Model Railway Project Strategy Document

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1 Glossary

Item	Meaning
Code 100	An oversized standard of rail for OO gauge track. Now superseded by code 75
DLoD	A structured template for functional breakdown.
Domestic lighting	The lighting that is provided in the room the railway is set-up in.
Double-slip	A *double slip switch* (*double slip*) is a narrow-angled diagonal flat crossing of two lines combined with four points in such a way as to allow vehicles to change from one straight track to the other, as well as going straight across. A composite which provides two exit routes for each entrance.
Down	A convention applied to the direction of rail traffic on a line
Electrofrog	The conductive crossing point for a pair of rails.
Fiddle yard	A **fiddle yard** or **staging yard** is a collection of model railway tracks (normally hidden from view) that allow trains to be stored and manipulated by the operators
Finescale	Or code 75 track, more accurate to scale than code 100.
Fishplates	The joiners that are used to connect rail ends that butt up against each other
Flexitrack	A length (normally 3ft) of track which by nature of the breaks in the sleeper webbing, can be shaped into curves.
Home signal	Also known as a Stop signal, used to protect the length of line beyond the signal
Facing points	As seen from the direction of travel along a line. A facing point provides a divergence of two routes.
Level	Horizontal and flat
Loadbearing	Intended to take the weight of track, buildings or any main feature.
Mainline	The mainline is the principal route for through traffic.
Mk1	A style of railway carriage design, the standard design for use post-nationalisation.
Module(s)	The name assigned to the individual baseboards, which combine to form the complete model railway
Non-loadbearing	Unlike load bearing, not Intended to take the weight of track, buildings or any main feature. Purely there for surface appearance.

Normal domestic parameters	Temperature, humidity and lighting conditions that would be expected in a domestic room
Normal sized doorway	The size of the doorway in a house. Approx 26ins wide.
Peco	A manufacturer of model railway track and accessories.
Rolling stock	The generic name for all vehicles that move on the railway, powered and unpowered.
Sacrifice modules	Modules which are to be included in the intended design, but which can be removed, to give a slightly smaller but still functional railway layout.
Set-track	Unlike flexi-track, set track has a fixed geometry and is not flexible.
Track gauge	A tool that provides the minimum spacing between the Up and Down lines.
Single-slip	A single slip is a point crossing combined with one pair of points, giving one switching possibility. A composite which provides two exit routes for only two entrances.
Superelevation	Also known as the cross slope or camber of the track. This is the difference in elevation (height) between the two rails. This is normally done where the railway is curved; raising the outer rail or the outer edge of the road providing a banked turn, thus allowing vehicles to maneuver through the curve at higher speeds than would otherwise be possible if the surface was flat or level.
Trailing points	As seen from the direction of travel along a line. A trailing point provides a convergence of two routes.
Transition curve	A curve of constantly changing radius, used to provide a smooth interface between a straight and an arc of different curvature.
Up	A convention applied to the direction of rail traffic on a line

2 Scope

The owner intends to construct a model railway, to be located inside a garden room that is to be built for that purpose. Because of the owners interest in BR period passenger express steam locomotives, backed up by an extensive collection of OO gauge rolling stock, this is to be the dominant feature of such a railway layout. Features such as sidings, industry and a fiddle yard will be employed to promote operational interest. Operation will include the running of Mainline passenger and goods services.

Because of the owners engineering background, it has been decided that the design and construction is to be treated as a formal project, using professional techniques, tailored to suit the application, in progressing the project from concept to delivery and operation.

The lifecycle of the project will take in:

- Concept design. Where ideas are explored and developed.
- Detailed design. Where the track plan and positions of main buildings will be finalised.
- Construction. This can be sub-divided into module construction, track laying, points & signals, electricals, landscaping, buildings and detailing.

To aid in developing the project, a functional breakdown of the project will be explored and requirements will be established from this. The requirements will be linked to design material and all tests.

3 Project lifecycle

The following steps define the lifecycle of the project from initial go-ahead to completion. Although they follow in sequence, some overlap between steps is expected.

3.1 Concept design

At concept design, ideas are explored, with the aim of developing a picture of what the project is to be, including the main features.

It is intended consideration be given to abilities of the owner in the construction of the layout.

Also that ease of setting-up, operation, maintenance and disassembly be considerations in the design and construction, as it is assumed that the owner will be working unaided.

The concept design is to produce the following outputs:

- Type of layout style.
- Selection of track and type of controller to be used.
- Method for controlling points & signals.

- Number of baseboards, outline dimensions, construction materials and fixings to be used.

The concept design will include inputs from prototype models, intended to test possible design features.

3.2 Options and costing

At options and costing, candidate design options are to be explored and a preferred option is to be selected with a complete costings breakdown.

Areas for options can include, but not limited to:

- Type and make of controller.
- Means for operating signals and points.
- Track to be used.

This can be achieved by comparing different options, listing their main features, with their interfaces and costing.

3.3 Detailed design

Detailed design may start once the concept design is completed and a costings breakdown is produced.

At detailed design, the following are to be established and completed:

- Accurate shape and dimensions for each baseboard are to be recorded as drawings. The shape and design of the baseboards is closely linked to the design of the track and the positions of points in particular.
- The question of whether or not to allow for the possibility of a reduced sized layout, by the provision of [sacrifice modules] and matching track alignment, is to be determined.
- Accurate track plan with positions for main railway features are to be recorded on a master track plan. Care must be taken to ensure that points do not straddle module joins, also that point motors do not conflict with internal bracing.
- Wiring schematics to be recorded as diagrams.
- Outline positioning of all other main features are to be recorded as drawings.
- Parts required for construction are to be recorded as a parts list.

The following parameters should have been established by the start of detailed design and must be taken into account in the detailed design:

- Maximum gradient, either as a ratio of vertical change and horizontal distance. Or as a percentage figure.
- Minimum curve radius.

- Maximum length of a train that can be accommodated.
- Minimum clearance between track at curves.
- The possibility of using [superelevation].
- The positioning of insulated fishplates, instead of metal fishplates, to ensure that there are no short-circuits.
- The extent to which prototypical operation is to be observed and where it may be ignored.

Units of measurement are to be given in metric as meter (m) and millimetres (mm). Additionally, the imperial system may be used in instances where measurements are given that way by suppliers; however, metric measurement is also to be given.

Trackplans are to be developed using a computer based application tool. When the plans have been completed, they are to be produced full scale, either by printing on a plotter or by copying by hand from scale drawings.

3.4 Construction

The construction phase is divided up into sub-phases, it is expected that there will be some overlap between them.

3.4.1 Baseboard construction

Forming the baseboards on which the layout is to be constructed. This will include the means for ensuring correct alignment and securing between boards and the legs that the boards will stand on. Also allowance for track clearances. The shape and design of the baseboards is closely linked to the design of the track and the positions of points in particular. Therefore, construction of the baseboards cannot start until design of the track has been finalised.

3.4.2 Track laying

This will cover the placing of the sound deadening sheet that the track is to stand on. Positioning and securing of all trackwork, with point motors. Connecting of power feeds to track.

3.4.3 Signal installation

This covers construction, fitting and wiring of all signals. Consideration is to be given to the removal of signals for maintenance/storage purposes.

3.4.4 Landscaping

This covers contouring, colouring and surfacing. Completion of roads and waterways. Placing of trees and bushes.

3.4.5 Buildings & detailing

This covers the construction and locating of buildings and other structures, including internal features. Signs of human activity. Other miscellaneous detailing to give realism.

3.5 Through life use

Through life use comprises the operation, maintenance, upgrading and storage of the completed layout.

4 Functional Breakdown

The functional breakdown will follow the [DLoD] structure. In functional breakdown, the functions within a project are decomposed until a level of detail is reached where a requirement can be defined.

Definitions:

- A function is a verb/noun combination that relates an action verb with an activity or deliverable.
- A function is a component of a project that defines what must be done.

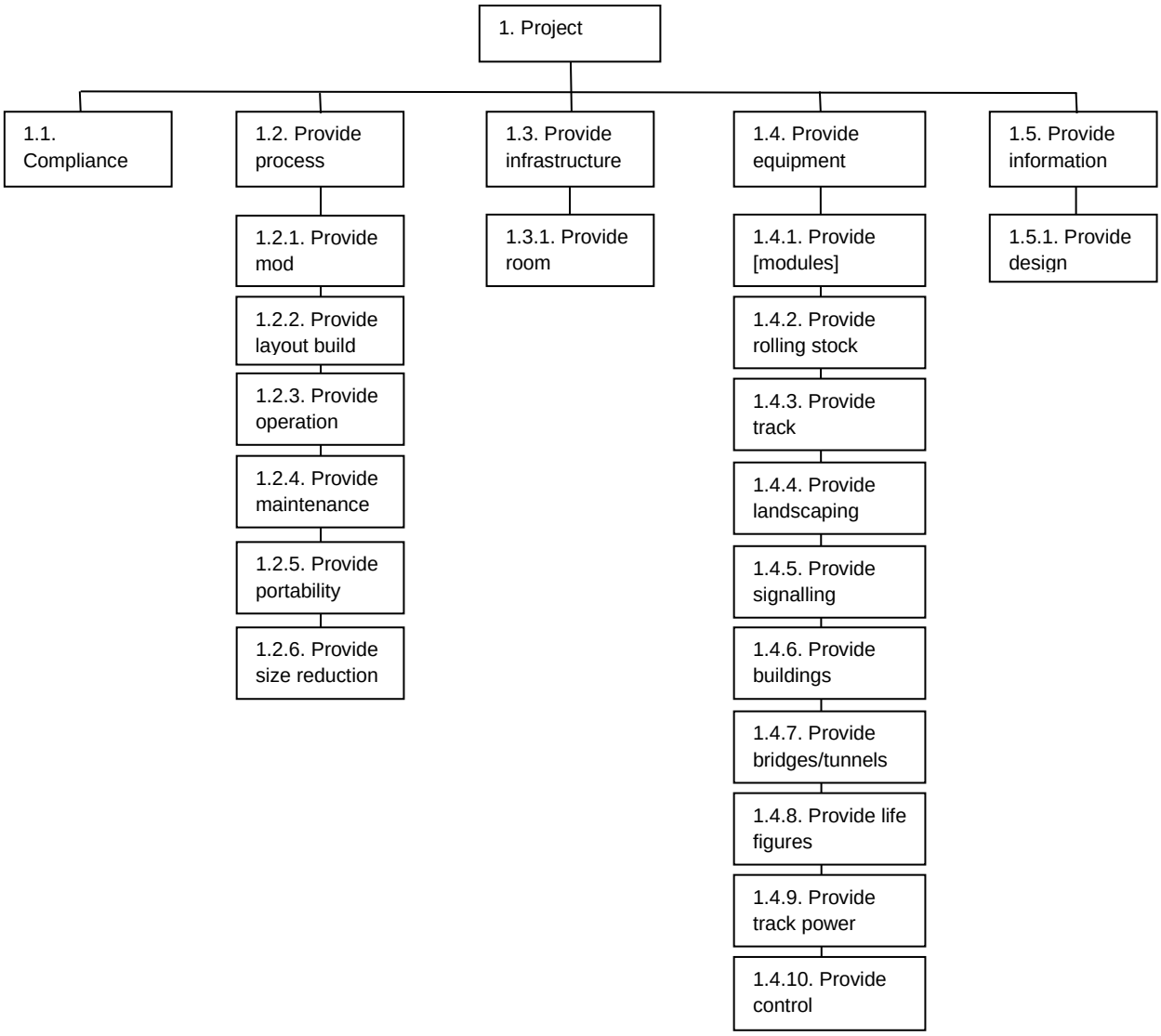

Figure 1. Top level functional breakdown of project

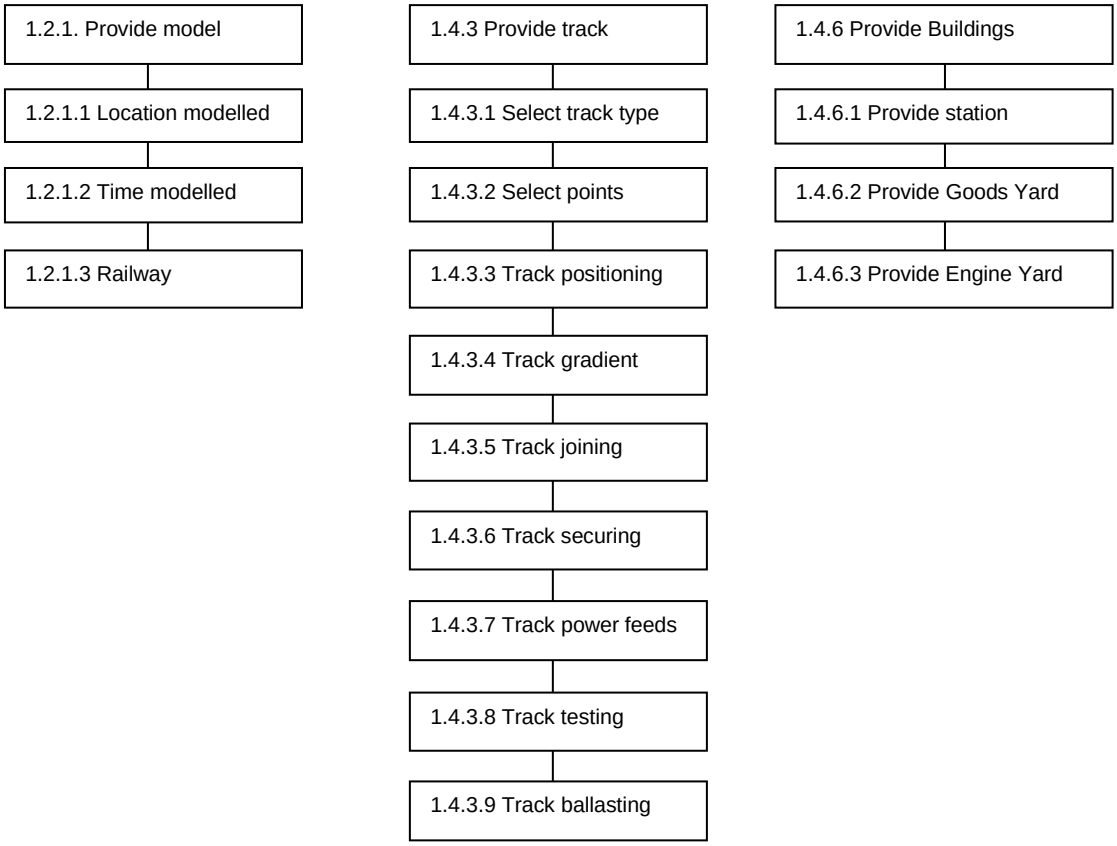

Figure 2. Lower level functional breakdown of project

5 Requirements

Definition:

- A requirement specifies how well a function must be performed.

A requirement is always associated with a function and it comprises four attributes:

1. Requirement statement.
   The Requirements statement is structured as follows:
   - The <subject> shall / shall not <condition> <performance criterion>
   - The subject is normally the function that the requirement is associated with.
   - The condition specifies what must/must not be done.
   - The performance criterion specifies what conditions apply to the requirement.
2. The Basis statement gives the reason for the requirement and is derived from the need.
3. The Verification method specifies how the requirement will be met.
4. The Acceptance criteria specifies what must be achieved to meet the requirement.

The basis statement gives the reason for the requirement and is derived from the need.

The verification method specifies how the requirement will be met.

The acceptance criteria specifies what must be achieved to meet the requirement.

Requirements must be singular i.e. they must not be composite in structure. They are to relate to the function that they are associated with. A requirement may be duplicated in a separate functional branch, but it may not be repeated in the same functional branch.

Additional fields associated with the requirements:

- Verification evidence is recorded to meet the acceptance criteria.
- Requirement status.

Status	Meaning
Compliant	Evidence has been submitted which completely satisfies the acceptance criteria.
Non Compliant	Evidence submitted indicates that the acceptance criteria has not been met.
Not tested	The requirement has not been tested
Compliant with concession	The stakeholder has examined the evidence and agreed that a concession may be made against the requirement.
Deleted	This requirement has been removed

Verification evidence must be submitted for each stage of the project development:

Concept design. Detailed design. Construction.

6 Testing

The process of testing is to be requirements driven, in that tests are to be associated with individual requirements. Testing is to start at the concept design phase and is to continue through the lifecycle to completion.

Write more about the stages and types of testing. Refer to the ISEB Course notes.

7 Through life use

Through life use covers those activities following the completion/commissioning of the project, which occur in service. They include:

- Routine maintenance.
- Repair/replacement.
- Upgrading and alteration to the design.
- Maintenance testing
- Relocation and storage of project modules.

8 Lessons Learned

This last section is not a formal document at all, rather it is a place to record observations and experiences to be learned from, with the intention that they can be fed into any future project and thereby give the opportunity for improvement.

The sections are:

- Area of interest — What this relates to.
- Issue — What the problem is.
- Details — A fuller description of the issue.
- Future Action — What improvement could have been made.
- Correction used — What was done to mitigate.

Model Railway Concept Design Document

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1 Glossary

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Fishplates	The joiners that are used to connect rail ends that butt up against each other
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Home signal	Also known as a Stop signal, used to protect the length of line beyond the signal
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Module(s)	The name assigned to the individual baseboards, which combine to form the complete model railway
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2 Scope

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- Selection of track and type of controller to be used.
- Method for controlling points & signals.
- Number of baseboards, outline dimensions, construction materials and fixings to be used.

3 Layout

3.1 Style

The layout style will be OO gauge, twin-track mainline continuous loop with sidings for goods shunting operations.

There is also the option for a single track end-to-end branchline to be considered and decided upon at detailed design.

The main emphasis for the railway, will be the operation of passenger services. It shall have a station and an engine yard with all normal facilities that would be expected to service steam locomotives.

Trains waiting to be used are to be stored on a multi-line fiddle yard, which is to be long enough to contain the longest train that will be run.

3.2 Geographical location

The geographical location will be a fictional place in the UK. There will be a town. It may be hilly but will not be mountainous.

3.3 Time period

The time period will be post-WW2 and in keeping with BR period steam operation.

4 Module construction

4.1 Dimensions

The Fully erected modules will fit inside a space approx 9ft 6ins x 13ft 6ins (2890mm x 4110mm)

4.2 Number of modules

There shall be 14+ modules in all: Four corner pieces. Two+ on each of the room short sides. Three+ on each of the room long sides.

4.3 Module construction style

Each module will be constructed as an open box with vertically oriented sides and diagonal cross-bracing internally to prevent twisting. There will be an upper surface of horizontally positioned load-bearing sheet material, cut to shape to support track, buildings and any features requiring support.

Construction options for consideration are:

- For the front and rear sides to be box-girders. Each box girder constructed out of two 5mm ply panels sandwiching 10mm softwood strips.
- The sides that connect to adjacent modules, to be constructed out of two sheets of 5mm ply glued together. The purpose for this is so that the need to purchase more than one thickness of ply is removed.
- The edges of the upper track-bearing surface to be reinforced with softwood strips, to prevent warping of the ply.

4.4 Module parameters

Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m. The side height of each module will be 100mm minimum. The weight of the module is to be not more than 5kg, including legs, track and permanent fittings but not including buildings.

The modules will enable the track height to be 0.75m to 1.2m above the floor.

4.5 Inter-module fixings

The fixing of one module to its neighbour will be achieved by spring tension lock clips.

4.6 Access into the erected modules.

To gain access to the open centre, the two side modules where the door is, will be attached to their adjacent corner modules by hinges, so that the two modules may be swung upwards, drawbridge fashion.

There will be alignment dowels fitted to the mating surfaces between modules, to ensure correct alignment.

When the modules are opened, traction power to the track will be cut, this is to prevent a locomotive from being driven off the end of a module.

A means of ensuring that the raised module does not accidentally fall, will be explored and be determined by detail design.

4.7 Module construction material

The modules will be constructed out of plywood.

4.8 Material thickness

The sides of each module which connect to adjacent modules, may (see section 4.2) be constructed from 12mm thick ply. The non-connecting sides may be 9mm thick. The internal bracing and the track surface will be 5.5mm thick.

4.9 Legs

Each module will have at least two legs, mounted at one end, support for the other end being achieved by connection to its neighbour. At least one module will need to be entirely free standing and so need four legs.

The legs will be constructed from ply strips joined to form an 'L' girder section. One end of the leg will be secured to the underside of the module by a bolt that it can pivot about. In this way, the leg will be able to pivot up and fold inside the module frame for storage. A locking mechanism will ensure that the leg remains rigid when lowered and carrying the module.

On the bottom of the leg will be a height adjustable foot.

4.10 Method of construction

The modules are to be constructed using hand tools that an amateur would normally be expected to own, plus a few readily available power tools, such as drill, plane and jigsaw.

4.11 Reduction in size

To allow for the possibility of transferring the completed railway to a smaller room at some future date, consideration will be given as to how the modules may be constructed so that, if necessary, nominated modules may be removed and the gap closed, so that the layout may be smaller.

5 Track

5.1 Track type

Track will be OO gauge [finescale] [flexitrack] with wooden style sleepers, sourced from [Peco].

The points will be [electrofrog] style.

5.2 Track positioning

Having conducted experiments with available locomotives, it has been determined that:

Curves will have a minimum radius of 24ins (61cms).

The spacing between straight parallel tracks is to be 51mm (centre to centre), as determined by the [Peco] track gauge. The distance between parallel tracks on a curve will need to be 4mm greater than that given by the [Peco] track gauge.

[Superelevation] on curves may be used. The increase in height on the outer rail was approx 1mm on the test track.

For a curve which turns through 90 degrees, a curve of not less than minimum radius, with an arc of 30 degrees will be bracketed between two transition curves, each with an arc of 30 degrees.

Having conducted experiments with available locomotives hauling a train of four Mk-1 carriages around a test track, it has been determined that a gradient of 1 in 70 (1.42%) is the maximum acceptable gradient. It would be preferred if gradients are not more than 1 in 76 (1.3%).

5.3 Track joining

Track will be joined by metal joiners [fishplates] by [Peco], except where electrical isolation is required, when plastic joiners [fishplates] will be used. Provision will be made so that thermal expansion does not cause buckling of the rails or any other damage.

Because of the tendency for rails to spring outwards, joins on all but the gentlest radius are to be avoided.

5.4 Points selected

The shape and size of points selected will be what provides the closest fit to meet the design of the track layout, with the following criteria:

Turnouts on the mainline will have as large a radius as possible, to reduce the risk of derailment. Wherever possible, points on mainlines are to be [trailing points].

5.5 Track fixing down

Track is to be secured to the base by track fixing pins at regular intervals. Care is to be taken to ensure that track sleepers are not damaged or deformed by the application of the pins. Where track crosses a join between two modules, the rails are to be positively secured to each side of the join, so that there is no movement.

6 Control

6.1 Locomotive Control

Locomotive control will be by the Prodigy Advance 2 system, by DCC Concepts and marketed via Gaugemaster. This is in preference to the NCE system for the following reasons:

1. For it's price band, the Prodigy Advance 2 system has a higher current rating of 3.5A, compared to the 1.5A of the NCE system. This is seen as being more than sufficient for the needs of the proposed layout.

2. The Prodigy Advance 2 system has a separate output dedicated to the programming of decoder chips. The NCE system does not have a separate output and will require an additional module for this purpose.

6.2 Point control

Points will be controlled by DCC.

Points will be operated by slow-action motors or servo motors that are to be mounted underneath the track. Operation for the point motors is to be located at one central place on the layout, on a mimic-panel. There is to be a visual feedback to the mimic panel, indicating the position of each point. The current preferred motor is the Cobalt iP digital, by DCC Concepts and marketed via Gaugemaster.

6.3 Signal control

The MegaPoints Controller system is considered to be a strong candidate for the control of signals. The reasons being:

- This system permits realistic bounce of the semaphore signals.
- Works with analogue or DCC.

The controller is obtained direct from www.megapointscontrollers.com

Servos, for the operation of the signals, are readily available from electronics hobby shops.

7 Housing

This section refers to a description of the room that the railway is to be accommodated in.

Model Railway Detailed Design – Baseboard Document

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1 Glossary

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Facing points	As seen from the direction of travel along a line. A facing point provides a divergence of two routes.
Level	Horizontal and flat
Loadbearing	Intended to take the weight of track, buildings or any main feature.
Mainline	The mainline is the principal route for through traffic.
Mk1	A style of railway carriage design, the standard design for use post-nationalisation.
Module(s)	The name assigned to the individual baseboards, which combine to form the complete model railway
Non-loadbearing	Unlike loadbearing, not Intended to take the weight of track, buildings or any main feature. Purely there for surface appearance.
Normal domestic parameters	Temperature, humidity and lighting conditions that would be expected in a domestic room
Normal sized doorway	The size of the doorway in a house. Approx 26ins wide.
Open box	The style of baseboard construction, where there is not necessarily a hard top surface covering the entire module, thus enabling the landscape to fall below the level that the track is on.
Peco	A manufacturer of model railway track and accessories.
Rolling stock	The generic name for all vehicles that move on the railway, powered and unpowered.
Sacrifice modules	Modules which are to be included in the intended design, but which can be removed, to give a slightly smaller but still functional railway layout.
Set-track	Unlike flexi-track, set track has a fixed geometry and is not flexible.

Track gauge	A tool that provides the minimum spacing between the Up and Down lines.
Single-slip	A single slip is a point crossing combined with one pair of points, giving one switching possibility. A composite which provides two exit routes for only two entrances.
Superelevation	Also known as the cross slope or camber of the track. This is the difference in elevation (height) between the two rails. This is normally done where the railway is curved; raising the outer rail or the outer edge of the road providing a banked turn, thus allowing vehicles to maneuver through the curve at higher speeds than would otherwise be possible if the surface was flat or level.
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Transition curve	A curve of constantly changing radius, used to provide a smooth interface between a straight and an arc of different curvature.
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2 Scope

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- Type of layout style.
- Selection of track and type of controller to be used.
- Method for controlling points & signals.
- Number of baseboards, outline dimensions, construction materials and fixings to be used.

The purpose of this document is to define details of the project. Detail design is split into the parts Baseboards, Trackwork, Control and Electrics, landscaping, Detailing.

This document concerns the design and structure of the baseboards.

Because the shape of each module and the track positioning are inter-related, drawings of modules will be presented separately.

Measurements shall be given in metres or millimetres.

3 Overview

There shall be 11 connecting modules which are to fit around the perimeter of a rectangular room approx 9ft 6ins x 13ft 6ins (2890mm x 4110mm). Each module will be constructed as an [open box] with vertically oriented sides and diagonal cross-bracing internally to prevent twisting. There will be an upper surface of horizontally positioned load-bearing sheet material, cut to shape to support track, buildings and any features requiring support.

Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m. The side height of each module will be 100mm minimum. The weight of the module is to be not more than 5kg, including track and permanent fittings but not including buildings.

The modules are to connect to each other by an alignment mechanism on the mating surfaces, to ensure accurate alignment, and spring catches on the external sides to hold the modules together. To ensure that there is correct alignment, mating surfaces, with alignment, are to be fabricated as a pair before each module is assembled.

To gain access to the open centre, the side module where the door is, will be attached to its adjacent corner module by hinges, so that the module may be swung upwards, drawbridge fashion. To

prevent an open module accidentally closing with force, a mechanism will be used to support the weight of the module e.g. counterweight or sprung damper.

The modules are to be supported by separate legs, which are not attached.

4 Module construction

4.1 Module construction material

The modules are to be constructed out of 5.5mm plywood, a good supply of plywood sheets (2.44m x 1.22m) is available at Travis Perkins Building Supplies. Softwood strips may also to be used.

4.2 Construction principle

The sides of each module will be box girders, each box girder constructed from two sheets of ply separated by narrow strips of ply, 10mm wide, placed along the upper and lower edges of the sheets to be separated, there will also be internal end pieces 30 – 40mm wide; this will form a closed box girder. This method is chosen because it gives considerable strength and rigidity that will resist warping for its very light weight. A test piece has been tried, comprising two sheets, 600mm x 85mm, separated by two strips 10mm wide; the whole being glued together. The end result was a box girder which was rigid.

Where a box girder is a mating surface with an adjacent module, there will be ply fillers inside the girder, so as to provide solid fixings for alignment dowels which will be secured inside the cross-section of the box girders. All parts are to be glued and clamped together and left until the glue has set.

The girders will be connected to each other to form the four (or five) sides required for each module. Mating ends will be cut or planed to the required angle, so as to give each module it's required shape. A butt join will be reinforced with 6mm x 30mm wooden dowel pins and glued together.

To give additional rigidity to the shape and to aid in resisting warping, ply cross-members will be positioned diagonally, braced against the opposite corners of the module.

Each module will have a unique shape. It cannot be assumed that they will be rectangles or that the corners will be right-angles.

As well as being unique in the plan shape, the modules may show uniqueness in their elevation because it is the intention that landscape be able to rise above/fall below the level of the track. This rising/falling is to be reflected in the shape of each mating panel on the module.

A sheet of ply will be secured as an upper surface where loadbearing is required. e.g. track and any flat features. Ply may be omitted where loadbearing is not required, so as not to add unnecessary

weight. Narrow softwood strips may be required to provide additional support to the upper surface along each edge, to prevent warping. A non-loadbearing surface will be provided to cover all voids and will form part of the landscaping.

Because the sides of a module are to be butt joined against each other, the left and right sides will be made to the dimensions of the module; the front and rear sides will be made to take into account the thickness of a side i.e. minus the thickness of the left and right sides. The reason for this is if modules are initially assembled without gluing, there is scope for the adjustment of the shape of a module, by planning the butting end of a side to ensure that when modules are connected together, they will be 'straight' with respect to each other. Once the modules are deemed to be correctly shaped, the joins may then be glued.

The completed module will be coated with a barrier (e.g. varnish, thinned PVA glue or thinned emulsion paint) on all surfaces, to seal against the ingress of moisture.

4.3 Positioning of alignment dowels

The positioning of the alignment dowels on each module will be standardised so as to allow for the possibility of changing the positional relationship of each module, or adding in additional modules at some future date.

Each mating side will have two alignment dowels, positioned 50mm below the upper edge of each mating side and with a 50cm horizontal separation between them. The rearmost dowel will be positioned 10cm from the external rear corner.

An exception to this ruling will be with modules that have a side that is less than 600mm wide, the horizontal separation of the dowels will be reduced.

The vertical position of the dowels is yet to be determined.

4.4 Identification of parts for module assembly

Because sides may be made up and not immediately assembled into modules, it is important to have a consistent marking to correctly identify each side. Each side will have written on it:

- The number of the module that it belongs to, e.g. 1 to 11.
- The position on the module, as viewed by the operator when set up, e.g. front, rear, left, right. Where front is the surface facing towards the centre of the layout and rear is the outward facing perimeter.

4.5 Support legs

Because of the complexity of construction and a question of reliability in use, the original decision to have integral legs has been reversed and legs will now be separate.

The revised plan is to have legs, or trestles supporting an open frame, upon which the modules will rest.

The support legs shall be long enough to enable the track to be between 0.75m to 1.2m above floor level.

4.6 Joining modules together

To ensure accurate alignment between adjacent modules, a pair of metal alignment dowels will be employed at each mating surface, the male and female components being mounted within the thickness of the ply panels. To improve a solid fixing, the panel at that position will not have an airgap. To ensure that there is an accurate alignment, the panels which align shall be constructed at the same time, as a match pair, and the dowels shall be fitted before the completed panels are assembled to form the complete module.

To secure adjacent modules together, Hinges with removable pins will be secured across the front and rear mating edges of the modules.

4.7 Upper loadbearing surface

A shaped sheet of ply will form the upper loadbearing surface where required. This is for supporting the track, roads, buildings and any other object which requires support. The shape of the surface can be obtained from the trackplan. The surface may require additional bracing underneath, to prevent flexing.

4.8 Resisting sideways movement

Because of the potential for knocking stock off the track, a means will be identified for preventing the accidental sideways movement of the layout should a force be applied to it. This may take to form of packing material wedged between the layout and the walls of room.

4.9 Module dimensions

The size of each module is influenced in part, by the track plan and so the size and shape of each module is given on the track plan. The latest version of the track plan is saved as 'Trackplan_V10point 6'.

The modules count clockwise, starting from the corner module to the left when entering the room.

All dimensions shall be given in metric (millimetres).

Diagonal dimensions are approximate.

Module number	Size (length x width)	Internal Diagonal
1 (corner)	900, 600	1052, 1111, 1052
2	1000, 700	1191, 960
3	900, 700	1111, 1111
4	1000, 700	1191, 960
5 (corner)	900, 600	1052, 1111, 1089
6	1180, 500	1179, 1270
7 (corner)	1100, 800	1331, 1331
8	1100, 800	1331, 1331
9	1000, 800	1251, 1251
10 (corner)	1000, 900	1316, 1137, 1175
11 (lifting access)	990, 600	1137, 1137

5 Appendix 1. Cutting list

Module	Front	Rear	Left	Right	Corner	Diag 1	Diag 2	Diag 3
1 (corner)	600	600	900	761.5	360.55	1052	1111	1052
2	700 *	1000 *	761.5	700	n/a	1191	960	
3	900 *	900 *	700	700	n/a	1111	1111	
4	700 *	1000 *	700	761.5	n/a	1191	960	
5 (corner)	509.9	600 *	761.5	900	500	1052	1111	1089
6	1100 *	1200 *	509.9	500	n/a	1179	1270	
7 (corner)	1100 *	1100 *	800	800	n/a	1331	1331	
8	1100 *	1100 *	800	800	n/a	1331	1331	
9	1000 *	1000 *	800	800	n/a	1251	1251	
10 (corner)	600	1000 *	800	900	360.55	1316	1137	1175
11 (lifting access)	1000 *	1000 *	600	600	n/a	1137	1137	

Note. * Indicates lengths that need to take into account thickness of side due to there being a butt joint e.g. – 30mm.

Model Railway Detailed Design – Baseboard Document

Length mm (approx.)	Position(s)	Quantity
1200	6 rear	2
1100	6 front	2
970	2 rear 4 rear 11 front & 11 rear 10 right 9 front & 9 rear	14
900	5 right 10 rear	10
885	1 left	
870	3 front & 3 rear	
800	10 left 9 left & 9 right 1 right * 2 left * 4 right * 5 left *	14
700	2 right 3 left & 3 right 4 left	12
670	2 front 4 front	
600	1 front 10 front 11 left & 11 right	12
585	1 rear 5 rear	
550 *	5 front 6 left	4
500	5 corner 6 right	4
360 *	1 corner 10 corner	4

Quantities required for 100mm wide strips

Length mm (approx.)	Module(s)	Quantity
1331	7, 8	4
1316	10	1
1270	6 *	1
1251	9	2
1191	2, 4	2
1179	6 *	1
1175	10	1
1137	10, 11 *	3
1111	1, 3, 5	4
1089	5	1
1052	1, 5	3
960	2, 4	2

Quantities required for 80mm wide strips

- Denotes diagonals that may not be utilised due to reduced height of modules.

6 Appendix 2 Materials - Suppliers

Material	Supplier	Quantity / Cost (estimated)
Plywood sheets 5.5mm x 2440mm x 1220mm	Travis Perkins	10 sheets x £14.34
Metal alignment dowels	Station Road Baseboards	30 sets
Suitcase spring loaded toggle latch	Essentra components	30 x £2.30
PVA Glue	Various	More than 1 bottle

Model Railway Detailed Design – Track Document

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1 Glossary

Item	Meaning
Code 100	An oversized standard of rail for OO gauge track. Now superseded by code 75
Domestic lighting	The lighting that is provided in the room the railway is set-up in.
Double-slip	A *double slip switch* (*double slip*) is a narrow-angled diagonal flat crossing of two lines combined with four points in such a way as to allow vehicles to change from one straight track to the other, as well as going straight across. A composite which provides two exit routes for each entrance.
Down	A convention applied to the direction of rail traffic on a line
Electrofrog	The conductive crossing point for a pair of rails.
Fiddle yard	A **fiddle yard** or **staging yard** is a collection of model railway tracks (normally hidden from view) that allow trains to be stored and manipulated by the operators
Finescale	Or code 75 track, more accurate to scale than code 100.
Fishplates	The joiners that are used to connect rail ends that butt up against each other
Flexitrack	A length (normally 3ft) of track which by nature of the breaks in the sleeper webbing, can be shaped into curves.
Home signal	Also known as a Stop signal, used to protect the length of line beyond the signal
Facing points	As seen from the direction of travel along a line. A facing point provides a divergence of two routes.
Level	Horizontal and flat
Loadbearing	Intended to take the weight of track, buildings or any main feature.
Mainline	The mainline is the principal route for through traffic.
Mk1	A style of railway carriage design, the standard design for use post-nationalisation.
Module(s)	The name assigned to the individual baseboards, which combine to form the complete model railway
Non-loadbearing	Unlike loadbearing, not Intended to take the weight of track, buildings or any main feature. Purely there for surface appearance.
Normal domestic parameters	Temperature, humidity and lighting conditions that would be expected in a domestic room
Normal sized doorway	The size of the doorway in a house. Approx 26ins wide.
Open box	The style of baseboard construction, where there is not necessarily a hard top surface covering the entire module, thus enabling the landscape to fall below the level that the track is on.
Peco	A manufacturer of model railway track and accessories.
Rolling stock	The generic name for all vehicles that move on the railway, powered and unpowered.
Sacrifice modules	Modules which are to be included in the intended design, but which can be removed, to give a slightly smaller but still functional railway layout.
Set-track	Unlike flexi-track, set track has a fixed geometry and is not flexible.

Track gauge	A tool that provides the minimum spacing between the Up and Down lines.
Single-slip	A single slip is a point crossing combined with one pair of points, giving one switching possibility. A composite which provides two exit routes for only two entrances.
Superelevation	Also known as the cross slope or camber of the track. This is the difference in elevation (height) between the two rails. This is normally done where the railway is curved; raising the outer rail or the outer edge of the road providing a banked turn, thus allowing vehicles to maneuver through the curve at higher speeds than would otherwise be possible if the surface was flat or level.
Trailing points	As seen from the direction of travel along a line. A trailing point provides a convergence of two routes.
Transition curve	A curve of constantly changing radius, used to provide a smooth interface between a straight and an arc of different curvature.
Up	A convention applied to the direction of rail traffic on a line

2 Scope

At concept design, ideas are explored, with the aim of developing a picture of what the project is to be, including the main features.

The concept design is to produce the following outputs:

- Type of layout style.
- Selection of track and type of controller to be used.
- Method for controlling points & signals.
- Number of baseboards, outline dimensions, construction materials and fixings to be used.

The purpose of this document is to define details of the project. Detail design is split into the parts Baseboards, Trackwork, Control and Electrics, landscaping, Detailing.

This document concerns the design and construction of the track.

Construction of the modules (baseboards) and the control system are covered in separate documents.

Because the shape of each module and the track positioning are inter-related, track plans will be presented separately.

Measurements shall be given in metres or millimetres.

3 Overview

There shall be 11 connecting modules which are to fit around the perimeter of a rectangular room approx 9ft 6ins x 13ft 6ins (2890mm x 4110mm). Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m.

To gain access to the open centre, the two side modules where the door is, will be attached to their adjacent corner modules by hinges, so that the two modules may be swung upwards, drawbridge fashion.

The track will be secured to the upper surface of the module and the shape of each module will be designed so that track will cross the module joins as near to perpendicular as is practical.

The design of the track will enable varied movements showing:

- The running of passenger trains on the [Up] and [Down] lines, with the ability to stop at the station.
- The running of goods trains on the [Up] and [Down] lines, with the ability to stop in the goods sidings for the purpose of dropping off/picking up goods wagons.
- The changing of locomotives.
- The reception, storage, servicing and dispatch of locomotives from the locomotive shed area.
- A [fiddle yard] for the storage of complete trains, permitting a varied running of trains.

The [fiddle yard] will comprise five lines for each direction of operation. Measurements taken from the track design indicate that for the clockwise direction of travel (the outer circuit) the shortest line in the [fiddle yard] will accommodate a train up to 1900mm (6ft 3ins) in length and the longest line will accommodate a train up to 2500mm (8ft 2ins) in length. For the anti-clockwise line (the inner circuit) the shortest line in the [fiddle yard] will accommodate a train up to 1600mm (5ft 3ins) in length and the longest line will accommodate a train up to 2400mm (7ft 10ins) in length. Therefore it will be possible to accommodate one six-carriage train for each direction. The shorter lines will accommodate five-carriage trains.

Measurements taken from the track design indicate that the two sidings into the engine shed are each 1100mm (3ft 7ins) in length. This will accommodate six large locomotives. There is also space to accommodate an additional two sidings of equal length. When locomotives are attached to trains in the fiddle yard, the layout in its current design will accommodate sixteen locomotives, with option for an additional six. This does not include any locomotives present in the goods sidings.

Measurement taken from the track design indicate that there is room for station platforms of 1500mm (4ft 11ins) in length. It may be possible to increase this by 200mm (8ins) by adjusting the position of the track. If it is permitted for a train to extend beyond the limits of the platform, then a six-carriage train can be accommodated.

4 Track design

The track plan is to be designed by a computer-based track plan design tool and the designs are to be saved in digital format on computer.

The latest version of the track design is saved under the filename ‘Trackplan_V10point8’.

In version 10.4, the turntable has been moved so as to make it possible for there to be an additional connection to it from one of the locomotive sidings, thus providing a second route for locomotives to move in case of congestion.

For version 10.7, it was recommended that there needs to be a catchpoint on the exit from the engine yard to the mainline. It was decided to follow the alternative suggestion of having a headshunt. To achieve this, point number 21b was added.

For version 10.8, signals are added to the trackplan.

Additionally, track has been extended out the back of where the engine shed is to be, so as to allow for buffer stops, also the provision of an engine hoist.

The track design shows a continuous loop for twin-track [mainline] operation. There is also provision for a fiddleyard, station, goods area and locomotive servicing.

A master plan is to be maintained. This is to be copied onto paper at a scale of 1:1 which is to be accurately positioned on the modules, thus enabling the track to be correctly positioned.

The locomotive servicing area will contain the functions associated with this area: Turntable, Water tower, coaling, ash removal, engine shed.

The goods area will contain the functions associated with this area: Goods shed, crane.

A line in the engine servicing area has been extended onto module 10, to provide for a length of track dedicated to locomotive DCC programming.

5 Track laying

5.1 Layout overview

The minimum curve radius as stated in the concept design, has been increased by 3ins (8cms). Curves will have a minimum radius of 27ins (69cms).

The spacing between straight parallel tracks is to be 51mm (centre to centre), as determined by the [Peco] track gauge. The distance between parallel tracks on a curve will need to be at least 4mm greater than that given by the [Peco] track gauge to allow for the overhang of carriages. This figure has been determined by experimentation on a test track, where the minimum radius was 61cms.

[Superelevation] on curves will be used. The increase in height on the outer rail will be 1mm to 2mm.

For a curve which turns through 90 degrees, a curve of not less than minimum radius, with an arc of 30 degrees will be bracketed between two transition curves, each with an arc of 30 degrees.

Where track crosses a module join, it shall do so at an angle of not more than 30degrees to the perpendicular, to minimise the possibility of derailment due to a wheel catching a sharp rail edge.

Track will be OO gauge [finescale] [flexitrack] with wooden style sleepers, sourced from [Peco].

The points will be [electrofrog] style.

All track will be accessible by a normally-abled adult, without having to dismantle the modules.

Because a folded-figure-of-eight track design has been considered and rejected, it is anticipated that the track will be on one level and will not have a gradient. However, if there is a gradient, 1 in 70 (1.42%) is the maximum acceptable gradient. It would be preferred if gradients are not more than 1 in 76 (1.3%).

5.2 Track positioning

Consideration will be given to the positioning of points, to ensure that point motors do not coincide with internal bracing within the module or edges.

Consideration will be given to how track interacts with surrounding buildings and features. For example:

- The spacing of track where the engine shed and goods shed are to go, shall take into consideration the dimensions of the engine shed and goods shed.

The track plan will be copied onto thin (tracing) paper that will be accurately positioned and secured over the entire area where track is to be placed. This will aid to positioning of track, which is to be secured over the paper. When tracklaying is complete, the paper can be torn away.

5.3 Points selected

The shape and size of points selected will be what provides the closest fit to meet the design of the track layout, with the following criteria:

- Turnouts on the mainline will have as large a radius as possible, to reduce the risk of derailment.
- Wherever possible, points on [mainlines] are to be [trailing points].

5.4 Track joining

Track will be joined by metal joiners [fishplates] by [Peco], except where electrical isolation is required, when plastic joiners [fishplates] will be used. Provision will be made, through the use of [fishplates], so that thermal expansion does not cause buckling of the rails or any other damage.

Because of the tendency for rails to spring outwards, joins on all but the gentlest radius are to be avoided.

5.5 Track fixing down

Track is to be secured to the base by track fixing pins at regular intervals. Care is to be taken to ensure that track sleepers are not damaged or deformed by the application of the pins. This will be achieved by the pre-drilling of holes through sleepers and into the base. The size of drill bit is to be selected so that the hole will positively grip the pin.

Prior to the track being laid, a layer of sound-deadening material e.g. cork sheeting, shall be secured to the upper surface.

When a length of track is laid, connecting wires will be joined to the underside of each rail when the track is secured in position, so that the wires will not be visible from above after ballasting is in place.

Where track crosses a join between two modules, the rails are to be positively secured to each side of the join, so that there is no movement. This is to be achieved by the application of copper-clad strip, secured along each side of a module edge on the upper surface. When laid, track sleepers are to be pushed back so that the rails can be soldered directly to the copper-clad strip. After all the tracks across a join are secured in place, they can be cut along the join.

Prior to the fixing down of points, a 10mm hole is to be drilled through the baseboard, to align with the hole in the tie bar operating the point. This is for the provision of the point motor operating lever.

5.5.1 Points

Prior to securing down a point, carry out the following actions:

- Break the links underneath the point, as indicated in the manufacturer instructions for using auxiliary switches on live frog points.
- Solder a link, to connect together each switch blade to its associated fixed blade. The manufacturer has provided a gap in the sleeper webbing for this purpose. The connection can also double-up as the power connection to the point.
- Mark and drill holes through the base for (i) The Point Motor operating wire. (ii) Power wires to the fixed blades. (iii) Power wire to the live frog.
- Ensure all power wires are fed through when positioning the point.

5.6 Track ballasting

Track ballasting will not commence until after all track testing is complete and the layout has been run for a while with a wide selection of rolling stock, to ensure the satisfactory design and operation of the layout.

5.7 Power feeds to track

See Detailed Design Control & Electrics.

5.8 Spring removal

When the point motor is connected, remove the spring that applies pressure to the switch blades. This is because it's presence will interfere with the correct operation of the point motor.

6 Track testing

The track shall be tested following laying, to ensure:

The quality of the installation.

Correct running of rolling stock.

Electrical conductivity.

Electrical isolation.

Operation of points.

7 Parts list

The track parts list, as presented by the track design software package, is as follows:

Code	Description	Quantity
SL-190	H0 Peco Streamline Code 75 SL-180 Double slip switch 248mm	1
SL-E1095,	H0 Peco Streamline Code 75 SL-E1095 Right turnout 219mm. (conductive frog) (concrete)	4
SL-E1096,	H0 Peco Streamline Code 75 SL-E1096 Left turnout 219mm. (conductive frog) (concrete)	4
SL-E186	H0 Peco Streamline Code 75 SL-E186 Right curved turnout 12º (conductive frog)	9
SL-E187	H0 Peco Streamline Code 75 SL-E187 Left curved turnout 12º (conductive frog)	9
SL-E188	H0 Peco Streamline Code 75 SL-E188 Right turnout 257mm. (conductive frog)	2
SL-E196,	H0 Peco Streamline Code 75 SL-E196 Left turnout 219mm. (conductive frog)	1
SL-100F,	H0 Peco Streamline Code 75 SL-100F. Flex 914.518mm. (wood)	45.3m
	Peco Turntable	1

8 Appendix 1 Materials - Suppliers

Material	Supplier	Quantity / Cost (estimated)
Track, including joiners		
Track pins		
Copper clad strip		
Tracksetta templates		

Model Railway Detailed Design (Control & electrics)

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Home signal	Also known as a Stop signal, used to protect the length of line beyond the signal
Inner rail	On a length of track, the inner rail is the rail nearest to the centre of the layout. See [outer rail].
Level	Horizontal and flat
Loadbearing	Intended to take the weight of track, buildings or any main feature.
Mainline	The mainline is the principal route for through traffic.
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Measurements shall be given in metres or millimetres.

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There shall be 11 connecting modules which are to fit around the perimeter of a rectangular room approx 9ft 6ins x 13ft 6ins (2890mm x 4110mm). Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m.

To gain access to the open centre, the two side modules where the door is, will be attached to their adjacent corner modules by hinges, so that the two modules may be swung upwards, drawbridge fashion.

Power to the track shall be supplied by feeder wires connected to each length of rail, installed at tracklaying. The feeders shall be brought to a central location on each module. Each module shall be connected to its neighbour by a plugged cabling, enabling an ease of connecting/disconnecting.

DCC control shall be used for control of the locomotives and operation of the point motors.

Locomotive control shall be executed by a hand-held controller.

Point control shall be executed by a switch control panel, which will also display a visible indication of the point's status on a mimic panel which represents the track plan.

Signal control shall be executed by servo motors and control system.

The controls for locomotives, signals and points shall be reachable without the need for the operator to move from a single location.

4 DCC Controller

The DCC controller selected for the operation of locomotives, is the NCE. The Gaugemaster was considered but rejected because it was felt that the NCE had superior features and felt easier to use.

5 Points motors

5.1 Point Operation

The point motors selected are the Cobalt iP Digital point motors.

These motors are selected because:

- They are readily available and it expected that they will have a long availability.
- They are to be DCC controlled.
- They provide slow operation.

Each point motor is to be positioned underneath the point that it operates. It is to be secured to the underside of the module and its operating wire passes through a hole drilled before the point is fixed into place. For fitting instructions, refer to the manufacturer's instructions.

5.2 Point Control

Candidate methods for controlling points are:

5.2.1 Lever frames supplied by Digital Concepts (preferred method)

This method will require the interfacing of the levers to the power bus by encoder circuit boards.

One lever will be required for each point (currently 35) and one board will be required for every twelve levers.

This will be the more expensive option.

Note. Because a number of point motors are working as pairs, the number of levers required is reduced to 24.

5.2.2 Push buttons (alternative method)

This method will require a mimic panel with two push buttons for each point.

This method will also require the use of three encoder circuit boards.

This will be the cheaper option as push buttons are an inexpensive item to purchase.

5.2.3 Interim control method

It will not be necessary to select a control method initially, as it will be possible to control point operation through the NCE controller. So this method can be utilised until a final decision is made.

5.2.4 Point motor electrical connection

Point motors will be connected to the main power bus and will utilise the same wire colours as selected for the track.

Connections:

Terminal 1 – DCC bus

Terminal 2 – DCC bus

Terminal 3 – Switched feed to point frog

5.2.5 Point motor Decoder addressing

Point motor addressing comes under a separate 'Auxiliary' numbering scheme, which means that there will be no conflict between locomotive addresses and point motor addresses. Address numbers 197 to 199 are reserved for resetting of the point motors, see manufacturer's instructions.

A number of points are intended to work in pairs. To enable this to happen, each pair shares one address.

To programme an auxiliary address to the Cobalt iP Digital point motors, do not follow the NCE instructions. The Cobalt point motors do not have CV's, so the NCE programming method will not work. Instead, follow the guidance given for the Cobalt motors:

https://www.dccconcepts.com/manual/owners-manual-cobalt-ip-digital-point-motors/

1) Connect the motor to the power bus.
2) Put the motor into 'SET' mode, using the switch on the motor.

3) Send the accessory command to change the point, using the address that is to be assigned to the motor.
4) Put the motor into 'RUN' mode, using the switch on the motor.

6 Signal operation

This section describes the operation of signals.

The preferred method of controlling the semaphore signals is to be the MegaPoints Controller system.

The reasons for this selection being:

- This system permits realistic bounce of the semaphore signals.
- Works with analogue or DCC.

The controller is obtained direct from www.megapointscontrollers.com

The controller enables control of the signals from a single location, remote from each signal.

Servos, for the operation of the signals, are readily available from electronics hobby shops.

The ground signals shall be non-operating.

7 Turntable motor

The turntable is powered from a low-voltage DC source, switched via a dual-pole, double-throw switch.
See http://www.ti.com/lit/ds/symlink/lm317-n.pdf for information on a regulated power output for motor control.

8 Control Panel

This section describes the control panel (s) for the operation of points and signals. <to be developed>

9 Interfacing

This section describes the interfacing of control panel(s) to point and signal motors. Also the interfacing of the locomotive controller and track.

9.1 Power bus

A power bus will be used as a distribution of control power to the track and point motors.

The power bus cannot be a continuous loop, as two paths of different length would introduce timing issues for the digital information. This means that the power bus becomes two transmission lines which must be loaded at their remote ends to prevent introducing interference that can affect running of the locomotives. Suitable passive loads have been purchased for this purpose and will be fitted when the bus is complete.

The power bus will connect to solder tag boards on each module, which will provide the interface to the track.

To enable assembly/disassembly of the layout, the bus will have in-line plug-in connectors at each module join.

The choice of wire for the power bus is to be at least 24/0.2 multistrand. Wires are to be twisted.

9.2 Connection of power to the track

Each length of rail (where possible) shall be directly wired to a connection point to the power bus, mounted to the underside of each module. The exception to this will be isolated sections of track, which shall be connected via switches on the point motors.

The connection points shall be solder tag boards that will be secured to the underside of each module.

The connecting wires will be joined to the underside of each rail and pass through holes drilled through the base when the track is being laid, so that the wires will not be visible from above after ballasting is in place. Connection will be achieved by soldering.

Connecting wires will also be connected to the outermost rails of each point. The wire connection to the live frog will also be utilised, providing a reliable switched power connection to the frog via the switched connection on the associated point motor (S1-FROG). Additionally, the switching blades will be connected to their associated fixed rails to ensure reliable electrical connection; there is a gap in the sleeper webbing to facility this connection.

The wire used for the track connections will be 15/0.2 multistrand insulated. Separate colours will be used for inner and outer rail.

Where the power bus crosses between modules, electrical connectors shall be used to enable the modules to be taken apart. The ‘female’ part of the connection shall be on the side towards the controller, to prevent accidental short-circuiting.

DCC output from the controller is switched, to permit selection of either the DCC power bus for normal operation, or the DCC decoder programming line.

Micro-switches mounted on either side of the lifting module, will cut-off DCC power to the modules on either side. This is a safety measure to prevent locomotives running off the end of the track in the event of the lifting section not being down.

A means will be explored so that it will not be possible to drive a locomotive past a signal at danger. On possible option for this would be to have the setting of the signal controlling the switching of power to the track.

To prevent a locomotive from being driven across the heel of a point that is set against it, and hence causing a short circuit across the power feed by bridging across the required insulated rail joiner; an isolated section of rail is to be placed before each point. This section is to be long enough that a locomotive cannot cause a short circuit. Power to this section is to be delivered through the secondary switches on the point motors. Where two or more points are close together, the secondary switches of each point motor shall be connected in series. A wiring chart for this is given in Appendix 3.

9.3 Connection of power to the point motors

Each Cobalt digital point motor will be connected to the power bus. Connection will be by using the same wire selected for track connection. Wiring details are supplied with the motors.

There will also be a switched feed from the motor to the live frog of the point that the motor serves.

Auxiliary switches mounted on the point motors are available for such services as the operation of signals, indication of point settings to a visual mimic panel etc.

9.4 Lifting section

One of the modules is designed to be opened, to allow for access. When it is lifted, power is to be cut to it and the modules on either side, to prevent locomotives being driven off the open end. On both the hinged side and the opening side, microswitches are to be mounted which will break the power feed to those modules.

10 Wire colour scheme

The colour scheme for wiring is as given in this table:

Connection	Wire insulation colour
Controller Bus for [inner rail]	Black
Controller Bus for [outer rail]	Red
[inner rail] feed	Black
[outer rail] feed	Red
Point switch rails and live frog feed	Yellow
Point motor feed	Black
Point motor feed	Red
Point motor switch (normally open)	<TBD>
Point motor switch (normally closed)	<TBD>
Point motor switch (common)	<TBD>
Signal motor feed	<TBD>
Signal motor feed	<TBD>
Turntable track feed [inner rail]	Black
Turntable track feed [outer rail]	Red
Turntable motor feed	Green
Turntable motor feed	Green
Program track [inner rail] feed	Green
Program track [outer rail] feed	Green

11 Decoder chips

Decoder chips, where not already fitted, will be installed in each locomotive. A number have been purchased for this purpose.

An address numbering scheme shall be selected for the decoders fitted into locomotives, such that the address number for each decoder appropriately reflects the locomotive number. It is recognised that short addresses are a three-digit number, long addresses are a four-digit number and that locomotive numbers are normally four to six-digits.

12 Addressing scheme

The 4-figure (long) locomotive addressing scheme will be used with the addressing of locomotives to the controller.

Each locomotive will have the number on its side as its address, unless that number is more than 4 digits, in which case the least significant 4 digits are used.

There is a separate auxiliary addressing for point motors, this shall be 01 upwards, with the exception of 197 to 199, which are reserved for resetting of the Cobalt point motors.

13 Testing

Complete testing of all electrical systems shall be carried out. Details of tests to be specified separately.

14 Appendix 1 Materials - Suppliers

Material/item	Supplier	Quantity / Cost (estimated)
NCE controller	Digitrains Ltd	1 x £149.95
DCC decoder chips	Digitrains Ltd	1 per locomotive, up to £20
Cobalt iP Digital point motors	Digitrains Ltd	Pack of 12 x 3 = £525
Cobalt lever switches	Digitrains Ltd / Hattons	1 per point.
Cabling	Widely available	
Connectors	Widely available	
MegaPoints Controller system (signals)	www.megapointscontrollers.com	
Actuators (signals)	Widely available	
36-tag Solder Tag Boards (TAB051)	Squires	22 x £2.99 each = £65.78

15 Appendix 2 Locomotive Addressing

Name of locomotive	Number	Address	Comments
King George I	6006	6006	Sound chip
Swithland Hall	6988	6988	Done
Victoria	45565	5565	Done
Class 8F	48151	8151	Lacks 'Stay alive'
Bunsen	45512	5512	Lacks 'Stay alive'
Overton Grange	6879	6879	Done
Clan Macgregor	72005	2005	Done
Sir Frederick Pike	34058	4058	Lacks 'Stay alive'
Standard Class 4	75005	5005	Done
Serlby Hall	61631	1631	Done
King William IV	6002	6002	Done
Cadbury Castle	7028	7028	Done
Sandwich	60039	0039	Done
Standard Class 4MT	76114	6114	Done
Clan Line	35028	5028	Done
Princess Margaret Rose	46203	6203	Done
Coeur de Lion	70007	7007 / 0007	Done
Earl of St German	5050	5050	Sound chip
4-4-0 E Tootal Broadhurst	45534	5534	Done
Class M7	30129	0129	Done

16 Appendix 3 Power feeds to isolated track sections

Connection from	Connection to	Colour
Outer rail feed (red)	Motor 6a, S2-C	Red
Motor 6a, S2-R *	Motor 21, S2-C	Blue
Motor 21, S2-R *	Rail, isolated section P	Red
Motor 21, S2-L *	Rail, isolated section Q	Red
Motor 21, S2-L *	Motor 27a, S2-C	Blue
Motor 27a, S2-R *	Rail, isolated section R	Red
Outer rail feed (red)	Motor 9a, S2-C	Red
Motor 9a, S2-R *	Rail, isolated section AC	
Outer rail feed (red)	Motor 11b, S2-C	Red
Motor 11b, S2-R *	Rail, isolated section AF	
Outer rail feed (red)	Motor 27b, S2-C	Red
Motor 27b, S2-R *	Rail, isolated section S	
Outer rail feed (red)	Motor 32, S2-C	Red
Motor 32, S2-R *	Motor 33, S2-C	Blue
Motor 33, S2-R *	Motor 34, S2-C	Blue
Motor 34, S2-R *	Rail, isolated section X	
Motor 34, S2-L *	Rail, isolated section W	
Motor 33, S2-L *	Rail, isolated section V	
Motor 32, S2-L *	Motor 29, S2-C	Blue
Motor 29, S2-R *	Rail, isolated section U	
Inner rail feed (black)	Motor 6b, S2-C	Black
Motor 6b, S2-R *	Rail, isolated section O	
Inner rail feed (black)	Motor 9b, S2-C	Black
Motor 9b, S2-R *	Rail, isolated section AD	
Inner rail feed (black)	Motor 11a, S2-C	Black
Motor 11a, S2-R *	Rail, isolated section AE	
Inner rail feed (black)	Motor 5a, S2-C	Black
Motor 5a, S2-R *	Motor 7, S2-C	Blue
Motor 7, S2-R *	Rail, isolated section Y	
Motor 7, S2-L *	Rail, isolated section Z	

Inner rail feed (black)	Motor 29a, S2-C	Black
Motor 29a, S2-R *	Rail, isolated section T	
Motor 30, S1-FROG	Motor 30, S2-C	
Motor 30, S2-R *	Rail, isolated section AB	
Motor 30, S2-L *	Rail, isolated section AA	
Motor 19, S1-FROG	Motor 19, S2-C	Blue
Motor 19, S2-R	Motor 17, S2-C	Blue
Motor 17, S2-L	Motor 18, S2-C	Blue
Motor 17, S2-R	Motor 16, S2-C	Blue
Motor 17, S2-L	Rail, isolated section (G)	Black
Motor 18, S2-R	Rail, isolated section (F)	Red
Motor 18, S2-L	Rail, isolated section (E)	Red
Motor 16, S2-R	Rail, isolated section (J)	Black
Motor 16, S2-L	Rail, isolated section (H)	Black

Model Railway Detailed Design – Buildings Document

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1 Glossary

Item	Meaning
Code 100	An oversized standard of rail for OO gauge track. Now superseded by code 75
Domestic lighting	The lighting that is provided in the room the railway is set-up in.
Double-slip	A *double slip switch* (*double slip*) is a narrow-angled diagonal flat crossing of two lines combined with four points in such a way as to allow vehicles to change from one straight track to the other, as well as going straight across. A composite which provides two exit routes for each entrance.
Down	A convention applied to the direction of rail traffic on a line
Electrofrog	The conductive crossing point for a pair of rails.
Fiddle yard	A **fiddle yard** or **staging yard** is a collection of model railway tracks (normally hidden from view) that allow trains to be stored and manipulated by the operators
Finescale	Or code 75 track, more accurate to scale than code 100.
Fishplates	The joiners that are used to connect rail ends that butt up against each other
Flexitrack	A length (normally 3ft) of track which by nature of the breaks in the sleeper webbing, can be shaped into curves.
Home signal	Also known as a Stop signal, used to protect the length of line beyond the signal
Facing points	As seen from the direction of travel along a line. A facing point provides a divergence of two routes.
Level	Horizontal and flat
Loadbearing	Intended to take the weight of track, buildings or any main feature.
Mainline	The mainline is the principal route for through traffic.
Mk1	A style of railway carriage design, the standard design for use post-nationalisation.
Module(s)	The name assigned to the individual baseboards, which combine to form the complete model railway
Non-loadbearing	Unlike loadbearing, not Intended to take the weight of track, buildings or any main feature. Purely there for surface appearance.
Normal domestic parameters	Temperature, humidity and lighting conditions that would be expected in a domestic room
Normal sized doorway	The size of the doorway in a house. Approx 26ins wide.
Open box	The style of baseboard construction, where there is not necessarily a hard top surface covering the entire module, thus enabling the landscape to fall below the level that the track is on.
Peco	A manufacturer of model railway track and accessories.
Rolling stock	The generic name for all vehicles that move on the railway, powered and unpowered.
Sacrifice modules	Modules which are to be included in the intended design, but which can be removed, to give a slightly smaller but still functional railway layout.
Set-track	Unlike flexi-track, set track has a fixed geometry and is not flexible.

Track gauge	A tool that provides the minimum spacing between the Up and Down lines.
Single-slip	A single slip is a point crossing combined with one pair of points, giving one switching possibility. A composite which provides two exit routes for only two entrances.
Superelevation	Also known as the cross slope or camber of the track. This is the difference in elevation (height) between the two rails. This is normally done where the railway is curved; raising the outer rail or the outer edge of the road providing a banked turn, thus allowing vehicles to maneuver through the curve at higher speeds than would otherwise be possible if the surface was flat or level.
Trailing points	As seen from the direction of travel along a line. A trailing point provides a convergence of two routes.
Transition curve	A curve of constantly changing radius, used to provide a smooth interface between a straight and an arc of different curvature.
Up	A convention applied to the direction of rail traffic on a line

2 Scope

At concept design, ideas are explored, with the aim of developing a picture of what the project is to be, including the main features.

The concept design is to produce the following outputs:

- Type of layout style.
- Selection of track and type of controller to be used.
- Method for controlling points & signals.
- Number of baseboards, outline dimensions, construction materials and fixings to be used.

The purpose of this document is to define details of the project. Detail design is split into the parts Baseboards, Trackwork, Control and Electrics, landscaping, Detailing.

This document concerns the design, construction and placing of buildings.

Construction of the modules (baseboards) and the control system are covered in separate documents.

Because the shape of each module and the track positioning are inter-related, track plans will be presented separately.

Measurements shall be given in metres or millimetres.

3 Overview

So that buildings and other structures are not exposed to any harm by the movement of the module, such as for transportation or maintenance, they shall either be securely fixed down and rigid enough to not be affected by movement, including being tipped onto the side; or be easily removable.

Buildings that can be viewed inside, may require interior detailing and/or lighting, as appropriate.

4 Railway buildings

4.1 Station

No decision has yet been made.

The station is not to have a covered train shed. This is so as not to restrict full access to the track.

4.2 Signal box(es)

No decision has yet been made.

4.3 Engine Shed

The selected engine shed is to be the CK12 Two-Road Engine Shed by Wills kits.

The shed has a footprint of 264mm x 132mm.

Several kits may be combined together to make a 4-road shed of sufficient length.

4.4 Water Tower

A candidate is the Large Water Tower by Ratio.

No decision has yet been made.

4.5 Coaling

The Locomotive Coaling Tower by Ratio Kits, part No. 547 is the preferred selection.

It has a footprint of 116mm x 92mm and is 181mm high.

4.6 Goods Shed

There are two candidates for a Goods Shed, one by Wills and the other by Ratio.

The ratio 534 Goods Shed has a footprint of 155mm x 170mm.

4.7 Other Ancillary Buildings

No decision has yet been made.

5 Permanent railway structures

5.1 Bridge

There is to be a red-brick arched bridge over the river on module 11. It is to be constructed out of plasticard sheeting, faced with brick-embossed sheet.

5.2 Viaduct

There is to be a red-brick arched viaduct over the river on module 6. It is to be constructed out of plasticard sheeting, faced with brick-embossed sheet.

5.3 Tunnels

No decision has yet been made.

Tunnel mouths on modules 1 and 5 are to be red-brick arched design. They are to be constructed out of plasticard sheeting, faced with brick-embossed sheet.

6 Other buildings

No decision has yet been made.

7 Parts list

Code	Description	Quantity

8 Appendix 1 Materials - Suppliers

Material	Supplier	Quantity / Cost (estimated)

Model Railway Detailed Design – Finishing

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- Method for controlling points & signals.
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The purpose of this document is to define details of the project. Detail design is split into the parts Baseboards, Trackwork, Control and Electrics, landscaping, Detailing.

This document concerns the finishing details which would not be captured in the other detailed design documents.

Measurements are given in metres or millimetres.

3 Overview

This layout is intended to present the operation of a UK mainline with station, situated on the edge of a town. With facilities for the handling of goods and the servicing of locomotives.

The location is not intended to be a representation of anywhere specifically.

Inspiration and ideas are drawn from articles in model railway magazines and models seen at exhibitions. In this regard, the railway is intended to be freelance and taking in whatever ideas seem interesting.

Features:

- A summer's day.
- Goods shed.
- Coal straithes/merchants.
- A valley with a river and/or canal running through it. The railway is to cross the river by a brick-arch bridge at one end and a bridge or viaduct at the other.

- The layout shall be BR operation and wholly or predominantly steam.
- Where the ends of the layout curve around into the fiddle yard, the ground shall rise up and the track shall disappear through tunnel mouths. Thus giving the impression that the layout is not a continuous loop.
- The layout shall be populated by people and animals, to represent scenes that would normally be expected.
- A rural scene, with vegetation e.g. bushes/trees, shall be included.
- The layout shall represent non-railway buildings typical of a town. These may be either complete buildings (where possible), or low-relief (where necessary).
- Point rodding that connects the points to the signal box, is to be installed. There is an article on this subject in British Railway Modeller, January 2018. It will be necessary to install the point rodding before the track is ballasted.

4 Parts list

Code	Description	Quantity

5 Appendix 1 Materials - Suppliers

Material	Supplier	Quantity / Cost (estimated)
Point rodding SS89 & SS90	Wills	

Model Railway Design – Requirements Document

ID	Requirement	Justification/Basis	Verification method Analysis Certification Inspection Demonstration Test	Acceptance criteria	Lifecycle stage Design Construction	Design/Construction evidence	Tradability Mandatory Tradeable 1 Tradeable 2	Concept Design status	Detailed Design status	Construction Status
1	1.Provide project				Function	n/a				
2	1.1 Comply with regulations				Function	n/a				
3	Other stakeholders shall approve the construction of the project	To ensure buy-in from stakeholders.	Certification	Design - Stakeholders give approval to design proposal.	Design	Stakeholder has approved the construction of an outdoor room to house the layout.	M	Compliant	Compliant	
3	Other stakeholders shall approve the construction of the project.	To ensure buy-in from stakeholders.	Certification	Construction - Not applicable.	Construction	Acceptance implied	M	Compliant	Compliant	Compliant
4	1.2 Provide processing				Function	n/a				
5	1.2.1 Provide model				Function	n/a				
6	1.2.1.1 Location modelled				Function	n/a				
7	The location modelled shall represent a real or fictional UK location	All of the owners locomotives are BR totem. Ref: Strategy, section 2, Scope.	Inspection	Design - The design represents a real or fictional UK location.	Design	The concept design states, "The geographical location will be a fictional place in the UK. "	1	Compliant		
7	The location modelled shall represent a real or fictional UK location.	All of the owners locomotives are BR totem. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The end result looks like a UK location.	Construction	Waiting completion.	1	n/a	n/a	
8	1.2.1.2 Time period modelled				Function	n/a				
9	The time period modelled shall be in keeping with the running of BR steam.	All of the owners locomotives are BR totem Ref: Strategy, section 2, Scope.	Inspection	Design - Caters for features that would have been present during the operation of BR.	Design	The concept design states that "The time period will be post-WW2 and in keeping with BR period steam operation."	1	Compliant		
9	The time period modelled shall be in keeping with the running of BR steam.	All of the owners locomotives are BR totem Ref: Strategy, section 2, Scope.	Demonstration	Construction - Features that are in keeping with BR.	Construction	Waiting completion.	1	n/a	n/a	
10	The season modelled shall not be late autumn/Winter	The owner does not wish to have late autumn/Winter represented.	Inspection	Design - Features in keeping with the season selected. E.g Trees in foliage, flowers, etc.	Design	Detailed design (detailing) states that the railway shall be set in a summers day.	1	n/a		
10	The season modelled shall not be late autumn/Winter.	The owner does not wish to have late autumn/Winter represented.	Demonstration	Construction - The end result reflects Spring/ Summer.	Construction	Waiting completion.	1	n/a	n/a	
11	1.2.1.3 Railway				Function	n/a				

12	The railway shall have the capacity to enable varied track operations.	To further a varied operation. Ref: Strategy, section 2, Scope.	Inspection	Design - A scale track plan to be drawn up and used to examine possible operational movements.	Design	The detailed design (track) states: "The design of the track will enable varied movements showing: The running of passenger trains on the [Up] and [Down] lines, with the ability to stop at the station. The running of goods trains on the [Up] and [Down] lines, with the ability to stop in the goods sidings for the purpose of dropping off/picking up goods wagons. The changing of locomotives. The reception, storage, servicing and dispatch of locomotives from the locomotive shed area. A [fiddle yard] for the storage of complete trains, permitting a varied running of trains." The detailed design (track) states: "Measurements taken from the track design indicate that the two sidings into the engine shed are each 1100mm (3ft 7ins) in length. This will accommodate six large locomotives. There is also space to accommodate an additional two sidings of equal length. When locomotives are attached to trains in the fiddle yard, the layout in its current design will accommodate sixteen locomotives, with option for an additional six. This does not include any locomotives present in the goods sidings."	1	n/a	Compliant

12	The railway shall have the capacity to enable varied track operations.	To further a varied operation. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The layout will enable: Through running of passenger trains. The dropping of/collecting of goods waggons. Stabling of locomotives.	Construction	A wide range of movements has been carried out: 1. Coal trucks being delivered to the coal depot from the UP line and then being collected for return via the DOWN line. 2. Coal trucks being delivered to the coal depot from the DOWN line and then being collected for return via the UP line. 3. Closed vans and open trucks being delivered to the goods depot from the UP line and then being collected for return via the DOWN line. 4. Closed vans and open trucks being delivered to the goods depot from the DOWN line and then being collected for return via the UP line. 5. The ability for the delivering/collecting locomotive to run around its train, so that trucks may be manouvered and the brake van may be put aside. 6. A passenger train at the station UP platform, may have the locomotive removed to the engine yard and another locomotive may be brought out to replace it. 7. A passenger train at the station DOWN platform, may have the locomotive removed to the engine yard and another locomotive may be brought out to replace it. 8. Locomotives in the engine yard may be moved about to any parts. Also rotated. 9. Trucks e.g. coal, may be delivered to the engine yard and deposited adjacient to the coal storage facility. Therefore, this requirement is considered compliant.	1	n/a	n/a	Compliant
15	The railway shall have a twin-line, [mainline] operation	This is where the owners interest lies. Ref: Strategy, section 2, Scope.	Inspection	Design - Design to cater for [Up] and [Down] running lines.	Design	The plan prepared is for a twin-line circuit.	1	Compliant	Compliant	
15	The railway shall have a twin-line, [mainline] operation.	This is where the owners interest lies. Ref: Strategy, section 2, Scope.	Demonstration	Construction - There is [Up] and [Down] running lines.	Construction	The construction of the layout follows the design i.e. a twin-track continuous loop for [mainline] operation.	1	n/a	n/a	Compliant

16	The railway [mainline] shall be a continuous loop.	The owner does not wish to have end-to-end operation. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design includes a [mainline] in a loop configuration.	Design	The plan prepared is for a continuous loop.	1	Compliant	Compliant	
16	The railway [mainline] shall be a continuous loop.	The owner does not wish to have end-to-end operation. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - The mainline is a continuous loop.	Construction	The construction of the layout follows the design i.e. a twin-track continuous loop for [mainline] operation.	1	n/a	n/a	Compliant
17	The [mainline] loop shall not give the impression of four straight sections joined by four corners	Does not look realistic. Need to disguise the fact that the layout is a loop. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to include features that obscure the loop.	Design	It is accepted that the track through the fiddle-yard has to be straight and this is considered off-scene. The two ends are large radius curves. The on-scene long side only has a short length of straight on the mainline, and that is partly obscured by the presence of the engine yard.	2			Compliant
17	The [mainline] loop shall not give the impression of four straight sections joined by four corners.	Does not look realistic. Need to disguise the fact that the layout is a loop. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Over 60% of the mainline shall be curved.	Construction	In the design and the construction, straight lengths have been kept to a minimum, mainly about the fiddle yerd area. The overall impression is that of a gentle curve.	2	n/a	n/a	Compliant
18	The railway shall permit the running of trains of length equal to up to at least six Mk 1 carriages.	This is the minimum length of train that is desired. Ref: Strategy, section 2, Scope. A Mk1 carriage is 273mm long.	Inspection	Design - The design allows for a train of six Mk1 carriages. If it is assumed that a locomotive is the same length as a carriage, then a 6-carriage train is 1911mm long (6ft 3ins). Length of fiddle yard will take this into account.	Design	The layout will accommodate 6-carriage trains.	1		Compliant	
18	The railway shall permit the running of trains of length equal to at least six Mk 1 carriages.	This is the minimum length of train that is desired. Ref: Strategy, section 2, Scope. A Mk1 carriage is 273mm long.	Demonstration	Construction - A six-carriage train can fit within the station and in the fiddle yard.	Construction	Of the 10 lines in the fiddleyard, only 2 will hold a 5-carriage train. The rest will all hold at least a six-carriage train. Therefore, this requirement is compliant	1	n/a	n/a	Compliant
19	1.2.2 Provide layout build.				Function	n/a				
20	The layout build shall use construction methods/skills normally expected of a DIY hobbyist without access to special facilities.	Normal amateur carpentry skills are within the capability of the owner. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - Consideration will be given to how the layout is to be constructed e.g selection of materials, availability of tools, skill level of construction.	Design	The concept design states, "The modules are to be constructed using hand tools that an amateur would normally be expected to own, plus a few readily available power tools, such as drill, plane and jigsaw." The detailed design (baseboard) goes into some detail as to how the modules are to be constructed and this supports the requirement for amateur construction.	1			

20	The layout build shall use construction methods/skills normally expected of a DIY hobbyist without access to special facilities.	Normal amateur carpentry skills are within the capability of the owner. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - n/a	Construction	Some power tools were purchased and used in this project, however, all tools, materials and skills used were within the normal range of what would be expected for an amateur hobbyist.	1	n/a	n/a	Compliant
21	The layout build shall comprise multiple interconnected modules.	To enable the layout to be transportable. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - (i) The design of the whole layout to be split up into interconnecting modules. (ii) Points to be positioned so that they do not straddle joins between modules. The modules will have features which enable : (i) Accurate and repeatable alignment. (ii) A means of securing one module to its neighbour.	Design	The concept design states: "There will be alignment dowels fitted to the mating surfaces between modules, to ensure correct alignment." The detailed design (baseboard) states that there will be connecting modules, using alignment dowells and spring catches.	1			
21	The layout build shall comprise multiple interconnected modules.	To enable the layout to be transportable. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - Modules will connect together.	Construction	The layout consists of 11 interconnection modules which are locked together by the use of hinges with removable pins. Alignment achieved via metal anignment dowels on the mating surfaces.	1	n/a	n/a	Compliant
22	The layout construction shall utilise tools normal for DIY and hobby use.	What is available for construction. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - Consideration will be given to how the layout is to be constructed e.g selection of materials, availability of tools, skill level of construction.	Design	The concept design states: "The modules are to be constructed using hand tools that an amateur would normally be expected to own, plus a few readily available power tools, such as drill, plane and jigsaw." The detailed design (baseboard) goes into some detail as to how the modules are to be constructed and this does support the requirement.	1			
22	The layout construction shall utilise tools normal for DIY and hobby use.	What is available for construction. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - n/a	Construction	The only significant tool purchase made for this project, has been for two circular saws. Additionally, several clamps have also been purchased. All of the tools used could be considered reasonable for hobby use.	1	n/a	n/a	Compliant

23	The layout build shall comprise modules that can be handled by one person.	To enable the ease of carrying around the house by one person. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - (i) The design of each module has a side length of not more than 1m and a diagonal length of not more than 1.2m. (ii) The module to weigh not more than <TBD>.	Design	The concept design states, "Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m. The side height of each module will be 10cm minimum. The weight of the module is to be not more than 5kg, including legs, track and permanent fittings but not including buildings." The detailed design (baseboard) states: " Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m. The side height of each module will be 100mm minimum. The weight of the module is to be not more than 5kg, including legs, track and permanent fittings but not including buildings." According to the trackplan, modules 6 to 10 all have diagonals between 1300mm and 1350mm in length. However, it is deemed impractical to reduce the size of the modules because of how this would impact upon track positioning. Therefore this requirement is concessed.	1			
23	The layout build shall comprise modules that can be handled by one person.	To enable the ease of carrying around the house by one person. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - One person unaided can fit the modules together.	Construction	During the construction, the modules have been assembled/disassembled on numerous occasions, unaided.	1	n/a	n/a	Compliant
24	1.2.3 Provide operation				Function	n/a				
25	Operations shall include a reason to drop off/pick up goods wagons.	The owner wishes to run goods trains. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to include a business or goods yard which requires rail connection.	Design	The concept design states: "The layout style will be twin-track mainline continuous loop with sidings for goods shunting operations." The detailed design (track) states that there is provision for a fiddleyard, station, goods area and locomotive servicing.	1			
25	Operations shall include a reason to drop off/pick up goods wagons.	The owner wishes to run goods trains. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - Goods waggons are dropped/picked up at a goods area.	Construction	There is a goods depot of two sidings adjacient to the station, comprising a goods shed and access to the station platform. Therefore, this requirement is considered compliant.	1	n/a	n/a	Compliant

26	Operations shall include the running of passenger services.	This is where the owners interest lies. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to include a railway station. A railway station is present and the layout is populated by civilian passengers.	Design	The concept design states, "The main emphasis for the railway, will be the operation of passenger services. It shall have a station and an engine yard with all normal facilities that would be expected to service steam locomotives." The detailed design (track) states that there is provision for station and locomotive servicing.	1			
26	Operations shall include the running of passenger services.	This is where the owners interest lies. Ref: Strategy, section 2, Scope.	Demonstration	Construction - Passenger trains are run.	Construction	One of the main features of the layout is the station. Train operation is predominantly the running of passenger trains.	1	n/a	n/a	Compliant
27	Operations shall include a [fiddle yard] with the capacity for at least six trains that can serve the UP and DOWN running lines.	So that there may be a varied traffic run. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to include a [fiddle yard] for at least six trains.	Design	The concept design states, "Trains waiting to be used are to be stored on a multi-line fiddle yard, which is to be long enough to contain the longest train that will be run." Detailed design (track) states: "The [fiddle yard] will comprise five lines for each direction of operation. "	1			
27	Operations shall include a [fiddle yard] with the capacity for at least six trains that can serve the UP and DOWN running lines.	So that there may be a varied traffic run. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - The fiddle yard serves up and down lines and houses at least six trains.	Construction	The [fiddle yard] comprises five lines in each direction. So not including any operating trains passing through, there is capacity for eight trains if there is just one train per line.	1	n/a	n/a	Compliant
28	Operations shall include the servicing of steam locomotives	This is where the owners interest lies. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to include locomotive servicing facilities.	Design	The concept design states, "The main emphasis for the railway, will be the operation of passenger services. It shall have a station and an engine yard with all normal facilities that would be expected to service steam locomotives." The detailed design (track) states that there is provision for locomotive servicing.	1			
28	Operations shall include the servicing of steam locomotives.	This is where the owners interest lies. Ref: Strategy, section 2, Scope.	Demonstration	Construction - There is an engine yard for servicing steam locomotives.	Construction	One of the main features of the layout is the engine yard. A number of locomotives can be housed here, details include: Turntable. Engine shed. Coaling. Watering.	1	n/a	n/a	Compliant
29	1.2.4 Maintain Project				Function	n/a				
30	1.2.4.1 Provide Track cleaning				Function	n/a				
31	Track cleaning shall be possible throughout the entire length of track, without the need to	So that track can be cleaned without dismantling. Ref: Strategy, section 3.1,	Inspection	Design - The design to state that all track is accessible.	Design	The detailed design (track) states that all track shall be accessible without having to dismantle the modules.	1			

	disassemble the modules.	Concept design.								
31	Track cleaning shall be possible throughout the entire length of track, without the need to disassemble the modules.	So that track can be cleaned without dismantling. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - All of the track can be reached.	Construction	All of the track may be reached without disassembly of the modules. Therefore, this requirement is compliant.	1	n/a	n/a	Compliant
32	1.2.5 Relocate Modules				Function	n/a				
33	The modules shall be able to be disassembled by a single person.	So that the railway can be moved/removed as necessary. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to permit disassembly by a single person.	Design	The detailed design (baseboards) specifies a weight limit and a size limit for the modules. Also that the support legs will be integral to the construction. Also specified is that alignment dowells and spring catches shall me used. All of this will aid ease of assembly/disassembly.	1			
33	The modules shall be able to be disassembled by a single person.	So that the railway can be moved/removed as necessary. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - The layout can be assembled/disassembled without assistance.	Construction	During the construction, the modules have been assembled/disassembled on numerous occasions, unaided.	1	n/a	n/a	Compliant
34	The modules shall be able to be moved through a [normal sized doorway] by a single person.	So that the railway can be moved/removed as necessary. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design of the modules to permit being moved through a [normal sized doorway] by a single person.	Design	The concept design and detailed design (baseboard) states: "Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m. The side height of each module will be 10cm minimum."	1			
34	The modules shall be able to be moved through a [normal sized doorway] by a single person.	So that the railway can be moved/removed as necessary. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - A module can be moved through a normal sized doorway without assistance.	Construction	The size and weight of each module is such that removal from the room where it is housed and passiage through a normal internal door, is possible for a single normally-abled adult.	1	n/a	n/a	Compliant
35	1.2.6 Provide size reduction				Function	~~n/a~~				
36	~~A size reduced layout shall be an available option after the completion of the project~~	~~To allow for the possibility of relocating to a slightly smaller room at some point in the future. Ref: Strategy, section 3.3, Detailed design.~~	~~Inspection~~	~~Design - The design to permit for a size reduced layout after the completion of the project.~~	Deleted	~~The concept design states, "To allow for the possibility of transferring the completed railway to a smaller room at some future date, consideration will be given as to how the modules may be constructed so that, if necessary, nominated modules may be removed and the gap closed, so that the layout may be smaller."~~	2	n/a	n/a	Deleted
36	~~A size reduced layout shall be an available option after the completion of the project~~	~~To allow for the possibility of relocating to a slightly smaller room at some point in the future. Ref: Strategy, section 3.3, Detailed design.~~	~~Demonstration~~	~~Construction - The size of the layout can be reduced and all tracks align correctly without the need for re-work.~~	Deleted	Deleted	2	n/a	n/a	Deleted

37	~~A size reduced layout shall be an available option without rework of the completed modules.~~	~~To allow for the possibility of relocating to a slightly smaller room at some point in the future. Ref: Strategy, section 3.3, Detailed design.~~	~~Inspection~~	~~Design - The design to permit for a size reduced layout without rework of the completed modules.~~	Deleted	~~The concept design states, "To allow for the possibility of transferring the completed railway to a smaller room at some future date, consideration will be given as to how the modules may be constructed so that, if necessary, nominated modules may be removed and the gap closed, so that the layout may be smaller. "~~	2	n/a	n/a	Deleted
37	~~A size reduced layout shall be an available option without rework of the completed modules.~~	~~To allow for the possibility of relocating to a slightly smaller room at some point in the future. Ref: Strategy, section 3.3, Detailed design.~~	~~Demonstration~~	~~Construction - The size of the layout can be reduced and all tracks align correctly without the need for re-work.~~	Deleted	Deleted	2	n/a	n/a	~~Deleted~~
38	~~A size reduced layout shall be an available option by 1m on the longest side.~~	~~To allow for the possibility of relocating to a slightly smaller room at some point in the future. Ref: Strategy, section 3.3, Detailed design.~~	~~Inspection~~	~~Design - The design to permit for a size reduced layout of 1m on the longest side.~~	Deleted	~~The concept design states, "To allow for the possibility of transferring the completed railway to a smaller room at some future date, consideration will be given as to how the modules may be constructed so that, if necessary, nominated modules may be removed and the gap closed, so that the layout may be smaller. "~~	2	n/a	n/a	~~Deleted~~
38	~~A size reduced layout shall be an available option by 1m on the longest side.~~	~~To allow for the possibility of relocating to a slightly smaller room at some point in the future. Ref: Strategy, section 3.3, Detailed design.~~	~~Demonstration~~	~~Construction - The size of the layout can be reduced by 1m on the longest side, without the need for re-work.~~	Deleted	Deleted	2	n/a	n/a	~~Deleted~~
39	1.2.7 Decommissioning Project				Function	n/a				-
40	No requirements have been identified.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
41	1.3 Provide Infrastructure				Function	n/a				-
42	1.3.1 Provide Room				Function	n/a				
43	The room shall have a temperature range within [normal domestic parameters].	The room is heated/ventilated to make it suitable for use. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that room heating will be provided.	Design	A 1kw heater is provided in the room.	2			
43	The room shall have a temperature range within [normal domestic parameters].	The room is heated/ventilated to make it suitable for use. Ref: Strategy, section 2, Scope.	Demonstration	Construction - Heating is provided in the room when outside conditions deem it necessary for comfort.	Construction	A 1kw heater is provided in the room.	2	n/a	n/a	Compliant
44	The room shall have a humidity range within [normal domestic parameters].	The room is heated/ventilated to make it suitable for use. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that ventilation will be provided.	Design	Because the door is not a sealed unit, there is sufficent natural ventilation, without the need for additional ventilation	2			
44	The room shall have a humidity range within [normal domestic parameters].	The room is heated/ventilated to make it suitable for use. Ref: Strategy, section 2, Scope.	Demonstration	Construction - There is no condensation in the room.	Construction	The room has been in use through the winter and heavy rain, with no evidence of ill-effect. There is natural ventilation in the	2	n/a	n/a	Compliant

						room and a dehumidifier is available, if required.				
45	The room shall have a [level] floor surface.	To enable the railway to stand on it. Ref: Strategy, section 2, Scope.	Inspection	Design - Instructions to builder confirming that the floor will be flat and level.	Design	Installation of building confirms that floor is flat and level.	1			Compliant
45	The room shall have a [level] floor surface.	To enable the railway to stand on it. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The floor is flat.	Construction	A flat, laminated floor surface has been laid	1	n/a	n/a	Compliant
46	The room shall be weatherproof.	Protection from outside environment. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that building will be weatherproof.	Design	Installation of building has been carried out to a high standard and carries a 10-year guarantee. Since installation, the building has been subjected to at least two severe rainstorms and there is no evidence of water ingress.	1			
46	The room shall be weatherproof.	Protection from outside environment. Ref: Strategy, section 2, Scope.	Demonstration	Construction - There is no weather ingress into the room.	Construction	The room has survived numerous rain storms with no evidence of water ingress.	1	n/a	n/a	Compliant
47	The room shall have [domestic lighting].	To make the room suitably equipped for use. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that lighting will be provided and an electrician will be engaged.	Design	Installation of lighting has been carried out by a competent electrician to instructions given.	1			Compliant
47	The room shall have [domestic lighting].	To make the room suitably equipped for use. Ref: Strategy, section 2, Scope.	Demonstration	Construction - Lighting is provided.	Construction	The electrical contractor has installed a cold-LED track lighting system, as per instructions.	1	n/a	n/a	Compliant
48	The room shall have 13A power sockets.	To make the room suitably equipped for use. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that power will be provided and an electrician will be engaged.	Design	The electrical installation includes the provision of four double 13A sockets as per instructions.	1			Compliant
48	The room shall have 13A power sockets.	To make the room suitably equipped for use. Ref: Strategy, section 2, Scope.	Demonstration	Construction - Power is provided by professional installer, meeting relevant safety regulations.	Construction	The electrical contractor has installed four double-13A sockets in the room, as per instructions.	1	n/a	n/a	Compliant
49	The room shall have internal dimensions not less than 9ft 6 ins x 13ft 6ins.	This is the expected internal dimensions of the allocated space. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that these dimensions, not less than 9ft 6 ins x 13ft 6ins, are specified	Design	The concept design states that, "The Fully erected modules will fit inside a space approx 9ft 6ins x 13ft 6ins (2890mm x 4110mm)" The detailed design (baseboards) states: "There shall be <n> connecting modules which are to fit around the perimeter of a rectangular room approx 9ft 6ins x 13ft 6ins (2890mm x 4110mm)."	1			Compliant
49	The room shall have internal dimensions not less than 9ft 6 ins x 13ft 6ins.	This is the expected internal dimensions of the allocated space. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - Internal dimensions will be 9ft 6 ins x 13ft 6ins +/- 1inch.	Construction	The internal dimensions of the room have been measured and are seen to be meeting requirements.	1	n/a	n/a	Compliant
50	1.4 Provide Equipment				Function	n/a				

51	1.4.1. Provide [Modules]				Function	n/a				
52	The [modules] shall fit together without any movement between them when secured.	To ensure correct alignment of rails. Ref: Strategy, section 3.4.1, Baseboard construction.	Inspection	Design - The design to state that appropriate securing methods are investigated and selected.	Design	The concept design states: "There will be alignment dowels fitted to the mating surfaces between modules, to ensure correct alignment." "The fixing of one module to its neighbour will be achieved by spring tension lock clips." The detailed design (baseboard) states: "The modules are to connect to each other by an alignment mechanism on the mating surfaces, to ensure accurate alignment, and spring catches on the external sides to hold the modules together. To ensure that there is correct alignment, mating surfaces, with alignment, are to be fabricated as a pair before each module is assembled."	1			Compliant
52	The [modules] shall fit together without any movement between them when secured.	To ensure correct alignment of rails. Ref: Strategy, section 3.4.1, Baseboard construction.	Demonstration	Construction - There is no discernible movement between the modules when connected.	Construction	Assembled modules are held together by a mechanical method of seturing and have been seen to be rigid.	1	n/a	n/a	Compliant
53	The [modules] shall stand on legs which will be height adjustable to a tolerance of plus or minus 10mm.	(i) The layout is to be freestanding, not hanging on a shelf. Ref: Strategy, section 3.3, Detailed design. (ii) To allow for unevenness of the floor.	Inspection	Design - The design to state that [modules] stand on legs which will be height adjustable to a tolerance of plus or minus 10mm.	Design	The concept design states: 1. "Each module will have at least two legs, mounted at one end, support for the other end being achieved by connection to its neighbour. At least one module will need to be entirely free standing and so need four legs." 2. "On the bottom of the leg will be a height adjustable foot." The detailed design (baseboard) states: "To the bottom of each leg shall be mounted a height-adjustable foot. "	1			
53	The [modules] shall stand on legs which will be height adjustable to a tolerance of plus or minus 10mm.	(i) The layout is to be freestanding, not hanging on a shelf. Ref: Strategy, section 3.3, Detailed design. (ii) To allow for unevenness of the floor.	Demonstration	Construction - The height of a module can be adjusted.	Construction	It is not possible to meet this requirement because the trestles purchased do not have fine height adjustment. They do, however, have a coarse height adjustment in steps of approximately 5cm.	1	n/a	n/a	Concessed
54	The [modules] shall have a track level of 0.75m to 1.2m above floor level.	Convenient height for operation. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that [modules] have a track level of 0.75m to 1.2m above floor level.	Design	The concept design states, "The modules will enable the track height to be 0.75m to 1.2m above the floor." The detailed design (baseboard) states: "The support legs shall be long	1			Compliant

						enough to enable the track to be between 0.75m to 1.2m above floor level."				
54	The [modules] shall have a track level of 0.75m to 1.2m above floor level.	Convenient height for operation. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - [modules] have a track level of 0.75m to 1.2m above floor level.	Construction	With the Trestles set to their lowest setting, the track is 1m above the floor. Trestles can adjust initially 5c and thereafter 10cm up to 1.5m. Therefore, this requirement is met.	1	n/a	n/a	Compliant
55	The [modules] shall have a side length of not more than 1m.	Limiting the size of the module. To enable the carrying around the house by a single person. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that [modules] have a side length of not more than 1m.	Design	The concept design states, "Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m. The side height of each module will be 10cm minimum." The detailed design (baseboard) states: "Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m."	2			
55	The [modules] shall have a side length of not more than 1m.	Limiting the size of the module. To enable the carrying around the house by a single person. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - [modules] have a side length of not more than 1m.	Construction	The dimensions of the modules as given in the Detailed Design Baseboards, have been measured and found to be approximately correct. Eight modules have a side length of no greater than 1m. Two modules have a side length of 1100mm and one module has a side length of 1180mm. Since most of the modules are within limits and the remainder are not excessive, these can be concessed. Therefore this requirement is considered compliant.	2	n/a	n/a	Compliant
56	The [modules] shall have a corner to corner length of not more than 1.2m	Limiting the size of the module. To enable the carrying around the house by a single person. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that [modules] have a corner to corner length of not more than 1.2m	Design	The concept design states, "Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m. The side height of each module will be 10cm minimum." The detailed design (baseboard) states: "Each module will have a maximum side length of 1m and a maximum diagonal length of 1.2m."	2			Compliant

56	The [modules] shall have a corner to corner length of not more than 1.2m.	Limiting the size of the module. To enable the carrying around the house by a single person. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - [modules] have a corner to corner length of not more than 1.2m	Construction	The dimensions of the modules as given in the Detailed Design Baseboards, have been measured and found to be approximately correct. Six modules have a diagonal length of no greater than 1.2m. The remaining diagonals are approximately: 1251mm, 1270mm, 1316mm and 1331mm. Since most of the modules are within limits and the remainder are not excessive, these can be concessed. Therefore this requirement is considered compliant.	2	n/a	n/a	Compliant
57	The [modules] shall weigh not more than 5kg each, including legs, track and permanent fittings but not including buildings.	Limiting the weight of the module. To enable the carrying around the house by a single person. Ref: Strategy, section 3.1, Concept design. 5kg was arbitrarily selected as being the weight of two empty drawers from an item of furniture.	Inspection	Design - The design to state that [modules] have a weigh not more than 5kg each, including legs, track and permanent fittings but not including buildings.	Design	The concept design states, "The weight of the module is to be not more than 5kg, including legs, track and permanent fittings but not including buildings." The detailed design (baseboard) states: "The weight of the module is to be not more than 5kg, including legs, track and permanent fittings but not including buildings."	2			
57	The [modules] shall weigh not more than 5kg each, including legs, track and permanent fittings but not including buildings.	Limiting the weight of the module. To enable the carrying around the house by a single person. Ref: Strategy, section 3.1, Concept design. 5kg was arbitrarily selected as being the weight of two empty drawers from an item of furniture.	Demonstration	Construction - [modules] have a weigh not more than 5kg each, including legs, track and permanent fittings but not including buildings.	Construction	Waiting completion.	2	n/a	n/a	
58	The [modules] shall have a rigid side shell.	To give the module physical strength and resist damage from rough handling. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that [modules] have a rigid side shell.	Design	A test track has been assembled using 5.5mm ply with a border 50mm high around its edge and a cross-diagonal bracing. This has given favorable results for a size of 4ft x 6ft. Therefore, it is concluded that a border of 98mm (additional depth to allow for folding legs) will be more than sufficient for modules of the required size. Also; The sides of each module will be box girders, each box girder constructed from two strips of ply separated by ply spacers, 5mm to 10mm wide, placed along the upper and lower edges of the strips to be separated,	1			

						forming a sealed box. This method is chosen because it gives considerable strength and rigidity that will resist warping for its very light weight. A test piece has been tried, comprising two sheets, 600mm x 85mm, separated by two strips 10mm wide; the whole being glued together. The end result was a box girder which is rigid. The detailed design (baseboard) states: "Each module will be constructed as an [open box] with vertically oriented sides and diagonal cross-bracing internally to prevent twisting" and "The side height of each module will be 100mm minimum. "				
58	The [modules] shall have a rigid side shell.	To give the module physical strength and resist damage from rough handling. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - [modules] have a rigid side shell.	Construction	Modules have been constructed with a shell of 5mm ply.	1	n/a	n/a	Compliant
59	The [modules] shall have a flat [loadbearing] surface material where the track, buildings, road or river are to be positioned.	(i) A smooth sheet material is required for the track bed. (ii) An open frame design permits landscape to fall below track level.	Inspection	Design - The design to state that [modules] have a flat [loadbearing] surface material where the track, buildings, road or river are to be positioned.	Design	The concept design states, "There will be an upper surface of horizontally positioned load-bearing sheet material, cut to shape to support track, buildings and any features requiring support." The detailed design (baseboard) states: "A sheet of ply will be secured as an upper surface where loadbearing is required. e.g. track and any flat features. Ply will not be fitted where loadbearing is not required, so as not to add unnecessary weight. "	1			
59	The [modules] shall have a flat [loadbearing] surface material where the track, buildings, road or river are to be positioned.	(i) A smooth sheet material is required for the track bed. (ii) An open frame design permits landscape to fall below track level.	Demonstration	Construction - Track, buildings and any other main features are supported by a flat [loadbearing] surface	Construction	Modules have been constructed with a loadbearing surface of 5mm ply, strengthened underneath.	1	n/a	n/a	Compliant
60	~~The [modules] shall not have a flat [loadbearing] surface material where it is not required for track, buildings, road or river.~~	~~To keep weight down.~~ ~~Ref: Strategy, section 3.1, Concept design.~~	~~Inspection~~	~~Design - The design to state that [modules] will not have a flat [loadbearing] surface material where it is not required for track, buildings, road or river.~~	Deleted	~~The detailed design (baseboard) states that a loadbearing surface will be provided where it is required and not provided where it is not required.~~	2	n/a	n/a	Deleted
60	~~The [modules] shall not have a flat [loadbearing] surface material where it is not required for track, buildings, road or river.~~	~~To keep weight down.~~ ~~Ref: Strategy, section 3.1, Concept design.~~	~~Demonstration~~	~~Construction - There is not a flat [loadbearing] surface where it is not required.~~	Deleted	Deleted	2	n/a	n/a	Deleted

61	The [modules] shall have a lightweight [non-loadbearing] surface to cover the voids between [loadbearing] surfaces.	To keep weight down. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that [modules] have a lightweight [non-loadbearing] surface to cover the voids between [loadbearing] surfaces.	Design	The detailed design (baseboard) states that a non-loadbearing surface will be provided to cover all voids.	1			Compliant
61	The [modules] shall have a lightweight [non-loadbearing] surface to cover the voids between [loadbearing] surfaces.	To keep weight down. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - [modules] have a lightweight [non-loadbearing] surface to cover the voids between [loadbearing] surfaces.	Construction	Because most of the top surface is devoted to track, there is very little non-loadbearing surface. For what little there is, it would be impractical to cut it out. Therefore, this requirement is concessed.	1	n/a	n/a	Concessed
62	The [modules] shall be strong and rigid enough to resist deformation when being leaned/worked upon or used.	The module needs to be strong enough to support reasonable force, but it shall not be required to support the weight of being stood upon.	Inspection	Design - The design to state that [modules] be strong and rigid enough to resist deformation when being leaned/worked upon or used.	Design	A test track has been assembled using 5.5mm ply with a border 50mm high around its edge and a cross-diagonal bracing. This has given favorable results for a size of 4ft x 6ft. Therefore, it is concluded that a border of 98mm (additional depth to allow for folding legs) will be more than sufficient for modules of the required size. Also; The sides of each module will be box girders, each box girder constructed from two strips of ply separated by ply spacers, 5mm to 10mm wide, placed along the upper and lower edges of the strips to be separated, forming a sealed box. This method is chosen because it gives considerable strength and rigidity that will resist warping for its very light weight. A test piece has been tried, comprising two sheets, 600mm x 85mm, separated by two strips 10mm wide; the whole being glued together. The end result was a box girder which is rigid. The detailed design (baseboard) states: "To give additional rigidity to the shape and to aid in resisting warping, ply cross-members will be positioned diagonally, braced against the opposite corners of the module."	1			
62	The [modules] shall be strong and rigid enough to resist deformation when being leaned/worked upon or	The module needs to be strong enough to support reasonable force, but it shall not be required to support the weight of	Demonstration	Construction - [modules] are not deformed when leaned upon during normal use.	Construction	The provision of diagonal bracing within each module ensures mechanical rigidity.	1	n/a	n/a	Compliant

	used.	being stood upon.								
63	The [modules] shall secure to each other by a means which enables assembly/disassembly by a single person.	To enable speed and convenience of assembly. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that [modules] secure to each other by a means which enables assembly/disassembly by a single person.	Design	Spring loaded toggle latches have been sourced and deemed to be a suitable securing method. The detailed design (baseboard) states: "The modules are to connect to each other by an alignment mechanism on the mating surfaces, to ensure accurate alignment, and spring catches on the external sides to hold the modules together. "	1			
63	The [modules] shall secure to each other by a means which enables assembly/disassembly by a single person.	To enable speed and convenience of assembly. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - One person can secure [modules] together.	Construction	Securing is achieved by the provision of hinges with removable pins that can be inserted/removed by hand alone.	1	n/a	n/a	Compliant
64	The [modules] shall secure to each other by a means which does not require tools.	To enable speed and convenience of assembly. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that [modules] secure to each other by a means which does not require tools.	Design	Spring loaded toggle latches have been sourced and deemed to be a suitable securing method. The detailed design (baseboard) states: "The modules are to connect to each other by an alignment mechanism on the mating surfaces, to ensure accurate alignment, and spring catches on the external sides to hold the modules together. "	1			Compliant
64	The [modules] shall secure to each other by a means which does not require tools.	To enable speed and convenience of assembly. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - Securing [modules] together does not require any tools.	Construction	Securing is achieved by the provision of hinges with removable pins that can be inserted/removed by hand alone.	1	n/a	n/a	Compliant
65	The [modules] positioned where access to the room is required shall permit walk-in access when the layout is set-up.	To allow for easy walk-in access. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that [modules] positioned where access to the room is required, permit walk-in access when the layout is set-up.	Design	The concept design states, "To gain access to the open centre. the two side modules where the door is, will be attached to their adjacent corner modules by hinges, so that the two modules may be swung upwards, drawbridge fashion. " The detailed design (baseboard) states: "To gain access to the open centre, the two side modules where the door is, will be attached to their adjacent corner modules by hinges, so that the two modules may be swung upwards, drawbridge fashion. To prevent an open module accidentally closing with force, a	1			Compliant

						mechanism will be used to support the weight of the module e.g. counterweight or sprung damper."				
65	The [modules] positioned where access to the room is required shall permit walk-in access when the layout is set-up.	To allow for easy walk-in access. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - There is an opening in the modules where the door is.	Construction	A lift-up opening has been provided with a width clearance of 900mm.	1	n/a	n/a	Compliant
66	The [modules] positioned where access to the room is required shall resist accidental movement when closed in it's normal position.	To prevent derailment through the module position being dislodged.	Inspection	Design - The design to state that [modules] positioned where access to the room is required, resist accidental movement when closed in its normal position.	Design	The concept design states, "There will be alignment dowels fitted to the mating surfaces between modules, to ensure correct alignment." The detailed design (baseboard) states: "The modules are to connect to each other by an alignment mechanism on the mating surfaces, to ensure accurate alignment,"	1			Compliant
66	The [modules] positioned where access to the room is required shall resist accidental movement when closed in it's normal position.	To prevent derailment through the module position being dislodged.	Demonstration	Construction - The modules do not move, except by intent.	Construction	When in the lowered position, the modules engage via the provision of alignment dowells on each mating side.	1	n/a	n/a	Compliant
67	The [modules] positioned where access to the room is required shall resist accidental movement when open.	To prevent damage/personal injury from falling.	Inspection	Design - The design to state that [modules] positioned where access to the room is required, resist accidental movement when open.	Design	The concept design states, "A means of ensuring that the raised module does not accidentally fall, will be explored and be determined by detail design." The detailed design (baseboard) states: "To prevent an open module accidentally closing with force, a mechanism will be used to support the weight of the module e.g. counterweight or sprung damper."	M			Compliant
67	The [modules] positioned where access to the room is required shall resist accidental movement when open.	To prevent damage/personal injury from falling.	Demonstration	Construction - The modules do not move, except by intent.	Construction	Flap supports, usually used in kitchen applications, have been sourced from Hafele and have been fitted between modules 11 and 1. Their positioning will hold module 11 just past the top-dead-centre position when raised, where it may stand otherwise unsupported. The flap supports are heavily damped and so some physical assistance is required to start the lowering of module 11.	M	n/a	n/a	Compliant

						Therefore, this requirement is considered compliant.				
68	The [modules] shall resist movement when all [modules] are connected.	Modules must not sway or collapse and must resist sideways forces. Ref: Strategy, section 3.4.1, Baseboard construction.	Inspection	Design - The design to state that [modules] resist movement when all [modules] are connected.	Design	The detailed design states: "Because of the potential for knocking stock off the track, a means will be identified for preventing the accidental sideways movement of the layout should a force be applied to it. This may take to form of packing material wedged between the layout and the walls of room."	1			Compliant
68	The [modules] shall resist movement when all [modules] are connected.	Modules must not sway or collapse and must resist sideways forces. Ref: Strategy, section 3.4.1, Baseboard construction.	Demonstration	Construction - The modules do not move when a sideways force is applied to them.	Construction	Adhesive-backed felt pads have been placed on the external sides of modules where there is a risk of collision with the internal walls of the room. Because the assembled layout is already a tight fit, the presence of the pads ensure that there is no sideways movement of the modules.	1	n/a	n/a	Compliant
69	The [modules] shall resist ingress of moisture.	Modules must be protected from dampness.	Inspection	Design - The design to state that [modules] are to be treated with a moisture barrier.	Design	The detailed design states: "The completed module will be coated with a barrier (e.g. varnish, thinned PVA glue or thinned emulsion paint) on all surfaces, to seal against the ingress of moisture."	1			
70	The [modules] shall resist ingress of moisture.	Modules must be protected from dampness.	Demonstration	Construction - The modules are treated with a moisture barrier.	Construction	The modules have been coated in primer paint, followed by emulsion paint, on all surfaces, except where cork tiles have been glued down.	1	n/a	n/a	Compliant
71	1.4.2 Provide [Rolling Stock]				Function	n/a				
72	[Rolling Stock] shall have locomotives that are predominantly steam.	The owners interest is towards steam. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that [Rolling Stock] shall have locomotives that are predominantly steam.	Design	The concept design states, "The time period will be post-WW2 and in keeping with BR period steam operation." The Detailed Design (Track) states: The locomotive servicing area will contain the functions associated with this area: Turntable, Water tower, coaling, ash removal, engine shed.	1			
73	[Rolling Stock] shall have locomotives that are predominantly steam.	The owners interest is towards steam. Ref: Strategy, section 2, Scope.	Demonstration	Construction - n/a	Construction	The owner has a few diesel locomotives which, for reason of their age, may not be converted to DCC operation and hernce, may not be run. Otherwise, all of the locomotives are steam.	1	n/a	n/a	Compliant

74	[Rolling Stock] shall have carriages that are predominantly [MK1]s.	This is where the owners interest is. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that [Rolling Stock] shall have carriages that are predominantly [MK1]s.	Design	Concept design states that track experiments were conducted using [Mk1] carriages.	1			
75	[Rolling Stock] shall have carriages that are predominantly [MK1]s.	This is where the owners interest is. Ref: Strategy, section 2, Scope.	Demonstration	Construction - n/a	Construction	The owners carriage stock is comprised of mainly Mk 1's, plus some Pullmans and Collett coaches.	1	n/a	n/a	Compliant
76	1.4.3 Provide track				Function	n/a				
77	1.4.3.1 Select Track Type				Function	n/a				
78	The track type selected shall be [code 100] or [finescale] [flexitrack].	Code 100 is standard, but finescale will also be considered as an alternative option. Ref: Strategy, section 3.2, Options and costing.	Inspection	Design - The design to state that track type selected shall be [code 100] or [finescale] [flexitrack].	Design	After checking the free running of rolling stock on a sample length of track, it has been decided that finescale track will be used. The concept design states, "Track will be OO gauge finescale flexitrack with wooden style sleepers, sourced from Peco." The detailed design (track) states: "Track will be OO gauge [finescale] [flexitrack] with wooden style sleepers, sourced from [Peco]."	1			
79	The track type selected shall be [code 100] or [finescale] [flexitrack].	Code 100 is standard, but finescale will also be considered as an alternative option. Ref: Strategy, section 3.2, Options and costing.	Demonstration	Construction - Track type selected is [code 100] or [finescale] [flexitrack].	Construction	[finescale] track has been purchased and is being used for the construction.	1	n/a	n/a	Compliant
80	1.4.3.2 Select Points				Function	n/a				
81	The points selected shall be [Peco] [electrofrog].	To maintain continuity of power, and smooth running, of a locomotive through a point.	Inspection	Design - The design to state that points selected shall be [Peco] [electrofrog]	Design	The concept design states, "The points will be [electrofrog] style." The detailed design (track) states, "The points will be [electrofrog] style."	1			
82	The points selected shall be [Peco] [electrofrog].	To maintain continuity of power, and smooth running, of a locomotive through a point.	Demonstration	Construction - [Peco] [electrofrog] points are used.	Construction	[Peco] [electrofrog] points have been purchased and are being used in the construction.	1	n/a	n/a	Compliant
83	The points selected shall not use [double-slips] if it can be avoided.	For reason of wiring complexity and cost.	Inspection	Design - The design to state that points selected shall not use [double-slips] if it can be avoided.	Design	The design has required the use of one double-slip. Therefore, this requirement has been concessed.	2			
84	The points selected shall not use [double-slips] if it can be avoided.	For reason of wiring complexity and cost.	Demonstration	Construction - [double-slips] are not used.	Construction	It has been necessary to provide one [double-slip] for operational need. This conclusion was reached after considering alternatives. Therefore this requirement is concessed.	2	n/a	n/a	Concessed
85	The points selected shall use the longest radius points that can be accommodated by the design, on main running lines.	Normal convention. Also to reduce de-railing hazzard. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that points selected shall use the longest radius points that can be accommodated by the design, on main running lines.	Design	The concept design states, "The shape and size of points selected will be what provides the closest fit to meet the design of the track layout, with the following criteria: Turnouts on the mainline will have as large a radius as possible, to reduce the risk of derailment. "	1			

						The detailed design (track) states: "• Turnouts on the mainline will have as large a radius as possible, to reduce the risk of derailment."				
86	The points selected shall use the longest radius points that can be accommodated by the design, on main running lines.	Normal convention. Also to reduce de-railing hazzard. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - The longest radius points that can be accommodated by the design, are used on main running lines.	Construction	Short radius points have not been used in the design and have not been purchased. All of the points are medium or long radius straights, also curved points.	1	n/a	n/a	Compliant
87	The points selected shall not use short radius points on main running lines.	Normal convention. Also to reduce de-railing hazzard. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that points selected shall not use short radius points on main running lines.	Design	The concept design states, "The shape and size of points selected will be what provides the closest fit to meet the design of the track layout, with the following criteria: Turnouts on the mainline will have as large a radius as possible, to reduce the risk of derailment. " The detailed design (track) states: "• Turnouts on the mainline will have as large a radius as possible, to reduce the risk of derailment."	1			
88	The points selected shall not use short radius points on main running lines.	Normal convention. Also to reduce de-railing hazzard. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Short radius points are not used on main running lines.	Construction	Short radius points have not been used in the design and have not been purchased. All of the points are medium or long radius straights, also curved points.	1	n/a	n/a	Compliant
89	The points selected shall be remotely operated from a single location.	No 'hand from the sky' operation is permitted. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that points selected shall be remotely operated from a single location.	Design	The concept design states, "Control for the point motors is to be located at one central place on the layout. There is to be a visual feedback indicating the position of each point." The detailed design (control & electrics) states: "Point control shall be executed by a switch control panel, which will also display a visible indication of the points status."	1			
90	The points selected shall be remotely operated from a single location.	No 'hand from the sky' operation is permitted. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Points are operated from a single location.	Construction	The points are all operated by Cobalt digital point motors, connected to the DCC power distribution. At the time of writing, they are controlled via the DCC hand controller, which is connected to module 9. It is proposed that in the future, a leverframe, also positioned on module 9, will be used. Therefore, this	1	n/a	n/a	Compliant

						requirement is compliant.				
91	1.4.3.3 Track Positioning				Function	n/a				
92	Track positioning shall be copied onto a [module] from the master track plan.	This is required for the correct positioning of track. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track positioning shall be copied onto a [module] from the master track plan.	Design	The detailed design (track) states that the track plan is to be copied onto paper at a scale of 1:1 from the master track plan and that this is to be used as an aid to correctly positioning the track.	1			
93	Track positioning shall be copied onto a [module] from the master track plan.	This is required for the correct positioning of track. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Track laid matches the master track plan.	Construction	The master track plan resides on a computer file, which has been printed out. This has been manually traced onto tracing paper which has been affixed to the modules where the track is to be placed. Correct alignment of the copied plan has been assured by careful measurement and lines drawn on the modules using thread under tension between seperate points.	1	n/a	n/a	Compliant
94	Track positioning shall ensure that track laid across [module] joins, crosses at an angle of less than 25 degrees to the perpendicular.	Desirable that track crosses perpendicular whenever possible, so that cuts across the join also be perpendicular. The shape of each module will be influenced by how track crosses the joins. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track positioning shall ensure that track laid across [module] joins, crosses at an angle of less than 25 degrees to the perpendicular.	Design	The detailed design (track) states that where track crosses a module join, it shall do so at an angle of not more than 30degrees to the perpendicular, to minimise the possibility of derailment due to a wheel catching a sharp rail edge.	1			
95	Track positioning shall ensure that track laid across [module] joins, crosses at an angle of less than 25 degrees to the perpendicular.	Desirable that track crosses perpendicular whenever possible, so that cuts across the join also be perpendicular. The shape of each module will be influenced by how track crosses the joins. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Track laid across [module] joins, crosses at an angle of less than 25 degrees to the perpendicular.	Construction	Track deflection from the perpendicular is as follows: Modules 1 - 2 , max 15 degrees. min 4 degrees. Modules 2 - 3 , all perpendicular. Modules 3 - 4, all perpendicular. Modules 4 - 5, max = 16 degrees. Min = perpendicular. Modules 5 - 6. max = 24 degrees. min = 5 degrees. Modules 6 - 7, max = 11 degrees. min = 11 degrees. Modules 7 - 8. max = 10 degrees. min = perpendicular. Modules 8 - 9. max = 15 degrees. min = perpendicular. Modules 9 - 10. max = 20 degrees. min = 13 degrees. Modules 10 - 11. max = 20 degrees. min = 19 degrees. Modules 11 - 1. max = 38 degrees. min = 23 degrees.	1	n/a	n/a	Concessed

						Measurements show that requirement is not met at only one interface and there by only one track. Because running tests have not revealed any problems at this location, this is concessed and is considered compliant.				
96	Track positioning shall ensure that no curve be tighter than the largest radius [Peco] [set-track].	This is an unrealistically tight curve and so is to be avoided. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track positioning shall ensure that no curve be tighter than the largest radius [Peco] [set-track]	Design	Following test runs of locomotives on a test track, it has been determined that a radius of 18inches (radius #2) is too tight for a number of locomotives. So the minimum radius will be 24inches (610mm). The concept design states, "Curves will have a minimum radius of 24ins (61cms)" In version 8.3 of the trackplan, minimum radius has been increased from 61cm to 69cm. The detailed design (track) states: "The minimum curve radius as stated in the concept design, has been increased by 3ins (8cms). Curves will have a minimum radius of 27ins (69cms)."	1			
97	Track positioning shall ensure that no curve be tighter than the largest radius [Peco] [set-track].	This is an unrealistically tight curve and so is to be avoided. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - No curve is tighter than the largest radius [Peco] [set-track].	Construction	At design, the minimum acceptable curve radius was set to 69cm, which is greater than the largest [set-track] radius.	1	n/a	n/a	Compliant
98	Track positioning shall ensure that curves have no sharp changes of direction.	To reduce the risk of de-railing. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track positioning shall ensure that curves have no sharp changes of direction.	Design	Peco Tracksettas will be purchased and used in all instances to ensure smooth curves. The detailed design (track) states: "Because of the tendency for rails to spring outwards, joins on all but the gentlest radius are to be avoided."	1			
99	Track positioning shall ensure that curves have no sharp changes of direction.	To reduce the risk of de-railing. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Curves have no sharp changes of direction.	Construction	[Tracksettas] have been used throughout the track laying and all rail joins have been visually observed, to ensure correct alignment and no sharp changes in direction.	1	n/a	n/a	Compliant

100	Track positioning shall ensure that the spacing between lines be no less than that prescribed by the [Peco] [track gauge].	To allow sufficient clearance between passing traffic on adjacent lines. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track positioning shall ensure that the spacing between lines be no less than that prescribed by the [Peco] [track gauge]	Design	The detailed design (track) states that the spacing between straight parallel tracks is to be 51mm (centre to centre), as determined by the [Peco] track gauge. The distance between parallel tracks on a curve will need to be at least 4mm greater than that given by the [Peco] track gauge to allow for the overhang of carriages.	1			
101	.Track positioning shall ensure that the spacing between lines be no less than that prescribed by the [Peco] [track gauge]	To allow sufficient clearance between passing traffic on adjacent lines. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - The spacing between lines is no less than that prescribed by the [Peco] [track gauge]	Construction	Except for where lines converge at points, all spacing has been no less than that prescribed by the [Peco] [track gauge].	1	n/a	n/a	Compliant
102	Track positioning shall ensure that the spacing between lines on a curve will not permit [rolling stock] on adjacent lines to impact.	Clearance may need to be increased on bends, to allow for the overhang on carriages. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track positioning shall ensure that the spacing between lines on a curve will not permit [rolling stock] on adjacent lines to impact.	Design	The concept design states, "The distance between parallel tracks on a curve will need to be 4mm greater than that given by the [Peco] track gauge." The detailed design (track) states: "The spacing between straight parallel tracks is to be 51mm (centre to centre), as determined by the [Peco] track gauge. The distance between parallel tracks on a curve will need to be at least 4mm greater than that given by the [Peco] track gauge to allow for the overhang of carriages." These measurements were derived from experimentation using te test track that was set-up for this purpose.	M			
103	Track positioning shall ensure that the spacing between lines on a curve will not permit [rolling stock] on adjacent lines to impact.	Clearance may need to be increased on bends, to allow for the overhang on carriages. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - [rolling stock] on adjacent lines does not impact.	Construction	Running tests with a variety of locomotives pulling Mk1 carriages, has confirmed that traffic on adjacient lines do not come into conflict. Therefore, this requirement is compliant.	M	n/a	n/a	Compliant
104	Track positioning shall ensure that a normally-abled adult operator be able to reach all parts of the railway track when the modules are set-up.	(i) Convenience of operation. Ref: Strategy, section 3.3, Detailed design. (ii) So that the operator can reach any derailment. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track positioning shall ensure that a normally-abled adult operator be able to reach all parts of the railway track when the modules are set-up.	Design	The detailed design (track) states that all track will be accessible by a normally-abled adult, without having to dismantle the modules.	1			

105	Track positioning shall ensure that a normally-abled adult operator be able to reach all parts of the railway track when the modules are set-up.	(i) Convenience of operation. Ref: Strategy, section 3.3, Detailed design. (ii) So that the operator can reach any derailment. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - All parts of the track can be reached without discomfort.	Construction	A manual check, with track at 1m elevation, has confirmed that all track can be reached, with the furthest parts only requiring a slight leaning forward. Therefore, this requirement is compliant.	1	n/a	n/a	Compliant
106	Track positioning shall ensure that all points on the mainline are [trailing points].	It is prototypical that points on mainlines not be [facing points] to reduce the risk of de-railing. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that all points on the mainline are [trailing points].	Design	The concept design states, "Turnouts on the mainline will have as large a radius as possible, to reduce the risk of derailment. Wherever possible, points on mainlines are to be [trailing points]. " The detailed design (track) states: "Wherever possible, points on [mainlines] are to be [trailing points].	1			
107	Track positioning shall ensure that all points on the mainline are [trailing points].	It is prototypical that points on mainlines not be [facing points] to reduce the risk of de-railing. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - All points on the mainline are [trailing points].	Construction	By necessity, half of the points associated with the fiddleyard must be leading points. These are disregarded. For the rest of the mainline, only the double-slip on module 7 could be considered a leading point; this is necessary for operational purposes and is concessed. Therefore, this requirement is compliant.	1	n/a	n/a	Compliant
108	Track positioning shall ensure that curves start with a [transition curve].	Prototypical, to avoid sudden changes of direction. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that curves start with a [transition curve].	Design	The detailed design (track) states: "For a curve which turns through 90 degrees, a curve of not less than minimum radius, with an arc of 30 degrees will be bracketed between two transition curves, each with an arc of 30 degrees."	1			
109	Track positioning shall ensure that curves start with a [transition curve].	Prototypical, to avoid sudden changes of direction. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - All curves start with a [transition curve].	Construction	When the track design was planned, each curve was bracketed by transitions curves of larger radius. This plan was plotted out full size and track was laid out on top of the plan.	1	n/a	n/a	Compliant
110	Track positioning shall be on top of a layer of sound deadening sheet material.	This is necessary to eliminate any resonant sounds. It will also look like a layer of ballast. Ref: Strategy, section 3.4.2, Track laying.	Inspection	Design - The design to state that Track positioning shall be on top of a layer of sound deadening sheet material.	Design	The detailed design (track) states that prior to the track being laid, a layer of sound-deadening material e.g. cork sheeting, shall be secured to the upper surface.	1			
111	Track positioning shall be on top of a layer of sound deadening sheet material.	This is necessary to eliminate any resonant sounds. It will also look like a layer of ballast. Ref: Strategy, section 3.4.2, Track laying.	Demonstration	Construction - Sound deadening sheet material is used under all track.	Construction	3mm cork sheeting has been glued onto the modules where track is to be placed.	1	n/a	n/a	Compliant

112	Track positioning shall use [superelevation] on the curves of main running lines.	The possibility of using [superelevation]. Ref: Strategy, section 3.3, Detailed design	Inspection	Design - The design to state that Track positioning is to use [superelevation] on the curves of main running lines.	Design	The concept design states, "[Superelevation] on curves may be used. The increase in height on the outer rail was approx 1mm on the test track." The detailed design (track) states: "[Superelevation] on curves will be used. The increase in height on the outer rail will be 1mm to 2mm. "	2			
113	Track positioning shall use [superelevation] on the curves of main running lines.	The possibility of using [superelevation]. Ref: Strategy, section 3.3, Detailed design	Demonstration	Construction - Track positioning uses [superelevation] on the curves of main running lines.	Construction	Under the outer rail of each curve, elevation of approx 1mm was introduced.	2	n/a	n/a	Compliant
114	1.4.3.4 Track Gradient				Function	n/a				
115	Track gradient shall not exceed that determined to be maximum acceptable for operation.	So that locomotives are not excessively loaded by the gradient. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track gradient shall not exceed that determined to be maximum acceptable for operation.	Design	The concept design states, "Having conducted experiments with available locomotives hauling a train of four Mk-1 carriages around a test track, it has been determined that a gradient of 1 in 70 is an acceptable incline." The detailed design (track) states: "Because a folded-figure-of-eight track design has been considered and rejected, it is anticipated that the track will be on one level and will not have a gradient. However, if there is a gradient, 1 in 70 (1.42%) is the maximum acceptable gradient. It would be preferred if gradients are not more than 1 in 76 (1.3%)."	1			
116	Track gradient shall not exceed that determined to be maximum acceptable for operation.	So that locomotives are not excessively loaded by the gradient. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Track gradient does not exceed that determined to be maximum acceptable for operation.	Construction	All of the track has zero gradient.	1	n/a	n/a	Compliant
117	Track gradient on a curve shall be less than that determined to be maximum acceptable for operation.	So that locomotives are not excessively loaded by the gradient. That loading is increased by curves. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track gradient on a curve shall be less than that determined to be maximum acceptable for operation.	Design	Detailed design states that because a folded-figure-of-eight track design has been considered and rejected, it is anticipated that the track will be on one level and will not have a gradient.	2			
118	Track gradient on a curve shall be less than that determined to be maximum acceptable for operation.	So that locomotives are not excessively loaded by the gradient. That loading is increased by curves. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Track gradient on a curve is less than that determined to be maximum acceptable for operation.	Construction	All of the track has zero gradient.	2	n/a	n/a	Compliant
119	1.4.3.5 Track Joins				Function	n/a				

120	Track Joins shall be achieved with conductive [fishplates] where continuity of power across rail joins is required.	(i) To help maintain continuity of power to the locomotive. (ii) To ensure mechanical rigidity and alignment of the rails. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track Joins shall be achieved with conductive [fishplates] where continuity of power across rail joins is required.	Design	The concept design states, "Track will be joined by metal joiners [fishplates] by Peco, except where electrical isolation is required, when plastic joiners [fishplates] will be used." The detailed design (track) states: "Track will be joined by metal joiners [fishplates] by [Peco], except where electrical isolation is required, when plastic joiners [fishplates] will be used."	1			
121	Track Joins shall be achieved with conductive [fishplates] where continuity of power across rail joins is required.	(i) To help maintain continuity of power to the locomotive. (ii) To ensure mechanical rigidity and alignment of the rails. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Conductive rail joiners [fishplates] are used where continuity of power across rail joins is required.	Construction	Conductive [fishplates] have been used throughout, except where it has been required to use plastic non-conductive [fishplates], as specified by [Peco] instructions.	1	n/a	n/a	Compliant
122	Track Joins shall be achieved with non-conductive [fishplates] where isolation of power across rail joins is required.	In more complex track configurations, electrical isolation is required to prevent short-circuits. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track Joins shall be achieved with non-conductive [fishplates] where isolation of power across rail joins is required.	Design	The concept design states, "Track will be joined by metal joiners [fishplates] by Peco, except where electrical isolation is required, when plastic joiners [fishplates] will be used." The detailed design (track) states: "Track will be joined by metal joiners [fishplates] by [Peco], except where electrical isolation is required, when plastic joiners [fishplates] will be used."	1			
123	Track Joins shall be achieved with non-conductive [fishplates] where isolation of power across rail joins is required.	In more complex track configurations, electrical isolation is required to prevent short-circuits. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Non-Conductive rail joiners [fishplates] are used where isolation of power across rail joins is required.	Construction	Conductive [fishplates] have been used throughout, except where it has been required to use plastic non-conductive [fishplates], as specified by [Peco] instructions.	1	n/a	n/a	Compliant
124	Track Joins shall be used in all rails which cross a module.	An unbroken rail length is not permitted. This is because a thermal expansion gap is required to prevent buckling or pulling away from the fixing at each end, because of thermal expansion/contraction.	Inspection	Design - The design to state that Track Joins shall be used in all rails which cross a module.	Design	The detailed design (track) states that provision will be made through the use of [fishplates], so that thermal expansion does not cause buckling of the rails or any other damage.	1			
125	Track Joins shall be used in all rails which cross a module.	An unbroken rail length is not permitted. This is because a thermal expansion gap is required to prevent buckling or pulling away from the fixing at each end, because of thermal expansion/contraction.	Demonstration	Construction - All track crossing a module from one side to the other will have at least one join.	Construction	Where a track passes from one side to the other without any points, it does contain at least one join, to ensure that thermal expansion can take place.	1	n/a	n/a	Compliant

126	Track Joins shall allow a thermal expansion gap.	To allow for thermal expansion and prevent buckling.	Inspection	Design - The design to state that Track Joins shall allow a thermal expansion gap.	Design	The concept design states, "Provision will be made so that thermal expansion does not cause buckling of the rails or any other damage." The detailed design (track) states: "Provision will be made through the use of [fishplates], so that thermal expansion does not cause buckling of the rails or any other damage."	1			
127	Track Joins shall allow a thermal expansion gap.	To allow for thermal expansion and prevent buckling.	Demonstration	Construction - Thermal expansion gaps are provided.	Construction	All track joins included a gap of 1mm - 2mm at the time of laying, to allow for thermal expansion.	1	n/a	n/a	Compliant
128	Track Joins between two lengths of flexi-track shall be avoided at the tightest point of a curve.	So that the natural inclination of the rail to resist curving does not put a kink in the course of the rail at a join.	Inspection	Design - The design to state that Track Joins between two lengths of flexi-track shall be avoided at the tightest point of a curve.	Design	The concept design states, "Because of the tendency for rails to spring outwards, joins on all but the gentlest radius are to be avoided." The detailed design (track) states: "Because of the tendency for rails to spring outwards, joins on all but the gentlest radius are to be avoided."	1			
129	Track Joins between two lengths of flexi-track shall be avoided at the tightest point of a curve.	So that the natural inclination of the rail to resist curving does not put a kink in the course of the rail at a join.	Demonstration	Construction - There are no rail joins at the tightest radius of a curve.	Construction	There are no track joins on the tightest radius curves. Joins are on the gentlest part of the curve possible.	1	n/a	n/a	Compliant
130	Track Joins between two lengths of flexi-track on a curve shall be located at the gentlest (transitional) point of a curve.	So that the natural inclination of the rail to resist curving does not put a kink in the course of the rail at a join.	Inspection	Design - The design to state that Track Joins between two lengths of flexi-track on a curve shall be located at the gentlest (transitional) point of a curve.	Design	The concept design states, "Because of the tendency for rails to spring outwards, joins on all but the gentlest radius are to be avoided." The detailed design (track) states: "Because of the tendency for rails to spring outwards, joins on all but the gentlest radius are to be avoided."	1			
131	Track Joins between two lengths of flexi-track on a curve shall be located at the gentlest (transitional) point of a curve.	So that the natural inclination of the rail to resist curving does not put a kink in the course of the rail at a join.	Demonstration	Construction - If a track joins is necessary between two lengths of flexi-track on a curve, it will be shall be located at the gentlest (transitional) point of a curve.	Construction	There are no track joins on the tightest radius curves. Joins are on the gentlest part of the curve possible.	1	n/a	n/a	Compliant
132	1.4.3.6 Track Securing				Function	n/a				
133	Track securing shall be provided at the edges of a module, where track crosses module joins.	To prevent movement of the rail and thus ensure correct alignment across connected modules.	Inspection	Design - The design to state that Track securing shall be provided at the edges of a module, where track crosses module joins.	Design	The concept design states, "Where track crosses a join between two modules, the rails are to be positively secured to each side of the join, so that there is no movement." The detailed design (track) states: "Where track crosses a join between two modules, the rails are to be	1			

						positively secured to each side of the join, so that there is no movement. "				
134	Track securing shall be provided at the edges of a module, where track crosses module joins.	To prevent movement of the rail and thus ensure correct alignment across connected modules.	Demonstration	Construction - Track crossing a [module] edge, will be secured at the edges.	Construction	Where a track crosses a module, the rails are soldered to copper-clad strip that has been securely glued to the module edge.	1	n/a	n/a	Compliant
135	Track securing shall be provided along the length of track to the module surface.	To ensure that the track does not move.	Inspection	Design - The design to state that Track securing shall be provided, where possible, along the length of track to the module surface.	Design	Track pins by Peco will be sourced and The detailed design (track) states: "Track is to be secured to the base by track fixing pins at regular intervals."	1			
136	Track securing shall be provided along the length of track to the module surface.	To ensure that the track does not move.	Demonstration	Construction - Track is secured to the surface at regular intervals.	Construction	Track has been secured down by track pins, sbaced as indicated by ther [tracksettas] or more frequently as required.	1	n/a	n/a	Compliant
137	1.4.3.7 Track Power Feeds				Function	n/a				
138	Track power feeds shall be supplied to each length of rail, where possible, independent of any connection via adjacent rails.	To maintain a reliable power feed to the track at all points. Ref: Strategy, section 3.4.2, Track laying.	Inspection	Design - The design to state that Track power feeds shall be supplied to each length of rail, independent of any connection via adjacent rails.	Design	The detailed design (control & electrics) states: "Power to the track shall be supplied by feeder wires connected to each length of rail, installed at tracklaying. The feeders shall be brought to a central location on each module. Each module shall be connected to its neighbour by a plugged cabling, enabling an ease of connecting/disconnecting."	1			
139	Track power feeds shall be supplied to each length of rail, where possible, independent of any connection via adjacent rails.	To maintain a reliable power feed to the track at all points. Ref: Strategy, section 3.4.2, Track laying.	Demonstration	Construction - Track power feeds are supplied to each length of rail.	Construction	When each length of track was laid, electrical feeds were soldered in place. These feeds all join to the power bus.	1	n/a	n/a	Compliant
140	Track power feeds for each module shall come from a single location on each module.	To facilitate the ease of connection for power to a single point. Ref: Strategy, section 3.4.2, Track laying.	Inspection	Design - The design to state that Track power feeds for each module shall come from a single location on each module.	Design	The detailed design (control & electrics) states: "Power to the track shall be supplied by feeder wires connected to each length of rail, installed at tracklaying. The feeders shall be brought to a central location on each module. Each module shall be connected to its neighbour by a plugged cabling, enabling an ease of connecting/disconnecting."	1			

141	Track power feeds for each module shall come from a single location on each module.	To facilitate the ease of connection for power to a single point. Ref: Strategy, section 3.4.2, Track laying.	Demonstration	Construction - Track power feeds for each module meet at a single location on each module.	Construction	One, or two, solder tag boards have been used on each module.Thus ensuring that distribution is at set locations and not distributed intermittently along the length of the Power Bus.	1	n/a	n/a	Compliant
142	Track power feeds shall be hidden from view on the completed layout when viewed from above.	So that after ballasting, the wires cannot be seen. Ref: Strategy, section 3.4.2, Track laying.	Inspection	Design - The design to state that Track power feeds shall be hidden from view on the completed layout when viewed from above. The detailed design (baseboard) states : "Each length of rail (where possible) shall be directly wired to a connection point mounted to the underside of each module. The connecting wires will be joined to the underside of each rail when the track is secured in position, so that the wires will not be visible from above after ballasting is in place. The exception to this rule may include the switch blades of points."	Design	Detailed design (track) states: "When a length of track is laid, connecting wires will be joined to the underside of each rail when the track is secured in position, so that the wires will not be visible from above after ballasting is in place. "	1			
143	Track power feeds shall be hidden from view on the completed layout when viewed from above.	So that after ballasting, the wires cannot be seen. Ref: Strategy, section 3.4.2, Track laying.	Demonstration	Construction - Track power feeds are hidden from view on the completed layout when viewed from above.	Construction	On all scenic modules, the track feed wired are obscured by the ballasting. Also , any exposed wires are painted black, to further hide them.	1	n/a	n/a	Compliant
144	1.4.3.8 Track Testing				Function	n/a				
145	Track testing shall be carried out to ensure correct electrical conductivity and isolation for operation.	To ensure that the tracks are correctly wired and that there are no continuity/short circuit faults. Ref: Strategy, section 6, Testing.	Inspection	Design - The design to state that Track testing shall be carried out to ensure correct electrical conductivity and isolation for operation.	Design	The detailed design (track) states that track testing shall be carried out to ensure electrical conductivity and isolation.	1			
146	Track testing shall be carried out to ensure correct electrical conductivity and isolation for operation.	To ensure that the tracks are correctly wired and that there are no continuity/short circuit faults. Ref: Strategy, section 6, Testing.	Demonstration	Construction - Track testing is carried out, according to a written test procedure, to ensure correct electrical conductivity and isolation for operation.	Construction	A mulit-meter has been used to check for correct continuity and the absence of short-circuits on the track prior to power-up. Subsequent to power-up, all short circuits due to connection reversals with point motors, has been corrected. Operation of locomotives along all lengths of track has confirmed correct electrical feeds. Therefore, this requirement is compliant.	1	n/a	n/a	Compliant
147	Track testing shall be carried out to ensure correct operation of points.	To ensure that the points are correctly wired and that the points operate correctly. Ref: Strategy, section 6, Testing.	Inspection	Design - The design to state that Track testing shall be carried out to ensure correct operation of points.	Design	The detailed design (track) states that track testing shall be carried out to ensure correct operation of points.	1			

148	Track testing shall be carried out to ensure correct operation of points.	To ensure that the points are correctly wired and that the points operate correctly. Ref: Strategy, section 6, Testing.	Demonstration	Construction - Track testing is carried out, according to a written test procedure, to ensure correct operation of points.	Construction	All points have been operated and it is confirmed that they all operate as expec ted and without fault. Therefore, this requirement is compliant.	1	n/a	n/a	Compliant
149	Track testing shall be carried out to ensure correct running of rolling stock.	(i) To ensure that locomotives are not excessively loaded by gradients. Ref: Strategy, section 6, Testing. (ii) To ensure that no rolling stock collides.	Inspection	Design - The design to state that Track testing shall be carried out to ensure correct running of rolling stock.	Design	The detailed design (track) states that track testing shall be carried out to ensure correct running of rolling stock	1			
150	Track testing shall be carried out to ensure correct running of rolling stock.	(i) To ensure that locomotives are not excessively loaded by gradients. Ref: Strategy, section 6, Testing. (ii) To ensure that no rolling stock collides.	Demonstration	Construction - Track testing is carried out, according to a written test procedure, to ensure correct running of rolling stock.	Construction	Track testing has not followed any formal test procedure. However, extensive running with a large variety of locomotives / carriages / wagons has been carried out over an extended period of time. Early delinquencies have been detected and corrected. Therefore, this requirement is considered compliant.	1	n/a	n/a	Compliant
151	1.4.3.9 Track Ballasting				Function	n/a				
152	Track ballasting shall not commence until after the operation of the layout has been assured and the design has been approved by the stakeholder.	Prototypical. Ballasting presents a no-return point, where it would be difficult to make track adjustments after ballast is in place.	Inspection	Design - The design to state that Track ballasting shall not commence until after the operation of the layout has been assured and the design has been approved by the stakeholder.	Design	The detailed design (track) states: "Track ballasting will not commence until after all track testing is complete and the layout has been run for a while with a wide selection of rolling stock, to ensure the satisfactory design and operation of the layout."	1			
153	Track ballasting shall not commence until after the operation of the layout has been assured and the design has been approved by the stakeholder.	Prototypical. Ballasting presents a no-return point, where it would be difficult to make track adjustments after ballast is in place.	Demonstration	Construction - Track ballasting does not commence until after the operation of the layout has been assured and the design has been approved by the stakeholder.	Construction	Ballasting has now started.	1	n/a	n/a	Compliant
154	Track ballasting shall not commence until after all track testing is completed with no unresolved faults.	Prototypical. Ballasting presents a no-return point, where it would be difficult to make track adjustments after ballast is in place.	Inspection	Design - The design to state that Track ballasting shall not commence until after all track testing is completed with no unresolved faults.	Design	The detailed design (track) states: "Track ballasting will not commence until after all track testing is complete and the layout has been run for a while with a wide selection of rolling stock, to ensure the satisfactory design and operation of the layout."	1			
155	Track ballasting shall not commence until after all track testing is completed with no unresolved faults.	Prototypical. Ballasting presents a no-return point, where it would be difficult to make track adjustments after ballast is in place.	Demonstration	Construction - Track ballasting does not commence until after all track testing is completed with no unresolved faults.	Construction	Track testing has been completed and ballasting has now started. Therefore, this requirement is considered compliant.	1	n/a	n/a	Compliant
156	1.4.3.10 Clearance above track				Function	n/a				

157	Clearance above track shall be provided to ensure that [Rolling Stock] does not collide with any obstacles.	When constructing the modules, take into account the thickness of sound deadening material under the track and the height of the rails. Also take into account the positioning of any fittings mounted underneath anything overhanging track. Ref: Strategy, section 3.4.1, Baseboard construction.	Inspection	Design - The design to state that there shall be sufficient vertical clearance between track and any overhanging structure and fittings, to allow clear passage of all [rolling stock].	Design	Detailed Design (Track) states: The spacing between straight parallel tracks is to be 51mm (centre to centre), as determined by the [Peco] track gauge. The distance between parallel tracks on a curve will need to be at least 4mm greater than that given by the [Peco] track gauge to allow for the overhang of carriages. This figure has been determined by experimentation on a test track, where the minimum radius was 61cms.	M			
158	Clearance above track shall be provided to ensure that [Rolling Stock] does not collide with any obstacles.	When constructing the modules, take into account the thickness of sound deadening material under the track and the height of the rails. Also take into account the positioning of any fittings mounted underneath anything overhanging track. Ref: Strategy, section 3.4.1, Baseboard construction.	Demonstration	Construction - There is sufficient vertical clearance between track and any overhanging structure and fittings, to allow clear passage of all [rolling stock].	Construction	At construction and fitting, all bridges are checked for clearance with a Mk 1 carriage and sufficient margin for error added.	M	n/a	n/a	Compliant
159	1.4.4 Provide Landscaping				Function	n/a				
160	The Landscape shall have contours that go above and below the track level.	It is to look as though the landscape was there before the railway. Also to maintain visual interest. Ref: Strategy, section 3.4.4, Landscaping.	Inspection	Design - The design to state that the Landscape shall have contours that go above and below the track level.	Design	The concept design states, "It may be hilly but will not be mountainous." The detailed design (baseboard) states: "As well as being unique in the plan shape, the modules may show uniqueness in their elevation because it is the intention that landscape be able to rise above/fall below the level of the track. This rising/falling is to be reflected in the shape of each mating panel on the module."	1			
161	The Landscape shall have contours that go above and below the track level.	It is to look as though the landscape was there before the railway. Also to maintain visual interest. Ref: Strategy, section 3.4.4, Landscaping.	Demonstration	Construction - The Landscape has contours that go above and below the track level.	Construction	The landscape is now in place. It comprises hills that go above track level and a valley with river, that goes below track level. Therefore, this requirement is considered compliant.	1	n/a	n/a	Compliant
162	The Landscape shall not be mountainous.	Mountains implies a lack of town. Ref: Strategy, section 3.4.4, Landscaping.	Inspection	Design - The design to state that the Landscape shall not be mountainous.	Design	The concept design states, "It may be hilly but will not be mountainous."	1			
163	The Landscape shall not be mountainous.	Mountains implies a lack of town. Ref: Strategy, section 3.4.4, Landscaping.	Demonstration	Construction - The Landscape is not mountainous.	Construction	The landscape is now in place. It comprises hills that go above track level and a valley with river, that goes below track level.	1	n/a	n/a	Compliant

						There are no mountains. Therefore, this requirement is considered compliant.				
164	The Landscape shall include at least one river or canal.	For visual interest. Ref: Strategy, section 3.4.4, Landscaping.	Inspection	Design - The design to state that the Landscape shall include at least one river or canal.	Design	Detailed desing (finishing) states: "A valley with a river and/or canal running through it."	2			
165	The Landscape shall include at least one river or canal.	For visual interest. Ref: Strategy, section 3.4.4, Landscaping.	Demonstration	Construction - The Landscape has at least one river or canal.	Construction	The landscape includes a valley with river. Therefore, this requirement is considered compliant.	2	n/a	n/a	Compliant
166	The Landscape shall include a town.	For visual interest. Although it is recognised that having a town and countryside so close may be mutually exclusive in the space available, forcing the decision to amend plans. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that the Landscape shall include a town.	Design	The concept design states, "The geographical location will be a fictional place in the UK. There will be a town."	1			
167	The Landscape shall include a town.	For visual interest. Although it is recognised that having a town and countryside so close may be mutually exclusive in the space available, forcing the decision to amend plans. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - The Landscape has a town.	Construction	A town scene has been constructed, comprising houses, shops, a pub and a church.	1	n/a	n/a	Compliant
168	The Landscape shall include a rural scene.	For visual interest. Although it is recognised that having a town and countryside so close may be mutually exclusive in the space available, forcing the decision to amend plans. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that the Landscape shall include a rural scene.	Design	Detailed desingn (finishing) states: "A rural scene, with vegetation e.g. bushes/trees, shall be included."	2			
169	The Landscape shall include a rural scene.	For visual interest. Although it is recognised that having a town and countryside so close may be mutually exclusive in the space available, forcing the decision to amend plans. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - The Landscape has a rural scene.	Construction	Ongoing	2	n/a	n/a	
170	The Landscape shall include a bridge or viaduct spanning an area of low contours.	For visual interest.	Inspection	Design - The design to state that the Landscape shall include a bridge or viaduct spanning an area of low contours.	Design	The detailed design (finishing) states: "The railway is to cross the river by a brick-arch bridge at one end and a bridge or viaduct at the other."	1			
171	The Landscape shall include a bridge or viaduct spanning an area of low contours.	For visual interest.	Demonstration	Construction - The Landscape has a bridge or viaduct spanning an area of low contours.	Construction	A four-arch brick viaduct has been built to carry the track over the valley built into module 6.	1	n/a	n/a	Compliant
172	1.4.5 Provide Signalling				Function	n/a				

173	Signalling shall be prototypical.	For visual interest and prototypical operation. Ref: Strategy, section 3.4.3, Signal installation.	Inspection	Design - The design to state that Signalling shall be prototypical.	Design	The detailed design (signals) states: "Signalling shall be prototypical."	1			
174	Signalling shall be prototypical.	For visual interest and prototypical operation. Ref: Strategy, section 3.4.3, Signal installation.	Demonstration	Construction - Signal operations conform to normal practice.	Construction	Phase 3	1	n/a	n/a	
175	Signalling shall be operating upper-quadrant semaphore signals.	(i) For visual interest and prototypical operation. (ii) To fit in with the steam period. (iii) Upper Quadrant signals give a wider range of possible regions. Ref: Strategy, section 3.4.3, Signal installation.	Inspection	Design - The design to state that Signalling shall be operating upper-quadrant semaphore signals.	Design	The detailed design (signals) states: "The signals shall be upper quadrant semaphores."	1			
176	Signalling shall be operating upper-quadrant semaphore signals.	(i) For visual interest and prototypical operation. (ii) To fit in with the steam period. (iii) Upper Quadrant signals give a wider range of possible regions. Ref: Strategy, section 3.4.3, Signal installation.	Demonstration	Construction - Signals are the operating upper-quadrant semaphore type.	Construction	Phase 3	1	n/a	n/a	
177	Signalling shall include the provision of correctly positioned signal box(es).	Signals are controlled from a signal box. Ref: Strategy, section 3.4.3, Signal installation.	Inspection	Design - The design to state that Signalling shall include the provision of correctly positioned signal box(es).	Design	The detailed design (signals) states: "Signal box(es) shall be provided."	1			
178	Signalling shall include the provision of correctly positioned signal box(es).	Signals are controlled from a signal box. Ref: Strategy, section 3.4.3, Signal installation.	Demonstration	Construction - The layout includes at least one signal box, prototypically positioned.	Construction	At the London Model Railway Festival, Alexandra Palace 2018, my track plan was shown to a Skills demonstrator and member of 'The Model Railway Club' who indicated that he was a retired Signal man. My track plan was marked with the suggested positions for signals, ground signals and two signal boxes, one on Module 8 at one end of the station, the other on Module 11 at the other end of the station. As a 'sanity check' of this information, I subsequently posted the annotated plan on the 'RM Web' forum with my query. The responses, as expected, were varied; but one respondant did indicate that although two signal boxes may have been excessive, this was possible and they were valid. Therefore, I consider this requirement met and compliant.	1	n/a	n/a	Compliant

179	Signalling shall include the placing of non-operating control rodding between the signals and the signal box(es).	For correct visual appearance. This is how signals/points would be operated.	Inspection	Design - The design to state that Signalling shall include the placing of non-operating control rodding between the signals and the signal box(es).	Design	The detailed design (signals) states: "Non-operating signal rodding/wiring shall be provided, linking back to the signal box(es)."	1			
180	Signalling shall include the placing of non-operating control rodding between the signals and the signal box(es).	For correct visual appearance. This is how signals/points would be operated.	Demonstration	Construction - There will be non-operating control rodding between the signals/points and the signal box(es).	Construction	Non-operating point rodding, as produced by [Peco] has been fitted between both signal boxes and all applicable points.	1	n/a	n/a	Compliant
181	Signalling design shall enable the removal of the signal from the layout, without needing to disconnect any mechanical connections.	So that the signal can be easily removed for maintenance/storage. Ref: Strategy, section 3.4.3, Signal installation.	Inspection	Design - The design to state that Signalling design shall enable the removal of the signal from the layout, without needing to disconnect any mechanical connections.	Design	The detailed design (signals) states: "The signals shall be fitted to the layout in a manner that enables ease of removal."	2			
182	Signalling design shall enable the removal of the signal from the layout, without needing to disconnect any mechanical connections.	So that the signal can be easily removed for maintenance/storage. Ref: Strategy, section 3.4.3, Signal installation.	Demonstration	Construction - It will be possible to remove the signal from the layout, without needing to disconnect any mechanical connections.	Construction	Phase 3	2	n/a	n/a	
183	Signalling design shall enable the removal of the signal from the layout, without needing access to the underside of the module.	So that the signal can be easily removed for maintenance/storage. Ref: Strategy, section 3.4.3, Signal installation.	Inspection	Design - The design to state that Signalling design shall enable the removal of the signal from the layout, without needing access to the underside of the module.	Design	The detailed design (signals) states: "The signals shall be fitted to the layout in a manner that enables ease of removal."	2			
184	Signalling design shall enable the removal of the signal from the layout, without needing access to the underside of the module.	So that the signal can be easily removed for maintenance/storage. Ref: Strategy, section 3.4.3, Signal installation.	Demonstration	Construction - It will be possible to remove the signal from the layout, without needing access to the underside of the module.	Construction	Phase 3	2	n/a	n/a	
185	Signalling shall include working lights in the signal lamps.	Greater level of accuracy and realism. Ref: Strategy, section 3.4.3, Signal installation.	Inspection	Design - The design to state that Signalling shall include working lights in the signal lamps.	Design	The detailed design (signals) states: "The signals shall have operating lights in the lamps."	2			
186	Signalling shall include working lights in the signal lamps.	Greater level of accuracy and realism. Ref: Strategy, section 3.4.3, Signal installation.	Demonstration	Construction - Signals include working lights in the signal lamps.	Construction	Phase 3	2	n/a	n/a	
187	Signalling shall be controlled remotely from a single location.	For reason of ease of operational control. Ref: Strategy, section 3.4.3, Signal installation.	Inspection	Design - The design to state that Signalling shall be controlled remotely from a single location.	Design	The detailed design (control & electrics) states: "The controller enables control of the signals from a single location, remote from each signal."	1			
188	Signalling shall be controlled remotely from a single location.	For reason of ease of operational control. Ref: Strategy, section 3.4.3, Signal installation.	Demonstration	Construction - Signalling are controlled remotely from a single location.	Construction	Phase 3	1	n/a	n/a	
189	1.4.6 Provide Buildings				Function	n/a				
190	Buildings on the completed layout shall include a Church.	For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that Buildings on the completed layout shall include a Church.	Design	Evidence to be provided at detail design.	2			

191	Buildings on the completed layout shall include a Church.	For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - There is a Church on the layout.	Deleted	The Free Church in Goring has been modelled and is placed in the town scene.	2	n/a	n/a	Compliant
192	Buildings on the completed layout shall include a Pub	For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that Buildings on the completed layout shall include a Pub	Design	Evidence to be provided at detail design.	2			
193	Buildings on the completed layout shall include a Pub	For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - There is a Pub on the layout.	Deleted	A pub has been constructed and is placed on the townscene.	2	n/a	n/a	Compliant.
194	Buildings on the completed layout shall include a terrace of houses	For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that Buildings on the completed layout shall include a terrace of houses	Design	Evidence to be provided at detail design.	2			
195	Buildings on the completed layout shall include a terrace of houses	For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - There is a terrace of houses on the layout.	Deleted	A terrace of houses has been constructed and is placed on the townscene.	2	n/a	n/a	Compliant.
196	Buildings on the completed layout shall include shops.	For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that Buildings on the completed layout shall include shops.	Design	Evidence to be provided at detail design.	2			
197	Buildings on the completed layout shall include shops.	For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - There are shops on the layout.	Deleted	A terrace of four shops has been constructed and is placed on the townscene.	2	n/a	n/a	Compliant.
198	Buildings on the completed layout shall include a School.	For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that Buildings on the completed layout shall include a School.	Design	Evidence to be provided at detail design.	2			
~~199~~	~~Buildings on the completed layout shall include a School.~~	~~For visual interest. Ref: Strategy, section 3.4.5 Buildings and detailing.~~	~~Demonstration~~	~~Construction - There is a School on the layout.~~	~~Deleted~~	~~Phase 3~~	~~2~~	~~n/a~~	~~n/a~~	~~Deleted~~
200	Buildings that can be viewed inside shall be fitted with interiors.	For visual interest. A level of detail is required so that it is not possible to see through a building. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that Buildings that can be viewed inside shall be fitted with interiors.	Design	Detail design (buildings) states: "Buildings that can be viewed inside, may require interior detailing and/or lighting, as appropriate."	2			
201	Buildings that can be viewed inside shall be fitted with interiors.	For visual interest. A level of detail is required so that it is not possible to see through a building. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - Buildings that can be viewed inside are fitted with interiors.	Construction	Phase 3	2	n/a	n/a	
202	Buildings that can be viewed inside shall be fitted with lights.	For visual interest. So that the insides can be seen. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that Buildings that can be viewed inside shall be fitted with lights.	Design	Detail design (buildings) states: "Buildings that can be viewed inside, may require interior detailing and/or lighting, as appropriate."	2			
203	Buildings that can be viewed inside shall be fitted with lights.	For visual interest. So that the insides can be seen. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - Buildings that can be viewed inside are fitted with lights.	Construction	Phase 3	2	n/a	n/a	

	Buildings and structures shall be able to withstand transportation of the module they stand on.	Buildings and other structures will not be exposed to harm by movement (transportation and maintenance) of the module.	Inspection	Design - The design to state that Buildings and structures can withstand transportation of the module they stand on.	Construction	Stated at design, Also to be met at construction.	2	n/a	n/a	
	Buildings and structures shall be able to withstand transportation of the module they stand on.	Buildings and other structures will not be exposed to harm by movement (transportation and maintenance) of the module.	Demonstration	Construction - Buildings and structures will: Either be secured to the module that they stand upon, so that they will not move when the module is tipped up on edge. Or be easily removable.	Construction	Phase 3	2	n/a	n/a	
204	1.4.6.1 Provide Station				Function	n/a				
205	The station shall accommodate the longest passenger train that the railway is designed for.	Passenger trains shall be run. A Mk1 carriage is 273mm long. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the station shall accommodate the longest passenger train that the railway is designed for. If it is assumed that a locomotive is the same length as a carriage, then a 6-carriage train is 1911mm long (6ft 3ins).	Design	The detailed design (track) states: "Measurement taken from the track design indicate that there is room for station platforms of 1500mm (4ft 11ins) in length. It may be possible to increase this by 200mm (8ins) by adjusting the position of the track. If it is permitted for a train to extend beyond the limits of the platform, then a six-carriage train can be accommodated."	1			
206	The station shall accommodate the longest passenger train that the railway is designed for.	Passenger trains shall be run. A Mk1 carriage is 273mm long. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The station accommodates the longest passenger train that the railway is designed for.	Construction	Now that the platform is in place, it is seen that a 5-carriage train and locomotive will fit within the limits of the platforms. A six-carriage train can be accomodated, but the back end of that last carriage will be off the end of the platform. This is not unusual in the real thing, so this requirement is cinsidered to be met.	1	n/a	n/a	Compliant
207	The station shall not have a covered train shed.	To permit unobstructed access to the track. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that the station shall not have a covered train shed.	Design	Detailed design (buildings) states: "The station is not to have a covered train shed. This is so as not to restrict full access to the track."	1			
208	The station shall not have a covered train shed.	To permit unobstructed access to the track. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - The station does not obstruct access to the track.	Construction	The station does not have a covered train shed. The track is exposed and accessible for cleaning.	1	n/a	n/a	Compliant
209	1.4.6.2 Provide Goods Yard				Function	n/a				
210	The Goods yard shall contain a goods shed.	This would be expected. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the Goods yard shall contain a goods shed.	Design	The detailed design (track) states: "The goods area will contain the functions associated with this area: Goods shed, crane."	1			
211	The Goods yard shall contain a goods shed.	This would be expected. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The Goods yard contains a goods shed.	Construction	A Wills goods shed is positioned on the layout, alongside the goods siding.	1	n/a	n/a	Compliant

212	The Goods yard shall be accessible to traffic travelling in either direction on the mainline.	For dropping off/picking up goods travelling in either direction. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the Goods yard shall be accessible to traffic travelling in either direction on the mainline.	Design	The concept design states, "The layout style will be OO gauge, twin-track mainline continuous loop with sidings for goods shunting operations." The detailed design (track) states: "The track design shows a continuous loop for twin-track [mainline] operation. There is also provision for a fiddleyard, station, goods area and locomotive servicing."	1			
213	The Goods yard shall be accessible to traffic travelling in either direction on the mainline.	For dropping off/picking up goods travelling in either direction. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The Goods yard is accessible to traffic travelling in either direction on the mainline.	Construction	The goods yard is accessible to traffic flowing in either direction on the [Mainline]	1	n/a	n/a	Compliant
214	The Goods yard shall contain a crane.	This would be expected. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the Goods yard shall contain a crane.	Design	The detailed design (track) states: "The goods area will contain the functions associated with this area: Goods shed, crane."	1			
215	The Goods yard shall contain a crane.	This would be expected. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The Goods yard contains a crane.	Construction	A Wills crane kit is positioned on the layout, alongside the goods siding.	1	n/a	n/a	Compliant
216	1.4.6.3 Provide Engine Yard				Function	n/a				
217	The engine yard shall contain an engine shed.	A steam service requires engine services, which requires a shed. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the engine yard shall contain an engine shed.	Design	The concept design states, "The main emphasis for the railway, will be the operation of passenger services. It shall have a station and an engine yard with all normal facilities that would be expected to service steam locomotives." The detailed design (track) states: "The locomotive servicing area will contain the functions associated with this area: Turntable, Water tower, coaling, ash removal, engine shed."	1			
218	The engine yard shall contain an engine shed.	A steam service requires engine services, which requires a shed. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The engine yard contains an engine shed.	Construction	The engine yard contains a two-track engine shed, long enough to house four locomotives.	1	n/a	n/a	Compliant
219	The engine yard shall contain coaling facilities.	A steam service requires engine services, which requires coal. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the engine yard shall contain coaling facilities.	Design	The concept design states, "The main emphasis for the railway, will be the operation of passenger services. It shall have a station and an engine yard with all normal facilities that would be expected to service steam locomotives." The detailed design (track) states: "The locomotive servicing area will contain the functions associated with this area: Turntable,	1			

						Water tower, coaling, ash removal, engine shed."				
220	The engine yard shall contain coaling facilities.	A steam service requires engine services, which requires coal. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The engine yard contains coaling facilities.	Construction	The engine yard contains a coal delivery mechanism.	1	n/a	n/a	Compliant
221	The engine yard shall contain watering facilities.	A steam service requires engine services, which requires water. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the engine yard shall contain watering facilities.	Design	The concept design states, "The main emphasis for the railway, will be the operation of passenger services. It shall have a station and an engine yard with all normal facilities that would be expected to service steam locomotives." The detailed design (track) states: "The locomotive servicing area will contain the functions associated with this area: Turntable, Water tower, coaling, ash removal, engine shed."	1			
222	The engine yard shall contain watering facilities.	A steam service requires engine services, which requires water. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The engine yard contains watering facilities.	Construction	The engine yard contains a water tower and water cranes.	1	n/a	n/a	Compliant
223	The engine yard shall contain ash removal facilities.	A steam service requires engine services, which requires ash removal. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the engine yard shall contain ash removal facilities.	Design	The concept design states, "The main emphasis for the railway, will be the operation of passenger services. It shall have a station and an engine yard with all normal facilities that would be expected to service steam locomotives." The detailed design (track) states: "The locomotive servicing area will contain the functions associated with this area: Turntable, Water tower, coaling, ash removal, engine shed."	1			
224	The engine yard shall contain ash removal facilities.	A steam service requires engine services, which requires ash removal. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The engine yard contains ash removal facilities.	Construction	Phase 3	1	n/a	n/a	
225	The engine yard shall contain turning facilities.	A steam service requires engine services, which requires turning. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the engine yard shall contain turning facilities.	Design	The concept design states, "The main emphasis for the railway, will be the operation of passenger services. It shall have a station and an engine yard with all normal facilities that would be expected to service steam locomotives."	1			

						The detailed design (track) states: "The locomotive servicing area will contain the functions associated with this area: Turntable, Water tower, coaling, ash removal, engine shed."				
226	The engine yard shall contain turning facilities.	A steam service requires engine services, which requires turning. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The engine yard contains turning facilities.	Construction	The engine yard contains a turntable.	1	n/a	n/a	Compliant
227	The engine yard shall contain ancillary railway buildings.	A steam service requires engine services, which requires support buildings. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the engine yard shall contain ancillary railway buildings.	Design	The concept design states, "The main emphasis for the railway, will be the operation of passenger services. It shall have a station and an engine yard with all normal facilities that would be expected to service steam locomotives." The detailed design (track) states: "The locomotive servicing area will contain the functions associated with this area: Turntable, Water tower, coaling, ash removal, engine shed."	1			
228	The engine yard shall contain ancillary railway buildings.	A steam service requires engine services, which requires support buildings. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The engine yard contains ancillary railway buildings.	Construction	Phase 3	1	n/a	n/a	
229	1.4.7 Provide Bridges and Tunnels				Function	n/a				
230	Bridges and Tunnels shall be high enough to give vertical and horizontal clearance for rolling stock.	When constructing the modules, take into account the thickness of sound deadening material under the track and the height of the rails. Ref: Strategy, section 3.4.1, Baseboard construction.	Inspection	Design - The design to state that Bridges and Tunnels shall be high enough to give vertical and horizontal clearance for rolling stock.	Design	Evidence to be provided at detail design.	M			
231	Bridges and Tunnels shall be high enough to give vertical and horizontal clearance for rolling stock.	When constructing the modules, take into account the thickness of sound deadening material under the track and the height of the rails. Ref: Strategy, section 3.4.1, Baseboard construction.	Demonstration	Construction - There is sufficient clearance under bridges/tunnels for all rolling stock.	Construction	The railway contains two bridges over the track, on modules 1 and 5. At the time of writing this evidence, the bridge on module 5 has been completed and positioned for some time and all stock has been run on the track. The bridge on module 1 has not yet been built, but a mock-up to determine dimensions and positioning has been located and a selection of locomotives and a number of Mk 1 carriages have been run under the bridge on various point settings, to identify any possible fouling. The smallest clearance	M	n/a	n/a	Compliant

						detected has been on the [UP] line by point 18a. The clearance against the mid-point of a Mk1 carriage is 3mm (a scale distance of 23cm). Some adjustment is possible. Locomotives used were: 72005, 34058, 6006, 60039, 35028 and 46203. This requirement will be reviewed again.				
232	1.4.8 Provide Figures				Function	n/a				
233	1.4.8.1 Provide People Figures				Function	n/a				
234	People figures shall populate the railway.	For interest and realism. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that People figures shall populate the railway.	Design	Detailed design (finishing) states: "The layout shall be populated by people and animals, to represent scenes that would normally be expected."	1			
235	People figures shall populate the railway.	For interest and realism. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - People figures populate the railway.	Construction	Phase 3	1	n/a	n/a	
236	1.4.8.2 Provide Animal Figures				Function	n/a				
237	Animal figures shall populate the railway.	For interest and realism. Ref: Strategy, section 3.4.5 Buildings and detailing.	Inspection	Design - The design to state that Animal figures shall populate the railway.	Design	Detailed design (finishing) states: "The layout shall be populated by people and animals, to represent scenes that would normally be expected."	2			
238	Animal figures shall populate the railway.	For interest and realism. Ref: Strategy, section 3.4.5 Buildings and detailing.	Demonstration	Construction - Animal figures populate the railway.	Construction	Phase 3	2	n/a	n/a	
239	1.4.9 Provide Track Electrical Supply				Function	n/a				
240	~~Track Electrical Supply to the rail feeds shall be in a ring-main formation.~~	~~This is to eliminate the possibility of voltage drops between modules. Ref: Strategy, section 3.3, Detailed design.~~	~~Inspection~~	~~Design - The design to state that Track Electrical Supply to the rail feeds shall be in a ring-main formation.~~	Construction	E mail communication from one controller manufacturer (DCC Concepts) has stated that a ring main must not be used if DCC control is selected because this will interfere with the operation of the controller. Therefore, this requirement is deleted.	2	n/a	n/a	Deleted
241	Track Electrical Supply to the rail feeds shall be in a ring-main formation.	This is to eliminate the possibility of voltage drops between modules. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Track Electrical Supply to the rail feeds shall be in a ring-main formation.	Construction	Following discussion with a representative from DCC Concepts, the detailed design includes this statement: "The power bus cannot be a continuous loop, as two paths of different length would introduce timing issues for the digital information. This means that the power bus becomes two transmission lines which must be loaded at their remote ends to prevent introducing	2	n/a	n/a	Concessed

						interference that can affect running of the locomotives. Suitable passive loads have been purchased for this purpose and will be fitted when the bus is complete." It is therefore decided that this requirement be concessed.				
242	Track Electrical Supply to a section of track at a [Home signal] shall be isolated by the operation of that signal.	This is to ensure that it is not possible to drive a locomotive past a Home signal at DANGER. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that Track Electrical Supply to a section of track at a [Home signal] shall be isolated by the operation of that signal.	Design	Stated in the detail design (control&electrics): A means will be explored so that it will not be possible to drive a locomotive past a signal at danger. On possible option for this would be to have the setting of the signal controlling the switching of power to the track.	2			
243	Track Electrical Supply to a section of track at a [Home signal] shall be isolated by the operation of that signal.	This is to ensure that it is not possible to drive a locomotive past a Home signal at DANGER. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Track Electrical Supply to a section of track at a [Home signal] is isolated by the operation of that signal.	Construction	May not be possible/practical to carry out.	2	n/a	n/a	
244	1.4.10 Provide Control				Function	n/a				
245	1.4.10.1 Provide Locomotive Control				Function	n/a				
246	Control of the locomotives shall be achieved by a DCC controller.	It is desirable that control of locomotives does not require the use of track sections.	Inspection	Design - The design to state that control of the railway be achieved by DCC controller.	Design	The concept design states, "Locomotive control will be by the Prodigy Advance 2 system" The detailed design (control & electrics) states: "The DCC controller selected for the operation of locomotives, is the DCC Prodigy Express, marketed through Gaugemaster. "	1			
247	Control of the locomotives shall be achieved by a DCC controller.	It is desirable that control of locomotives does not require the use of track sections.	Demonstration	Construction - Control of the railway be achieved by DCC controller.	Construction	A DCC controller has been purchased by NCE and the layout is being wired for DCC operation.	1	n/a	n/a	Compliant
248	Control of the railway shall be possible by a single operator.	Intended to be a single user operation. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that control of the railway be possible by a single operator.	Design	The concept design states, "Locomotive control will be by the Prodigy Advance 2 system" The detailed design (control & electrics) states: "The controls for locomotives, signals and points shall be reachable without the need for the operator to move from a single location."	1			
249	Control of the railway shall be possible by a single operator.	Intended to be a single user operation. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - Control of the railway is possible by a single operator.	Construction	All locomotive and point control is achieved via a DCC hand-held controller. Therefore, this requirement is compliant.	1	n/a	n/a	Compliant

250	Control of the locomotives shall permit the operator to move about the room.	So that the operator is not fixed to one spot. Ref: Strategy, section 3.1, Concept design.	Inspection	Design - The design to state that control of the locomotives permit the operator to move about the room.	Design	The concept design states, "Locomotive control will be by the Prodigy Advance 2 system". This is a hand-held controller which allows movement. The detailed design (control & electrics) states: "The DCC controller selected for the operation of locomotives, is the DCC Prodigy Express, marketed through Gaugemaster. "	1			
251	Control of the locomotives shall permit the operator to move about the room.	So that the operator is not fixed to one spot. Ref: Strategy, section 3.1, Concept design.	Demonstration	Construction - The operator is able to move about the room while controlling locomotives.	Construction	The NCE controller comes with a 2m long cable.	1	n/a	n/a	Compliant
252	Control of the locomotives shall take into account the aspect of signals.	This is to ensure that it is not possible to drive a locomotive past a Home signal at DANGER. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that control of the locomotives take into account the aspect of signals.	Design	Stated in the detail design (control&electrics): A means will be explored so that it will not be possible to drive a locomotive past a signal at danger. On possible option for this would be to have the setting of the signal controlling the switching of power to the track.	2			
253	Control of the locomotives shall take into account the aspect of signals.	This is to ensure that it is not possible to drive a locomotive past a Home signal at DANGER. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Control of the locomotives takes into account the aspect of signals.	Construction	May not be possible/practical to carry out.	2	n/a	n/a	
254	Control of the locomotives shall take into account the connection integrity of the modules.	This is to ensure that it is not possible to run a locomotive off the end of a module, when the ajacient module is opened for access.	Inspection	Design - The design to state that control of the locomotives takes into account the connection integrity of the modules.	Construction	Stated at design. Met at construction through the use of micro-switches that isolate the modules either side of the opening module, when it is not in its closed position.	1	Compliant	Compliant	Compliant
255	Control of the locomotives shall take into account the connection integrity of the modules.	This is to ensure that it is not possible to run a locomotive off the end of a module, when the ajacient module is opened for access.	Demonstration	Construction - It will not be possible th run any locomotive when the opening module at the door is not in the closed position.	Construction	Micro-switches have been mounted on modules 1 and 10, to cut supply of power to these modules, including module 11, when module 11 is raised. Thus preventing locomotives from running off unprotected track ends. Therefore, this requirement is compliant.	1	n/a	n/a	Compliant
256	1.4.10.2 Provide Point Control				Function	n/a				
257	Point Control shall be achieved by the use of a mimic panel.	A mimic panel will provide a schematic of the layout.	Inspection	Design - The design to state that point Control be achieved by the use of a mimic panel	Design	The concept design states: Points will be operated by slow-action motors or servo motors that are to be mounted underneath the track. Operation for the point motors is to be located at one central place on the layout, on a mimic-panel." The detailed design (control & electrics) states: "Point control shall be	1			

						executed by a switch control panel, which will also display a visible indication of the points status on a mimic panel which represents the track plan."				
258	Point Control shall be achieved by the use of a mimic panel.	A mimic panel will provide a schematic of the layout.	Demonstration	Construction - Point control uses feedback of point status to the mimic panel.	Construction	To be demonstrated at Phase 2/3	1	n/a	n/a	
259	Point control shall use feedback of point status to the mimic panel.	The mimic panel will provide a visual indication of the points settings.	Inspection	Design - The design to state that point control uses feedback of point status to the mimic panel.	Construction	Stated at design, Also to be met at construction.	1	n/a	n/a	
260	Point control shall use feedback of point status to the mimic panel.	The mimic panel will provide a visual indication of the points settings.	Demonstration	Construction - Point control uses feedback of point status to the mimic panel.	Construction	To be demonstrated at Phase 2/3	1	n/a	n/a	
261	1.5 Provide Information				Function	n/a				
262	1.5.1 Provide Design				Function	n/a				
263	The design shall include a track plan, to be drawn before construction starts.	The position of the track influences the shape of each module. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that a track plan to be drawn before construction starts.	Design	The detailed design (track) states: "A master plan is to be maintained. This is to be copied onto paper at a scale of 1:1 which is to be accurately positioned on the modules, thus enabling the track to be correctly positioned."	1			
264	The design shall include a track plan, to be drawn before construction starts.	The position of the track influences the shape of each module. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - The track plan is complete before construction starts.	Construction	A track plan has been drawn up on a computer-based tool and has been through several revisions before being printed out fiull size.	1	n/a	n/a	Compliant
265	The design shall include a full-size master track plan, to be corrected if there are any changes.	All construction measurements will be taken from this. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that a full-size master track plan, to be corrected if there are any changes.	Design	The detailed design (track) states: "A master plan is to be maintained. This is to be copied onto paper at a scale of 1:1 which is to be accurately positioned on the modules, thus enabling the track to be correctly positioned."	1			
266	The design shall include a full-size master track plan, to be corrected if there are any changes.	All construction measurements will be taken from this. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - Positioning of the track is taken directly from a master plan.	Construction	A track plan has been drawn up on a computer-based tool and has been through several revisions before being printed out fiull size.	1	n/a	n/a	Compliant
267	The design shall be for OO gauge.	This is the gauge that the owner works with and a lot of stock is in ownership. Ref: Strategy, section 2, Scope.	Inspection	Design - The design to state that the layout shall be for OO gauge.	Design	The concept design states, "Track will be OO gauge finescale flexitrack with wooden style sleepers, sourced from Peco." The detailed design (track) states: "Track will be OO gauge [finescale] [flexitrack] with wooden style sleepers, sourced from [Peco]."	1			

268	The design shall be for OO gauge.	This is the gauge that the owner works with and a lot of stock is in ownership. Ref: Strategy, section 2, Scope.	Demonstration	Construction - The layout is OO gauge.	Construction	The layout is OO gauge.	1	n/a	n/a	Compliant
269	The design shall consider a folded-figure-of-eight continuous loop as a candidate configuration.	This concept will give a longer track run. Also gives a longer viewing length. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - The design to state that a folded-figure-of-eight continuous loop be considered as a candidate configuration.	Design	This concept has been considered, then rejected on the grounds that there is not enough room to make a convincing model.	1	Compliant	n/a	n/a
270	The design shall consider a folded-figure-of-eight continuous loop as a candidate configuration.	This concept will give a longer track run. Also gives a longer viewing length. Ref: Strategy, section 3.3, Detailed design.	n/a	Construction - n/a	Construction	The design of the layout was considered at the design stage and a folded-figure-of-eight was rejected.	1	n/a	n/a	n/a
271	1.5.2 Provide measurements				Function	n/a				
272	Measurements shall be given in the metric system of meters (m) and millimeters (mm).	For reason of convention. Also because the geometric parameters of points is given in millimeters. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - Metric measurements, meters (m) and millimeters (mm), are given for dimensions at detailed design.	Design	The plans show dimensions in mm and this unit was used in the construction.	1	Compliant	n/a	n/a
273	Measurements shall be given in the metric system of meters (m) and millimeters (mm).	For reason of convention. Also because the geometric parameters of points is given in millimeters. Ref: Strategy, section 3.3, Detailed design.	Inspection	Construction - n/a	Construction	Measurements on the plans and transferred onto the modules, are all given in millimetres.	1	n/a	n/a	Compliant
274	1.5.3 Provide trackplans				Function	n/a				
275	Track plans shall be developed using a computer based application tool intended for that purpose.	To ensure that track geometries are correct. Ref: Strategy, section 3.3, Detailed design.	Inspection	Design - Track plans are developed using a computer based application tool intended for that purpose.	Design	A computer-based application was purchased and used to produce the track plan	2	n/a	Compliant	n/a
276	Track plans shall be developed using a computer based application tool intended for that purpose.	To ensure that track geometries are correct. Ref: Strategy, section 3.3, Detailed design.	Demonstration	Construction - n/a	Construction	A trackplan was designed using a computer based application and the design saved to disk-based file.	2	n/a	n/a	Compliant
277	1.6 Provide Logistics				Function	n/a				
278	No requirements have been identified.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
279	1.7 Provide Organisation				Function	n/a				
280	No requirements have been identified.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
281	1.8 Provide Personnel				Function	n/a				
282	No requirements have been identified.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
283	1.9 Provide Training				Function	n/a				
284	No requirements have been identified.	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
0	0	0	0	0	0		0			
						129				
						132			Compliant	Concessed
					No of design requirements =				6	0
					No of construction requirements =				101	5

Lessons Learned

Area of interest	Issue	Details	Possible future action	Correction used
Plans/design	Format of plans printout	The trackplan was printed out in too many sheets. It was hoped to printout one sheet per side of the layout, however, the [front] and [back] were printed out on four sheets each, causing a problem with accurate alignment.	Explore different formats to present the plans, thus making it easier to print on a single sheet.	Errors were very small and when it came to tracklaying, the plan was not precisely adhered to. So the impact was negligible.
Track	Track pins sticking through underside of of base	The track pins are so long that the pointed ends are exposed by about 2mm underneath.	1. Lay thicker cork. 2. Lay layer of card/foam under cork. 3. shorter pins (may not be available). 4. face underside with cork. 5. Do without pins and just glue track down with PVA.	The pins were soft enough that I was able to crop them with a pair of cutters. However, as a safety measure, wear protective goggles.
Track Tools	Track parallel on curves	Tracksettas have been used for inner track on curves, but not possible for outer track. This is because there is only a limited selection of tracksetta radii available.	A tool was seen at recent exhibition, which ensured a consistent spacing on curves. Keep a look out for it and purchase.	None
Tools	Transition curves	Tracksettas were used where required, but the largest radius curve was not purchased and could have been useful.	Purchase largest radius (60inch) Tracksetta.	None
Electrical	Consistency in use of tagboards.	The soldering of main power bus to tagboards was inconsistent, as was the orientation when fitting.	Ensure consistency in soldering/ locating of tag boards.	None
Track Electrical	Double-sided copper-clad strip board	The strip-board that is used to secure track to the edges of modules, has copper-clad on both sides. This leaves open the possibility for short-circuits between rails as power jumps from one side to the other via whiskers of copper or solder crosses the gap. Where this has happened, a workaround has been to use a razor saw to cut through the strip between the affected rails.	Since single-sided strip is not available, one possible remedy is to peel the copper clad off one surface before securing the strip down on the module edge.	With the last piece of strip board laid, I did strip the copper off one side first. This was not a difficult task.
Track	Points close to module edge	It is essential that point rails coming from the live frog, are electrically isolated from the rails that feed into them, for this an insulated rail joiner is required. However, a problem occurs when the point is so close to the edge of a module, that the short distance from rail joiner to copper-clad strip means that (a) either there is not the space to solder a dropper wire to the rail or (b) the insulated rail joiner would be melted by soldering the rail to the copper-clad strip.	Plan the track design such that there is a minimum distance between rail end of a point and copper-clad strip along module edge, 3cm should be enough.	In one instance, I used a conductive rail connector instead of an insulated one, so as to dispense with an additional dropper wire. This was not an ideal solution.
Materials	Purchasing of materials used	I have consistently underestimated the quantities of materials required (e.g. multi-strand wire, cable ties, cable anchors, insulated sleeving, PVA Glue, flap supports), resulting in repeated visits to shops and on-line re-orders, hence time wasted.	In any future projects, be more realistic in my estimation of quantities required and don't be afraid to buy more than I think I need.	None
Electrical	A single DCC power bus.	When carrying out open-circuit testing across the track/power bus, it was expected that the result would be an open-circuit. However, with the introduction of the point motors, it was realised that I had introduced a resistive load which would obscure any leakage between the rails.	Consider in any future project, having a separate bus for the point motors, or having the ability to segregate the point motors on each module.	None

Model Railway Design – Lessons Learned

Plans/design	Track not perpendicular to module joins	In the plans, I had allowed for track to cross module joins at angles other than a right-angle. In one place, there is a potential problem where a sharp rail end could catch a wheel and cause a derailment.	Ensure that all rail cross perpendicular in future projects. Consider how to make mating edges which are 'stepped' so as to permit this. A possible alternative approach, is to permit non-perpendicular module crossing; but where so, cut each rail individually and perpendicular to the rail.	Chamfered rail ends.
Baseboard Electrical	Noisy turntable motor	The turntable motor resonates the plywood in the module that it is mounted on.	Consider a suitable acoustic decoupling. Slower motor speed.	Have glued cork sheeting to the underside of the module. Am also considering reduced voltage to the motor, to make it run slower.
Track	Rails going out of alignment crossing module joins.	Where a curved track crosses a module join, the tension that the curve puts into the track, is causing the rails to 'splay out' where it is cut crossing the module join. At best, this results in a kink in the curve. At worst, this results in rail ends going out of alignment, causing a derailment.	Provide a more secure means of fixing the copper-clad strip to the module edges. Avoid an adhesive which allows movement (i.e. a gum-based adhesive), consider an epoxy-resin based adhesive in future. Also consider pinning.	Have secured strip with pins.
Track	Turntable movement is being jammed by track	The short lengths of track, placed to catch any locomotive runover, have nothing to hold then securely and so can creep back & forth in their sleepers. Thus they are able to creep forward and foul the turntable bridge. There is no power feed to these lengths.	Track must be positively secured. E.g. by gluing down.	
Baseboard / track	track base drooping.	On module 6, where the track spans over the valley, the board supporting the track is drooping by about 10mm in its middle.	Needs support.	Threaded rods have been inserted from underneath, so that they pass through the middle of the viaduct piers and support the track base. Holes have been made in the piers prior to fitting.
Track Electrical	Locomotive short-circuits power supply.	It has been discovered that the placing of insulated rail joiners at the heel of a point, as per instructions in the Peco information sheet, does not protect the power supply from being short circuited, should the locomotive be driven into the heel of a point that is not set for that direction. The locomotive wheels will bridge across the insulated rail joiner.	If planning any future layout. Take this problem into account when designing the track layout and plan to include isolated sections , length equal to the longest locomotive, when track laying. Also consider the switching of power as a 'paper exercise' to ensure that there are no conflicts. A discussion with MegaPoints Controllers revealed another possible option, involving the use of his servo controller board for the operation of signals. study the MegaPoints controllers website.	Where a single point works in isolation, it is sufficient to have an isolated length of rail long enough to prevent 'bridging' by a locomotive. Power to the rail to be switched by the secondary switch on the point motor. For more complex point arrangements, DCC Concepts have been contacted and they have advised connecting the secondary switches in series. It will also be necessary to insert additional insulated rail joiners in the track.
Track	Fitting of inspection pits	Several inspection pits have been purchased from Peco. To fit them, it is necessary to thread the rails through them and cut holes in the baseboard, for them to fit into.	For any future layout, plan where to place them before laying track and fit them with the track laying.	It was necessary to lift the track where the pits are to be fitted.
Track	Review of track plan	When consulting with a Model Club member about the positioning of signals, he pointed out that the exit from the engine yard onto the main running line, should be protected with a catch-point or headshunt.	With any future layout, plan for such feature before constructing.	I chose to install a headshunt.
Track	Fitting of buffer stops.	Fitting of the Peco buffer stops has been made difficult because ballasting has already started and is dry/hard where buffers are to be placed.	Install buffers before starting to lay ballast.	Need to dig ballast away where buffer grips the rail.
Track	ballasting around points	Great care is needed when ballasting around points, to ensure that the moving parts are not affected by glue or the presence of grains of gravel. For this reason, it has been decided not to ballast under the switch blades. However, that means that the cork underlay is now visible.	Paint over the cork underlay where a point is to be positioned and with a paint that is the colour of the ballast, before laying the point.	A thin brush has been used to carefully paint the cork between the sleepers, under the switch blades and around the tie bar.
Electrical	Access to dropper wires	There are a few places, modules 6 and 11, where the dropper wires are hidden by the bridges. This could become a problem if I need access to these wires.	Try to plan where to fit droppers, to avoid bridges, or gradients, where support is required.	None

Model Railway Design – Lessons Learned

Track	Change to track resulted in unexpected side-effect.	When fitting the additional headshunt between points #21 and #27, it was not realised that the effect of previously installing 'dead' sections to protect the controller from accidental short-circuiting, had been circumvented. (see entry above) By the time this had been discovered, the track had already been ballasted in place, making it impossible to insert additional insulated rail joiners.	Always review track testing and ensure that any change does not have any side effects before ballasting.	Having reviewed the track and wiring plans, it is planned to use a slitting disc to make a cut in the offending length of rail (possibly between the new point and point #27), to extend the dead-section over the length of the new point. To hold the cut rail ends in place and maintain the gap, it it thought that squeezing epoxy-resin into the gap and on the outside of the rails should suffice.
Kits	Painting plastic kits	Experimentation has shown that it is easiest to spray primer onto plastic kit parts, whilst they are still affixed to their sprues. It is also worth considering painting parts their final colour prior to / during assembly.	Consider how a kit is to be painted, before cutting the parts off their sprues.	None
Clothing	Damage to clothing	Always change into old clothes prior to doing any job.	Keep old clothing to hand.	Too late!
Painting	Mixing of brush-on paint	Always stir the paint. Never shake it!	Have a stock of cocktail sticks available.	Too late!
Buildings	Position of station platform.	Because the station platform is on a relatively sharp curve, this presents a gap between the platform and the side of a carriage, either at the centre, or at the ends.	Either avoid placing a platform on a curve, or ensure that the radius is considerably larger.	None
Buildings	Forming platform edge	Because of the relationship between platform and track on a curve (see previous entry), it has not been straightforward to carve material away so that it does not get hit by parts of rolling stock.	Before building the platform, consider placing a moveable edge to represent the platform edge, so that it may be adjusted when trying a representative range of rolling stock; the aim being to determine the final position of the platform before building it.	The top surface was laid, overlapping the sidewall. It was then carved with a scalpel whilst running a range of stock back and forth. When comparing the platform edge against my collection of locomotives, I found that it was the A3 Pacific 60039 'Sandwich' that required the greatest clearance.
Buildings	Painting platform edges	Although I was able to paint the strips of brick sheeting after they had been the glued into place along the edges of the platforms, this still caused some disruption with access to the edges for painting. It would have been easier if I had painted the entire sheet(s) before cutting into strips for fitting.	Consider this action for any parts that could be painted before fitting.	Painted in situ.
Track	Locomotive fouling ground signal	It was found that one of my locomotives, A3 60039 'Sandwich' was fouling a ground signal positioned by point 6b, due to the large overhang of the right-hand steps behind the front buffers.	Ensure an adequate clearance for all 'track furniture'.	The offending ground signal was relocated about 35cm further away from point 6b, where the clearance between the Up and Down lines was 8mm greater.
Environment	Too hot in the summer, no ventilation	When the building was ordered, opening windows were not specified, because of the cost. This has turned out to be a false economy because the space overheats in the summer and the doors need to be left open during the daytime. It would have helped if a fitted ventilator had been installed.	Install opening windows / fitted ventilators.	The doors are left open whenever the house is occupied. Also an electric fan was purchased, but all it does is stir up the hot air.
Plans/design	Non-track features	It has been realised that it is not enough to plan the trackwork and ignore the off-track features, such as buildings, hoping that it will all work out. With the layout construction well advanced, I have the problem of not really knowing where to put things, or what the end result will look like.	With any future layout, plan for such features before constructing. Also, consider making a reduced-size mock-up.	Too late!
Landscaping	Fences	When drilling holes for fences, I accidentally snagged some Postice and ripped it off.	Position fences before Postice.	Too late! No serious harm done.
Buildings	Platform ramps	The gradient of my platform ends, does not match the fencing in the ratio kit.	When making platforms, refer to the fence kits for the correct gradient.	Cannot put kit fencing on the platform ends.

Model Railway Design – Lessons Learned

Buildings	Don't take shortcuts	Don't take shortcuts with constructing buildings because it seems like too much trouble at the time. It will show up later and you will eventually have to re-do it. For example: Installing doors that are flat and printed, rather than constructed with cut-out panels. Windows that don't have sills. Roofs that are flat printed sheets, instead of layered strips.	I will have to revisit earlier models built, to attend to window sills and roofs.	I will have to redo a couple of doors.
Electrical	DCC Bus	Originally, I had wired the point motors to the track bus. When exploring options for controlling the motors, it came out that the motors need to be on a separate bus.	Include a second DCC bus at construction.	I added a second bus. There was also a third bus added, for DC.