

# Effects of Filtered Stormwater on Zebrafish Sensory Systems

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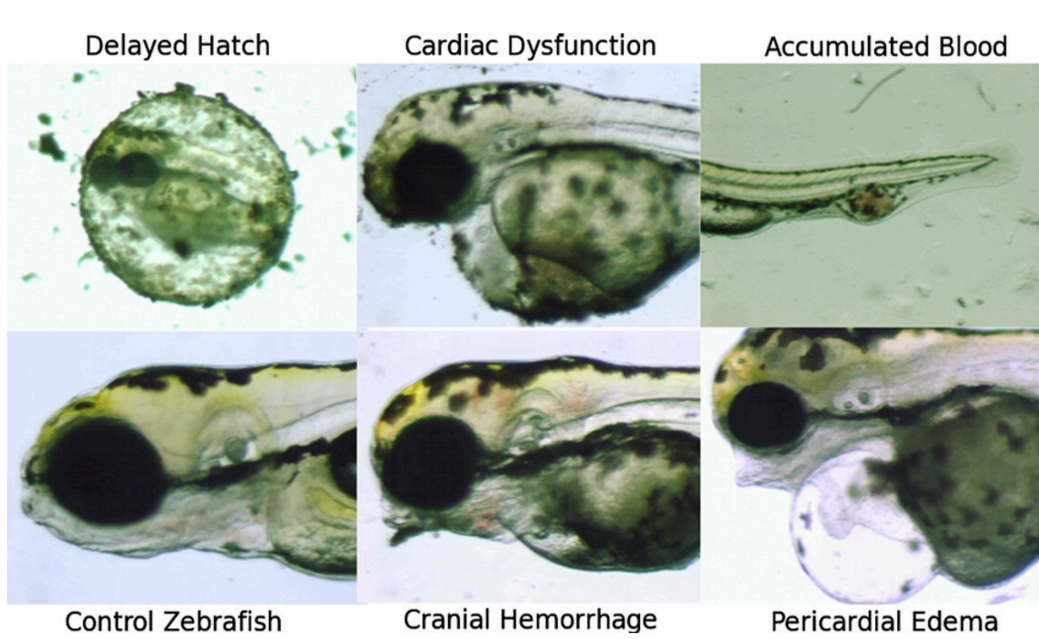


## Introduction

Storm water runoff in urban areas surface areas contains a mix of toxins that can have a serious effect on ecological integrity of aquatic habitats. Filtration columns are beneficial to prevent the introduction of harmful pollutants into these aquatic habitats. These columns remove most toxins but there is still evidence that residual toxins can impact fish health.



Storm event on the 520 floating bridge in Seattle washes pollutants into Lake Washington. From Seattletime.com



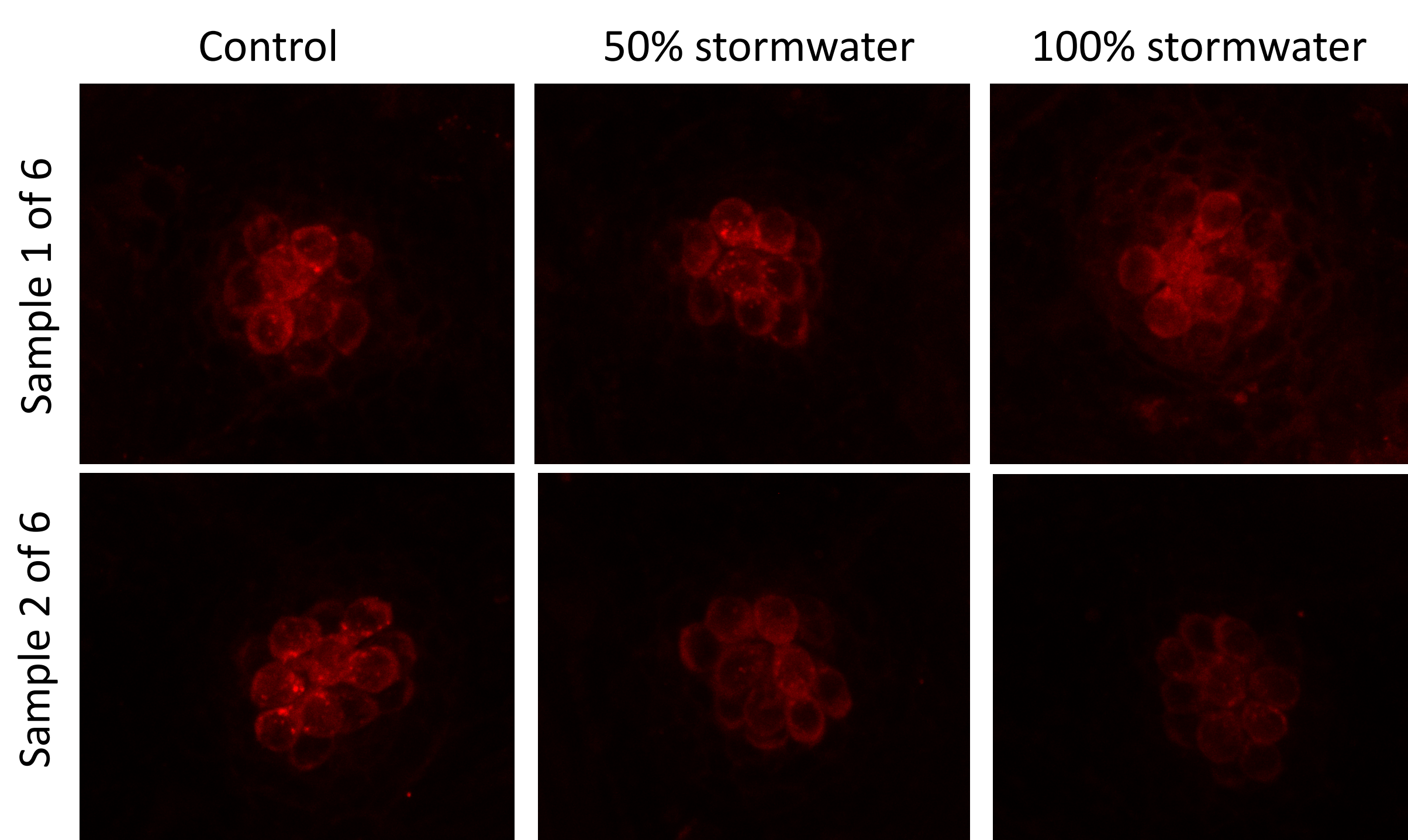
This image demonstrates the toxicity of stormwater on zebrafish development. From McIntyre et al. 2014

**The purpose of this project is to find out how long the stormwater filtration systems will last before unwanted pollutants begin to make their way into waterways.**

Here we use the lateral line as a sensitive assay for residual stormwater toxicity. The lateral line is a collection of organs on the outside of the fish. Each organ contains sensory hair cells that allow the fish to sense nearby water movement.

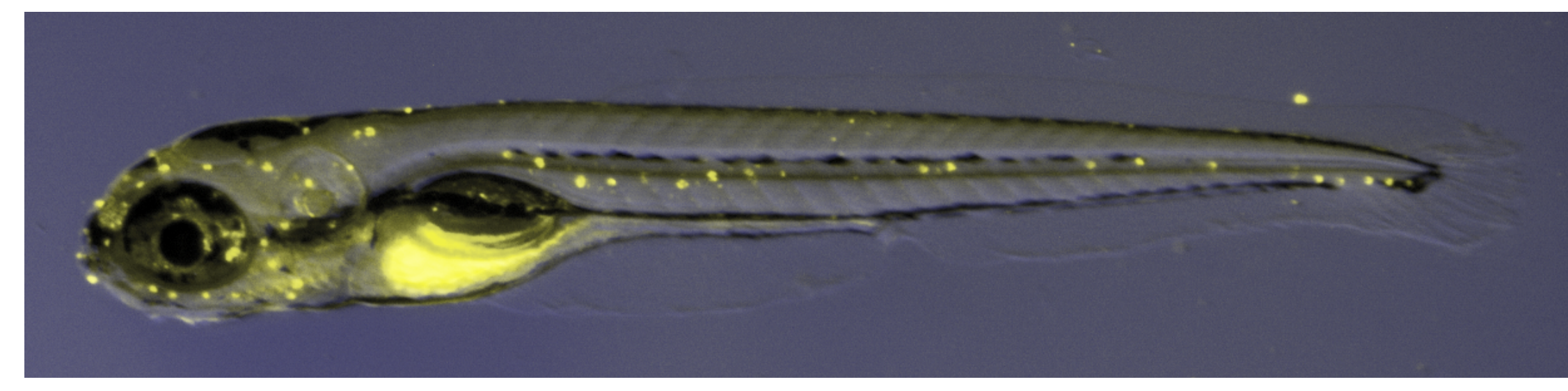
## Does stormwater reduce hair cell function?

Functional hair cells take up the dye FM1-43, which labels the cells red. We treated fish with stormwater and asked if dye uptake was reduced.



For sample 1 of 6, the red dye is bright in all three samples, suggesting healthy hair cells. For sample 2 of 6, dye labeling is very dim in fish treated with 100% stormwater, meaning this sample reduces hair cell function. These data demonstrate that unfiltered stormwater can be toxic to hair cells. Future studies will examine filtered stormwater.

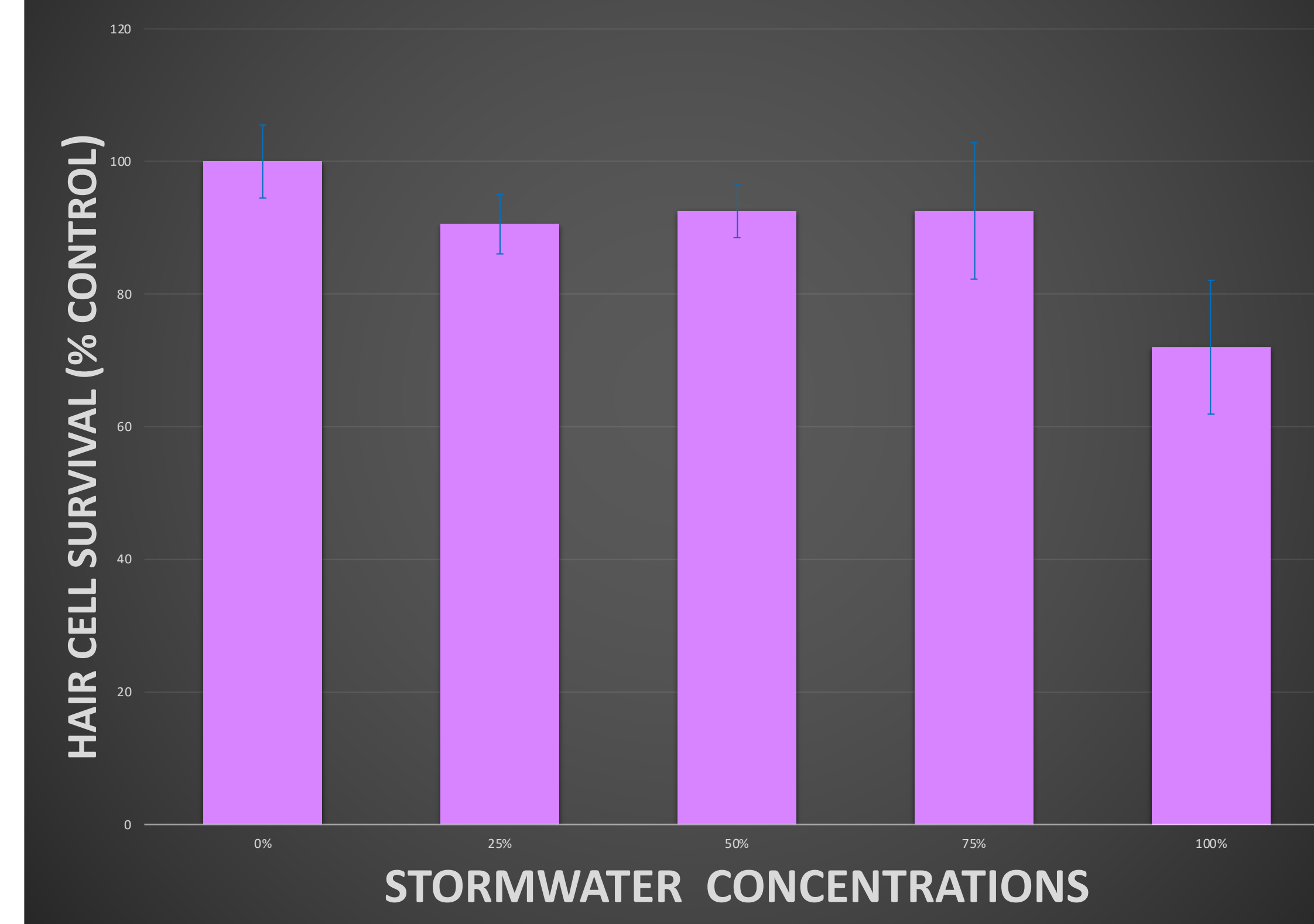
## Does filtered stormwater affect hair cell survival?



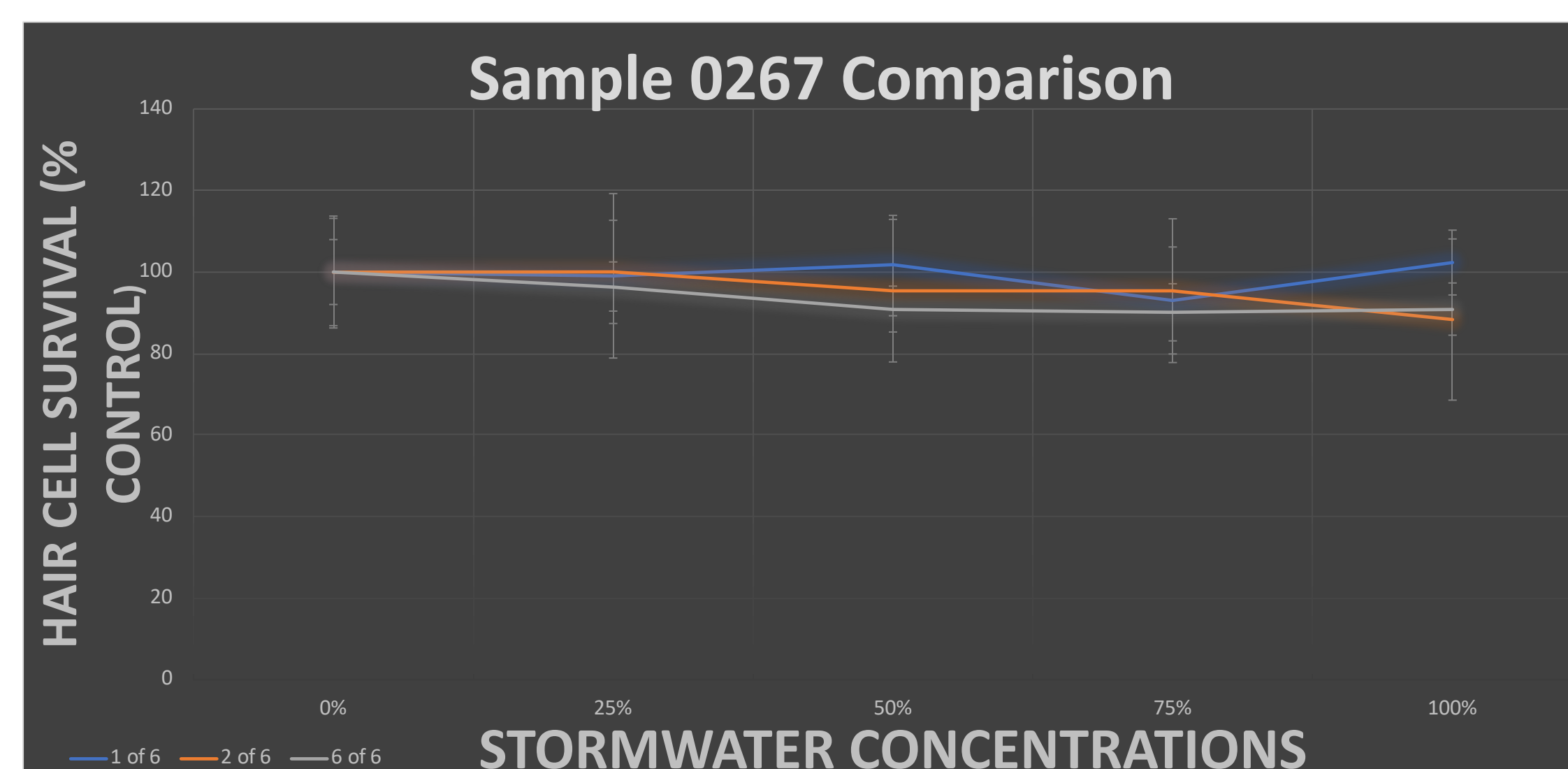
DASPEI, which is a vital dye used to quantify hair cell presence. In this picture, each yellow dot represents a cluster of hair cells.

- 5-6 day-old fish were treated with stormwater for 24 hours.
- Fish were incubated in DASPEI for 15 minutes to dye their hair cells yellow.
- The healthier hair cells are brighter
- Unhealthy hair cells are dimmer or not seen at all.

### Stormwater Averages Normalized to Control

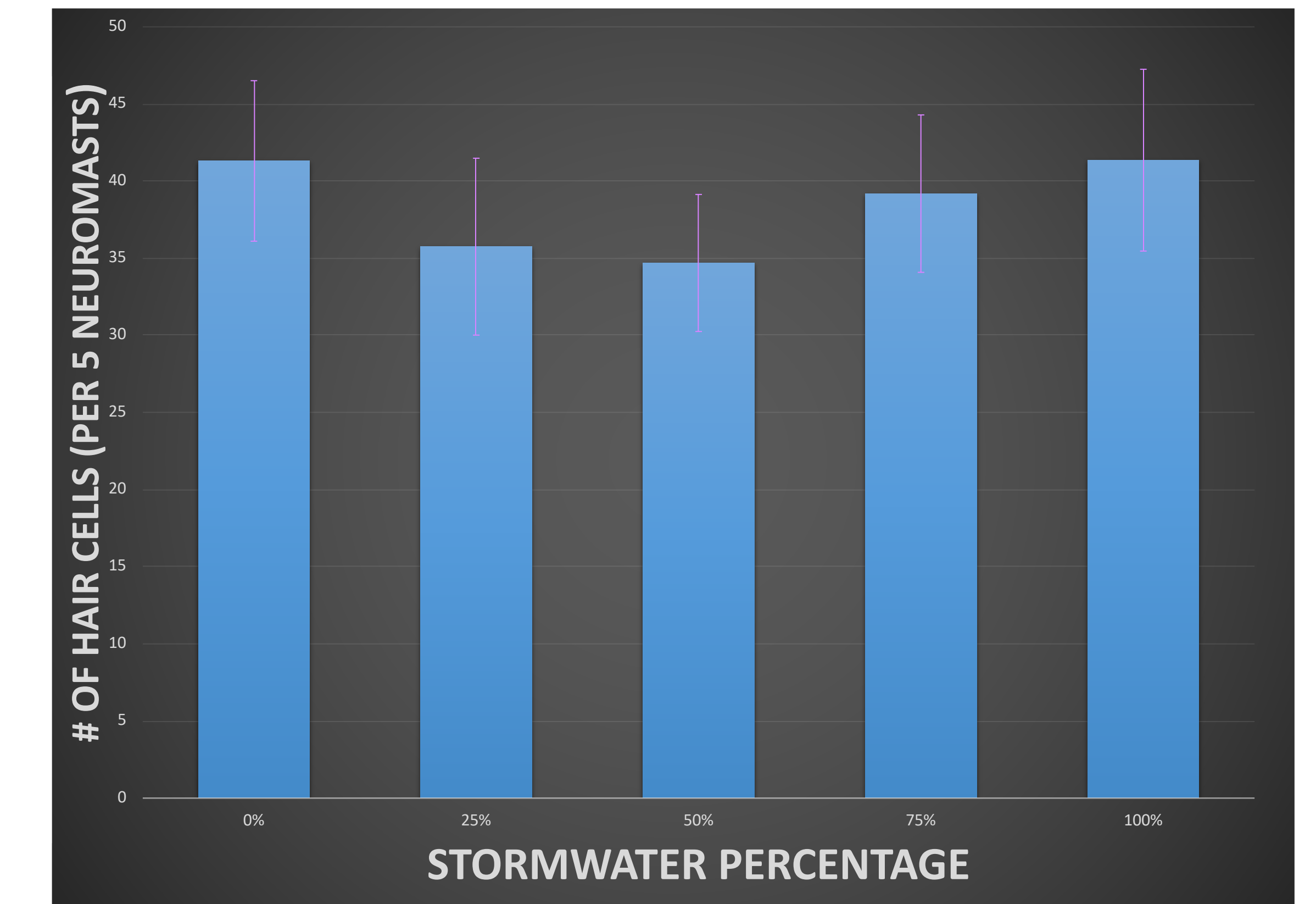


We have data from one filtered stormwater sample from a single storm event. Our preliminary data suggests that when hair cells are acutely exposed to high concentration of stormwater we will see increased in toxicity of hair cells along the lateral line.



These samples came from the stormwater event and were unfiltered. In general the trend is that later samples (6/6) show some hair cell toxicity at higher concentrations, while early samples (1/6) are not toxic at all.

## Does filtered stormwater influence lateral line development?



- Fish were reared in varying concentrations of stormwater for 4 days, with stormwater changed each day
- At 4 days old the fish were euthanized and tissues were labeled so hair cells could be counted using a compound fluorescence microscope
- After analyzing the preliminary hair cell count data we have found no significant differences between the treatment groups
- This preliminary data suggests that filtration of stormwater is effective at decreasing toxicity to zebrafish hair cells in the developing lateral line

## Conclusion & Future Directions

- We have tested seven water samples to date and are still collecting and analyzing data from these samples
- Most filtered stormwater samples have not been toxic to zebrafish lateral line hair cells
- Most unfiltered stormwater samples have not been toxic to zebrafish
- We expect that as more data is collected, we will see toxicity caused by some unfiltered samples
- This work will provide vital information as to how urban stormwater filters are operating and the potential impact on aquatic life when they fail

## Acknowledgement

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## References

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Young A, Kochenkov V, McIntyre JK, Stark JD, Coffin AB. 2018. Urban stormwater runoff negatively impacts lateral line development in larval zebrafish and salmon embryos. *Sci Rep* 8: 2830