



HR Wallingford
Working with water

Support to Trans-Tasman Resources

Laboratory testing of sediments



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October 2014

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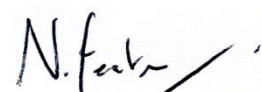
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Executive summary

Trans-Tasman Resources Ltd (TTR) plans to extract titanomagnetite sand (ironsand) from an area in South Taranaki Bight. As input to the Environmental Impact Assessment (EIA) for the proposed mining project, the National Institute of Water & Atmospheric Research Ltd. (NIWA) was commissioned by TTR to investigate the potential environmental impacts of the proposed extraction operation.

Following the refusal of consent by the Decision Making Committee in June 2014, TTR are re-assessing their scientific case as background for a possible appeal and re-hearing. One issue that arose was the need to re-assess the degree of uncertainty and conservatism in the NIWA sediment plume modelling studies and the interpretation of these results. In July 2014 HR Wallingford (HRW) undertook a review of the NIWA modelling work (HR Wallingford, 2014).

As a result of this review it became apparent that there was a degree of uncertainty as to how the tailings rejected from the ironsand extraction process might be expected to behave in a saline water environment. The assumptions for the NIWA plume modelling were that the materials released into the marine environment would remain in their particulate form (unfloculated) and would therefore have low settling velocities. It was also noted that the NIWA laboratory tests to support the assessment of the optical effects of the plumes had been carried out in fresh water.

HR Wallingford was commissioned by TTR to undertake a series of laboratory tests to investigate the behaviour of the tailings under both saline and fresh water conditions. Tests were carried out to look at settling velocity, flocculation and critical shear stress for deposition and erosion.

The results of the tests undertaken by HRW suggest that the mass of fine sediment that will be dispersed within the middle and upper parts of the water column upon release by mining will reduce by a factor of 3-5 (compared to the revised NIWA prediction) as the majority of released fine sediment will settle to the bed or near-bed waters because of higher rates of settling. It was also found that the critical shear stress for resuspension of freshly deposited material was likely to be in the range of 0.2 to 0.3Pa rather than the 0.1Pa assumed by NIWA.

The results of HRW's optical backscatter tests show that the sediment in suspension in the water column has different backscattering properties in saline water compared to that in de-ionised water. It is likely that the material will behave differently than that identified in the Optical Effects Study as a result of flocculation in saline (rather than fresh) water.

Contents

Executive summary

1. Introduction	1
1.1. Background	1
1.2. Scope of Work	1
1.3. Report Structure	1
2. Source Material	2
2.1. Container 1 of 2	2
2.1.1. Sediment 1 (grip seal plastic bag)	2
2.1.2. Sediment 2 (woven polypropylene bag)	3
2.2. Container 2 of 2	4
2.2.1. Sediment 3 (loose in sample container)	4
3. Laboratory Testing	5
3.1. Introduction	5
3.2. Methodology	5
3.3. Results	5
3.4. Discussion	5
3.5. Conclusion	5
3.6. References	5
3.7. Appendix A	5
3.8. Appendix B	5
3.9. Appendix C	5
3.10. Appendix D	5
3.11. Appendix E	5
3.12. Appendix F	5
3.13. Appendix G	5
3.14. Appendix H	5
3.15. Appendix I	5
3.16. Appendix J	5
3.17. Appendix K	5
3.18. Appendix L	5
3.19. Appendix M	5
3.20. Appendix N	5
3.21. Appendix O	5
3.22. Appendix P	5
3.23. Appendix Q	5
3.24. Appendix R	5
3.25. Appendix S	5
3.26. Appendix T	5
3.27. Appendix U	5
3.28. Appendix V	5
3.29. Appendix W	5
3.30. Appendix X	5
3.31. Appendix Y	5
3.32. Appendix Z	5
3.33. Appendix AA	5
3.34. Appendix AB	5
3.35. Appendix AC	5
3.36. Appendix AD	5
3.37. Appendix AE	5
3.38. Appendix AF	5
3.39. Appendix AG	5
3.40. Appendix AH	5
3.41. Appendix AI	5
3.42. Appendix AJ	5
3.43. Appendix AK	5
3.44. Appendix AL	5
3.45. Appendix AM	5
3.46. Appendix AN	5
3.47. Appendix AO	5
3.48. Appendix AP	5
3.49. Appendix AQ	5
3.50. Appendix AR	5
3.51. Appendix AS	5
3.52. Appendix AT	5
3.53. Appendix AU	5
3.54. Appendix AV	5
3.55. Appendix AW	5
3.56. Appendix AX	5
3.57. Appendix AY	5
3.58. Appendix AZ	5
3.59. Appendix BA	5
3.60. Appendix BB	5
3.61. Appendix BC	5
3.62. Appendix BD	5
3.63. Appendix BE	5
3.64. Appendix BF	5
3.65. Appendix BG	5
3.66. Appendix BH	5
3.67. Appendix BI	5
3.68. Appendix BJ	5
3.69. Appendix BK	5
3.70. Appendix BL	5
3.71. Appendix BM	5
3.72. Appendix BN	5
3.73. Appendix BO	5
3.74. Appendix BP	5
3.75. Appendix BQ	5
3.76. Appendix BR	5
3.77. Appendix BS	5
3.78. Appendix BT	5
3.79. Appendix BU	5
3.80. Appendix BV	5
3.81. Appendix BW	5
3.82. Appendix BX	5
3.83. Appendix BY	5
3.84. Appendix BZ	5
3.85. Appendix CA	5
3.86. Appendix CB	5
3.87. Appendix CC	5
3.88. Appendix CD	5
3.89. Appendix CE	5
3.90. Appendix CF	5
3.91. Appendix CG	5
3.92. Appendix CH	5
3.93. Appendix CI	5
3.94. Appendix CJ	5
3.95. Appendix CK	5
3.96. Appendix CL	5
3.97. Appendix CM	5
3.98. Appendix CN	5
3.99. Appendix CO	5
3.100. Appendix CP	5
3.101. Appendix CQ	5
3.102. Appendix CR	5
3.103. Appendix CS	5
3.104. Appendix CT	5
3.105. Appendix CU	5
3.106. Appendix CV	5
3.107. Appendix CW	5
3.108. Appendix CX	5
3.109. Appendix CY	5
3.110. Appendix CZ	5
3.111. Appendix DA	5
3.112. Appendix DB	5
3.113. Appendix DC	5
3.114. Appendix DD	5
3.115. Appendix DE	5
3.116. Appendix DF	5
3.117. Appendix DG	5
3.118. Appendix DH	5
3.119. Appendix DI	5
3.120. Appendix DJ	5
3.121. Appendix DK	5
3.122. Appendix DL	5
3.123. Appendix DM	5
3.124. Appendix DN	5
3.125. Appendix DO	5
3.126. Appendix DP	5
3.127. Appendix DQ	5
3.128. Appendix DR	5
3.129. Appendix DS	5
3.130. Appendix DT	5
3.131. Appendix DU	5
3.132. Appendix DV	5
3.133. Appendix DW	5
3.134. Appendix DX	5
3.135. Appendix DY	5
3.136. Appendix DZ	5
3.137. Appendix EA	5
3.138. Appendix EB	5
3.139. Appendix EC	5
3.140. Appendix ED	5
3.141. Appendix EE	5
3.142. Appendix EF	5
3.143. Appendix EG	5
3.144. Appendix EH	5
3.145. Appendix EI	5
3.146. Appendix EJ	5
3.147. Appendix EK	5
3.148. Appendix EL	5
3.149. Appendix EM	5
3.150. Appendix EN	5
3.151. Appendix EO	5
3.152. Appendix EP	5
3.153. Appendix EQ	5
3.154. Appendix ER	5
3.155. Appendix ES	5
3.156. Appendix ET	5
3.157. Appendix EU	5
3.158. Appendix EV	5
3.159. Appendix EW	5
3.160. Appendix EX	5
3.161. Appendix EY	5
3.162. Appendix EZ	5
3.163. Appendix FA	5
3.164. Appendix FB	5
3.165. Appendix FC	5
3.166. Appendix FD	5
3.167. Appendix FE	5
3.168. Appendix FF	5
3.169. Appendix FG	5
3.170. Appendix FH	5
3.171. Appendix FI	5
3.172. Appendix FJ	5
3.173. Appendix FK	5
3.174. Appendix FL	5
3.175. Appendix FM	5
3.176. Appendix FN	5
3.177. Appendix FO	5
3.178. Appendix FP	5
3.179. Appendix FQ	5
3.180. Appendix FR	5
3.181. Appendix FS	5
3.182. Appendix FT	5
3.183. Appendix FU	5
3.184. Appendix FV	5
3.185. Appendix FW	5
3.186. Appendix FX	5
3.187. Appendix FY	5
3.188. Appendix FZ	5
3.189. Appendix GA	5
3.190. Appendix GB	5
3.191. Appendix GC	5
3.192. Appendix GD	5
3.193. Appendix GE	5
3.194. Appendix GF	5
3.195. Appendix GG	5
3.196. Appendix GH	5
3.197. Appendix GI	5
3.198. Appendix GJ	5
3.199. Appendix GK	5
3.200. Appendix GL	5
3.201. Appendix GM	5
3.202. Appendix GN	5
3.203. Appendix GO	5
3.204. Appendix GP	5
3.205. Appendix GQ	5
3.206. Appendix GR	5
3.207. Appendix GS	5
3.208. Appendix GT	5
3.209. Appendix GU	5
3.210. Appendix GV	5
3.211. Appendix GW	5
3.212. Appendix GX	5
3.213. Appendix GY	5
3.214. Appendix GZ	5
3.215. Appendix HA	5
3.216. Appendix HB	5
3.217. Appendix HC	5
3.218. Appendix HD	5
3.219. Appendix HE	5
3.220. Appendix HF	5
3.221. Appendix HG	5
3.222. Appendix HH	5
3.223. Appendix HI	5
3.224. Appendix HJ	5
3.225. Appendix HK	5
3.226. Appendix HL	5
3.227. Appendix HM	5
3.228. Appendix HN	5
3.229. Appendix HO	5
3.230. Appendix HP	5
3.231. Appendix HQ	5
3.232. Appendix HR	5
3.233. Appendix HS	5
3.234. Appendix HT	5
3.235. Appendix HU	5
3.236. Appendix HV	5
3.237. Appendix HW	5
3.238. Appendix HX	5
3.239. Appendix HY	5
3.240. Appendix HZ	5
3.241. Appendix IA	5
3.242. Appendix IB	5
3.243. Appendix IC	5
3.244. Appendix ID	5
3.245. Appendix IE	5
3.246. Appendix IF	5
3.247. Appendix IG	5
3.248. Appendix IH	5
3.249. Appendix II	5
3.250. Appendix IJ	5
3.251. Appendix IK	5
3.252. Appendix IL	5
3.253. Appendix IM	5
3.254. Appendix IN	5
3.255. Appendix IO	5
3.256. Appendix IP	5
3.257. Appendix IQ	5
3.258. Appendix IR	5
3.259. Appendix IS	5
3.260. Appendix IT	5
3.261. Appendix IU	5
3.262. Appendix IV	5
3.263. Appendix IW	5
3.264. Appendix IX	5
3.265. Appendix IY	5
3.266. Appendix IZ	5
3.267. Appendix JA	5
3.268. Appendix JB	5
3.269. Appendix JC	5
3.270. Appendix JD	5
3.271. Appendix JE	5
3.272. Appendix JF	5
3.273. Appendix JG	5
3.274. Appendix JH	5
3.275. Appendix JI	5
3.276. Appendix JJ	5
3.277. Appendix JK	5
3.278. Appendix JL	5
3.279. Appendix JM	5
3.280. Appendix JN	5
3.281. Appendix JO	5
3.282. Appendix JP	5
3.283. Appendix JQ	5
3.284. Appendix JR	5
3.285. Appendix JS	5
3.286. Appendix JT	5
3.287. Appendix JU	5
3.288. Appendix JV	5
3.289. Appendix JW	5
3.290. Appendix JX	5
3.291. Appendix JY	5
3.292. Appendix JZ	5
3.293. Appendix KA	5
3.294. Appendix KB	5
3.295. Appendix KC	5
3.296. Appendix KD	5
3.297. Appendix KE	5
3.298. Appendix KF	5
3.299. Appendix KG	5
3.300. Appendix KH	5
3.301. Appendix KI	5
3.302. Appendix KJ	5
3.303. Appendix KK	5
3.304. Appendix KL	5
3.305. Appendix KM	5
3.306. Appendix KN	5
3.307. Appendix KO	5
3.308. Appendix KP	5
3.309. Appendix KQ	5
3.310. Appendix KR	5
3.311. Appendix KS	5
3.312. Appendix KT	5
3.313. Appendix KU	5
3.314. Appendix KV	5
3.315. Appendix KW	5
3.316. Appendix KX	5
3.317. Appendix KY	5
3.318. Appendix KZ	5
3.319. Appendix LA	5
3.320. Appendix LB	5
3.321. Appendix LC	5
3.322. Appendix LD	5
3.323. Appendix LE	5
3.324. Appendix LF	5
3.325. Appendix LG	5
3.326. Appendix LH	5
3.327. Appendix LI	5
3.328. Appendix LJ	5
3.329. Appendix LK	5
3.330. Appendix LL	5
3.331. Appendix LM	5
3.332. Appendix LN	5
3.333. Appendix LO	5
3.334. Appendix LP	5
3.335. Appendix LQ	5
3.336. Appendix LR	5
3.337. Appendix LS	5
3.338. Appendix LT	5
3.339. Appendix LU	5
3.340. Appendix LV	5
3.341. Appendix LW	5
3.342. Appendix LX	5
3.343. Appendix LY	5
3.344. Appendix LZ	5
3.345. Appendix MA	5
3.346. Appendix MB	5
3.347. Appendix MC	5
3.348. Appendix MD	5
3.349. Appendix ME	5
3.350. Appendix MF	5
3.351. Appendix MG	5
3.352. Appendix MH	5
3.353. Appendix MI	5
3.354. Appendix MJ	5
3.355. Appendix MK	5
3.356. Appendix ML	5
3.357. Appendix MM	5
3.358. Appendix MN	5
3.359. Appendix MO	5
3.360. Appendix MP	5
3.361. Appendix MQ	5
3.362. Appendix MR	5
3.363. Appendix MS	5
3.364. Appendix MT	5
3.365. Appendix MU	5
3.366. Appendix MV	5
3.367. Appendix MW	5
3.368. Appendix MX	5
3.369. Appendix MY	5
3.370. Appendix MZ	5
3.371. Appendix NA	5
3.372. Appendix NB	5
3.373. Appendix NC	5
3.374. Appendix ND	5
3.375. Appendix NE	5
3.376. Appendix NF	5
3.377. Appendix NG	5
3.378. Appendix NH	5
3.379. Appendix NI	5
3.380. Appendix NJ	5
3.381. Appendix NK	5
3.382. Appendix NL	5
3.383. Appendix NM	5
3.384. Appendix NN	5
3.385. Appendix NO	5
3.386. Appendix NP	5
3.387. Appendix NQ	5
3.388. Appendix NR	5
3.389. Appendix NS	5
3.390. Appendix NT	5
3.391. Appendix NU	5
3.392. Appendix NV	5
3.393. Appendix NW	5
3.394. Appendix NX	5
3.395. Appendix NY	5
3.396. Appendix NZ	5
3.397. Appendix OA	5
3.398. Appendix OB	5
3.399. Appendix OC	5
3.400. Appendix OD	5
3.401. Appendix OE	5
3.402. Appendix OF	5
3.403. Appendix OG	5
3.404. Appendix OH	5
3.405. Appendix OI	5
3.406. Appendix OJ	5
3.407. Appendix OK	5
3.408. Appendix OL	5
3.409. Appendix OM	5
3.410. Appendix ON	5
3.411. Appendix OO	5
3.412. Appendix OP	5
3.413. Appendix OQ	5
3.414. Appendix OR	5
3.415. Appendix OS	5
3.416. Appendix OT	5
3.417. Appendix OU	5
3.418. Appendix OV	5
3.419. Appendix OW	5
3.420. Appendix OX	5
3.421. Appendix OY	5
3.422. Appendix OZ	5
3.423. Appendix PA	5
3.424. Appendix PB	5
3.425. Appendix PC	5
3.426. Appendix PD	5
3.427. Appendix PE	5
3.428. Appendix PF	5
3.429. Appendix PG	5
3.430. Appendix PH	5
3.431. Appendix PI	5
3.432. Appendix PJ	5
3.433. Appendix PK	5
3.434. Appendix PL	5
3.435. Appendix PM	5
3.436. Appendix PN	5
3.437. Appendix PO	5
3.438. Appendix PP	5
3.439. Appendix PQ	5
3.440. Appendix PR	5
3.441. Appendix PS	5
3.442. Appendix PT	5
3.443. Appendix PU	5
3.444. Appendix PV	5
3.445. Appendix PW	5
3.446. Appendix PX	5
3.447. Appendix PY	5
3.448. Appendix PZ	5
3.449. Appendix QA	5
3.450. Appendix QB	5
3.451. Appendix QC	5
3.452. Appendix QD	5
3.453. Appendix QE	5
3.454. Appendix QF	5
3.455. Appendix QG	5
3.456. Appendix QH	5
3.457. Appendix QI	5
3.458. Appendix QJ	5
3.459. Appendix QK	5
3.460. Appendix QL	5
3.461. Appendix QM	5
3.462. Appendix QN	5
3.463. Appendix QO	5
3.464. Appendix QP	5
3.465. Appendix QQ	5
3.466. Appendix QR	5
3.467. Appendix QS	5
3.468. Appendix QT	5
3.469. Appendix QU	5
3.470. Appendix QV	5
3.471. Appendix QW	5
3.472. Appendix QX	5
3.473. Appendix QY	5
3.474. Appendix QZ	5
3.475. Appendix RA	5
3.476. Appendix RB	5
3.477. Appendix RC	5
3.478. Appendix RD	5
3.479. Appendix RE	5
3.480. Appendix RF	5
3.481. Appendix RG	5
3.482. Appendix RH	5
3.483. Appendix RI	5
3.484. Appendix RJ	5
3.485. Appendix RK	5
3.486. Appendix RL	5
3.487. Appendix RM	5
3.488. Appendix RN	5
3.489. Appendix RO	5
3.490. Appendix RP	5
3.491. Appendix RQ	5
3.492. Appendix RR	5
3.493. Appendix RS	5
3.494. Appendix RT	5
3.495. Appendix RU	5
3.496. Appendix RV	5
3.497. Appendix RW	5
3.498. Appendix RX	5
3.499. Appendix RY	5
3.500. Appendix RZ	5
3.501. Appendix SA	5
3.502. Appendix SB	5
3.503. Appendix SC	5
3.504. Appendix SD	5
3.505. Appendix SE	5
3.506. Appendix SF	5
3.507. Appendix SG	5
3.508. Appendix SH	5
3.509. Appendix SI	5
3.510. Appendix SJ	5
3.511. Appendix SK	5
3.512. Appendix SL	5
3.513. Appendix SM	5
3.514. Appendix SN	5
3.515. Appendix SO	5
3.516. Appendix SP	5
3.517. Appendix SQ	5
3.518. Appendix SR	5
3.519. Appendix SS	5

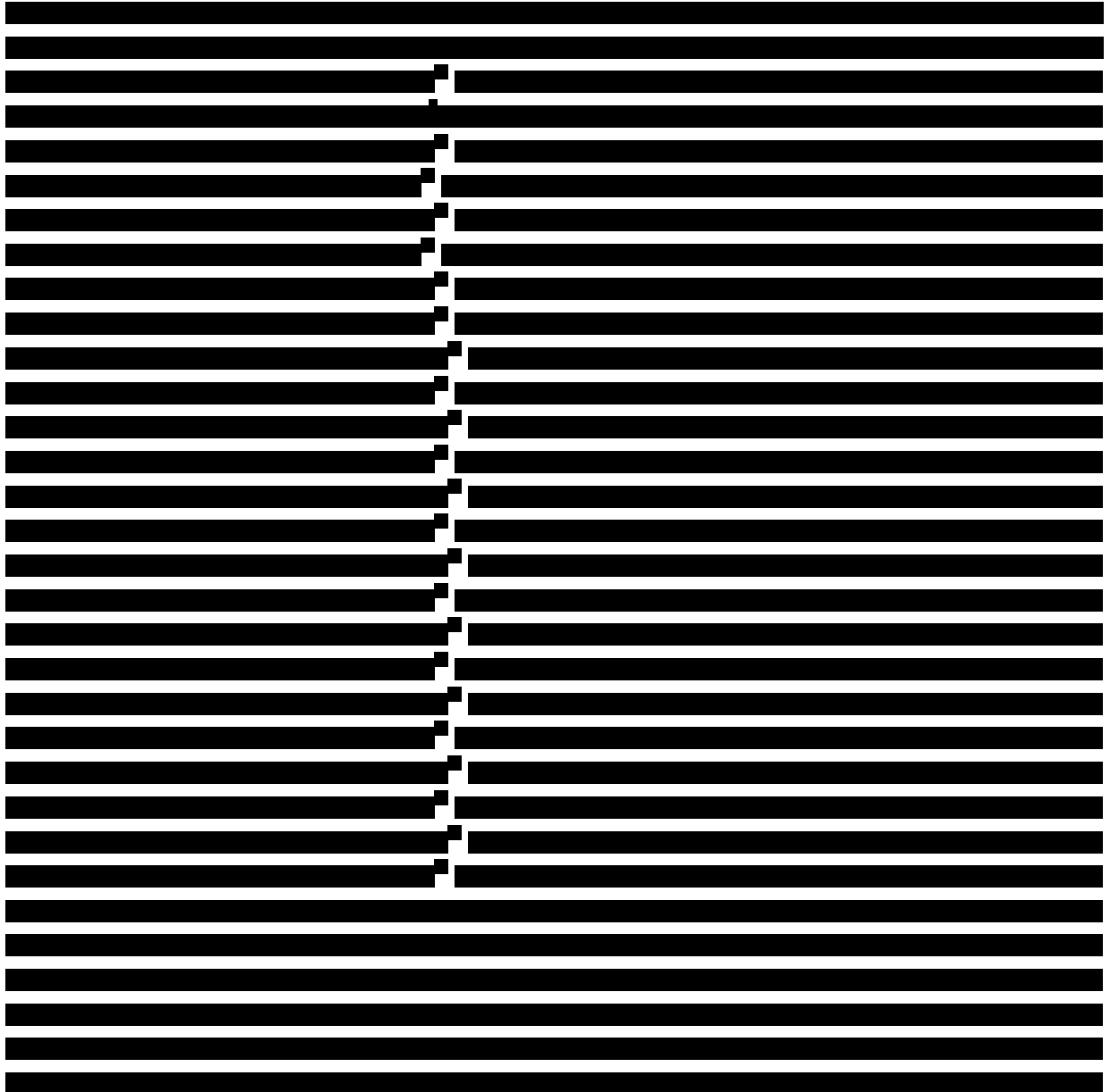
Figures

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Photographs

Photograph 2.1: Sediment 1 – TTR. X451. 2 kg. Post-grind tailings. Composite sample.	3
Photograph 2.2: Sediment 2 – Bulk 503D. Pre-grind. Ultra fines.	4
Photograph 2.3: Sediment 3 – Bulk 501. L2. P1. IBC. Tails. 11.7 kg.	5



1. Introduction

1.1. Background

Trans-Tasman Resources Ltd (TTR) plans to extract titanomagnetite sand (ironsand) from an area in South Taranaki Bight. As input to the Environmental Impact Assessment (EIA) for the proposed mining project, the National Institute of Water & Atmospheric Research Ltd. (NIWA) was commissioned by TTR to investigate the potential environmental impacts of the proposed extraction operation.

Following the refusal of consent by the Decision Making Committee in June 2014, TTR are re-assessing their scientific case as background for a possible appeal and re-hearing. One issue that arose was the need to re-assess the degree of uncertainty and conservatism in the NIWA sediment plume modelling studies and the interpretation of these results. In July 2014 HR Wallingford (HRW) undertook a review of the NIWA modelling work (HR Wallingford, 2014).

As a result of this review it became apparent that there was a degree of uncertainty as to how the tailings rejected from the ironsand extraction process might be expected to behave in a saline water environment. The assumptions for the NIWA plume modelling were that the materials released into the marine environment would remain in their particulate form (unfloculated) and would therefore have low settling velocities. It was also noted that the NIWA laboratory tests to support the assessment of the optical effects of the plumes had been carried out in fresh water. In September 2014 TTR commissioned HR Wallingford to undertake a series of laboratory tests to investigate the behaviour of the tailings under both saline and fresh water conditions. Tests were carried out to look at settling velocity, flocculation and critical shear stress for resuspension.

1.2. Scope of Work

The following laboratory tests were carried out by HRW on the supplied tailing sediments:

- Sediment specific gravity;
- Sediment particle size distribution;
- Settling tests;
- Turbidity tests;
- Settling velocity measurements;
- Flocculation measurements;
- Critical shear stress for deposition and erosion.

1.3. Report Structure

The remainder of this report comprises a further three sections. Section 2 describes the materials supplied by TTR for testing. Section 3 presents the methodology and results of the various tests undertaken and Section 4 summarises the results of the investigations.

2. Source Material

TTR arranged for three samples of sediment arising from the ironsand extraction process to be delivered to HRW in two 25 litre airtight plastic containers. The accompanying covering letter from TTR stated that the samples are fine sediment that:

1. Originate from the west coast of New Zealand.
2. Are samples that have been obtained from depths greater than 2m below the seafloor.
3. Have been heated to 100°C.
4. Is clean and free of quarantine risk material.
5. Are for material properties testing.
6. Have a commercial value of \$10.

The materials, which were received on 10 September 2014, are described in the sections below.

2.1. Container 1 of 2

Container 1 of 2 weighed 8.9 kg and contained two sediment types.

2.1.1. Sediment 1 (grip seal plastic bag)

Bag label: TTR. X451. 2 kg. Post-Grind Tailings. Composite Sample.

The contents of the Sediment 1 bag, which weighed 2.0 kg, are shown in Photograph 2.1. The material was a very fine grey powder, where there were smaller lumps these broke down very easily between the fingers leaving fingers with a fine covering of powder.



Photograph 2.1: Sediment 1 – TTR. X451. 2 kg. Post-grind tailings. Composite sample.

2.1.2. Sediment 2 (woven polypropylene bag)

Bag label: Bulk 503D. Pre Grind. Ultra Fines.

The contents of the Sediment 2 bag, which weighed 6.05 kg, are shown in Photograph 2.2. The material comprised large dense lumps of clay type material that could be reformed by squeezing between the fingers. There appeared to be fine metallic looking particles present on some of the exposed edges.



Photograph 2.2: Sediment 2 – Bulk 503D. Pre-grind. Ultra fines.

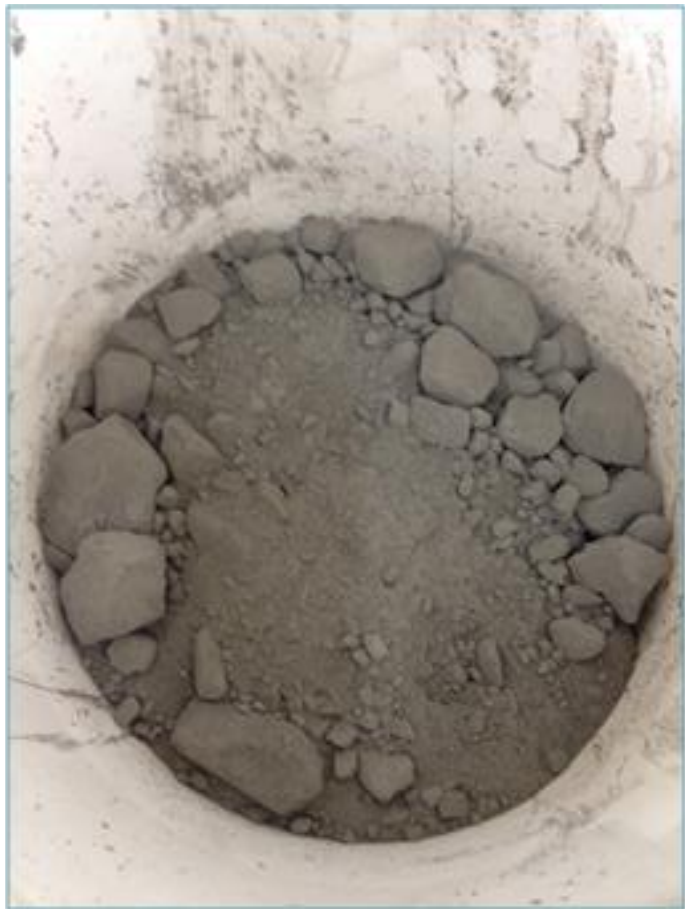
2.2. Container 2 of 2

Container 2 of 2 weighed 11.7 kg and contained one sediment type.

2.2.1. Sediment 3 (loose in sample container)

Container label: Bulk 501. L2. P1. IBC. Tails. 11.7 kg.

The contents of the Sample 3 container, which weighed 11.7 kg, are shown in Photograph 2.3. The material was largely a very fine powder with some lumps of various sizes, the largest having a width of about 60 mm. All lumps broke down very easily between the fingers leaving fingers with a fine covering of powder.



Photograph 2.3: Sediment 3 – Bulk 501. L2. P1. IBC. Tails. 11.7 kg.

3. Laboratory Testing

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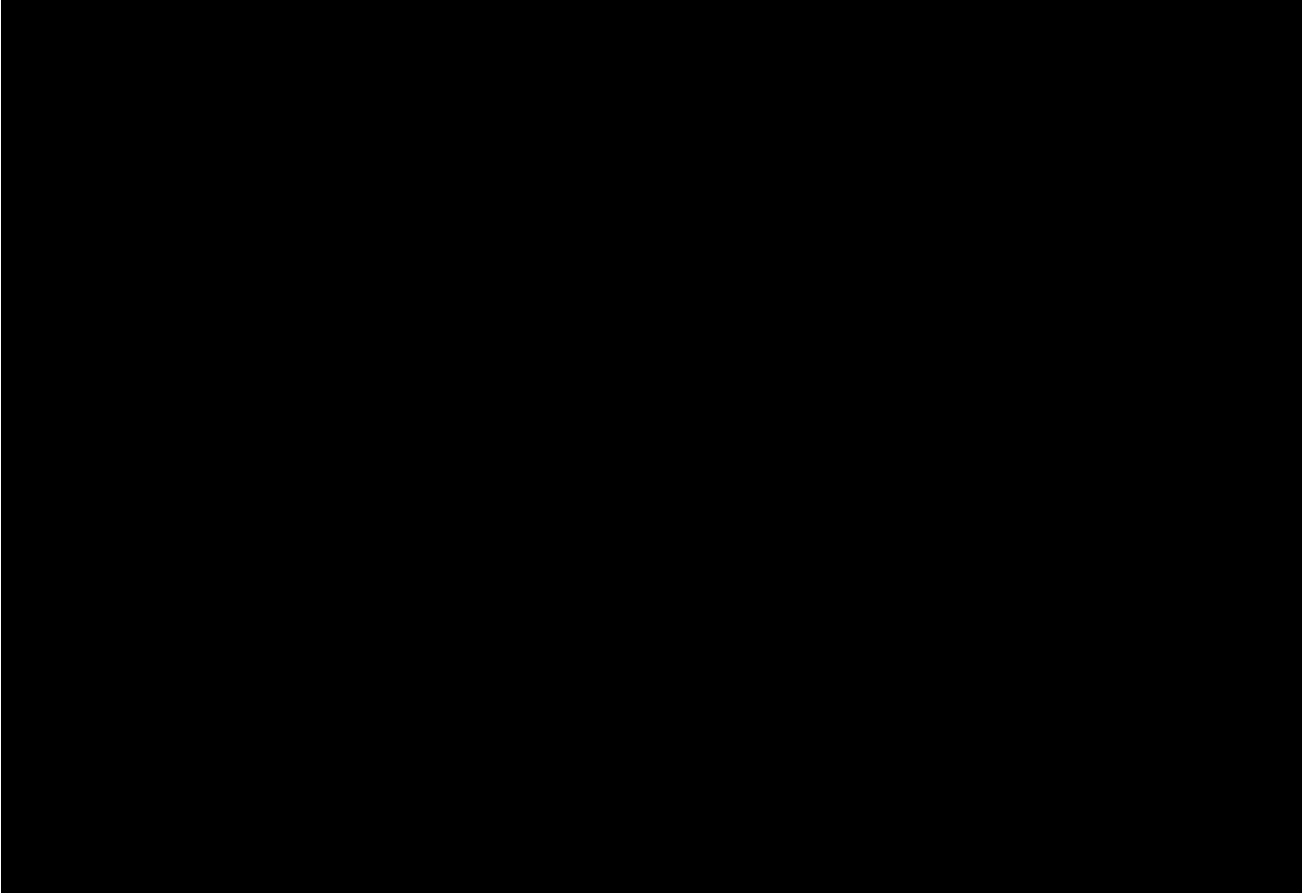
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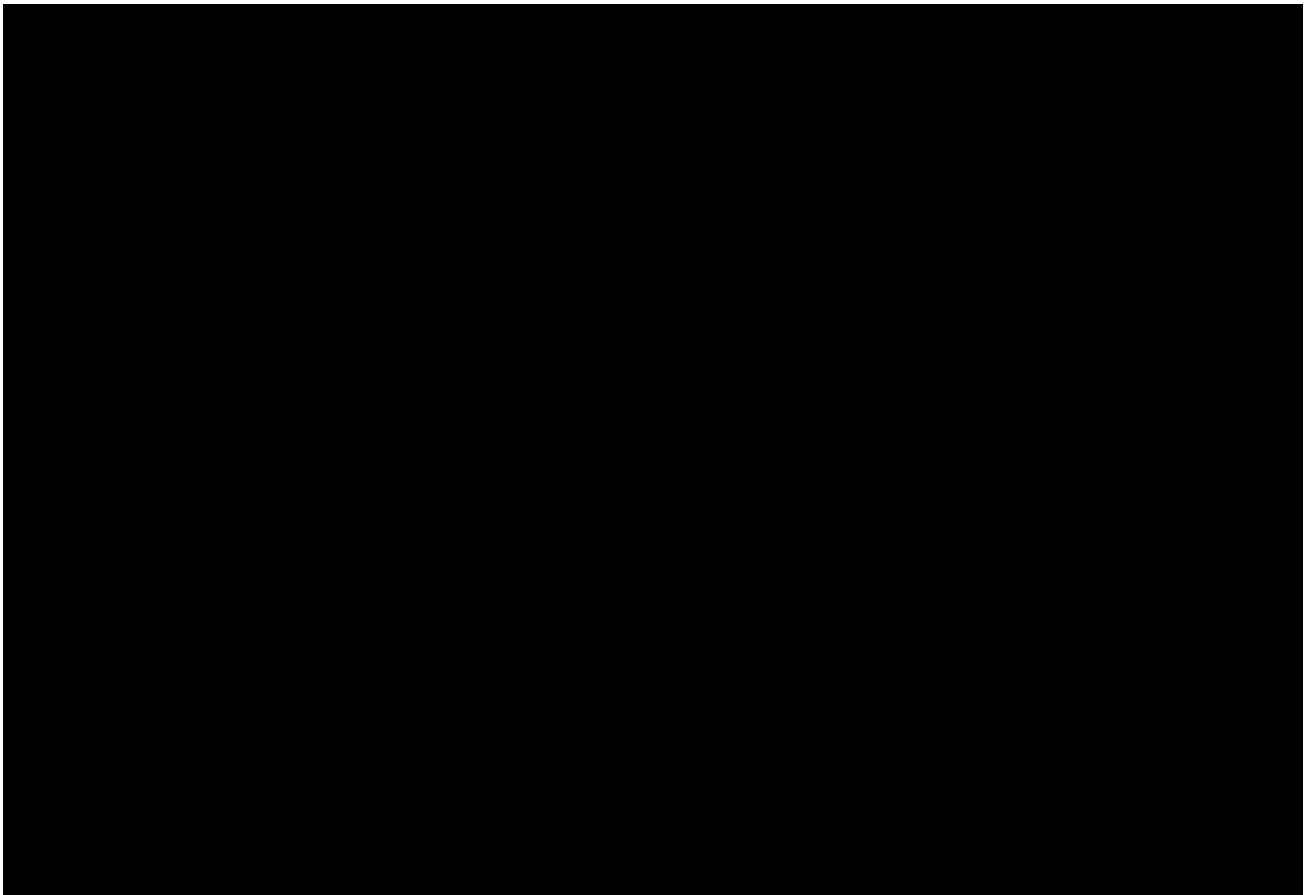
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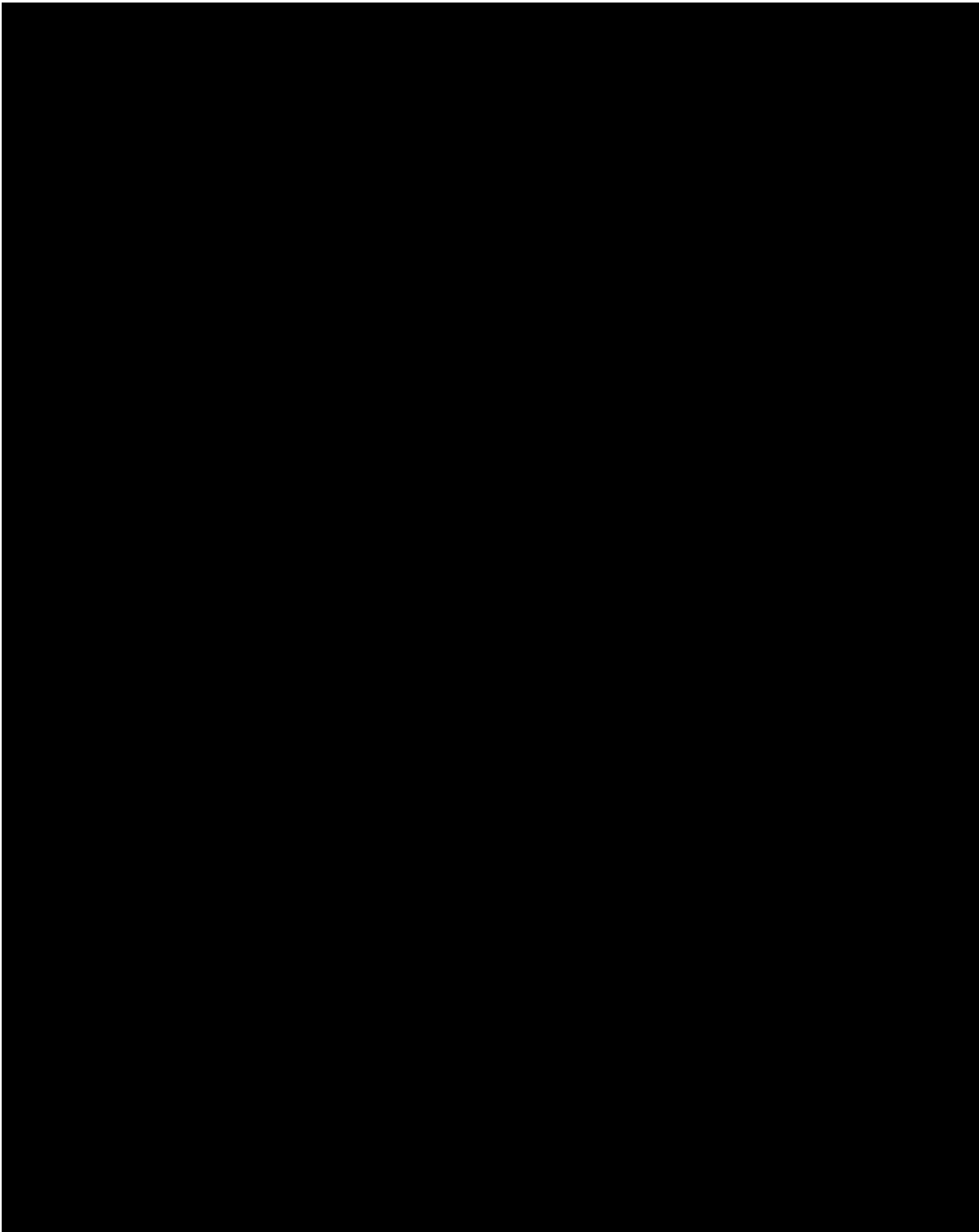
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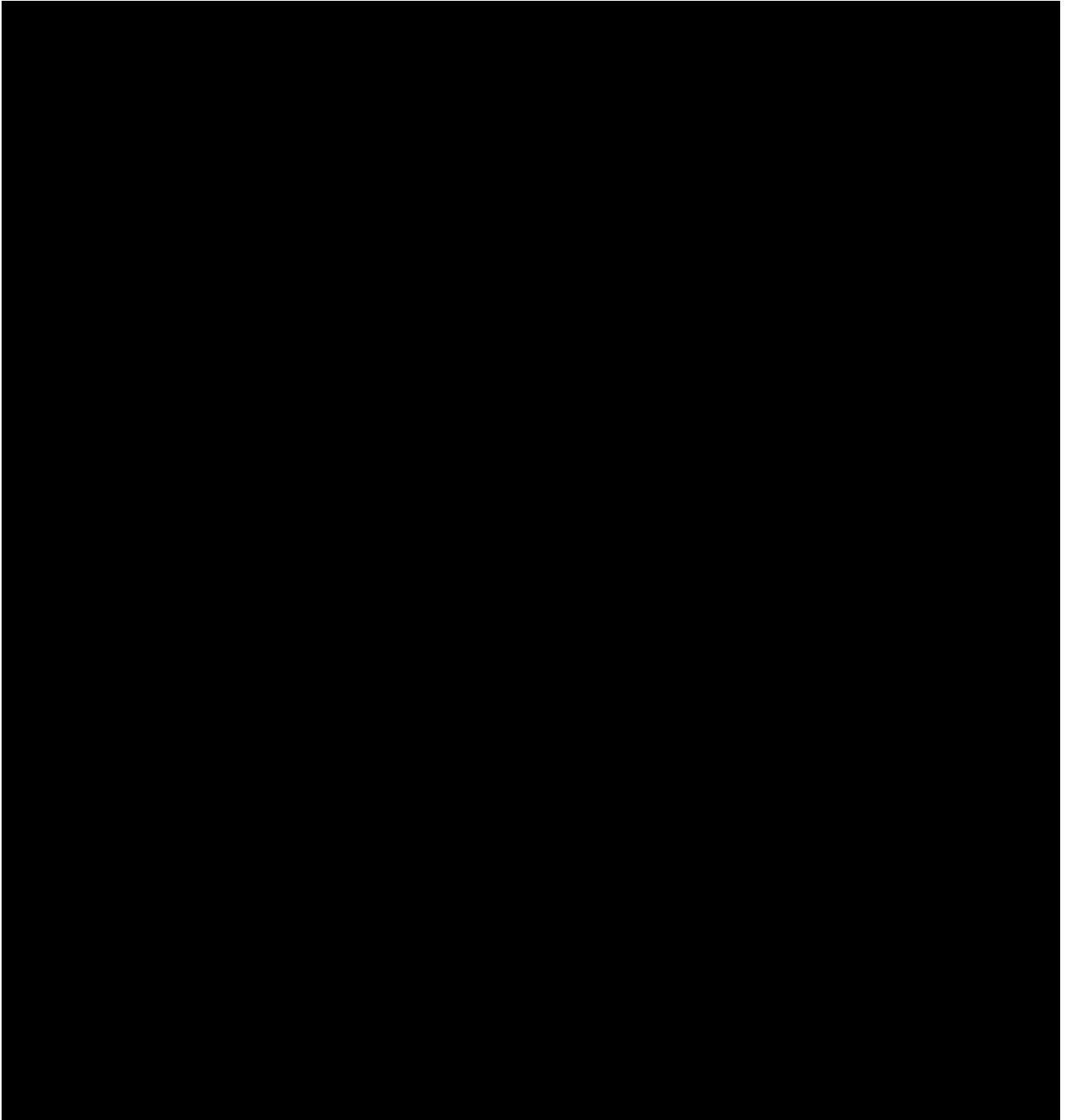
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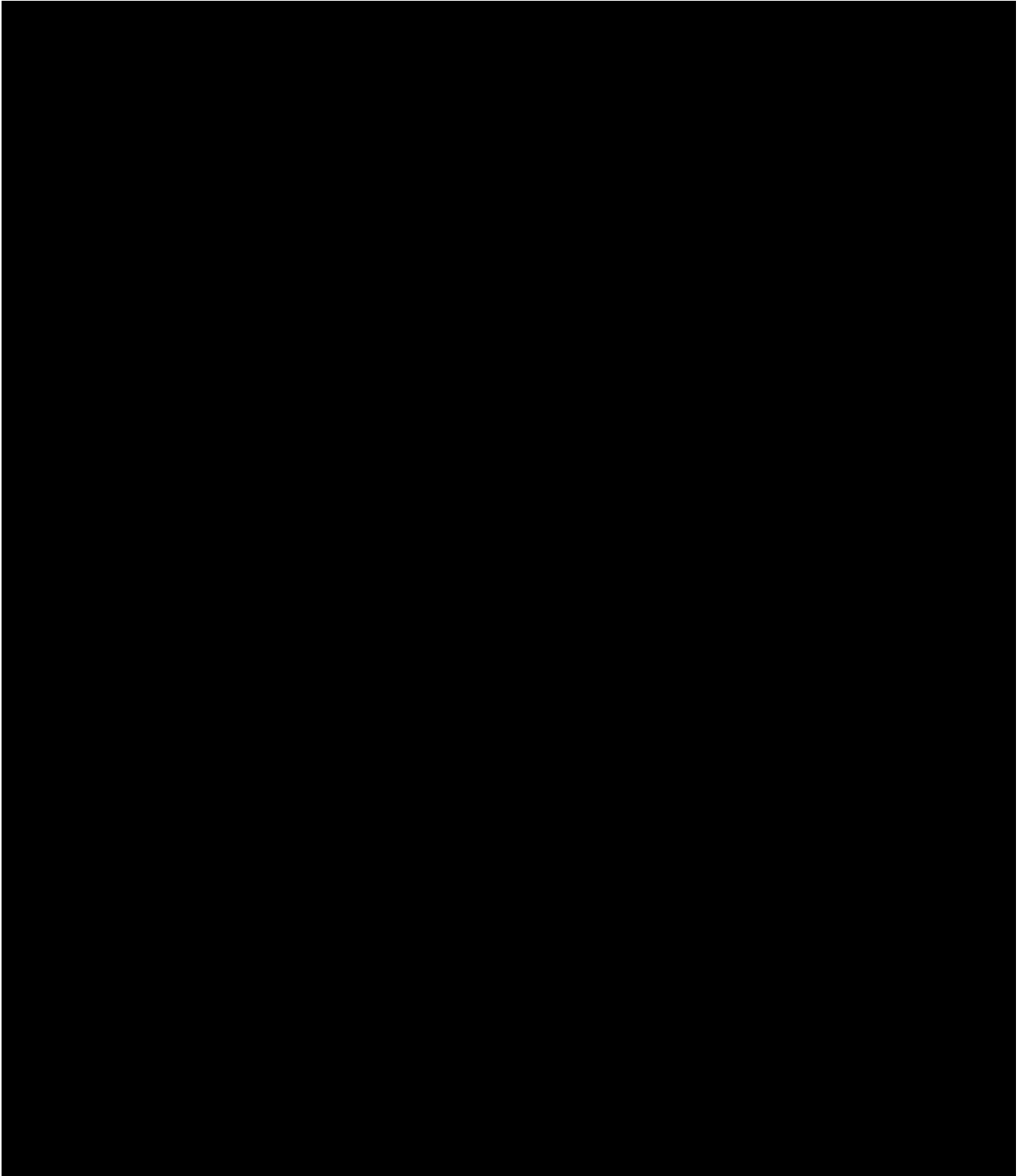
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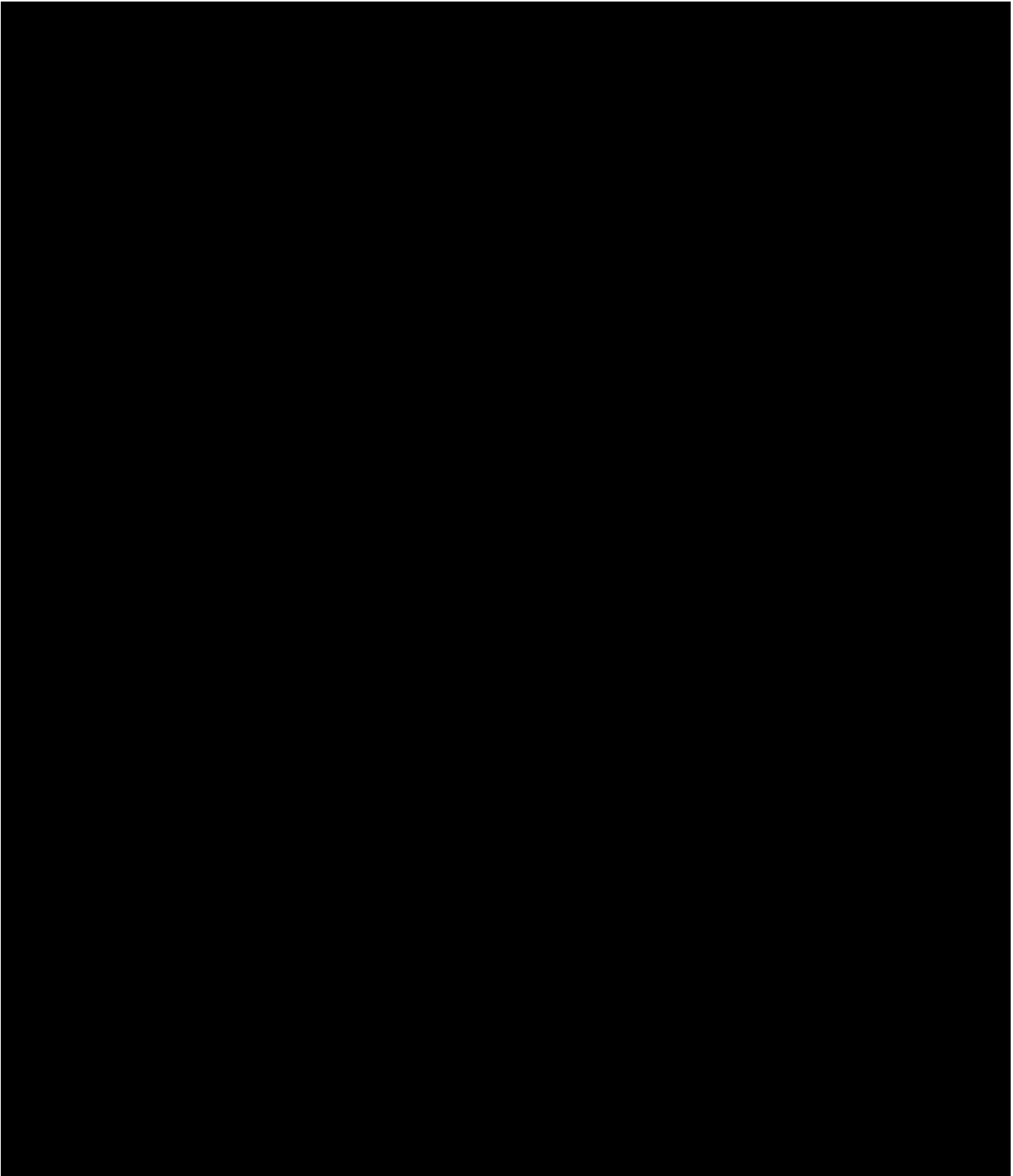


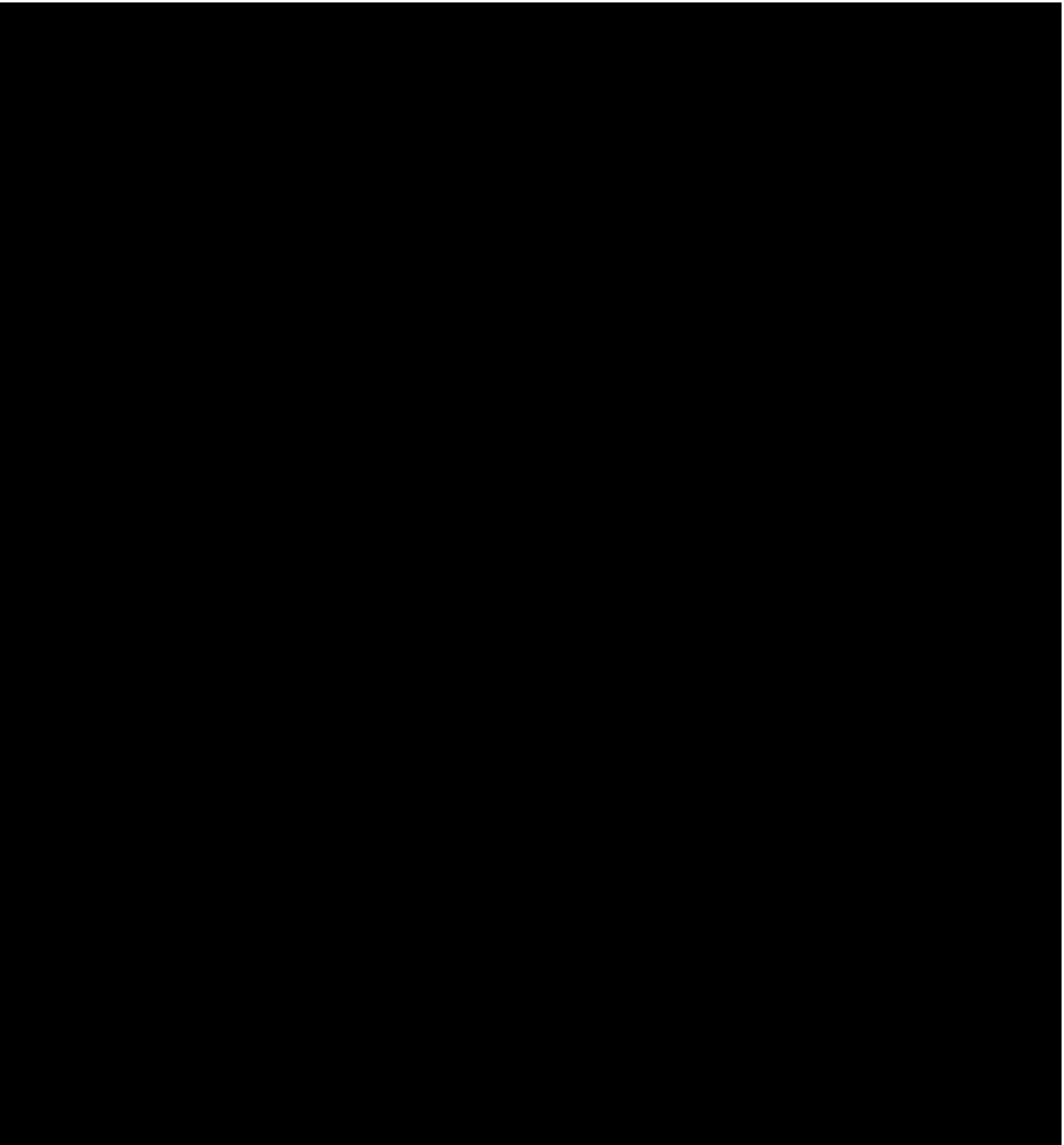
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3.5. Suspension Mass Tests

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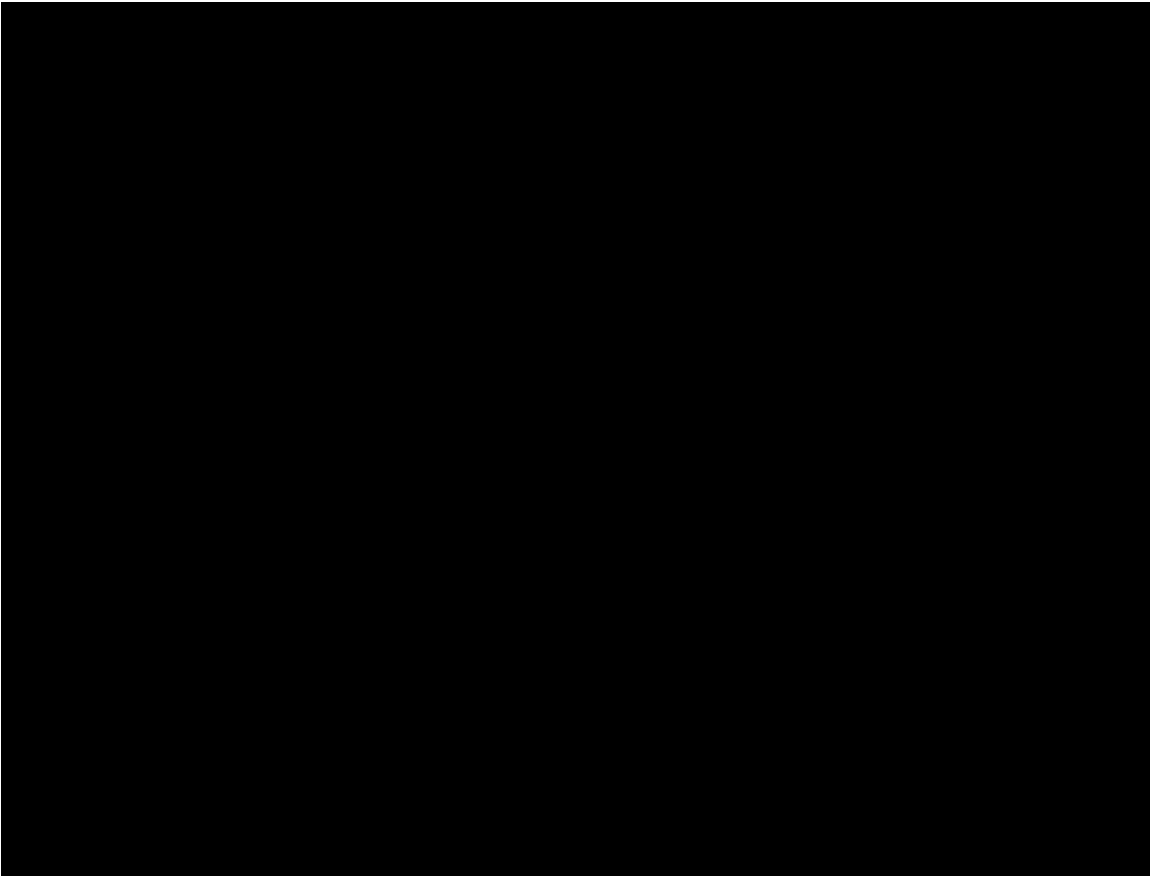
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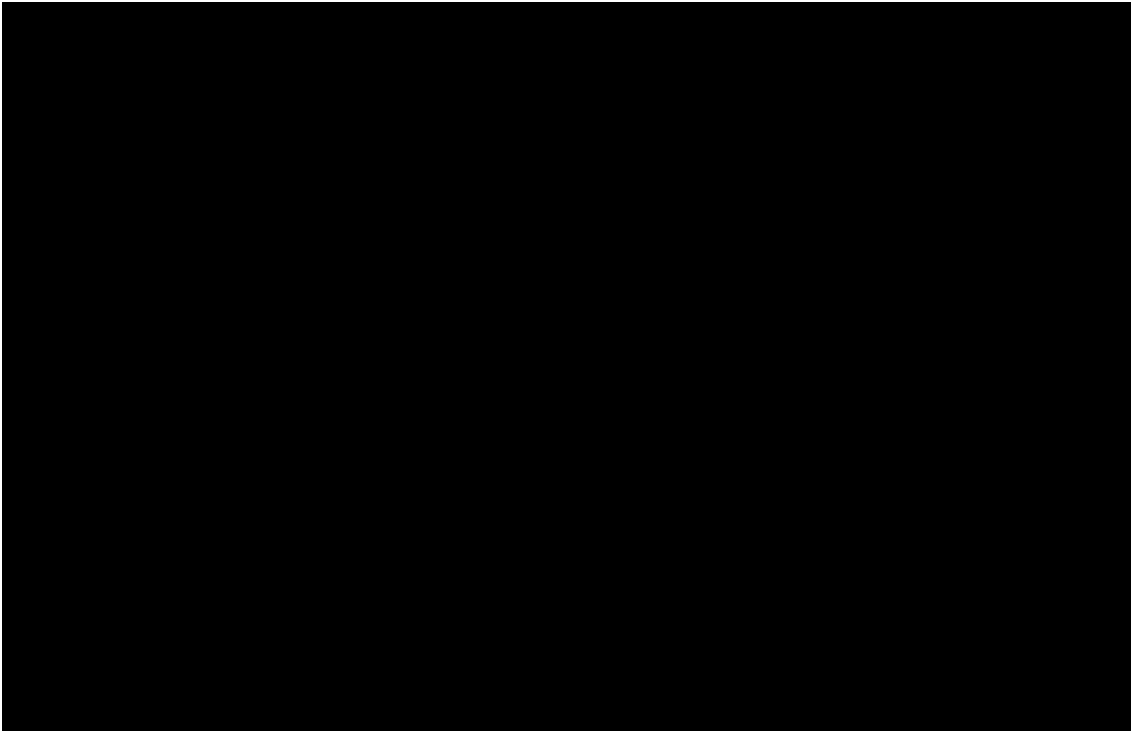
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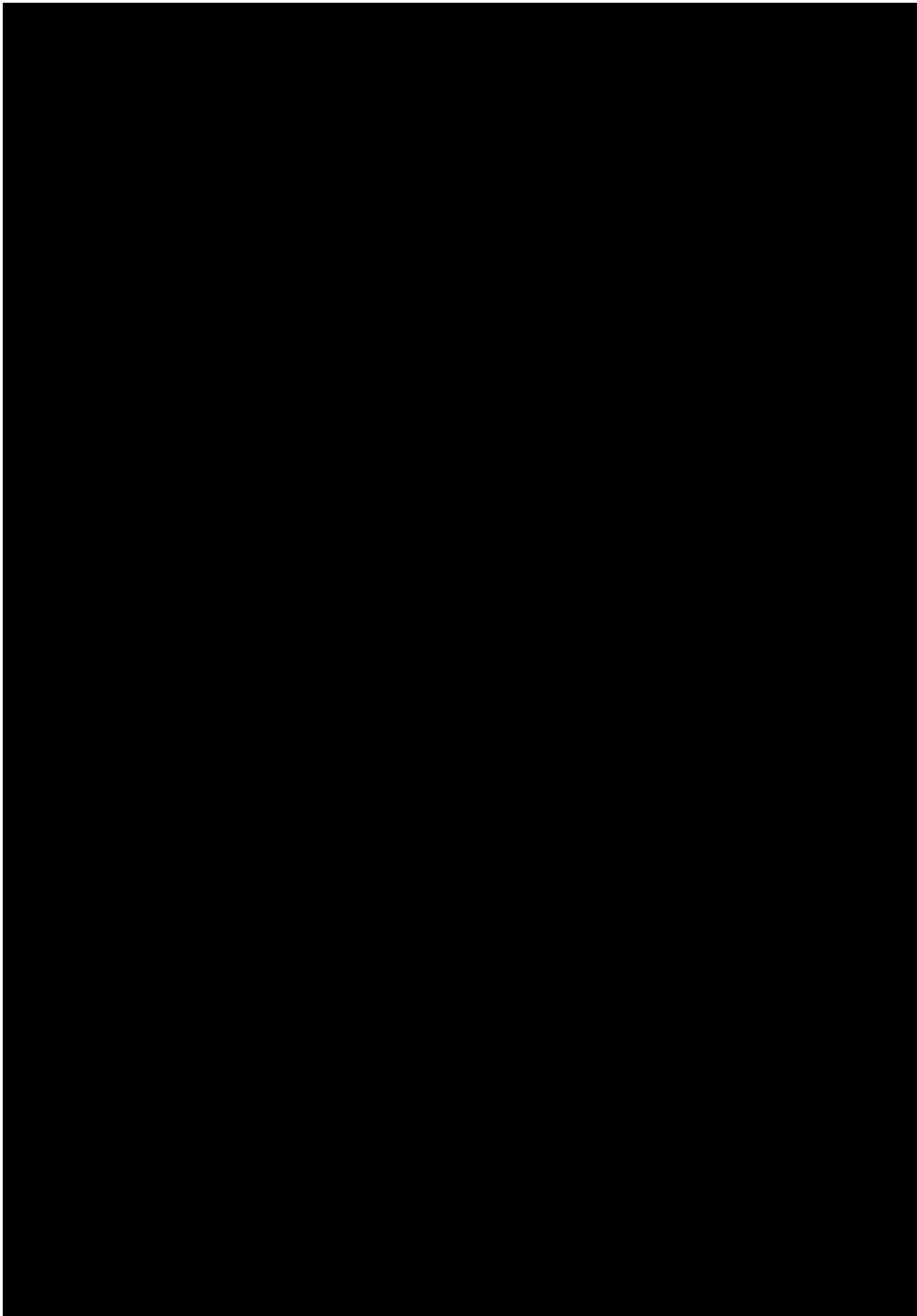
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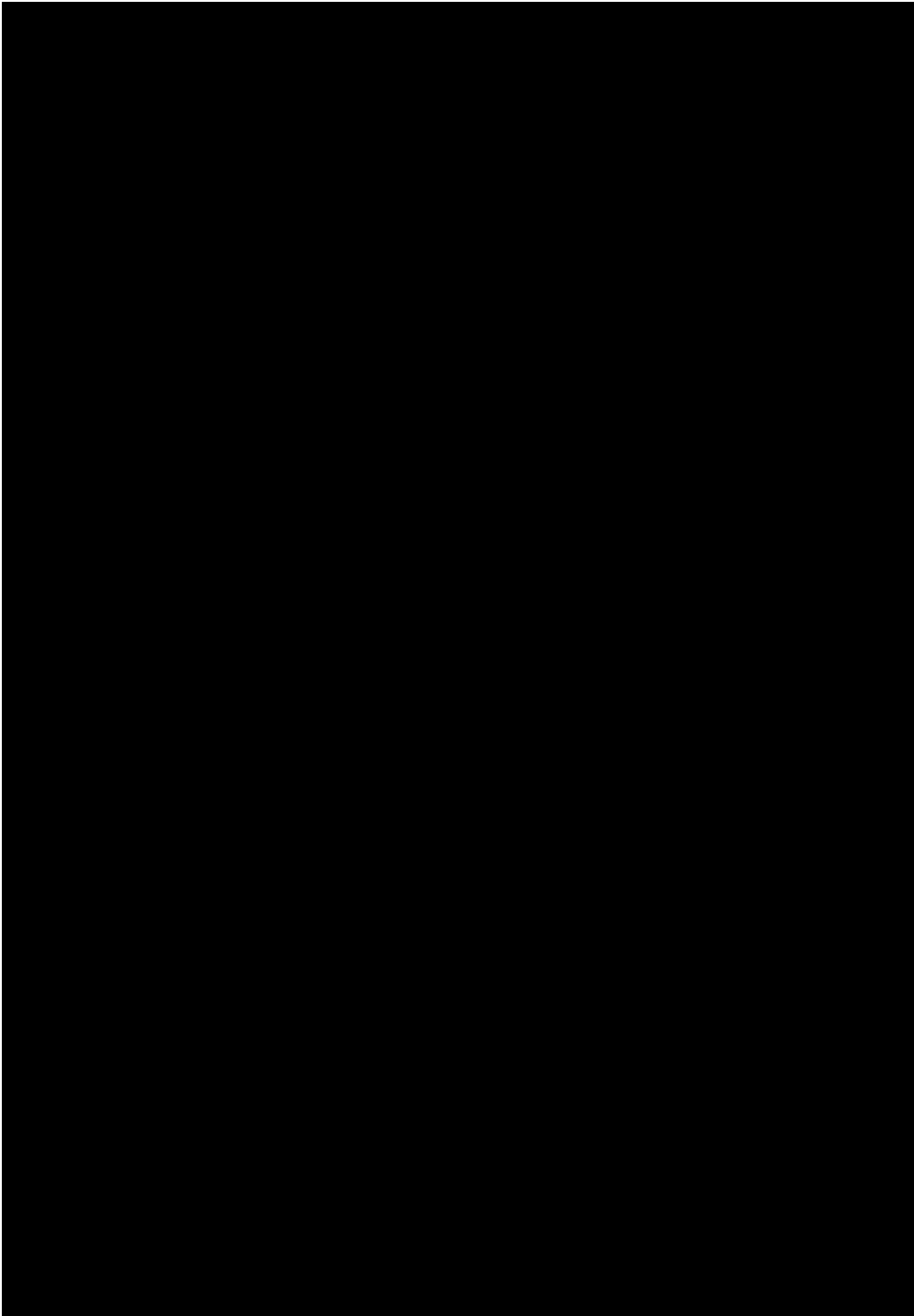
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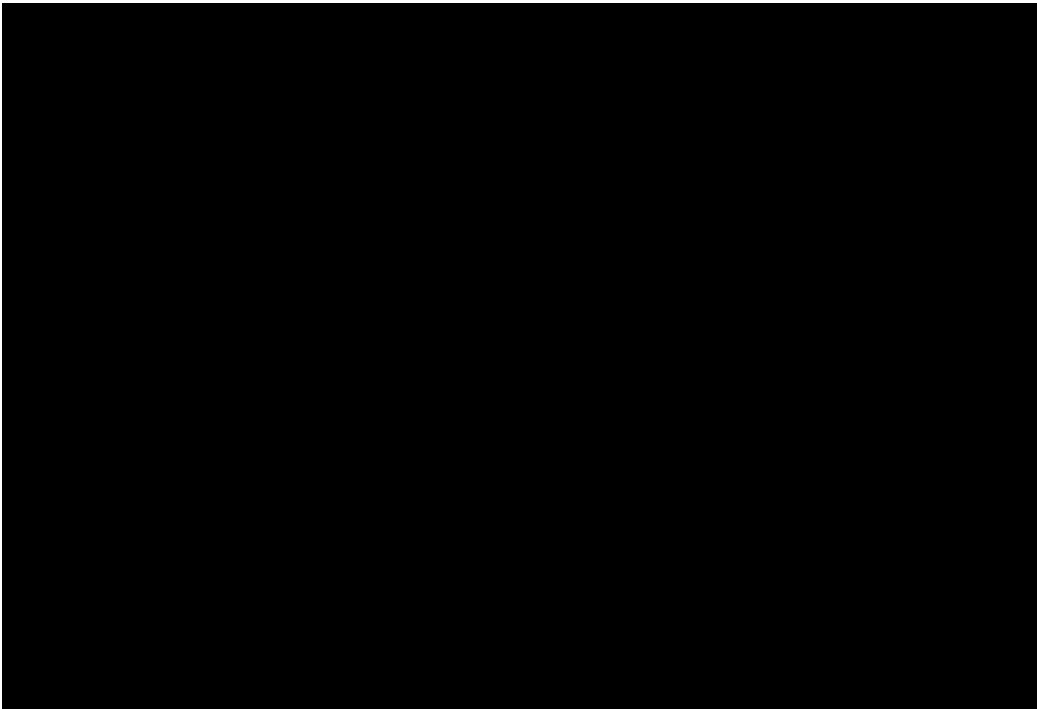
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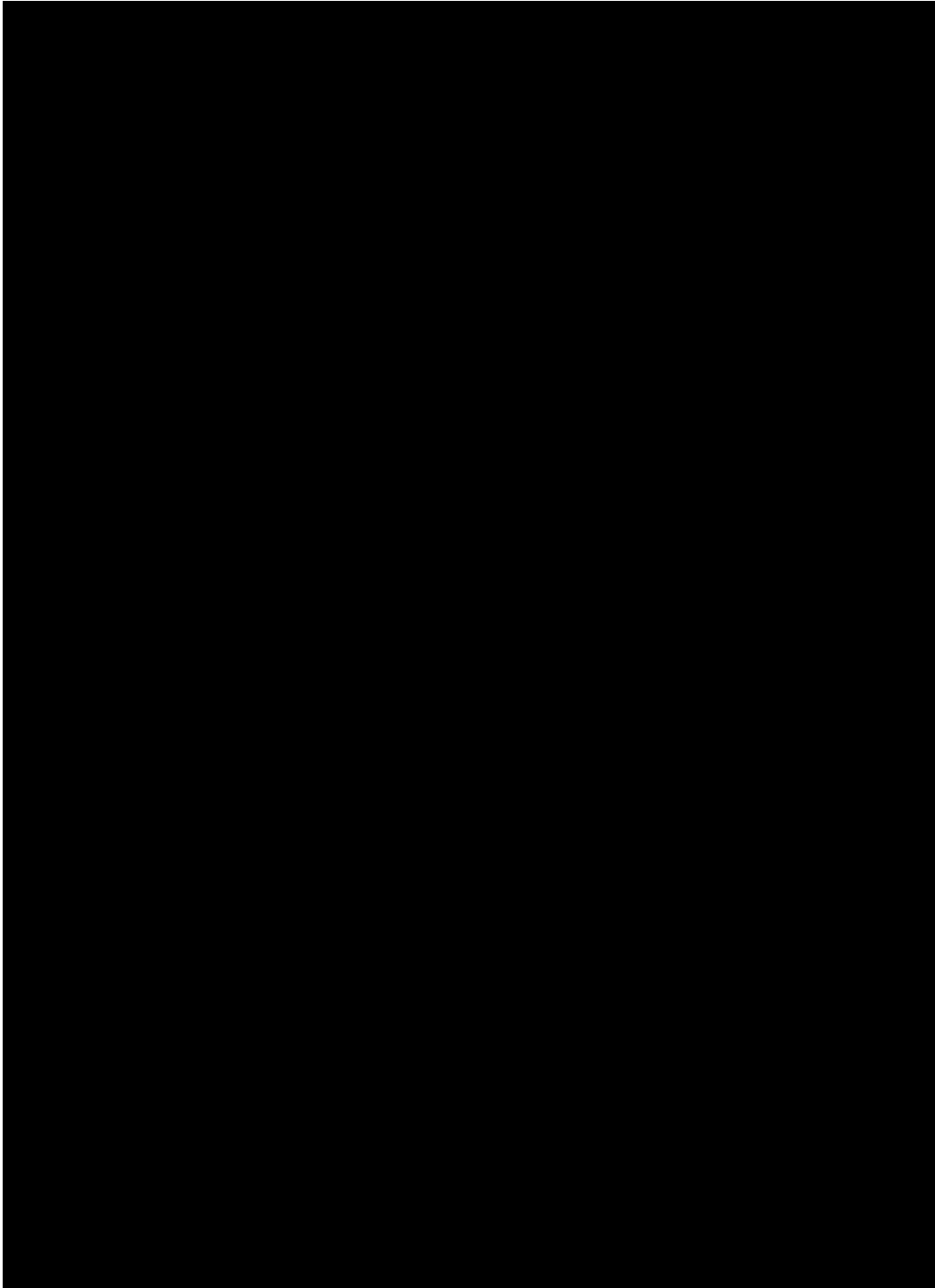
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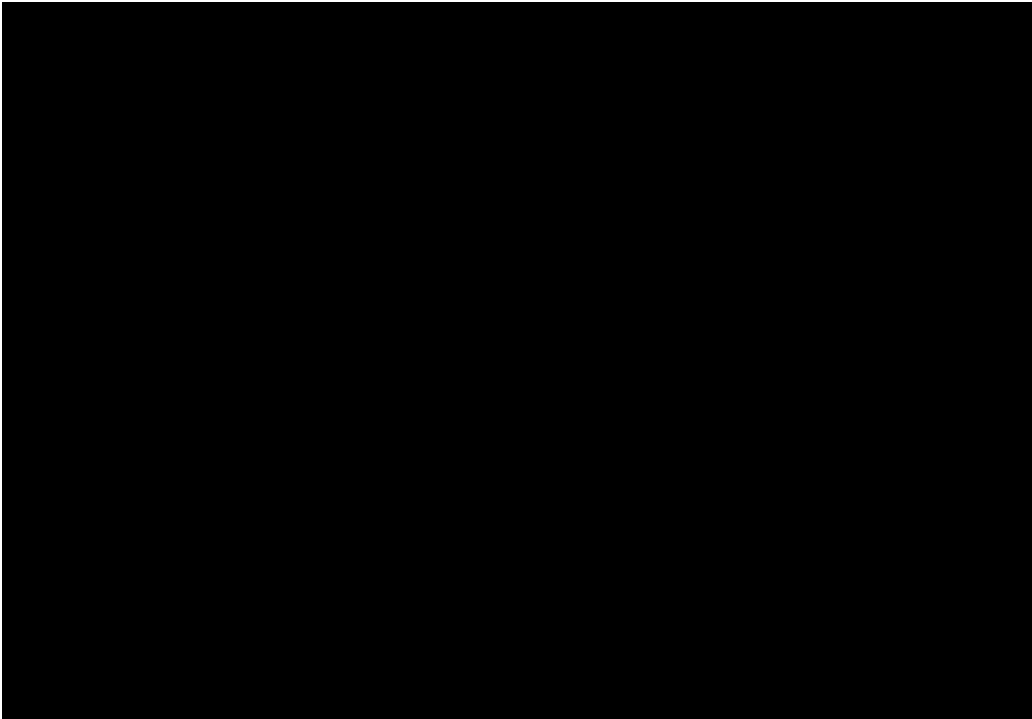
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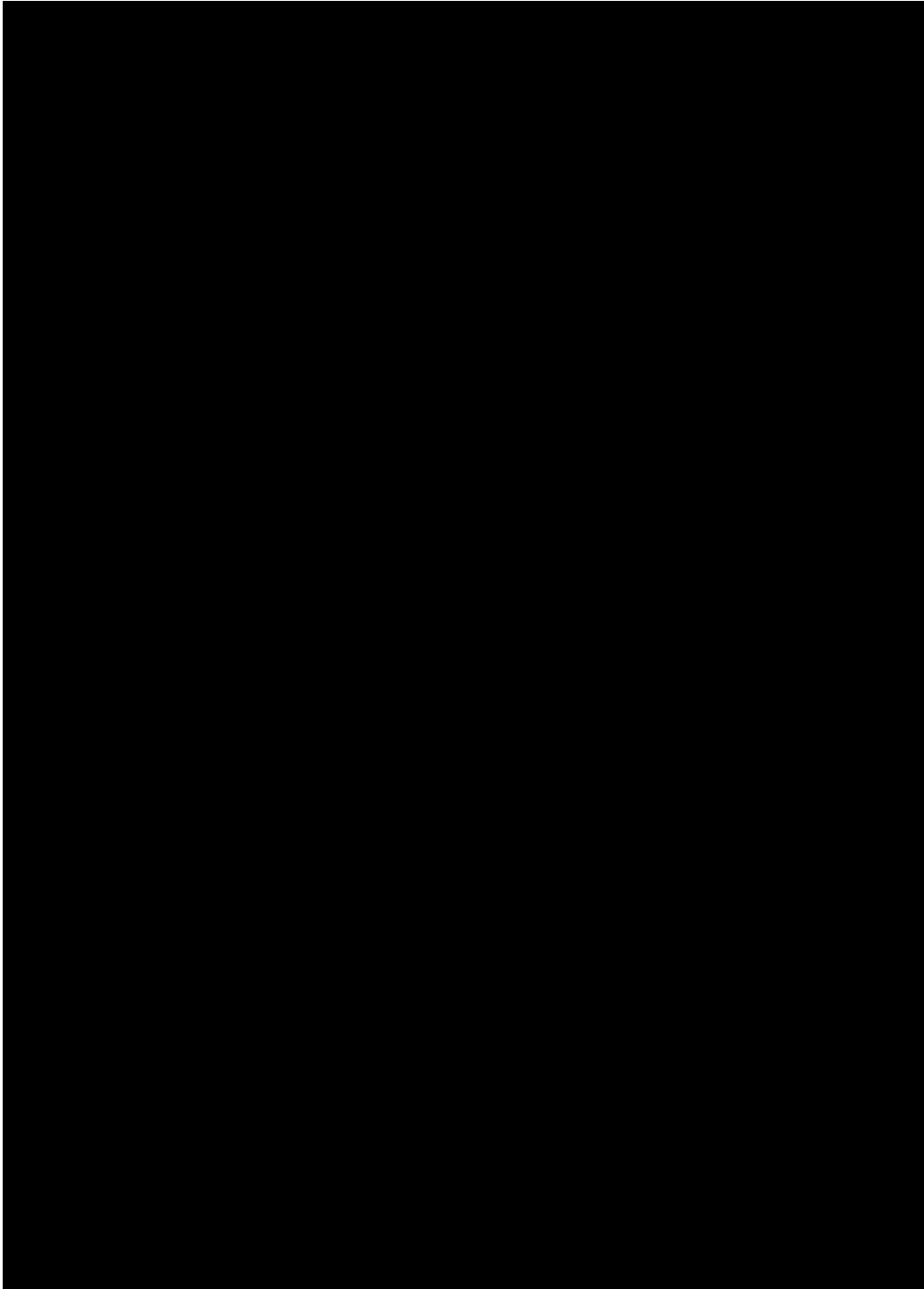
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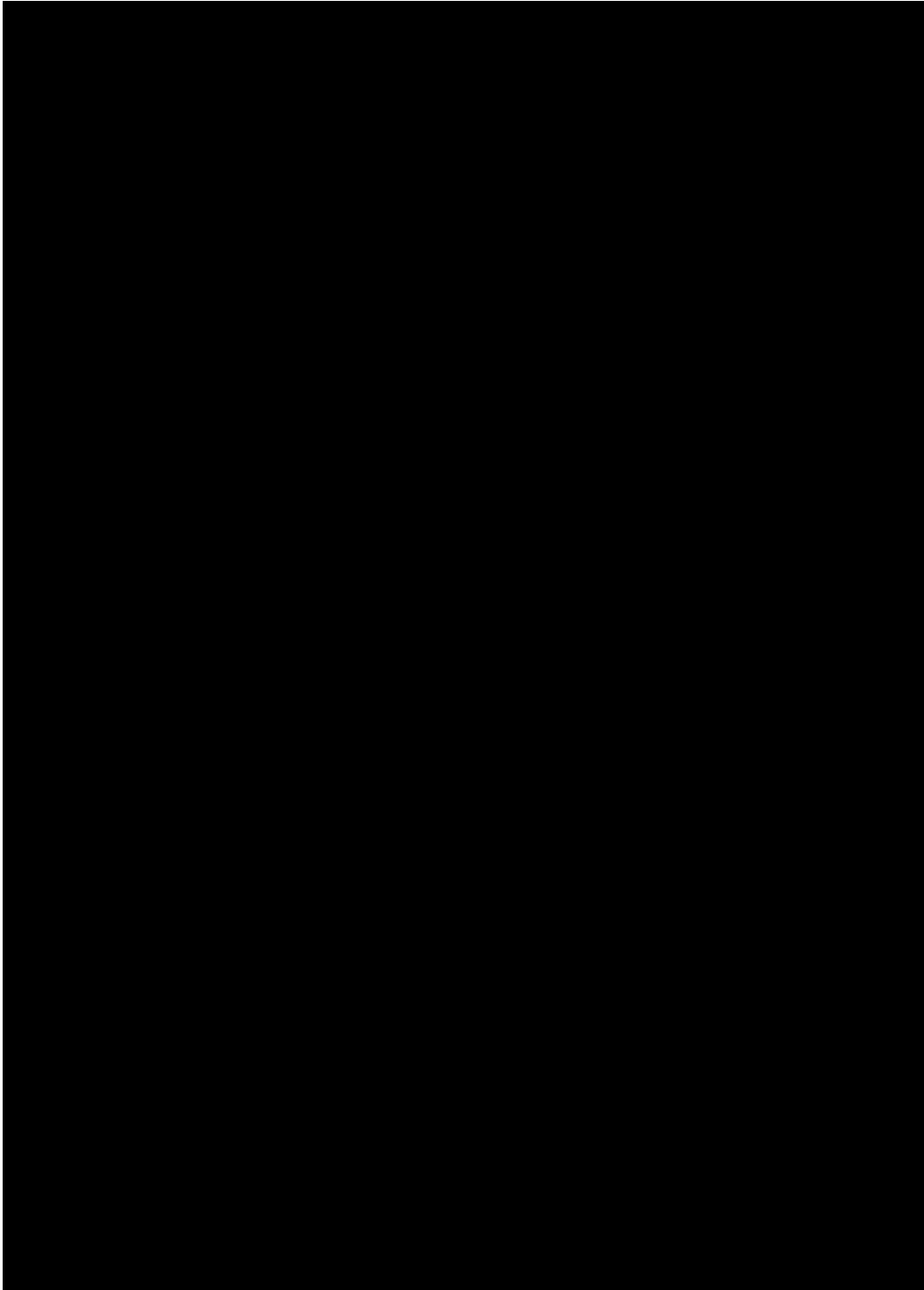
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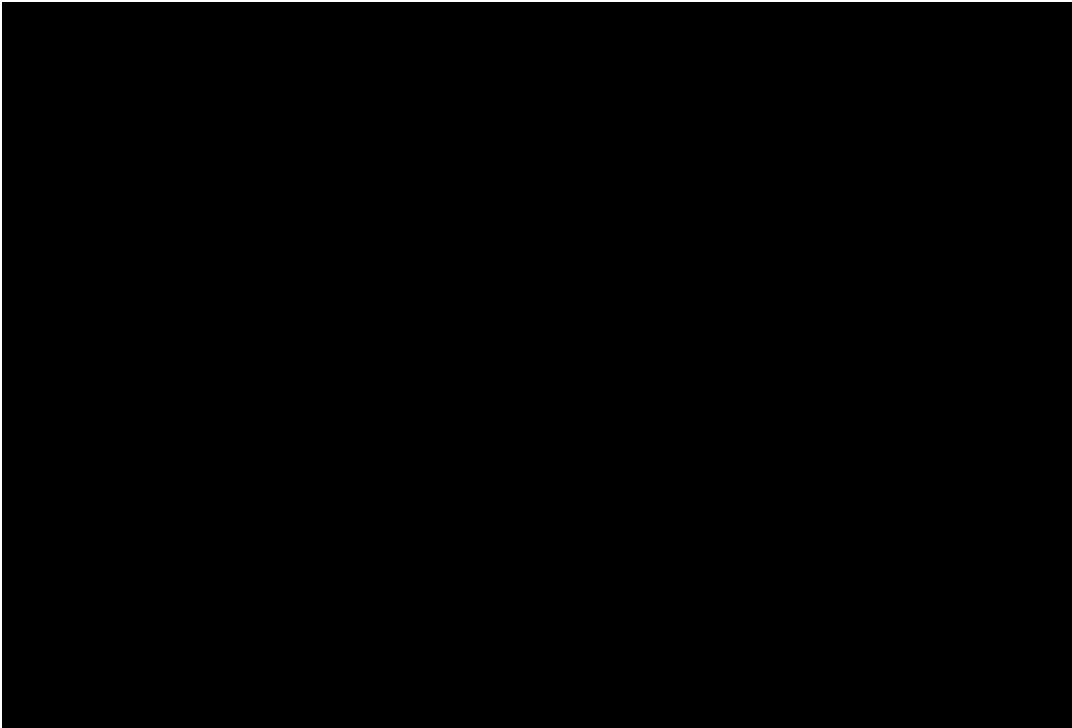
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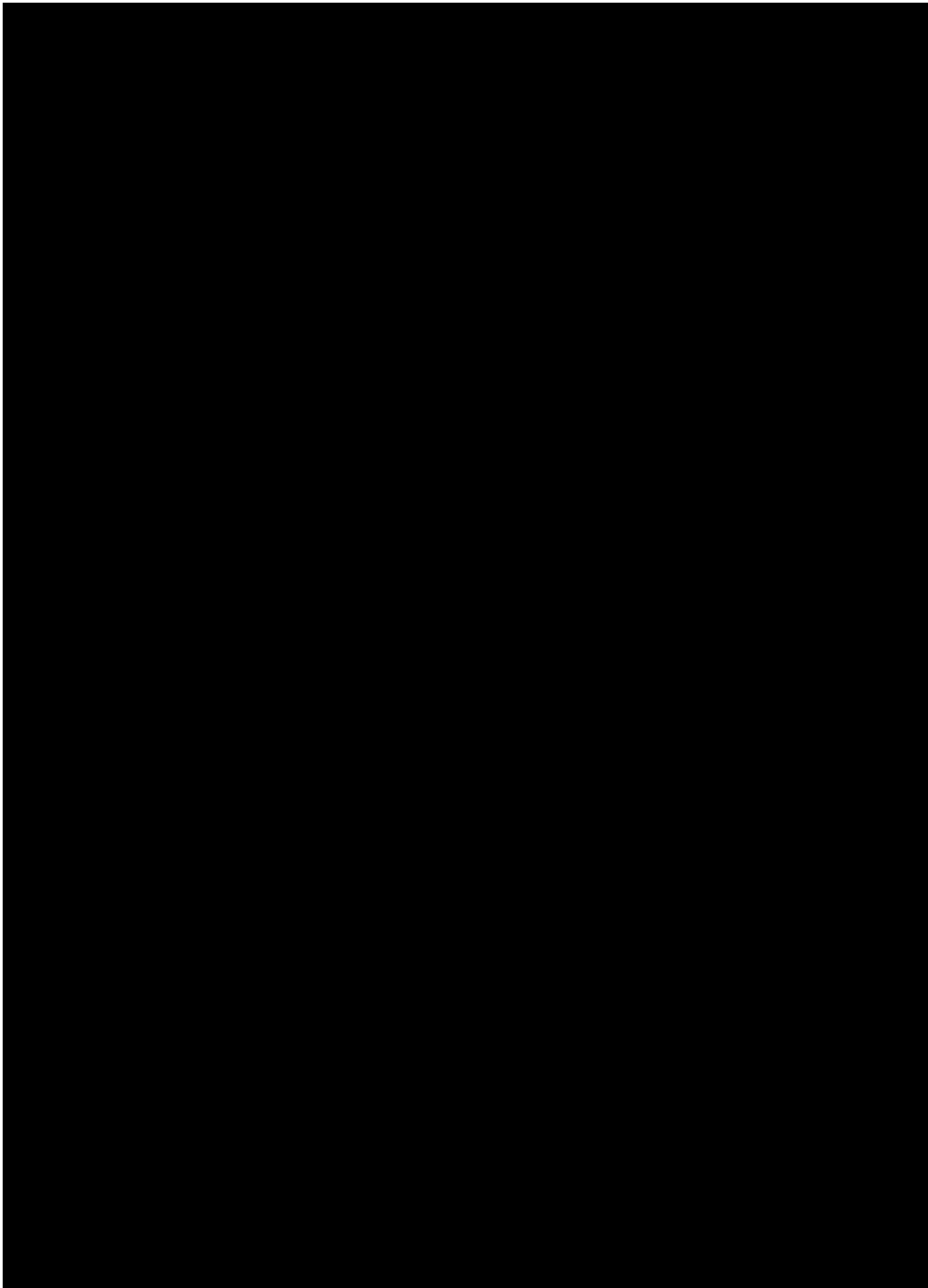
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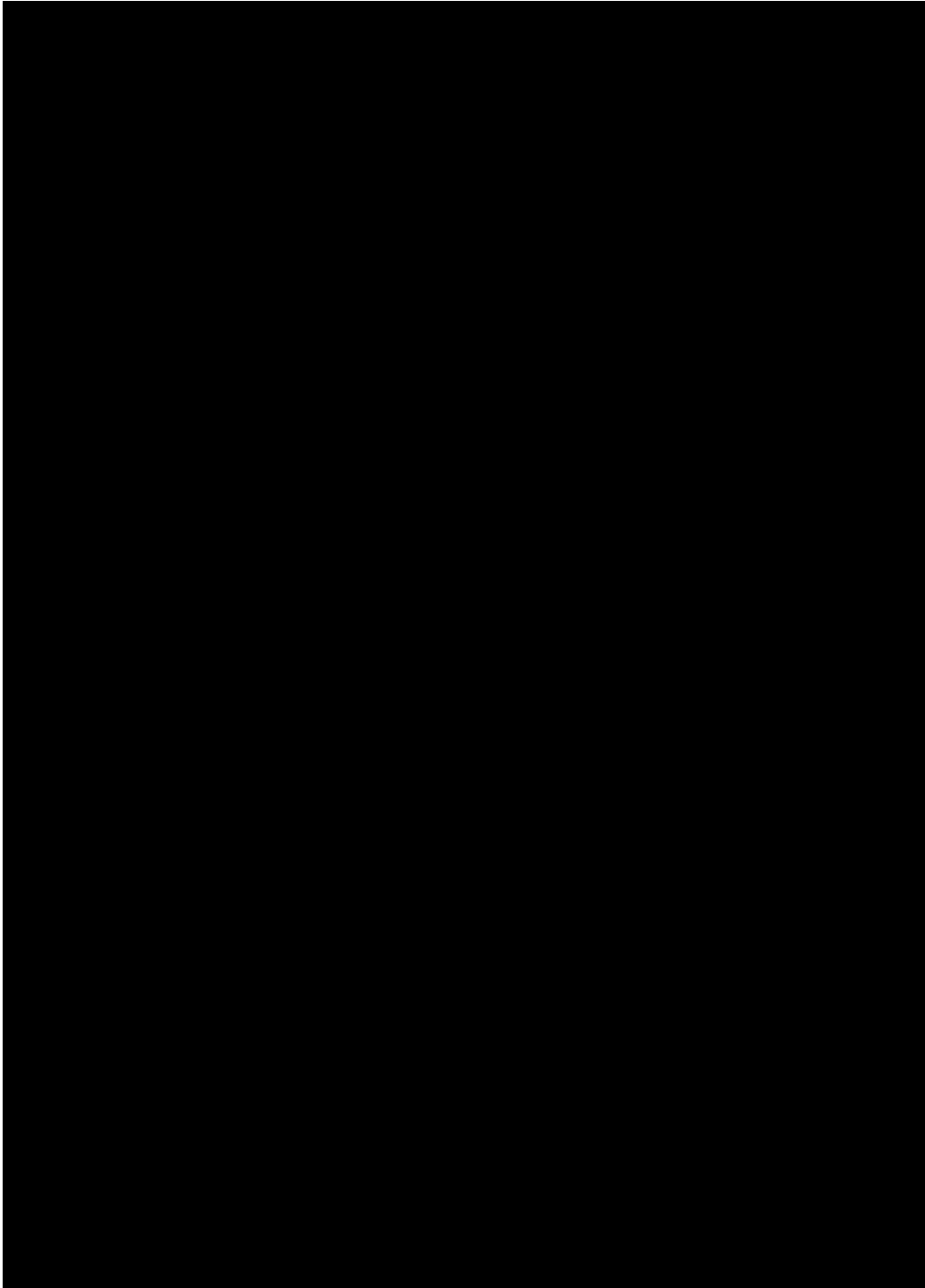
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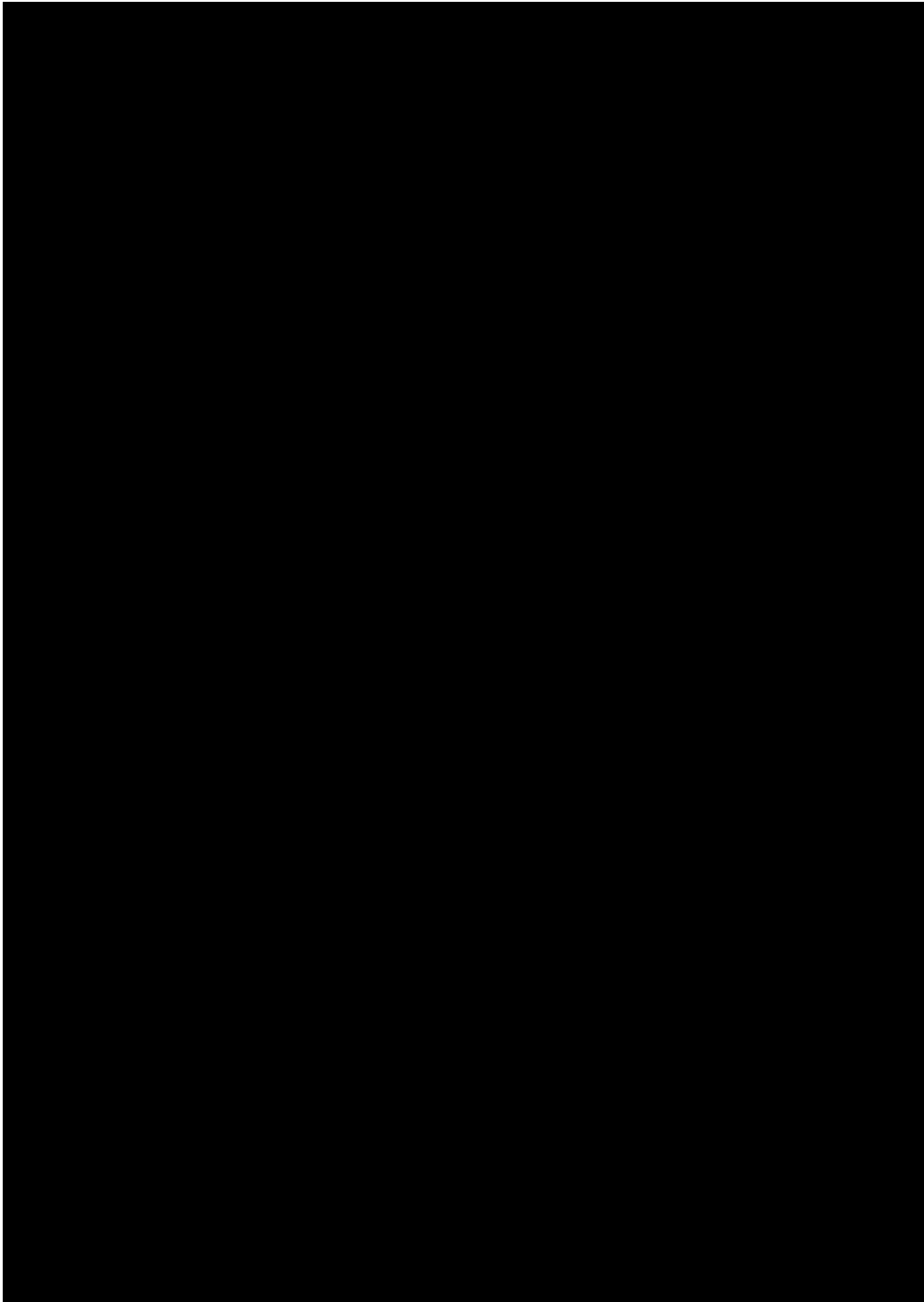
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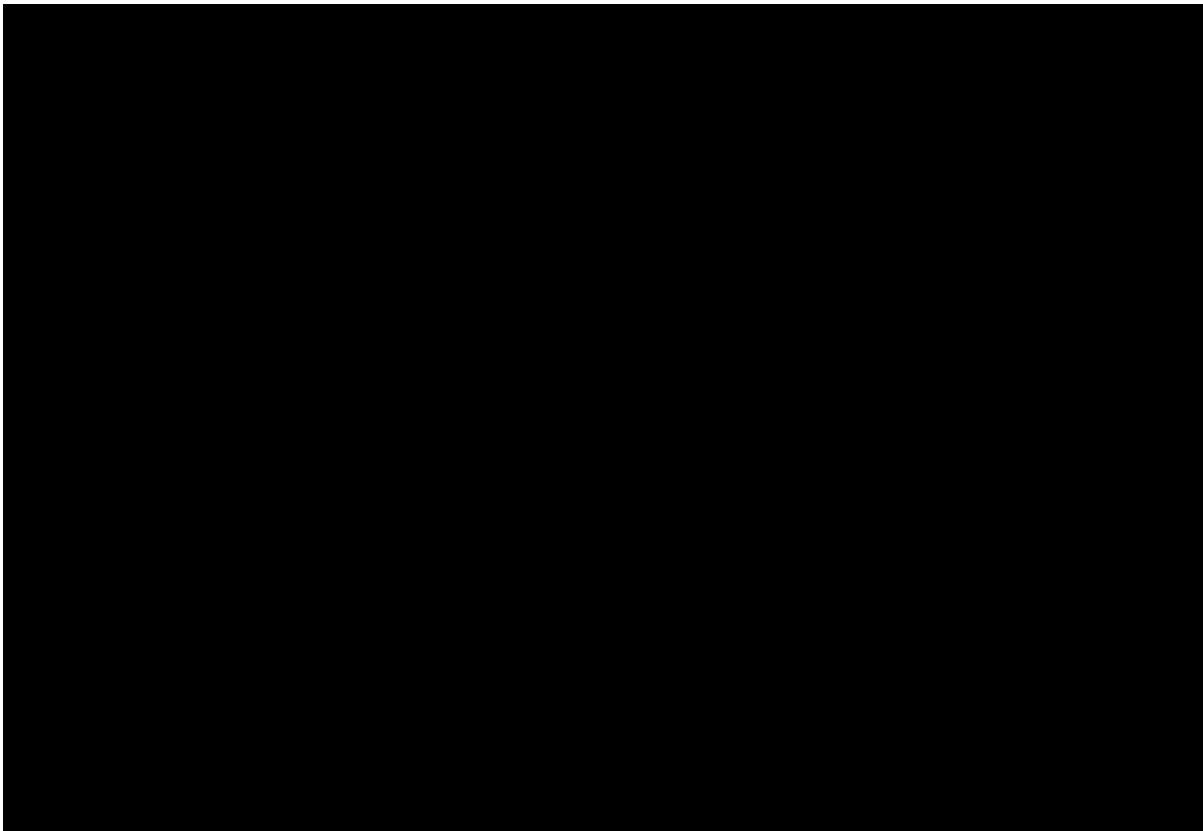
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4. Discussion of Results

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