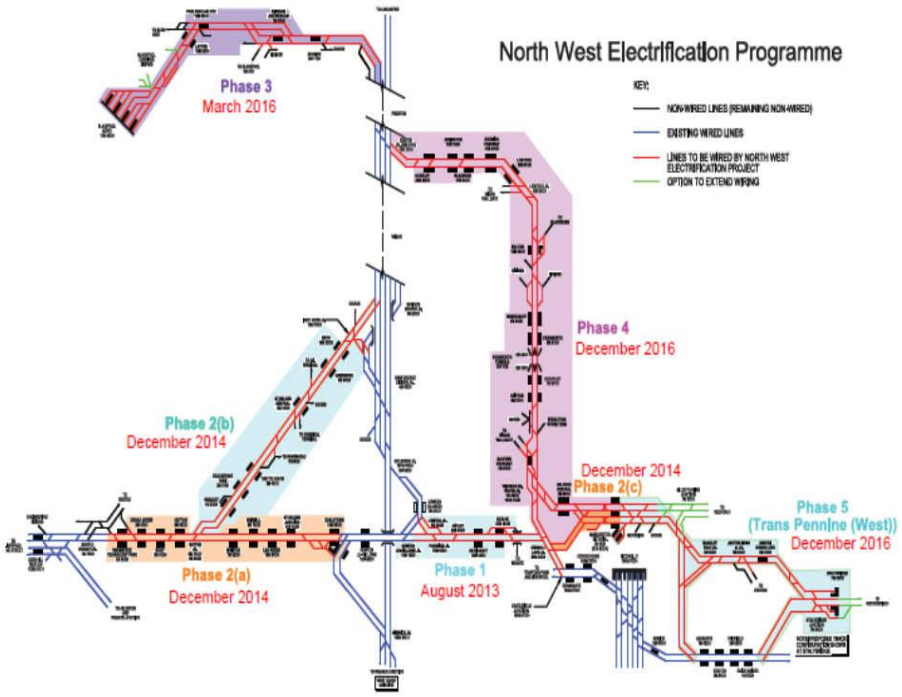
Embedding a Lean Production Culture in the North West Electrification Project

FOUNDATIONS

Background

- The North West Electrification Project is a £500M programme of works to electrify the existing rail network in the North West of England.



Remit

- CWI were engaged to review the concrete foundation, steelwork and wiring processes in Phase 2 and recommend improvements to facilitate improved productivity and programme certainty for both Phase 2 and future phases.
- The activities of which included:
  - Setting up governance
  - Forming the Core Improvement Team (CIT)
  - Support for the Lean Improvement Steering Group
  - Undertaking process mapping
  - Site observation and Lean analysis
  - Deliver recommendations for improvements
- Work collaboratively with NR and BBR applying Lean techniques to define the process, measure each activity within the process and analyse the data to provide improvement recommendations for current and future phases.
- Tasked to facilitate the development of the Technical Solutions Group and the implementation of agreed recommendations through solutions development, pilots, measures of improvement, lessons learned and roll out.

Approach

A standard Lean approach - **The Five Principles of Lean:**

NO.	PRINCIPLE
Value	Specify what creates value from the customer's perspective
Value Stream	Identify all steps across the whole value stream and remove waste
Flow	Design the new value stream so that work flows through those actions that create value.
Pull	Customer demand should pull work through the system – only when it is needed.
Perfection	Strive for perfection by continually removing layers of waste!

The most significant of these principles, in the context of the electrification works, is that of FLOW. Not merely is this essential for the foundations, for example tackling the foundations sequentially to ensure minimal waste in resource movement, but also in the overall project flow activities, foundations, steelwork and wiring.

Approach

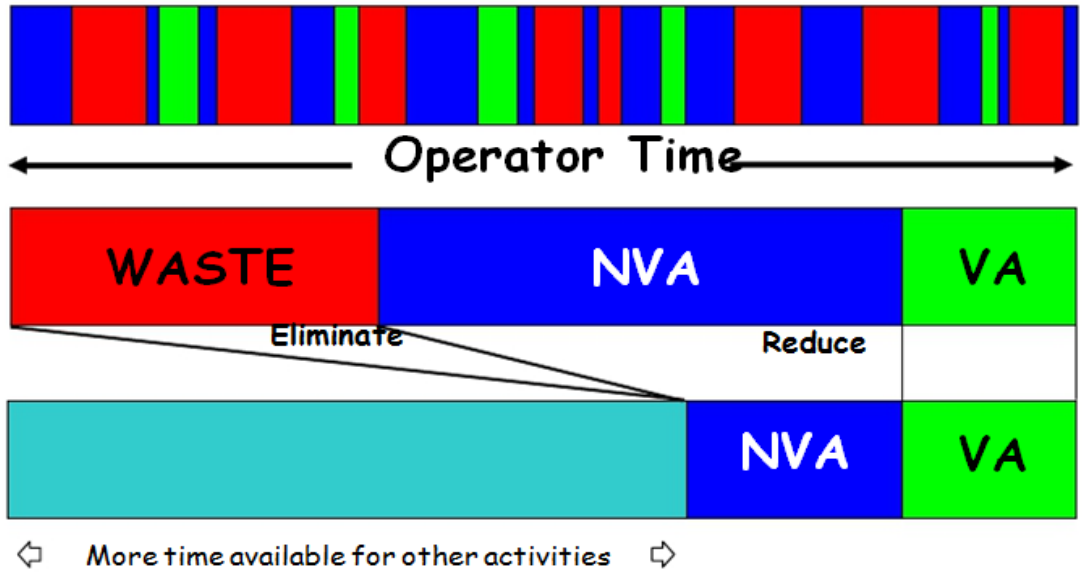
General Approach:

We used the industry standard improvement methodology DEMAIC, which is a structured improvement process using a range of situation appropriate Lean Improvement tools and a central methodology of Plan Do Check Act at every stage.

The stages are defined as:

Approach and Methodology

Defining the work processes

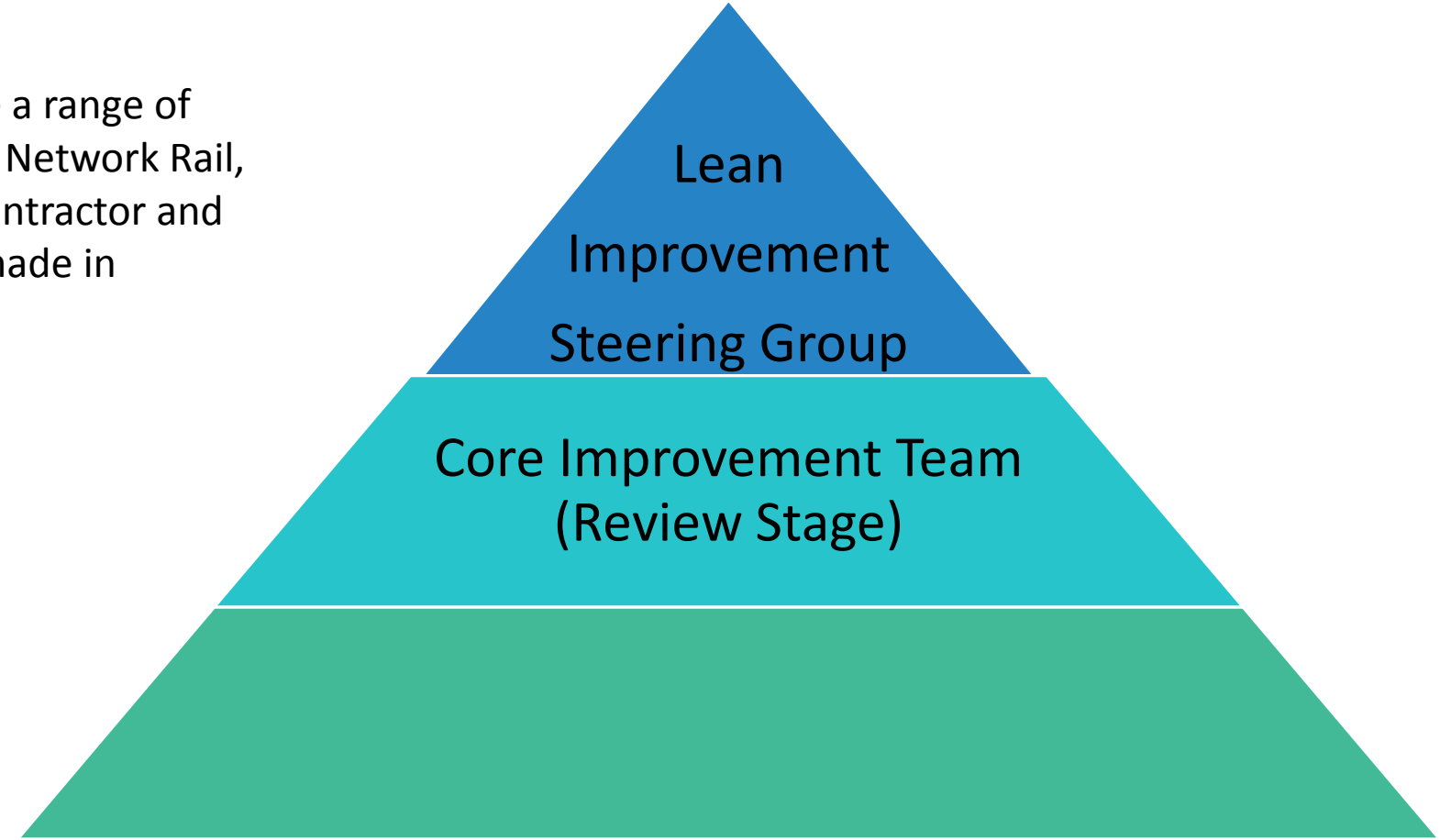


In observed shifts we categorised work processes into elements of Value Added (VA), Non Value Add (NVA) and, the remainder, Waste (W).

We mapped every process and recorded times accordingly

Governance

All groups have a range of members from Network Rail, CWI and the contractor and decisions are made in collaboration



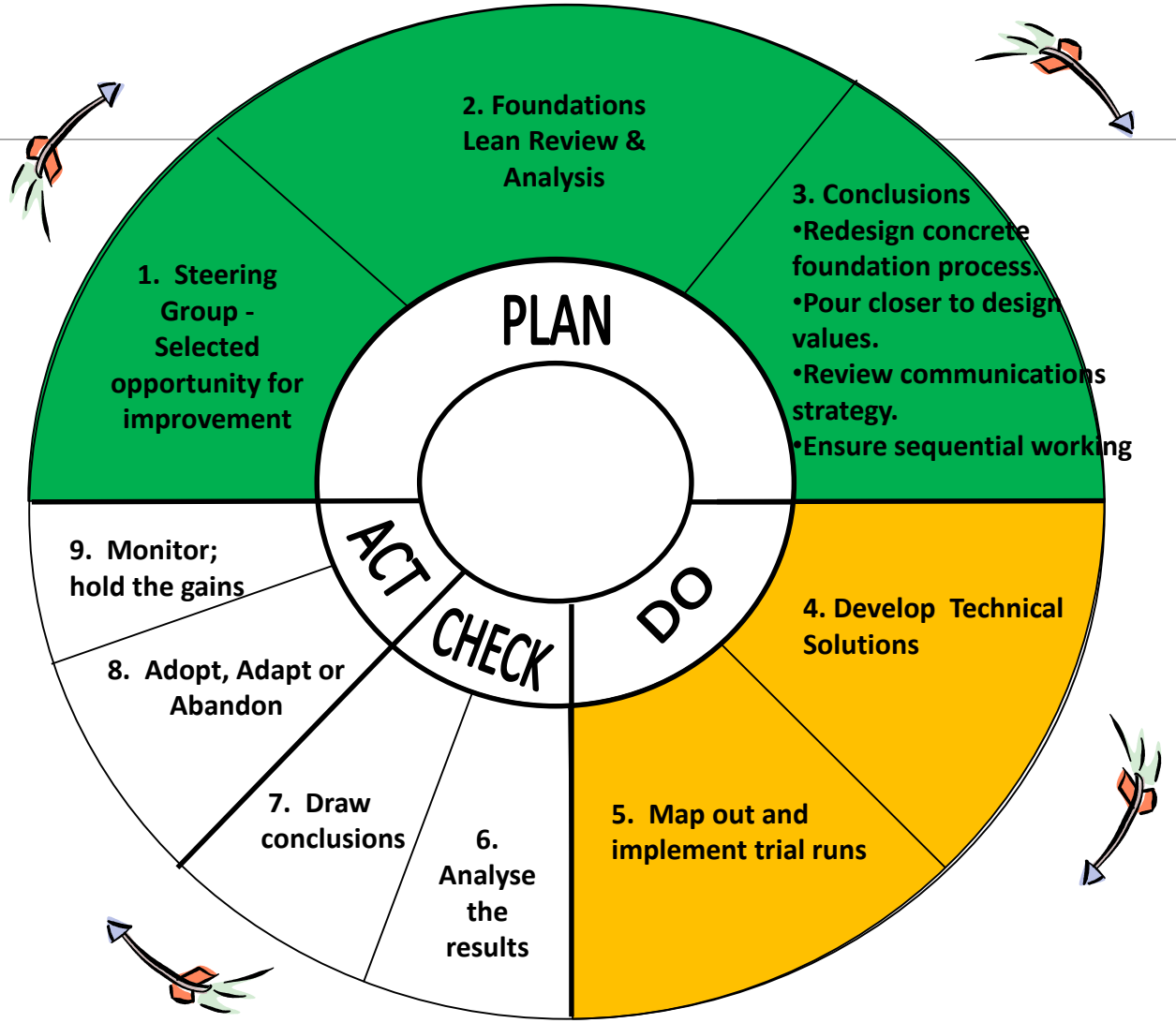
PDCA

Where we are now

Complete

In Progress

To do

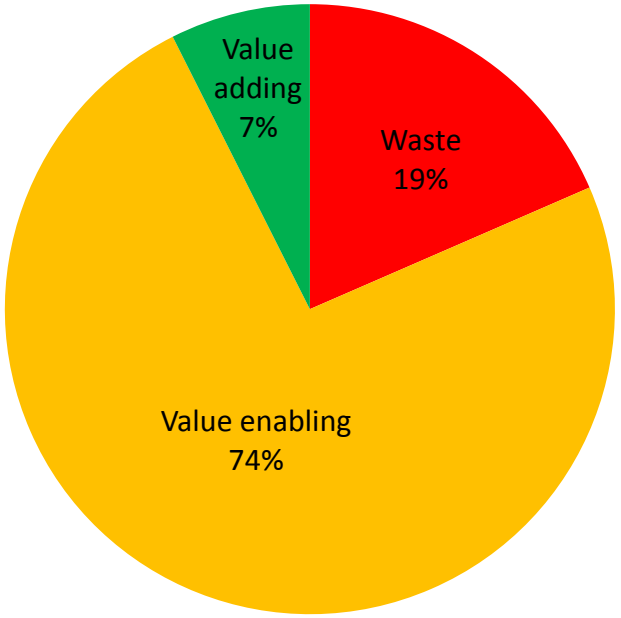


Review stage Findings

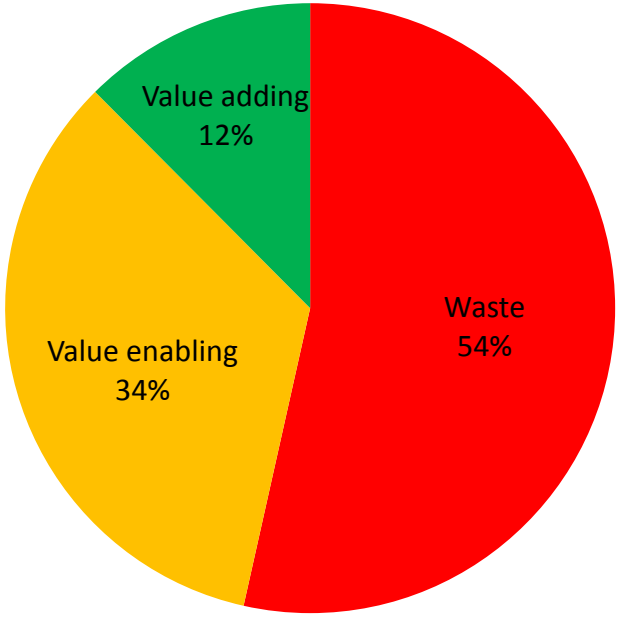
Percentage of Value adding, Value enabling and Waste per shift for both the excavation and concreting process.

The following pie charts summarise for the observed shifts for the two operations from start to end of shift

Concreting



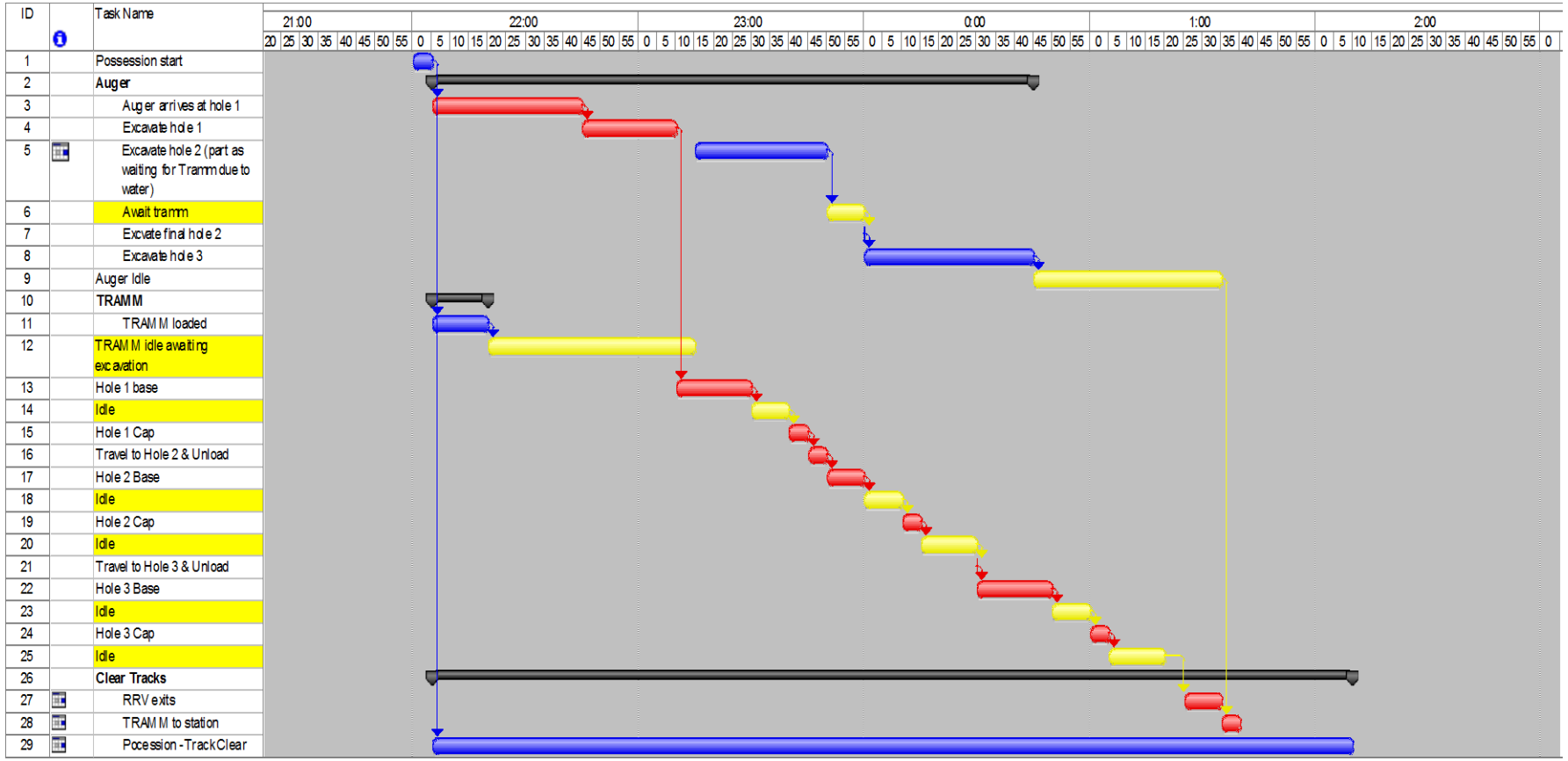
Excavating



Review stage Findings

Concreting is on the critical path once the first excavation is complete.

Significant idle times TRAMM 28.6%, Auger 53.6% idle



Issues and Challenges

Review Stage - Challenges and Issues

- water in the excavations – excavation time increased or hole abandoned
- communication – lack of information on previously abandoned holes
- communication – lack of flexibility on the shift in order to overcome problems
- TRAMM reaching concrete capacity – no further works can proceed
- non- sequential working – travel waste
- excavation of harder material (rock)
- lack of contingency foundations to accommodate either early completion or abandoned excavations
- possession delays
- shortage of materials
- buried cables

Implementation Stage – Challenges and Issues

- Building buy in and engagement with the contractor at all levels to implement a different way of doing things
- Programme delays
- Political influences – Future phases on pause
- Transition to a new contractor

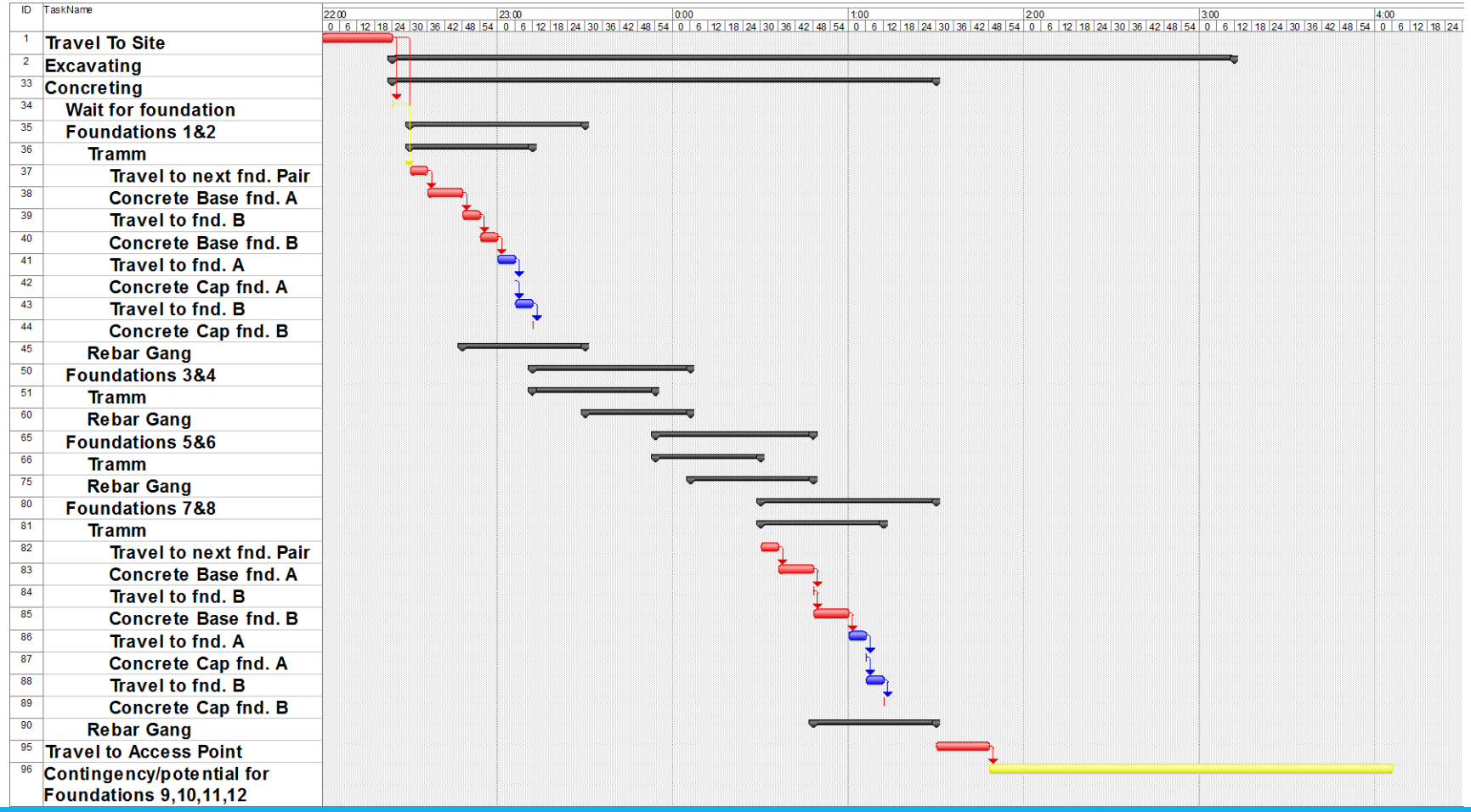
Conclusions

Our conclusions from observation are:

- non-sequential working is increasing waste and value enabling times
- in most instances concreting works are on the critical path once the first excavation is complete
- significant idle times for both the high cost concreting machine (TRAMM) and the excavating machine (Auger):
  - TRAMM 28.6% idle
  - Auger 53.6% idle
- significant additional concrete is used to fill excavation over break of 71%
- traditional concreting method delivering more concrete on average per shift than the TRAMM, in some situations
- the TRAMM is not discharging its full capacity in the shift
- the TRAMM is constrained by its concrete capacity
- communication between planning and delivery can be improved:
  - knowledge of previously aborted foundations
  - lack of contingency foundations
  - no flexibility in the plan to adjust works if unexpected conditions manifest

These conclusions have been addressed in the recommendations.

Review Stage
Key Outcome – Improve Flow



ID	TaskName
1	Travel To Site
2	Excavating
33	Concreting
34	Wait for foundation
35	Foundations 1&2
36	Tramm
37	Travel to next fnd. Pair
38	Concrete Base fnd. A
39	Travel to fnd. B
40	Concrete Base fnd. B
41	Travel to fnd. A
42	Concrete Cap fnd. A
43	Travel to fnd. B
44	Concrete Cap fnd. B
45	Rebar Gang
50	Foundations 3&4
51	Tramm
60	Rebar Gang
65	Foundations 5&6
66	Tramm
75	Rebar Gang
80	Foundations 7&8
81	Tramm
82	Travel to next fnd. Pair
83	Concrete Base fnd. A
84	Travel to fnd. B
85	Concrete Base fnd. B
86	Travel to fnd. A
87	Concrete Cap fnd. A
88	Travel to fnd. B
89	Concrete Cap fnd. B
90	Rebar Gang
95	Travel to Access Point
96	Contingency/potential for Foundations 9,10,11,12

Review Stage – Outcomes, Benefits and Savings

Key outcome for Phases 3,4 & 5

- **Redesign the current Foundations process** – introduce a disconnect between the Auger and the TRAMM. This will allow the TRAMM to move off the critical path and deliver as much concrete as possible restrained only by the time window available in the shift. This is to be achieved by pre-augering the holes. With optimised flow 12 Foundations completed in a single mid week shift can be delivered compared to 4.2 average output at the time of the review stage.

Benefits for Phases 3, 4 & 5

Benefits were defined in two areas:

- Efficiency savings - these are the operational savings calculated on the improved efficiency gained by adopting the recommendations.
- Time savings - these are the savings in overhead charges due to the reduction in time from the increased production output.

Savings for Phases 3,4 & 5

- Potential savings totalled over 9.5m

- Additional quick wins identified to deliver further short term savings

*These total project overhead savings were calculated for the time saved (13 months) by adopting the redesign of the current process

Review Stage – Recommendations

1. Undertake the pre-augering of holes.

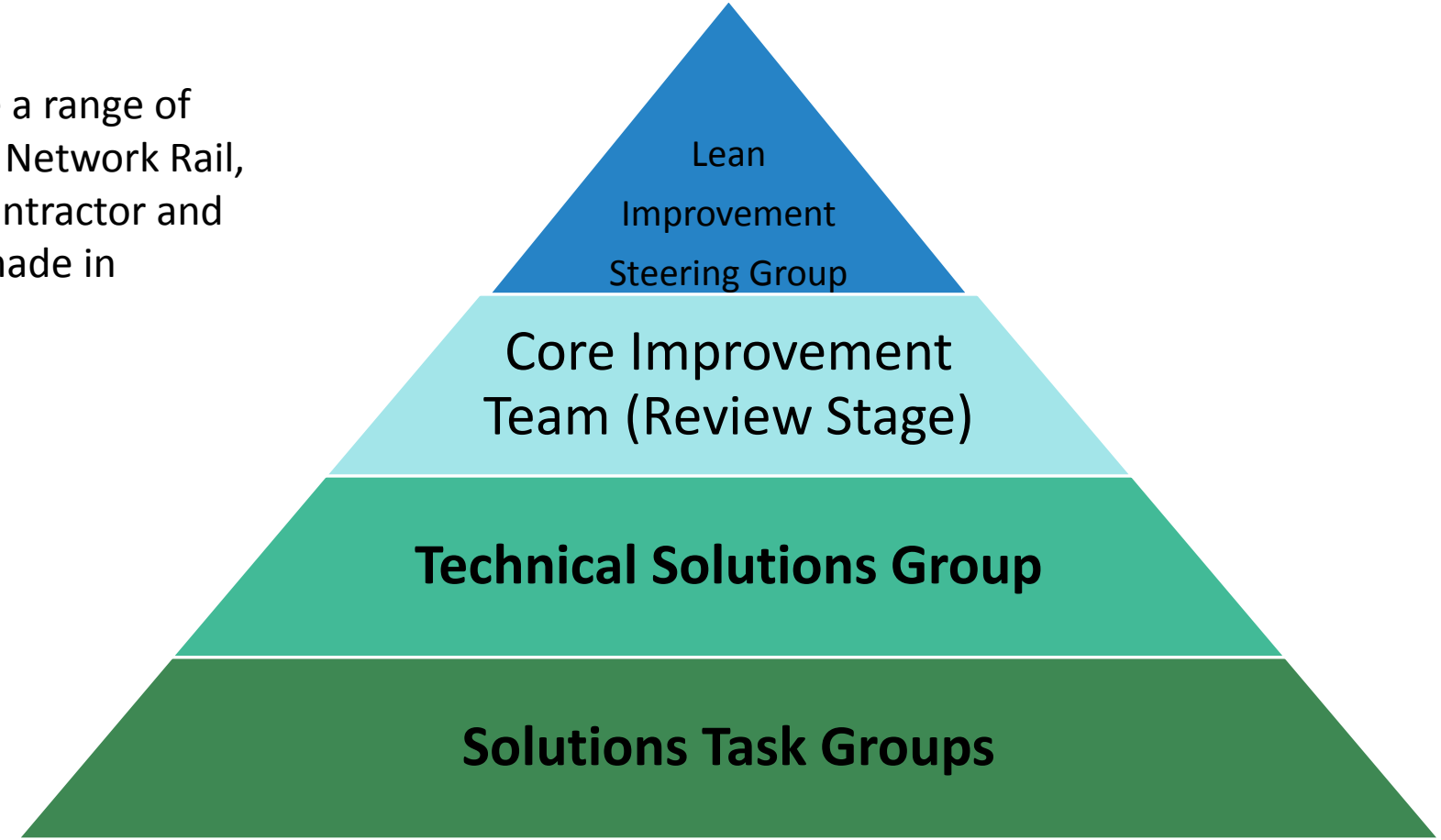
2. Set up a technical group to overcome the challenges of:
   i. delivery of concrete in excess of the current TRAMM capacity
   ii. restraining the concrete delivery to within 15 to 25% of design requirement
   iii. overcoming the challenges of pre-augering the holes, making safe and minimising any over break if re-excavated
   iv. investigating the opportunity to leave a hole open (a bladder shutter arrangement).

3. Develop a communication process to include a strong “cause and effect” link between planning and delivery at the programming, planning and delivery stages.

4. Develop a design process that overcomes the challenges of non-sequential working. This must allow for all stakeholders to fully understand the implications.

Governance

All groups have a range of members from Network Rail, CWI and the contractor and decisions are made in collaboration



Implementation Stage – Technical Solutions Group

The Technical Solutions Group were responsible for the Solutions Development phases born out of the Review stage recommendations that were agreed with all parties. Task groups were created to manage each of the sub improvement areas, four were established to look at:

1. Safe Excavation method - Separation of excavation and concrete pouring
2. Reduction in concrete
3. Increasing concrete capacity on site
4. Ground informed excavation

Each Task Group consisted of a Lead member and supporting members with relevant technical experience

Any questions, thoughts, feedback?

What other opportunities could be explored?