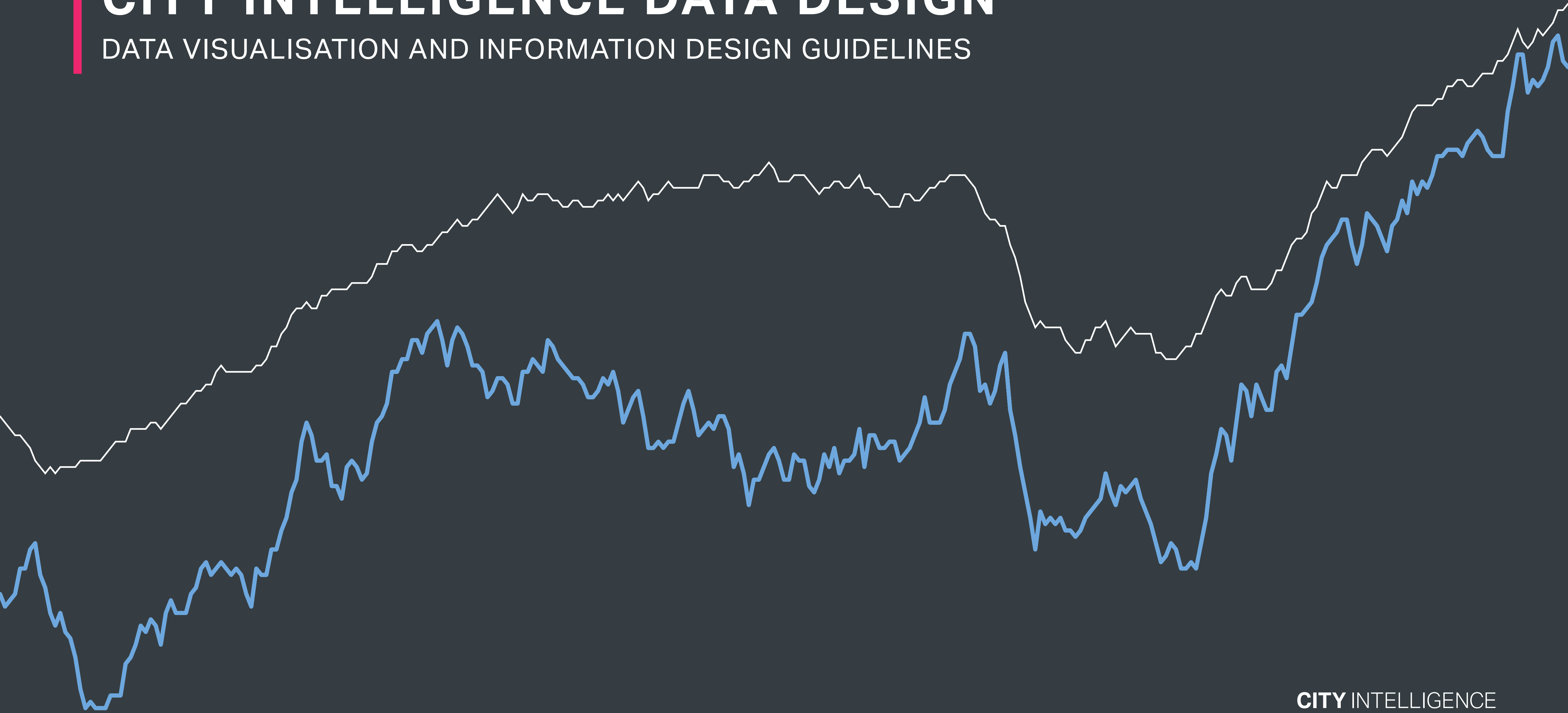# CITY INTELLIGENCE DATA DESIGN

DATA VISUALISATION AND INFORMATION DESIGN GUIDELINES

CITY INTELLIGENCE

CITY INTELLIGENCE DATA DESIGN
DATA VISUALISATION AND INFORMATION DESIGN GUIDELINES

CITY INTELLIGENCE

INTRODUCTION

INTRODUCTION
WHAT IS THIS GUIDE FOR?

A Work in Progress

Within the City Intelligence Unit at City Hall, we work on a diverse range of data visualisation and information design projects. These projects range from static presentations, simple chart publishing, interactive visualisation applications and both simple and more complex web mapping applications.

This guide has evolved out of documenting principles & styles that have worked across those projects so far, in order to keep our work consistent.

Now seemed like a good time to share these simple principles so far, to help us all think about how we present data, and as handy guide if you are looking for answers to your own chart design challenges.

This is an ongoing, evolving work in progress, that will expand, shift and change format as we tackle more projects, and see what does & doesn't work. So, if you have any thoughts or feedback on the guide so far, then do get in touch: **mike.brondbjerg@london.gov.uk**

Guiding principles, not rigid rules

Your data and design challenges will be unique to you and the context you are working in. The solution you create will never be perfect, and will always be compromised, but using some guiding principles can help us keep aiming for the best and most consistent design outcome possible.

For every chart or graphic you design, you have to make the decisions about adding, removing or highlighting elements, and these guidelines are here to help that decision-making process.

"

The code is more what you'd call "guidelines" than actual rules. Welcome aboard the Black Pearl, Miss Turner.

- Captain Barbossa, Pirates of the Caribbean1

Guidelines are just a guide, and not rules to be dogmatically followed.

You should make a conscious decision about the charts types you choose, the data you use, and the elements you add or remove to highlight the data.

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CHART DESIGN

CHART DESIGN
PRINCIPLES

Remove the noise, highlight the signal

The quote below is one of Dieter Rams' 10 Principles of good design and is particularly pertinent to the field of data visualisation & information design (as noted in the book "Data Visualisation" by Andy Kirk[2]).

> **Good design is as little design as possible. Less, but better.**
>
> - Dieter Rams[3]

Within data visualisation, **"Less, but better"** means removing unnecessary visual clutter, but keeping, improving and highlighting only elements that reinforce or illustrate the point we are trying to make with the data.... Because a chart isn't the data, it's an opinion about (or at least a narrow view of) the data.

The same principle can be applied to the editorial content surrounding and contextualising our charts too.

Maximizing the Data-Ink Ratio

Edward Tufte has an interesting approach to reducing visual clutter, and focusing only on elements that "show the data".

> **Above all else, show the data.**
>
> - Edward Tufte[4]

"Data-Ink" is the "non-erasable core of a graphic", and he encourages you to dedicate as much of the ink in a graphic to showing the data.

The "Data-Ink Ratio" describes the amount of ink that is used to communicate data vs other decorative clutter.

Edward Tufte's Five "Laws" of Data-Ink:

1. Above all else show the data.
2. Maximize the data-ink ratio.
3. Erase non-data ink.
4. Erase redundant data-ink.
5. Revise and edit.

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CHART DESIGN
PRACTICAL STEPS

Practical steps to reduce clutter

Minimal gridlines & tick marks
Use as few gridlines and ticks as is necessary to understand the range & context of your data. Aiming for around 5 gridlines / tick marks is usually adequate. Make your gridlines as light as possible, but still visible.

Remove borders
Remove borders around the chart to give it more space.

Minimise labelling
Labelling your axis as unobtrusively as possible, gives you space to accentuate important points on the axis or in the data.

Remove decoration and effects
Get rid of any unnecessary key lines around shapes, drop shadows and bevelling effects.

Don't try and show too much
If you have lots of data to show, perhaps use small multiples of charts rather than over complicating one chart.

Minimise use of colour
Remove colour encoding of data that is there only for context or comparison. Using lighter/thinner grey lines for this contextual data allows to better highlight with meaningful colour later.

This chart needs some work
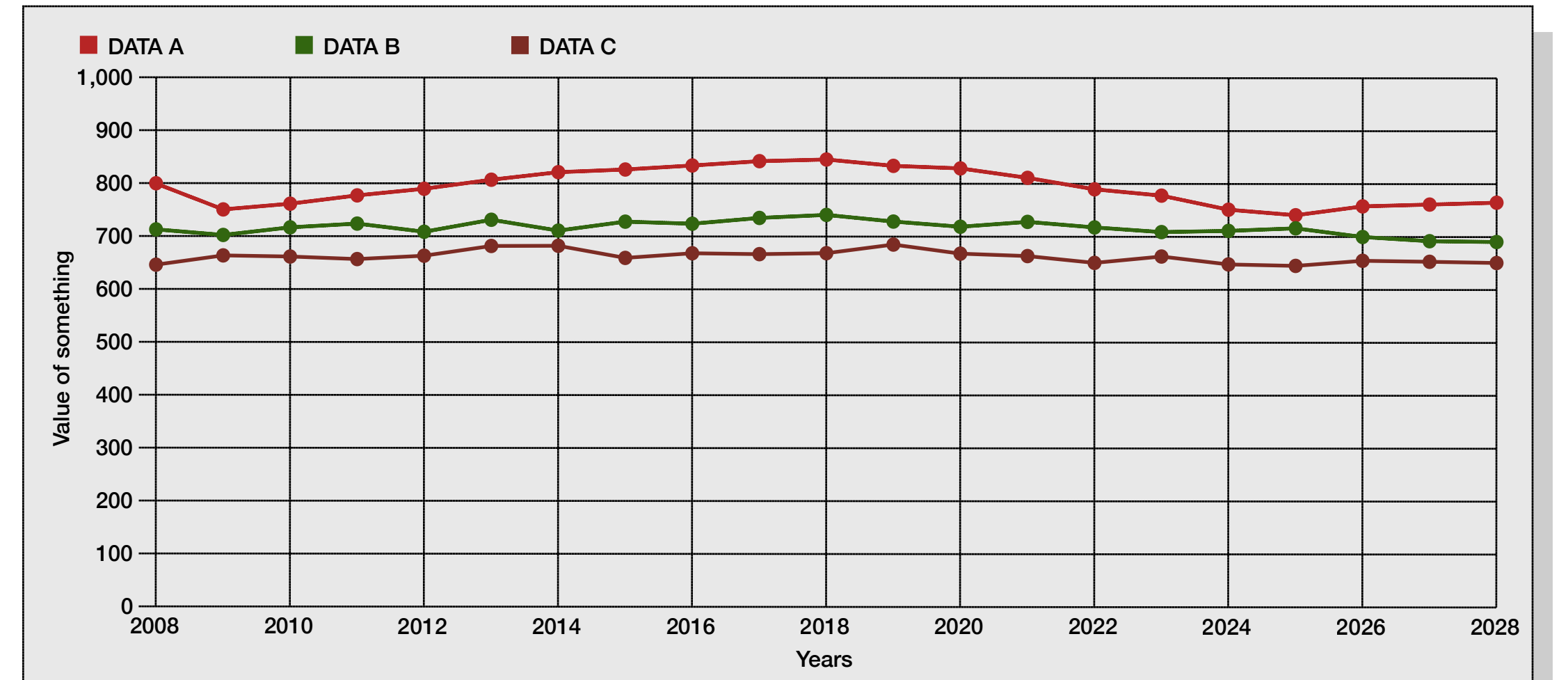
A cleaner chart, but could still be better
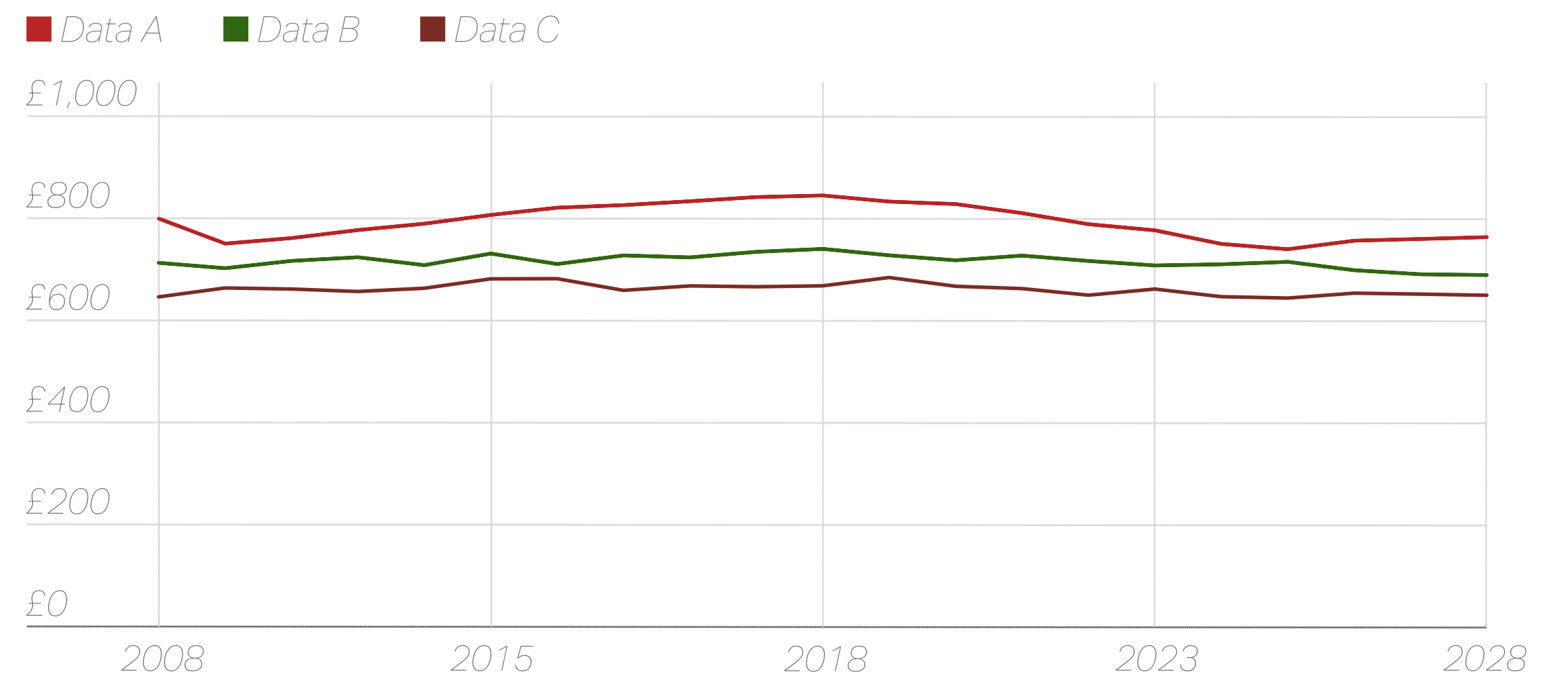
CHART DESIGN
PRACTICAL STEPS

Practical steps to highlight the data or message

Focus
Focus ranges to show data most clearly. Only if doing so doesn't remove important context.

Use colour or line weight
Highlight the important data with a consistent / thematic colour, and increasing the weight of the line

Label directly
This can help draw attention to a key data point and simplifies reading by not having to translate the meaning of a colour legend.

Show key points on the axis
Highlight key dates or values on the axis. Consider only including the date ticks on your axis that are relevant to the chart.

Highlight important thresholds and contextual ranges
Draw attention to important thresholds in the range of your data. E.g. placing a stronger gridline when your y-axis DOES start at zero. Or where you need to show data around a threshold.

Only use dots & marks on important data points
- First & last values
- Interesting events
- Show where there are few, or inconsistent data points.

Say what you see
Help the reader by titling the chart with a description of what you want them to see in the graphic. **Use colour to connect body copy in your document** to data points in your chart.

The value of A is projected to fall, but then recover
A longer more detailed description of the context and methodology behind the projection that A, will fall but eventually rise again.
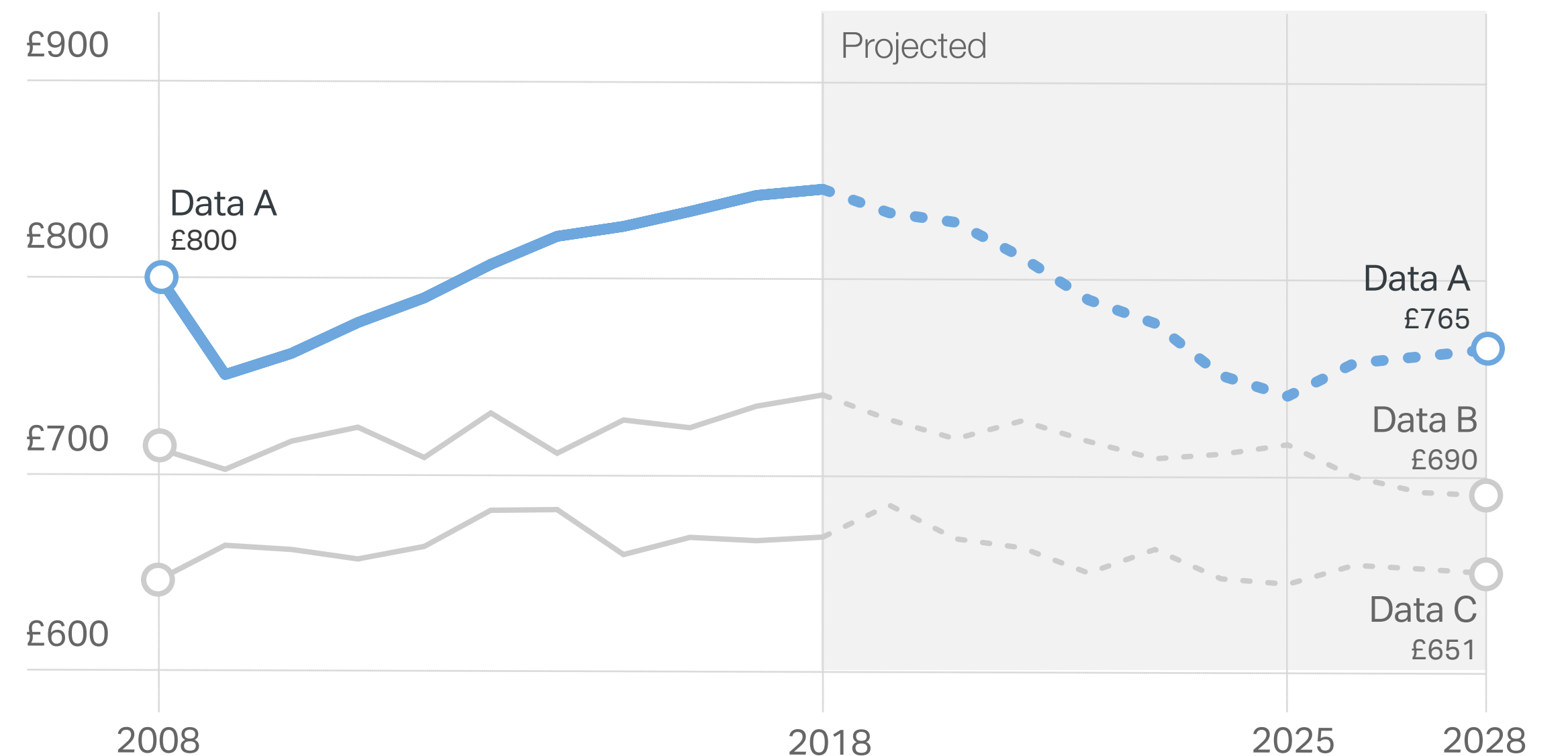
CHART DESIGN
PRACTICAL STEPS

Practical steps to improve presentation layout, design & readability

Maintain consistency
Make consistent design decisions throughout your work, and certainly within any given presentation. For example, once your reader has learned that "pink" might mean "London" don't contradict that in your next chart.

Aid navigation & context
Allow users to navigate your presentation or document easily by signposting (with colour or icons) where they are. This also gives them context for the data they are reading.

Consider chart comparison
Ensure any two charts that are likely to be compared, use the same space for layout and use the same scale on the x & y axis.

Consistent text hierarchy across charts and within document
Your chart should feel that it belongs to your document, so keep the text size consistent with the hierarchy of your document or web page.

Connect data and narrative
Highlight body copy in your document with a colour or style that connects it to a highlighted data in your chart.

Keep the visual quality high
Avoid poor quality icons or pictograms that don't lend clear meaning to your design or might appear trite or cliched. Try to avoid poor quality or tired stock photography.

Audience
Pick the style, tone, depth & layout of your presentation to suit your audience and the platform they will be viewing it on. Print, presentation, online, or all of the above.

Perhaps start thinking about working "Digital First"
Should we still be presenting work as a Word document, PowerPoint presentation, or (like this) PDF? Web based content makes navigation easier and content richer and more accessible.

If we can create the infrastructure, support & training, can we strive towards "digital first" publication?
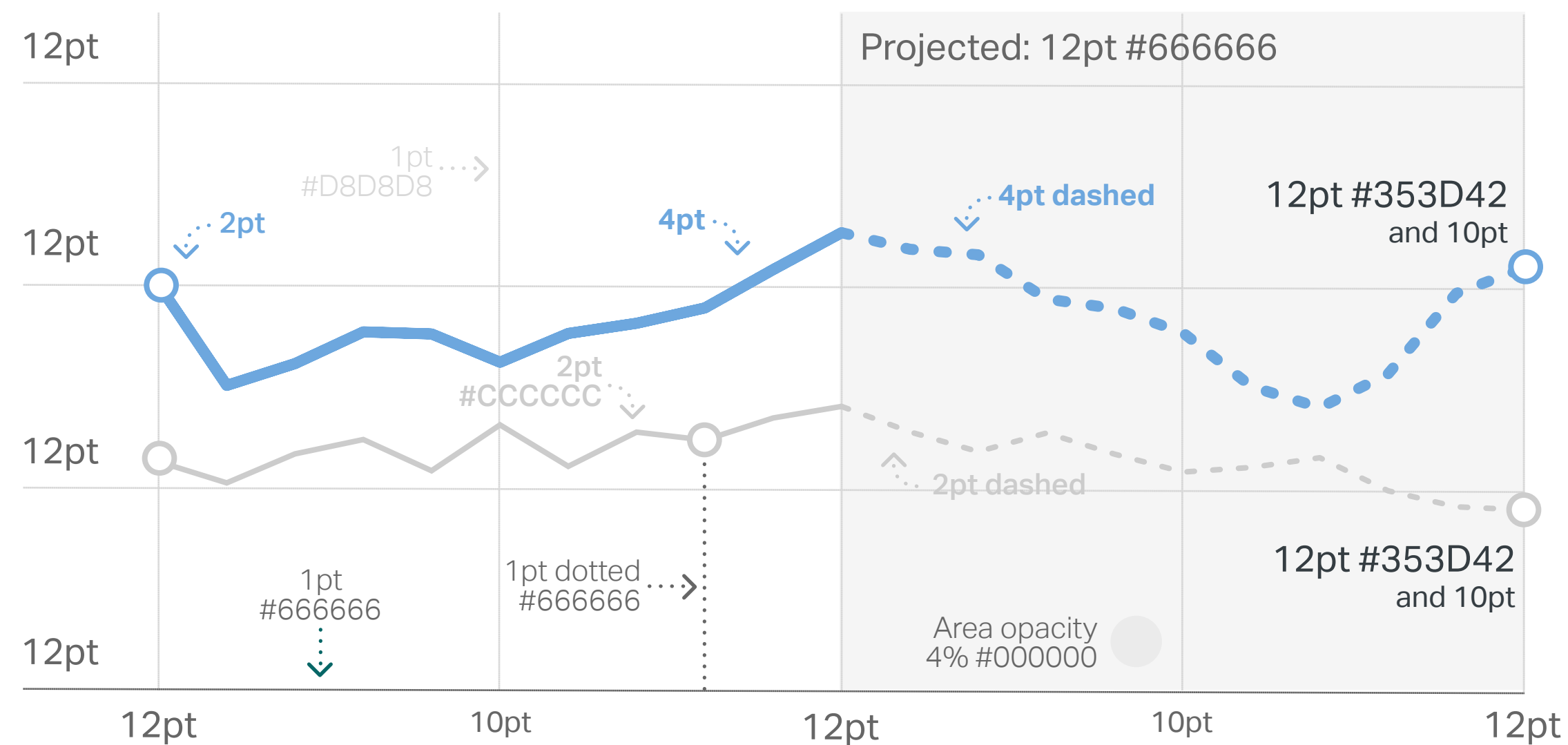
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CHART DESIGN
STYLING & LAYOUT

Consistent layout, labels & lines

For ease of comprehension, it's important that your charts are presented consistently, and are as clean and uncluttered as possible.

Remember, your charts should feel part of the document they are displayed within, and so text sizes should relate to the document text hierarchy and all chart text should be consistent across the document.

Shown are typical text and line weight settings derived from the London Datastore's body copy. Depending on your tools, device / document context, and resolution, you may want to change the specific settings, but the relative relationships between lines & type settings should be similar.

A descriptive chart title in 18pt Bold #353d42
More detailed explanation matching the document body copy in 14pt

12pt

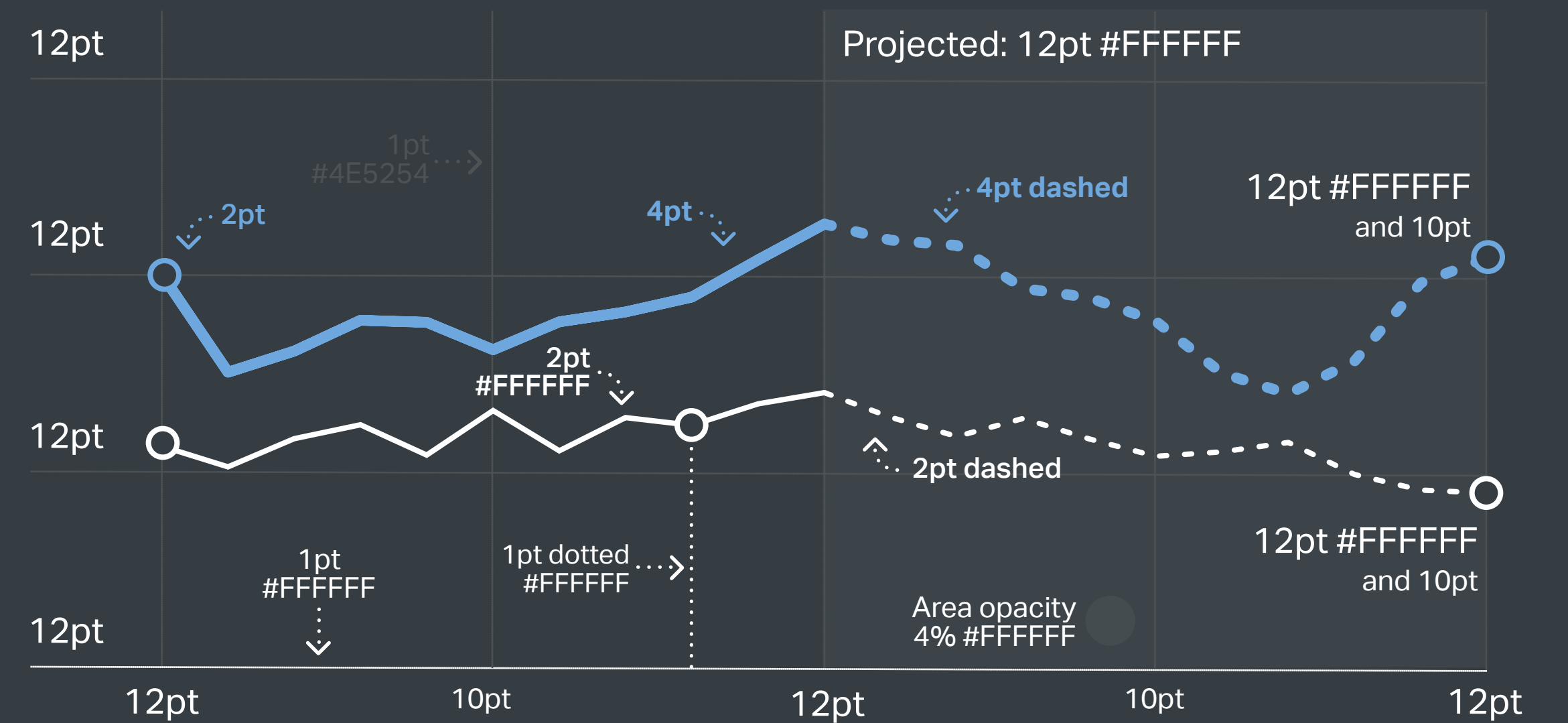Projected: 12pt #666666

1pt ···→
#D8D8D8

2pt

4pt

4pt dashed

12pt #353D42
and 10pt

2pt
#CCCCCC

2pt dashed

1pt
#666666

1pt dotted
#666666 ···→

12pt #353D42
and 10pt

Area opacity
4% #000000

12pt

12pt

12pt

12pt

12pt   10pt   12pt   10pt   12pt

Source: General chart text in 12pt #666666

A descriptive chart title in 18pt Bold #FFFFFF
More detailed explanation matching the document body copy in 14pt

12pt

Projected: 12pt #FFFFFF

1pt ···→
#4E5254

2pt

4pt

4pt dashed

12pt #FFFFFF
and 10pt

2pt
#FFFFFF

2pt dashed

1pt
#FFFFFF

1pt dotted
#FFFFFF ···→

12pt #FFFFFF
and 10pt

Area opacity
4% #FFFFFF

12pt

12pt

12pt

12pt

12pt   10pt   12pt   10pt   12pt

Source: General chart text in 12pt #FFFFFF

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CHART DESIGN
USING COLOUR

When we produce a graphic, we often use colour for differentiating categories or encoding value. But colour is tricky to get right, and not always as useful as we might hope. Balancing accessibility, perception, cultural association, branding and it's appearance in different contexts, and to different users, can limit our options.

Consider the following principles when using colours:
- Favour direct labelling over using a wide range of categorical colours
- Try and use a single colour to highlight your data, and grey/white for contextual / comparison data.
- Apply colour to meaning consistently across all your charts that are likely to be read in the same context.
- Use colour to connect information across different charts and editorial.
- Some colours have overriding cultural, policticalor contextual meaning. Try and reserve those if you'll need them later in your presentation. E.g. Red = Bad, Failing or Hot, Green = Good, improving or Environment, Blue = cold, etc...

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CHART DESIGN
MAYOR OF LONDON BRAND COLOURS

The Mayor of London brand guildlines contain this set of 11 colours, of which Pink (#ee266d) is the hero colour. These colours are brilliantly impactful for brand communications when used in isolation or small pairings. However for data visualisation and information design we need to think about colour slightly differently.
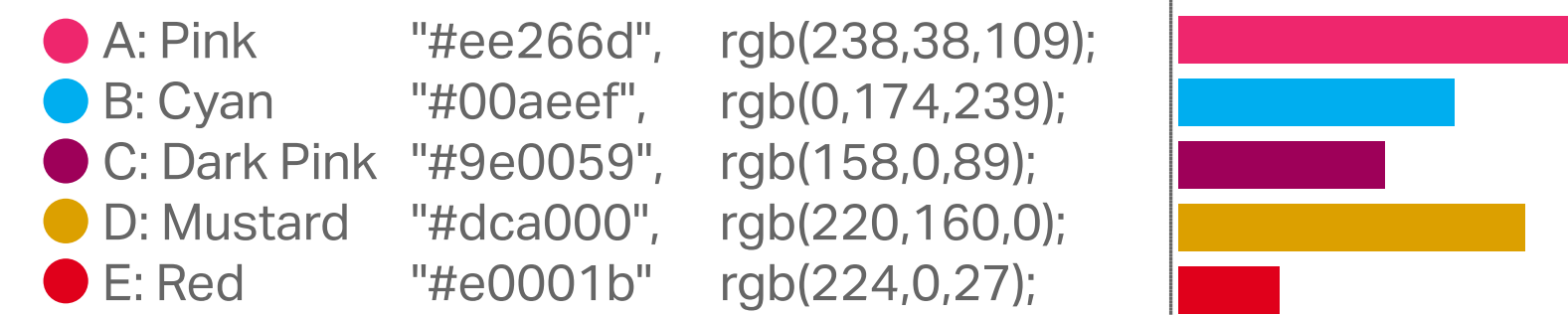
PINK
C0 M95 Y35 K0
R238 G38 B109
P 213
#EE266D

CYAN
C100 M0 Y0 K0
R0 G174 B239
P Process Cyan
#00AEEF

GREEN
C100 M0 Y100 K0
R0 G141 B72
P Bright Green
#008D48

YELLOW
C0 M0 Y100 K0
R255 G242 B0
P Process Yellow
#FFF200

ORANGE
C0 M70 Y100 K0
R233 G88 B20
P 164
#E85713

RED
C0 M100 Y100 K0
R224 G0 B27
P Red 032
#E0001B

DARK PINK
C20 M100 Y35 K30
R158 G0 B89
P 228
#9E0059

BLUE
C100 M5 Y0 K47
R0 G87 B125
P 308
#00577D

MUSTARD
C10 M40 Y100 K0
R220 G160 B0
P 124
#DCA000

PURPLE
C50 M89 Y0 K0
R121 45 B137
P 258
#792C89

GREY
C25 M10 Y10 K85
R54 G62 B66
P 432
#353D42

BLACK
K100
R0 G0 B0
P Black
#000000

Mayor of London Brand Guidelines:

https://www.london.gov.uk/about-us/governance-and-spending/sharing-our-information/our-brand-guidelines
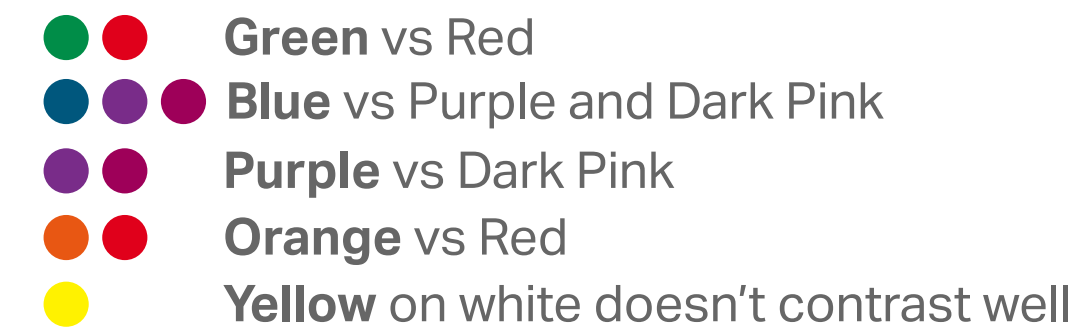
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When presenting data, and while not ideal, we sometimes need to use a wide range of categorical colours. These categorical colours, for the sake of clarity and accessibility need to be visually distinct from each other.

Some of the brand colours, can't be used to together in a visualisation because they are not visually distinct enough for some readers, and in some environments and applications (like small lines or points).

This subset of the brand colours do work as categorical colours:

A: Pink   "#ee266d",   rgb(238,38,109);
B: Cyan   "#00aeef",   rgb(0,174,239);
C: Dark Pink   "#9e0059"   rgb(158,0,89);
D: Mustard   "#dca000",   rgb(220,160,0);
E: Red   "#e0001b"   rgb(224,0,27);

These colours and pairings are problematic for accessibility:

Green vs Red

Blue vs Purple and Dark Pink

Purple vs Dark Pink

Orange vs Red

Yellow on white doesn't contrast well

As a solution to this need for an extended range of categorical colours, we have used the Hero Pink and Dark Pink, and then developed a new set of colours around them. They are as similar as possible to the brand colours but with modifications in Hue, Saturation and Brightness to give them more visual separation.

CHART DESIGN
CORE CATEGORICAL COLOUR PALETTE

Core colours and chart design system

Below are a quick reference to our core categorical colours that have been developed to extend the LDN Pink and Dark Pink brand colours.

Blue	LDN Dk Pink	Yellow	Red	Green	Purple	Turquoise	Pink	Orange	LDN Pink
#6da7de	#9e0059	#dee000	#d82222	#5ea15d	#943fa6	#63c5b5	#ff38ba	#eb861e	#ee266d
109,167,222	158,0,89	222,224,0	216,34,34	94,161,93	148,63,166	99,197,181	255,56,186	235,134,30	238,38,109

Light BG Context Data	Light Chart BG Highlight Area	Light BG Strong Grid	Light BG Light Grid	Dark BG Context Data	Dark Chart BG Highlight Area	Dark BG Strong Grid	Dark BG Light Grid
#cccccc	4% #000000	#666666	#d8d8d8	#ffffff	4% #ffffff	#ffffff	#4e5254
204,204,204	0,0,0	102,102,102	216,216,216	255,255,255	255,255,255	255,255,255	78,82,84

Document Headlines	Document Body Text	Axis Text & Labels	Highlighted Labels	Chart Label Black	Chart Label White
#353d42	#666666	#666666	#353d42	#000000	#ffffff
53,61,66	102,102,102	102,102,102	53,61,66	0,0,0	255,255,255

Dark App
#121516
18,21,22
Base for web applications

Dark Panel
#1b2021
27,32,33
Web app UI panels

All colours work on a dark background

LDN Grey
#353d42
53,61,66
London.gov.uk style panels

LDN Dark
#2a3135
42,49,53
London.gov.uk dark UI

LDN Light
#868b8e
134,139,142
London.gov.uk light UI

This subset work well on the LDN Grey background

White
#ffffff
255,255,255
Printed page and simple app

Light App
#f5f5f5
245,245,245
Light base for web apps

All colours work on a light background

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CHART DESIGN
CORE CATEGORICAL COLOUR PALETTE

While fewer colours are better, we often need numerous categorical colours on charts and maps. The following colours have been carefully chosen to work with LDN Pink and Dark Pink and (unless coloured areas are small) are discernable by people with most* colour vision deficiancies.
Below are suggested default usage order and possible colour ramps.
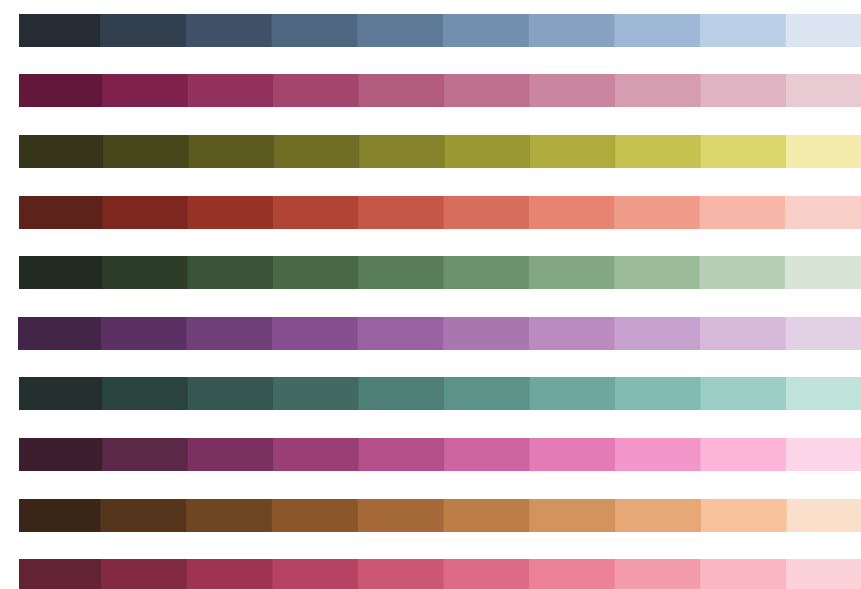
Core categorical colours by default use order

A: Blue	"#6da7de",	rgb(109,167,222);
B: LDN Dk Pink	"#9e0059",	rgb(158,0,89);
C: Yellow	"#dee000",	rgb(222,224,0);
D: Red	"#d82222",	rgb(216,34,34);
E: Green*	"#5ea15d",	rgb(94,161,93);
F: Purple	"#943fa6",	rgb(148,63,166);
G: Turquoise	"#63c5b5",	rgb(99,197,181);
H: Pink	"#ff38ba",	rgb(255,56,186);
I: Orange	"#eb861e",	rgb(235,134,30);
J: LDN Pink*	"#ee266d"	rgb(238,38,109);

*Avoid Together

A B C D E* F G H I J*

Example single hue categorical colour ramp end/mid points:
Visit https://gka.github.io/palettes/ to generate your own steps

A: Blue	252c35, 6da7de, dbe5f1
B: LDN Dk Pink	63193b, 9e0059, e8cad3
C: Yellow	36351a, dee000, f3ecaa
D: Red	5d221a, d82222, f9d0c7
E: Green	212b20, 5ea15d, d8e4d6
F: Purple	432648, 943fa6, e3d1e5
G: Turquoise	23312f, 63c5b5, bfe2db
H: Pink	3c1f30, ff38ba, fcd6e9
I: Orange	3a2718, eb861e, fadfcb
J: LDN Pink	642434, ee266d, fad2d8

Core categorical colour palette

J: LDN Pink*
D: Red
B: LDN Dk Pink
I: Orange
H: Pink
C: Yellow
Core suggested categorical combinations
F: Purple
E: Green*
A: Blue
G: Turquoise
use order
lighter to #f5f5f5
suggested ramp end/mid points
darker to #121212

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CHART DESIGN
CORE CATEGORICAL COLOUR PALETTE

For accessibility and clarity, you ideally wouldn't use this many colours, but here we show all 10 categorical colours together on a map. They work on both light and dark basemaps or application canvases. A couple of colour ramps for choropleths are also shown.
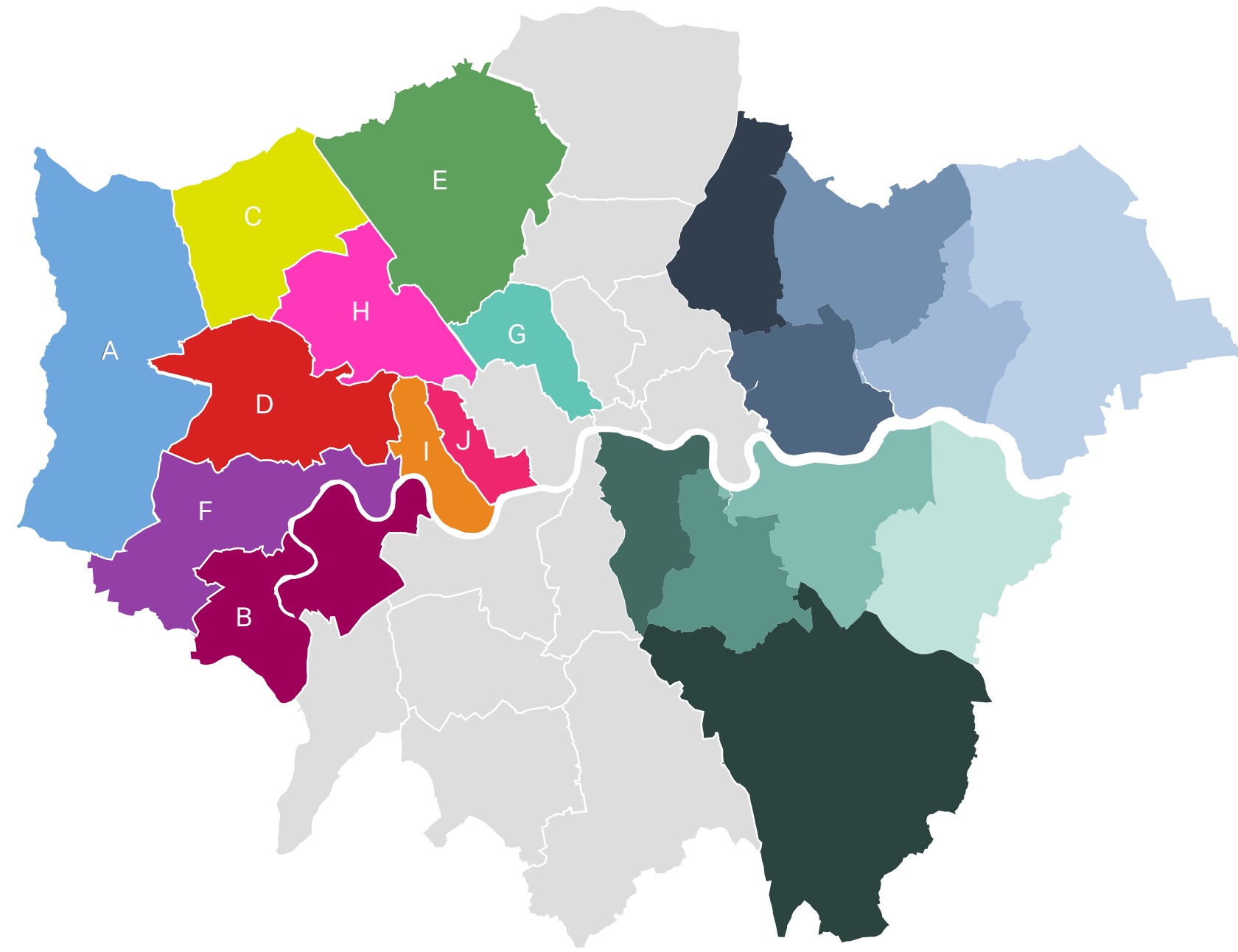
BG: White   "#ffffff",   rgb(255,255,255);
Map: Grey   "#dddddd"   rgb(204,204,204);

Core categorical colour palette on a dark application background
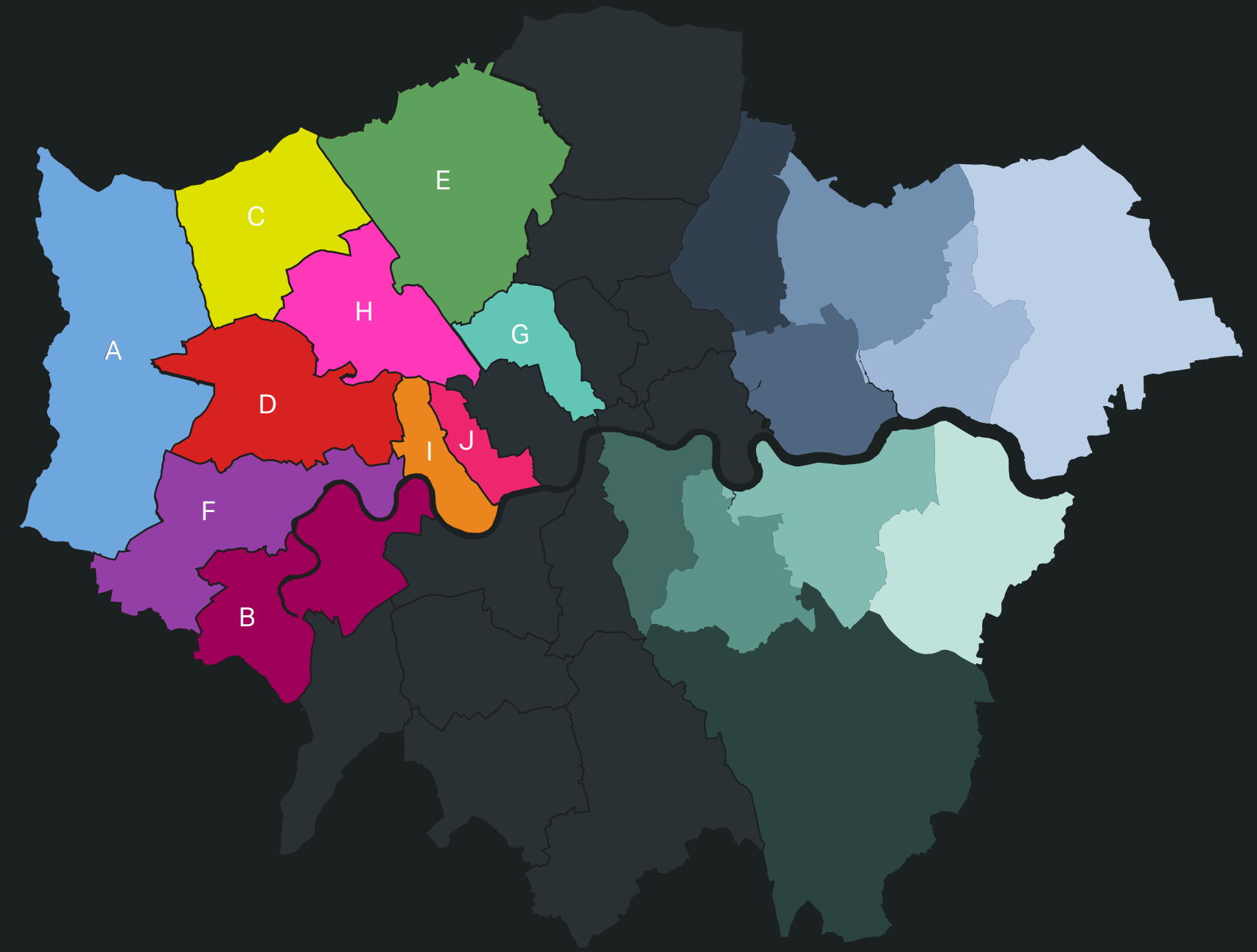
BG: Dark Panel   "#1b2021",   rgb(27,32,33);
Map: LDN Dark   "#2a3135"   rgb(42,49,53);

CITY INTELLIGENCE

CHART DESIGN
CORE CATEGORICAL COLOUR PALETTE

Some colours don't contrast well with the "mid" LDN grey background, so here we have a reduced palette of 6 of our core categorical colours.

Reduced Core categorical colours by default use order

- A: Blue   "#6da7de",   rgb(109,167,222);
- C: Yellow   "#dee000",   rgb(222,224,0);
- E: Green   "#5ea15d",   rgb(94,161,93);
- G: Turquoise "#63c5b5",   rgb(99,197,181);
- I: Orange   "#eb861e",   rgb(235,134,30);
- J: LDN Pink   "#ee266d"   rgb(238,38,109);
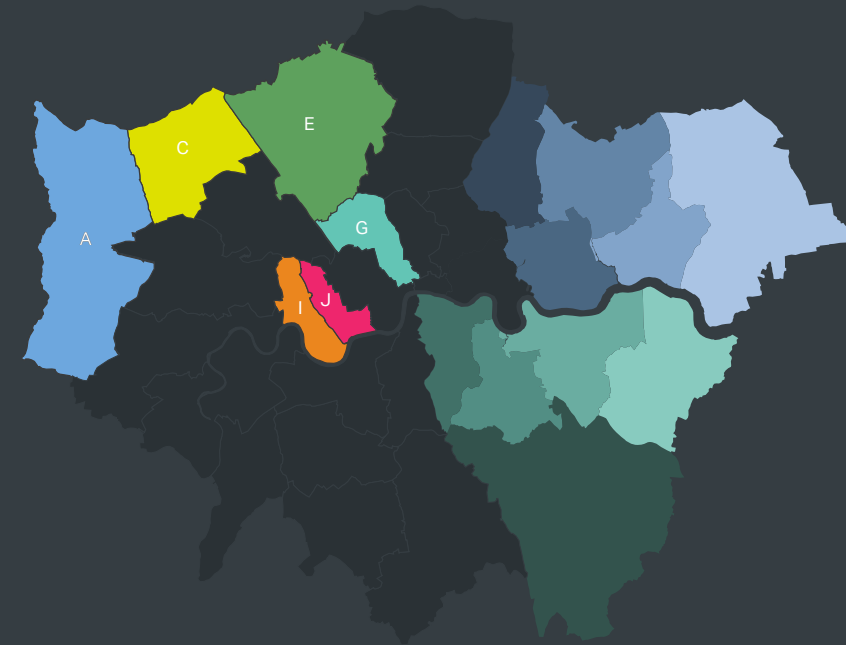
It looks odd if ramps start darker than this LDN grey BG. Here we have a some example ramps, starting from a lighter base, as shown in the colour wheel. Visit https://gka.github.io/palettes/ to generate your own steps

- A: Blue   37485b, 6da7de, c3d5ec
- C: Yellow   5d5b1f, dee000, f5f0ce
- E: Green   3f633e, 5ea15d, d8e4d6
- G: Turquoise 33534d, 63c5b5, a2d9ce
- I: Orange   8e541f, eb861e, fadfcb
- J: LDN Pink   bd2a59, ee266d, fad2d8
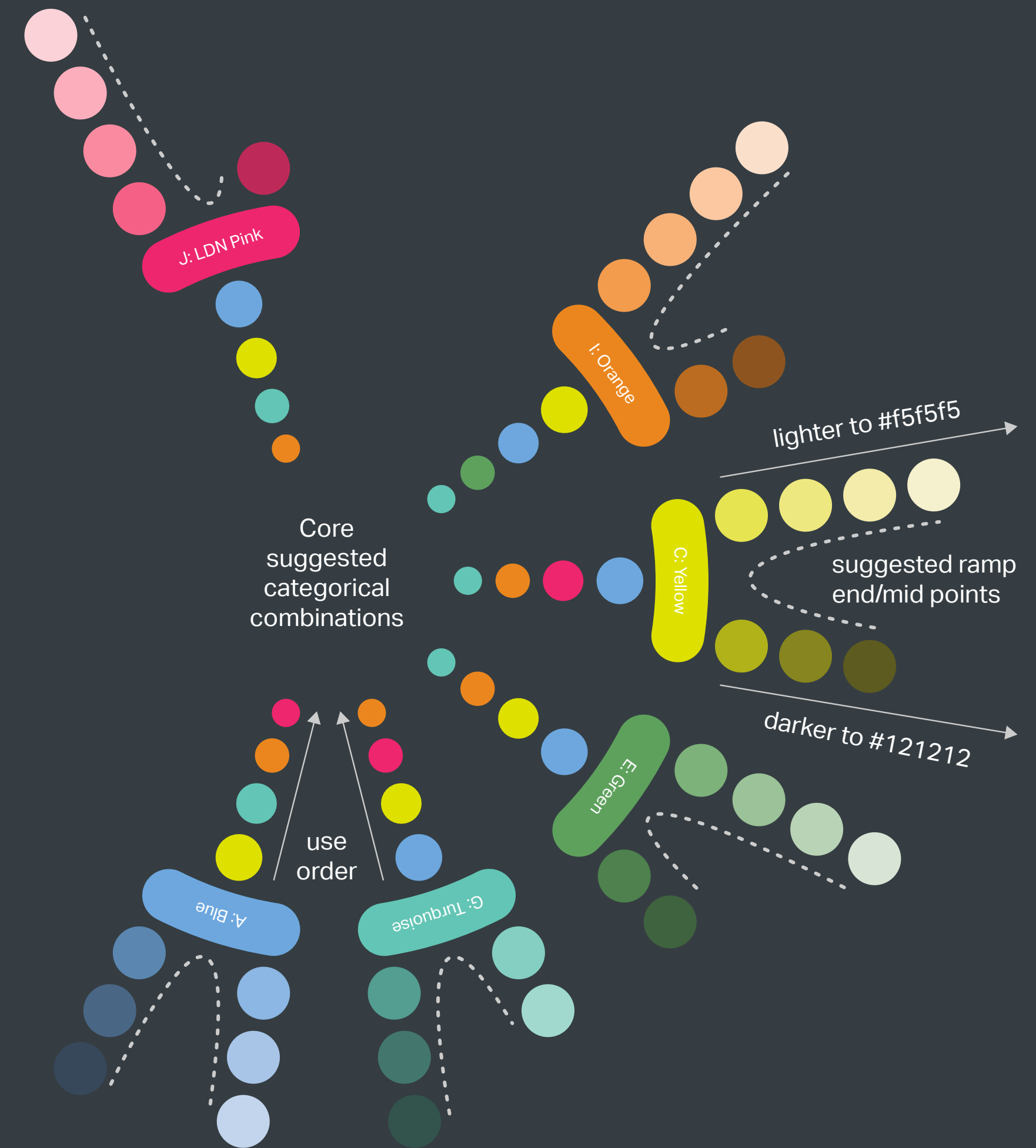
Core suggested categorical combinations

lighter to #f5f5f5

suggested ramp end/mid points

darker to #121212

use order

J: LDN Pink

I: Orange

C: Yellow

E: Green

A: Blue

G: Turquoise

CITY INTELLIGENCE

CHART DESIGN
DARKER CATEGORICAL COLOUR PALETTE

The core categorical colours (above) work well with the GLA brand mayoral & pink and used as key colours they are great. However, as a group they are quite bright and saturated, so here we have a set of less saturated, less contrasting, darker variations. As a consequence we have fewer categorical colours to use, but still enough for most projects.

Dark (lower contrast) categorical colours by default use order

- A: Blue: "#3681bf",   rgb(54,129,191);
- B: Magenta   "#89105d",   rgb(137,16,93);
- C: Yellow   "#d3c913",   rgb(211,201,19);
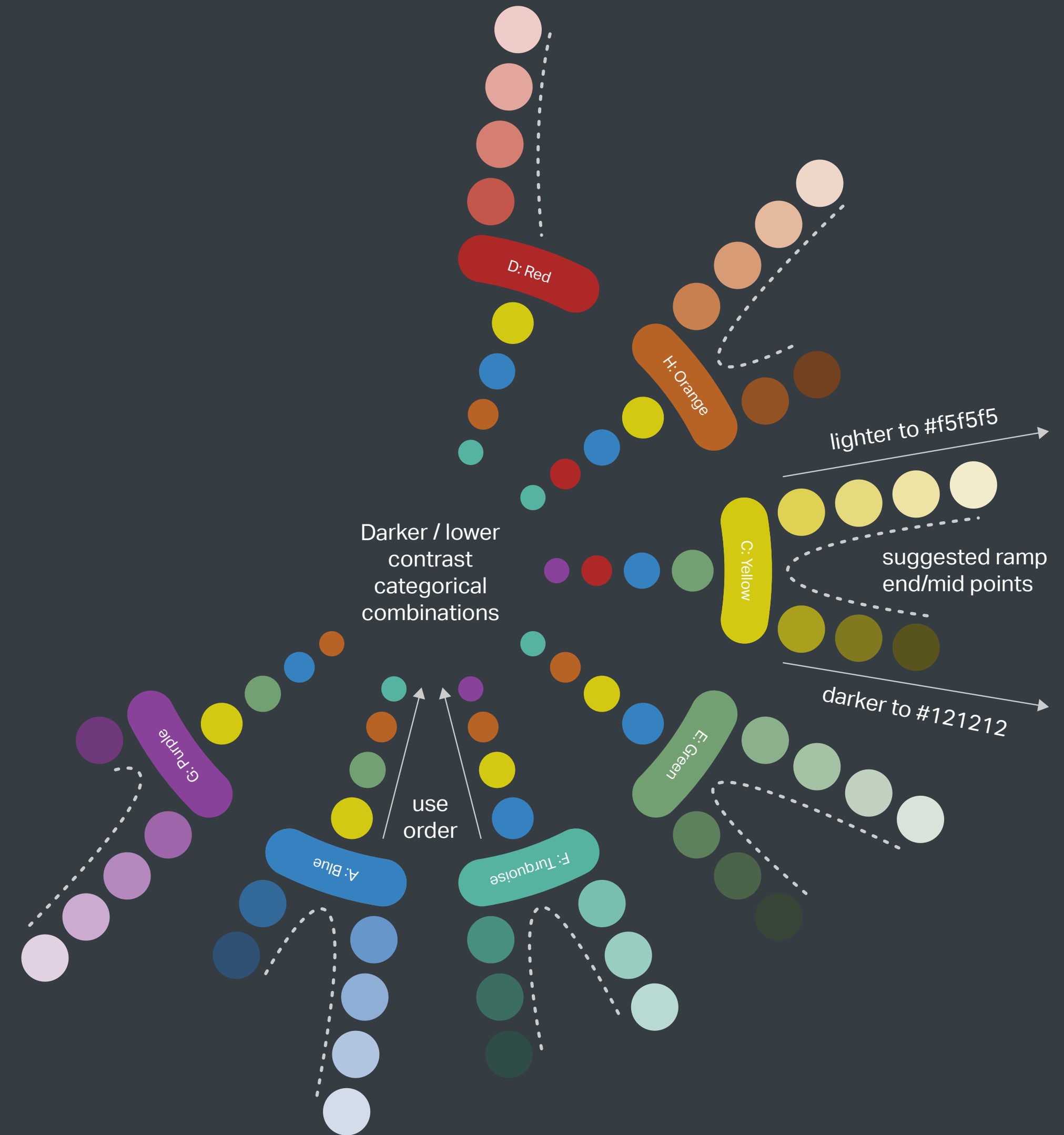- D: Red   "#af2828",   rgb(175,40,40);
- E: Green   "#73a072",   rgb(115,160,114);
- F: Turquoise "#56b2a1",   rgb(86,178,161);
- G: Purple   "#884299",   rgb(136,66,153);
- H: Orange   "#b76325"   rgb(183,99,37);

Example single hue categorical colour ramp end/mid points:
Visit https://gka.github.io/palettes/ to generate your own steps

- A: Blue: 1e2630, 3681bf, d3ddea
- B: Magenta   581a3e, 89105d, e2cad5
- C: Yellow   35321a, d3c913, f2eccc
- D: Red   4e201b, af2828, eecdc8
- E: Green   242c24, 73a072, dae3d9
- F: Turquoise 212e2c, 56b2a1, d7e8e3
- G: Purple   3f2644, 884299, e0d1e3
- H: Orange   312118, b76325, eed7c9
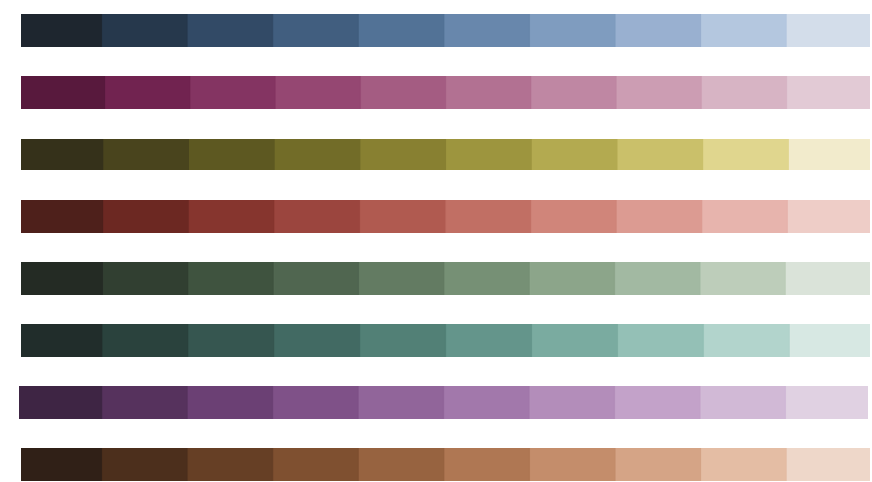
Darker, less contrasting categorical colour palette
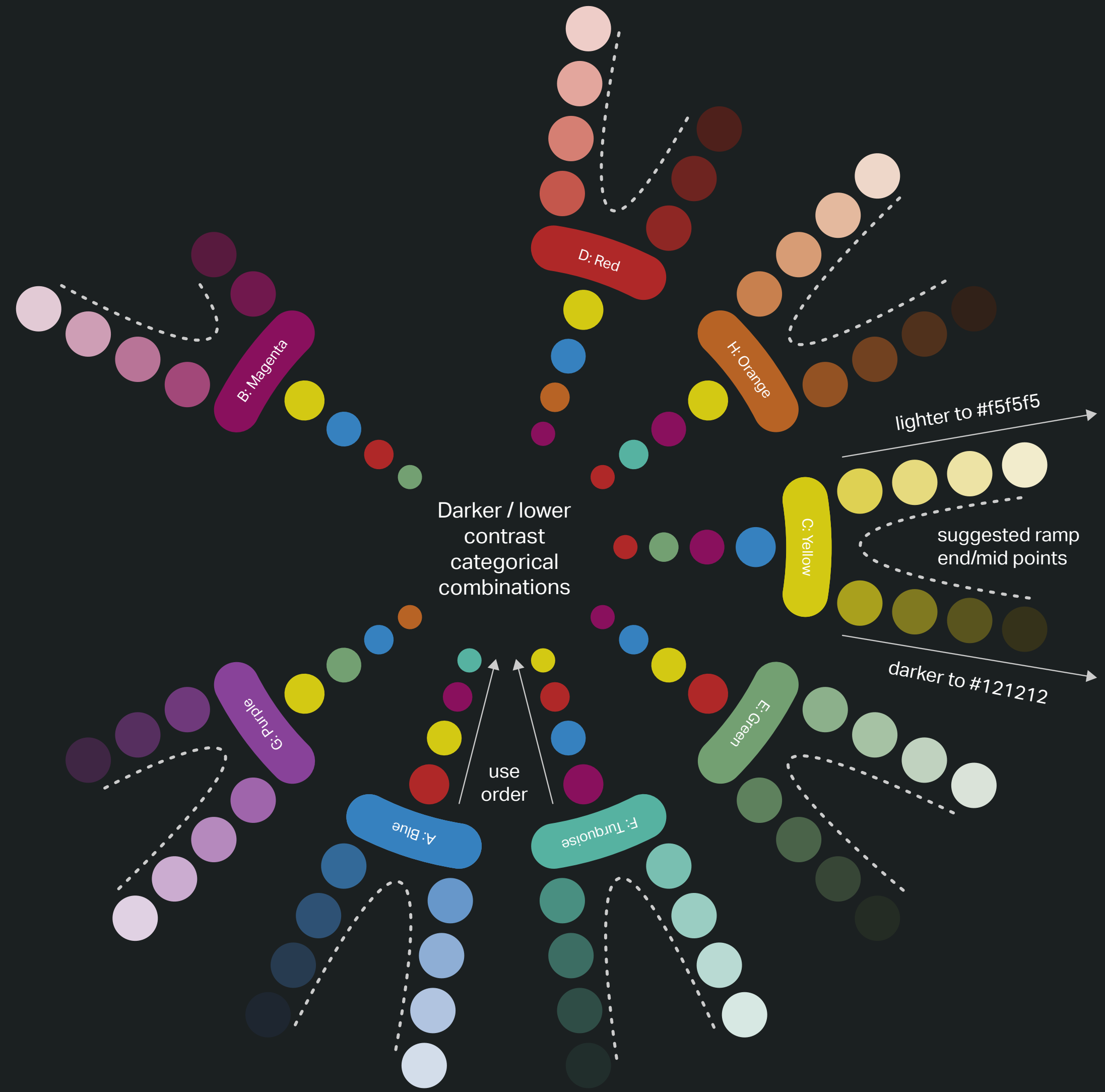
lighter to #f5f5f5

suggested ramp end/mid points

darker to #121212

Darker / lower contrast categorical combinations

use order

D: Red
H: Orange
B: Magenta
C: Yellow
G: Purple
E: Green
A: Blue
F: Turquoise

CITY INTELLIGENCE

CHART DESIGN
DARKER CATEGORICAL COLOUR PALETTE

For accessibility and clarity, you ideally wouldn't use this many colours, but here we show all 8 darker categorical colours together on a map. They work on both light and dark basemaps or application canvases. A couple of colour ramps for choropleths are also shown.
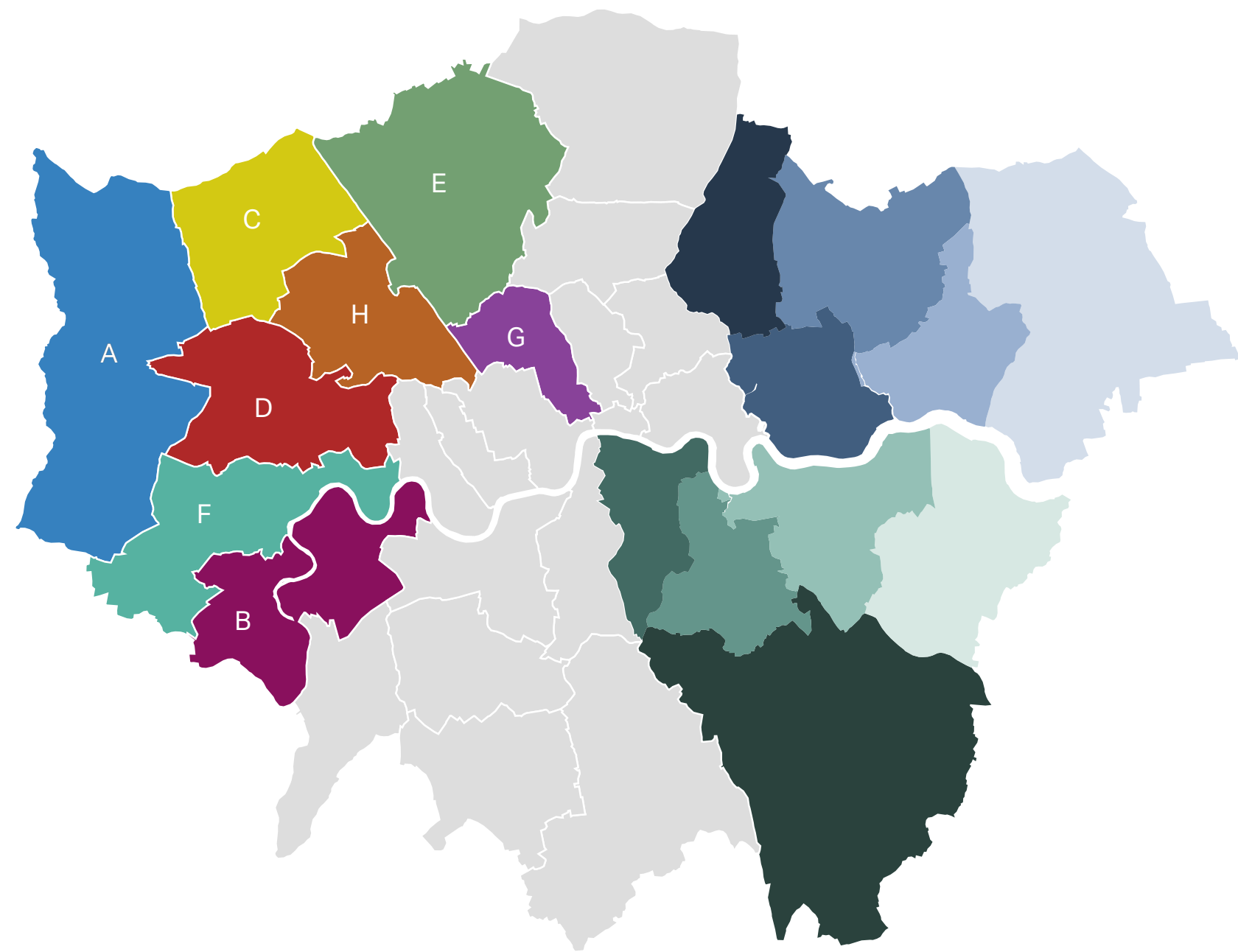
BG: White   "#ffffff",   rgb(255,255,255);
Map: Grey   "#dddddd"   rgb(204,204,204);

Darker categorical colour palette on a dark application background
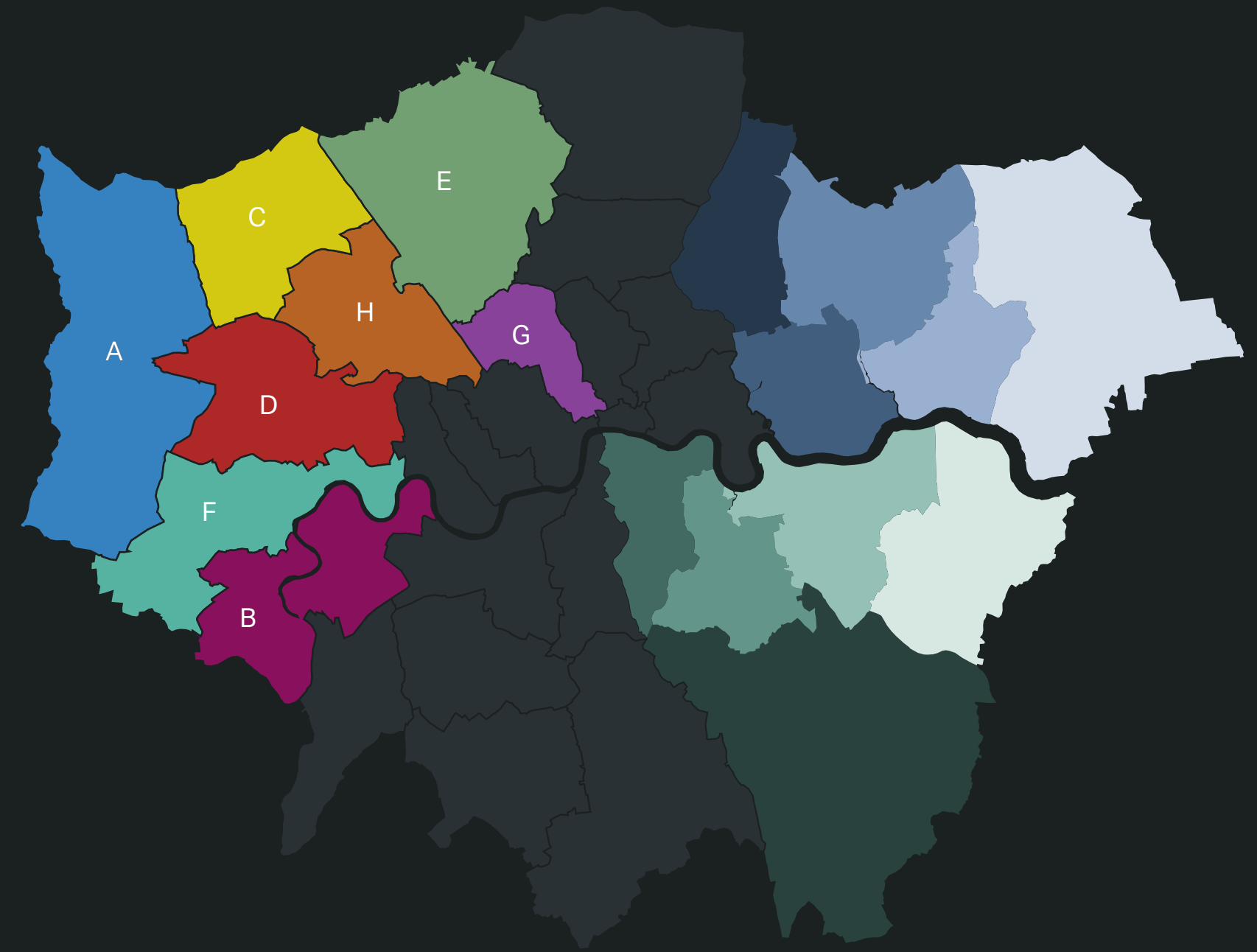
BG: Dark Panel   "#1b2021",   rgb(27,32,33);
Map: LDN Dark   "#2a3135"   rgb(42,49,53);

CITY INTELLIGENCE

CHART DESIGN
DARKER CATEGORICAL COLOUR PALETTE

Some colours don't contrast well with the "mid" LDN grey background, but with the darker/less contrasting set we can still use 7 colours.

Reduced dark (lower contrast) categorical colours by default use order

- A: Blue: "#3681bf",   rgb(54,129,191);
- C: Yellow   "#d3c913",   rgb(211,201,19);
- D: Red*   "#af2828",   rgb(175,40,40);
- E: Green   "#73a072",   rgb(115,160,114);
- F: Turquoise "#56b2a1",   rgb(86,178,161);
- G: Purple   "#884299",   rgb(136,66,153);
- H: Orange   "#b76325"   rgb(183,99,37);
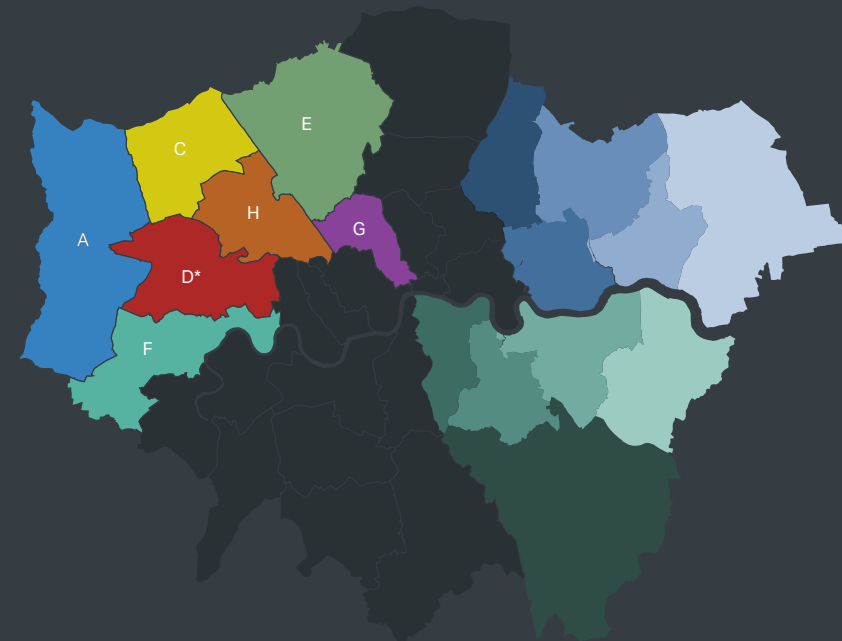
*Avoid red unless needed on this LDN BG

It looks odd if ramps start darker than this LDN grey BG. Here we have a some example ramps, starting from a lighter base, as shown in the colour wheel.
Visit https://gka.github.io/palettes/ to generate your own steps

- A: Blue: 2e5174, 3681bf, d3ddea
- C: Yellow   59541e, d3c913, f2eccc
- D: Red   af2828, eecdc8
- E: Green   374636, 73a072, dae3d9
- F: Turquoise 2f4d46, 56b2a1, b9dad3
- G: Purple   6f397b, 884299, e0d1e3
- H: Orange   714120, b76325, eed7c9

Darker / lower contrast categorical combinations

lighter to #f5f5f5

suggested ramp end/mid points

darker to #121212

use order

D: Red

H: Orange

C: Yellow

G: Purple

E: Green

A: Blue

F: Turquoise

CITY INTELLIGENCE

CHART DESIGN
LIGHTER CATEGORICAL COLOUR PALETTE

The core categorical colours (above) work well with the GLA brand mayoral & pink and used as key colours they are great. However, as a group they are quite bright and saturated, so as well as they darker, less saturated set, we have also created this reduced, lighter, less saturated, less contrasting palette of 7 colours.

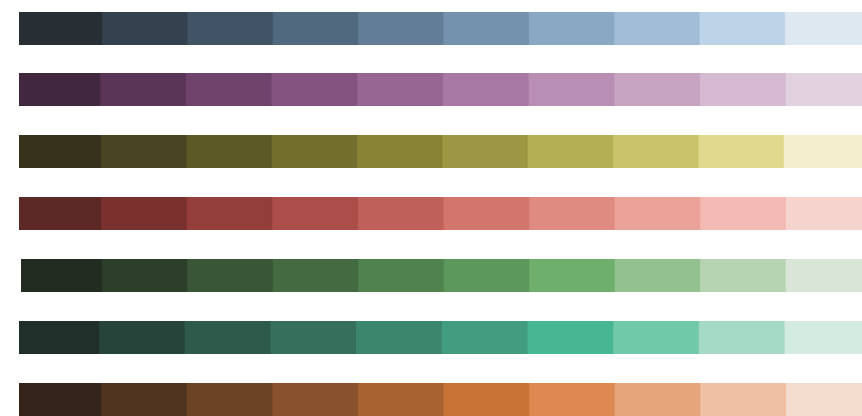### Light (lower contrast) Categorical colours by default use order

●	A: Blue	"#7ab5e5",	rgb(122,181,229);
●	B: Purple	"#964a92",	rgb(150,74,146);
●	C: Yellow	"#ddd82c",	rgb(221,216,44);
●	D: Red	"#d84545",	rgb(216,69,69);
●	E: Green	"#65aa63",	rgb(101,170,99);
●	F: Turquoise	"#49bf9a",	rgb(73,191,154);
●	G: Orange	"#d6793a"	rgb(214,121,58);

Example single hue categorical colour ramp end/mid points:
Visit https://gka.github.io/palettes/ to generate your own steps

●	A: Blue	272f36, 7ab5e5, dee8f2
●	B: Purple	432940, 964a92, e3d2e0
●	C: Yellow	36331c, ddd82c, f4efcf
●	D: Red	5d2926, d84545, f6d4cf
●	E: Green	222d21, 65aa63, d9e6d7
●	F: Turquoise	20302a, 49bf9a, d5ebe2
●	G: Orange	35251b, d6793a, f4dcce

Lighter / lower contrast categorical combinations
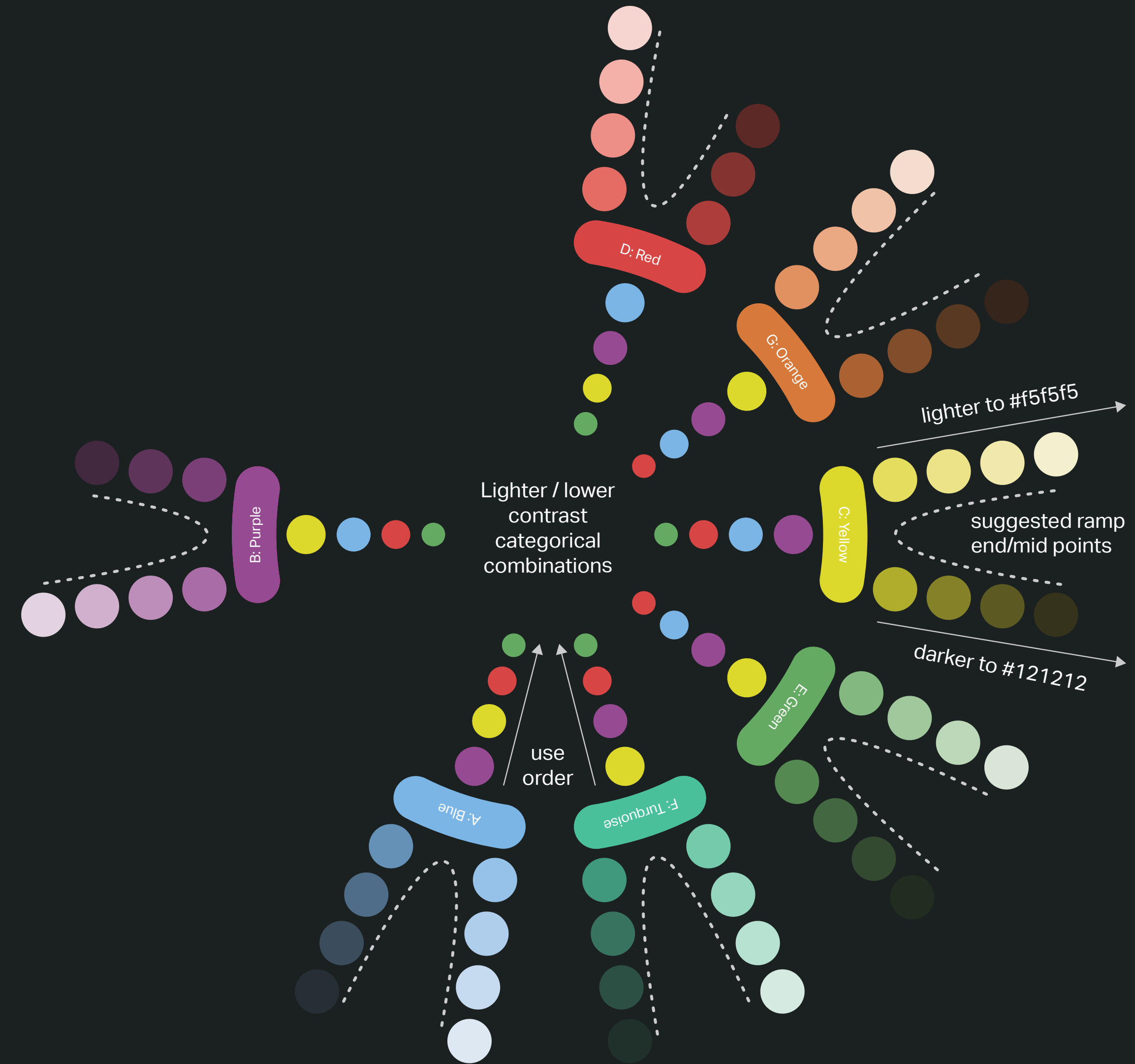
lighter to #f5f5f5

suggested ramp end/mid points

darker to #121212

use order

D: Red
G: Orange
B: Purple
C: Yellow
E: Green
A: Blue
F: Turquoise

CITY INTELLIGENCE

CHART DESIGN
LIGHTER CATEGORICAL COLOUR PALETTE

For accessibility and clarity, you ideally wouldn't use this many colours, but here we show all 7 lighter categorical colours together on a map. They work on both light and dark basemaps or application canvases. A couple of colour ramps for choropleths are also shown.
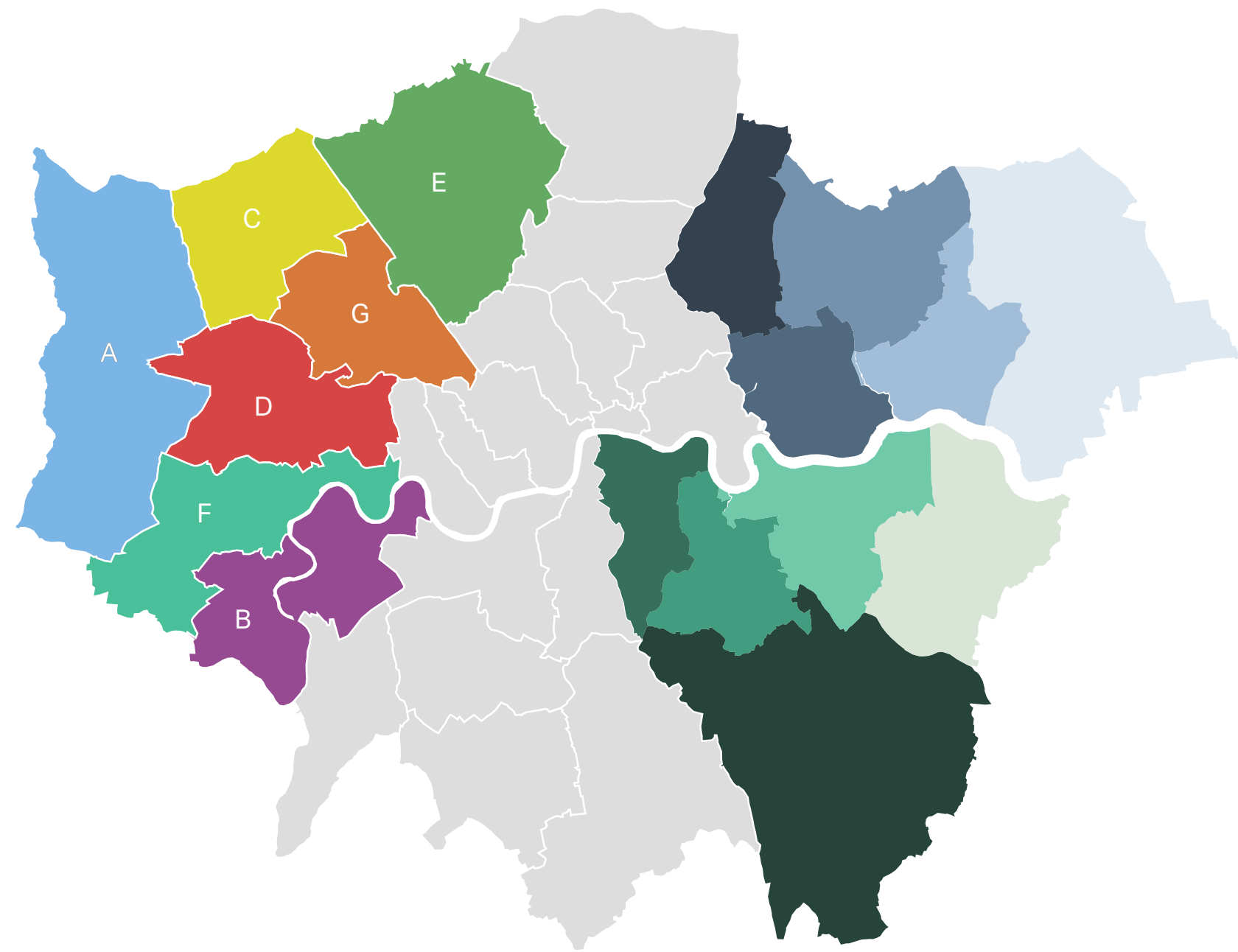
BG: White   "#ffffff",   rgb(255,255,255);
Map: Grey   "#dddddd"   rgb(204,204,204);

Lighter categorical colour palette on a dark application background
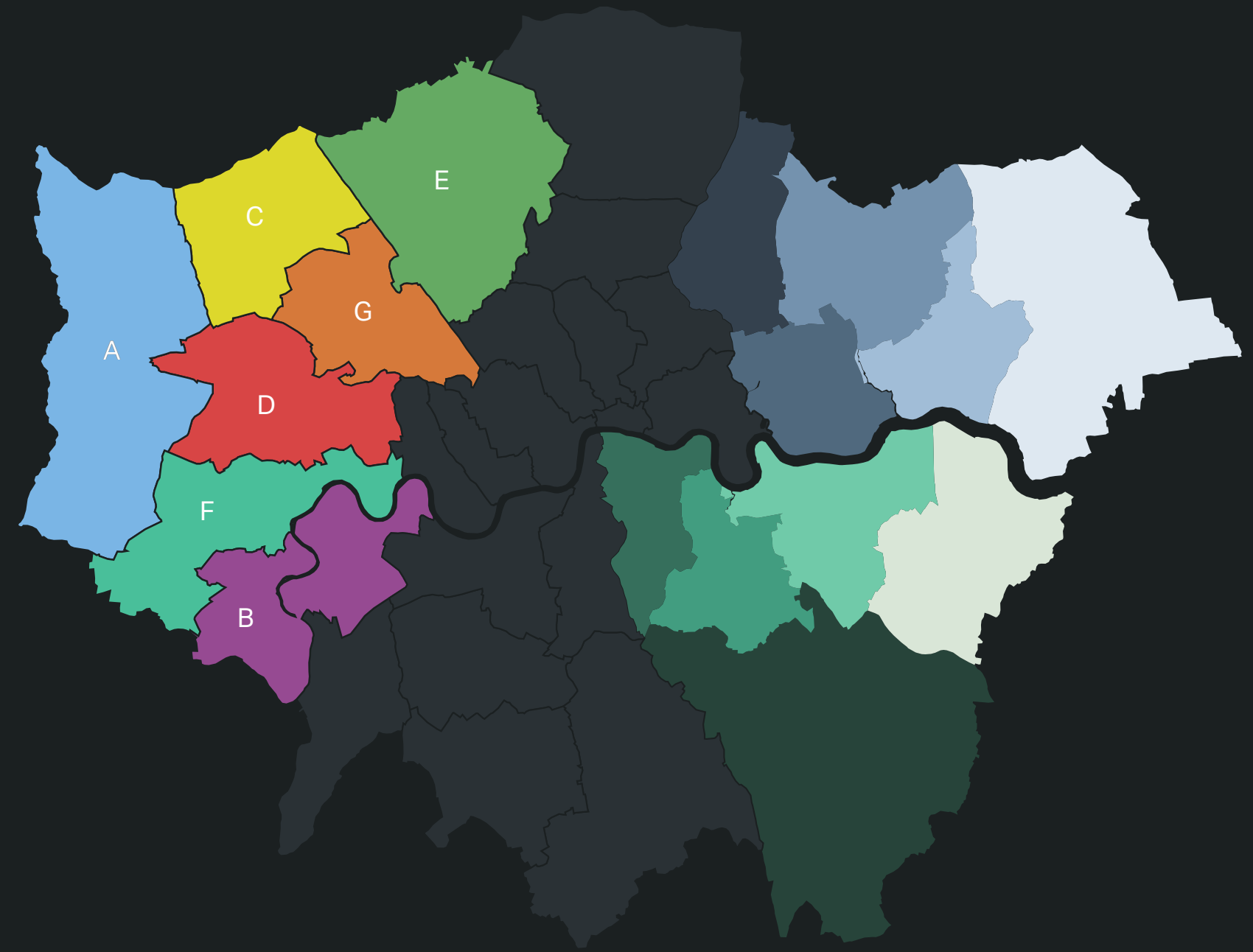
BG: Dark Panel   "#1b2021",   rgb(27,32,33);
Map: LDN Dark   "#2a3135"   rgb(42,49,53);

CITY INTELLIGENCE

CHART DESIGN
LIGHTER CATEGORICAL COLOUR PALETTE

All 7 of these lighter, less saturated, lower contrast colours work with LDN grey background.

Light (lower contrast) Categorical colours by default use order

- A: Blue   "#7ab5e5",   rgb(122,181,229);
- B: Purple   "#964a92",   rgb(150,74,146);
- C: Yellow   "#ddd82c",   rgb(221,216,44);
- D: Red   "#d84545",   rgb(216,69,69);
- E: Green   "#65aa63",   rgb(101,170,99);
- F: Turquoise "#49bf9a",   rgb(73,191,154);
- G: Orange   "#d6793a"   rgb(214,121,58);
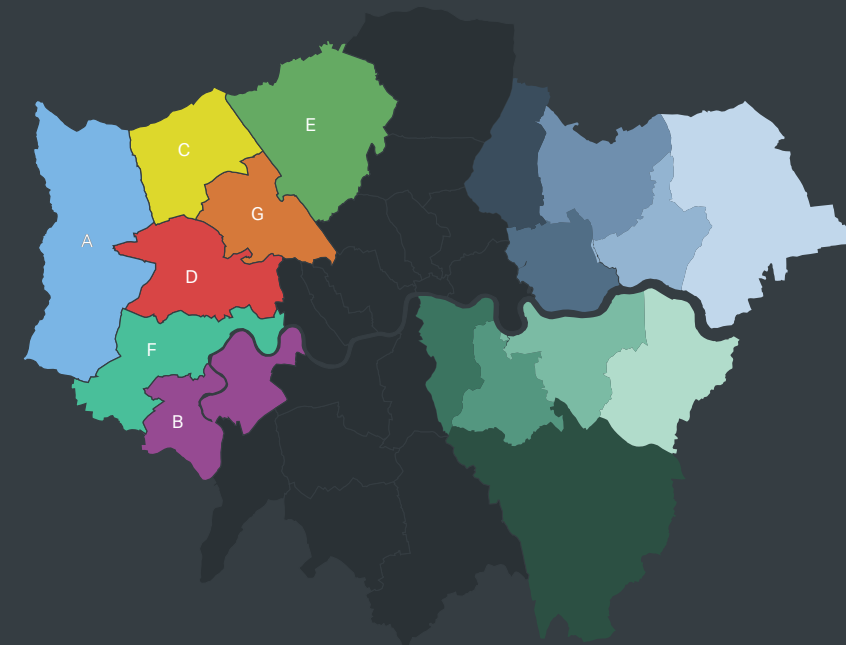
It looks odd if ramps start darker than this LDN grey BG. Here we have a some example ramps, starting from a lighter base, as shown in the colour wheel.
Visit https://gka.github.io/palettes/ to generate your own steps

- A: Blue   3b4d5d, 7ab5e5, dee8f2
- B: Purple   793f76, 964a92, e3d2e0
- C: Yellow   5c5923, ddd82c, f4efcf
- D: Red   ad3d3a, d84545, f6d4cf
- E: Green   334a31, 65aa63, d9e6d7
- F: Turquoise 2c5043, 49bf9a, d5ebe2
- G: Orange   824d2b, d6793a, f4dcce

lighter to #f5f5f5

suggested ramp end/mid points

darker to #121212

Lighter / lower contrast categorical combinations

use order

D: Red
G: Orange
C: Yellow
E: Green
B: Purple
A: Blue
F: Turquoise

CITY INTELLIGENCE
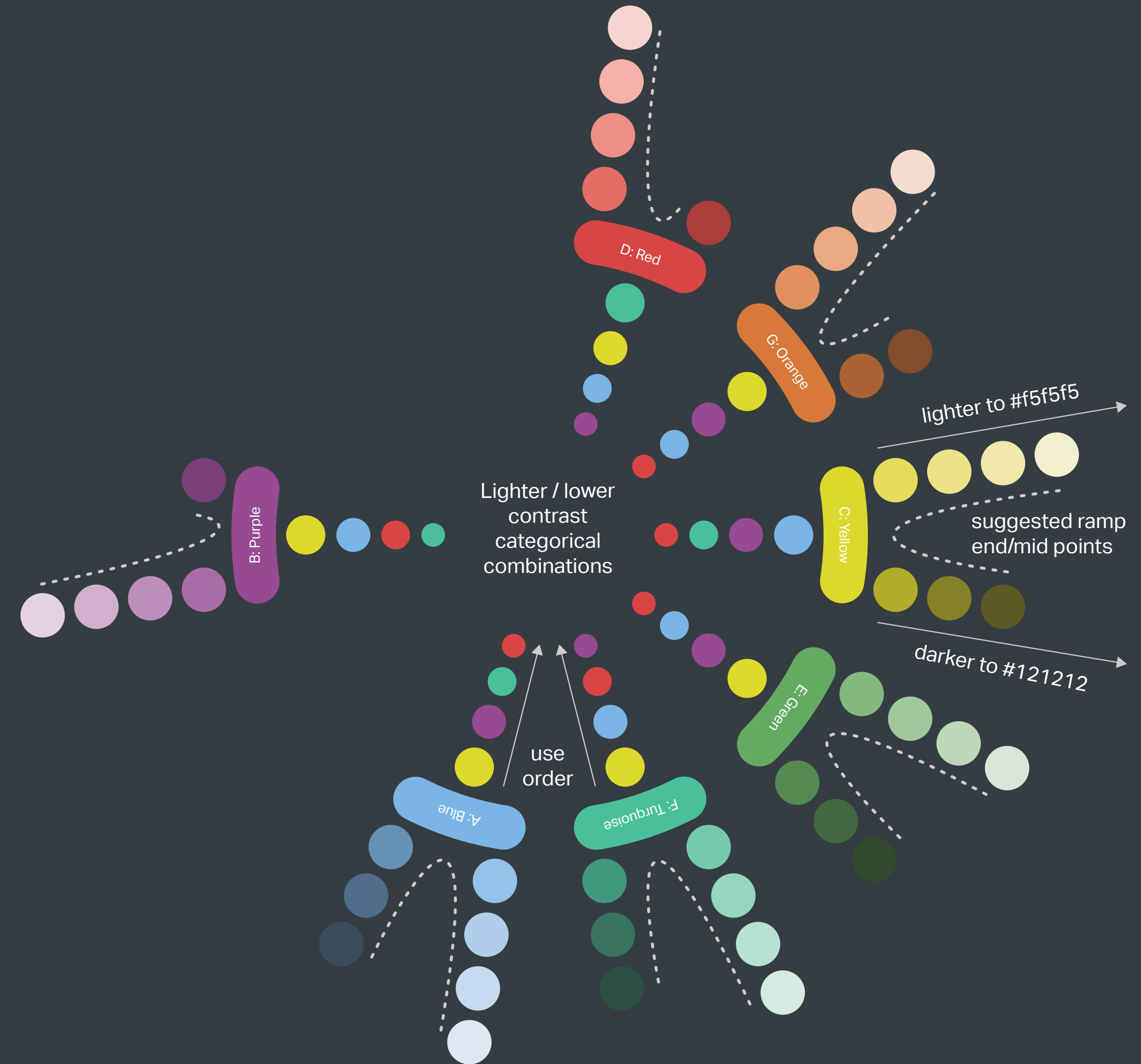
CHART DESIGN
FIND & TEST YOUR OWN COLOUR VARIATIONS

Our three colour palettes have been developed to work in various contexts, with the GLA/MOL brand & (if used sparingly) will be accessible to most people in most applications.

However, you will inevitably need a different colour or shade at some point. You could combine colours or shades from within these palettes, or pick your own.

Either way you will need to test that there is good visual separation between categorical colours to make them as clear and accessible to as many people as possible.

Here we'll show you some tools to help you do just that!

There are many different types of colour impairment that affect people's ability to differentiate colour, in lesser or greater amounts. Also, everyone struggles to differentiate visually similar colours on bad screens, in difficult environments, and if used on very fine lines or text.

Viz Palette

https://projects.susielu.com/viz-palette
This is a great tool that helps check and emulate a colour palette for different colour impairments.

Core Palette

Darker Palette

Lighter Palette

CITY INTELLIGENCE
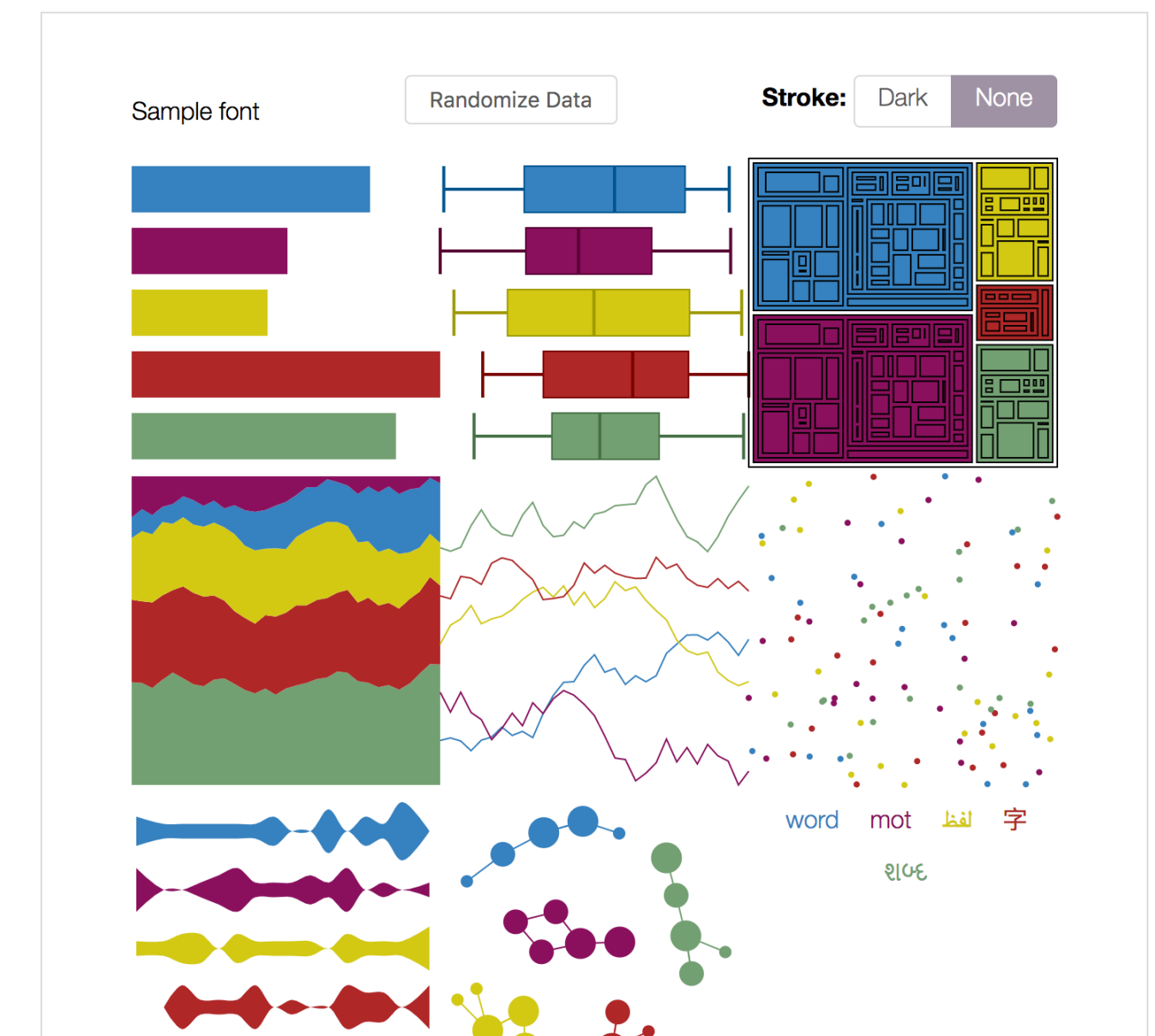
CHART DESIGN
FIND & TEST YOUR OWN COLOUR VARIATIONS

Viz Palette (continued)

Here you can see, tested under "Deuteranopia" colour deficiancy (affecting 0.56% of the population) our core colour palette has a few minor issues (thin connections), and one major issue (thick connection), when trying to combine ALL 10 colours together.

So, we should make sure that if we are using certain colours together, we should ensure our lines are not too fine, and (as mentioned above) avoid the LDN Pink with this green if possible.

COLOR REPORT

Arcs link colors difficult to tell apart as:

— Lines or small points
— Medium areas
▬ Large areas

● Minimize name conflicts for categorical palettes

|		Original
#ffd089	light orange	#dee000
#c99619	orange	#eb861e
#8a9fe0	light blue ●	#6da7de
#908ba7	light blue ●	#ff38ba
#46639a	blue	#943fa6
#c1aebb	light purple	#63c5b5
#ae8a64	tan	#5ea15d
#8d6915	brown	#d82222
#5a4e4f	grey ●	#9e0059
#937760	grey ●	#ee266d

Remember, we shouldn't rely on colour alone, particularly when using more than around 5 colours.

We can use other methods too, like labelling and interactivity, to help users navigate and decode the data.

Picking a new colour methodically

The "Viz Palette" tool makes use of another great library (under the hood) called chroma.js. Within the colour picker it allows use to move away from a particular colour in steps of "lightness/darkness" and "saturation" that are reasonably perceivable.
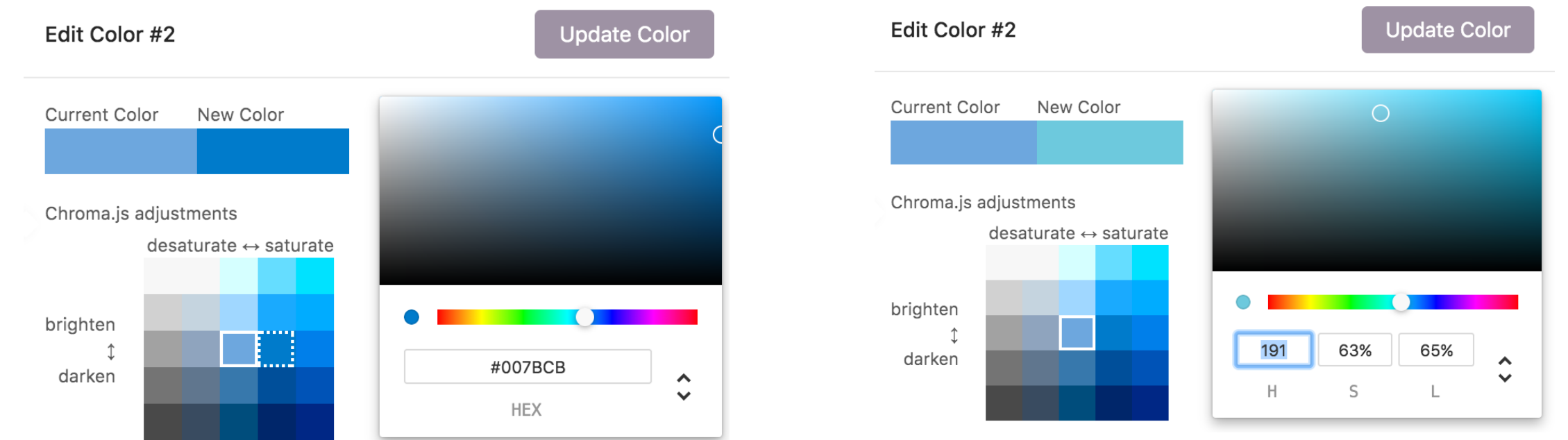
You can also use the HSL controls to shift around the Hue spectrum and make finer adjustments to your Saturation and Lightness.
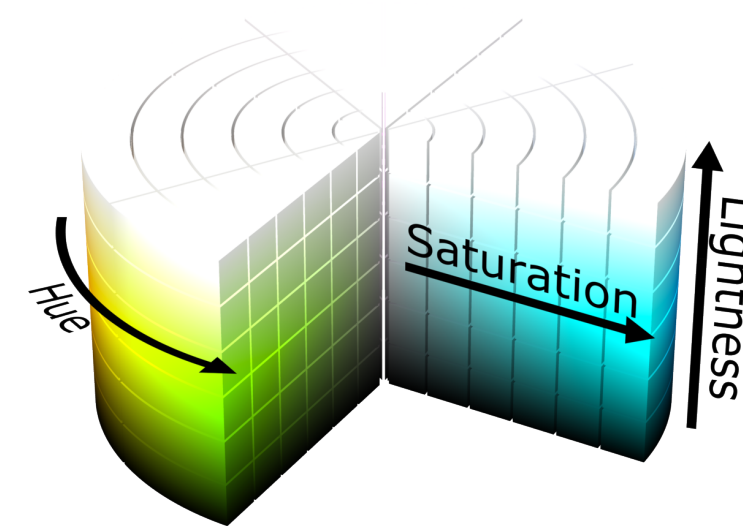
It's useful to imagine the HSL colour model as a cylinder. Move around the perimeter for different Hues on the colour spectrum, away from the center for saturation (amount of colour) and vertically for lightness.

Image credit:
https://commons.wikimedia.org/wiki/File:HSL_color_solid_cylinder_saturation_gray.png

CHART DESIGN
CREATE YOUR OWN COLOUR SCALES

A bit of background on colour scales

Creating Single Hue colour scales (one hue, moving from lighter to darker) is fairly simple (though errors can occur), but creating multi-hued scales (moving from one hue to another) can create real problems, because not all colours across the specturm are perceived equally.

Looking at this rainbow scale, we can see there are brighter and darker areas, and places where the colour seems to change faster than others. This it makes it hard to read and perceive value correctly.

Rainbow:

This issue has been addressed recently and researchers have developed a more perceptually uniform set of scales known as the Viridis Scales:

Viridis:

Magma:

Plasma:

Inferno:

Cividis:

More Info: https://cran.r-project.org/web/packages/viridis/vignettes/intro-to-viridis.html

Chroma.js Colour Scale Helper

https://gka.github.io/palettes/

You will inevitably need to create your own colour scales at some point for a choropleth map or some continuous data. This tool (developed by Gregor Aisch, and also built into Datawrapper.de) can help you create single and multi-hued, sequential and diverging scales are that are perceptually correct.

It helps adjust a scale's brightness, avoids colour kinks that occur when you interpolate across the spectrum and let's choose your step count.
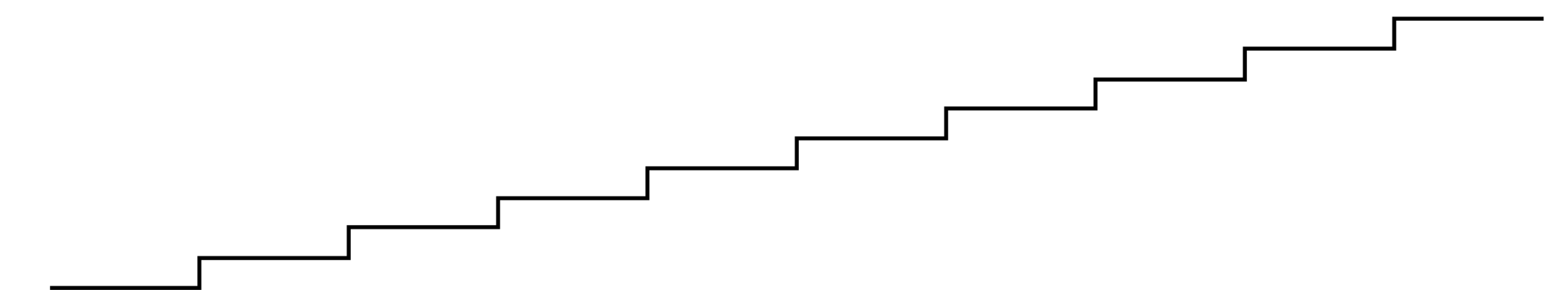
Chroma.js Color Scale Helper

sequential / diverging

This chroma.js-powered tool is here to help us mastering multi-hued, multi-stops color scales.

Enter named colors or hex codes:

`4e201b, af2828, eecdc8`

Step count

`10`

☑ Bezier interpolation   ☑ Correct lightness gradient
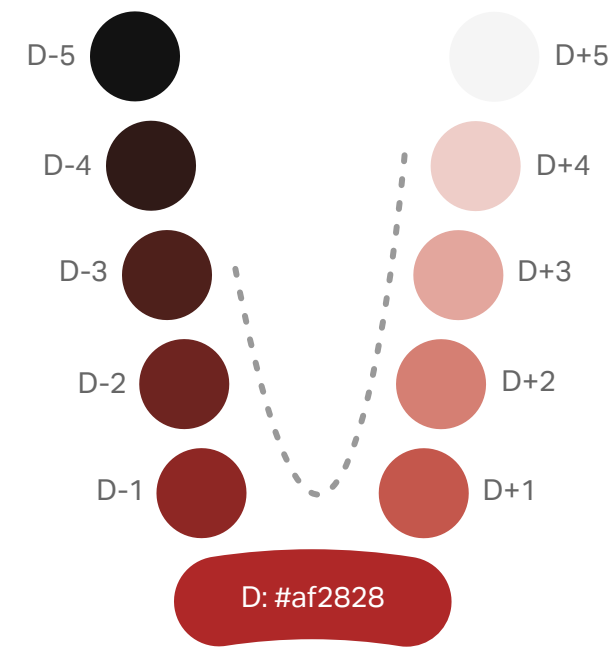
CHART DESIGN

CREATE YOUR OWN COLOUR SCALES

Chroma.js colour scales (continued)

In our colour wheels you can see we have the core categorical colours, but also suggestions of darker and lighter shades from which you can start and end your colour scales.

We found the dark and light shades, by generating an 11 step diverging scale from the core colour out to dark (#121212) and light grey (#f5f5f5).
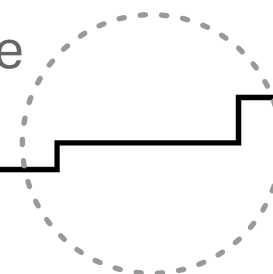

You can see in the diverging scale there is a slight perceptual kink in the center where they converge on our core colour.
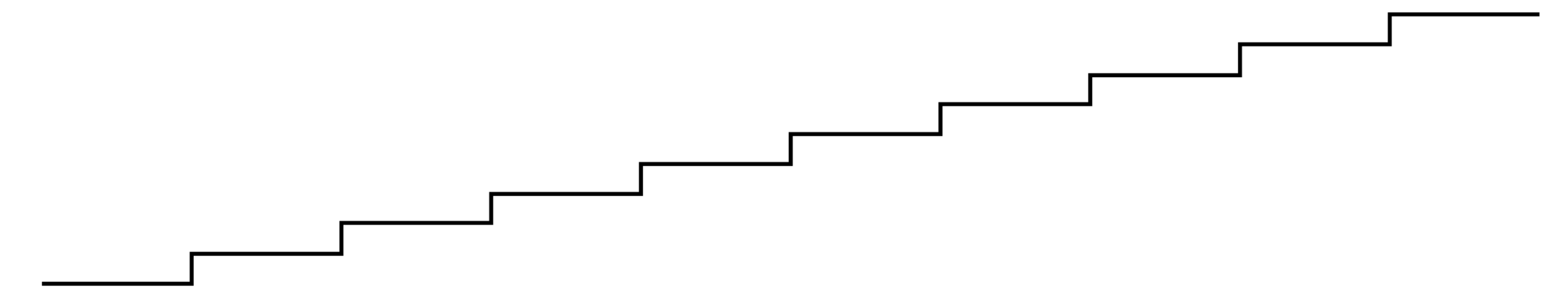
Also the dark step at D-4 is (we judge) probably a bit too dark to be useful, so we want to run our scale from D-3, smoothly through our core red, and then too D+4, the lightest shade.

Remember, on screen, the dark shades will be harder to see on a white background so think about the context your colours will be seen in.

Finally we switch back to the "sequential" mode, and generate a nice smooth scale from D-3, bending toward our core red, and out to D+4.

Note: the kink in the scale

CHART DESIGN
DIVERGING COLOUR SCALES

Diverging scales with Chroma.js

https://gka.github.io/palettes/#diverging

Chroma.js tool can also help you generate diverging scales. Here we have created a few for you as a starting point, but you can of course adjust them to your required number of steps and endpoints.
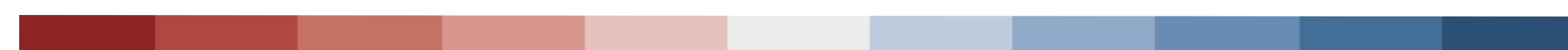
left	right	steps
2e5174,3681bf,eeeeee	eeeeee,73a072,4a6349	11
☑ bezier interpol. ☑ lightness correction	☑ bezier interpol. ☑ lightness correction	

For data on light backgrounds and maps
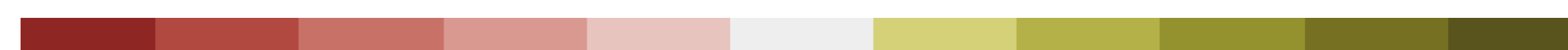
Blue - Green: Left: 2e5174,3681bf,eeeeee   Right: eeeeee,73a072,4a6349
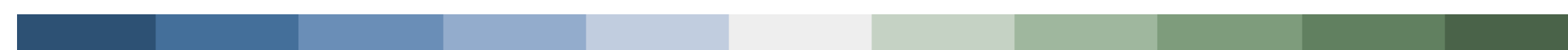
Red - Blue: Left: 8e2724,af2828,eeeeee   Right: eeeeee,3681bf,2e5174

Red - Yellow: Left: 8e2724,af2828,eeeeee   Right: eeeeee, dee000, 59541e

Red - Green*: Left: 8e2724,af2828,eeeeee   Right: eeeeee, 73a072, 4a6349
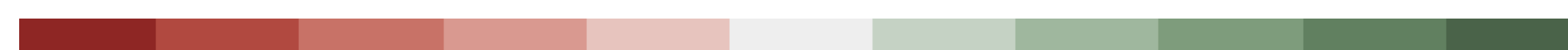
*With caution

For data on dark backgrounds and maps

Blue - Green: Left: 8eaed5,3681bf, 333333   Right: 333333, 73a072, 8cb08b
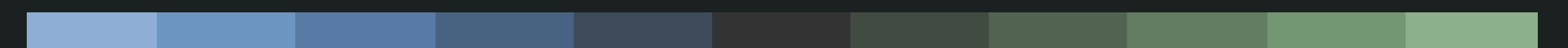
Red - Blue: Left: d57f73,af2828, 333333   Right: 333333,3681bf,8eaed5

Red - Yellow: Left: d57f73,af2828, 333333   Right: 333333, d3c913, ded153

Red - Green*: Left: d57f73,af2828,333333   Right: 333333, 73a072, 8cb08b

*With caution

Hex to rgb() - Colour code conversion tool

https://bjoernkw.github.io/hexrgb/

Once you have worked with these tools, you will end up with strings of Hex values, but you can convert them to RGB here if you need to.

Introducing gglaplot for R

https://github.com/Greater-London-Authority/gglaplot

In an effort to make the layout, styling and colour palettes we have introduced in this styleguide easier to access, we have started the development of a new R package called "gglaplot". As you can guess it's a branch of the popular ggplot.

gglaplot

CITY INTELLIGENCE

CHART DESIGN
OTHER COLOUR CONSIDERATIONS

Colour in your presentation context

We also need to consider the context in which our graphics are going to be displayed. Think about who is viewing your graphic and how?

- Will it be printed to make notes on in a meeting?
- Will you be presenting in a brightly lit room with a poor projector?
- Not all monitors are equal… lighter greys and washed out colours can be hard to see on some monitors.
- Will the audience need to be able understand the colour quickly and without labelling?
- Think about accessibility and use distinct colours. Larger blocks of colour can also help those with colour blindness perceive the colour better.

What to consider if printing (if you have to print)

- Use white / light backgrounds to reduce ink and improve readability.
- Pink looks great on screen, but can print quite red. This may communicate the wrong meaning, and be confused with other reds.

Projectors

Just like monitors, some projectors are better than others. Some meeting rooms are brighter than others too. Check that your projector is using the correct colour mode, and not changing your colours, but also think about your data colours.

- Bright rooms make light colours hard to see
- Increasing contrast in your presentation will help
- The neon pink can sometimes appear indistinct on thin lines if used on a darker background.

Subject & cultural considerations

The core colour palettes are a suggested first place to look for your colours, but of course sometimes they won't be appropriate.

If you are presenting data of a sensitive nature, then a bright, saturated colour palette may well not be appropriate. Perhaps think about using the darker less saturated palette (above).

CITY INTELLIGENCE

CHART DESIGN
EXAMPLES

Some real world examples

We have been working with, and evolving this system over a few different projects. Here you'll find a few examples of common charts, Illustrating where we have stuck to the system, and some places where we have deviated from it, hopefully to increase clarity.

Standard line chart
Key features of this chart:

- Y-Axis starts at 0, and is clearly indicated by use of a stronger baseline that stands out from the background gridlines.
- Only enough gridlines to show range and groups of values
- Data is highlighted using a thematic colour and by marking and labelling key dates & values.
- A legend is no longer needed as data is labelled directly.
- Projections differentiated through line style and a highlighted future date range.

London's population is bigger than ever and still growing
With approximately 8.9m residents, London's population is bigger than ever, and is set to grow to approximately 10.5m inhabitants by 2041.

Projected
2050: 10.9m

Projected
2041: 10.5m

New Peak
2018: 8.9m

Previous Peak
1939: 8.6m

12m

10m

8m

6m

4m

2m

0

1801   1939   2018   2041

Source: London Measured Report (Sep 2018)

CITY INTELLIGENCE
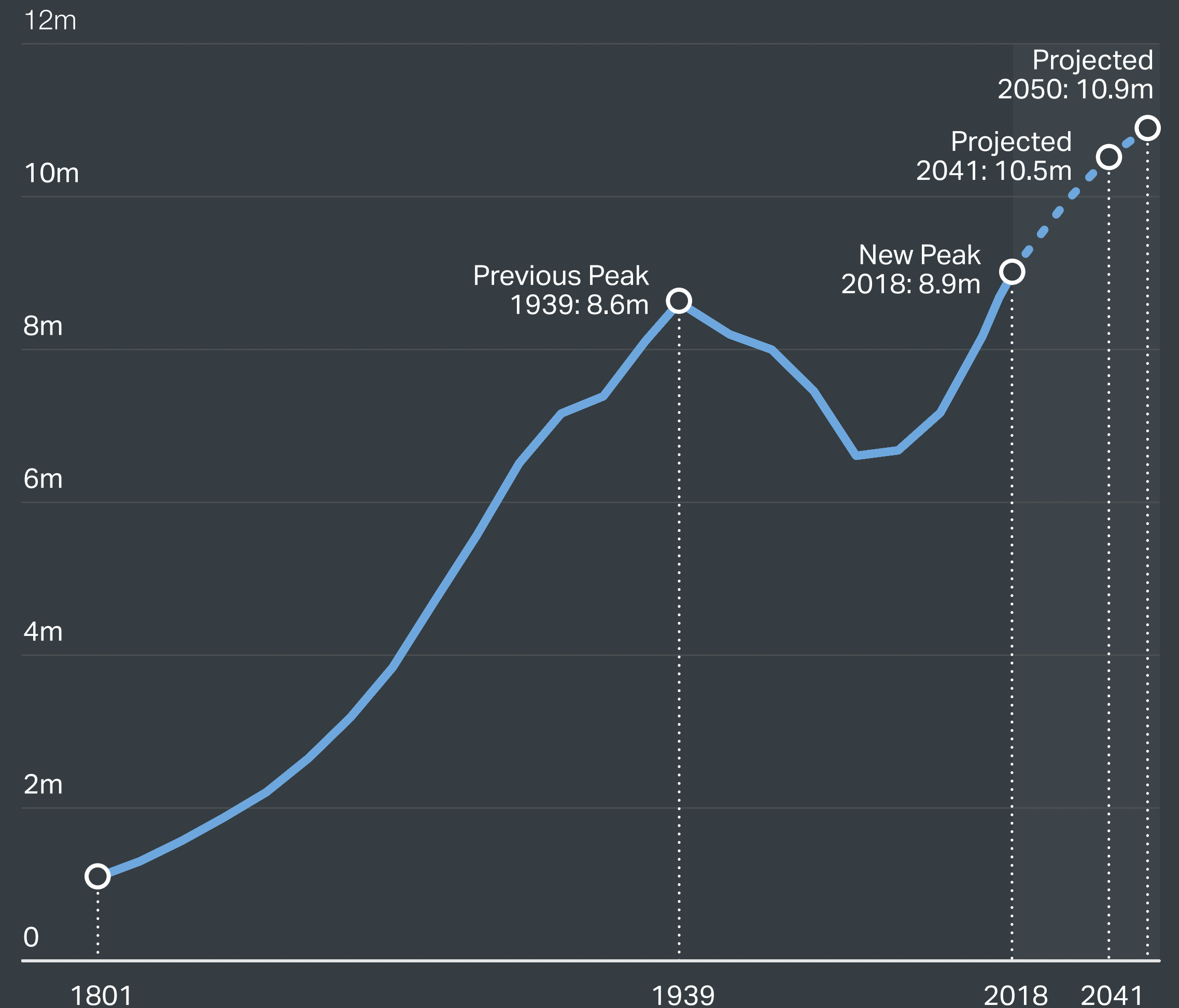
CHART DESIGN
EXAMPLES

Standard line chart variations

Key features of this chart:

- To focus on the detail of the data, we have NOT started the Y-Axis at zero. To highlight this, we have removed the strong baseline. We have also shown the vertical gridlines extending beyond the horizontal grid, to imply that the range continues beyond our current view.
- London data highlighted by use of thematic colour and UK shown in white for context.
- The labelling is tricky to place so we have connected the labels to the data with dotted lines. Labels are using large 20pt & smaller 16pt text.
- As the data is quite granular and detailed, we must reduce the default line weight to 2pt, so as not to obscure any detail.
- We needed to include months as well as years on the X-Axis, which meant reducing the default axis text from 20pt to 16pt.

London's employment rate stands near to a record high
Working age (16-64) employment rate % 1992-2018 seasonally adjusted

UK
Mar - May 2018:
75.7%

London
Mar - May 2018:
74.7%

London
Jun - Aug 1999:
70.7%

London
Apr - Jun 2008:
70.5%

Source: London Measured Report (Sep 2018)

CITY INTELLIGENCE
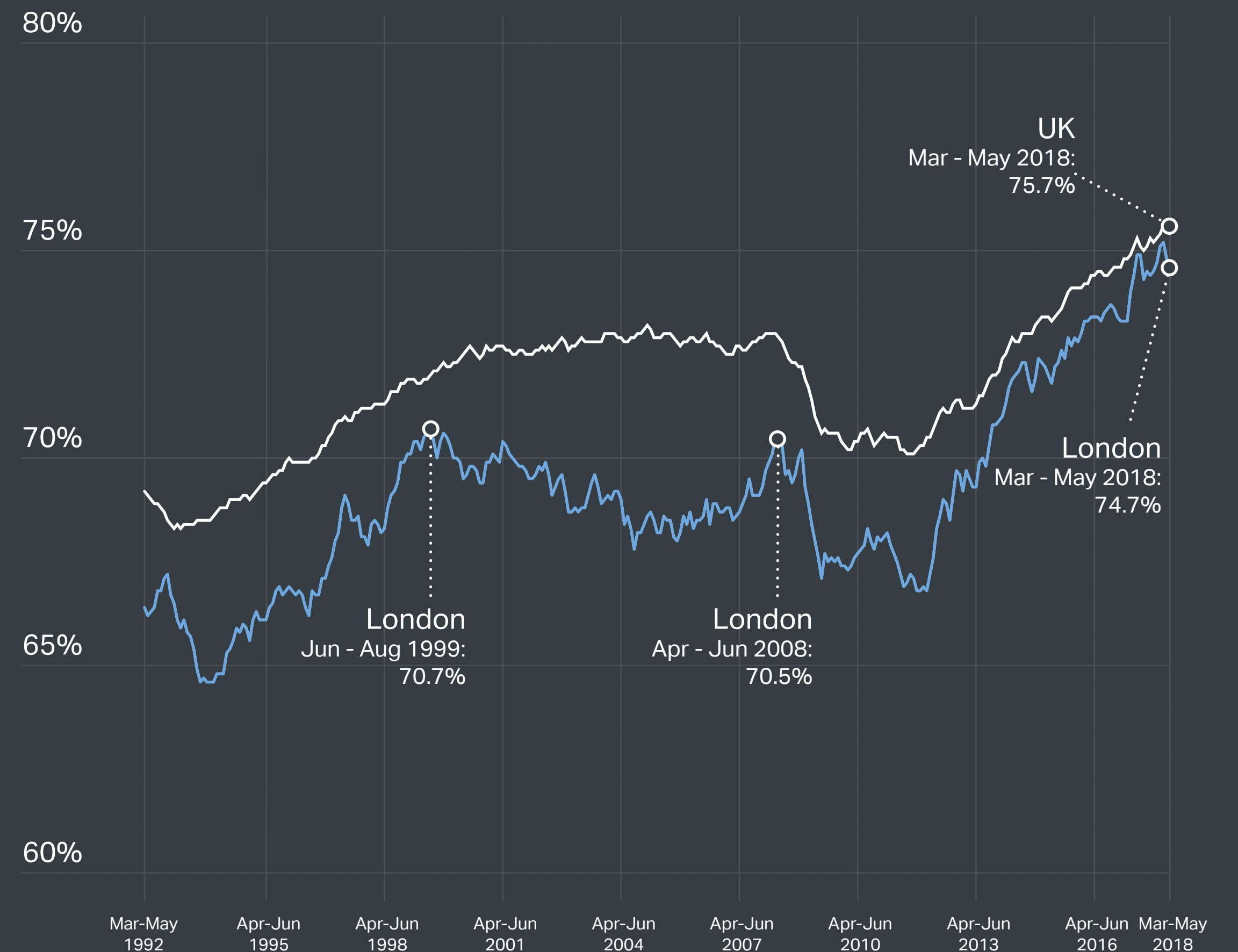
CHART DESIGN
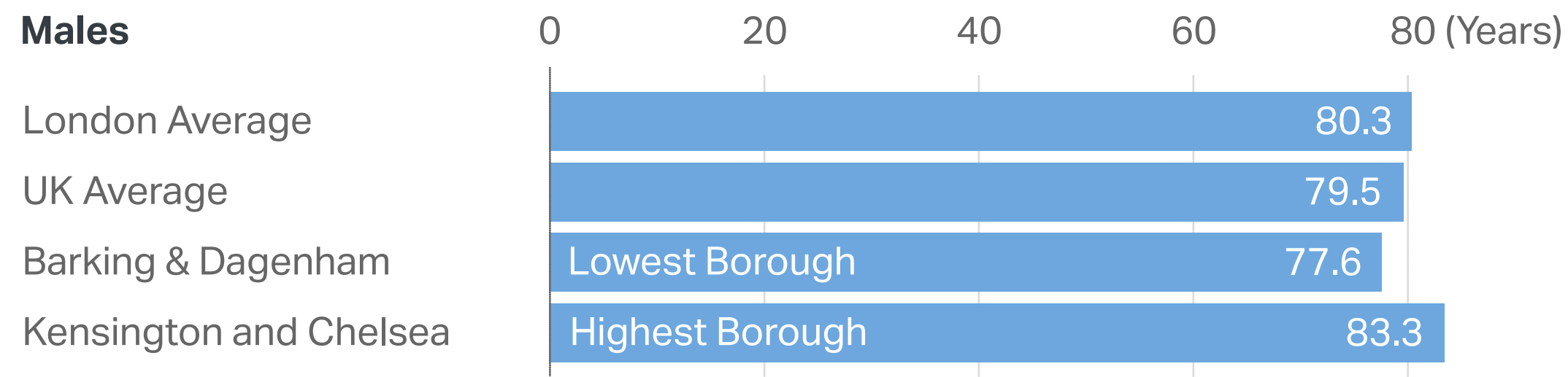## EXAMPLES

Bar / column chart

Key features of this chart:

- Always start bar Y-Axis at zero, and indicate with a strong baseline.
- Show just enough gridlines to frame the data.
- Colour bars to visually group and easily focus on key vs context data
- Group through labelling rather than many colour variations.
- Label bars with value directly if possible (right: using small 16pt text)

Life expectancy in London is higher than the UK, but is inconsistent across Boroughs
Life expectancy at birth (Males only shown here)

Males	Value
London Average	80.3
UK Average	79.5
Barking & Dagenham (Lowest Borough)	77.6
Kensington and Chelsea (Highest Borough)	83.3

Source: London Measured Report (Sept 2018)

London is more highly qualified than the rest of the UK
Qualification level of 25-64 year olds in London and rest of UK, 2017

■ London □ Rest of UK

Qualification	London	Rest of UK
NVQ4+ (High)	56%	40%
NVQ3 (Mid)	11%	15%
Trade (Mid)	1%	4%
NVQ2 (Low)	8%	15%
NVQ1 (Low)	7%	11%
Other (Low)	10%	7%
None (Low)	7%	8%

Source: London Measured Report (Sep 2018)

CITY INTELLIGENCE
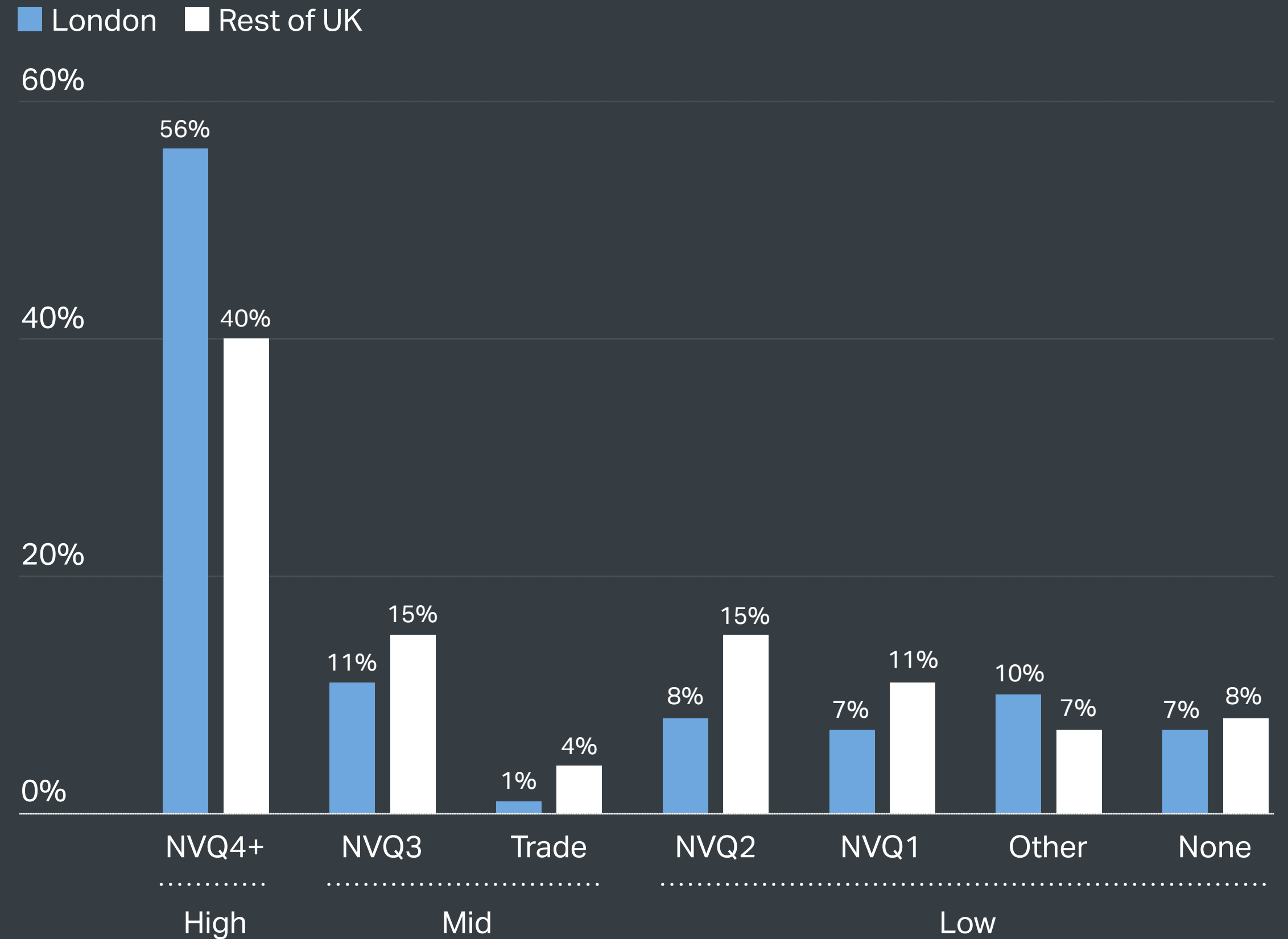
CHART DESIGN
EXAMPLES

Stacked bars (for cumulative total)

Key features of this chart:

• Good for comparing grand total score or count.
• Good for showing categorical breakdown of total, however comparing categories can be tricky as baseline shifts. So, essential to label each segment with a value directly. Consider using split bars instead.

London pupils do better than those across England as a whole, on each element of the Attainment 8
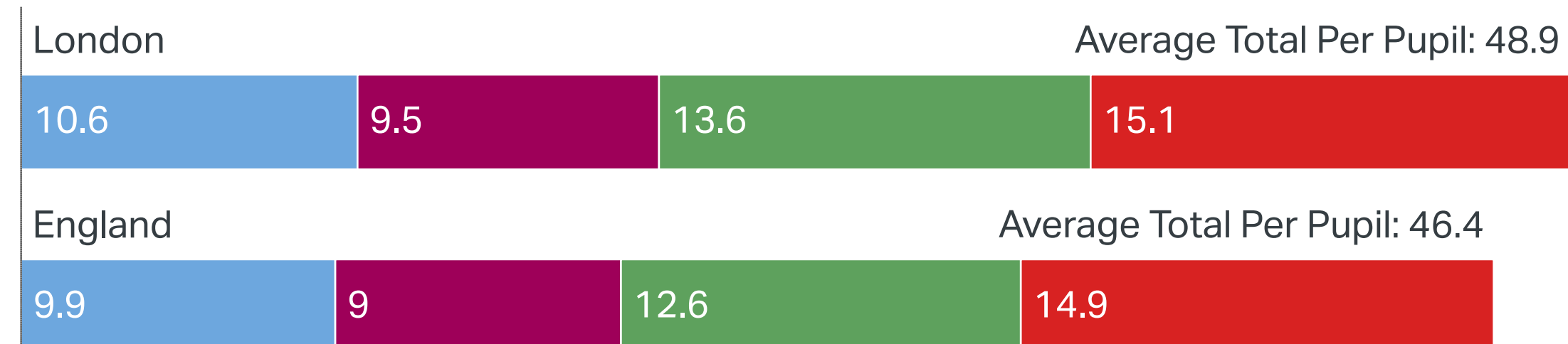
Average score per pupil in each Attainment 8 element - 2016/17

■ English ■ Mathematics ■ English Baccalaureate ■ Open

London   Average Total Per Pupil: 48.9

| 10.6 | 9.5 | 13.6 | 15.1 |

England   Average Total Per Pupil: 46.4

| 9.9 | 9 | 12.6 | 14.9 |

Source: Department for Education / data.london.gov.uk/economic-fairness/

Stacked bars (for proportions of total)
Key features of this chart:

• All variables sum to 100% to show proportion of total.
• Single colour and labelling in place to highlight narrative in text.

London is renowned for its diversity
40% of London perceived themselves as Black, Asian or Minority Ethnic.

	White	Asian	Black	Mixed /Other
London	60%	18%	12%	10%
UK	87%	7%		

Source: London Measured Report (Sep 2018)

• If showing a single variable, lightly shade the background to 100%

London vs UK Employment Rate

	Employed
London	74.7%
UK	75.7%

Source: London Measured Report (Sep 2018)

CITY INTELLIGENCE
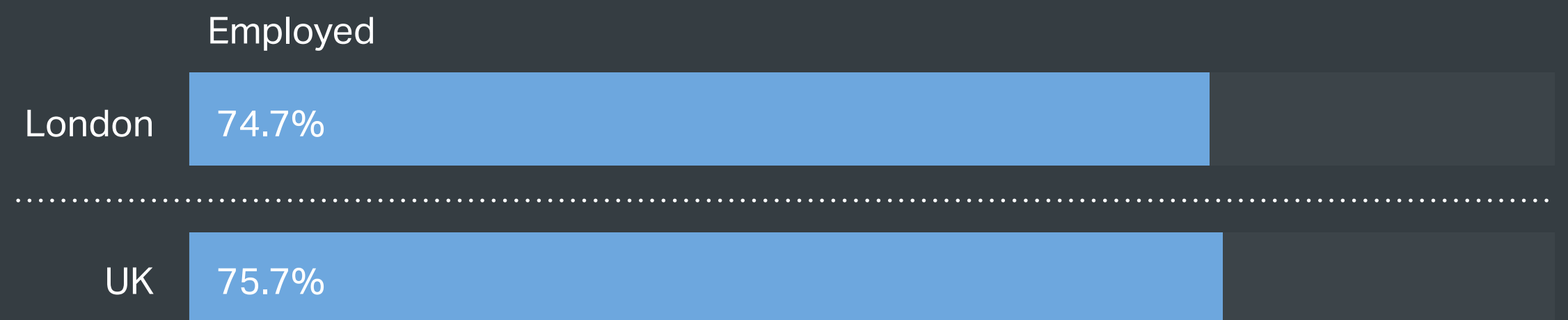
CHART DESIGN
EXAMPLES

Donut charts (for proportions of the total)

Because, donuts are nicer than pies... But beware, as with real donuts, inappropriate use can be bad for your health, but sometimes you need a change from stacked bar charts.

Key features of this chart:

• Showing proportion of parts within whole.
• Visual variation from stacked bars, but not as good for comparison.
• Use as few variables as possible (ideally 2, but no more than 3 or 4).
• Indicate what the entire donut represents.
• Label segments directly.
• Proportion of ring to hole, is important...not too skinny or too thick.

Pies aren't as elegant as donuts

Too skinny

Too thick
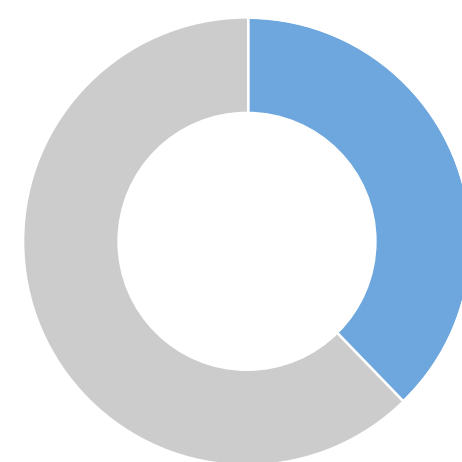
Just right!

Stacked bars (for proportions of total)
Key features of this chart:

• All variables sum to 100% to show proportion of total.
• Single colour and labelling in place to highlight narrative in text.
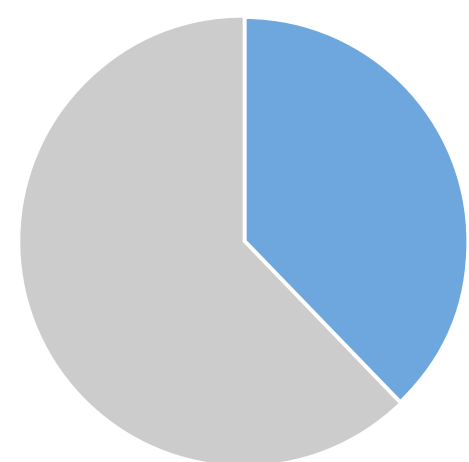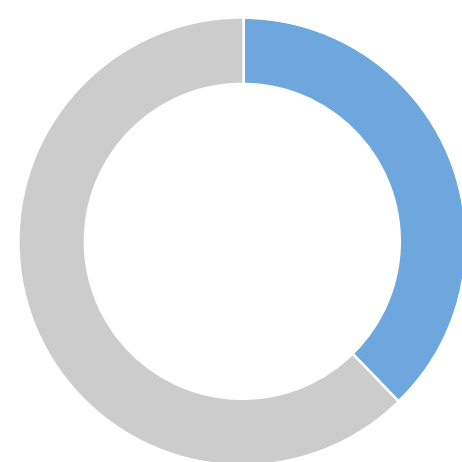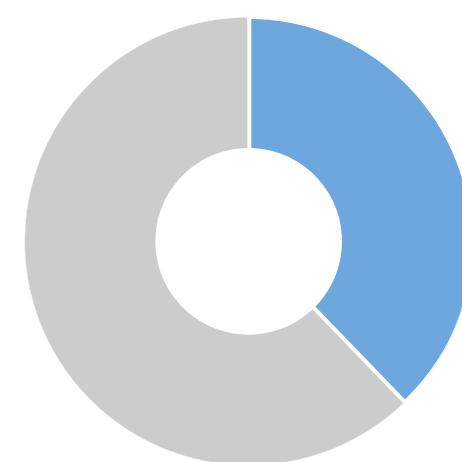
London accounts for 23% of UK economic output

In 2016 London's economic output (its 'Gross Value Added') totalled £396 billion accounting for around 23% of UK economic output. London makes up 13% of the UK population as a whole.

UK Economic Output

London: 23%
£396 billion

Rest of UK: 77%

London: 13%

Total UK Population
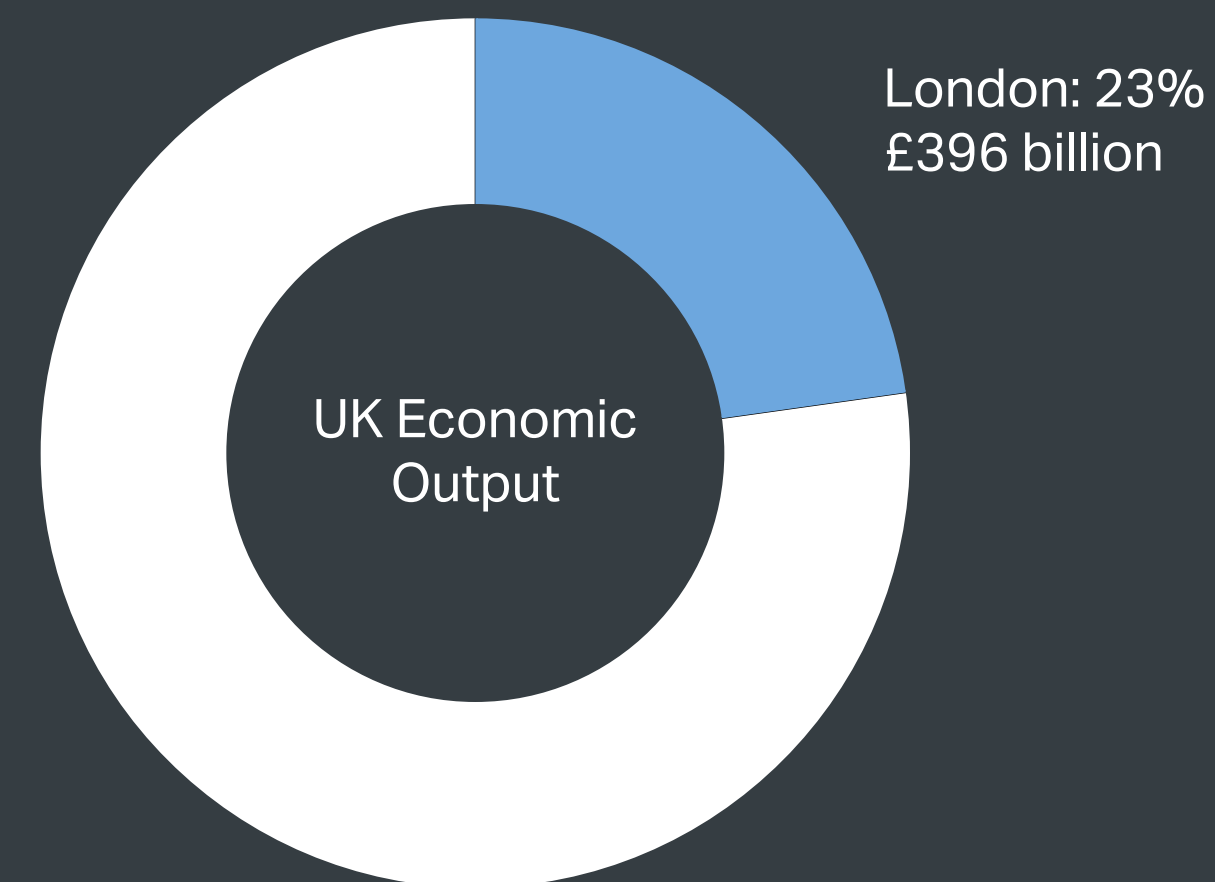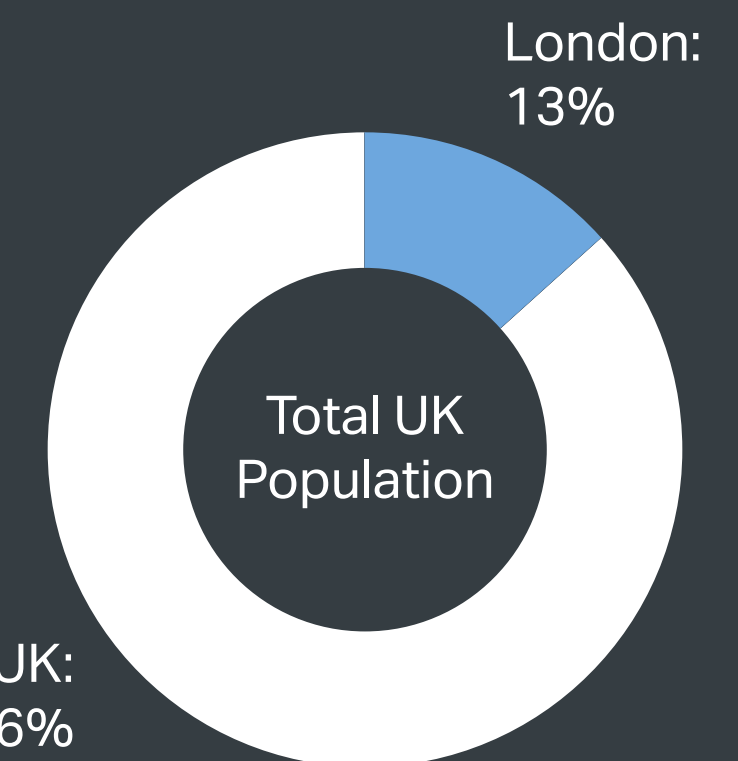
Rest of UK: 86%

Source: London Measured Report (Sep 2018)

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CHART DESIGN
EXAMPLES

Choropleth maps

Key features of this chart:

- Use a continuous or or quantized colour scale to show value.
- Differentiating colour can be tricky, so label map & legend if possible.
- Choropleths can be misleading as larger areas can be perceived as having higher values. Try a symbol map or hex map instead.

Barnet
379,806

Newham
334,269

City of London
7,160

Borough Population
7,160
203,520
249,090
296,111
324,814
379,806
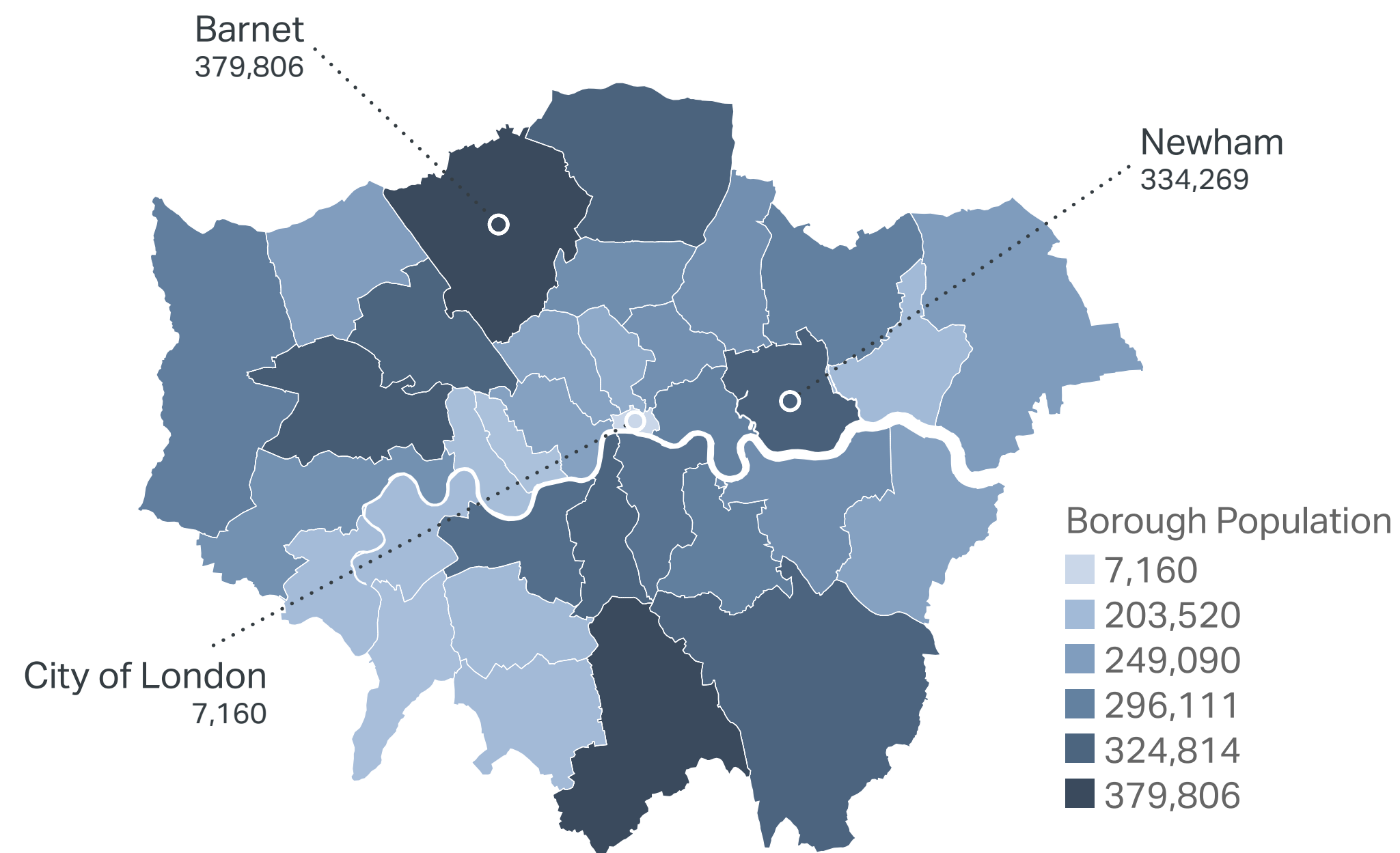
London Borough Populations
ONS Mid-Year London Borough Population Estimates 2015

Barnet
379,806

Newham
334,269

City of London
7,160

Borough Population
7,160
203,520
249,090
296,111
324,814
379,806
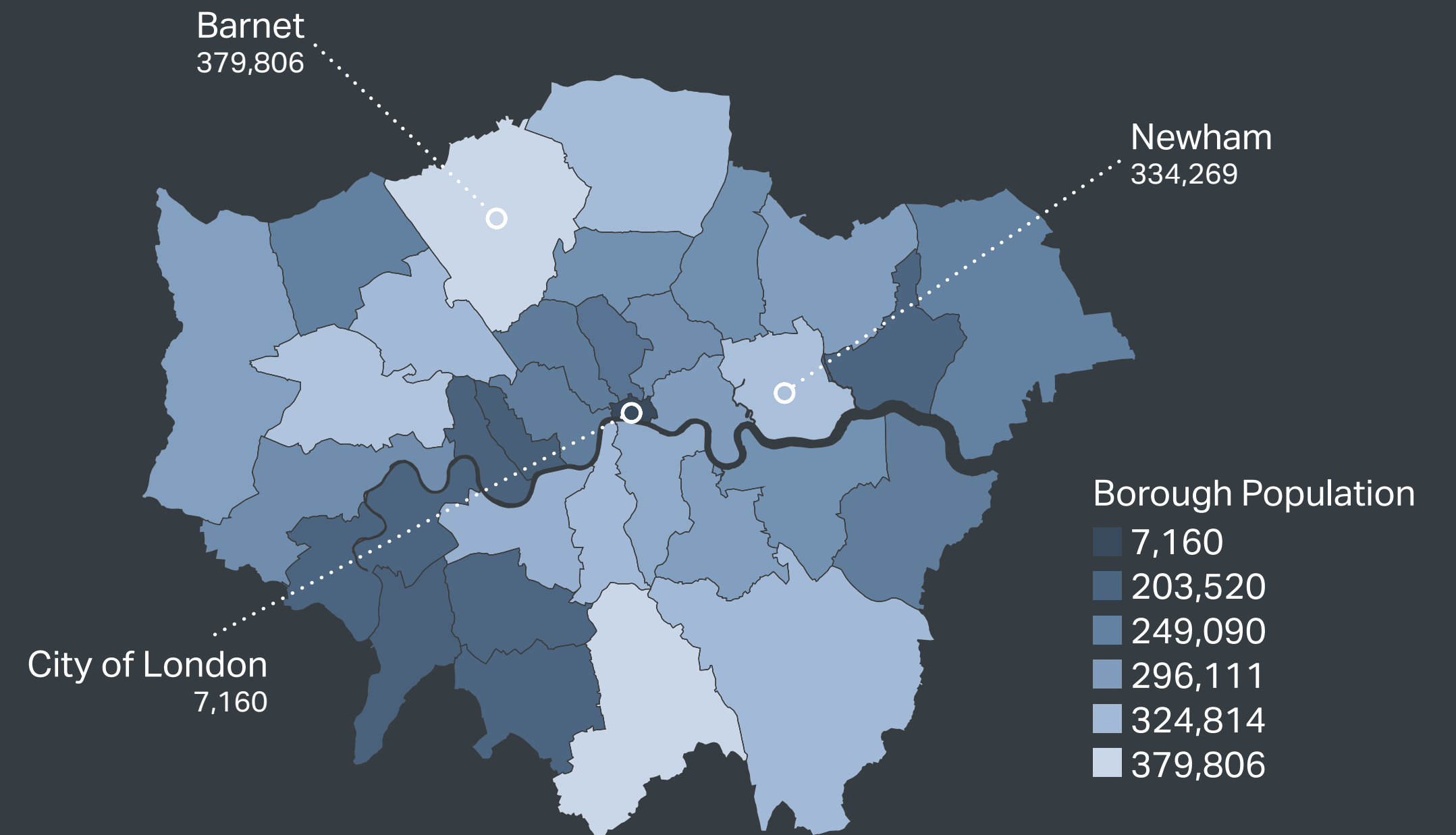
Source: London Datastore

Higher value, more "ink"
Here we're showing two different scales based around the core blue.
On the lighter background, darker colour means higher value. On the dark background, it's the opposite. Higher values are shown as brighter.
This LDN dark BG is not very dark, so it's important that the darkest shade of the map is NOT darker than the LDN grey background.

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CHART DESIGN
EXAMPLES

Custom charts

Some data and narratives can't be communicated well through a regular chart, so sometimes we need to create custom graphics.

Wealth in London is more unequally divided than income

Percentage of total wealth owned by households in each decile 2014-16

London   Population %   GB

Wealthiest

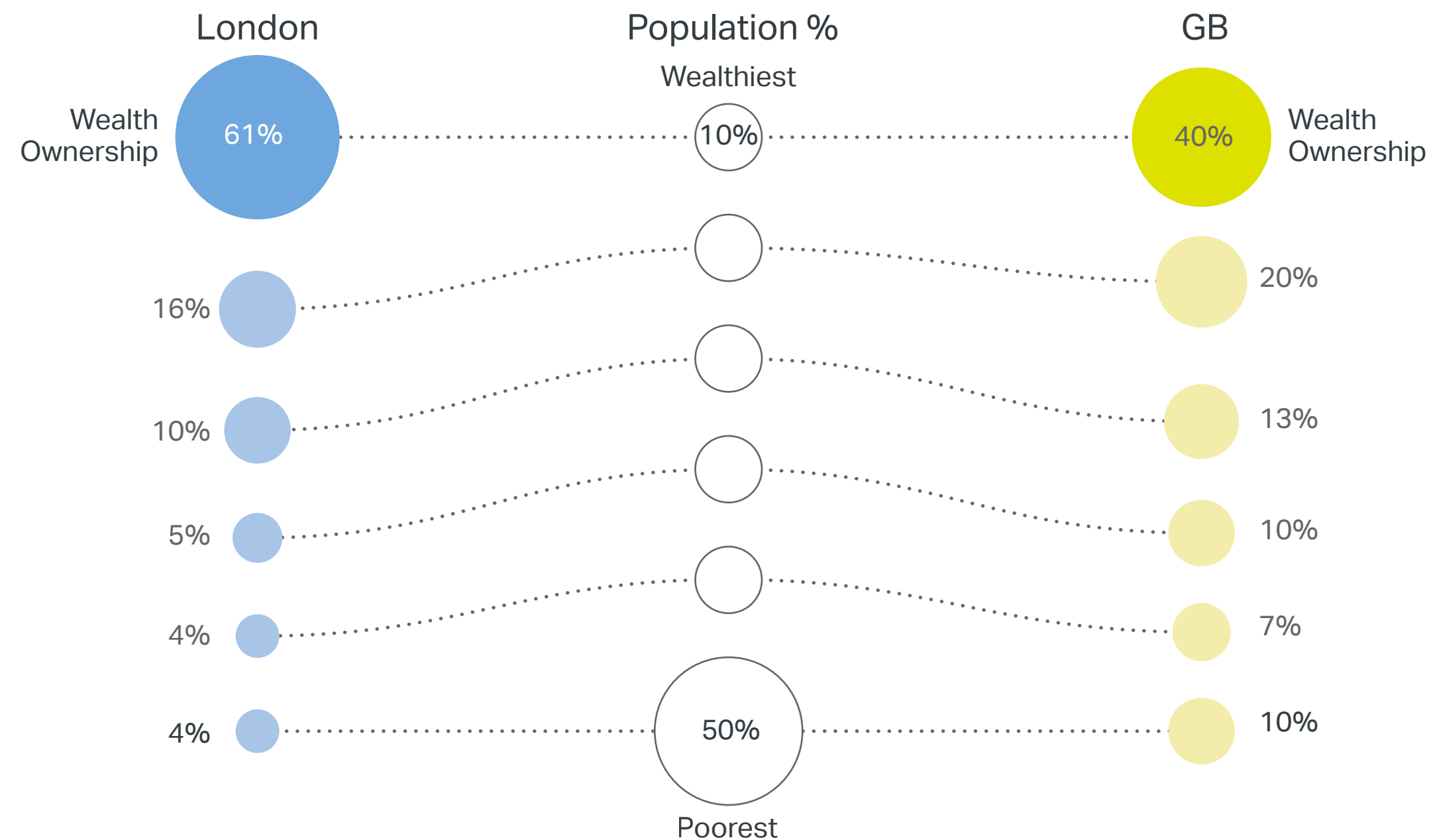Wealth Ownership   61%   10%   40%   Wealth Ownership

16%   20%

10%   13%

5%   10%

4%   7%

4%   50%   10%

Poorest

Source: Wealth & Assets Survey 2014-16

London's richest 10% have 9.6x the income of it's poorest 10%. A difference greater than the rest of the UK

Weekly Income (After Housing Costs)

£1,200   London   Rest of UK

£1,059

£1,000

       90%

£862

£800

9.6x difference between top 10% and bottom 10%

£600   80%

      70%

£400   60%

     50%

5.1x difference between top 10% and bottom 10%

     40%

£200   30%

     20%

     10%

£0

£111   £169
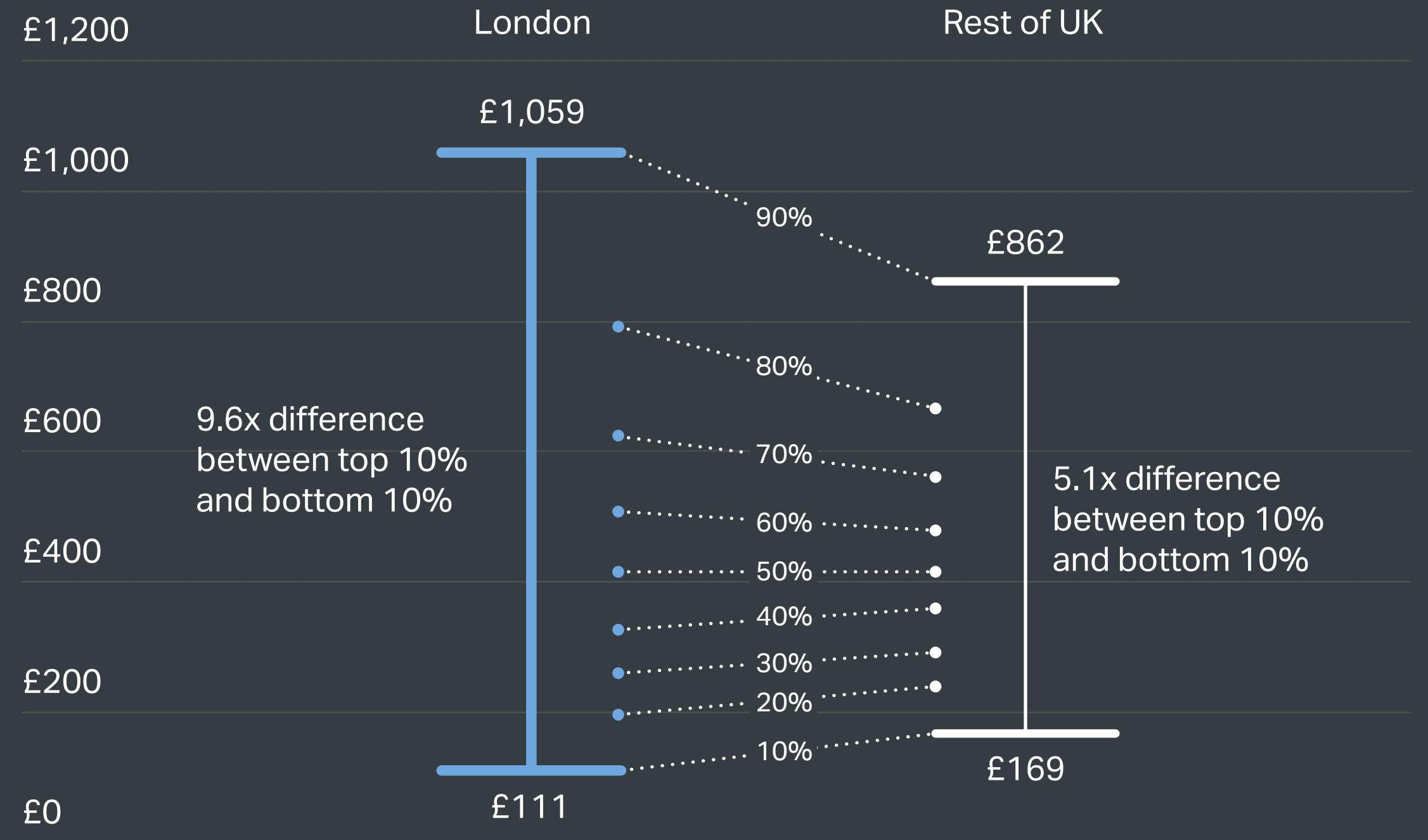
Source: Department for Work and Pensions

Custom charts like these are created by generating simpler visualisations with tools like D3 and or Datawrapper, outputting as PDF/SVG and then enhancing and adapting the graphic in Adobe Illustrator.

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CONCLUSION

CONCLUSION
NEXT STEPS

This guide has focused on the general principles of better information design, but it does rasie issues around the format and technology we should / could be using to produce our work (including this document).

"

Roads? Where we're going, we don't need roads.
- Dr. Emmett Brown, Back to the Future[5]

Can we aim to produce more of our work as "digital first"?
Producing content for the web, simplifies navigation issues, helps keep chart and document text consistent, makes labelling more dynamic, charts more accessible and creates opportunity for richer, deeper, personalised interaction and discovery. It also allows content to be kept up to date, eases sharing an extends the reach of content.

If we can better define who our users are, what they need, and work on tools, platforms & training to support easier web publishing, perhaps we can move faster toward producing work as "digital first".

Feedback
This style guide is a collection of rules and guides I had made for myself, over a range of projects, to keep my own work consistent.

By opening it open for all to share, I'm hoping it will make everyone's work a little easier, and maybe a little more beautiful.

But, it's a work in progress! So please let me know if you spot any issues, find things that don't work for you, or need anyhting else covered.

Email: mike.brondbjerg@london.gov.uk

References:

1. Captain Barbossa - Pirates of the Caribbean
   - https://www.imdb.com/title/tt0325980/
2. Data Visualisation by Andy Kirk
   - http://www.visualisingdata.com/book/
3. Dieter Rams – 10 Principles of good design
   - https://en.wikipedia.org/wiki/Dieter_Rams
4. The Visual Display of Quantitative Information - Edward Tufte
   - https://www.edwardtufte.com/tufte/books_vdqi
5. Dr. Emmett Brown – Back to the Future
   - https://www.imdb.com/title/tt0088763/

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CONCLUSION
FURTHER READING

Not exhaustive (at all), but a hopefully useful collection of articles, podcasts, tools & resources from around the data viz world.

Data Viz Reading & Listening
1. FT Chart doctor - https://www.ft.com/chart-doctor
2. Datawrapper Blog - https://blog.datawrapper.de/
3. ONS Style - https://style.ons.gov.uk/category/data-visualisation/
4. Andy Kirk's Blog - http://www.visualisingdata.com/blog/
5. PolicyViz - https://policyviz.com/
6. DataViz Today Podcast - https://dataviztoday.com/
7. Data Stories Podcast - http://datastori.es/
8. Inspiration from IIB - https://www.informationisbeautifulawards.com/

Chart Choosers
1. FT Visual Vocabulary - http://ft.com/vocabulary
2. Data Viz Project - https://datavizproject.com/
3. Data Viz Catalogue - https://datavizcatalogue.com/
4. Data To Viz - https://www.data-to-viz.com/

Guidance / How To
1. Policy Viz - https://policyviz.com/2018/08/07/dataviz-cheatsheet/
2. Datawrapper How To - https://academy.datawrapper.de/
3. Scott Murray D3 Book - http://alignedleft.com/work/d3-book
4. Netflix's Elijah Meeks - https://medium.com/@Elijah_Meeks/
5. Nathan Yau Tutorials (R) - https://flowingdata.com/category/tutorials/
6. Stephanie Evergreen (Excel)- https://stephanieevergreen.com/how-to/

Resource Lists & Tools
1. Viz Palette Tool - https://projects.susielu.com/viz-palette
2. Chroma.js Colour Scale Tool - https://gka.github.io/palettes
3. HEX to RGB Conversion Tool - https://bjoernkw.github.io/hexrgb/
4. Andy Kirk:
    Chartmaker Directory - http://chartmaker.visualisingdata.com/
    Resources - http://www.visualisingdata.com/resources/
5. Lena Groeger Resources: http://lenagroeger.com/resources/
6. Datawrapper - https://www.datawrapper.de/
7. D3 - https://d3js.org/
8. DC.js - https://dc-js.github.io/dc.js/
9. C3.js - https://c3js.org/
10. Flourish - https://flourish.studio/
11. Kepler.gl - https://kepler.gl/#/
12. A new "Illustrator" from Adobe - http://www.data-illustrator.com/

CONCLUSION
QUICK STYLE REFERENCE

A Chart Title

Axis Tick

Small Axis Tick

Previous Peak
1939: 8.6m

1939

Previous Peak
1939: 8.6m

1939

Focus

Comparison

40%   37%

Part of a whole (not comparison)

0%   50%   Something 68%   100%

80%

68%

lighter grey

Stacked bar elements seperated by thin keyline

London   33.3%   33.3%   33.3%

Blue	LDN Dk Pink	Yellow	Red	Green	Purple	Turquoise	Pink	Orange	LDN Pink
#6da7de	#9e0059	#dee000	#d82222	#5ea15d	#943fa6	#63c5b5	#ff38ba	#eb861e	#ee266d
109,167,222	158,0,89	222,224,0	216,34,34	94,161,93	148,63,166	99,197,181	255,56,186	235,134,30	238,38,109

Light BG Context Data	Light Chart BG Highlight Area	Light BG Strong Grid	Light BG Light Grid	Dark BG Context Data	Dark Chart BG Highlight Area	Dark BG Strong Grid	Dark BG Light Grid
#cccccc	4% #000000	#666666	#d8d8d8	#ffffff	4% #ffffff	#ffffff	#4e5254
204,204,204	0,0,0	102,102,102	216,216,216	255,255,255	255,255,255	255,255,255	78,82,84

Document Headlines	Document Body Text	Axis Text & Labels	Highlighted Labels	Chart Label Black	Chart Label White
#353d42	#666666	#666666	#353d42	#000000	#ffffff
53,61,66	102,102,102	102,102,102	53,61,66	0,0,0	255,255,255

Dark App	Dark Panel	LDN Grey	LDN Dark	LDN Light	White	Light App
#121516	#1b2021	#353d42	#2a3135	#868b8e	#ffffff	#f5f5f5
18,21,22	27,32,33	53,61,66	42,49,53	134,139,142	255,255,255	245,245,245
Base for web applications	Web app UI panels	London.gov.uk style panels	London.gov.uk dark UI	London.gov.uk light UI	Printed page and simple app	Light base for web apps

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