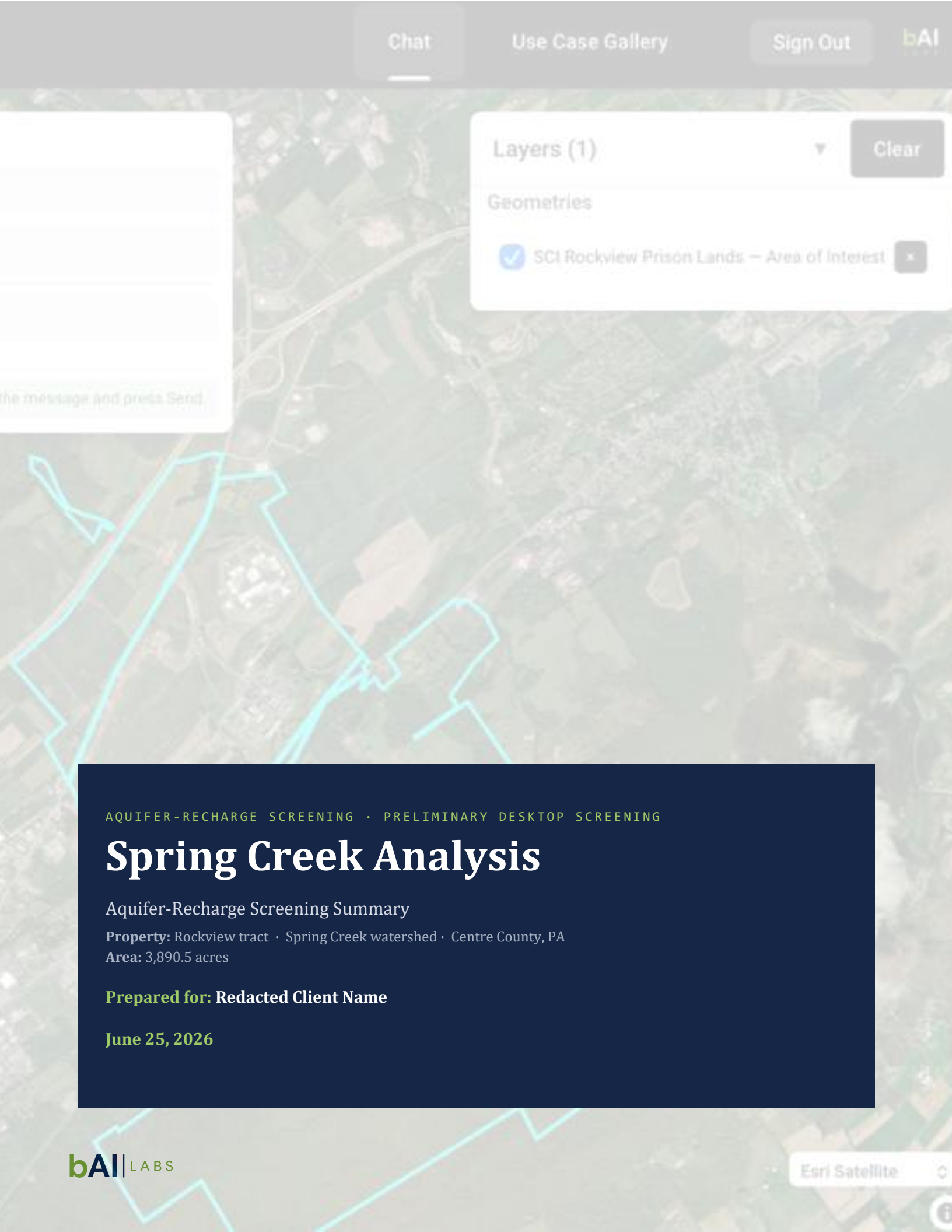


AQUIFER-RECHARGE SCREENING · PRELIMINARY DESKTOP SCREENING

Spring Creek Analysis

Aquifer-Recharge Screening Summary

Property: Rockview tract · Spring Creek watershed · Centre County, PA
Area: 3,890.5 acres

Prepared for: **Redacted Client Name**

June 25, 2026

bAI | LABS

Introduction

This preliminary screening was prepared by bAI Labs, a BAI Group company focused on the application of artificial intelligence to civil and environmental engineering. Combining geology & engineering expertise with advanced geospatial analysis and AI-assisted workflows, this early screening was prepared for <REDACTED> and <REDACTED> to support initial evaluation of the Rockview property development inside the Spring Creek Watershed, and identify key opportunities and constraints for further study.

The two questions, answered

Q1

What portions can be placed in impermeable cover without reducing aquifer recharge?

→ About 61 acres — 1.6% of the property.

The rest either recharges the aquifer or is regulated.

Q2

How much recharge now, and in ~30 years?

→ ~4,000 ac-ft/yr now (~3.6 MGD, ~1.3 billion gal).

In 30 years, climate change alone leaves it roughly flat; the real control is how much land gets paved.

NOTE **Preliminary desktop screening, not a model or field survey.** Every number below is defensible at screening grade and is sourced. Parcel-scale lines and volumes would shift with a field soil/geophysical survey and a coupled hydrologic model.

How this screening was produced

This screening was assembled with an **AI-assisted geospatial workflow, directed and verified by our team**:

- **Built on our in-house GeoAI agent (AWS, Sonnet 4.6)**, fetched the data, ran the GIS, terrain, and water-balance computations, and drafted the synthesis under our direction.
- **Operated with Claude Code (Opus 4.8)** as the analytical operator. The model extended where its standard tools fell short (multi-layer overlay, raster sampling, terrain flow-routing, reaching unregistered datasets).
- **Customized around a data source list curated by our geologists**. A vetted set of authoritative datasets (USDA SSURGO soils; USGS 3DEP elevation; PA DCNR PaGWIS wells; PASDA geology, karst, wetlands, and FEMA flood layers; NLCD land cover; USGS / PA DEP / SRBC studies).
- **Independently cross-checked** against Transect (see appendix) and verified by our team.

Every input, prompt, and computation is auditable — see the companion **Observability & Explainability Report** *(Spring Creek Report - Observability.pdf).*

Q1 — Where can you develop? (suitability tiers)

Regulatory & hazard constraints and setbacks

Before any acre was scored, the regulated and hazard-prone ground was mapped and buffered. The setback distances below are policy choices (adjustable), applied uniformly across the property:

CONSTRAINT	BUFFER	NOTE
Karst feature	100 ft	Carbonate-area stormwater setback
Stream (HQ/EV; Ch. 102.14)	150 ft	Adopted from Transect report that identified High Quality/Exceptional Value water is present
Spring	100 ft	—
Wetland	0 ft (polygon)	Could add 50–100 ft transition buffer
FEMA SFHA	polygon	Zones A/AE

Applied to the property, these constraints place 325 acres of ground off-limits to impervious cover: stream buffers 175 ac · karst buffers 111 ac · potential wetlands 52 ac · FEMA floodplain 4 ac, all concentrated along the valley drainages.



Figure 1. *Constraint buffers (stream 150 ft, karst 100 ft, wetlands, FEMA floodplain) concentrated along the valley drainages.*

Suitability tiers

Each acre was scored by stacking soil infiltration (SSURGO hydrologic group), bedrock type (carbonate vs. siliciclastic), and the regulatory/hazard constraints defined above, then classified into three-tier set.

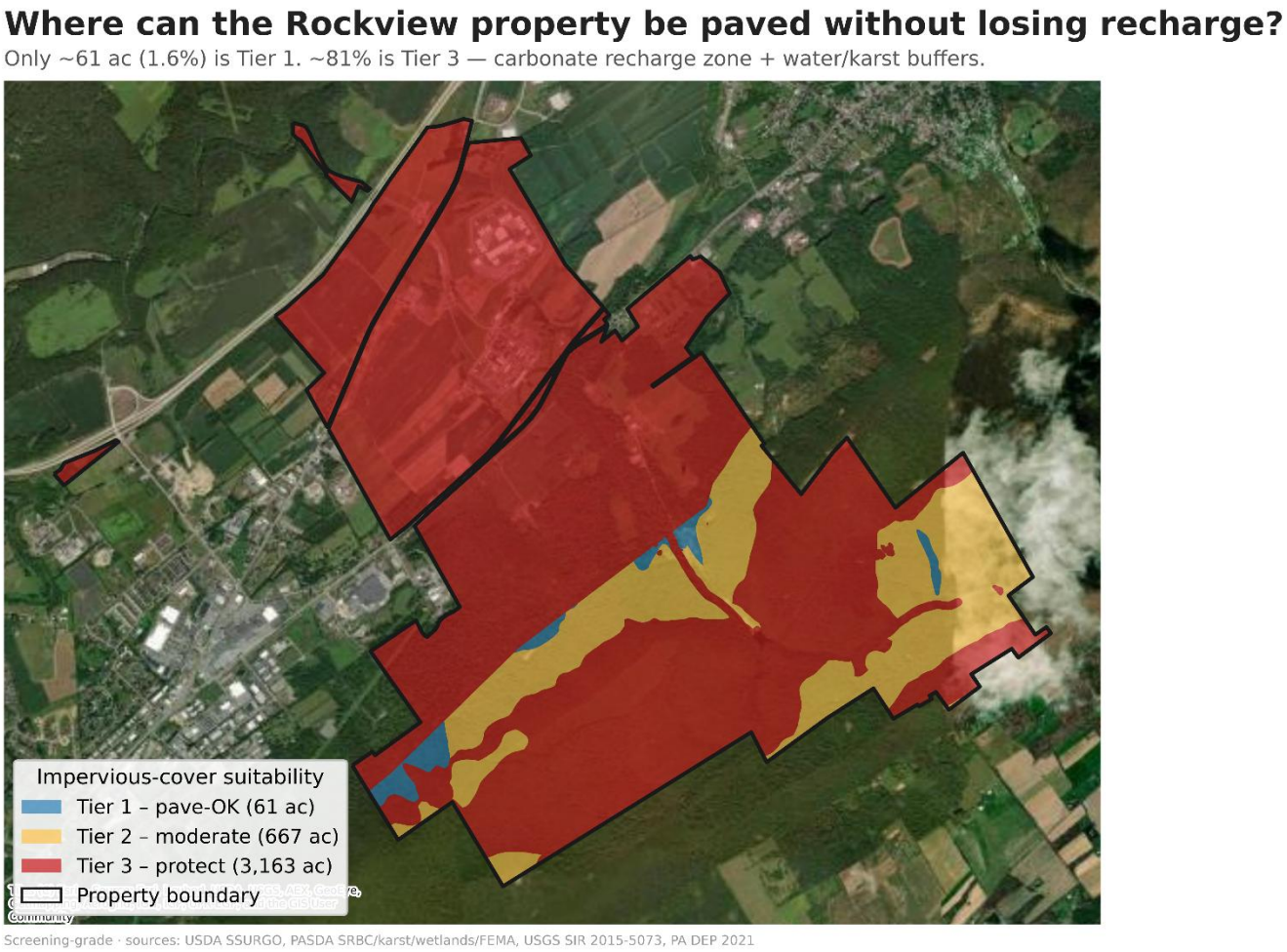


Figure 2. *Impervious-cover suitability. Blue = Tier 1 (pave-OK), amber = Tier 2, red = Tier 3 (protect).*

TIER	ACRES	%	WHAT IT MEANS
Tier 1 — lowest recharge impact	61	1.6%	Non-carbonate, low-infiltration soil, no constraints — pave here first
Tier 2 — moderate	667	17.1%	Possible with stormwater mitigation
Tier 3 — protect	3,163	81.3%	High recharge or regulated — avoid impervious cover

Why so little is Tier 1: 52% of the property sits on carbonate bedrock (limestone/dolomite of the Nittany Valley). Carbonate looks like poor *surface* soil but is a **rapid aquifer-recharge** zone through karst conduits and paving it directly harms the aquifer and raises sinkhole risk. **325 acres** fall inside stream, karst, wetland, and floodplain buffers.

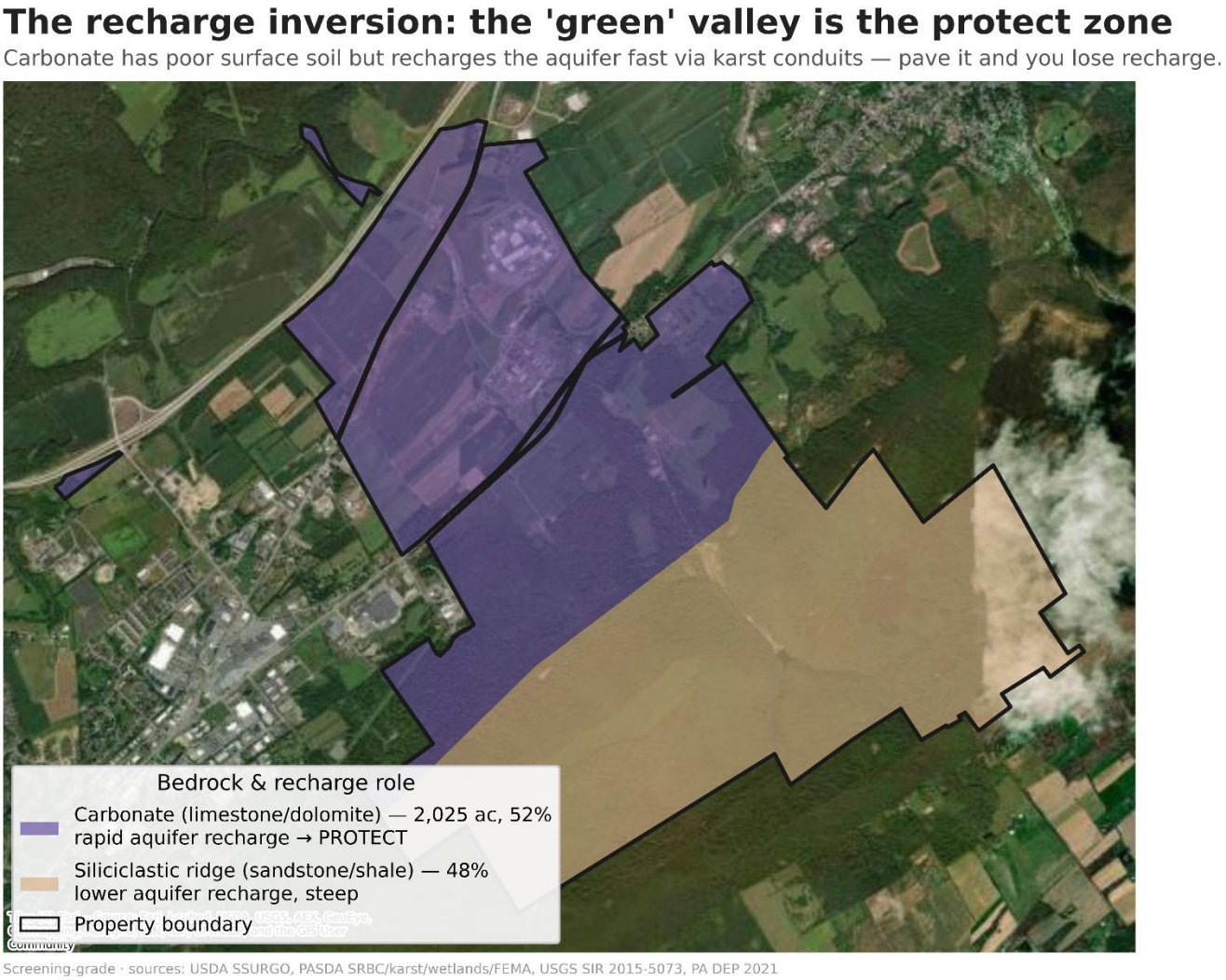


Figure 3. *The recharge inversion. The carbonate valley (purple) has poor surface soil but recharges the aquifer fast through karst conduits, which is exactly why it must be protected, not paved.*

Recommendation: concentrate development on Tier 1 and on **already-disturbed land** (existing compound, former quarry, urban-Hagerstown soils). Treat Tier 3 as constrained from the outset.

Focused karst recharge — the highest-priority protect ground

Using USGS 3DEP elevation (1 m), we isolated the **top-decile, highest-elevation karst features** which include 17 closed depressions/cave/mine above 1,114 ft, and delineated the surface catchment draining to them.

Where recharge is focused: high-elevation karst intake points

~5% of the property's recharge concentrates through 17 up-gradient swallets and their 194-ac surface catchment.



Screening-grade · sources: USDA SSURGO, PASDA SRBC/karst/wetlands/FEMA, USGS SIR 2015-5073, PA DEP 2021

Figure 4. *High-elevation karst intake points and their recharge catchments.*

METRIC	VALUE
High-elevation karst features (top decile, >1,114 ft)	17 (15 depressions, 1 cave, 1 mine)
Collective contributing catchment (union, no double-count)	194 ac (184 on-property, 10 upslope)
Recharge focused through these swallets @12.4 in/yr	~200 ac-ft/yr (~0.18 MGD)
Share of total property recharge	~5%

WHY IT MATTERS ~5% of all property recharge concentrates through 17 point features in the aquifer's up-gradient intake position. Paving within these 194 ac **severs concentrated recharge at the swallets and raises sinkhole-collapse risk, and development surrounding these areas presents a direct conduit to groundwater for potential water quality contaminants far from the stream itself.** These are the highest-priority protect acres.

CAVEAT DEM flow-routing gives a surface contributing area; karst subsurface diversion isn't visible to a DEM, so 194 ac is a screening estimate, not a dye-traced capture zone.

Q2 — How much recharge, now and in 30 years?

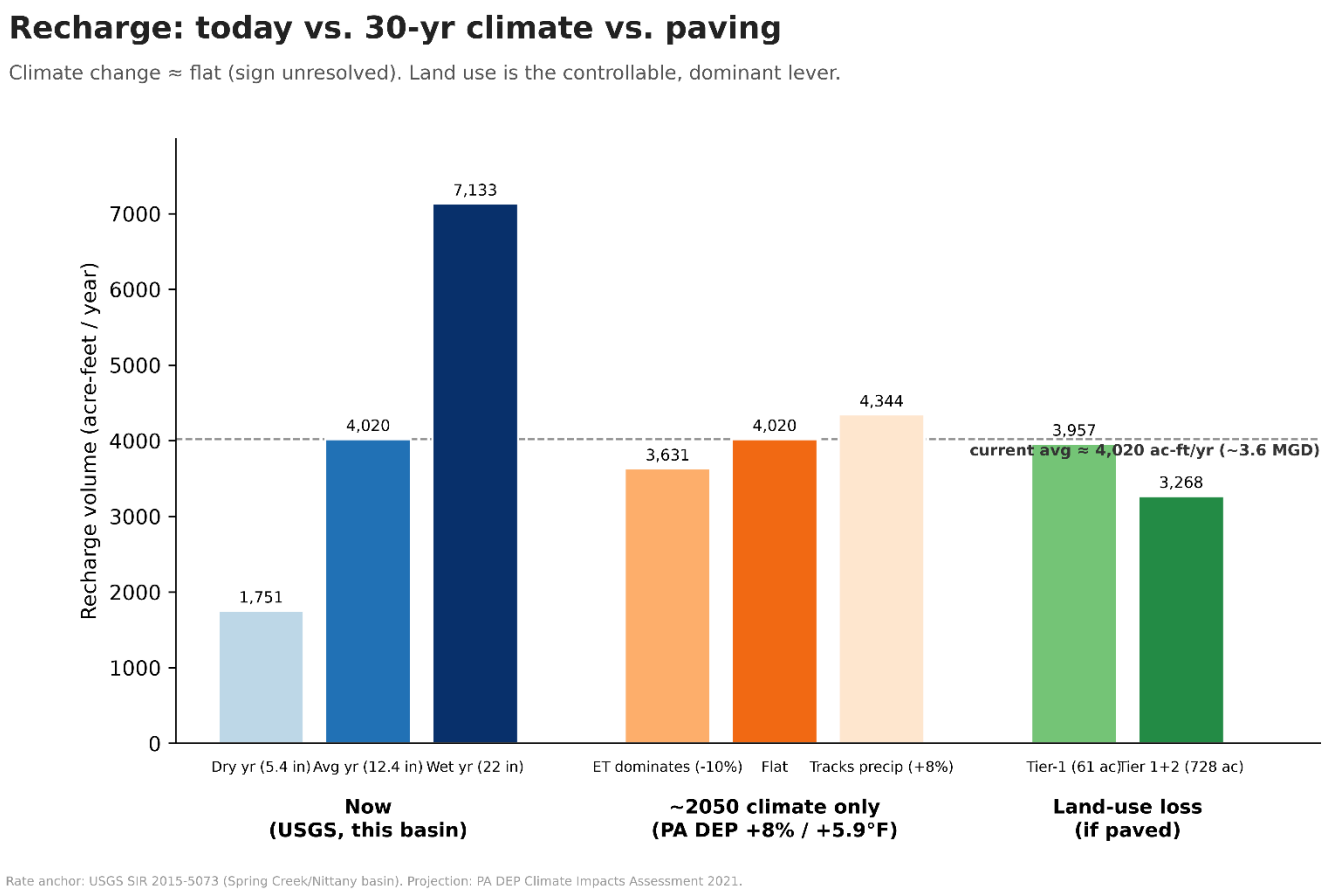


Figure 5. *Recharge today (dry/avg/wet) vs. ~2050 climate scenarios vs. recharge lost to paving. The climate signal is roughly flat; the controllable, dominant lever is land use.*

Now

Anchored to **USGS SIR 2015-5073** which is a published water-budget model of the property's own Spring Creek / Nittany Creek basin.

	RECHARGE RATE	VOLUME	≈ MGD
Average year	12.4 in/yr	~4,020 ac-ft/yr	3.6
Dry year	5.4 in/yr	~1,750 ac-ft/yr	1.6
Wet year	22.0 in/yr	~7,130 ac-ft/yr	6.4

Cross-check: that's ~30% of the property's 41.6 in/yr precipitation — the expected fraction for this terrain. **The dry-to-wet swing (±65%) is bigger than any 30-year climate trend.**

In ~30 years

Climate (PA DEP Climate Impacts Assessment 2021): +8% precipitation, +5.9°F by ~2050. More rain, but warming raises evapotranspiration and storms get flashier — these cancel.

PLANNING BASIS We report the 30-year recharge as a range, not a single number: **≈ 3,600–4,340 ac-ft/yr** (roughly −10% to +8% of today's ~4,020). Screening data cannot confidently call even the direction of the climate signal, so an absolute point value would overstate our certainty.

NOTE The regional growth and groundwater demand factors discussed below both push the realistic outcome toward the lower end of this band. Treat ~4,020 as a present-day central estimate and the **lower half of the range** as the more prudent planning basis for 2050.

The controllable lever is land use, and it dominates: every ~100 acres paved on recharge ground removes ~100 ac-ft/yr (~0.09 MGD).

DEVELOPMENT FOOTPRINT	RECHARGE LOST
Tier-1 only (61 ac)	~63 ac-ft/yr (0.06 MGD)
500 ac	~520 ac-ft/yr (0.46 MGD)
Full Tier-1+2 (728 ac)	~750 ac-ft/yr (0.67 MGD)

Bottom line: keep development on Tier-1/disturbed land and recharge loss stays inside the climate noise (<0.1 MGD). Development into Tier 2/3 is where measurable, permanent recharge loss begins.

(The table above is the conservative bound — 100% impervious, uniform placement. The realistic, optimally-placed footprint is computed in the Maximum developable footprint section.)

Is the 30-year rate "static"? Demographic & development drivers

1. Centre County is a growth county but the growth is steered away from Spring Creek. The PA State Data Center projects Centre County from **157,962 (2020) → 177,459 (2050), about +12.3% over 30 years** and this is far above the near-flat statewide trend (+1.6%). But that growth is concentrated inside the Centre Region Regional Growth Boundary. **Spring Creek is in Benner Township, outside that growth boundary** and its sewer service area. County population growth does not drive development onto the property.

2. The property's own land use is a Commonwealth decision, not a market one. Rockview is state-owned (SCI Rockview prison lands). Its development trajectory is set by what the Commonwealth chooses to build, not by county population-driven demand. This is exactly the lever we already bracket in the Maximum developable footprint section.

Where the static assumption does bite — the borrowed basin rate. The recharge rate (USGS SIR 2015-5073) was calibrated to early-2000s land cover. Basin impervious cover rose from **6.9% (2001) to 9.3% (2024)**, which is a +2.4 percentage points, ~2,235 acres of new impervious in 23 years and extrapolates to

~12% by 2050. That erosion lowers the basin-mean recharge rate by **~3% from 2024 to 2050**. This is about ~120 ac-ft/yr off the property's borrowed rate.

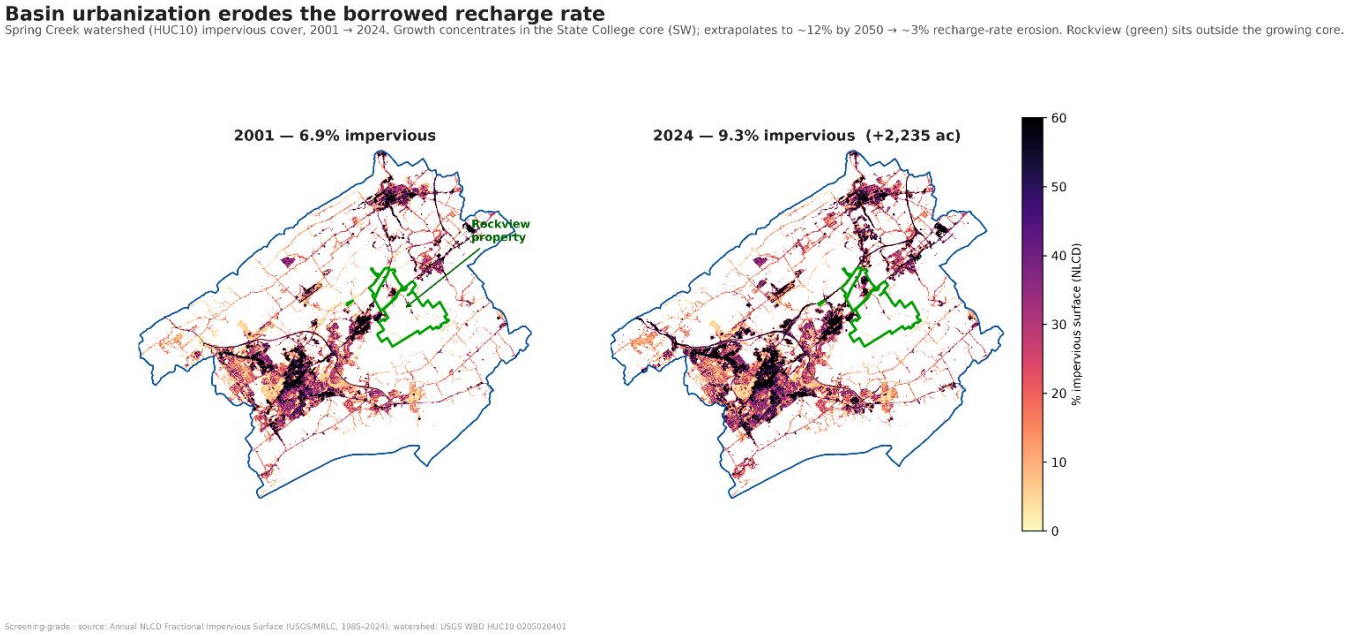


Figure 6. *Basin impervious change 2001 vs. 2024 (Annual NLCD).*

NET FINDING The county is not static (+12% to 2050), but both drivers that would change Spring Creek's recharge are bounded. On-property change is a state decision modeled explicitly, and basin-wide urbanization is policy-steered and only modestly erodes the borrowed rate (**confirmed ~3% downward pressure**). This nudges the 30-yr number toward the lower half of the 3,600–4,340 ac-ft/yr band, not outside it.

Groundwater demand — the other side of the ledger

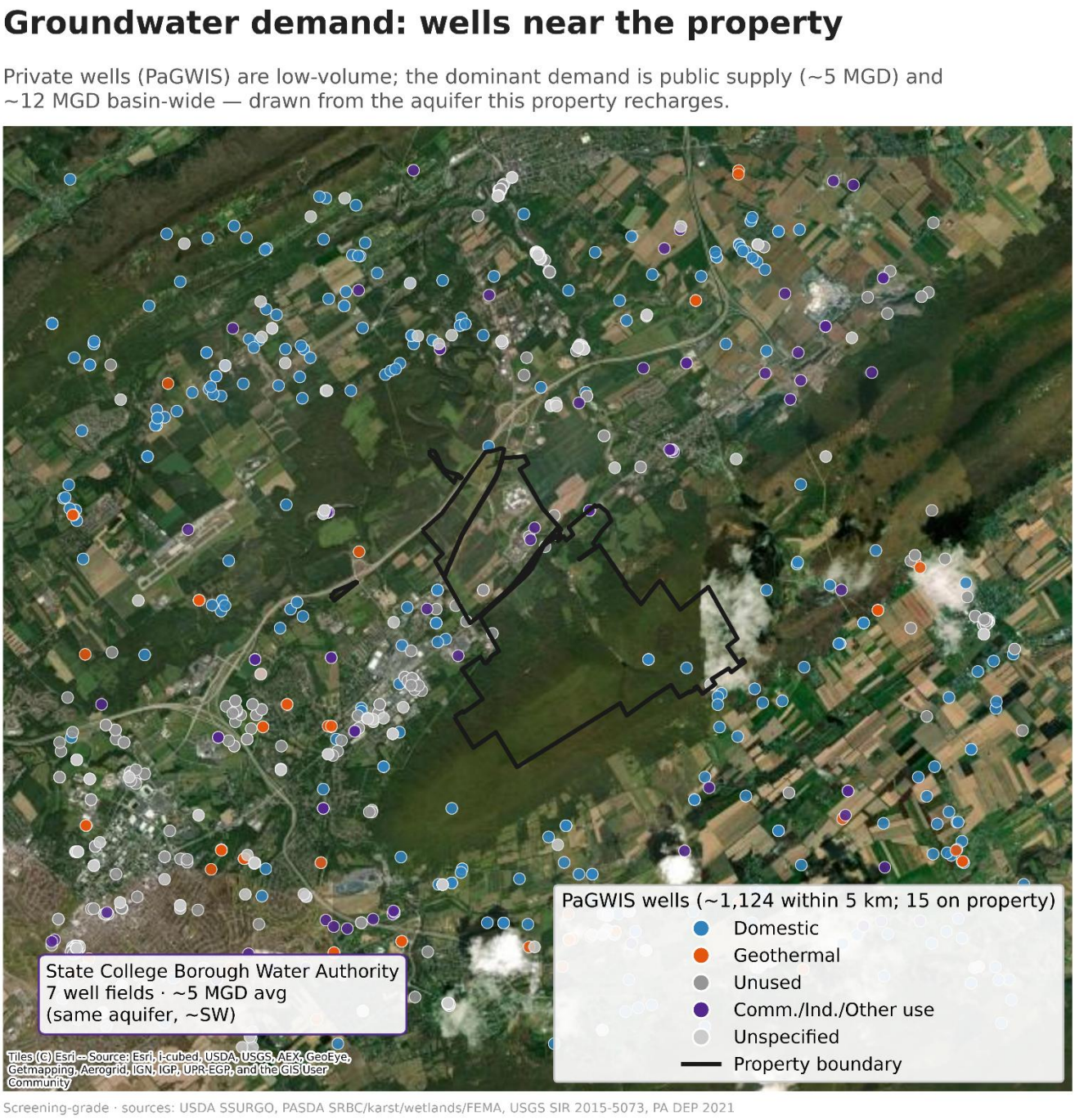


Figure 7. *Groundwater wells near the Rockview property.*

Recharge is only the **supply** side of the aquifer. The PA Groundwater Information System records **15 wells within the property** and **~1,124 within ~5 km**, overwhelmingly domestic, unused, or geothermal. The volumetrically dominant demand is public supply:

SOURCE	PERMITTED (SRBC)	ACTUAL USE	NOTES
State College Borough Water Authority (system)	8.0 MGD	~5.0 avg / 6.0 peak	7 well fields, 23 wells in Spring Creek / Slab Cabin aquifer; serves >75,000 incl. parts of Benner Township
SCBWA wells in Benner Township (Wells 71/73/78/79)	4.82 MGD	(subset)	SCBWA sources physically nearest Rockview — same aquifer, same township
Spring Creek basin — all groundwater withdrawals	—	~12 MGD	USGS / Spring Creek Watershed Atlas (SCBWA + Penn State + others)
Context — basin water budget	—	precip ~333 → ET ~185 MGD	leaves ~148 MGD as streamflow + usable groundwater; ~12 MGD withdrawal ≈ 8% of that

Why this matters for Rockview: The property is a **recharge source area (~3.6 MGD)** feeding the same carbonate aquifer that the basin already withdraws ~12 MGD from and that supplies the water authority serving its own township. Preserving Rockview's recharge directly offsets a real, metered, and growing demand on a shared aquifer.

30-year demand projection: If withdrawals scale with the projected +12% county population, basin pumping rises from **~12 → ~13.5 MGD** and SCBWA from ~5.0 → ~5.6 MGD. That ~1.5 MGD of added demand is comparable to nearly half the property's entire recharge yield which is why **rising demand, not the property's own land-use change, is the more likely binding 30-year stress on the aquifer.**

NET On the supply side our 30-yr recharge range (3,600–4,340 ac-ft/yr) is robust; on the demand side the trend is unambiguously upward. The prudent planning read is a **flat-to-declining supply meeting a rising demand** thus reinforcing the lower-half-of-range guidance and the case for protecting the property's recharge function.

Maximum developable footprint

Question: how much development can the property absorb without pushing 30-year recharge outside the range climate change itself would cause?

Recharge budget: keep loss within the climate-noise band which is **±8% ≈ 322 ac-ft/yr** (a change smaller than the climate signal is not meaningfully detectable).

SOURCE OF DEVELOPMENT	ACRES	RECHARGE COST
New build — Tier 1 (low-recharge ground)	~56	~14 ac-ft/yr
New build — Tier 2 (moderate ground)	~629	~267 ac-ft/yr
Maximum NEW development (undeveloped land)	~685 ac	~281 ac-ft/yr (7.0%)
+ redevelopment of already-disturbed land (~0 cost)	~284	~0
Gross developable footprint	~970 ac	—

Resulting 30-yr recharge ≈ 3,740 ac-ft/yr — inside the 3,600–4,340 climate range.

KEY FINDING Recharge is ***not* the binding constraint.** The budget would permit the entire ~685-ac unconstrained (Tier 1+2) envelope with headroom to spare. What limits development is the **Tier-3 protections** (carbonate recharge zone, stream/karst/wetland buffers, the 194-ac focused catchment) and, very likely, **legal constraints** not the recharge volume. Site within the non-protected envelope and the 30-year recharge budget takes care of itself.

Main assumptions

ASSUMPTION	VALUE USED	EFFECT IF CHANGED
Tolerance	Within climate noise (±8%)	Strict zero-loss → answer shrinks to ~the disturbed land only
Impervious fraction	55% (typical commercial/institutional)	100% impervious → ~430 ac; 35% → larger
Placement	Lowest-recharge-first, avoiding carbonate + focused catchment	Random/uniform placement → smaller
Per-class recharge rate	HIGH:MOD:LOW ≈ 1:0.7:0.4, calibrated to 12.4 in/yr	Reasoned, not measured (see future studies)
Stormwater mitigation	None credited	Infiltration BMPs would raise the ceiling

Limitations of this number

- **Legal/ownership is likely the tighter limit.** The ~685-ac figure is the hydrologic ceiling; the legally developable area is probably far smaller. This analysis says "recharge won't stop you" but the easements may.
- **Tier 1/2 still carry their own requirements.** slope, NPDES, PAG-02 (HQ/EV individual permit), stormwater design.
- The per-class recharge rates are screening-grade calibrations, not field-measured; a recharge model would firm up the budget arithmetic.

What this screening can't do

1 No live recharge / precipitation / climate-projection data service exists for the automated tool and these figures were assembled by hand from rasters + published USGS/PA-DEP studies.

2 The regional recharge map is a relative index, not a volumetric rate and it under-ranks karst recharge. It cannot size volume; the USGS basin model supplies the rate.

3 A true 30-year recharge forecast needs a coupled climate–ET–runoff model (e.g., GSFLOW with downscaled CMIP6). This is a screening bracket, not a model run.

4 Parcel-scale soil/karst lines, wetland locations, and floodplain boundaries are generalized; confirm with field survey before design.

Recommended next studies

This is a preliminary desktop screening, not a substitute for modeling or field investigation. Every number here is meant to bound the problem and direct effort. The following would materially improve confidence, roughly in priority order:

#	STUDY / DATA	WHAT IT RESOLVES	TURNS SCREENING-GRADE → DEFENSIBLE FOR DESIGN
1	Coupled hydrologic model (GSFLOW or MODFLOW + PRMS) forced with downscaled CMIP6	Replaces the ±10% climate bracket with an actual 30-yr recharge projection; firms the per-class recharge rates	Q2 forecast; the recharge budget arithmetic
2	Field soil & karst survey + geophysics (test pits, borings, ER/microgravity)	Confirms parcel-scale hydrologic-group and carbonate/karst lines; locates unmapped sinkholes, springs, or other karst features	Tier boundaries; Tier-1 acreage; sinkhole risk
3	Dye-trace / spring-monitoring study of the high-elevation swallets	Replaces the DEM surface catchment with the true subsurface capture zone	The 194-ac focused-recharge finding (Fig 5)
4	Infiltration testing (double-ring, percolation) on candidate development parcels	Site-specific recharge rates instead of the basin-average 12.4 in/yr	Recharge volume; max-development budget
5	Stormwater / BMP infiltration design study	Quantifies how much development a recharge-neutral design could support beyond ~685 ac	Maximum developable footprint
6	Wetland delineation & jurisdictional determination (field)	Replaces modeled wetlands (~21–52 ac range) with surveyed, regulatory boundaries	Tier-3 constraint extent; permitting
7	Title / easement & legal review	Resolves Ag Conservation Easement, conservancy easements, and Commonwealth-ownership limits	The legally developable area (likely the true binding constraint)
8	Local precipitation & gauge records (PSU Climate, USGS NWIS)	Site-calibrated water balance vs. the regional normals used here	Recharge now; interannual range
9	Basin land-cover / development projection — NLCD impervious trend now computed (6.9%→9.3%, 2001–24 → ~3% rate erosion to 2050)	Turns the linear NLCD extrapolation into a plan-based land-use forecast feeding the recharge model	Whether the 30-yr basin rate drifts faster/slower than the ~3% computed here
10	Groundwater demand & water-balance study — SRBC docket figures now in hand; remaining work is the full	Confirms whether basin withdrawals actually draw from the property's recharge area, and the true demand trajectory	Aquifer sustainability (supply vs. demand)

#	STUDY / DATA	WHAT IT RESOLVES	TURNS SCREENING-GRADE → DEFENSIBLE FOR DESIGN
	reported-use time series and well capture-zone delineation		
11	Historical site & prison operating records — land-use history, water-supply and wastewater-discharge records, existing on-site groundwater monitoring	Establishes a baseline and quantifies the existing facility's current impact on recharge and groundwater	Baseline groundwater condition; the "as-is" footprint

How to read this: items 1–4 convert the physical screening into a modeled/measured basis; items 6–7 convert the regulatory/legal screening into surveyed fact. Practical first step: (2) + (3) — a field soil/karst survey with dye-tracing.

Confidence

FINDING	CONFIDENCE
~52% carbonate / high-recharge valley	High
Tier-3 ≈ 80%+ of property	High
Tier-1 ≈ 61 ac	Moderate
Recharge now ~4,000 ac-ft/yr	Moderate–High
30-yr climate change ≈ flat	Low
30-yr land use a bounded driver (county +12%, but steered off-site; on-site = state decision)	Moderate
Basin impervious rising 6.9%→9.3% (2001–24) → ~3% recharge-rate erosion to 2050	Moderate–High
Groundwater demand rising (~12→~13.5 MGD basin; SCBWA permitted 8 / used ~5 MGD)	Moderate–High
Land-use sensitivity (~100 ac → ~0.09 MGD)	High
Focused karst recharge (~194 ac, ~5% via high swallets)	Moderate
Max developable ≈ 685 ac (recharge not the binding limit)	Moderate

Sources: USGS SIR 2015-5073; PA DEP Climate Impacts Assessment 2021; USDA SSURGO; USGS 3DEP elevation; PA State Data Center county population projections 2020–2050; Centre Region & Nittany Valley Joint comprehensive plans; Annual NLCD Fractional Impervious Surface (1985–2024) for Spring Creek HUC10 0205020401; PA DCNR PaGWIS wells; SRBC dockets & State College Borough Water Authority production figures; Spring Creek Watershed Atlas; PASDA SRBC, karst, wetlands, FEMA NFHL, Ch.93 streams.

AI provenance & reproducibility

Every quantitative claim above is **computed by re-runnable code or cited to a published source.** The analysis was AI-assisted (orchestration, data fetching, synthesis) with a human operator. The report was then evaluated and assessed by two Geologist. Additional independent cross-checks against the Transect report were performed. Full auditability is provided in:

- `ai_trace/` — the raw AI session trace (every prompt and tool call), a readable rendering, and a README on how to reproduce the results step-by-step.
- `data/` — every spatial/data artifact behind the analysis, documented in `data/README.md` with its source and which figure/section uses it.
- `report_figures/` — the figure scripts (`run_all.sh` rebuilds Figs 1–7 from `data/`).
- Companion **Observability & Explainability Report** (`observability_report.pdf`) gives the full audit trail including the complete AI session.

Appendix — Comparison with the independent Transect report

What Transect is. Transect is an independent environmental due-diligence and site-assessment platform we use at bAI Labs and BAI Group to screen properties for regulatory, permitting, and protected-species constraints. Because it is built and maintained entirely independently of this recharge screening, its output serves as a **neutral, third-party cross-check** on our physical inputs (boundaries, soils, geology, floodplain, hydrography).

Transect is an early **permitting / species** screen; it does ***not*** compute recharge or a development-suitability map. The two are complementary: Transect validates the physical inputs and adds a legal/regulatory constraint layer this screening did not include.

Where the two agree (independent corroboration → high confidence)

ITEM	THIS SCREENING	TRANSECT	VERDICT
Property area	3,890.5 ac	3,881.6 ac	☑ match (<0.3%)
Centroid	40.840, −77.769	40.8416, −77.7735	☑ match
FEMA Zone A floodplain	3.8 ac	3.804 ac	☑ exact
Bedrock split	52% carbonate valley / 48% siliciclastic ridge	Limestone+dolostone valley, sandstone+shale ridge	☑ match
SSURGO soils (major units)	Hazleton 591 / 399.8 / Hagerstown 258.5 / Urban-Hagerstown 76	590.1 / 399.0 / 258.1 / 75.7	☑ near-exact
Soil hydrologic group	HG A on ridge, B/D in valley	HG map identical pattern	☑ match
Streams	Spring Creek, Logan Branch, Gap Run	Spring Creek, Logan Branch, Gap Run + Black Hawk Gap Run, Rockview Reservoir	☑ match

ITEM	THIS SCREENING	TRANSECT	VERDICT
Watershed	Spring Creek (Bald Eagle / HUC 02050204)	Bald Eagle 02050204	☑ match

Where they differ (refinements that were applied)

1 **Wetland acreage.** This screening: ~52 ac. Transect's regulatory NWI count: **20.95 ac** (14 wetlands). This report is conservative-high; for permitting, use Transect's ~21 ac. Effect on tiers is small.

2 **Riparian buffer width.** Transect confirms **High Quality / Exceptional Value waters** and cites **PA Ch. 102.14 — 150 ft riparian buffer.** → Adopt 150 ft. Re-running the overlay: Tier 1: 61.2 → 60.3 ac, Tier 3 +13 ac — the headline is robust to this buffer choice, and the change is in the protective direction.

What Transect adds (major)

Transect surfaces a legal/ownership constraint layer that independently restricts development — and points the same direction as the recharge map:

- **Agricultural Conservation Easement** on part of the AOI — prohibits non-agricultural development in perpetuity.
- **ClearWater Conservancy conservation easements** on multiple "Rockview–PSU" parcels.
- **State Game Land 333** (PA Game Commission) and Spring Creek–Rockview (PA Fish & Boat); Mount Nittany Conservancy / Stony Batter Nature Park.
- **Ownership:** essentially the entire property is **Commonwealth of PA** (Bureau of Correction et al., ~3,882 ac across 5 parcels) not private developable land.
- **Species:** Bald Eagle (up to 660 ft nest buffer), Indiana/NLEB/tricolored bats (tree-clearing restrictions), plus PNDI review all add siting limits.

What this screening adds that Transect does not have

- **Recharge volume** (~4,000 ac-ft/yr, ~3.6 MGD) — Transect computes no water budget.
- **30-year climate-change outlook** and the land-use sensitivity (~100 ac → ~0.09 MGD).
- **The suitability overlay itself** — Transect lists soil, geology, and constraints on separate pages; this screening intersects them into one paveable-vs-protect tier map.
- **The carbonate-recharge inversion** — the key interpretive call that the carbonate valley, despite poor surface soils, is the property's highest aquifer-recharge zone.

Bottom line

CONVERGENCE Two independent analyses, different methods, **converge**: very little of the Rockview property located in Spring Creek watershed is realistically developable. This screening reaches ~81% "protect" on **hydrologic** grounds (carbonate recharge + water buffers); Transect shows much of the same ground is **already legally protected** (easements, game lands, state ownership) and that the waters are HQ/EV. The recommendation to confine any impervious cover to the small Tier-1 / already-disturbed footprint is reinforced from both directions — and the one correction Transect prompts makes the developable envelope **smaller**, not larger.

Transect report: "Spring Creek," Transect (BAI Group), 2026-06-22, 60 pp.