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# Supply Side II DR Pilot 2018 Summary and Findings (Public Version)

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## 1 Acknowledgements

The work described in this report was funded as part of PG&E's Supply Side II Demand Response Pilot (SSP II), which was proposed by PG&E as part of its 2015 – 2016 Demand Response (DR) bridge filing and the subsequent 2017 DR bridge filing which were approved by the California Public Utilities Commission (CPUC) in Decision (D.) 14-05-025 and Decision (D.) 16-06-029, respectively.

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## 2 Executive Summary

This report summarizes the market context, project objectives, technical results and lessons learned for the Supply Side Demand Response Pilot (SSP/SSP II) from 2015-2018. This report also covers the genesis of the pilot from the earlier Intermittent Renewable Resources (IRR) and Intermittent Renewable Management Pilot Phase 2 (IRM2).

### Background

Current California policies and the establishment of other state goals along with the penetration of new end-use technologies continuously adds complexity to future grid needs. Furthermore, the California Independent System Operator (CAISO) identified that with a 33% penetration of renewables, net load to be served will have steep ramps during both winter and spring. These changes in net load, policy and technology, require California to evaluate which resources can address future grid needs. With a focus placed on the importance of wholesale integration of demand resources by the CAISO and subsequently the CPUC<sup>1</sup>, the Supply Side Pilot (SSP) is designed to test various mechanisms to ensure a successful path forward to meet California's policy goals.

In the SSP II, responsive loads are being considered as one of the many resources that can support economic and reliability needs of the future grid. In addition to traditional demand response that addresses summer peak shaving, new demand response offerings must be constructed in order to meet future transmission and distribution grid needs. This pilot program was developed by PG&E and Olivine to facilitate demand response on the commercial and residential side of the grid. This pilot is in its second phase (i.e., the SSP Phase 2 or SSP II), and builds upon earlier pilots.

In 2010, the Intermittent Renewable Resources Pilot (IRR) integrated demand response with the CAISO as Participating Load. This project predates the modern CAISO demand response resource types and provided inputs into the design of PDR. The subsequent 2013 Intermittent Renewable Management Pilot Phase 2 (IRM2) extended the learnings by demonstrating with third-party aggregators and large commercial and industrial customers that DR resources can participate in the CAISO wholesale market and provide flexible resources with the then-new Proxy Demand Resource (PDR) resource type. The Pilot continued in 2015 renamed as the Supply Side Pilot with an expansion into residential customers and closer alignment to the CPUCs Resource Adequacy policies. Finally, in 2017 the Supply Side Pilot went into its second phase with the addition of distribution-need to the existing wholesale market integration framework.

### Pilot Objectives

The pilot concentrated on understanding issues related to direct participation of third-parties and customers in the wholesale market, including the following:

- Wholesale program design: Wholesale markets operate differently from conventional retail DR programs. As such, it was paramount to pilot a program that could meet wholesale market

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<sup>1</sup> Order Instituting Rulemaking to Enhance the Role of Demand Response in Meeting the State's Resource Planning Needs and Operational Requirements ("Bifurcation Decision") D.14-03-026.

requirements for resource composition, bidding, and notification timing – among other constraints – that would also be compatible with retail-facing constructs.

- Testing customer acceptance and participation interest: Given necessary differences in program design, it was necessary to understand what components of such a design would be acceptable to garner interest for participation.
- Understanding market transformation challenges: The transformations required to enable wholesale-integrated retail programs as well as direct participation were mainly hypothetical when the SSP precursor, the IRM2, began. Throughout, the pilots have addressed market transformation issues as an important input into the various proceedings and stakeholder processes.
- Determining technical and operational feasibility: Due to the increased complexity of wholesale-integration programs, various technical and operational challenges were expected; ultimately, resulting in higher costs and calendar lead times for new resource entry. The pilot acts as a testing ground to identify such issues to better understand the process for enablement of wholesale market resources.
- Testing feasibility of participation by residential customers: Due to the lower capacity values of residential customers, an objective was to understand any opportunities and challenges integrating such customers into the wholesale market.
- Testing interest and feasibility of participation in other grid services: While day-ahead energy in the wholesale market is the closest fit to conventional retail programs, there are other wholesale services that DR is capable to provide. Considering these services come with higher cost and potentially limited benefit, the pilot enables participants to test such participation with some costs covered by the pilot.
- Testing ability of wholesale / distribution resources: The key addition to SSP II is testing out distribution-need concepts against wholesale-integrated resources. This focus has been twofold: to provide signals stemming from actual distribution need tested with and without conflicting wholesale signals; and, to enable partial resource dispatch where only specific locations within an aggregation are deployed.

### **Key Accomplishments and Lessons Learned**

- First year-round PDRs: Back to the inception of the pilot, the pilot successfully bid Proxy Demand Resource (PDR) resources in the CAISO market year-round.
- First battery storage: The first battery storage deployed in the CAISO markets was within the pilot. This integration helped to inform sub-metering challenges and ultimately the CAISO Meter Generator Output (MGO)
- First electric vehicles: The first electric vehicle charging in the CAISO markets was within the pilot in a work-place charging application.
- Enrollment: Through the pilot's enrollment process, administrators gained insights into why there was greater interest up front versus actual enrollment. Reasons for decreased enrollment versus interest may be attributable to: education, ability to provide load increase, alternatives which would prohibit participation due to dual participation rules, and the short-

term nature of the pilot. In addition, some interested providers had enabling technology, but not a pathway to customers for enrollment.

- Residential is uniquely challenging: Customer authorizations, CAISO registration process and meter data requirements become more challenging at scale making residential a lower benefit to cost in the wholesale market.
- CAISO Settlements require active engagement: Throughout the pilots, many issues arose in CAISO settlements ultimately resulting in a broad multi-year resettlement. While some issues can be expected due to the inherent complexity of the CAISO IT systems, it underscores the importance of continuous review of CAISO settlements.
- Market timelines: Wholesale market and retail demand response program timelines are mismatched and continue to pose a challenge. Issues include early bidding timelines at the CAISO being in advance of day-ahead planning for the utility; as well as very short (2.5 minutes) response required in the real-time market. This makes day-of programs difficult to integrate, particularly.
- Automation is not always required: Several participants were able to participate as day-ahead resources without IT integration, reducing costs for such providers.
- Key input into design of DRAM: The Demand Response Auction Mechanism (DRAM) was heavily influenced by the success of the pilot as a model for the combination of retail and wholesale programs; noting, that there are several controversial aspects of the DRAM implementation which were not visible in the pilot because the pilot has a single administrator providing oversight.
- Key input into the design of the latest PG&E CBP: The 2018 Capacity Bidding Program (CBP) introduced Elect and Elect+ options, both of which were influenced directly by the pilot.

## Recommendations

### Product Recommendations:

- Grid Needs: Any products should serve grid needs associated specifically with renewable integration challenges. Needs should also be examined outside of the resource adequacy periods to ensure that demand response is not only utilized as a ramping or peaking product. Such needs include resource-level response at other times of the day, but also localized needs that have specific value to the distribution utility.
- Distribution Value: There is much work to be done on quantifying distribution value in a standard way that utilities can use to fund such programs and incentivize customer participation. Without standards it will be difficult to scale any such programs both from a budgetary perspective but also for marketing outreach.
- Technology Neutral: Demand response programs should generally be technology agnostic to enable any end use to provide reduction. Some technologies may thrive under demand response paradigms while others may not. However, being technology neutral allows technology providers to best determine how to make their solutions viable and competitive.
- Participation payments are a requirement: The pilot has provided clear data on the relatively low revenues to be achieved from CAISO market participation through the energy markets.

Without the pilot capacity payment, and participations payments more broadly, demand response cannot be incentivized sufficiently from such energy payments.

#### Operational Recommendations:

- Availability: Periods of availability should be based on grid needs with flexibility to reflect participants' abilities to respond. As part of this, participants should be allowed to specify their availability to provide load decrease at any hours, noting that incentive payments should be adjusted accordingly.
- Frequency: Frequency of dispatch should be based on customer abilities, but also needs to be tied into incentives payments. The pilot protects against customers avoiding dispatch through high market bidding with a day-ahead price cap, but in general any capacity program that incentivizes customers to bid into the wholesale market should ensure that dispatches are feasible in the market. Distribution-related dispatch frequency must also be considered, noting that if the distribution need requires very frequent dispatch, then new performance methodologies may be necessary.
- Dispatch Timelines: Response time of a load decrease event should match grid needs, meaning if the resource is participating in the wholesale market the resource should respond in line with market dispatches and if the resource is responding to distribution planners, the response should match distribution timelines.
- Distribution Planning and Operations: Due to the potential impact of distribution-related events on distribution planning and operations – particularly in delaying distribution upgrades – it is imperative that development and operation of this type of product be integrated with distribution planning and operations groups; otherwise, the distribution value will not be realized.

#### **Conclusion and Next Steps**

The SSP II and its precursors have been on the cutting edge of retail / wholesale integration issues since their inception, heavily influencing the development of such programs. As illustrated throughout this report, the pilot has resulted in a variety of lessons learned for participants, PG&E specifically, and for the IOUs more generally. These lessons have helped inform proceedings at the CPUC and the CAISO and directly influenced the design of the DRAM and the PG&E's CBP program. However, work on utilizing DR resources for distribution services is just starting, and there are still unanswered questions around if/how this can be accomplished.

The pilot is scheduled to continue through 2020. While continuing to support the existing participation models, the following items are being addressed beginning in 2019:

- Development of new materials to focus on the distribution aspects of the SSP II.
- Enable the partial dispatch of resources for distribution need, enabling resources to be partially dispatchable by location.
  - These dispatches will target PNode, Feeder, rate-class, and possibly other artificial distinctions to test out the flexibility of sub-dispatch.

- In conjunction with sub-dispatch, the SSP II will also evaluate various performance-measurement methodologies to ensure fairly compensating participants for providing such flexibility.
- Recruit new participants into SSP II to test wholesale / distribution bidding and dispatch strategies as well as baseline and settlement interactions.

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## 3 Introduction

### 3.1 Background

California policies in addition to the establishment of other state goals along with the penetration of new end use technologies continuously adds complexity to future grid needs. Furthermore, the California Independent System Operator (CAISO) identified that with a 33% penetration of renewables, net load to be served will have steep ramps during both winter and spring. These changes in net load, policy and technology, require California to evaluate which resources can address future grid needs. In this project, demand responsive loads are being considered as one of the many resources that can support economic and reliability needs of the future grid. In addition to traditional demand response that addresses summer peak shaving, new demand response offerings must be constructed in order to meet future transmission and distribution grid needs. This pilot program was developed by PG&E and Olivine to facilitate demand response on the commercial and residential side of the grid. This pilot -- the Supply Side II DR Pilot (SSP II) -- stems from earlier pilots, described in the following sections.

### 3.2 The First Two Phases of the Demand Response Pilot

There have been three phases to date of the SSP II, each with a slightly different name and objectives. The first phase was called the Intermittent Renewable Resources (IRR) pilot. During this phase, two commercial buildings and one industrial facility were equipped with automated demand response and telemetry equipment. Each facility was tested for response time, duration and latencies (Kiliccote et al. 2010). The next phase of the pilot was approved on April 2, 2013 by the California Public Utilities Commission (CPUC) as filed in PG&E's Advice Letter 4077-E-B. The objective for this second phase was to demonstrate with third-party aggregators and large commercial and industrial customers that DR resources can participate in the CAISO wholesale market and provide flexible resources. With the introduction of the CAISO Proxy Demand Resource (PDR), the IRR2 was designed so resources could bid into the CAISO wholesale day-ahead energy market as this new resource type. The SSP included a monthly participation commitment with CAISO bidding requirements. Each participant had the option of committing to either contiguous three-hour blocks for 24 days per month or six-hours for 12 days per month with day-ahead notification that aligned with the CAISO integrated forward market (IFM). In recognition of their availability and by meeting all requirements, the customer was paid \$10/kilowatt (kW)-month for capacity. Olivine, Inc. served as the program administrator and took on scheduling coordination for third party and customer resources. For initial participation, prospective participants were required to commit their resources for six months and the minimum resource size was 100 kW. The pilot concentrated on understanding issues related to direct participation of third-parties and customers including the following:

- Customer acceptance;
- Market transformation challenges (wholesale market, technology);
- Technical and operational feasibility; and
- Value to the rate payers, DR resource owners and the utility on providing an enabling mechanism for DR resources into the wholesale markets.

### 3.3 The Supply Side and Supply Side II Pilot

As part of the 2015-2016 DR bridge funding Decision, the Commission approved a continuation and expansion of the IRM2 in D.14-05-025. This next phase, known as the Supply Side DR Pilot (SSP), continued with the objective of engaging participants in a third-party wholesale integrated capacity program. This phase was designed to facilitate daily energy bids into the wholesale market in usable blocks. Retail capacity incentives were provided from the utility so as to understand the following:

1. Whether DR is able to provide valuable capacity through utility agreements;
2. The process of enablement of resources to bid directly into the wholesale market

Better understanding of these mechanisms would enable the provision of support for the integration of intermittent renewables into the grid and subsequently be valued as a supply resource.

The SSP moved beyond day-ahead energy provided by C&I customers in the IRM2, enabling:

- Participation by residential customers
- Participation in real-time energy and non-spinning reserves (for non-residential participants)
- A simplified program design, particularly around the wholesale market pricing rules
- A program design that is more closely tied to resource-adequacy must-offer-obligations. For example, this results in a single 4-hour contiguous block instead of the 3 and 6-hour block options in IRM2.

Figure 1 displays the concept for integration of the retail resources with wholesale PDR model.

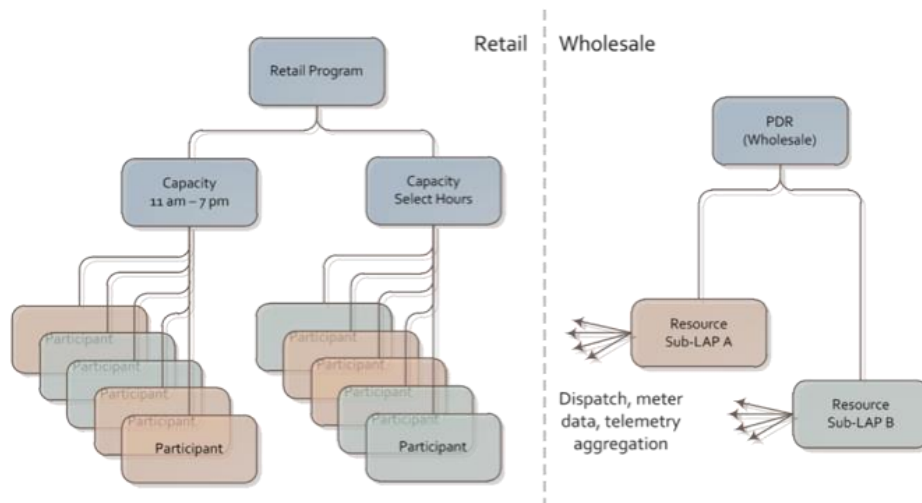


Figure 1: Concept for Integration of Retail and Wholesale DR. Courtesy of Olivine, Inc.

The pilot team roles and responsibilities are identified in Figure 2. Both large single customers and aggregators can participate in the pilot. Olivine serves as a scheduling coordinator (SC) and wholesale market demand response provider (DRP). It provides the interface between participant and pilot, including the CAISO market, and handles recruitment, enrollment and registration; nominations and

bidding; award and dispatch notifications; meter data aggregation and submissions; resource certification; credit and collateral; and settlements and payments.

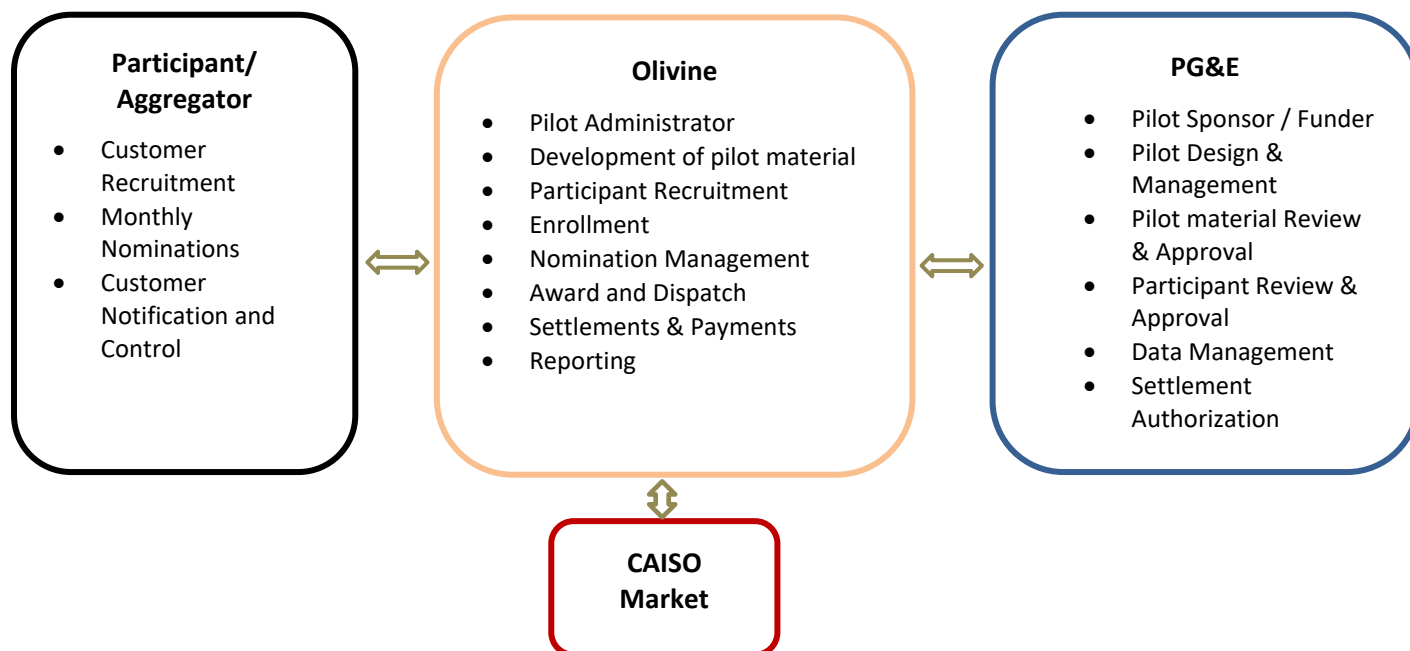


Figure 2: Entities Involved in the SSP/SSP II and Their Roles

The SSP was initially scheduled to run from 2015 through 2016. However, PG&E received approval from the Commission to continue the pilot through 2017 in D.16-06-029 and then from 2018 – 2020 in D.17-12-003. In addition to providing CAISO market-based services, this extension, known as the Supply Side II DR Pilot (SSP II) II is looking into how to enable the option for DR resources to be called to address local distribution reliability issues for the distribution grid.

The SSP II is meant to augment the Distribution Resources Plan (DRP) and integrated Distributed Energy Resources (IDER) proceedings: whereas the DRP and IDER proceedings are focused on determining where Distributed Energy Resources (DER) can meet distribution system needs and the associated value, the SSP II is investigating the operational feasibility of utilizing DR resources that are integrated in the wholesale energy market and provide Resource Adequacy (RA) to also address local distribution needs.

The focus of this effort was the integration of the SSP II with the PG&E EPIC 2.02 - Distributed Energy Resource Management System (DERMS) pilot, which was an Electric Program Investment Charge (EPIC) funded project. However, due to delays in customer equipment installation at the sites selected for the DERMS pilot, testing of these locations did not start until early 2018 and testing only lasted for a few months. An in-depth discussion of the DERMS pilot, including coordination with the SSP II, can be found in the EPIC Final Report which is available at [https://www.pge.com/pge\\_global/common/pdfs/about-pge/environment/what-we-are-doing/electric-program-investment-charge/PGE-EPIC-2.02.pdf](https://www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/electric-program-investment-charge/PGE-EPIC-2.02.pdf).

## 4 Pilot Participation

To participate in the pilot, participants need to meet several requirements for eligibility as well as enroll through many steps, detailed in this section. Requirements have changed over the pilot period, and these changes are also identified throughout.

### 4.1 Pilot Resources and Eligibility

To facilitate the integration of wholesale-integrated demand response, the CAISO developed a resource model known as Proxy Demand Resource (PDR). Like other conventional resource models (e.g., Multi-Stage Generator or MSG), the PDR models the physical characteristics of a resource supplied to the CAISO and is the basis for bidding, awards, dispatch, outages, and settlement.

The PDR is composed of either a single customer location or an aggregation of customer locations. For example, a commercial or residential aggregator can assemble a collection of customers into a resource that can then bid into the wholesale market as a PDR. A large customer may also directly enroll one or more locations, as long as the set of locations meets the eligibility requirements. For consistency, Olivine uses the term *participant* to indicate the party that enrolls in the pilot, including either the aggregator or direct customer. The term *customer* identifies the underlying utility customer whether the participant or a customer of the participant.

In general, each participant in the pilot is allowed to enroll a single PDR resource, composed of an aggregation of one or more customer locations<sup>2</sup>. Due to the volume of residential customers required to achieve the 100 kW PDR requirement, the pilot has a residential-only 30 kW option. Due to CAISO requirements, resources utilizing this option do not participate in the CAISO markets.

For those resources integrated in the CAISO market, certain CAISO requirements for enrollment and participation must be met, detailed in the following sections.

#### 4.1.1 The resource must meet a minimum of 100 kW of load curtailment

Any PDR at the CAISO is required by tariff to be able to achieve a minimum of a 100 kW load curtailment. Note that this requirement is not defined any further so does not reference seasonality, time of day, or any other operational limitation. For example, if a resource is made up of locations that can achieve a 100 kW load drop only during hot summer days, it would be considered a valid PDR even though on most days it would not be able to achieve that load drop. In addition, the CAISO does not have any requirements for testing energy-only PDRs in the wholesale market, so the actual curtailment is not verified by the CAISO before wholesale market entry. Because of this, the Pilot requires a qualified capacity test before entry.

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<sup>2</sup> [REDACTED] was one exception to this rule since their existing resources were grandfathered into the SSP and subsequently the SSP II. In addition, other providers were given the option of an additional resource as long as adding that resource would create further benefit for the Pilot.

#### 4.1.2 Customers must not be enrolled in any other CAISO resource

The CAISO prohibits customer locations from enrolling in more than one market resource at a time. If a customer is found to be enrolled in another CAISO resource, that customer is deemed ineligible for the pilot, noting that this has not occurred during the life of the pilot.

#### 4.1.3 Customers must be served by one Load Serving Entity (LSE)

Individual CAISO demand response resources cannot include customer locations served by different LSEs. The LSE is the entity responsible for procuring electricity for their customers. For vertically-bundled utility customers, the LSE is always PG&E. For Direct Access customers, the LSE is an Energy Service Provider (ESP) (e.g., [REDACTED] is one of the LSEs utilized by a Pilot participant). Another example of an LSE is one of the Community Choice Aggregators (e.g., Marin Clean Energy or Silicon Valley Clean Power).<sup>3</sup>

#### 4.1.4 Customers must be located within a single Sub-LAP

All of the locations within the resource must be located within a single Sub-LAP. A Sub-LAP is a geographically defined area, such as PG&E East Bay or PG&E San Francisco. Thus, a resource cannot contain locations from both the East Bay and San Francisco.

#### 4.1.5 Customers must not be enrolled in any other DR program or rate

In addition to the CAISO requirement limiting any customer location to a single CAISO resource, PG&E and the CPUC generally limit customers to a single utility demand response program or rate. As such, customers were not allowed to enroll in the pilot if they were on another program or on the “demand-response”-like rates of SmartRate or Peak Day Pricing.

Note that there was an exception in that a customer could participate in the SSP/SSP II and the PG&E Excess Supply DR Pilot (XSP) as long as the resource met certain criteria. No participants elected in joint enrollment until the beginning of 2018. The joint enrollment exception was discontinued in August of 2018 as part of updates to the participation rules of the XSP.

#### 4.1.6 Residential Option

As noted in section 4.1, residential participation had a lower capacity requirement for entry into the SSP. Instead of requiring the 100 kW minimum curtailment, residential aggregators were given the option of enrolling at 30 kW. In this case, such participation is not integrated into the wholesale market, but simulated as being in the market. A Participant would meet the same requirements of a conventional participant by bidding and receiving dispatches in the normal way. The difference is that without the resource being in the CAISO markets, Olivine retrieves the market clearing price as applicable to the location of the resource, and then triggers based on participant bids clearing those prices. In this case, there are no wholesale market settlement to pass onto the participant. The rationale was that the enrollment process turned out to be very difficult for residential aggregators,

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<sup>3</sup> The CAISO has committed to removing this requirement as a part of the ESDER 3 stakeholder process for planned implementation in the fall of 2019.

particularly with the somewhat manual process of obtaining customer authorization service request (CISR) forms from customers.

Attempts have been made in previous years to enroll residential customers into the pilot. [REDACTED] attempted to enroll a [REDACTED] resource but, was unable to demonstrate that capacity in testing. In another case, [REDACTED] was given the option of enrolling a [REDACTED] resource after having failed two attempts at achieving [REDACTED]; however, they opted out of the pilot at that point. Since then, there has been no interest by any other aggregator to enroll residential customers. While the initial intention of the lower 30 kW requirement was target at residential aggregators, the pilot made an exception for non-residential participants who were interested in joint enrollment with the XSP.

4.2 Pilot Rules

Aside from the eligibility requirements enumerated above to gain entry into the pilot, participants had several requirements for qualification and ongoing participation to earn their capacity payment. This is outline in the following figure:

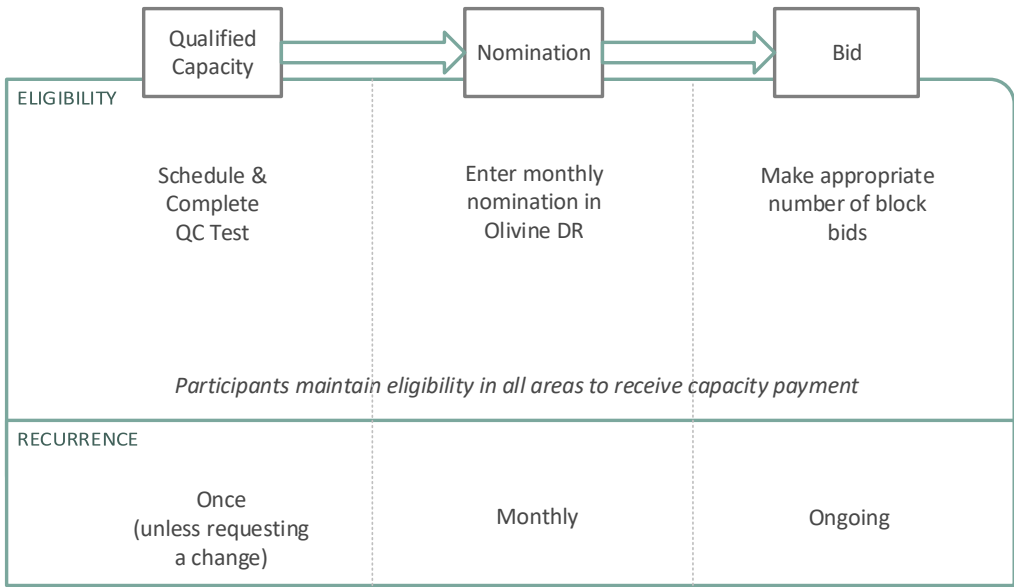


Figure 3: Participant Operational Tasks. Courtesy of Olivine, Inc.

4.2.1 Qualified Capacity (QC)

Participants undergo an out of market capacity test prior to becoming operational to determine the resource’s Qualified Capacity (QC). The QC test simulated a market dispatch and measured the average energy delivered over a four-hour period against the PDR baseline. The result of the QC test became the resource’s QC.

The QC test serves two purposes for the SSP II. The first being to verify a resource’s ability to meet the prescribed minimum reductions of 100 kW or 30 kW for a residential resource. The second purpose of the QC test was to set the maximum capacity value participants could nominate into the Pilot. This

nomination value also becomes a basis for the capacity incentive calculation as described in Section 4.2.5. Resource's that could not achieve the minimum capacity reduction had the ability to re-test

#### 4.2.2 Capacity Nominations

On a monthly basis, participants nominate a capacity value for their resource. The capacity nomination must be equal to or greater than 100 kW – or 30 kW for a residential resource – and equal to or less than the resource's QC.

Note that if a Participant routinely delivers below their nomination, the program administrator has the option of lowering their QC going forward; however, this has not been necessary during the pilot.

#### 4.2.3 Bidding Requirements

Participants are required to submit bids in the Olivine Distributed Energy Resource management system (Olivine DER), whether through the user interface or web API. The bids are ultimately forwarded to the CAISO for inclusion in the market runs.

Resources that do not meet the 100 kW requirement to participate in the wholesale market (e.g. residential) are still required to submit bids to the Olivine DER, though they were not forwarded to the CAISO.

In order to be eligible for the capacity incentive there is a monthly requirement of submitting at least 18 qualified bids across 18 unique days. A qualified bid consists of a 4-hour contiguous block. As such, participants would have 72 bid hours per month. Participants who receive a cumulative total of 24 qualified awards (e.g. dispatches) over the course of the month also satisfy the requirement for the capacity incentive. All bidding obligations are met for the month after 24 hours of qualified awards.

Additional bids that exceed the requirements of the pilot are acceptable. Though they do not result in an increased capacity incentive, it can be an opportunity for the participant to earn additional wholesale market payments. In the early months of the Pilot (from 1/1/2015 through 9/30/2015), participants were expected to bid half of all hours at the Demand Response Net Benefits Test (NBT) price. As of 10/1/2015, this requirement was removed enabling participation at any price between the NBT and the \$150 price ceiling. This requirement was changed both to simplify participation and due to the high number of dispatches that were occurring due to market conditions.



#### 4.2.4 Bid Price & Quantity Limits

In the SSP II, the day-ahead (DA) bid has a price floor equal to that of the month's Net Benefits Test (NBT) price<sup>4</sup> and a price ceiling of \$150/MWh.<sup>5</sup>

$$NBT \leq \text{Bid Price} \leq \text{Ceiling}$$

At the CAISO, bids have a quantity floor of 10 kW and a quantity ceiling of the maximum as detailed in the CAISO's MasterFile for the resource (i.e., the Pmax). Note that eligibility for the capacity payment is predicated on submitting qualified bids and one aspect of a qualified bid includes bidding the quantity at or above the resource's QC.

$$10 \text{ kW} \leq \text{Bid Quantity} \leq P_{\max}$$

Each month the CAISO publishes an NBT value, one for on-peak and one for off-peak periods. In this context, the on-peak periods are defined by the North American Electric Reliability Corporation (NERC) as Monday through Saturday from 6:00 AM to 10:00 PM. Off-peak periods include the complement of the above weekday times, Sundays, and six holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day. For a table of monthly net benefit prices during the SSP II, please refer to Appendix A.

Note that the SSP II allows resources to bid into the real-time market. When doing so, the price floor is maintained at the NBT as described above, but the price ceiling is aligned with the CAISO at \$1,000/MWh.

#### 4.2.5 Capacity Incentives and Wholesale Opportunity

The SSP II provides customers with two main forms of compensation:

1. A performance-based monthly retail capacity payment of \$10/kW-month.
2. Payments – net any imbalance energy charges – arising from wholesale market awards and resulting settlements. These net charges specifically exclude CAISO Grid Management Charges (GMC) which are paid by PG&E. Noting again that these payments are not available for out-of-market resources.

##### 4.2.5.1 Awards

In the day-ahead market, an award is the signal to the participant that the offer bid to the CAISO has been accepted and should be delivered over the awarded hour(s). Note that although participants

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<sup>4</sup> FERC Order No. 745 requires the CAISO to implement a net benefits test that establishes a price threshold above which demand response resource bids are deemed cost effective. The CAISO must perform a monthly analysis based on historical data from the previous year's supply curve to identify the price threshold estimate that shows where customer net benefits occur and publishes them to the CAISO web site. The CAISO usually publishes the monthly NBT values by the middle of the preceding month.

<sup>5</sup> The CAISO enforces a \$1000/MWh price ceiling, but prices above \$150 are quite rare particularly at the aggregated-PNode level at which PDRs are priced; the lower price ceiling was designed to ensure that CAISO market awards would not be a rarity in the Pilot.

submit qualified bids that are contiguous 4-hour blocks, awarded hours can range from 1 to 4-hours and need not be contiguous.

The award notifications are generally posted by the CAISO at 1 PM the calendar day before the trade date. Award notifications from Olivine DER to the participant are delivered through email or SMS. Participants whose resource(s) have been integrated with Olivine DER can also utilize OpenADR 2.0b or other APIs. In cases where the CAISO publication of awards is delayed, Olivine DER will deliver the award notification as soon as the CAISO publishes the results for the day-ahead market.

#### *4.2.5.2 Wholesale Payments*

The wholesale settlements that resources earn by participating in the market are calculated by the CAISO. Olivine passes the settlement payments or chargers received directly to the participant. These payments and charges include:

- Day-Ahead Awards which are paid at the Day-Ahead energy price
- Over-delivery during an event interval is paid at the Real-time Uninstructed Imbalance Energy price.
- Under-delivery during an event interval charged at the Real-time Uninstructed Imbalance Energy price.

All prices are as defined for the PDR itself. Where conventional wholesale market resources are paid at the Locational Marginal Price (LMP) for a specific PNode, PDRs have a price derived from a distribution of PNodes with the Sub-LAP. This type of PNode is referred to as an Aggregated PNode (or APNode). Note that typically, participants would be exposed to grid management charges from the CAISO, but this fee is paid by PG&E as part of the pilot.

#### *4.2.5.3 Distribution Loss Factor (DLF)*

Distribution Loss Factors (DLFs) are applied to the metered quantities utilized within the pilot reflecting the fact that power is lost through distribution and transmission. This results in the quantities used for operations (i.e., in nomination values, awards, and settlements) being slightly higher than the quantities metered at the participant's location. The exact amount the DLF fluctuates differs hourly and is specified by PG&E. Participants will find that the loss factors range between 3% and 7%. For more information on DLFs please consult the following report: [http://mads.pge.com/dlf/dlf\\_rsif.doc](http://mads.pge.com/dlf/dlf_rsif.doc).

#### *4.2.5.4 PDR Baseline*

For the pilot (with the exception described below in Section 4.2.5.5 on the use of ISO Type 2 / statistical sampling), the load drop is calculated according to a CAISO Type 1<sup>6</sup> baseline methodology. The pilot utilizes the whole premises metering in alignment with CAISO requirements (i.e. no sub-

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<sup>6</sup> The CAISO Type 1 methodology is based on the North American Energy Standards Board (NAESB) Baseline Type-I methodology which is described in the NAESB WEQ Business Practice Standards WEQ-015, Measurement and Verification of Wholesale Electricity Demand Response. The basis for a Type 1 methodology is that it uses historical whole-premises data to determine a counterfactual of expected usage outside of the DR event.

metering). The baseline is a “10-in-10” calculation that takes the average of a target number of the most recent similar day-type non-event days, subject to a morning-of adjustment with a  $\pm 20\%$  cap.

Note that as of November 1, 2018, the CAISO has established several new baseline methodologies including:

- A residential specific day-matching baseline, called a “3-in-5” baseline.
- A weather matching baseline that uses actual temperature data to determine baseline usage.
- A control group methodology.

Future participation within the pilot may take these new baselines into account as appropriate for the customer sector and underlying demand-response technologies.

Below is a detailed example of the baseline calculation process for the “10-in-10” baseline:

1. Identify the target number of previous similar day-type non-event days
  - Day-types are defined as weekdays (Monday – Friday) and weekends/NERC holidays.
  - The target number of days for each day-type are,
    - Weekdays: 10 days
    - Weekends/holidays: 4 days
  - Previous event days are excluded.
  - The maximum look-back window is 45 days.
  - If 10 non-event “Weekdays” cannot be identified within the 45-day look-back window, but at least 5 days can be identified, the baseline is calculated using the available days.
  - If at least 5 non-event Weekdays or 4 non-event Weekends/holidays cannot be identified in the look-back window, the highest usage prior event days within the look-back window are then included as needed to reach the minimum number of days.

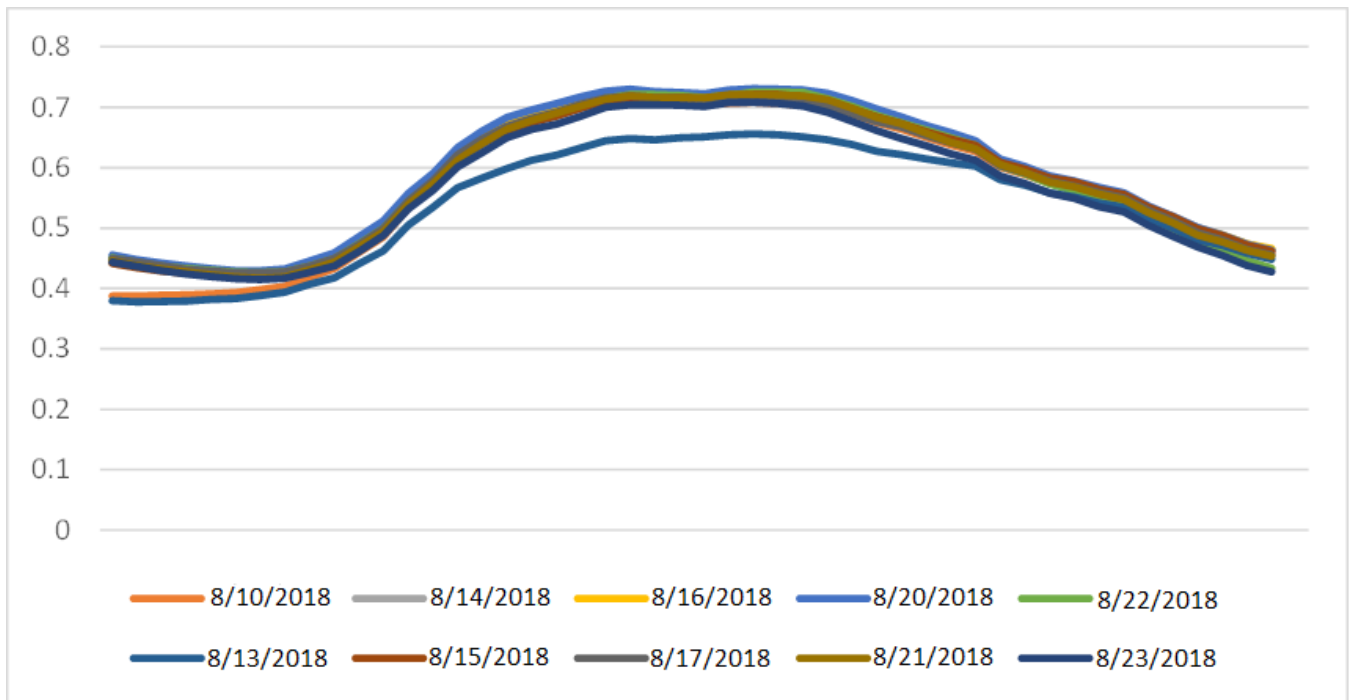


Figure 4: Identify 10 Similar Non-Event Days. Courtesy of Olivine, Inc.

## 2. Calculate average profile

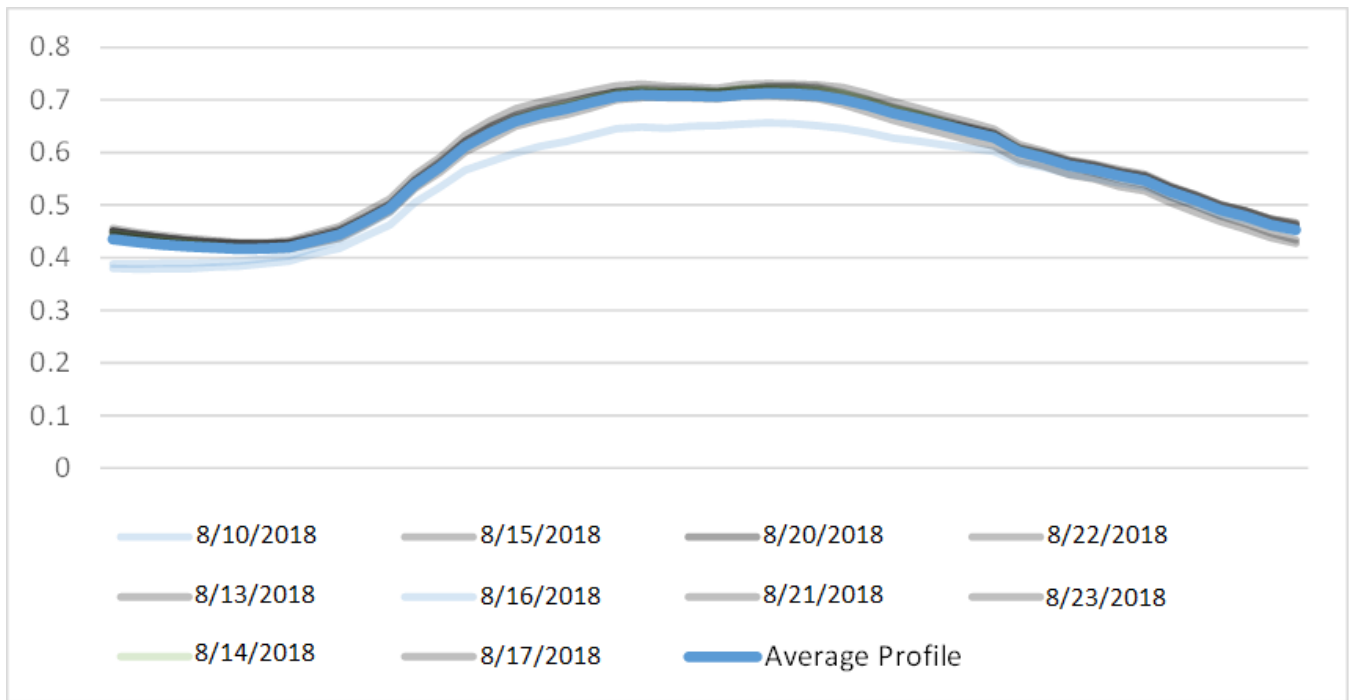


Figure 5: Calculate Average Profile. Courtesy of Olivine, Inc.

3. Determine day-of adjustment

- The day-of adjustment is based on the first three of the four hours prior to the event.
- A multiplier of the ratio of the average load for these three hours to the three-hour average from the baseline is calculated.
- The day-of adjustment is bi-directional (i.e. may be positive or negative) and is capped at  $\pm 20\%$ .

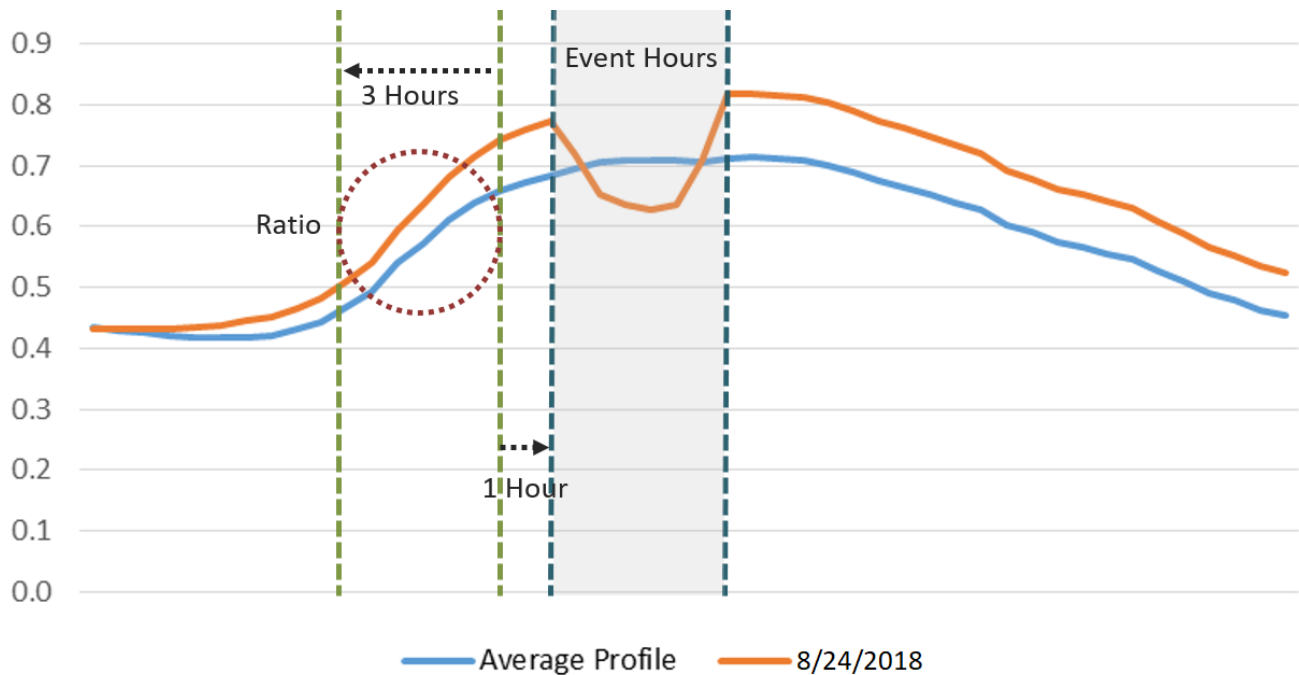


Figure 6: Determine Day-Of Adjustment. Courtesy of Olivine, Inc.

4. Apply day-of adjustment to create baseline

- The day-of adjustment multiplier is applied to the average profile for all hours of the event to produce the baseline.
- In the example included, this results in a baseline with higher quantities than the average profile.

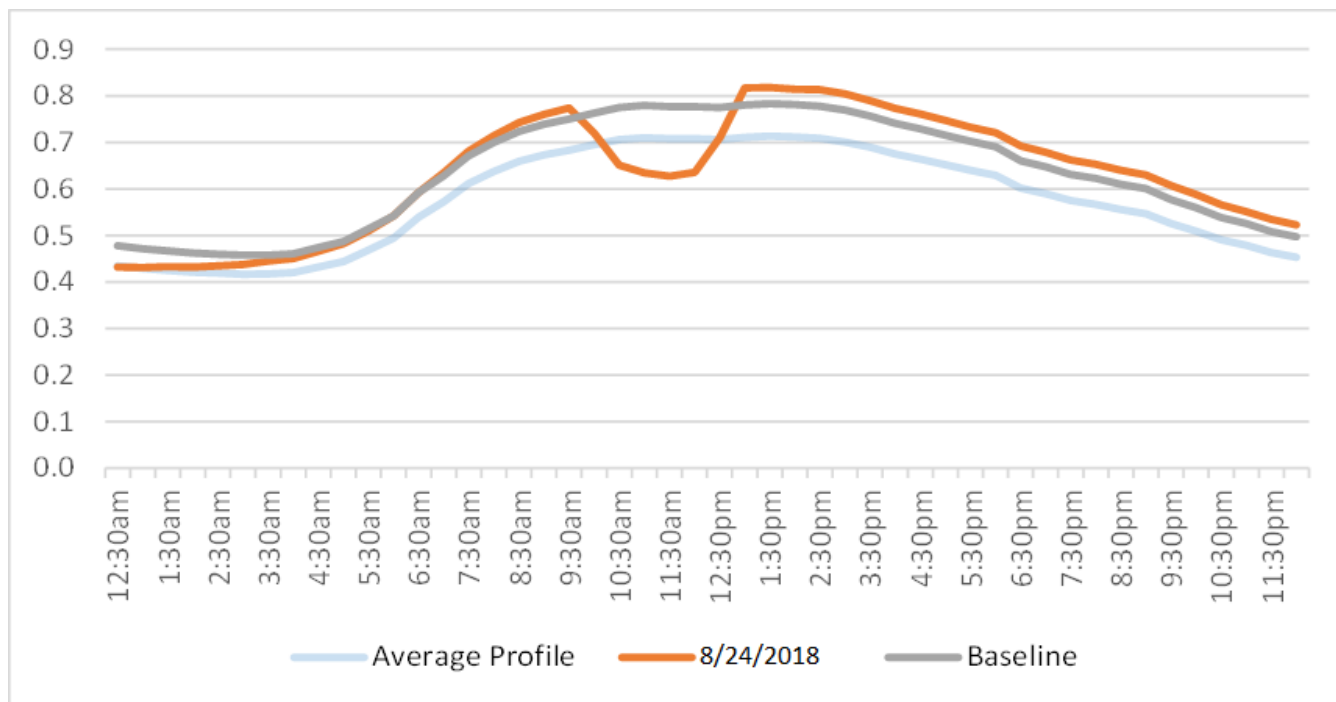


Figure 7: Apply Day-Of Adjustment to Create Baseline. Courtesy of Olivine, Inc.

The same baseline is used by the CAISO for measuring delivery as well as by Olivine for calculating performance for capacity settlement.

#### 4.2.5.5 Statistical Sampling / ISO Type 2 Baseline

As detailed above, the default methodology that the CAISO uses to evaluate PDR and RDRR market performance is a NAESB Type 1 baseline methodology. Under such a methodology, the resource's performance is based on an aggregation of the interval Revenue Quality Meter Data (RQMD) for all locations in the resource. The interval RQMD for all resources are used to create Settlement Quality Meter Data (SQMD) that is submitted to the CAISO for settlement.

In addition to various ISO Type 1 methodologies, the CAISO allows a statistical sampling approach aligned with the NAESB Baseline Type-II<sup>7</sup>. This is generally available for resources that do not have interval RQMD available for all locations in the resource; instead, Type 2 utilizes statistical sampling to calculate the SQMD for the entire resource based on interval RQMD for a subset of the locations in the resource. It should be noted that throughout the life of the SSP II the availability of interval-metered data for residential customers has improved greatly.

To use this methodology, a proposal must be submitted to and approved by the CAISO, and this proposal must include the sampling plan and model used to come up with the sampling plan, which had never been done prior to the pilot.

<sup>7</sup> As described in the NAESB WEQ Business Practice Standards WEQ-015, Measurement and Verification of Wholesale Electricity Demand Response.

Though residential customers with SmartMeters have interval data available, currently interval RQMD is not available for all residential customers because PG&E only creates interval RQMD for customers who are interval billed (e.g. customers who are on a time-of-use rate). As a result, resources composed of these customers are unable to participate in the CAISO market using the ISO Type 1 methodology. Instead, such resources must utilize the ISO Type 2 methodology in order to participate in the CAISO market.

An objective of the pilot was to develop and get CAISO approval of a statistical sampling plan for the provision of SQMD for mass market residential customers using the Type 2 baseline methodology as a way to increase the number of customers that could be integrated into the wholesale market. The approach could subsequently be used for the pilot as well as other programs.

During the 2015-2016 phase, a proposed resource submitted by [REDACTED], a residential aggregator was selected as a test case. The proposed resource had characteristics detailed in Table 1.

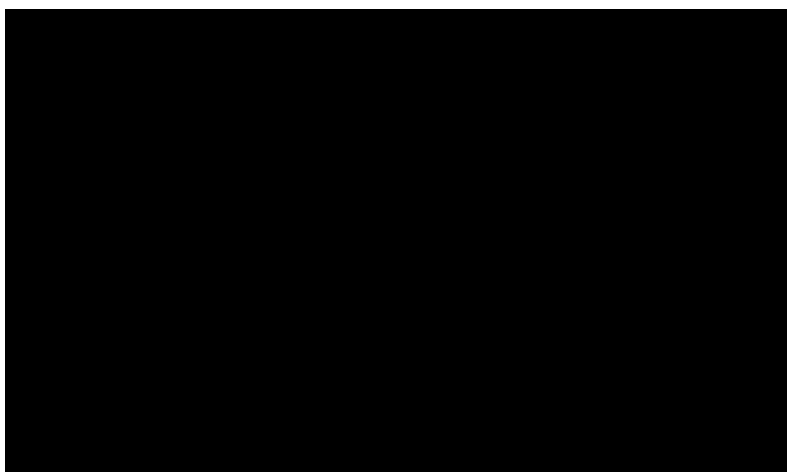


Table 1: [REDACTED] Proposed Residential Resource

At an aggregator estimated resource size of [REDACTED], the proposed resource was not necessarily a great candidate for statistical sampling. Nevertheless, this resource was deemed a good test case because the limited set of locations would provide a unique testing bed for establishing a solid operational and procedural foundation upon which larger resources may subsequently be created.

The sampling plan was submitted to the CAISO on April 29, 2016 and was based on and in accordance with the ISO Type 2 statistical sampling methodology outlined in the CAISO's Revised Draft Final Proposal of the Energy Storage and Distributed Energy Resources (ESDER) Stakeholder Initiative, which was approved by the CAISO Board of Governors on February 3, 2016. The CAISO tentatively approved

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<sup>8</sup> Additional locations were subsequently added to the resource, but these were the values for the original sampling plan submitted to and approved by the CAISO.

<sup>9</sup> Based on the statistical sampling methodology outlined in the CAISO's Revised Draft Final Proposal of the Energy Storage and Distributed Energy Resources (ESDER) Stakeholder Initiative (dated December 23, 2015 and approved by the CAISO Board of Governors on February 3, 2016).

<sup>10</sup> The amount that the available hourly interval RQMD meter data is scaled to represent the total population.

the plan mid-May 2016, with some follow-up questions. After reviewing responses from PG&E and Olivine, the CAISO gave final approval of the sampling plan in July 2016. However, as discussed elsewhere, [REDACTED] ultimately decided not to participate in the pilot and thus the sampling plan was never utilized. Nonetheless, by working through the application and approval process for a Type 2 baseline sampling plan with the CAISO, it was demonstrated that this approach can be used for future DR resources, including mass market residential.

Apart from the test case with [REDACTED], there have been no other residential aggregators interested in participating with this methodology, thus a lack of ability to implement the ISO Type 2 baseline.

#### 4.2.5.6 Capacity Settlement

The monthly capacity payment is calculated using the following equation. The capacity price is \$10/kW-month:

$$(Monthly\ Performance) \times (Nomination) \times (Capacity\ Price)$$

*Monthly performance* is computed from a weighted average of hourly adjusted performance, computed from raw performance and awarded energy:

- a. *Raw performance*: the hourly measurement of performance represented by the ratio of actual hourly delivery to the nomination<sup>11</sup> for each qualified award hour. Note that these performance numbers utilize the PDR baseline, calculated by the CAISO. The meter data used for retail performance calculations will be based on the PDR registration in effect during that trade date.

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<sup>11</sup> Note that in the context of a qualified bid, the bid quantity will always be equal to or greater than the nomination; however, under some unusual conditions the awarded quantity may be below the bid quantity. In this case, the raw performance is the ratio of actual hourly delivery to the awarded quantity, not the ratio to the nomination.



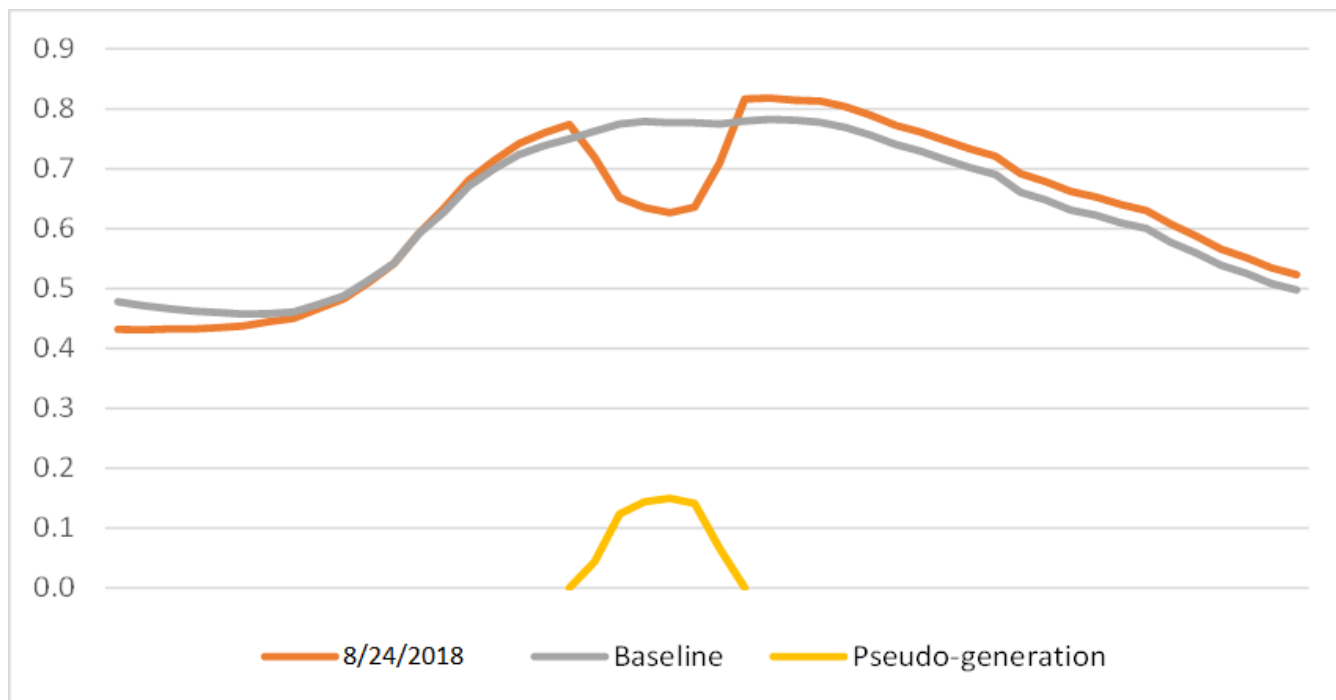


Figure 8: Calculate Performance. Courtesy of Olivine, Inc.

- b. *Adjusted performance*: an adjustment to the raw performance for use in pilot settlement payment calculations using the following step function:

Raw Performance	Adjusted Performance
$0.75 < x$	1.00
$0.50 < x \leq 0.75$	0.75
$0.25 < x \leq 0.50$	0.50
$0 < x \leq 0.25$	0.25
$x \leq 0$	0

Table 2: Adjusted Performance Tiers based on Raw Performance

- c. *Monthly performance*: The monthly performance is an average of all hourly adjusted performance values, weighted by hourly energy award.

If a resource does not meet the pilot bidding or award requirements for a given month, the participant will forfeit the entire capacity payment for that month.

The capacity payments have no penalties though are adjusted by actual event performance. They are settled at the enrollment, but payment was forfeited if bidding requirements were not fulfilled.

Wholesale energy settlements are provided to the participants at the PDR level, and they are paid for

over-delivery at the real-time price and charged the replacement cost for under-delivery at the real-time price consistent with CAISO settlements. All grid management charges are covered by PG&E.

#### 4.2.6 Real-time Bidding

Participants also have the option to participate in the Real-Time market by submitting Real-Time bids, subject to resource operational characteristics, as long as they met the following requirement:

- The pilot resource must have successfully participated in the day-ahead market for at least three months preceding adding the real-time option.
- The participant must integrate with Olivine DER for real-time dispatch signals using either OpenADR or the PAP 19 Deployment API.

Real-time bidding in the pilot did not alter any of the pilot participation and bidding requirements: such resources were still required to meet the same day-ahead bidding requirements. In addition, there was no additional capacity payment for participating in the real-time market. Any income earned in the real-time market was passed through to the participants.

## 5 Pilot Operations

### 5.1 Recruitment and Enrollment

Recruitment efforts in the pilot have occurred throughout the various phases. The first step in each recruiting effort is to perform marketing outreach to as many appropriate entities as possible. For the pilot, a list of 32 possible organizations and their contacts was drafted including IRM2 prospective participants, contacts from other PG&E programs, and Olivine contacts. The contacts on the list were notified in this outreach phase, both via email and phone. Olivine developed education and enrollment materials which were initially provided in a public presentation at the PG&E Pacific Energy Center in January 2015. Education materials included presentation materials, a summary of the enrollment process with timelines, a checklist of all required documentation, and a list of frequently asked questions.<sup>12</sup> Olivine also developed training materials and held training sessions for potential participants.

#### 5.1.1 Enrollment Process

Potential participants fill out a declaration of interest (DOI) and provide detailed information on customer locations and DR capacity. In the case that the participant is an aggregator, the participant also provides customer-executed agreements authorizing PG&E to release customer data to the participant. These forms, called customer information service-request forms (CISRs), also acknowledge that the customer is enrolling in the pilot.

Once submitted, Olivine reviews the enrollment materials and submits them to PG&E for final review. PG&E proceeds with validation of the CISRs and checks eligibility of customers for enrollment, including identifying Sub-LAP and LSE membership. Ultimately the participant acknowledges the enrollment of the eligible customers with the intention of placing them into a PDR for participation, or in the case of the 30-kW option, a simulated PDR.

Following enrollment, the participant executes a participation agreement with Olivine. Two training sessions are held: one on the rules, requirements and process of the pilot, and one on using the Olivine DER system to place bids and manage the resources. A qualified capacity test is then arranged to ensure the participant can meet the minimum curtailment requirements.


#### 5.1.2 Enrollment Details

From the original list of 32 organizations, 12<sup>13</sup> filled out a DOI, and three followed the steps to enrollment. These organizations are detailed in Table 3.

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<sup>12</sup> <http://olivineinc.com/wp2/wp-content/uploads/2015/02/PGE-Supply-side-Pilot-FAQ-v2.pdf>

<sup>13</sup> Note that IRM2 participants were not required to re-submit declarations of interest for the SSP.



*Table 3: Initial Outreach Organizations Interested in Participation*

Of these organizations, Olivine had ongoing discussions over several months, with many of the organizations failing to submit prospective locations, with reasons enumerated here:

- Delays with the project at [REDACTED] and potentially metering issues stopped the [REDACTED] from completing enrollment.
- [REDACTED] delayed and ultimately chose not to enroll into the pilot due to not being awarded [REDACTED].
- [REDACTED] was interested in utilizing existing or new storage assets to enroll in the pilot. Ultimately the lack of [REDACTED] and [REDACTED] resulted in no enrollment.
- [REDACTED] separately provided a declaration of interest into the pilot from before [REDACTED]. There was no further communication from [REDACTED]

- [REDACTED] ultimately told the pilot team that they had “no interested locations”.
- [REDACTED] did not provide a reason for not pursuing enrollment; however, it is public knowledge they received contracts in the [REDACTED] and may have chosen to focus on delivering those contracts.
- [REDACTED] was in the same situation as [REDACTED] regarding [REDACTED] and they did acknowledge to the pilot team that they were focusing on [REDACTED] with the hope of enrolling into the pilot if it continued into 2017. However, while the DR pilots continued, [REDACTED] decided not to participate because they felt the paper enrollment process was too difficult for residential customers and would likely not lead to high enough residential enrollment to warrant the cost of customer outreach.
- [REDACTED] ultimately decided to focus on other opportunities, partially because of the perception that the paper CISR process would be onerous and result in marketing costs incurred with few customers ultimately enrolled.

Three organizations went further into the enrollment process with Olivine, detailed below.

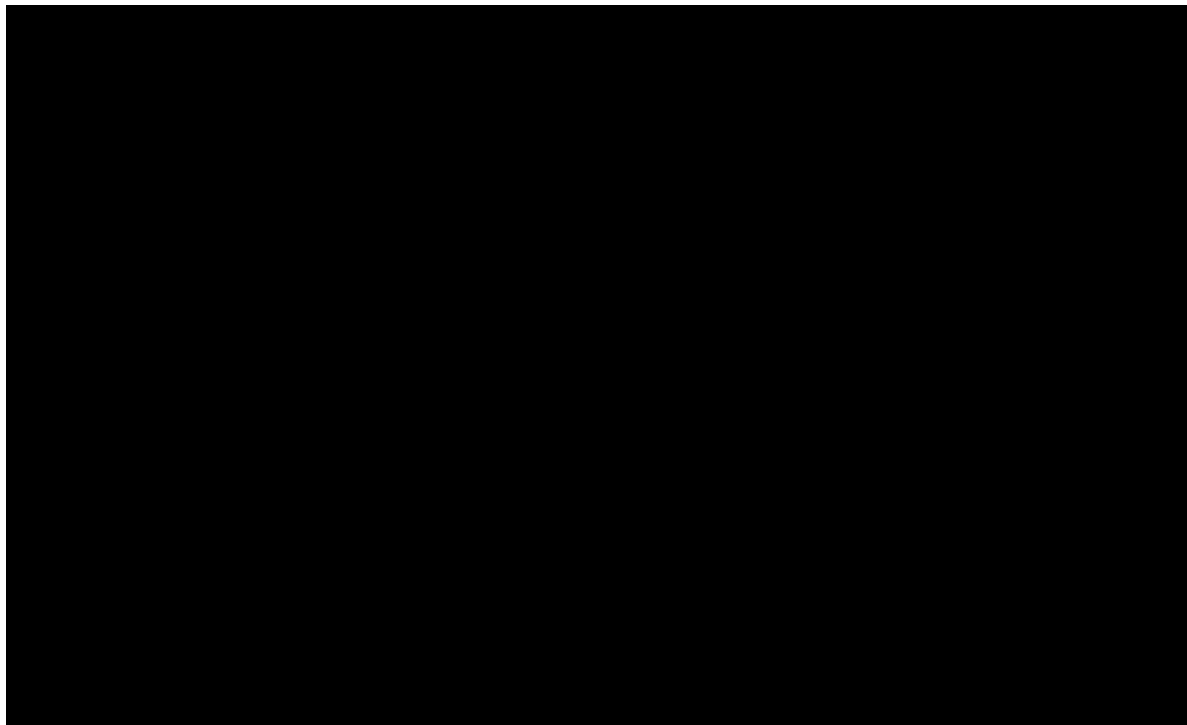
- [REDACTED], a commercial aggregator, submitted a complete enrollment package to Olivine in [REDACTED]. The customers involved were deemed eligible and removed from [REDACTED] by [REDACTED] to enroll in the pilot. This disenrollment from [REDACTED] threatened an [REDACTED] that the customer was due – and was tied directly to [REDACTED] – as a result, [REDACTED] decided to re-enroll the customers in [REDACTED] and not pursue enrollment in the pilot. Note that since [REDACTED] was made the commitment that disenrolling from [REDACTED] would not result in a financial shortfall, the pilot paid [REDACTED] the equivalent in missed [REDACTED] funds for the duration that the customers were disenrolled from that program.
- [REDACTED] began enrollment in [REDACTED] with the intention of achieving the [REDACTED] level of participation. After going through the entire process of authorization and eligibility checks, a capacity test was performed on [REDACTED] with a tested result of [REDACTED]. While this made [REDACTED] eligible for the [REDACTED] option, [REDACTED] decided to hold off on completing the enrollment process to add more customers. Ultimately a retest was performed on [REDACTED]. This test included a larger number of customers, but the result was [REDACTED]. Although the pilot team offered them enrollment at the [REDACTED] level, [REDACTED] decided to cease their enrollment in the pilot.
- [REDACTED] also began enrollment in [REDACTED] with the intention of achieving a [REDACTED] level of participation. After following the steps to schedule a test, one was performed on [REDACTED] with a test result of [REDACTED]. A retest was performed on [REDACTED] with a result of [REDACTED]. At that time, [REDACTED] determined that the [REDACTED] of their locations during their test hours was such that they would not be able to perform in the pilot. At that point they withdrew.

### 5.1.3 Enrolled Participants

Of the potential participants, six submitted locations for validation and three ultimately enrolled in the pilot, providing four PDR resources in total.

An issue that was common for many of the prospective participants was an overestimation of the number of locations that would pass validation as well as the DR potential for those locations. Table 4

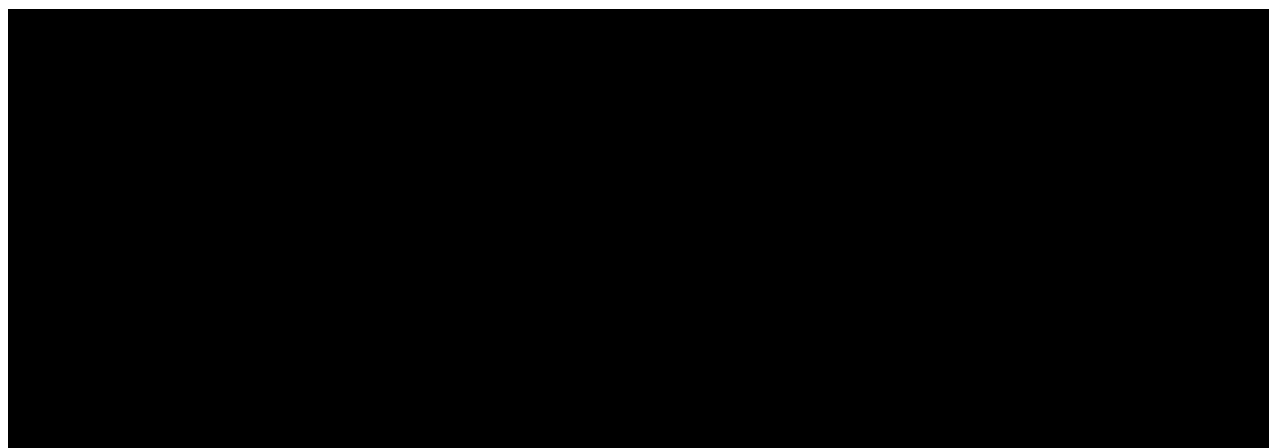
summarizes the attrition of locations and load from initial submission by the prospective participants through validation and then QC testing. As described elsewhere, this resulted in two of the prospective participants from ultimately enrolling in the pilot.

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*Table 4: Prospective Participants That Went Through Validation*

## 5.2 Example Events

The following figures provide example event dispatches in the pilot.



*Figure 9:* [REDACTED]

Figure 9 shows the measured load and calculated baseline along with the [REDACTED] delivery of [REDACTED] resource from [REDACTED]. The light blue line identifies the baseline

calculated per the rules as defined in Section 4.2.5.4. The dark blue line identifies the target increase to achieve the [REDACTED] award. Finally, the green line identifies the actual load during that time.

No participants elected to bid in the Real-Time Market in 2017 and 2018. The following example is a real time event dispatch from 2016.

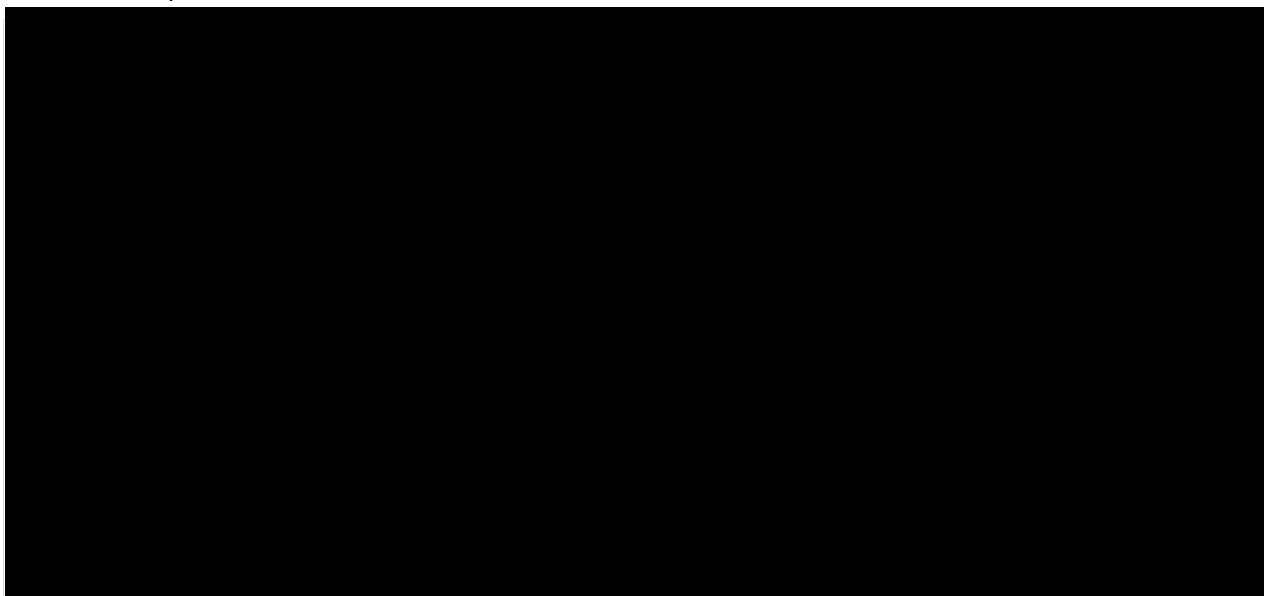


Figure 10: [REDACTED]

Figure 10 and Figure 11 show an event for the [REDACTED] resource showing both real-time dispatch from [REDACTED], and a day-ahead award from [REDACTED]. In each case, the resource is expected to deliver the energy equivalent of [REDACTED]. Figure 11 shows a closeup of the event. Note that these two different events occurring in the same day are the result of [REDACTED] submitting day-ahead bids to meet the pilot requirements followed by real-time bids. There is no market prohibition against their being multiple discrete events within a single day as seen here.

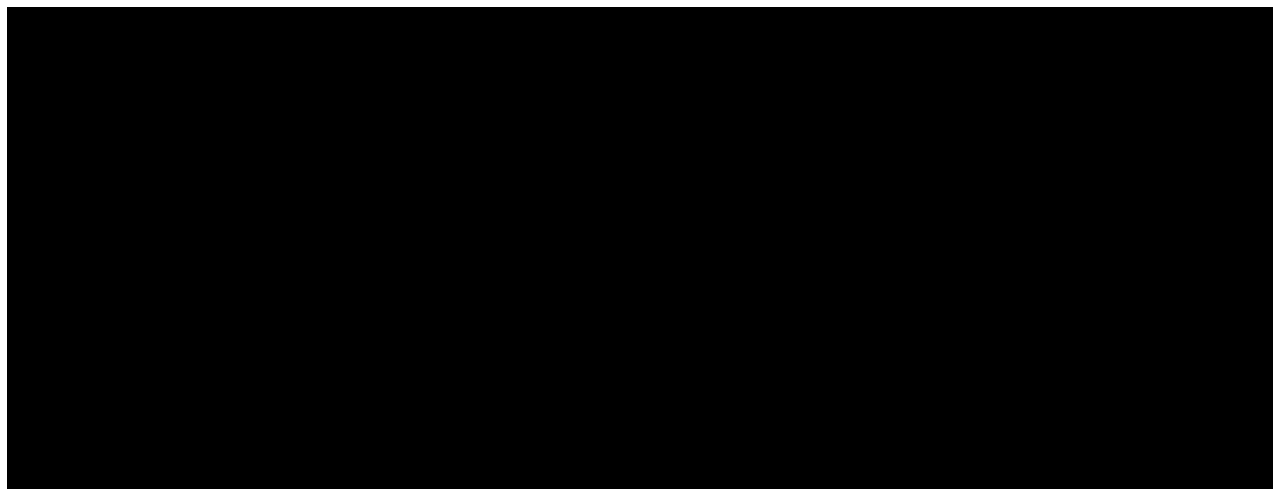
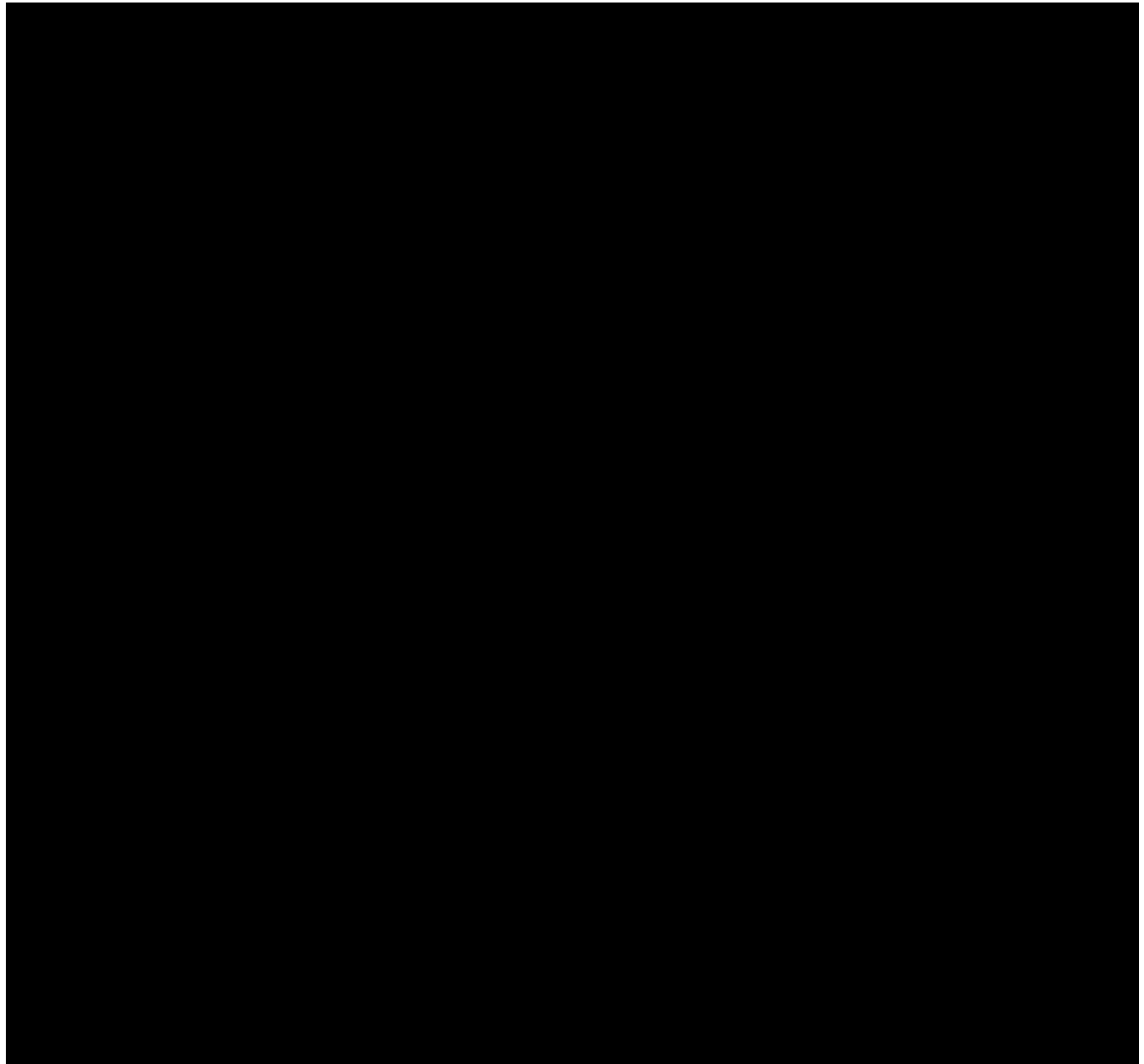


Figure 11: [REDACTED] (Zoomed In)

### 5.3 Resource Operations

Table 5 summarizes the Qualified Capacity and the underlying technology used to deliver the reductions by participant for 2017 and 2018, respectively. Note that resource QCs can be subject to change.



*Table 5: Participant Qualified Capacity(s) and Underlying DR Technology*





[REDACTED]

Table 6 and Table 7 provide a summary of the bid and award details for the [REDACTED] resources in 2018. Bid and award details for 2017 can be found in Appendix B.

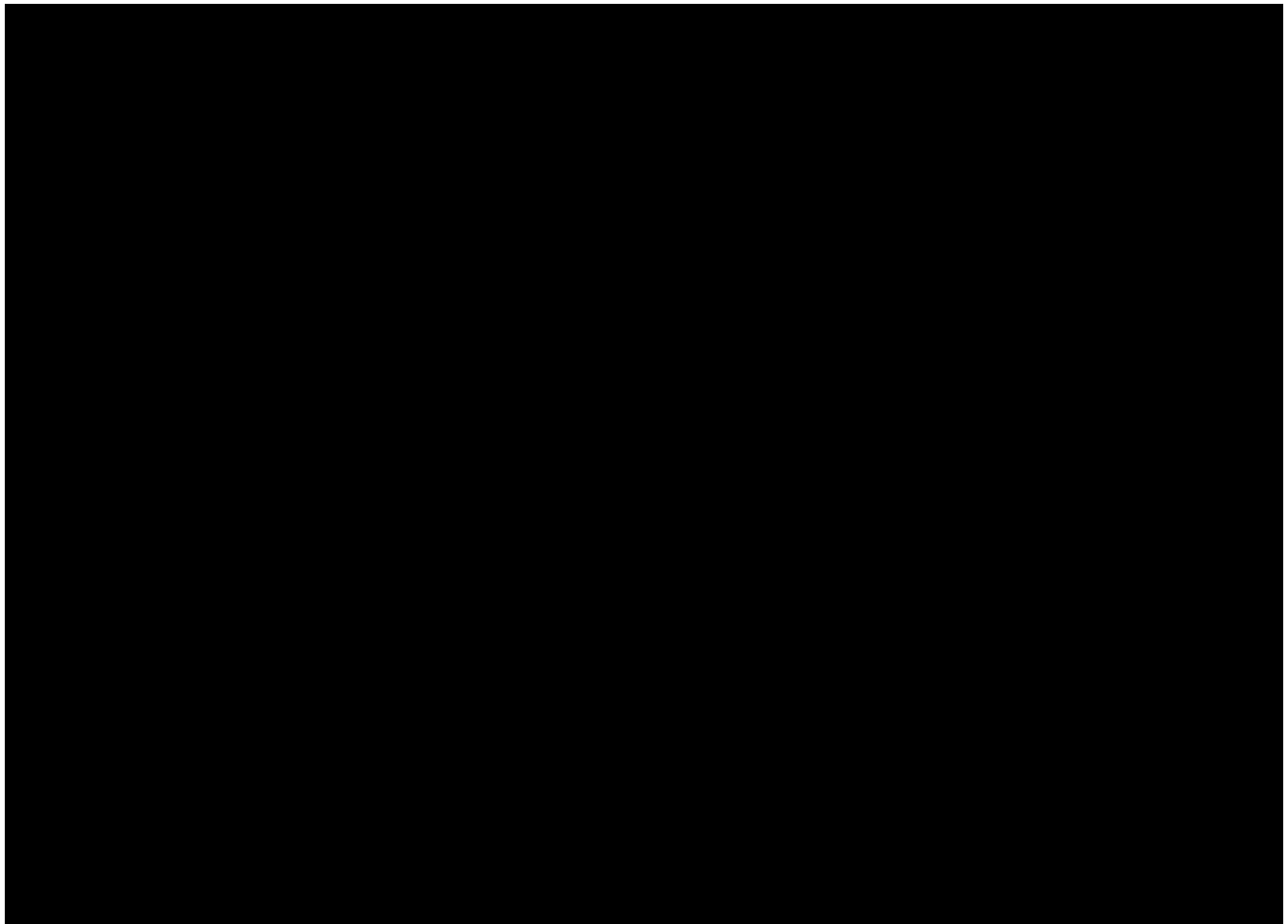


Table 6: [REDACTED]

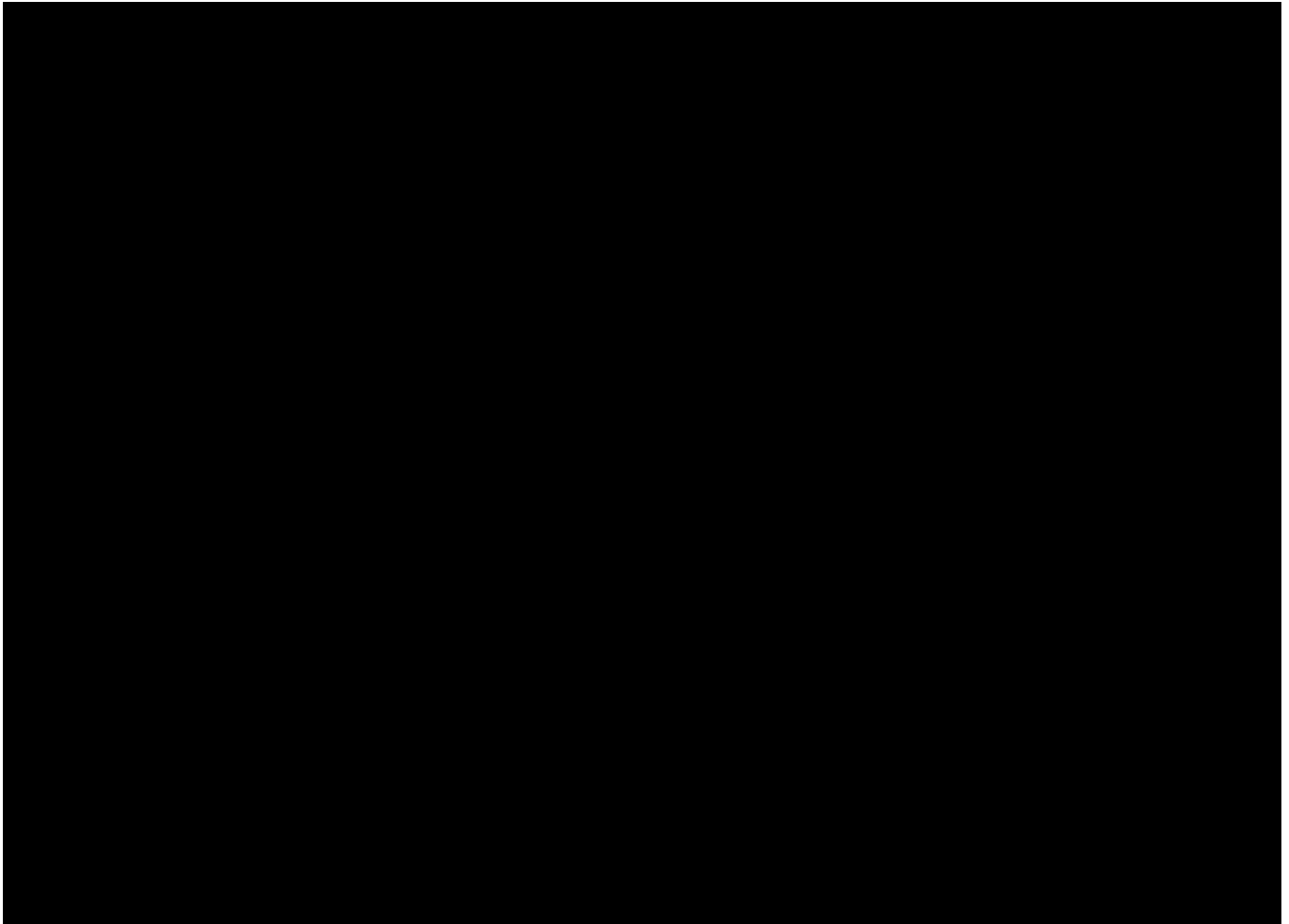


Table 7



Table 8 and Table 9 provide a summary of the event performance for the [REDACTED] resources in 2018. Event performance details for 2017 can be found in Appendix C.

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Table 8: 

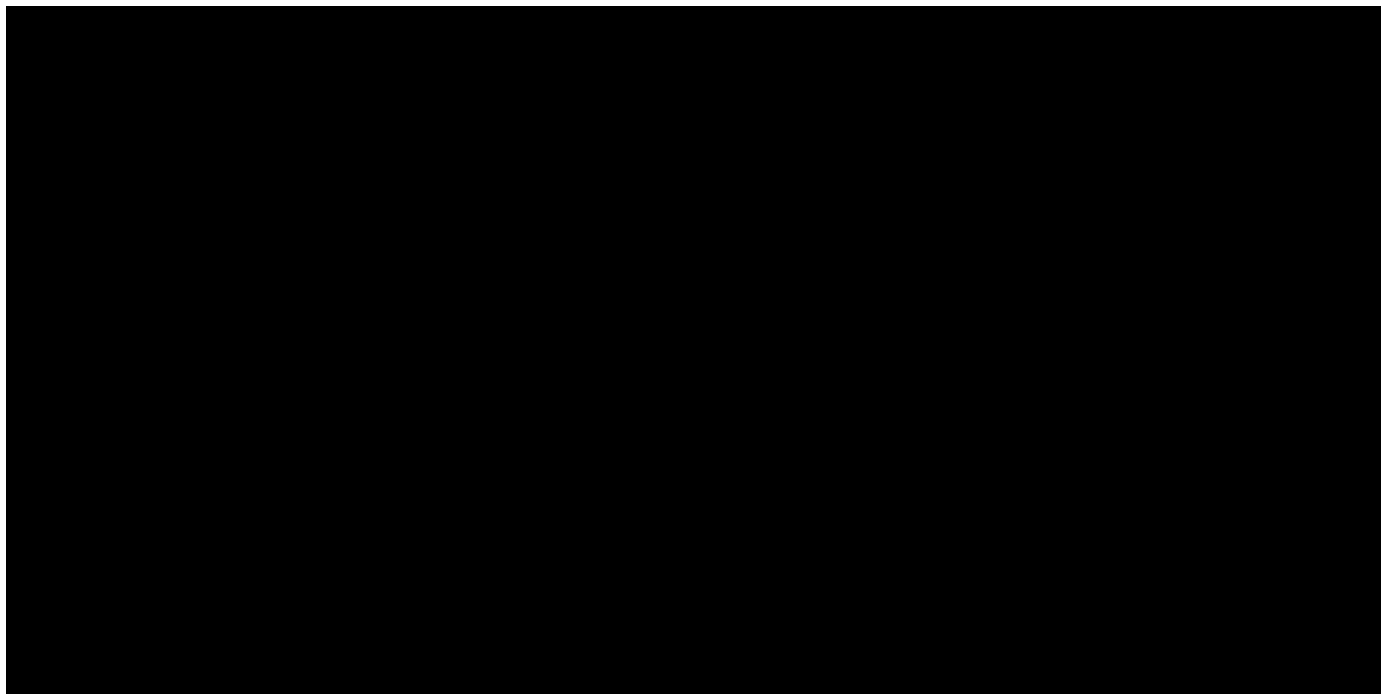
A large rectangular area that has been completely redacted with a solid black fill, obscuring any data or text that might have been present.

Table 9: 

Two horizontal lines of redacted content, each a solid black bar of varying length.

[REDACTED]

[REDACTED]

Table 10 and Table 11 provide a summary of the bid and award details for [REDACTED] resources in 2018. Bid and award details for 2017 can be found in Appendix B.

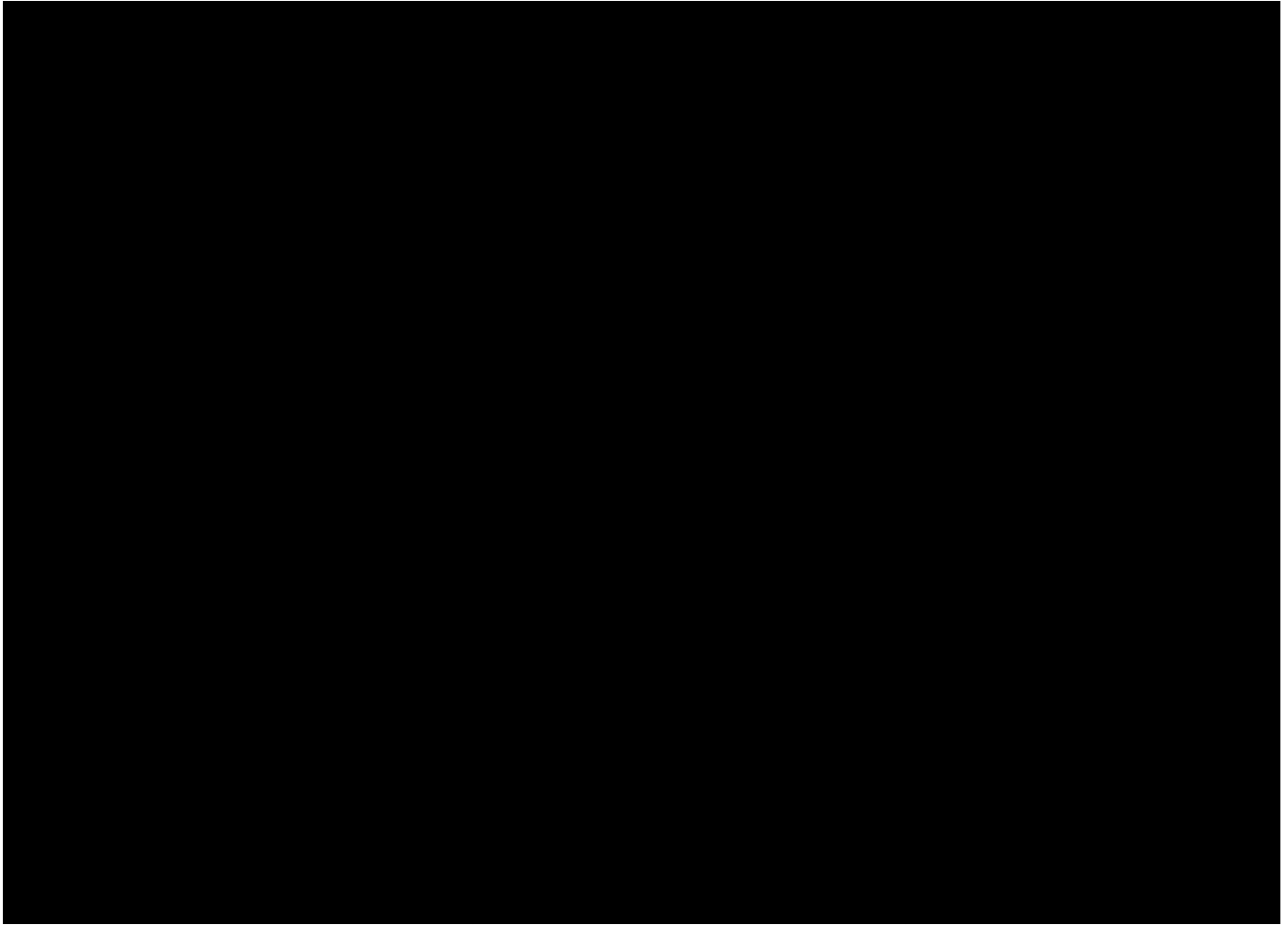
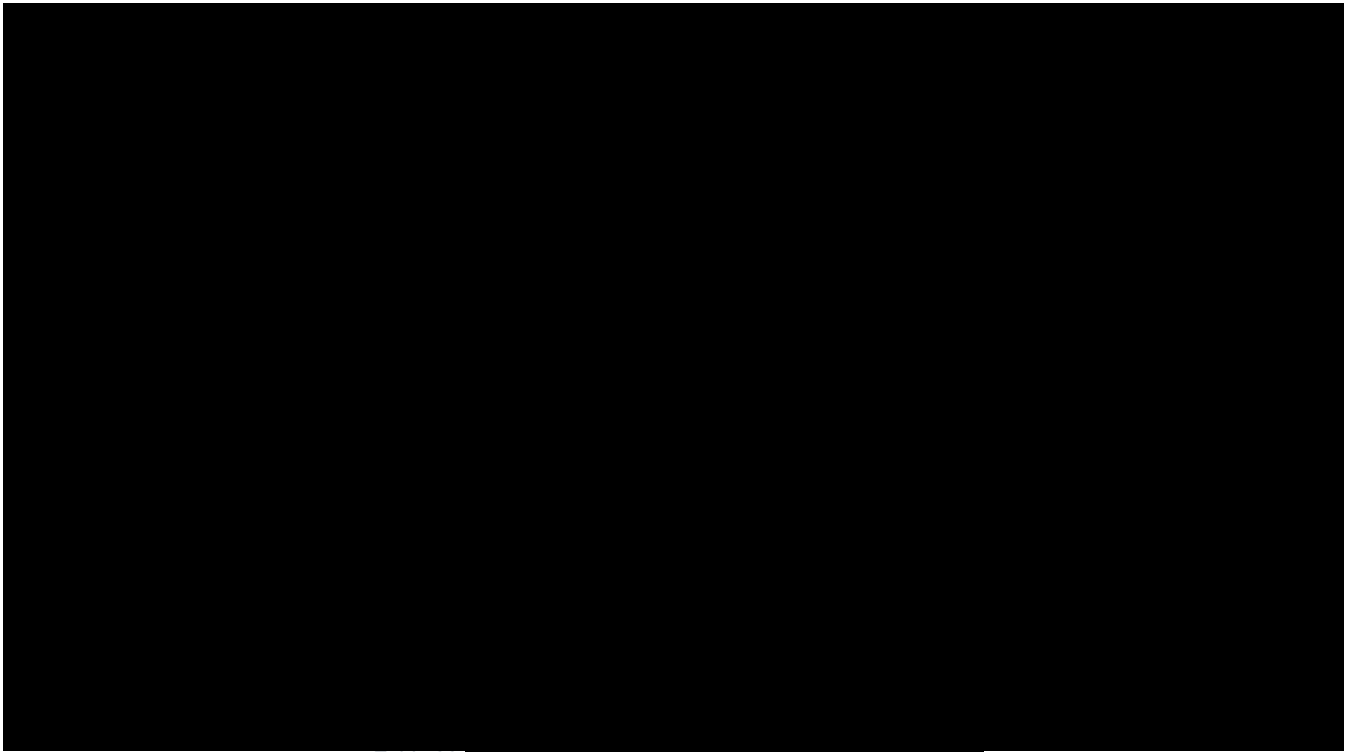
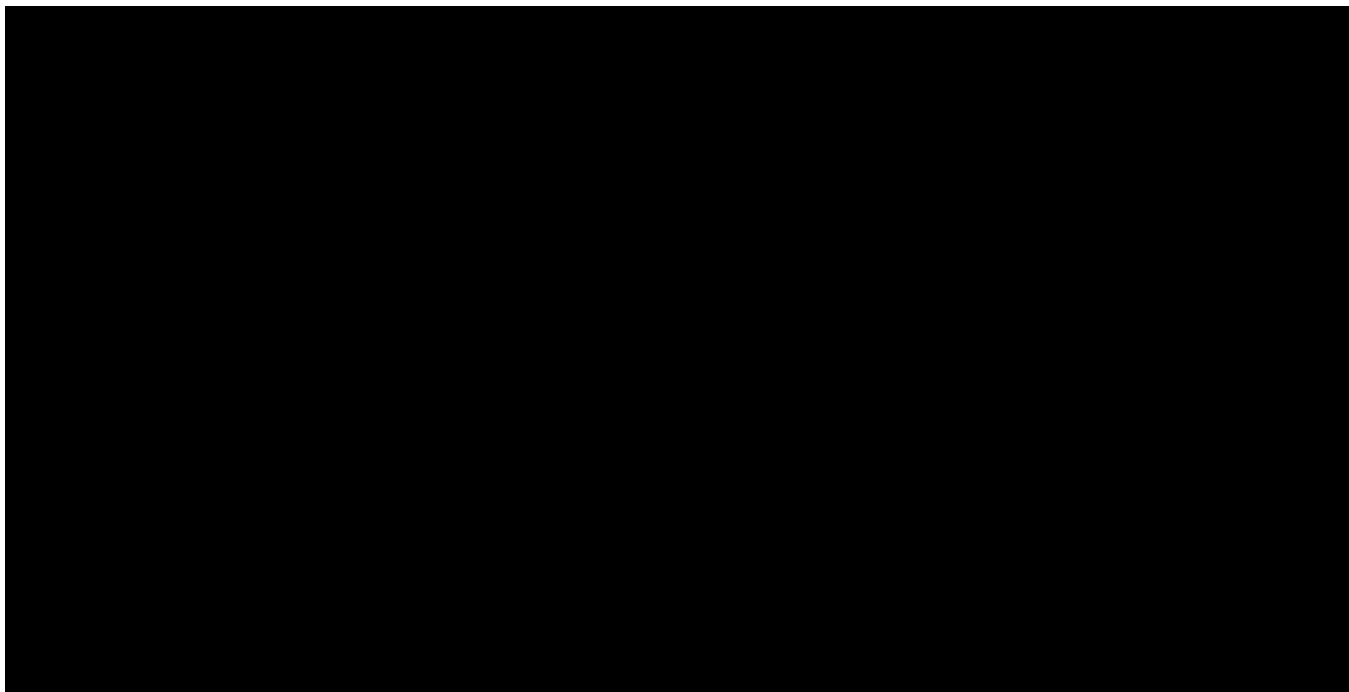


Table 10: 

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*Table 11:*

Table 12 and Table 13 provide a summary of the event performance for the [REDACTED] resources in 2018. Event performance details for 2017 can be found in Appendix C.

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*Table 12:*

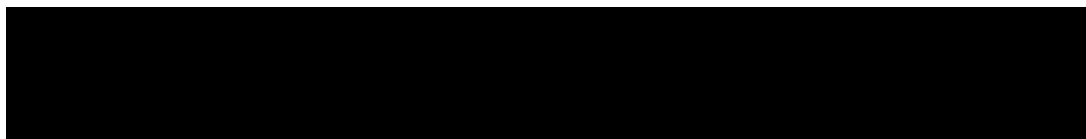


Table 13: [REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]
[REDACTED]

[REDACTED] An in-depth discussion of the DERMS pilot, including coordination with the SSP II, can be found in the EPIC Final Report which is available at [https://www.pge.com/pge\\_global/common/pdfs/about-pge/environment/what-we-are-doing/electric-program-investment-charge/PGE-EPIC-2.02.pdf](https://www.pge.com/pge_global/common/pdfs/about-pge/environment/what-we-are-doing/electric-program-investment-charge/PGE-EPIC-2.02.pdf).



[REDACTED]

Table 14.

### 5.3.1 Bidding and Time of Day

At the start of the pilot, each participant experimented with bid hours to find what worked best. Over time, the bid blocks settled into a regular pattern with little to no variation in time. [REDACTED]

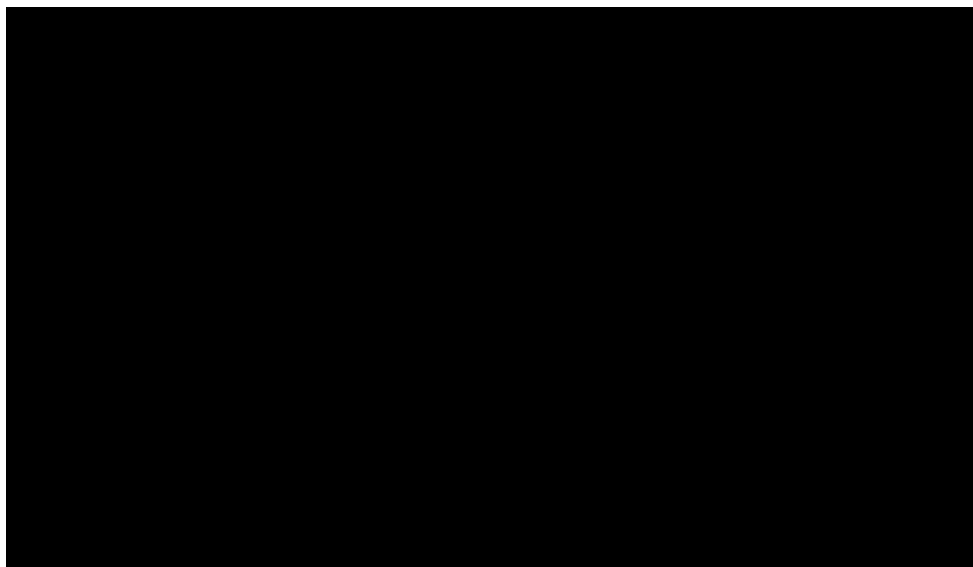
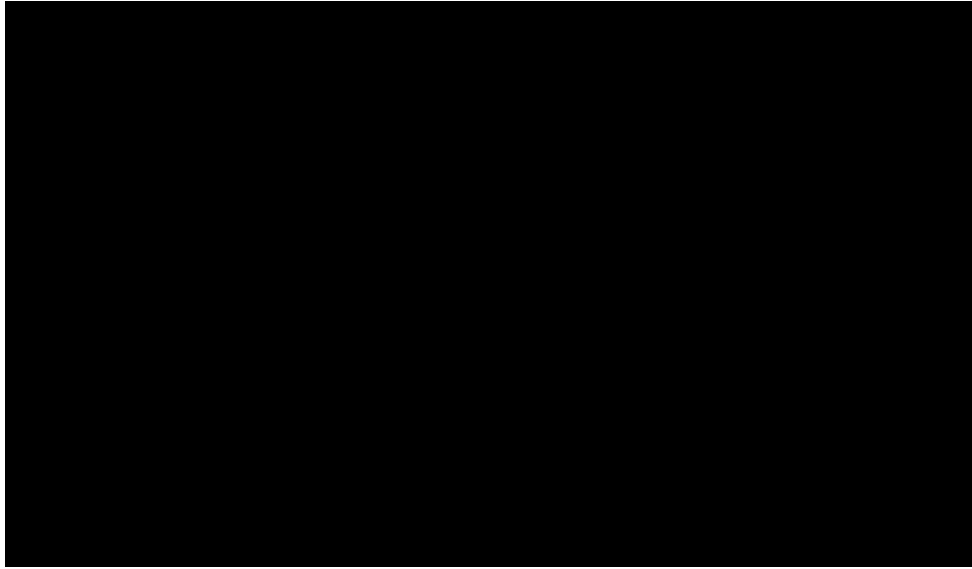


Figure 12: Percent of Bids in Each Hour by Participant, 2017





*Figure 13: Percent of Bids in Each Hour by Participant, 2018*

Table 15 and Table 16 summarize the cumulative number of bids placed by all participants segregated by month and hour. Note that hours ending 1 through 7 are omitted as there were no bids placed in those hours.

*Table 15: Total Number of Day-Ahead Bids Per Hourly Interval, 2017*

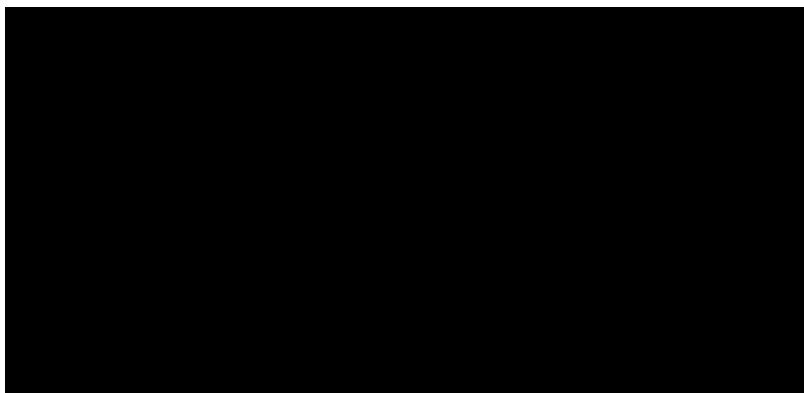
Table 16: Total Number of Day-Ahead Bids Per Hourly Interval, 2018

### 5.3.2 Bid Structure

## 5.4 Value of Participation

Each participant received capacity incentives for each month they nominated resources as well as payments from CAISO for the energy they delivered. Table 17 and Table 18 summarizes capacity and CAISO settlements received by each individual resource based on its participation in 2017 and 2018, respectively. As expected, the capacity payments, which is an incentive offered by the pilot, were significantly higher than the CAISO settlements. A set of monthly data for each resource can be found in Appendix E.

Table 17: Total Payments to Participants, 2017

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*Table 18: Total Payments to Participants, 2018*

## 6 Lessons Learned

In this section, we outline the lessons learned throughout the pilot implementation.

We categorize the lessons learned in this pilot into customer acceptance, market transformation challenges (wholesale market, technology), technical and operational feasibility, and value to participants.

### 6.1 Enrollment

In terms of enrollment, there was initially much interest from parties, but not as much follow through as one might expect. This can be attributed to several factors:

- Engagement in pilot presentation meetings is a way for parties to learn without any cost other than time. In fact, it is the job of many of the attendees to the pilot outreach meetings to network with IOUs, to learn about potential programs, regardless of fit.
- Some prospective participants are looking for funding mechanisms that would help them enroll customers into their own energy management service offerings. As such, a common theme is a declaration of interest, but ultimately the prospect cannot recruit actual customers for the project.
- The DRAM created an alternative for some prospects. This had the effect of forestalling prospects because of their incorrect belief that they would get a DRAM contract, or for those who were awarded a contract, forestalling pilot participation while fulfilling the DRAM. With the DRAM being continued through 2019, this continued as an issue throughout the pilot.
- Some prospective participants were concerned with the limited duration of the pilot (initially approved for 2 years with a subsequent 1-year extension) and the risk that the pilot might not be extended further. Even with further extensions, this concern has continued. As a result, they felt that the investment in time and equipment needed to qualify for and participate in the pilot was not worth the potentially short duration.
- A related issue is that some participants wanted a larger capacity allocation for participation to be impactful. With the pilot limiting participants to 1 resource and 1 MW of capacity, large individual customers and participants who felt they could not reasonably target a single region to meet the one Sub-LAP requirement per resource.
- Residential aggregators found recruitment of enough residential customers to meet the minimum load requirement more difficult than anticipated.
- An industrial participant chose not to enroll because their load could only be controlled discretely and far exceeded the per-participant cap of 1 MW. As such, participation would have resulted in many MWs of load reduction with a potential payment capped at 1 MW.

It was common for parties to initially overestimate the number of sites that would pass the validation process as well as the potential load reduction that could be achieved by the final resource. As already discussed, this resulted in several prospective participants failing to meet minimum capacity

requirements or deciding that the amount of load that they could control was insufficient to justify participation.

Another major issue – as was seen for both [REDACTED] and [REDACTED] was their inability to judge the actual impact of the 10-in-10 baseline on their viability as a PDR resource. The issue of a potential challenge with the baseline was well known to both organizations, but their ability to only control a portion of the total customer load and lack of whole-premises meter data likely made it difficult for them to determine in advance if their resources could meet the requirements.

Note that as SSP II has moved its focus to combining wholesale and distribution benefit, a new push has been awaiting finalized program design elements.

## 6.2 Value to Participants

- CAISO energy settlements alone do not result in significant value for the participants. This fact reinforces that programs like the pilot are necessary for demand response to be successful both in the CAISO markets specifically and in general to support California's grid needs.
- CAISO settlement systems had several major problems, outlined in Section 7.4 noting that these have been resolved during the life of the project.
- Several participants and prospective participants have given feedback that learnings from the pilot have been helpful in getting experience in customer recruitment as well as wholesale market participation. One of the participants, [REDACTED], chose not to continue in the pilot after 2016 and instead decided to take learnings from the pilot and scale up to participate in other DR programs.
- In one case, a resource was made up of a relatively small [REDACTED] controllable load behind a large variable load. In this case, the actual response was not visible using the whole-premises baseline performance methodology. This resulted in both significant over and under-performance of the resource measured in many MWs. As a result, the participant's performance settlement did not align with the performance of the load they were controlling.
- As expected, the CAISO settlements received by participants for the energy they provided were significantly less than the pilot participation incentives and did not add up to a significant value for the participants. This underscores the need for such incentives to enlist and maintain demand response resources.
- Many of the sites have been successful without direct integration with the Olivine DER system, presumably reducing the costs of these participants.

## 6.3 Operational Issues

There are several general issues that are raised within the pilot:

- Inherent problems in the regular retrieval and delivery of revenue quality meter data, particularly when site conditions change (e.g., service account changes or meter changeout). This has been improved for PG&E with the investment into the Rule 24 systems and processes – noting that these processes are not used within PG&E pilots – but the underlying issues will always result in ongoing resource management issues.

- Training is needed for customers to understand the basic CAISO market operations, including baselines, determining load shed strategies in response to program requirements, quantifying nominations, qualifying capacity, understanding retail incentives and wholesale settlements.
- Despite consistent efforts to engage conventional aggregators, there was no participation. The pilot would be richer if aggregators made use of the training and had first-hand experience in participating in PDR. Noting that with the introduction of the DRAM in 2016, many such participants engaged in the CAISO directly or indirectly without taking advantage of the pilot.

There are several lessons resulting from [REDACTED] taking the real-time option in the pilot:

- The real-time market operations result in very short dispatch notifications (i.e., 2.5 minutes before the event period). As such, it is clear that real-time operation is best suited for fully automatic control systems.
- Because of the short notice, pre-charging – whether charging an electric battery or pre-cooling a building envelope – is difficult to accomplish without real-time price forecasting.
- A shortcoming of real-time dispatch for demand response at the wholesale market, is that the participant is only paid for the intervals included in the dispatch even though the dispatches may be noncontiguous. For example, a DR event might receive 10 minutes of dispatch followed by 10 minutes of no dispatch followed by another 10 minutes of dispatch. Regardless of whether delivery occurs within the middle period, it is not observed by the CAISO, so any such delivery is paid \$0. This is different from conventional CAISO resources that are always in the market. In that case, over-delivery during the zero dispatch is still paid by the CAISO.

Baseline Calculation for Load Increase and Decrease.

- [REDACTED] had a resource cross-enrolled in the SSP II and XSP creating the potential that the resource could be dispatched twice in a single day. This did not end up occurring as the SSP II events and the XSP events ultimately did not coincide. However, considerations for how the baseline is calculated if such case were to occur is pertinent. In fact, in the latter half of XSP 2018, the [REDACTED] resource did receive multiple dispatches within the same day. For event days where there are both load increase and decrease dispatches, the later decrease event utilizes the same day-of adjustment from the afternoon increase event. This was implemented to avoid potential overlap between the afternoon event hours and the evening hour adjustment hours. For example, a 12 PM – 1 PM load increase event and a 4 PM – 6 PM load decrease event could be dispatched on the same day. If the evening event were to have its own day-of adjustment factor, the adjustment hours used in the calculation (12 PM – 3 PM) would overlap with the 12 PM – 1 PM increase event.

## 6.4 CAISO Settlement Issues

There were several persistent issues with CAISO systems that resulted in incorrect settlement by the CAISO for PDR energy settlement.

These issues were recognized by the CAISO as being systemic and as a result, the CAISO undertook a full resettlement of all PDR events from 2015 through the first half of 2017 to resolve the items listed in 6.4.1, 6.4.2, and 6.4.3. As of the implementation of ESDER 2 – and primarily due to removing the reliance on the CAISO’s problematic Demand Response System (DRS) – these particular issues will no longer surface.

### 6.4.1 55B Clawback

There were frequent issues relating to the CAISO settlement system not syncing with the Demand Response System (DRS). Meter data was sent to the DRS by Olivine, where the system would then calculate a baseline and event performance in the form of “pseudo-generation” (i.e., the delivered energy from the event as positive MWh values). Under normal conditions, this data was supposed to be sent to the CAISO’s Settlements system to calculate the imbalance energy and resulting financial settlements based on real-time prices; however, very often the data was not forwarded to Settlements. When the Settlements system does not receive meter data – regardless of the reason – the energy is deemed as not delivered. Thus, the end result would be that the 55 business day (55B) settlement is based on zero performance from the PDR. We term this generally as a “55B clawback”.

While the CAISO acknowledged this issue at the time, and Olivine disputed these issues as they arose, this continued to be a persistent problem until the resettlement in 2015. Note that after disputing settlements, the next opportunity for a correction is at the 9-month settlement (referred to as 9M). Olivine has found consistently that disputes are not resulting in corrections.

To help mitigate this as an issue for participants, the SSP project team decided to make up for this unfair “55B clawback” by estimating the performance of the resource utilizing the published CAISO baseline algorithm utilizing the same meter data that Olivine submits to the CAISO. We then calculated an approximate financial impact of this error using the 55B net amount (in dollars) and our calculated average performance. This is only done if the total load reduction is greater than zero.

$$55B \text{ Clawback} = 55B_{Net} \times \frac{Q_p}{Q_d}$$

where  $55B_{Net}$  is the dollar amount charged in the 55B settlement statement,  $Q_p$  is the total load reduction over the dispatch interval (including negative performance), and  $Q_d$  is the dispatched quantity. The original clawback was netted out of customer incentives, but this correction was then added back in, resulting in the customer being made whole. Olivine then billed this incentive to PG&E.

Note that there was a special case of this that we deem “partial clawback”. We only observed this issue on three events but there is an example of the CAISO charging for imbalance energy on the 12B statement and then charging for additional energy on the 55B. The UIE indicated a performance quantity different from the performance in DRS, but still less than what was calculated based on the

proper baseline in Olivine's system. The clawback amount calculated under the above formula was adjusted by the percentage of DA energy ultimately settled as UIE by the ISO.

$$\text{Clawback} = 55B_{\text{Net}} \times \frac{Q_{\text{OLV}} - Q_{\text{ISO}}}{Q_d} \times \frac{Q_{\text{UIE}}}{Q_d}$$

where  $Q_{\text{UIE}}$  is the total settlement quantity in the 55B statement.

See Appendix F for a summary which includes the 55B clawbacks. Table 7 includes a description of the type of problem. Most issues were related to the CAISO not processing information from the DRS. Olivine only started calculating "partial clawback" in July 2016, when a large number of missing events (see below) led to significant discrepancies in the baseline calculation. We have also noted event-days where there was a 9-month (9M) settlement. Overall, we have calculated approximately [REDACTED] from CAISO.

#### 6.4.2 Disappearing Events

Another persistent issue at the CAISO DRS was the issue of missing events. In many cases events that were clearly dispatched by the CAISO never were created in DRS (or later disappeared). For such cases, no performance would be calculated and forwarded to settlements. The settlement statements confirm the dispatch with a day-ahead energy settlement, but with no event in DRS, this is equivalent to the previous case where the resource appears to have delivered zero energy. Missing events posed additional problems because if the CAISO does not recognize an event day, the baseline for future events will include it. For a customer with frequent dispatches, this can have an effect on the baseline for more than a month after the day of the missing event. In this case, while there would be no wholesale energy payments to provide the participant, Olivine used the correct event times for the capacity baseline.

See Appendix F for a summary of incorrect baseline adjustments due to missing events.

#### 6.4.3 Incorrect Event Times

Another persistent issue in the CAISO DRS was the issue of incorrect start and stop times of DR events. This issue would generally result in a start time 5 or 15 minutes before the actual start time, and an end time similarly extended. This sort of problem results in two issues:

1. Over payment for real-time energy during these extended times (i.e., there should have been no payment for these times, but there would be).
2. In the case of an earlier-start time, the day-of adjustment would be calculated based on a different set of hours. For example, instead of the day-of adjustment relying on the first three hours of the four before the event, it would be the first three hours of the five before the event (e.g., 8 AM - 11 AM instead of 9 AM – 12 PM for a 1 PM event).

In this case, Olivine passed the wholesale energy payments to the participant, but used the correct event times for the capacity baseline.

See Appendix F for a summary of incorrect event times.



#### 6.4.4 Incorrect Holiday Treatment

The CAISO 10-in-10 baseline calculation is intended to treat holiday weekdays as weekends; however, in practice this was not the case. In particular, non-event holidays were wrongly included in weekday baseline calculations and excluded from weekend baseline calculations.

This impact results in a different calculation of the baseline being used by the CAISO than by Olivine systems. The difference in performance between the CAISO and Olivine is used to calculate an approximate settlement implication. The 55B settlement amount is multiplied by the difference between Olivine's calculated performance and DRS performance. This could result in a positive or negative financial settlement depending on if the CAISO baseline is higher or lower than the baseline using all dispatched events and proper treatment of holidays.

$$Clawback = 55B_{Net} \times \frac{Q_{OLV} - Q_{ISO}}{Q_d}$$

where  $Q_{OLV}$  is the performance calculated from Olivine's baseline and  $Q_{ISO}$  is the performance in DRS based on CAISO events and baseline. Olivine only started including baseline errors specifically starting July 2016. However, we used Olivine's and not CAISO's calculated baseline when determining clawback amounts for events where the ISO did not follow DRS.

The holidays that were impacted during the SSP were:

- Memorial Day 2015
- July 4<sup>th</sup>, 2015
- Labor Day 2015
- Thanksgiving 2015
- Christmas Day 2016
- New Year's Day 2016
- Memorial Day 2016
- July 4<sup>th</sup>, 2016

See Appendix F for a summary of incorrect event times.

#### 6.4.5 Ignored Event Days in Baselines After Registration Change

When a resource has its registration changed (either due to adding locations or due to re-registering the resource in the new year), the CAISO ignores any previous event-days. Olivine calculates event performance, both for settlement purposes and for performance for capacity payments excluding all previous events from baseline calculations, even if they were from a previous registration. This error only happened to affect [REDACTED], which changed registrations on [REDACTED] [REDACTED] [REDACTED]. Recalculation of the baseline by excluding event days from the old registration led to an increase in the capacity payment of around [REDACTED].

## 6.5 Default Load Adjustment

The default load adjustment (DLA) is an adjustment made by the CAISO that results in a reduction in the scheduled load of an LSE equal to the amount of energy delivered during a demand response award.

During the life of the IRM2 and throughout the Supply DR Integration Working Groups of 2014, Olivine and PG&E presented to stakeholders that the CAISO calculation of the DLA was incorrectly applied according to the CAISO tariff.

The expectation of stakeholders – based on the public workshops in advance of this decision and the approved CAISO tariff – was that the DLA would only be applied to an LSE load schedule in those cases that the demand response energy was paid at a price below the NBT. While the pilot has required participants to bid at or above the NBT in all hours, it is still possible in that case for that participant to be paid for energy at below the NBT if they over-delivered energy and the real-time market price during the award period was below the NBT. The dispute with the CAISO arose when it became clear that when the real-time market price was below the NBT, the entire delivery – including the day-ahead portion paid at a price higher than the NBT – was deducted from the LSE schedule.

While Olivine and PG&E were correct about the tariff not matching the algorithm, ultimately the CAISO made public that their calculation was different and intentionally so. At that point, Olivine dropped the issue, noting that it is our belief that the stakeholders that were a part of the original direct participation / Rule 24 proceedings would not have agreed to the NBT bid price floor in the day-ahead market as a way to eliminate the DLA when in fact the bid price does not determine application of the DLA. This is something that parties may want to undertake in a future DR proceeding at the CPUC.

Note that the CAISO has agreed to eliminate the DLA as a part of the 2018 Energy Storage and Distributed Energy Resource Phase 3 (ESDER 3) implementation in the fall of 2019.

## 6.6 LSE Changes

The single LSE requirement caused issues with multiple participants in the pilot in 2017. In both cases, one or more customers within a PDR switched LSEs from PG&E to a Community Choice Aggregator (CCA). In one case, the customer locations continued switching to the CCA over a period of several months with ultimately all of the enrolled customers having made the switch. In the other case, only one customer switched with the other remaining with PG&E. Because this impacted the wholesale market resource formation, special rules and procedures were followed to ensure the customer locations and resources could continue in the pilot.

For the resource where all locations moved, the following steps were applied;

1. Test the existing resource without LSE changes to ensure qualified capacity can still be met.
2. Identify DR capacity potential for each location, used to determine a wholesale market bidding cap when a subset of locations is registered in the resource.
3. Move customer locations that have changed LSEs out of the PDR immediately, re-registering them in the CAISO DRRS under the new LSE for future transition back into the resource.

4. Participant bids the reduced quantity into the pilot (for forwarding to the CAISO), but nominates the full capacity of all locations into the program.
5. If there is a market dispatch, participant dispatches all of the locations (irrespective of whether they are currently in the market).
6. Continue transitioning customers out as they switch LSEs.
7. Once the remaining locations get below 100 kW of bundled load, convert the single resource to be under the new LSE, and continue with #4 through #6 until all locations have switched.
8. Ultimately all locations are back in the resource.

The same principle was applied to the other resource, but in that case only one of the two customer locations ended up migrating. In this case, the resource was reduced to a single location with a reduced capacity amount.

Capacity under the pilot was paid based on the all locations, making the participants eligible for 100% of the capacity.

Note that the CAISO has agreed to eliminate the single-LSE requirement as a part of the 2018 Energy Storage and Distributed Energy Resource Phase 3 (ESDER 3) implementation in the fall of 2019.

## 7 Conclusion and Next Steps

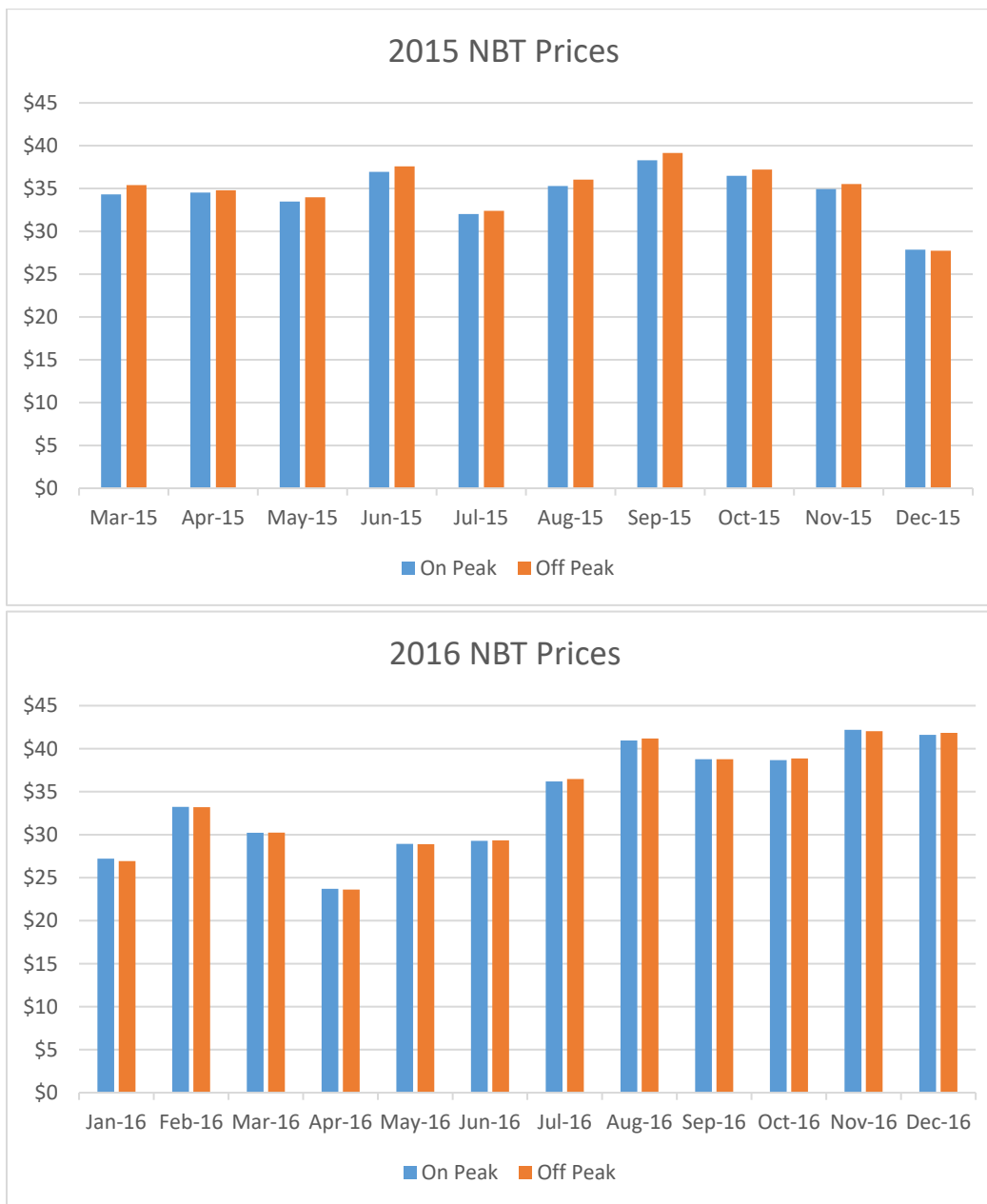
The SSP II and its precursors have been on the cutting edge of retail / wholesale integration issues since their inception, heavily influencing the development of such programs. As illustrated throughout this report, the pilot has resulted in a variety of lessons learned for participants, PG&E specifically, and for the IOUs more generally. These lessons have helped inform proceedings at the CPUC and the CAISO and directly influenced the design of the DRAM and the PG&E's CBP program. However, work on utilizing DR resources for distribution services is just starting, and there are still unanswered questions around if/how this can be accomplished.

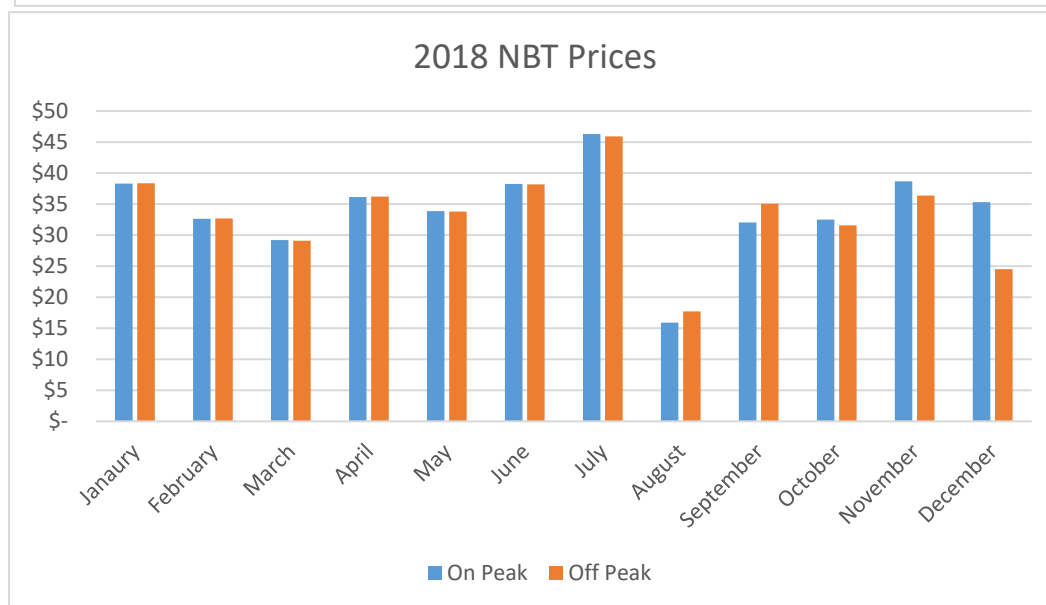
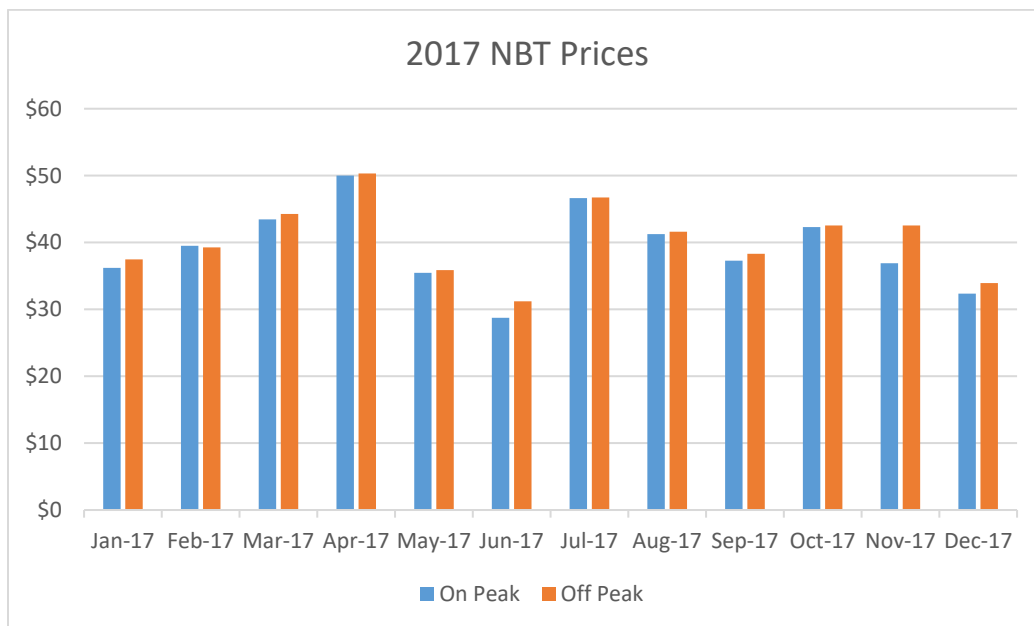
### 7.1 Next Steps

The pilot is scheduled to continue through 2020. While continuing to support the existing participation models, the following items are being addressed beginning in 2019:

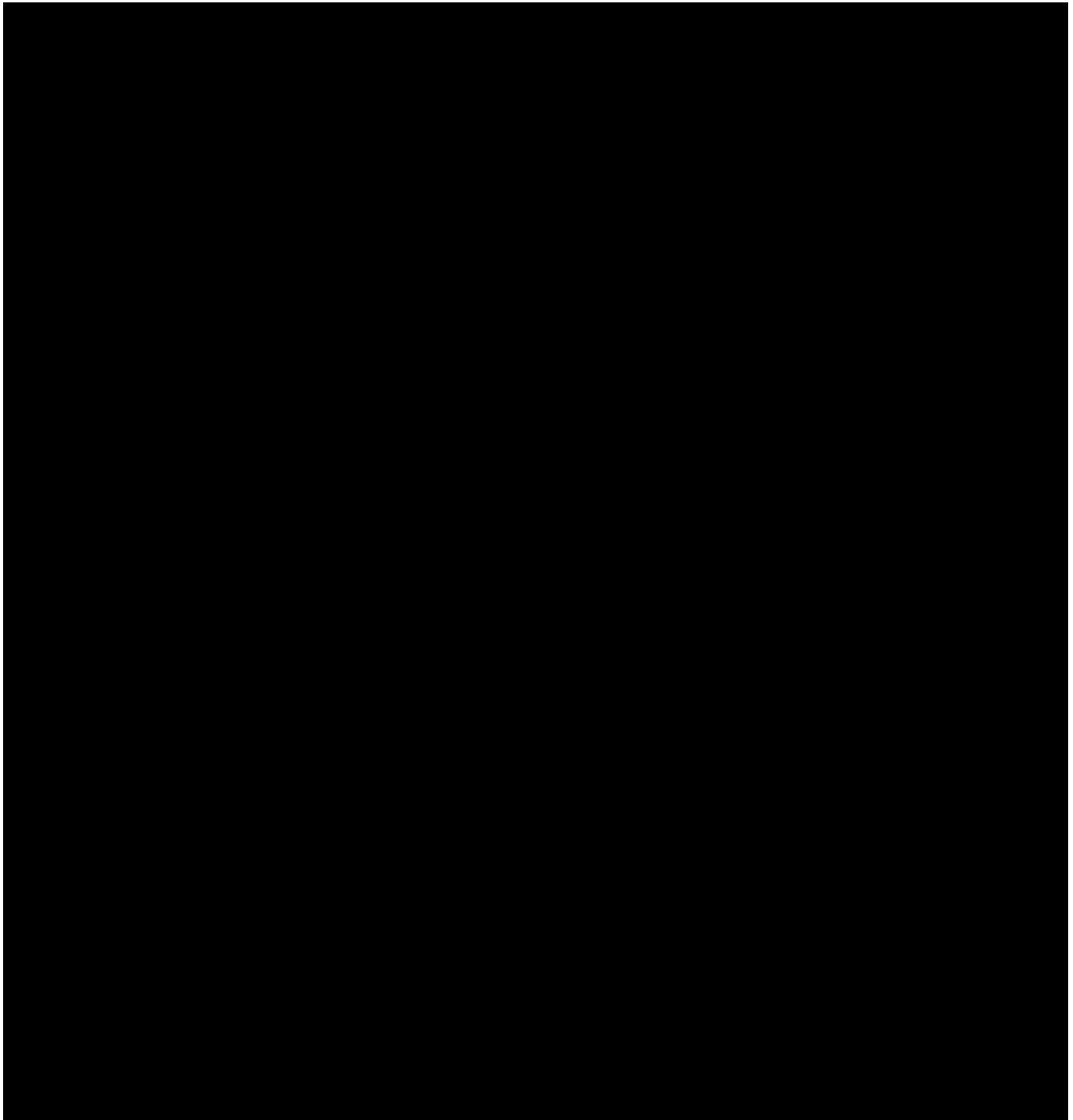
- Development of new materials to focus on the distribution aspects of the SSP II.
- Enable the partial dispatch of resources for distribution need, enabling resources to be partially dispatchable by location.
  - These dispatches will target PNode, Feeder, rate-class, and possibly other artificial distinctions to test out the flexibility of sub-dispatch.
  - In conjunction with sub-dispatch, the SSP II will also evaluate various performance-measurement methodologies to ensure fairly compensating participants for providing such flexibility.
- Recruit new participants into SSP II to test wholesale / distribution bidding and dispatch strategies as well as baseline and settlement interactions.

## Appendix A      2015 - 2018 Monthly Net Benefits Test (NBT) Prices



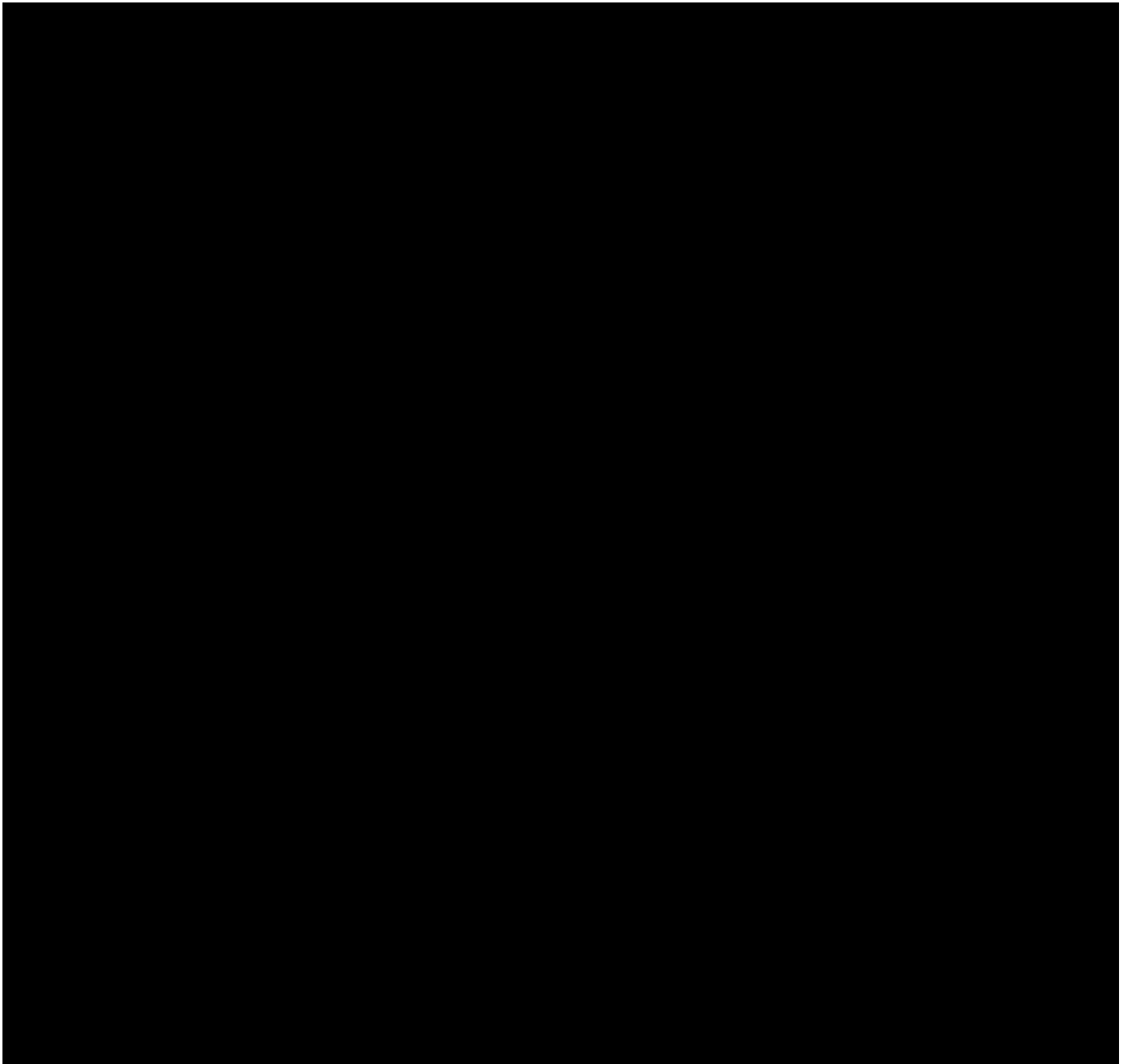


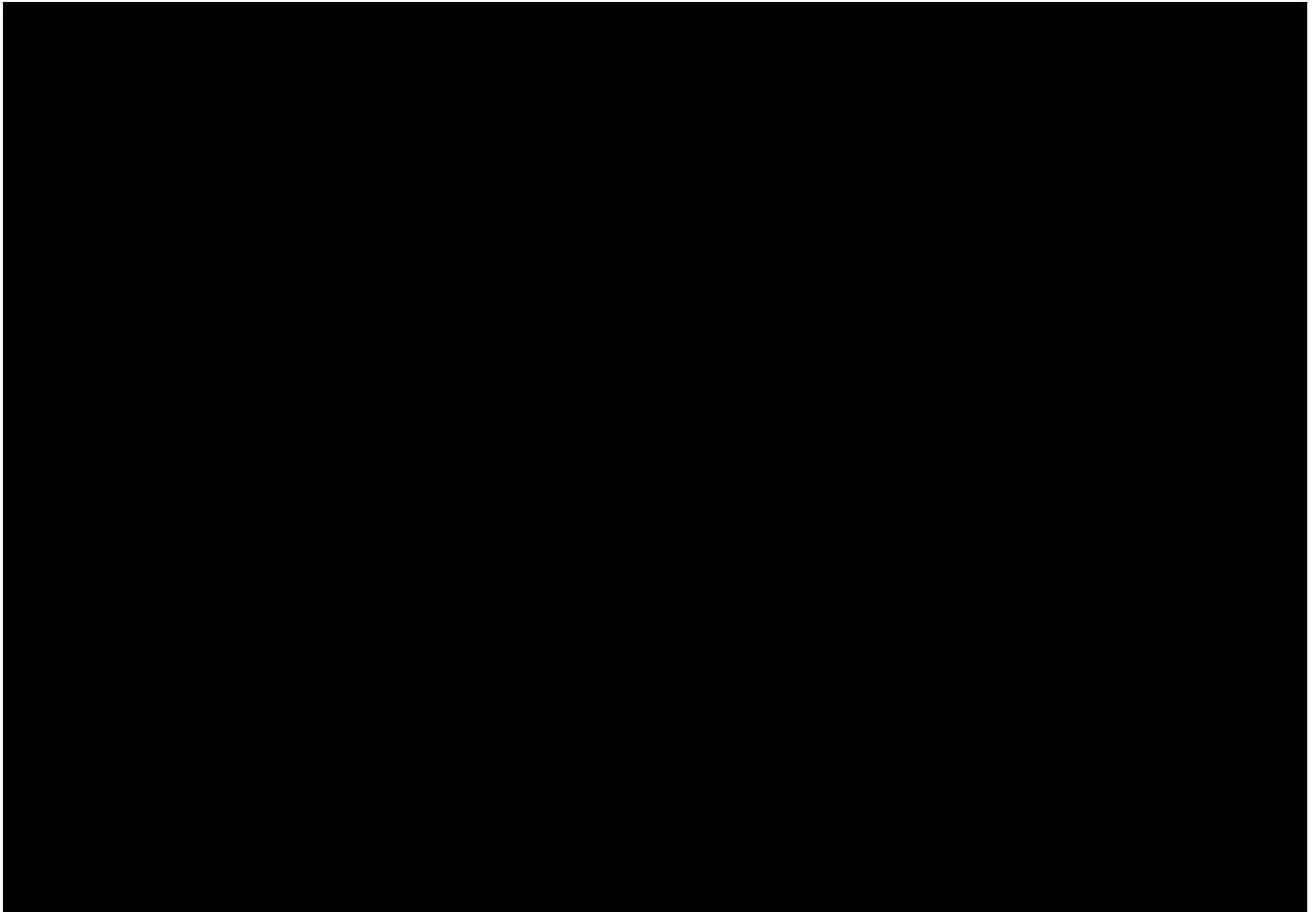
## Appendix B      2015 - 2017 Monthly Bids and Awards

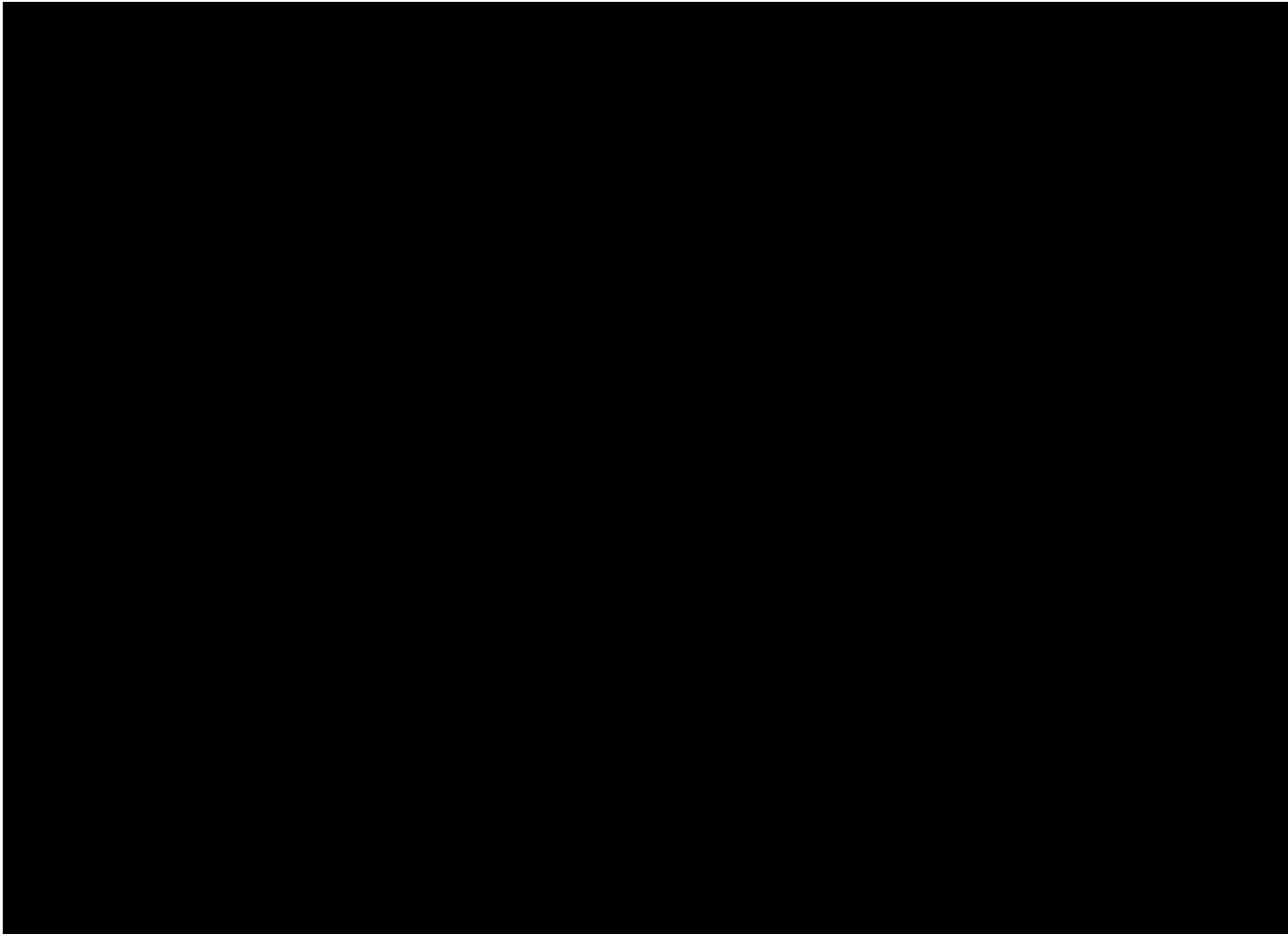


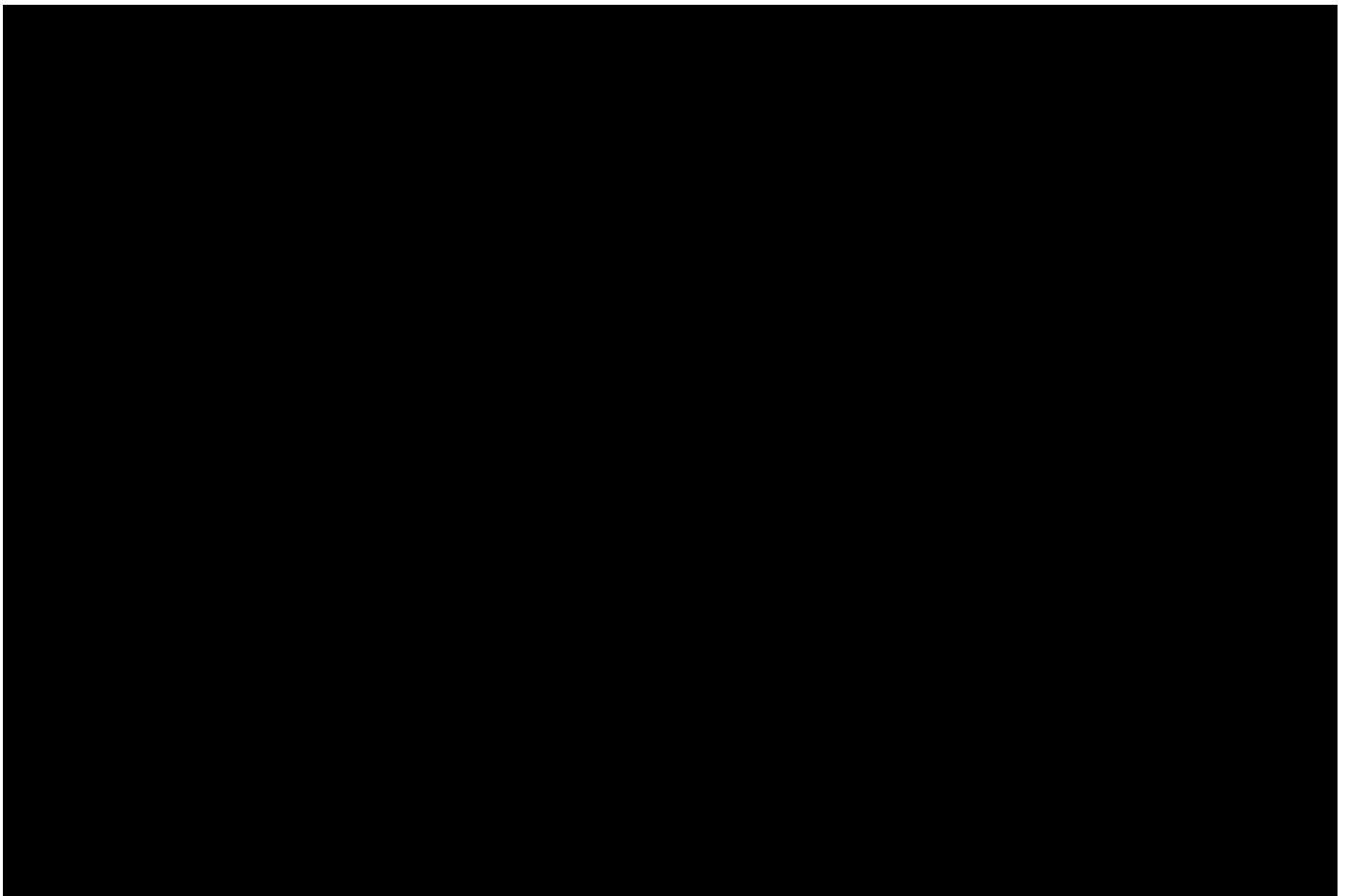


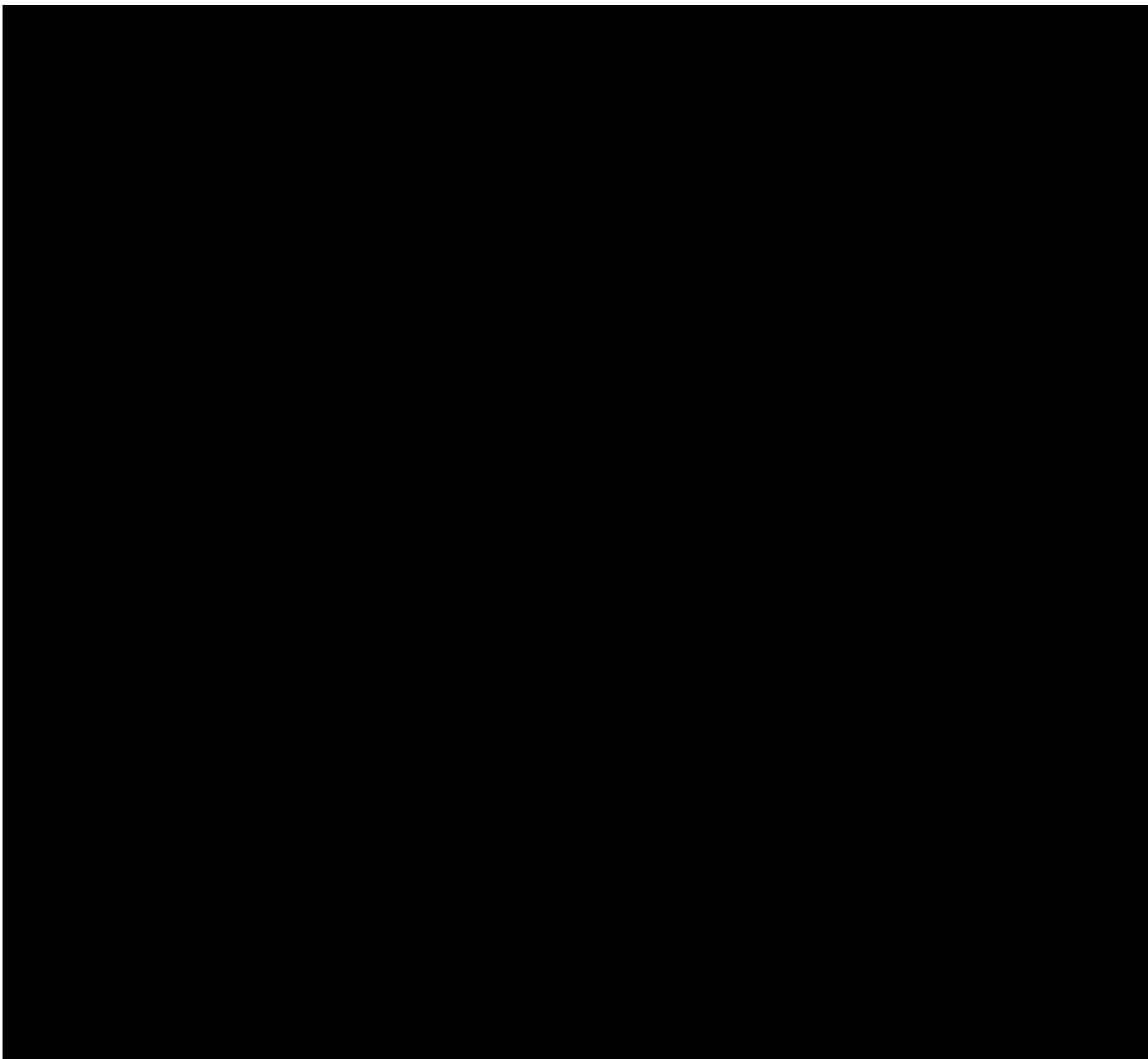


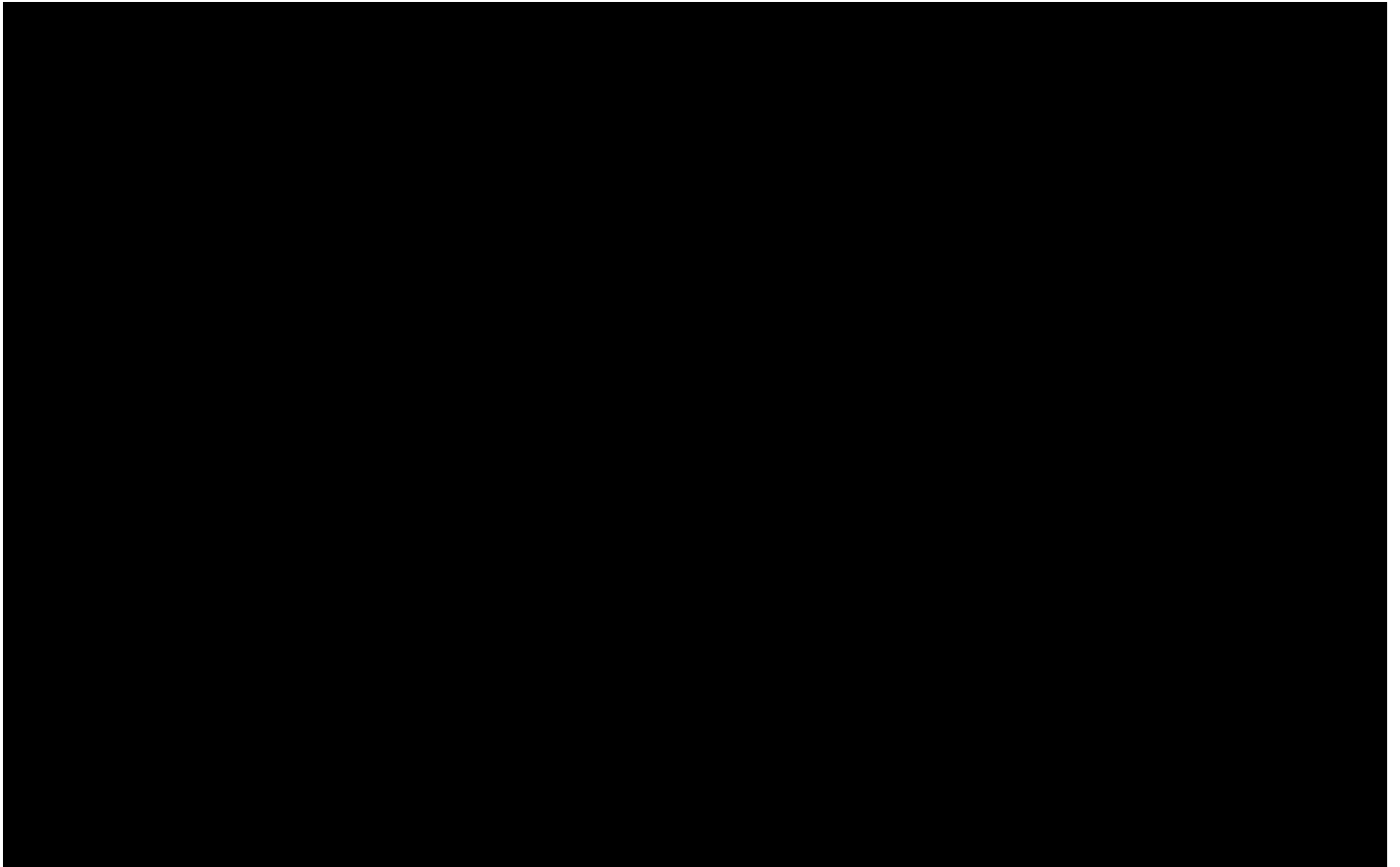




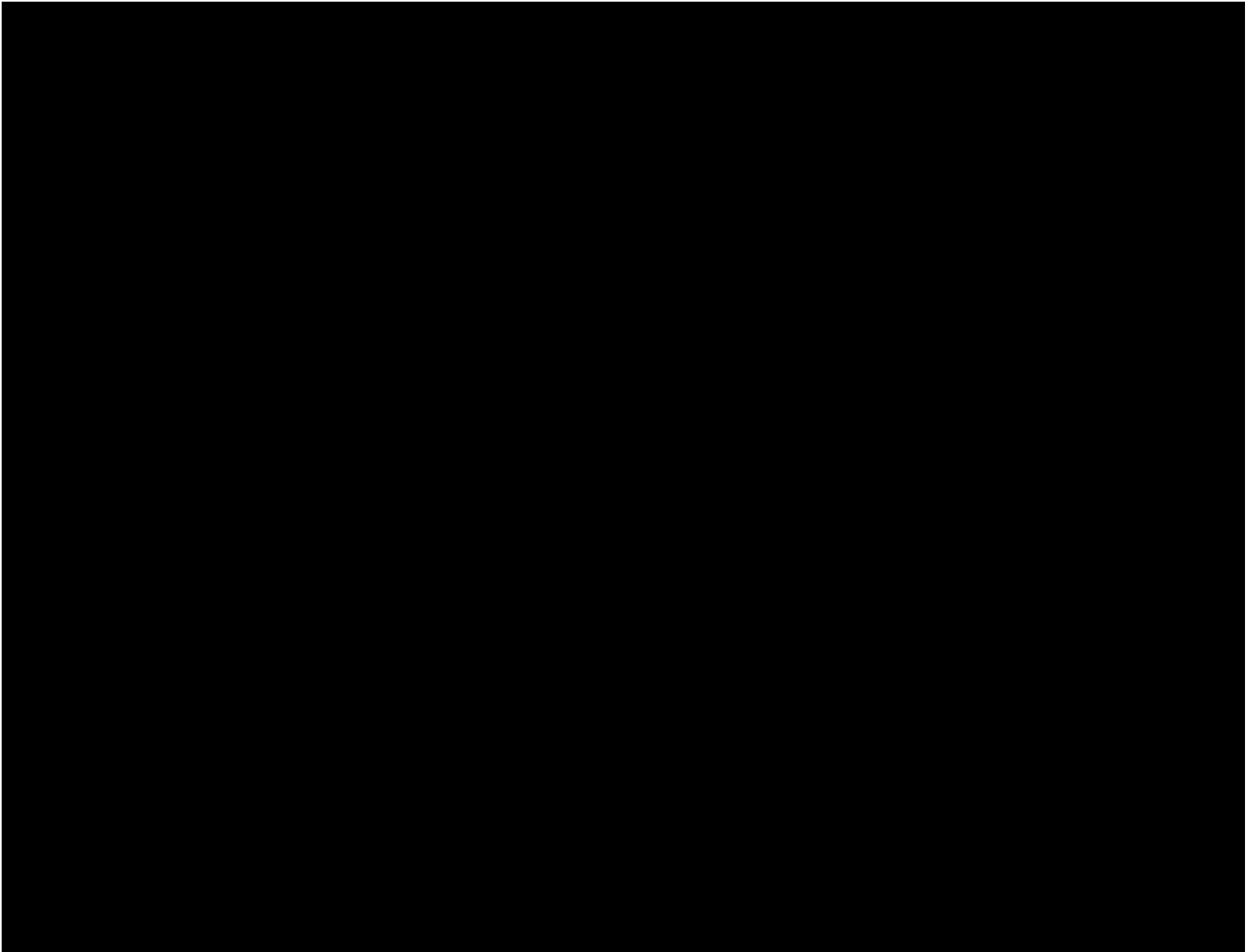




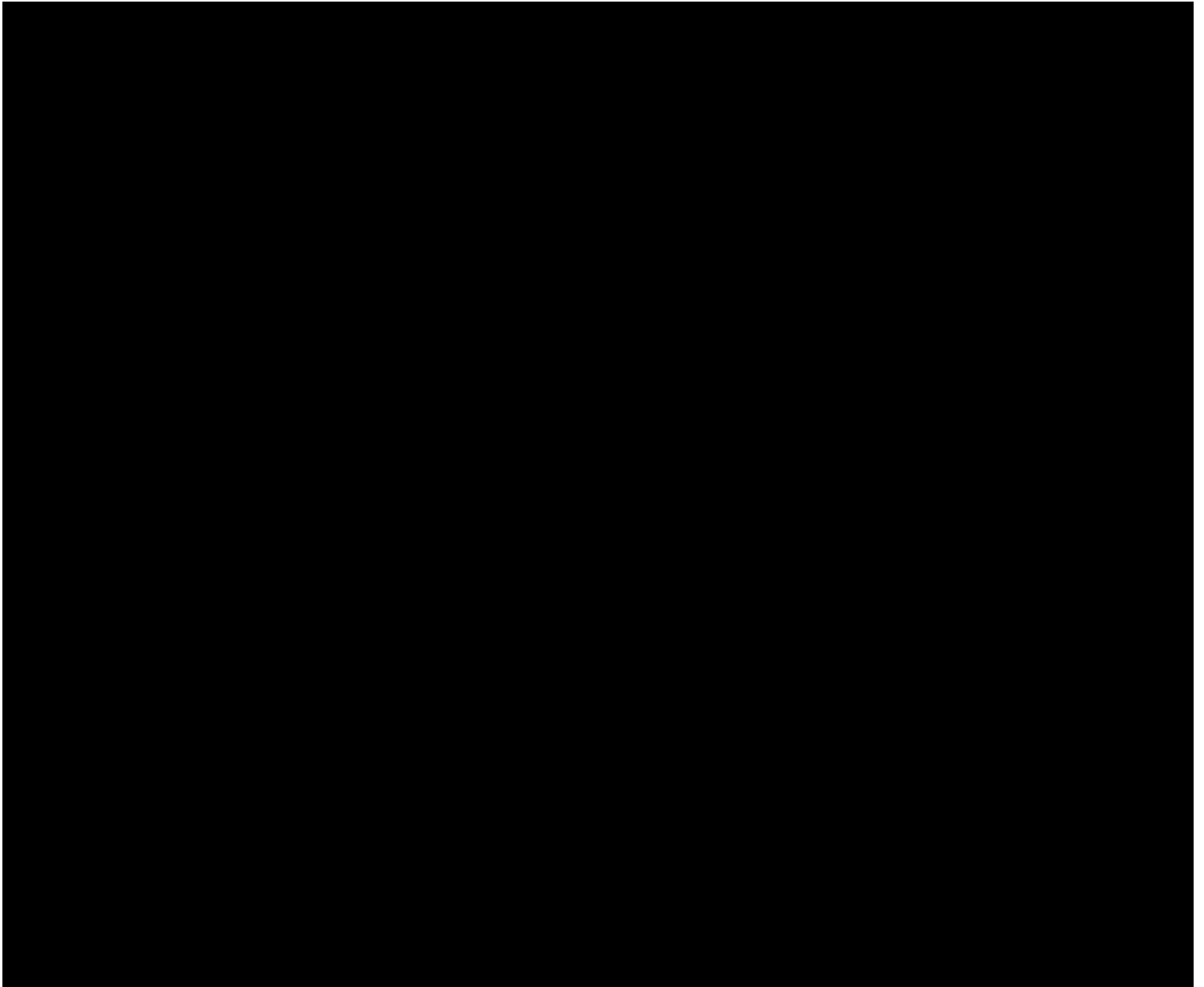




**Number of Day Ahead Bids per Hourly Interval: Note hours with no bids were omitted from the table.**

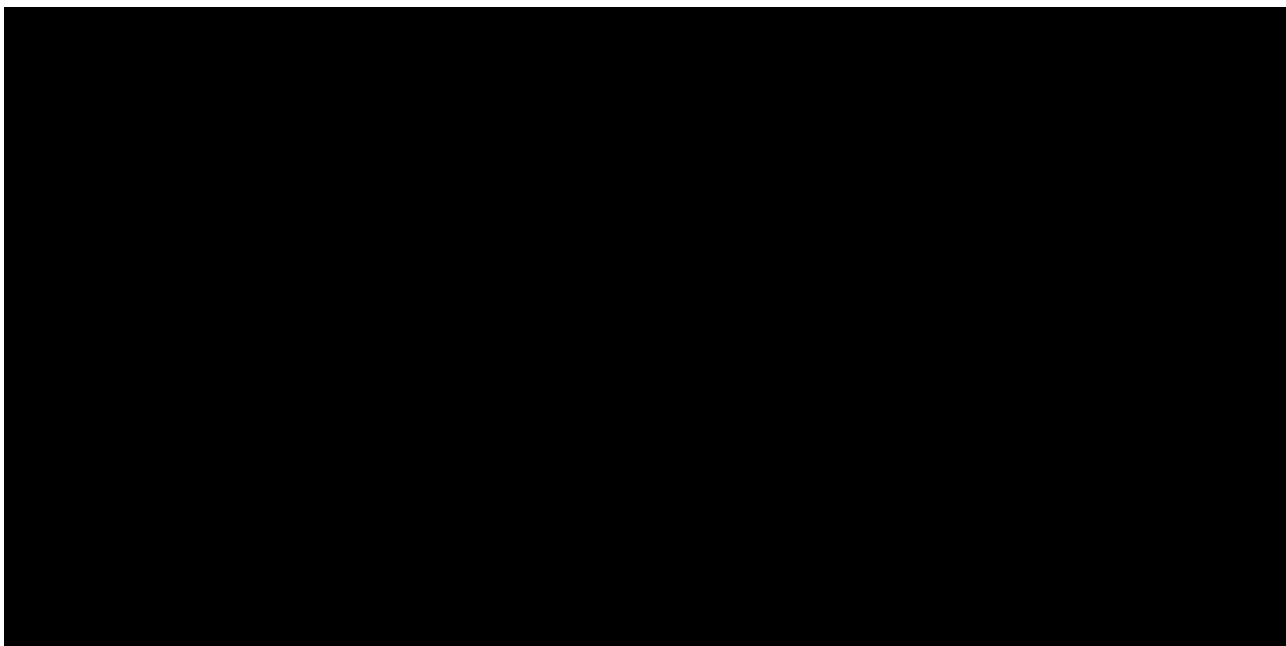
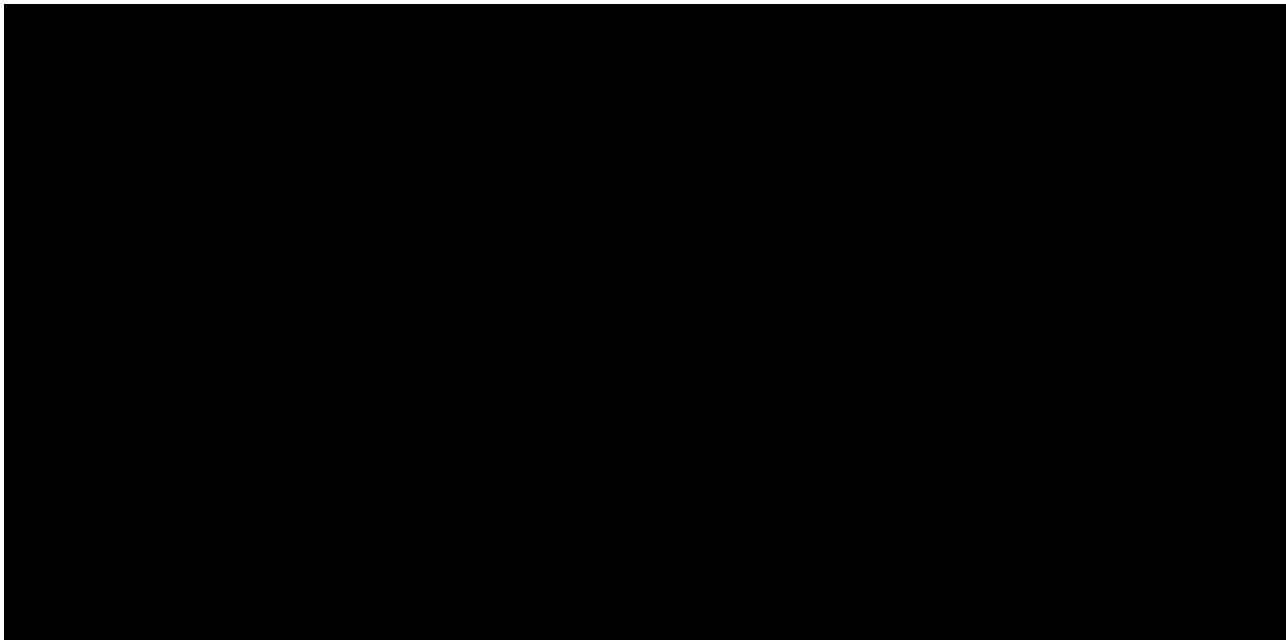


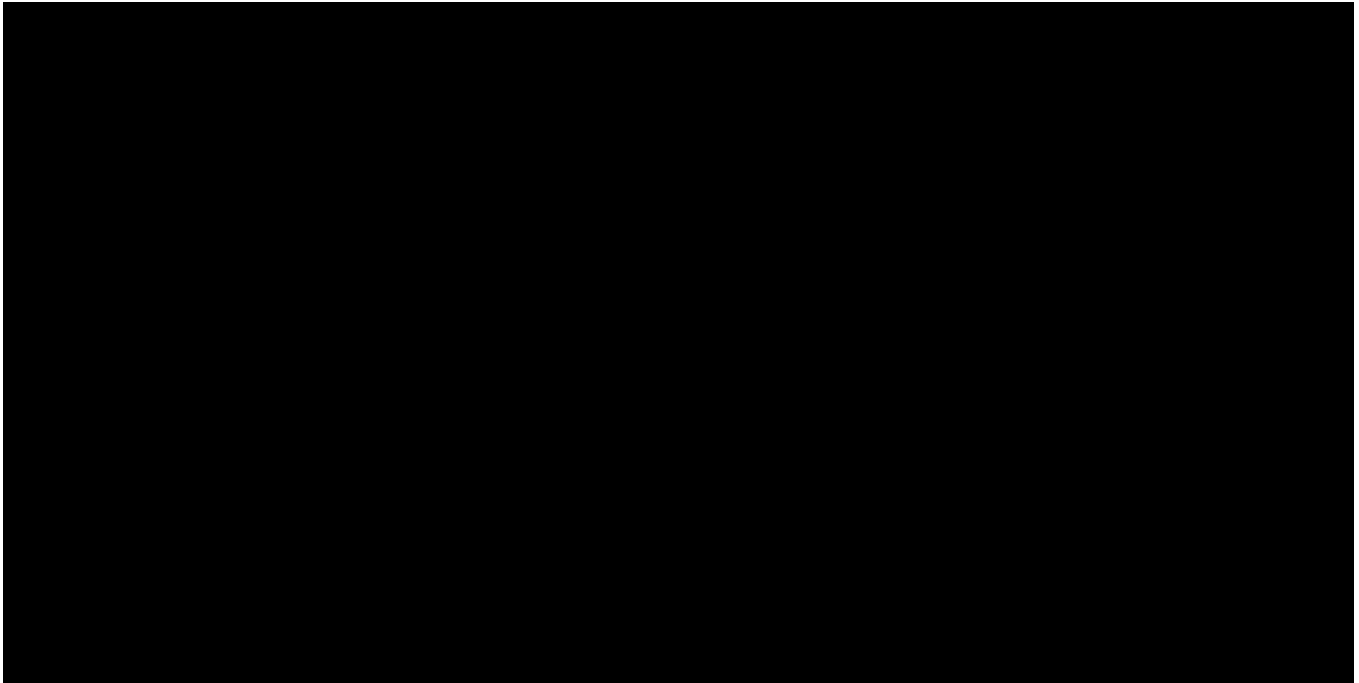
Number of Day Ahead Awards per Hourly Interval: Note hours with no awards were omitted from the table.



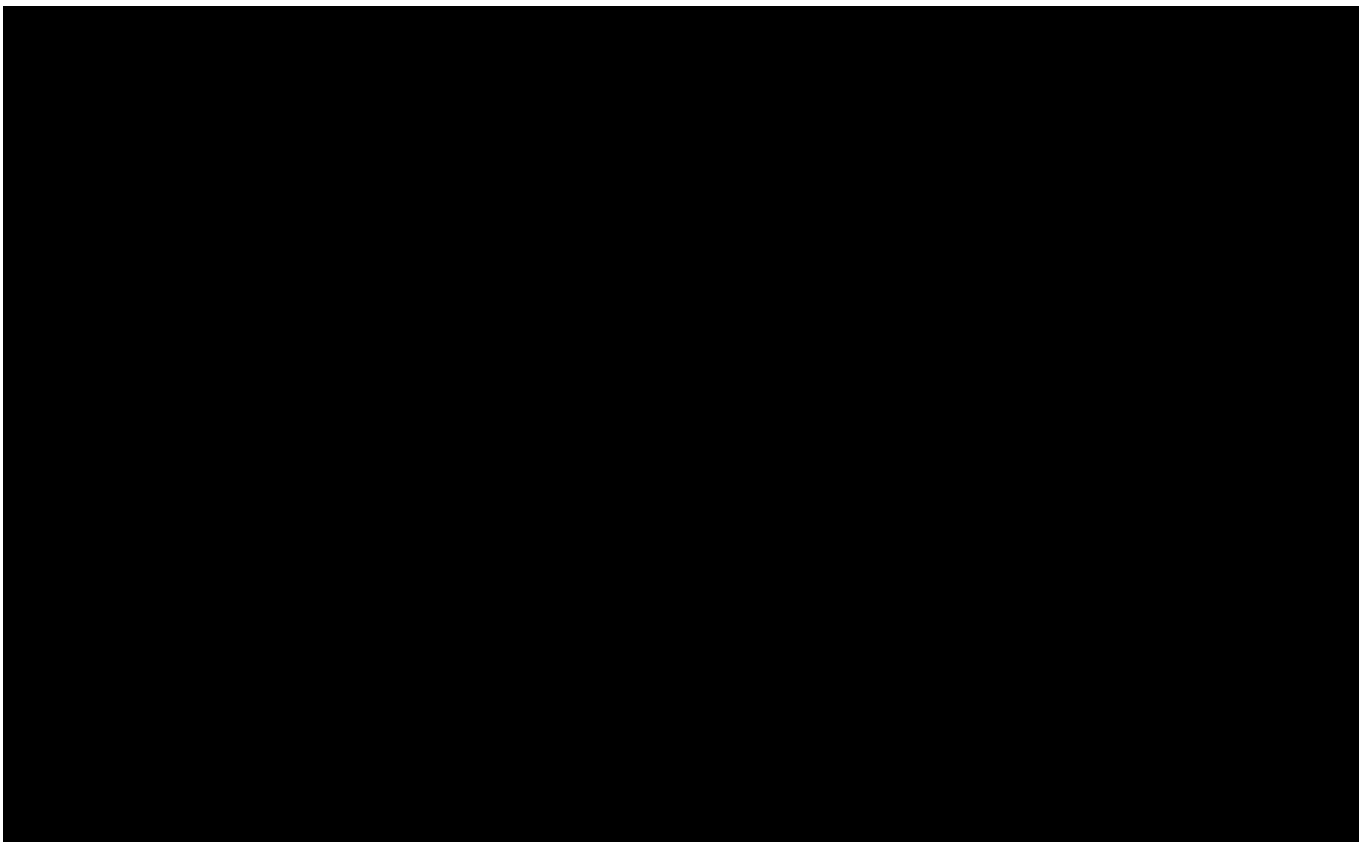


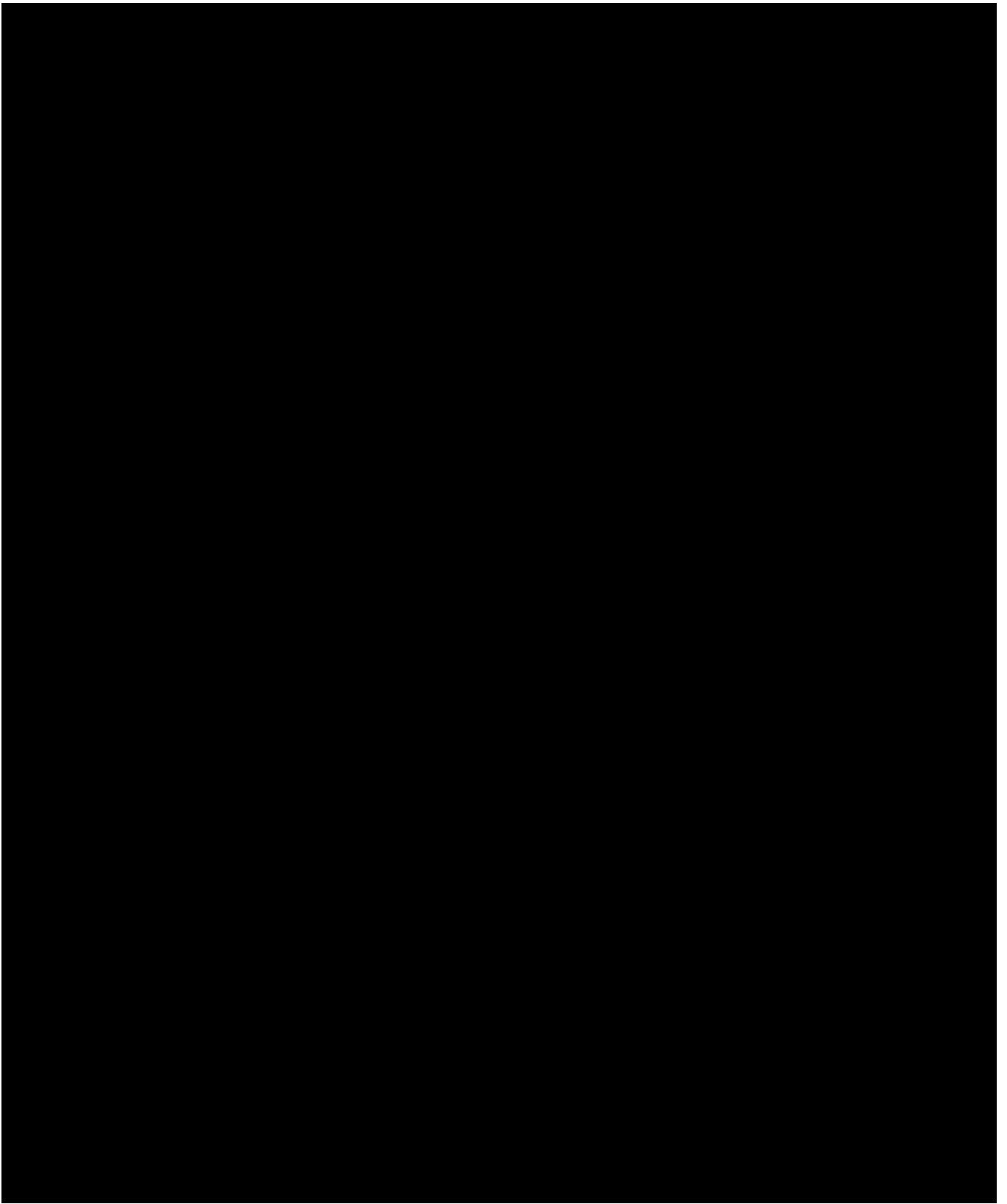
## Appendix C      2015-2017 Awards and Performance

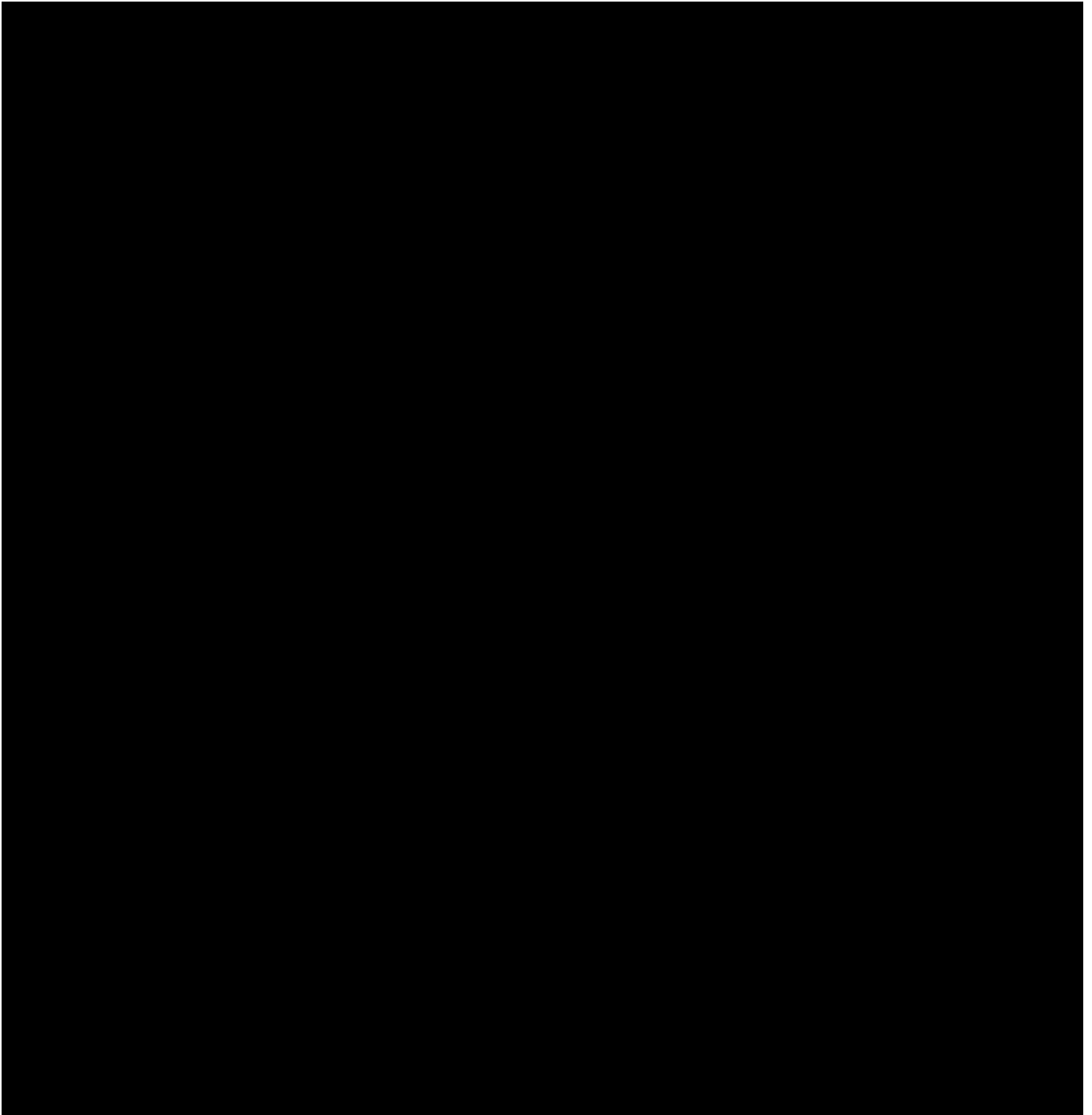




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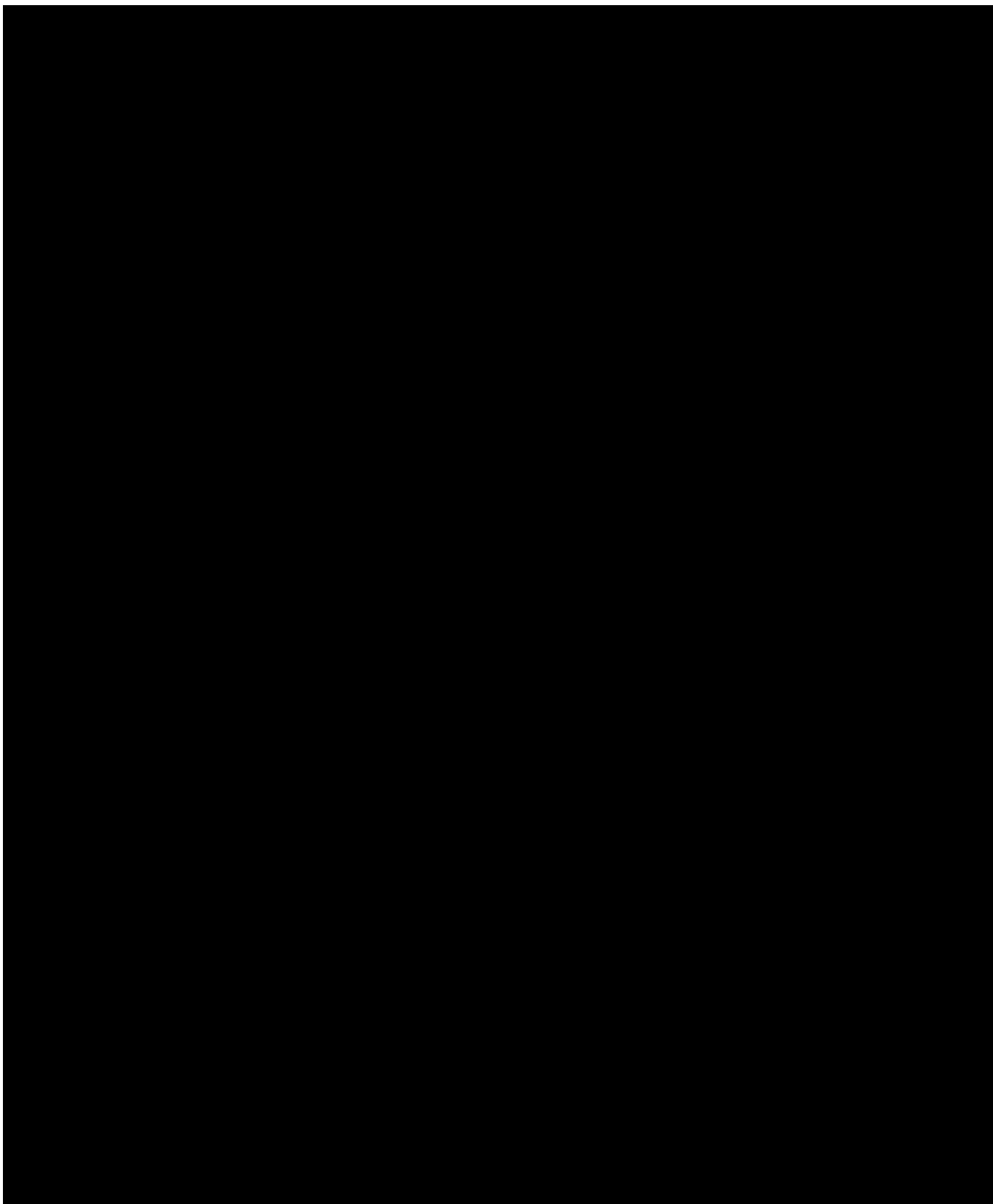


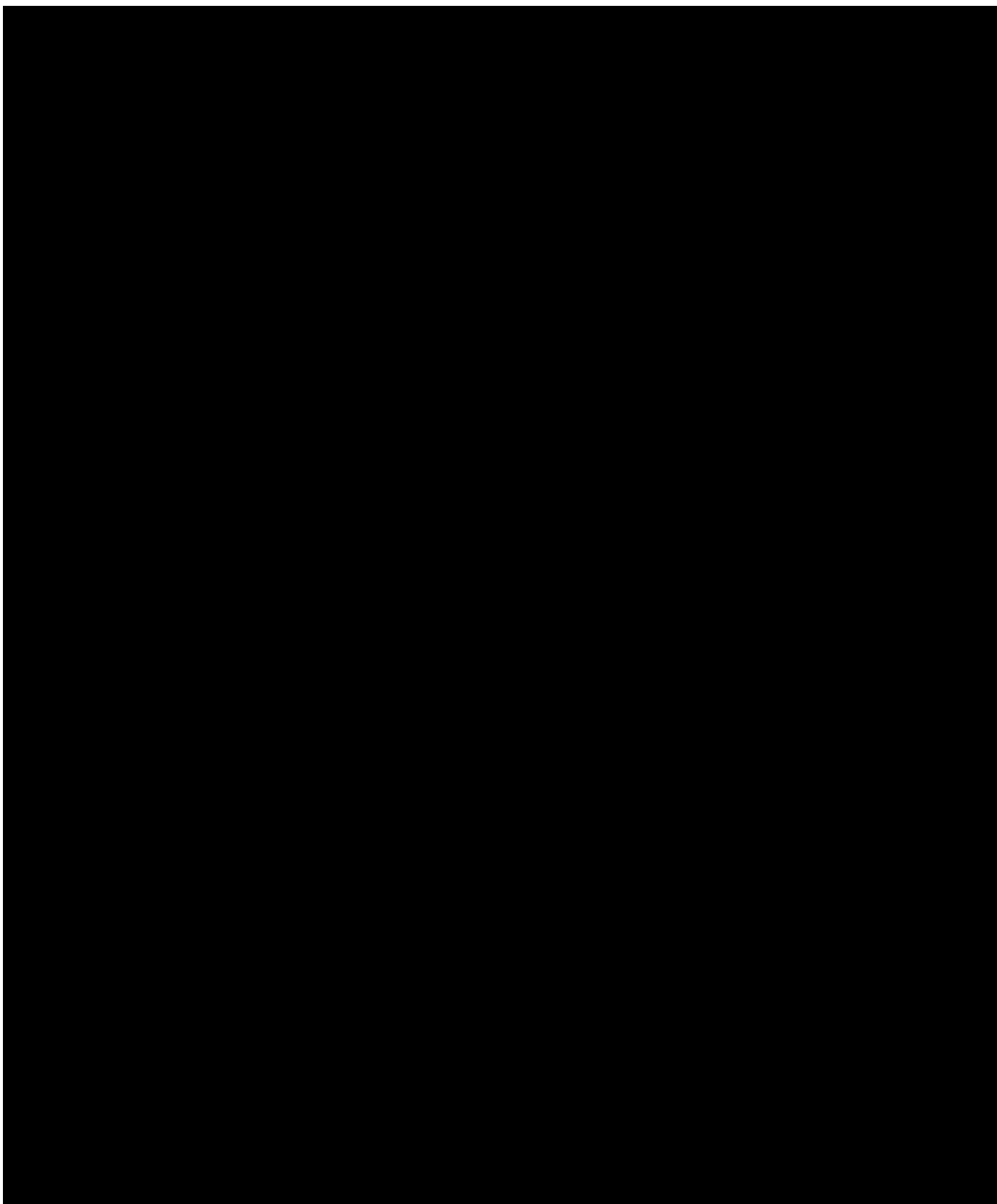


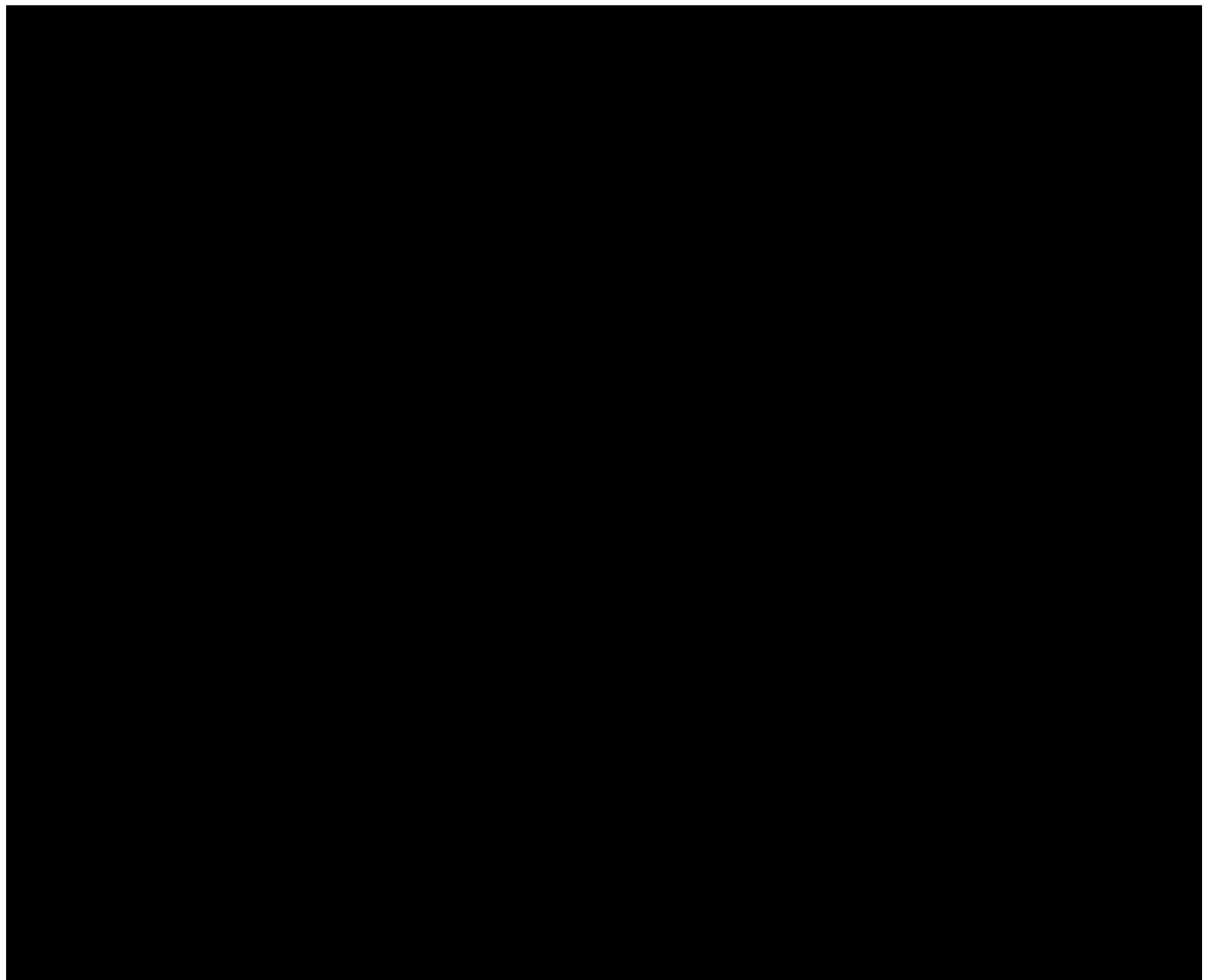
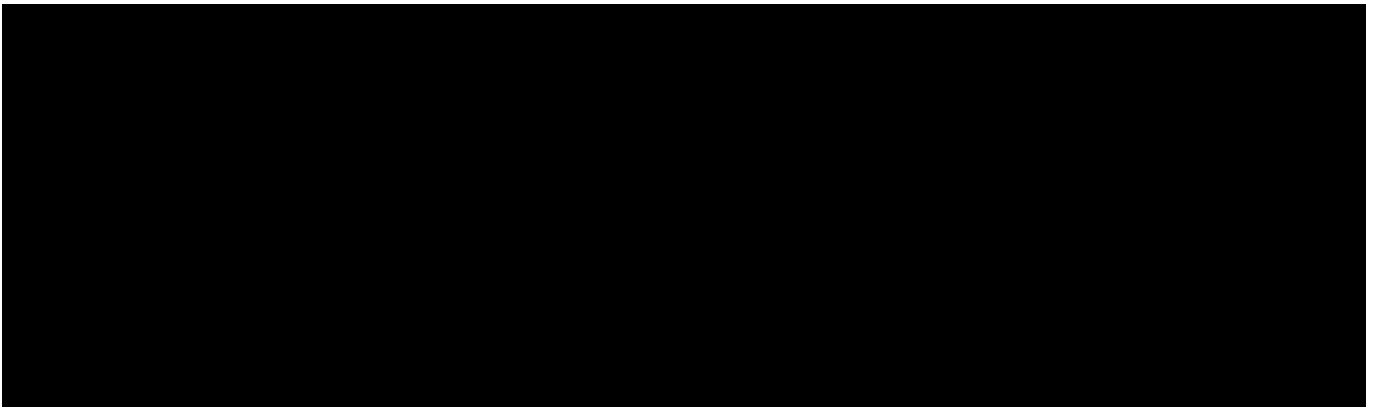


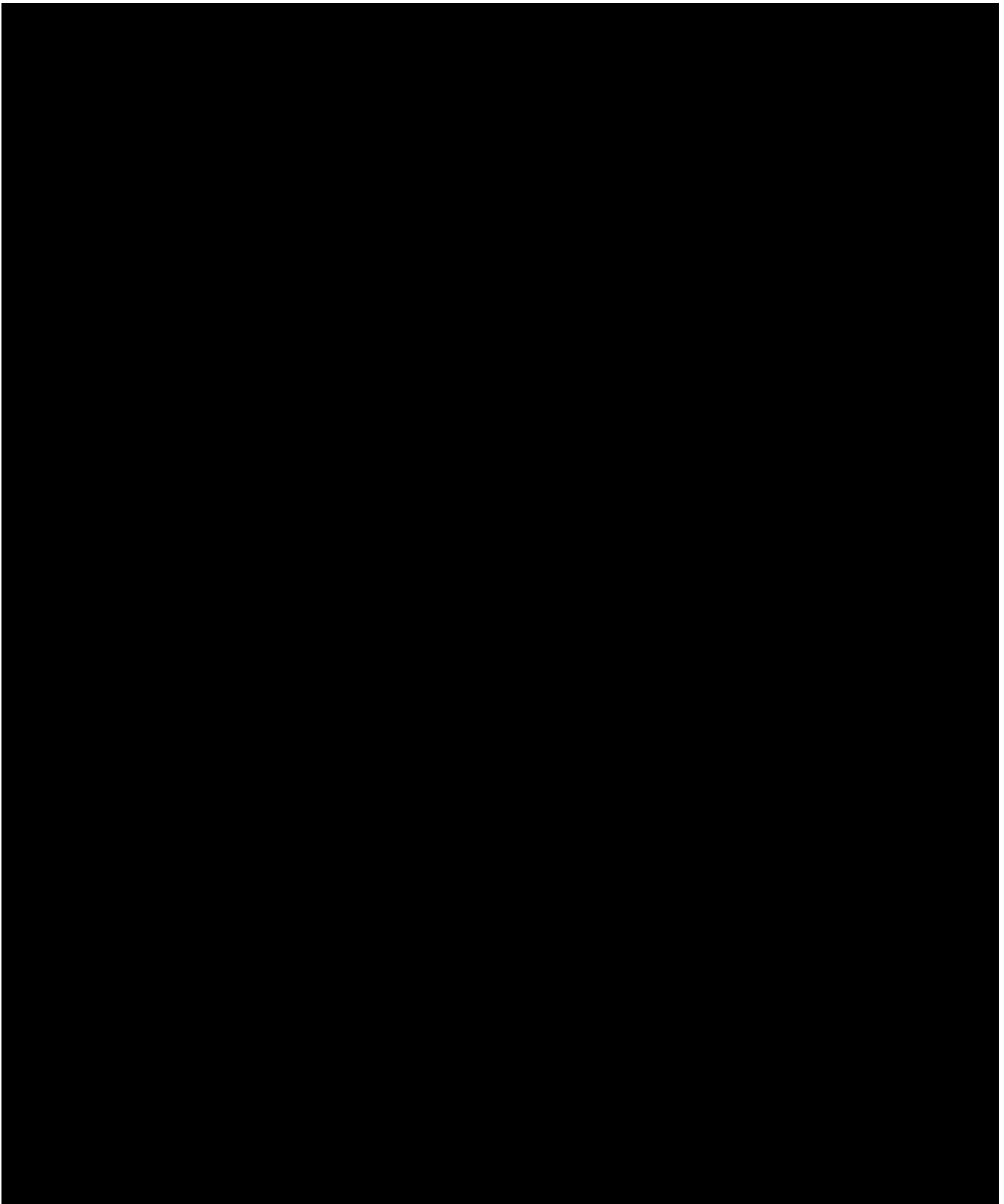
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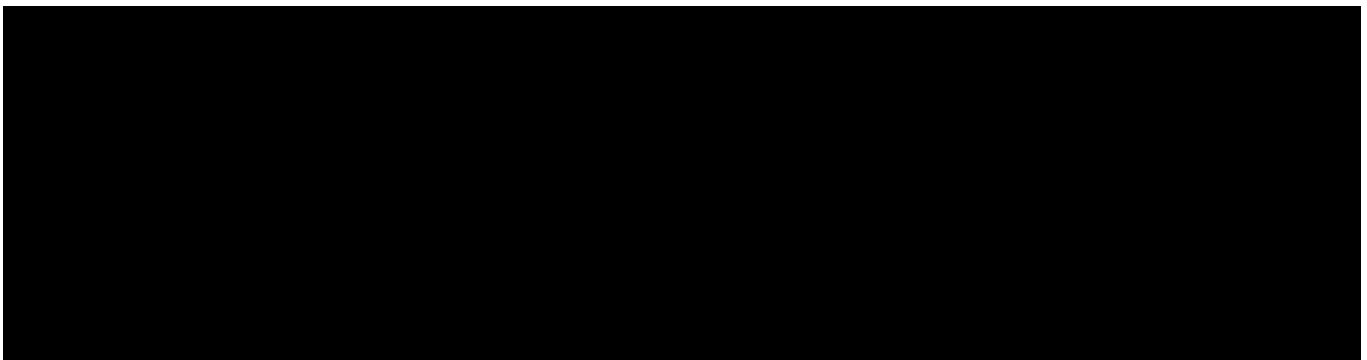
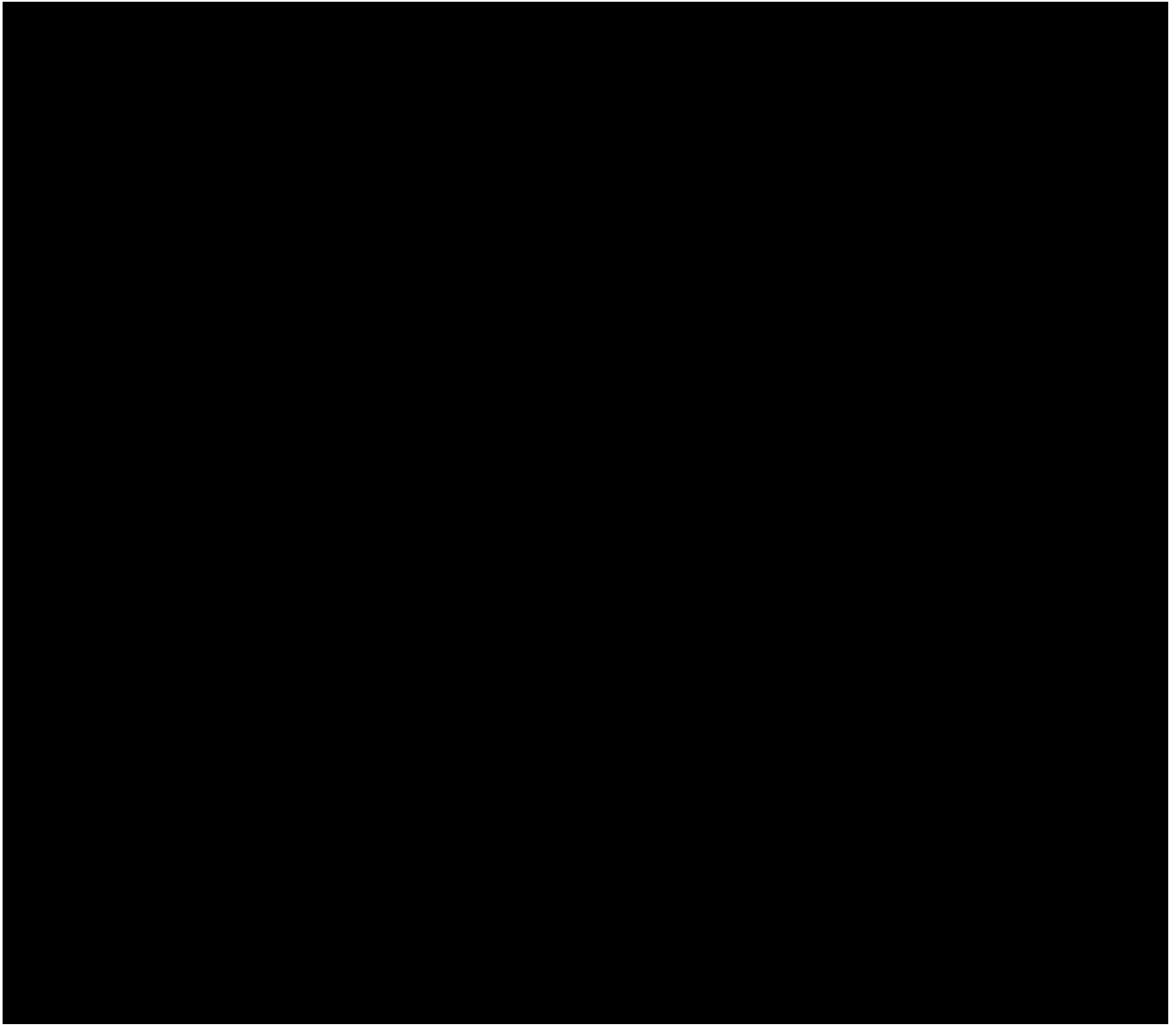


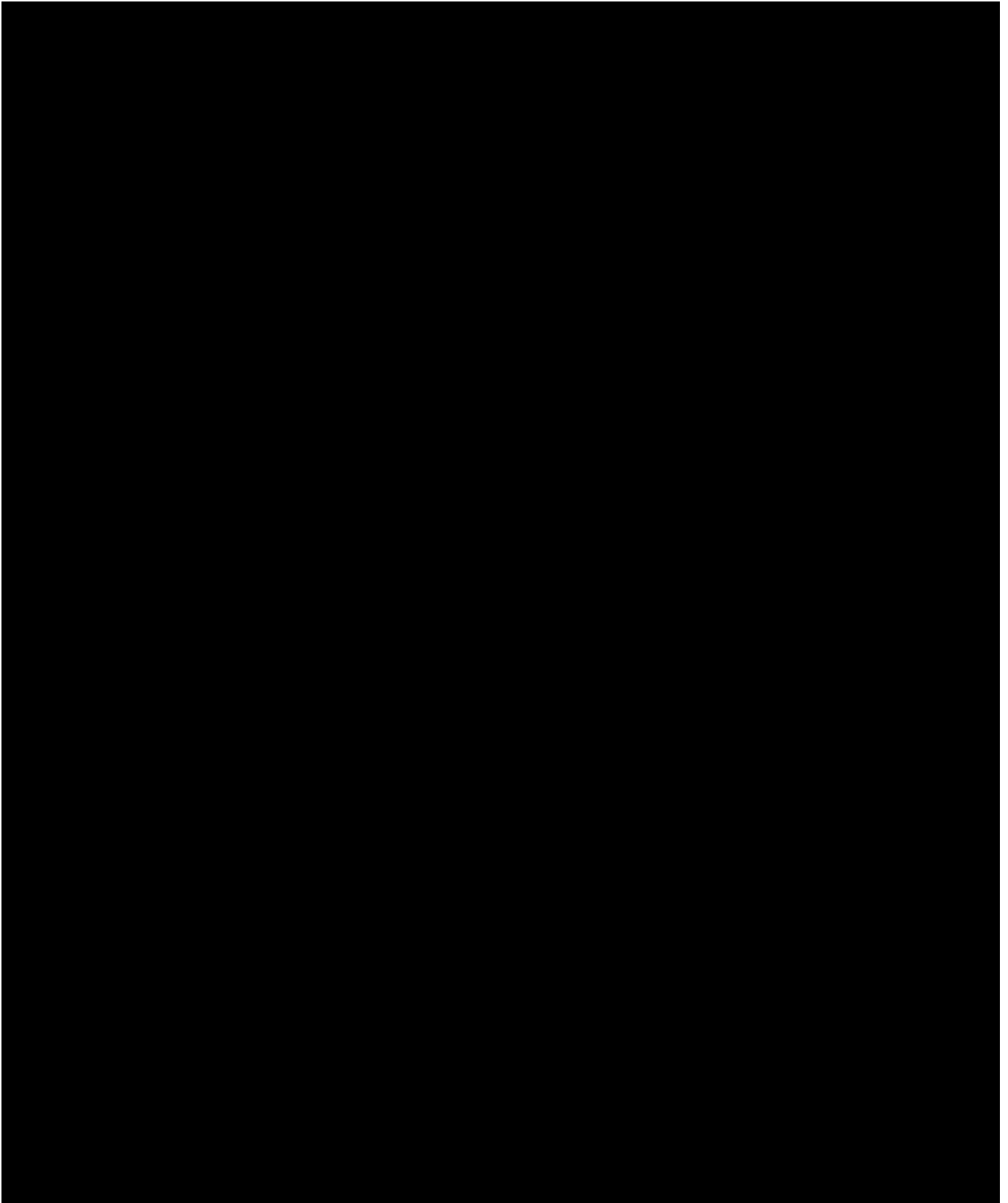


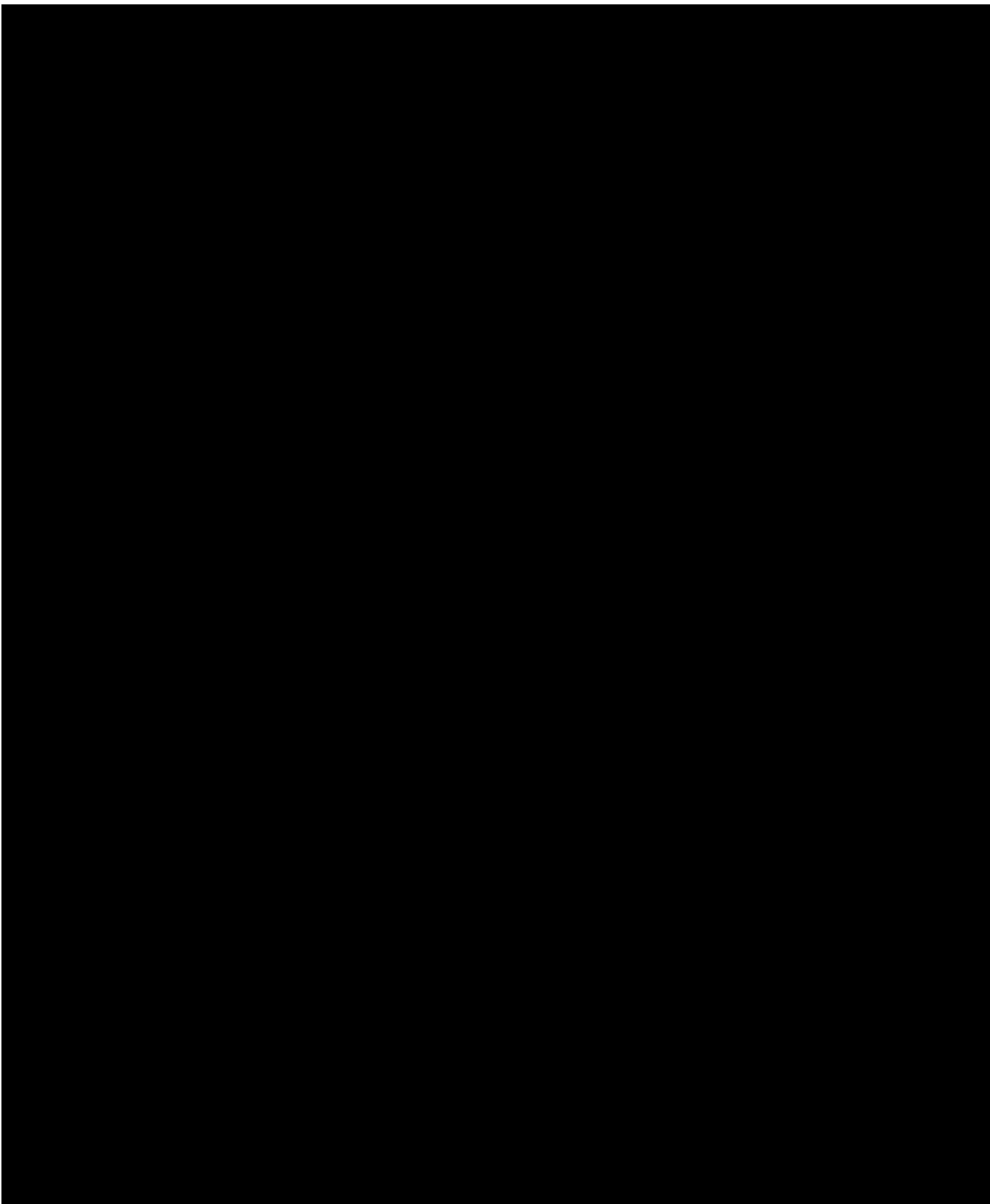










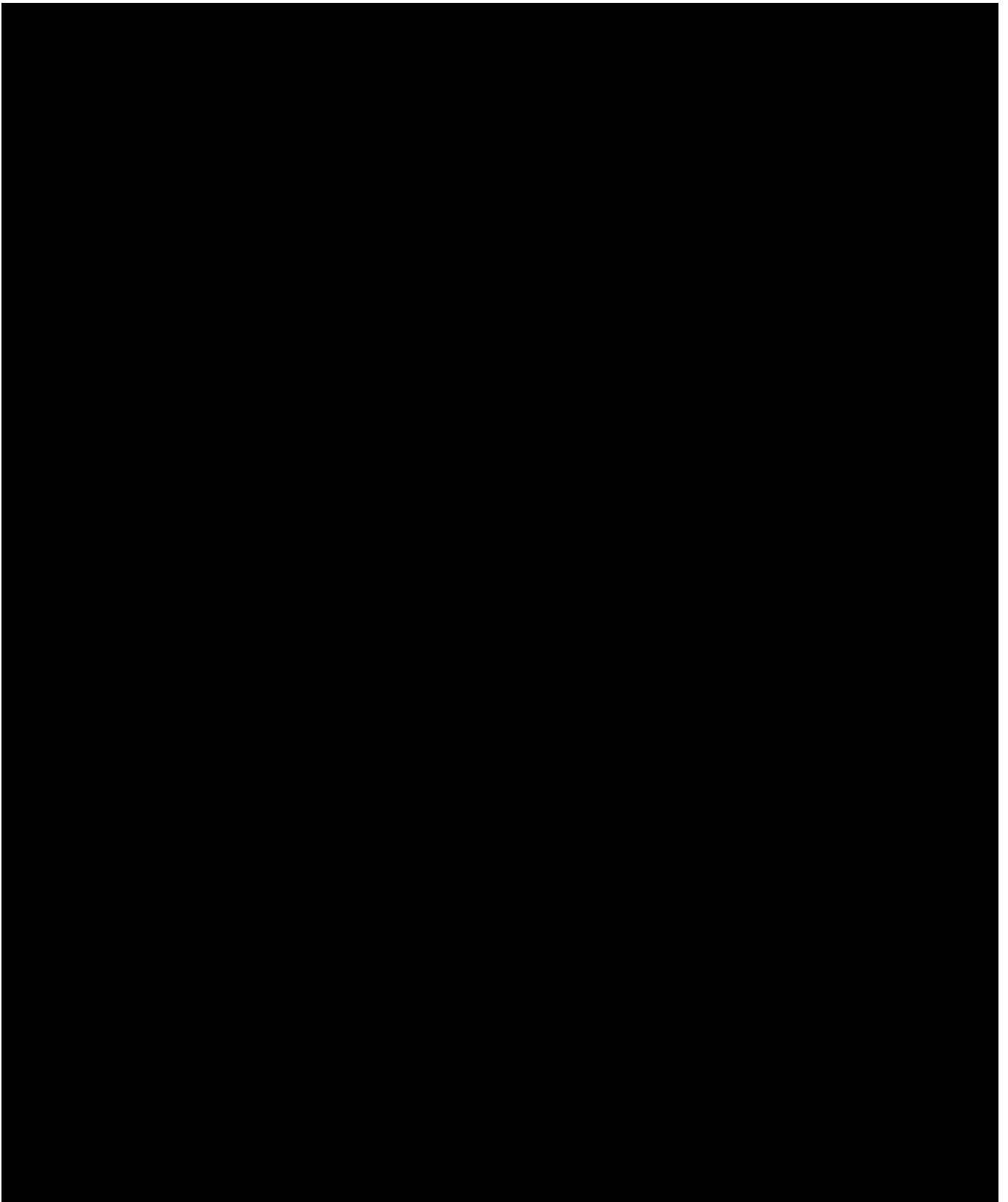


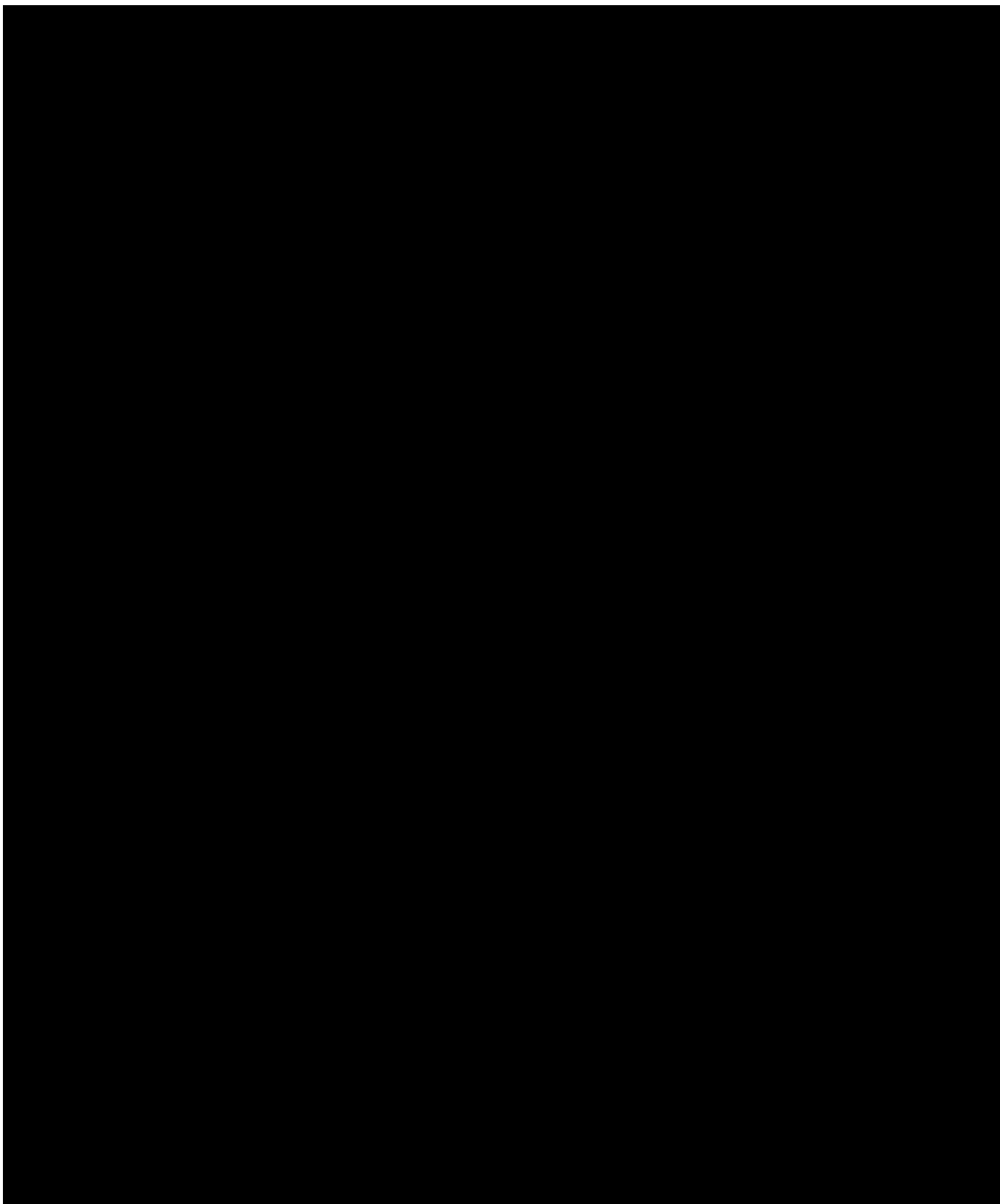
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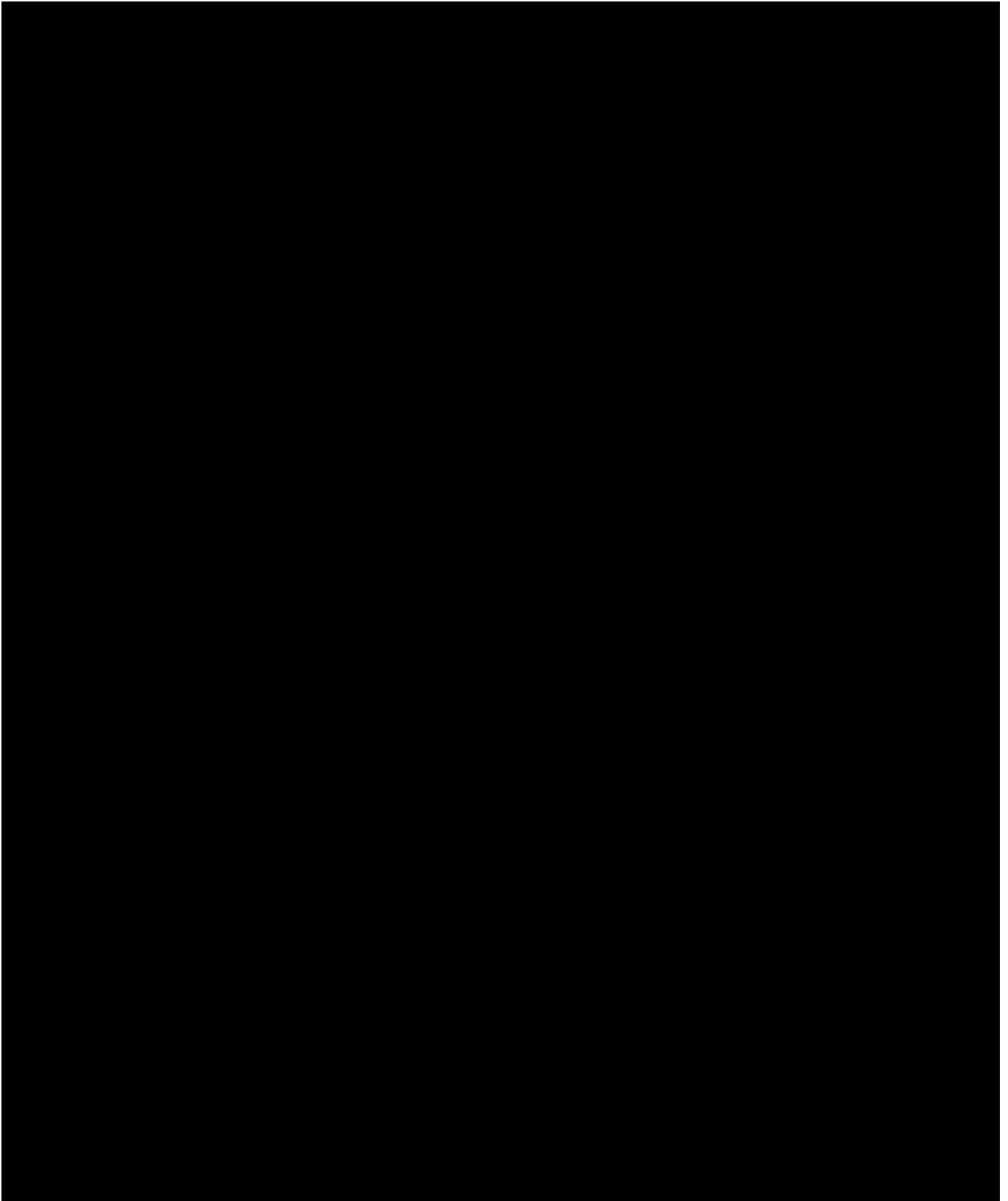
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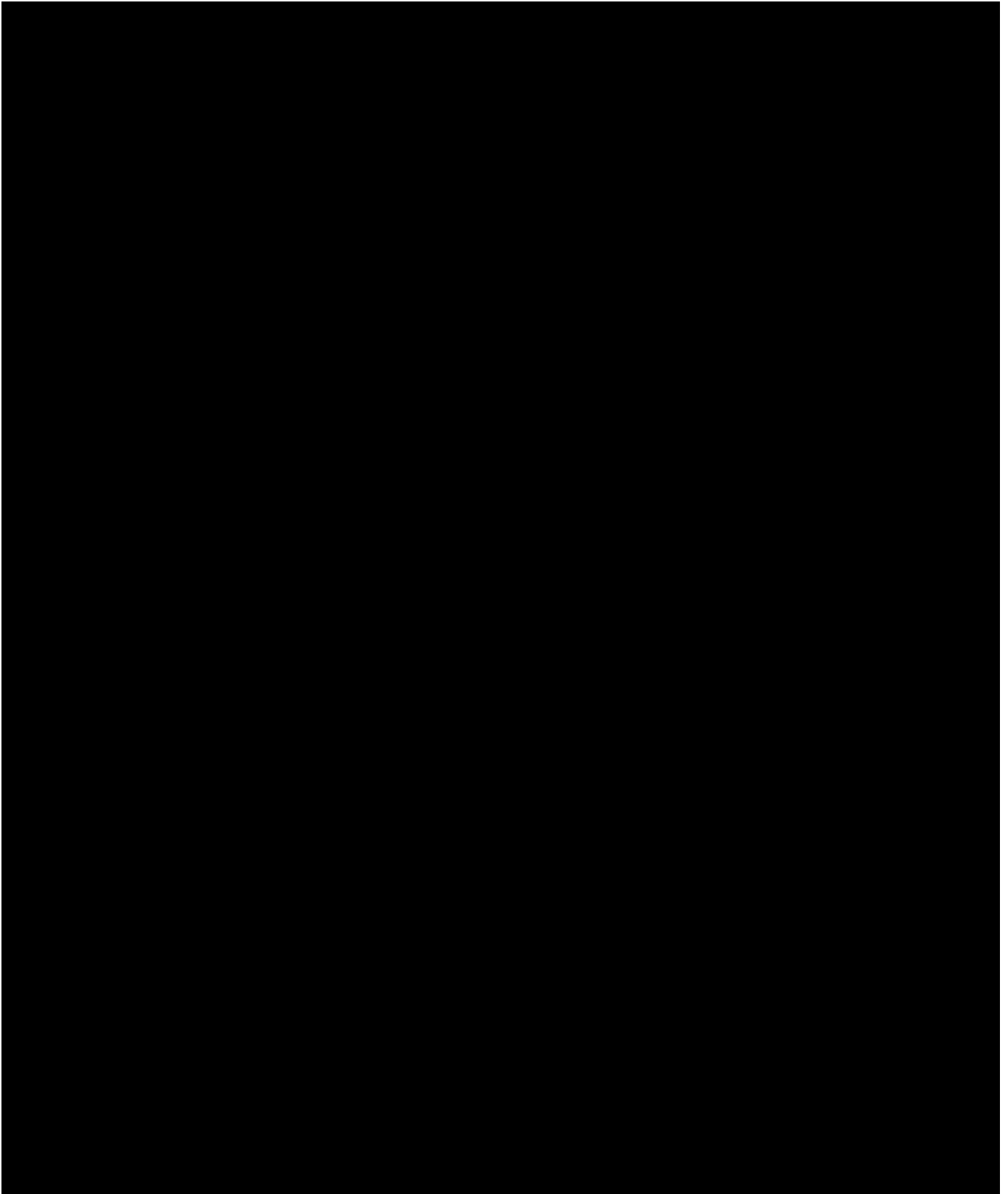
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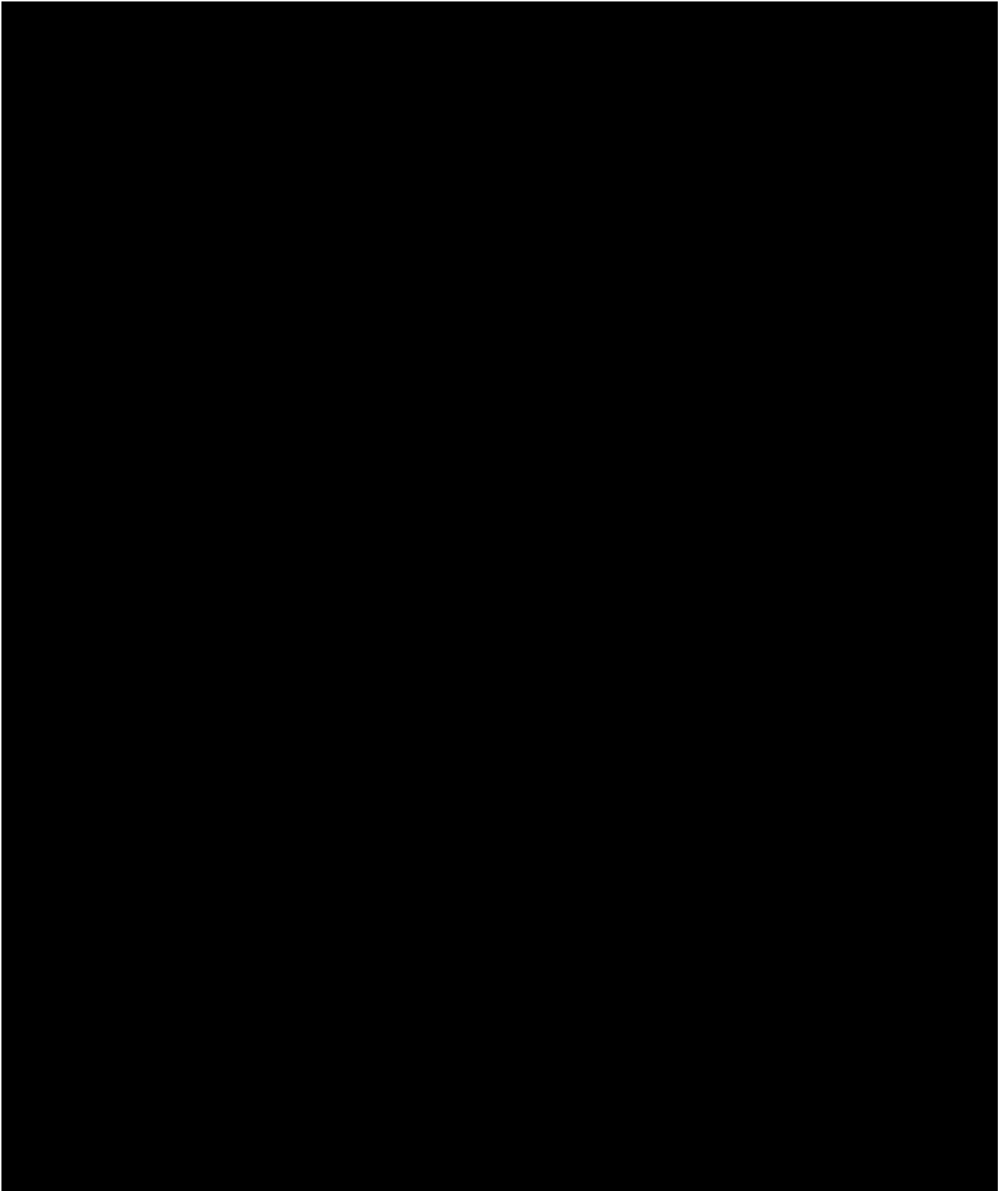


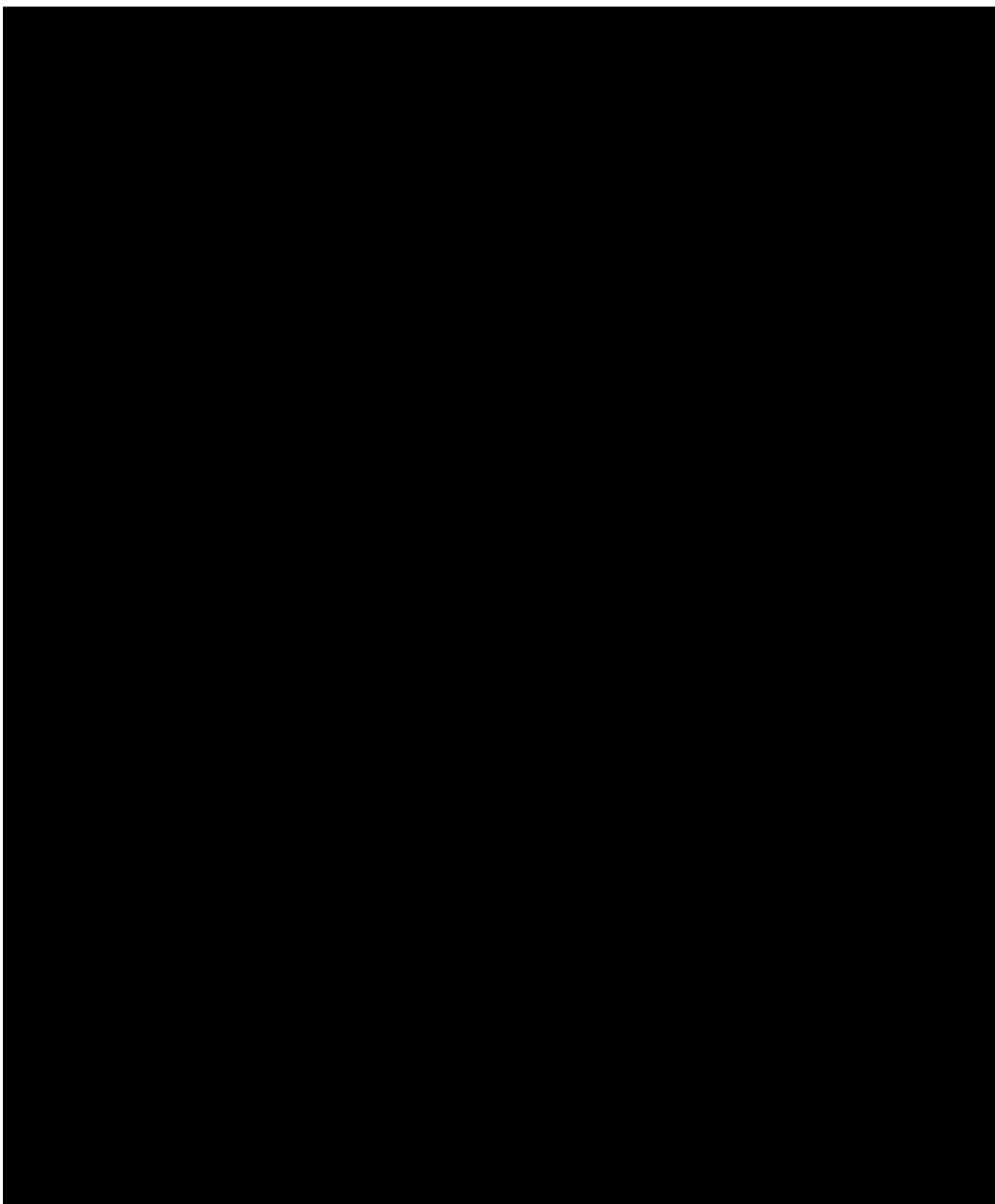


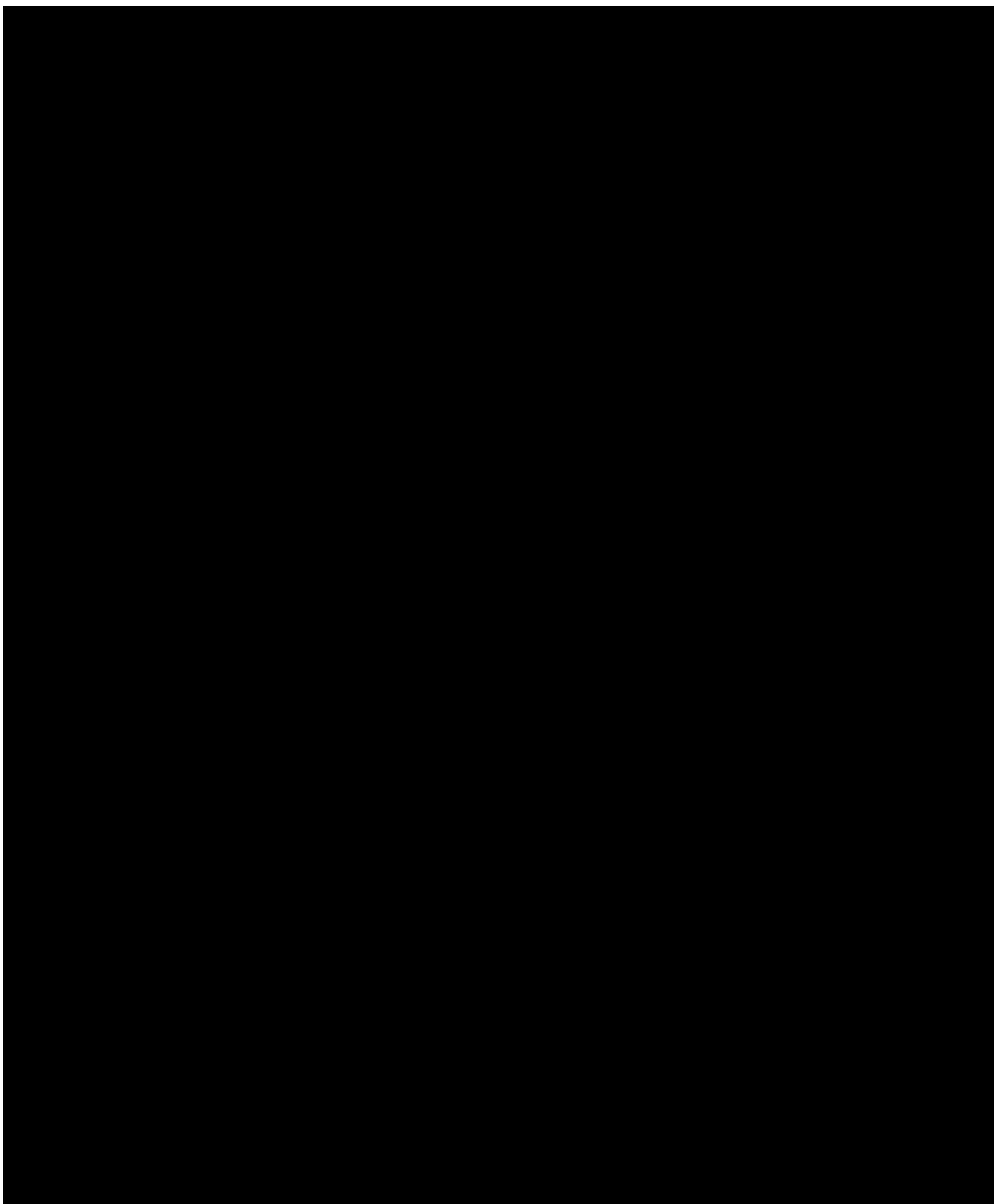








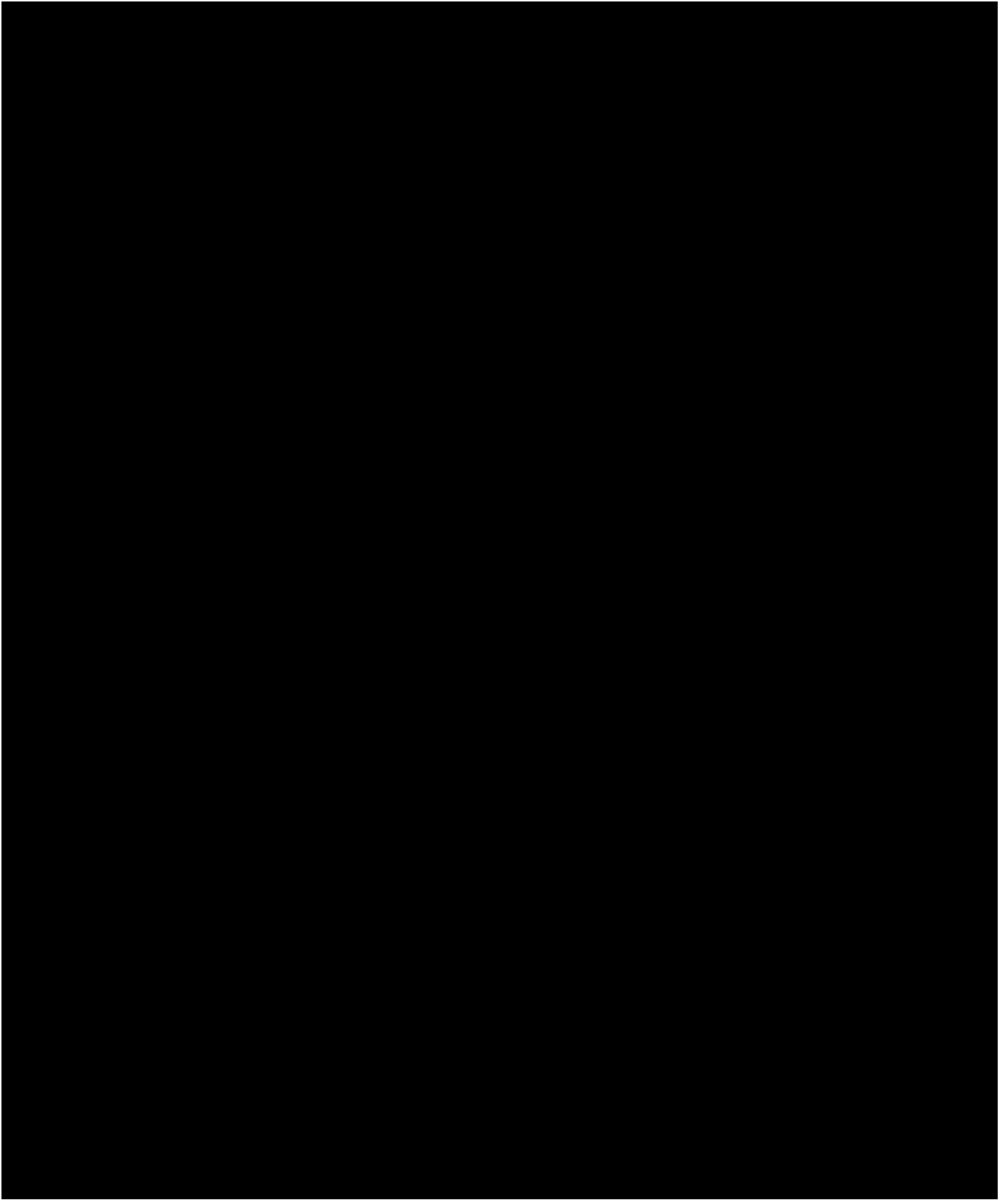


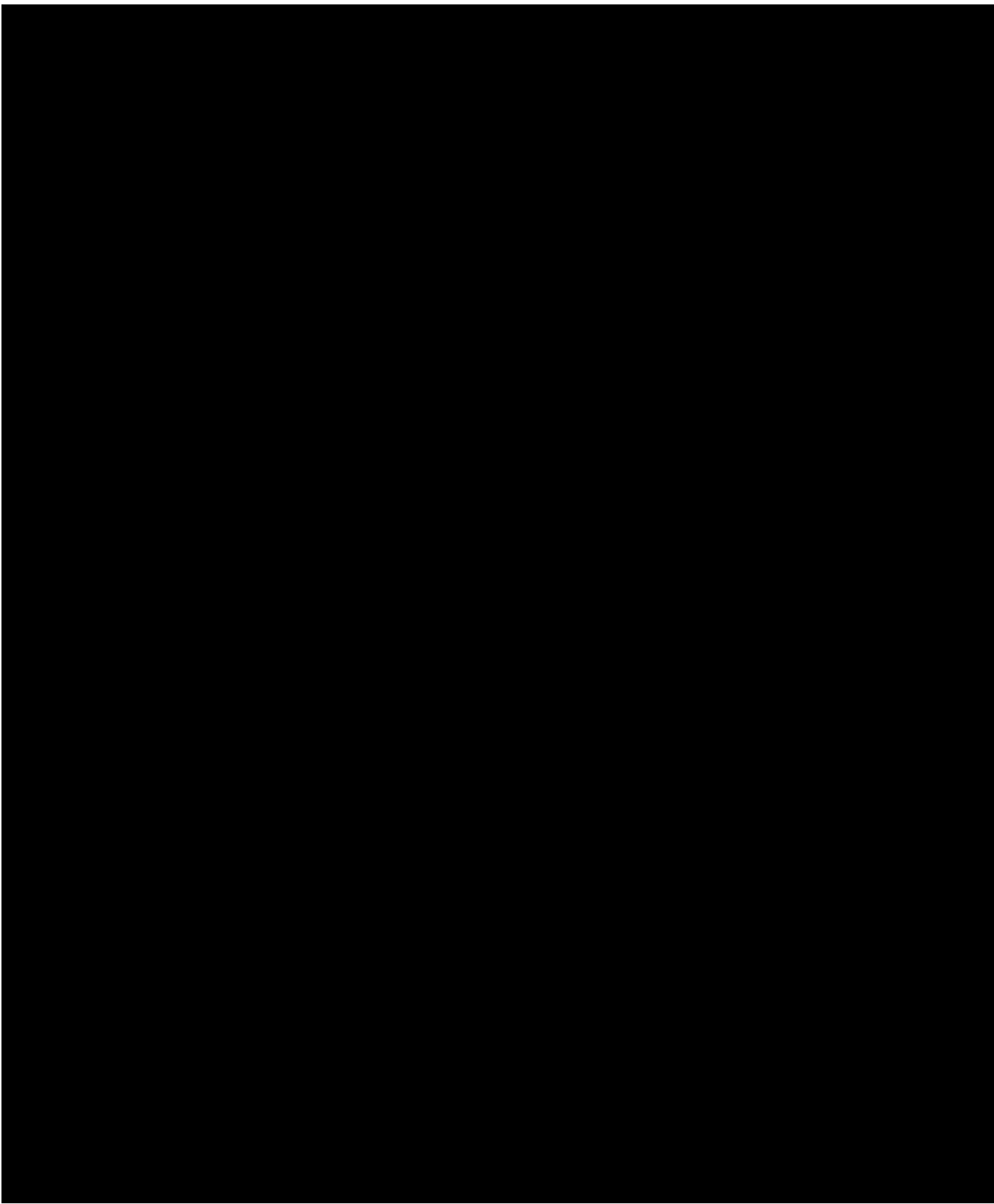


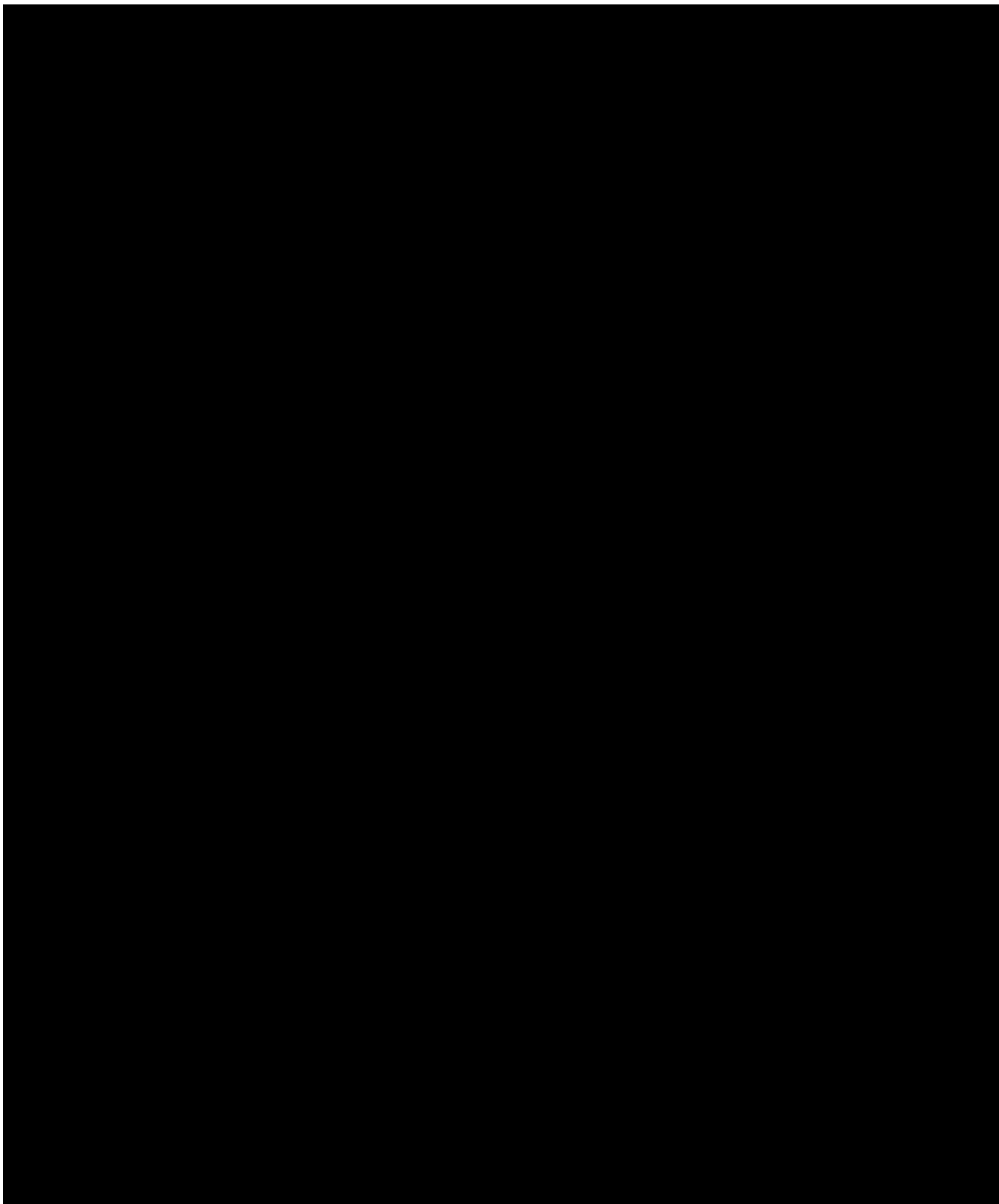
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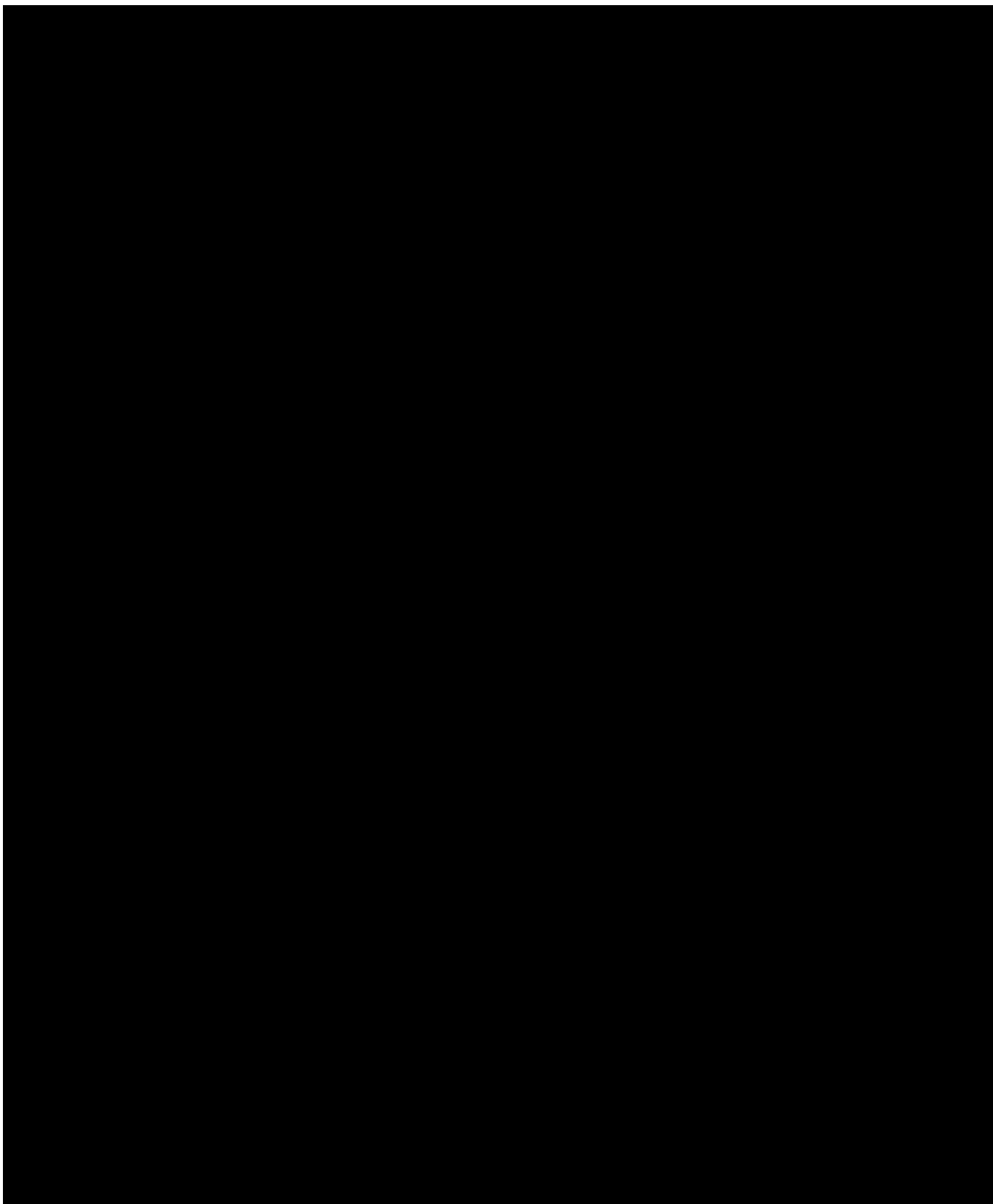
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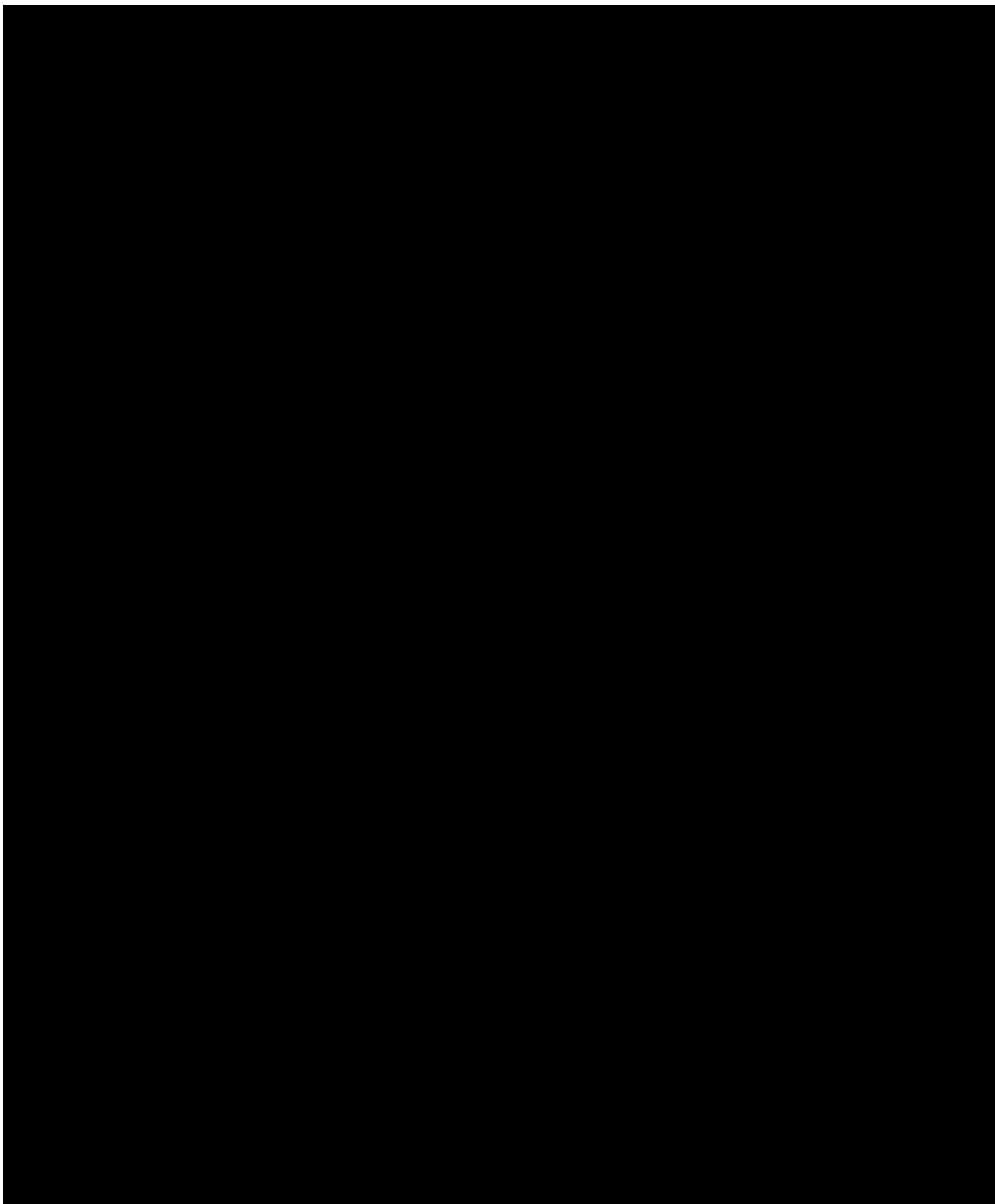


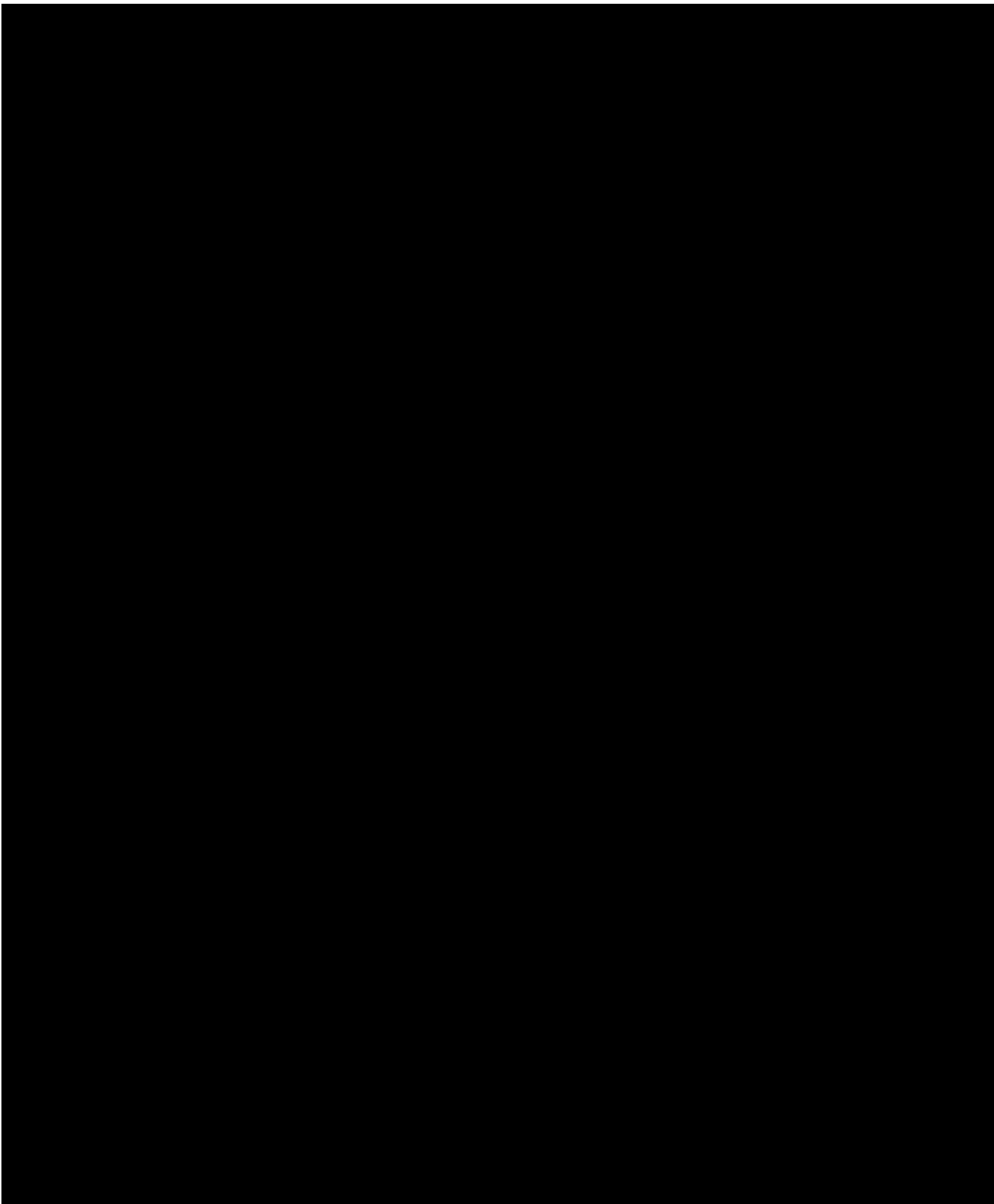


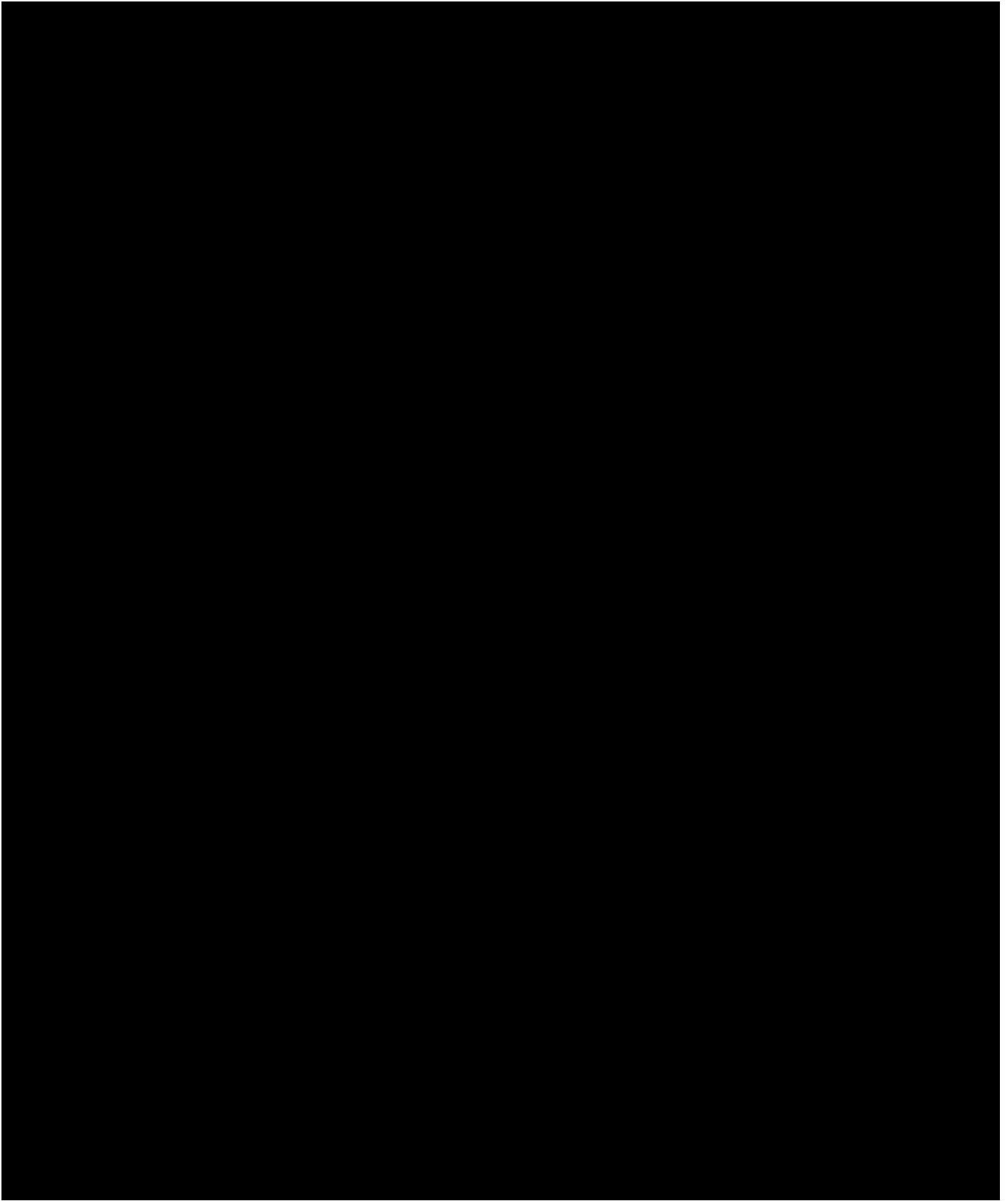


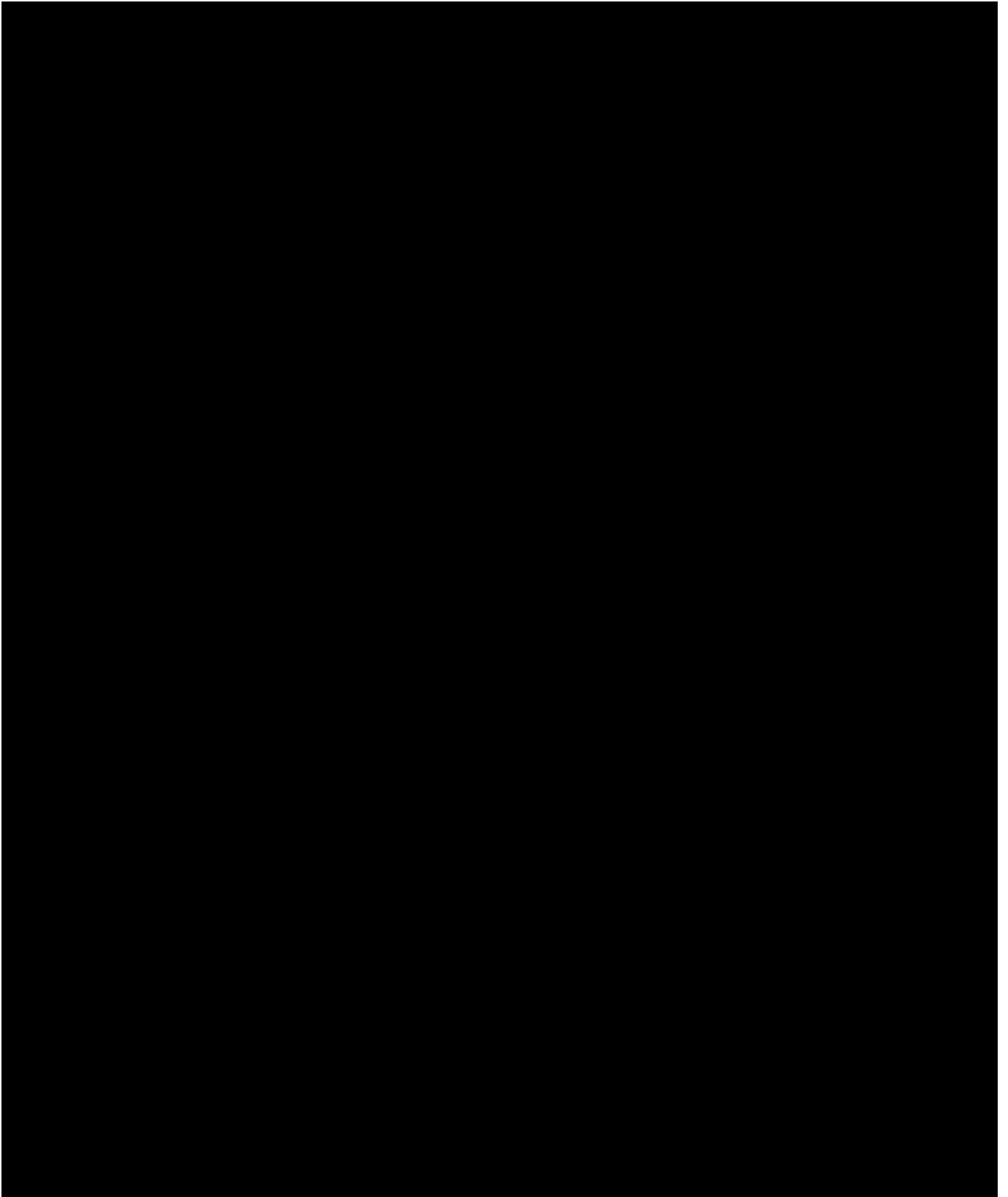










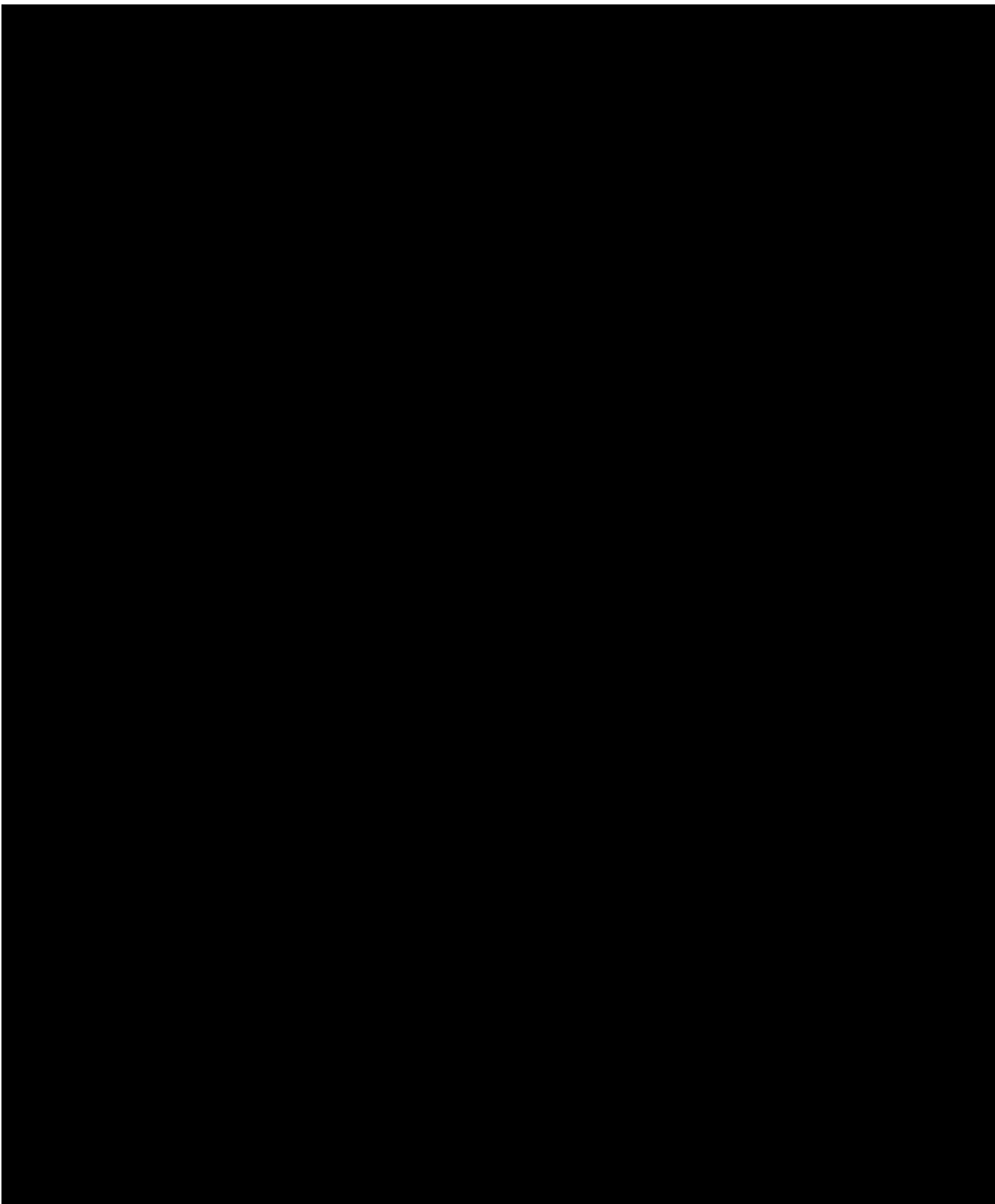


[REDACTED]

\* [REDACTED].

[REDACTED]

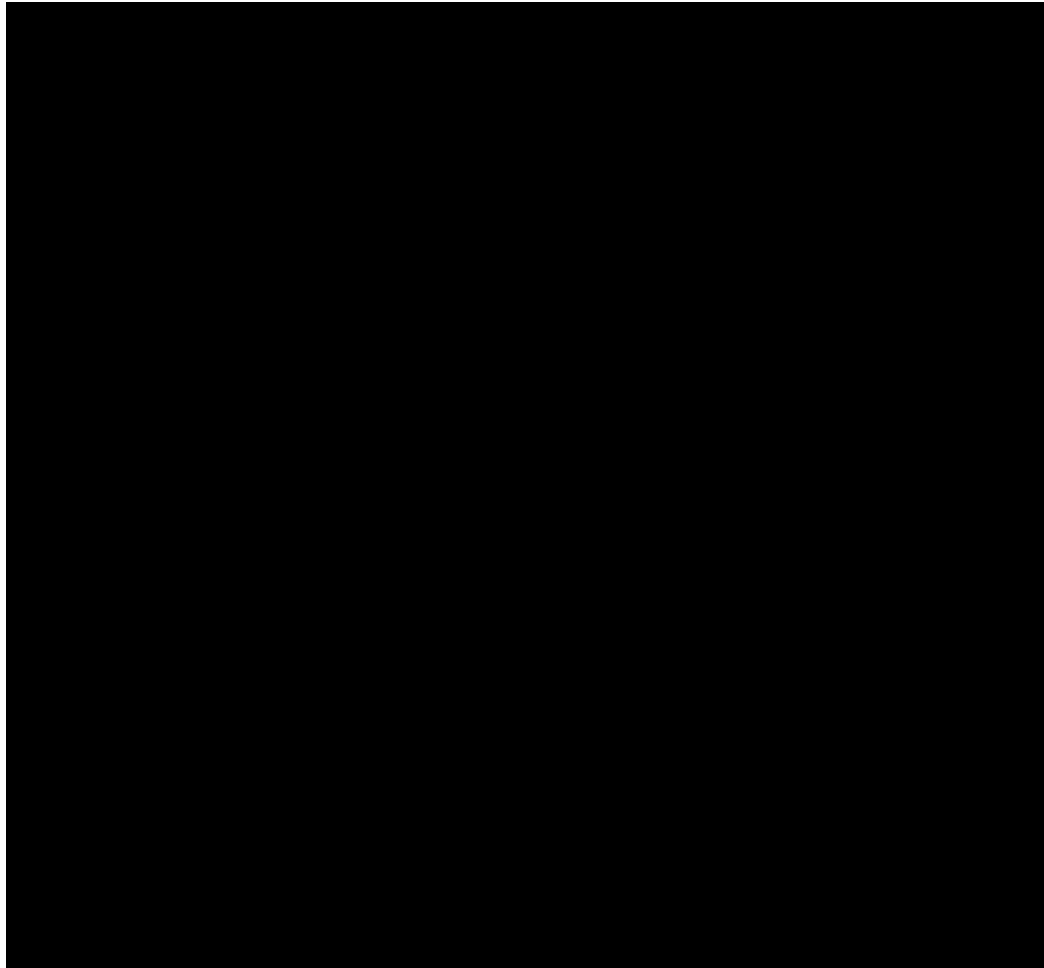
[REDACTED]



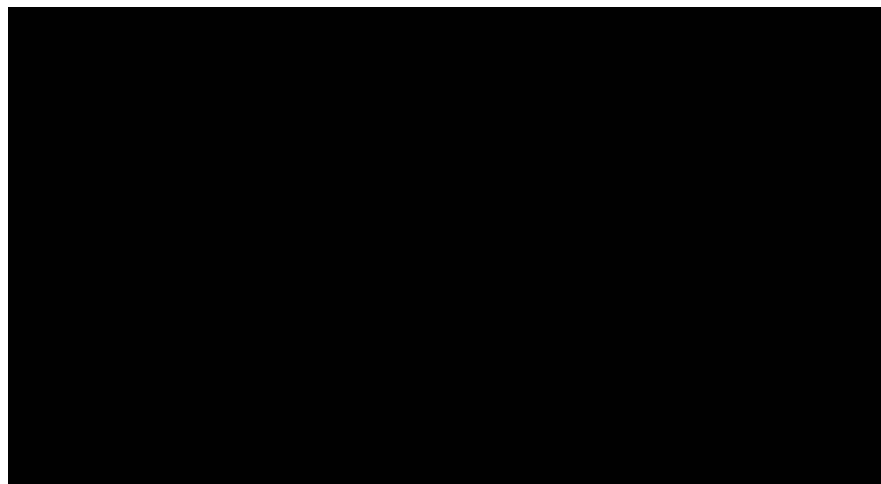


## Appendix D Real Time Bids, Awards, and Events

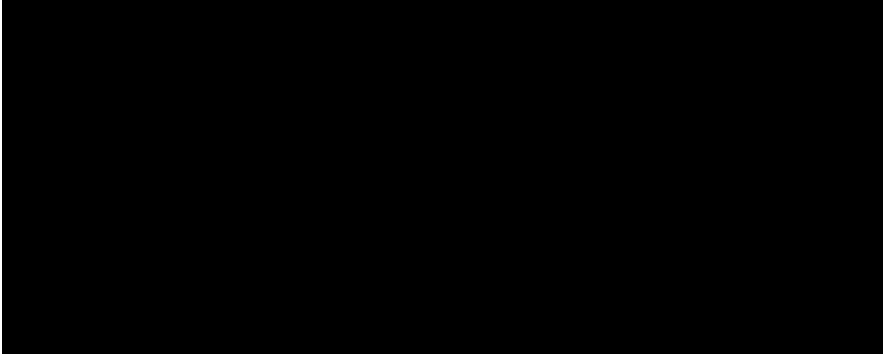
### Real Time Bids and Awards



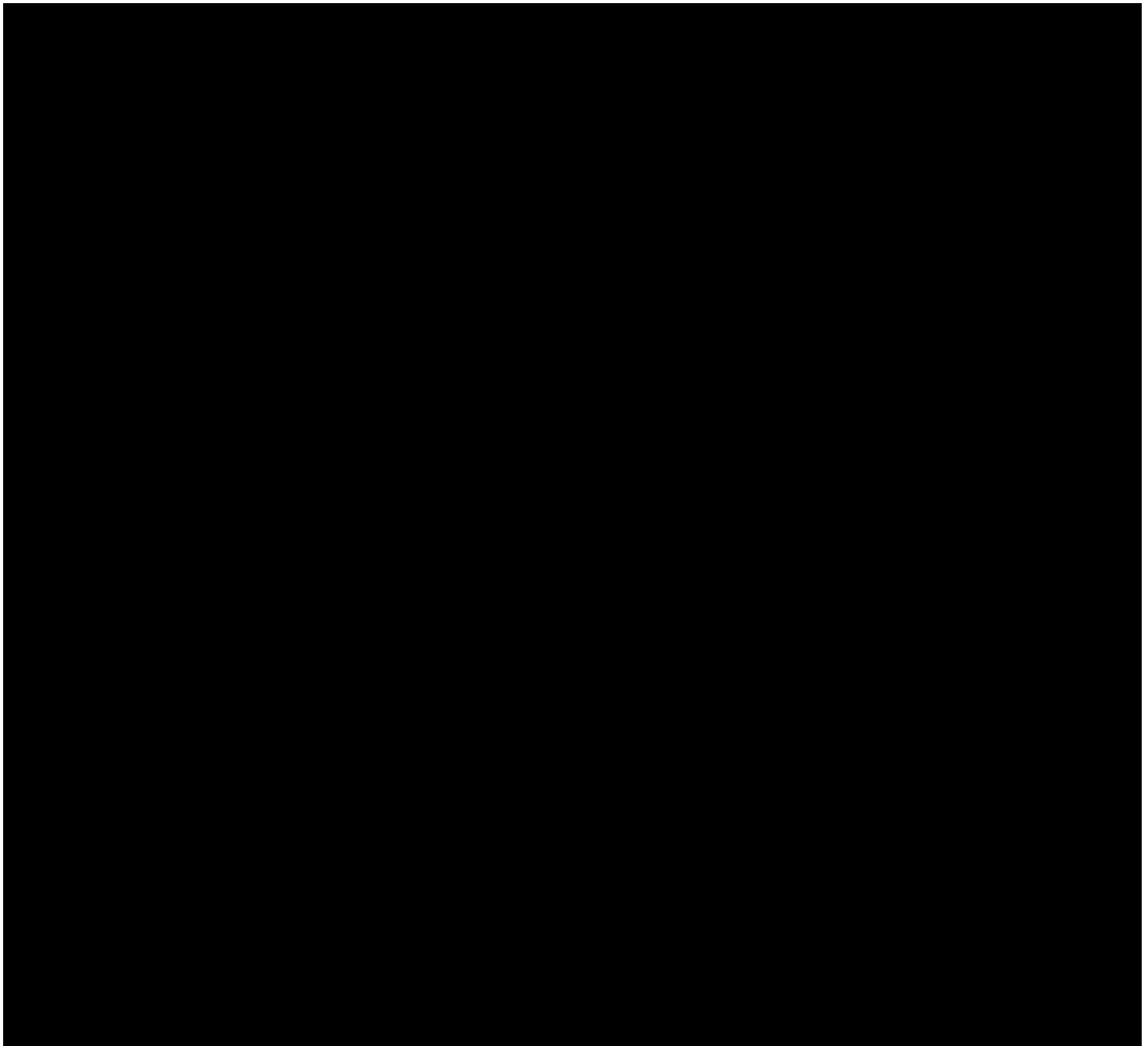
### Real Time Event Duration



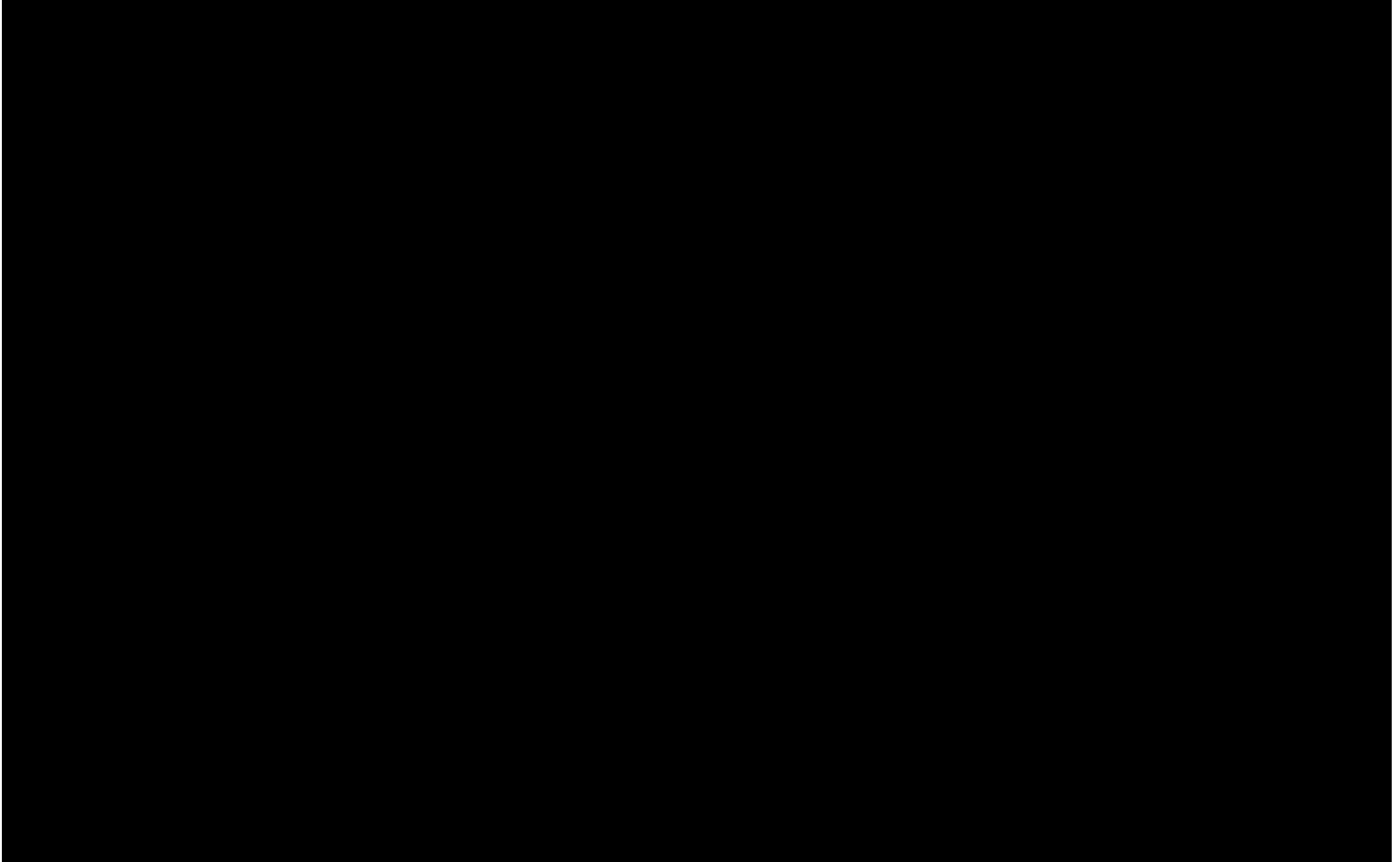




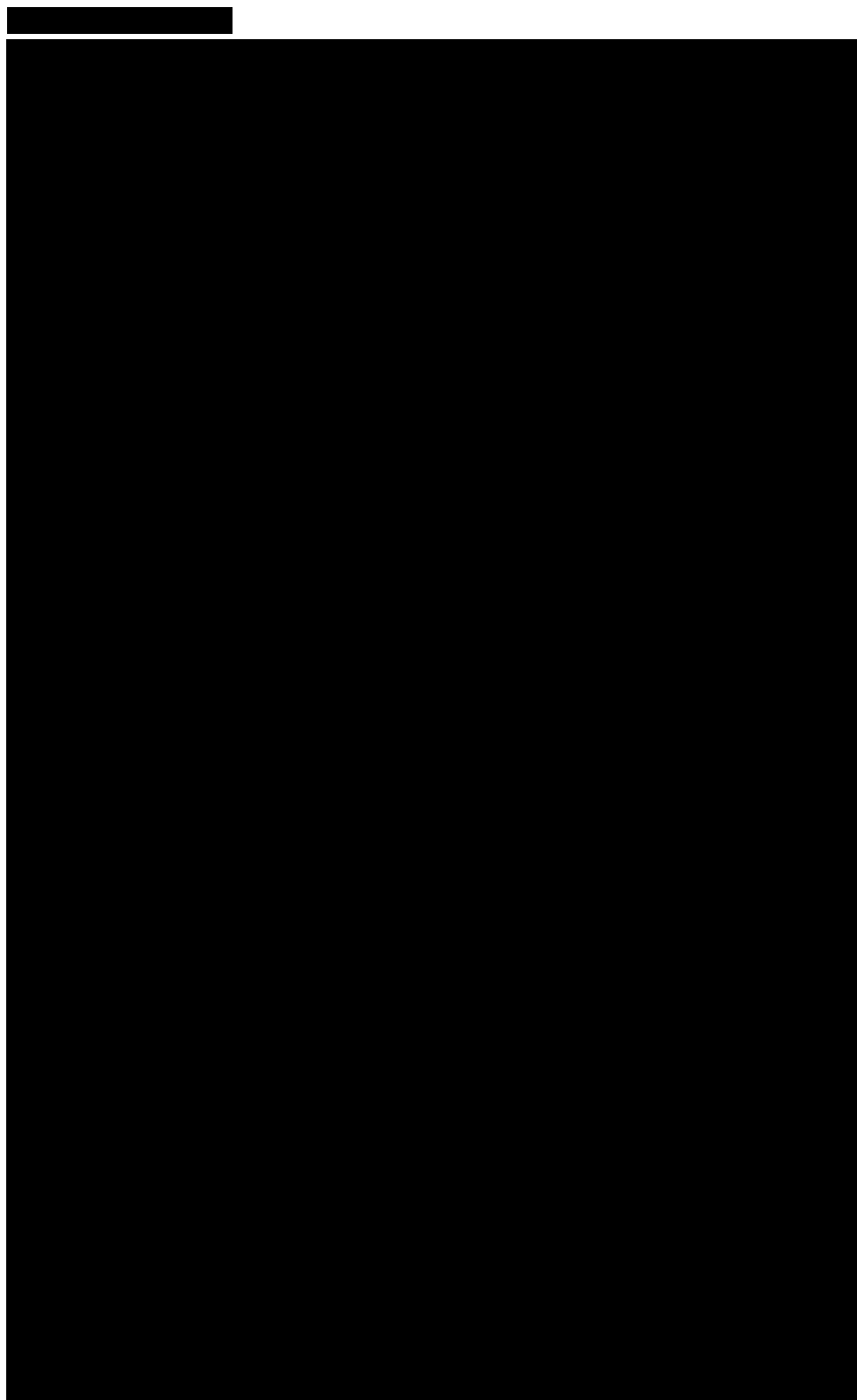
## Real Time Events

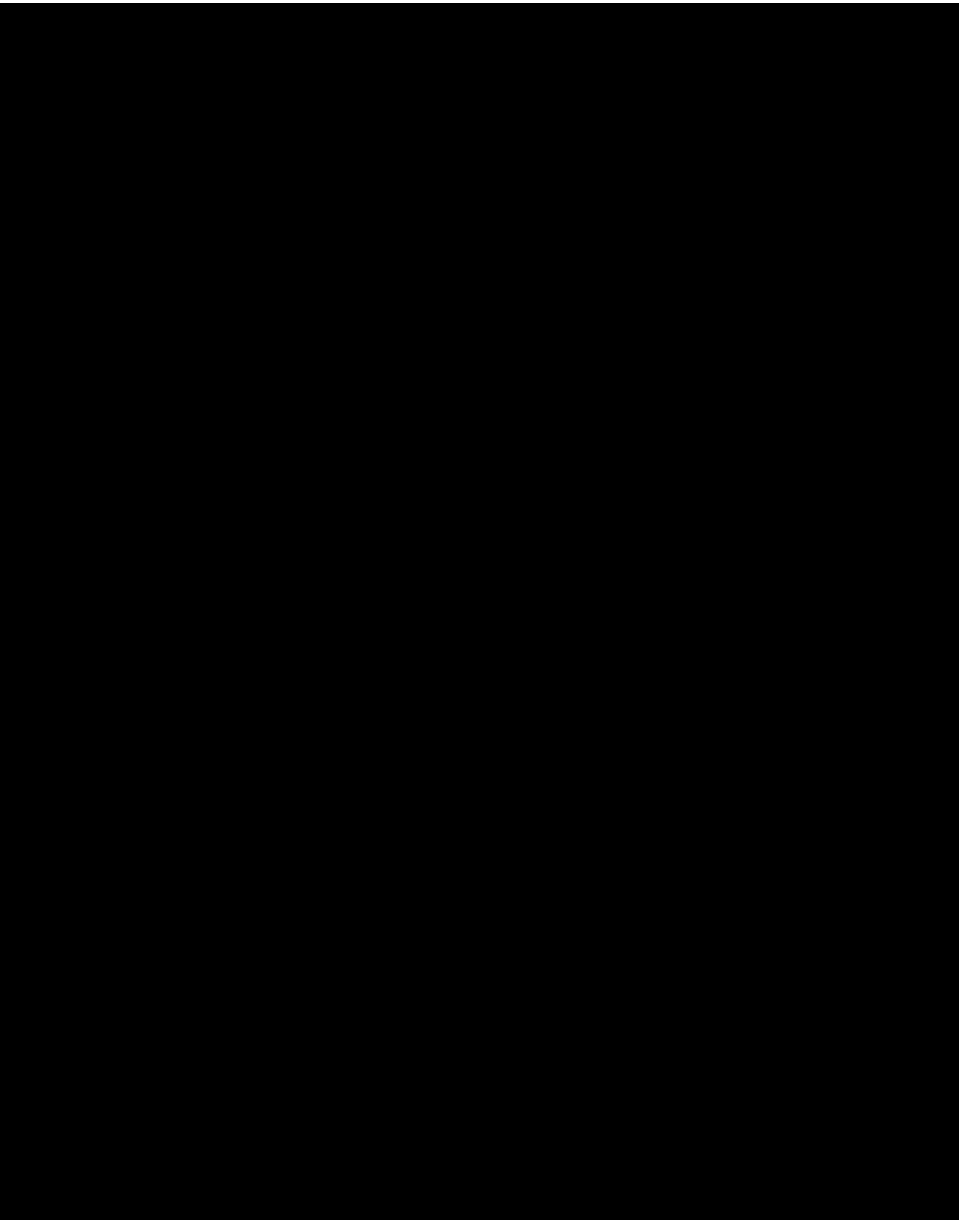


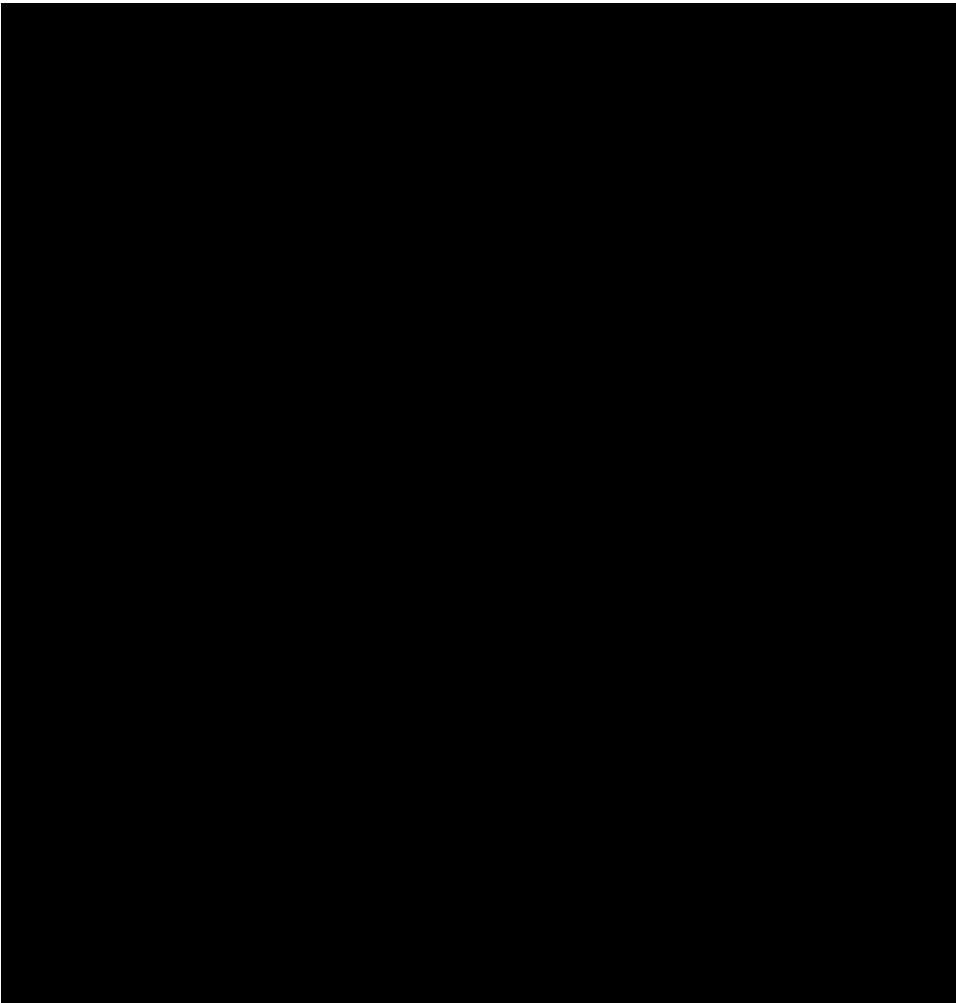
Number of Real Time Bids per Hourly Interval: Note Only Hours Ending with Values Included

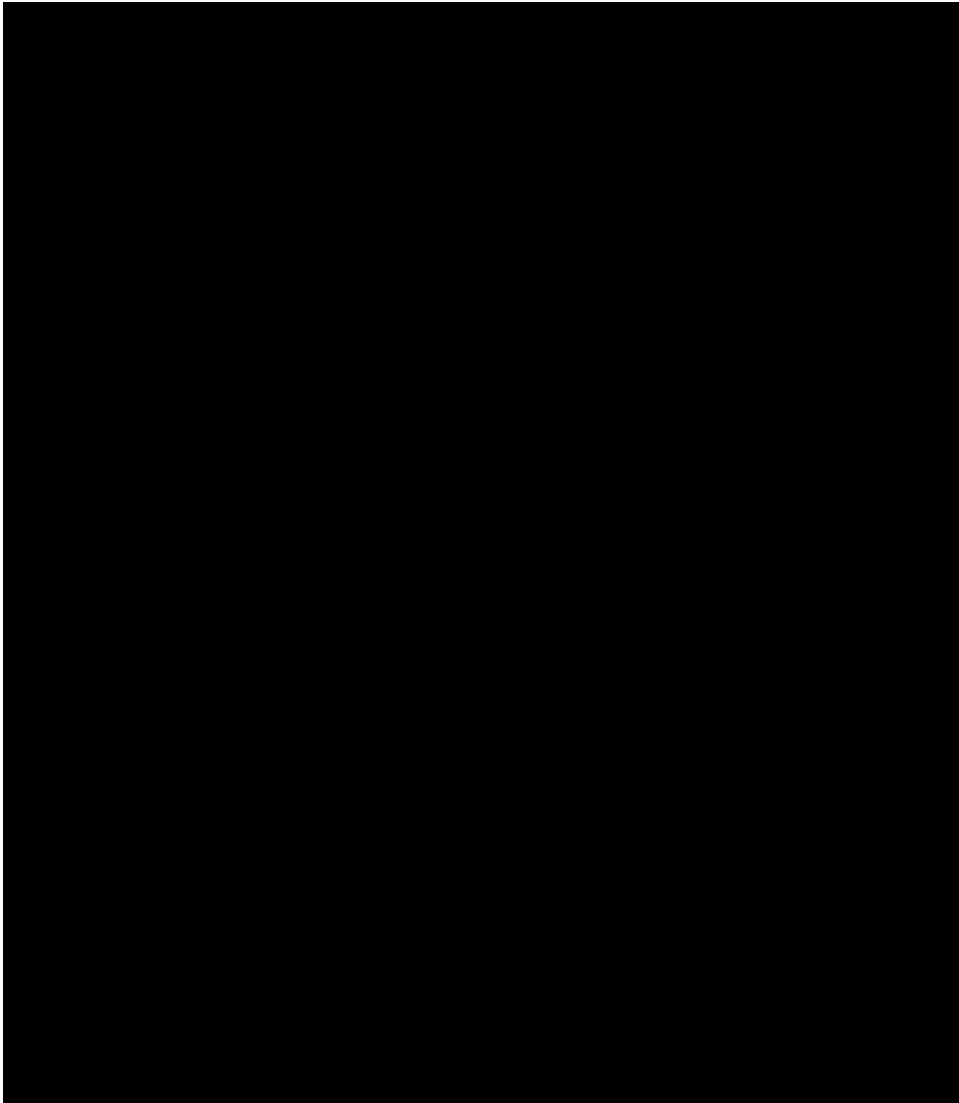
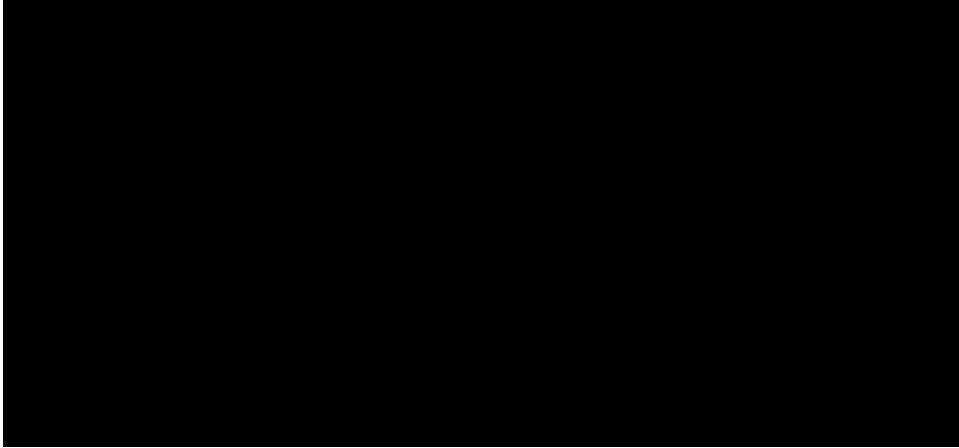


## Appendix E      2015-2017 Monthly Payments to Participants









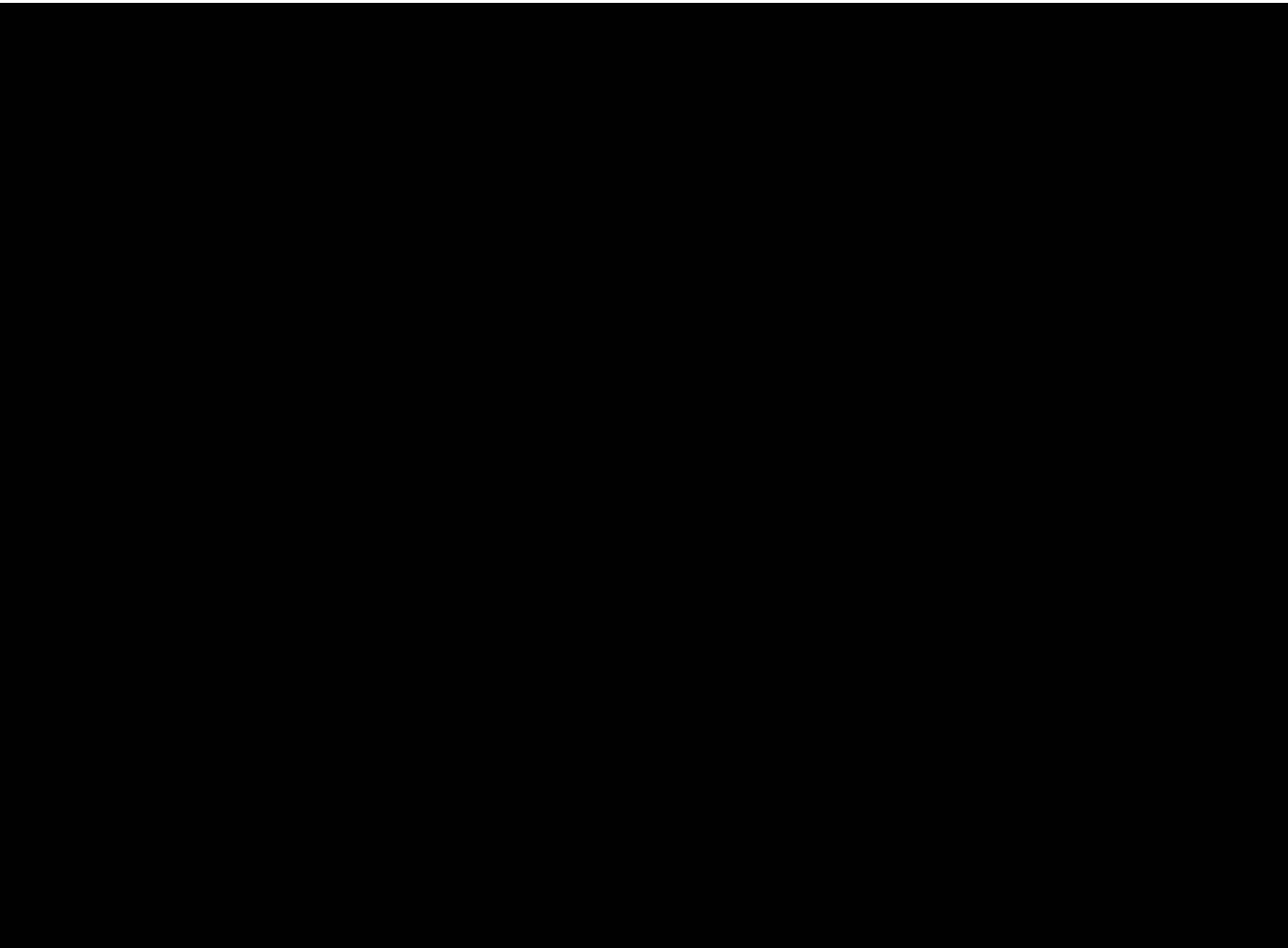




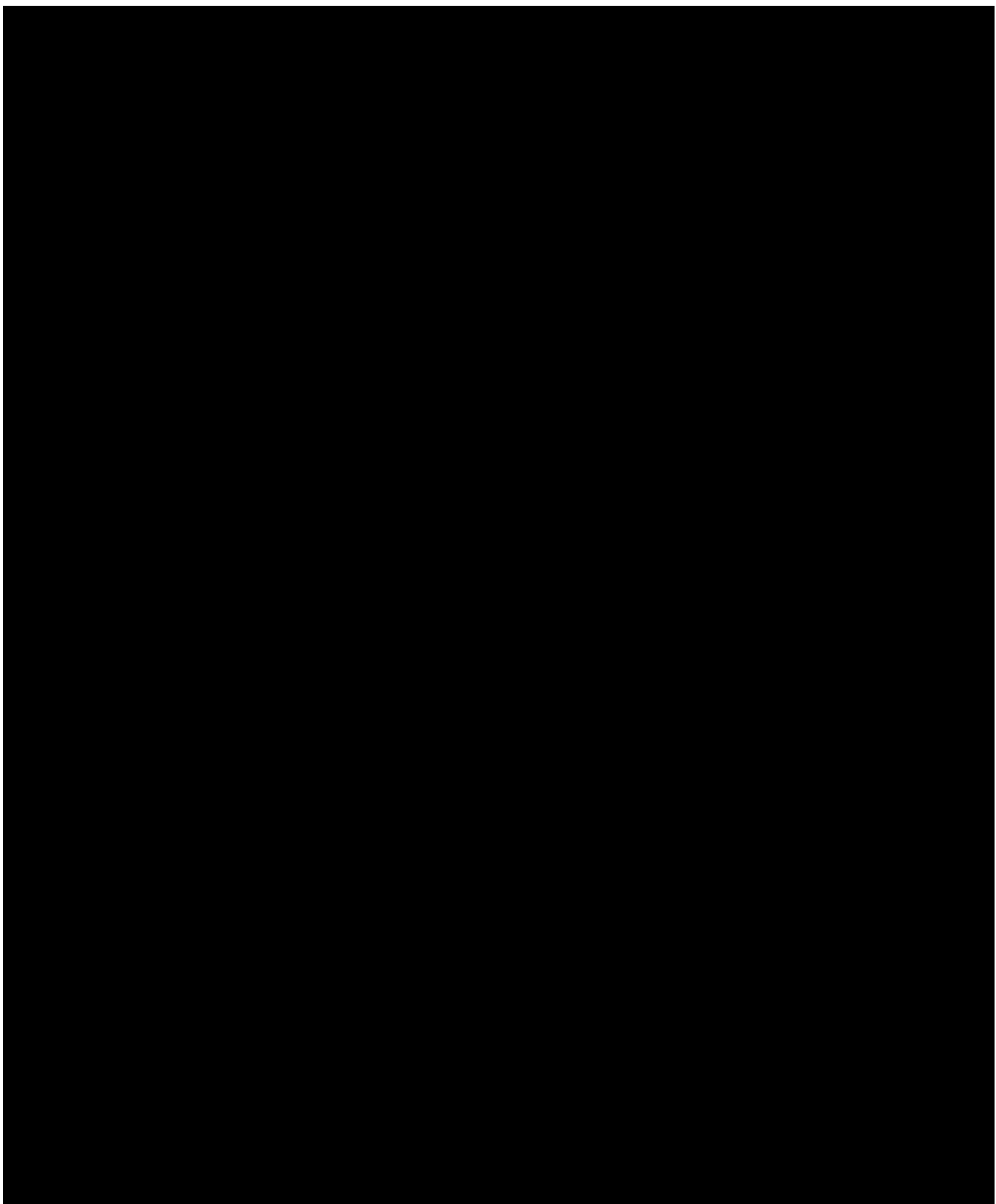
# Appendix F CAISO Settlement Issues

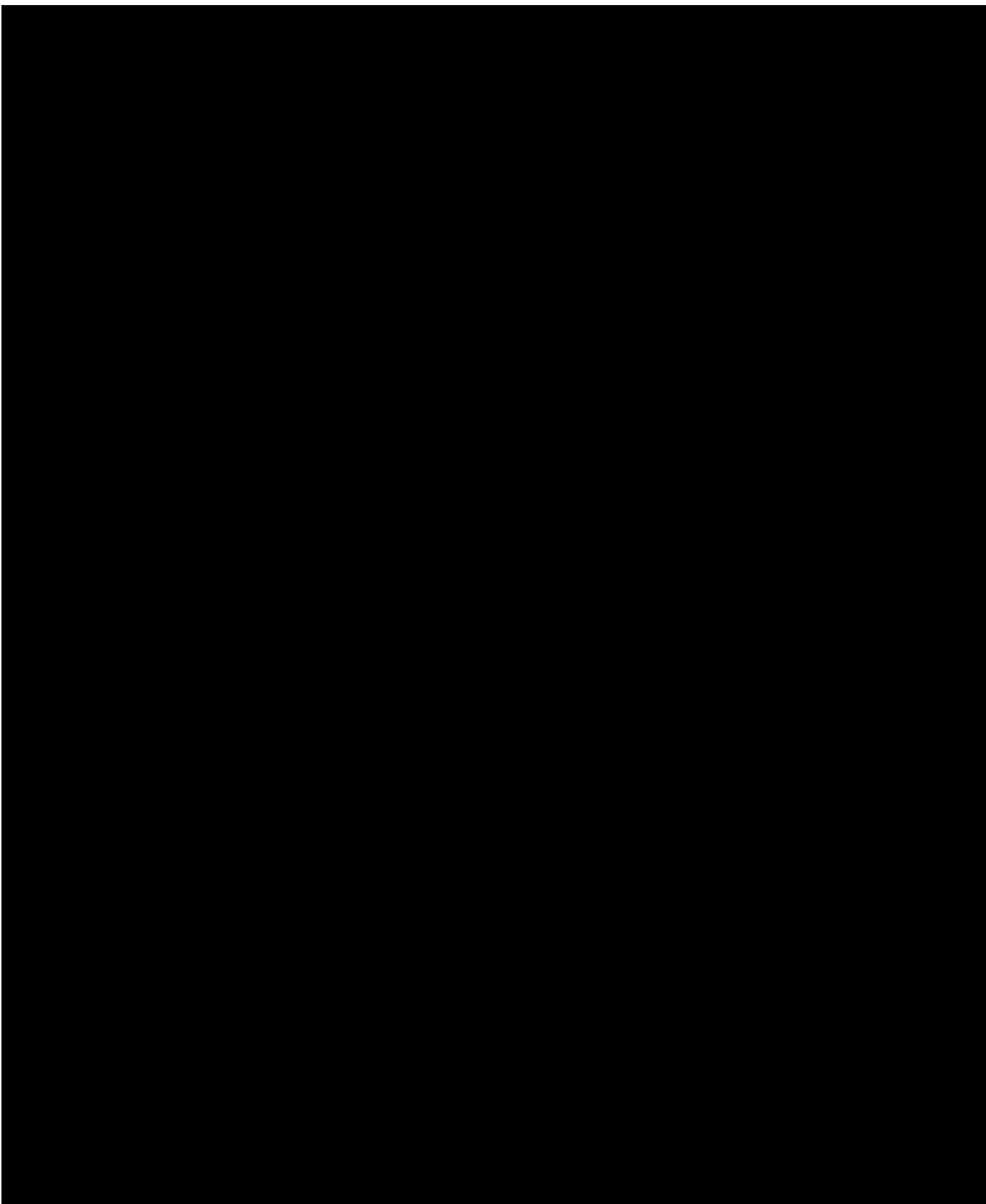
Table 7 below includes events where the CAISO did not pay for any performance in the 55B statement. Olivine started tracking the clawbacks in June 2015. Most of these are due to failure to process DRS data, but there are also several events that did not get entered in DRS. Some of these events also have performance different from what was calculated in DRS, due to differing baselines from a combination of missing events and improper holiday treatment. The 9M to CAISO reflects the 9M settlement in response to disputes submitted to Olivine. A negative value indicates that Olivine received payments relating to the dispute. The 9M values are broken out by day, but not by resource. The “clawback amount” is the dollar value charged to Olivine in the 55B statement. The performance is the total load reduction divided by the total award quantity. The adjusted dollar value is the clawback amount multiplied by the percent performance.

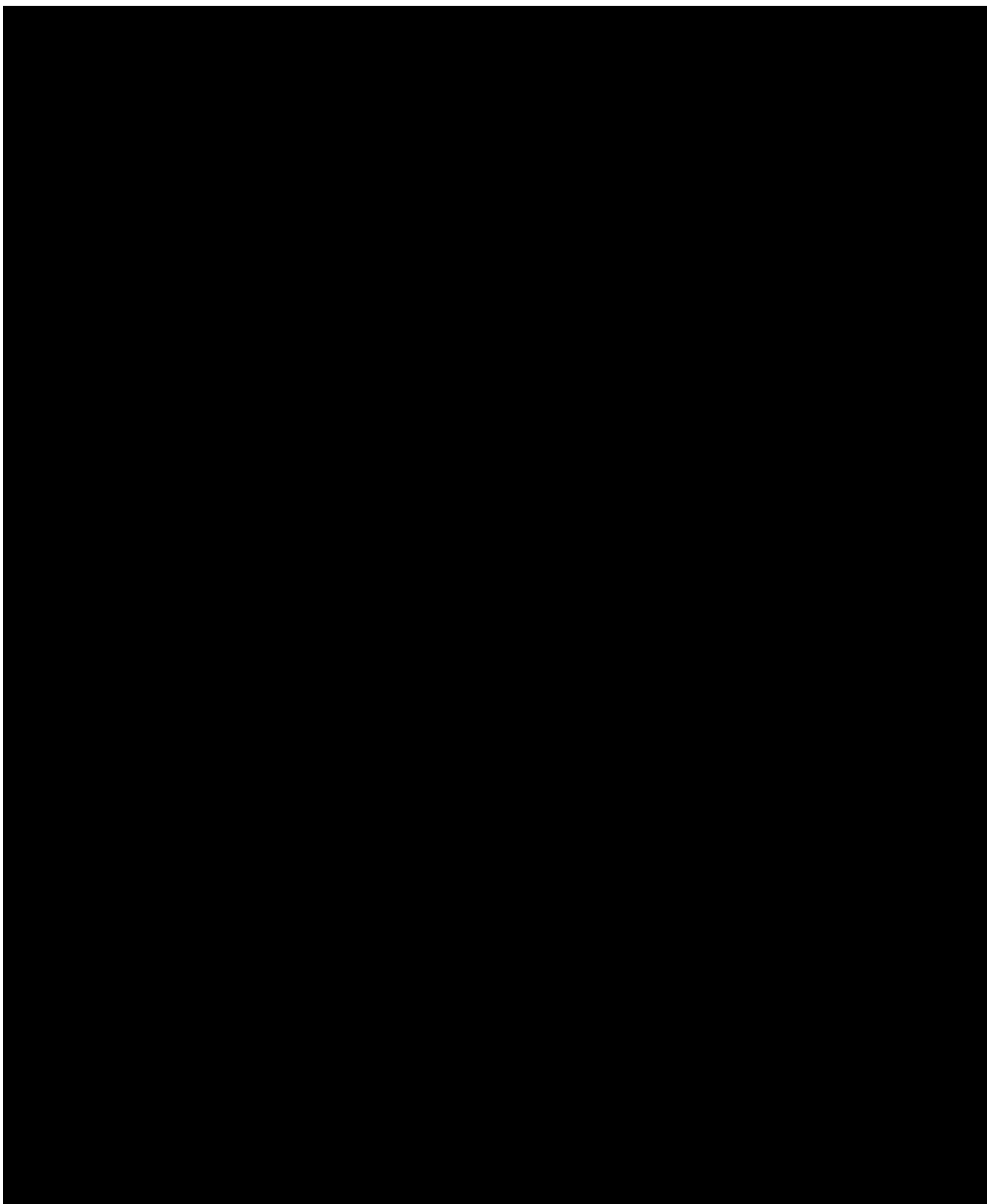
Table 7: Full 55B Clawbacks

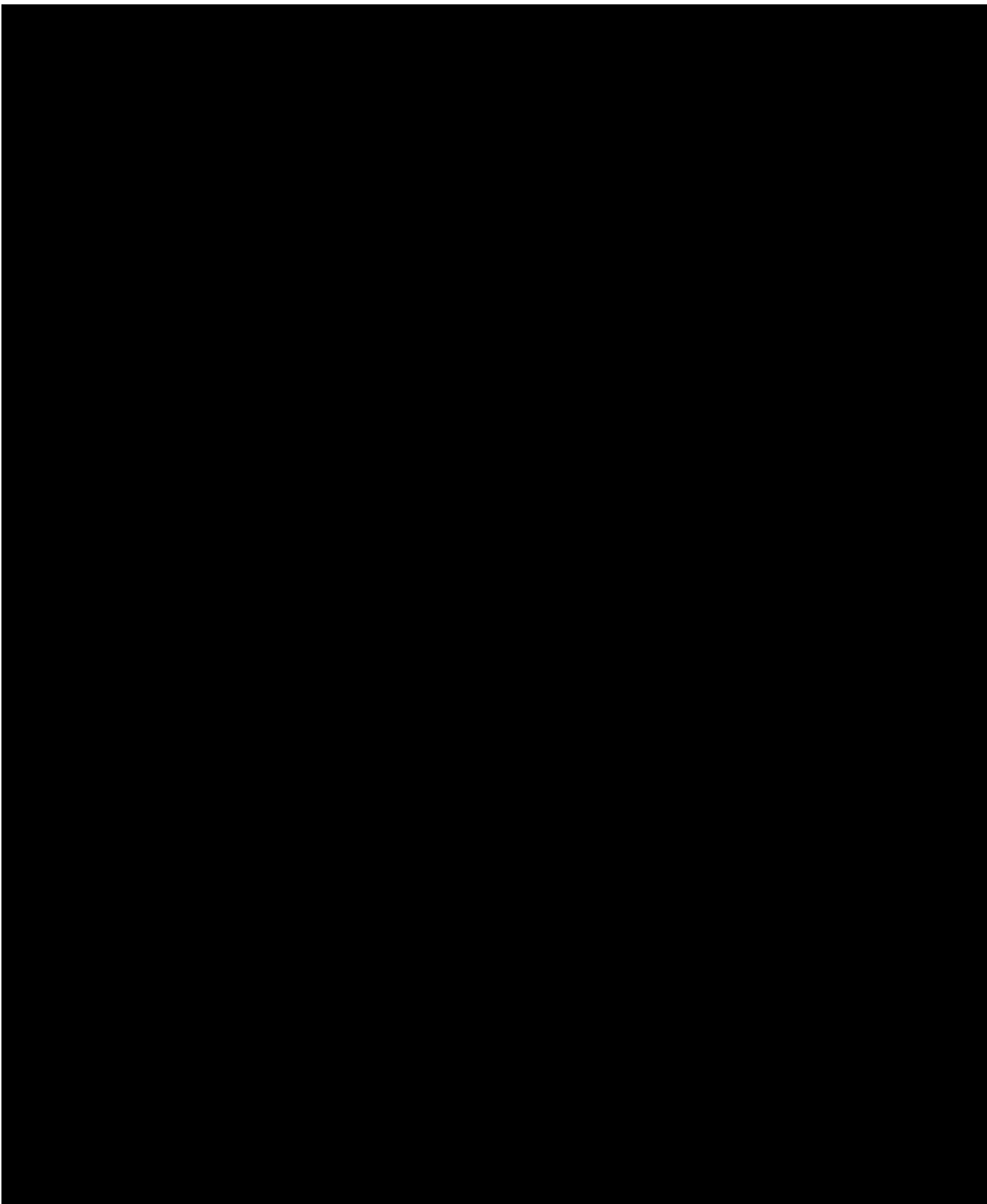


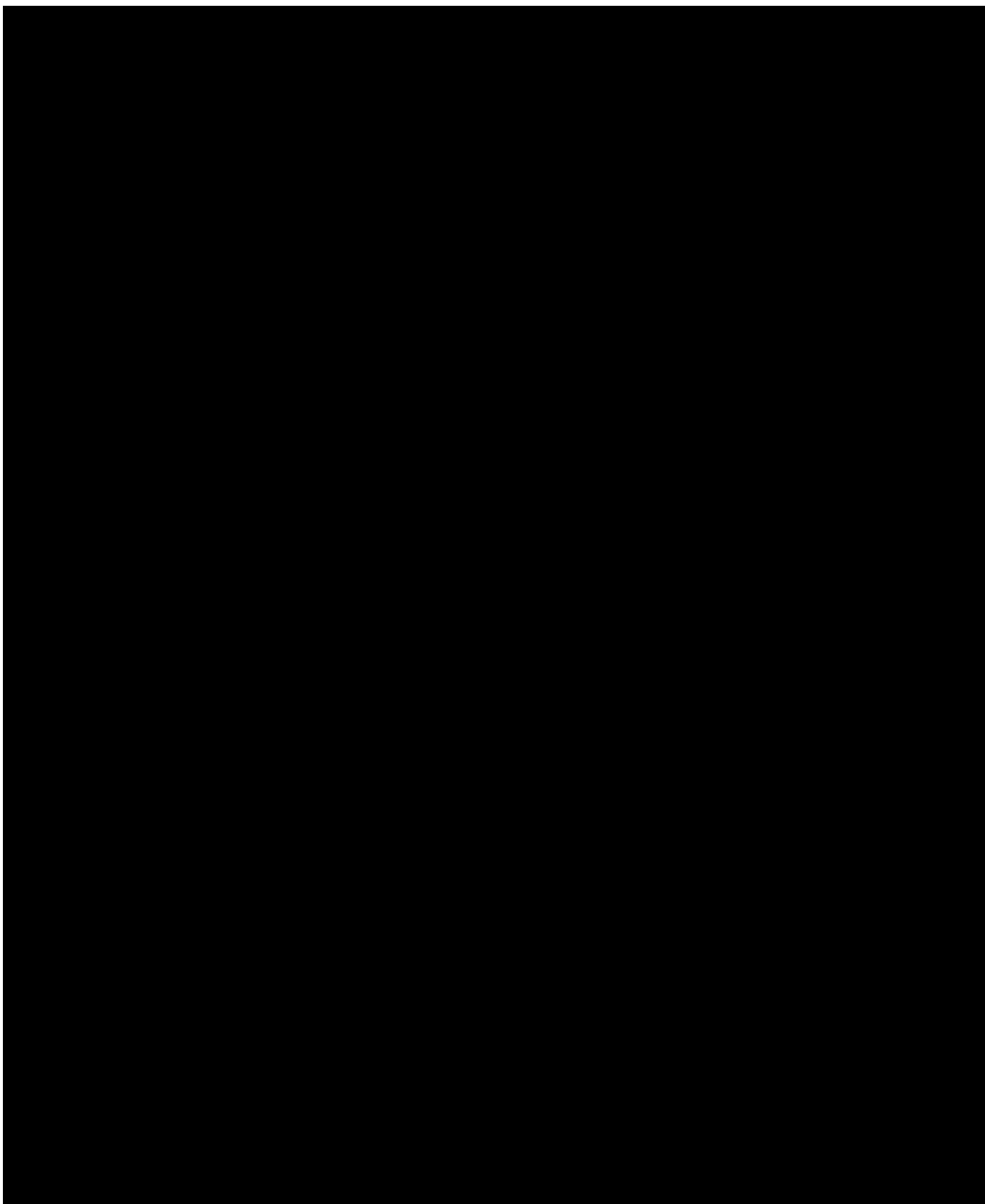
<sup>14</sup> Merged cells indicate that this was not reconciled against individual resources.











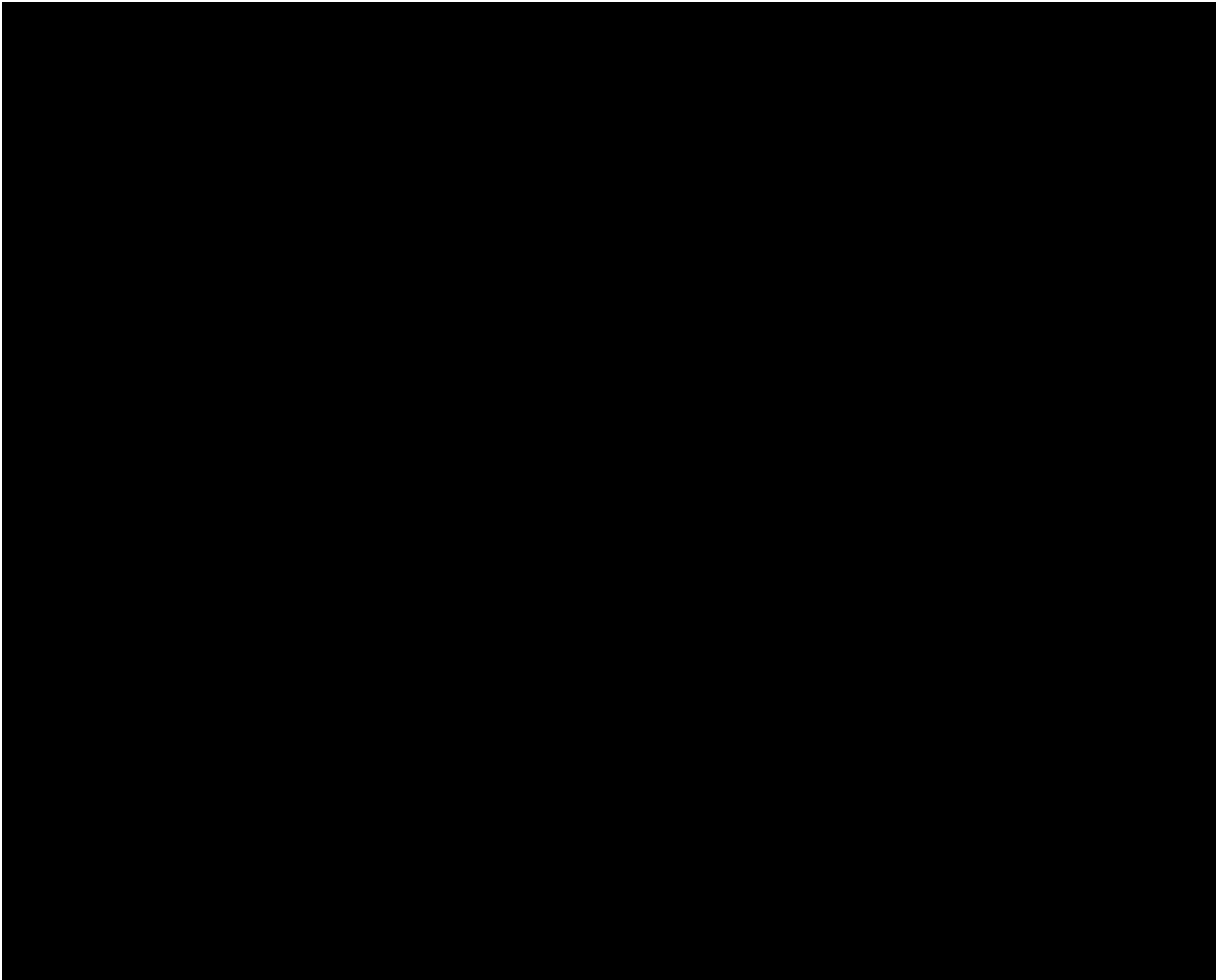
A large rectangular area of the page is completely blacked out, indicating that the content of Table 8 has been redacted.

Table 8 includes partial clawbacks only. The clawback amount is multiplied by the performance and the percentage clawback to get to the adjusted dollar value.

*Table 8: Partial 55B Clawbacks*

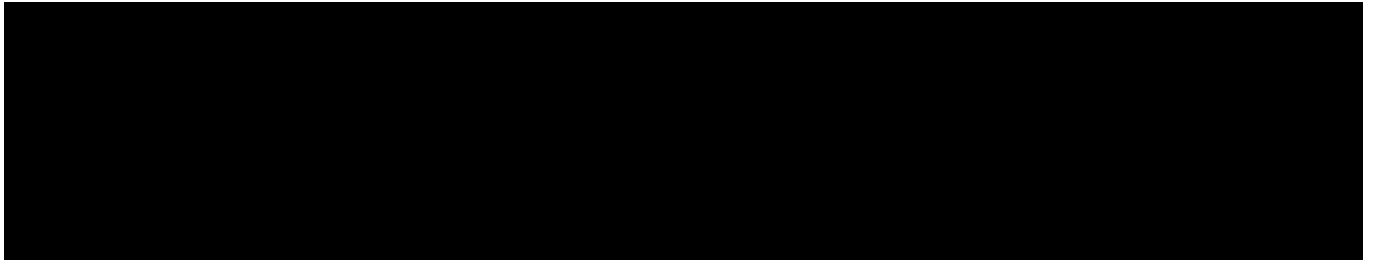
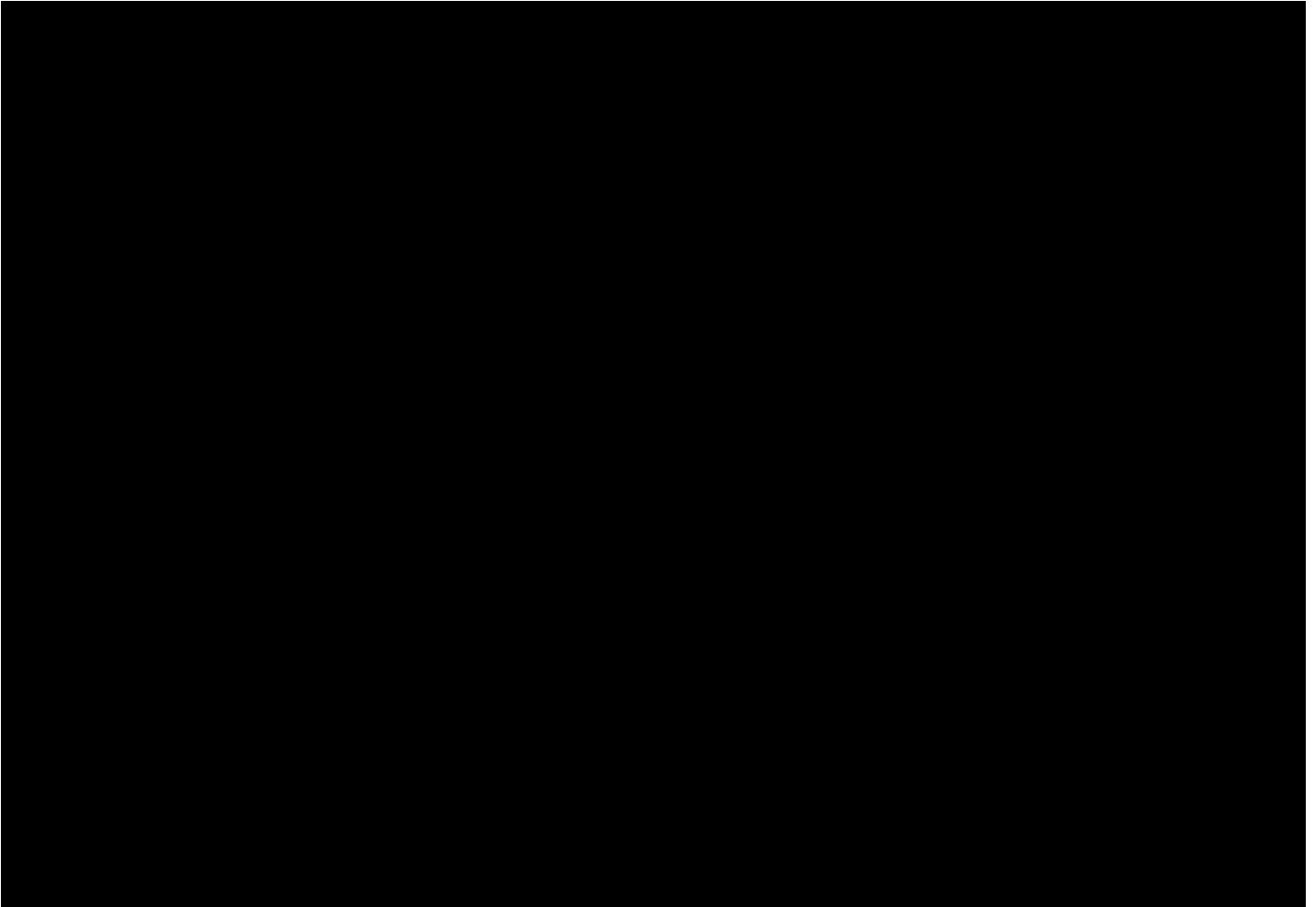
A rectangular area of the page is completely blacked out, indicating that the content of Table 9 has been redacted.

Table 9: includes partial clawbacks where the CAISO properly processed DRS results, but due to the reasons listed in column 3, did not end up with the correct baseline. The adjusted value is the clawback

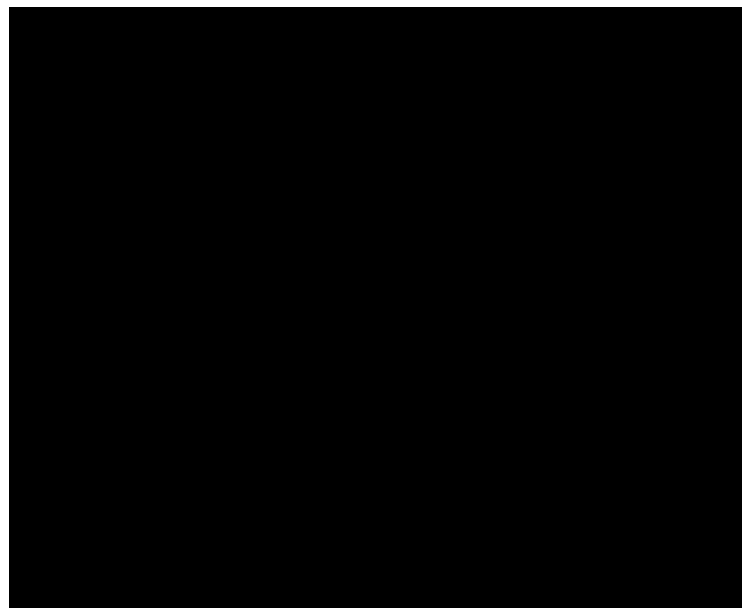
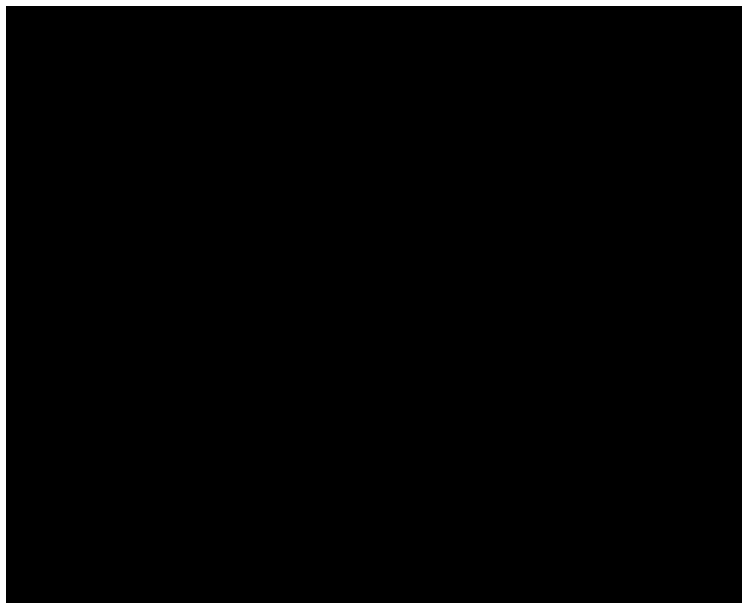
amount multiplied by the difference between the event performance and DRS performance. It is negative when the CAISO's calculated event performance is greater than Olivine's calculated performance.

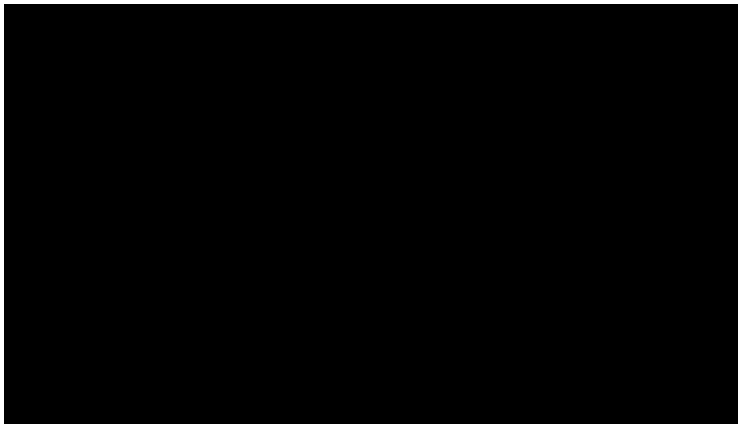
*Table 9: Incorrect Baseline Adjustments due to Missing Events*





## Appendix G      2018 Monthly Capacity Incentive Payment Details

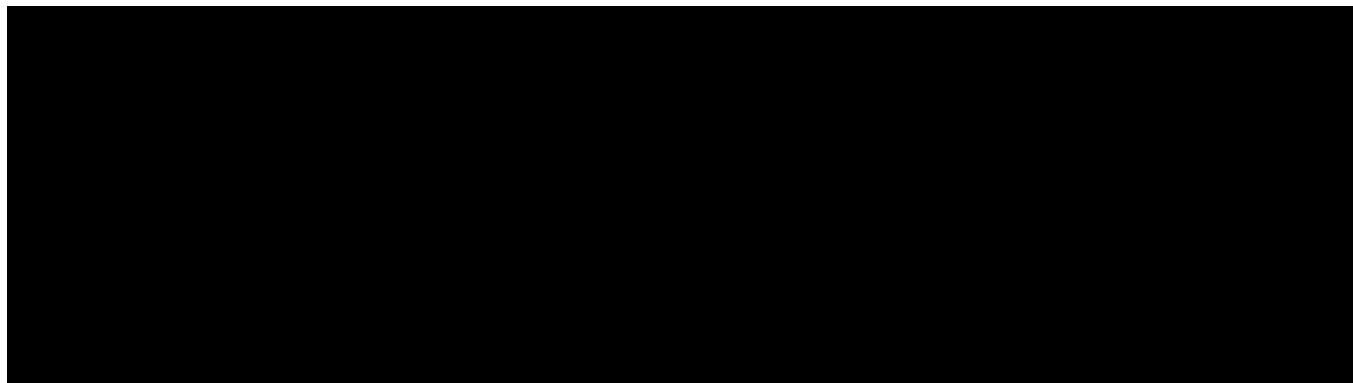




## Appendix H Enumeration of Payment Rounding

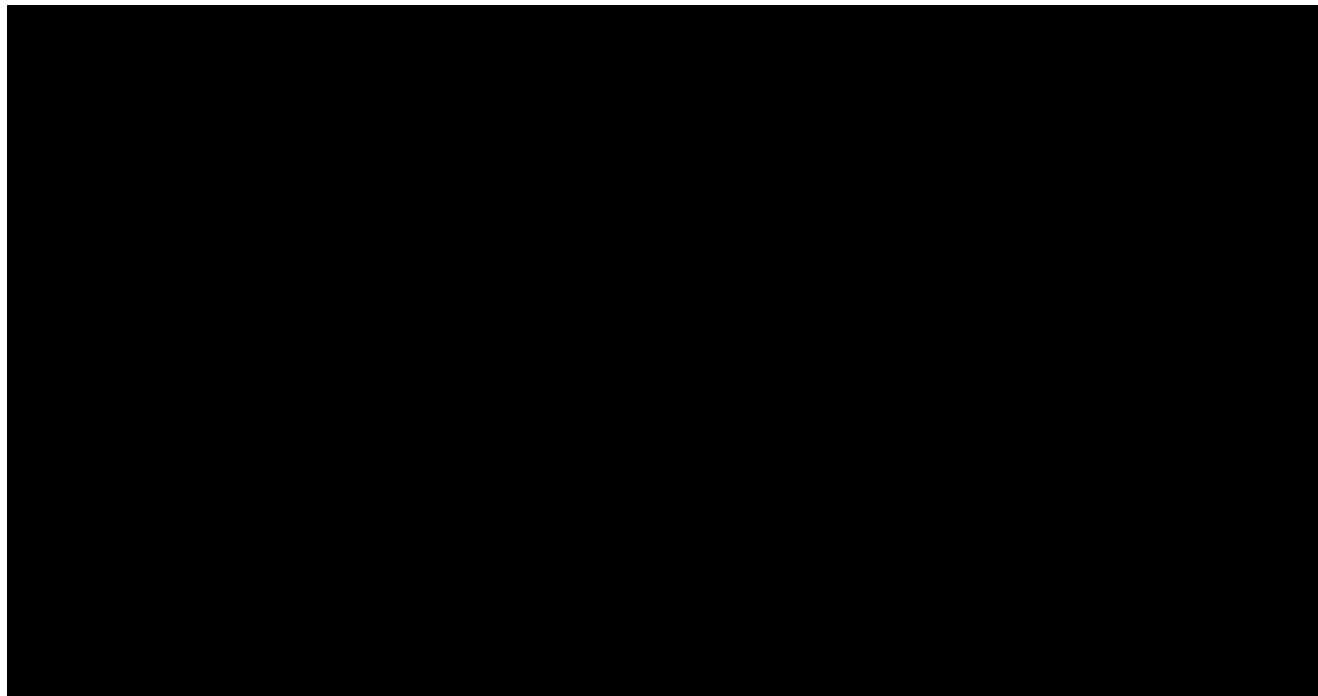
In a limited number of months, there is a discrepancy between the Raw and Adjusted Performance values in Appendix C and the Raw and Adjusted Performance values that were used to calculate participant capacity incentives. In the case of the calculation, a greater number of significant figures were used than that displayed in Appendix C. As a result, readers using the values in Appendix C to verify payment amounts in Appendix G will encounter minor discrepancies in the final amount due to rounding.

The following table enumerates this discrepancy:

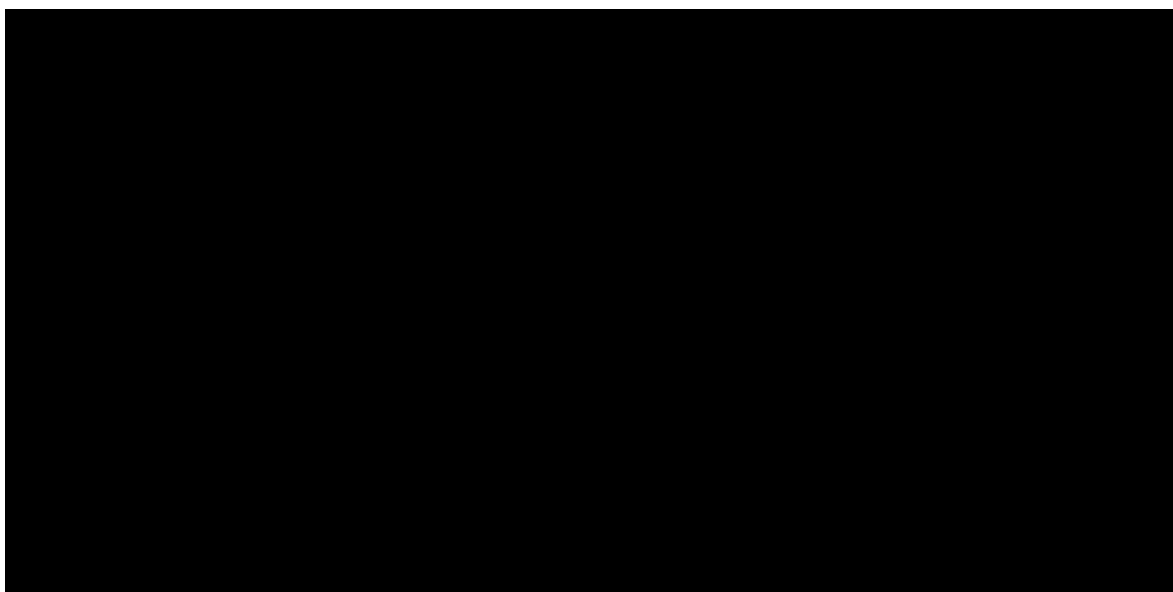


## Appendix I      Historical Data

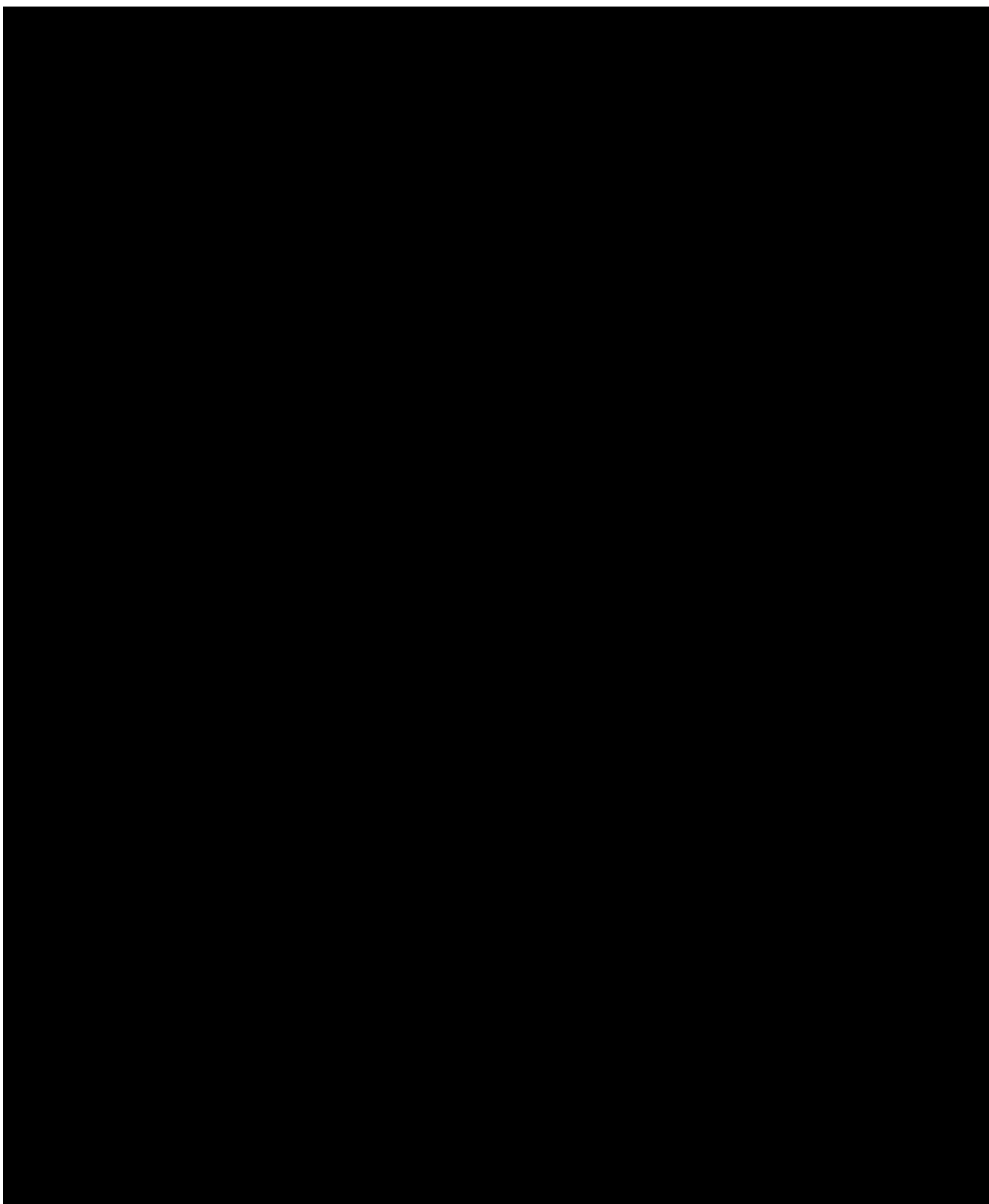
### 2015 – 2017 Bids and Awards

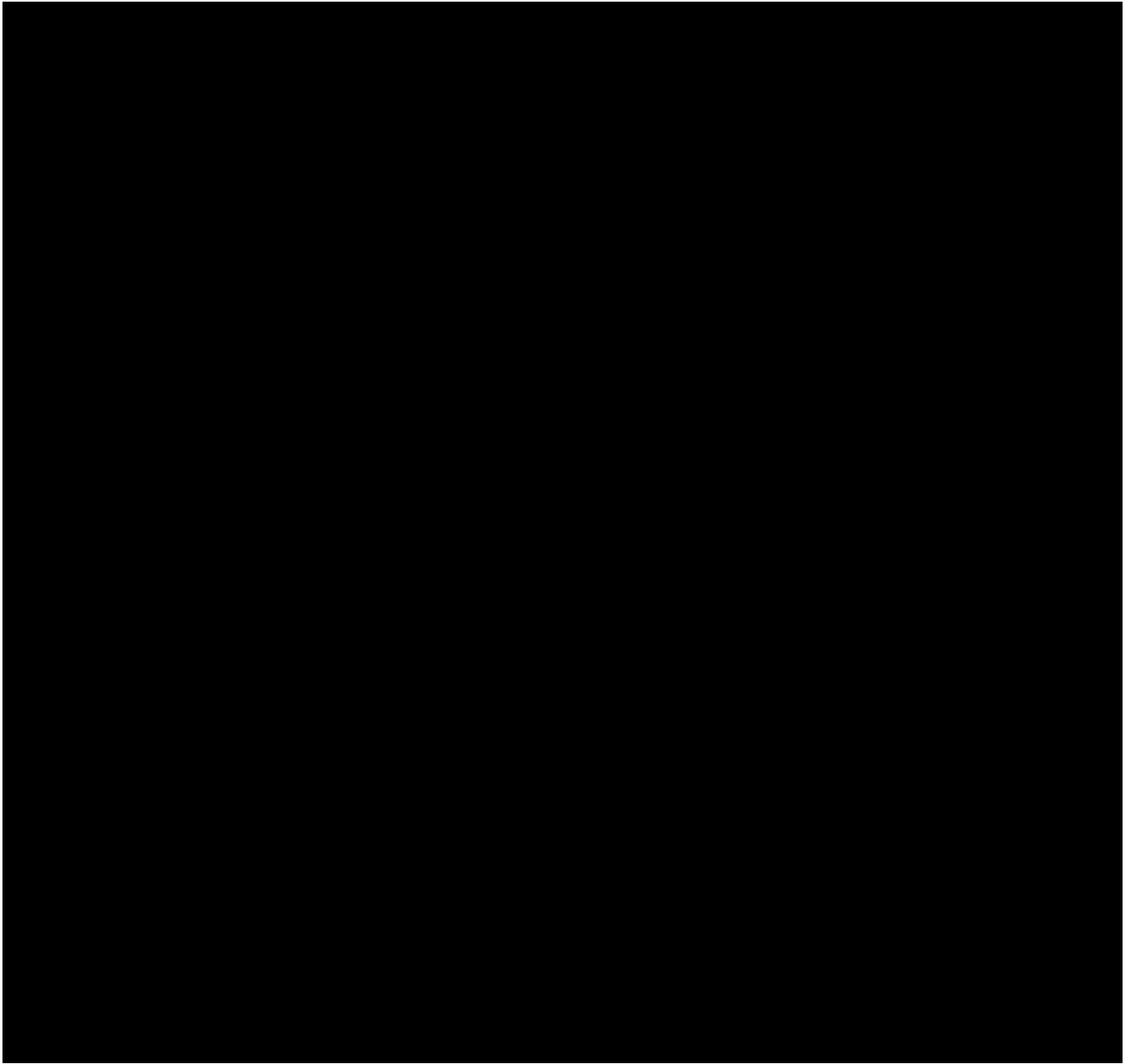


### Summary of Awards and Performance, 2015-2017



### Monthly Awards and Performance, 2015-2017





[REDACTED]