8 INJECTION WELL PLUGGING PLAN
40 CFR 146.92(b)

POLK CARBON STORAGE COMPLEX (PCSC)

Facility Information

Facility (site) Name: Polk Carbon Storage Complex (PCSC)

Facility Operator: Tampa Electric Company (TEC)

Facility Contact: Claimed as PBI [redacted]

Project Location: Polk County, Florida

Injection Well Name and Coordinates:

Well Name	Latitude	Longitude
PSC_IW1	Claimed as PBI [redacted]	
PSC_IW2		
PSC_IW3		

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List of Acronyms/Abbreviations

BOPs	Blowout Preventers
CBL	Cement Bond Log
DTS	Distributed Temperature Sensing
MD	Measured Depth
MIT	Mechanical Integrity Testing
MR	Mobilize Rig
NU	Nipple Up
RU	Rig Up
TD	Total Depth
TIH	Trip In Hole
USDW	Underground Source of Drinking Water

8. Injection Well Plugging Plan

TEC will conduct injection well plugging and abandonment for PSC_IW1, PSC_IW2, and PSC_IW3 according to the procedures below. In accordance 40 CFR §146.92, TEC will comply with this plugging plan for the PSC IW_1, PSC IW_2, and PSC IW_3 CO_2 injection wells, in addition to maintaining and updating the plan as required throughout the operational phase of the TEC CCS-1 project. TEC will send a written notice documenting the intent to plug the PSC IW-1, PSC IW_2, and PSC IW_3 wells at least 60 days prior to plugging the well. Any proposed revisions to this plugging plan will only be incorporated into this plan and/or implemented in the field, upon approval from the Region IV UIC Director and will be incorporated into the permit, subject to the permit modification requirements of 40 CFR §144.39 or §144.41. After plugging operations are complete for the PSC IW_1, PSC IW_2, and PSC IW_3 wells, a plugging report will be submitted to the Region IV UIC Director within 60 days of plugging, and TEC will retain the well plugging report for 10 years following site closure.

8.1 Plugging and Abandonment Strategy

A generalized summary of the plugging and abandonment (P&A) approach and operations for the PSC_IW1, PSC_IW2, and PSC_IW3 wells are as follows:

1. TEC will submit a written notice of intent to plug to the Region IV UIC Director at least 60 days prior to the intended commencement of P&A operations [40 CFR §146.91 (e) and §146.92 (c)].
2. Prior to plugging the injection wells, bottom hole measurements will be taken from downhole gauges to determine bottomhole reservoir pressure and necessary fluid density to kill the well. Subsequently, the well will then be flushed with a brine fluid with sufficient kill weight [40 CFR §146.92]. A minimum of three tubing volumes will be injected without exceeding fracture pressure.
3. The well will undergo mechanical integrity testing (MIT) to ensure external mechanical integrity prior to commencement of P&A operations [40 CFR §146.89, 40 CFR §146.92]. If a mechanical integrity issue is encountered, remedial activities will be completed prior to proceeding with P&A activities.
4. All casing in the wells will be cemented to the surface during construction [40 CFR §146.86] and will not be retrievable at abandonment.
5. Upon permanent cessation of well operations, the tubing and packer will be removed.
6. After removal of the tubing and packer, the balanced-plug placement method will be used to plug the well. If, after flushing, the tubing and packer cannot be released, an electric line with tubing cutter will be used to cut off the tubing above the packer and the packer will be left in the well, and the cement retainer method will be used for plugging the injection formation below the abandoned packer.
7. All of the casing strings will be cut off at least 3 feet below the surface, below the plow line. A blanking plate with the required permit information will be welded to the top of the cutoff casing.
8. All surface features associated with the plugged well and well-pad will be removed.
9. A plugging report will be submitted within 60 days after plugging operations are completed to the Region IV UIC Director [40 CFR §146.92].

8.2 Planned Tests or Measures to Determine Bottomhole Reservoir Pressure

TEC will record bottom hole pressure measurements from a down hole pressure gauge and calculate kill fluid density prior to flushing the well [40 CFR §146.92].

8.3 Planned External MIT(s)

TEC will conduct at least one of the tests listed in **Table 8-1** to verify external mechanical integrity prior to plugging the injection well as required by 40 CFR 146.92(a) on each well (PSC_IW1, PSC_IW2, and PSC_IW3).

Table 8-1. Planned MITs.

Test Description	Location
DTS or Equivalent	Distributive temperature measurement across wellbore
PNC Log	Wireline well log

Temperature measurements, which may include distributed temperature sensing (DTS) or equivalent, will be used to measure external mechanical integrity pursuant to 40 CFR 146.89. Either a DTS will be run and continuously monitoring temperature along the wells entire depth or an equivalent test like a temperature log will be run after injection before plugging the well. The temperature data obtained will be evaluated. A comparison will be made between this data and the baseline temperature data conducted. If notable deviations are observed in the temperature logs taken before the start of and after the cessation of CO2 injection the cement integrity may be insufficient and remedial options will be identified. A Cement Bond Log (CBL) will also be run along the entire length of the well. This log will confirm if all the intervals of interest along the wellbore have a good bond. These intervals include the underground source of drinking water (USDWs), injection zones, and confining layers. If these formations do not display sufficient bond then remedial options will be identified, these may include a cement squeeze.

8.4 Information on Plugs

TEC will use the plugging materials presented in **Table 8-2**, **Table 8-3**, and **Table 8-4** to plug the PSC_IW1, PSC_IW2, and PSC_IW3 CO2 injection wells. The volume and depth of the plug or plugs will depend on the final geology and downhole conditions of the well.

The types of cement formulated for plugging wells which penetrate the CO2 storage complex will be compatible with the CO2 stream and will consist of EverCRETE, or a similar product. Wells which do not penetrate the storage complex will be plugged with class A or H cement. The cement formulation and required certification documents will be submitted to the agency with the well plugging plan. The owner or operator will report the wet density and will retain duplicate samples of the cement used for each plug. The lower plugs that cover the perforations will be squeezed to fill in the perforations.

Table 8-2. PSC_ IW1 Plugging details.

Plug Information	Plug #1	Plug #2	Plug #3	Plug #4	Plug #5	Plug #6	Plug #7	Plug #8	Plug #9
Diameter of boring in which plug will be placed (Inches)	Claimed as PBI								
Depth to bottom of tubing or drill pipe (ft)									
Sacks of cement to be used									
Slurry volume to be pumped (ft3)									
Slurry weight (lb./gal)									
Calculated top of plug (ft)									
Bottom of plug (ft)									
Type of cement or other material									
Method of emplacement (e.g., balance method, retainer method, or two-plug method)									

* - An equivalent product with comparable performance characteristics may be used in substitute

Table 8-3. PSC_ IW2 Plugging details.

Plug Information	Plug #1	Plug #2	Plug #3	Plug #4	Plug #5	Plug #6	Plug #7	Plug #8	Plug #9	Plug #10
Diameter of boring in which plug will be placed (Inches)	Claimed as PBI									
Depth to bottom of tubing or drill pipe (ft)										
Sacks of cement to be used										
Slurry volume to be pumped (ft3)										
Slurry weight (lb./gal)										
Calculated top of plug (ft)										
Bottom of plug (ft)										
Type of cement or other material										
Method of emplacement (e.g., balance method, retainer method, or two-plug method)										

* - An equivalent product with comparable performance characteristics may be used in substitute

Table 8-4. PSC_ IW3 Plugging details.

Plug Information	Plug #1	Plug #2	Plug #3	Plug #4	Plug #5	Plug #6	Plug #7	Plug #8	Plug #9	Plug #10	Plug #11	Plug #12	Plug #13
Diameter of boring in which plug will be placed (Inches)	Claimed as PBI												
Depth to bottom of tubing or drill pipe (ft)													
Sacks of cement to be used													
Slurry volume to be pumped (ft3)													
Slurry weight (lb./gal)													
Calculated top of plug (ft)													
Bottom of plug (ft)													
Type of cement or other material													
Method of emplacement (e.g., balance method, retainer method, or two-plug method)													

* - An equivalent product with comparable performance characteristics may be used in substitute

8.5 Casing and Tubing Record after Plugging

Casing and tubing specifications for PSC_IW1, PSC_IW2, and PSC_IW3 are shown below in **Table 8-5**, **Table 8-6**, and **Table 8-7** respectively.

Table 8-5. Casing and Tubing Specifications After Well Plugging for PSC_IW1

Tubular OD	Weight (lb/ft)	To be put in well (ft)	To be left in well (ft)	Diameter of boring
Claimed as PBI				

Table 8-6. Casing and Tubing Specifications After Well Plugging for PSC_IW2

Tubular OD	Weight (lb/ft)	To be put in well (ft)	To be left in well (ft)	Diameter of boring
Claimed as PBI				

Table 8-7. Casing and Tubing Specifications After Well Plugging for PSC_IW3

Tubular OD	Weight (lb/ft)	To be put in well (ft)	To be left in well (ft)	Diameter of boring
Claimed as PBI				

8.6 Description of Plugging Procedures

8.6.1 Notifications, Permits, and Inspections

In compliance with 40 CFR 146.92(c), TEC will notify the regulatory agency at least 60 days before plugging the well and provide updated Injection Well Plugging Plan, if applicable.

8.6.2 Plugging Procedures

TEC will use the following steps to plug the wells:

1. Upon receiving written approval from the Region IV UIC Director, well plugging and abandonment operations will commence.
2. Mobilize the rig (MR) and field staff to the PCSC and rig up (RU). All CO_2 pipelines will be marked and noted with rig the supervisor prior.
3. Conduct and document a safety meeting to identify site specific occupational hazards.
4. Record the bottom hole pressure from downhole gauge and calculate the kill fluid density.
5. Open up all valves on the vertical run of the tree and check pressures.
6. Test the pump and line to 2,500 psi.
7. Fill tubing with kill weight brine (11.5 ppg or a density determined by bottom hole pressure measurement). Bleeding off pressure occasionally may be necessary to remove all air from the system.
8. Test casing annulus to , psi and monitor as in annual MIT. If there is pressure remaining on tubing, rig up to pump down tubing and inject two tubing volumes of kill weight brine. Monitor tubing and casing pressure for 1 hour. If both the casing and tubing are dead, then nipple up blowout preventers (NU BOPs) and monitor casing and tubing pressures.
9. If the well is not dead or the pressure cannot be bled off of the tubing, RU a slickline and set a plug in lower profile nipple below packer. Circulate tubing and annulus with kill weight fluid until well is dead.
10. After the well is dead, nipple down the tree.
11. NU the BOPs and perform a function test. The BOPs should have appropriately sized single pipe rams on top and blind rams in the bottom ram for tubing.
12. Test the pipe rams and blind rams to 250 psi (low) and 3,000 psi (high).
13. Test annular preventer to 250 psi (low) and 3,000 psi (high).
14. Test all Texas Iron Works (pressure valve), BOPs choke and kill lines, and choke manifold to 250 psi (low) and 3,000 psi (high). NOTE: Make sure casing valve is open during all BOP tests**.**
15. After testing the BOPs pick up the tubing string and unlatch seal assembly from seal bore.

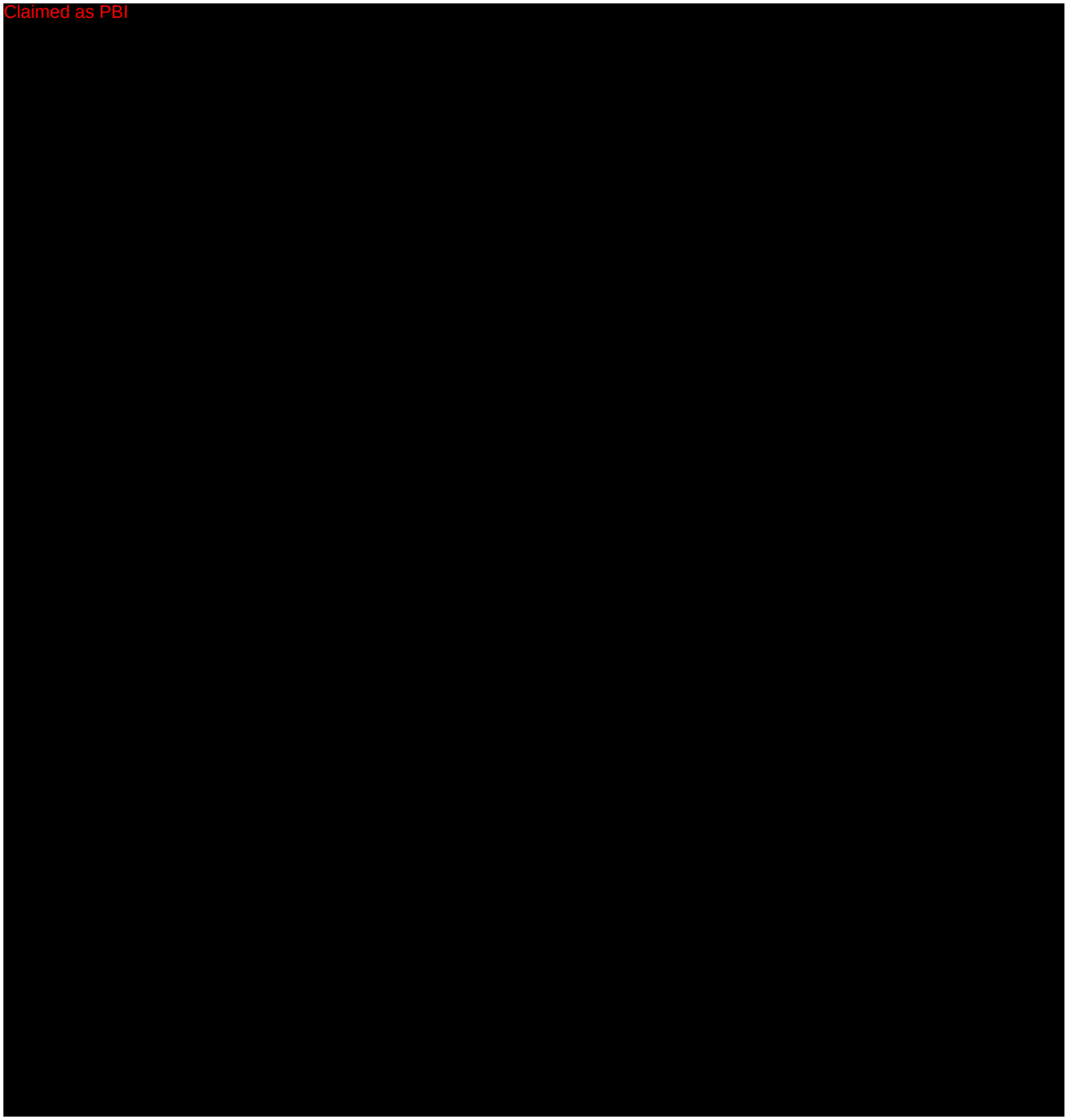
16. Rig the slick line and lubricator back to well and remove plug from well.
17. Rig to pump via the lubricator and circulate until well is dead.
18. Pull out of the hole with the tubing, laying it down. NOTE: Ensure that the well is over-balanced so there is no backflow due to formation pressure and there are at least two well control barriers in place at all times.
19. Pull the seal assembly, pick up the work string, and trip into the hole (TIH) with the packer retrieving tools. Latch onto the packer and pull it out of the hole, laying it down.
20. Test the well's mechanical integrity by performing one of the permitted external mechanical integrity tests listed in **Table 8-1**.
    a. ***Contingency:*** If the seal assembly cannot be pulled, RU an electric line and make cut on tubing string just above packer. Note: Cut must be made above packer at least 5-10 ft measured depth (MD). If unable to pull the packer, pull the work string out of the hole and proceed to next step. If problems are noted, update cement remediation plan and execute prior to plugging operations.
21. TIH with the work string to total depth (TD). Keep the hole full at all times. Circulate the well and prepare for cement plugging operations.
22. Claimed as PBI [redacted]. Any extra plugs will depend on the squeeze job needed to plug the perforations. When plugging the injection zones, 20 stands of pipe will be pulled, and fluid will be reverse circulated to clean the tubing. Then the tubing will be lowered to about five stands above the zone and the anulus and tubing will be pressurized to around 500 psi to perform a squeeze job at the perforations.
23. Wait for cement to set, tag the top of cement and if the perforations are not fully covered by the plug, pump another plug down and repeat. No more than two plugs will be set before cement is allowed to set and plugs verified by setting work string weight down onto the plug. Claimed as PBI [redacted].
24. Set a 13 ppg kill fluid between plugs to maintain pressure inside the casing to mitigate casing collapse.
25. Circulate the well and ensure it is in balance. Place the tubing just above cement top from previous plug. Claimed as PBI [redacted] (using a density of

approximately 15.6 ppg slurry a yield of approximately 1.18 ft^3/sk for Class A cement). Pull out of plug and reverse circulate tubing.

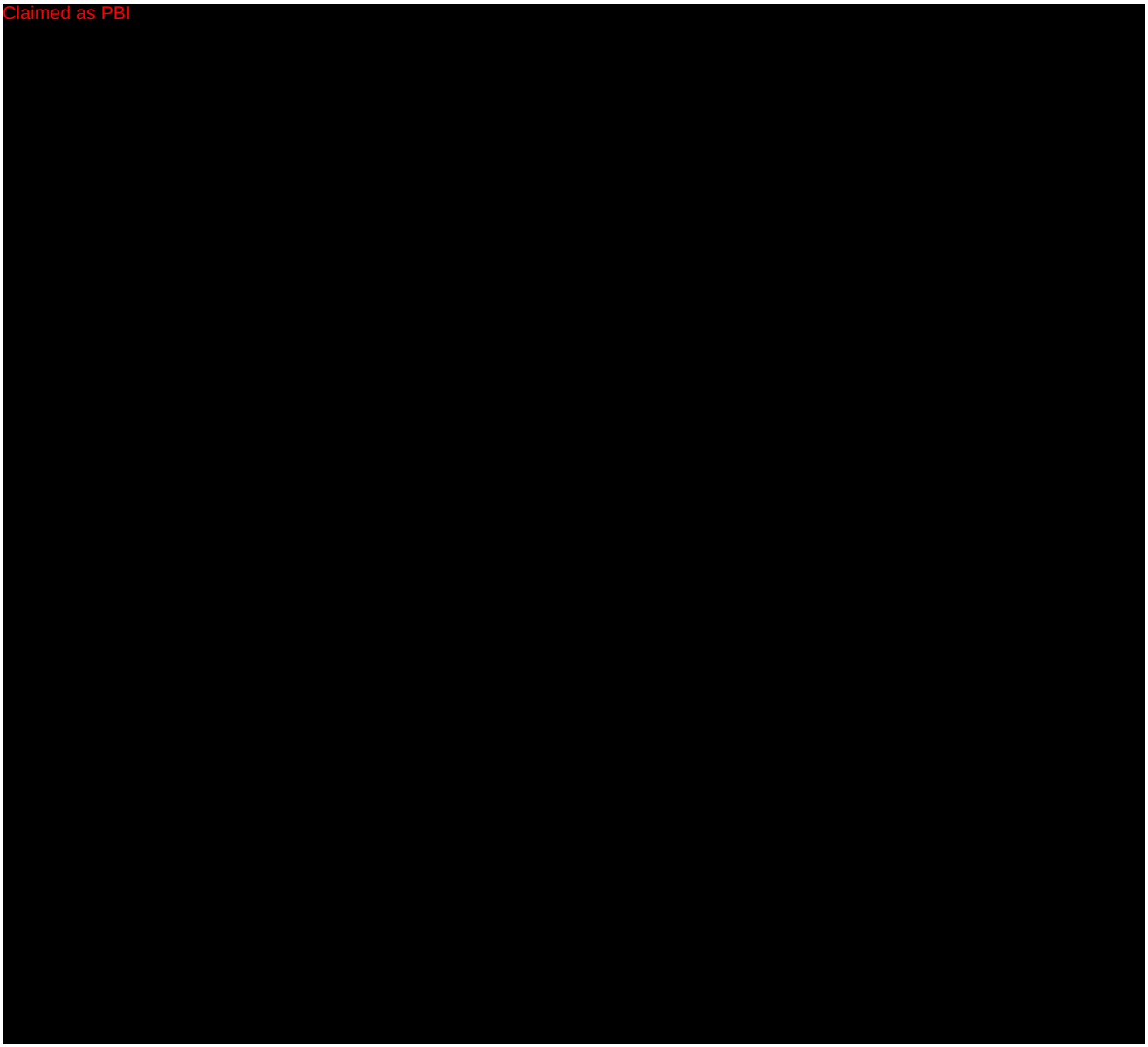
26. Repeat this operation until a all plugs have been set. Set 13 ppg kill fluid between plugs to maintain pressure inside the casing to mitigate casing collapse. Note: If the plugs are well balanced, then the reverse circulation step can be omitted until after each third plug.
27. Lay down the work-string while pulling from well. If the rig is working daylights only, then pull ten stands and rack back in derrick and reverse tubing before shutting down for night. After waiting overnight, trip back in hole and tag plug and continue.
28. After the plugs have been set, pull the tubing from well and shut in for 12 hours.
29. TIH with tubing and tag cement top and pull tubing back out of well.
30. Nipple down BOPs and cut all of the casing strings below plow line (3 feet below ground level or per local policies/standards).
31. Trip in the well and set the final cement plug.
32. Lay down all work string and rig down all equipment and move out.
33. Clean the cellar to where a plate can be on welded with well name.

The procedures described above are subject to modification during execution as necessary to ensure a plugging operation that protects worker safety and is effective to protect USDWs. Any significant modifications due to unforeseen circumstances will be described in the Plugging report. After plugging, a plugging report, any plugging forms and all charts and lab information will be submitted as required to the Region IV UIC Director within 60 in accordance with 40 CFR §146.92. A reference schematic for the plugging protocol mentioned above is shown in **Table 8-2.**

8.7 Well Design and Plugging Schematics



Claimed as PBI



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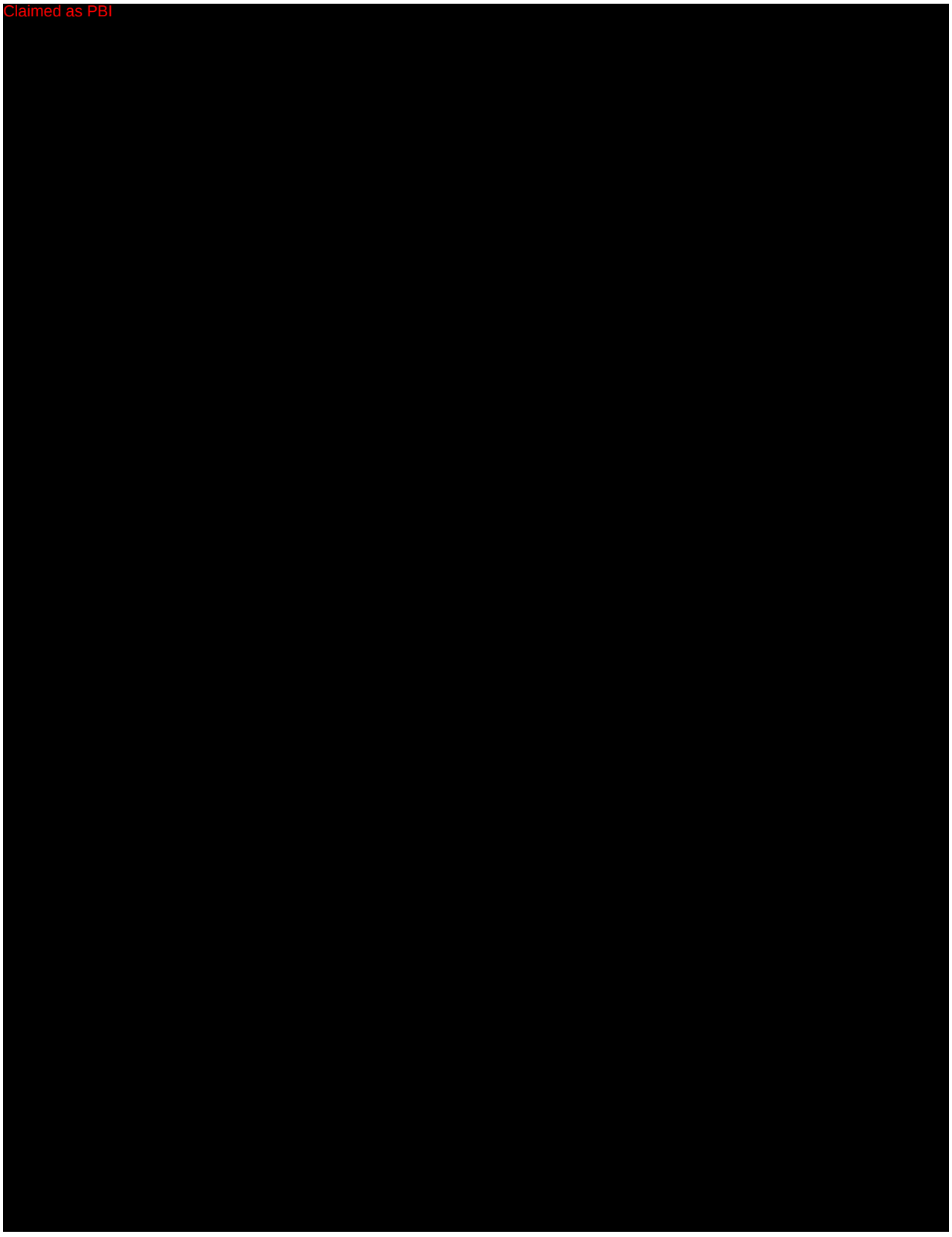

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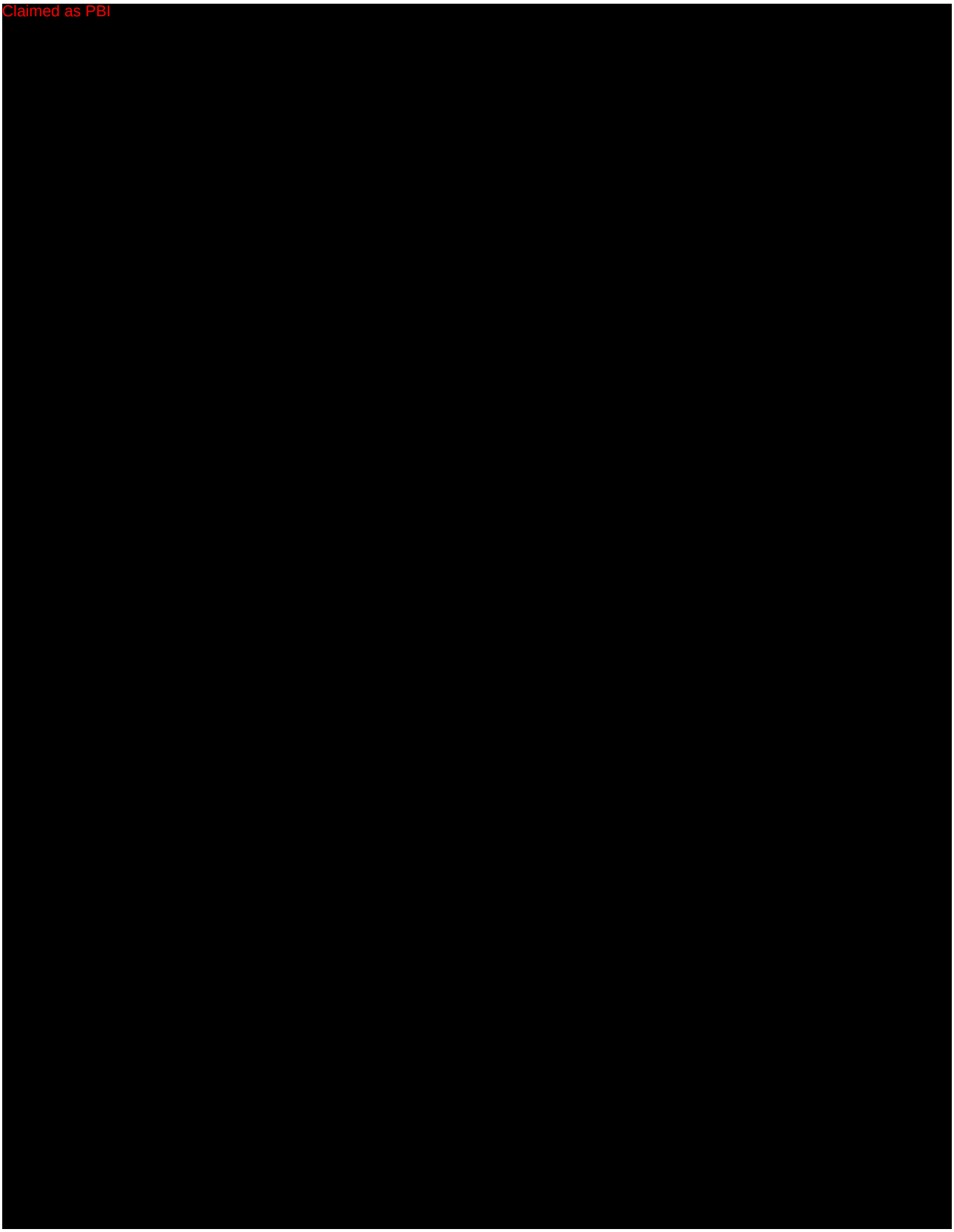

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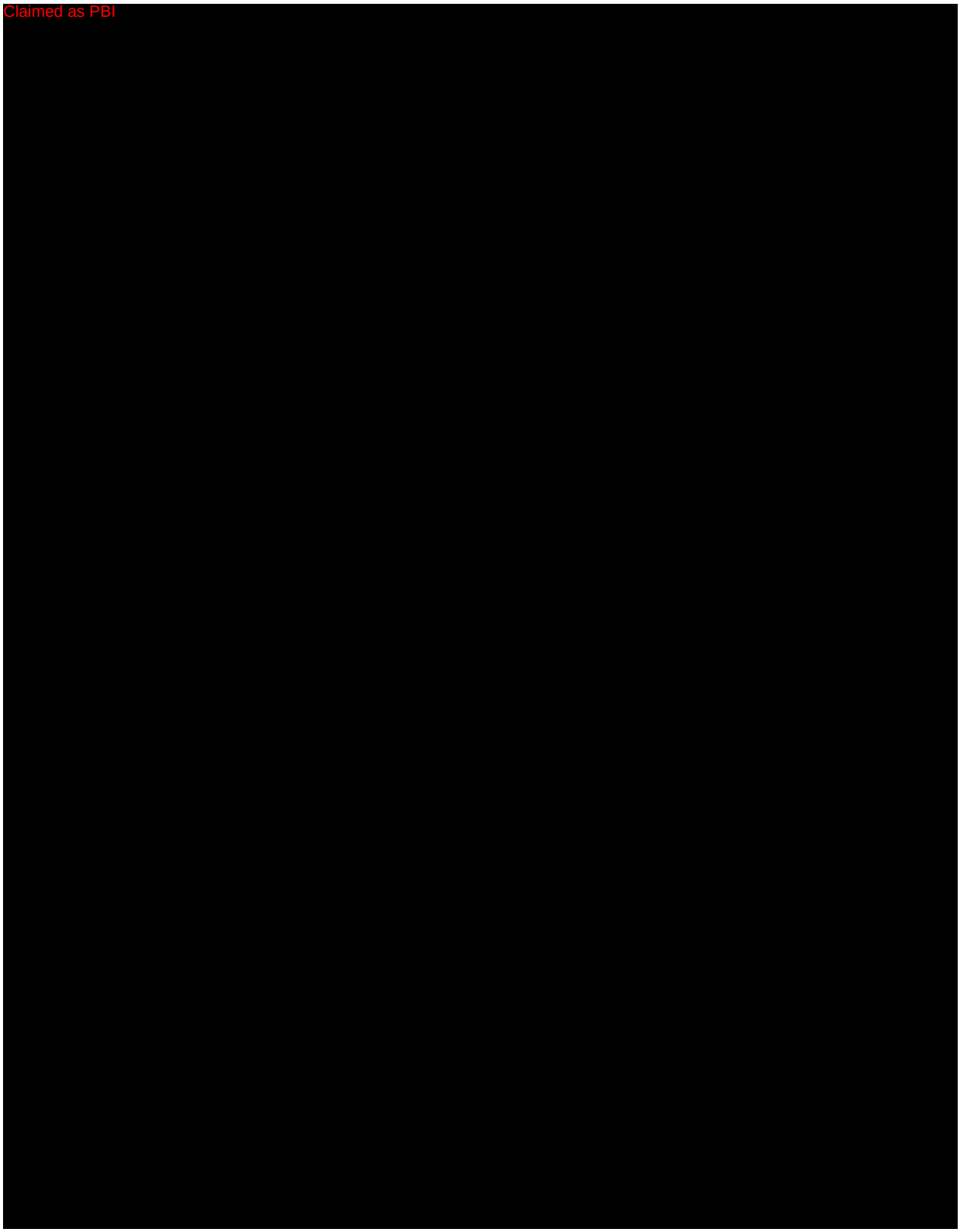

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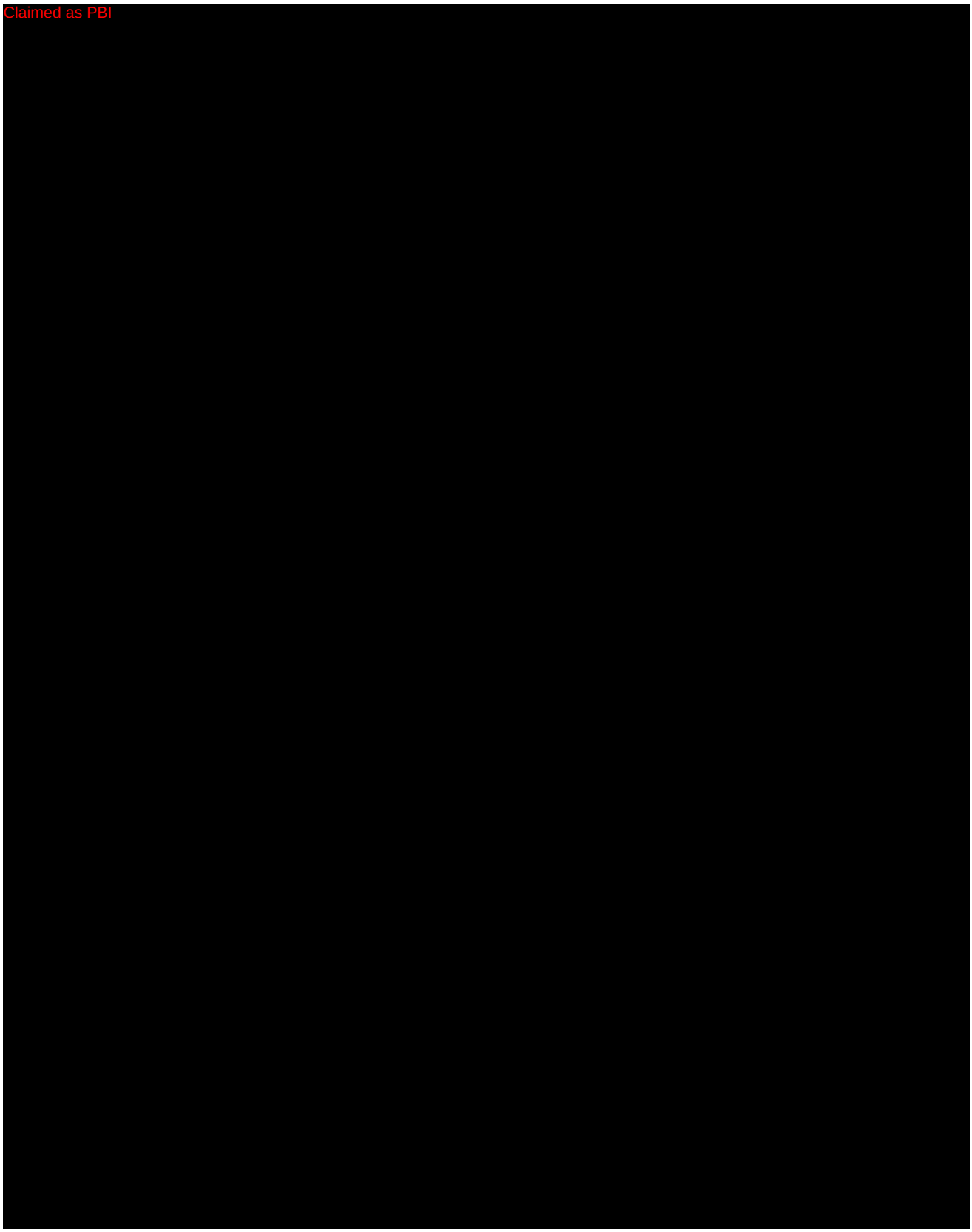

8.8 Report Retention

A copy of this injection well plugging report will be retained by PCSC for 10 years following the date of site closure.

8.1. Certification

The plugging report will be certified by an authorized individual with certification language such as presented below:

Certification		
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. (Ref. 40 CFR 144.32(d))		
Name and Official Title (please type or print)	**Signature**	**Date Signed**