An indicator for accelerating acid generating processes is when increasing alkalinity is observed without proportional change to pH. The BCAWQG-FST guideline for pH ranges from 6.5-9.0. There is no guideline for alkalinity or acidity.

Water clarity is measured as turbidity (nephelometric turbidity units, NTU) or as total suspended solids (TSS), which is an indicator of the amount of sediment (generally accepted as silt sized particles and coarser, or >0.45 µm in diameter), contained within the water column. TSS can increase if sediment loading occurs due to erosion, or due to rapid precipitation of secondary minerals from chemical reactions such as neutralization of acidic water. The bulk chemistry of water with high TSS tends to mimic the chemical composition of the source sediment being eroded, or in the case of mineral precipitation tends to be high in iron as iron-oxide minerals are the most common secondary mineral to form. Rapid temporal changes to TSS measurements within a catchment due to formation of secondary minerals can indicate presence of active ARD-ML reactions. The BCAWQG-FST guideline is based on deviations to background TSS.

Measurements such as total dissolved solids (TDS), electrical conductivity (EC) and salinity are indicators for the concentration of dissolved components and/or ions in solution. Sudden or gradual increases in these parameters can indicate changes in water chemistry such as an increase in reactive ions or dissolved metals as a result of potential metal leaching processes. Changes to these parameters in association with changes to pH or alkalinity may also indicate active metal leaching processes. BCAWQG-FST guidelines are not specifically stated for these parameters.

Dissolved sulphate can originate from anthropogenic sources, microbial processes and through chemical processes related to degradation of rock forming minerals in environments with potential for acid generation through the oxidation of primary sulphide (e.g., pyrite) or dissolution of sulphate minerals (e.g., gypsum). Elevated sulphate concentrations may indicate oxidation, or weathering, of potentially acid generating (PAG) materials in proximity to sample collection locations, however, may also indicate influence from regional groundwater sources. Water quality with elevated sulphate and pH > 7.0 may indicate ARD-ML processes with sufficient acid neutralizing materials, whereas sulphate with decreasing pH may indicate a shortage of acid neutralizing materials. Sulphate is commonly reactive with several cations and metal ions under ambient environmental conditions forming both soluble and non-soluble mineral precipitate.

Marine shales such as the local Shaftsbury Formation commonly contain sulphide minerals (mainly pyrite, FeS_2) and may also have primary sulphate minerals such as anhydrite ($CaSO_4$), gypsum ($CaSO_4 \cdot 2H_2O$), or barite ($BaSO_4$), and/or other sulphate minerals. Preliminary characterization determined that the primary sulphur species in the shale was sulphide with some detectable sulphate (Klohn Crippen Berger, 2015). Based on this mineral association and site observations, it is possible that groundwater contacting fractured bedrock could contain naturally elevated sulphate concentrations. Only one well from the Dam Construction Site was reported in the baseline groundwater sampling conducted as part of the project's Environmental Impact Statement (Hemmera Envirochem Inc. and BGC Engineering Inc., 2012) which did indicate groundwater contained elevated sulphate. Ongoing Groundwater monitoring up-gradient and down-gradient of RSEM R5a and R5b measure elevated sulphate concentrations below the BCAWQG-FLT guideline (The Site C Clean Energy Project, 2019 Q4 Groundwater Quality, Monitoring Report for RSEM R5a and R5b) indicating the ongoing presence of sulphate in the groundwater systems. It is noted that the down-gradient monitoring wells at RSEM R5b are screened in overburden materials above the bedrock contact. The guideline value for sulphate is not stated in the short term BCAWQG-FST guideline, however, a long-term average guideline value is stated (variable with hardness) and is referenced in this report.

Water hardness is derived from the total concentration of calcium and magnesium ions in solution, and often reported as mg/L of dissolved $CaCO_3$) is known to mitigate the effect of certain metals on aquatic organisms, and the guidelines are presented with equations derived from experimental data for sulphate and numerous metals (cadmium, copper, fluoride, lead, manganese, silver and zinc that tests a range of hardness specific to each metal or sulphate). Water hardness classification on-site is Hard to Very Hard and is often measured above the guideline threshold used to calculate BCAWQG-FST guideline values. Where the ambient hardness values exceed the guideline limited listed for BCAWQG, the exceedance criteria have been calculated using the upper limit "capped" hardness value instead of the measured ambient hardness. The BC Approved WQG Summary Report (2019) states that a site-specific assessment may be necessary when ambient hardness values are outside the range tested in BC's Approved WQGs.

Water quality screening efforts have focused on elements with BCAWQG-FST guidelines, which include pH, ammonia, chloride, nitrite, total concentrations of arsenic, boron, cobalt, copper, iron, lead, manganese, molybdenum, silver, and zinc, and dissolved concentrations of aluminum, cadmium, and iron. Dissolved copper was added, and total copper removed from the BCAWQG-FST guidelines, commencing on the September 24, 2019 sampling event.

Changes in concentrations of some elements or metals, reported as both total and dissolved, can have various implications for water quality under ARD-ML conditions. The solubility of individual elements can vary with pH. Geochemical modelling completed by Klohn Crippen Berger (2015) identified copper, cobalt, cadmium and zinc as having high probability of leaching into solution of site water during oxidation of the local shale bedrock under oxic acid rock generating and metal leaching conditions.

Formation of iron-oxide precipitate is the most widely recognized indicator of active ARD-ML processes. Total iron concentrations are associated with ARD-ML due to liberation of ferric iron from the oxidation of primary iron bearing sulphides. Subsequent formation of iron-oxide or iron hydroxide minerals can precipitate when acidic waters are neutralized and may be present as suspended solids or can form scaling on reactive surfaces such as limestone.

Aluminum is abundant in rock forming minerals and can be released as part of oxidation and degradation of rocks during ARD-ML processes. Aluminum is soluble in acidic water and is typically not soluble in neutral and alkaline waters. Aluminum, as Al^{3+}, can also contribute to the acidity along with H^{+}. When concentrations of aluminum are measured in detectible concentrations in neutral or alkaline water, it is possible that the formation of very fine aluminum hydroxide clays may occur in previously acidic waters that have been neutralized. Aluminum hydroxide mineral species (e.g., polymorphs of gibbsite or hydrargillite) can form on rock surfaces and are indicators of acid generating conditions.

Concentrations of aluminum, iron and copper are typically low in neutral pH drainage, however, elements such as antimony, arsenic, cadmium, molybdenum, selenium, and zinc can be present in neutral pH drainage. Neutral pH metal leaching is an important mechanism to be observed on the Site C project as several these neutral pH soluble elements are prevalent in the shale bedrock. These elements can be concentrated within secondary mineral formation on shale bedrock during prolonged period of low moisture, then released into run-off water in elevated concentration during high precipitation events.

Under BC's Approved WQG's, the intention of freshwater long-term (FLT; "chronic") WQG's are for the protection of the most sensitive species and life stage against sub-lethal and lethal effects for indefinite explores, and uses an averaging period, whereas the freshwater short term (FST; "acute") WQG's are intended to protect against severe effects, e.g., lethality, to the most sensitive species and life stage over a defined short term exposure period approach (BC Approved WQG Summary Report, 2019). Working water quality guidelines (WWQG) have not been assessed as part of this monitoring program.

The sampling program in each area is briefly described in the following sections.

2.2 Description of River Road Sample Locations

A total of twelve (12) monitoring locations have been established in the River Road catchment near Blind Corner.

Sample locations have been established along the River Road ditch for in situ testing, primarily as a means of monitoring the effectiveness of the limestone riprap and to observe longer term trends related to the PAG outcrop at Blind Corner and run-off/seepage from Howe Pit. Laboratory and in situ testing are conducted at three main locations, including 1) the lower chimney drain (LBRR-LC), 2) upstream of the lower chimney drain within the River Road ditch (LBRR-12+500), and 2) at the discharge of culvert RR-11 (LBRR-DD). In situ samples are only conducted at locations LBRR-12+430, LBRR-12+600, LBRR-12+700, LBRR-12+810 and LBRR-12+920.

The April 19, 2018, water sampling event included establishment of three additional locations: LBRR-EDP, LBRR RR9 and LBRR-RR8. LBRR-EDP is located at the end of a diversion pipe installed on March 19, 2018; the inlet is within the River Road ditch at station 12+430 to divert water down-gradient into the River Road ditch towards culverts RR9 and RR8. The pipe bypasses the lower chimney drain (LBRR-LC), which continues to discharge from culvert RR-11, and bypasses L3 Creek, which continues to discharge from culvert RR-10. The purpose of the diversion pipe is to address erosion and sediment control by transport of run-off water into an elongated ditchline to reduce flow velocities and to promote settlement of suspended sediment. Inlets to culverts RR9 and RR8 are slightly elevated from the ditch base which will allow water to pond within the ditch and infiltrate or discharge via the culverts only if water levels reach sufficient height. Both culverts are made of HDPE materials. The monitoring program includes collection of discharge from these LBRR-RR8 and -RR9 culverts, however, no discharge was observed to be coincident with the scheduled 2019 sampling events.

Sampling was attempted on a routine monthly basis from four of the River Road catchment locations, and laboratory analyses were conducted on samples collected when flowing water was observed. The analyses results were used to understand water quality prior to mixing and discharging into the Peace River. These four locations are located: in the lower chimney drain (LBRR-LC), upstream of the lower chimney drain within the River Road ditch (LBRR-12+500) and at the end of the diversion pipe (LBRR-EDP).

In situ observations and measurements were routinely collected at all eleven locations within the River Road ditch when flowing water was observed.

The established River Road monitoring locations are shown in Figure 1 and photos of the locations are included in the Photographs (Photos 21 to 25) section of the Appendix.

2.3 Description of South Bank Initial Access Road Locations

A total of five (5) monitoring locations have been established in and with proximity to the SBIAR catchment. The sample locations have been established to monitor water quality flowing through the SBIAR road cut. The sample locations will also monitor the potential changes to water quality in the side channel down-gradient of the SBIAR construction (RBSC-DS). Sample locations allow for data collection of long-term characterization of SBIAR water management from the upstream location in the west ditch (RBSBIAR-US) and the downstream location in the west ditch (RBSBIAR-DS). Upstream and downstream sampling locations (RBSBIAR-EUS and RBSBIAR-EDS, respectively) were added during the June 2018, sampling event. In situ and laboratory analysis are conducted at all five locations.

It is noted that the water flowing from RBSBIAR-DS does not have a direct downstream receptor; the water flows from SBIAR into a limestone armoured spillway into a ditch which conveys to the RSEM R6 pond. Water quality monitoring is not conducted from within the spillway or ditch.

The RBSC-DS location is sampled as a verification point to check for potential influence from, or direct connectivity with, the PAG contact water that is collected within the SBIAR facility and diverted to the RSEM R6 pond. Groundwater and local surface run-off contribute to the local water quality; however, this location remains hydraulically connected to the Peace River which is interpreted as the primary influence of local water quality, particularly TSS measurements.

The SBIAR sampling locations were monitored on a monthly basis and water quality samples were collected for ten months between March and December 2019. Frozen conditions prevailed during the winter months of January and February 2019, preventing water quality sampling at SBIAR locations.

The established SBIAR monitoring locations are shown in Figure 2 and photos of the locations are included in the Photographs (Photos 1 to 8) section of the Appendix.

2.4 Description of L3 Catchment Sample Locations

The catchment for L3 Creek includes RSEM L3 which is currently not considered, nor permitted, for placement of construction related PAG material. Due to potential influence on discharge water quality from the Howe Pit area and inflow from L4 Creek, the water quality within the L3 Creek catchment is being monitored in context of ARD-ML management.

Five monitoring locations are established within the L3 and L4 Creek catchment to characterize water quality along the creeks and at the discharge location. A baseline location up-gradient of RSEM L3 (LBL3C-3.32) is 3.32 km from the L3 Creek discharge location. One midstream location, LBL3C-1.65, is above and one midstream location, LBL3C-1.43, is below the confluence of L4 Creek and Gulley Road box culvert. The LBL3C-1.65 and -1.43 locations are 1.65 km and 1.43 km, respectively, from the L3 Creek discharge location, and are monitored to characterize changes through the drainage towards the downstream discharge location at culvert RR-10 (LBL3C-0.02), located 20 metres from the L3 Creek discharge location. The LBL3C-0.02 location is used as a proxy for discharge water quality. Due to intermittent construction activities at LBL3C-1.65 during 2019, minimal sampling was done at this location.

L4 Creek is a naturally incised gully which is located downstream from the off-site 85th Avenue Industrial Lands gravel quarry work being conducted. One monitoring location established in L4 Creek, LBL4C-0.18, is 180 metres upstream from the confluence with L3 Creek. Comparison of the measurements from the L3 and L4 Creek monitoring locations are used to characterize the mixed waters monitored at the L3 Creek midstream location, LBL3C-1.43.

The L3 Catchment monitoring locations are shown in Figure 3 and a representative photo is included in the Photographs (Photos 9 to 20) section of the Appendix.

2.5 Description of Additional Temporary Sampling Locations

Periodically, water samples are collected from new locations to evaluate water quality on a single event or recurring event basis.

2.5.1 Gully Road Ditch

On April 18 and May 23, 2019, water quality samples were collected from Gully Road ditch in continuation of previous in situ and lab sampling in May, June, July, August, September, and October 2018. Site observations were initially made of a small shale exposure in the northern cut-bank of the River Road ditch in April 2018 and the presence of iron-oxide staining on the sandstone riprap lining the ditch near road station 72+900. Water in the ditch flows to the east under Upper River Road into an overburden pit located approximately 150 m southeast of security Gate B. The Gully Road ditch was established as a temporary monitoring location in May 2018 along the ditch just west of Gate B (map in Figure 1). A representative photo of Gully Road ditch is included in the Photographs (Photos 27 and 28) section of the Appendix. Water quality lab data results are provided in Appendix B, Table B4 and discussed in Section 4.5.1. Sampling at this location ceased in June 2019.

2.5.2 Road Runner 1 and 2

Two new locations were sampled on April 18, 2019 for laboratory analysis at two separate seeps along the base of the east side of the Tailrace wall named Road Runner 1 and 2 (Photos 29 to 32).

2.5.3 Seep-1 (RCC Excavation, AFDE Powerhouse Area)

One new location was sampled for laboratory analysis on August 1 and 20, and September 24, 2019 near the northeastern portion of AFDE's working area within the RCC Excavation adjacent to the Powerhouse construction named Seep-1. This location is not the same as those previously sampled at Road Runner 1 and 2 which were reported from the April 18, 2019 sampling event. The Seep-1 sample represents a single water seep which daylights along the northern shale cut behind the RCC Slurry Wall (Photo 26) and flows down exposed shale into a sump constructed to collect inflow water. Map 2 indicates the location of this sampling location.

2.5.4 Left Bank Sediment Pond (LBSP)

A water quality verification sample was collected on May 23 and June 20, 2019 from a new temporary location named LBSP, from near the surface of the northeastern corner of the Left Bank Sediment Pond (Photo 33). Map 3 indicates the sample location of the LBSP water quality sample. The LBSP was decommissioned and removed in mid-July of 2019.

3.0 LOCAL CONDITIONS

3.1 Weather Conditions – Temperature and Precipitation

The minimum, maximum, and average daily and preceding seven-day temperature range, and the mean precipitation measured for the preceding seven days, the day prior to, and day of each sampling event between

January and December 2019, was collected from BC Hydro's Site C Meteorological and Air Quality Station (Figure 4; BC Hydro, 2019), Station 7C Site C North Camp, with results summarized in Table 2.

Mean temperatures on sampling events ranged from -14.7 °C (January 23) to +16.7 °C (July 19). The range of minimum temperatures on sampling events ranged from -16.6 °C (January 23) to +13.2 °C (July 19), whereas range of maximum temperatures on sampling events ranged from -13.0 °C (January 23 17) to +21.4 °C (May 23). Sampling events in June, July, August and December 2019 were coincident with minimal precipitation of 0.51 mm (10:00-11:00 AM), 2.87 mm (1:00-7:00 PM), 1.14 mm (1:00-8:00 AM), and 0.18 mm (1:00-2:00 AM), respectively. The March and September 2019 sampling events had no precipitation in the prior seven days. Minimal to moderate precipitation for the Site C area was recorded in the previous seven days for sampling events in January (5.82 mm), April (5.51 mm), May (7.18 mm), June (4.22 mm), July (8.27 mm), October (12.96 mm), November (0.95 mm), and December (5.58 mm) during the 2019 monitoring period. The August 2019 sampling event had the highest precipitation of 45.73 mm in the preceding seven days.

Residence time for water is low in the SBIAR and River Road ditches due to their small catchment size. The climate data was used to evaluate water availability and potential water source for flows that were observed in the ditches.

3.1.1 Classification of Seasonal Flows in Ditch

The flows in ditches at SBIAR and River Road are susceptible to seasonal change and flow rate is highly influenced by local precipitation events, thus the classification of flow in ditches can assist to interpret the source and subsequent chemical fluctuations in water sampled (Table 3). For example, flows in ditches can be attributed to shallow or regional groundwater, spring freshet or surface run-off, dependant on the season and amount of precipitation recorded in the previous 24-hours and 7-days to the sampling event. This association may be less apparent in L3 Creek due to a larger catchment size and residence time for water within the drainage, however, it is interpreted that similar trends may be observed.

Regional bedrock groundwater in locations sampled are suspected to have elevated concentrations of dissolved sulphates due to groundwater interaction with local pyritic-shale bedrock and local bacteria, and may, to some degree, be responsible for the high sulphate-content pervasive in water samples following minimal precipitation during the previous 7-day and 24-hours to the sampling event (e.g., January, April, May, June, October, December 2019).

When significant precipitation has occurred in the previous 7-days, but minimal precipitation within the prior 24-hour period to the sampling event, the flows in ditches can result from shallow groundwater flow, mainly through unconsolidated overburden. Significant precipitation in the preceding seven days to and during the August 20, 2019 sampling event correlates with a spike in TSS and turbidity measured in the Peace River (Table 4) and higher levels of TSS and conductivity measured in water quality samples collected from the RBSBIAR and L3 Creek monitoring locations.

During spring freshet and snow melt, sampling events (e.g., March and April 2019) can be classified as having a 'dilution' effect to the water chemistry, although increased TSS from turbid high flows can counteract this effect. To the contrary, during more arid seasons with little to no precipitation occurring in the previous 7-days and 24-hours (e.g., March and September 2019), flows in ditches can be attributed to regional groundwater baseline seepage. In this event, when precipitation and sampling occur following dry periods, the surface chemistry of the rocks will be washed into the ditches and be concentrated. Significant rainfall events coincident to sampling events occurred on August 20, 2019, and possibly, but less significant rainfall leading up to and including June 19 and July 18, 2019. This occurrence of moderate to significant rainfall prior to and including a sampling event would produce increased turbidity and flow in the ditches, having short term effects on measurements such as TDS, TSS and potentially total metal concentrations from flushing of exposed slopes and ditch fill material.

The classification of seasonal flows in ditches, therefore, are important to consider when interpreting fluctuations and exceedances in parameters measured in water quality guidelines over the period of one year.

3.2 Peace River Turbidity and TSS (Total Suspended Solids)

Turbidity of the Peace River is monitored by BC Hydro through a series of data loggers situated both upstream and downstream of the Main Civil Works (MCW) construction area. Time series data collected on the left and right banks of the Peace River up-gradient of the Moberly River (stations PAM-LB and PAM-RB, respectively) were provided to Tetra Tech by Ecofish Research Ltd. (Ecofish) to provide general understanding of influence by precipitation on natural sediment within the Peace River upstream from the construction area surrounding sampling events.

Measured turbidity gradually increases during early spring and freshet then decreases and levels off for the remainder of the year with exception to high precipitation events that are related to spikes in turbidity and TSS, such as recorded during the August 21, 2019 sampling event (Figure 5).

The data include turbidity measurements for the day prior, during, and day following the January through December sampling events in 2019 (Table 4). The turbidity data is converted to a value representing total suspended solids (TSS) using a preliminary factor developed by Ecofish using calibration of field measurements with laboratory data. Although the data have undergone initial verification and review for quality assurance, measurements may still have drift corrections applied, therefore, the TSS-turbidity relationship will continue to be updated following sample collection over time and all ranges of river conditions. Subsequent quality assurance and verification procedures may result in differences between what is currently provided and what will become the official record.

4.0 WATER QUALITY MONITORING PROGRAM

A summary of each water quality sampling event and corresponding analytical results were reported monthly to BC Hydro in a routine memo for eleven sampling events in 2019: January 23, March 22, April 18, May 23, June 20, July 19, August 20, September 24, October 30, November 22, and December 19, 2019. Water quality sampling and development of a routine memo were not completed for February 2019, due to frozen conditions on-site. Laboratory results for each upstream and midstream locations were used to evaluate ambient conditions and to characterize the results at the discharge or downstream locations; laboratory results for each location (River Road, South Bank Initial Access Road, and L3 and L4 Creek) are provided in Appendix B (Tables B1 to B3).

4.1 Quality Control and Quality Assurance Program

4.1.1 Tetra Tech QA/QC

The Quality Control (QC) program included experienced field staff familiar with the water quality monitoring program adhering to the British Columbia Field Sampling Manual, Part E: Water and Wastewater Sampling (Clark, 2003). New sample containers were acquired from the laboratory the day preceding the sampling event and all handling of the containers, sampling devices and equipment during sample collection was completed wearing new nitrile gloves to minimize potential for contamination of the samples. A new disposable syringe and 0.45 µm filter were used for each sample being submitted for dissolved metals, except when the concentration of TSS was observed as being high and field filtration was not possible. Samples not filtered and preserved in the field were identified and filtered at the laboratory. All samples were stored in a cooler filled with ice packs at a temperature between approximately 4°C and 8°C.

Analytical results were received monthly from ALS labs. No external lab was contracted during the 2019 monitoring period.

The Quality Assurance (QA) program incorporated use of a Travel Blank (TB), Field Blank (FB) and replicate sample to test for potential contamination during sample collection, handling or laboratory preparation, and to evaluate the precision of laboratory analysis. Table 5 lists the results of the QA program.

The analytical results of these samples were reviewed by Tetra Tech, and if potential contamination or concerns with analytical results were identified, they were discussed with the laboratory and the samples were reanalyzed for verification. Blank samples were considered to 'fail' where any measured value was in concentrations above the reported detection limits for that parameter.

Replicate samples were evaluated using relative percent difference (RPD), where an RPD value of less than 30% is considered an acceptable threshold for variation of surface waters.

Tetra Tech also reviewed the data for more general anomalies and inconsistencies. The total and dissolved concentrations for the full suite of elements were continued to be compared since there are frequent occurrences of dissolved concentrations exceeding total concentrations. The results were screened for analytical error, then assessed for expected natural variability of surface waters. Most instances were due to measurements at or near the analytical detection limit and could be explained by being within an acceptable range of error up to five times the lower detection limit for the respective element. Here, the total concentrations are considered equal to the dissolved concentrations.

Elemental concentrations measured at or slightly above the analytical detection limits in travel (TB) and field (FB) blanks occurred at times during the 2019 monitoring period, specifically for nitrate (July TB), dissolved organic carbon (December FB), total aluminum (October FB), barium (October FB), chromium (September and October FB), magnesium (October FB), manganese (October FB), tin (September FB and December TB), dissolved copper (December FB), mercury (April FB), zinc (January FB) summarized in Table 5. Consistently, an average low pH of 5.66 is measured across travel and field blanks collected between January to December 2019; this low pH result is typical for distilled water and is not identified to be an issue. The elemental concentrations measured above detection limit could be attributable to field contamination or calibration of analytical instrumentation. The majority of blank samples with elevated concentrations occurred with field blanks (75%) rather than travel blanks (25%), and similar anomalous elemental concentrations were not observed in their corresponding travel blank. Travel blanks were prepared by the laboratory and field blanks were prepared in the field at sample collection sites by field staff using the same source water as was used for the travel blank. If the source distilled water was contaminated, similar elemental anomalies would be expected in both the TB and the FB. The issues have been communicated with both the analytical laboratories and field personnel. Due to anomalous values being so close to detection limits and that particular elements were not recurring throughout the year; the accumulated error was not interpreted as a concern for this monitoring program.

Field replicate samples with differences of elemental concentrations above the acceptable threshold of RPD > 30% were noticeable for a variable number of parameters measured in January (2), April (1), May (3), June (3), July (27), August (1), October (1), November (4), December (6). Discrepancies are attributed to sediment disturbance during the collection of the first sample.

The July 19, 2019, sampling event QAQC check found that the replicate samples (LBL3C-0.02 and LBL3C-0.02-R) had significant occurrences of RPD > 30%, calculated for twenty-seven (27) parameters including TSS (RPD = 68.9%), twenty-six (26) total metals (Al, Sb, As, Ba, Be, Bi, Cd, Cs, Cr, Co, Cu, Fe, Pb, Li, Ni, P, K, Rb, Si, Ag, Te, Tl, Th, Sn, W, V, Zn) with an RPD between 30.7% to 111.8%, and no dissolved metals. Following communication with the field sampling personnel and ALS Laboratories, this discrepancy was attributed to the replicate sample containing sediment from disturbance during collection of the first sample. The replicate sample was therefore not considered a reliable comparison of the in situ conditions and laboratory analysis.

Occurrences of dissolved concentrations exceeding total concentrations in samples was calculated below the acceptable threshold of an RPD < 30%, although measurements above the acceptable threshold occurred in the following sampling events: January 23, 2019 (rubidium), April (zinc), May (cadmium), July (selenium) and December 19, 2018 (tin, molybdenum, copper).

4.1.2 Laboratory QA/QC

ALS Laboratories was used as the principle laboratory for sample analysis. Certificates of Analysis from ALS Laboratories were provided in each monthly routine memo submitted during 2019.

The lab implements a detailed QC program into the sample analysis which includes a series of checks and evaluations for consistency in the sample analysis. The QC program includes method blanks, certified reference materials, laboratory control samples and duplicates. The QC Lot reported on Assay Certificates consistently met internal ALS Data Quality Objectives.

4.2 River Road Water Quality Monitoring

There was sufficient flowing water for samples to be collected on March 22, 2019 at the RR8 and RR9 locations. Dry, freezing and/or low or no flow conditions prevailed from January through December at all locations, preventing reliable sampling at the River Road monitoring locations for 2019. In situ measurements were not collected from each station consistently every month due to dry (e.g., July, August) or frozen (e.g., October, November, December) conditions. Field observations were documented each month. A total of eighteen monthly sampling events have been conducted at the River Road catchment locations, seven in 2017 (April to October), ten in 2018 (March to December), and one in 2019 (January) by Tetra Tech; two prior sampling events occurred in 2016 (October and November) by Lorax. Since water quality sampling was not possible during 2019, except for one sample from RR8 and RR9 in March 2019, no updated time series charts are available for 2019. Please refer to the 2018 Annual Report for time series charts that summarize 2017 and 2018 water quality at River Road.

4.2.1 In Situ Measurements and Field Observations

Values for water temperature, pH, total alkalinity and electrical conductivity measured at the River Road monitoring locations are included in Table 6. At River Road during 2019, the range in water temperatures was 0.0 °C to 19.8 °C. Measurements of pH ranged between 7.59 and 9.20, whereas alkalinity ranged between 40 and 240 ppm. The trends are interpreted to be related to PAG contact waters draining into the ditch from location 12+810 and 12+700, and the increasing trend related to effects of limestone riprap within the ditch in addition to influence from alkaline run-off from the lower cut-off chimney near location 12+500.

The collection ditch on the cut-bank (north) side of River Road between approximately 12+340 and 12+960 (Blind Corner) was lined with limestone riprap in 2017 to assist with mitigating the potential effects of acid rock drainage (ARD) and metal leaching (ML) from potentially acid generating (PAG) bedrock that was exposed during the initial road construction in 2015 and early 2016. Limestone riprap within the ditch between road stations 12+600 and 12+900 continued to be maintained in 2018, including completion of a hydroseeding program and a limestone buttress as the tow of the shale slope at blind corner to support long-term erosion control and slope stability in March 2018. The hydroseed appeared to remain in place on the slope, however, germination was not successful at year's end. No maintenance activities were completed in 2019.

Potentially acidic leachate generated from the rock cut-slopes reacts with the alkaline limestone to help neutralize water as it passes through the riprap lined ditch. The ditch also serves to convey run-off water and fine sediment shed from River Road through the end-of-diversion pipe between 12+430 and LBRR-EDP where water is pooled and infiltrates or is discharged through culvert RR8 and RR9 into the Peace River if water levels exceed the inlet height of culverts. Water from the lower chimney ditch, LBRR-LC, is conveyed through culvert RR-11 to the discharge location, LBRR-DD, and Peace River.

Location LBRR-12+920 is located immediately up-gradient of the upper cut-off chimney and PAG exposure, whereas LBRR-12+810 is located immediately down-gradient the upper cut-off chimney and sits below the PAG exposure at Blind Corner. Notable decrease in water pH and alkalinity generally occurs between these stations with a gradual recovery from acidic to circumneutral pH and available alkalinity towards location 12+500.

The limestone is effective at mitigating the pH of the drainage when there are fresh surfaces of limestone available for chemical reactions. The limestone material used as riprap along this road section has become progressively coated with a mineral precipitate (visually estimated as hydroxides containing calcium, iron and aluminum) due to chemical neutralization reactions and almost entirely encased by sludge due to settlement of suspended solids within the water. Additionally, the roadside portion of the ditch, particularly from LBRR-12+600 downstream to the inlet of the diversion pipe, is being encroached with sand and gravel sediment from grading activities on River Road which covers the limestone, further reducing its exposure to the run-off water. The effectiveness of the limestone to provide the neutralizing potential is considered to be negatively compromised by these coatings.

Flows within the River Road ditch are ephemeral. On March 26, 2019, flow was observed at the LBRR-12+500 and LBRR-LC. Dry or frozen conditions prevailed for the remainder of 2019. At the RR8 and RR9 locations, no flow was recorded on March 26, 2019.

In the River Road catchment, water temperatures ranged between 0.0°C (March, October, November) to 19.8°C (July). One TSS measurement from RR8 (467 mg/L) and RR9 (684 mg/L) was collected on March 22, 2019. The source of TSS is primarily from River Road run-off, scouring of sediment deposited within the River Road ditch and washing from the cut-slopes. Elevated total metal concentrations measured in the ditch near the inlet of the RR8 and RR9 culverts on March 22, 2019 are interpreted to be directly related to washing, or flushing, of sediment and secondary mineral precipitant during freshet as water contacted accumulated sediment within the ditch in addition to the exposed shale, colluvium and overburden cut-banks. These conditions are interpreted to have been temporary in the early freshet seasons and was observed in 2018 and 2019. The March 22, 2019 sampling event indicated neutral pH values at RR8 and RR9 measuring a laboratory pH of 7.87 and 7.80, respectively.

4.2.2 Freshwater Short Term Maximum Exceedances

On March 22, 2019, exceedances to the BCAWQG-FST guidelines were measured for total and dissolved iron, dissolved aluminum and total arsenic at both the RR8 and RR9 locations, and additionally total copper at RR9 (Table 7; Appendix B1). This result suggests active ARD-ML processes on exposed PAG at Blind Corner and within Howe Pit are influencing water quality when there is flowing water.

4.2.3 Trend Monitoring

Monthly water quality monitoring measures instantaneous ambient conditions at the time of sampling and as discussed in Section 3.1 the measurements are highly susceptible to temporal climate conditions due to the small catchment and short residence time of water within the River Road ditch. Event data characterizes the influences of seasonal conditions at the site.

Recurring trends for pH and alkalinity, TSS and TDS, sulphate, total and dissolved aluminum, and total and dissolved iron at River Road during the 2017 and 2018 monitoring periods were presented in the 2018 annual report. No updates for trends along River Road were available from the 2019 monitoring period since only two samples from RR8 and RR9 were collected in 2019.

4.2.4 Freshwater Long-term Average Exceedances

In addition to BCAWQG-FST (short term) screening, laboratory results have been screened against the BCAWQG-FLT (long-term) guideline values, shown in Appendix B1 for River Road water quality data that reference results of the two samples collected from RR8 and RR9 during the 2019 monitoring periods. Insufficient data was able to be collected during 2019 at River Road to determine any long-term averages or observations.

4.3 SBIAR Water Quality Monitoring

Sufficient flowing water permitted samples to be collected monthly throughout 2019 at the SBIAR monitoring locations, specifically ten sampling events at RBSBIAR-US, RBSBIAR-DS, and RBSBIAR-EUS (March to December), nine at RBSBIAR-EDS (March to November), and nine at RBSC-DS (April to December). Field observations were documented each month.

4.3.1 In Situ Measurements and Field Observations

Values for water temperature, pH, total alkalinity and electrical conductivity measured at the SBIAR monitoring locations are included in Table 8. Flows in the SBIAR ditch system can vary between upstream (RBSBIAR-US and RBSBIAR-EUS) and downstream (RBSBIAR-DS and RBSBIAR-EDS) locations, with flows of approximately 0.10 L/s to 2.0 L/s, respectively. Seepage in the western cut-slope ditch is received partly from ponded water from Area 21. RBSC-DS is located in the side channel with connectivity to the Peace River where stagnant to minimal “flow” is observed.

Water levels at RBSC-DS are coincident with the actual levels of the Peace River. Table 4 shows the measured upstream turbidity, and converted TSS concentrations, within the Peace River. Increased turbidity measured in the Peace River results from precipitation events which can be correlated with TSS measurements collected from RBSC-DS. Thus, TSS measured at the RBSC-DS location (Figure 10) are interpreted to be attributable to, or directly influenced by, the in-river turbidity measurements (Table 4).

Algae was occasionally observed in the water during 2019 at RBSBIAR-US (April and June), RBSBIAR-EUS (April, June, September, October), and RBSBIAR-DS (April).

The range in water temperatures at RBSBIAR-US (0.4-15.6 °C), RBSBIAR-EUS (0.0-13.9 °C), RBSBIAR-DS (0.0-18.2 °C), RBSBIAR-EDS (0.0-15.2 °C), and RBSC-DS (3.3-16.2 °C), were recorded in 2019.

4.3.2 Freshwater Short Term Maximum Exceedances

Concentrations of total and dissolved iron, dissolved aluminum, and total arsenic, copper, and zinc were measured above the BCAWQG-FST at various locations and months during 2018 and 2019 within the RBSBIAR catchment. At the downstream RBSBIAR locations, at RBSBIAR-DS exceedances were reported for total and dissolved iron, total zinc and dissolved aluminum, and at RBSBIAR-EDS exceedances were reported for total iron, arsenic, copper, and zinc, and dissolved aluminum in 2019. At the upstream locations, exceedances were reported for total iron in July and December 2019 at RBSBIAR-US and in June and July 2019 at RBSBIAR-EUS.

The water flowing from RBSBIAR-DS and -EDS do not have a direct downstream receptor. In 2018, exceedances in the metals, total arsenic, copper, and zinc occurred solely at the upstream west ditch location, RBSBIAR-US (March 2018), whereas these same metals measure exceedances solely in the downstream ditches in 2019.

Exceedances to the BCAWQG-FST guidelines were measured for total and dissolved iron in August, October, November, and December (dissolved only), and total manganese in May and August, at RBSC-DS. These exceedances are considered to be transported by sediment entrainment from run-off and groundwater inflows and elevated concentrations may be in association with algal development in the side channel; these concentrations are not interpreted to be directly influenced by construction related PAG contact water.

A summary of water quality exceedances relative to BCAWQG-FST listed by monitoring location in and month are listed in Table 9, and the screening results based on the laboratory data are tabulated in Appendix B, Table B2.

4.3.3 Trend Monitoring

Monthly water quality monitoring measures instantaneous ambient conditions at the time of sampling and, as discussed in Section 3.1, the measurements are highly susceptible to temporal climate conditions due to the small catchment and short residence time of water with the SBIAR ditch. Recurring trends at SBIAR over the 2017, 2018 and 2019 monitoring periods may be preliminary indicative of long-term trends, and are discussed below for pH (Figure 6) and alkalinity (Figure 7), sulphate (Figure 8), TDS (Figure 9), TSS (Figure 10a), TSS long-term running average (10b), total and dissolved aluminum (Figures 11a and 11b), and total and dissolved iron (Figures 12a and 12b), in addition to trends in specific metals such as arsenic (Figure 13a and 13b), cadmium (Figure 14a and 14b), cobalt, (Figure 15a and 15b), copper (Figure 16a and 16b), zinc (Figure 17a and 17c) and total zinc long-term running average (Figure 17b). A comparison of downstream vs. upstream concentrations of zinc in the west RBSBIAR-DS (Figure 18a) and east RBSBIAR-EDS (Figure 18b) ditch is provided for discussion of observed trends between upstream and downstream sample locations.

4.3.3.1 Alkalinity and pH

Alkalinity and pH values indicate that waters have remained alkaline during 2017, 2018 and 2019. In 2019, values for pH measured at RBSBIAR-DS range between 8.03 to 8.29 with a mean pH value of 8.15, and at RBSBIAR-EDS range between pH 7.80 to 8.31 with a mean pH value of 8.08 (Table 10). Alkalinity trends between the upstream and downstream monitoring location are variable yet show similar trends between upstream (RBSBIAR-US/-EUS) and downstream (RBSBIAR-DS/-EDS), and east (RBSBIAR-EUS/-EDS) and west (RBSBIAR-US/-DS) ditches (Figures 6 and 7).

There is an increasing trend for alkalinity in both upstream and downstream (east and west) ditches and RBSC between March and April/May followed by a significant decrease in July at all locations except RBSBIAR-DS which remains more constant. Alkalinity returned to former higher April/May levels in August through the remainder of 2019. Values for alkalinity at RBSBIAR-DS range between 102 mg/L and 287 mg/L $CaCO_3$ equivalent (mean value of 210 mg/L $CaCO_3$ equivalent), and at RBSBIAR-EDS range between 202 mg/L and 331 mg/L $CaCO_3$ equivalent (mean value of 270 mg/L $CaCO_3$ equivalent) (Table 10).

Measured pH at the side channel location RBSC-DS range between 7.44 and 8.44, and alkalinity range between 200 and 440 mg/L $CaCO_3$ equivalent. The RBSC-DS location generally measures higher alkalinity values and similar to slightly lower pH values relative to the other SBIAR sampled ditch locations, and there is low to negligible similarity in trends observed for pH and some similarity in trends for alkalinity between the side channel and the SBIAR waters.

4.3.3.2 Hardness

Water hardness measured at RBSBIAR-DS ranges between 192 and 517 mg/L, with a mean value of 328 mg/L, and at RBSBIAR-EDS ranges between 231 and 1,150 mg/L with a mean value of 456 mg/L. The water hardness was commonly above the upper threshold used by the BCAWQG-FST (250 mg/L) to guide calculation and exceedance criteria for various metal or element concentrations (e.g., total sulphate, copper, lead, manganese, silver, zinc; dissolved cadmium). When the maximum hardness value is reached for elements that are hardness-dependent for BCAWQG-FST guideline calculations, the respective maximum hardness values for zinc, copper, and cadmium are used as capped hardness values in the calculations. Elevated ambient water hardness values are also observed in measurements from other catchments on-site and likely is characteristic of elevated background conditions of hard soils and groundwater.

4.3.3.3 Total Suspended Sediment (TSS) and Total Dissolved Sediment (TDS)

TSS measurements at the downstream RBSBIAR-DS/-EDS and upstream RBSBIAR–US/-EUS locations are variable both between upstream and downstream, and between west and east ditches, thus have different trends during the 2019 sampling period (Figure 10a). The overall variability in TSS is attributable to the relatively small catchment and short residence time of waters within both the west and east SBIAR ditches and sensitivity to flux in surface water inputs from precipitation or seepage inputs from Area 21. TSS concentrations measured at RBSBIAR-DS range between <3.0 and 124 mg/L with mean value of 23.8 mg/L, and at RBSBIAR-EDS range between 11.6 and 1,680 mg/L TSS. Measured TDS concentrations ranged between 347 and 848 mg/L with mean value of 545 mg/L at RBSBIAR-DS, and between 282 and 1,720, with a mean value of 1,176 mg/L TDS at RBSBIAR-EDS.

During freshet in March 2019, the downstream RBSBIAR-EDS and RBSBIAR-DS locations measured elevated TSS values. TSS is highly variable and sensitive to the local conditions at the time of sampling. The upstream RBSBIAR-EUS and RBSBIAR-US locations measure lower TSS values than the downstream locations.

Measured TSS values within the RBSC-DS ranged between <3.0 and 29.5 mg/L , peaking in the August 2019 sampling event, and differs from trends and peaks for TSS in 2017 and 2018. TSS values at RBSC appear to occasionally, but not always, have a similar trend as the downstream ditch locations, RBSBIAR-DS and RBSBIAR-EDS, showing an increase and decrease in the same months of August through November.

Measured TDS values within the RBSC-DS ranged between 763 and 2,150 mg/L showing a wide variability with peak TDS values observed in the June and August 2019 sampling events. Notably, TDS values also peaked in June 2018 and July 2017, therefore may occur seasonally during warm and drier months. TDS shows strong positive correlation (0.94-0.99) with dissolved calcium, dissolved magnesium, dissolved potassium, chlorine and hardness values (Appendix C) monitoring. Increased TSS levels observed between the upstream and downstream monitoring locations are a result of active erosion from the cut-bank above the west and east SBIAR ditches, and from roadway run-off. TSS shows strong correlation with some total metal concentrations (e.g. total aluminum, total arsenic, total iron; Appendix C correlation values > 0.92) resulting from the entrainment of metals within the shale material and also concentrated metals contained in secondary mineral precipitates. The long-term running average for TSS during 2019 released into the east ditch (520 mg/L), calculated as the difference between downstream and upstream TSS (Figure 10b), is an estimated 65 times greater than the running average for TSS released in the west ditch (7.6 mg/L), indicating significantly higher erosion rates occur from the slope along the east ditch. Based on an estimated 5000 m^2 area along the RBSIAR east ditch and average flow rate of 0.75 L/s, an estimated 390 mg/s rate of sediment may be released into the east ditch. This estimation is based on assumptions for surface area, flow rate and averaged TSS values from nine sampling data points during 2019. Higher erosion rate could be a source of higher total metal concentrations. Although the erosion rate is subject to significant error it contributes to understand the significantly higher erosion rates to likely be occurring in the SBIAR east ditch (390 mg/s) than in the SBIAR west ditch (1.52 mg/s).

4.3.3.4 Sulphate

Sulphate values measured at the upstream RBSBIAR-US/–EUS locations are similar and significantly lower than in the downstream RBSBIAR-DS/-EDS locations, indicating a net increase downstream in sulphate from groundwater seepage, and local shale run-off (Figure 8). Sulphate concentrations measured at RBSBIAR-DS ranged between 59.4 and 219 mg/L with mean value of 118 mg/L, and at RBSBIAR-EDS ranged between 79 and 391 mg/L with mean value of 188 mg/L. There is a seasonal trend of sulphate concentrations peaking in June or July of each year (2017 through 2019). The upstream RBSBIAR-US/-EUS locations show more consistent sulphate concentrations between 2017 and 2019, whereas the downstream RBSBIAR-DS/-EDS locations show higher sulphate values and RBSC location shows lower sulphate values relative to previous years.

Measured sulphate concentrations at the RBSC-DS location in 2019 varied widely between 262 and 1,060 mg/L. A seasonal trend may be evident whereby sulphate concentration peaks in late spring/early summer during June relative to lower sulphate values during the early spring and autumn/winter seasons. Sulphate concentrations at the side channel RBSC-DS location appear to generally, but not always, follow a similar trend to the RBSBIAR-DS location, although this observation may be related to other sources.

The BCAWQG-FLT guideline for sulphate is variable with ambient hardness for each sample location and is plotted on Figure 8 for the RBSBIAR-DS location for reference. The RBSC-DS location is the only sampling location that measures sulphate above the BCAWQG-FLT guideline consistently through 2017, 2018 and 2019.

4.3.3.5 Total and Dissolved Aluminum

Total aluminum concentrations during 2019 measured at RBSBIAR-DS ranged from 48.3 to 2,680 µg/L with mean value of 746 µg/L, and at RBSBIAR-EDS ranged from 167 to 14,200 µg/L with mean value of 5,216 µg/L. A seasonal trend from trailing three years suggests that total aluminum concentrations at RBSBIAR-DS peak in early freshet (March) and can either peak again in late summer (August) and/or fall (September/October) (Figure 11a).

At the downstream RBSBIAR-DS and RBSBIAR-EDS locations, dissolved aluminum concentrations fluctuated below and above the BCAWQG-FST guideline value (100 µg/L) during 2019, whereas the upstream RBSBIAR-US and RBSBIAR-EUS locations and RBSC location remained below the guideline value. Exceedances to the BCAWQG-FST guideline for dissolved aluminum at RBSBIAR-DS were measured in four occurrences in March (102 µg/L), July (250 µg/L), August (238 µg/L), and November (107 µg/L) 2019, and at RBSBIAR-EDS six occurrences in March (126 µg/L), May (128 µg/L), July (321 µg/L), August (349 µg/L), September (161 µg/L) and November (259 µg/L) 2019. A decreasing trend or 'dip' in both total and dissolved aluminum measured at RBSBIAR-DS is observed in June 2017, 2018 and 2019, preceded and followed by an increase in total and dissolved aluminum during March/April and August/September for all three years. The east and west downstream ditches RBSBIAR-DS/-EDS follow similar trends in 2019 with the east ditch slightly higher in dissolved aluminum than the west ditch.

Although the downstream RBSBIAR-DS and RBSBIAR-EDS locations show similar trends in both total and dissolved aluminum, there is a more significant difference in concentrations between upstream and downstream for dissolved than total aluminum.

The RBSC-DS trends are more similar to the upstream RBSBIAR-US/-EUS locations in dissolved aluminum values, that commonly measure near or below the detection limit (1.0 µg/L) and significantly below the BCAWQG-FST guideline (100 µg/L).

The overall decrease of total aluminum at RBSBIAR-US observed to occur between spring and winter within both the 2017 and 2018 sampling periods is not observed between March and December of 2019, and instead shows an overall increase during the 2019 sampling period. Total aluminum measured at the RBSC-DS location decreased overall during the 2019 monitoring period, whereas the other SBIAR ditch locations slightly increase or remain steady overall in total aluminum concentrations during 2019.

It is noted that dissolved aluminum is the most variable at the downstream RBSBIAR-DS/-EDS locations, and total aluminum is equally variable at all locations throughout 2017, 2018 and 2019.

4.3.3.6 Total and Dissolved Iron

Total iron concentrations are variable during the monitoring period (Figure 12), with concentrations at the RBSBIAR-DS location ranging between 41.0 to 5,640 µg/L with mean value 1,272 µg/L. At RBSBIAR-DS, exceedances to the BCAWQG-FST guideline (1,000 µg/L) for total iron concentration were measured in March (5,640 µg/L), July (1,840 µg/L), August (2,830 µg/L) and December (1,070 µg/L) 2019 and significantly decreased to below guideline levels in the other sampled months during 2019 especially June, September and November 2019. At the downstream east ditch RBSBIAR-EDS location, exceedances to the BCAWQG-FST guideline (1000 µg/L) for total iron concentration were measured in March (23,800 µg/L), April (39,600 µg/L), July (7,040 µg/L), August (11,000 µg/L), October (29,700 µg/L) and November (9,370 µg/L) 2019 and decreased to below guideline levels in the other sampled months of May, June and September 2019. Exceedances to the BCAWQG-FST guideline for total iron concentration also occurred at RBSBIAR-US (July and December), RBSBIAR-EUS (June and July), and RBSC (August, October and November).

Dissolved iron concentrations measured well below the BCAWQG-FST guideline (350 µg/L) ranging between < 10 to 64 µg/L at RBSBIAR-EDS, RBSBIAR-US and RBSBIAR-EUS through the 2019 sampling season. At RBSBIAR-DS, dissolved iron measured below or near detection limit of 10 µg/L in nine of the ten months sampled in 2019, and above the BCAWQG-FST guideline (350 µg/L) in August 2019 (401 µg/L). At RBSC-DS dissolved iron measured below the BCAWQG-FST guideline in five of the nine months sampled in 2019 ranging between 26 to 124 µg/L, and above the BCAWQG-FST guideline in August (530 µg/L), October (1,980 µg/L), November (1,280 µg/L), and December (661 µg/L).

4.3.3.7 Metals: Arsenic, Cadmium, Cobalt, Copper, and Zinc

Metals such as arsenic, cadmium, cobalt, copper, and zinc are important indicators of ARD-ML processes and environmental changes in the water supply. In 2019, ten sampling events (March to December) occurred at the downstream west RBSBIAR-DS location, and nine sampling events (March to November) occurred at the downstream east RBSBIAR-EDS location, discussed below. Table 10 summarizes the minimum, maximum and mean concentrations for the following measurements and water quality data for the SBIAR monitoring locations is provided in Appendix Table B2.

At the downstream west RBSBIAR-DS, one exceedance was measured during 2019 for total zinc on March 22, 2019. At the downstream east RBSBIAR-EDS during 2019, exceedances for three metals including total arsenic, copper and zinc were measured in March, April and August, in addition to total zinc in July and total arsenic in October. No exceedances for these three metals were measured in the May, June, September or December 2019 sampling events at the downstream RBSBIAR-DS/-EDS ditch locations. No exceedances were measured at the upstream RBSBIAR-US and -EUS locations in 2019 for the metals: arsenic, cadmium, cobalt, copper and zinc.

Arsenic

Total arsenic concentrations measured during 2019 at RBSBIAR-DS ranged from 0.25 to 3.14 µg/L with mean value of 0.83 µg/L, and dissolved arsenic ranged from 0.15 to 0.25 µg/L with mean value of 0.20 µg/L. No BCAWQG-FST guideline exceedances in total arsenic occurred at the downstream west RBSBIAR-DS during 2019. Four exceedances to the BCAWQG-FST guideline (5.0 µg/L) for total arsenic were measured at the downstream east

RBSBIAR-EDS during 2019 in March (11.0 µg/L), April (15.7 µg/L), August (5.9 µg/L) and October (12.0 µg/L), whereas in the other five sampled months total arsenic values ranged between 0.31 to 4.51 µg/L below the BCAWQG-FST guideline. Trends for total arsenic at the downstream ditch locations, RBSBIAR-EDS and RBSBIAR-DS will continue to be observed during the 2020 sampling period. Total arsenic concentrations in the upstream and RBSC locations remain within the same general range of total arsenic concentrations measured during 2017 and 2018 (Figure 13a and 13b).

Cadmium

Total cadmium concentrations during 2019 measured at the downstream west RBSBIAR-DS ranged from 0.027 to 1.22 µg/L with mean value of 0.333 µg/L, and dissolved cadmium ranged from 0.021 to 1.010 µg/L with mean value of 0.237 µg/L. Total cadmium measured at the downstream east RBSBIAR-EDS ranged from 0.13 to 3.07 µg/L with mean value of 1.20 µg/L, and dissolved cadmium ranged from 0.01 to 1.21 µg/L with mean value of 0.41 µg/L. No BCAWQG-FST guideline exceedances in dissolved cadmium occurred at either the RBSBIAR-DS or RBSBIAR-EDS locations during 2019, although dissolved cadmium values show an increasing trend in 2019 relative to previous years of 2017 and 2018 at the downstream ditches (Figure 14a and 14b).

Cobalt

Total cobalt concentrations measured at RBSBIAR-DS during 2019 ranged from 0.27 to 26.9 µg/L with mean value of 6.96 µg/L, and dissolved cobalt ranged from 0.13 to 27.6 µg/L with mean value of 6.24 µg/L. Total cobalt concentrations measured at RBSBIAR-EDS ranged from 2.44 to 65.6 µg/L with mean value of 23.3 µg/L, and dissolved cobalt ranged from 0.45 to 56.10 µg/L with mean value of 16.27 µg/L. No BCAWQG-FST guideline (110 µg/L) exceedances in total cobalt occurred at RBSBIAR-DS or -EDS, although four of the ten measurements for total cobalt at RBSBIAR-DS and eight of the nine measurements for total cobalt at RBSBIAR-EDS are elevated above the BCAWQG-FLT guideline (4.0 µg/L). Total cobalt values are within the same general range as 2017 and 2018 at the upstream RBSBIAR-US/-EUS locations but show increasing concentrations and variability relative to 2017 and 2018 at the downstream RBSBIAR-DS/-EDS locations in 2019. Figure 15a and 15b summarize trends for total and dissolve cobalt at the RBSBIAR ditches and side channel locations.

Copper

Total copper concentrations measured at RBSBIAR-DS during 2019 ranged from 0.72 to 20.2 µg/L with mean value of 5.96 µg/L, whereas dissolved copper ranged from 0.52 to 4.93 µg/L with mean value of 1.77 µg/L. Total copper concentrations measured at RBSBIAR-EDS during 2019 ranged from 1.91 to 58.0 µg/L with mean value of 25.6 µg/L, whereas dissolved copper ranged from 0.56 to 4.20 µg/L with mean value of 2.04 µg/L. Total copper was subject to BC's Ministry of Environment BCAWQG-FST guideline prior to August 2019, thus the testing for total copper was ceased following August 20, 2019 and dissolved copper was utilized from that point. No BCAWQG-FST guideline exceedances in total copper occurred at RBSBIAR-DS, and three exceedances to the BCAWQG-FST guidelines (32.5-39.6 µg/L; hardness-dependent) for total copper was measured at RBSBIAR-EDS in March (38.4 µg/L), April (45.2 µg/L) and August (58.0 µg/L) 2019. Total copper values show increasing concentrations and variability relative to 2017 and 2018 values (Figure 16a).

The BCAWQG-FST guideline for dissolved copper introduced in August 2019 was implemented into the monthly water quality sampling program for the September 24, 2019 sampling event. No exceedances for dissolved copper were measured in the RBSBIAR ditch and side channel locations in 2019, although increasing variability and dissolved copper values are apparent. (Figure 16b).

Zinc

Total zinc concentrations measured at RBSBIAR-DS during 2019 ranged from 7.80 to 289 µg/L with mean value of 73.3 µg/L, whereas dissolved zinc ranged from 2.0 to 175 µg/L with mean value of 41.9 µg/L. Total zinc concentrations measured at RBSBIAR-EDS during 2019 ranged from 26.2 to 717 µg/L with mean value of 248.5 µg/L, whereas dissolved zinc ranged from 3.1 to 117 µg/L with mean value of 49.6 µg/L. At RBSBIAR-DS, one exceedance to the BCAWQG-FST guideline (hardness-dependent range of 109.5 to 340.5 µg/L) for total zinc was measured on March 22, 2019 (137 µg/L). At RBSBIAR-EDS, four exceedances to the BCAWQG-FST guideline (hardness-dependent range of 209 to 340.5 µg/L) were measured for total zinc in March (269 µg/L), April (315 µg/L), July (412 µg/L) and August (717 µg/L). Total and dissolved zinc values show increasing concentrations and variability in 2019 relative to 2017 and 2018 values (Figure 17a and 17c) follow a different trend in 2018 than in 2017, reaching slightly higher concentrations in March and September, and slightly lower concentration in June 2018.

The chart shown in Figure 18a (RBSBIAR-DS/-US) and 18b (RBSBIAR-EDS/-EUS) depicts the ratio difference in total zinc concentration between the downstream vs upstream location in the west and east ditch, in order to measure the relative contribution of zinc to water from ARD-ML activity each RBSBIAR ditch. A possible overall trend in total zinc concentration shows a progressive increase both seasonally in early spring freshet and summer within each sampling year of 2018 and 2019, and the overall maximum total zinc concentration reached each year has progressively increased. The metric will continue to be monitored going forward to validate potential trends.

4.3.3.8 Ammonia and Nitrogen Species

Ammonia (NH_4 as N) is subject to a temperature and pH-dependent BCAWQG-FST and -FLT guideline. Although no exceedances are measured, it is observed that ammonia values measure higher in the downstream RBSBIAR ditches (RBSBIAR-DS/-EDS) than in both the upstream ditches and the RBSC side channel. A peak in ammonia in July 2019 coincides with a peak in monitored metals such as copper and cobalt. Nitrate (NO_3 as N) and nitrite (NO_2 as N) show seasonal sharp peaks primarily at the RBSBIAR-DS in either June, July or August through the 2017, 2018 and 2019 monitoring periods. The source of ammonia and nitrogen species is unknown although it could possibly be related to nearby agricultural inputs into the water supply; no explosives are known on-site. In contrast, RBSC-DS measured low nitrate and nitrite. This parameter will continue to be monitored in 2020.

4.3.3.9 Trend Monitoring Summary

Notably, the sampling in 2018 and 2019 at the SBIAR ditches and RBSC-DS results in a similar trend showing for zinc, cobalt, copper, cadmium, iron, aluminum and TSS with an inverse trend for sulphate more apparent in 2018 than in 2019. In July, a decrease in pH and alkalinity at the downstream RBSBIAR-DS and SBIAR-EDS locations coincides with a sharp increase in TDS and TSS, and in metals such as cobalt, zinc, aluminum, arsenic, iron, copper, and also sulphate. The lowest pH recorded during the 2017, 2018 and 2019 sampling periods in the SBIAR ditches and side channel is at the RBSC-DS location of approximately pH 7.5 which occurred in May, August and October 2019 although pH remains within the BCAWQG-FST guidelines (pH 6.50 - 9.00).

TSS trends show more similar trends with the metal concentrations on month-to-month comparison than with TDS. The majority of metals present in the solid phase and are interpreted as washing of mineral precipitate from the shale slopes, and with some sediment input from roadway run-off.

The RBSBIAR-EDS location commonly measures higher values but similar trends to the downstream west ditch RBSBIAR-US. The downstream east and west ditches show generally similar trends to the upstream east and west ditch trends. An exception to this observation is for alkalinity values which relate more closely between upstream and downstream within one ditch.

Measurements for pH are more variable in 2019 than in 2018 in the RBSBIAR catchment. The trend in total alkalinity (as bicarbonate) in water samples during 2019 measured an increase between March to May, decrease between May and July 2019, and an increase to earlier 2019 levels between August and December 2019. Alkalinity values show a variable and general increasing trend especially for the downstream ditch locations although remain within normal to decreasing values at the upstream ditch locations, relative to the range in alkalinity values recorded in 2017 and 2018. The alkalinity measured at RBSC-DS during 2019 reached higher values in May and August 2019 than in 2017 and 2018, although remained within normal range of 2017 and 2018 values for the majority of 2019. This increasing trend for the downstream ditch locations suggests increased acidity loading within the SBIAR ditch due to ARD-ML processes on the exposed PAG cut-slopes within the facility.

At the Peace River side channel at the base of SBIAR, RBSC-DS, total and dissolved iron were in exceedance of BCAWQG-FST guidelines in August, October, November and December 2019. This 2019 trend at RBSC is similar to 2018 trends for total and dissolved iron. The RBSC location is a verification point to check for potential leakage from, or direct connectivity with, the SBIAR PAG contact water with the side channel. There has not appeared to be hydraulic connectivity between SBIAR and the RBSC side channel previously, although increased variability at RBSC during 2019 will continue to be monitored in 2020. Exceedances thus far have not been considered to be influenced by construction related PAG contact water but rather related to natural turbidity.

Total zinc concentration shows a progressive increasing trend over the three years up to the end of 2019 and will continue to be monitored.

Monthly sampling in the SBIAR catchment occurred during 2019 and will need to continue to be monitored for effective observations of trends.

4.3.4 Freshwater Long-term Average Exceedances

Exceedances to the long-term BCAWQG-FLT guidelines (lower values) that do not exceed the short term BCAWQG-FST (higher value) guidelines were measured at the downstream east and west ditches, RBSBIAR-EDS and RBSBIAR-DS. Since long-term exceedances are not intended for screening of discreet events, long-term trends relative to the BCAWQG-FLT will be investigated during the 2020 monitoring period with the accumulation of further data. An investigation of the long-term running average of total zinc values measured between 2017 and 2019 (Figure 17b) indicate an increasing trend in the two downstream ditch sample locations, and to lesser extent in the side channel location, as part of the SBIAR monitoring.

4.4 L3 Creek Catchment Water Quality Monitoring

Sufficient flowing water through 2019 permitted samples to be collected for nine months (March to November) at the downstream LBL3C-0.02 and upstream LBL3C-3.32 locations, ten months (March to December) at the lower midstream LBL3C-1.43 location, eight months at the upper midstream LBL3C-1.65 location (January, March-April, July-August, October-December), and eight months (March-May, July-November) at the L4 Creek LBL4C-0.18 location. Field observations were documented each month.

The L3 Creek catchment is not being monitored as a construction related PAG waterway. Water quality monitoring has been conducted within this catchment to monitor discharge water quality and to maintain a record for potential future use. The BCAWQG-FST values were also used as benchmark for monitoring water quality at the discharge location (LBL3C-0.02) from L3 Creek.

4.4.1 In Situ Measurements and Field Observations

Water flow estimated during water sampling events in 2019 range between 3.0 L/s (June and September) and 20.0 L/s (April and August) from the LBL3C-0.02 location into the RR-10 culvert. Midstream water flow was estimated to range between 0.05 L/s (December) and 20.0 L/s (August) at the LBL3C-1.43 site (Table 11).

The range in water temperatures at LBL3C-0.02 (0.0-12.7 °C), LBL3C-1.43 (0.0-13.1 °C), LBL3C-1.65 (0.0-17.6 °C), LBL3C-3.32 (0.0-12.3 °C), and LBL4C-0.18 (0.0-13.0 °C), with the lowest temperatures recorded in March and highest temperatures recorded in July and August during 2019 (Table 11).

Turbidity was observed as being clear within the L3 Creek locations throughout the 2019 monitoring program, except for turbid conditions recorded at LBL3C-1.43 (July, August, October, November), LBL3C-1.65 (April), LBL3C-3.32 (April), LBL3C-3.32 (April) and LBL4C-0.018 (April, July, August, November). Algae was observed at LBL3C-1.43 (June, September), and turbid water quality was recorded in March 2019 at all five locations. On January 23, 2019, orange staining was noted in the field observations at LBL3C-1.65 and was interpreted to be related to a small bedrock seepage channel instead of the main L3 Creek channel.

4.4.2 Freshwater Short Term Maximum Exceedances

Within the four L3 Creek and one L4 Creek sample locations during 2019, total and dissolved iron, total cobalt, zinc, copper, arsenic, manganese, silver, and dissolved aluminum, cadmium and copper were measured a minimum of one occurrence above BCAWQG-FST guidelines, and pH below BCAWQG-FST guidelines, summarized in Table 12 with screening results based on laboratory data provided in Appendix B, Table B3.

At the four sampling locations within L3 Creek, exceedances to the BCAWQG-FST guidelines were reported for nine parameters in at least one instance for total and dissolved iron, total cobalt, zinc, copper, arsenic and manganese, and dissolved aluminum and cadmium during the 2019 monitoring period. The LBL3C-0.02 discharge location measured exceedances in total iron (six samples), zinc (March), copper (March), arsenic (July), and dissolved aluminum (eight samples) during the nine months (March through November) of sampling in 2019. The LBL3C-3.32 upstream location measured one exceedance in total manganese (July 2019). The LBL3C-1.65 upper midstream location measured BCAWQG-FST exceedances in eight parameters and LBL3C-1.43 lower midstream location measured BCAWQG-FST exceedances in seven parameters in at least one occurrence.

The total iron exceedances in four of the five L3 and L4 Creek locations (except upstream LBL3C-3.32) in March, April, August, and November 2019 are interpreted to be directly related to TSS concentrations within the creek. Management of TSS originating from RSEM L3 was under active monitoring, management and mitigation through 2017, 2018 and 2019. Dissolved iron exceeded the BCAWQG-FST guideline (350 µg/L) at LBL3C-1.43, -1.65 and LBL4C-0.18 locations at least once during 2019, although minimal iron was measured in the dissolved phase at the discharge LBL3C-0.02 between March and November 2019 (<10 to 138 µg/L) and remained below BCAWQG-FST guidelines.

At LBL3C-0.02, dissolved aluminum was measured to exceed the BCAWQG-FST in eight of the nine months sampled in 2019 (April through November 2019) and are interpreted to be primarily related to water inputs from both L4 Creek and from seepage into L3 Creek between sample location LBL3C-1.43 and LBL3C-0.02. Dissolved aluminum is potentially measurable as concentrations of aluminum hydroxide complexes in solution. Groundwater seepage from natural shale bedrock and the Howe Pit area is interpreted as the main input to this portion of the L3 Creek, with secondary inputs as surface run-off from the Howe Pit area. Twelve parameters in at least one instance exceeded or outside the BCAWQG-FST at the LBL4C-0.18 location for total and dissolved iron, total cobalt, zinc, copper, arsenic, manganese and silver, dissolved aluminum, cadmium and copper, and pH during the 2019 monitoring period.

4.4.3 Trend Monitoring

Recurring trends within the L3 catchment over the 2017, 2018 and 2019 monitoring period may be indicative of long-term trends, and are discussed below for pH (Figure 19), alkalinity (Figure 20), TSS (Figure 21) and TDS (Figure 22), sulphate (Figure 23), total and dissolved aluminum (Figures 24a and 24b), total and dissolved iron (Figures 25a and 25b), in addition to trends in specific metals such as total and dissolved arsenic (Figures 26a and 26b), total and dissolved cadmium (Figures 27a and 27b), total and dissolved cobalt, (Figures 28a and 28b), total and dissolved copper (Figures 29a and 29b), and total and dissolved zinc (Figures 30a and 30b).

4.4.3.1 Alkalinity and pH

Alkalinity and pH values measured in L3 Creek indicate that the waters have remained alkaline between January and December 2019, with exception to low pH (below the BCAWQG-FST guideline in September/October 2019) coupled with low alkalinity levels measured in LBL4C-0.18 (May, September and October 2019), and low pH coupled with elevated alkalinity measured at LBL3C-1.65 in December 2018 and 2019. These two observances indicate there are variable acidic waters within the L3 catchment (Figures 19 and 20). Measured pH at location LBL3C-0.02 ranged between 7.80 and 8.39 with mean value of 8.18, and alkalinity ranging between 72.2 and 265 mg/L $CaCO_3$ equivalent with mean value of 194 mg/L $CaCO_3$ equivalent. Generally, pH remained consistently neutral (with exception to the above-mentioned occurrences at LBL4C-0.18 and LBL3C-1.65), while alkalinity gradually increased between March and December in 2019 at all L3 Creek sampling locations, with the exception of LBL4C-0.18, indicating lack of correlation between the L3 Creek monitoring locations and the L4 Creek.

The trends in pH for 2017 and 2018 similarly show more variability at LBL3C-1.65 and LBL4C-0.18 locations and more consistency of neutral pH at LBL3C-0.02, LBL3C-1.43, and LBL3C-3.32 locations. A trend in alkalinity shows a general increase occurred between March and December during both 2018 and 2019 at L3 Creek locations which was not observed at L4 Creek.

4.4.3.2 Hardness

Water hardness measured at LBL3C-0.02 was consistently above the upper bound (250 mg/L) used by the BCAWQG-FST to guide criteria for metal concentrations except for March 22, 2019 (111 mg/L), with values ranging between 284 and 1,130 mg/L in April to November, with mean value of 720 mg/L (Table 10).

4.4.3.3 Total Suspended Sediment (TSS) and Total Dissolved Sediment (TDS)

TSS concentrations measured within L3 Creek varied on a monthly basis between monitoring locations (Figure 21). TSS concentrations measured at LBL3C-0.02 ranged between 3.70 and 1,600 mg/L with a mean value of 400 mg/L. Concentrations were generally observed to be either similar or less at the discharge location (LBL3C-0.02) relative to the immediate upstream location (LBL3C-1.43) except for June 20, 2019. It is believed that the decreasing trend in TSS from upstream to downstream locations is due to settlement.

TDS concentrations show moderate to high correlation between monitoring locations with overall variability on a monthly basis. TDS concentrations measured at the LBL3C-0.02 location ranged between 282 and 1,720 mg/L with a mean value of 1,176 mg/L.

The increasing trend observed for TDS appears to be inverse to the decreasing trend for TSS in both the 2018 and 2019 monitoring period (Figure 22). As discussed in Section 3.1, the role of dominant input waters to flow conditions in L3 Creek strongly influences the measured water quality. Events resulting in high TSS measurements may be higher flows related to precipitation or recent precipitation in the form of shallow groundwater flow, whereas events resulting with high TDS and low TSS measurements may be related to low precipitation and high regional groundwater baseflow. As spring freshet wanes and the dominant influent water transitions to regional groundwater, trends in TDS and TSS are influenced. In 2018 and 2019, it is observed that freshet is related to low concentrations of TDS that gradually increase towards May and June then level off with some more minor variability for the remainder of the year.

4.4.3.4 Sulphate

Sulphate measurements have remained highly variable between January and December 2019, for the LBL3C-0.02, LBL3C-1.43 and LBL3C-3.32 locations, spiking in March, July and November 2019 (Figure 23). Sulphate also spiked in different yet specific months in both 2017 (April and September) and 2018 (April). Sulphate concentrations measured at LBL3C-0.02 ranged between 50.9 and 943 mg/L with mean value of 540 mg/L.

Monthly variability in measured sulphate shows a similar trend for TDS including the overall increase in both sulphate and TDS over the monitoring period of the three monitoring periods of 2017, 2018 and 2019. The similar trend in TDS and sulphate suggests that possibly elevated sulphate concentrations represent months where groundwater inputs dominate flow in L3 Creek and relate to the transition from freshet early in the season to regional groundwater input throughout the remainder of the year, especially during the dry or minimal precipitation, e.g. July and September 2019, or summer and autumn months as was the case in the region for 2018. Significant precipitation in the preceding seven days to the August 20, 2019 likely contributed to increased surface run-off that is related to the decrease in sulphate and TDS.

The BCAWQG-FLT guideline for sulphate is variable with ambient hardness for each sample. The FLT is plotted on Figure 23 at the LBL3C-0.02 location, for reference.

4.4.3.5 Total and Dissolved Aluminum

Total aluminum concentrations measured at the LBL3C-0.02 location ranged between 353 and 16,800 µg/L with mean value of 4,595 µg/L and shows variability (Figure 24a).

Dissolved aluminum also shows variability throughout 2019 (Figure 24b), with eight (April through November 2019) of nine measurements at LBL3C-0.02 exceeding the BCAWQG-FST guideline (100 µg/L) ranging between 40.1 to 210 µg/L with mean value of 139 µg/L. It is observed that dissolved aluminum concentrations are generally higher at the discharge location LBL3C-0.02 relative to the LBL3C-1.43 location, likely due to input from impacted waters in the Howe Pit area, likely due to exposure of shale or prolonged removal of the overburden cover. A possible winter trend is indicated at LBL3C-1.65 with increased dissolved aluminum measured in January and December 2019, similar to December 2018, that exceed the BCAWQG-FST guideline and measures higher than the downstream LBL3C-1.43 location. This increase in dissolved aluminum at LBL3C-1.65 in December and January 2019 corresponds to a decrease in pH in the same months at this location due to increased solubility of aluminum with decreasing pH.

The LBL3C-0.02 and -1.43 locations generally have similar trends for dissolved aluminum in 2017, 2018 and 2019, with the discharge location, LBL3C-0.02, measuring higher values than the upstream LBL3C-1.43 location, and LBL3C-0.02 exceeding the BCAWQG-FST guideline for dissolved aluminum in the majority (eight of nine) of sampling events. During 2019, the upstream LBL3C-3.32 and upper midstream LBL3C-1.65 locations follow a similar trend and concentrations in dissolved aluminum that are the lowest values in L3 Creek. The LBL4C-0.18 location consistently measures the highest dissolved and total aluminum concentrations in the L3 catchment throughout 2017, 2018 and 2019. Water quality measured at the LBL3C-1.43 location measures ARD-ML influence from L4 Creek inflow to the downstream waters in low concentration, indicating that these high inputs from L4 Creek are diluted or settled downstream of the confluence with L3 Creek.

4.4.3.6 Total and Dissolved Iron

Total iron values were measured at elevated concentrations throughout 2019 in continuation from 2017 and 2018, (Figure 25a), with concentrations in 2019 measured at LBL3C-0.02 ranging between 290 and 39,700 µg/L with mean value 9,309 µg/L, resulting in six of nine sampling events measuring above the BCAWQG-FST guideline for total iron (Table 12). Locations within the L3 catchment that had total iron concentrations measured above the BCAWQG-FST guideline during 2019 were the downstream LBL3C-0.02 and -1.43 locations (March-April, July-August, October-November), midstream above the L4 Creek confluence, LBL3C-1.65 (January, March-April, August, November-December) and LBL4C-0.18 (March-November). The upstream LBL3C-3.32 location did not exceed the BCAWQG-FST guideline (1000 µg/L) for total iron in 2019 or 2018.

For all sampling events in 2019 at LBL3C-0.02, minimal iron was measured in the dissolved phase ranging between <10.0 to 138 µg/L and mean value of 38.2 µg/L. A trend is observed of an increase in dissolved iron values early (March/April) and late (November) 2019 but values remain below the BCAWQG-FST guideline (350 µg/L) (Figure 25b). Dissolved iron concentrations were measured above the BCAWQG-FST guideline at LBL3C-1.43 (October and November), LBL3C-1.65 (January and December), and LBL4C-0.18 (May, September, October, November), however, no exceedance was measured at LBL3C-3.32 or -0.02. Notably, during 2017, 2018 and 2019, the same two LBL3C-1.65 and LBL4C-0.18 locations measured dissolved iron concentrations above the BCAWQG-FST guideline, whereas LBL3C-1.43 measured an exceedance for the first time in October and November 2019. At LBL3C-1.65 and LBL4C-0.18, occurrences of exceedances in dissolved iron are increasing in 2019 (eight) relative to previously in 2018 (four) and 2017 (three).

Throughout the monitoring period, water quality at the LBL3C-0.02 discharge location measures a consistent pH and, with an exception to dissolved aluminum, the dissolved metals remained low. Influence of ARD-ML processes on water within the catchment are limited to natural occurrences within L4 Creek and previous disturbance within Howe Pit. Input volume from L4 Creek is relatively low and generally diluted by L3 Creek water. Influent water volume from the Howe Pit area is uncertain, however, water quality between monitoring locations LBL3C-1.43 and LBL3C-0.02 is believed to be influenced by groundwater that is influenced by Howe Pit.

Investigations aim to explain the occurrence of dissolved aluminum and total iron measured above detectible concentrations in the downstream location LBL3C-0.02 but not at comparable concentrations in the upstream L3 Creek locations, LBL3C-1.43 or -3.32. Evidence of PAG outcrop in L4 Creek, reduced pH levels, and the occurrence of anomalous metal concentrations at the LBL4C-0.018 location indicate background water quality of local naturally occurring PAG contact waterways. L4 Creek waters are eventually diluted, or attenuated, by L3 Creek waters and PAG related metal concentrations are significantly reduced towards and at the LBL3C-0.02 discharge location.

4.4.3.7 Metals: Arsenic, Cadmium, Cobalt, Copper, and Zinc

Metals such as arsenic, cadmium, cobalt, copper, and zinc are important indicators of ARD-ML processes and environmental changes in the water supply. Nine sampling events between March and November 2019 occurred during the monthly sampling at the downstream location, LBL3C-0.02, discussed below.

Total arsenic concentrations during 2019 measured at LBL3C-0.02 ranged from 0.33 to 15.7 µg/L with mean value of 3.99 µg/L, whereas dissolved arsenic ranged from 0.21 to 1.05 µg/L with mean value of 0.43 µg/L. Two BCAWQG-FST guideline exceedances in total arsenic occurred at LBL3C-0.02 in March and July 2019, an overall increasing trend during the 2019 monitoring period, and values indicate more variability and an increase in total arsenic to higher values in 2019 than in 2017 and 2018 (Figure 26a).

Total cadmium concentrations during 2019 measured at LBL3C-0.02 ranged from 0.331 to 1.85 µg/L with mean value of 0.702 µg/L, whereas dissolved cadmium ranged from 0.0612 to 0.493 µg/L with mean value of 0.260 µg/L. No BCAWQG-FST guideline exceedances in dissolved cadmium occurred at LBL3C-0.02 during 2019, and an overall similar to slight decreasing trend shows through the 2019 monitoring period relative to 2018 although values remained within the same general range of concentrations measured during 2017 and 2018 (Figure 27b).

Total cobalt concentrations during 2019 measured at LBL3C-0.02 ranged from 4.40 to 27.6 µg/L with mean value of 13.9 µg/L, whereas dissolved cobalt ranged from 0.48 to 16.1 with mean value of 8.32 µg/L. No BCAWQG-FST guideline exceedances in total cobalt occurred at LBL3C-0.02 during 2019, an overall consistent trend shows through the 2019 monitoring period and values indicate slightly increasing dissolved cobalt concentrations and variability slightly above the general range of concentrations measured during 2017 and 2018 (Figure 28a).

Total copper concentrations during 2019 measured at LBL3C-0.02 ranged from 1.37 to 50.8 µg/L with mean value of 13.0 µg/L, whereas dissolved copper ranged from 1.08 to 3.34 µg/L with mean value of 1.70 µg/L. The BCAWQG-FST guideline was applicable for total copper until August 2019 then transitioned to dissolved copper onwards commencing in the September 22, 2019 water sampling event. Between January to August 2019, one BCAWQG-FST guideline exceedance in total copper occurred at LBL3C-0.02 on March 22, 2019, an overall highly variable yet decreasing trend occurs through the 2019 monitoring period, and total copper values increased above the general range of concentrations measured during 2017 and 2018 at LBL3C-0.02 (Figure 29a). Between September to December 2019, no BCAWQG-FST guideline exceedances for dissolved copper were recorded at LBL3C-0.02 (Figure 29b).

Total zinc concentrations during 2019 measured at LBL3C-0.02 ranged from 37.9 to 233 µg/L with mean value of 86.3 µg/L, whereas dissolved zinc ranged from 1.50 to 38.8 µg/L with mean value of 20.3 µg/L. In 2019, one BCAWQG-FST guideline exceedance in total zinc occurred at LBL3C-0.02 on March 22, 2019, an overall increasing variability yet decreasing trend occurs through the 2019 monitoring period. Total zinc values increased above the general range of concentrations measured during 2017 and 2018 at LBL3C-0.02 (Figure 30).

The continuation of monthly sampling in the L3 catchment occurred during the 2019 monitoring period, providing a useful reference for observing clearer seasonal trends.

4.4.4 Freshwater Long-term Average Exceedances

At the discharge location, LBL3C-0.02, minimal occurrences of measured concentrations during 2019 exceed the BCAWQG-FLT guidelines and long-term trends do not generally show an increasing trend in metals to be occurring at L3 Creek. During the 2020 monitoring period, long-term trends will be investigated with further data collection.

4.5 Other Locations

Based upon on-site field observations, five additional locations were sampled for temporary monitoring at the following locations:

1. Gully Road ditch in two sampling events on April 18 and May 23, 2019,
2. Road Runner 1 on April 18, 2019,
3. Road Runner 2 on April 18, 2019,
4. Seep 1 on August 1 and 20, and September 24, 2019,
5. LBSP on May 23 and June 20, 2019, and

The screening results based on the laboratory data are tabulated in Appendix B, Table B4.

4.5.1 Gully Road Ditch

During the June 19, 2018, sampling event, a sample location was established as a temporary monitoring location along the Gully Road ditch, just west of Gate B (map in Figure 1), following site observation of a small shale exposure in the northern cut-bank of the ditch and presence of iron-oxide staining on the riprap lining the ditch. In situ and laboratory results were collected from Gully Road Ditch on April 18 and May 23, 2019 (Photo 28) in continuation of previously six sampling events between May to October 2018.

At Gully Road ditch, no exceedances to the BCAWQG-FST guidelines were recorded in 2019 and the location was not sampled since May 23, 2019.

4.5.2 Road Runner 1 and 2

Two new locations were sampled on April 18, 2019 for laboratory analysis at Road Runner 1 and 2 representing two separate seeps along the base of the east side of the Tailrace wall (Photos 29 to 32). Figure 2 indicates the location of these two seepage water quality samples. No exceedances to the BCAWQG-FST guidelines were recorded in on April 18, 2019 at either Road Runner 1 or 2 seepages and the location was not sampled since.

4.5.3 Seep-1 (RCC Excavation, AFDE Powerhouse Area)

The Seep-1 sample represents a single water seep which daylights along the northern shale cut behind the RCC Slurry Wall (Photo 26) and flows down exposed shale into a sump constructed to collect inflow water. Figure 2 indicates the location of this sampling location.

Total copper was measured in exceedance to the BCAWQG-FST guideline on August 20 (3.34 µg/L) and September 24 (4.58 µg/L), 2019. Total iron was measured in exceedance (3,390 µg/L) to the BCAWQG-FST guideline (1000 µg/L) on September 24, 2019.

4.5.4 Left Bank Sediment Pond (LBSP)

A water quality verification sample was collected on May 23 and June 20, 2019 from a new temporary location named LBSP, from near the surface of the northeastern corner of the Left Bank Sediment Pond (Photo 33). Figure 3 indicates the sample location of the LBSP water quality sample.

Dissolved aluminum was measured in exceedance (110 µg/L) to the BCAWQG-FST guideline (100 µg/L) on May 23, 2019.

5.0 CONCLUSIONS AND RECOMMENDATIONS

A water quality monitoring program was implemented on behalf of BC Hydro to monitor the water quality at discharge locations from River Road at Blind Corner, SBIAR, and L3 Creek. Upstream and midstream monitoring locations were established to characterize water quality at the discharge location and to maintain a continuous monitoring record commensurate with previous sampling completed in 2016 by Lorax on behalf of PRHP.

The program has incorporated monthly in situ water quality measurements and observations with laboratory analysis throughout 2017, 2018 and 2019. Field observations were recorded monthly regardless of weather conditions or ability to collect measurements.

Across all sampling events at River Road, SBIAR, and L3 Creek during 2019, moderate to high hardness values (44.5 mg/L to 3,460 mg/L $CaCO_3$) were observed in the waters sampled, although more consistently high in the L3 catchment and moderate in the RR and SBIAR catchments. The River Road ditch and SBIAR catchments are generally ephemeral. Monthly water quality monitoring measures instantaneous water quality and may not be reflective of longer term baseline conditions. Flow volumes are highly susceptible to precipitation, and water quality is influenced by whether flow is derived from precipitation, run-off, shallow groundwater or regional groundwater flow. Water chemistry has been assessed to identify influence of ARD-ML processes on water quality at River Road from exposed shale at Blind Corner and within Howe Pit, exposed bedrock related to construction activities within the L3 Creek drainage at LBL3C-1.65, in L4 Creek (LBL4C-0.18) from local naturally occurring shale outcrop, and in the shale exposed in the east and west ditches within SBIAR.

5.1 River Road Water Quality Monitoring

Water quality laboratory data was collected from two locations and in situ measurements were collected at eight locations of a total of twelve observed locations along the River Road catchment from January to December 2019, in continuation of the 2017 and 2018 monitoring periods.

Water quality monitoring continues to show that active ARD-ML process are progressing on shale slopes shown in observed trends, such as elevated concentrations above the BCAWQG-FST for arsenic, copper, iron and aluminum at RR8 and RR9 measured on March 22, 2019. No other sampling occurred along River Road in 2019 for further assessment due to dry or frozen conditions. Minor seepage observed at the base of the LBRR-LC above the main ditch channel suggests groundwater with high sulphate concentrations is providing additional input to the River Road ditch.

Elevated TSS measurements are mainly attributed to scouring of accumulated sediment within the ditch from road grading and run-off from previous events, in addition to washing, or flushing, of the exposed shale, colluvium and overburden cut-banks. Continued management of the effectiveness of the end-of-diversion pipe installed between LBRR-12+430 and LBRR-EDP, and plant germination with survival from hydroseeding efforts on the shale slope above the ditch is required to monitor erosion control and the amount of sediment infilling to the ditch from road grading operations.

Additionally, it was also noted from in situ pH measurements within the ditch that acidic waters are collected in the upper portions of the ditch underlying the exposed shale cut-bank. The pH values progressively return to circumneutral levels at the discharge and end-of-diversion pipe locations in part due to contact with limestone riprap in the ditch, settling of sediment/solids and potential mixing with alkaline input from groundwater or outflow from the lower cut-off ditch. Orange coating, or mineral precipitate, continued to be observed on the visible limestone. Chemical efficiency of the limestone to buffer acidic water is decreased when coated in precipitate or sediment. The formation of mineral scale can concentrate metals from solution as a result of the aqueous acid-base reactions. The mineral scale and sludge are susceptible to scouring and being washed during heavier rain events which has potential to reduce overall water quality conveyed down gradient.

The diversion pipe has successfully reduced the amount of direct high TSS discharge into the Peace River by allowing the water to be collected and slowly infiltrate into the River Road ditch. It is anticipated that sediment in the ditch may now also be accumulating a small amount of secondary mineral formed by up-gradient ARD-ML processes. These minerals commonly contain an elevated concentration of metals related to ML and mineral precipitation from acid neutralizing reactions.

Between March and November 2019, a total of twenty-nine (29) in situ field measurements of pH within the River Road ditch indicated a neutral to alkaline pH of between 7.59 and 9.20 pH. Previously during 2018, acidic waters were collected in the upper portions of the ditch underlying the exposed shale cut-bank. The pH values progressively returned to circumneutral levels at the discharge location in part due to contact with limestone riprap in the ditch, and potential alkalinity input from groundwater or outflow from the upper cut-off ditch. Orange coating, or mineral precipitate, continued to be observed in the visible limestone. Chemical efficiency of the limestone to buffer acidic water is decreased when coated in precipitate. The formation of mineral scale can concentrate metals from solution as a result of the aqueous acid-base reactions.

Recommendations for River Road

The sediment source for elevated TSS is mainly attributed to scouring of accumulated sediment within the ditch from road grading and run-off from previous events, which includes washing, or flushing, of the exposed shale, colluvium and overburden cut-banks. Continued management of the drainage system is required to reduce the amount of sediment infilling to the ditch from road grading operations as this sediment encases the limestone which reduces chemical efficiency for ARD mitigation and prematurely fills the cistern, which limits its performance to supress TSS.

The limestone contained in the ditch must continue to be regularly maintained through cleaning and descaling. This procedure should include cleaning the limestone riprap material within the River Road ditch in a controlled facility where the sludge can be recovered and relocated to an approved RSEM area, and re-placement of the refreshed limestone into the ditch. Sludge should also be removed from the cistern and transported to an approved RSEM area. Control of sediment erosion was responded to by BC Hydro during 2018, in efforts to reduce sedimentation into the River Road drainage system from shale slopes and road grading operations. Continued management of the limestone riprap and mitigation of the active ARD-ML processes from the shale exposure at Blind Corner along River Road are recommended, such as implementing hydroseeding on the shale slope for erosion control, in addition to monitoring the effectiveness of controlling sedimentation into the River Road drainage system by the end-of-diversion pipe (LBRR-EDP). The sediment within the ditch, particularly at the outlet of the diversion pipe should be monitored on a quarterly basis for metal accumulation.

The monitoring program includes collection of discharge from the RR8 and RR9 culverts (LBRR-RR8 and LBRR-RR9, respectively), however, since no discharge was observed to be coincident with the scheduled sampling events, it is recommended that in situ water quality measurements are collected from any discharge observed from culvert RR8 and/or RR9 during high flow events.

Identification of the source of dissolved aluminum in previous sampling events is hypothesized to be related to fine mineral particulate (<45 µm) that is passing through the field filter as colloid or fine microcrystalline form. Aluminum hydroxide mineral species (e.g., polymorphs of gibbsite or hydrargillite) can form on rock surfaces and can be indicators of acid generating processes under base flow conditions. Locally impacted groundwater may also be seeping into the lower chimney ditch and may contribute to the measured dissolved aluminum concentrations. Similar water quality characteristics are observed in the lower L3 Creek catchment which may indicate that locally impacted groundwater from the exposed shale in the legacy Howe Pit area may be a common contributing factor. BC Hydro should consider options for remediation of this facility.

In 2019, minimal water quality samples collected from River Road indicate that in addition to the water quality data collected in 2017 and 2018, run-off water quality is influenced by active ARD-ML processes within the ditch catchment. Although flows are generally low to no flow and/or ephemeral, there is some potential for run-off to impact downstream water quality. As per CEMP Appendix E Section 5.2.1.7, it is recommended that water quality monitoring is continued on a monthly basis at the established locations within the River Road catchment. Continuous monthly monitoring will enable the effectiveness of mitigation strategies that are implemented on the shale at Blind Corner.

5.2 SBIAR Water Quality Monitoring

Water quality data was collected from five established sampling locations, four of which measure water directly from within the SBIAR monitoring locations and one which measures water outside of the SBIAR facility at the closest water receptor as a verification check for potential influence from, or direct connectivity with, the PAG contact water that is collected and conveyed from the SBIAR facility. Water flowing through the SBIAR ditch has no direct downstream receptor, and all water in the east and west ditches is currently conveyed directly to the RSEM R6 pond which is an approved PAG contact water management facility. Downstream water quality is monitored by PRHP within the RSEM R6 pond for management prior to discharge into the Peace River.

Based on water quality monitoring results collected within SBIAR and the downstream side channel, there was not an apparent correlation in water quality trends between SBIAR and the side channel during 2017 and 2018, however, during 2019 there were some indications from water quality data which could indicate a common trend in the side channel to the SBIAR ditches. Further data and observations collected in 2020 will help to verify a correlation, should one exist.

Alkalinity and pH indicate that the waters in SBIAR have consistently remained alkaline during the 2017, 2018 and 2019 monitoring periods. Screening of analytical data for the downstream ditch locations resulted in identification at RBSBIAR-DS of four parameters (total iron and zinc, dissolved iron and aluminum) and at RBSBIAR-EDS of five parameters (total iron, arsenic, copper, zinc and dissolved aluminum) that exceeded BCAWQG-FST guidelines during 2019.

Evidence of active ARD-ML process are observed on the shale slopes in SBIAR through rinse pH and observation of secondary iron hydroxide mineral formation. Water quality measurements fluctuate above and below the BCAWQG-FST guidelines predominantly at the downstream RBSBIAR-DS and -EDS locations, and upward trends are observed for various metal concentrations (i.e. iron, zinc, arsenic, copper and cadmium) over time in the ditches in addition to an apparent increase in downstream over upstream metal concentrations.

The downstream locations show minimal occurrences of parameters that slightly exceed the BCAWQG-FLT guidelines at RBSBIAR-DS (chloride, total cobalt, copper, zinc, dissolved aluminum, cadmium, copper) and RBSBIAR-EDS (total cobalt, copper, zinc, and dissolved aluminum, cadmium, copper) during 2019, but do not exceed the BCAWQG-FST.

Recommendations for SBIAR Water Quality Monitoring

Recommendations for future sampling include collection of water samples from the pooled water in Area 21. The collection of one up-gradient and one down-gradient water sample from both the western and eastern SBIAR ditch is suggested to continue through 2020 for comparative purposes.

Evidence of active ARD-ML processes were observed in the shale exposed in the east and west ditch within SBIAR. In 2017 and 2018, the water quality measured at RBSBIAR sampling locations did not indicate significant impacts due to these ARD-ML processes, however, in 2019 there are indications that ARD-ML processes are resulting in increased metals that are progressively higher especially in the downstream east and west ditches. Downstream water is collected within the RSEM R6 pond for management prior to discharge into the Peace River. As per CEMP Section 5.2.1.7, since there is low to moderate risk of negative downstream effects on water quality, monitoring of water quality within SBIAR is recommended to be continued on a monthly basis in 2020. BC Hydro should consider implementing a shale slope monitoring program to assess the weathering profile and rate of acid production to help predict changes to run-off quality and assess whether the slopes have potential to self-exhaust the active ARD-ML processes. This program will be used to provide recommendation for long-term mitigation of this facility.

5.3 L3 Creek Water Quality Monitoring

Water quality data was collected from five established sampling locations during 2019 in continuation to 2017 and 2018 sampling within the L3 Creek catchment to maintain a continuous record of water quality within the catchment and to monitor potential changes to water chemistry related to construction related activities within the catchment. PAG indicator elements have been observed in elevated concentration on occasion from water quality monitoring during 2017, 2018 and 2019.

Screening of analytical data for the LBL3C-0.02 location resulted in identification of five parameters (total iron, zinc, copper, arsenic, and dissolved aluminum, copper) that exceeded BCAWQG-FST guidelines at variable times during the 2019 monitoring period.

L3 Creek is not identified as, nor is it being managed as a PAG contact water facility , however, the occurrence of a naturally occurring shale (PAG) outcrop identified in L4 Creek is monitored by sampling at the LBL4C-0.18 location where signatures of ARD-ML processes are prevalent. Elevated metal concentrations (total iron, cobalt, zinc, copper, arsenic, manganese, and dissolved iron, aluminum, and cadmium) and low pH have been measured in routine WQ sampling during 2018 and 2019. Water mixing from L4 Creek with L3 Creek is generally diluted towards the lower midstream LBL3C-1.43 and discharge LBL3C-0.02 locations. Influence from ARD-ML processes at Howe Pit are observed in the lower portions of L3 Creek between locations LBL3C-1.43 and LBL3C-0.02.

Alkalinity and pH values measured in L3 Creek indicate that the waters have remained alkaline, with exception to the highly variable pH at the L4 Creek LBL4C-0.18 location that in September and October 2019 measured below the acceptable BCAWQG-FST guideline range (pH 6.5-9.0). Further observation indicates that decreases in pH align with decreases in alkalinity at LBL4C-0.18. Notably, in contrast at the upper midstream LBL3C-1.65 location, sharp decreases in pH align with increased alkalinity on January 23 and December 19, 2019 although pH remained within the acceptable BCAWQG-FST guideline range. Trends in pH and alkalinity in 2019 are within normal range of measured pH and alkalinity trends during 2017 and 2018, although alkalinity at the upstream LBL3C-3.32 increases with more variability in 2019 than in previous years. Overall, there is more variability in alkalinity than pH during 2017, 2018 and 2019 within the L3 Creek.

Water quality in L3 Creek between LBL3C-1.43 and the discharge LBL3C-0.02 is influenced by influent waters originating in the Howe Pit areas. This is more evident from sulphate, dissolved aluminum, and total (not dissolved) iron, which generally increase throughout this portion of the creek bed. In 2019, concentrations of sulphate and dissolved metal species of aluminum, iron, cadmium, copper and zinc generally remain within normal range of 2017 and 2018 values, whereas an increase in concentrations of total metal species of cobalt, copper, cadmium, zinc, iron and arsenic is observed in 2019 relative to 2018 and 2017. Monthly assessment for these metals should be conducted as part of the regular monitoring program in 2020.

Sulphate, TDS and dissolved aluminum and copper concentrations were observed to increase slightly between the up-gradient LBL3C-1.43 location and the discharge LBL3C-0.02 location. Conversely, an opposite trend of decreasing concentrations relative to midstream LBL3C-1.43 were measured for total and dissolved iron, total arsenic, zinc, cobalt, and cadmium. Most other parameters show variability between the location of increased concentrations between LBL3C-1.43 and -0.02.

As discussed for River Road, the source of elevated dissolved aluminum concentration is believed to be related to fine mineral particulate (<45um) that is passing through the field filter as colloid or fine microcrystalline form (i.e., gibbsite, or equivalent polymorph) from secondary mineral precipitation within Howe Pit area, or locally impacted groundwater. Trend observations from sulphate, TDS, and dissolved iron and aluminum data also support interpretation of additional water input to L3 Creek between the up-gradient LBL3C-1.43 and LBL3C-0.02 discharge location. These inputs may be related to Howe Pit surface run-off, and or local impacted shallow groundwater seepage.

Recommendations for L3 Creek Water Quality Monitoring

Based on the results of the 2017, 2018 and 2019 water quality monitoring programs there is low risk of negative downstream effects on water quality due to ARD-ML processes within the L3 Creek catchment. As per CEMP Appendix E Section 5.2.1.7, monitoring of water quality including ARD-ML parameters within the L3 Creek catchment should continue. BC Hydro may choose to continue monitoring water quality on a monthly frequency in order to monitor changing conditions within the L3 Creek due to pre-existing facilities and future construction related activities in and around the catchment area. The location of the monitoring location LBL3C-1.65 may need to be adjusted to accommodate construction activities in the area which has resulted in filling of the L3 Creek Channel with rip rap which generally obscures the natural flow of water thus preventing samples from being collected.

6.0 CLOSURE

We trust this document meets your present requirements. If you have any questions or comments, please contact the undersigned.

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TABLES

Table 1: Water Sampling Locations and In Situ and Lab Events

Catchment	Sample Site	UTM Coordinates Zone 10 (NAD83)		Elevation	23-Jan-19		22-26-Mar-19		18-Apr-19		23-May-19		20-Jun-19		19-Jul-19		20-Aug-19		24-Sep-19		30-Oct-19		22-Nov-19		19-Dec-19	
		Easting	Northing		In-Situ	Lab	In-Situ	Lab	In-Situ	Lab	In-Situ	Lab	In-Situ	Lab	In-Situ	Lab	In-Situ	Lab	In-Situ	Lab	In-Situ	Lab	In-Situ	Lab	In-Situ	Lab
Right Bank - South Bank Initial Access Road [1]	RBSBIAR-US	630327	6228397	468.0			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RBSBIAR-DS	630320	6228645	445.2			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RBSBIAR-EUS	630376	6228399	464.6	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RBSBIAR-EDS	630370	6228635	437.4			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	RBSC-DS	630475	6228672	418.6					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Left Bank River Road [1]	LBRR-DD	632853	6229862	422.0			✓																			
	LBRR-EDP	632715	6229832	416.4																						
	LBRR-LC	632856	6229899	427.2			✓																			
	LBRR-UC	633018	6230253	463.2			✓		✓		✓		✓		✓		✓				✓					
	LBRR-12+430	632857	6229885	426.0																						
	LBRR-12+500	632914	6229921	432.0			✓																			
	LBRR-12+600	632948	6229983	436.0			✓																			
	LBRR-12+700	632992	6230078	442.8			✓														✓					
	LBRR-12+810	633039	6230195	454.0							✓				✓		✓		✓		✓		✓			
	LBRR-12+920	633000	6230282	463.0					✓		✓		✓		✓		✓		✓		✓		✓			
	RR8	632262	6229624	412.0			✓	✓																		
	RR9	632460	6229680	412.5			✓	✓																		
L3 Creek [1]	LBL3C-0.02	632767	6229860	418.0			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
	LBL3C-1.43	631728	6230210	486.6			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	LBL3C-1.65	631504	6230417	493.0	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
	LBL3C-3.32	630248	6231262	579.0			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
L4 Creek [1]	LBL4C-0.18	631524	6230578	507.0			✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Other	Gully Road Ditch	632410	6230440	492.2			✓		✓	✓	✓	✓														
	Road Runner 1	629560	6229366	402.5					✓	✓																
	Road Runner 2	629530	6229352	403.0																						
	LBSP	629772	6230078	415.0							✓	✓		✓	✓											
	SEEP 1	629570	6229218	383.2														✓	✓	✓						

[1] Monthly Sampling.

[2] Temporary Sampling.

Note: In any months of the calendar year not listed (e.g. January, February, and December), frozen/dry conditions persisted at all sampling locations (verified by field staff).

Table 2: Daily and 7-Day Mean Temperature and Precipitation

Date	Time	Precipitation[1]		Temperature[1]			Summary
Sample Event Date Bolded	Time Period	Precipitation Event	Total (mm)	Mean (°C)	Minimum (°C)	Maximum (°C)	24 Hr and 7 Day Precipitation
January 16-22, 2019	7 days	January 16, 17, 18, 19	5.82	-14.9	-18.9	-5.0	Minimal precipitation (5.82 mm) in preceding 7 days
January 22, 2019	24 hrs.	none	0.00	-11.6	-15.9	-5.0	No precipitation
January 23, 2019	<24 hrs.	none	0.00	-14.7	-16.6	-13.0	No precipitation
March 15-21, 2019	7 days	none	0.00	5.9	-3.8	16.1	No precipitation in preceding 7 days
March 21, 2019	24 hrs.	none	0.00	5.0	-1.6	11.7	No precipitation
March 22, 2019	<24 hrs.	none	0.00	5.5	-0.4	12.7	No precipitation
April 11-17, 2019	7 days	April 14 and 15	5.51	5.4	-1.3	13.6	Minimal (5.51 mm) precipitation in preceding 7 days
April 17, 2019	24 hrs.	none	0.00	8.5	4.1	13.1	No precipitation
April 18, 2019	<24 hrs.	none	0.00	9.8	6.1	13.7	No precipitation
May 16-22, 2019	7 days	May 16, 17, 18, 22	7.18	12.6	6.1	22.0	Moderate (7.18 mm) precipitation in preceding 7 days
May 22, 2019	24 hrs.	3:00 - 5:00 PM	0.96	14.7	11.2	19.0	Minimal (0.96 mm) precipitation in previous 24 hrs.
May 23, 2019	<24 hrs.	5:00 PM	1.97	14.7	9.4	21.4	Minimal (1.97 mm) precipitation following sampling event
June 13-19, 2019	7 days	June 13, 14, 19	4.22	17.5	8.2	28.0	Minimal (4.22 mm) precipitation in preceding 7 days
June 19, 2019	24 hrs.	6:00 - 7:00 PM	0.57	11.9	8.2	16.1	Minimal (0.57 mm) in previous 24 hrs.
June 20, 2019	<24 hrs.	10:00 - 11:00 AM	0.51	9.3	7.1	12.4	Minimal (0.51 mm) during sampling event
July 12-18, 2019	7 days	July 15, 16, 17, 18	8.27	17.1	9.9	25.8	Moderate (8.27 mm) precipitation in preceding 7 days
July 18, 2019	24 hrs.	10:00 PM - 12:00 AM	2.32	14.3	11.4	17.4	Minimal (2.32 mm) precipitation in previous 24 hrs.
July 19, 2019	<24 hrs.	1:00 - 7:00 AM	2.87	16.7	13.2	21.1	Minimal (2.87 mm) precipitation morning of sampling event
August 13-19, 2019	7 days	August 15, 16, 17, 18, 19	45.73	13	4.7	25.8	Significant (45.73 mm) precipitation in preceding 7 days
August 19. 2019	24 hrs.	1:00 - 6:00 AM / 5:00 PM	2.92	8.5	4.7	12.8	Minimal (2.92 mm) precipitation in previous 24 hrs.
August 20, 2019	<24 hrs.	1:00 - 8:00 AM	1.14	14.3	8.8	19.1	Minimal (1.14 mm) precipitation morning of sampling event
September 17-23, 2019	7 days	none	0.00	12.5	2.5	19.5	No precipitation
September 23, 2018	24 hrs.	none	0.00	9.6	6.8	13.2	No precipitation
September 24, 2019	<24 hrs.	none	0.00	10.5	7.3	13.4	No precipitation
October 23-29, 2019	7 days	October 23, 24, 25	12.96	0.9	-10.5	11.2	Moderate (12.96 mm) precipitation in preceding 7 days
October 29, 2019	24 hrs.	none	0.00	-4.3	-10.5	1.2	No precipitation
October 30, 2019	<24 hrs.	3:00 - 10:00 PM	0.36	3.8	0.4	8.4	Minimal (0.36 mm) precipitation afternoon to evening of sampling event
November 15-21, 2019	7 days	November 16	0.95	2.8	-6.8	11.2	Minimal (0.95 mm) precipitation in preceding 7 days
November 21, 2019	24 hrs.	none	0.00	5.6	3.6	7.1	No precipitation
November 22, 2019	<24 hrs.	none	0.00	6.9	4.4	8.4	No precipitation
December 12-18, 2019	7 days	December 12, 13, 16, 18	5.58	-14.3	-20.6	4.3	Minimal (5.58 mm) precipitation in preceding 7 days
December 18, 2019	24 hrs.	none	1.19	-14.6	-17.1	-12.6	Minimal (1.19 mm) precipitation in previous 24 hrs.
December 19, 2019	<24 hrs.	1:00 - 2:00 AM	0.18	-12	-13.1	-10.5	Minimal (0.26 mm) precipitation on morning of sampling event

[1] BC Ministry of Environment, BC Air quality data: Fort St John North Camp C_Met_60 weather station. https://envistaweb.env.gov.bc.ca/.

Table 3: Classification of Flows in Ditch

Date	Time	Precipitation		Temperature	Summary	Classification
Sample Event Date Bolded	Time Period	Precipitation Event	Total (mm)	Mean (°C)	24 hr. & 7 day Precipitation	Flows in Ditch
January 16-22, 2019	7 days	January 16, 17, 18, 19	5.82	-14.9	Minimal precipitation (5.82 mm) in preceding 7 days	Regional groundwater flow; precipitation as snowfall; frozen to near frozen conditions.
January 22, 2019	24 hrs.	none	0.00	-11.6	No precipitation	
January 23, 2019	<24 hrs.	none	0.00	-14.7	No precipitation	
March 15-21, 2019	7 days	none	0.00	5.9	No precipitation	Regional groundwater flow; near frozen conditions; preliminary freshet.
March 21, 2019	24 hrs.	none	0.00	5.0	No precipitation	
March 22, 2019	<24 hrs.	none	0.00	5.5	No precipitation	
April 11-17, 2019	7 days	April 14 and 15	5.51	5.4	Minimal (5.51 mm) precipitation in preceding 7 days	Regional groundwater flow; surface runoff; spring freshet
April 17, 2019	24 hrs.	none	0.00	8.5	No precipitation	
April 18, 2019	<24 hrs.	none	0.00	9.8	No precipitation	
May 16-22, 2019	7 days	May 16, 17, 18, 22	7.18	12.6	Moderate (7.18 mm) precipitation in preceding 7 days	Regional groundwater flow and/or surface runoff.
May 22, 2019	24 hrs.	3:00 - 5:00 PM	0.96	14.7	Minimal (0.96 mm) precipitation in previous 24 hrs.	
May 23, 2019	<24 hrs.	5:00 PM	1.97	14.7	Minimal (1.97 mm) precipitation following sampling event	
June 13-19, 2019	7 days	June 13, 14, 19	4.22	17.5	Minimal (4.22 mm) precipitation in preceding 7 days	Regional groundwater flow.
June 19, 2019	24 hrs.	6:00 - 7:00 PM	0.57	11.9	Minimal (0.57 mm) in previous 24 hrs.	
June 20, 2019	<24 hrs.	10:00 - 11:00 AM	0.51	9.3	Minimal (0.51 mm) during sampling event	
July 12-18, 2019	7 days	July 15, 16, 17, 18	8.27	17.1	Moderate (8.27 mm) precipitation in preceding 7 days	Shallow groundwater flow.
July 18, 2019	24 hrs.	10:00 PM - 12:00 AM	2.32	14.3	imal (2.32 mm) precipitation in previous 24	
July 19, 2019	<24 hrs.	1:00 - 7:00 AM	2.87	16.7	Minimal (2.87 mm) precipitation morning of sampling event	
August 13-19, 2019	7 days	August 15, 16, 17, 18, 19	45.73	13.0	Significant (45.73 mm) precipitation in preceding 7 days	Regional groundwater flow; surface runoff.
August 19. 2019	24 hrs.	1:00 - 6:00 AM / 5:00 PM	2.92	8.5	Minimal (2.92 mm) precipitation in previous 24 hrs.	
August 20, 2019	<24 hrs.	1:00 - 8:00 AM	1.14	14.3	Minimal (1.14 mm) precipitation morning of sampling event	
September 17-23, 2019	7 days	none	0.00	12.5	No precipitation	Regional groundwater flow; relatively dry conditions.
September 23, 2018	24 hrs.	none	0.00	9.6	No precipitation	
September 24, 2019	<24 hrs.	none	0.00	10.5	No precipitation	
October 23-29, 2019	7 days	October 23, 24, 25	12.96	0.9	Moderate (12.96 mm) precipitation in preceding 7 days	Regional groundwater flow; near frozen conditions.
October 29, 2019	24 hrs.	none	0.00	-4.3	No precipitation	
October 30, 2019	<24 hrs.	3:00 - 10:00 PM	0.36	3.8	Minimal (0.36 mm) precipitation afternoon to evening of sampling event	
November 15-21, 2019	7 days	November 16	0.95	2.8	Minimal (0.95 mm) precipitation in preceding 7 days	Regional groundwater flow; relatively dry, near frozen conditions.
November 21, 2019	24 hrs.	none	0.00	5.6	No precipitation	
November 22, 2019	<24 hrs.	none	0.00	6.9	No precipitation	
December 12-18, 2019	7 days	December 12, 13, 16, 18	5.58	-14.3	Minimal (5.58 mm) precipitation in preceding 7 days	Regional groundwater flow; precipitation as snowfall; frozen to near frozen conditions.
December 18, 2019	24 hrs.	none	1.19	-14.6	Minimal (1.19 mm) precipitation in previous 24 hrs.	
December 19, 2019	<24 hrs.	1:00 - 2:00 AM	0.18	-12.0	Minimal (0.26 mm) precipitation on morning of sampling event	

Table 4: Daily Mean Turbidity and TSS Measurements with the Peace River 2019

Date	Turbidity (Daily Mean) and TSS Measurements and Calculations Peace River above Moberly River			
Sampling Event Date Bolded	**Left Bank**		**Right Bank**	
	NTU [1]	TSS [1] (mg/L)	NTU [1]	TSS [1] (mg/L)
January 12-18, 2019	5.2	3.8	6.3	4.6
January 18, 2019	3.9	2.8	4.4	3.2
January 19, 2019	**3.8**	**2.8**	**4.2**	**3.1**
January 20, 2019	3.6	2.6	4.1	3.0
March 15-21, 2019	27.9	20.3	5.1	3.7
March 21, 2019	57.9	42.3	6.0	4.4
March 22, 2019	**204.2**	**149.1**	**7.5**	**5.5**
March 23, 2019	141.1	103.0	4.6	3.3
April 11-17, 2019	329.9	240.8	154.6	112.9
April 17, 2019	302.2	220.6	160.4	117.1
April 18, 2019	**422.0**	**308.0**	**276.5**	**201.9**
April 19, 2019	518.2	378.3	377.2	275.3
May 16-22, 2019	148.7	108.6	127.2	92.9
May 22, 2019	140.0	102.2	121.6	88.7
May 23, 2019	**125.3**	**91.5**	**108.7**	**79.4**
May 24, 2019	118.8	86.8	103.7	75.7
June 13-19, 2019	29.9	21.9	24.7	18.0
June 19, 2019	21.6	15.8	20.0	14.6
June 20, 2019	**20.2**	**14.8**	**19.4**	**14.2**
June 21, 2019	17.8	13.0	18.7	13.6
July 12-18, 2019	39.3	28.7	36.2	26.4
July 18, 2019	31.6	23.1	29.9	21.8
July 19, 2019	**32.0**	**23.4**	**28.7**	**20.9**
July 20, 2019	45.2	33.0	43.6	31.8
August 13-19, 2019	200.9	144.6	143.4	103.2
August 19. 2019	910.1	655.2	653.9	470.8
August 20, 2019	**1842.2**	**1326.4**	**1218.1**	**877.0**
August 21, 2019	942.2	678.4	523.6	377.0
September 17-23, 2019	38.9	28.0	23.7	17.1
September 23, 2018	27.2	19.6	17.8	12.8
September 24, 2019	**25.8**	**18.6**	**18.6**	**13.4**
September 25, 2019	18.1	13.0	12.8	9.2
October 23-29, 2019	27.5	19.8	14.9	10.7
October 29, 2019	17.7	12.7	13.0	9.3
October 30, 2019	**19.2**	**13.8**	**14.5**	**10.4**
October 31, 2019	18.1	13.0	13.2	9.5
November 15-21, 2019	13.7	9.9	12.2	8.8
November 21, 2019	10.8	7.8	9.7	6.9
November 22, 2019	**19.1**	**13.8**	**17.3**	**12.5**
November 23, 2019	17.8	12.8	15.7	11.3
December 12-18, 2019	9.7	7.0	11.8	8.5
December 18, 2019	9.6	6.9	12.3	8.8
December 19, 2019	**10.9**	**7.9**	**13.0**	**9.3**
December 20, 2019	8.6	6.2	10.2	7.3

[1] NTU (Nephelometric Turbidity Unit) and TSS (total suspended sediment) data provided by Ecofish Ltd., January 8, 2019.

NTU: to some extent, measures (scattered light at 90 degrees from the incident light beam) how much light reflects for a given amount of particulates dependent upon properties of the particles, e.g. their shape, color, and reflectivity.

Note: 7-day average turbidity values are calculated as the average turbidity measured during the prior seven days to the sampling event.

Table 5: Surface Water Quality Assurance/Quality Control Analytical Results

Parameter	Unit	RDL	Travel Blank	Field Blank	Travel Blank	Field Blank	Travel Blank	Field Blank	Travel Blank	Field Blank	Travel Blank	Field Blank
			19-Jan-19	19-Jan-19	22-Mar-19	22-Mar-19	18-Apr-19	18-Apr-19	23-May-19	23-May-19	20-Jun-19	20-Jun-19
Physical Parameters												
Electrical Conductivity (EC)	µS/cm	2.0	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Hardness as $CaCO_3$	µg/L	500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
pH	pH Units	0.1	5.38	5.36	5.74	5.77	5.29	5.31	5.71	5.50	6.08	5.98
Total Dissolved Solids (TDS)	µg/L	10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Total Suspended Solids (TSS)	µg/L	3000	<3000	<3000	<3000	<3000	<3000	<3000	<3000	<3000	<3000	<3000
Anions and Nutrients												
Acidity (as $CaCO_3$)	µg/L	1000	2600	2600	1600	1600	1800	2300	1900	2100	2100	1900
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Hydroxide as $CaCO_3$)	µg/L	1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ammonia (NH_4 as N)	µg/L	5.0	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloride (Cl^-)	µg/L	500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Nitrate (NO_3^- as N)	µg/L	5.0	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Nitrite (NO_2^- as N)	µg/L	1.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Sulphate (SO_4)	µg/L	300	<300	<300	<300	<300	<1020	<300	<300	<300	<300	<300
Dissolved Organic Carbon (DOC)	µg/L		-	-	-	-	-	-	-	-	-	-
Metals, Total												
Aluminum	µg/L	3.0	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Antimony	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Barium	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Beryllium	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cadmium	µg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	µg/L	50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cesium	µg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	<0.1	<0.1
Cobalt	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	µg/L	0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Lead	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	1.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium	µg/L	5.0	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Manganese	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mercury	µg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phosphorus	µg/L	50.0	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	µg/L	50.0	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Rubidium	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	µg/L	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Silver	µg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	µg/L	50.0	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Strontium	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sulfur	µg/L	500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Tellurium	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	0.30	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Tungsten	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	µg/L	0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	3.0	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Zirconium	µg/L	0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.2	<0.2
Metals, Dissolved												
Aluminum	µg/L	1.0		<1	<1			<1		<1		<1
Antimony	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Arsenic	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Barium	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Beryllium	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Bismuth	µg/L	0.05		<0.05	<0.05			<0.05		<0.05		<0.05
Boron	µg/L	10.0		<10	<10			<10		<10		<10
Cadmium	µg/L	0.005		<0.005	<0.005			<0.005		<0.005		<0.005
Calcium	µg/L	50.0		<50	<50			<50		<50		<50
Cesium	µg/L	0.01		<0.01	<0.01			<0.01		<0.01		<0.01
Chromium	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Cobalt	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Copper	µg/L	0.20		<0.2	<0.2			<0.2		<0.2		<0.2
Iron	µg/L	10.0		<10	<10			<10		<10		<10
Lead	µg/L	0.05		<0.05	<0.05			<0.05		<0.05		<0.05
Lithium	µg/L	1.0		<1	<1			<1		<1		<1
Magnesium	µg/L	5.0		<5	<5			<5		<8.2		<5
Manganese	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Mercury	µg/L	0.005		<0.005	<0.005			0.0052		<0.005		<0.005
Molybdenum	µg/L	0.05		<0.05	<0.05			<0.05		<0.05		<0.05
Nickel	µg/L	0.50		<0.5	<0.5			<0.5		<0.5		<0.5
Phosphorus	µg/L	50.0		<50	<50			<50		<50		<50
Potassium	µg/L	50.0		<50	<50			<50		<50		<50
Rubidium	µg/L	0.20		<0.2	<0.2			<0.2		<0.2		<0.2
Selenium	µg/L	0.05		<0.05	<0.05			<0.05		<0.05		<0.05
Silicon	µg/L	50.0		<50	<50			<50		<50		<50
Silver	µg/L	0.01		<0.01	<0.01			<0.01		<0.01		<0.01
Sodium	µg/L	50.0		<50	<50			<50		<50		<50
Strontium	µg/L	0.2		<0.2	<0.2			<0.2		<0.2		<0.2
Sulfur	µg/L	500		<500	<500			<500		<500		<500
Tellurium	µg/L	0.20		<0.2	<0.2			<0.2		<0.2		<0.2
Thallium	µg/L	0.01		<0.01	<0.01			<0.01		<0.01		<0.01
Thorium	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Tin	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Titanium	µg/L	0.30		<0.3	<0.3			<0.3		<0.3		<0.3
Tungsten	µg/L	0.10		<0.1	<0.1			<0.1		<0.1		<0.1
Uranium	µg/L	0.01		<0.01	<0.01			<0.01		<0.01		<0.01
Vanadium	µg/L	0.50		<0.5	<0.5			<0.5		<0.5		<0.5
Zinc	µg/L	1.0		1.1	<1			<1		<1		<1
Zirconium	µg/L	0.06		<0.06	<0.06			<0.06		<0.06		<0.2
Laboratory Work Order Number			L2224203	L2224203	L2248301	L2248301	L2260745	L2260745	L2278405	L2278405	L2295954	L2295954
Laboratory Identification Number			L2224203-3	L2224203-2	L2248301-9	L2248301-10	L2260745-6	L2260745-7	L2278405-11	L2278405-12	L2295954-6	L2295954-7

Notes:

RDL - Reportable detection limit

RPD - Relative percent difference calculated as (ABS[(difference between two values)]/((sum of two values/2))*100

"-" Indicates RPD not calculated. RPD cannot be calculated if one or more of the analytical results is less than detection limits or within 5 times the RDL.

BOLD and Shaded - above detection limit (field/travel blanks) or RPD greater than 30% (field replicates)'

Blank - not analyzed.

Table 5: Surface Water Quality Assurance/Quality Control Analytical Results

Parameter	Unit	RDL	Travel Blank	Field Blank	Travel Blank	Field Blank	Travel Blank	Field Blank	Travel Blank	Field Blank	Travel Blank	Field Blank
			19-Jul-19	19-Jul-19	20-Aug-19	20-Aug-19	24-Sep-19	24-Sep-19	30-Oct-19	30-Oct-19	22-Nov-19	22-Nov-19
Physical Parameters												
Electrical Conductivity (EC)	µS/cm	2.0	<2	<2	<2	<2	<2	2.2	<2	<2	<2	<2
Hardness as $CaCO_3$	µg/L	500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
pH	pH Units	0.1	6.36	6.70	5.80	5.89	5.00	5.12	5.42	5.40	5.45	5.44
Total Dissolved Solids (TDS)	µg/L	10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Total Suspended Solids (TSS)	µg/L	3000	<3000	<3000	<3000	<3000	<3000	<3000	<3000	<3000	<3000	<3000
Anions and Nutrients												
Acidity (as $CaCO_3$)	µg/L	1000	1900	1800	2400	2000	<2000	<2000	2500	2400	<2000	<2000
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Hydroxide as $CaCO_3$)	µg/L	1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ammonia (NH_4 as N)	µg/L	5.0	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloride (Cl^-)	µg/L	500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Nitrate (NO_3^- as N)	µg/L	5.0	5.1	<5	<5	<5	<16.5	<5	<5	<5	<5	<5
Nitrite (NO_2^- as N)	µg/L	1.0	<1	<1	<1	<1	<3.6	<1	<1	<1	<1	<1
Sulphate (SO_4)	µg/L	300	<300	<300	<300	<300	<300	<300	<300	<300	<300	<300
Dissolved Organic Carbon (DOC)	µg/L		-	-	-	-	-	-	-	<0.50		<0.50
Metals, Total												
Aluminum	µg/L	3.0	<3	<3	<3	<3	<3	<3	<3	5.1	<3	<3
Antimony	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Barium	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.17	<0.1	<0.1
Beryllium	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Cadmium	µg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	µg/L	50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cesium	µg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	0.32	<0.1	0.27	<0.1	<0.1	<0.1
Cobalt	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	µg/L	0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron	µg/L	10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Lead	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	1.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Magnesium	µg/L	5.0	<5	<5	<5	<5	<5	<5	<5	8.2	<5	<5
Manganese	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.23	<0.1	<0.1
Mercury	µg/L	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nickel	µg/L	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Phosphorus	µg/L	50.0	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	µg/L	50.0	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Rubidium	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Selenium	µg/L	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	µg/L	100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Silver	µg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	µg/L	50.0	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Strontium	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Sulfur	µg/L	500	<500	<500	<500	<500	<500	<500	<500	<500	<500	<500
Tellurium	µg/L	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	0.73	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	0.30	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Tungsten	µg/L	0.10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium	µg/L	0.50	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	3.0	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Zirconium	µg/L	0.06	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Metals, Dissolved												
Aluminum	µg/L	1.0		<1		<1				<1		<1
Antimony	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Arsenic	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Barium	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Beryllium	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Bismuth	µg/L	0.05		<0.05		<0.05				<0.05		<0.05
Boron	µg/L	10.0		<10		<10				<10		<10
Cadmium	µg/L	0.005		<0.005		<0.005				<0.005		<0.005
Calcium	µg/L	50.0		<50		<50				<50		<50
Cesium	µg/L	0.01		<0.01		<0.01				<0.01		<0.01
Chromium	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Cobalt	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Copper	µg/L	0.20		<0.2		<0.2				<0.2		<0.2
Iron	µg/L	10.0		<10		<10				<10		<10
Lead	µg/L	0.05		<0.05		<0.05				<0.05		<0.05
Lithium	µg/L	1.0		<1		<1				<1		<1
Magnesium	µg/L	5.0		<5		<5				<5		<5
Manganese	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Mercury	µg/L	0.005		<0.005		<0.005				<0.005		<0.005
Molybdenum	µg/L	0.05		<0.05		<0.05				<0.05		<0.05
Nickel	µg/L	0.50		<0.5		<0.5				<0.5		<0.5
Phosphorus	µg/L	50.0		<50		<50				<50		<50
Potassium	µg/L	50.0		<50		<50				<50		<50
Rubidium	µg/L	0.20		<0.2		<0.2				<0.2		<0.2
Selenium	µg/L	0.05		<0.05		<0.05				<0.05		<0.05
Silicon	µg/L	50.0		<50		<50				<50		<50
Silver	µg/L	0.01		<0.01		<0.01				<0.01		<0.01
Sodium	µg/L	50.0		<50		<50				<50		<50
Strontium	µg/L	0.2		<0.2		<0.2				<0.2		<0.2
Sulfur	µg/L	500		<500		<500				<500		<500
Tellurium	µg/L	0.20		<0.2		<0.2				<0.2		<0.2
Thallium	µg/L	0.01		<0.01		<0.01				<0.01		<0.01
Thorium	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Tin	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Titanium	µg/L	0.30		<0.3		<0.3				<0.3		<0.3
Tungsten	µg/L	0.10		<0.1		<0.1				<0.1		<0.1
Uranium	µg/L	0.01		<0.01		<0.01				<0.01		<0.01
Vanadium	µg/L	0.50		<0.5		<0.5				<0.5		<0.5
Zinc	µg/L	1.0		<1		<1				<1		<1
Zirconium	µg/L	0.06		<0.2		<0.2				<0.2		<0.2
Laboratory Work Order Number			L231378	L231378	L2332423	L2332423	L2353312	L2353312	L2374685	L2374685	L2386755	L2386755
Laboratory Identification Number			L231378-7	L231378-6	L2332423-7	L2332423-6	L2353312-13	L2353312-7	L2374685-11	L2374685-12	L2386755-13	L2386755-12

Notes:

RDL - Reportable detection limit

RPD - Relative percent difference calculated as (ABS[(difference between two values)]/((sum of two values/2))*100

"-" Indicates RPD not calculated. RPD cannot be calculated if one or more of the analytical results is less than detection limits or within 5 times the RDL.

BOLD and Shaded - above detection limit (field/travel blanks) or RPD greater than 30% (field replicates)'

Blank - not analyzed.

Table 5: Surface Water Quality Assurance/Quality Control Analytical Results

Parameter	Unit	RDL	Travel Blank	Field Blank	LBL3C-1.65	LBL3C-1.65-R	RPD	LBL3C-1.65	LBL3C-1.65 R	RPD	RBSBIAR-DS	RBSBIAR-DS-R	RPD
			19-Dec-19	19-Dec-19	23-Jan-19			22-Mar-19			18-Apr-19		
Physical Parameters													
Electrical Conductivity (EC)	µS/cm	2.0	<2	<2	3790	3770	0.53	202	205	1.47	809	811	0.25
Hardness as $CaCO_3$	µg/L	500	<500	<500	2420000	2390000	1.25	74200	77000	3.70	266000	264000	0.75
pH	pH Units	0.1	5.88	5.92	6.94	6.74	2.92	7.79	7.86	0.89	8.18	8.17	0.12
Total Dissolved Solids (TDS)	µg/L	10000	<10000	<10000	4050000	4040000	0.25	200000	200000	0.00	501000	523000	4.30
Total Suspended Solids (TSS)	µg/L	3000	<3000	<3000	18400	82000	126.69	542000	418000	25.83	13300	13500	1.49
Anions and Nutrients													
Acidity (as $CaCO_3$)	µg/L	1000	2100	<2000	75100	89800	17.83	2700	2700	0.00	<1000	<1000	-
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	<1000	<1000	294000	291000	1.03	58300	60000	2.87	215000	217000	0.93
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	<1000	<1000	<1000	<1000	-	<1000	<1000	-	<1000	<1000	-
Alkalinity (Hydroxide as $CaCO_3$)	µg/L	1000	<1000	<1000	<1000	<1000	-	<1000	<1000	-	<1000	<1000	-
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	<1	<1	294	291	1.03	58.3	60	2.87	215	217	0.93
Ammonia (NH_4 as N)	µg/L	5.0	<5	<5	290	285	1.74	27.1	25.6	5.69	231	227	1.75
Chloride (Cl^-)	µg/L	500	<500	<500	15000	15000	0.00	14000	14100	0.71	58400	58100	0.52
Nitrate (NO_3^- as N)	µg/L	5.0	<5	<5	<100	<100	-	270	274	1.47	2230	2220	0.45
Nitrite (NO_2^- as N)	µg/L	1.0	<1	<1	<20	<20	-	8.4	7.9	6.13	17.9	18.6	3.84
Sulphate (SO_4)	µg/L	300	<300	<300	2580000	2590000	0.39	20100	20700	2.94	116000	116000	0.00
Dissolved Organic Carbon (DOC)	µg/L			1.37									
Metals, Total													
Aluminum	µg/L	3.0	<3	<3	2080	1520	31.11	4340	4120	5.20	272	240	12.50
Antimony	µg/L	0.10	<0.1	<0.1	<2	<2	-	0.36	0.34	5.71	0.3	0.31	3.28
Arsenic	µg/L	0.10	<0.1	<0.1	<2	<2	-	3.8	3.65	4.03	0.43	0.4	7.23
Barium	µg/L	0.10	<0.1	<0.1	21.4	22	2.76	163	153	6.33	136	134	1.48
Beryllium	µg/L	0.10	<0.1	<0.1	<2	<2	-	0.25	0.23	8.33	<0.1	<0.1	-
Bismuth	µg/L	0.05	<0.05	<0.05	<1	<1	-	0.063	0.06	4.88	<0.05	<0.05	-
Boron	µg/L	10	<10	<10	<200	<200	-	28	28	0.00	115	113	1.75
Cadmium	µg/L	0.005	0.016	<0.005	6.39	6.48	1.40	0.32	0.318	0.63	0.324	0.319	1.56
Calcium	µg/L	50	<50	<50	520000	578000	10.56	23200	22900	1.30	74600	71700	3.96
Cesium	µg/L	0.01	<0.01	<0.01	<0.2	<0.2	-	0.777	0.74	4.88	0.051	0.049	4.00
Chromium	µg/L	0.10	<0.1	<0.1	<2	<2	-	7.97	7.68	3.71	0.98	0.45	**74.13**
Cobalt	µg/L	0.10	<0.1	<0.1	1310	1300	0.77	4.13	4	3.20	6.4	6.11	4.64
Copper	µg/L	0.50	<0.5	<0.5	<10	<10	-	12.6	12.1	4.05	3.03	2.85	6.12
Iron	µg/L	10	<10	<10	2090	2320	10.43	8660	8340	3.76	466	387	18.52
Lead	µg/L	0.05	<0.05	<0.05	<1	<1	-	4.78	4.63	3.19	0.176	0.151	15.29
Lithium	µg/L	1.0	<1	<1	144	146	1.38	7.3	7	4.20	38.2	37.3	2.38
Magnesium	µg/L	5.0	<5	<5	282000	281000	0.36	8400	8240	1.92	19900	18900	5.15
Manganese	µg/L	0.10	<0.1	<0.1	86200	85500	0.82	157	149	5.23	80.5	78	3.15
Mercury	µg/L	0.005	<0.005	<0.005	0.0063	<0.005	23.01	<0.005	<0.005	-	<0.005	0.0065	-
Molybdenum	µg/L	0.05	<0.05	<0.05	<1	<1	-	1.08	1.14	5.41	6	6.31	5.04
Nickel	µg/L	0.5	<0.5	<0.5	2270	2280	0.44	15.2	15.1	0.66	24.1	23.7	1.67
Phosphorus	µg/L	50.0	<50	<50	<1000	<1000	-	508	478	6.09	<50	<50	-
Potassium	µg/L	50.0	<50	<50	10200	10300	0.98	9060	8980	0.89	2880	2830	1.75
Rubidium	µg/L	0.2	<0.2	<0.2	5	<4	-	7.8	7.48	4.19	2.31	2.19	5.33
Selenium	µg/L	0.05	<0.05	<0.05	<1	<1	-	0.486	0.455	6.59	1.19	1.24	4.12
Silicon	µg/L	100	<100	<100	7700	7700	0.00	7860	7820	0.51	3250	3210	1.24
Silver	µg/L	0.01	<0.01	<0.01	<0.2	<0.2	-	0.093	0.087	6.67	<0.01	<0.01	-
Sodium	µg/L	50.0	<50	<50	153000	152000	0.66	8410	8360	0.60	82700	78800	4.83
Strontium	µg/L	0.2	<0.2	<0.2	1260	1270	0.79	89.8	86.6	3.63	375	375	0.00
Sulfur	µg/L	500	<500	<500	885000	872000	1.48	7030	6730	4.36	44000	43900	0.23
Tellurium	µg/L	0.2	<0.2	<0.2	<4	<4	-	<0.2	<0.2	-	<0.2	<0.2	-
Thallium	µg/L	0.01	<0.01	<0.01	<0.2	<0.2	-	0.086	0.084	2.35	0.015	0.016	6.45
Thorium	µg/L	0.10	<0.1	<0.1	<2	<2	-	0.79	0.8	1.26	<0.1	<0.1	-
Tin	µg/L	0.10	0.16	<0.1	<2	<2	-	<0.1	<0.1	-	<0.1	<0.1	-
Titanium	µg/L	0.30	<0.3	<0.3	<6	<6	-	54.9	54.4	0.91	3.69	3.27	12.07
Tungsten	µg/L	0.10	<0.1	<0.1	<2	<2	-	<0.1	<0.1	-	<0.1	<0.1	-
Uranium	µg/L	0.01	<0.01	<0.01	2.16	2.04	5.71	0.461	0.448	2.86	1.29	1.35	4.55
Vanadium	µg/L	0.50	<0.5	<0.5	<10	<10	-	15	14.4	4.08	0.69	0.56	20.80
Zinc	µg/L	3.0	<3	<3	2380	2350	1.27	48.7	49.5	1.63	47.3	46.9	0.85
Zirconium	µg/L	0.06	<0.2	<0.2	<1.2	<1.2	-	0.273	0.271	0.134	0.14	4.38	0.18
Metals, Dissolved													
Aluminum	µg/L	1.0		<1	1350	1320	2.25	103	110	6.57	72.4	69.7	3.80
Antimony	µg/L	0.10		<0.1	<2	<2	-	<0.1	<0.1	-	0.26	0.25	3.92
Arsenic	µg/L	0.10		<0.1	<2	<2	-	0.6	0.72	18.18	0.2	0.23	13.95
Barium	µg/L	0.10		<0.1	20	19.8	1.01	33.1	35.2	6.15	119	117	1.69
Beryllium	µg/L	0.10		<0.1	<2	<2	-	<0.1	<0.1	-	<0.1	<0.1	-
Bismuth	µg/L	0.05		<0.05	<1	<1	-	<0.05	<0.05	-	<0.05	<0.05	-
Boron	µg/L	10.0		<10	<200	<200	-	25	24	4.08	100	103	2.96
Cadmium	µg/L	0.005		<0.005	6.06	6.11	0.82	0.0715	0.0712	0.42	0.267	0.281	5.11
Calcium	µg/L	50.0		<50	533000	528000	0.94	19400	20500	5.51	74300	73600	0.95
Cesium	µg/L	0.01		<0.01	<0.2	<0.2	-	<0.01	<0.01	-	0.02	0.019	5.13
Chromium	µg/L	0.10		<0.1	<2	<2	-	0.19	0.19	0.00	0.11	0.11	0.00
Cobalt	µg/L	0.10		<0.1	1240	1230	0.81	0.53	0.51	3.85	6.04	6.09	0.82
Copper	µg/L	0.20		0.43	<4	<4	-	2.47	2.48	0.40	1.86	1.82	2.17
Iron	µg/L	10.0		<10	1820	1750	3.92	162	179	9.97	<10	<10	-
Lead	µg/L	0.05		<0.05	<1	<1	-	0.2	0.157	24.09	<0.05	<0.05	-
Lithium	µg/L	1.0		<1	146	143	2.08	2.2	2.2	0.00	39	39.3	0.77
Magnesium	µg/L	5.0		<5	264000	262000	0.76	6240	6270	0.48	19500	19500	0.00
Manganese	µg/L	0.10		<0.1	83200	84900	2.02	23.9	22.8	4.71	75.1	75.8	0.93
Mercury	µg/L	0.005		<0.005	0.006	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-
Molybdenum	µg/L	0.05		<0.05	<1	<1	-	0.713	0.709	0.56	5.73	6.06	5.60
Nickel	µg/L	0.50		<0.5	2140	2130	0.47	3.25	3.34	2.73	23.4	23.7	1.27
Phosphorus	µg/L	50.0		<50	<1000	<1000	-	199	185	7.29	<50	<50	-
Potassium	µg/L	50.0		<50	9300	9100	2.17	8460	8580	1.41	2960	2960	0.00
Rubidium	µg/L	0.20		<0.2	4	4	0.00	1.2	1.21	0.83	2.01	1.95	3.03
Selenium	µg/L	0.05		<0.05	<1	<1	-	0.215	0.249	14.66	1.14	1.23	7.59
Silicon	µg/L	50.0		<50	7200	7200	0.00	1590	1560	1.90	2930	3000	2.36
Silver	µg/L	0.01		<0.01	<0.2	<0.2	-	<0.01	<0.01	-	<0.01	<0.01	-
Sodium	µg/L	50.0		<50	143000	141000	1.41	9640	9650	0.10	83600	84100	0.60
Strontium	µg/L	0.2		<0.2	1260	1270	0.79	68.9	71	3.00	377	389	3.13
Sulfur	µg/L	500		<500	857000	859000	0.23	6800	6450	5.28	39000	40100	2.78
Tellurium	µg/L	0.20		<0.2	<4	<4	-	<0.2	<0.2	-	<0.2	<0.2	-
Thallium	µg/L	0.01		<0.01	<0.2	<0.2	-	<0.01	<0.01	-	0.013	0.013	0.00
Thorium	µg/L	0.10		<0.1	<2	<2	-	0.11	0.12	8.70	<0.1	<0.1	-
Tin	µg/L	0.10		<0.1	<2	<2	-	<0.1	<0.1	-	<0.1	<0.1	-
Titanium	µg/L	0.30		<0.3	<6	<6	-	4.52	5.95	27.32	<0.3	<0.3	-
Tungsten	µg/L	0.10		<0.1	<2	<2	-	<0.1	<0.1	-	<0.1	<0.1	-
Uranium	µg/L	0.01		<0.01	2.11	2.22	5.08	0.231	0.241	4.24	1.31	1.29	1.54
Vanadium	µg/L	0.50		<0.5	<10	<10	-	0.62	0.68	9.23	<0.5	<0.5	-
Zinc	µg/L	1.0		<1	2220	2160	2.74	2.6	2.3	12.24	78.4	37.8	69.88
Zirconium	µg/L	0.06		<0.2	<1.2	<1.2	-	0.54	0.53	1.87	<0.06	<0.06	-
Laboratory Work Order Number			L2398938	L2398938	L2224203	L2224203		L2248302	L2248302		L2260745	L2260745	
Laboratory Identification Number			L2398938-9	L2398938-8	L2224203-1	L2224203-4		L2248302-1	L2248302-2		L2260745-3	L2260745-8	

Notes:

RDL - Reportable detection limit

RPD - Relative percent difference calculated as (ABS[(difference between two values)]/((sum of two values/2))*100

"-" Indicates RPD not calculated. RPD cannot be calculated if one or more of the analytical results is less than detection limits or within 5 times the RDL.

BOLD and Shaded - above detection limit (field/travel blanks) or RPD greater than 30% (field replicates)'

Blank - not analyzed.

TETRA TECH

Table 5: Surface Water Quality Assurance/Quality Control Analytical Results

Parameter	Unit	RDL	LBL3C-0.02	LBL3C-0.02 R	RPD	LBL3C-1.43	LBL3C-1.43-R	RPD	LBL3C-0.02	LBL3C-0.02-R	RPD	RBSBIAR-DS	RBSBIAR-DS-R	RPD
			23-May-19			20-Jun-19			19-Jul-19			20-Aug-19		
Physical Parameters														
Electrical Conductivity (EC)	µS/cm	2.0	1730	1840	6.16	1720	1710	0.58	1410	1400	0.71	1150	1160	0.87
Hardness as $CaCO_3$	µg/L	500	1060000	1040000	1.90	978000	1020000	4.20	678000	674000	0.59	517000	493000	4.75
pH	pH Units	0.1	8.21	8.27	0.73	8.02	8.02	0.00	8.39	8.42	0.36	8.14	8.07	0.86
Total Dissolved Solids (TDS)	µg/L	10000	1630000	1580000	3.12	1480000	1400000	5.56	1210000	1270000	4.84	848000	900000	5.95
Total Suspended Solids (TSS)	µg/L	3000	19400	7600	87.41	<3000	<3000		1010000	492000	68.97	24300	23700	2.50
Anions and Nutrients														
Acidity (as $CaCO_3$)	µg/L	1000	1400	1500	6.90	6800	6800	0.00	<1000	<1000	-	2700	3600	28.57
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	218000	215000	1.39	242000	250000	3.25	208000	210000	0.96	185000	187000	1.08
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	<1000	<1000	-	<1000	<1000	-	5400	6400	16.95	<1000	<1000	-
Alkalinity (Hydroxide as $CaCO_3$)	µg/L	1000	<1000	<1000	-	<1000	<1000	-	<1000	<1000	-	<1000	<1000	-
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	218	215	1.39	242	250	3.25	214	216	0.93	185	187	1.08
Ammonia (NH_4 as N)	µg/L	5.0	17	18.6	8.99	11.6	12.5	7.47	26.2	<21.5	19.71	242	249	2.85
Chloride (Cl^-)	µg/L	500	38600	38200	1.04	33100	34000	2.68	50500	49900	1.20	142000	142000	0.00
Nitrate (NO_3^- as N)	µg/L	5.0	1690	1700	0.59	8520	8660	1.63	1700	1710	0.59	5610	5620	0.18
Nitrite (NO_2^- as N)	µg/L	1.0	10	5	66.67	10	10	0.00	<5	<5	-	73.7	73.7	0.00
Sulphate (SO_4)	µg/L	300	848000	845000	0.35	737000	742000	0.68	537000	551000	2.57	219000	218000	0.46
Dissolved Organic Carbon (DOC)	µg/L													
Metals, Total														
Aluminum	µg/L	3.0	763	738	3.33	43.8	47.7	8.52	14100	5500	87.76	2680	2700	0.74
Antimony	µg/L	0.10	0.27	0.22	20.41	0.13	0.14	7.41	0.73	0.46	45.38	0.32	0.33	3.08
Arsenic	µg/L	0.10	0.57	0.52	9.17	0.25	0.25	0.00	9.62	3.42	95.09	1.6	1.49	7.12
Barium	µg/L	0.10	64.2	63.4	1.25	45.4	49.1	7.83	319	146	74.41	174	177	1.71
Beryllium	µg/L	0.10	0.11	<0.1	-	<0.1	<0.1	-	0.78	0.44	55.74	0.78	0.79	1.27
Bismuth	µg/L	0.05	<0.05	<0.05	-	<0.05	<0.05	-	0.18	0.054	107.69	<0.05	<0.05	-
Boron	µg/L	10	107	100	6.76	109	101	7.62	85	87	2.33	134	143	6.50
Cadmium	µg/L	0.005	0.618	0.581	6.17	0.226	0.22	2.69	1.85	0.883	70.76	1.22	1.22	0.00
Calcium	µg/L	50	250000	234000	6.61	233000	223000	4.39	191000	185000	3.19	133000	136000	2.23
Cesium	µg/L	0.01	0.066	0.065	1.53	<0.01	<0.01	-	1.75	0.651	91.55	0.054	0.059	8.85
Chromium	µg/L	0.10	0.47	0.42	11.24	0.21	0.27	25.00	24	7.49	104.86	2.16	2.2	1.83
Cobalt	µg/L	0.10	15.4	14.8	3.97	31.7	33.3	4.92	27.6	18.2	41.05	26.9	27	0.37
Copper	µg/L	0.50	2.52	2.27	10.44	0.75	0.58	25.56	35.2	11.9	98.94	20.2	20.3	0.49
Iron	µg/L	10	761	732	3.88	103	98	4.98	25100	8410	99.61	2830	2760	2.50
Lead	µg/L	0.05	0.223	0.236	5.66	<0.05	<0.05	-	12.2	3.45	111.82	0.112	0.112	0.00
Lithium	µg/L	1.0	49.3	49	0.61	54.4	48.8	10.85	59	43.3	30.69	54.9	58	5.49
Magnesium	µg/L	5.0	80000	71500	11.22	91400	87200	4.70	63700	59300	7.15	36700	37300	1.62
Manganese	µg/L	0.10	1140	1100	3.57	3110	3170	1.91	1320	1120	16.39	282	280	0.71
Mercury	µg/L	0.005	<0.005	<0.005	-	<0.005	<0.005	-	0.1	0.1	0.00	<0.005	<0.005	-
Molybdenum	µg/L	0.05	1.36	1.59	15.59	0.91	0.965	5.87	2.66	2.12	22.59	3.64	3.75	2.98
Nickel	µg/L	0.5	51.8	49.3	4.95	82.3	83.1	0.97	87	56.9	41.83	92.9	93.5	0.64
Phosphorus	µg/L	50.0	<50	<50	-	<50	<50	-	650	208	103.03	120	<98	-
Potassium	µg/L	50.0	6710	6420	4.42	4870	5090	4.42	7540	6650	12.54	5730	5860	2.24
Rubidium	µg/L	0.2	2.15	1.97	8.74	0.77	0.79	2.56	15.8	6.43	84.30	3.34	3.34	0.00
Selenium	µg/L	0.05	4.02	3.8	5.63	8.49	7.71	9.63	3.02	2.7	11.19	0.773	0.828	6.87
Silicon	µg/L	100	4480	4320	3.64	5690	5790	1.74	24800	11100	76.32	5520	5600	1.44
Silver	µg/L	0.01	0.017	<0.01	-	<0.01	<0.01	-	0.178	0.063	95.44	<0.01	<0.01	-
Sodium	µg/L	50.0	58300	54600	6.55	36700	36300	1.10	47800	48500	1.45	48500	48900	0.82
Strontium	µg/L	0.2	767	789	2.83	728	741	1.77	661	626	5.44	829	870	4.83
Sulfur	µg/L	500	337000	328000	2.71	262000	281000	7.00	184000	194000	5.29	84200	85200	1.18
Tellurium	µg/L	0.2	0.21	<0.2	-	<0.2	<0.2	-	0.4	<0.2	66.67	0.21	0.25	17.39
Thallium	µg/L	0.01	0.027	0.028	3.64	0.013	0.012	8.00	0.252	0.092	93.02	0.029	0.028	3.51
Thorium	µg/L	0.10	0.12	<0.1	-	<0.1	<0.1	-	3.76	1.16	105.69	1.5	1.43	4.78
Tin	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	0.2	0.12	50.00	<0.1	<0.1	-
Titanium	µg/L	0.30	4.2	3	33.33	<0.3	<0.3	-	129	59.5	73.74	1.8	2.77	42.45
Tungsten	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	0.2	<0.1	66.67	<0.1	<0.1	-
Uranium	µg/L	0.01	5.03	5.22	3.71	5.06	5	1.19	4.71	4.09	14.09	2.89	2.97	2.73
Vanadium	µg/L	0.50	0.87	0.79	9.64	<0.5	<0.5	-	42.5	13.6	103.03	0.56	0.57	1.77
Zinc	µg/L	3.0	60.4	57.8	4.40	32.2	33.6	4.26	233	124	61.06	289	299	3.40
Zirconium	µg/L	0.06	0.16	11.76	<0.2	<0.2	-	0.49	0.44	10.75	<0.2	<0.2	-	
Metals, Dissolved														
Aluminum	µg/L	1.0	**210**	**213**	1.42	11	18.6	**51.35**	180	220	20.00	238	283	17.27
Antimony	µg/L	0.10	0.22	0.21	4.65	0.13	0.13	0.00	0.22	0.19	14.63	0.29	0.3	3.39
Arsenic	µg/L	0.10	0.21	0.22	4.65	0.19	0.19	0.00	0.35	0.35	0.00	0.15	0.17	12.50
Barium	µg/L	0.10	59.4	57.7	2.90	47.4	48.4	2.09	75.9	73.1	3.76	175	176	0.57
Beryllium	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	0.11	-
Bismuth	µg/L	0.05	<0.05	<0.05	-	<0.05	<0.05	-	<0.05	<0.05	-	<0.05	<0.05	-
Boron	µg/L	10.0	94	96	2.11	94	93	1.07	88	87	1.14	129	128	0.78
Cadmium	µg/L	0.005	0.493	0.506	2.60	0.208	0.208	0.00	0.243	0.289	17.29	1.01	0.999	1.10
Calcium	µg/L	50.0	276000	273000	1.09	240000	253000	5.27	174000	172000	1.16	144000	136000	5.71
Cesium	µg/L	0.01	0.013	<0.01	-	<0.01	<0.01	-	<0.01	<0.01	-	0.05	0.052	3.92
Chromium	µg/L	0.10	<0.1	0.11	-	0.23	0.17	**30.00**	0.13	<0.1	26.09	<0.1	0.13	-
Cobalt	µg/L	0.10	14.7	14.2	3.46	32	33.4	4.28	9.5	10.6	10.95	27.6	26.4	4.44
Copper	µg/L	0.20	1.52	1.45	4.71	0.53	0.55	3.70	1.7	1.56	8.59	4.93	5.07	2.80
Iron	µg/L	10.0	<10	20	-	<10	22	**75.00**	11	<10	9.52	401	415	3.43
Lead	µg/L	0.05	<0.05	<0.05	-	<0.05	<0.05	-	<0.05	<0.05	-	<0.05	<0.05	-
Lithium	µg/L	1.0	50.3	51.3	1.97	50.7	49.3	2.80	39.2	38.9	0.77	56.9	55.1	3.21
Magnesium	µg/L	5.0	89400	86500	3.30	91700	94200	2.69	59200	59200	0.00	38600	37300	3.43
Manganese	µg/L	0.10	1130	1080	4.52	3240	3430	5.70	973	1020	4.72	294	278	5.59
Mercury	µg/L	0.005	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-
Molybdenum	µg/L	0.05	1.5	1.39	7.61	0.845	0.865	2.34	2.02	1.76	13.76	3.73	4.06	8.47
Nickel	µg/L	0.50	49.1	47.2	3.95	80.1	83.7	4.40	32.2	34.4	6.61	94.3	90.2	4.44
Phosphorus	µg/L	50.0	<50	<50	-	<50	<50	-	<50	<50	-	<50	<50	-
Potassium	µg/L	50.0	7170	6850	4.56	5480	5380	1.84	6100	6230	2.11	6220	6220	0.00
Rubidium	µg/L	0.20	1.81	1.63	10.47	0.8	0.82	2.47	1.26	1.33	5.41	3.47	3.54	2.00
Selenium	µg/L	0.05	3.3	3.76	13.03	8.41	7.58	10.38	2.92	2.79	4.55	0.732	0.835	13.15
Silicon	µg/L	50.0	3730	3830	2.65	5490	5540	0.91	4250	4290	0.94	4730	4900	3.53
Silver	µg/L	0.01	<0.01	<0.01	-	<0.01	<0.01	-	<0.01	<0.01	-	<0.01	<0.01	-
Sodium	µg/L	50.0	60200	58100	3.55	36400	36500	0.27	47900	47700	0.42	51600	49300	4.56
Strontium	µg/L	0.2	874	823	6.01	711	747	4.94	584	562	3.84	857	850	0.82
Sulfur	µg/L	500	310000	322000	3.80	247000	246000	0.41	209000	206000	1.45	79800	80000	0.25
Tellurium	µg/L	0.20	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2	-
Thallium	µg/L	0.01	0.023	0.022	4.44	0.013	0.013	0.00	0.016	0.016	0.00	0.026	0.028	7.41
Thorium	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-
Tin	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-
Titanium	µg/L	0.30	<0.3	<0.3	-	<0.3	<0.3	-	<0.3	<0.3	-	<0.3	<0.3	-
Tungsten	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-
Uranium	µg/L	0.01	4.89	4.66	4.82	5.02	4.93	1.81	3.96	3.84	3.08	2.46	2.43	1.23
Vanadium	µg/L	0.50	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	-
Zinc	µg/L	1.0	38.8	37.9	2.35	28.1	30.3	7.53	9.7	10.9	11.65	175	168	4.08
Zirconium	µg/L	0.06	<0.06	<0.06	-	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2	-
Laboratory Work Order Number			L2278405	L2278405		L2295954	L2295954		L2313718	L2313718		L2332423	L2332423	
Laboratory Identification Number			L2278405-1	L2278405-13		L2295954-10	L2295954-8		L2313718-04	L2313718-8		L2332423-11	L2332423-8	

Notes:

RDL - Reportable detection limit

RPD - Relative percent difference calculated as (ABS[(difference between two values)]/((sum of two values/2))*100

"-" Indicates RPD not calculated. RPD cannot be calculated if one or more of the analytical results is less than detection limits or within 5 times the RDL.

BOLD and Shaded - above detection limit (field/travel blanks) or RPD greater than 30% (field replicates)'

Blank - not analyzed.

Table 5: Surface Water Quality Assurance/Quality Control Analytical Results

Parameter	Unit	RDL	RBSBIAR-DS	RBSBIAR-DS-R	RPD	RBSBIAR-DS	RBSBIAR-DS-R	RPD	RBSC	RBSC-R	RPD	LBL3C-1.65	LBL3C-1.65-R	RPD
			24-Sep-19			30-Oct-19			22-Nov-19			19-Dec-19		
Physical Parameters														
Electrical Conductivity (EC)	µS/cm	2.0	746	748	0.07	810	791	2.37	1450	1490	2.72	2140	2140	0.0
Hardness as $CaCO_3$	µg/L	500	327000	324000	0.23	348000	340000	2.33	722000	748000	3.54	1310000	1210000	7.9
pH	pH Units	0.1	8.08	8.04	0.12	8.21	8.13	0.98	7.25	8.12	11.32	7.08	6.88	2.9
Total Dissolved Solids (TDS)	µg/L	10000	489000	513000	1.20	487000	409000	17.41	1050000	1110000	5.56	2050000	1860000	9.7
Total Suspended Solids (TSS)	µg/L	3000	<3000	<3000	-	7800	5600	**32.84**	6000	3800	**44.90**	16300	5500	**99.1**
Anions and Nutrients														
Acidity (as $CaCO_3$)	µg/L	1000	<2000	<2000	-	<2000	2100	-	36800	3300	**167.08**	33600	44400	27.7
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	230000	241000	1.17	256000	270000	5.32	388000	387000	0.26	272000	274000	0.7
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	<1000	<1000	-	<1000	<1000	-	<1000	<1000	-	<1000	<1000	-
Alkalinity (Hydroxide as $CaCO_3$)	µg/L	1000	<1000	<1000	-	<1000	<1000	-	<1000	<1000	-	<1000	<1000	-
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	230	241	1.17	256	270	5.32	388	387	0.26	272	274	0.7
Ammonia (NH_4 as N)	µg/L	5.0	97.8	92.3	1.45	104	105	0.96	31.5	40.1	24.02	214	200	6.8
Chloride (Cl^-)	µg/L	500	66000	67300	0.49	64400	65000	0.93	28600	29700	3.77	68000	62000	9.2
Nitrate (NO_3^- as N)	µg/L	5.0	2660	2710	0.47	3020	3040	0.66	<25	<25	-	270	280	3.6
Nitrite (NO_2^- as N)	µg/L	1.0	10.7	15.3	8.85	7.5	8.2	8.92	<5	<5	-	<20	<20	-
Sulphate (SO_4)	µg/L	300	86500	88300	0.51	89000	89700	0.78	447000	466000	4.16	1030000	1030000	0.0
Dissolved Organic Carbon (DOC)	µg/L					2.02	1.62	21.98	2.29	3.23	**34.06**	8.39	-	-
Metals, Total														
Aluminum	µg/L	3.0	104	93.6	2.63	202	191	5.60	4.5	3.5	25.00	1130	671	**51.0**
Antimony	µg/L	0.10	0.23	0.21	2.27	0.17	0.17	0.00	<0.1	<0.1	-	<0.5	<0.5	-
Arsenic	µg/L	0.10	0.25	0.24	1.02	0.28	0.26	7.41	1	0.81	20.99	<0.5	<0.5	-
Barium	µg/L	0.10	143	140	0.53	131	133	1.52	31.8	29.6	7.17	35.2	32.9	6.8
Beryllium	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.5	<0.5	-
Bismuth	µg/L	0.05	<0.05	<0.05	-	<0.05	<0.05	-	<0.05	<0.05	-	<0.25	<0.25	-
Boron	µg/L	10	91	94	0.81	63	63	0.00	126	134	6.15	117	112	4.4
Cadmium	µg/L	0.005	0.0776	0.0707	2.33	0.128	0.121	5.62	0.246	0.302	20.44	3.46	3.47	0.3
Calcium	µg/L	50	93900	95800	0.50	94900	96200	1.36	201000	209000	3.90	333000	339000	1.8
Cesium	µg/L	0.01	0.028	0.026	1.85	0.028	0.03	6.90	<0.01	<0.01	-	<0.05	<0.05	-
Chromium	µg/L	0.10	0.38	0.28	7.58	0.73	0.67	8.57	<0.1	<0.1	-	<0.5	<0.5	-
Cobalt	µg/L	0.10	1.93	1.93	0.00	2.67	2.49	6.98	2.2	2.23	1.35	188	186	1.1
Copper	µg/L	0.50	0.92	1.09	4.23	1.65	1.4	16.39	<0.5	<0.5	-	<2.5	<2.5	-
Iron	µg/L	10	98	92	1.58	305	264	14.41	1660	1250	28.18	1170	740	**45.0**
Lead	µg/L	0.05	<0.05	<0.05	-	0.075	0.072	4.08	<0.05	<0.05	-	<0.25	<0.25	-
Lithium	µg/L	1.0	22.1	22.8	0.78	20.5	19.8	3.47	71.7	75.2	4.77	87.3	86.3	1.2
Magnesium	µg/L	5.0	24100	24400	0.31	27100	26600	1.86	58400	58600	0.34	112000	112000	0.0
Manganese	µg/L	0.10	26.8	27.1	0.28	38	36.6	3.75	2990	3100	3.61	18700	19000	1.6
Mercury	µg/L	0.005	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-
Molybdenum	µg/L	0.05	3.67	3.77	0.67	3.77	3.79	0.53	0.978	0.984	0.61	2.06	1.38	**39.5**
Nickel	µg/L	0.5	11	11.1	0.23	14.1	13.5	4.35	58.9	66.6	12.27	439	438	0.2
Phosphorus	µg/L	50.0	<50	<50	-	<50	<50	-	<50	<50	-	<250	<250	-
Potassium	µg/L	50.0	4750	4790	0.21	4230	4210	0.47	2240	2320	3.51	5970	5990	0.3
Rubidium	µg/L	0.2	2.07	2.05	0.24	1.87	1.98	5.71	1.86	2.03	8.74	2.3	2.4	4.3
Selenium	µg/L	0.05	0.601	0.573	1.19	0.845	0.692	19.91	0.076	0.077	1.31	0.47	0.5	6.2
Silicon	µg/L	100	4390	4440	0.28	4690	4670	0.43	4970	5000	0.60	7340	7430	1.2
Silver	µg/L	0.01	<0.01	<0.01	-	<0.01	<0.01	-	<0.01	<0.01	-	<0.05	<0.05	-
Sodium	µg/L	50.0	35000	35200	0.14	35400	34300	3.16	77500	78600	1.41	59500	60000	0.8
Strontium	µg/L	0.2	514	512	0.10	520	515	0.97	580	593	2.22	744	700	6.1
Sulfur	µg/L	500	29000	30000	0.85	34300	33300	2.96	170000	180000	5.71	401000	409000	2.0
Tellurium	µg/L	0.2	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2	-	<1	<1	-
Thallium	µg/L	0.01	0.015	0.014	1.72	0.012	0.013	8.00	<0.01	0.012	-	0.055	0.056	1.8
Thorium	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.5	<0.5	-
Tin	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.5	<0.5	-
Titanium	µg/L	0.30	0.4	<0.3	-	1.99	1.92	3.58	<0.3	<0.3	-	<1.5	<1.5	-
Tungsten	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.5	<0.5	-
Uranium	µg/L	0.01	1.04	1.02	0.49	1.11	1.09	1.82	2.08	2.19	5.15	1.99	1.91	4.1
Vanadium	µg/L	0.50	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	-	<2.5	<2.5	-
Zinc	µg/L	3.0	20.1	20.1	0.00	28.2	26.6	5.84	24.3	31.1	24.55	457	456	0.2
Zirconium	µg/L	0.06	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2	-	<1.0	<1.0	-
Metals, Dissolved														
Aluminum	µg/L	1.0	65.7	61.4	1.69	73.5	69	6.32	2.6	2.5	3.92	608	608	0.0
Antimony	µg/L	0.10	0.21	0.2	1.22	0.17	0.15	12.50	<0.1	<0.1	-	<0.5	<0.5	-
Arsenic	µg/L	0.10	0.19	0.2	1.28	0.19	0.18	5.41	0.88	0.68	25.64	<0.5	<0.5	-
Barium	µg/L	0.10	141	139	0.36	128	125	2.37	32.2	33.6	4.26	35.8	31.5	12.8
Beryllium	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1		<0.1	<0.1	-	<0.5	<0.5	-
Bismuth	µg/L	0.05	<0.05	<0.05	-	<0.05	<0.05		<0.05	<0.05	-	<0.25	<0.25	-
Boron	µg/L	10.0	86	90	1.14	62	62	0.00	109	111	1.82	109	127	15.3
Cadmium	µg/L	0.005	0.0657	0.0648	0.34	0.102	0.104	1.94	0.0425	0.032	28.19	3.43	3.07	11.1
Calcium	µg/L	50.0	92500	91700	0.22	100000	97500	2.53	197000	203000	3.00	342000	314000	8.5
Cesium	µg/L	0.01	0.025	0.023	2.08	0.015	0.015	0.00	<0.01	<0.01	-	<0.05	<0.05	-
Chromium	µg/L	0.10	0.17	0.16	1.52	0.37	0.43	15.00	<0.1	<0.1	-	<0.5	<0.5	-
Cobalt	µg/L	0.10	1.86	1.87	0.13	2.4	2.33	2.96	2.07	2.42	15.59	194	177	9.2
Copper	µg/L	0.20	0.64	0.72	2.94	1.32	1.17	12.05	<0.2	0.21	-	2.6	1.2	**73.7**
Iron	µg/L	10.0	21	22	1.16	35	35	0.00	1280	1180	8.13	670	667	0.4
Lead	µg/L	0.05	<0.05	<0.05	-	<0.05	<0.05	-	<0.05	<0.05	-	<0.25	<0.25	-
Lithium	µg/L	1.0	22.1	22.5	0.45	20	19.6	2.02	65.8	67.3	2.25	89.1	85.8	3.8
Magnesium	µg/L	5.0	23400	23100	0.32	23700	23400	1.27	56000	58500	4.37	110000	103000	6.6
Manganese	µg/L	0.10	26	25.7	0.29	32	30.9	3.50	2940	3170	7.53	19000	16700	12.9
Mercury	µg/L	0.005	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-	<0.005	<0.005	-
Molybdenum	µg/L	0.05	3.62	3.6	0.14	3.7	3.66	1.09	1.04	0.947	9.36	0.55	0.53	3.7
Nickel	µg/L	0.50	10.4	10.3	0.24	12.8	12.1	5.62	56.7	62.4	9.57	445	427	4.1
Phosphorus	µg/L	50.0	<50	<50	-	<50	<50	-	<50	<50	-	<250	<250	-
Potassium	µg/L	50.0	4670	4600	0.38	4070	3970	2.49	2330	2440	4.61	5960	5720	4.1
Rubidium	µg/L	0.20	1.9	2.04	1.78	1.75	1.69	3.49	1.8	1.86	3.28	2.2	2.2	0.0
Selenium	µg/L	0.05	0.663	0.616	1.84	0.883	0.794	10.61	0.084	0.066	24.00	0.5	0.34	**38.1**
Silicon	µg/L	50.0	4350	4420	0.40	4040	4030	0.25	4980	5010	0.60	7300	7090	2.9
Silver	µg/L	0.01	<0.01	<0.01	-	<0.01	<0.01	-	<0.01	<0.01	-	<0.05	<0.05	-
Sodium	µg/L	50.0	34700	34800	0.07	32100	30800	4.13	71200	74000	3.86	58700	57200	2.6
Strontium	µg/L	0.2	500	498	0.10	496	472	4.96	563	575	2.11	738	685	7.4
Sulfur	µg/L	500	28200	29100	0.79	30800	32000	3.82	166000	174000	4.71	408000	358000	13.1
Tellurium	µg/L	0.20	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2	-	<1	<1	-
Thallium	µg/L	0.01	0.014	0.013	1.85	<0.01	<0.01	-	<0.01	0.014	-	0.053	<0.05	-
Thorium	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.5	<0.5	-
Tin	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.5	<0.5	-
Titanium	µg/L	0.30	<0.3	<0.3	-	<0.3	<0.3	-	<0.3	<0.3	-	<1.5	<1.5	-
Tungsten	µg/L	0.10	<0.1	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	-	<0.5	<0.5	-
Uranium	µg/L	0.01	0.968	0.985	0.44	1.03	1.03	0.00	2.12	2.2	3.70	1.84	1.84	0.0
Vanadium	µg/L	0.50	<0.5	<0.5	-	<0.5	<0.5	-	<0.5	<0.5	-	<2.5	<2.5	-
Zinc	µg/L	1.0	17.6	16.8	1.16	23	21.4	7.21	21.3	29.5	**32.28**	487	473	2.9
Zirconium	µg/L	0.06	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2	-	<1	<1	-
Laboratory Work Order Number			L2353312	L2353312		L2374685	L2374685		L2386755	L2386755		L2398938	L2398938	
Laboratory Identification Number			L2353312-3	L2353312-8		L2374685-8	L2374685-13		L2386755-5	L2386755-11		L2398938-6	L2398938-7	

Notes:

RDL - Reportable detection limit

RPD - Relative percent difference calculated as (ABS[(difference between two values)]/((sum of two values/2))*100

"-" Indicates RPD not calculated. RPD cannot be calculated if one or more of the analytical results is less than detection limits or within 5 times the RDL.

BOLD and Shaded - above detection limit (field/travel blanks) or RPD greater than 30% (field replicates)'

Blank - not analyzed.

TETRA TECH

Table 6: In Situ Water Quality Sampling Along the River Road Ditch

Sample Site	Date	Time	In-Situ Tests - 2019						
			pH	EC (µS/cm)	Hardness (ppm)	Alkalinity (ppm)	Water Temp (°C)	Turbidity	Estimated Flow (L/sec)
LBRR-DD (Discharge)	22/Mar/19	15:42	8.07	283	120	40	0.0 UR	turbid; brown	n/a
LBRR-LC (Mid-stream)	22/Mar/19	15:51	7.59	1185	250	180	6.7	clear	< 1.0
LBRR-UC	22/Mar/19	16:31	8.29	1145	250	100	3.5	clear	< 1.0
	18/Apr/19	11:52	8.39	1100	425	240	8.0	clear	0.05
	23/May/19	10:58	8.40	922	425	180	13.7	clear	0.20
	20/Jun/19	11:27	8.37	951	500	240	10.9	n/a	n/a
	19/Jul/19	n/a	8.28	830	500	180	15.0	n/a	n/a
	20/Aug/19	11:58	8.24	789	800	240	12.3	clear	0.10
	30/Oct/19	13:12	8.85	853	800	180	UR	clear	0.10
LBRR-12+500	22/Mar/19	16:05	8.49	1465	120	80	0.2	medium brown	n/a
LBRR-12+600	22/Mar/19	16:12	8.58	1620	250	40	0.4	medium brown	1.00
LBRR-12+700	22/Mar/19	16:20	8.67	1904	250	40	0.2	light brown	2.00
	30/Oct/19	12:57	9.20	687	800	180	0.0	clear	0.10
LBRR-12+810	23/May/19	10:47	8.52	960	425	240	13.2	clear	0.10
	19/Jul/19	11:16	8.57	1121	500	240	19.8	clear	0.10
	20/Aug/19	11:51	8.80	942	800	240	16.8	clear	0.20
	24/Sep/19	13:55	8.63	671	450	240	12.2	clear	0.10
	30/Oct/19	13:06	9.27	770	800	180	0.0 UR	clear	0.10
	22/Nov/19	13:15	8.57	908	800	180	0.0 UR	clear	0.10
LBRR-12+920	18/Apr/19	11:58	8.57	502	425	240	7.9	clear	0.10
	23/May/19	11:05	8.40	1296	425	240	14.0	clear	n/a
	20/Jun/19	11:35	8.33	1203	500	240	11.7	clear	0.20
	19/Jul/19	11:30	8.46	1208	1000	240	18.7	clear	0.10
	20/Aug/19	11:58	8.55	1213	800	240	15.4	clear	0.50
	24/Sep/19	14:02	8.00	1216	800	240	10.8	clear	0.20
	30/Oct/19	13:15	8.95	1310	800	180	0.0 UR	clear	0.10
	22/Nov/19	13:19	8.77	1365	500	180	0.8	clear	0.20
RR8	22-Mar-19	15:12	8.84	572	250	80	3.1	cloudy	n/a
RR9	22-Mar-19	14:52	8.26	1016	425	40	4.1	cloudy	flowing

UR: Not Read (< 0.0)

TETRA TECH

Table 7: Summary of Water Quality Exceedances (BCAWQG-FST) Along River Road from Water Sampling Events in 2019

	Sampling Dates	Total Iron (Fe)	Dissolved Iron (Fe)	Dissolved Aluminum (Al)	Total Copper (Cu)	Total Arsenic (As)
RR8	March 22, 2019	✓	✓	✓		✓
RR9	March 22, 2019	✓	✓	✓	✓	✓

[1] British Columbia Ministry of Environment, Water Protection & Sustainability Branch. 2018. British Columbia Approved Water Quality Guidelines (BCAWQG): Aquatic Life, Wildlife & Agriculture Summary Report. Referenced Guidelines are for Freshwater Aquatic Life (F) water use and Short Term Maximum (ST) WQG. Exceedances denoted by a check mark.

Hardness-dependent parameters (Cu, Pb, Mn, Zn, Cd) use capped hardness values in guideline calculations.

Copper-dissolved guideline is DOC-dependent (Dissolved Organic Carbon)

Table 8: In Situ Water Quality Measurements Along the South Bank Initial Access Road

Sample Site	Date	Time	In-Situ Tests - 2019						
			pH	EC (µS/cm)	Hardness (ppm)	Alkalinity (ppm)	Water Temp (°C)	Turbidity	Estimated Flow (L/sec)
RBSBIAR-DS	22/Mar/19	12:50	7.23	283	250	100	1.9	cloudy	n/a
	18/Apr/19	8:30	8.38	824	425	120	4.2	algae; clear	0.50
	23/May/19	8:19	8.36	873	250	180	10.4	clear	0.50
	20/Jun/19	9:10	8.16	722	500	240	9.5	clear	1.00
	19/Jul/19	8:27	7.96	999	1000	240	14.4	clear	2.00
	20/Aug/19	8:37	7.66	1086	450	180	18.2	n/a	n/a
	24/Sep/19	n/a	8.22	686	450	240	8.9	n/a	n/a
	30/Oct/19	9:30	8.59	710	800	180	2.8	clear	1.00
	22/Nov/19	9:29	8.36	703	450	180	2.3	clear	1.00
	19/Dec/19	8:35	8.21	670	800	120	0.0 UR	clear	n/a
RBSBIAR-EDS	22/Mar/19	13:17	8.15	814	250	80	< 0.0	cloudy	flowing
	18/Apr/19	10:32	9.13	959	425	120	3.7	turbid	0.25
	23/May/19	9:04	8.46	1015	425	240	10.2	clear	0.25
	20/Jun/19	9:58	8.1	828	500	240	9.1	clear	0.25
	19/Jul/19	9:20	8.33	2410	1000	240	15.2	turbid	1.00
	20/Aug/19	9:40	8.43	1324	800	180	13.6	clear	1.00
	24/Sep/19	9:50	8.51	756	450	240	8.9	clear	1.00
	30/Oct/19	11:00	9.27	790	800	180	2.4	turbid	1.00
	22/Nov/19	10:25	8.81	950	800	180	2.5	cloudy	1.50
RBSBIAR-US	22/Mar/19	13:04	8.10	502	250	80	3.1	cloudy	flowing
	18/Apr/19	10:06	8.66	631	425	120	6.5	algae; clear	n/a
	23/May/19	8:36	7.90	872	250	180	8.9	clear	0.20
	20/Jun/19	9:24	7.54	732	500	240	10.8	algae; clear	0.10
	19/Jul/19	8:44	7.93	2900	1000	40	15.6	turbid	0.20
	20/Aug/19	9:11	7.48	1030	450	180	14.2	clear	0.30
	24/Sep/19	9:00	7.70	618	450	240	11.3	clear	0.50
	30/Oct/19	10:08	8.47	722	800	240	5.8	clear	0.25
	22/Nov/19	9:45	7.80	756	800	240	4.5	clear	n/a
	19/Dec/19	9:00	8.40	545	450	120	0.4	clear	0.35
RBSBIAR-EUS	23/Jan/19	10:18	7.86	892	250	120	0.1	clear	0.10
	22/Mar/19	14:01	8.36	767	250	120	4.5	cloudy	flowing
	18/Apr/19	10:19	7.99	811	425	120	3.3	algae; clear	0.10
	23/May/19	8:49	7.85	781	250	180	7.3	clear	0.10
	20/Jun/19	9:40	7.61	737	500	240	9.5	algae; clear	0.10
	19/Jul/19	9:05	7.46	1775	1000	240	13.3	turbid	0.20
	20/Aug/19	9:26	7.08	718	450	180	13.9	clear	0.30
	24/Sep/19	9:20	7.5	550	450	240	12.9	algae; clear	n/a
	30/Oct/19	10:41	8.18	582	800	240	8.2	algae; clear	0.25
	22/Nov/19	10:12	7.85	704	800	180	5.4	clear	0.20
	19/Dec/19	9:16	8.5	462	450	120	0.0	clear	0.20
RBSC-DS	18/Apr/19	10:52	8.12	1501	425	240	10.9	clear	n/a
	23/May/19	9:36	7.23	1960	425	240	16.0	clear	n/a
	20/Jun/19	10:18	7.31	2240	1000	240	10.4	-	n/a
	19/Jul/19	9:45	7.47	2220	1000	240	16.2	clear	n/a
	20/Aug/19	10:30	7.11	2000	800	240	13.7	cloudy	n/a
	24/Sep/19	10:10	7.67	1613	800	240	5.7	clear	n/a
	30/Oct/19	11:50	8.23	1282	800	240	5.0	clear	n/a
	22/Nov/19	11:03	7.33	1290	800	180	5.0	clear	n/a
	19/Dec/19	9:32	8.09	1069	450	120	3.3	clear	n/a

UR: Not Read(< 0.0)

Table 9: Summary of Water Quality Exceedances (BCAWQG-FST) Along SBIAR from Water Sampling Events in 2019

	Sampling Dates	Total Iron (Fe)	Dissolved Iron (Fe)	Dissolved Aluminum (Al)	Total Arsenic (As)	Total Copper (Cu)	Total Zinc (Zn)	Total Manganese (Mn)	Chloride (Cl^-)
RBSBIAR-DS (West ditch; downstream)	22/Mar/19	✓		✓			✓		
	18/Apr/19								
	23/May/19								
	20/Jun/19								
	19/Jul/19	✓		✓					
	20/Aug/19	✓	✓	✓					
	24/Sep/19								
	30/Oct/19								
	22/Nov/19			✓					
	19/Dec/19	✓							
RBSBIAR-US (West ditch; upstream)	22/Mar/19								
	18/Apr/19								
	23/May/19								
	20/Jun/19								
	19/Jul/19	✓							✓
	20/Aug/19								
	24/Sep/19								
	30/Oct/19								
	22/Nov/19								
	19/Dec/19	✓							
RBSBIAR-EDS (East ditch; downstream)	22/Mar/19	✓		✓	✓	✓	✓		
	18/Apr/19	✓			✓	✓	✓		
	23/May/19			✓					
	20/Jun/19								
	19/Jul/19	✓		✓			✓		✓
	20/Aug/19	✓		✓	✓	✓	✓		
	24/Sep/19			✓					
	30/Oct/19	✓			✓				
	22/Nov/19	✓		✓					
RBSBIAR-EUS (East ditch; upstream)	23/Jan/19								
	22/Mar/19								
	18/Apr/19								
	23/May/19								
	20/Jun/19	✓							
	19/Jul/19	✓							✓
	20/Aug/19								
	24/Sep/19								
	30/Oct/19								
	22/Nov/19								
	19/Dec/19								
RBSC-DS (side channel)	18/Apr/19								
	23/May/19							✓	
	20/Jun/19								
	19/Jul/19								
	20/Aug/19	✓	✓					✓	
	24/Sep/19								
	30/Oct/19	✓	✓						
	22/Nov/19	✓	✓						
	19/Dec/19		✓						

[1] British Columbia Ministry of Environment, Water Protection & Sustainability Branch. 2018. British Columbia Approved Water Quality Guidelines (BCAWQG): Aquatic Life, Wildlife & Agriculture Summary Report. Referenced Guidelines are for Freshwater Aquatic Life (F) water use and Short Term Maximum (ST) WQG. Exceedances denoted by a check mark.

Table 10: Minimum, Maximum and Mean Values for Measurements at Discharge and Downstream Locations

Discharge/Downstream Locations	Unit	LBRR-DD [a]			RBSBIAR-DS [b]			RBSBIAR-EDS [c]			LBL3C-0.02 [c]		
		Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean
Hardness as $CaCO_3$	mg/L	No samples collected in 2019			192	517	328	231	1150	456	111	1130	720
pH	pH				8.03	8.29	8.15	7.80	8.31	8.08	7.80	8.39	8.18
Total Dissolved Solids (TDS)	mg/L				347	848	545	506	2440	849	282	1720	1176
Total Suspended Solids (TSS) [d]	mg/L				<3.0	124	23.8	11.6	1670.0	535.2	3.7	1600	399.7
Anions													
Alkalinity (Total as $CaCO_3$)	mg/L				102	287	210	202	331	270	72.2	265	194
Chloride (Cl^-)	mg/L				38.1	151	74.4	33.1	678	120.9	13.4	206	57.3
Sulphate (SO_4)	mg/L				59.4	219	118	79	391	188	50.9	943	540
Metals, Total													
Aluminum	µg/L				48.3	2680	746	167	14200	5216	353	16800	4595
Iron	µg/L				41.0	5640	1272	175	39600	13535	290	39700	9309
Arsenic	µg/L				0.25	3.14	0.83	0.31	15.70	5.94	0.33	15.7	3.99
Cadmium	µg/L				0.027	1.220	0.333	0.13	3.07	1.20	0.331	1.850	0.702
Cobalt	µg/L				0.27	26.9	6.96	2.44	65.60	23.33	4.40	27.6	13.9
Copper	µg/L				0.72	20.2	5.96	1.91	58.00	25.62	1.37	50.8	13.0
Zinc	µg/L				7.80	289	73.3	26.20	717.00	248.52	37.9	233	86.3
Metals, Dissolved													
Aluminum	µg/L				8.50	250	95.7	23.30	349.00	171.24	40.1	210	139
Iron [d]	µg/L				<10.0	401	58.0	< 10.0	63.00	18.33	<10.0	138	38.2
Arsenic	µg/L				0.15	0.25	0.20	0.17	0.41	0.26	0.21	1.05	0.43
Cadmium	µg/L				0.021	1.010	0.237	0.01	1.21	0.41	0.0612	0.493	0.260
Cobalt	µg/L				0.13	27.6	6.24	0.45	56.10	16.27	0.48	16.1	8.32
Copper	µg/L				0.52	4.93	1.77	0.56	4.20	2.04	1.08	3.34	1.70
Zinc	µg/L				2.00	175	41.9	3.10	117.00	49.59	1.50	38.8	20.3

[a] No samples collected during 2019 due to dry or frozen conditions.
[b] Monthly sampling March through December 2019 (ten sampling events).
[c] Monthly sampling March through November 2019 (nine sampling events).
[d] Mean value calculated between half the detection limit and all other values for dissolved iron (all locations) and TSS (RBSBIAR-DS only).

Table 11: In Situ Water Quality Measurements Along L3 Creek

Sample Site	Date	Time	In-Situ Tests - 2019						
			pH	EC (µS/cm)	Hardness (ppm)	Alkalinity (ppm)	Water Temp (°C)	Turbidity	Estimated Flow (L/sec)
LBL3C-0.02 (Discharge)	22/Mar/19	14:45	8.96	283	250	40	0.0 UR	cloudy	n/a
	18/Apr/19	11:22	8.72	644	425	120	4.9	turbid	20.0
	23/May/19	10:09	8.34	1717	425	180	10.1	clear	5.00
	20/Jun/19	11:00	8.48	1785	500	240	8.9	clear	3.00
	19/Jul/19	10:36	8.27	1264	1000	240	12.7	turbid	5.00
	20/Aug/19	11:20	8.32	1226	800	180	12.2	n/a	n/a
	24/Sep/19	n/a	8.40	1487	800	240	9.2	n/a	n/a
	30/Oct/19	12:25	9.04	1478	800	180	1.8	clear	4.00
	22/Nov/19	12:35	8.65	1210	800	180	2.0	clear	4.00
LBL3C-1.43	22/Mar/19	10:47	8.62	212	120	40	0.0 UR	cloudy	n/a
	18/Apr/19	14:07	8.66	650	425	120	4.7	turbid	6.00
	23/May/19	13:58	8.26	1584	425	180	10.6	clear	4.00
	20/Jun/19	14:16	8.23	1553	1000	180	8.1	clear; algae	2.00
	19/Jul/19	13:43	8.40	1030	500	180	12.2	turbid	4.00
	20/Aug/19	14:43	8.35	1145	800	120	13.1	slightly turbid	20.0
	24/Sep/19	12:52	7.10	1340	800	240	8.4	clear; algae	2.50
	30/Oct/19	15:04	8.37	1365	800	180	3.6	turbid	3.00
	22/Nov/19	15:05	9.27	1047	500	120	2.3	turbid	10.0
	19/Dec/19	14:47	7.45	1539	800	120	3.6	clear	0.50
LBL3C-1.65	23/Jan/19	12:22	6.51	502	250	120	0.0 UR	orange stain; clear	0.10
	22/Mar/19	9:41	8.12	248	250	120	0.0 UR	cloudy	n/a
	18/Apr/19	13:28	9.15	465	250	40	3.4	turbid	3.00
	19/Jul/19	13:05	8.71	1013	500	240	17.6	clear	1.00
	20/Aug/19	13:43	8.84	802	800	240	11.3	clear	10.0
	30/Oct/19	13:55	0.40	1068	800	240	2.2	clear	0.50
	22/Nov/19	14:25	9.17	981	500	120	0.0 UR	clear	5.00
	19/Dec/19	14:29	8.39	1800	450	80	0.8	clear	0.15
LBL3C-3.32	22/Mar/19	11:20	8.37	140	50	40	< 0.8	brown	n/a
	18/Apr/19	15:16	8.69	467	425	80	5.7	slightly turbid	4.00
	23/May/19	14:53	7.75	1124	250	180	12.3	clear	0.25
	20/Jun/19	8:29	7.00	1499	1000	240	8.8	clear	0.05
	19/Jul/19	14:23	8.62	1128	500	180	12.2	clear	1.00
	20/Aug/19	13:08	8.57	923	800	180	11.3	clear	10.0
	24/Sep/19	11:17	8.28	1636	800	240	7.3	clear	0.25
	30/Oct/19	8:45	8.67	1270	800	240	0.0 UR	clear	0.40
	22/Nov/19	15:30	8.74	1378	500	120	0.0 UR	clear	3.00
LBL4C-0.18	22/Mar/19	10:22	8.43	224	120	80	0.0 UR	cloudy	n/a
	18/Apr/19	13:47	8.42	728	425	80	3.7	turbid	3.00
	23/May/19	14:30	7.29	1465	425	40	11.1	cloudy	0.25
	19/Jul/19	13:25	8.18	845	500	120	13.0	turbid	2.00
	20/Aug/19	14:08	8.41	763	450	120	11.4	turbid	n/a
	24/Sep/19	12:24	4.30	1767	800	0	8.4	clear	n/a
	30/Oct/19	14:42	8.57	1358	800	0	0.7	clear	n/a
	22/Nov/19	14:45	9.15	894	500	120	0.6	turbid	n/a

UR: Not Read (< 0.0)

Table 12: Summary of Water Quality Exceedances (BCAWQG-FST) Along L3 Creek From Water Sampling Events in 2019

	Sampling Dates	Total Iron (Fe)	Dissolved Iron (Fe)	Dissolved Aluminum (Al)	Dissolved Cadmium (Cd)	Total Cobalt (Co)	Total Zinc (Zn)	Total Copper (Cu)	Dissolved Copper (Cu)	Total Arsenic (As)	Total Manganese (Mn)	Total Silver (Ag)	pH
LBL3C-0.02 (discharge)	22/Mar/19	✓					✓	✓		✓			
	18/Apr/19	✓		✓									
	23/May/19			✓									
	20/Jun/19			✓									
	19/Jul/19	✓		✓						✓			
	20/Aug/19	✓		✓									
	24/Sep/19			✓									
	30/Oct/19	✓		✓									
	22/Nov/19	✓		✓									
LBL3C-1.43 (midstream)	22/Mar/19	✓					✓	✓					
	18/Apr/19	✓											
	23/May/19										✓		
	20/Jun/19												
	19/Jul/19	✓		✓						✓			
	20/Aug/19	✓											
	24/Sep/19										✓		
	30/Oct/19	✓	✓								✓		
	22/Nov/19	✓	✓	✓									
	19/Dec/19												
LBL3C-1.65	23/Jan/19	✓	✓	✓	✓	✓	✓				✓		
	22/Mar/19	✓		✓			✓	✓					
	18/Apr/19	✓											
	19/Jul/19												
	20/Aug/19	✓											
	30/Oct/19												
	22/Nov/19	✓											
	19/Dec/19	✓	✓	✓	✓	✓	✓				✓		
LBL3C-3.32 (upstream)	22/Mar/19												
	18/Apr/19												
	23/May/19												
	20/Jun/19												
	19/Jul/19										✓		
	20/Aug/19												
	24/Sep/19												
	30/Oct/19												
	22/Nov/19												
LBL4C-0.18	22/Mar/19	✓					✓	✓		✓		✓	
	18/Apr/19	✓		✓						✓			
	23/May/19	✓	✓	✓	✓		✓						
	19/Jul/19	✓					✓	✓		✓			
	20/Aug/19	✓		✓									
	24/Sep/19	✓	✓	✓	✓	✓	✓		✓		✓		✓
	30/Oct/19	✓	✓	✓					✓				✓
	22/Nov/19	✓	✓	✓									

[1] British Columbia Ministry of Environment, Water Protection & Sustainability Branch. 2018. British Columbia Approved Water Quality Guidelines (BCAWQG): Aquatic Life, Wildlife & Agriculture Summary Report. Referenced Guidelines are for Freshwater Aquatic Life (F) water use and Short Term Maximum (ST) WQG. Exceedances denoted by a check mark.

Note: L3 and L4 Creek are not considered a construction-related PAG management facility and are not monitored under requirement of the CEMP.

Table 13: In Situ Water Quality Sampling - Other Locations

Sample Site	Date	Time	In-Situ Tests - 2019						
			pH	EC (µS/cm)	Hardness (ppm)	Alkalinity (ppm)	Water Temp (°C)	Turbidity	Estimated Flow (L/sec)
Gully Road Ditch	26/Mar/19	16:53	8.60	283	120	40	UR 0.0	med. Brown	n/a
	18/Apr/19	12:56	8.22	2550	425	240	7.1	clear	0.10
	23/May/19	13:30	7.93	1688	250	180	21.2	clear	0.05
Road Runner 1	18/Apr/19	9:30	7.76	1241	425	240	7.1	clear w/algae	0.40
Road Runner 2	18/Apr/19	9:41	7.62	1660	425	240	5.5	clear	0.30
LBSP	23/May/19	11:41	*Or*	*Or*	425	40	17.6	n/a	n/a
	03/Jul/19	n/a	7.79	2040	425	80	23.0	n/a	n/a
SEEP 1	24/Sep/19	8:45	8.84	1030	0	180	10	clear	0.20

UR / Or: Not Read (< 0.0)

Table 14: Summary of Water Quality Exceedances (BCAWQG-FST) at Other Temporary Locations From Water Sampling Events in 2019

	Sampling Dates	Total Iron (Fe)	Dissolved Aluminum (Al)	Total Copper (Cu)
Gully Road Ditch	18/Apr/19			
	23/May/19			
Road Runner 1	18/Apr/19			
Road Runner 2	18/Apr/19			
Seep 1	01/Aug/19			
	20/Aug/19			✓
	24/Sep/19	✓		✓
LBSP	23/May/19		✓	
	20/Jun/19			

[1] British Columbia Ministry of Environment, Water Protection & Sustainability Branch. 2018. British Columbia Approved Water Quality Guidelines (BCAWQG): Aquatic Life, Wildlife & Agriculture Summary Report. Referenced Guidelines are for Freshwater Aquatic Life (F) water use and Short Term Maximum (ST) WQG. Exceedances denoted by a check mark.

FIGURES

LEGEND

- Water Sample (Insitu Testing Only)
- Water Sample (Insitu Testing & External Lab Testing)
- Culvert
- Ditch
- Ditch Diversion
- Howe Pit
- Blind Corner Outcrop
- Site C Project Boundary
- Original Watercourse

NOTES
Base data source:
Imagery provided by the client (Oct 2017).

STATUS
ISSUED FOR USE

SITE C WATER QUALITY MONITORING 2019 ANNUAL REPORT

Left Bank - River Road

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:3,500
50 25 0 50
Metres

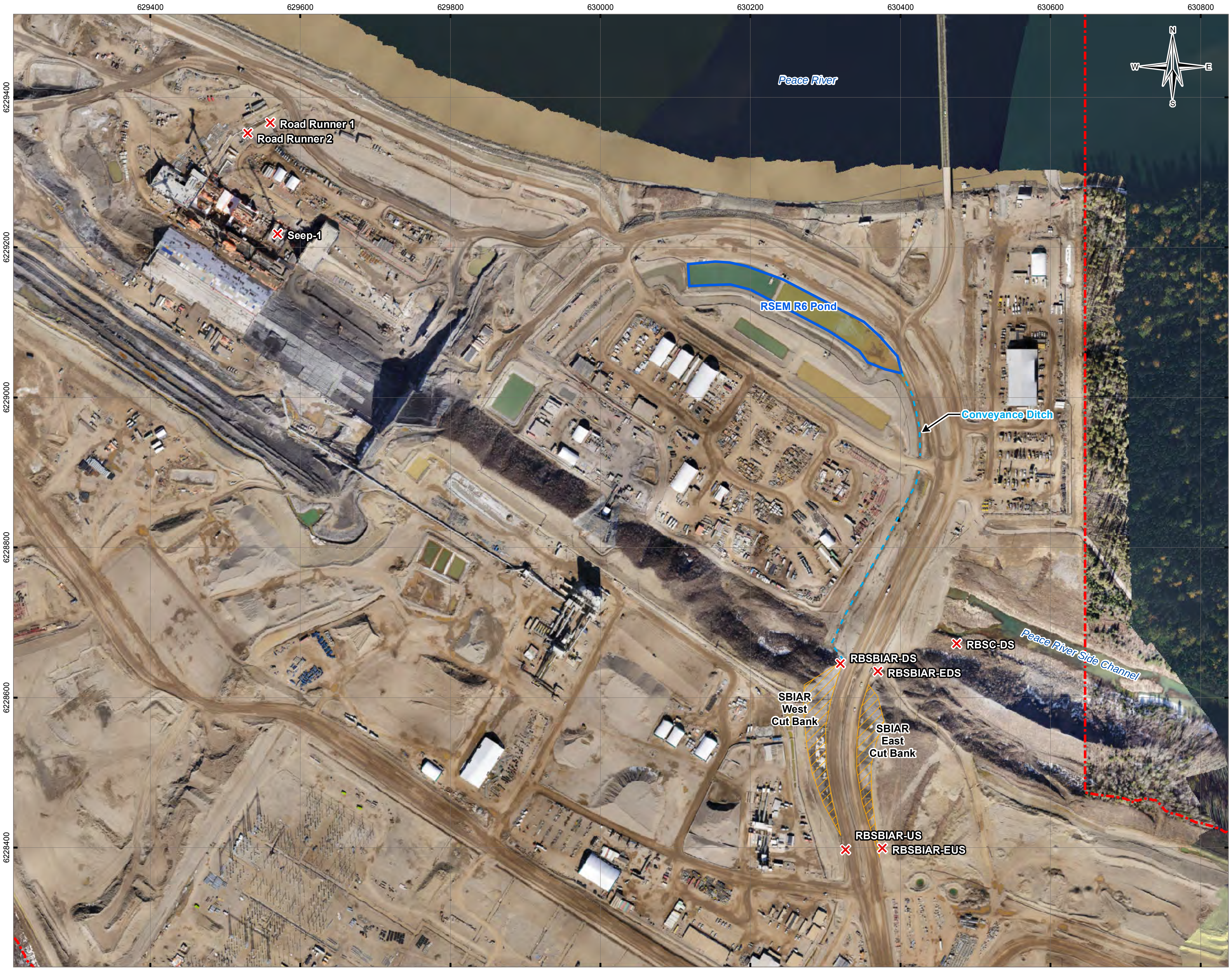
TETRA TECH

FILE NO.
VMIN03021-02_Figure1_WaterSamplesLBRR.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	BB	JB	0

DATE	PROJECT NO.
February 20, 2020	ENG.VMIN03021-02

Figure 1



Q:\Vancouver\GIS\ENGINEERING\VMIN\VMIN03021-02\Maps\AnnualReport_20200212\VMIN03021-02_Figure2_WaterSamplesRB.mxd modified 2/20/2020 by stephanie.leusink

LEGEND

- Water Sample (Insitu Testing & External Lab Testing)
- Ditch
- Cut Bank
- RSEM R6 Pond
- Site C Project Boundary

NOTES
Base data source:
Imagery provided by the client (April 2019).

STATUS
ISSUED FOR USE

SITE C WATER QUALITY MONITORING 2019 ANNUAL REPORT

Right Bank - SBIAR

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:5,000
100 50 0 100
Metres

FILE NO.
VMIN03021-02_Figure2_WaterSamplesRB.mxd

TETRA TECH

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	BB	JB	0

DATE
February 20, 2020

PROJECT NO.
ENG.VMIN03021-02

Figure 2

LEGEND

- Water Sample (Insitu Testing & External Lab Testing)
- Culvert
- Ditch
- Ditch Diversion
- Howe Pit
- Blind Corner Outcrop
- Site C Project Boundary
- Original Watercourse

NOTES
Base data source:
Imagery provided by the client (Oct 2017).

STATUS
ISSUED FOR USE

SITE C WATER QUALITY MONITORING 2019 ANNUAL REPORT

Left Bank - L3 Creek

PROJECTION	DATUM	CLIENT
UTM Zone 10	NAD83	BC hydro

Scale: 1:12,000
200 100 0 200
Metres

TETRA TECH

FILE NO.
VMIN03021-02_Figure3_WaterSamplesLBL3.mxd

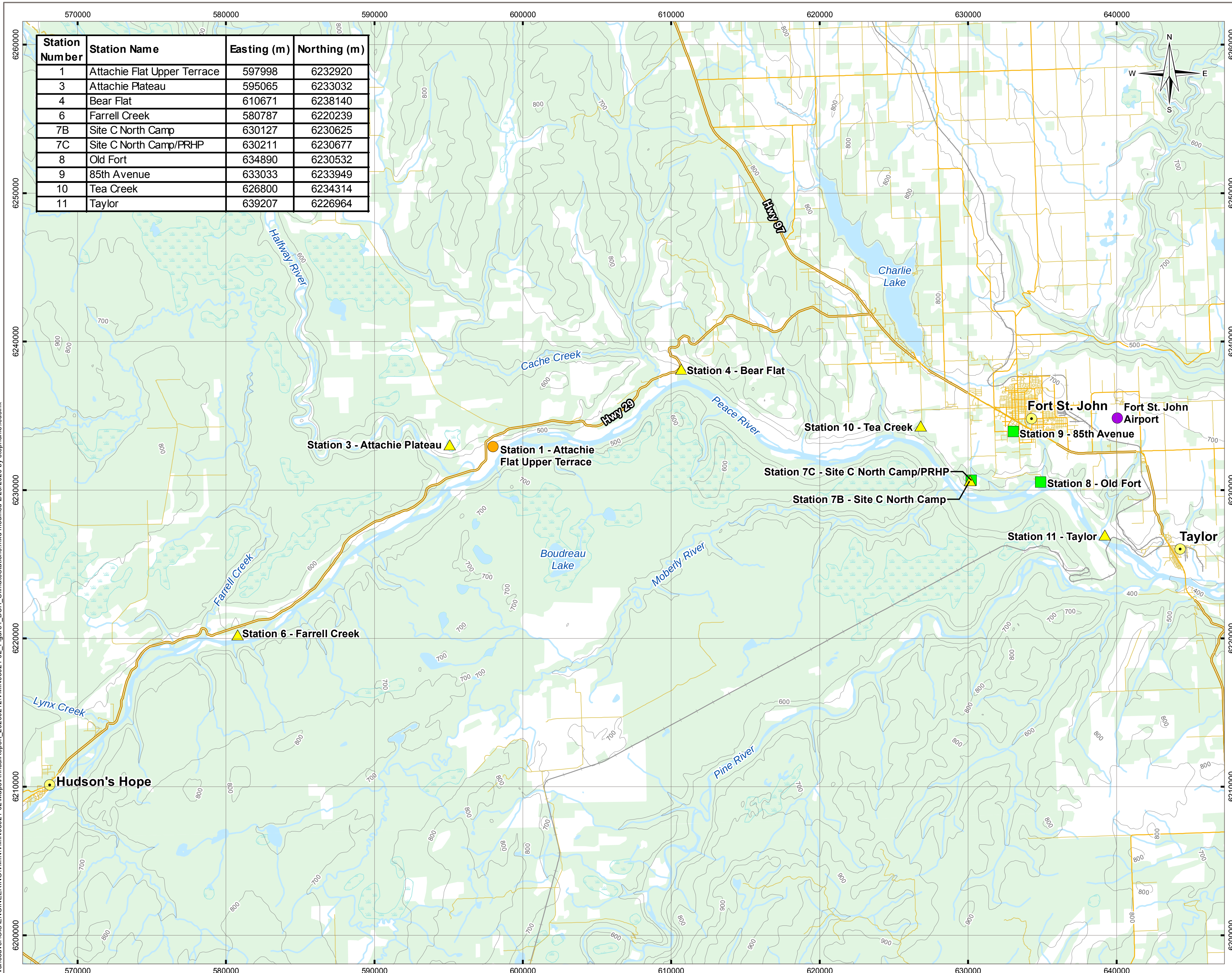
OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	BB	JB	0

DATE	PROJECT NO.
February 20, 2020	ENG.VMIN03021-02

Figure 3

Q:\Vancouver\GIS\ENGINEERING\VMIN\VMIN03021-02\Maps\AnnualReport_20200212\VMIN03021-02_Figure3_WaterSamplesLBL3.mxd modified 2/20/2020 by stephanie.leusink

Station Number	Station Name	Easting (m)	Northing (m)
1	Attachie Flat Upper Terrace	597998	6232920
3	Attachie Plateau	595065	6233032
4	Bear Flat	610671	6238140
6	Farrell Creek	580787	6220239
7B	Site C North Camp	630127	6230625
7C	Site C North Camp/PRHP	630211	6230677
8	Old Fort	634890	6230532
9	85th Avenue	633033	6233949
10	Tea Creek	626800	6234314
11	Taylor	639207	6226964



LEGEND

Station Type

- Meteorological Only
- Air Quality Only
- Meteorological and Air Quality
- Environment Canada Meteorological Station

Base Features

- City/District Municipality
- Highway
- Main Road
- Local Road
- Resource/Recreational Road
- Railway
- Residential Area
- Contour (100 m)
- Watercourse
- Waterbody
- Wetland
- Wooded Area

NOTES
Station locations provided by BC Hydro and RWDI (September 2017).
Base data source: CanVec 1:250,000.

STATUS
ISSUED FOR USE

SITE C WATER QUALITY MONITORING 2019 ANNUAL REPORT

Site C Meteorological and Air Quality Stations

PROJECTION: UTM Zone 10
DATUM: NAD83
CLIENT: BC hydro

Scale: 1:250,000
5 2.5 0 5
Kilometres

TETRA TECH

FILE NO.: VMIN03021-02_Figure4_BCH_ClimateStations.mxd

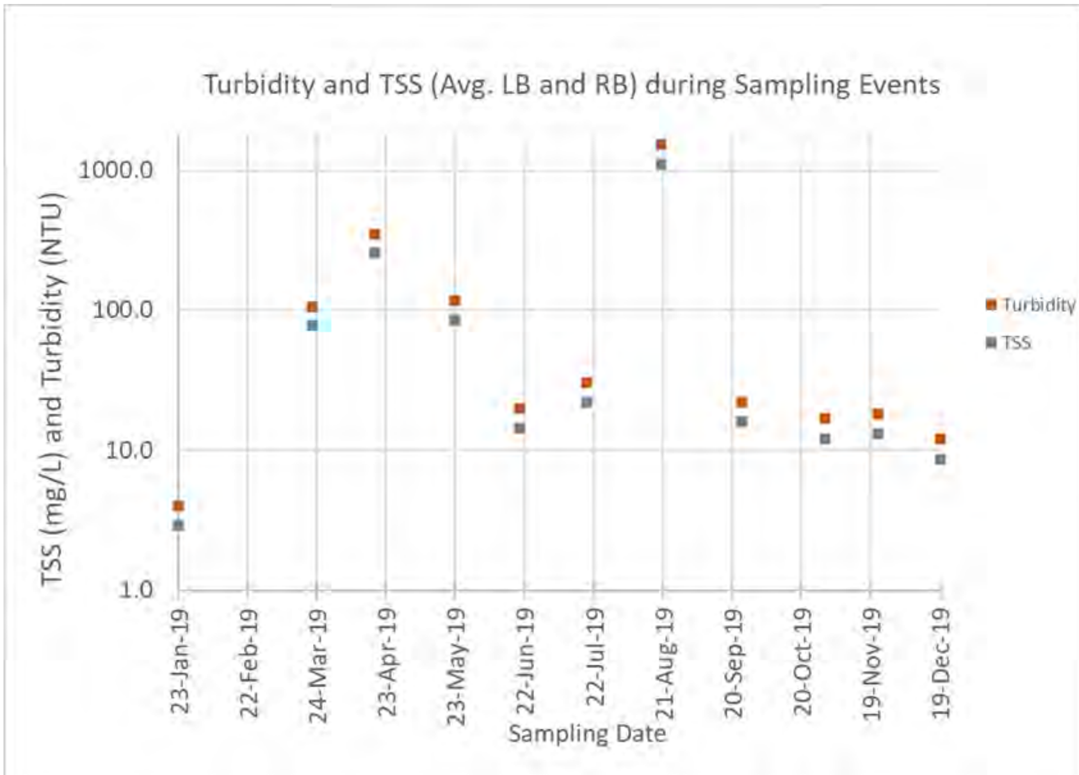
OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	YL	JB	0

DATE: February 20, 2020
PROJECT NO.: ENG.VMIN03021-02

Figure 4

Q:\Vancouver\GIS\ENGINEERING\VMIN\VMIN03021-02\Maps\AnnualReport_20200212\VMIN03021-02_Figure4_BCH_ClimateStations.mxd modified 2/20/2020 by stephanie.leusink

Figure 5: Turbidity and TSS Measured in the Peace River



EcoFish Disclaimer: TSS:turbidity relationship used was the same all year. Note, these relationships are specific to a particular make/model of sensor. Please exercise caution if relationship applied to any data collected.

Figure 6: pH at SBIAR Locations

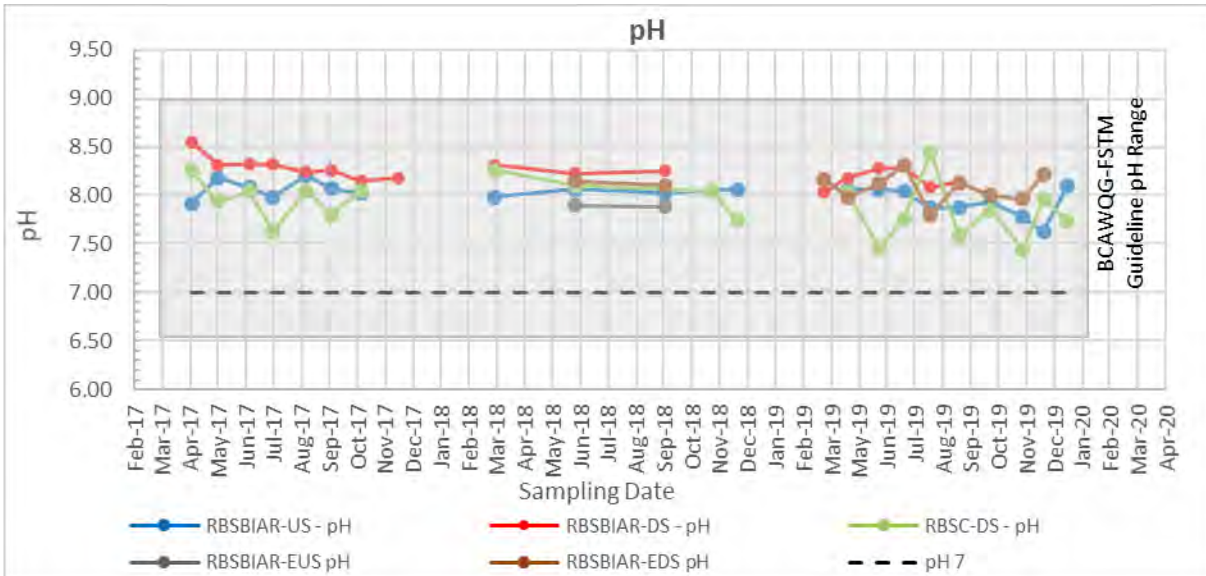


Figure 7: Alkalinity at SBIAR Locations

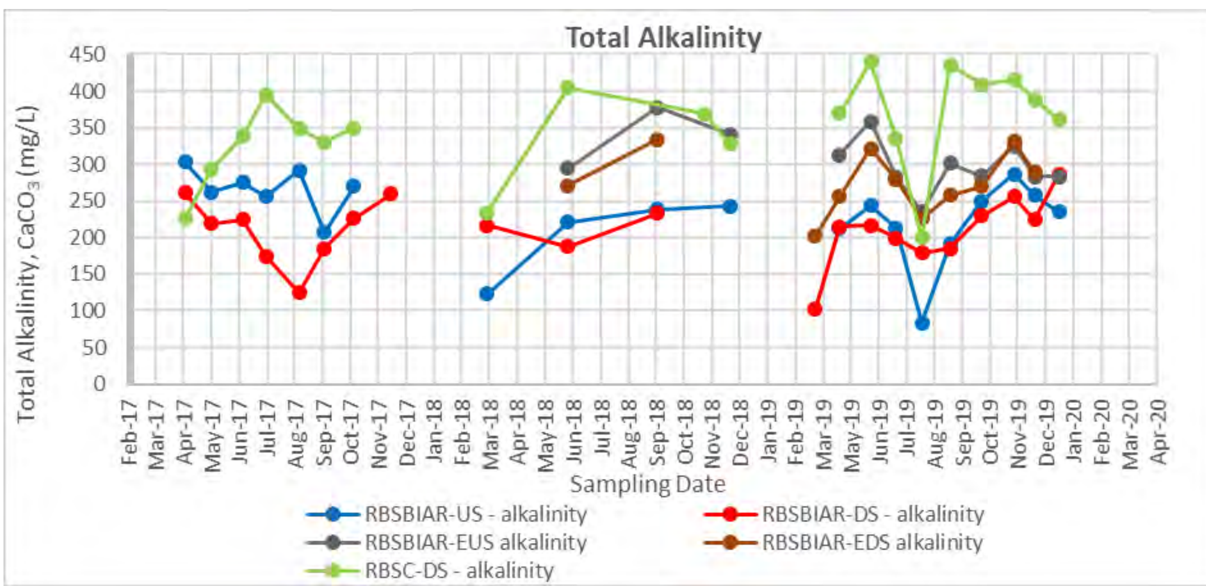


Figure 8: Sulphate at SBIAR Locations

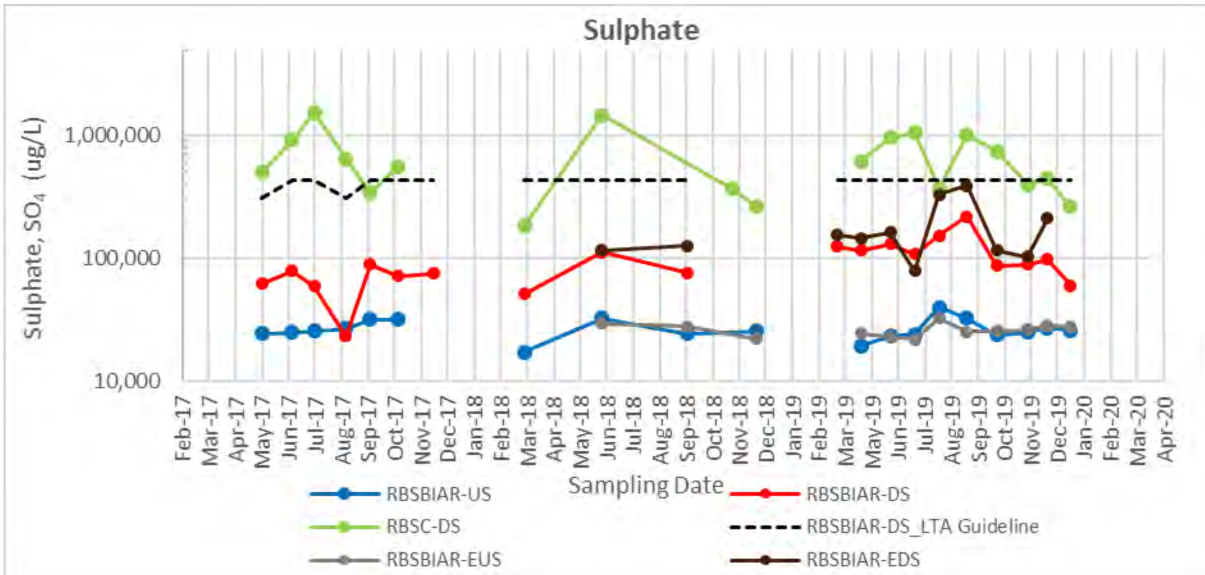


Figure 9: Total Dissolved Solids at SBIAR Locations

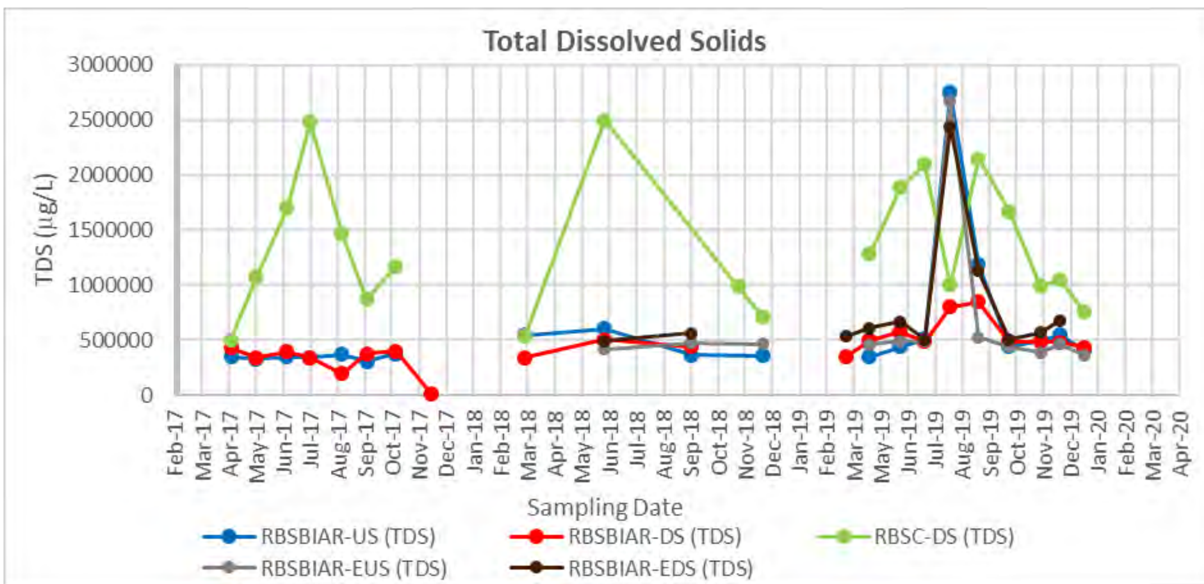


Figure 10a: Total Suspended Solids (TSS) at SBIAR Locations

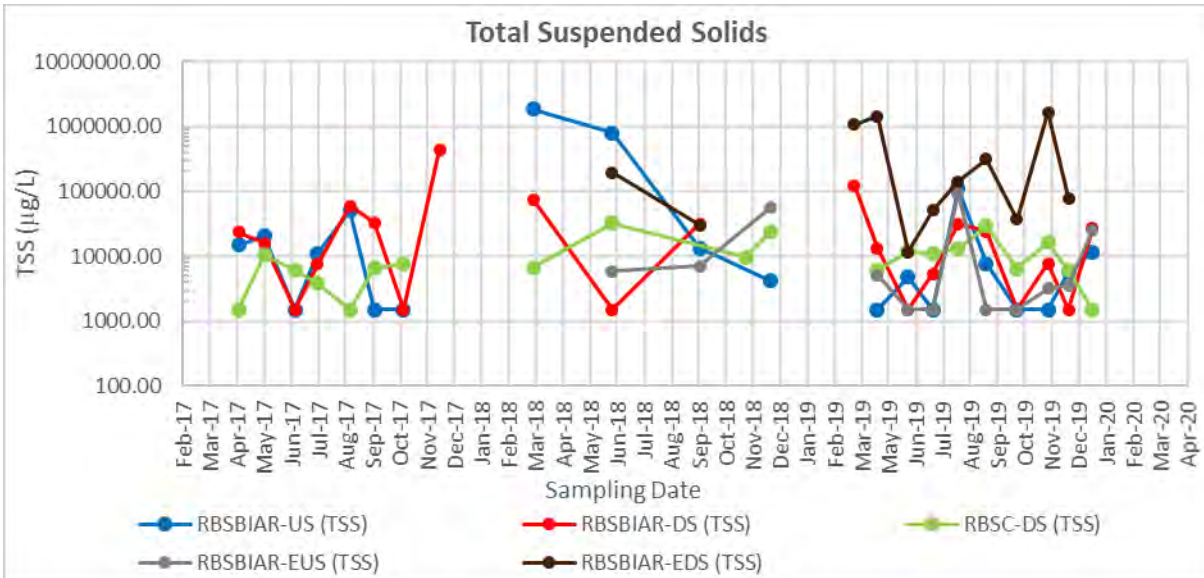


Figure 10b: TSS Long-term Running Average at SBIAR during 2019

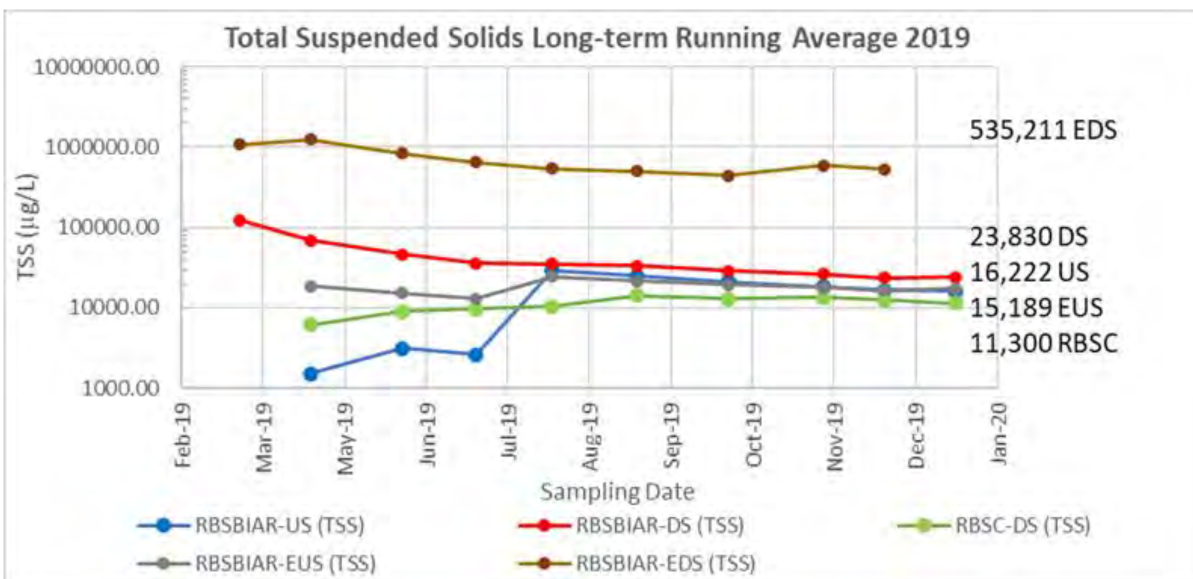


Figure 11a: Total Aluminum at SBIAR Locations

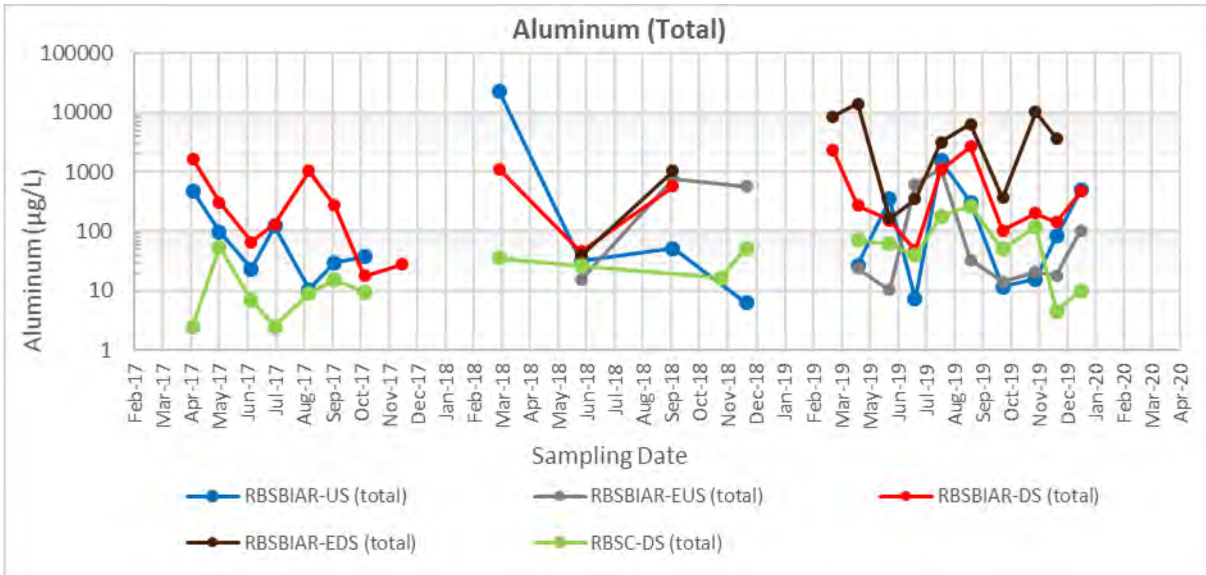


Figure 11b: Dissolved Aluminum at SBIAR Locations

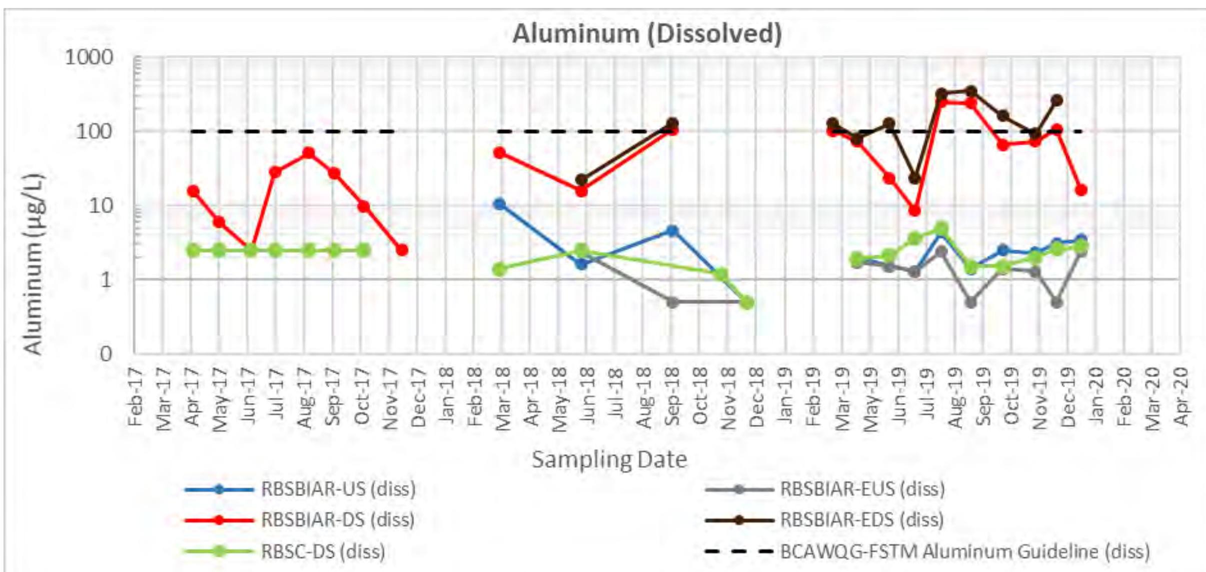


Figure 12a: Total Iron at SBIAR Locations

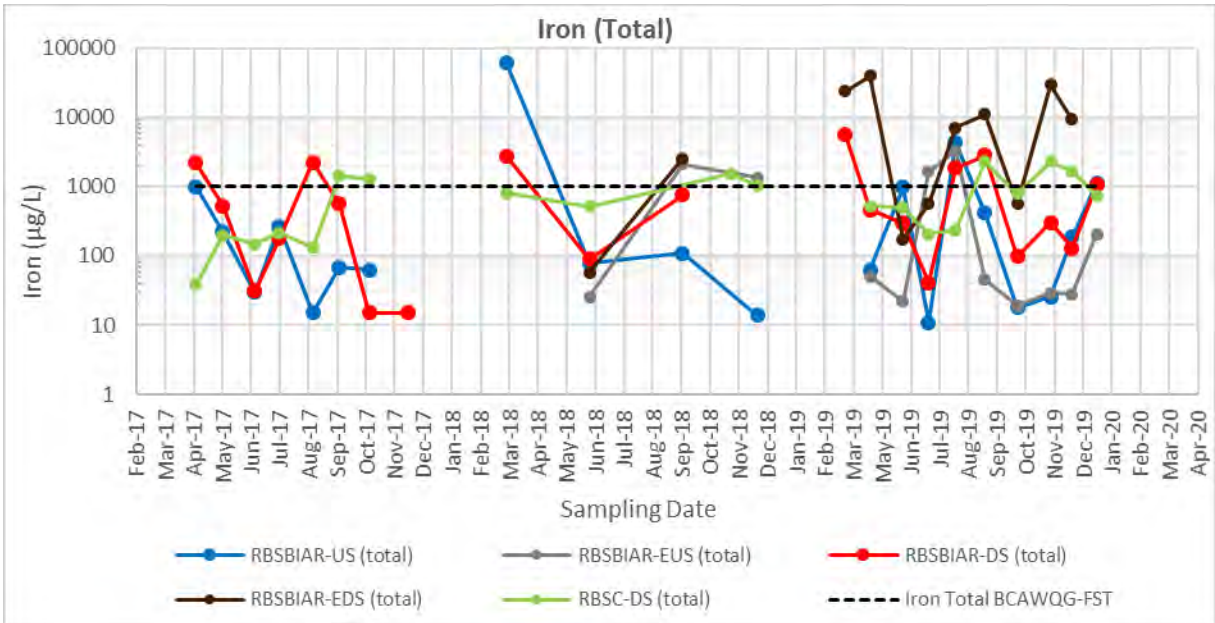


Figure 12b: Dissolved Iron at SBIAR Locations

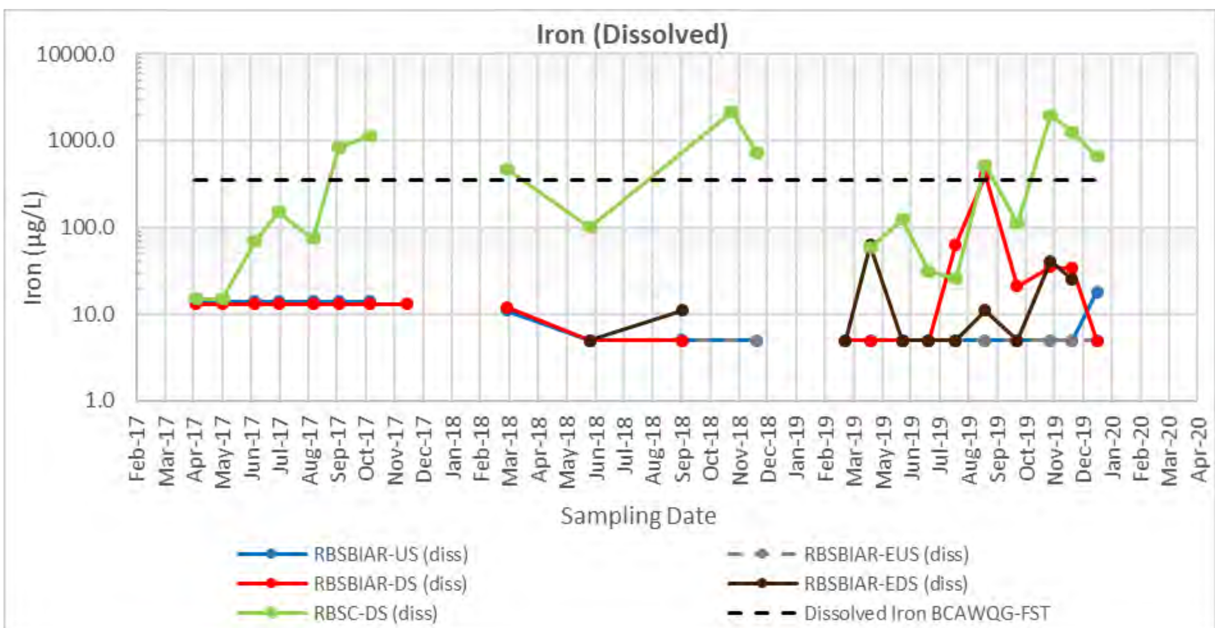


Figure 13a: Total Arsenic at SBIAR Locations

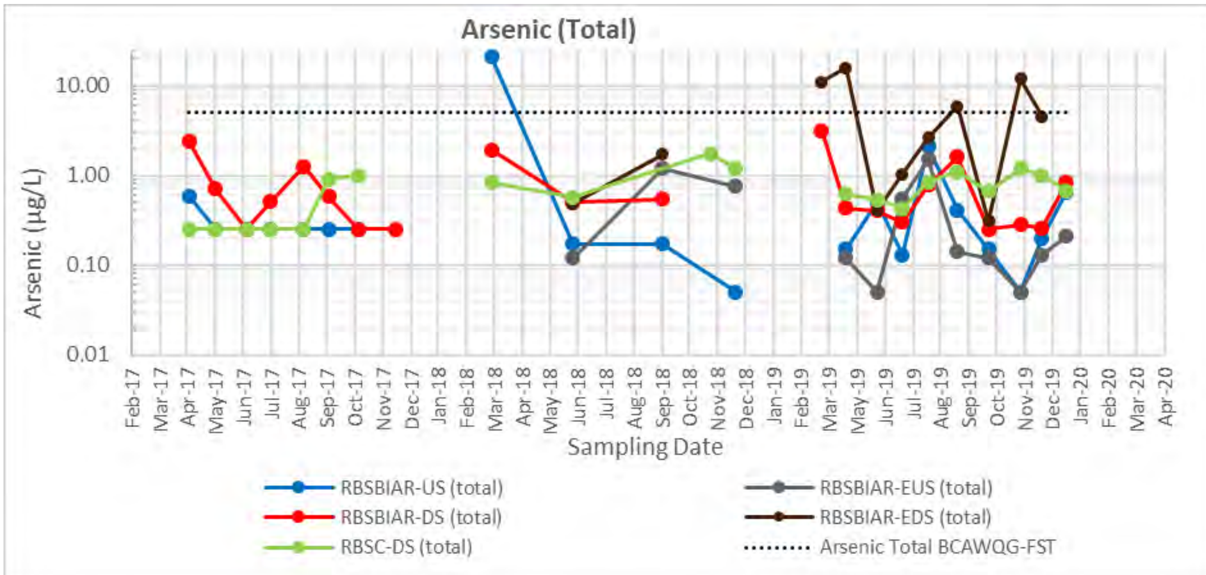


Figure 13b: Dissolved Arsenic at SBIAR Locations

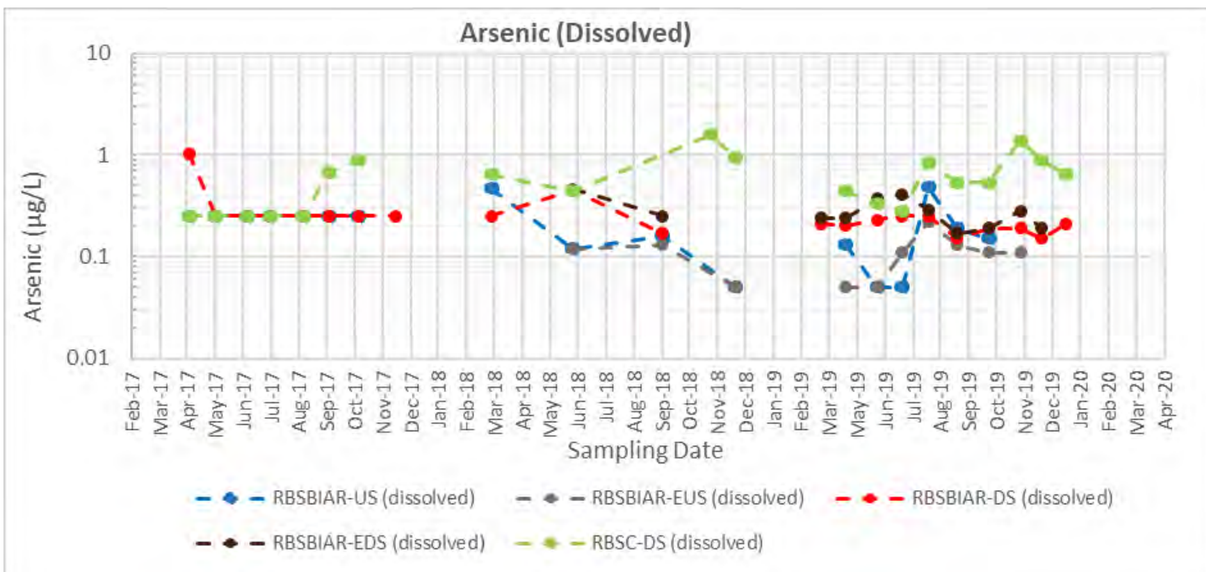


Figure 14a: Total Cadmium at SBIAR Locations

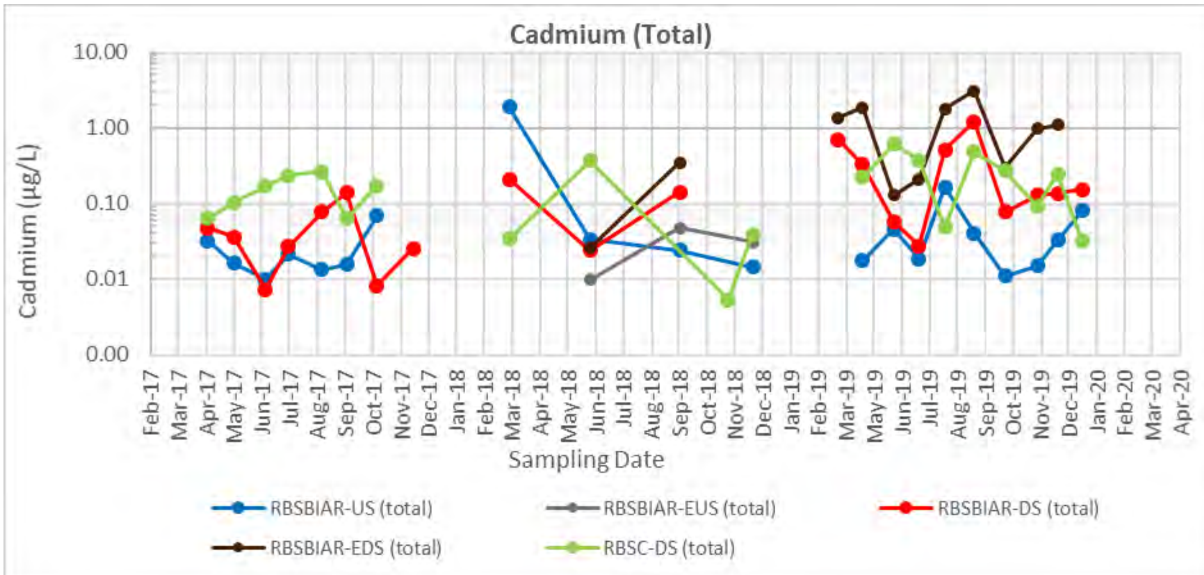


Figure 14b: Dissolved Cadmium at SBIAR Locations

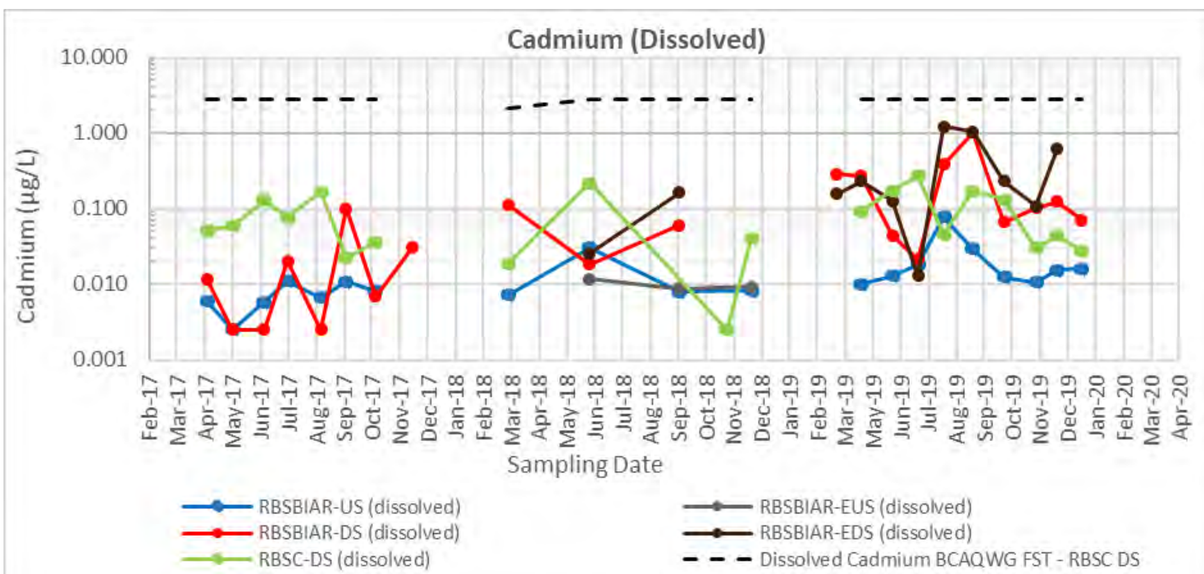


Figure 15a: Total Cobalt at SBIAR Locations

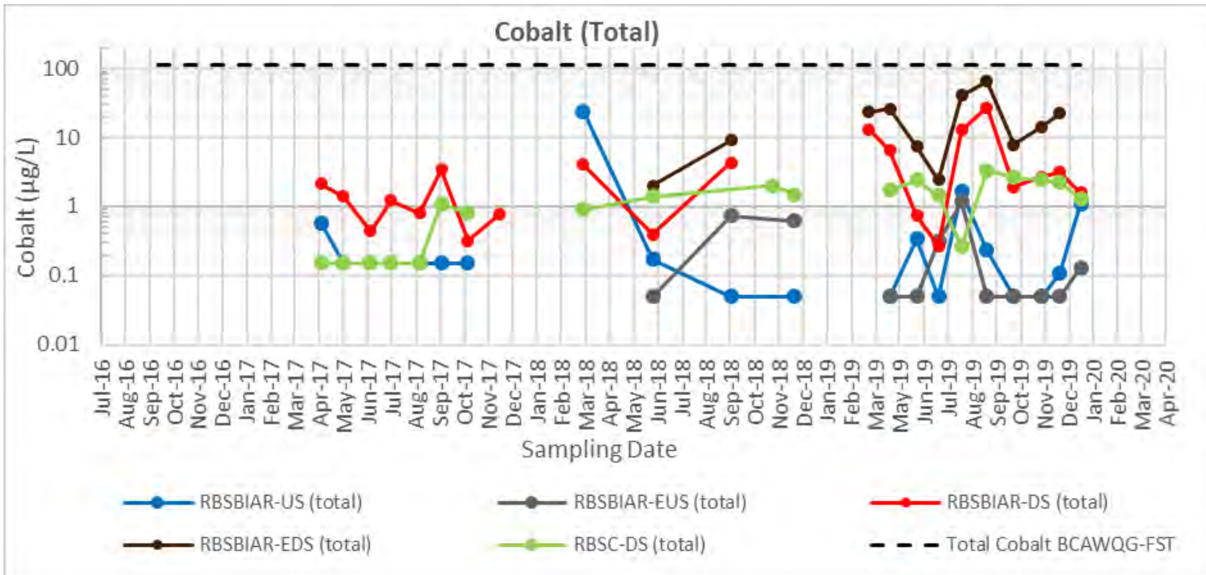


Figure 15b: Dissolved Cobalt at SBIAR Locations

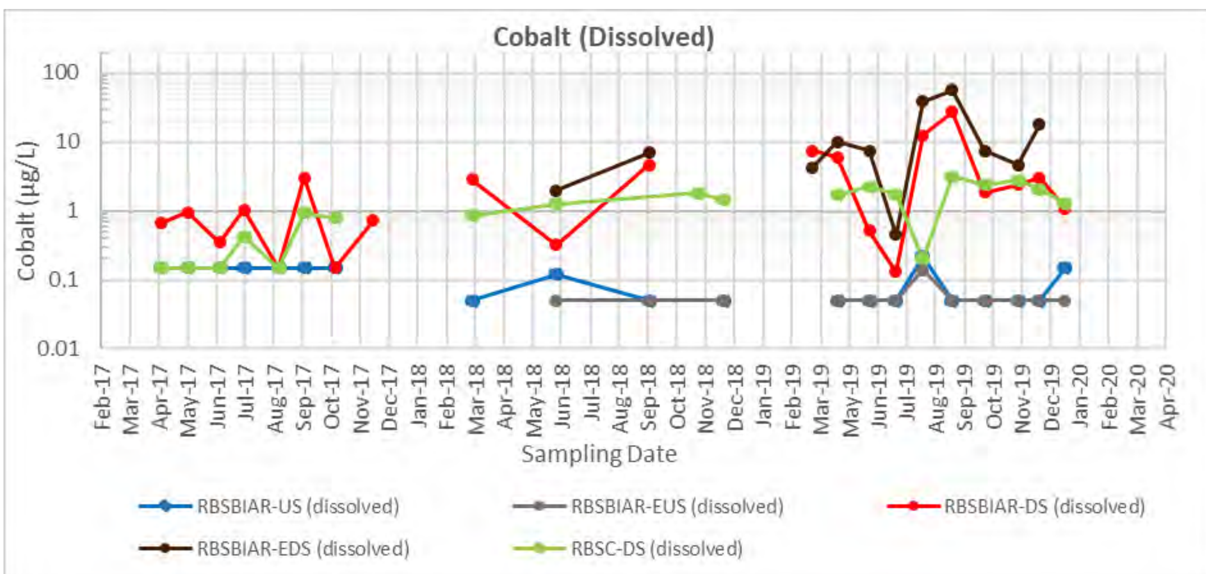


Figure 16a: Total Copper at SBIAR Locations

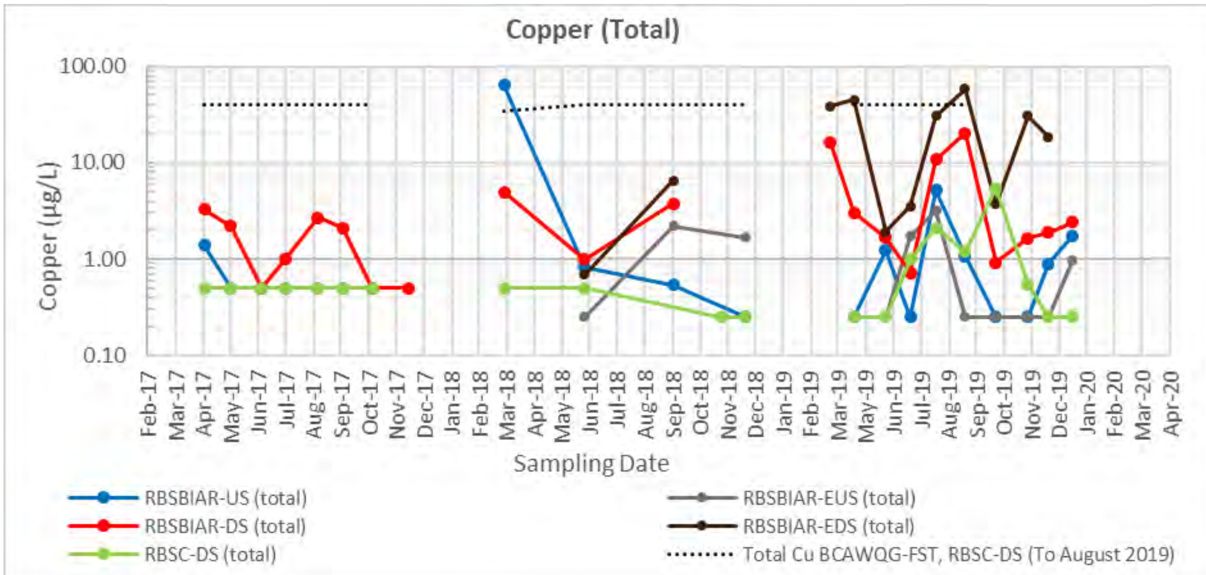


Figure 16b: Dissolved Copper at SBIAR Locations

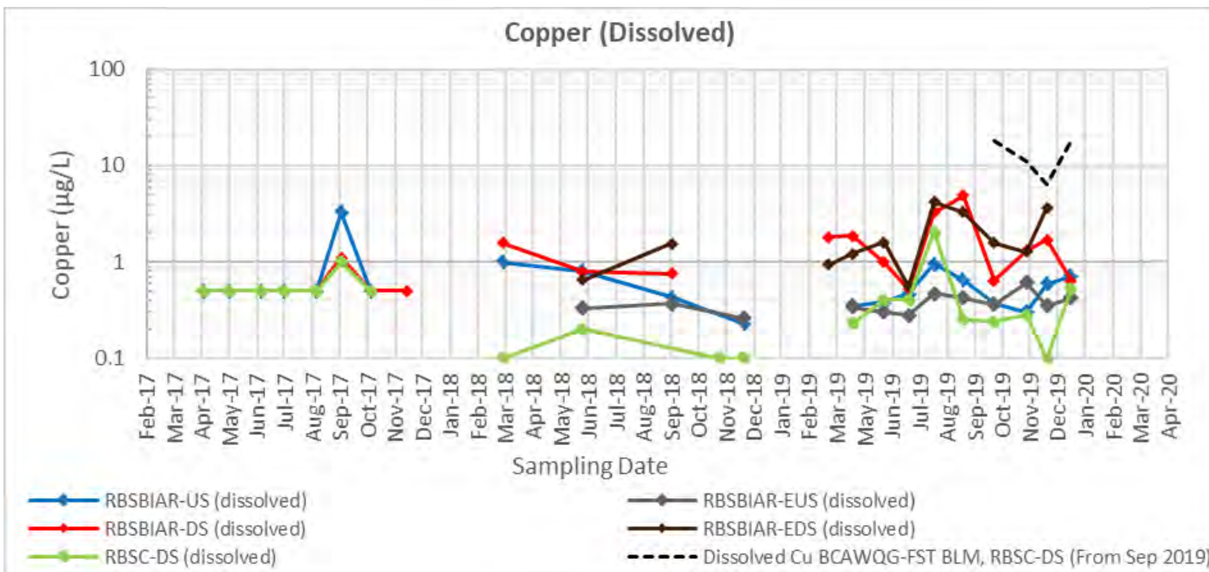


Figure 17a: Total Zinc at SBIAR Locations

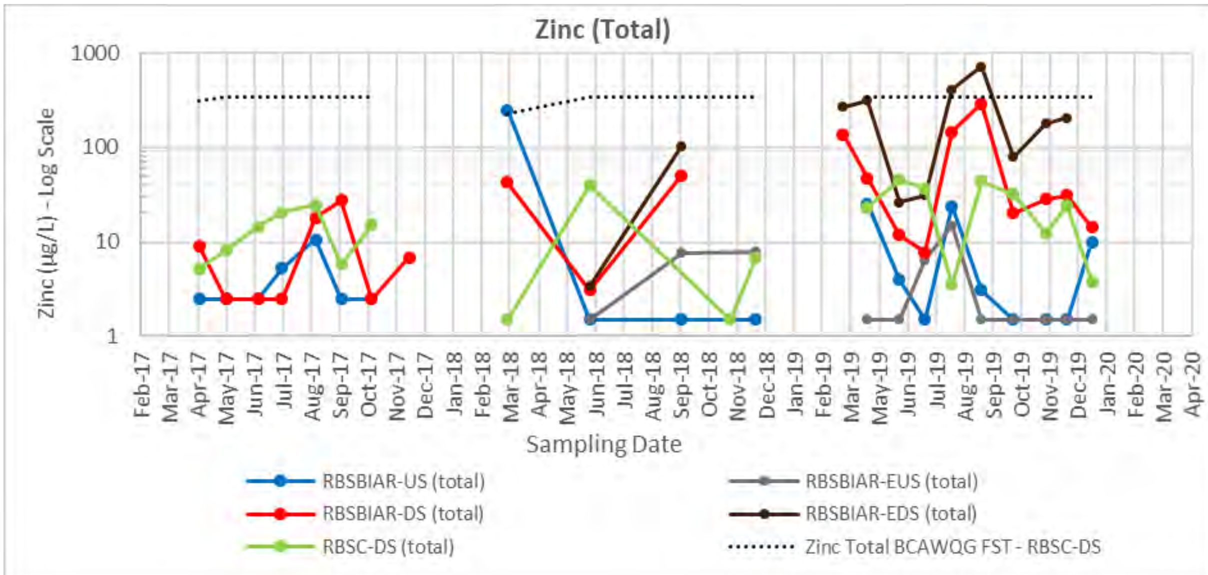


Figure 17b: Running Average of Total Zinc at SBIAR Locations

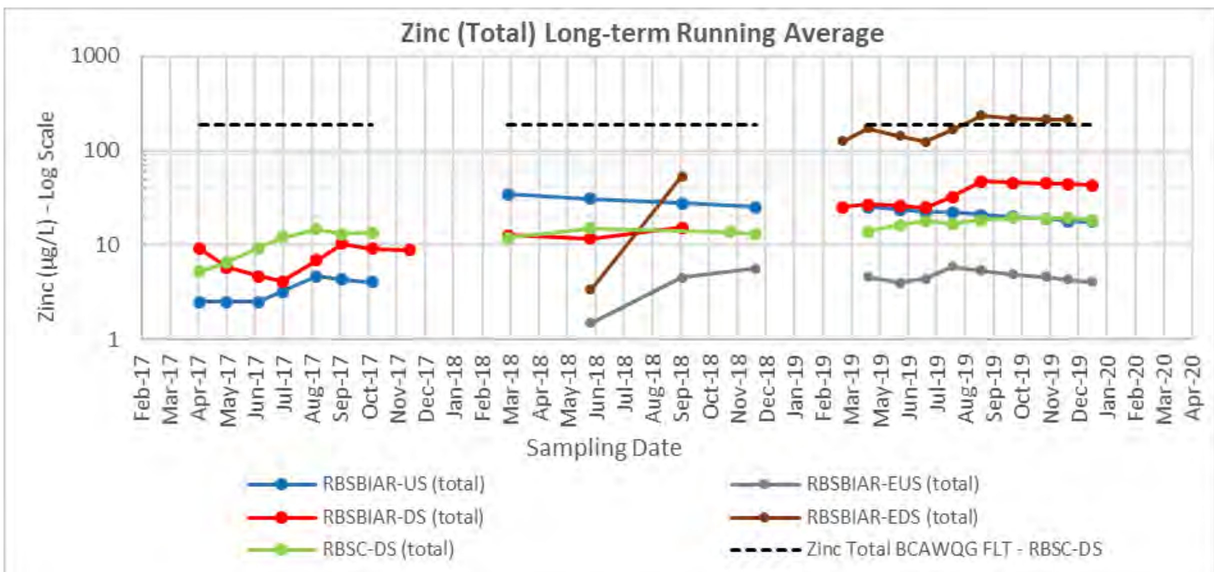


Figure 17c: Dissolved Zinc at SBIAR Locations

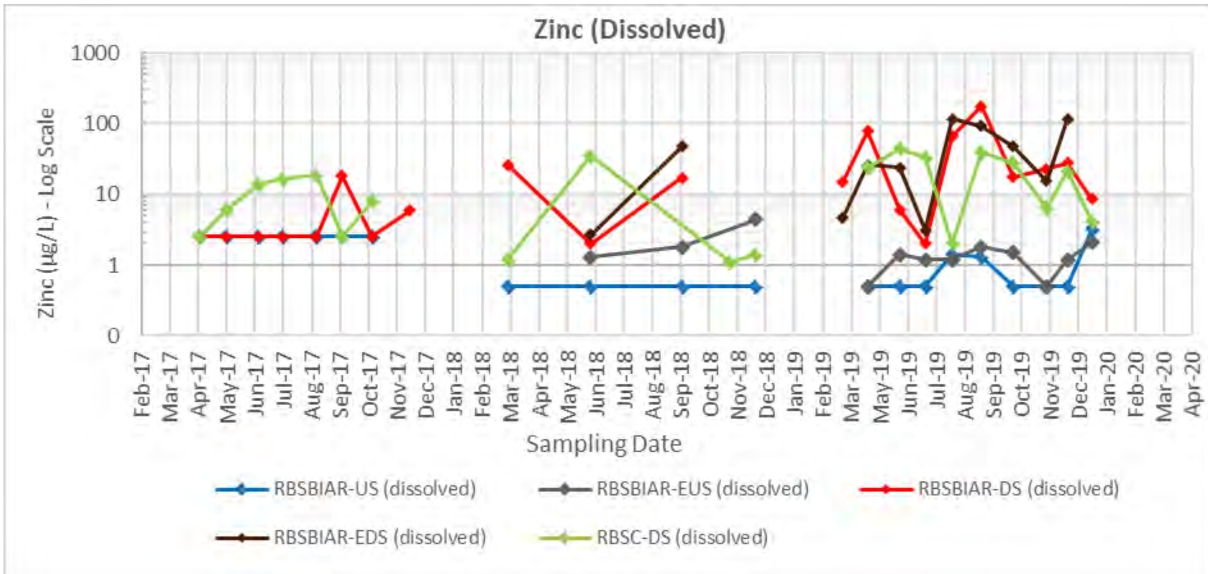


Figure 18a: Downstream vs. Upstream Total Zinc in SBIAR West Ditch

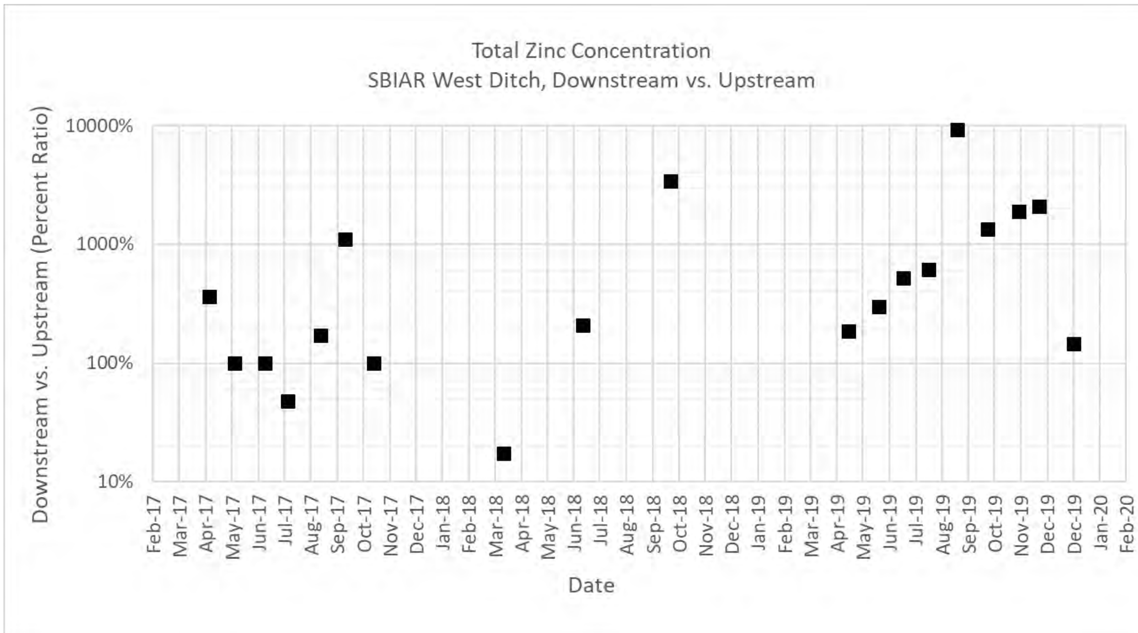


Figure 18b: Downstream vs. Upstream Total Zinc in SBIAR East Ditch

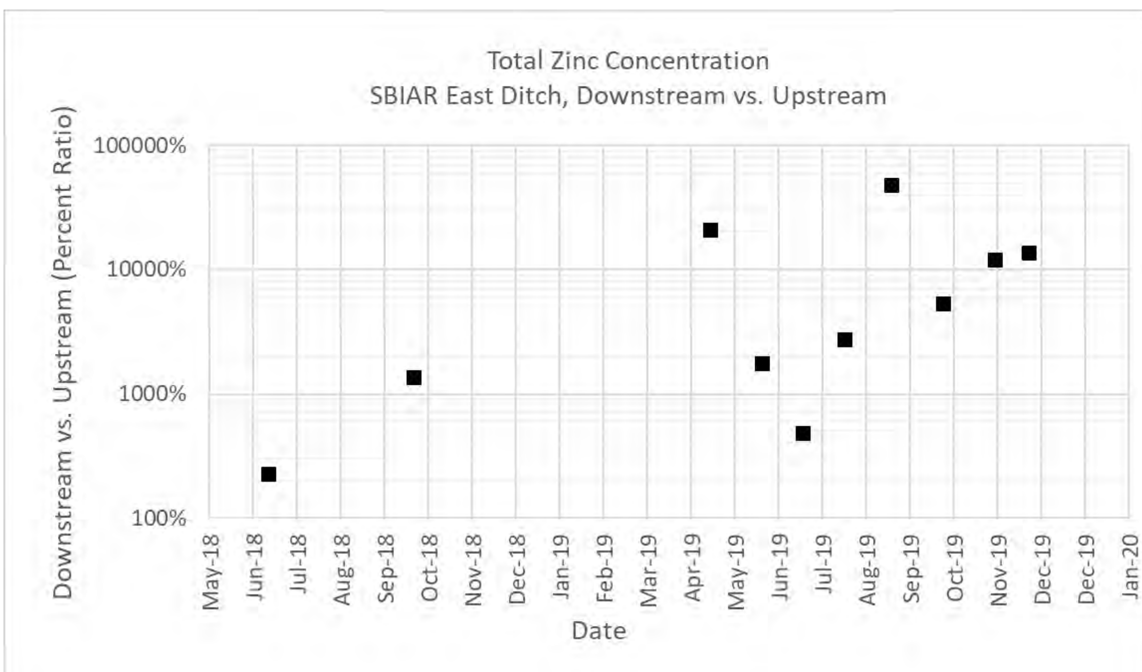


Figure 19: pH at L3 Creek Locations

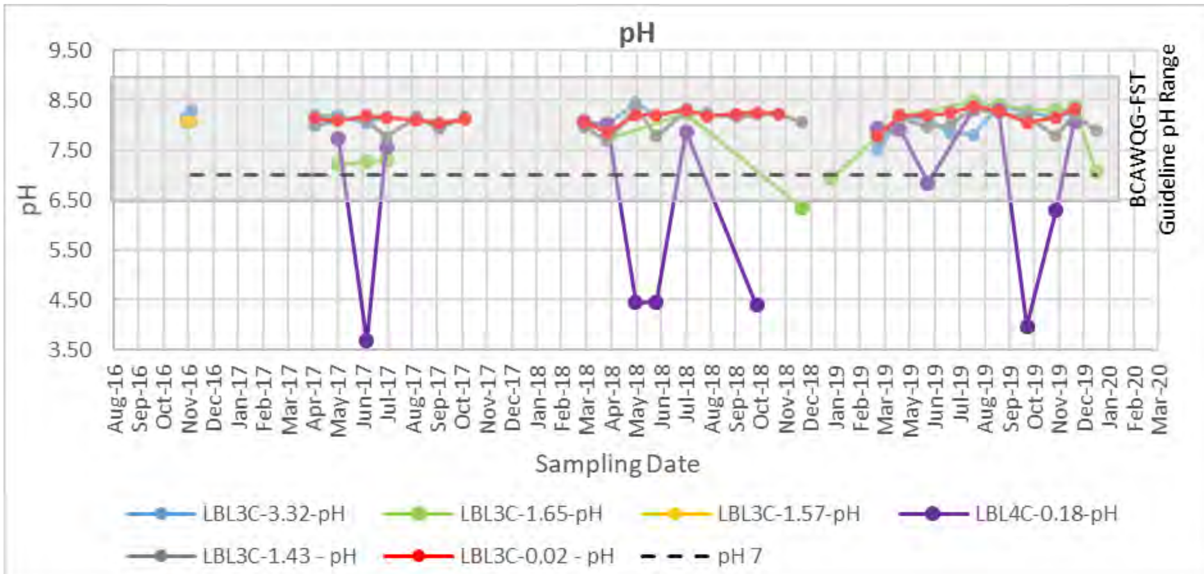


Figure 20: Alkalinity at L3 Creek Locations

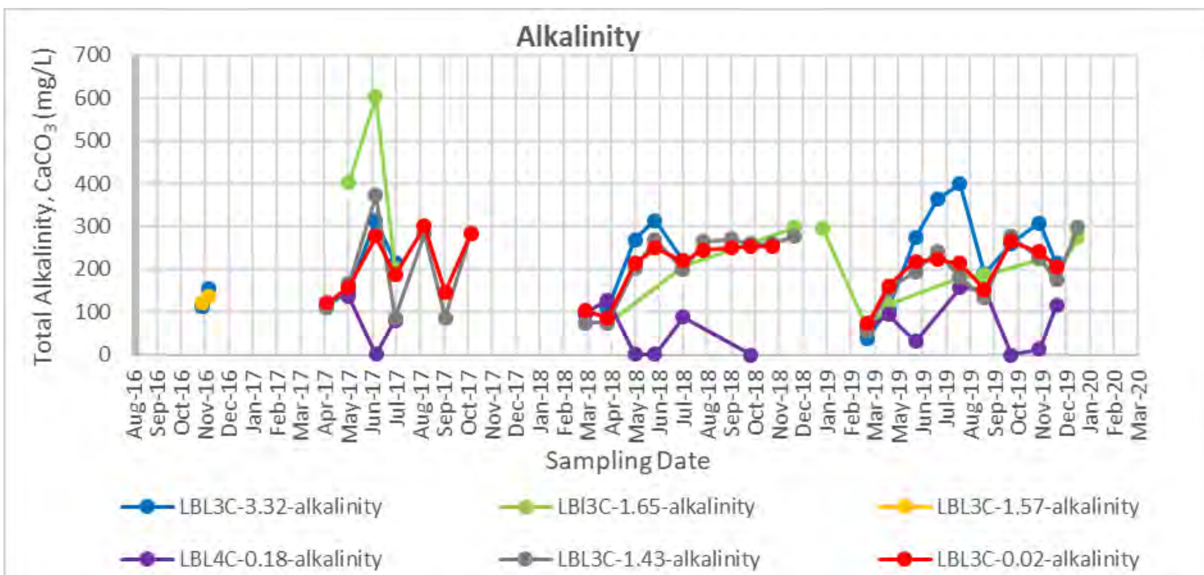


Figure 21: Total Dissolved Solids at L3 Creek Locations

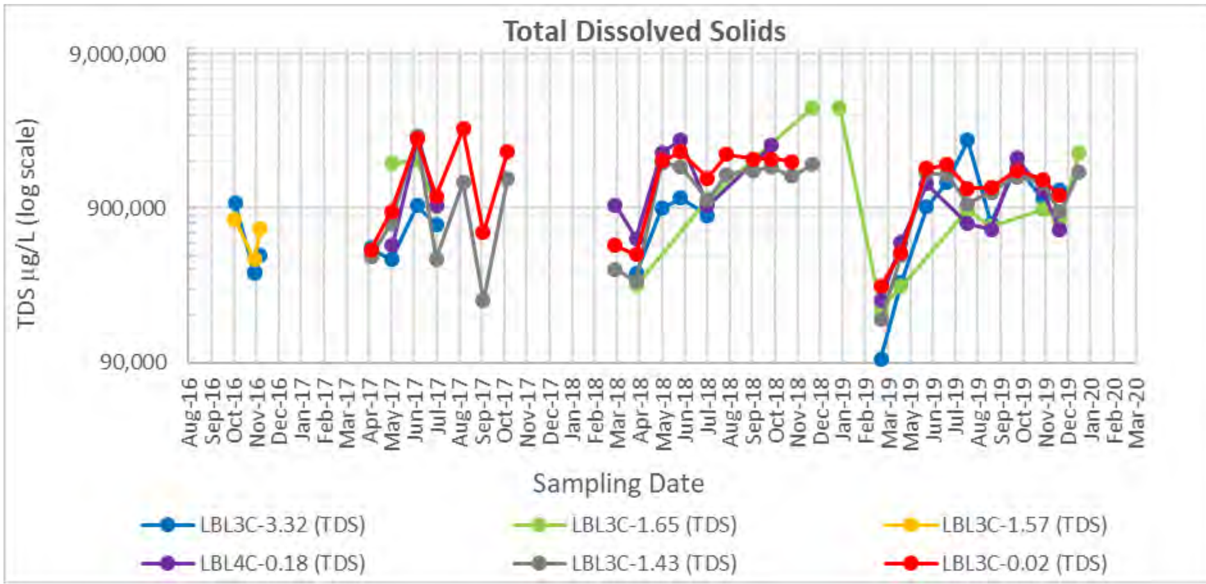


Figure 22: Total Suspended Solids at L3 Creek Locations

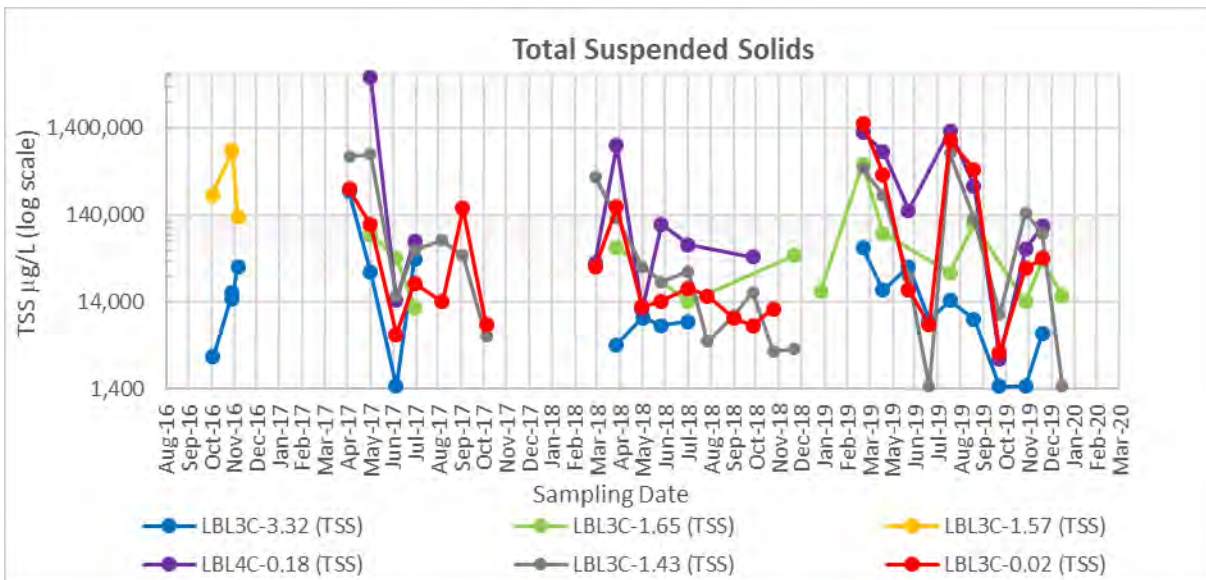


Figure 23: Sulphate at L3 Creek Locations

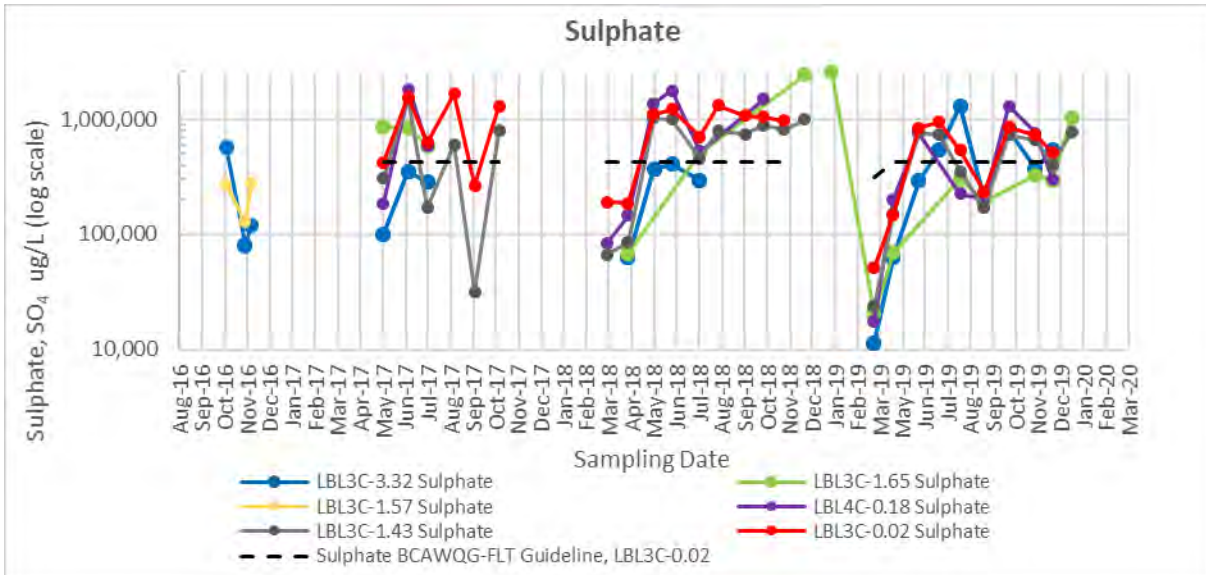


Figure 24a: Total Aluminum at L3 Creek Locations

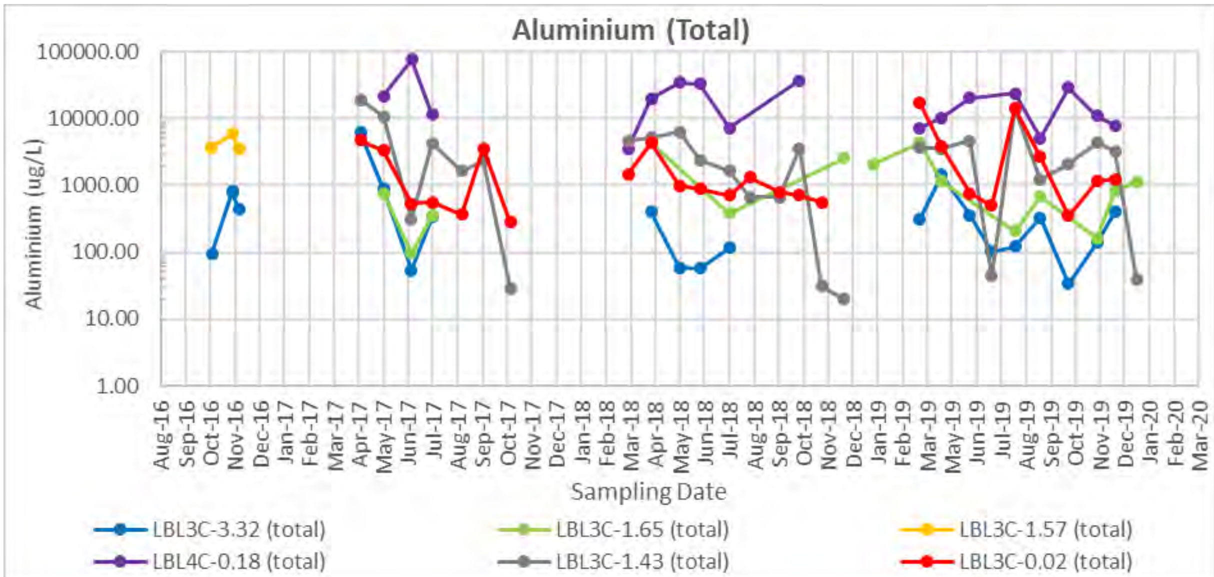


Figure 24b: Dissolved Aluminum at L3 Creek Locations

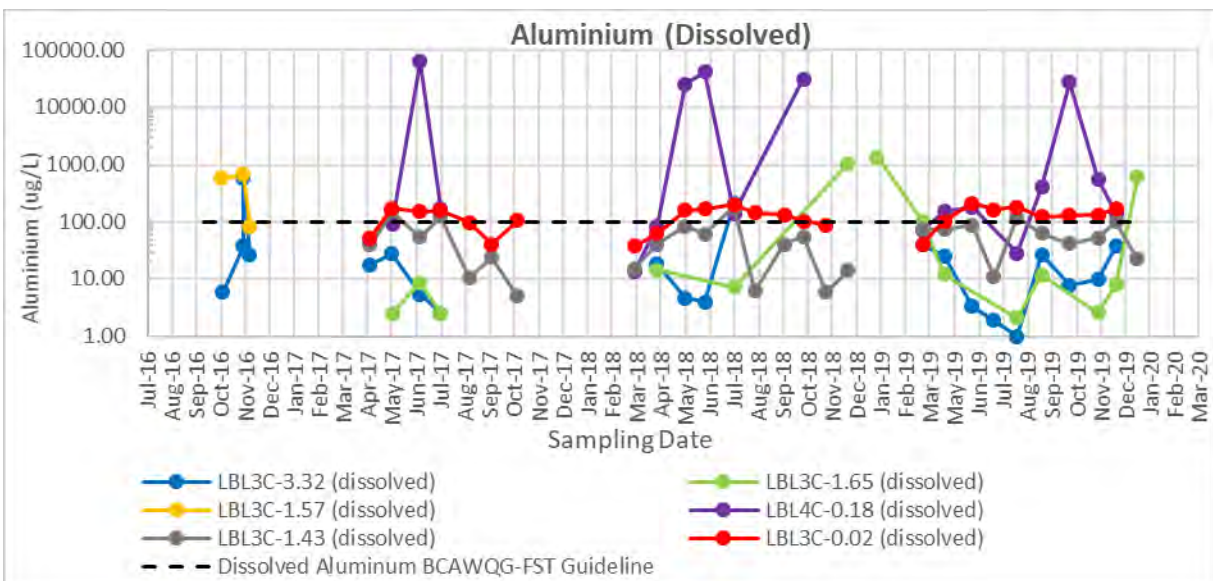


Figure 25a: Total Iron at L3 Creek Locations

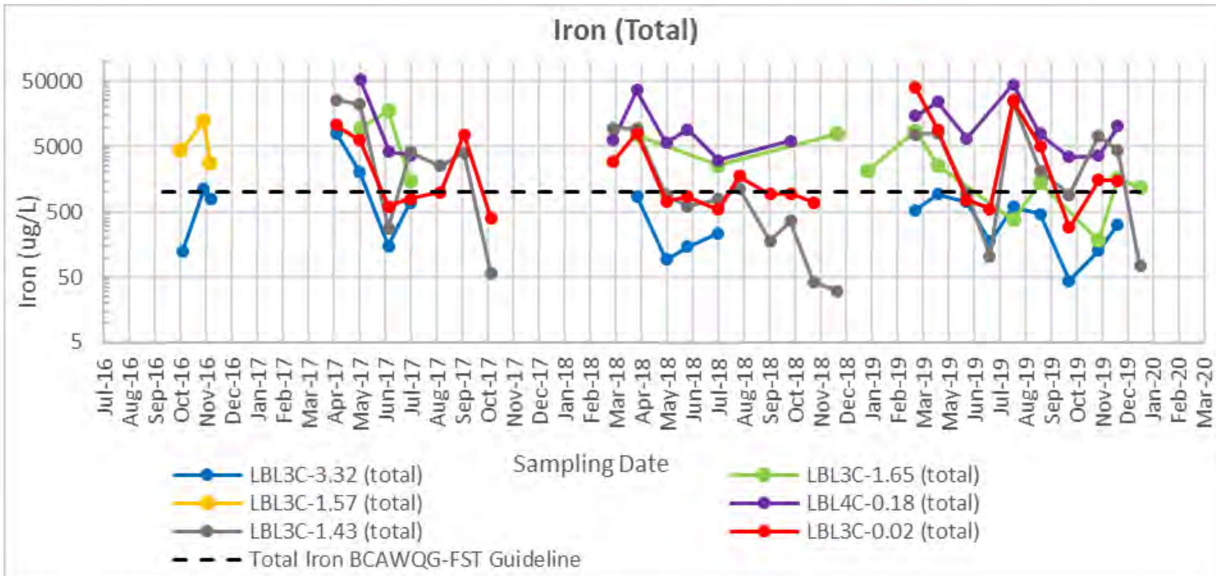


Figure 25b: Dissolved Iron at L3 Creek Locations

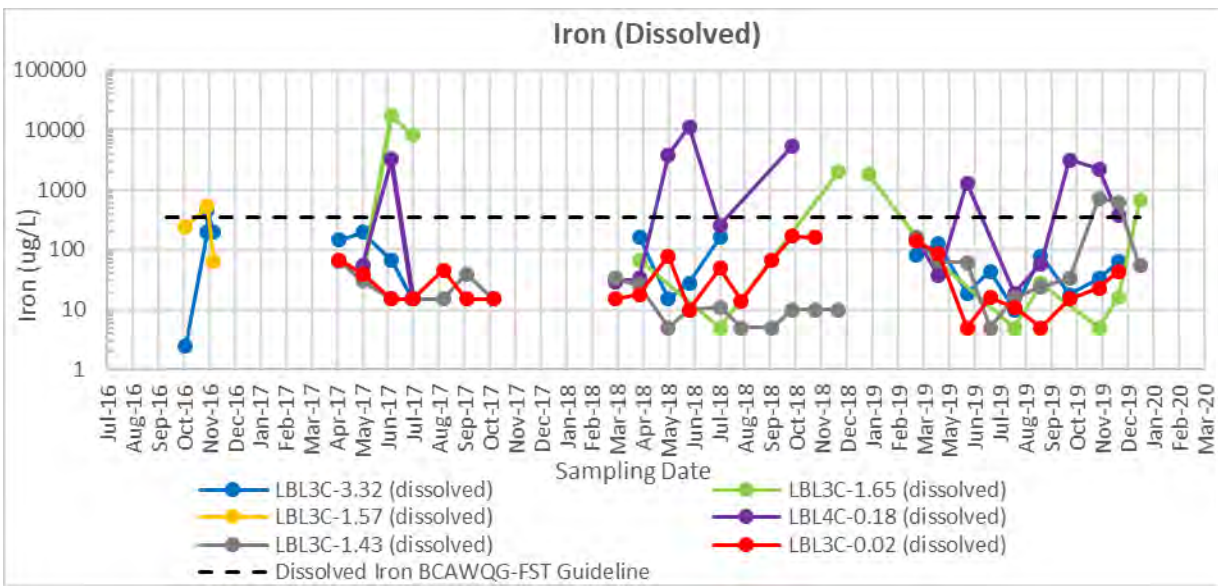


Figure 26a: Arsenic (Total) at L3 Creek Locations

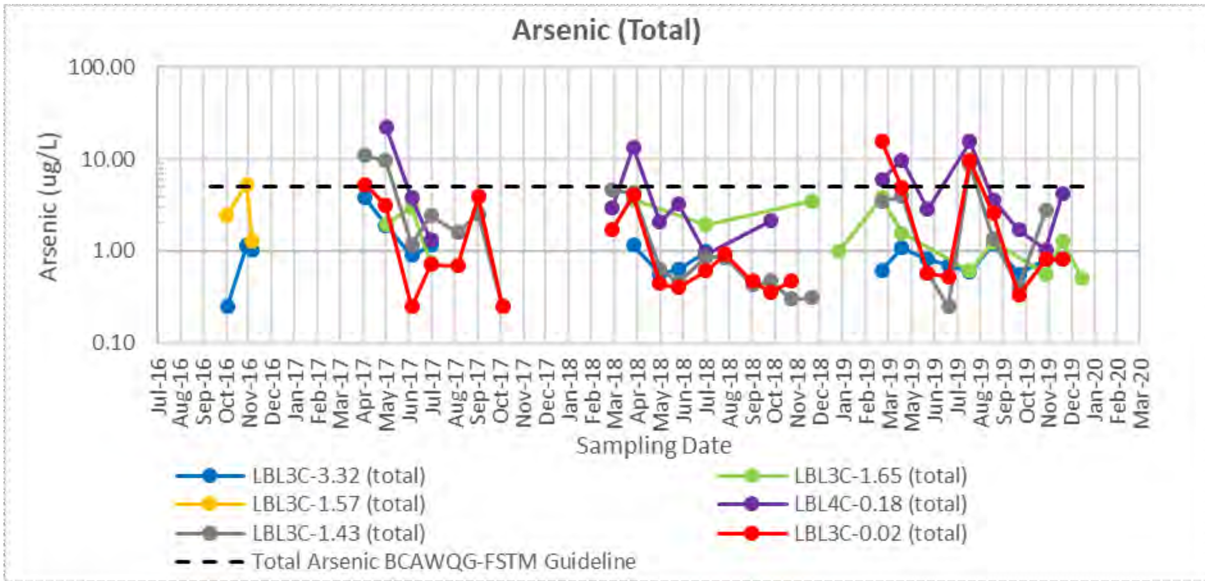


Figure 26b: Arsenic (Dissolved) at L3 Creek Locations

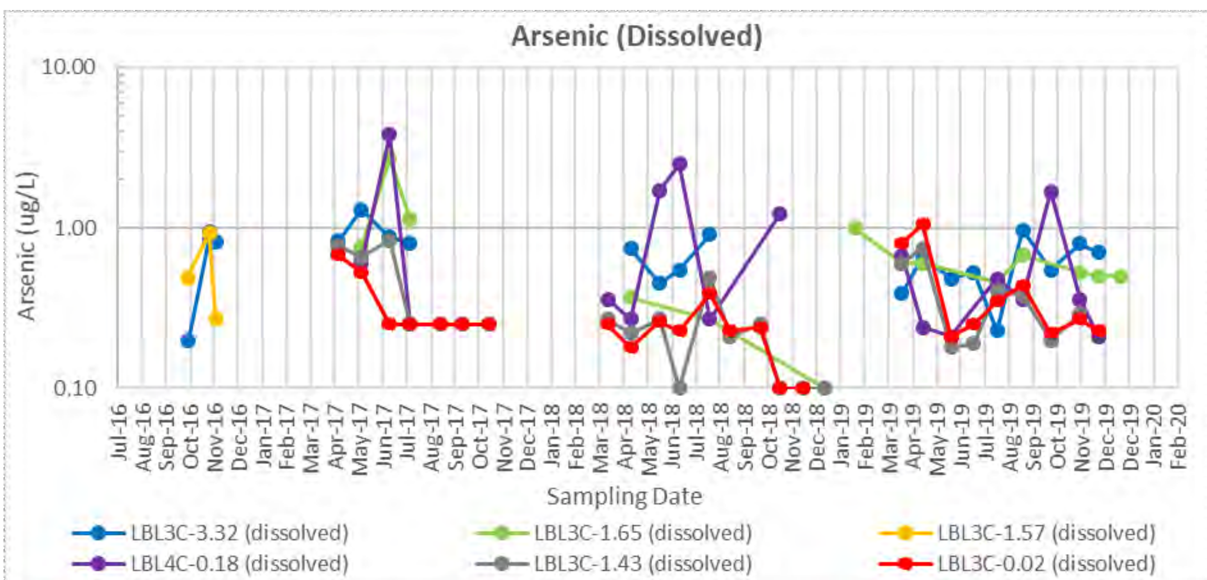


Figure 27a: Cadmium (Total) at L3 Creek Locations

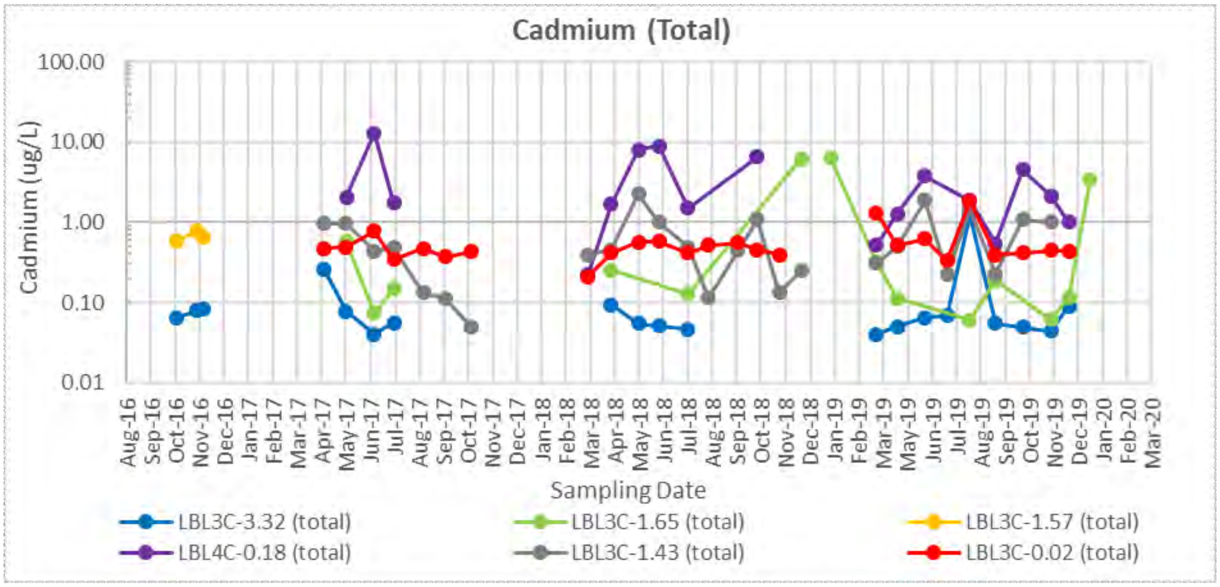


Figure 27b: Cadmium (Dissolved) at L3 Creek Locations

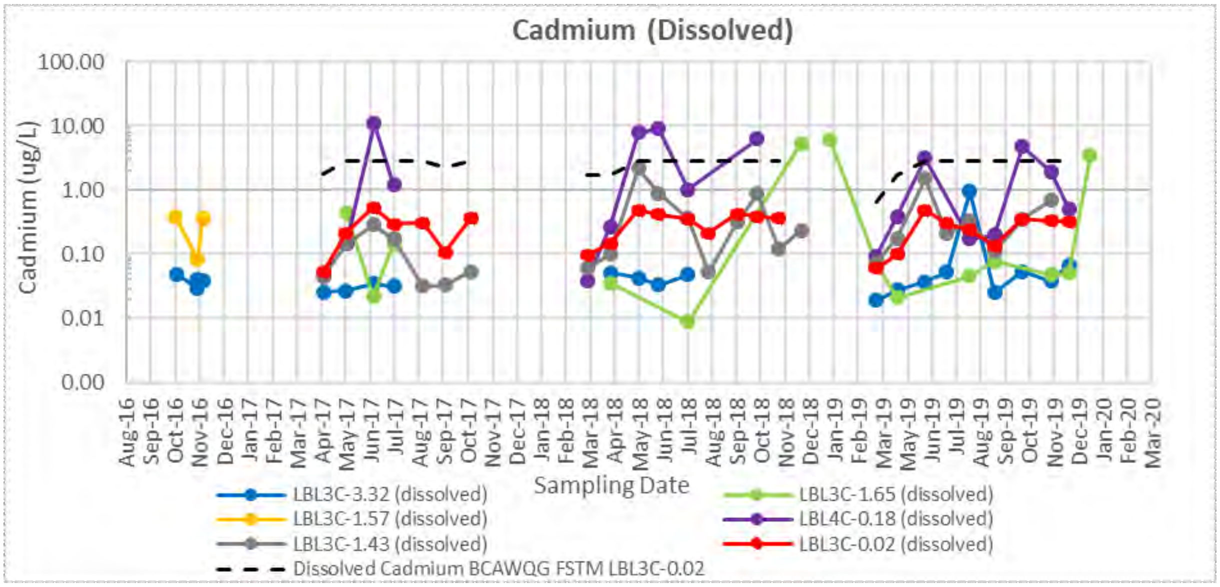


Figure 28a: Cobalt (Total) at L3 Creek Locations

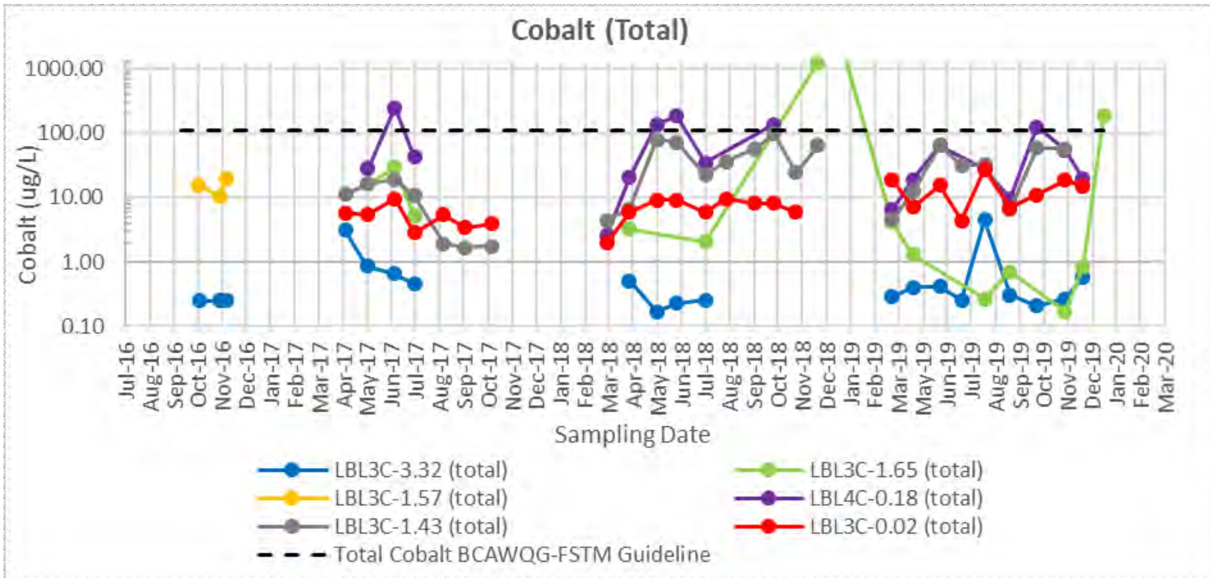


Figure 28b: Cobalt (Dissolved) at L3 Creek Locations

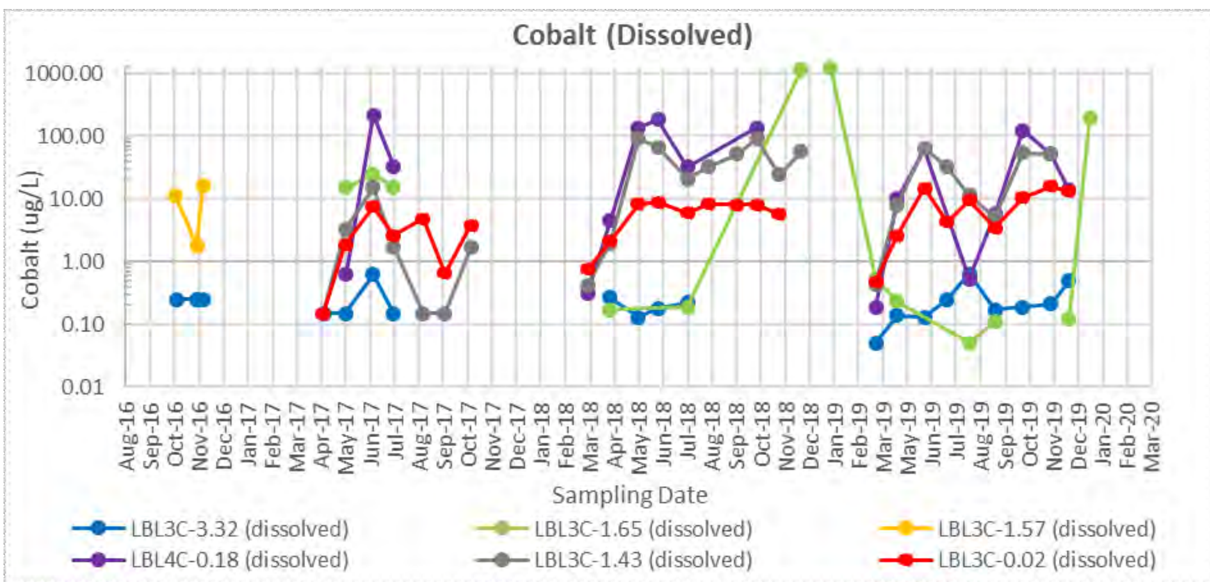


Figure 29a: Copper (Total) at L3 Creek Locations

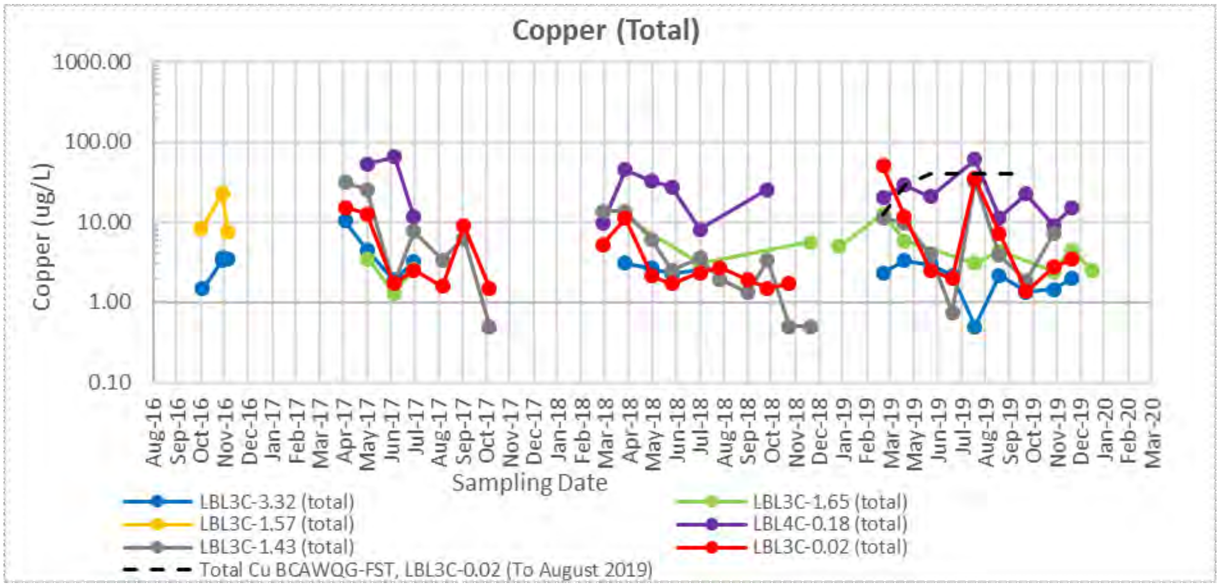


Figure 29b: Copper (Dissolved) at L3 Creek Locations

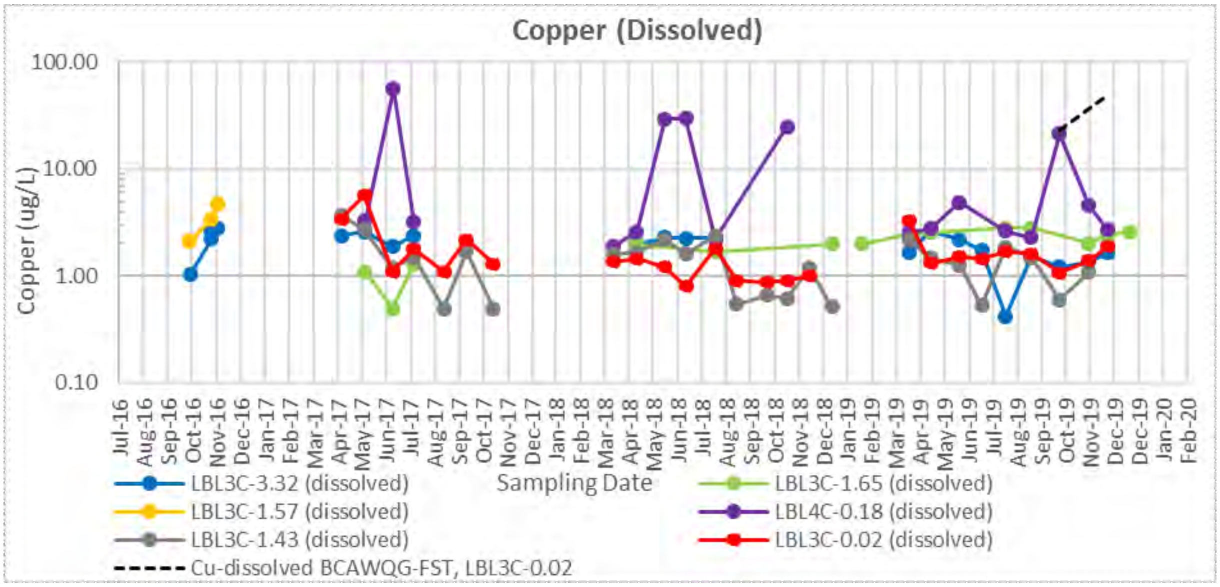


Figure 30a: Zinc (Total) at L3 Creek Locations

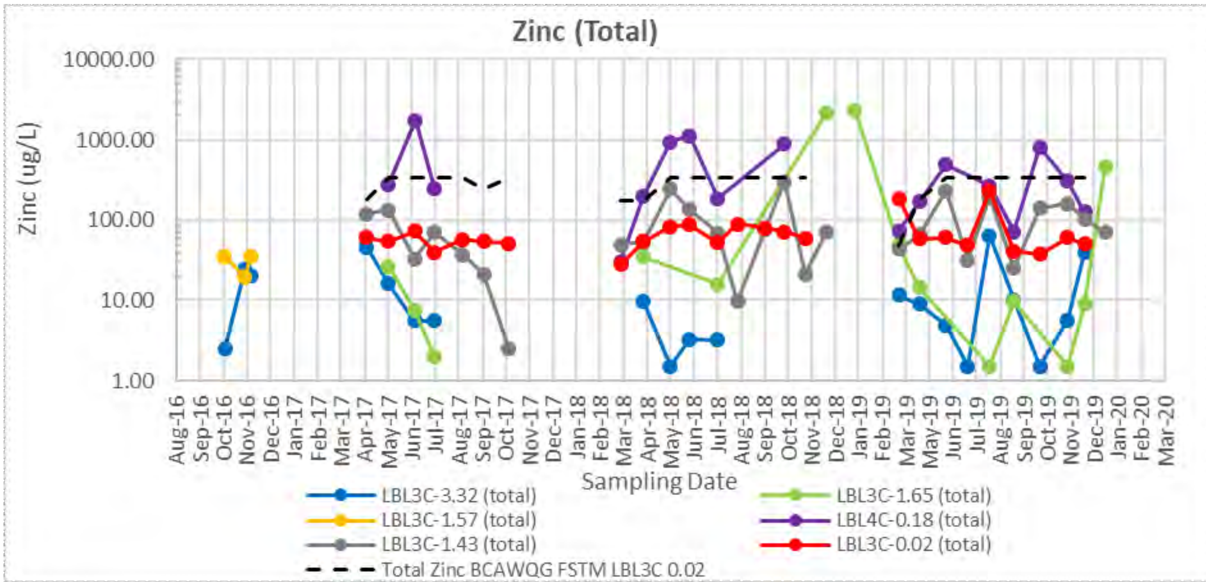
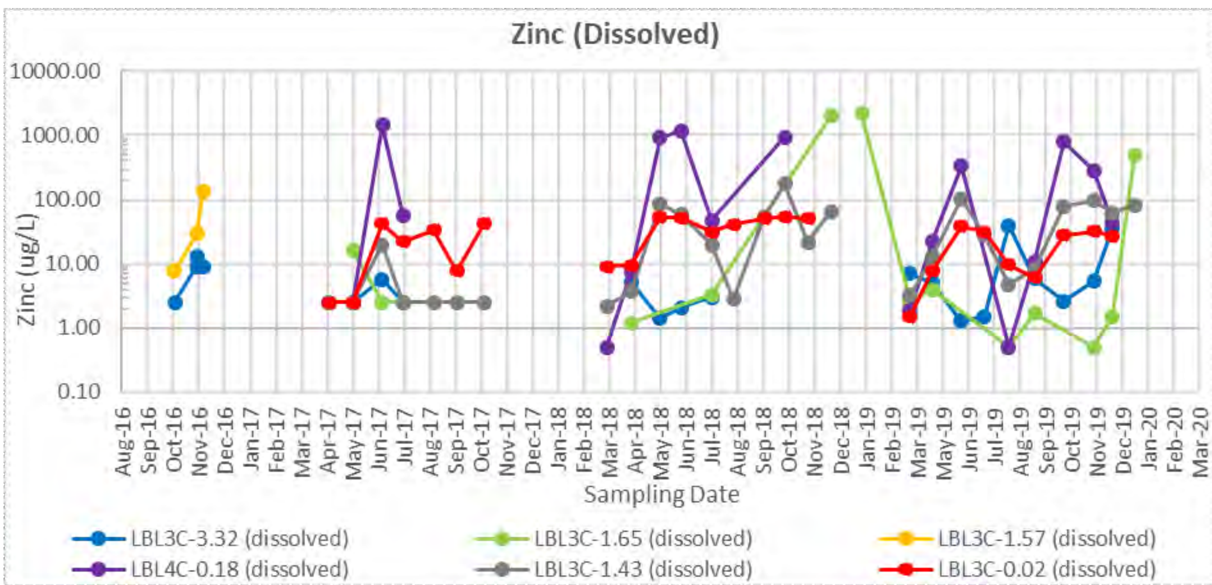


Figure 30b: Zinc (Dissolved) at L3 Creek Locations



PHOTOGRAPHS

SOUTH

Photo 1: RBSBIAR-DS west downstream ditch sample location looking south, dated March 22, 2019.

Photo 2: RBSBIAR-DS west downstream ditch sample location looking north, dated March 22, 2019.

Photo 3: RBSBIAR-EDS east downstream ditch sample location looking south, dated March 22, 2019.

Photo 4: RBSBIAR-EDS east downstream ditch sample location looking north, dated March 22, 2019.

Photo 5: Right Bank Side Channel (RBSC) sampling location, dated June 20, 2019.

Photo 6: RBSBIAR-US west upstream sample location looking north, dated March 22, 2019.

Photo 7: RBSBIAR-EUS east upstream sample location looking south, dated March 22, 2019.

Photo 8: RBSBIAR-EUS east upstream sample location looking north, dated March 22, 2019.

Photo 9: L3 Creek water sample location LBL3C-0.02 looking north, dated March 22, 2019.

Photo 10: L3 Creek water sample location LBL3C-0.02 looking south, dated March 22, 2019.

Photo 11: L3 Creek water sample location LBL3C-1.43 looking south, dated June 20, 2019.

Photo 12: L3 Creek water sample location LBL3C-1.43 looking north, dated May 23, 2019.

Photo 13: L3 Creek water sample location LBL3C-1.43 looking north, dated March 22, 2019.

Photo 14: L3 Creek water sample location LBL3C-1.65, dated March 22, 2019.

Photo 15: Spillway from RSEM L3, dated May 23, 2019.

Photo 16: L3 Creek water sample location LBL3C-1.65 area, dated May 23, 2019.

Photo 17: L3 Creek water sample location LBL3C-1.65 looking south, dated March 22, 2019.

Photo 18: L3 Creek water sample location LBL3C-3.32 looking north, dated May 22, 2019.

Photo 19: L4 Creek water sample location LBL4C-0.18, dated March 22, 2019.

Photo 20: L4 Creek water sample location LBL4C-0.18 looking northeast, dated May 23, 2019.

Photo 21: River Road water sample location RR8, dated March 22, 2019.

Photo 22: River Road water sample location RR8, dated March 22, 2019.

Photo 23: River Road culvert from RR8; no water flow; not a sample location, dated March 22, 2019.

Photo 24: River Road water sample location RR9 at culvert inlet, dated March 22, 2019.

Photo 25: River Road water sample location near RR9 looking east, dated March 22, 2019.

Photo 26: SEEP-1 water sample location looking northwest, dated August 19, 2019.

Photo 27: Gully Road Ditch water sample location looking east, dated May 23, 2019.

Photo 28: Gully Road Ditch water sample location, dated May 23, 2019.

Photo 29: Road Runner 1 and Road Runner 2 water sample locations looking north, dated April 18, 2019.

Photo 30: Road Runner 1 water sample location, dated April 18, 2019.

Photo 31: Road Runner 1 water sample location looking southeast, dated April 18, 2019.

Photo 32: Road Runner 2 water sample location looking east, dated April 18, 2019.

Photo 33: Left Bank Sediment Pond (LBSP) water sample location looking west, dated May 23, 2019.

APPENDIX A

TETRA TECH'S LIMITATIONS ON THE USE OF THIS DOCUMENT

LIMITATIONS ON USE OF THIS DOCUMENT

GEOENVIRONMENTAL

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While TETRA TECH endeavours to verify the accuracy of such information, TETRA TECH accepts no responsibility for the accuracy or the reliability of such information even where inaccurate or unreliable information impacts any recommendations, design or other deliverables and causes the Client or an Authorized Party loss or damage.

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The Client, and any Authorized Party, acknowledges that the Professional Document is based on limited data and that the conclusions, opinions, and recommendations contained in the Professional Document are the result of the application of professional judgment to such limited data.

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In certain instances, the discovery of hazardous substances or conditions and materials may require that regulatory agencies and other persons be informed and the client agrees that notification to such bodies or persons as required may be done by TETRA TECH in its reasonably exercised discretion.

APPENDIX B

SURFACE WATER ANALYTICAL LABORATORY RESULT TABLES

B1 – 2019 Surface Water Laboratory Analytical Results from River Road Monitoring Locations Evaluated against the BCAWQG-FST Guidelines

B2 – 2019 Surface Water Laboratory Analytical Results from SBIAR Monitoring Locations Evaluated against the BCAWQG-FST Guidelines

B3 – 2019 Surface Water Laboratory Analytical Results from L3 Creek Monitoring Locations Evaluated against the BCAWQG-FST Guidelines

B4 – 2019 Surface Water Laboratory Analytical Results from Other Sampling Locations Evaluated against the BCAWQG-FST Guidelines

Appendix B1: LBRR Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG-FLT [2]	RR8	RR9
					22-Mar-19	22-Mar-19
Physical Parameters						
Temperature (°C)	°C				3.1	4.1
Flow Rate (L/sec)	L/s				no flow	flowing
Electrical Conductivity (EC)	µS/cm	2.0	NG	NG	544	955
Hardness as $CaCO_3$	µg/L	500	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn)	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn)	282000	481000
pH	pH Units	0.10	6.5 - 9	6.5-9.0	7.87	7.80
Total Dissolved Solids (TDS)	µg/L	10000	NG	NG	435000	678000
Total Suspended Solids (TSS)	µg/L	3000	NG	NG	467000	684000
Anions and Nutrients						
Acidity (Total as $CaCO_3$)	µg/L	1000	NG	NG	2900	4700
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	NG	NG	77700	75800
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	NG	NG	<1000	<1000
Alkalinity (Hydroxide) as $CaCO_3$	µg/L	1000	NG	NG	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	NG	NG	77.7	75.8
Ammonia (NH_4 as N)	µg/L	5.0	pH dependent (6.5-9.0)	pH dependent (6.5-9.0)	462	147
Ammonia FST Guideline	µg/L		pH dependent (at Temp 4 ˚C or in situ T)		7420	8770
Ammonia FLT Guideline	µg/L			pH dependent (at Temp 4 ˚C or in situ T)	1430	1690
Chloride (Cl^-)	µg/L	500	600,000	150,000	125000	117000
Nitrate (NO_3^- as N)	µg/L	5.0-100	NG	NG	91.7	153
Nitrite (NO_2^- as N)	µg/L	1.0-20	Cl-dependent (> 10,000 µg/L) Guideline: 600 ug/L	Cl-dependent (> 10,000 µg/L) Guideline: 200 ug/L	18.9	12.1
Sulphate (SO_4) [3]	µg/L	300.00	NG	309,000 - 429,001	7910	269000
SO_4 STM & LTA Guideline Calc (Based on Hardness as CaCO3)	µg/L		NG	Hardness 76,000-180,000 = 309,000 Hardness 181,000-250,000 = 429,000; Hardness > 250,000 site-specific	429000	429000
Metals, Total						
Aluminum	µg/L	3.00	NG	NG	7000	11300
Antimony	µg/L	0.1-0.2	NG	NG	0.78	0.71
Arsenic	µg/L	0.10	5.0	5.0	**6.11**	**19.7**
Barium	µg/L	0.10	NG	NG	477	420
Beryllium	µg/L	0.10	NG	NG	0.38	1.05
Bismuth	µg/L	0.05-0.10	NG	NG	0.1	0.133
Boron	µg/L	10.0	1200	1200	68	53
Cadmium	µg/L	0.005	NG	NG	0.471	2.05
Calcium	µg/L	50	NG	NG	94400	149000
Cesium	µg/L	0.01		NG	0.816	1.25
Chromium [4]	µg/L	0.1-0.7	NG	NG	18.3	24.3
Cobalt	µg/L	0.10	110	4.0	6.21	33.4
Copper [3]	µg/L	0.50	Calc. based on Hardness	2 to 10	18.3	**46.0**
Cu STM Guideline Calc.	µg/L		Hardness 13,000 - 400,000 : calc.; Hardness > 400,000 is Capped Value of 400,000		28.51	39.60
Cu LTA Guideline Calc.	µg/L			Hardness 50,000 - 250,000: calc.; Hardness > 250,000, Cu = 10	10.00	10.00
Iron	µg/L	10	1000	NG	**20000**	**37900**
Lead [3]	µg/L	0.05-0.1	Calc. based on Hardness	Calc. based on Hardness	7.5	10.4
Pb STM Guideline Calc.	µg/L		Hardness ≤ 8000 is 3; Hardness 8000-360,000: calc. Hardness>360,000 is Capped Value of 360,000		306	417
Pb LTA Guideline Calc.	µg/L			Hardness 8000-360,000: calc. Hardness > 360,000 is Capped Value of 360,000	15	20
Lithium	µg/L	1.0	NG	NG	22.5	53.5
Magnesium	µg/L	5.0	NG	NG	15600	36600
Manganese [3]	µg/L	0.10	Calc. based on hardness	Calc. based on Hardness	663	934
Mn STM Guideline Calc.	µg/L		Hardness 25,000 - 259,000 : calc.; Hardness > 259,000 is Capped Value of 259,000		3394	3394
Mn LTA Guideline Calc.	µg/L			Hardness 37,000 - 450,000: calc.; Hardness > 450,000 is Capped Value of 450,000	1846	2585
Mercury (Based on methyl Hg & total mass Hg)	µg/L	0.005	NG	Calc.	0.05	0.054
Molybdenum	µg/L	0.05	2000	≤ 1000	2.55	4.98
Nickel	µg/L	0.5	NG		19.5	118
Phosphorus	µg/L	50-100	NG	NG	900	1490
Potassium	µg/L	50.0	NG	NG	9240	7480
Rubidium	µg/L	0.2	NG	NG	10.3	14.2
Selenium	µg/L	0.05	NG	2.0	0.364	1.32
Silicon	µg/L	100		NG	13000	13200
Silver [3]	µg/L	0.01-0.02	0.10 - 3.0	0.05 - 1.5	0.107	0.192
Ag STM Guideline Calc	µg/L		Hardness ≤ 100,000 Ag = 0.10 Hardness > 100,000 Ag = 3.0		3.0	3.0
Ag LTA Guideline Calc				Hardness ≤ 100,000 Ag = 0.05 Hardness > 100,000 Ag = 1.5	1.5	1.5
Sodium	µg/L	50.0	NG	NG	10600	22300
Strontium	µg/L	0.2	NG	NG	1320	1090
Sulfur	µg/L	500	NG	NG	3160	110000
Tellerium	µg/L	0.2-0.4	NG	NG	0.33	0.37
Thallium	µg/L	0.01-0.055	NG	NG	0.153	0.236
Thorium	µg/L	0.1-0.2	NG	NG	2.29	7.29
Tin	µg/L	0.1-0.2	NG	NG	0.3	0.24
Titanium	µg/L	0.3-1.2	NG	NG	164	125
Tungsten	µg/L	0.1-0.2	NG	NG	0.29	0.37
Uranium	µg/L	0.01	NG	NG	1.28	4.58
Vanadium	µg/L	0.5-1.0	NG	NG	24.3	31.1
Zinc [3]	µg/L	3.0	Calc. based on Hardness	Calc. based on Hardness	79.2	273
Zn STM Guideline Calc.	µg/L		Hardness < 90,000 = 33.0 Hardness 90,000 - 500,000, Calc. Hardness > 500,000, Capped Value		177.0	326.3
Zn LTA Guideline Calc.				Hardness < 90,000 = 7.5 Hardness 90,000 - 330,000, Calc. Hardness > 330,000, Capped Value	151.5	187.5
Zirconium	µg/L	0.06-0.12	NG	NG	0.462	0.253
Metals, Dissolved						
Aluminum [5]	µg/L	1.0	100	50	**1430**	**5140**
Al STM Guideline Calc.	µg/L		pH < 6.5 : calc. Al pH ≥ 6.5 : 100.0 Al		100	100
Al LTA Guideline Calc.				median pH < 6.5 : calc. Al median pH ≥ 6.5 : 50.0 Al	50	50
Antimony	µg/L	0.1-0.2	NG	NG	0.26	0.2
Arsenic	µg/L	0.10	NG	NG	1.18	9.03
Barium	µg/L	0.10	NG	NG	420	125
Beryllium	µg/L	0.1-0.2	NG	NG	0.17	0.84
Bismuth	µg/L	0.05-0.1	NG	NG	<0.05	<0.05
Boron	µg/L	10.0	NG	NG	61	42
Cadmium [3]	µg/L	0.005	Calc. based on Hardness	Calc. based on hardness	0.36	1.83
Cd STM Guideline Calc.	µg/L		Hardness 7,000 - 455,000, Calc. Hardness > 455,000, is Capped Value of 455,000		1.71	2.80
Cd LTA Guideline Calc.				Hardness 3,400 - 285,000, Calc. Hardness > 285,000, is Capped Value of 285,000	0.45	0.46
Calcium	µg/L	50.0	NG	NG	93700	145000
Cesium	µg/L	0.01	NG	NG	0.049	0.054
Chromium	µg/L	0.10	NG	NG	7.16	12.8
Cobalt	µg/L	0.10	NG	NG	3.23	28.9
Copper [6]	µg/L	0.20	Calc. based on BLM Model	Calc. based on BLM Model	9.28	32.9
Cu STM (Acute) Guideline Value	µg/L		BLM Ligand Model value		-	-
Cu LTA (Chronic) Guideline Value	µg/L			BLM Ligand Model value	-	-
Iron	µg/L	10.0-20.0	350	NG	**4480**	**17900**
Lead	µg/L	0.05-0.1	NG	NG	4.07	3.64
Lithium	µg/L	1.0	NG	NG	17.9	48.6
Magnesium	µg/L	5.0	NG	NG	11600	28500
Manganese	µg/L	0.10	NG	NG	537	778
Mercury	µg/L	0.005	NG	NG	<0.005	<0.005
Molybdenum	µg/L	0.05	NG	NG	0.282	0.884
Nickel	µg/L	0.50	NG	NG	8.35	98.9
Phosphorus	µg/L	50.0-100.0	NG	NG	611	1270
Potassium	µg/L	50.0	NG	NG	8270	5720
Rubidium	µg/L	0.20	NG	NG	3.13	2.52
Selenium	µg/L	0.05	NG	2.0	0.208	0.681
Silicon	µg/L	50.0	NG	NG	3110	3560
Silver	µg/L	0.01-0.02	NG	NG	0.029	0.039
Sodium	µg/L	50.0	NG	NG	9730	19300
Strontium	µg/L	0.20	NG	NG	1200	987
Sulfur	µg/L	500	NG	NG	2510	99300

Appendix B1: LBRR Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG-FLT [2]	RR8	RR9
					22-Mar-19	22-Mar-19
Tellerium	µg/L	0.2-0.4	NG	NG	<0.2	<0.2
Thallium	µg/L	0.01	NG	NG	0.048	0.044
Thorium	µg/L	0.1-0.2	NG	NG	0.12	4.07
Tin	µg/L	0.1-0.2	NG	NG	<0.1	<0.1
Titanium	µg/L	0.3-0.6	NG	NG	6.17	6.9
Tungsten	µg/L	0.1-0.2	NG	NG	<0.1	<0.1
Uranium	µg/L	0.01	NG	NG	1.07	4.2
Vanadium	µg/L	0.5-1.0	NG	NG	6.28	9.55
Zinc	µg/L	1.00	NG	NG	38.9	217
Zirconium	µg/L	0.06-0.12	NG	NG	0.276	0.33
Laboratory Work Order Number					L2248301	L2248301
Laboratory Identification Number					L2248301-5	L2248301-6

Notes:

Screening completed on BCAWQG-FST [1] and FLT [2] guideline values.

[1] BC Ministry of Environment, Water Protection & Sustainability Branch (2019). British Columbia Approved Water Quality Guidelines (BCAWQG): Aquatic Life, Wildlife & Agriculture Summary Report. 36 pp. Referenced for Freshwater Aquatic Life (F) water use and Short Term Maximum (ST) guidelines.

[2] BC Ministry of Environment, Water Protection & Sustainability Branch (2018). British Columbia Approved Water Quality Guidelines (BCAWQG): Aquatic Life, Wildlife & Agriculture Summary Report. 36 pp. Referenced for Freshwater Aquatic Life (F) water use and Long Term

[3] Guideline is hardness dependant. Where results are above laboratory reportable detection limits, guideline limits have been evaluated based on individual sample hardness. Sample-specific guideline values are listed in parentheses after the laboratory result, where applicable.

[4] Guideline is for Chromium (IV) cation. Analytical results are for unspeciated Chromium. Where analytical results exceed the guideline, speciated analysis may be warranted.

[5] Guideline is pH dependant.

NG - No Guideline

Detection limit can vary as described in the COA. Detection limit can be raised when dilutation is required due to high Dissolved Solids/Electrical Conductivity (DLDS), e.g. nitrite.

BOLD and shaded dark gray: Exceeds BCAWQG-FST (Freshwater Short Term) guideline.

Shaded Light Gray: Exceeds BCAWQG-FLT (Freshwater Long Term) guideline.

RED - Measured value is below detection limit (DL); value shown is 50% of DL

Blank - Not analyzed

Appendix B2: SBIAR Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST 1	BCAWQG - FLT 2	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-US	RBSBIAR-US	RBSBIAR-US	RBSBIAR-US	RBSBIAR-US	RBSBIAR-US
					22-Mar-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19	19-Dec-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19
Physical Parameters																				
Temperature	°C				1.90	4.20	10.40	9.50	14.40	18.20	8.90	2.80	2.30	0.00	6.50	8.90	10.80	15.60	14.20	11.30
Flow Rate	L/sec				-	0.50	0.50	1.00	2.00	1.00	2.00	1.00	1.00	0.25	0.25	0.20	0.10	0.20	0.30	0.50
Electrical Conductivity (EC)	µS/cm	2.0	NG	NG	539	809	855	768	1070	1150	746	810	765	747	564	632	721	3750	1230	670
Hardness (as $CaCO_3$)	µg/L	500	NG	NG	192000	266000	300000	287000	407000	517000	327000	348000	325000	314000	297000	316000	359000	1640000	582000	347000
pH	pH Units	0.10	6.5 - 9	6.5-9.0	8.03	8.18	8.28	8.29	8.08	8.14	8.08	8.21	8.18	8.04	8.06	8.06	8.04	7.87	7.88	7.93
Total Dissolved Solids (TDS)	µg/L	10000	NG	NG	347000	501000	574000	487000	800000	848000	489000	487000	480000	436000	345000	441000	508000	2750000	1190000	443000
Total Suspended Solids (TSS)	µg/L	3000	NG	NG	124000	13300	1500	5400	31900	24300	1500	7800	1500	27100	1500	4800	1500	110000	7700	1500
Anions and Nutrients																				
Acidity (Total as $CaCO_3$)	µg/L	1000	NG	NG	2600	<1000	1100	<1000	3200	2700	<2000	<2000	2100	4600	2900	3200	4000	6400	7900	3200
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	NG	NG	102000	215000	217000	199000	179000	185000	230000	256000	225000	287000	212000	244000	213000	83800	191000	250000
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	NG	NG	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Hydroxide) as $CaCO_3$	µg/L	1000	NG	NG	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	NG	NG	102	215	217	199	179	185	230	256	225	287	212	244	213	83.8	191	250
Ammonia (NH_4 as N)	µg/L	5.0	pH dependent (6.5-9.0)	pH dependent (6.5-9.0)	251	231	52.5	69.9	130	242	97.8	104	96.3	185	8.7	2.5	2.5	589	44.2	2.5
Ammonia FST Guideline	µg/L		pH dependent (at Temp 4 °C or in situ T)		6220	3950	3150	2990	4950	4950	4950	3950	3950	6220	4950	6220	5810	7420	7420	7420
Ammonia FLT Guideline				pH dependent (at Temp 4 °C or in situ T)	1200	759	606	575	952	952	952	759	759	1200	952	1200	1120	1430	1430	1430
Chloride (Cl^-)	µg/L	500	600000	150,000	38100	58400	67600	50900	151000	142000	66000	64400	58900	46800	45200	50000	73200	**1200000**	265000	61600
Nitrate (NO_3^- as N)	µg/L	5.0-25.0	NG	NG	582	2230	3340	1850	1800	5610	2660	3020	2740	1580	634	1240	1500	1870	2960	2180
Nitrite (NO_2^- as N)	µg/L	1.0-5.0	Cl-dependent (> 10,000 µg/L) Guideline: 600 ug/L	Cl-dependent (> 10,000 µg/L) Guideline: 200 ug/L	18.1	17.9	27.9	11.8	11.5	73.7	10.7	7.5	7.7	12.5	3.0	0.5	0.5	28.0	31.2	0.5
Sulphate (SO_4) [3]	µg/L	300	NG	309,000 - 429,000	125000	116000	130000	108000	152000	219000	86500	89000	97800	59400	19400	23100	24000	39800	32300	23700
SO4 FLT Guideline Calc	µg/L		NG	Hardness 76,000-180,000 = 309,000 Hardness 181,000-250,000 = 429,000; Hardness > 250,000 site-specific	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000
Dissolved Organic Carbon (DOC)	mg/L		NG	NG	-	-	-	-	-	-	1.43	2.02	1.34	3.26	-	-	-	-	-	1.65
Metals, Total																				
Aluminum	µg/L	3.00	NG	NG	2310	272	153	48.3	1080	2680	104	202	144	465	26.8	349	7.2	1540	305	11.7
Antimony	µg/L	0.10	NG	NG	0.57	0.3	0.4	0.28	0.38	0.32	0.23	0.17	0.18	0.23	<0.1	0.2	0.12	0.88	1.3	0.14
Arsenic	µg/L	0.10	5.0	5.0	3.14	0.43	0.40	0.30	0.78	1.60	0.25	0.28	0.26	0.83	0.15	0.50	0.13	2.08	0.41	0.15
Barium	µg/L	0.10	NG	NG	160	136	114	114	184	174	143	131	118	196	220	232	246	1030	365	270
Beryllium	µg/L	0.10	NG	NG	0.36	<0.1	<0.1	<0.1	0.31	0.78	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1
Bismuth	µg/L	0.05	NG	NG	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.25	<0.05	<0.05
Boron	µg/L	10.0	1200	1200	47	115	162	158	141	134	91	63	65	68	14	17	22	208	65	32
Cadmium	µg/L	0.005	NG	NG	0.696	0.324	0.0579	0.0274	0.511	1.22	0.0776	0.128	0.135	0.153	0.0175	0.0457	0.0187	0.166	0.0405	0.0109
Calcium	µg/L	50	NG	NG	67900	74600	76700	71100	123000	133000	93900	94900	91900	99500	86500	89500	93500	569000	181000	105000
Cesium	µg/L	0.01	NG	NG	0.289	0.051	0.054	0.03	0.062	0.054	0.028	0.028	0.022	0.144	<0.01	0.066	<0.01	0.209	0.043	<0.01
Chromium [4]	µg/L	0.1-1.0	NG	NG	7.14	0.98	0.57	0.24	1.34	2.16	0.38	0.73	0.62	0.96	1.01	0.97	0.14	4.35	0.71	0.14
Cobalt	µg/L	0.10	110	4.0	13.1	6.4	0.73	0.27	12.9	26.9	1.93	2.67	3.1	1.59	0.05	0.34	0.05	1.63	0.23	0.05
Copper [3]	µg/L	0.50	Calc. based on Hardness	2 to 10	16.2	3.03	1.67	0.72	10.9	20.2	0.92	1.65	1.89	2.43	0.25	1.24	0.25	5.2	1.08	0.25
Cu FST Guideline Calc. (relevant prior to August 2019)	µg/L		Hardness 13,000 - 400,000 : calc.; Hardness ≥ 400,000 is Capped Value of 400,000		20.05	27.00	30.20	28.98	39.60	39.60	32.74	34.71	32.55	31.52	29.92	31.70	35.75	39.60	39.60	34.62
Cu FLT Guideline Calc. (relevant prior to August 2019)	µg/L			Hardness 50,000 - 250,000: calc.; Hardness > 250,000, Cu = 10	7.68	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Iron	µg/L	10	1000	NG	**5640**	466	297	41	**1840**	**2830**	98	305	131	**1070**	63	980	11	**4380**	421	18
Lead [3]	µg/L	0.05	101 - 348	Calc. based on Hardness	1.77	0.176	0.14	0.025	0.278	0.112	<0.05	0.075	<0.05	0.509	0.025	0.502	0.025	1.9	0.232	<0.05
Pb FST Guideline Calc (Based on Hardness as CaCO3), applies to water hardness 8000-360,000 µg/L	µg/L		Based on Hardness 8000-360,000 Hardness ≤ 8000: 3 Hardness > 8000 : calc.		187.3	283.7	330.6	312.5	417.0	417.0	368.9	399.4	366.1	350.4	326.4	353.2	415.5	417.0	417.0	397.9
Pb FLT Guideline Calc (Based on Hardness as CaCO3)	µg/L			Applies to Hardness 8000-360,000 Hardness ≤ 8000, NG Hardness > 8000 : calc.	10.6	14.4	16.2	15.5	19.6	19.6	17.7	18.9	17.6	17.0	16.0	17.1	19.5	19.6	19.6	18.8
Lithium	µg/L	1.0	NG	NG	23.2	38.2	34	30.1	45.8	54.9	22.1	20.5	20.5	21.2	6.3	8	8.7	92.7	15.9	9.9
Magnesium	µg/L	5.0	NG	NG	14900	19900	18400	21500	28900	36700	24100	27100	25100	23500	18900	17600	21600	49500	29300	23300
Manganese [3]	µg/L	0.10	Calc. based on Hardness	Calc. based on Hardness	213	80.5	12.9	4.28	132	282	26.8	38.0	37.3	29.1	5.83	24.7	0.96	155	21.9	2.57
Mn FST Guideline Calc (Based on Hardness as CaCO3)	µg/L		Applies to Hardness 25000-259000 µg/L Mn : calc.		2655.8	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2
Mn FLT Guideline Calc (Based on Hardness as CaCO3)	µg/L			Applies to Hardness 37000-450000 µg/L Mn : calc.	1449.8	1775.4	1925.0	1867.8	2395.8	2585.0	2043.8	2136.2	2035.0	1986.6	1911.8	1995.4	2184.6	2585.0	2585.0	2131.8
Mercury (Based on methyl Hg & total mass Hg)	µg/L	0.005	NG	Calc.	<0.025	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.1	0.006	<0.005
Molybdenum	µg/L	0.05	2000	≤ 1000	19.6	6.0	6.8	4.9	4.5	3.6	3.7	3.8	4.3	4.0	1.0	1.0	1.1	4.7	2.1	1.3
Nickel	µg/L	0.50	NG		44.3	24.1	8.69	6.18	45.3	92.9	11	14.1	15.7	9.84	0.56	1.24	<0.5	5.6	1.07	<0.5
Phosphorus	µg/L	50.0	NG	NG	277	<50	<50	<50	<54	120	<50	<50	<50	74	<50	<66	<50	250	<50	<50
Potassium	µg/L	50.0	NG	NG	3920	2880	3330	3600	5700	5730	4750	4230	3800	3670	2830	3300	3990	36100	8160	4220
Rubidium	µg/L	0.2	NG	NG	5.33	2.31	2.13	2.02	3.44	3.34	2.07	1.87	1.92	2.71	0.41	0.92	0.62	19	1.97	0.67
Selenium	µg/L	0.05	NG	2.0	1.32	1.19	1.24	0.75	0.913	0.773	0.601	0.845	0.866	0.826	0.586	0.567	0.498	0.83	0.603	0.636
Silicon	µg/L	100.0	NG	NG	5320	3250	3130	3750	4870	5520	4390	4690	4030	5090	3570	4960	5300	6390	6220	5390
Silver [3] (Based on Hardness < or > 100000)	µg/L	0.01	0.10 - 3.0	0.05 - 1.5	0.034	0.005	0.005	0.005	0.005	0.005	<0.01	<0.01	<0.01	<0.01	0.005	0.005	0.005	0.05	0.005	<0.01
Ag FST Guideline Calc	µg/L		Hardness ≤ 100,000 Ag = 0.10 Hardness > 100,000 Ag = 3.0		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Ag FLT Guideline Calc	µg/L			Hardness ≤ 100,000 Ag = 0.05 Hardness > 100,000 Ag = 1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

TETRA TECH

Appendix B2: SBIAR Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST 1	RBSBIAR-US 30-Oct-19	RBSBIAR-US 22-Nov-19	RBSBIAR-US 19-Dec-19	RBSC-DS 18-Apr-19	RBSC-DS 23-May-19	RBSC-DS 20-Jun-19	RBSC-DS 19-Jul-19	RBSC-DS 20-Aug-19	RBSC-DS 24-Sep-19	RBSC-DS 30-Oct-19	RBSC-DS 22-Nov-19	RBSC-DS 19-Dec-19	RBSBIAR-EDS 22-Mar-19	RBSBIAR-EDS 18-Apr-19	RBSBIAR-EDS 23-May-19	RBSBIAR-EDS 20-Jun-19
Physical Parameters																			
Temperature	°C			5.80	4.50	0.40	10.90	16.00	10.40	16.20	13.70	5.70	5.00	5.00	3.30	0.00	3.70	10.20	9.10
Flow Rate	L/sec			0.25	0.10	0.35	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-	0.25	0.25	0.25
Electrical Conductivity (EC)	µS/cm	2.0	NG	812	858	676	1690	2230	2360	1220	2260	1920	1420	1450	1100	766	870	992	813
Hardness (as $CaCO_3$)	µg/L	500	NG	383000	420000	343000	894000	1120000	1250000	589000	1250000	1010000	683000	722000	531000	325000	377000	328000	231000
pH	pH Units	0.10	6.5 - 9	7.78	7.63	8.10	8.03	7.46	7.76	8.44	7.59	7.85	7.44	7.96	7.73	8.17	7.98	8.12	8.31
Total Dissolved Solids (TDS)	µg/L	10000	NG	491000	544000	412000	1280000	1890000	2100000	998000	2150000	1670000	993000	1050000	763000	531000	609000	669000	507000
Total Suspended Solids (TSS)	µg/L	3000	NG	1500	5800	11700	6100	11800	11000	12900	29500	6500	16400	6000	1500	1070000	1440000	11600	51600
Anions and Nutrients																			
Acidity (Total as $CaCO_3$)	µg/L	1000	NG	8000	15200	3600	7200	12700	19100	<1000	25600	8700	32900	9900	14400	3000	4700	3700	<1000
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	NG	287000	258000	235000	370000	440000	336000	191000	435000	409000	415000	388000	361000	202000	256000	322000	278000
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	NG	<1000	<1000	<1000	<1000	<1000	<1000	8800	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	2600
Alkalinity (Hydroxide) as $CaCO_3$	µg/L	1000	NG	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	NG	287	258	235	370	440	336	200	435	409	415	388	361	202	256	322	280
Ammonia (NH_4 as N)	µg/L	5.0	pH dependent (6.5-9.0)	2.5	2.5	48.1	5.3	15.3	2.5	9.3	2.5	2.5	2.5	31.5	24.3	118	249	138	27.8
Ammonia FST Guideline	µg/L		pH dependent (at Temp 4 °C or in situ T)	8770	11900	4950	6220	13600	8250	2520	11900	7420	15300	6220	10300	3950	6220	4950	3010
Ammonia FLT Guideline				1690	1970	952	1200	1970	1590	484	1970	1430	1970	1200	1980	759	1200	952	579
Chloride (Cl^-)	µg/L	500	600000	82600	107000	58300	22000	30100	38000	84900	57400	41700	24600	28600	19800	49200	51600	47200	36800
Nitrate (NO_3^- as N)	µg/L	5.0-25.0	NG	2550	2410	1710	12.5	25	50	12.5	50	12.5	12.5	12.5	12.5	445	635	595	668
Nitrite (NO_2^- as N)	µg/L	1.0-5.0	Cl-dependent (> 10,000 µg/L) Guideline: 600 ug/L	2.5	0.5	2.5	5.0	10.0	20.0	2.5	5.0	2.5	2.5	2.5	2.5	12.7	8.6	20.1	6.4
Sulphate (SO_4) [3]	µg/L	300	NG	24800	26900	25700	614000	956000	1060000	370000	1010000	749000	399000	447000	262000	154000	146000	162000	79000
SO4 FLT Guideline Calc	µg/L		NG	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	309000
Dissolved Organic Carbon (DOC)	mg/L		NG	1.3	1.17	2.88	-	-	-	-	-	3.77	3.29	2.29	4.01	-	-	-	-
Metals, Total																			
Aluminum	µg/L	3.00	NG	15.6	82.8	498	70.8	60.9	39.2	177	262	49.6	121	4.5	9.9	8540	14200	167	349
Antimony	µg/L	0.10	NG	<0.1	<0.1	0.15	<0.1	0.11	0.2	0.23	0.2	<0.1	<0.1	<0.1	<0.1	0.76	1.08	0.43	0.33
Arsenic	µg/L	0.10	5.0	0.05	0.20	0.65	0.62	0.53	0.42	0.85	1.09	0.66	1.19	1.00	0.67	**11.0**	**15.7**	0.40	1.02
Barium	µg/L	0.10	NG	259	296	270	71.5	42.1	40.9	109	47.9	37.3	50.3	31.8	29.5	608	745	142	134
Beryllium	µg/L	0.10	NG	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.84	1	<0.1	<0.1
Bismuth	µg/L	0.05	NG	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	0.128	0.166	<0.05	<0.05
Boron	µg/L	10.0	1200	23	21	20	113	195	203	116	249	179	92	126	72	66	144	288	313
Cadmium	µg/L	0.005	NG	0.0149	0.0327	0.0807	0.223	0.611	0.378	0.0481	0.486	0.27	0.0924	0.246	0.0322	1.37	1.85	0.128	0.207
Calcium	µg/L	50	NG	112000	124000	108000	247000	287000	311000	137000	298000	288000	191000	201000	157000	121000	158000	82300	69800
Cesium	µg/L	0.01	NG	<0.01	0.012	0.147	0.023	0.026	0.02	0.027	0.097	0.012	0.026	<0.01	<0.01	1.72	1.98	0.026	0.041
Chromium [4]	µg/L	0.1-1.0	NG	0.13	0.31	1.36	0.6	0.12	0.2	0.5	0.44	<0.1	0.27	<0.1	<0.1	17.2	31.9	0.24	0.7
Cobalt	µg/L	0.10	110	0.05	0.11	1.1	1.72	2.41	1.46	0.26	3.35	2.66	2.41	2.2	1.31	23.3	26.2	7.4	2.44
Copper [3]	µg/L	0.50	Calc. based on Hardness	0.25	0.89	1.75	0.25	0.25	1.0	2.11	1.2	5.41	0.55	0.25	0.25	**38.4**	**45.2**	1.91	3.53
Cu FST Guideline Calc. (relevant prior to August 2019)	µg/L		Hardness 13,000 - 400,000 : calc.; Hardness ≥ 400,000 is Capped Value of 400,000	38.00	39.60	34.24	39.60	39.60	39.60	39.60	39.60	39.60	39.60	39.60	39.60	32.55	37.44	32.83	23.71
Cu FLT Guideline Calc. (relevant prior to August 2019)	µg/L			10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	9.24
Iron	µg/L	10	1000	26	187	**1130**	525	494	207	237	**2280**	786	**2280**	**1660**	744	**23800**	**39600**	175	570
Lead [3]	µg/L	0.05	101 - 348	<0.05	0.121	0.547	0.08	0.127	0.1	0.173	0.45	0.157	0.112	<0.05	<0.05	9.72	14.1	0.07	0.425
Pb FST Guideline Calc (Based on Hardness as CaCO3), applies to water hardness 8000-360,000 µg/L	µg/L		Based on Hardness 8000-360,000 Hardness ≤ 8000: 3 Hardness > 8000 : calc.	417.0	417.0	392.1	417.0	417.0	417.0	417.0	417.0	417.0	417.0	417.0	417.0	366.1	417.0	370.4	237.0
Pb FLT Guideline Calc (Based on Hardness as CaCO3)	µg/L			19.6	19.6	18.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.6	17.6	19.6	17.8	12.6
Lithium	µg/L	1.0	NG	9.4	9.2	8.3	55.6	92.7	101	12.1	118	95.8	52.3	71.7	38.5	37.7	54.2	54.2	43.9
Magnesium	µg/L	5.0	NG	27100	28500	22500	66900	77500	95200	48600	95300	81400	55600	58400	42600	32800	40800	23700	21900
Manganese [3]	µg/L	0.10	Calc. based on Hardness	1.21	6.54	31.9	2710	**3770**	2910	9.84	**3490**	3300	1800	2990	1830	552	1010	95.6	80.2
Mn FST Guideline Calc (Based on Hardness as CaCO3)	µg/L		Applies to Hardness 25000-259000 µg/L Mn : calc.	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3085.6
Mn FLT Guideline Calc (Based on Hardness as CaCO3)	µg/L			2290.2	2453.0	2114.2	2585.0	2585.0	2585.0	2585.0	2585.0	2585.0	2585.0	2585.0	2585.0	2035.0	2263.8	2048.2	1621.4
Mercury (Based on methyl Hg & total mass Hg)	µg/L	0.005	NG	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.01	<0.005	<0.005	<0.005	<0.005	0.068	0.092	<0.005	<0.005
Molybdenum	µg/L	0.05	2000	1.0	0.8	1.4	1.1	0.9	0.9	1.4	1.0	1.1	1.0	1.0	1.1	3.7	4.2	2.4	2.2
Nickel	µg/L	0.50	NG	<0.5	<0.5	2.54	50.6	84.5	84.2	5.55	91.9	70.3	20.7	58.9	15.8	73.8	87	28.3	10.5
Phosphorus	µg/L	50.0	NG	<50	<50	78	<50	<50	<100	<50	130	<50	54	<50	<50	848	1440	<50	309
Potassium	µg/L	50.0	NG	4150	3800	3410	2210	2770	2770	9440	3320	3130	2120	2240	1860	4490	5430	3230	2850
Rubidium	µg/L	0.2	NG	0.66	0.68	1.56	1.71	2.43	2	1.18	3.19	2.37	1.35	1.86	1.17	16.7	21.8	2.1	2.14
Selenium	µg/L	0.05	NG	0.654	0.71	0.809	0.293	0.242	0.13	0.34	0.12	0.106	0.102	0.076	0.065	1.93	1.8	0.835	0.527
Silicon	µg/L	100.0	NG	5730	4970	5480	4690	5520	4460	3520	5710	5700	5670	4970	4810	14300	22300	4580	4370
Silver [3] (Based on Hardness < or > 100000)	µg/L	0.01	0.10 - 3.0	<0.01	<0.01	<0.01	0.005	0.005	0.02	0.005	0.01	<0.01	<0.01	<0.01	<0.01	0.168	0.556	0.005	0.005
Ag FST Guideline Calc	µg/L		Hardness ≤ 100,000 Ag = 0.10 Hardness > 100,000 Ag = 3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Ag FLT Guideline Calc	µg/L			1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

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Appendix B2: SBIAR Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST 1	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS
				19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19	19-Dec-19
Physical Parameters																	
Temperature	°C			15.20	13.60	8.90	2.40	2.50	3.30	7.30	9.50	13.30	13.90	12.90	8.20	5.40	0.00
Flow Rate	L/sec			1.00	1.00	1.00	1.00	1.50	0.10	0.10	0.10	0.20	0.30	0.50	0.25	0.20	0.20
Electrical Conductivity (EC)	µS/cm	2.0	NG	2810	1420	765	857	1060	712	774	763	3510	692	615	690	757	622
Hardness (as $CaCO_3$)	µg/L	500	NG	1150000	581000	351000	356000	404000	417000	438000	430000	1210000	420000	362000	354000	405000	337000
pH	pH Units	0.10	6.5 - 9	7.80	8.13	8.00	7.96	8.22	7.96	7.93	7.93	7.32	7.86	7.95	7.84	7.78	7.99
Total Dissolved Solids (TDS)	µg/L	10000	NG	2440000	1130000	506000	567000	682000	455000	494000	489000	2670000	528000	440000	389000	463000	362000
Total Suspended Solids (TSS)	µg/L	3000	NG	143000	315000	37300	1670000	78400	5100	1500	1500	93700	1500	1500	3200	3600	25100
Anions and Nutrients																	
Acidity (Total as $CaCO_3$)	µg/L	1000	NG	26600	<1000	<2000	6600	<2000	6700	7900	7800	190000	10400	3900	9600	13100	6800
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	NG	226000	258000	270000	331000	289000	313000	358000	283000	235000	302000	284000	325000	283000	283000
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	NG	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Hydroxide) as $CaCO_3$	µg/L	1000	NG	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	NG	226	258	270	331	289	313	358	283	235	302	284	325	283	283
Ammonia (NH_4 as N)	µg/L	5.0	pH dependent (6.5-9.0)	525	413	225	262	307	2.5	2.5	2.5	178	2.5	2.5	2.5	2.5	2.5
Ammonia FST Guideline	µg/L		pH dependent (at Temp 4 °C or in situ T)	8770	4950	6220	6220	3950	6220	7420	6980	17100	7420	6220	8770	8770	6220
Ammonia FLT Guideline				1690	952	1200	1200	759	1200	1430	1340	1970	1430	1200	1690	1690	1200
Chloride (Cl^-)	µg/L	500	600000	**678000**	91600	33100	40100	60900	38800	41200	36300	**1030000**	41900	29100	24600	57500	20800
Nitrate (NO_3^- as N)	µg/L	5.0-25.0	NG	560	436	642	759	743	620	482	464	720	585	920	1110	1140	1090
Nitrite (NO_2^- as N)	µg/L	1.0-5.0	Cl-dependent (> 10,000 µg/L) Guideline: 600 ug/L	44.4	2.5	6.4	5.3	6.0	5.0	5.0	5.0	10.0	0.5	0.5	2.5	0.5	1.7
Sulphate (SO_4) [3]	µg/L	300	NG	331000	391000	116000	103000	210000	24300	22800	21800	32400	25100	25300	26200	28400	27200
SO4 FLT Guideline Calc	µg/L		NG	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000	429000
Dissolved Organic Carbon (DOC)	mg/L		NG	-	-	1.82	4.13	2.59	-	-	-	-	-	1.89	1.33	1.28	3.12
Metals, Total																	
Aluminum	µg/L	3.00	NG	3160	6340	368	10100	3720	23.6	10.3	620	1150	33.3	14.1	20.3	18.3	102
Antimony	µg/L	0.10	NG	0.53	0.3	0.14	1.01	0.47	<0.1	0.13	0.16	0.41	0.13	0.12	<0.1	0.11	0.11
Arsenic	µg/L	0.10	5.0	2.64	**5.90**	0.31	**12.0**	4.51	0.12	0.05	0.55	1.50	0.14	0.12	0.05	0.13	0.21
Barium	µg/L	0.10	NG	449	210	204	617	299	279	271	293	533	319	275	246	288	235
Beryllium	µg/L	0.10	NG	0.79	1.67	<0.1	0.66	0.39	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	0.05	NG	0.1	<0.05	<0.05	0.14	<0.05	<0.05	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	10.0	1200	325	268	169	150	173	15	19	23	95	26	21	18	19	16
Cadmium	µg/L	0.005	NG	1.77	3.07	0.297	0.981	1.1	0.009	0.0025	0.0367	0.204	0.0166	0.0148	0.011	0.0113	0.018
Calcium	µg/L	50	NG	372000	154000	102000	147000	124000	119000	118000	113000	459000	120000	107000	101000	119000	105000
Cesium	µg/L	0.01	NG	0.212	0.174	0.027	1.54	0.629	<0.01	<0.01	0.042	0.155	<0.01	<0.01	<0.01	<0.01	0.015
Chromium [4]	µg/L	0.1-1.0	NG	4.28	6.49	0.28	19.4	6.14	0.73	0.28	0.86	2.66	0.13	<0.1	0.11	0.12	0.25
Cobalt	µg/L	0.10	110	40.7	65.6	7.91	14.2	22.2	0.05	0.05	0.31	1.17	0.05	0.05	0.05	0.05	0.13
Copper [3]	µg/L	0.50	Calc. based on Hardness	30.7	**58.0**	3.73	30.5	18.6	0.25	0.25	1.72	3.2	0.25	0.25	0.25	0.25	0.98
Cu FST Guideline Calc. (relevant prior to August 2019)	µg/L		Hardness 13,000 - 400,000 : calc.; Hardness ≥ 400,000 is Capped Value of 400,000	39.60	39.60	34.99	35.46	39.60	39.60	39.60	39.60	39.60	39.60	36.03	35.28	39.60	33.68
Cu FLT Guideline Calc. (relevant prior to August 2019)	µg/L			10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Iron	µg/L	10	1000	**7040**	**11000**	559	**29700**	**9370**	51	22	**1640**	**3280**	46	19	29	28	208
Lead [3]	µg/L	0.05	101 - 348	1.43	1.16	<0.05	11.2	3.69	<0.05	<0.05	0.396	1.19	<0.05	<0.05	<0.05	<0.05	0.111
Pb FST Guideline Calc (Based on Hardness as CaCO3), applies to water hardness 8000-360,000 µg/L	µg/L		Based on Hardness 8000-360,000 Hardness ≤ 8000: 3 Hardness > 8000 : calc.	417.0	417.0	403.7	411.1	417.0	417.0	417.0	417.0	417.0	417.0	417.0	408.1	417.0	383.4
Pb FLT Guideline Calc (Based on Hardness as CaCO3)	µg/L			19.6	19.6	19.1	19.3	19.6	19.6	19.6	19.6	19.6	19.6	19.6	19.2	19.6	18.3
Lithium	µg/L	1.0	NG	134	113	37.9	48.2	60.1	7.2	8.3	8.9	65.9	10.3	9.7	8.7	8.9	7.7
Magnesium	µg/L	5.0	NG	64200	49400	28100	39000	37400	28400	23100	29000	51300	25500	24800	25300	27100	24000
Manganese [3]	µg/L	0.10	Calc. based on Hardness	543	779	104	710	388	1.78	1.15	26.9	109	5.22	2.27	3.23	3.52	6.87
Mn FST Guideline Calc (Based on Hardness as CaCO3)	µg/L		Applies to Hardness 25000-259000 µg/L Mn : calc.	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2	3394.2
Mn FLT Guideline Calc (Based on Hardness as CaCO3)	µg/L			2585.0	2585.0	2149.4	2171.4	2382.6	2439.8	2532.2	2497.0	2585.0	2453.0	2197.8	2162.6	2387.0	2087.8
Mercury (Based on methyl Hg & total mass Hg)	µg/L	0.005	NG	0.1	0.012	<0.005	0.0424	0.0154	<0.005	<0.005	<0.005	0.1	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05	2000	2.7	1.5	1.3	2.6	2.1	0.6	0.6	0.7	2.1	0.8	0.8	0.7	0.7	0.7
Nickel	µg/L	0.50	NG	136	209	28.7	48.8	73.2	<0.5	<0.5	1.05	3.9	<0.5	<0.5	<0.5	<0.5	0.62
Phosphorus	µg/L	50.0	NG	220	713	<50	1270	392	<50	<50	107	130	<50	<50	<50	<50	<50
Potassium	µg/L	50.0	NG	16100	4640	3440	5130	3550	2830	3150	4150	21300	4270	4000	3490	3250	3040
Rubidium	µg/L	0.2	NG	11.5	4.41	1.46	15.2	7.08	0.35	0.34	0.96	13.1	0.72	0.58	0.52	0.47	0.43
Selenium	µg/L	0.05	NG	1.26	1.13	0.462	1.04	1.03	0.693	0.611	0.759	0.71	0.657	0.541	0.619	0.57	0.733
Silicon	µg/L	100.0	NG	8210	8180	5300	20500	8930	4790	5400	6940	8380	6760	5770	5940	5240	5370
Silver [3] (Based on Hardness < or > 100000)	µg/L	0.01	0.10 - 3.0	0.047	<0.019	<0.01	0.209	0.069	0.005	0.005	0.005	0.03	<0.01	<0.01	<0.01	<0.01	<0.01
Ag FST Guideline Calc	µg/L		Hardness ≤ 100,000 Ag = 0.10 Hardness > 100,000 Ag = 3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Ag FLT Guideline Calc	µg/L			1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5

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Appendix B2: SBIAR Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST 1	BCAWQG - FLT 2	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-DS	RBSBIAR-US	RBSBIAR-US	RBSBIAR-US	RBSBIAR-US	RBSBIAR-US	RBSBIAR-US
					22-Mar-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19	19-Dec-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19
Sodium	µg/L	50.0	NG	NG	29800	82700	65700	63000	48600	48500	35000	35400	37200	41600	13200	8300	11000	31300	17300	7920
Strontium	µg/L	0.2	NG	NG	359	375	531	510	1200	829	514	520	483	530	221	272	287	12200	1600	399
Sulfur	µg/L	500.0	NG	NG	50100	44000	47800	41500	52100	84200	29000	34300	36100	21900	7440	8880	9450	15800	12400	8200
Tellerium	µg/L	0.2	NG	NG	0.22	<0.2	<0.2	<0.2	0.22	0.21	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.2	0.33	<0.2
Thallium	µg/L	0.01	NG	NG	0.061	0.015	0.018	0.016	0.032	0.029	0.015	0.012	<0.01	0.031	<0.01	<0.01	<0.01	0.132	0.013	<0.01
Thorium	µg/L	0.10	NG	NG	1.98	<0.1	<0.1	<0.1	0.68	1.5	<0.1	<0.1	<0.1	0.22	<0.1	0.11	<0.1	0.51	<0.1	<0.1
Tin	µg/L	0.10	NG	NG	0.13	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.11	<0.1	<0.1	<0.1	0.5	0.21	<0.1
Titanium	µg/L	0.3-4.5	NG	NG	29.9	3.69	2.86	0.9	5.98	1.8	0.4	1.99	<0.3	30	0.68	8.99	<0.3	47	8.64	<0.3
Tungsten	µg/L	0.10	NG	NG	0.11	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1
Uranium	µg/L	0.01	NG	NG	1.85	1.29	1.4	1.04	1.65	2.89	1.04	1.11	1.21	1.2	1.02	1.26	1.15	0.938	1.18	1.24
Vanadium	µg/L	0.50	NG	NG	5.47	0.69	<0.5	<0.5	1.09	0.56	<0.5	<0.5	<0.5	1.81	<0.5	1.47	<0.5	5.8	1.33	<0.5
Zinc [3] (Based on Hardness < or > 90,000)	µg/L	3.0	Calc. based on Hardness	Calc. based on Hardness	**137**	47.3	11.8	7.8	146	289	20.1	28.2	31.2	14.4	25.4	4.0	1.5	24	3.1	1.5
Zn FST Guideline Calc.	µg/L		Hardness 90,000 - 500,000, Calc. Hardness > 500,000, is Capped Value of 500,000		109.50	165.00	190.50	180.75	270.75	340.50	210.75	226.50	209.25	201.00	188.25	202.50	234.75	340.50	340.50	225.75
Zn FLT Guideline Calc.				Hardness 90,000 - 330,000, Calc. Hardness > 330,000, is Capped Value of 330,000	84	140	165	155	188	188	185	188	184	176	163	177	188	188	188	188
Zirconium	µg/L	0.06	NG	NG	0.7	0.134	0.173	<0.2	0.21	<0.2	<0.2	<0.2	<0.2	0.24	<0.06	0.256	<0.2	1	<0.24	<0.2
Metals, Dissolved																				
Aluminum [5]	µg/L	1.0	100	50	**102**	72.4	23.6	8.5	**250**	**238**	65.7	73.5	**107**	16.5	2.0	1.5	1.3	4.3	1.4	2.5
Al FST Guideline Calc (based on pH)	µg/L		pH < 6.5 : calc. Al pH ≥ 6.5 : 100.0 Al		100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Al FLT Guideline Calc (based on median pH)				median pH < 6.5 : calc. Al median pH ≥ 6.5 : 50.0 Al	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Antimony	µg/L	0.10	NG	NG	0.37	0.26	0.44	0.3	0.35	0.29	0.21	0.17	0.18	0.19	<0.1	0.14	<0.1	0.76	1.24	0.13
Arsenic	µg/L	0.10	NG	NG	0.21	0.2	0.23	0.25	0.25	0.15	0.19	0.19	0.15	0.21	0.13	0.05	0.05	0.48	0.19	0.15
Barium	µg/L	0.10	NG	NG	98.9	119	99.7	118	176	175	141	128	120	123	219	216	255	934	380	270
Beryllium	µg/L	0.10	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth		0.05	NG	NG	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	10.0	NG	NG	37	100	153	142	149	129	86	62	55	62	13	17	20	216	60	29
Cadmium [3] (Based on Hardness as $CaCO_3$)	µg/L	0.005	Calc. based on Hardness	Calc. based on hardness	0.285	0.267	0.0439	0.0211	0.379	1.01	0.0657	0.102	0.123	0.0694	0.01	0.0127	0.0182	0.0778	0.029	0.0124
Cd FST Guideline Calc.	µg/L		Hardness 7,000 - 455,000, Calc. Hardness > 455,000, is Capped Value of 455,000		1.152	1.611	1.824	1.742	2.497	2.801	1.993	2.125	1.980	1.911	1.805	1.924	2.194	2.8008	2.8008	2.8008
Cd FLT Guideline Calc.				Hardness 3,400 - 285,000, Calc. Hardness > 285,000, is Capped Value of 285,000	0.342	0.435	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.4571	0.4571	0.4571
Calcium	µg/L	50.0	NG	NG	53600	74300	81100	78300	115000	144000	92500	100000	91000	87700	86600	91900	107000	571000	184000	103000
Cesium		0.01	NG	NG	0.017	0.02	0.028	0.02	0.029	0.05	0.025	0.015	0.019	0.016	<0.01	<0.01	<0.01	0.027	<0.01	<0.01
Chromium	µg/L	0.10	NG	NG	2.93	0.11	0.15	0.14	<0.1	<0.1	0.17	0.37	0.47	0.17	0.23	0.19	<0.1	1.12	0.22	<0.1
Cobalt	µg/L	0.10	NG	NG	7.47	6.04	0.51	0.13	12.3	27.6	1.86	2.4	3.03	1.08	0.05	0.05	0.05	0.22	0.05	0.05
Copper [6]	µg/L	0.20	Calc. based on BLM Model	Calc. based on BLM Model	1.82	1.86	0.99	0.52	3.3	4.93	0.64	1.32	1.71	0.64	0.35	0.38	0.47	0.95	0.65	0.37
Cu FST Guideline Value (Acute)	µg/L		BLM Ligand Model value		-	-	-	-	-	-	7.8	14.1	9.3	20.8	-	-	-	-	-	7.7
Cu FLT Guideline Value (Chronic)	µg/L			BLM Ligand Model value	-	-	-	-	-	-	1.4	2.3	1.5	3.7	-	-	-	-	-	1.4
Iron	µg/L	10.0	350	NG	5.0	5.0	5.0	5.0	64	**401**	21	35	34	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead	µg/L	0.05	NG	NG	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	1.0	NG	NG	17.4	39	32.1	27.1	43.6	56.9	22.1	20	18.4	21.8	6.8	7.3	8.6	95.7	15.8	9.9
Magnesium	µg/L	5.0	NG	NG	14200	19500	23700	22200	28900	38600	23400	23700	23700	23100	19500	20900	22600	53400	29400	22000
Manganese	µg/L	0.10	NG	NG	160	75.1	6.21	2.97	128	294	26	32	37.2	17.8	3.94	0.69	0.62	80.3	12	2.26
Mercury	µg/L	0.005	NG	NG	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05	NG	NG	17.1	5.73	7.03	5.72	5.06	3.73	3.62	3.7	4.31	4.03	0.899	1.08	1.03	5.37	2.31	1.25
Nickel	µg/L	0.50	NG	NG	22	23.4	8.42	5.66	43.7	94.3	10.4	12.8	14.8	8.65	<0.5	<0.5	<0.5	1.35	0.57	<0.5
Phosphorus	µg/L	50.0	NG	NG	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	µg/L	50.0	NG	NG	3990	2960	3650	4020	5880	6220	4670	4070	3890	3400	3000	3380	4280	37900	8650	4180
Rubidium	µg/L	0.20	NG	NG	3.44	2.01	2.05	1.84	3.11	3.47	1.9	1.75	1.85	1.61	0.38	0.43	0.6	19.4	1.6	0.63
Selenium	µg/L	0.05	NG	2.0	1.06	1.14	1.09	0.849	0.808	0.732	0.663	0.883	0.96	0.965	0.571	0.513	0.428	0.751	0.786	0.854
Silicon	µg/L	50.0	NG	NG	2390	2930	2930	3530	4650	4730	4350	4040	3910	4140	3480	4330	4950	4200	5300	5340
Silver	µg/L	0.01	NG	NG	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.017	<0.01	<0.01
Sodium	µg/L	50.0	NG	NG	30700	83600	73600	61100	49000	51600	34700	32100	33400	42300	14300	8930	11300	32600	17600	7940
Strontium	µg/L	0.20	NG	NG	296	377	570	534	1050	857	500	496	482	438	229	272	282	12100	1650	385
Sulfur	µg/L	500	NG	NG	42000	39000	46400	36700	56300	79800	28200	30800	32800	21100	6720	8280	7840	16500	12200	7820
Tellurium	µg/L	0.20	NG	NG	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.89	<0.2	<0.2
Thallium	µg/L	0.01	NG	NG	0.014	0.013	0.015	0.015	0.029	0.026	0.014	<0.01	0.011	0.012	<0.01	<0.01	<0.01	0.098	<0.01	<0.01
Thorium	µg/L	0.10	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	0.10	NG	NG	<0.1	<0.1	<0.1	<0.1	0.18	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	0.30	NG	NG	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Tungsten	µg/L	0.10	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	0.01	NG	NG	1.43	1.31	1.19	1.08	1.5	2.46	0.968	1.03	1.17	1.17	1.02	1.05	1.14	0.751	1.2	1.17
Vanadium	µg/L	0.50	NG	NG	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	1.00	NG	NG	15	78.4	6.0	2.0	66	175	17.6	23	27.4	8.6	0.5	0.5	0.5	1.4	1.3	0.5
Zirconium	µg/L	0.06	NG	NG	<0.06	0.06	0.06	0.2	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.06	<0.06	0.2	<0.2	<0.2	<0.2
Laboratory Work Order Number					L2248301	L2260745	L2278405	L2295954	L2313718	L2332423	L2353312	L2374685	L2386755	L2398938	L2260745	L2278405	L2295954	L2313718	L2332423	L2353312
Laboratory Identification Number					L2248301-7	L2260745-3	L2278405-8	L2295954-3	L2313718-11	L2332423-11	L2353312-3	L2374685-8	L2386755-2	L2398938-1	L2260745-1	L2278405-6	L2295954-1	L2313718-10	L2332423-10	L2353312-1

Appendix B2: SBIAR Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST 1	RBSBIAR-US	RBSBIAR-US	RBSBIAR-US	RBSC-DS	RBSC-DS	RBSC-DS	RBSC-DS	RBSC-DS	RBSC-DS	RBSC-DS	RBSC-DS	RBSC-DS	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EDS
				30-Oct-19	22-Nov-19	19-Dec-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19	19-Dec-19	22-Mar-19	18-Apr-19	23-May-19	20-Jun-19
Sodium	µg/L	50.0	NG	9580	9600	8550	89000	125000	143000	48800	149000	113000	63900	77500	49600	28900	62700	107000	109000
Strontium	µg/L	0.2	NG	358	394	356	666	812	892	546	856	764	492	580	452	580	649	521	445
Sulfur	µg/L	500.0	NG	9710	9580	10300	240000	389000	408000	134000	383000	279000	156000	170000	108000	61100	54700	62500	30800
Tellerium	µg/L	0.2	NG	<0.2	<0.2	0.32	<0.2	<0.2	0.4	<0.2	0.4	<0.2	<0.2	<0.2	0.28	0.26	<0.2	<0.2	<0.2
Thallium	µg/L	0.01	NG	<0.01	<0.01	0.015	0.021	0.022	0.025	<0.01	0.026	0.021	0.011	<0.01	<0.01	0.246	0.301	0.024	0.023
Thorium	µg/L	0.10	NG	<0.1	<0.1	0.15	<0.1	<0.1	0.2	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	5.03	5.24	<0.1	0.17
Tin	µg/L	0.10	NG	<0.1	0.14	0.18	<0.1	<0.1	0.2	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.24	0.37	<0.1	<0.1
Titanium	µg/L	0.3-4.5	NG	0.49	2.42	13.2	1.5	1.5	3	6.42	3.86	1.5	3.71	<0.3	<0.3	82.5	150	1.64	2.79
Tungsten	µg/L	0.10	NG	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	0.15	0.14	<0.1	<0.1
Uranium	µg/L	0.01	NG	1.23	1.22	1.25	3.27	4.82	4.76	2.64	4.09	4.12	3.01	2.08	1.62	3.3	3.1	1.91	1.15
Vanadium	µg/L	0.50	NG	<0.5	0.52	1.88	<0.5	<0.5	1	1.16	1.3	<0.5	<0.5	<0.5	<0.5	25.7	46.4	<0.5	1.16
Zinc [3] (Based on Hardness < or > 90,000)	µg/L	3.0	Calc. based on Hardness	1.5	1.5	10	23.2	45.1	37	3.5	44.2	32	12.4	24.3	3.8	**269**	**316**	26.2	31.1
Zn FST Guideline Calc.	µg/L		Hardness 90,000 - 500,000, Calc. Hardness > 500,000, is Capped Value of 500,000	252.75	280.50	222.75	340.50	340.50	340.50	340.50	340.50	340.50	340.50	340.50	340.50	209.25	248.25	211.50	138.75
Zn FLT Guideline Calc.				188	188	188	188	188	188	188	188	188	188	188	188	184	188	186	113
Zirconium	µg/L	0.06	NG	<0.2	<0.2	0.26	0.065	0.086	0.4	<0.4	<0.4	<0.2	<0.2	<0.2	<0.2	0.177	0.219	0.093	0.23
Metals, Dissolved																			
Aluminum [5]	µg/L	1.0	100	2.3	3.1	3.4	1.9	2.1	3.6	4.9	1.5	1.5	2	2.6	2.8	**126**	81.2	**128**	23.3
Al FST Guideline Calc (based on pH)	µg/L		pH < 6.5 : calc. Al pH ≥ 6.5 : 100.0 Al	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Al FLT Guideline Calc (based on median pH)				50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Antimony	µg/L	0.10	NG	0.11	<0.1	<0.1	<0.1	0.2	0.2	0.22	<0.1	<0.1	<0.1	<0.1	<0.1	0.22	0.25	0.41	0.29
Arsenic	µg/L	0.10	NG	<0.1	<0.1	<0.1	0.44	0.33	0.28	0.84	0.53	0.53	1.39	0.88	0.64	0.24	0.24	0.37	0.41
Barium	µg/L	0.10	NG	267	282	203	76.7	36.6	39.6	107	36.8	33.1	36	32.2	29	111	218	129	114
Beryllium	µg/L	0.10	NG	<0.1	<0.1	<0.1	<0.1	0.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth		0.05	NG	<0.05	<0.05	<0.05	<0.05	0.1	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	10.0	NG	23	19	19	104	179	187	134	251	174	89	109	70	45	118	253	290
Cadmium [3] (Based on Hardness as $CaCO_3$)	µg/L	0.005	Calc. based on Hardness	0.0105	0.0153	0.0158	0.0914	0.172	0.268	0.0458	0.173	0.131	0.0304	0.0425	0.0276	0.156	0.229	0.125	0.0129
Cd FST Guideline Calc.	µg/L		Hardness 7,000 - 455,000, Calc. Hardness > 455,000, is Capped Value of 455,000	2.8008	2.8008	2.8008	2.801	2.801	2.801	2.801	2.801	2.801	2.801	2.801	2.801	1.980	2.308	1.999	1.393
Cd FLT Guideline Calc.				0.4571	0.4571	0.4571	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.392
Calcium	µg/L	50.0	NG	113000	124000	99400	246000	302000	334000	148000	341000	273000	193000	197000	149000	86800	102000	84500	58300
Cesium		0.01	NG	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.021	<0.01	0.015	0.012
Chromium	µg/L	0.10	NG	0.14	0.13	0.4	<0.1	0.2	0.2	0.23	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	0.34
Cobalt	µg/L	0.10	NG	0.05	0.05	0.15	1.7	2.24	1.74	0.2	3.13	2.41	2.79	2.07	1.28	4.23	10	7.48	0.45
Copper [6]	µg/L	0.20	Calc. based on BLM Model	0.3	0.59	0.71	0.23	0.4	0.4	2.05	0.25	0.24	0.28	0.1	0.52	0.94	1.21	1.61	0.56
Cu FST Guideline Value (Acute)	µg/L		BLM Ligand Model value	5.5	4.2	16.2	-	-	-	-	-	17.9	11.1	6.4	18.2	-	-	-	-
Cu FLT Guideline Value (Chronic)	µg/L			0.9	0.7	2.9	-	-	-	-	-	1.4	1.6	2.2	2.4	-	-	-	-
Iron	µg/L	10.0	350	5.0	5.0	18	59	124	31	26	**530**	112	**1980**	**1280**	**661**	5.0	63	5.0	5.0
Lead	µg/L	0.05	NG	<0.05	<0.05	<0.05	<0.05	0.1	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	1.0	NG	9.1	8.5	8	59.3	88.1	104	13.4	130	91.9	50.8	65.8	36.1	24.5	43.9	55	43.1
Magnesium	µg/L	5.0	NG	24600	27100	23000	68100	88600	101000	53100	96600	79300	49200	56000	38600	26400	29700	28400	20800
Manganese	µg/L	0.10	NG	0.31	0.23	3.82	2800	3560	3350	7.49	3580	3140	1800	2940	1720	168	206	90.4	9.48
Mercury	µg/L	0.005	NG	<0.005	<0.005	0.0052	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05	NG	0.968	0.898	1.24	1.01	0.91	0.91	1.29	0.878	0.912	0.878	1.04	1.53	1.84	1.83	2.54	2.46
Nickel	µg/L	0.50	NG	<0.5	<0.5	1.27	52.2	80.6	87	5.87	87.5	67.2	12.3	56.7	15.8	11.1	37.7	28.2	4.84
Phosphorus	µg/L	50.0	NG	<50	<50	<50	<50	<100	<100	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	µg/L	50.0	NG	4070	3850	3120	2340	2570	2860	11800	3390	3000	1930	2330	1850	2860	2820	3350	2840
Rubidium	µg/L	0.20	NG	0.74	0.55	0.43	1.67	1.92	1.92	1.17	2.53	2.03	0.97	1.8	1.14	2.03	1.68	2.1	1.67
Selenium	µg/L	0.05	NG	0.716	0.695	0.761	0.297	0.27	0.19	0.412	0.133	0.101	0.054	0.084	0.065	1.38	1.33	0.862	0.596
Silicon	µg/L	50.0	NG	5090	4820	4510	4520	4840	4380	3450	5480	5140	4920	4980	4440	2700	3500	4310	3890
Silver	µg/L	0.01	NG	<0.01	<0.01	<0.01	<0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	µg/L	50.0	NG	8900	9020	8430	90500	123000	144000	57500	154000	111000	57600	71200	45400	28100	63200	115000	107000
Strontium	µg/L	0.20	NG	329	401	330	701	846	939	549	947	725	447	563	403	434	522	596	430
Sulfur	µg/L	500	NG	8080	8820	9370	217000	353000	371000	141000	383000	269000	142000	166000	86800	51100	48800	58200	27600
Tellurium	µg/L	0.20	NG	<0.2	<0.2	<0.2	<0.2	0.4	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	0.01	NG	<0.01	<0.01	<0.01	0.014	0.02	0.02	<0.01	0.018	0.019	<0.01	<0.01	<0.01	0.019	0.017	0.022	0.015
Thorium	µg/L	0.10	NG	<0.1	<0.1	<0.1	<0.1	0.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	0.10	NG	<0.1	0.3	0.82	<0.1	0.2	0.2	<0.1	<0.1	<0.1	0.53	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	0.30	NG	<0.3	<0.3	<0.3	<0.3	0.6	0.6	1.51	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	0.98	<0.3	<0.3
Tungsten	µg/L	0.10	NG	<0.1	<0.1	<0.1	<0.1	0.2	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	0.01	NG	1.22	1.28	1.19	3.23	4.4	4.91	2.72	4.32	3.96	2.79	2.12	1.63	1.96	1.68	1.72	0.949
Vanadium	µg/L	0.50	NG	<0.5	<0.5	<0.5	<0.5	1	1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	1.00	NG	0.5	0.5	3.2	23.8	43.3	33.2	2	39	27.8	6.5	21.3	4.2	4.7	26	23.7	3.1
Zirconium	µg/L	0.06	NG	<0.2	<0.2	<0.2	0.06	<0.12	0.4	<0.31	<0.2	<0.2	<0.2	<0.2	<0.2	<0.06	0.06	<0.06	0.2
Laboratory Work Order Number				L2374685	L2386755	L2398938	L2260745	L2278405	L2295954	L2313718	L2332423	L2353312	L2374685	L2386755	L2398938	L2248301	L2260745	L2278405	L2295954
Laboratory Identification Number				L2374685-6	L2386755-1	L2398938-2	L2260745-5	L2278405-10	L2295954-5	L2313718-9	L2332423-9	L2353312-5	L2374685-10	L2386755-5	L2398938-4	L2248301-8	L2260745-4	L2278405-9	L2295954-4

Appendix B2: SBIAR Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST 1	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EDS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS	RBSBIAR-EUS
				19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19	19-Dec-19
Sodium	µg/L	50.0	NG	121000	112000	55100	62700	92200	5400	5080	6200	17700	5900	5270	5160	6010	4990
Strontium	µg/L	0.2	NG	6930	1020	458	669	714	277	294	297	9280	334	273	253	446	302
Sulfur	µg/L	500.0	NG	116000	161000	39100	40500	77400	9770	9220	9530	12000	9800	8840	10500	10300	10800
Tellerium	µg/L	0.2	NG	0.83	0.28	<0.2	0.26	<0.2	<0.2	<0.2	<0.2	1.06	<0.2	<0.2	<0.2	<0.2	0.3
Thallium	µg/L	0.01	NG	0.112	0.049	<0.01	0.24	0.088	<0.01	<0.01	<0.01	0.113	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	0.10	NG	2.44	6.63	0.16	3.77	1.69	<0.1	<0.1	<0.1	0.35	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	0.10	NG	0.2	<0.1	<0.1	0.49	0.13	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	0.3-4.5	NG	36.9	29.4	1.06	148	56.1	0.83	<0.3	19.3	35.3	0.98	0.41	0.61	0.42	3.27
Tungsten	µg/L	0.10	NG	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	0.01	NG	4.21	7.46	1.28	2.4	2.23	1.33	1.49	1.29	1.42	1.12	1.13	1.07	1.14	1.08
Vanadium	µg/L	0.50	NG	5.2	4.32	<0.5	34	11.1	<0.5	<0.5	1.57	4.4	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc [3] (Based on Hardness < or > 90,000)	µg/L	3.0	Calc. based on Hardness	**412**	**717**	79.4	180	206	1.5	1.5	6.4	14.9	1.5	1.5	1.5	1.5	1.5
Zn FST Guideline Calc.	µg/L		Hardness 90,000 - 500,000, Calc. Hardness > 500,000, is Capped Value of 500,000	340.50	340.50	228.75	232.50	268.50	278.25	294.00	288.00	340.50	280.50	237.00	231.00	269.25	218.25
Zn FLT Guideline Calc.				188	188	188	188	188	188	188	188	188	188	188	188	188	188
Zirconium	µg/L	0.06	NG	<0.4	<0.4	<0.2	<0.2	<0.2	<0.06	<0.06	<0.2	<0.4	<0.2	<0.2	<0.2	<0.2	<0.2
Metals, Dissolved																	
Aluminum [5]	µg/L	1.0	100	**321**	**349**	**161**	92.7	**259**	1.7	1.5	1.3	2.4	0.5	1.4	1.3	0.5	2.4
Al FST Guideline Calc (based on pH)	µg/L		pH < 6.5 : calc. Al pH ≥ 6.5 : 100.0 Al	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Al FLT Guideline Calc (based on median pH)				50	50	50	50	50	50	50	50	50	50	50	50	50	50
Antimony	µg/L	0.10	NG	0.36	0.16	0.14	0.15	0.18	<0.1	0.12	<0.1	0.29	0.13	0.12	<0.1	0.13	<0.1
Arsenic	µg/L	0.10	NG	0.29	0.17	0.19	0.28	0.19	0.05	0.05	0.11	0.22	0.13	0.11	0.11	<0.1	<0.1
Barium	µg/L	0.10	NG	351	132	187	120	126	283	290	304	461	333	268	242	268	220
Beryllium	µg/L	0.10	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth		0.05	NG	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	10.0	NG	333	245	158	127	146	14	18	22	87	25	20	19	16	19
Cadmium [3] (Based on Hardness as $CaCO_3$)	µg/L	0.005	Calc. based on Hardness	1.21	1.03	0.228	0.107	0.628	0.0116	0.0108	0.009	0.105	0.0121	0.0138	0.0094	0.0126	0.0083
Cd FST Guideline Calc.	µg/L		Hardness 7,000 - 455,000, Calc. Hardness > 455,000, is Capped Value of 455,000	2.801	2.801	2.144	2.175	2.478	2.560	2.693	2.642	2.801	2.579	2.213	2.163	2.484	2.056
Cd FLT Guideline Calc.				0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.457
Calcium	µg/L	50.0	NG	351000	149000	96200	98700	107000	120000	127000	126000	401000	126000	106000	104000	118000	98500
Cesium		0.01	NG	0.048	0.026	0.018	<0.01	0.013	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	µg/L	0.10	NG	0.16	<0.1	<0.1	0.13	<0.1	<0.1	<0.1	0.36	0.41	<0.1	<0.1	<0.1	<0.1	<0.1
Cobalt	µg/L	0.10	NG	38.2	56.1	7.37	4.6	18	0.05	0.05	0.05	0.14	0.05	0.05	0.05	0.05	0.05
Copper [6]	µg/L	0.20	Calc. based on BLM Model	4.2	3.29	1.58	1.28	3.65	0.34	0.3	0.28	0.47	0.42	0.36	0.61	0.35	0.42
Cu FST Guideline Value (Acute)	µg/L		BLM Ligand Model value	-	-	9.1	26	21.1	-	-	-	-	-	9.0	5.9	5.4	15.6
Cu FLT Guideline Value (Chronic)	µg/L			-	-	1.7	3.6	3.0	-	-	-	-	-	1.6	1.0	0.9	2.8
Iron	µg/L	10.0	350	5.0	11.0	5.0	41	25	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lead	µg/L	0.05	NG	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	1.0	NG	131	111	36.8	34.8	49	7.4	8.1	8.8	55.6	10.7	9.6	8.6	7.9	7.4
Magnesium	µg/L	5.0	NG	66500	50600	26800	26600	33500	28500	29500	28300	50200	26000	23700	22800	26600	22100
Manganese	µg/L	0.10	NG	500	723	101	86.4	223	0.64	0.79	1.7	46.3	4.43	1.66	2.6	2.83	2.37
Mercury	µg/L	0.005	NG	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05	NG	2.81	1.47	1.21	1.23	1.4	0.536	0.666	0.743	2.12	0.824	0.788	0.736	0.659	0.646
Nickel	µg/L	0.50	NG	129	180	26.3	18.7	61.3	<0.5	<0.5	<0.5	0.8	<0.5	<0.5	<0.5	<0.5	<0.5
Phosphorus	µg/L	50.0	NG	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Potassium	µg/L	50.0	NG	16500	4690	3340	3260	3030	2890	3490	4000	19800	4440	3860	3380	3350	2930
Rubidium	µg/L	0.20	NG	10.2	2.86	1.28	1.22	1.62	0.41	0.44	0.55	10.7	0.64	0.58	0.57	0.46	0.38
Selenium	µg/L	0.05	NG	1.32	1.16	0.524	0.707	0.855	0.635	0.68	0.741	0.965	0.701	0.744	0.794	0.774	0.679
Silicon	µg/L	50.0	NG	5950	5450	5110	4650	4600	4610	5190	6030	7210	6380	5980	5370	5250	4830
Silver	µg/L	0.01	NG	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.011	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	µg/L	50.0	NG	133000	117000	58000	58300	84600	5580	5690	5670	16400	5910	5180	4940	5790	4670
Strontium	µg/L	0.20	NG	6120	1010	429	479	626	279	325	289	7560	359	263	242	437	285
Sulfur	µg/L	500	NG	131000	161000	38200	34600	73300	8670	8170	7950	12600	9420	8620	9480	9770	9000
Tellurium	µg/L	0.20	NG	0.76	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.98	<0.2	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	0.01	NG	0.076	0.028	<0.01	<0.01	0.015	<0.01	<0.01	<0.01	0.075	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium	µg/L	0.10	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	0.10	NG	<0.1	0.12	<0.1	0.19	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	0.30	NG	<0.3	<0.3	<0.3	0.6	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Tungsten	µg/L	0.10	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	0.01	NG	3.58	5.36	1.17	1.13	1.86	1.28	1.35	1.4	1.35	1.22	1.09	1.03	1.07	1.05
Vanadium	µg/L	0.50	NG	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc	µg/L	1.00	NG	116	93.2	47.3	15.3	117	0.5	1.4	1.2	1.2	1.8	1.5	0.5	1.2	2.1
Zirconium	µg/L	0.06	NG	<0.2	<0.2	<0.2	<0.2	<0.2	0.06	<0.06	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Laboratory Work Order Number				L2313718	L2332423	L2353312	L2374685	L2386755	L2260745	L2278405	L2295954	L2313718	L2332423	L2353312	L2374685	L2386755	L2398938
Laboratory Identification Number				L2313718-13	L2332423-13	L2353312-4	L2374685-9	L2386755-4	L2260745-2	L2278405-7	L2295954-2	L2313718-12	L2332423-12	L2353312-2	L2374685-7	L2386755-3	L2398938-3

Notes:

Screening completed on BC AWQG-FWAL FST 1 and FLT 2 guideline values.

[1] BC Ministry of Environment, Water Protection & Sustainability Branch (2019). British Columbia Approved Water Quality Guidelines (BCAWQG): Aquatic Life, Wildlife & Agriculture Summary Report. 36 pp. Referenced for Freshwater Aquatic Life (FWAL) water use and Short Term Maximum (FST) guidelines.

[2] BC Ministry of Environment, Water Protection & Sustainability Branch (2018). British Columbia Approved Water Quality Guidelines (BCAWQG): Aquatic Life, Wildlife & Agriculture Summary Report. 36 pp. Referenced for Freshwater Aquatic Life (FWAL) water use and Long Term Average (FLT) guidelines.

[3] Guideline is hardness dependant. Where results are above laboratory reportable detection limits, guideline limits have been evaluated based on individual sample hardness. Sample-specific guideline values are listed in parentheses after the laboratory result, where applicable.

[4] Guideline is for Chromium (IV) cation. Analytical results are for unspeciated Chromium. Where analytical results exceed the guideline, speciated analysis may be warranted.

[5] Guideline is pH dependant.

[6] Guideline is Dissolved Organic Carbon (DOC) dependent. BML Model assumed 10% DOC and Humic acid 10% of DOC value, due to no DOC in lab analysis.

NG - No Guideline

Detection limit can vary as described in the COA. Detection limit can be raised when dilution is required due to high Dissolved Solids/Electrical Conductivity (DLDS), e.g. nitrite.

BOLD and shaded dark gray: Exceeds BCAWQG-FFST (Short-term Maximum) guideline.

Shaded Light Gray: Exceeds BCAWQG-FLT (Long-term Average) guideline.

RED - Measured value is below detection limit (DL); value shown is 50% of DL

Blank - Not analyzed

TETRA TECH

Appendix B3: L3 Creek and L4 Creek Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG-FLT [2]	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43
					22-Mar-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19	22-Mar-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19
Physical Parameters																				
Temperature	°C				0.0	4.9	10.1	8.9	12.7	12.2	9.2	1.8	2.0	0.0	4.7	10.6	8.1	12.2	13.1	8.4
Flow Rate	L/sec				-	20.00	5.00	3.00	5.00	20.00	3.00	4.00	4.00	-	6.00	4.00	2.00	4.00	20.00	2.50
Electrical Conductivity (EC)	µS/cm	2.0	NG	NG	285	626	1730	1940	1410	1330	1800	1740	1400	199	630	1690	1720	1110	1310	1720
Hardness as $CaCO_3$	µg/L	500	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn, F)	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn, F)	111000	284000	1060000	1130000	678000	645000	1000000	867000	704000	73300	298000	945000	978000	532000	619000	927000
pH	pH Units	0.10	6.5 - 9.0	6.5-9.0	7.80	8.19	8.21	8.25	8.39	8.28	8.05	8.15	8.34	7.73	8.14	7.98	8.02	8.33	8.24	8.20
Total Dissolved Solids (TDS)	µg/L	10000	NG	NG	282000	461000	1630000	1720000	1210000	1220000	1580000	1390000	1090000	171000	444000	1540000	1480000	961000	1140000	1440000
Total Suspended Solids (TSS)	µg/L	3000	NG	NG	1600000	408000	19400	7600	1010000	469000	3700	34200	45000	475000	237000	26800	1500	723000	128000	10100
Anions and Nutrients																				
Acidity (Total as $CaCO_3$)	µg/L	1000	NG	NG	3400	1300	1400	1300	<1000	<1000	2900	2800	<2000	2900	1600	5600	6800	<1000	<1000	<2000
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	NG	NG	72200	161000	218000	222000	208000	152000	265000	240000	197000	55700	152000	194000	242000	177000	133000	276000
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	NG	NG	<1000	<1000	<1000	<1000	5400	<1000	<1000	<1000	8200	<1000	<1000	<1000	<1000	3600	<1000	<1000
Alkalinity (Hydroxide) as $CaCO_3$	µg/L	1000	NG	NG	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	NG	NG	72.2	161	218	222	214	152	265	240	206	55.7	152	194	242	181	133	276
Ammonia (NH_4 as N)	µg/L	5.0	pH dependent (6.5-9.0)	pH dependent (6.5-9.0)	59.1	181	17.0	18.7	26.2	9	11.1	34.6	32.9	69.5	176	59.8	11.6	30	10.3	72.9
Ammonia FST Guideline	µg/L		pH dependent (at Temp 4 C or in situ T)		8770	3950	3950	3010	2520	3150	6220	4950	3150	10,300	4950	6220	5960	3150	3950	3950
Ammonia FLT Guideline	µg/L			pH dependent (at Temp 4 C or in situ T)	1690	759	759	579	484	606	1200	759	606	1980	952	1200	1150	606	759	759
Chloride (Cl^-)	µg/L	500	600000	150,000	13400	18800	38600	35400	50500	206000	47200	51800	54100	11500	25300	47700	33100	61600	236000	57700
Nitrate (NO_3^- as N)	µg/L	5.0-100	NG	NG	368	229	1690	2670	1700	689	3530	3340	3160	241	424	3730	8520	1890	705	7120
Nitrite (NO_2^- as N)	µg/L	1.0-20.0	Cl-dependent (> 10,000 µg/L) Guideline: 600 ug/L	Cl-dependent (> 10,000 µg/L) Guideline: 200 ug/L	12.2	0.5	10.0	10.0	2.5	2.5	5.0	5.0	2.5	10.0	1.2	5.0	10.0	2.5	2.5	2.5
Sulphate (SO_4) [3]	µg/L	300	NG	309,000 - 429,000	50900	147000	848000	943000	537000	234000	851000	735000	518000	23600	150000	770000	737000	355000	169000	730000
SO_4 LTA Guideline Calc (Based on Hardness as CaCO3)	µg/L		NG	Hardness 0-30,000 = 128,000; Hardness 31,000-75,000 = 218,000; Hardness 76,000-180,000 = 309,000 Hardness 181,000-250,000 = 429,000; Hardness > 250,000 site-specific	309000	429000	429000	429000	429000	429000	429000	429000	429000	218000	429000	429000	429000	429000	429000	429000
Total Dissolved Carbon (DOC)	mg/L				-	-	-	-	-	-	4.04	5.64	6.45	-	-	-	-	-	-	4.30
Metals, Total																				
Aluminum	µg/L	3.00	NG	NG	16800	3770	763	495	14100	2680	353	1160	1230	3640	3520	4600	43.8	13800	1210	2080
Antimony	µg/L	0.1-1.0	NG	NG	0.75	0.44	0.27	0.2	0.73	0.44	0.14	0.18	0.17	0.33	0.41	0.21	0.13	0.8	0.36	0.14
Arsenic	µg/L	0.10	5.0	5.0	**15.7**	4.92	0.57	0.53	**9.62**	2.6	0.33	0.81	0.82	3.51	3.92	0.58	0.25	**8.77**	1.36	0.41
Barium	µg/L	0.10	NG	NG	722	202	64.2	54.9	319	219	59.6	77.6	70.5	164	175	60.2	45.4	349	199	65.8
Beryllium	µg/L	0.1-1.0	NG	NG	1.03	0.23	0.11	0.11	0.78	0.19	<0.1	0.13	0.14	0.22	0.26	0.63	<0.1	0.75	0.11	0.29
Bismuth	µg/L	0.05-0.10	NG	NG	0.34	0.083	<0.05	<0.05	0.18	<0.05	<0.05	<0.05	<0.05	0.063	0.055	<0.05	<0.05	0.17	<0.05	<0.05
Boron	µg/L	10.0	1200	1200	45	47	107	125	85	73	117	102	82	29	43	96	109	70	69	102
Cadmium	µg/L	0.005	NG	NG	1.31	0.519	0.618	0.331	1.85	0.396	0.412	0.446	0.44	0.307	0.502	1.87	0.226	1.44	0.225	1.08
Calcium	µg/L	50	NG	NG	61400	81800	250000	273000	191000	171000	270000	241000	184000	24200	73800	227000	233000	150000	165000	246000
Cesium	µg/L	0.01-0.02	NG	NG	2.86	0.778	0.066	0.017	1.75	0.42	0.017	0.081	0.11	0.667	0.637	0.021	<0.01	1.84	0.164	0.011
Chromium [4]	µg/L	0.10	NG	NG	32.2	6.71	0.47	0.16	24	4.79	0.14	1.09	1.15	6.63	6	0.85	0.21	23.6	2.35	0.35
Cobalt	µg/L	0.10	110.0	4.0	19.2	7.1	15.4	4.4	27.6	7.0	11.0	18.5	15.1	4.5	12.5	64.1	31.7	32.4	6.6	58.1
Copper [3]	µg/L	0.5-1.0	Calc. based on Hardness	2 to 10	**50.8**	11.9	2.52	2.0	35.2	7.32	1.37	2.77	3.46	**11.1**	9.76	4.02	0.75	32.2	3.88	1.88
Cu STM Guideline Calc. (relevant prior to Aug. 2019)	µg/L		Hardness 13,000 - 400,000 : calc.; Hardness ≥ 400,000 is Capped Value of 400,000		12.43	28.70	39.60	39.60	39.60	39.60	39.60	39.60	39.60	8.89	30.01	39.60	39.60	39.60	39.60	39.60
Cu LTA Guideline Calc. (relevant prior to Aug. 2019)	µg/L			Hardness 50,000 - 250,000: calc.; Hardness > 250,000, Cu = 10	4.44	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	2.93	10.00	10.00	10.00	10.00	10.00	10.00
Iron	µg/L	10	1000	NG	**39700**	**9240**	761	549	**25100**	**5110**	290	**1520**	**1510**	**7690**	**7980**	956	103	**23900**	**2170**	911
Lead [3]	µg/L	0.05-0.1	Calc. based on Hardness	Calc. based on Hardness	22.2	5.35	0.223	<0.05	12.2	2.43	<0.05	0.473	0.51	4.17	3.73	0.125	<0.05	10.6	1.0	0.094
Pb STM Guideline Calc.	µg/L		Hardness ≤ 8000 is 3; Hardness 8000-360,000: calc. Hardness>360,000 is Capped Value of 360,000		93	308	417	417	417	417	417	417	417	55	328	417	417	417	417	417
Pb LTA Guideline Calc.	µg/L			Hardness 8000-360,000: calc. Hardness > 360,000 is Capped Value of 360,000	6.9	15.3	19.6	19.6	19.6	19.6	19.6	19.6	19.6	5.5	16.1	19.6	19.6	19.6	19.6	19.6
Lithium	µg/L	1.0	NG	NG	26.4	15.7	49.3	48.3	59	25.9	55.1	48.9	38.9	6.7	15.8	66.6	54.4	44.7	22	61.3
Magnesium	µg/L	5.0	NG	NG	20300	27000	80000	90600	63700	45000	87500	87500	64700	8410	26800	78800	91400	50900	41100	89500
Manganese [3]	µg/L	0.10	Calc. based on Hardness	Calc. based on Hardness	713	437	1140	216	1320	478	903	1580	1190	204	856	**4700**	3110	1910	495	**4700**
Mn STM Guideline Calc.	µg/L		Hardness 25,000 - 259,000 : calc.; Hardness > 259,000 is Capped Value of 259,000		1763	3394	3394	3394	3394	3394	3394	3394	3394	1348	3394	3394	3394	3394	3394	3394
Mn LTA Guideline Calc.	µg/L			Hardness 37,000 - 450,000: calc.; Hardness > 450,000 is Capped Value of 450,000	1093	1855	2585	2585	2585	2585	2585	2585	2585	928	1916	2585	2585	2585	2585	2585
Mercury (Based on methyl Hg & total mass Hg)	µg/L	0.005	NG	Calc.	0.115	0.042	<0.005	<0.005	0.1	0.019	<0.005	<0.005	<0.005	0.032	0.025	<0.005	<0.005	0.1	0.011	<0.005
Molybdenum	µg/L	0.05-0.10	2000	≤ 1000	2.83	2.17	1.36	1.86	2.66	2.7	1.28	1.51	1.18	1.15	1.82	0.794	0.91	3.09	2.71	0.92
Nickel	µg/L	0.5	NG	NG	62.5	24.6	51.8	26.7	87	21.9	40.6	52.3	41.3	14.4	35.5	167	82.3	91.9	17.5	130
Phosphorus	µg/L	50-500	NG	NG	1480	355	<50	<50	650	181	<50	58	54	567	313	<50	<50	570	124	<50
Potassium	µg/L	50.0	NG	NG	10600	9790	6710	6760	7540	9700	6160	5940	5790	8930	9180	6120	4870	7800	10100	5810
Rubidium	µg/L	0.2	NG	NG	25.3	7.52	2.15	1.92	15.8	4.57	1.67	1.97	1.91	6.62	6.46	1.68	0.77	16.1	2.46	1.57
Selenium	µg/L	0.05	NG	2.0	2.03	1.06	4.02	3.85	3.02	1.61	3.71	3.75	2.63	0.55	1.22	5.68	8.49	2.8	1.33	5.26
Silicon	µg/L	100.0	NG	NG	27100	7580	4480	3970	24800	6950	5160	6130	5060	7090	7030	6010	5690	24000	4650	6050
Silver [3] (Based on Hardness < or > 100000)	µg/L	0.01-0.02	0.10 - 3.0	0.05 - 1.5	0.407	0.115	0.017	0.005	0.178	0.052	0.005	0.005	0.005	0.085	0.074	0.005	0.005	0.176	0.021	0.005
Ag STM Guideline Calc	µg/L		Hardness ≤ 100,000 Ag = 0.10 Hardness > 100,000 Ag = 3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.100	3.0	3.0	3.0	3.0	3.0	3.0
Ag LTA Guideline Calc	µg/L			Hardness ≤ 100,000 Ag = 0.05 Hardness > 100,000 Ag = 1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	0.050	1.5	1.5	1.5	1.5	1.5	1.5

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Appendix B3: L3 Creek and L4 Creek Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG-FLT [2]	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32
					30-Oct-19	22-Nov-19	19-Dec-19	23-Jan-19	22-Mar-19	18-Apr-19	19-Jul-19	20-Aug-19	30-Oct-19	22-Nov-19	19-Dec-19	22-Mar-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19
Physical Parameters																					
Temperature	°C				3.6	2.3	3.6	0.0	0.0	3.4	17.6	11.3	2.2	0.0	0.8	0.8	5.7	12.3	8.8	12.2	11.3
Flow Rate	L/sec				3.00	10.00	0.50	0.10	-	3.00	1.00	10.00	0.50	5.00	0.15	-	4.00	0.25	0.05	1.00	10.00
Electrical Conductivity (EC)	µS/cm	2.0	NG	NG	1630	1210	1860	3790	202	434	1080	961	1230	1090	2140	133	435	1170	1660	2620	992
Hardness as $CaCO_3$	µg/L	500	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn, F)	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn, F)	844000	567000	1080000	2420000	74200	189000	515000	459000	550000	500000	1310000	44500	183000	590000	854000	1560000	410000
pH	pH Units	0.10	6.5 - 9.0	6.5-9.0	7.78	8.23	7.89	6.94	7.79	8.20	8.48	8.40	8.30	8.37	7.08	7.50	8.14	8.16	7.84	7.82	8.37
Total Dissolved Solids (TDS)	µg/L	10000	NG	NG	1330000	853000	1560000	4050000	200000	280000	876000	691000	880000	753000	2050000	95000	298000	915000	1330000	2490000	723000
Total Suspended Solids (TSS)	µg/L	3000	NG	NG	149000	85800	1500	18400	542000	86200	30300	112000	14000	41600	16300	58600	19000	35800	8600	14700	8900
Anions and Nutrients																					
Acidity (Total as $CaCO_3$)	µg/L	1000	NG	NG	8500	<2000	11400	75100	2700	<1000	<1000	<1000	<2000	<2000	33600	3100	1500	1900	13100	15500	<1000
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	NG	NG	226000	174000	298000	294000	58300	116000	170000	179000	217000	181000	272000	38000	107000	273000	363000	399000	184000
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	NG	NG	<1000	<1000	1000	<1000	<1000	<1000	8800	7200	5000	9800	1000	<1000	<1000	<1000	<1000	<1000	6200
Alkalinity (Hydroxide) as $CaCO_3$	µg/L	1000	NG	NG	<1000	<1000	1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	NG	NG	226	174	298	294	58.3	116	179	186	222	190	272	38	107	273	363	399	190
Ammonia (NH_4 as N)	µg/L	5.0	pH dependent (6.5-9.0)	pH dependent (6.5-9.0)	66.8	52.7	36.9	290	27.1	92.2	7.1	8.4	17.6	26	214	91.6	14.1	11.0	15.8	2.5	12.1
Ammonia FST Guideline	µg/L		pH dependent (at Temp 4 ·C or in situ T)		8770	3950	7420	23300	8770	3950	2010	2520	3150	2520	20400	13,600	4950	4950	8320	8770	2520
Ammonia FLT Guideline	µg/L			pH dependent (at Temp 4 C or in situ T)	1690	759	1430	1970	1690	759	387	484	606	484	1970	1970	952	952	1600	1690	484
Chloride (Cl^-)	µg/L	500	600000	150,000	58800	60100	44000	15000	14000	25800	72900	86000	98200	75100	68000	8150	33700	69400	61300	50000	85500
Nitrate (NO_3^- as N)	µg/L	5.0-100	NG	NG	5700	3720	15400	50	270	126	510	531	400	3400	270	114	4.5	12.5	73	50	733
Nitrite (NO_2^- as N)	µg/L	1.0-20.0	Cl-dependent (> 10,000 µg/L) Guideline: 600 ug/L	Cl-dependent (> 10,000 µg/L) Guideline: 200 ug/L	5.0	5.9	5.0	10.0	8.4	1.4	2.5	2.5	2.5	9.8	10.0	8.9	0.5	5.0	5.0	10.0	2.5
Sulphate (SO_4) [3]	µg/L	300	NG	309,000 - 429,000	661000	400000	771000	2580000	20100	69300	304000	193000	327000	294000	1030000	11400	63300	292000	543000	1300000	203000
SO_4 LTA Guideline Calc (Based on Hardness as CaCO3)	µg/L		NG	Hardness 0-30,000 = 128,000; Hardness 31,000-75,000 = 218,000; Hardness 76,000-180,000 = 309,000 Hardness 181,000-250,000 = 429,000; Hardness > 250,000 site-specific	429000	429000	429000	429000	218000	429000	429000	429000	429000	429000	429000	218000	429000	429000	429000	429000	429000
Total Dissolved Carbon (DOC)	mg/L				6.07	7.23	5.06	-	-	-	-	-	11.60	12.40	8.39	-	-	-	-	-	-
Metals, Total																					
Aluminum	µg/L	3.00	NG	NG	4330	3210	38.3	2080	4340	1140	208	682	161	807	1130	315	1450	358	102	121	329
Antimony	µg/L	0.1-1.0	NG	NG	0.36	0.27	0.11	<2.0	0.36	0.32	0.4	0.4	0.26	0.28	0.5	<0.1	0.18	0.33	0.23	<0.2	0.22
Arsenic	µg/L	0.10	5.0	5.0	2.75	1.79	0.23	1.0	3.8	1.57	0.61	1.25	0.56	1.27	0.5	0.62	1.08	0.82	0.7	0.59	1.19
Barium	µg/L	0.10	NG	NG	155	110	38.5	21.4	163	117	115	135	91.1	120	35.2	28.7	75.7	137	153	39.2	106
Beryllium	µg/L	0.1-1.0	NG	NG	0.41	0.32	0.1	<2.0	0.25	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1
Bismuth	µg/L	0.05-0.10	NG	NG	<0.05	<0.05	0.05	<1.0	0.063	<0.05	<0.05	<0.05	<0.05	<0.05	0.25	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05
Boron	µg/L	10.0	1200	1200	90	66	114	<200	28	38	68	70	55	56	117	28	37	65	84	294	71
Cadmium	µg/L	0.005	NG	NG	1	0.747	0.571	6.39	0.32	0.113	0.0606	0.187	0.0619	0.114	3.46	0.0402	0.0498	0.0654	0.0686	1.25	0.0549
Calcium	µg/L	50	NG	NG	214000	144000	271000	520000	23200	50500	122000	102000	138000	124000	333000	11100	45400	139000	210000	354000	117000
Cesium	µg/L	0.01-0.02	NG	NG	0.358	0.309	0.01	<0.2	0.777	0.199	0.036	0.116	0.018	0.137	0.05	0.052	0.113	0.078	0.017	0.034	0.047
Chromium [4]	µg/L	0.10	NG	NG	5.09	3.51	0.28	<2.0	7.97	2.4	0.65	1.57	0.51	1.85	0.5	0.61	2.28	0.86	0.29	0.2	0.71
Cobalt	µg/L	0.10	110.0	4.0	58	32.7	33.9	**1310**	4.13	1.31	0.27	0.71	0.17	0.84	**188**	0.29	0.41	0.42	0.26	4.51	0.31
Copper [3]	µg/L	0.5-1.0	Calc. based on Hardness	2 to 10	7.23	6.6	0.73	5.0	**12.6**	5.92	3.09	4.4	2.42	4.51	2.5	2.35	3.34	2.97	2.17	0.5	2.18
Cu STM Guideline Calc. (relevant prior to Aug. 2019)	µg/L		Hardness 13,000 - 400,000 : calc.; Hardness ≥ 400,000 is Capped Value of 400,000		39.60	39.60	39.60	39.60	8.97	19.77	39.60	39.60	39.60	39.60	39.60	6.18	19.20	39.60	39.60	39.60	39.60
Cu LTA Guideline Calc. (relevant prior to Aug. 2019)	µg/L			Hardness 50,000 - 250,000: calc.; Hardness > 250,000, Cu = 10	10.00	10.00	10.00	10.00	2.97	7.56	10.00	10.00	10.00	10.00	10.00	1.78	7.32	10.00	10.00	10.00	10.00
Iron	µg/L	10	1000	NG	**7210**	**4320**	74	**2090**	**8660**	**2580**	381	**1410**	185	**1640**	**1170**	536	943	714	176	588	464
Lead [3]	µg/L	0.05-0.1	Calc. based on Hardness	Calc. based on Hardness	2.24	1.49	0.05	<1.0	4.78	1.38	0.217	1.217	0.109	0.855	0.25	0.291	0.487	0.395	0.114	0.16	0.223
Pb STM Guideline Calc.	µg/L		Hardness ≤ 8000 is 3; Hardness 8000-360,000: calc. Hardness>360,000 is Capped Value of 360,000		417	417	417	417	56	184	417	417	417	417	417	29	176	417	417	417	417
Pb LTA Guideline Calc.	µg/L			Hardness 8000-360,000: calc. Hardness > 360,000 is Capped Value of 360,000	19.6	19.6	19.6	19.6	5.5	10.5	19.6	19.6	19.6	19.6	19.6	4.4	10.2	19.6	19.6	19.6	20
Lithium	µg/L	1.0	NG	NG	51.3	34.4	63.4	144	7.3	5	7.1	7.7	7.1	8.1	87.3	1.5	4.7	15.5	22.6	145	9
Magnesium	µg/L	5.0	NG	NG	88800	56400	109000	282000	8400	17300	43100	36400	56400	48800	112000	4670	15400	42900	76200	113000	42600
Manganese [3]	µg/L	0.10	Calc. based on Hardness	Calc. based on Hardness	**4350**	2240	3370	**86200**	157	103	6.27	21.7	3.13	27.6	**18700**	25.4	10.3	27.3	35.2	**5050**	13.0
Mn STM Guideline Calc.	µg/L		Hardness 25,000 - 259,000 : calc.; Hardness > 259,000 is Capped Value of 259,000		3394	3394	3394	3394	1358	2623	3394	3394	3394	3394	3394	1030	2557	3394	3394	3394	3394
Mn LTA Guideline Calc.	µg/L			Hardness 37,000 - 450,000: calc.; Hardness > 450,000 is Capped Value of 450,000	2585	2585	2585	2585	931	1437	2585	2585	2585	2585	2585	801	1410	2585	2585	2585	2409
Mercury (Based on methyl Hg & total mass Hg)	µg/L	0.005	NG	Calc.	0.0151	0.0152	0.005	0.0063	<0.005	0.014	0.0069	0.0139	0.011	0.0151	0.005	0.0066	0.0052	0.0067	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05-0.10	2000	≤ 1000	1.77	1.41	0.919	<1.0	1.08	1.54	2.94	2.04	2.62	1.87	2.06	0.599	0.766	1.27	1.19	0.78	0.949
Nickel	µg/L	0.5	NG	NG	128	72.6	85.7	2270	15.2	6.52	3.71	5.33	3.56	5.72	439	1.72	4.38	4.78	4.77	129	4.61
Phosphorus	µg/L	50-500	NG	NG	216	119	50	<1000	508	137	<50	<92	<50	78	250	502	109	<61	<50	<100	<85
Potassium	µg/L	50.0	NG	NG	6440	6320	5250	10200	9060	8440	8970	9300	8560	8590	5970	9540	9390	11800	13200	3150	11200
Rubidium	µg/L	0.2	NG	NG	4.15	3.42	0.75	5	7.8	2.2	0.74	1.26	0.49	1.27	2.3	2.5	3.51	1.75	1.21	2.41	1.77
Selenium	µg/L	0.05	NG	2.0	4.19	2.01	7.42	<1.0	0.486	0.531	0.732	0.735	0.769	0.661	0.47	0.094	0.327	1.13	0.739	0.11	0.366
Silicon	µg/L	100.0	NG	NG	9370	6730	6740	7700	7860	4080	3870	4310	3630	4300	7340	1900	4780	3260	4550	5090	3900
Silver [3] (Based on Hardness < or > 100000)	µg/L	0.01-0.02	0.10 - 3.0	0.05 - 1.5	0.036	0.025	0.01	0.1	0.093	0.03	0.005	0.019	0.005	0.01	0.05	0.005	0.012	0.016	0.005	0.01	0.005
Ag STM Guideline Calc	µg/L		Hardness ≤ 100,000 Ag = 0.10 Hardness > 100,000 Ag = 3.0		3.0	3.0	3.0	3.0	0.10	3.0	3.0	3.0	3.0	3.0	3.0	0.10	3.0	3.0	3.0	3.0	3.0
Ag LTA Guideline Calc	µg/L			Hardness ≤ 100,000 Ag = 0.05 Hardness > 100,000 Ag = 1.5	1.5	1.5	1.5	1.5	0.05	1.5	1.5	1.5	1.5	1.5	1.5	0.05	1.5	1.5	1.5	1.5	1.5

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Appendix B3: L3 Creek and L4 Creek Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG-FLT [2]	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18
					24-Sep-19	30-Oct-19	22-Nov-19	22-Mar-19	18-Apr-19	23-May-19	19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19
Physical Parameters															
Temperature	°C				7.3	0.0	0.0	0.0	3.7	11.1	13.0	11.4	8.4	0.7	0.6
Flow Rate	L/sec				0.25	0.40	3.00	-	3.00	0.25	2.00	5.00	0.20	0.40	4.00
Electrical Conductivity (EC)	µS/cm	2.0	NG	NG	1940	1440	1560	209	741	1530	905	819	2140	1550	1010
Hardness as $CaCO_3$	µg/L	500	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn, F)	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn, F)	1010000	648000	755000	91800	297000	718000	367000	355000	875000	612000	397000
pH	pH Units	0.10	6.5 - 9.0	6.5-9.0	8.30	8.14	8.31	7.94	7.93	6.85	8.32	8.30	**3.97**	**6.31**	8.08
Total Dissolved Solids (TDS)	µg/L	10000	NG	NG	1680000	1050000	1180000	227000	543000	1300000	716000	659000	1900000	1190000	652000
Total Suspended Solids (TSS)	µg/L	3000	NG	NG	1500	1500	6000	1240000	761000	158000	1310000	305000	3100	57000	105000
Anions and Nutrients															
Acidity (Total as $CaCO_3$)	µg/L	1000	NG	NG	<2000	3100	<2000	2100	3300	13300	<1000	<1000	179000	15100	<2000
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	NG	NG	255000	308000	206000	63700	94500	30400	155000	151000	<1000	13700	115000
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	NG	NG	4600	<1000	6800	<1000	<1000	<1000	1600	2200	<1000	<1000	<1000
Alkalinity (Hydroxide) as $CaCO_3$	µg/L	1000	NG	NG	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	NG	NG	260	308	213	63.7	94.5	30.4	157	153	<1	13.7	115
Ammonia (NH_4 as N)	µg/L	5.0	pH dependent (6.5-9.0)	pH dependent (6.5-9.0)	9.5	15.6	838	21.1	47.1	139	28.4	25.7	200	126	48.8
Ammonia FST Guideline	µg/L		pH dependent (at Temp 4 °C or in situ T)		3150	6220	3150	7420	7420	23300	3150	3150	-	-	4950
Ammonia FLT Guideline	µg/L			pH dependent (at Temp 4 C or in situ T)	606	952	606	1430	1430	1970	606	606	-	-	952
Chloride (Cl^-)	µg/L	500	600000	150,000	98700	115000	93800	14800	49400	46900	72800	51300	54600	55300	72200
Nitrate (NO_3^- as N)	µg/L	5.0-100	NG	NG	42	221	2390	284	39.4	48	12.5	2.5	50	31	12.5
Nitrite (NO_2^- as N)	µg/L	1.0-20.0	Cl-dependent (> 10,000 µg/L) Guideline: 600 ug/L	Cl-dependent (> 10,000 µg/L) Guideline: 200 ug/L	2.5	2.5	27.2	6.5	0.5	5.0	2.5	0.5	5.0	2.5	2.5
Sulphate (SO_4) [3]	µg/L	300	NG	309,000 - 429,000	815000	371000	538000	17300	201000	753000	225000	202000	1300000	763000	303000
SO_4 LTA Guideline Calc (Based on Hardness as CaCO3)	µg/L		NG	Hardness 0-30,000 = 128,000; Hardness 31,000-75,000 = 218,000; Hardness 76,000-180,000 = 309,000 Hardness 181,000-250,000 = 429,000; Hardness > 250,000 site-specific	429000	429000	429000	309000	429000	429000	429000	429000	429000	429000	429000
Total Dissolved Carbon (DOC)	mg/L				12.40	18.70	14.90	-	-	-	-	-	5.14	4.06	-
Metals, Total															
Aluminum	µg/L	3.00	NG	NG	33.6	139	401	7130	10300	20100	23800	5070	28800	10800	7860
Antimony	µg/L	0.1-1.0	NG	NG	0.17	0.18	0.18	0.43	0.6	0.31	0.93	0.39	<0.1	0.11	0.42
Arsenic	µg/L	0.10	5.0	5.0	0.56	0.81	0.83	**6.00**	**9.75**	2.83	**15.5**	3.64	1.69	1.03	4.17
Barium	µg/L	0.10	NG	NG	143	102	110	251	342	91.5	529	156	23.5	51.5	163
Beryllium	µg/L	0.1-1.0	NG	NG	<0.1	<0.1	<0.1	0.44	0.79	2.84	1.23	0.41	4.7	1.61	0.75
Bismuth	µg/L	0.05-0.10	NG	NG	<0.05	<0.05	<0.05	0.122	0.163	<0.05	0.34	0.056	<0.05	<0.05	0.065
Boron	µg/L	10.0	1200	1200	130	74	107	32	41	86	66	46	175	101	54
Cadmium	µg/L	0.005	NG	NG	0.0494	0.0441	0.09	0.519	1.27	3.75	1.89	0.549	4.52	2.14	1.01
Calcium	µg/L	50	NG	NG	267000	165000	184000	28100	79100	154000	132000	81300	200000	154000	106000
Cesium	µg/L	0.01-0.02	NG	NG	<0.01	0.013	0.039	1.25	1.92	0.378	3.03	0.647	0.049	0.069	0.83
Chromium [4]	µg/L	0.10	NG	NG	0.26	0.48	0.86	12.8	16.9	5.73	43.6	7.1	1.16	1.8	9.33
Cobalt	µg/L	0.10	110.0	4.0	0.21	0.27	0.59	6.5	19.1	64	27.4	9.51	**125**	55.2	19.5
Copper [3]	µg/L	0.5-1.0	Calc. based on Hardness	2 to 10	1.36	1.44	1.99	**20.0**	29.20	20.90	**60.6**	11.40	22.50	9.09	15.10
Cu STM Guideline Calc. (relevant prior to Aug. 2019)	µg/L		Hardness 13,000 - 400,000 : calc.; Hardness ≥ 400,000 is Capped Value of 400,000		39.60	39.60	39.60	10.63	29.92	39.60	36.50	35.37	39.60	39.60	39.32
Cu LTA Guideline Calc. (relevant prior to Aug. 2019)	µg/L			Hardness 50,000 - 250,000: calc.; Hardness > 250,000, Cu = 10	10.00	10.00	10.00	3.67	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Iron	µg/L	10	1000	NG	44	128	326	**14600**	**24400**	**6610**	**44400**	**7740**	**3430**	**3650**	**10300**
Lead [3]	µg/L	0.05-0.1	Calc. based on Hardness	Calc. based on Hardness	<0.05	0.063	0.144	8.42	11.0	1.71	20	3.43	0.089	0.328	4.25
Pb STM Guideline Calc.	µg/L		Hardness ≤ 8000 is 3; Hardness 8000-360,000: calc. Hardness>360,000 is Capped Value of 360,000		417	417	417	73	326	417	417	410	417	417	417
Pb LTA Guideline Calc.	µg/L			Hardness 8000-360,000: calc. Hardness > 360,000 is Capped Value of 360,000	19.6	19.6	19.6	6.2	16	20	20	19.3	19.6	19.6	19.6
Lithium	µg/L	1.0	NG	NG	23.1	13.2	17.2	11.7	31.6	103	55.1	22.4	158	81.7	39.6
Magnesium	µg/L	5.0	NG	NG	92900	65900	74300	10600	29600	57600	45200	31400	92300	69400	41600
Manganese [3]	µg/L	0.10	Calc. based on Hardness	Calc. based on Hardness	24.5	25.7	88.7	212	705	2280	995	416	**4900**	2630	874
Mn STM Guideline Calc.	µg/L		Hardness 25,000 - 259,000 : calc.; Hardness > 259,000 is Capped Value of 259,000		3394	3394	3394	1552	3394	3394	3394	3394	3394	3394	3394
Mn LTA Guideline Calc.	µg/L			Hardness 37,000 - 450,000: calc.; Hardness > 450,000 is Capped Value of 450,000	2585	2585	2585	1009	1912	2585	2220	2167	2585	2585	2352
Mercury (Based on methyl Hg & total mass Hg)	µg/L	0.005	NG	Calc.	<0.005	<0.005	0.0054	0.05	0.051	0.011	0.1	0.02	<0.005	<0.005	0.0219
Molybdenum	µg/L	0.05-0.10	2000	≤ 1000	1.04	0.746	0.73	1.17	2.94	0.729	3.32	1.34	0.093	0.438	1.28
Nickel	µg/L	0.5	NG	NG	5.11	5.41	6.26	23.3	66.1	213	101	35.6	404	174	63.9
Phosphorus	µg/L	50-500	NG	NG	<50	51	81	655	664	140	1030	247	<50	<50	304
Potassium	µg/L	50.0	NG	NG	14600	12300	14900	9340	7970	7030	9140	7060	5600	5450	6910
Rubidium	µg/L	0.2	NG	NG	1.49	1.15	3.69	11.4	17.5	5.65	25.9	6.79	4.99	2.78	8.13
Selenium	µg/L	0.05	NG	2.0	0.243	0.363	0.311	0.704	1.33	1.12	2.15	0.635	0.528	0.627	1.09
Silicon	µg/L	100.0	NG	NG	3420	3730	4530	12400	14600	9140	38600	10100	11000	8120	11900
Silver [3] (Based on Hardness < or > 100000)	µg/L	0.01-0.02	0.10 - 3.0	0.05 - 1.5	0.005	0.005	0.005	**0.155**	0.205	0.041	0.339	0.059	0.005	0.005	0.073
Ag STM Guideline Calc	µg/L		Hardness ≤ 100,000 Ag = 0.10 Hardness > 100,000 Ag = 3.0		3.0	3.0	3.0	0.10	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Ag LTA Guideline Calc	µg/L			Hardness ≤ 100,000 Ag = 0.05 Hardness > 100,000 Ag = 1.5	1.5	1.5	1.5	0.05	1.5	1.5	1.5	1.5	1.5	1.5	1.5

Appendix B3: L3 Creek and L4 Creek Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG-FLT [2]	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-0.02	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43
					22-Mar-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19	22-Mar-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19	24-Sep-19
Sodium	µg/L	50.0	NG	NG	10000	16300	58300	64100	47800	32400	56600	62600	52600	7360	19100	47800	36700	41900	27800	42400
Strontium	µg/L	0.2	NG	NG	222	296	767	832	661	1610	856	757	583	85.1	267	715	728	534	1940	795
Sulfur	µg/L	500.0	NG	NG	21500	56400	337000	369000	184000	94200	298000	296000	199000	9260	59700	309000	262000	118000	74000	258000
Tellurium	µg/L	0.2-2.0	NG	NG	<0.4	<0.2	0.21	0.22	0.4	0.32	<0.2	0.24	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	0.42	<0.2
Thallium	µg/L	0.01-0.02	NG	NG	0.437	0.138	0.027	0.022	0.252	0.061	0.022	0.025	0.022	0.082	0.1	0.027	0.013	0.241	0.032	0.023
Thorium	µg/L	0.1-1.0	NG	NG	4.43	1.26	0.12	<0.1	3.76	0.56	<0.1	0.17	0.18	0.72	1.18	0.13	<0.1	3.59	0.24	<0.1
Tin	µg/L	0.1-1.0	NG	NG	<0.2	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	0.17	0.19	<0.1	<0.1	<0.1	<0.1	0.34	<0.1	0.24
Titanium	µg/L	0.3-6.3	NG	NG	114	51	4.2	0.6	129	39.1	1.37	14.4	11.4	45.4	49.8	1.5	<0.3	163	19.5	0.64
Tungsten	µg/L	0.1-1.0	NG	NG	<0.2	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
Uranium	µg/L	0.01	NG	NG	2.13	2.06	5.03	5.97	4.71	2.83	5.28	4.84	3.42	0.56	2.03	4.19	5.06	3.87	2.51	4.72
Vanadium	µg/L	0.5-1.0	NG	NG	56.3	13.1	0.87	<0.5	42.5	8.79	<0.5	1.96	2.4	12.5	10.8	<0.5	<0.5	41.6	3.66	<0.5
Zinc [3]	µg/L	3.0	Calc. based on Hardness	Calc. based on Hardness	**185**	58.3	60.4	49.1	233	41.2	37.9	60.9	50.7	**43.3**	65.9	233	32.2	193	25	141
Zn STM Guideline Calc.	µg/L		Hardness 90,000 - 500,000, Calc. Hardness > 500,000, is Capped Value of 500,000		48.75	178.50	340.50	340.50	340.50	340.50	340.50	340.50	340.50	33.0	189.00	340.50	340.50	340.50	340.50	340.50
Zn LTA Guideline Calc.	µg/L			Hardness 90,000 - 330,000, Calc. Hardness > 330,000, is Capped Value of 330,000	23.3	153.0	187.5	187.5	187.5	187.5	187.5	187.5	187.5	7.5	163.5	187.5	187.5	187.5	187.5	187.5
Zircronium	µg/L	0.06-0.28	NG	NG	0.25	0.383	0.18	<0.2	0.49	<0.4	<0.2	<0.37	<0.28	0.23	0.398	0.136	<0.2	0.71	<0.33	<0.2
Metals, Dissolved																				
Aluminum [5]	µg/L	1.0	100.0	50.0	40.1	**103**	**210**	**163**	**180**	**124**	**129**	**134**	**168**	75.7	74.0	88.4	11.0	**120**	63.4	41.8
Al STM Guideline Calc.	µg/L		pH < 6.5 : calc. Al pH ≥ 6.5 : 100.0 Al		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Al LTA Guideline Calc.	µg/L			median pH < 6.5 : calc. Al median pH ≥ 6.5 : 50.0 Al	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Antimony	µg/L	0.1-2.0	NG	NG	0.12	0.14	0.22	0.18	0.22	0.25	0.13	0.14	0.27	<0.1	0.16	0.15	0.13	0.21	0.3	0.13
Arsenic	µg/L	0.1-2.0	NG	NG	0.81	1.05	0.21	0.25	0.35	0.44	0.22	0.27	0.23	0.6	0.75	0.18	0.19	0.41	0.38	0.2
Barium	µg/L	0.10	NG	NG	46.9	63.9	59.4	52.7	75.9	141	57.2	61.7	58.7	35.5	73.9	60.7	47.4	75.8	171	62.6
Beryllium	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Bismuth	µg/L	0.05-1.0	NG	NG	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Boron	µg/L	10.0	NG	NG	26	42	94	121	88	69	110	85	69	23	41	82	94	72	64	94
Cadmium [3]	µg/L	0.005	Calc. based on Hardness	Calc. based on hardness	0.0612	0.0993	0.493	0.300	0.243	0.134	0.359	0.331	0.321	0.074	0.180	1.51	0.208	0.334	0.109	0.357
Cd STM Guideline Calc.	µg/L		Hardness 7,000 - 455,000, Calc. Hardness > 455,000, is Capped Value of 455,000		0.655	1.724	2.801	2.801	2.801	2.801	2.801	2.801	2.801	0.427	1.811	2.801	2.801	2.801	2.801	2.801
Cd LTA Guideline Calc.	µg/L			Hardness 3,400 - 285,000, Calc. Hardness > 285,000, is Capped Value of 285,000	0.228	0.456	0.457	0.457	0.457	0.457	0.457	0.457	0.457	0.168	0.457	0.457	0.457	0.457	0.457	0.457
Calcium	µg/L	50.0	NG	NG	30400	71500	276000	300000	174000	183000	264000	221000	177000	19500	74000	240000	240000	138000	179000	232000
Cesium	µg/L	0.01-0.2	NG	NG	<0.01	<0.01	0.013	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	µg/L	0.1-2.0	NG	NG	0.17	0.12	<0.1	<0.1	0.13	0.44	<0.1	<0.1	<0.1	0.19	0.14	0.12	0.23	0.15	0.62	0.13
Cobalt	µg/L	0.10	NG	NG	0.48	2.62	14.7	4.26	9.5	3.48	10.4	16.1	13.3	0.44	8.01	64.5	32	11.4	5.17	54.7
Copper [6]	µg/L	0.2-4.0	Calc. based on BLM Model	Calc. based on BLM Model	3.34	1.33	1.52	1.46	1.7	1.62	1.08	1.39	1.89	2.21	1.48	1.27	0.53	1.87	1.49	0.6
Cu STM (Acute) Guideline Value	µg/L		BLM Ligand Model value		-	-	-	-	-	-	23.4	37	49.2	-	-	-	-	-	-	28.3
Cu LTA (Chronic) Guideline Value	µg/L			BLM Ligand Model value	-	-	-	-	-	-	4.6	6.9	9.1	-	-	-	-	-	-	5.6
Iron	µg/L	10.0	350	NG	138	87	5.0	16	11	5.0	15	23	44	161	63	61	5.0	16	24	33
Lead	µg/L	0.05-1.0	NG	NG	0.119	0.059	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.138	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lithium	µg/L	1.0	NG	NG	3.3	11.2	50.3	52.9	39.2	23.4	52.7	43.5	33.1	2	13.6	68.7	50.7	29.1	21.5	60
Magnesium	µg/L	5.0	NG	NG	8650	25600	89400	92100	59200	45600	83700	76400	63800	5960	27600	83700	91700	45500	41700	84500
Manganese	µg/L	0.10	NG	NG	37.7	258	1130	211	973	341	890	1340	1130	31.1	724	4670	3240	1770	436	4580
Mercury	µg/L	0.005-0.1	NG	NG	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05-1.0	NG	NG	1.56	1.15	1.5	1.67	2.02	2.56	1.18	1.35	1.12	0.76	1.22	0.801	0.845	1.83	2.92	0.868
Nickel	µg/L	0.50	NG	NG	3.68	11	49.1	26.6	32.2	12.1	38	43.8	36.8	3.54	22.4	162	80.1	32.7	12.9	120
Phosphorus	µg/L	50-1000	NG	NG	144	<50	<50	<50	<50	<50	<50	<50	<50	269	<50	<50	<50	<50	<50	<50
Potassium	µg/L	50.0	NG	NG	7720	9550	7170	7140	6100	9740	5990	5470	5860	8340	8600	6250	5480	7160	10600	5590
Rubidium	µg/L	0.20	NG	NG	1.12	1.54	1.81	1.74	1.26	1.26	1.51	1.14	0.98	1.32	1.19	1.57	0.8	1.14	1.67	1.26
Selenium	µg/L	0.05-1.0	NG	2.0	0.676	0.78	3.3	3.88	2.92	1.5	4.01	3.86	2.66	0.234	1.46	4.55	8.41	2.13	1.24	5.75
Silicon	µg/L	50.0	NG	NG	1470	2360	3730	3710	4250	3050	4860	4250	4140	1460	2900	5670	5490	3900	2780	5600
Silver	µg/L	0.01-0.2	NG	NG	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	µg/L	50.0	NG	NG	8880	15200	60200	63400	47900	32200	55600	54500	49000	6950	17300	50300	36400	48000	27000	41400
Strontium	µg/L	0.20	NG	NG	100	247	874	821	584	1770	815	740	565	68.9	265	757	711	456	2280	761
Sulfur	µg/L	500	NG	NG	17100	49600	310000	278000	209000	92000	280000	247000	195000	7700	55300	285000	247000	128000	63100	246000
Tellurium	µg/L	0.2-4.0	NG	NG	<0.2	<0.2	<0.2	<0.2	<0.2	0.25	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.29	<0.2
Thallium	µg/L	0.01-0.2	NG	NG	0.011	<0.01	0.023	0.022	0.016	0.011	0.019	0.013	0.014	<0.01	<0.01	0.023	0.013	0.014	0.013	0.022
Thorium	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Tin	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Titanium	µg/L	0.3-6.0	NG	NG	5.06	1.21	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	5.8	1.2	<0.3	<0.3	1.42	<0.3	<0.3
Tungsten	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	0.01	NG	NG	0.684	1.38	4.89	6.02	3.96	2.87	4.85	4.64	3.41	0.278	1.8	3.39	5.02	3.28	2.49	4.04
Vanadium	µg/L	0.5-10	NG	NG	0.68	0.55	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.65	<0.5	<0.5	<0.5	0.52	<0.5	<0.5
Zinc	µg/L	1.00	NG	NG	1.5	7.7	38.8	31.3	9.7	6.1	27.8	32.3	27.3	3.2	12.9	103	28.1	4.8	8.2	79.2
Zirconium	µg/L	0.06-1.2	NG	NG	0.442	0.189	<0.06	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.512	0.199	0.06	0.2	<0.2	<0.2	<0.2
Laboratory Work Order Number					L2248301	L2260583	L2278405	L2295954	L2313718	L2332423	L2353312	L2374685	L2386755	L2248301	L2260583	L2278405	L2295954	L2313718	L2332423	L2353312
Laboratory Identification Number					L2248301-1	L2260583-1	L2278405-1	L2295954-9	L2313718-4	L2332423-4	L2353312-9	L2374685-1	L2386755-6	L2248301-2	L2260583-2	L2278405-2	L2295954-10	L2313718-3	L2332423-3	L2353312-10

TETRA TECH

Appendix B3: L3 Creek and L4 Creek Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG-FLT [2]	LBL3C-1.43	LBL3C-1.43	LBL3C-1.43	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-1.65	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32
					30-Oct-19	22-Nov-19	19-Dec-19	23-Jan-19	22-Mar-19	18-Apr-19	19-Jul-19	20-Aug-19	30-Oct-19	22-Nov-19	19-Dec-19	22-Mar-19	18-Apr-19	23-May-19	20-Jun-19	19-Jul-19	20-Aug-19
Sodium	µg/L	50.0	NG	NG	53200	45000	42600	153000	8410	13700	35000	42200	54100	45500	59500	4440	16800	40600	80000	176000	52400
Strontium	µg/L	0.2	NG	NG	699	484	846	1260	89.8	189	462	402	528	459	744	42.5	182	583	797	1040	466
Sulfur	µg/L	500.0	NG	NG	266000	147000	314000	885000	7030	26900	110000	80100	129000	107000	401000	4470	22900	109000	214000	465000	85200
Tellurium	µg/L	0.2-2.0	NG	NG	0.29	<0.2	0.43	<4.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1	<0.2	<0.2	<0.2	<0.2	<0.4	<0.2
Thallium	µg/L	0.01-0.02	NG	NG	0.066	0.043	0.016	<0.2	0.086	0.026	0.011	0.021	<0.01	0.015	0.055	<0.01	0.017	0.014	<0.01	0.033	<0.01
Thorium	µg/L	0.1-1.0	NG	NG	0.74	0.54	0.1	<2.0	0.79	0.41	<0.1	0.19	<0.1	0.25	0.5	<0.1	0.21	0.12	<0.1	<0.2	<0.1
Tin	µg/L	0.1-1.0	NG	NG	0.18	<0.1	0.1	<2.0	<0.1	<0.1	<0.1	0.13	<0.1	0.2	0.5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1
Titanium	µg/L	0.3-6.3	NG	NG	50.6	35.5	0.3	<6.0	54.9	26.7	6	15.9	5.99	18.7	1.5	5.16	64.6	6.29	3	2.5	8.39
Tungsten	µg/L	0.1-1.0	NG	NG	<0.1	<0.1	0.1	<2.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1
Uranium	µg/L	0.01	NG	NG	4.8	3.16	5.81	2.16	0.461	2	6.73	3.48	6.31	4.43	1.99	0.124	0.907	6.43	8.69	4.94	1.67
Vanadium	µg/L	0.5-1.0	NG	NG	8.36	6.33	0.5	<10	15	4.48	1.27	3.05	0.71	3.26	2.5	1.28	5.64	1.61	0.75	<1.0	1.57
Zinc [3]	µg/L	3.0	Calc. based on Hardness	Calc. based on Hardness	162	103	70	**2380**	**48.7**	14.5	1.50	9.7	1.50	9.0	**457**	11.6	9.0	4.9	1.50	63.9	10.3
Zn STM Guideline Calc.	µg/L		Hardness 90,000 - 500,000, Calc. Hardness > 500,000, is Capped Value of 500,000		340.50	340.50	340.50	340.50	33.00	107.25	340.50	309.75	340.50	340.50	340.50	33.00	102.75	340.50	340.50	340.50	273.00
Zn LTA Guideline Calc.	µg/L			Hardness 90,000 - 330,000, Calc. Hardness > 330,000, is Capped Value of 330,000	187.5	187.5	187.5	187.5	7.5	81.8	187.5	187.5	187.5	187.5	187.5	7.5	77.3	187.5	187.5	187.5	187.5
Zircronium	µg/L	0.06-0.28	NG	NG	0.75	0.49	<0.2	<1.2	0.271	0.42	<0.24	<0.36	<0.22	0.5	<1.0	0.215	1.8	0.513	0.36	<0.4	0.8
Metals, Dissolved																					
Aluminum [5]	µg/L	1.0	100.0	50.0	53.1	**101**	22.4	**1350**	**103**	12.0	2.1	11.8	2.6	7.9	**608**	39.9	25.7	3.3	1.9	1.0	27
Al STM Guideline Calc.	µg/L		pH < 6.5 : calc. Al pH ≥ 6.5 : 100.0 Al		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Al LTA Guideline Calc.	µg/L			median pH < 6.5 : calc. Al median pH ≥ 6.5 : 50.0 Al	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Antimony	µg/L	0.1-2.0	NG	NG	0.17	0.15	0.12	<2.0	<0.1	0.2	0.35	0.27	0.25	0.21	0.5	<0.1	0.17	0.32	0.22	<0.2	0.29
Arsenic	µg/L	0.1-2.0	NG	NG	0.29	0.28	0.21	1.0	0.6	0.6	0.46	0.68	0.53	0.5	0.5	0.39	0.66	0.48	0.53	0.23	0.97
Barium	µg/L	0.10	NG	NG	84.6	71.7	40.2	20	33.1	69.5	100	103	92.3	81.2	35.8	24.1	60.2	115	151	26.9	93.3
Beryllium	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	0.1	<2.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1
Bismuth	µg/L	0.05-1.0	NG	NG	<0.05	<0.05	0.05	<1.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.25	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05
Boron	µg/L	10.0	NG	NG	83	55	121	<200	25	37	78	68	50	48	109	25	36	62	72	326	70
Cadmium [3]	µg/L	0.005	Calc. based on Hardness	Calc. based on hardness	0.694	0.543	0.612	**6.06**	0.0715	0.021	0.0459	0.0785	0.0486	0.0501	**3.43**	0.0192	0.0278	0.0372	0.0526	0.952	0.0252
Cd STM Guideline Calc.	µg/L		Hardness 7,000 - 455,000, Calc. Hardness > 455,000, is Capped Value of 455,000		2.801	2.801	2.801	2.801	0.433	1.133	2.801	2.801	2.801	2.801	2.801	0.255	1.096	2.801	2.801	2.801	2.801
Cd LTA Guideline Calc.	µg/L			Hardness 3,400 - 285,000, Calc. Hardness > 285,000, is Capped Value of 285,000	0.457	0.457	0.457	0.457	0.170	0.338	0.457	0.457	0.457	0.457	0.457	0.117	0.330	0.457	0.457	0.457	0.457
Calcium	µg/L	50.0	NG	NG	212000	138000	266000	533000	19400	46800	133000	120000	136000	122000	342000	10900	46800	155000	222000	418000	105000
Cesium	µg/L	0.01-0.2	NG	NG	<0.01	<0.01	0.01	<0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01
Chromium	µg/L	0.1-2.0	NG	NG	0.13	0.13	0.21	<2.0	0.19	0.12	0.27	0.23	0.23	0.27	0.5	0.12	0.24	<0.1	0.12	<0.2	0.25
Cobalt	µg/L	0.10	NG	NG	51.3	29.8	34	1240	0.53	0.23	0.05	0.11	<0.1	0.12	194	0.05	0.14	0.13	0.25	0.64	0.17
Copper [6]	µg/L	0.2-4.0	Calc. based on BLM Model	Calc. based on BLM Model	1.09	2.02	0.8	2.0	2.47	2.55	2.82	2.83	2.03	2.4	2.6	1.65	2.59	2.19	1.75	0.42	1.54
Cu STM (Acute) Guideline Value	µg/L		BLM Ligand Model value		26.9	49.5	23.3	-	-	-	-	-	87.8	96.1	15.5	-	-	-	-	-	-
Cu LTA (Chronic) Guideline Value	µg/L			BLM Ligand Model value	4.8	8.7	3.3	-	-	-	-	-	15.0	16.9	1.4	-	-	-	-	-	-
Iron	µg/L	10.0	350	NG	**723**	**624**	54	**1820**	162	61	5.0	27	5.0	16	**670**	82	125	19	44	10	78
Lead	µg/L	0.05-1.0	NG	NG	<0.05	<0.05	0.05	<1.0	0.2	0.052	<0.05	<0.05	<0.05	<0.05	0.25	<0.05	0.073	<0.05	<0.05	<0.1	<0.05
Lithium	µg/L	1.0	NG	NG	47.5	27.7	60.6	146	2.2	3.9	7.2	7.5	6.7	6.4	89.1	1.1	4.3	15	20.9	164	8.2
Magnesium	µg/L	5.0	NG	NG	76400	54200	100000	264000	6240	17500	44200	39000	50900	47500	110000	4200	16000	49700	72600	126000	36000
Manganese	µg/L	0.10	NG	NG	3780	2150	3300	83200	23.9	61	0.58	0.67	0.24	0.64	19000	1.05	3.59	15.8	44.8	4250	7.07
Mercury	µg/L	0.005-0.1	NG	NG	<0.005	<0.005	0.005	0.006	<0.005	0.0072	0.0051	0.0085	0.0089	0.0096	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05-1.0	NG	NG	1.37	1.14	0.81	<1.0	0.713	1.44	2.96	2.07	2.45	1.71	0.55	0.562	0.718	1.24	1.06	0.96	0.795
Nickel	µg/L	0.50	NG	NG	108	65.9	86.2	2140	3.25	2.75	3.34	3.28	2.99	2.87	445	1.14	3.42	3.77	4.23	121	3.89
Phosphorus	µg/L	50-1000	NG	NG	<50	<50	50	<1000	199	<50	<50	<50	<50	<50	250	419	57	<50	<50	<100	67
Potassium	µg/L	50.0	NG	NG	5800	6120	5130	9300	8460	8560	10100	9250	8270	8590	5960	9300	10400	12900	13300	3460	10300
Rubidium	µg/L	0.20	NG	NG	1.13	0.88	0.86	4	1.2	0.87	0.45	0.39	0.31	0.28	2.2	2.3	1.07	1.14	1.04	2.3	1.26
Selenium	µg/L	0.05-1.0	NG	2.0	5.25	1.83	7.5	<1.0	0.215	0.468	0.907	0.718	0.817	0.706	0.5	0.051	0.294	1.17	0.892	0.17	0.229
Silicon	µg/L	50.0	NG	NG	5060	4130	6560	7200	1590	2450	3690	3320	2720	3150	7300	1290	2470	2660	4200	5070	3150
Silver	µg/L	0.01-0.2	NG	NG	<0.01	<0.01	0.01	<0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01
Sodium	µg/L	50.0	NG	NG	47800	42300	38700	143000	9640	13600	39000	43400	48800	42400	58700	4290	17400	42500	73400	193000	47800
Strontium	µg/L	0.20	NG	NG	676	470	801	1260	68.9	178	453	440	497	445	738	40.4	172	589	813	1160	425
Sulfur	µg/L	500	NG	NG	234000	148000	281000	857000	6800	25300	113000	81100	112000	108000	408000	3860	22400	105000	179000	510000	78100
Tellurium	µg/L	0.2-4.0	NG	NG	<0.2	<0.2	0.2	<4.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1	<0.2	<0.2	<0.2	<0.2	<0.4	<0.2
Thallium	µg/L	0.01-0.2	NG	NG	0.019	0.012	0.017	<0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.053	<0.01	<0.01	<0.01	<0.01	0.029	<0.01
Thorium	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	0.1	<2.0	0.11	<0.1	<0.1	0.2	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1
Tin	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	0.1	<2.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1
Titanium	µg/L	0.3-6.0	NG	NG	<0.3	<0.3	0.3	<6.0	4.52	1.93	<0.3	1.8	<0.3	0.91	1.5	2.76	3.54	<0.3	<0.3	<0.6	3.95
Tungsten	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	0.1	<2.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.2	<0.1
Uranium	µg/L	0.01	NG	NG	4.25	2.97	5.97	2.11	0.231	1.69	6.95	3.68	5.96	4.23	1.84	0.103	0.864	5.9	8.67	5.32	1.46
Vanadium	µg/L	0.5-10	NG	NG	<0.5	<0.5	0.5	<10.0	0.62	<0.5	<0.5	<0.5	<0.5	<0.5	2.5	<0.5	0.57	<0.5	<0.5	<1.0	<0.5
Zinc	µg/L	1.00	NG	NG	96.8	62.6	82.4	2220	2.6	4.0	0.5	1.7	0.5	1.5	487	7.1	5.1	1.3	1.5	39.2	5.8
Zirconium	µg/L	0.06-1.2	NG	NG	<0.2	<0.2	<0.2	<1.2	0.54	0.399	<0.2	<0.21	<0.2	<0.2	<1.0	0.257	0.473	0.275	0.3	<0.4	0.54
Laboratory Work Order Number					L2374685	L2386755	L2398938	L2224203	L2248302	L2260583	L2313718	L2332423	L2374685	L2386755	L2398938	L2248301	L2260583	L2278405	L2295954	L2313718	L2332423
Laboratory Identification Number					L2374685-2	L2386755-7	L2398938-5	L2224203-1	L2248302-2	L2260583-3	L2313718-2	L2332423-2	L2374685-3	L2386755-8	L2398938-6	L2248301-3	L2260583-4	L2278405-3	L2295954-11	L2313718-1	L2332423-1

TETRA TECH

Appendix B3: L3 Creek and L4 Creek Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG-FLT [2]	LBL3C-3.32	LBL3C-3.32	LBL3C-3.32	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18	LBL4C-0.18
					24-Sep-19	30-Oct-19	22-Nov-19	22-Mar-19	18-Apr-19	23-May-19	19-Jul-19	20-Aug-19	24-Sep-19	30-Oct-19	22-Nov-19
Sodium	µg/L	50.0	NG	NG	72800	70800	64700	10300	38400	73500	54600	43800	136000	102000	58100
Strontium	µg/L	0.2	NG	NG	949	633	659	105	312	529	495	313	604	491	382
Sulfur	µg/L	500.0	NG	NG	299000	147000	209000	6960	80800	283000	78900	80400	470000	303000	113000
Tellurium	µg/L	0.2-2.0	NG	NG	0.22	0.21	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2	<0.2	<0.2
Thallium	µg/L	0.01-0.02	NG	NG	<0.01	<0.01	<0.01	0.157	0.292	0.074	0.402	0.077	0.071	0.031	0.102
Thorium	µg/L	0.1-1.0	NG	NG	<0.1	<0.1	<0.1	1.53	3.77	1.06	6.89	0.99	0.17	0.25	1.51
Tin	µg/L	0.1-1.0	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.13	<0.1	0.23
Titanium	µg/L	0.3-6.3	NG	NG	1.22	5.14	9.61	61.5	78.2	27.2	229	58.6	<0.3	10	77.5
Tungsten	µg/L	0.1-1.0	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1
Uranium	µg/L	0.01	NG	NG	3.66	3.29	2.51	0.778	2.26	3.88	3.31	1.28	3.5	1.72	1.71
Vanadium	µg/L	0.5-1.0	NG	NG	<0.5	0.64	1.44	23	28.7	5.51	72.6	13.9	<0.5	1.31	17.3
Zinc [3]	µg/L	3.0	Calc. based on Hardness	Calc. based on Hardness	1.50	5.7	39.7	**73**	169	**496**	**272**	71.9	**814**	309	128
Zn STM Guideline Calc.	µg/L		Hardness 90,000 - 500,000, Calc. Hardness > 500,000, is Capped Value of 500,000		340.50	340.50	340.50	34.35	188.25	340.50	240.75	231.75	340.50	340.50	263.25
Zn LTA Guideline Calc.	µg/L			Hardness 90,000 - 330,000, Calc. Hardness > 330,000, is Capped Value of 330,000	187.5	187.5	187.5	8.9	162.8	187.5	187.5	187.5	187.5	187.5	187.5
Zirconium	µg/L	0.06-0.28	NG	NG	<0.29	<0.33	0.49	0.298	0.422	0.44	0.81	0.58	<0.2	<0.23	0.54
Metals, Dissolved															
Aluminum [5]	µg/L	1.0	100.0	50.0	7.7	9.8	37.8	70.8	**149**	**181**	27.9	**404**	**27300**	**559**	**138**
Al STM Guideline Calc.	µg/L		pH < 6.5 : calc. Al pH ≥ 6.5 : 100.0 Al		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	20.2	68.6	100.0
Al LTA Guideline Calc.	µg/L			median pH < 6.5 : calc. Al median pH ≥ 6.5 : 50.0 Al	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	5.1	33.8	50.0
Antimony	µg/L	0.1-2.0	NG	NG	0.16	0.2	0.17	0.11	0.15	0.17	0.19	0.32	0.2	<0.1	0.11
Arsenic	µg/L	0.1-2.0	NG	NG	0.55	0.8	0.7	0.67	0.24	0.21	0.48	0.36	1.69	0.36	0.21
Barium	µg/L	0.10	NG	NG	145	103	110	60.3	40.7	41.9	60	66	24.3	43.1	45.6
Beryllium	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	0.19	<0.1	<0.1	4.92	0.29	<0.1
Bismuth	µg/L	0.05-1.0	NG	NG	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	<0.05	<0.05
Boron	µg/L	10.0	NG	NG	122	66	91	25	35	85	66	43	177	90	42
Cadmium [3]	µg/L	0.005	Calc. based on Hardness	Calc. based on hardness	0.0537	0.0381	0.0675	0.0932	0.391	**3.12**	0.173	0.201	**4.72**	1.96	0.508
Cd STM Guideline Calc.	µg/L		Hardness 7,000 - 455,000, Calc. Hardness > 455,000, is Capped Value of 455,000		2.801	2.801	2.801	0.539	1.805	2.801	2.245	2.169	2.801	2.801	2.434
Cd LTA Guideline Calc.	µg/L			Hardness 3,400 - 285,000, Calc. Hardness > 285,000, is Capped Value of 285,000	0.457	0.457	0.457	0.199	0.457	0.457	0.457	0.457	0.457	0.457	0.457
Calcium	µg/L	50.0	NG	NG	258000	164000	180000	25600	72600	171000	89000	89400	201000	149000	93600
Cesium	µg/L	0.01-0.2	NG	NG	<0.01	<0.01	<0.01	<0.01	<0.01	0.024	<0.01	<0.01	0.05	<0.01	<0.01
Chromium	µg/L	0.1-2.0	NG	NG	0.22	0.28	0.35	0.18	<0.1	<0.1	<0.1	<0.1	1.14	<0.1	<0.1
Cobalt	µg/L	0.10	NG	NG	0.19	0.21	0.49	0.19	9.86	62.9	0.53	5.71	123	51.9	14
Copper [6]	µg/L	0.2-4.0	Calc. based on BLM Model	Calc. based on BLM Model	1.22	1.35	1.64	2.55	2.77	4.9	2.64	2.28	**21.5**	**4.55**	2.76
Cu STM (Acute) Guideline Value	µg/L		BLM Ligand Model value		90.5	135.3	118.4	-	-	-	-	-	0.20	2.3	-
Cu LTA (Chronic) Guideline Value	µg/L			BLM Ligand Model value	17	21.3	20.9	-	-	-	-	-	0.20	0.3	-
Iron	µg/L	10.0	350	NG	18	33	63	148	37	**1290**	19	59	**3180**	**2230**	**381**
Lead	µg/L	0.05-1.0	NG	NG	<0.05	<0.05	<0.05	0.13	<0.05	<0.05	<0.05	<0.05	0.1	<0.05	<0.05
Lithium	µg/L	1.0	NG	NG	22.6	12.7	15.3	2.4	22.2	102	13.3	19.5	166	74.6	28.1
Magnesium	µg/L	5.0	NG	NG	88200	58300	74100	6760	28200	70700	35200	31900	90500	58400	39700
Manganese	µg/L	0.10	NG	NG	23.4	22.7	86.6	29.7	512	2480	239	338	4860	2220	746
Mercury	µg/L	0.005-0.1	NG	NG	<0.005	<0.005	<0.005	<0.005	0.0061	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05-1.0	NG	NG	0.954	0.722	0.683	0.735	0.868	0.473	1.59	1.05	0.1	0.344	0.629
Nickel	µg/L	0.50	NG	NG	4.87	4.95	5.58	3.06	35.3	210	4.54	22.8	401	161	46.9
Phosphorus	µg/L	50-1000	NG	NG	<50	<50	<50	116	<50	<50	<50	<50	<100	<50	<50
Potassium	µg/L	50.0	NG	NG	14100	11600	15300	8190	6440	7430	6410	6680	5260	5090	6420
Rubidium	µg/L	0.20	NG	NG	1.37	1.02	3.01	1.07	1.19	3.21	0.92	1.25	4.9	2.13	1.14
Selenium	µg/L	0.05-1.0	NG	2.0	0.307	0.364	0.309	0.266	0.615	0.774	1.24	0.423	0.44	0.47	0.883
Silicon	µg/L	50.0	NG	NG	3220	3130	4090	1710	2990	5240	3520	3820	10700	5670	3740
Silver	µg/L	0.01-0.2	NG	NG	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	<0.01
Sodium	µg/L	50.0	NG	NG	70100	65700	61800	9800	38400	84400	54700	46900	132000	89700	56100
Strontium	µg/L	0.20	NG	NG	906	598	632	85	242	535	368	356	611	453	338
Sulfur	µg/L	500	NG	NG	283000	130000	203000	5490	75400	278000	82700	80100	434000	271000	108000
Tellurium	µg/L	0.2-4.0	NG	NG	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2
Thallium	µg/L	0.01-0.2	NG	NG	<0.01	<0.01	<0.01	<0.01	<0.01	0.038	<0.01	0.014	0.081	0.024	<0.01
Thorium	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	<0.1	0.18	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
Tin	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	0.14
Titanium	µg/L	0.3-6.0	NG	NG	<0.3	0.6	3.43	4.34	1.13	<0.3	1.2	0.6	0.6	<0.3	<0.3
Tungsten	µg/L	0.1-2.0	NG	NG	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1	<0.1
Uranium	µg/L	0.01	NG	NG	3.58	3.16	2.6	0.146	1.32	0.428	2	1.17	3.51	0.322	1.28
Vanadium	µg/L	0.5-10	NG	NG	<0.5	<0.5	<0.5	0.76	<0.5	<0.5	0.53	<0.5	1	<0.5	<0.5
Zinc	µg/L	1.00	NG	NG	2.6	5.3	35.6	1.9	22.3	333	0.5	10.9	807	284	43.8
Zirconium	µg/L	0.06-1.2	NG	NG	<0.22	<0.27	<0.38	0.536	0.159	0.06	<0.2	<0.2	<0.4	<0.2	<0.2
Laboratory Work Order Number					L2353312	L2374685	L2386755	L2248301	L2260583	L2278405	L2313718	L2332423	L2353312	L2374685	L2386755
Laboratory Identification Number					L2353312-11	L2374685-4	L2386755-9	L2248301-4	L2260583-5	L2278405-4	L2313718-5	L2332423-5	L2353312-12	L2374685-5	L2386755-10

Notes:

Screening completed on BC AWQG-FWAL STM [1] and LTA [2] guideline values.

[1] BC Ministry of Environment, Water Protection & Sustainability Branch (2018). British Columbia Approved Water Quality Guidelines (BCAWQG) & Agriculture Summary Report. 36 pp. Referenced for Freshwater Aquatic Life (FWAL) water use and Short Term Maximum (STM) guidelines.

[2] BC Ministry of Environment, Water Protection & Sustainability Branch. 2018. British Columbia Approved Water Quality Guidelines (BCAWQG): Agriculture Summary Report. 36 pp. Referenced for Freshwater Aquatic Life (FWAL) water use and Long Term Average (LTA) guidelines.

[3] Guideline is hardness dependant. Where results are above laboratory reportable detection limits, guideline limits have been evaluated based o hardness. Sample-specific guideline values are listed in parentheses after the laboratory result, where applicable.

[4] Guideline is for Chromium (IV) cation. Analytical results are for unspeciated Chromium. Where analytical results exceed the guideline, speciate warranted.

[5] Guideline is pH dependant.

[6] Guideline is Dissolved Organic Carbon (DOC) dependent. BML Model assumed 10% DOC and Humic acid 10% of DOC value, due to no DOC in la

NG - No Guideline

Detection limit can vary as described in the COA. Detection limit can be raised when dilutation is requited due to high Dissolved Solids/Electrical e.g. nitrite.

BOLD and shaded dark gray: Exceeds BCAWQG-FSTM (Short-term Maximum) guideline.

Shaded Light Gray: Exceeds BCAWQG-LTA (Long-term Average) guideline.

RED - Measured value is below detection limit (DL); value shown is 50% of DL

Blank - Not analyzed

Appendix B4: Other Sampling Locations Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG -FLT [2]	Gully Rd Ditch		Road Runner 1	Road Runner 2	Seep 1			LBSP	
					18-Apr-19	23-May-19	18-Apr-19	18-Apr-19	1-Aug-19	20-Aug-19	24-Sep-19	23-May-19	20-Jun-19
Physical Parameters													
Temperature	°C				7.1	21.2	7.1	5.5	-	-	10	17.6	23
Flow Rate (L/s)	L/sec				0.1	0.05	0.4	0.3	-	-	0.2	N/A	N/A
Electrical Conductivity (EC)	µS/cm	2.0	NG	NG	2640	1760	1260	1620	1060	1330	1220	2730	2380
Hardness as $CaCO_3$	µg/L	500	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn, F)	NG (Acceptable ranges exist when calculating exceedances for Cd, Cu, Pb, Mn, Zn, F)	1120000	564000	526000	739000	4500	8610	9060	520000	1160000
pH	pH Units	0.10	6.5 - 9	6.5-9.0	8.05	8.10	8.18	8.11	8.82	8.98	8.68	7.82	8.00
Total Dissolved Solids (TDS)	µg/L	10000	NG	NG	1850000	1210000	911000	1260000	691000	785000	808000	2120000	2180000
Total Suspended Solids (TSS)	µg/L	3000	NG	NG	25800	5400	<3000	<3000	11600	<3000	35700	9600	5400
Anions and Nutrients													
Acidity (Total as $CaCO_3$)	µg/L	1000	NG	NG	6900	1900	3300	5000	1000	<1000	<2000	1300	3300
Alkalinity (Bicarbonate as $CaCO_3$)	µg/L	1000	NG	NG	260000	206000	337000	320000	383000	367000	359000	38900	105000
Alkalinity (Carbonate as $CaCO_3$)	µg/L	1000	NG	NG	<1000	<1000	<1000	<1000	37800	49400	29000	<1000	<1000
Alkalinity (Hydroxide) as $CaCO_3$	µg/L	1000	NG	NG	<1000	<1000	<1000	<1000	1000	<1000	<1000	<1000	<1000
Alkalinity (Total as $CaCO_3$)	mg/L	1.0	NG	NG	260	206	337	320	421	417	388	38.9	105
Ammonia (NH_4 as N)	µg/L	5.0	pH dependent (6.5-9.0)	pH dependent (6.5-9.0)	290	22.4	<5	<5	5	<5	223	988	406
Ammonia FST Guideline	µg/L		pH dependent (at Temp 4 ·C)		4950	4950	4950	4950	1040	685	1300	8770	5740
Ammonia FLT Guideline	µg/L			pH dependent (at Temp 4 ·C)	952	952	759	952	201	132	249	1690	762
Chloride (Cl^-)	µg/L	500	600,000	150,000	471000	241000	37100	42600	40800	44600	39200	43000	13000
Nitrate (NO_3^- as N)	µg/L	5.0-100	NG	NG	440	233	1330	3350	25	<25	345	340	3020
Nitrite (NO_2^- as N)	µg/L	1.0-20	Cl-dependent (> 10,000 µg/L) Guideline: 600 ug/L	Cl-dependent (> 10,000 µg/L) Guideline: 200 ug/L	20	10	10	10	5	<5	28.6	32	73
Sulphate (SO_4) [3]	µg/L	300.00	NG	309,000 - 429,001	551000	363000	323000	550000	99100	200000	207000	1400000	1330000
SO_4 STM & LTA Guideline Calc (Based on Hardness as CaCO3)	µg/L		NG	Hardness 76,000-180,000 = 309,000 Hardness 181,000-250,000 = 429,000; Hardness > 250,000 site-specific	429000	429000	429000	429000	309000	128000	128000	429000	429000
Dissolved Organic Carbon (DOC)	µg/L				-	-	-	-	-	-	4.29	-	-
Metals, Total													
Aluminum	µg/L	3.00	NG	NG	345	96.5	24.6	18.2	761	280	1940	176	209
Antimony	µg/L	0.1-0.2	NG	NG	<0.1	0.17	0.44	0.65	0.19	0.18	0.6	1.04	0.94
Arsenic	µg/L	0.10	5.0	5.0	0.26	0.26	0.3	0.56	2.34	1.86	2.67	1.39	0.76
Barium	µg/L	0.10	NG	NG	39	41.1	92.3	62.3	64.1	40.6	267	26	60.9
Beryllium	µg/L	0.10	NG	NG	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.11	0.2	<0.2
Bismuth	µg/L	0.05-0.10	NG	NG	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	0.1	<0.1
Boron	µg/L	10.0	1200	1200	208	228	45	66	643	589	475	222	142
Cadmium	µg/L	0.005	NG	NG	1.37	0.113	0.0177	0.0222	0.0359	0.0537	0.0882	0.095	1.28
Calcium	µg/L	50	NG	NG	285000	129000	165000	207000	1430	2560	5170	134000	336000
Cesium	µg/L	0.01	NG	NG	0.013	0.017	<0.01	<0.01	0.125	0.059	0.637	0.148	0.053
Chromium [4]	µg/L	0.1-0.7	NG	NG	0.28	0.18	2.48	4.36	1.09	0.39	3.05	4.29	0.29
Cobalt	µg/L	0.10	110	4.0	10.1	1.12	<0.1	<0.1	0.38	0.44	2.28	0.86	17.3
Copper [3]	µg/L	0.50	Calc. based on Hardness	2 to 10	2.84	1.16	<0.5	<0.5	2.14	**3.34**	**4.58**	3.0	2.9
Cu STM Guideline Calc.	µg/L		Hardness 13,000 - 400,000 : calc.; Hardness ≥ 400,000 is Capped Value of 400,000		39.60	39.60	39.60	39.60	2.42	2.81	2.85	39.60	39.60
Cu LTA Guideline Calc.	µg/L			Hardness 50,000 - 250,000: calc.; Hardness > 250,000, Cu = 10	10.00	10.00	10.00	10.00	0.18	0.34	0.36	10.00	10.00
Iron	µg/L	10	1000	NG	640	78	<10	<10	306	119	**3390**	166	230
Lead [3]	µg/L	0.05-0.1	Calc. based on Hardness	Calc. based on Hardness	<0.05	<0.05	<0.05	<0.05	0.294	0.166	1.94	0.1	0.16
Pb STM Guideline Calc (Based on Hardness as $CaCO_3$)	µg/L		Applies to Hardness 8000-360,000 Hardness ≤ 8000: 3 Hardness > 8000 : calc.		966.3	416.97	417	417	3.00	3.60	3.84	416.97	416.97
Pb LTA Guideline Calc (Based on Hardness as $CaCO_3$)	µg/L			Applies to Hardness 8000-360,000 Hardness ≤ 8000, NG Hardness > 8000 : calc.	72	19.57	20	20	3.37	3.45	3.46	19.57	19.57
Lithium	µg/L	1.0	NG	NG	82.4	61.5	16.2	22.2	63.2	87.8	78.5	32.3	52.3
Magnesium	µg/L	5.0	NG	NG	84300	43000	40300	49700	416	661	1170	32200	110000
Manganese [3]	µg/L	0.10	Calc. based on hardness	Calc. based on Hardness	514	45.9	1.66	3.55	2.4	6.07	74.4	25	1070
Mn STM Guideline Calc (Based on Hardness as $CaCO_3$)	µg/L		Applies to Hardness 25000-259000 µg/L Mn : calc.		8202	3394	3394	3394	590	635	640	3394	3394
Mn LTA Guideline Calc (Based on Hardness as $CaCO_3$)	µg/L			Applies to Hardness 37000-450000 µg/L Mn : calc.	5533	2585	2585	2585	625	643	645	2585	2585
Mercury (Based on methyl Hg & total mass Hg)	µg/L	0.005	NG	Calc.	0.0064	<0.005	<0.005	<0.005	0.005	<0.005	0.0101	<0.005	<0.005
Molybdenum	µg/L	0.05	2000	≤ 1000	1.2	1.61	5.51	4.8	4.6	6.79	6.12	202	16.5
Nickel	µg/L	0.5	NG		56.6	13.4	0.79	0.52	1.59	1.78	5.22	4.9	67.1
Phosphorus	µg/L	50-100	NG	NG	<50	<50	<50	<50	145	<50	234	<100	<100
Potassium	µg/L	50.0	NG	NG	6550	5620	3090	3550	1040	1110	1500	19100	8760
Rubidium	µg/L	0.2	NG	NG	2.63	2.43	1.3	1.53	2.13	1.41	5.72	17.2	3.94
Selenium	µg/L	0.05	NG	2.0	0.466	0.376	10.6	20.6	0.376	0.57	2.2	6.96	13.9
Silicon	µg/L	100	NG	NG	3990	3370	5430	5680	3820	1760	7450	200	2170
Silver [3] (Based on Hardness < or > 100000)	µg/L	0.01-0.02	0.10 - 3.0	0.05 - 1.5	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	0.025	0.02	<0.02
Ag STM Guideline Calc	µg/L		Hardness ≤ 100,000 Ag = 0.10 Hardness > 100,000 Ag = 3.0		3.0	3.0	3.0	3.0	0.100	0.100	0.100	3.0	3.0
Ag LTA Guideline Calc				Hardness ≤ 100,000 Ag = 0.05 Hardness > 100,000 Ag = 1.5	1.5	1.5	1.5	1.5	0.050	0.050	0.050	1.5	1.5
Sodium	µg/L	50.0	NG	NG	204000	161000	80000	130000	267000	304000	288000	416000	167000
Strontium	µg/L	0.2	NG	NG	2010	981	474	609	32.1	57.1	52.7	548	951
Sulfur	µg/L	500	NG	NG	209000	137000	124000	218000	39600	74800	71500	534000	506000
Tellerium	µg/L	0.2-0.4	NG	NG	0.37	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	0.4	<0.4
Thallium	µg/L	0.01-0.055	NG	NG	0.03	0.023	<0.01	<0.01	0.01	<0.01	0.055	0.052	0.058

TETRA TECH

Appendix B4: Other Sampling Locations Surface Water Analytical Results

Parameter	Unit	RDL	BCAWQG - FST [1]	BCAWQG -FLT [2]	Gully Rd Ditch		Road Runner 1	Road Runner 2	Seep 1			LBSP	
					18-Apr-19	23-May-19	18-Apr-19	18-Apr-19	1-Aug-19	20-Aug-19	24-Sep-19	23-May-19	20-Jun-19
Thorium	µg/L	0.1-0.2	NG	NG	0.16	<0.1	<0.1	<0.1	0.1	<0.1	0.51	0.2	<0.2
Tin	µg/L	0.1-0.2	NG	NG	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	<0.2
Titanium	µg/L	0.3-1.2	NG	NG	0.72	1.02	<0.3	0.6	4.71	4.32	27.8	1.8	<3.6
Tungsten	µg/L	0.1-0.2	NG	NG	<0.1	<0.1	<0.1	0.13	0.13	0.13	<0.1	0.3	<0.2
Uranium	µg/L	0.01	NG	NG	3.72	1.97	3.45	4.37	0.728	1.04	0.794	4.31	14.2
Vanadium	µg/L	0.5-1.0	NG	NG	0.52	<0.5	0.59	1.25	2.53	0.93	6.57	1	<1
Zinc [3] (Based on Hardness < or > 90,000)	µg/L	3.0	Calc. based on Hardness	Calc. based on Hardness	77	6.0	<3	<3	5.2	6.6	20.4	6.0	44.4
Zn STM Guideline Calc.	µg/L		Hardness 90,000 - 500,000, Calc. Hardness > 500,000, is Capped Value of 500,000		340.5	340.5	340.5	340.5	33.0	33.0	33.0	340.5	340.5
Zn LTA Guideline Calc.				Hardness 90,000 - 330,000, Calc. Hardness > 330,000, is Capped Value of 330,000	187.5	187.5	187.5	187.5	7.5	7.5	7.5	187.5	187.5
Zirconium	µg/L	0.06-0.12	NG	NG	<0.06	<0.06	0.061	0.109	0.71	<0.33	<0.25	0.12	<0.4
Metals, Dissolved													
Aluminum [5]	µg/L	1.0	100	50	32.4	66.2	18.2	12.1	36.5	68.1	19.9	**110**	62.4
Al STM Guideline Calc (based on pH)	µg/L		pH < 6.5 : calc. Al pH ≥ 6.5 : 100.0 Al		100	100	100	100	100	100	100	100	100
Al LTA Guideline Calc (based on median pH)				median pH < 6.5 : calc. Al median pH ≥ 6.5 : 50.0 Al	50	50	50	50	50	50	50	50	50
Antimony	µg/L	0.1-0.2	NG	NG	<0.1	0.18	0.42	0.31	0.19	0.36	0.51	1.23	0.89
Arsenic	µg/L	0.10	NG	NG	0.16	0.24	0.27	0.3	2.03	2.05	1.19	1.27	0.51
Barium	µg/L	0.10	NG	NG	38.8	37.5	87.1	56.8	45.9	34.4	91.1	22.3	47.5
Beryllium	µg/L	0.1-0.2	NG	NG	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	<0.2
Bismuth	µg/L	0.05-0.1	NG	NG	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	0.1	<0.1
Boron	µg/L	10.0	NG	NG	199	223	39	52	540	515	453	202	133
Cadmium [3] (Based on Hardness as $CaCO_3$)	µg/L	0.005	Calc. based on Hardness	Calc. based on hardness	1.44	0.111	0.0141	0.0235	0.0159	0.0248	0.0071	0.20	1.27
Cd STM Guideline Calc.	µg/L		Hardness 7,000 - 455,000, Calc. Hardness > 455,000, is Capped Value of 455,000		2.80	2.80	2.80	2.80	0.0241	0.0471	0.0496	2.80	2.80
Cd LTA Guideline Calc.				Hardness 3,400 - 285,000, Calc. Hardness > 285,000, is Capped Value of 285,000	0.46	0.46	0.46	0.46	0.0216	0.0348	0.0361	0.46	0.46
Calcium	µg/L	50.0	NG	NG	304000	140000	152000	213000	1250	2430	2980	143000	296000
Cesium	µg/L	0.01	NG	NG	<0.01	0.011	<0.01	<0.01	0.013	0.012	0.02	0.122	0.039
Chromium	µg/L	0.10	NG	NG	<0.1	0.26	2.15	1.66	0.1	<0.1	0.14	3.97	<0.2
Cobalt	µg/L	0.10	NG	NG	10	1.15	<0.1	<0.1	0.17	0.29	<0.1	0.59	16.7
Copper [6]	µg/L	0.20	Calc. based on BLM Model	Calc. based on BLM Model	1.68	1.18	0.25	0.32	1.24	1.11	0.28	2.48	2.17
Cu STM (Acute) Guideline Value	µg/L		BLM Ligand Model value		-	-	-	-	-	-	12.4	-	-
Cu LTA (Chronic) Guideline Value	µg/L			BLM Ligand Model value	-	-	-	-	-	-	2.1	-	-
Iron	µg/L	10.0-20.0	350	NG	82	12	<10	<10	40	22	20	20	<20
Lead	µg/L	0.05-0.1	NG	NG	<0.05	<0.05	<0.05	<0.05	0.11	<0.05	<0.05	0.1	<0.1
Lithium	µg/L	1.0	NG	NG	85.1	60.6	13.1	24	56.8	77.5	76.7	30.9	47.8
Magnesium	µg/L	5.0	NG	NG	87000	52000	35600	50400	337	617	391	39600	101000
Manganese	µg/L	0.10	NG	NG	539	45.7	1.36	2.01	0.73	4.68	4.23	4.91	996
Mercury	µg/L	0.005	NG	NG	<0.005	<0.005	<0.005	0.0064	0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	µg/L	0.05	NG	NG	1.31	1.64	4.9	2	4.52	6.8	6.16	206	16.4
Nickel	µg/L	0.50	NG	NG	56.2	14	0.65	<0.5	1.04	1.1	0.56	4	63.6
Phosphorus	µg/L	50.0-100.0	NG	NG	<50	<50	<50	<50	99	<50	<77	<100	<100
Potassium	µg/L	50.0	NG	NG	6930	6260	2880	3240	932	1030	847	19400	8120
Rubidium	µg/L	0.20	NG	NG	2.55	2.38	1.33	1.17	0.89	0.97	0.78	17	3.61
Selenium	µg/L	0.05	NG	2.0	0.515	0.335	11.3	20.1	0.367	0.723	2.34	5.66	15.0
Silicon	µg/L	50.0	NG	NG	3940	3300	5040	5060	2210	1270	4380	<100	2020
Silver	µg/L	0.01-0.02	NG	NG	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	0.02	<0.02
Sodium	µg/L	50.0	NG	NG	205000	176000	76200	131000	252000	304000	278000	442000	149000
Strontium	µg/L	0.20	NG	NG	1830	1060	456	618	27.9	51.5	41.2	573	884
Sulfur	µg/L	500	NG	NG	191000	136000	120000	199000	38300	67900	67800	524000	545000
Tellerium	µg/L	0.2-0.4	NG	NG	<0.2	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	0.4	<0.4
Thallium	µg/L	0.01	NG	NG	0.03	0.022	<0.01	<0.01	0.01	<0.01	<0.01	0.046	0.053
Thorium	µg/L	0.1-0.2	NG	NG	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	<0.2
Tin	µg/L	0.1-0.2	NG	NG	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.2	<0.2
Titanium	µg/L	0.3-0.6	NG	NG	<0.3	<0.3	<0.3	<0.3	0.83	0.57	0.45	0.6	<0.6
Tungsten	µg/L	0.1-0.2	NG	NG	<0.1	<0.1	<0.1	<0.1	0.12	0.13	<0.1	0.28	<0.2
Uranium	µg/L	0.01	NG	NG	3.63	1.83	3.48	4.27	0.716	1.01	0.599	4.04	14.9
Vanadium	µg/L	0.5-1.0	NG	NG	<0.5	<0.5	<0.5	0.61	0.5	<0.5	0.62	1	<1
Zinc	µg/L	1.00	NG	NG	73.7	5.9	2.8	1.3	1.5	1.7	<1	2	38.8
Zirconium	µg/L	0.06-0.12	NG	NG	0.06	<0.06	0.061	0.107	0.2	<0.2	<0.2	<0.12	<0.4
Laboratory Work Order Number					L2260583	L2278405	L2260745	L2260745	L2321612	L2333371	L2353312	L2278405	L2303362
Laboratory Identification Number					L2260583-6	L2278405-5	L2260745-9	L2260745-10	L2321612-1	L2333371-1	L2353312-6	L2278405-14	L2303362-1

Notes:

Screening completed on BC AWQG-FWAL STM [1] and LTA [2] guideline values.

[1] BC Ministry of Environment, Water Protection & Sustainability Branch (2018). British Columbia Approved Water Quality Guidelines

[2] BC Ministry of Environment, Water Protection & Sustainability Branch. 2018. British Columbia Approved Water Quality Guidelines (BCAWQG): Aquatic Life, Wildlife & Agriculture Summary Report. 36 pp. Referenced for Freshwater Aquatic Life (FWAL) water use and Long Term Average (LTA) guidelines.

[3] Guideline is hardness dependant. Where results are above laboratory reportable detection limits, guideline limits have been evaluated based

[4] Guideline is for Chromium (IV) cation. Analytical results are for unspeciated Chromium. Where analytical results exceed the guideline, speciated analysis may be warranted.

[5] Guideline is pH dependant.

[6] Guideline is Dissolved Organic Carbon (DOC) dependent. BML Model assumed 10% DOC and Humic acid 10% of DOC value, due to no DOC in lab analysis.

NG - No Guideline

Detection limit can vary as described in the COA. Detection limit can be raised when dilutation is requited due to high Dissolved Solids/Electrical Conductivity (DLDS), e.g. nitrite.

BOLD and shaded dark gray: Exceeds BCAWQG-FSTM (Short-term Maximum) guideline.

Shaded Light Gray: Exceeds BCAWQG-LTA (Long-term Average) guideline.

RED - Measured value is below detection limit (DL); value shown is 50% of DL

Blank - Not analyzed

TETRA TECH

APPENDIX C

CORRELATIVE ANALYSIS OF ELEMENTS AND PARAMETERS IN THE RBSBIAR-DS AND RBSBIAR-EDS DOWNSTREAM DITCHES, 2017 TO 2019

Appendix C: Correlative Analysis of Elements and Parameters in the RBSBIAR-DS and RBSBIAR-EDS Downstream Ditches, 2017 to 2019

Correlation > 0.8
Correlation < -0.8

	EC	*Hardness*	*pH*	*TDS*	*TSS*	*Alkalinity*	*NH4*	*Cl*	*NO3*	*NO2*	*SO4*	*Al-t*	*As-t*	*Cd-t*	*Ca-t*	*Co-t*	*Cu-t*	*Fe-t*	*Mg-t*	*Mn-t*	*K-t*	*Ag-t*	*Zn-t*	*Al-d*	*As-d*	*Cd-d*	*Ca-d*	*Co-d*	*Cu-d*	*Fe-d*	*Mg-d*	*Mn-d*	*K-d*	*Ag-d*	*Zn-d*
EC	1.0000																																		
Hardness	0.9789	1.0000																																	
pH	-0.5582	-0.6002	1.0000																																
TDS	0.9955	0.9811	-0.5725	1.0000																															
TSS	-0.0130	0.0329	-0.3830	0.0018	1.0000																														
Alkalinity	0.0559	0.0263	-0.1194	0.0035	0.2264	1.0000																													
NH4	0.7333	0.7504	-0.6986	0.7358	0.2145	0.0971	1.0000																												
Cl	0.9442	0.9390	-0.5652	0.9538	-0.0677	-0.1497	0.6212	1.0000																											
NO3	-0.1138	-0.0692	0.3103	-0.1243	-0.3472	-0.3843	-0.3106	-0.0264	1.0000																										
NO2	0.2162	0.2404	0.0170	0.2461	-0.2240	-0.3693	0.0741	0.3103	0.6141	1.0000																									
SO4	0.7792	0.7665	-0.3828	0.7830	0.0635	-0.0227	0.7745	0.5978	-0.1418	0.1452	1.0000																								
Al-t	0.1521	0.2039	-0.4168	0.1635	0.9222	0.1356	0.4024	0.0513	-0.3418	-0.2046	0.3266	1.0000																							
As-t	0.0638	0.1104	-0.3668	0.0756	0.9470	0.1535	0.3175	-0.0224	-0.3900	-0.2458	0.2273	0.9890	1.0000																						
Cd-t	0.5595	0.5931	-0.4339	0.5709	0.4787	-0.0006	0.7411	0.3852	-0.2870	-0.0756	0.8413	0.7291	0.6513	1.0000																					
Ca-t	0.9332	0.9613	-0.7044	0.9384	0.2531	0.0595	0.7616	0.9137	-0.1981	0.1413	0.6812	0.3946	0.3202	0.6296	1.0000																				
Co-t	0.6479	0.6729	-0.4274	0.6581	0.3123	-0.0064	0.7850	0.4642	-0.2588	-0.0197	0.9228	0.5778	0.4875	0.9759	0.6593	1.0000																			
Cu-t	0.4373	0.4781	-0.4380	0.4545	0.6673	0.0106	0.6440	0.2832	-0.3425	-0.1305	0.7145	0.8598	0.8063	0.9675	0.5695	0.9016	1.0000																		
Fe-t	0.0847	0.1326	-0.4092	0.0950	0.9554	0.1648	0.3235	0.0098	-0.3669	-0.2351	0.2043	0.9877	0.9948	0.6231	0.3481	0.4565	0.7793	1.0000																	
Mg-t	0.8502	0.8880	-0.6174	0.8458	0.3818	0.2127	0.7997	0.7201	-0.2064	0.0670	0.8053	0.5614	0.4763	0.8138	0.9136	0.8290	0.7558	0.4873	1.0000																
Mn-t	0.3975	0.4386	-0.5072	0.4082	0.7991	0.1484	0.6228	0.2562	-0.3934	-0.1720	0.5841	0.9481	0.9058	0.8893	0.5807	0.7878	0.9527	0.9000	0.7500	1.0000															
K-t	0.9187	0.9370	-0.6866	0.9326	0.1239	-0.1133	0.6652	0.9694	-0.0677	0.2701	0.5894	0.2310	0.1587	0.4687	0.9562	0.5152	0.4066	0.1951	0.7935	0.4039	1.0000														
Ag-t	0.0014	0.0479	-0.3641	0.0102	0.8433	0.1414	0.1949	-0.0340	-0.2901	-0.2011	0.0476	0.8943	0.8984	0.4586	0.2621	0.2776	0.6042	0.9244	0.3549	0.7778	0.1400	1.0000													
Zn-t	0.6078	0.6413	-0.4212	0.6205	0.3714	-0.0195	0.7528	0.4289	-0.2492	-0.0411	0.8889	0.6280	0.5401	0.9863	0.6429	0.9941	0.9293	0.5093	0.8219	0.8183	0.4964	0.3295	1.0000												
Al-d	0.7057	0.7212	-0.4350	0.6987	0.0015	-0.0082	0.7439	0.5545	-0.1479	-0.0022	0.8585	0.2581	0.1588	0.7358	0.6566	0.8332	0.6102	0.1452	0.7626	0.4961	0.5567	-0.0205	0.7997	1.0000											
As-d	-0.0039	-0.0891	0.0855	0.0220	0.0414	0.1928	-0.2045	0.0190	-0.2045	0.3573	-0.1329	-0.1193	-0.0666	-0.2602	-0.0753	-0.2582	-0.2112	-0.0665	-0.1221	-0.1406	-0.0116	-0.0272	-0.2758	-0.3585	1.0000										
Cd-d	0.7999	0.8231	-0.4387	0.7996	-0.0329	-0.1355	0.8091	0.6913	0.0202	0.2412	0.8970	0.2467	0.1322	0.7670	0.7424	0.8527	0.6130	0.1221	0.7968	0.5019	0.6737	-0.0102	0.8179	0.8937	-0.3051	1.0000									
Ca-d	0.9724	0.9957	-0.6111	0.9761	0.0196	-0.0051	0.7269	0.9604	-0.0594	0.2457	0.7138	0.1752	0.0863	0.5412	0.9647	0.6188	0.4307	0.1129	0.8581	0.4006	0.9562	0.0389	0.5875	0.6806	-0.0883	0.7927	1.0000								
Co-d	0.7296	0.7451	-0.3821	0.7337	0.0274	-0.0191	0.8000	0.5512	-0.1149	0.0970	0.9522	0.3070	0.1931	0.8575	0.6562	0.9422	0.7136	0.1695	0.7914	0.5761	0.5482	0.0142	0.9163	0.8870	-0.2658	0.9329	0.6940	1.0000							
Cu-d	0.6583	0.6784	-0.3380	0.6484	-0.1169	-0.1637	0.6465	0.5739	0.1390	0.2482	0.7440	0.1383	0.0323	0.5830	0.5935	0.6762	0.4353	0.0302	0.6366	0.3520	0.5371	-0.0796	0.6359	0.8788	-0.3383	0.9176	0.6564	0.7858	1.0000						
Fe-d	0.1027	0.1731	-0.0483	0.0968	0.0124	-0.2020	0.1007	0.0881	0.6126	0.4770	0.2012	0.1257	0.0439	0.2098	0.1061	0.2194	0.1588	0.0521	0.1988	0.1319	0.1210	0.0456	0.2278	0.2957	-0.2817	0.4529	0.1594	0.2854	0.5828	1.0000					
Mg-d	0.9424	0.9554	-0.5292	0.9397	0.0733	0.1235	0.7820	0.8161	-0.0936	0.2148	0.8904	0.2844	0.1817	0.7243	0.8943	0.8061	0.6014	0.1883	0.9318	0.5345	0.8212	0.0740	0.7753	0.8083	-0.0859	0.8739	0.9240	0.8645	0.7116	0.2121	1.0000				
Mn-d	0.7061	0.7275	-0.4270	0.7186	0.1586	-0.0433	0.8186	0.5366	-0.2285	0.0401	0.9497	0.4337	0.3336	0.9244	0.6775	0.9820	0.8135	0.3045	0.8112	0.6819	0.5579	0.1385	0.9634	0.8572	-0.2485	0.8987	0.6776	0.9800	0.7172	0.2051	0.8437	1.0000			
K-d	0.9216	0.9242	-0.5765	0.9353	-0.1320	-0.1897	0.6115	0.9835	0.0398	0.3606	0.5917	-0.0203	-0.1010	0.3465	0.8764	0.4420	0.2358	-0.0686	0.6860	0.1892	0.9615	-0.1140	0.4080	0.5538	0.0079	0.6898	0.9450	0.5563	0.5719	0.1368	0.8042	0.5282	1.0000		
Ag-d	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	
Zn-d	0.5973	0.6219	-0.2717	0.5749	-0.1567	-0.0628	0.6365	0.4905	0.2176	0.2617	0.6842	0.0995	-0.0093	0.5360	0.5230	0.6234	0.3695	-0.0093	0.6002	0.3027	0.4484	-0.0882	0.5829	0.8065	-0.3988	0.8881	0.5963	0.7480	0.9466	0.6402	0.6708	0.6632	0.4867	0.0000	1.0000