WE CLAIM:

1. A multi-stage filter system for remediation of water from a contaminated water source to provide a purified water product, the system comprising:

- a first filter stage configured to remove coarse solid contaminants, the first filter stage comprising:

an intake port for placement into the contaminated water source;

at least one strainer element; and

a pump configured to draw water from the contaminated water source into the intake port and through the strainer element to provide a first filtrate;

- a second filter stage configured to remove contaminants larger than about 20 nm to about 40 nm to provide a second filtrate;

- a third filter stage configured to remove dissolved chemical contaminants from the second filtrate to provide a third filtrate, the third filter stage comprising at least one graphene-based filter containing at least one graphene-based material;

- a fourth filter stage configured to remove residual nanoparticle contaminants from the third filtrate to provide the purified water product; and

- an outflow structure configured to convey the purified water product from the fourth filter stage for discharge.

2. The system of claim 1, wherein the contaminated water source is contaminated groundwater, industrial wastewater, mine tailings, natural flowing fresh water, lake water, pond water, rain water runoff, or a source of fresh water with unknown dissolved or dispersed contaminants.

3. The system of claim 1 or 2, wherein the system further comprises a power source.

4. The system of any one of claims 1 to 3, wherein the system is provided within a single housing.

5. The system of any one of claims 1 to 4, wherein the first filter stage further comprises a coarse strainer element configured to remove coarse solid contaminants larger than about 0.2 cm, wherein the coarse strainer element is located at the intake end of the intake port.

6. The system any one of claims 1 to 5, wherein the second filter stage comprises a filter element having an average pore opening diameter of about ~~20~~ 10 nm to about 40 nm, preferably about 10 nm to about 20 nm.

~~7. The system of any one of claims 1 to 5, wherein the second filter stage comprises a filter element having an average pore opening diameter of about 10 nm to about 20 nm.~~

~~8~~7. The system of any one of claims 1 to ~~7~~6, wherein the second filter stage comprises an ultrafiltration device, wherein the ultrafiltration device is preferably a ceramic filter or a hollow fiber membrane, and wherein the second filter stage optionally comprises a booster pump to pull the first filtrate through the filter.

~~9. The system of claim 8, wherein the ultrafiltration device is a ceramic filter or a hollow fiber membrane.~~

~~10. The system of claim 8 or 9, wherein the second filter stage further comprises a booster pump to pull the first filtrate through the filter.~~

~~11~~8. The system of ~~any one of claims 8 to 10~~claim 7, wherein the second filter stage is regenerated by flushing with clean water in a reverse flow or crossflow direction.

~~12~~9. The system of claim ~~11~~8, wherein the second filter stage is regenerated automatically once the second filter stage has reached filtration capacity.

~~13~~10. The system of any one of claims 1 to ~~12~~9, wherein the graphene-based material in the third filter stage is graphene, preferably few layer graphene, and/or graphene-oxide, preferably few layer graphene oxide.

~~14. The system of any one of claims 1 to 12, wherein the graphene-based material in the third filter stage is few layer graphene.~~

~~15. The system of any one of claims 1 to 12, wherein the graphene-based material in the third filter stage is few layer graphene oxide.~~

~~16~~11. The system of any one of claims 1 to ~~12~~9, wherein the at least one graphene-based filter in the third filter stage comprises a combination of few-layer graphene powder and pellets comprising a mixture of polyether sulfone, graphene oxide, and dimethylformamide (Type A).

~~17~~12. The system of any one of claims 1 to ~~12~~9, wherein the at least one graphene-based filter in the third filter stage comprises few-layer graphene powder (Type B).

~~18~~13. The system of any one of claims 1 to ~~12~~9, wherein the at least one graphene-based filter in the third filter stage comprises a composite comprising chitosan, about 0.1% to about 10% by weight of few layer graphene oxide, sodium sulfate, and ferric chloride hexahydrate (Type C).

~~19~~14. The system of any one of claims 1 to ~~12~~9, wherein the at least one graphene-based filter in the third filter stage comprises few-layer graphene powder, a composite comprising chitosan, about 0.1% to about 10% by weight of few layer graphene oxide, sodium sulfate, and ferric chloride hexahydrate, and granular activated carbon (Type M1).

~~20~~15. The system of any one of claims ~~16~~ 11 to ~~19~~14, wherein the at least one graphene-based filter is regenerated by flushing with a dilute aqueous acid solution.

~~21~~16. The system of any one of claims 1 to ~~20~~15, wherein the fourth filter stage comprises a filter membrane having an average pore opening diameter of from about 8 nm to about 20 nm.

~~22~~17. The system of any one of claims 1 to ~~21~~16, wherein the fourth filter stage comprises a hollow fiber membrane filter.

~~23~~18. The system of any one of claims 1 to ~~22~~17, wherein each of the first filter stage, the second filter stage, the third filter stage and the fourth filter stage is removable and replaceable.

~~24~~19. A graphene-based filter cartridge comprising a filtering material in a filter cartridge housing, wherein the filtering material comprises at least one graphene-based material.

~~25~~20. The cartridge of claim ~~24~~19, wherein the filtering material comprises:

few-layer graphene powder, and pellets comprising a mixture of polyether sulfone, graphene oxide, and dimethylformamide (Type A);

few-layer graphene powder (Type B);

a combination of chitosan, about 0.1% to about 10% by weight of few layer graphene oxide, sodium sulfate, and ferric chloride hexahydrate (Type C); or

few-layer graphene powder, a composite comprising chitosan, about 0.1% to about 10% by weight of few layer graphene oxide, sodium sulfate, and ferric chloride hexahydrate, and granular activated carbon (Type M1).

~~26. The cartridge of claim 24, wherein the filtering material comprises few-layer graphene powder (Type B).~~

~~27. The cartridge of claim 24, wherein the filtering material comprises a combination of chitosan, about 0.1% to about 10% by weight of few layer graphene oxide, sodium sulfate, and ferric chloride hexahydrate (Type C).~~

~~28. The cartridge of claim 24, wherein the filtering material comprises few-layer graphene powder, a composite comprising chitosan, about 0.1% to about 10% by weight of few layer graphene oxide, sodium sulfate, and ferric chloride hexahydrate, and granular activated carbon (Type M1).~~