

Paducah Ultra-Scale Brownfield Power Campus

High-Discipline, Planning-Only Project Definition for DOE AI Infrastructure on DOE Lands

Primary Site (Planning Reference): Former Paducah Gaseous Diffusion Plant (PGDP), Kentucky
Posture: Planning-only, unclassified, proxy-based conceptual framework

Source Boundary: All site descriptions and role characterizations are drawn from the March 2025 “AI Infrastructure on DOE Lands” Request for Information and public DOE / Paducah materials. No additional site facts, capacities, or timelines are introduced.

Executive Summary

This project defines a planning-grade concept for a Paducah Ultra-Scale Brownfield Power Campus: a conceptual AI infrastructure planning construct situated conceptually within the former Paducah Gaseous Diffusion Plant reservation in planning models. The concept explores, at a high-discipline planning level, whether very large AI infrastructure footprints could potentially be evaluated on previously industrial land using proxy modeling constructs, without asserting any specific capacity, readiness, or deployment feasibility.

The project treats Paducah’s historical industrial scale, legacy utilities context, and logistics footprint strictly as planning references derived from public DOE descriptions and the RFI. All energy, water, transmission, and logistics attributes are modeled abstractly using qualitative or range-based proxies. No assumption is made about current availability, operability, suitability, or regulatory readiness of any asset.

This document establishes a disciplined planning framework that allows DOE to compare brownfield reuse pathways against other candidate sites using consistent architectural templates, governance assumptions, risk framing, and reversibility logic. All outputs are planning artifacts only and do not imply operational control, construction intent, procurement action, or site commitment.

Program Purpose and Planning Disclaimer

The purpose of this project is to define a high-discipline, planning-only framework for evaluating whether large-footprint AI infrastructure concepts could, in principle, be examined within a brownfield industrial context using proxy modeling and conservative governance assumptions.

All concepts in this document are planning-grade and proxy-based. They do not authorize design, construction, operation, or procurement. Energy integration refers exclusively to conceptual

modeling linkages between AI workload abstractions and abstract energy system representations, not physical or operational coupling to any real asset.

Where site details are not explicitly provided in the RFI or public DOE materials, they are treated as “Not specified” and intentionally left undefined.

Strategic Rationale

The RFI identifies Paducah as a candidate site with significant historical industrial infrastructure, a large disturbed land footprint, and legacy utility and logistics systems associated with prior enrichment operations. These characteristics make Paducah uniquely suited for exploring brownfield reuse scenarios in conceptual planning models, particularly for evaluating very large infrastructure footprints without asserting specific capacity assumptions.

From a portfolio perspective, Paducah provides a complementary planning case to greenfield research campuses and constrained mission sites. It allows DOE to explore how brownfield reuse concepts might behave under environmental remediation constraints, legacy infrastructure uncertainty, and complex site governance conditions, all within a conservative modeling framework.

The objective is not to claim environmental advantage or readiness, but rather to evaluate, in planning terms, whether brownfield contexts could potentially limit additional greenfield disturbance in principle, subject to future environmental review and regulatory decisions.

Site Context (RFI-Bounded)

Public DOE materials and the RFI describe the Paducah site as a former uranium enrichment complex with a large industrial footprint, legacy power and water infrastructure, and rail and river logistics connectivity developed for historical operations.

Historical power and water design bases, where mentioned in DOE materials, are treated solely as contextual planning references. No assumption is made regarding current availability, suitability, or regulatory status for AI loads.

Legacy power, water, rail, and river logistics are represented only as abstract capacity bands in proxy models, not as validated, usable assets. Environmental conditions, remediation status, land controls, and access restrictions remain uncertain and are not resolved by this project.

All site characteristics beyond what appears in the RFI or public DOE descriptions remain explicitly unspecified.

Problem Statement and Opportunity

The planning challenge is that brownfield sites introduce layered uncertainties across environmental remediation status, infrastructure condition, regulatory sequencing, and long-term stewardship obligations. Without a disciplined planning framework, brownfield reuse discussions can easily drift into speculative or capacity-driven claims that are not defensible.

The opportunity is to create a rigorous planning construct that evaluates brownfield reuse using conservative abstractions, reversible architectures, and governance-first controls. This enables DOE to understand comparative tradeoffs between brownfield and greenfield AI infrastructure pathways without assuming any readiness or viability.

These uncertainties are identified generically. This project does not attempt to resolve them and does not introduce new estimates or assumptions.

Scope and Non-Scope

In Scope

- Definition of a conceptual AI campus planning construct using brownfield land as a proxy modeling environment.
- Representation of energy, water, transmission, and logistics solely as abstract capacity bands in planning models.
- Development of phased architectural templates for pilot, distributed, and long-horizon evolution.
- Planning-level governance constructs emphasizing reversibility, environmental caution, and regulatory gating.
- Qualitative risk framing and decision readiness logic.

Explicitly Out of Scope

- Any operational control, site engineering, or asset validation.
- Any numerical capacity estimates, throughput claims, or timeline commitments.
- Environmental determinations, remediation decisions, or permitting assumptions.
- Procurement, vendor selection, financing, or contracting structures.
- Any claim of readiness, suitability, or comparative advantage beyond planning analysis.

RFI Alignment Narrative

This project aligns with the RFI by addressing:

- Site characterization through disciplined use of appendix descriptions without extrapolation.
- On-site and off-site energy considerations through abstract modeling constructs.
- Environmental constraints as primary gating factors.
- Economic and logistics context at a qualitative planning level.
- Challenges and uncertainties explicitly surfaced rather than resolved.
- Engagement and governance treated as prerequisite planning disciplines.

No RFI category is treated as satisfied operationally; all alignment remains conceptual.

Concept of Operations (Planning Construct)

The Paducah campus exists only within planning models as a hypothetical AI load cluster subject to environmental, governance, and infrastructure abstractions. AI workloads are represented as synthetic demand profiles suitable for stress testing infrastructure envelopes and governance sequencing.

Energy supply, water availability, transmission access, and logistics flows are modeled generically as qualitative bands rather than numeric systems. Scenario exploration evaluates how different envelope assumptions interact with phased expansion logic.

No real-time signals, control paths, or asset interactions exist in this model.

Architecture Templates

Three planning templates structure exploration:

P1 – Pilot Brownfield Node

A minimal conceptual footprint used to explore governance sequencing, environmental gating, and infrastructure uncertainty under conservative assumptions.

P2 – Distributed Modular Brownfield Cluster

Multiple conceptual nodes distributed across modeled parcels to explore cumulative constraints and coordination complexity.

P3 – Long-Horizon Brownfield Evolution

A phased growth construct that explores how conceptual capacity envelopes might evolve under changing remediation and governance conditions.

These templates mirror the phased planning patterns used across the portfolio (pilot, distributed modules, long-horizon evolution), adapted specifically to Paducah's brownfield context.

Design Principles

- Planning-only discipline.
- Environmental conservatism.
- Governance before scale.
- Reversibility at every phase.
- Proxy modeling only.
- No implied readiness or capacity claims.
- Portfolio coherence with other DOE sites.

Unclassified Proxy Use-Case Menu

- Synthetic infrastructure envelope stress testing.
- Brownfield remediation sequencing scenarios.
- Governance pathway simulations.
- Logistics abstraction modeling.
- Portfolio comparative evaluation.

All datasets are synthetic or public proxies.

Proxy Modeling Plan

Models use qualitative abstractions for demand, energy, water, logistics, and environmental constraints. Scenario analysis explores envelope interactions, phasing sensitivity, and governance gating behavior. No numerical forecasting or optimization is implied.

Validation, Sensitivity, Robustness, and Reversibility

Validation ensures all assumptions trace to RFI or public DOE materials. Sensitivity testing explores envelope tightening and sequencing impacts qualitatively. Robustness examines stability of planning conclusions across scenarios. Reversibility ensures no pathway creates irreversible commitments in planning logic.

Risk Landscape (Qualitative)

Key planning risks include:

- Environmental remediation uncertainty.
- Legacy infrastructure reliability ambiguity.
- Regulatory sequencing complexity.
- Long-term stewardship obligations.
- Market and policy volatility.

Risk characterization remains qualitative and comparative only; no quantitative probabilities are assigned.

Governance and Oversight (Target Construct)

The program is structured around a proposed governance model emphasizing phased approvals, environmental gating, independent technical review, and explicit stop-authority. Governance is a planning construct only and does not represent existing authority.

Deliverables

Deliverables include planning templates, proxy modeling artifacts, scenario narratives, governance frameworks, and comparative portfolio summaries. All deliverables are internal planning artifacts and do not constitute recommendations, proposals, or decisions.

Success Criteria

- Clear articulation, in planning terms, of Paducah's potential and limits for brownfield reuse.
- Portfolio comparability with other sites.

- Governance clarity and reversibility integrity.
- Absence of fabricated data or implied commitments.

No-Fabrication and Sourcing Note

This document is derived exclusively from the March 2025 “AI Infrastructure on DOE Lands” RFI and publicly available DOE descriptions of the Paducah site, supplemented with generic federal program planning constructs. No site-specific capacities, power levels, water volumes, transmission ratings, schedules, or readiness claims are introduced beyond those sources. Where information is not available in public DOE materials, it remains explicitly unspecified. All concepts are planning-only and proxy-based.

Instruction for future edits: Maintain this document’s planning-only, RFI-bounded posture; do not add new site facts, capacities, schedules, or commitments in subsequent revisions.

[View Implementation Guide \(Planning\)](https://ucdpforge.com/pdfs/NLIG/PGDP_AI_Campus_Impl_Guide.pdf) (Manual link: https://ucdpforge.com/pdfs/NLIG/PGDP_AI_Campus_Impl_Guide.pdf)