



Adventures in Engineering!

MOVING A

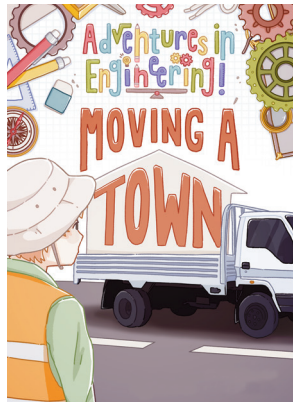
TOWN



QUEENSLAND NORTHERN TERRITORY

IPWEA

INSTITUTE OF PUBLIC WORKS
ENGINEERING AUSTRALASIA



Adventures in Engineering: Moving a Town

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Moving a Town

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First Edition

With thanks to the National Careers Institute

Chapter 1

Tom was looking back at his high school yearbooks. It had been many years since Tom had been at high school, and he had managed to do a lot in that time. He came across an article showing the Year 10 Careers Day that he had attended. The photos showed the school gymnasium where many organisations had set up stalls advertising their career options.

The local council had a stall, staffed by a civil engineer – he had asked Tom and his friend, Sarah, if they liked the new skate park that the council had built. They told him they thought it was pretty good. The ramps were fun and challenging, and he'd only fallen off his skateboard twice. The only problem, they said, was there were no seats under the shade and no lights for when it got dark.



‘Thanks for the feedback,’ said the civil engineer. ‘We should have thought of that. If you think of anything else that would be good, can you write it down, or even better, draw it for me? Maybe ask your mates down the park. Let me know what else they think will make the park better and I’ll see what I can do.’

Tom did that and spent a couple of nights a week drawing everyone’s ideas on an A3 piece of paper.

When he took the finished version to the council offices, he went through it with the civil engineer and his colleagues. They showed him how to copy the sketches he’d drawn into a computer program. They could use the program to move things around and change the size. It was pretty cool. Although Tom had thought that what he and the local kids had come up with was good, he could see how experts in designing and building could use their **expertise** and technology to make things even better.

Chapter 2

A few months later, Tom enjoyed watching as construction teams worked on the skate park. Following the designs Tom had helped with, the builders installed lighting, seating, water bubblers and a sunshade. Once finished, more people came to the skate park. It was more comfortable now and skaters could stay there longer. Tom had even met new people who he was still friends with all these years later.



Tom decided that this civil engineering career looked like a great option for him. He liked drawing and building things and he was enjoying how good facilities make life better for people. Tom chose his senior school subjects based on the advice from the engineers at the council. Once finished, he enrolled in a Bachelor of Civil Engineering at university. Although he had to move away from his hometown, the skate park and his friends, it was still the best decision Tom had made.

Chapter 3

After finishing university, Tom had saved up enough money to travel overseas. Apart from seeing the usual tourist places that people enjoyed, Tom wanted to visit the buildings that he had learned about during his studies; the big **feats** of engineering that were world famous.



In Europe, he travelled through the Channel Tunnel – a 50 km long railway tunnel that lay 115 m below the English Channel. Traveling between England and France under water was amazing to Tom. He looked out the window to try to see how it had been constructed. He then travelled to Italy to see the tide barrier built to keep the sea waters from flooding the ancient town of Venice. He went to The Netherlands to see the canals. Even though they were built in the 17th century, they still kept the 25% of land that was under sea level, free from flooding. Tom felt the most spectacular were the Palm Islands in Dubai. A whole residential and tourist area had been built in the sea using 94 million cubic metres of sand and 7 million tonnes of rock.

Tom returned home inspired.

Chapter 4

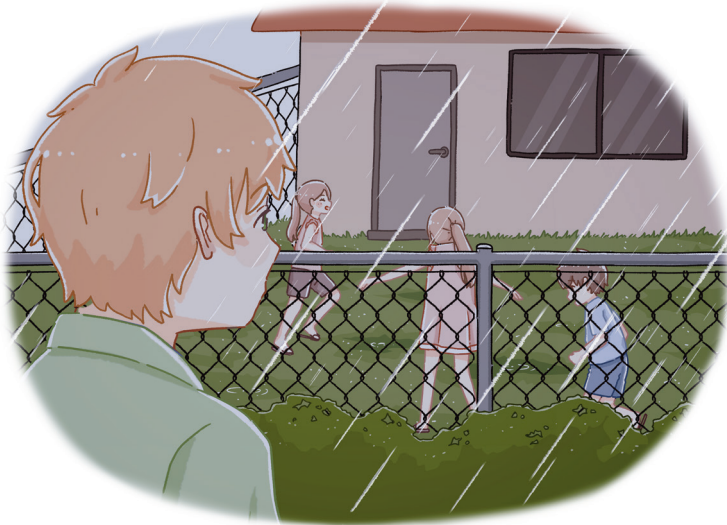
After many years of working on projects around Australia, in 2010 Tom found himself living in South East Queensland. Living in Queensland enabled him to work on many kinds of projects. Being a large state, Queensland had a variety of landscapes and climate types. Unfortunately, it also meant it experienced frequent natural disasters. These required the reconstruction of many buildings and **infrastructure** like roads, railway lines, bridges and seafronts. There was no shortage of projects for a civil engineer like Tom to work on, and he never got bored. He still enjoyed solving problems and building things that communities enjoyed using.

Unlike other places where he had lived, summer in Queensland was wet – the season of the year when most of the rainfall occurred. It was more pleasant experiencing rain in summer when it was warm than in winter, when it was freezing cold, like he had done in Europe.

The summer of 2010 and 2011 was different though. It was the wettest summer that Queensland had experienced for a very long time.

According to the Bureau of Meteorology website that Tom checked regularly, a La Nina weather system was causing much higher rainfall than usual. The monsoon season also started earlier than normal. Tom had a friend in Central Queensland, who said it had been raining almost every day since September 2010. She had been able to empty out her full rain gauge more than once a day. Tom could tell the

difference at his own house, too. There had been so much rain that the lawn in his yard couldn't absorb any more water. When it rained, the water lay on top in large puddles. He enjoyed listening to the neighbour's children splash around in their yard.

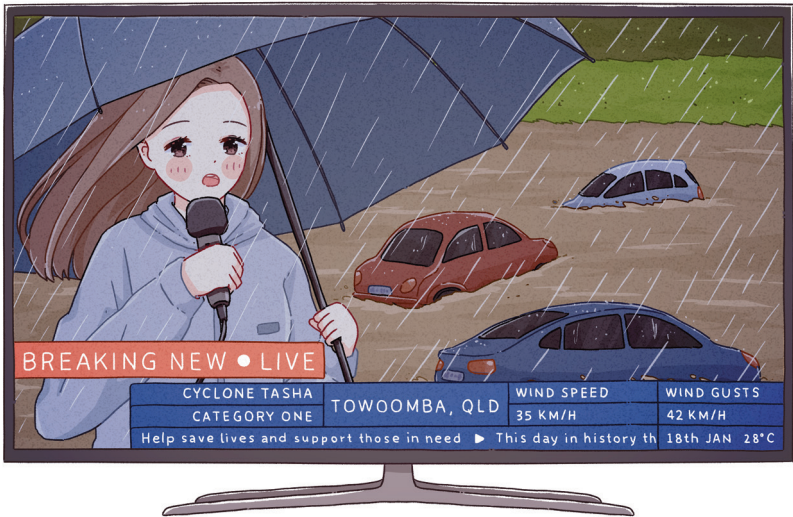


There had been many cyclones too. There had been one or two in north Western Australia, and then a serious one in Queensland. Tropical Cyclone Tasha crossed into Queensland along the coast between Cairns and Innisfail. It had winds at up to 105 km/hr and rain so heavy that at one stage approximately 100 mm of rain fell in only one hour.

It was a scary time to live in Queensland.

Chapter 5

One afternoon in mid-January, Tom was working from home. He hadn't been able to get into the office as the roads around his place had flooded from all the rain. He was glad he had been able to buy a house on the top of a hill. The sound of the water gushing down the gutters of his house and along the side of the street reminded him of waterfalls.



Turning on the TV news later that afternoon, Tom was horrified to see the **havoc** that the rain had been causing. Earlier in the day, the town of Toowoomba had experienced a flash flood. Shops and other buildings had water half-way up and it looked like it was getting higher. The footage showed cars being lifted in car parks and being carried away by the rushing water. The news readers couldn't believe what they were seeing. They reported that people had been injured, some had gone

missing, and very sadly, some had drowned. Tom had never seen anything like this before. He had seen lots of flooded Queensland towns this summer, but the water was generally calm and still like a lake, not rushing like a river.

Tom watched the weather report to attempt to comprehend what was happening. According to the meteorologist, two large storm cells had come in from the east and had joined together creating one very large storm cell. Unfortunately, this meant that the storm moved slowly, resulting in a lot more rain. This was why Toowoomba had received so much rain so quickly. With between 30-50 mm of rain in half an hour, the creeks and **gullies** could not absorb the water. It rushed through the streets of the town, washing away anything in its path.

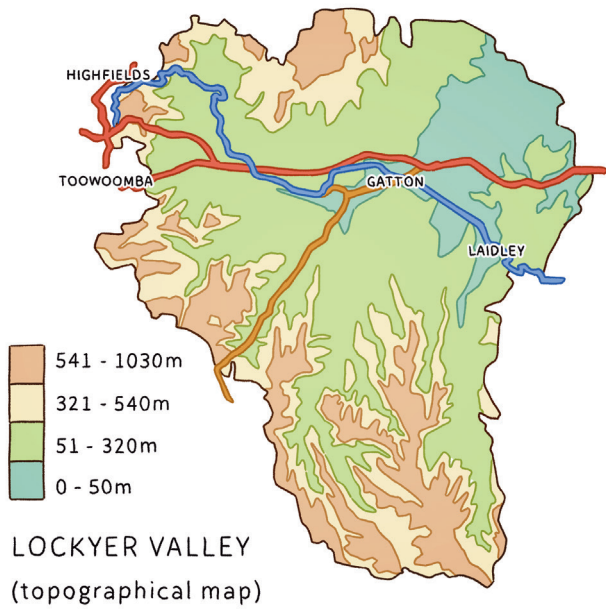


Figure 1: Lockyer Valley - Rainfall

Tom had worked on construction projects out that way and was worried for the town of Toowoomba. Knowing that the town sat upon a ridge of the Great Dividing Range, Tom was also worried for all the towns at the bottom of the range. He had crossed the creeks when they were dry many times, driving to and from different towns. He knew from previous research that some of these towns were built on floodplains. Floodplains are areas adjacent to creeks and rivers. They are very flat, and water sits on them for a long time when rains are heavy and waterways flood. It had made sense when settlers arrived in these towns to build close to water sources. Although with flooding having occurred several times over the past hundred years, it wasn't necessarily still a good idea to live on floodplains.

Tom had had good reason to be worried.

Chapter 6

At work a few weeks later, Tom was in a meeting. His manager was explaining a new project with which his company was going to be involved.

'Let's **recap** what we know,' said the manager, standing up the front of the boardroom table.

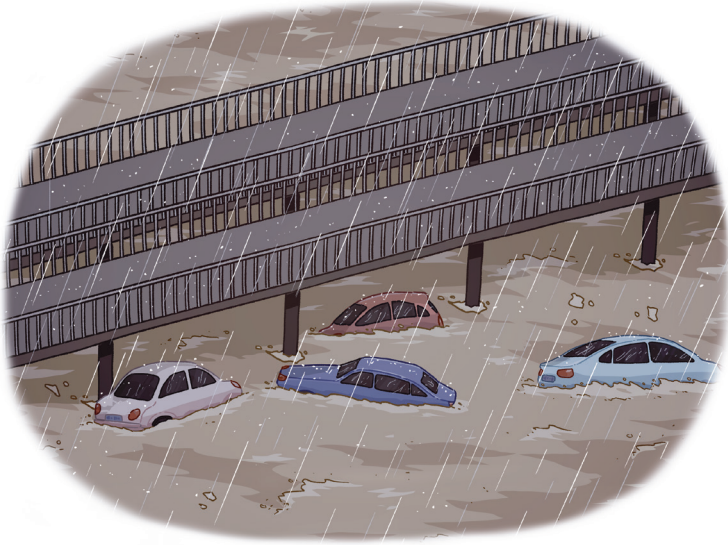
'On Monday 10th of January 2011, following the flash flooding in Toowoomba, the storm cell responsible moved over a number of creek systems that feed into the Lockyer Creek. Rainfall of about 550 mm had fallen since December last year, and the ground was water-logged. Within the space of two-hours, approximately 90 mm of rain fell. It flowed down through the Lockyer Creek, flooding the township of Grantham that had been built along its banks.'

The room was silent.

'It took only 30 minutes for the water level to reach 8 metres in height. The townspeople had no warning. They described it as a "wall of water" that washed away everything in its path.'

Tom could still replay in his mind the footage he watched on the news. The town where he had once stopped to buy lunch looked like a fast flowing river. He recalled seeing families with their pets sitting on the roofs of their houses, with the water lapping at their feet, waiting for the rescue helicopters to come and winch them to safety. Some houses had been swept off their stumps and had floated away. A whole pile of cars had been wedged together against the nearby railway bridge.

It was an absolute disaster.



The manager interrupted the silence. 'Very sadly 12 people were killed, and many houses were destroyed. It will be our job to help the survivors to rebuild their lives.' Tom knew this would be a very important project. It might not be the most impressive project he had worked on as a civil engineer, but he knew it might be the most important.

Tom, along with many other experts, were going to relocate to the town of Grantham.

Chapter 7

Some days later Tom found himself at the Grantham State School at a community meeting.



The Mayor of the Lockyer Valley Regional Council was speaking to the assembled residents. There were lots of people in the room who still looked in shock after the terrible flood event. Many of them had lost their homes, lost family members and friends. It felt like a strange time to have a meeting, but Tom knew it was necessary.

The Mayor was explaining the plans for the town and how the residents could be involved.

‘As much as we love our town of Grantham, there is little logic in rebuilding our homes in places where we know it floods. This is not an event we ever want to experience again, and it can be avoided. There is land available that the council can buy. It is up

the hill here,' said the Mayor pointing. 'We know it is unlikely to flood. Some of you fled to safety there. If you agree, we will buy and develop this land and you can rebuild your homes there, where it is safe.'

Tom watched the crowd as they absorbed this information. Some nodded. Some looked surprised.

Tom thought it was a good idea. Although he had seen many **feats** of engineering that helped keep flood water at bay, the most sensible idea in this situation was the most obvious. Move to where flood waters cannot reach.

Tom had access to the map of the area and knew where the homes in the town would be moved to if the residents agreed.

The 485 hectare block of land was on top of a hill, to the north-west of the town. The closest point between this site and where the flood levels had reached was about 50 m. The difference in height above sea level was about 3m. Tom thought this was a significant distance that should be out of reach of any future floods.

Tom's daydreaming was interrupted by the Mayor asking for a show of hands of who was in favour of relocating their homes to the land on the hill. Tom scanned the room. Although not everyone had their hand up, most people did.

'That's decided then,' said the Mayor. 'We'll relocate our town.'

Chapter 8

Tom gathered his gear and continued his walk. He and other engineers and urban designers were conducting a site analysis. Surveyors were using their **theodolites** and **total stations** to measure the distances between the boundaries of the land parcel, and to calculate the incline of any slopes. Tom had learned it was important when designing to know what the land is like. This would allow the engineers and designers to know where land might need to be flattened, dug out or built up.



Tom's role was to identify the features of the natural environment on the land. Much of the land in the area had been used for farming for over a hundred years. Most trees had already been cleared to allow cattle and sheep to graze there. Given the lack of vegetation, this area of land was also quite safe from the risk of fire. There were some clumps of gumtrees though, on the eastern and western sides of the area.

Tom made a note that he would need to investigate this section further. He needed to ensure that the native flora and fauna would be identified correctly so that it could be protected from the construction. He made a note to contact the team of wildlife officers who would be able to help spot if any koalas lived within this area of eucalypts. He may need them to be on spotting duty during the construction to keep the koalas safely away from the machinery.

Back in their offices, the engineering and urban design team collated the data they had collected as part of their site analysis, research, and discussions with the community. Some of the suggestions had been made in the meetings, and others had been discussed in conversation with residents individually.

Just like younger Tom had helped the council civil engineer with ideas for the skate park, Tom and the team were keen to know what the residents wanted from the area that would become their new home.

There were many excellent suggestions. Some wanted a new school, many wanted a park and playground, and some wanted a new sport field. The council didn't just want to construct a place that was safer physically. They also wanted to create a space that was safer mentally and emotionally – no more worry about flooding. They also wanted to build a place where residents would be happy to live and that helped keep the community together. The community of Grantham and the Lockyer Valley had supported each other after the flooding. It was important that people were still able to interact and support each other in their new location. The more

spaces created for people to enjoy together, the happier the community would be.

The goal was to have the first resident of Grantham in their own home on the relocated site by Christmas.

Tom knew the engineering team would have to work smart and hard!

Chapter 9

Although Tom really enjoyed the design aspect of being a civil engineer, his favourite part was when the plans were approved and the work could start.

In June 2011, only six months after the flooding, Tom attended a ceremony at the relocation site. Using a spade to dig the first hole, the Mayor, the Premier of Queensland, and other **dignitaries** officially declared that the construction work could begin.

It was time to put the plan into practice.

The construction of the site proceeded smoothly for a while. Tom spent some time in the office, working on designs for where important parts of the relocation construction would go. The plan included 121 residential 'lots' – blocks of land on which residents could then rebuild their houses. However, measuring out a block of land was not enough. Each house would need a road to get to it, which needed kerbing and footpaths. Trenches needed to be dug to hold the water and sewage pipes, electrical **conduit** and cables for the internet connections. All these elements had to be planned out carefully. Tom had to make sure the roads flowed logically, and each house had access to town water, sewerage, electricity and internet.



The agreement between the Council and the residents was one that had rarely been done in Australia before. Willing residents would 'swap' their land that had been flooded, with a block of land up on the hill. It would be approximately the same size. The smallest block was 1,000 m² of which there were 22, and the largest at 10,000 m² of which there were 16. There were others that were 2,000 m², and 4,000 m² size blocks. Everyone would have ample space and be able to do the same activities on these new blocks that they had done on their old. Some would be able to build new houses. Others, if the house hadn't been too damaged, would be able to move the house up the hill to their new block. This was a feature of the Queenslander style house that was very convenient, being able to put it on a truck and move it to a new location.

Chapter 10

One day, during a site visit, Tom heard a loud 'clang'. Turning around, he could see that an excavator operator had tried to dig into the soil but had hit a large rock. Walking over to see if he could help, Tom watched as the road construction crew members dug away with spades at a massive rock **deposit**. As more soil was removed, the more nervous the site supervisor became. The rock was right where plans showed that underground water, sewerage and stormwater services were to be built. Looking at the length, width, and depth of the rock, it would be very difficult to continue with that plan.

Tom went back to his office and analysed, using engineering computer software, if there were alternative places to put these services. Unfortunately, there were no alternatives that would work. Changing the design now would require many days and weeks of reworking the plans, which would cause a delay to the project. It would make the goal of having the first residents in by Christmas difficult to achieve.

A solution to this problem was needed, and quickly.

The next day the whole team gathered at the rock **deposit** to come up with a solution. 'I know,' said one of the road crew, 'There is a quarry down the road. They cut rock all the time. They must have tools that can help with this rock.'

The morning after, a team from the quarry arrived with a very large saw on the back of a truck.

Tom had never seen a saw as large as this. The blade was sharp, easily 2 m in diameter and was attached to the end of a crane-like vehicle. Everyone made sure they had their earmuffs, protective glasses, long sleeves and safety boots on as the operator sat in the cabin and slowly lowered the saw to the line of rock.



Even through the protection of the earmuffs, the sound of the saw cutting through the rock was piercing, but it worked. Tom could feel the sense of relief around him once the crew realised that their problem had been solved and that their Christmas deadline was within their grasp.

Chapter 11

The end of August was busy for Tom. Being on the site became busier as residents who had been allocated their block of land came up to visit. They were keen to see where they would soon live. Residents who were happy to move had listed their three most preferred blocks on a piece of paper. These were drawn in a **ballot**, just like at a raffle.

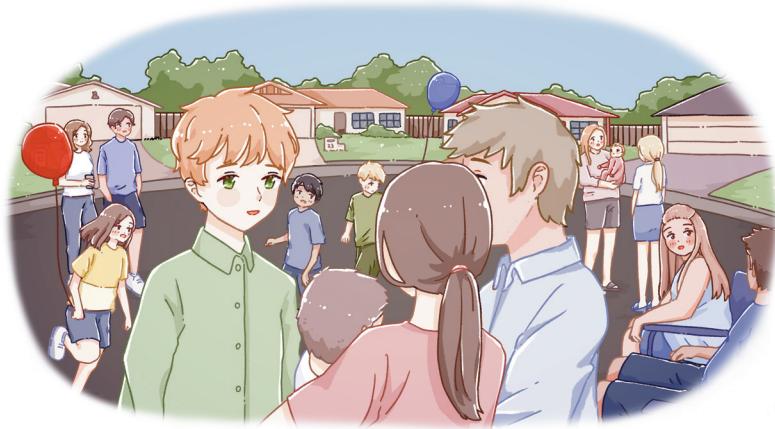
Although it sometimes interrupted the technical work he was doing, speaking to the people who would soon call this area home was a privilege. Tom enjoyed showing them the features of their new property and the **infrastructure** they would soon enjoy. The park and the area for new showgrounds pleased people the most. He smiled when children discovered that they were living on the same street as their friends. He imagined the games of street cricket and other fun that they would have in their new home.



By November, Tom was pleased to see builders had started to construct the houses. Occasionally he'd watched wide-load trucks with Queenslander houses loaded on the back, as it drove up the road to its new location.

Chapter 12

The work Christmas celebration was a happier and more relieved one than usual for Tom and his team. They had visited the Grantham relocation site and celebrated with the families who had, as promised, been able to move into their new homes. The roads were functioning, and the new houses had running water, sewerage, electricity and the internet, all the things that helped people to have a good life. Tom looked forward to the time when all the blocks had houses on them, when the show would be in full swing at the new showgrounds and kids would be playing at the playground with their friends.



The residents of Grantham would now be able to restart their lives in this new location. They could feel confident and safe that history was not going to repeat itself.

Glossary

ballot	(n) the piece of paper on which somebody marks who they are voting for
conduit	(n) a pipe, channel or tube through which liquid, gas or electrical wire can pass
deposit (rock)	(n) a layer of a substance that has formed naturally underground
dignitaries	(n) people with important official positions
expertise	(n) expert knowledge or skill in a particular subject, activity or job
feat, feats (plural)	(n) an action or a piece of work that needs skill, strength or courage
gully, gullies (plural)	(n) a small, narrow channel, usually formed by a stream or by rain
havoc	(n) a situation in which things are seriously damaged, destroyed or very confused
infrastructure	(n) the basic systems and services that are necessary for a country or an organisation to run smoothly, for example, buildings, transport water and power supplies
recap	(v) to repeat or give a summary of what has already been said, decided, etc.

theodolite	(n) a piece of equipment used by surveyors for measuring angles
total station	(n) an electronic theodolite that also measures distance in metres

Glossary definitions sourced from
<https://www.oxfordlearnersdictionaries.com/>

Activities

Chapter 1

In this chapter, a civil engineer working for the council asks Tom to provide feedback on the local skatepark by asking others for input and drawing the ideas. Think about your school playground. What improvements do you and your classmates think could be made to the school playground?

Sketch the existing school playground and draw in other suggestions that you and your classmates feel would improve it.

What computer programs do you have access to that could help you create this drawing digitally?

Chapter 4

What weather events are discussed in this chapter? How many of these have you experienced? What happened before, during, and after the weather event that you experienced? What would you do to be prepared in the future?

Chapter 5

On page 14 it says that towns tend to be established around water sources – access to the sea, rivers, creeks or lakes. Why would that have been considered a good decision in the past? What might people living near water sources need to be aware of now?

Discuss

Imagine that you had the power to create your own town.

What climate would you like to live in?

Where would you locate your town?

What facilities and **infrastructure** would you include?

What kind of homes would you have? Apartments, houses on big blocks or houses on little blocks?

How would you want to travel around your town?

What would you include to ensure that people had everything they needed for a good quality of life?

Draw your town either on paper and/or digitally.

Label important elements of your town plan.

Describe how people would feel living in your town.

What tasks did Tom perform in his job as a civil engineer?

What skills did Tom use to help solve the problem?

Are there any aspects of Tom's job you think you would like to do?



Adventures in Engineering!

Queensland experiences many natural disasters. How can Tom use his engineering skills to help a town devastated by flooding? Tom had moved towns many times in his life, but he had never before moved a town. Could it be done?



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