

Assignment 1: Using a project design, preferably from a completed project with which you have had direct involvement, critically assess the extent to which the design successfully delivered a contextualised research design, appropriate methodology, effective project management and communication within and beyond the project team, and a suitable outcome in terms of publication and archive

Introduction

The application of isotope analysis to large-scale projects is becoming increasingly popular within academic and commercial sectors of archaeology (see for example: Parker Pearson *et al.* 2019; Smith and West 2019; MOLA Headland 2021). With its ability to extract otherwise invisible data directly from skeletal remains to facilitate interpretations of important aspects of past people's lives on an individual and population-level scale (Roberts 2022), it is no surprise that its use is in demand to expand data collection from excavated remains. This analytical technique was built into the methodology of the archaeological project design (APD – see supporting documentation) for the mass exhumation of an estimated 17,000 burials at Trinity Burial Ground (TBG) in Hull, undertaken by Oxford Archaeology (OA) with Humber Field Archaeology (HFA) as part of Highways England's improvements to the A63 at Castle Street (OA-HFA 2018; OA-HFA 2020b). As part of the project's off-site post-excavation analysis, the contract for the isotope work was awarded to Durham University's Archaeological Isotope and Peptide Research Laboratory (AIPRL) to analyse a sub-sample of the excavated remains and produce a specialist report (AIPRL 2023 – see supporting documentation). To critically assess the successful delivery of different aspects of the APD, the document will be considered alongside AIPRL's specialist report and experience throughout the project to evaluate how effectively the initial design's plan was actualised. By examining the APD from the perspective of the sub-contracted specialists and exploring how the research design, proposed methodology, project management decisions and communication impacted the produced isotope report, this essay aims to highlight the strengths and weaknesses of the design's delivery. Additionally, it is important to preface this essay with the acknowledgement that due to the juniority of the author's current role and novelty to it at the time of the project's undertaking, whilst the author was involved in limited sample preparation towards the end of the project, much knowledge of AIPRL's involvement is derived solely from reading the specialist reports and communication with AIPRL's research technician.

Archaeological Project Design

Although this essay will focus primarily on the delivery of the isotope work within the wider project, it is important to evaluate the impacts of the initial project design on the methodologies chosen to recover, sample, and analyse the excavated TBG burials. Due to the scale, complexity, and sensitivity of the TBG excavations, a separate APD (OA-HFA 2020b) was produced for this portion of the Main Line Works (OA-HFA 2020a), outlining the TBG project's background, research design, and methodology. The discussion of existing knowledge of the site and investigative work preceding the APD's creation was surprisingly brief for such a large-scale project, providing only basic details and summaries of findings from desk-based assessment and advanced archaeological works, and directing readers to other internal documents for further detail which unfortunately were not available to the author (e.g. OA-HFA 2014; 2016a; 2016b; Arup 2015; 2016). Admittedly, high levels of detail are not needed within supposedly concise documents like APDs (Historic England 2015) and are understandably omitted for sake of brevity. However, choosing not to reiterate important aspects such as basic osteological information (number of individuals excavated, age and sex profiles, etc.) from the initial burial assemblage recovered during evaluation trenching (OA-HFA 2016a) resulted in information foundational to the development of the chosen methodologies for large-scale exhumation and analysis being excluded, ultimately preventing readers from fully understanding the methodology's justification. Additionally, whilst the document acknowledges the unique context of the project as northern England's largest excavation of human remains from a 18th-19th century Church of England (CoE) burial ground (OA-HFA 2020b; OA 2021; 2024), no formal reference is made to either guidance provided by the Advisory Panel on the Archaeology of Burials in England (APABE) on choosing a suitable justified sampling strategy for excavation and analysis of large burial grounds (Mays *et al.* 2015), or any size-comparable excavations such as the contemporaneous New Bunhill Fields burial ground, Southwark, London (Miles and Connell 2012). This excluded information would again have been useful to inform methodology development, and ensure the project not only conformed to relevant guidance but had a comprehensive research design well-situated within its wider research context from the beginning (Mays *et al.* 2015). Consequently, if viewed independently as a standalone document, which an APD should be able to do (Historic England 2015), this project seems isolated from regional, national and even local research contexts within the scope of the wider A63 project, often missing opportunities to provide key information to support the business case for this potentially contentious mass exhumation (and subsequent costly analyses) from an archaeological research perspective, outside of the need of the land for road widening and to conform with legal requirements of the CoE Faculty (DAC 2018).

Despite these potential oversights, the APD still delivered a comprehensive and conscientious research design overall. The portrayal of the research framework as a matrix (Appendix 2: OA-HFA 2020b) linking relevant academic themes with the site's assessed research potential to create focused research questions (RQs) and clear objectives with which to address them, rationalised the project and its ambitions in a concise way that emphasised the importance of the chosen multidisciplinary approach and outlined how each project stage and its products will feed into the wider scheme to benefit key stakeholders and the public. This focus on cohesion and flow between aspects of the project is particularly evident in the methodology for recovering, analysing, and subsampling exhumed human remains as part of project stage 2 (OA-HFA 2020b). As the construction program required the removal of all burials from c. 32% of TBG (Highways England 2019), meticulous planning was crucial at all stages from recovery to reburial to ensure the project not only adhered to construction timelines, but also the tight restrictions placed on exhumation and analysis by the Diocesan Advisory Committee (DAC 2018). This was achieved through a pragmatic approach, whereby the 1500 individuals permitted through the Faculty for detailed on-site osteological analysis were selected using strict preservation criteria from sampling areas across the site, with other exhumations receiving basic osteological assessment following recognised standards (Brickley and McKinley 2004) and digital recording prior to reburial (OA-HFA 2020b). Although Historic England argued a greater number of remains be retained for analysis and not immediately reburied (Highways England 2019), this number was non-negotiable with the DAC and the chosen sampling strategy permitted a representative cross-section (roughly 10%) of the burial population to be examined in detail, whilst still ensuring all burials were recorded in some way to contribute towards a holistic understanding of TBG's inhabitants (OA-HFA 2020b; OA 2024). Furthermore, alongside such high numbers of burials needing to be lifted in a relatively short space of time (9 months), the excavation's main phase was also impacted by the Covid-19 pandemic but still managed to finish on schedule and within budget, attesting to the strength of the methodology and overall project design in ensuring targets were met despite the site's complex nature and having to mitigate severe unprecedented conditions (OA 2024). Ultimately, whilst some important contextualising details were left out of the APD, in practice this did not hinder the application of the research design and methodology in the field. However, to fully appreciate the influence of the APD on the project's successful delivery overall, it is also necessary to consider how this initial design facilitated the planned off-site post-excavation analyses (OA-HFA 2020b).

AIPRL Specialist Report

As one of the biochemical analysis techniques chosen to analyse a sub-sample of the 1500 individuals recovered from TBG, it was surprising and disappointing to see that so little time and detail was afforded to the outline of the isotopic study in the APD. Besides stating the planned use of carbon and nitrogen isotope analysis to explore dietary behaviour, and strontium and oxygen isotope analysis to investigate mobility and residential origins of around 10% of the previously sub-sampled burial population (OA-HFA 2020b), no further discussion of the methodology was provided or referenced to, despite a brief but more substantive description being included in the Main Line works APD (OA-HFA 2020a). It is evident that there was limited specialist consultation for post-excavation analyses during the project's creation, as only one external isotopes specialist was referenced in the Main Line APD (OA-HFA 2020a) and no standard practice or guidance documents (e.g. Mays *et al.* 2023) were cited in reference to the destructive biochemical analyses. Indeed, so little was the involvement of post-excavation specialists (excluding osteologists) throughout the project and its planning, that the TBG APD and related documentation was not seen by anyone at AIPRL involved in the contracted project until it was found online by the author for this essay (Moore *pers comm*). Although one of the planned products of project stage 3 was to produce a joint interim report and updated project design using the findings from fieldwork to inform the methodologies and refine RQs and objectives for post-excavation analyses (OA-HFA 2020b), this document could not be found online and was also not provided to AIPRL. Nevertheless, aside from this apparent lack of deliberation with relevant professionals, the APD's considerate allocation of a two-year timeframe for post-excavation analyses (OA-HFA 2020b) combined with formal and informal communication with AIPRL via email and digital meetings, ensured the isotope project was managed effectively, and suitable specialised RQs were developed directly with AIPRL based on the laboratory's capabilities (AIPRL 2023; Moore *pers comm*).

A summary of the findings from the final isotope report (AIPRL 2023) are presented in Table 1 and are linked to relevant RQ's and research themes to emphasise the scale of information recovered. Using a multi-isotope approach combined with trace element analysis allowed numerous avenues of interpretation to be explored such as sex and age differences, socioeconomic class, and health, disease, and medical treatment, which were compiled and gradually expanded upon across the progress summary (AIPRL 2021a), interim report (AIPRL 2021b), data presentation (AIPRL 2022), and final report (AIPRL 2023). One interesting aspect of OA's management of the isotope works was that whilst AIPRL was provided with most of the osteological analysis results from the digital archive, named individuals with associated historical documentation were not disclosed at the beginning of

the project to prevent biased interpretations (Moore *pers comm*). This communication choice was particularly advantageous for gaining insight into the life of [REDACTED] who, although believed to have spent their childhood and later life in the local area, was found to have high lead isotope ratios and concentration indicative of exposure to a non-British lead source (AIPRL 2023). The later revelation of the name and known locality to Hull during a progress meeting ultimately prevented [REDACTED] from being identified as a potential non-local migrant, whilst also allowing different interpretations to be put forward for this contrasting evidence such as exposure to imported lead products or prolonged periods spent outside Britain during childhood (AIPRL 2023; Moore *pers comm*). This combination of documentary and scientific evidence attests to the strength of the multidisciplinary nature of the APD.

Table 1: A summary of the techniques used within AIPRL's isotope project and the resulting interpretations. The research questions are also listed and associated with the techniques that contributed evidence towards them (information derived from: Moore *pers comm*; AIPRL 2021a; 2021b; 2022; 2023).

Isotope Research Questions		
1) Was the population of Hull geographically diverse in the 18 th -19 th century? 2) What was the diet like in 18 th -19 th century Hull and how does this compare with other 19 th century port cities in Britain? 3) How did environmental pollution impact upon the lives of people in Hull? 4) Are there any differences in diet, mobility, and exposure to pollution between males and females? 5) Could sailors be identified within the TBG burial population?		
Technique	Interpretation	Associated Research Questions
Carbon and nitrogen analysis (bulk)	- Predominantly terrestrial C₃ diet with some contribution from marine and/or non-native C₄ resources. - Male individuals may have consumed more meat than female individuals and displayed more dietary variability. - Female individuals may have relied more on marine resources than males. - Adult diets seemed to suggest an increase in marine and/or C₄ resource consumption compared to childhood diets. - No evidence of individuals with particularly high marine influence in diet that could be interpreted as sailors (likely that sailors took terrestrial food with them on ships so sailor profession may not show in carbon and nitrogen values). - Comparison with contemporaneous inland and port cities suggested greater consumption of higher trophic-level fish (e.g. cod) or omnivorous meat (e.g. pork) within TBG population.	2, 4, 5
Carbon and nitrogen analysis (incremental dentine)	16 non-adults were sampled to investigate weaning and health in early childhood. - Weaning curves were more pronounced in female individuals. - Throughout childhood, male individuals showed a more consistent diet than females. - More females died during weaning than males.	2, 4

	Incremental analysis of permanent and deciduous teeth supports interpretation of predominantly terrestrial C₃ diet with some marine or C₄ resource consumption.	
Strontium isotope analysis	- The results for the majority of individuals were consistent with a local origin. 33 individuals plotted outside expected strontium isotope range, but the majority of these are still consistent with an origin elsewhere in Yorkshire. - One individual had a higher strontium isotope ratio consistent with areas such as northern and western Wales, Scotland, and England. - Some individuals had combined strontium isotope ratios and concentrations suggestive of coastal or island origins, potentially in Scotland.	1
Oxygen isotope analysis	- Oxygen isotope values for most of the population were much lower than expected. - Potentially indicative of environmental or cultural impact of urban industrial living conditions on drinking water sources or biological fractionation. - Concluded that oxygen isotope ratios could not be reliably used to interpret childhood origin for majority of TBG population due to unknown influence on measured values. - One individual displayed a very low oxygen isotope ratio in combination with an enamel carbon isotope value indicative of C₄ or significant marine resource consumption, which together may indicate a non-local childhood origin in areas such as northern Scandinavia or Greenland. - One individual had a high oxygen ratio suggesting a childhood origin in western Britain in areas such as Cornwall, the Hebrides, or southwest Wales. Other possible origins included western Ireland or western Europe along the Atlantic coast.	1, 3
Sulphur isotope analysis	15 individuals were sampled for sulphur isotope analysis. - A local origin was expected to produce higher sulphur isotope values than those observed due to Hull's coastal proximity. - Industrial pollution seems to impact and lower measured sulphur isotope ratios so they were not useful for identifying potential sailors as any marine influence was obscured.	1, 3, 5
Lead isotope analysis	- The results for the majority of individuals were consistent with a local origin. [REDACTED] had high lead isotope ratios and concentrations suggesting a non-British origin, but was thought to have spent their whole life local to Hull. Potential explanations include spending parts of childhood living outside Britain, or regular exposure to an imported lead-containing product.	1, 3
Trace element analysis	- The results for the majority of individuals indicated significant exposure to lead during childhood. 6 individuals were identified as having potentially grown up in rural non-industrial environments due to low lead concentrations. 5/6 of these potentially rural individuals were male, which contrasts idea that more females migrated to urban areas for domestic service during this period.	1, 3, 4

	• 14 individuals had high lead concentrations potentially suggesting they suffered from lead poisoning. • 10 individuals displayed elevated arsenic and mercury concentrations suggestive of heavy metal poisoning (expected to be higher for urban environment).	
Amelogenin peptide analysis	• Amelogenin peptide analysis was undertaken for 16 deciduous teeth of non-adults to determine biological sex and aid interpretations of the incremental carbon and nitrogen analysis. • 8 individuals were determined to be females. • 2 individuals failed to produce a peptide result (identified as female by aDNA analysis). • 6 individuals were determined to be males.	2, 4

Yet, like with fieldwork, the isotope study was not without issues including lab closures for emergency repairs and key staff absence that made the scale of analysis more difficult to navigate. Nevertheless, by working with OA to mitigate these obstacles by agreeing to allow some of the 180 individuals to be sampled and analysed as part of PhD theses and MSc dissertations, not only was the work effectively delegated and controlled but the research outputs of the TBG project were diversified (Moore *pers comm*, AIPRL 2021b; AIPRL 2022; AIPRL 2023). Moreover, these issues did not affect the report's quality or comprehensiveness, as even unanticipated results such as the unusually low oxygen isotope ratios observed in a large proportion of individuals suggestive of non-British origins were afforded in-depth discussion and contextualisation with comparative data (AIPRL 2023). Ultimately, AIPRL's isotope project went above and beyond the APD's initial specifications, with additional techniques (see Table 1) employed to produce an integrated, quality-assured assessment of TBG's burial population before the 2024 reburial deadline. This report will be collated with other specialist studies for publication including a site monograph and online deposition with ADS and the HER at the development's closure (OA-HFA 2020a; HFA-2020b).

Conclusion

In summary, the ambitious nature of the APD and scale of the wider project inevitably meant that all aspects of TBG's investigation would have to navigate expected complications covered by the Risk Register (OA-HFA 2020b) and were also likely to be impacted by any severe unprecedented obstacles. Despite the actualisation of some critical incidents during both fieldwork and analysis stages, the clarity and strength of the APD's multidisciplinary research design allowed the project to remain focused on its products, mitigating the effects and providing flexibility where needed. With a practical excavation approach adopted to accommodate legal restrictions placed on post-excavation analyses alongside a continuous

but measured management and communication style, OA's implementation of the APD enabled such an in-depth and engaged specialist isotope project and resulting report to be created regardless of the lack of specific methodological detail within the APD. Overall, the APD's successful delivery is ultimately highlighted by the breadth and depth of information recovered from just one portion of the large-scale analyses, although in future more must be done to prioritise involvement of specialists earlier in project development.

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